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VOLUME 6 - FRESHWATER ENVIRONMENT

Whale Tail Pit Project Meadowbank Division

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REPORT

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EXECUTIVE SUMMARY – VOLUME 6 FRESHWATER ENVIRONMENT

Volume 6 of the Final Environmental Impact Statement for the Whale Tail Pit and Haul Road Project (the Project) addresses Guidelines issues by the Nunavut Impact Review Board for the Project, specifically those relating to the effect of the Project on the Freshwater Environment, including hydrogeology and groundwater, surface water quantity and quality, and fish population.

Volume 6 includes a discussion on valued components (VCs), incorporation of Inuit Qaujimajatuqangit (IQ), description of the study areas, and an assessment of direct effects to changes to the Freshwater Environment in the study area. The effects assessment evaluates all Project phases, including the construction, dewatering, operational, closure, and post-closure phases.

Public / Inuit Qaujimajatuqangit concerns

Inuit Qaujimajatuqangit highlighted the cultural significance of water to the Inuit, including rivers and lakes, which were considered important travel routes during the winter, areas adjacent to lakes were considered preferred locations for camping and caching, critical in providing habitat for fish and important secondary source of traditional food for Baker Lake community members, and prime harvesting sites where caribou crossings were located. Inuit Qaujimajatuqangit related to knowledge and observations of changing weather and climate and its effects on water levels in rivers and lakes was identified as a key concern.

Concerns have been raised regarding the effect of specific project activities that could affect water quality (e.g., spills and accidents, dust deposition, disturbance of lakes from construction activities, dewatering of waterbodies, and accumulation of toxic substances), fish, waterfowl, and aquatic ecosystems. Concerns were also raised regarding specific project activities about the protection of lakes, including restricted water flow and dewatering of waterbodies, watercourse crossings.

Concerns related explicitly to fish populations and habitats were effects of siltation, spills, the accumulation of toxic substances, habitat loss, restricted water flow and dewatering of waterbodies, dust, and the potential overharvesting of fish species near construction sites or camps.

Key Project Elements and Findings of Environmental Impact Statement

Hydrogeology and Groundwater

Pathway analysis for groundwater and hydrogeology identifies and assesses the linkages between the Project components or activities. No primary pathways were identified. Changes in hydrogeology and groundwater quantity and quality were evaluated in the context of how these changes in turn may result in changes to VCs (i.e. surface water hydrology and surface water quality).

Surface Water Quantity

Primary pathways for surface water quantity are the result of dewatering, mine infrastructure development, and diversion activities for the Project. Infrastructure development will modify the configuration of a watershed, including drainage area, and lake water surface fractions. Dewatering and diversion of waterbodies will augment discharges and water levels of receiving lakes. Effects resulting from the Project on discharges, water levels, and channel/bank stability are summarized below by Project phases: During construction and dewatering discharge and water level regimes from Lake A16 (Mammoth Lake) and downstream lakes are expected to decrease from the baseline values, and no effects are expected on channel/bank stability . During operations, the Whale Tail Lake (South Basin) diversion to the Lake A16 (Mammoth Lake) watershed, and the North-East sector diversion to the Lake C38 (Nemo Lake) watershed, are expected to increase water levels in Whale Tail Lake (South Basin), flood discharge and water level regimes are expected to increase slightly from the baseline values at Lake A16 (Mammoth Lake), discharge and water level regimes are expected to increase from the baseline values at Lake C38 (Nemo Lake), and negligible effects are expected on channel/bank stability. No effects are expected on channel/bank stability at Lake A16 (Mammoth Lake) or Lake C38 (Nemo Lake). During closure discharge and water level regimes from Lake A16 (Mammoth Lake) and downstream lakes are expected to decrease from the baseline values. No effects are expected on channel/bank stability. The effects are expected to remain confined to the Local Study Area (LSA). There are no reasonably foreseeable future developments and cumulative effects are expected to be negligible.

Surface Water Quality

Assessment of water and sediment quality provides a basis for evaluation of the aquatic ecosystems to determine whether water quality during each phase of the Project meets acceptable levels for the protection of aquatic life, source drinking water, and water for wildlife consumption. Primary pathways to water and sediment quality are potential Project effects from the deposition of dust of metals from air emissions, from alteration of watersheds, and from release of mine wastewater. Assessment results of each primary pathway are summarized below.

Air Emissions

Generation of dust and air emissions are linked to Project activities such as operations of diesel powered equipment, blasting, and transportation along the haul roads. The duration of these effects are predicted to be short to medium-term in length, primarily restricted to operations, with some pathways in construction and closure. Based on monitoring data from Meadowbank Mine and other Northern mines, the spatial extent of dust deposition is expected to be local, and measureable changes in water quality from deposition of dust and acidifying air emissions is expected to be low. Based on the results of the air quality predictions for the Project, the use of mitigation such as low-sulfur diesel fuel, and watering of roads, the effects of deposition of dust and acidifying air emissions is predicted to have a negligible effect on water quality, and thus a negligible effect on aquatic ecosystems and traditional and non-traditional uses.

Flooding

The planned diversion of Whale Tail Lake (South Basin) will result in flooding of tributary lakes which may result in increased concentrations of mercury in the water and biota, from decomposition of newly flooded vegetation.

The effects of flooding on mercury cycling will be limited to the period of time when Whale Tail Lake (South Basin) is flooding (i.e., approximately 2 years). Based on the literature, mercury concentrations in water and biota can start to increase one to two years after flooding; the time to return to baseline conditions is unknown, but it is assumed that the time will be less than the time observed in naturally flooded reservoirs since the flooded state will be temporary. Based on these assumptions, the duration of effects was rated as medium-term and the geographical extent of effects was considered local because effects will be limited to Whale Tail Lake. The potential magnitude of the effect was rated as moderate because some parameters may increase above guidelines, but not to a level that could affect the sustainability of the ecosystem nor limit the continued traditional and non-traditional uses.

Effluent Discharge

Management of water in the Whale Tail Pit area and the discharge of effluent to the downstream environment has the potential to change water quality through disturbance of lakes and effluent release. There is the potential to change Lake A16 (Mammoth Lake) and the downstream receiving environment from the Project activities related to this pathway. Lakes that have been identified as culturally important (e.g., Innugugayualik and Pipedream lakes; Section 6.4.1.1; Volume 7, Appendix 7-A) will not be affected by this pathway.

Management of water on site will be necessary to manage and minimize downstream effects. Discharge of effluent will be limited to the operations phase, but the potential effects may extend through to early post-closure. It is predicted that there will be a change in downstream water quality due to the Project but that changes will be limited to one constituent: phosphorus. The predictions are conservative but suggest there could be increases in phosphorus in the downstream lakes, which could change productivity.

The duration of the effect was rated as long-term but not permanent because the model predicts a return to baseline conditions in post-closure. The geographic extent was rated as regional as there is the potential for changes in nutrients to Downstream Node 2. The magnitude was rated as moderate to high because there is a high degree of conservatism in the predictions, increased phosphorus could affect sustainability of the ecosystem, in a select system of lakes, but may not affect aquatic health.

The Project is not anticipated to have a significant effect to water quality. There are no reasonably foreseeable future developments and cumulative effects are expected to be negligible.

Fish and Fish Habitat

Primary pathway effects will result largely from direct habitat losses from the construction of the Mammoth and Whale Tail dikes, the Whale Tail Pit, the dewatering and fish out of the diked area in Lake A16 (Mammoth Lake) and Lake A17 (Whale Tail Lake), and the flooding of Lake A17 (Whale Tail Lake). Indirect effects to fish and fish habitat will include those related to changes in surface water quantity and water quality.

The effects from the Project are expected not to have a significant adverse effect on fish and fish habitat VCs based on the weight of evidence from the analysis of primary pathways, summarized below. There are no existing or planned developments (other than the Project) that would contribute to cumulative effects to fish and fish habitat within the aquatics Regional Study Area (RSA). Any measurable effects of the Project to the productivity of the fishery (or support for the productivity of the fishery) will be restricted to the assessment area for fish and fish habitat within the aquatics RSA. Furthermore, unavoidable effects to the productivity of the fishery from the construction of the dikes and subsequent dewatering of the diked area will be addressed with the implementation of offsetting measures developed in consultation with Fisheries and Oceans Canada (DFO) and local stakeholders with the goal of maintaining or improving the productivity of a fishery.

Habitat Losses

The construction of the North East, Mammoth, and Whale Tail dikes and the subsequent dewatering of the diked area will result in habitat losses for Arctic Char, Lake Trout, and Round Whitefish. These changes are expected to occur on a regional scale and have a moderate effect on VC fish species that rely on coarse substrate habitat for spawning and rearing in Mammoth Lake and Whale Tail Lake. Most of the residual effects from direct changes in habitat will be long-term in duration and reversible following back-flooding, breach of dikes, and reconnection of habitats. Residual effects from direct losses of lake habitat from the dike (sections remaining at post-closure) and the open pit development are expected to be permanent, but are expected to be low in magnitude and occur at the local scale.

Fish-Out

Dewatering of Whale Tail Lake (North Basin) and a small portion of Mammoth Lake at the narrows between Whale Tail Lake and Mammoth Lake will be required to access the mineral deposit. Prior to dewatering, a fish-out will be conducted to remove fish from the dewatered area. Fish mortality is expected to result in a moderate effect to Arctic Char, Lake Trout, and Lake Round Whitefish, and the forage species that support the fishery. Residual effects from the fish-out are expected to occur at the regional scale and be short-term in duration. DFO and affected Inuit communities will continue to be consulted during the DFO authorization phase of the Project to ensure measures and standards to avoid and mitigate serious harm to fish are approved, are of benefit to Inuit stakeholders and successful. The Final Fish-Out Work Plan may include a fish salvage (or transfer) to mitigate effects to fish mortality.

Habitat Fragmentation

Construction and operations of the Mammoth, Whale Tail, and North East dikes and diversions will also result in effects to habitat connectivity. The presence of the dikes will impede fish passage between Whale Tail Lake and Mammoth Lake, and between these lakes and affected tributary habitats. Fish populations above and below any barriers are expected to be maintained. Habitats with the potential to provide overwintering, spawning, rearing, and foraging functions will remain available for populations during construction through post-closure. Fragmentation effects related to the Project dikes are expected to be low in magnitude, long-term in duration, and occur at the regional scale. Any effects would be reversible when the dikes are breached at closure.

Habitat Alteration from Flooding

The construction and operations of the Mammoth, Whale Tail, and North East dikes and their associated diversions will result in the flooding of tributary streams, affecting the abundance and distribution of Arctic Char, Lake Trout, and Round Whitefish. With flooding, affected stream habitat would be eliminated with the increase in elevation and total surface area of Whale Tail Lake (South Basin). Species distributions have the potential to shift (i.e., expand distributions) as Arctic Char, Lake Trout, and Round Whitefish gain access to forage fish populations in small lakes and ponds. The effects of flooding from the Project dikes and diversions are possible, and effects, if any, are expected to be low in magnitude, medium-term in duration, and occur at the local scale.

Downstream Changes to Flows

Water diversions during construction and operations phases will reduce water depths and volumes of Mammoth Lake and downstream lakes, resulting in a reduction in fish habitat. A similar effect is expected for streams below Mammoth Lake where the timing window for fish use of affected streams may be limited to periods of high flow, such as the spring freshet period in June. Project activities resulting in downstream reductions in flows during construction and closure phases are expected to have a moderate impact on Arctic Char, Lake Trout, and Round Whitefish, occurring on a regional scale. Residual effects will be short-term in duration for the construction phase and medium-term during back-flooding of the diked area at closure.

Changes to Lake Ecosystem Productivity

The effect of increased nutrient concentrations to Mammoth Lake, and downstream lakes during operations and closure may result in a general increase in productivity at lower trophic levels. Biomass of phytoplankton, zooplankton, and benthic invertebrates will likely increase during this period. Possible shifts in overall community structure and dominant taxonomic groups may result due to the meso-eutrophic trigger value being exceeded in Mammoth Lake, Lake A15, and Lake A12 during operations and closure with a subsequent return to oligotrophic conditions expected by 2039. Due to the increased food base (lower trophic levels and forage fish), there may also be a minor increase in growth and reproduction rates in Arctic Char, Lake Trout, and Round Whitefish, and the forage fish that support the fishery. However, an increase in nutrient levels in Mammoth Lake and downstream lakes may also result in a moderate increase in algae or sediment on lake habitats, including spawning shoals, leading to reductions in oxygen levels. Thus, an increase in nutrient levels is expected to result in negative residual effects to the fishery in response to any changes in trophic status during closure and operations. Residual effects from changes in nutrient levels are expected to have a moderate effect on fish and fish habitat, occur at the regional scale, and be long-term in duration with effects being reversible during post-closure.

Mitigation Measures

Monitoring programs will be implemented during the life of the Project through a variety of monitoring plans, and may be a combination of environmental monitoring to track conditions and implementing further mitigation as required and follow-up monitoring to verify the accuracy of effect predictions and adaptively manage and implement further mitigation as required. Monitoring programs for hydrogeology and groundwater, and surface water quantity, will include monitoring of surface and groundwater flows, water quality and levels at key locations in the LSA and Project infrastructure during all phases of the Project. Visual inspections will also be undertaken to assess the integrity of shorelines, outlets and stream crossings to monitor for the development of channel or bank erosion. Monitoring is included in the following plans to determine if effects are as follows:

- Dike Construction and Monitoring Plan;
- Water Quality and Flow Monitoring Plan;
- Water Management Plan;
- Aquatic Effects Management Program;
- Core Receiving Environment Monitoring Plan;
- Fisheries Offsetting Plan; and
- Habitat Compensation Monitoring Plan.

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ᐅᖃᓕᒫᖅ 6 ᑭᓱᓕᕆᓂᖅ ᐊᐸᑎᑎᑦ ᐊᐅᑐᖃᓯᕐᓗᑦ ᑎᑎᖅᑲᖅ Whale Tail ᐃᓗᓕᑐᖃᓯᓂᔪᓗᑦ ᐊᒪᒪᓗ ᐅᓯᑲᑦᑕᓐᓄᕐᓗᑦ ᐊᑦᔪᐸᑎᒧᑦ ᐱᓕᕆᐊᕐᓗᑦ (ᐱᓕᕆᐊᖅ) ᐱᓕᕆᐊᖅᖃᐅᑎ ᒪᓕᐅᑕᐅᓴᐃᓕᓴᓄᐅᔪᓂᐅ ᓄᓇᕗᒻᒥ ᐊᐅᑐᖃᓯᓗᑦ ᑭᒥᖅᑭᔨᔪᓂᓂ ᐱᓕᕆᐊᕐᓗᑦ, ᐱᓗᐊᖅᑐᑦᑎᓂ ᐱᔨᔪᑎᖅᑐᑐᓂᐅᔪᓂᐅ ᖃᓄᐃᓐᓇᖅᑐᑎᓂᐅᔪᓂᐅ ᐱᓕᕆᐊᕐᒥᑦ ᐱᔪᓂᐅ ᑕᓯᐅ ᐃᒪᓐᓕᑕ ᐊᐸᑎᖃᓕᓂᒃ, ᐃᓕᐅᔪᓂᑐᑎᑦ ᐃᒪᓕᕆᓂᖅ ᐊᒪᒪᓗ ᓄᓇᒥᑦ ᐃᒪᖅ, ᐃᒪᐅᔪᓂ ᖃᓄᐃᓐᓇᖅᑐᑎᓂᐅᔪᓂᐅ ᐊᒪᒪᓗ ᖃᓄᐃᓐᓇᖅᑐᑎᓂᐅᔪᓂᐅ, ᐊᒪᒪᓗ ᐃᖃᓗᐃᑦ ᖃᓄᐃᓐᓇᖅᑐᑎᓂᐅᔪᓂᐅ.

ᐅᖃᓕᒫᖅ 6-ᒥᑦ ᐃᓕᐅᔪᑦ ᐅᖃᐅᔪᖃᓂᐅᔪᑦ ᐃᑲᐱᓂᖃᓂᕆᔨᔪᓂᐅ ᐃᓕᒥᑎᐅᔪᓂᐅ (VC), ᐃᓕᓚᐅᑎᕆᐅᓂᖅᓂᑦ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖅᑐᓂᑦ (IQ), ᖃᓄᐃᑉᑐᓂᖅᓂᑦ ᖃᐅᔨᓴᖃᓂᐅᔪᑦ, ᐊᒪᒪᓗ ᖃᐅᔨᓴᐃᓂᓂᖅ ᑕᐃᑲᖓᑦ ᖃᓄᐃᓐᓇᖅᑐᑎᓂᑎᓂᐅᔪᓂᐅ ᐊᓯᐊᖏᖅᑐᓄᐃᑦ ᑕᓯᐅᑦ ᐃᓕᖅᑭᖅᑐᑦ, ᐃᓕᓴᕐᓗᑦ ᐊᒪᒪᓗ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖅᑐᓂᑦ ᐊᐸᑎᖃᓕᓂᒃ ᖃᐅᔨᓴᐃᓂᓂᐅᔪᓂᐅ. ᖃᓄᐃᓐᓇᖅᑐᑎᓂᐅᓂᔪᓂ ᖃᐅᔨᓴᐃᓂᖅ ᑭᒥᖅᑭᔨᔪᓂ ᐱᓕᕆᐊᕐᓂᑦ ᐃᓐᓇᐃᓐᓇᑦᑎᓐᓄᑦ, ᐃᓕᓚᐅᑎᕆᐅᓂᖅᓂᑦ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖅᑐᓂᑦ ᐊᐸᑎᖃᓕᓂᒃ ᖃᐅᔨᓴᐃᓂᓂᐅᔪᓂᐅ ᐊᒪᒪᓗ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖅᑐᓂᑦ ᐊᐸᑎᖃᓕᓂᒃ

ᐊᔪᖏᑦᓂᓗᓴᖅᑎᑦᓂᓄᑦ. ᐊᐅᓪᓚᕐᓂᐅᑎᒋᔭᒍ, Whale Tail ᑕᓯᖅ (ᓂᒋᐊᓂᑦ) ᓴᖅᒍᑎᓂᑎᓂᖅ ᑕᓯᖅ A16-ᒧᑦ (Mammoth ᑕᓯᖅ) ᐃᒪᖏᒧᑦ, ᐊᖏᓪᓚ ᓂᒋᐊᓂᒋᓴᑦᑐᓂᓄᑦ ᓴᖅᒍᑎᓂᑎᓂᖅ ᑕᓯᖅ C38-ᒧᑦ (Nemo ᑕᓯᖅ) ᐃᒪᖏᒧᑦ, ᓂᕆᔨᖅᑕᐃᓂᒃ ᐊᔪᖏᑦᓂᓗᓴᖅᑎᑦᓂᓄᑦ ᓂᓗᐅᑎᓂᐅᓂᓄᑦ Whale Tail ᑕᓯᖏᑦ (ᓂᒋᐊᓂᑦ), ᐃᒋᖅᑐᐃᓂᓕᒧᑦ ᑯᕆᔪᓂᑦ ᐊᖏᓪᓚ ᐃᒪᓐᓕᑕ ᐊᔪᖏᑦᓂᓗᓴᖅᑎᑦᓂᓄᑦ Whale Tail ᑕᓯᖏᑦ (ᓂᒋᐊᓂᑦ), ᐃᒋᖅᑐᐃᓂᓕᒧᑦ ᑯᕆᔪᓂᑦ ᐊᖏᓪᓚ ᐃᒪᓐᓕᑕ ᐊᔪᖏᑦᓂᓗᓴᖅᑎᑦᓂᓄᑦ ᐸᓚᐅᔨᓂᑦ ᓂᓗᐅᑎᓂᐅᓂᓄᑦ ᐊᖏᓪᓚᕐᓂᐅᑎᒋᔭᒍ ᓂᕆᔨᖅᑕᐃᓂᒃ ᑯᕆᔪᓂᑦ ᐊᖏᓪᓚ ᐃᒪᓐᓕᑕ ᐃᓕᑦ ᐊᔪᖏᑦᓂᓗᓴᖅᑎᑦᓂᓄᑦ ᑕᓯᖅ A16-ᒧᑦ (Mammoth ᑕᓯᖅ) ᐅᓴᓗᓂᓂᑦ ᑕᓯᖅ C38-ᒧᑦ (Nemo ᑕᓯᖅ). ᐅᓴᐃᖅᓯᓪᓕᐊᑎᒋᔭᒍᒧᑦ ᐃᒪᓐᓕᑕ ᐃᓕᑦ ᓇᓂᓂᓗᓴᖅᑎᑦᓂᓄᑦ ᑕᓯᖅ A16-ᒧᑦ (Mammoth ᑕᓯᖅ) ᐊᖏᓪᓚ ᑕᐅᓄᖓ ᐃᒪᓐᓕᑕ ᑕᓯᖏᑦᓂᓄᑦ ᑎᓪᓗᐊᓂᓂᓕᓂᓄᑦ ᑭᓚᐅᔪᓂᑦ ᓂᓗᐅᑎᓂᐅᓂᓄᑦ. ᖃᓄᐃᓖᓯᓂᖅᑐᓂᓗᓂᓄᑦ ᓂᓗᐅᑎᓂᐅᓂᓄᑦ ᐊᔪᖏᑦᓂᓗᓴᖅᑎᑦᓂᓄᑦ ᓂᓗᐅᑎᓂᐅᓂᓄᑦ ᑕᓯᖅ A16-ᒧᑦ (Mammoth ᑕᓯᖅ) ᐅᓇᓗᓅᓂ ᑕᓯᖅ C38-ᒧᑦ (Nemo ᑕᓯᖅ). ᐅᓴᐃᓂᕐᓂᓕᒫᒧᑦ ᐃᒪᓐᓕᑕ ᐃᓕᑦ ᓇᓂᓂᓗᓴᖅᑎᑦᓂᓄᑦ ᑕᓯᖅ A16-ᒧᑦ (Mammoth ᑕᓯᖅ) ᐊᖏᓪᓚ ᑕᐅᓄᖓ ᐃᒪᓐᓕᑕ ᐊᓚᐅᔨᓂᑦ ᖃᐅᔨᓂᓂᓕᓂᓄᑦ ᑕᓯᖏᑦᓂᓄᑦ ᑎᓪᓗᐊᓂᓂᓕᓂᓄᑦ ᐃᒪᓐᓕᑕ ᐊᓚᐅᔨᓂᑦ ᑕᓯᖅ ᐃᒪᓐᓕᑕ ᐊᔪᖏᑦᓂᓗᓴᖅᑎᑦᓂᓄᑦ ᑕᓯᖅ A16-ᒧᑦ (Mammoth ᑕᓯᖅ) ᐊᖏᓪᓚ ᑕᐅᓄᖓ ᐃᒪᓐᓕᑕ ᐊᓚᐅᔨᓂᑦ ᖃᐅᔨᓂᓂᓕᓂᓄᑦ ᑕᓯᖏᑦᓂᓄᑦ ᑎᓪᓗᐊᓂᓂᓕᓂᓄᑦ ᐃᒪᓐᓕᑕ ᐊᓚᐅᔨᓂᑦ ᑕᓯᖅ

ᖃᐅᔨᓐᓂᖅᓯᒪᔨᖅᑐᑦ ᑯᓘᐃ

ᐊᐅᓪᓚᑎᓂᖅ ᐃᒪᖏᑦ Whale Tail ᐃᓗᑦᑐᖅᓭᒪᔪᑦ ᖃᓄᑕᖅᓯᓂᑦ ᐊᒻᒪᓗ ᑯᘐᓕᕆᔨᓂᖅᓚ ᖃᐅᔨᓐᓂᖅᓯᓂᑦᑐᖅᓭᓐᓂᒃ ᐃᒪᐅᑦ ᖃᓄᐃᓕᖅᑐᑦ ᐃᓗᑦᑐᖅᓭᓐᓂᒃ ᖃᐅᔨᓐᓂᖅᓯᓂᑦ. ᐊᓯᐊᓯᐅᖅᓴᖅᑐᖅ ᑕᓯᖅ A16 (Mammoth ᑕᓯᖅ) ᐊᒻᒪᓗ ᑕᐅᓄᖅ ᑯᓘᑦᑐᓂ ᐱᓕᕆᐊᖏᑦ ᐱᔨᑎ ᐱᔪᓐᖓᖅᑐᖅ ᑕᒪᑐᒍᒪᓐᓚ. ᑕᓯᑦ ᐃᓕᑕᓗᒃᐅᓕᐅᖅᑐᑦ ᐱᖅᑯᓯᓗᒃᐅᓕᐅᖅᑯᑦ ᐱᓕᓗᐅᓂᖅᓚᓄᑦ (ᓯᔪᓗ ᐃᓱᓄᒍᔨᐊᓕᓂᒃ ᐊᒻᒪᓗ Pipdream ᑕᓯᑦ; ᐃᓕᑎᒃᐅᔨᖅ 6.4.1.1; ᐅᖃᓕᒪᓚᖅ 7, ᑎᑎᖅᑲᖅ ᐃᓕᓴᐅᑎᓯᒪᔨᖅ 7-A) ᐊᐅᑐᖅᑕᐅᓴᖏᓐᓂᑐᖅ ᑕᒪᑐᒍᒪᓐᓚ.

ᐊᐅᓪᓚᑎᓂᖅ ᐃᒪᖏᑦ ᐃᓂᐅᔨᒥᑦ ᐱᔭᕆᐊᖃᖏᓂᐊᖅᑐᖅ ᐊᐅᓪᓚᑎᓂᓕᒧ ᐊᒻᒪᓗ ᒥᑭᓕᓂᒃ ᖃᐅᔨᓐᓂᖅᓯᓂᑦᑎᓂᐅᑎᓪᓗᒍ ᐃᓱᓐᓂᒃ ᖃᓄᐃᓕᖅᑐᑦ ᖃᐅᔨᓐᓂᖅᓯᓂᑦᑎᓂᐅᑎᒃᓴᓪᓗᒍ. ᐃᓚᖓᑦ ᖃᓄᐃᓕᖅᑐᑦ ᑯᘐᓕᕆᔨᓂᖅᓯᓂᑦ ᐊᐅᓪᓚᑎᓂᓕᒧ ᐃᓱᓐᓂᒃ ᐃᓕᑕᓗᒃᐅᓕᐅᖅᑯᑦ ᐱᔭᕆᐊᖃᖏᓂᐊᖅᑐᖅ ᑎᑎᐅᑦᑐᖅᓭᓐᓂᒃ ᐱᔭᕆᐊᖃᖏᓂᐊᖅᑐᖅ ᐃᓱᓐᓂᒃ ᐃᓕᑕᓗᒃᐅᓕᐅᖅᑯᑦ

ᐃᓂᒋᐅᓂᖓᓂᒃ ᐊᓯᐊᔪᓂᖅ

ᐱᓇᓱᐅᓂᖓ ᐅᐊᖏᓇᖓᓂᑦ ᑲᓇᖏᓇᖓᓂᑦ, Mammoth, ᐊᒻᒪᓗ Whale Tail ᓯᕐᓗᓂᑦ ᐊᒻᒪᓗ ᑭᖑᓂᐊᒍᑦ ᐃᒪᐃᓱᐃᓂᐅᓂᐊᖅᑐᖅ ᓯᕐᓗᓂᖅᓱᐃᐅᓯᓂᑦ ᐃᓂᒋᐅᓱᐅᓯᓂᒃ ᐊᓯᐅᔪᓂᖅᓴᓂᐊᖅᑐᖅ ᐃᖅᓗᒃᐱᖏᓂᒃ, ᐃᓕᓴᕆᓂᒃ, ᐊᒻᒪᓗ ᐊᒥᕐᓴᒃᑐᓗᓂᒃ. ᐊᓯᐊᖑᓱᓂᐅᔪᓂ ᓂᓚᐅᑎᒃᐱᐅᔪᓂ ᑕᐃᒪᐅᓂᐊᖅᓯᓂᖅᓴᖅᑐᓄᓂ ᐅᖓᓯᓂᖓᓴᒧᖓᔪᒧᑦ ᐊᒻᒪᓗ ᖃᑎᒌᓂ ᖃᓄᐊᓂᒃ ᖃᓄᐃᖏᓇᓕᖅᑎᑎᓂᖅᓴᖅᓴᓂ VC-ᓄᑦ ᐃᖃᓗᖓᓂᑦ ᐊᑐᖅᑕᖅᑕᖅᑐᑦ ᓯᐅᑕᐅᓂᐅᔪᓂᒃ ᐃᓂᐅᔪᓂᒃ ᒪᓂᓀᐃᓂᒍᑦ ᐊᒻᒪᓗ Mommoth ᑕᓯᕐᑕᑦ ᐊᒻᒪᓗ Whale Tail ᑕᓯᕐᑕᑦ. ᖃᐅᔨᑎᑐᑦ ᖃᓄᐃᖏᓇᖓᓂᕐᓂᑎᓂᓕᓂᕐᒥᓴᐅᓯᐃᓂᑦ ᐊᓯᐊᖑᓱᓯᐅᔪᓂᑦ ᐃᓂᐅᔪᓄᑦ ᐊᐸᓂᐅᑎᓂᖓᓐᓂᒃ ᐊᒻᒪᓗ ᐅᑎᑭᓇᖓᓂᒃ ᐃᖃᓗᐃᑦᑐᖅᓯᓂᒃᑐᓗᒍ, ᐋᖅᑕᐅᓂᖓᓂᑦ ᓯᕐᓗᐃᓂᑦ, ᐊᒻᒪᓗ ᑲᑎᒪᓂᖅᑐᑦᑐᖅᑐᓂᒃ ᐃᓂᐅᔪᓄᑦ ᐃᑲᔪᐃᔪᓂᑦ ᐃᖃᓗᐃᓂᖅᑐᑦ ᖃᐅᔨᑎᑐᑦ ᐃᓂᐅᔪᓄᑦ ᐃᑲᔪᐃᔪᓂᑦ ᐃᖃᓗᐃᓂᖅ

ᑯᐃᑐᐃᑦ ᐊᓯᐊᖏᔪᓂᖅᑎᑦ ᑯᖏᓂᖅ

ᐃᒪᖏᑎᐅ ᓴᖅᓯᑎᑕᓚᓂᖅ ᓴᓇᕆᐅᑎᓪᓗᒍ ᐊᖏᓚᒪᓂ ᒥᓂᓕᐊᖅᑎᑕᑎᓂᓕᐊᖅᑐᖅ ᐃᒪᐃᑦ ᐃᑎᑕᖅᑎᓪᓗᒍ Mammoth ᑕᓯᖏᑦ ᐊᖏᓚᒪᓂ ᑯᖏᓂᖅ, ᑕᓯᐅᓕᐊᖅᑎᑕᑎᓂᓕᐊᖅᑐᖅ ᐃᖅᑲᐃᐃᑦ ᐃᓂᖅᓴᓪᓗᒍ ᐊᑐᖅᑕᓯᓂᖅᑐᓂᖅ ᐊᖏᓚᒪᓂ ᐊᑐᖅᑕᓯᓂᖅᑐᓂᖅ ᓴᖅᓯᑎᑕᑎᓂᓕᐊᖅᑐᖅ ᐊᖏᓚᒪᓂ ᐊᑐᖅᑕᓯᓂᖅᑐᓂᖅ ᐃᓂᖅᓴᓪᓗᒍ ᐊᑐᖅᑕᓯᓂᖅᑐᓂ

SOMMAIRE DE GESTION – VOLUME 6 L'ENVIRONNEMENT D'EAU DOUCE

Le Volume 6 de l'Énoncé des incidences environnementales du Projet de gisement Whale Tail et de route de transport (le Projet) traite des directives et lignes directrices émises par la Commission du Nunavut chargée de l'examen des répercussions, plus particulièrement celles relatives aux effets du Projet sur l'environnement d'eau douce, notamment l'hydrogéologie et la quantité et la qualité des eaux souterraines et des eaux de surface, ainsi que la population des poissons.

Le Volume 6 inclut une discussion sur les composantes valorisées (CV), l'intégration des Inuit Qaujimajatuqangit (IQ), la description des zones d'étude, ainsi qu'une évaluation des effets directs sur les modifications à l'environnement d'eau douce dans la zone d'étude. L'évaluation des effets s'attarde à évaluer toutes les phases du Projet, incluant la construction, l'assèchement, les opérations, la fermeture et la post-fermeture.

Préoccupations du public / Inuit Qaujimajatuqangit

L'Inuit Qaujimajatuqangit a mis en évidence l'importance culturelle de l'eau pour les Inuits, incluant les rivières et les lacs, lesquels étaient considérés comme des voies de passage importantes au cours de l'hiver. De plus, les secteurs adjacents aux lacs étaient considérés comme des emplacements de prédilection pour le camping et la cache, essentiels pour fournir un habitat aux poissons et une source secondaire importante de nourriture traditionnelle pour les membres de la collectivité de Baker Lake. Ce sont aussi des sites principaux de récolte faunique, là où des traverses de caribous sont situées. L'Inuit Qaujimajatuqangit a été associée aux connaissances et aux observations sur les changements climatiques et météorologiques et leurs effets sur les niveaux d'eau des rivières et des lacs ont été identifiés comme une préoccupation majeure.

Des préoccupations ont été soulevées au sujet des effets d'activités spécifiques du Projet qui pourraient affecter la qualité de l'eau (ex. : déversements et accidents, dépôt de poussière, perturbations des lacs en raison des activités de construction, assèchement de plans d'eau et accumulation de substances toxiques), de même que les poissons, les sauvagines et les systèmes aquatiques. Des préoccupations ont également été soulevées concernant des activités spécifiques du Projet et touchant la protection des lacs, incluant le débit d'eau restreint et l'assèchement des plans d'eau, et les traverses de cours d'eau.

Les préoccupations associées explicitement aux populations de poissons et à leurs habitats concernaient les effets de l'envasement, des déversements, de l'accumulation des substances toxiques, de la perte d'habitat, du débit d'eau restreint et de l'assèchement des plans d'eau, de la poussière et du risque de surrécolte des espèces de poissons près des sites de construction ou des campements du Projet.

Éléments clés du Projet et résultats de l'Énoncé des incidences environnementales

Hydrogéologie et eaux souterraines

L'analyse de trajectoire sur les eaux souterraines et l'hydrogéologie identifie et évalue les liens entre les composantes ou les activités du Projet. Aucune trajectoire primaire n'a été identifiée. Les changements à l'hydrogéologie et à la quantité et la qualité des eaux souterraines ont été évalués en s'attardant à la façon dont ces changements pourraient ensuite entraîner des changements sur les CV (c.-à-d. l'hydrogéologie des eaux de surface et la qualité des eaux de surface).

Quantité des eaux de surface

Les trajectoires primaires concernant la quantité des eaux de surface sont le résultat de l'assèchement, développement des infrastructures minières et des activités de dérivation du Projet. Le développement des infrastructures modifiera la configuration du bassin versant, incluant la zone de drainage, ainsi que des fractions de surface de l'eau du lac. L'assèchement et la dérivation de plans d'eau augmenteront les déversements et les niveaux d'eau des lacs récepteurs. Les effets résultant du Projet sur les déversements, les niveaux d'eau et la stabilité des chenaux/berges sont résumés ci-dessous, par phases du Projet : Au cours de la construction et de l'assèchement, les déversements et les régimes de niveau d'eau provenant du Lac A16 (lac Mammoth) et des lacs en aval devraient diminuer par rapport aux valeurs de référence, et aucun effet n'est anticipé sur la stabilité des chenaux/berges. Au cours de la phase des opérations, la dérivation du lac Whale Tail (bassin sud) vers le bassin versant du lac A16 (lac Mammoth) et la dérivation du secteur nord-est vers le bassin versant du lac C38 (lac Nemo) devraient augmenter les niveaux d'eau dans le lac Whale Tail (bassin sud); le débit de crue et les régimes de niveau d'eau devraient augmenter légèrement par rapport aux valeurs de référence dans le lac A16 (lac Mammoth); les déversements et les régimes de niveau d'eau devraient augmenter par rapport aux valeurs de référence du lac C38 (lac Nemo); et il est anticipé qu'il y aura des effets négligeables sur la stabilité des chenaux/berges. Aucun effet n'est anticipé sur la stabilité des chenaux/berges du lac A16 (lac Mammoth) ou du lac C38 (lac Nemo). Au cours de la fermeture, les déversements et les régimes de niveau d'eau provenant du Lac A16 (lac Mammoth) et des lacs en aval devraient diminuer par rapport aux valeurs de référence. Aucun effet n'est anticipé sur la stabilité des chenaux/berges. Les effets devraient demeurer confinés à la zone d'étude locale (ZEL). Aucun développement futur n'est raisonnablement envisagé et les effets cumulatifs devraient être négligeables.

Qualité des eaux de surface

L'évaluation de la qualité de l'eau et des sédiments procure une base pour l'évaluation des écosystèmes aquatiques afin de déterminer si la qualité de l'eau au cours de chacune des phases du Projet satisfait aux niveaux acceptables en matière de protection de la vie aquatique, des sources d'eau potable et de l'eau consommée par la faune. Les trajectoires primaires de la qualité de l'eau et des sédiments sont des effets potentiels du Projet occasionnés par le dépôt de poussières métalliques par le biais d'émissions atmosphériques, par l'altération des bassins versants et par le rejet des eaux usées de la mine. Les résultats de l'évaluation de chaque trajectoire primaire sont résumés ci-dessous.

Émissions atmosphériques

La production de poussière et les émissions atmosphériques sont liées aux activités du Projet, tels les opérations de l'équipement motorisé au diesel, l'abattage par explosion et le transport le long des routes de transport. La durée de ces effets devrait se poursuivre à court et moyen termes. Ces effets seront surtout limités aux opérations, avec quelques trajectoires dans les phases de construction et de fermeture. En se basant sur les données de surveillance de la mine Meadowbank et d'autres mines situées dans le nord, l'étendue spatiale des dépôts de poussière devrait être locale, et les changements mesurables à la qualité de l'eau en raison des dépôts de poussière et des émissions atmosphériques acidifiantes devraient être faibles. En se basant sur les résultats des prévisions sur la qualité de l'air, l'utilisation de mesures d'atténuation telles que le carburant diesel faible en soufre et l'arrosage des routes, les dépôts de poussière et des émissions atmosphériques acidifiantes devraient avoir un effet négligeable sur la qualité de l'eau, et ainsi avoir un effet tout aussi négligeable sur les écosystèmes aquatiques et l'utilisation traditionnelle et non traditionnelle.

Les inondations

La dérivation planifiée du lac Whale Tail (bassin sud) entraînera l'inondation des lacs affluents ce qui pourrait mener à des concentrations accrues de mercure dans l'eau et le biote en raison de la décomposition d'une végétation nouvellement inondée.

Les effets des inondations sur le cycle du mercure seront limités à la période de temps où le lac Whale Tail (bassin sud) est inondé (c.-à-d. environ 2 ans). En se basant sur la documentation, les concentrations de mercure dans l'eau et le biote peuvent commencer à augmenter de 1 à 2 ans suivant l'inondation; le délai pour revenir aux conditions de base est inconnu, mais il est pressenti que le délai sera moindre que le délai observé dans les réservoirs naturellement inondés étant donné que l'état d'inondation ne sera que temporaire. En se basant sur ces hypothèses, la durée des effets a été évaluée comme étant à moyen terme et l'étendue géographique des effets a été considérée locale puisque les effets seront limités au lac Whale Tail. L'ampleur potentielle des effets a été évaluée comme modérée étant donné que quelques paramètres pourraient augmenter au-dessus des directives, mais pas à un niveau qui pourrait affecter la durabilité de l'écosystème ni limiter les utilisations continues traditionnelle et non traditionnelle.

Déversement des effluents

La gestion de l'eau de la zone du gisement Whale Tail et le déversement des effluents dans l'environnement en aval ont le potentiel de modifier la qualité de l'eau par la perturbation des lacs et du rejet des effluents. Cela a le potentiel de modifier les paramètres du lac A16 (lac Mammoth) et l'environnement récepteur en aval en raison des activités du Projet associées à cette trajectoire. Les lacs qui ont été identifiés comme culturellement importants (c.-à-d. les lacs Innugugayualik et Pipedream; Section 6.4.1.1; Volume 7, Annexe 7-a) ne seront pas touchés par cette trajectoire.

La gestion de l'eau sur le site sera nécessaire afin de gérer et de réduire les effets en aval. Le déversement des effluents sera limité à la phase des opérations, mais les effets potentiels pourraient se poursuivre jusqu'au début de la phase de post-fermeture. Il est prédit qu'il y aura une modification de la qualité de l'eau en aval en raison du Projet, mais que cette modification sera limitée à un seul constituant : le phosphore. Les prévisions sont conservatrices, mais suggèrent qu'il pourrait y avoir une augmentation du phosphore dans les lacs en aval, ce qui pourrait changer la productivité.

La durée des effets a été évaluée comme étant à long terme, mais non permanente, puisque le modèle prédit un retour aux conditions de base lors de la post-fermeture. L'étendue géographique a été évaluée comme régionale étant donné le potentiel de modifications des nutriments dans le Nœud 2 en aval. L'ampleur a été évaluée comme modérée à élevée puisqu'il y a un haut degré de conservatisme dans les prévisions. L'augmentation du phosphore pourrait affecter la durabilité de l'écosystème, dans certains lacs, mais n'affecterait pas la santé aquatique.

Il n'est pas anticipé que le Projet ait un effet important sur la qualité de l'eau. Aucun développement futur n'est raisonnablement envisagé et les effets cumulatifs devraient être négligeables.

Le poisson et l'habitat du poisson

Des effets des trajectoires primaires seront largement occasionnés par des pertes directes d'habitat en raison de la construction des digues Mammoth et Whale Tail, de la fosse Whale Tail, de l'assèchement et de l'enlèvement de poissons du secteur des digues dans le lac A16 (lac Mammoth) et lac A17 (lac Whale Tail), ainsi que de l'inondation du lac A17 (lac Whale Tail). Les effets indirects sur le poisson et l'habitat du poisson incluront ceux associés aux modifications à la quantité de l'eau de surface et à la qualité de l'eau.

Les effets du Projet ne devraient pas comporter d'effet négatif important sur les CV du poisson et de l'habitat du poisson, si l'on se base sur les éléments de preuve issus de l'analyse des trajectoires primaires, éléments de preuve résumés ci-dessous. Il n'y a pas de développements actuels ou planifiés (autres que le Projet) qui pourraient contribuer à des effets cumulatifs sur le poisson ou l'habitat du poisson au sein de la zone d'étude régionale (ZER) aquatique. Tout effet mesurable du Projet sur la productivité de la pêche (ou soutenant la productivité de la pêche) sera limité à la zone d'évaluation du poisson et de l'habitat du poisson au sein de la ZER aquatique. De plus, les effets inévitables sur la productivité de la pêche engendrés par la construction des digues et l'assèchement subséquent de la zone endiguée seront traités grâce à la mise en œuvre des mesures de compensation développées en consultation avec Pêches et Océans Canada (MPO) et les parties prenantes locales avec pour objectif de maintenir ou d'améliorer la productivité de la pêche.

Pertes d'habitat

La construction des digues Nord-Est, Mammoth et Whale Tail et l'assèchement subséquent de la zone endiguée entraîneront des pertes d'habitat pour l'omble chevalier, la truite de lac et le ménomini rond. Ces changements devraient se produire à l'échelle régionale et avoir un effet modéré sur espèces de poissons CV qui reposent sur un habitat de substrat grossier pour la reproduction et la croissance dans les lacs Mammoth et Whale Tail. La majorité des effets résiduels provenant des changements directs sur l'habitat sera d'une durée à long terme et réversible à la suite du reflux, de la rupture des digues et de la reconnexion des habitats. Les effets résiduels engendrés par les pertes directes de l'habitat du lac en raison de la digue (les sections restantes à la post-fermeture) et du développement de la fosse à ciel ouvert devraient être permanents, mais il est anticipé qu'ils seront de faible ampleur et demeureront à l'échelle locale.

Enlèvement de poissons

L'assèchement du lac Whale Tail (bassin nord) et d'une petite portion du lac Mammoth au niveau des rétrécissements entre le lac Whale Tail et le lac Mammoth sera requis pour accéder au gisement de minerai. Préalablement à l'assèchement, un enlèvement de poissons sera effectué afin de retirer les poissons de la zone à assécher. La mortalité sur les poissons devrait entraîner un effet modéré sur l'omble chevalier, la truite de lac et le ménomini rond de lac, ainsi que sur les espèces fourragères qui sont au cœur de la pêche. Les effets résiduels de l'enlèvement de poissons devraient se produire à l'échelle régionale et être d'une durée à court terme. Le MPO et les collectivités inuites touchées continueront d'être consultés au cours de la phase d'autorisation du Projet par le MPO afin d'assurer que des mesures et des normes permettant d'éviter et d'atténuer des préjudices graves aux poissons sont approuvées, bénéficient aux parties prenantes inuites et fonctionnent. Le Plan final de l'enlèvement de poissons pourrait inclure la récupération de poissons (ou un transfert) afin d'atténuer les effets sur la mortalité des poissons.

Fragmentation de l'habitat

La construction et les opérations des digues et dérivations de Mammoth, Whale Tail et Nord-Est entraîneront également des effets à la connectivité de l'habitat. La présence des digues gênera le passage des poissons entre le lac Whale Tail et le lac Mammoth, ainsi qu'entre ces lacs et les habitats affluents touchés. Les populations de poissons au-dessus et en dessous des barrières devraient être maintenues. Les habitats ayant le potentiel de procurer des fonctions d'hivernage, de reproduction, de croissance et de fourrage demeureront disponibles aux populations durant la construction et jusqu'à la post-fermeture. Les effets de fragmentation associés aux digues du Projet devraient être faibles en terme d'ampleur, d'une durée à long terme, et se produire à l'échelle régionale. Tous les effets seraient réversibles lorsque les digues seront rompues à la fermeture.

Altération de l'habitat en raison des inondations

La construction et les opérations des digues Mammoth, Whale Tail et Nord-Est et de leurs ouvrages de dérivation associés entraîneront l'inondation des courants affluents, affectant l'abondance et la répartition de l'omble chevalier, de la truite de lac et du ménomini rond. Grâce à l'inondation, l'habitat lotique touché serait éliminé avec l'augmentation de l'élévation et la zone de surface totale du lac Whale Tail (bassin sud). Les répartitions des espèces ont le potentiel d'être modifiées (c.-à-d. des répartitions élargies) alors que l'omble chevalier, la truite de lac et le ménomini rond obtiennent un accès aux populations de poissons-fourrages dans les petits lacs et les étangs. Des effets de l'inondation des digues et des dérivations du Projet sont possibles, et ces effets, s'il y en a, devraient être de faible ampleur, d'une durée moyenne, et se produire à l'échelle locale.

Changements en aval sur les débits

Les ouvrages de dérivation de l'eau durant les phases de construction et des opérations réduiront les profondeurs et les volumes d'eau du lac Mammoth et des lacs en aval, entraînant une diminution de l'habitat des poissons. Un effet similaire est attendu pour les cours d'eau en dessous du lac Mammoth où la fenêtre de temps d'utilisation par les poissons des cours d'eau touchés peut se limiter aux périodes à débit élevé, telle la période de crue printanière en juin. Les activités du Projet entraînant des réductions de débit en aval durant les phases de construction et de fermeture devraient avoir un impact modéré sur l'omble chevalier, la truite de lac et le ménomini rond, et ce, à une échelle régionale. Les effets résiduels seront de courte durée pour la phase de construction et de durée moyenne durant le reflux de la zone endiguée à la fermeture.

Changements à la productivité de l'écosystème du lac

Les effets d'une concentration accrue de nutriments dans le lac Mammoth et les lacs en aval durant les opérations et la fermeture peuvent entraîner une augmentation générale de la productivité dans les niveaux trophiques inférieurs. La biomasse de phytoplancton, de zooplancton et d'invertébrés benthiques est susceptible d'augmenter au cours de cette période. De possibles changements dans la structure générale de la communauté et des groupes taxonomiques dominants peuvent se produire en raison du dépassement de la valeur de déclenchement méso-eutrophisée dans les lacs Mammoth, A15 et A12 durant les opérations et la fermeture, avec un retour ultérieur à des conditions oligotrophes prévu d'ici à 2039. En raison de l'augmentation de la nourriture de base (niveaux trophiques inférieurs et poissons-fourrages), il pourrait également y avoir une légère augmentation des taux de croissance et de reproduction de l'omble chevalier, de la truite de lac et du ménomini rond, ainsi que du poisson-fourrage qui soutient la pêche. Cependant, une augmentation des niveaux de nutriments dans le lac Mammoth et les lacs en aval peut également entraîner une augmentation modérée des algues ou des sédiments sur les habitats du lac, incluant des hauts-fonds de frai, menant à des réductions des niveaux d'oxygène. Ainsi, une augmentation des niveaux de nutriments devrait entraîner des effets résiduels négatifs à la pêche en réponse à tout changement du statut trophique durant la fermeture et les opérations. Les effets résiduels provenant des changements des niveaux de nutriments devraient avoir un effet modéré sur le poisson et l'habitat du poisson, se produire à l'échelle régionale et être d'une durée à long terme. Ces effets seront réversibles durant la post-fermeture.

Les mesures d'atténuation

Des programmes de surveillance seront mis en œuvre au cours de la durée de vie du Projet par le biais d'une panoplie de plans de surveillance, et possiblement par une combinaison de surveillance environnementale afin de suivre les conditions et de mettre en œuvre des mesures d'atténuation supplémentaires lorsque nécessaires. Également, il faudra un suivi des activités de surveillance afin de vérifier l'exactitude des prévisions des effets et d'adapter la gestion et la mise en œuvre de mesures d'atténuation supplémentaires, au besoin. Les programmes de surveillance concernant l'hydrogéologie et la quantité des eaux souterraines et de l'eau de surface incluront la surveillance des débits des eaux de surface et souterraines, la qualité et les niveaux de l'eau à des endroits stratégiques dans la ZEL, ainsi que l'infrastructure du Projet durant toutes les phases du Projet. Des inspections visuelles seront également entreprises dans le but d'évaluer l'intégrité des bandes riveraines, des sorties d'eaux et des traverses de cours d'eau afin de surveiller le développement d'érosion sur les chenaux ou les berges. La surveillance des impacts est incluse dans les plans suivants :

- Plan de construction et de surveillance des digues;
- Plan de surveillance des débits et de la qualité de l'eau;
- Plan de gestion de l'eau;
- Programme de gestion des effets aquatiques;
- Plan de surveillance de base du milieu récepteur;
- Plan de compensation de la pêche; et
- Plan surveillance des compensations pour perte d'habitat.

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ACRONYMS

AWAR	All-Weather Access Road
BSA	Baseline Study Area
CCME	Canadian Council Of Ministers of the Environment
CDWQG	Canadian Drinking Water Quality Guidelines
COPC	Constituents of Potential Concern
COSEWIC	Committee on the Status of Endangered Wildlife In Canada
CRA	commercial, recreational, or Aboriginal
CREMP	Core Receiving Environment Monitoring Program
CWQG	Canadian Water Quality Guidelines
DFO	Fisheries and Oceans Canada
EA	Environmental Assessment
EPZ	Enhanced Permeability Zone
IQ	Inuit Qaujimajatuqangit
ISQG	Interim Sediment Quality Guidelines
LSA	Local Study Area
NIRB	Nunavut Impact Review Board
PEL	Probable Effect Level
Project	Whale Tail Pit And Haul Road
RSA	Regional Study Area
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
VC	Valued Component
WRSF	Waste Rock Storage Facility

UNITS OF MEASURE

%	percent
°C	degrees Celsius
km	kilometre(s)
km2	square kilometre(s)
ha	hectare(s)
M	metre(s)
m^3/day	cubic metre per day
masl	metres above sea level
mg/L	milligram per litre
mm	millimetre

6.0 FRESHWATER ENVIRONMENT

6.1 Introduction

The purpose of this section is to address the Guidelines issued by the Nunavut Impact Review Board (NIRB) for the Meadowbank Mine (NIRB 2004), and specifically those relating to the effect of the Whale Tail Pit and Haul Road (the Project) on the Freshwater Environment (i.e., hydrogeology and groundwater, surface water quantity, surface water quality, sediment quality, and fish population). Volume 2, Appendix 2-B list the specific requirements set out in the guidelines, and relating to the baseline and effect assessment of these components.

Volume 6 includes a discussion on valued components, incorporation of Inuit Qaujimajatuqangit (IQ), description of the study areas, and an assessment of direct effects to changes to the Freshwater Environment in the study area. The effects assessment evaluates all Project phases, including the construction, dewatering, operations, closure, and post-closure phases.

6.1.1 Volume Structure

- **Section 6.1:** Introduction
- **Section 6.2:** Hydrogeology and groundwater
- **Section 6.3:** Surface water quantity
- **Section 6.4:** Surface water quality
- **Section 6.5**: Fish and fish habitat

6.1.2 Valued Components

Valued components (VC) of the Freshwater Environment are identified in Table 6.1-1.

Table 6.1-1: Summary of Aquatic Environment Valued Components

Valued Component	Rationale for Inclusion
Hydrogeology and groundwater quality and quantity	■ Groundwater is not considered a VC because sources from the active layer and from the deep groundwater below the permafrost are not currently used ■ Due to the presence of deep permafrost, the seasonal nature of the active layer, and the availability of good-quality drinking water from surface water sources near the Project, it is unlikely that groundwater will be used as a drinking water source in the future ■ Not included as a VC in Cumberland (2005) ■ Considered here because groundwater provides a pathway/link to VCs, such as surface hydrology and aquatic chemistry ■ No IQ information for this
Surface water quantity	■ The Project is expected to affect existing availability of the spatial and temporal distribution of water quantity for aquatic and terrestrial ecosystems ■ Inuit Qaujimajatuqangit highlighted concerns about the effects of climate change on precipitation, freeze-thaw cycle, and water level conditions

Table 6.1-1: Summary of Aquatic Environment Valued Components (continued)

Valued Component	Rationale for Inclusion
Water Quality	■ The Project is expected to affect the concentration of total and dissolved constituents in water ■ Water quality to support aquatic and human health is defined by the concentration of various constituents ■ Changes in the quality of water can influence aquatic organisms and the use of water as a drinking water source for Inuit or for recreational purposes ■ The quality of water was identified as an issue ■ The quality of water is a pathway to fish and aquatic health ■ IQ highlighted concerns about the effects of mines on the quality of drinking water
Sediment Quality	■ Sediment quality is not considered a VC because changes to sediment quality will be managed by minimizing changes to water quality and best management practices to reduce or minimize erosion and sedimentation ■ Not included as a VC in Cumberland (2005) ■ It is considered in the impact assessment because of the link between water quality, sediment quality, and aquatic biota
Arctic Grayling (ᐊᒥᕐᕙᒃᑐᖅ) 	■ Fished for traditional/subsistence use in Nunavut ■ Although not captured in the vicinity of the Whale Tail Pit, the species was recorded in watercourses crossed by the proposed haul road ■ Uses stream habitats for spawning and rearing, but overwinters in lakes; adfluvial life history suitable for assessing potential effects to stream habitats ■ Feeds primarily on aquatic and terrestrial insects, as well as plankton; suitable for assessing how potential changes to lower trophic levels may affect fish ■ Listed as “sensitive” in the Northwest Territories
Arctic Char (ᐃᖃᓗᐃᑦ / ᑕᓇᐅᖏᑦᑐᖅ) 	■ Fished for traditional/subsistence use, and has been fished commercially in Nunavut at certain locations ■ Found in Lake A17 (Whale Tail Lake). Completes most of its adult life history in lakes, with a portion of its juvenile life history that can be in streams, so suitable for assessing potential changes to lake habitats ■ Long-lived predatory species; primarily piscivorous ■ Often a top predator in an Arctic lake, so suitable for assessing potential effects of water quality changes in lakes
Lake Trout (ᐃᓱᒪᖅ) 	■ Fished for traditional/subsistence use, and is a popular sportfish in Nunavut ■ Abundant in Lake A16 (Mammoth Lake) and Lake A17 (Whale Tail Lake) ■ Completes most of its life history in lakes, with occasional movements into streams, so suitable for assessing potential changes to lake habitats ■ Long-lived predatory species; primarily piscivorous ■ Top of food chain, so suitable for assessing potential effects of water quality changes (changes in lower trophic organisms or forage fish will ultimately affect lake trout), as well as for potential effects of metals or other substances that have the potential to bioaccumulate

Table 6.1-1: Summary of Aquatic Environment Valued Components (continued)

Valued Component	Rationale for Inclusion
Round Whitefish (ᓴᓗᒃᑐᐅᓚᒃ) 	■ Fished for traditional/subsistence use, and has been fished commercially in Nunavut at certain locations ■ Abundant in Lake A16 (Mammoth Lake) and Lake A17 (Whale Tail Lake) ■ Completes most of its life history in lakes, with occasional movements into streams ■ Feeds primarily on benthic organisms; suitable for assessing how potential changes to sediment quality and benthic invertebrates may affect fish

IQ = Inuit Qaujimajatuqangit; VC = valued component.

The criteria used to select the fish VC species for the Project environmental assessment were as follows:

- occurrence and relative abundance of species near the Whale Tail Project;
- species conservation status (e.g., COSEWIC 2016);
- trophic position/life history; and
- species that are part of a commercial, recreational, or Aboriginal (CRA) fishery (DFO 2013).

Candidate VCs included species recorded or expected to occur near the Project based on IQ studies (Volume 7, Appendix 7-A) and fisheries sampling conducted for the Project (VAppendix 6-D; Appendix 6-J; Appendix 6-K). Previously completed studies in Nunavut were also reviewed (Cumberland 2005a) and combined with any other relevant sources of information on the distribution of species (Scott and Crossman 1998) that have the potential to interact with Project activities within an area spanning the Meadowbank River, Quoich River, and Thelon River watersheds.

Fish species expected to potentially interact with Project activities and the species codes used in this report are presented in Table 6.1-2. None of the baseline study species listed in Table 6.1-2 are classified as federally listed species or species with a designated conservation status by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2016). The only species potentially warranting attention in the environmental assessment because of its conservation status is Arctic Grayling. Although Arctic Grayling does not have a conservation status in Canada under COSEWIC (2016), Arctic Grayling is classified as a sensitive species in the Northwest Territories (NWT Infobase 2016). The species is considered sensitive to warming climate trends and also to habitat degradation, such as siltation, corridor blockage, or removal of riparian vegetation (NWT Infobase 2016). Arctic Char, Arctic Grayling, Lake Trout, and Round Whitefish were identified as species of economic and cultural importance to traditional users in the region during the IQ baseline study associated with the Project (Volume 7, Appendix 7-A).

Table 6.1-2: Common and Scientific Names of Fish Species with the Potential to Occur in the Baseline Study Area

Family	Common Name	Code[a]	Scientific Name	Recorded During Baseline Sampling
Salmonidae	Lake Trout	LKTR	*Salvelinus namaycush* (Walbaum)	√
	Arctic Grayling	ARGR	*Thymallus arcticus* (Pallas)	√
	Cisco	CISC	*Coregonus artedii* (Lesueur)	
	Lake Whitefish	LKWH	*Coregonus clupeaformis* (Mitchell)	
	Round Whitefish	RNWH	*Prosopium cylindraceum* (Pallas)	√
Esocidae	Northern Pike	NRPK	*Esox lucius* (Linnaeus)	
Gadidae	Burbot	BURB	*Lota lota* (Linnaeus)	√
Catostomidae	Longnose Sucker	LNSC	*Catostomus catostomus* (Forster)	
Gasterostieidae	Ninespine Stickleback	NNST	*Pungitius pungitius* (Linnaeus)	√
	Threespine Stickleback	THST	*Gasterosteus aculeatus* (Linnaeus)	
Cyprinidae	Lake Chub	LKCH	*Couesius plumbeus* (Agassiz)	
Cottidae	Slimy Sculpin	SLSC	*Cottus cognatus* (Richardson)	√
	Spoonhead Sculpin	SPSC	*Cottus ricei (*Nelson)	

Note: All fish species present in the project lakes were included in the fish population VC in the Meadowbank EIS. However, the main fish species VCs were Lake Trout, Arctic Char, and Round Whitefish (Cumberland 2005c).

[a] According to Mackay et al. (1990).

6.1.2.1 Overview of VC Species Biology

6.1.2.1.1 Arctic Grayling

Arctic Grayling are found throughout Nunavut in rivers, streams, and lakes with clear cold waters (Evans et al. 2002). Their life history is riverine, adfluvial, and lacustrine, and they frequent clear streams, rivers, and lakes in the east Arctic eco-region, including Baker Lake. Arctic grayling undertake spawning migrations from over-wintering habitat (usually lakes) in the early spring prior to or at ice break-up, moving into smaller streams between mid-May and early June. Arctic grayling prefer to spawn over gravel or rocky bottoms with a small percentage of sandy bottom (<15 to 20 percent [%]). Arctic Grayling spawn in areas with surface current velocities less than 1.4 m/s, varying water depths, and small, unembedded gravels about 25 millimetres (mm) in diameter. A post-spawning run of Arctic Grayling from small streams to adjoining rivers and lakes occurs in late June following spawning (Chang-Kue and Cameron 1980). Arctic Grayling have been found to summer feed on invertebrates, terrestrial insects, some fish and small mammals after spawning in rubble and gravel, fine-grained and coarse-grained substrates (Stewart et. al 2007b, Evans et al. 2002) have documented Arctic Grayling spawning migrations of up to 320 kilometres (km) from overwintering habitat.

Arctic Grayling can mature as early as age-2 or as late as age-9 (Evans et al. 2002). Once mature, Arctic Grayling typically spawn each year. Spawning takes place over a two to three week period (Ford et al. 1995), young hatch within 16 to 18 days at 9 degrees Celsius (°C), newly hatched alevins spend three to five days under substrate and fry are first collected from late June to early July (Evans et al. 2002). Fry reside in semi-deep pools and side channels over boulder, cobble, silt, and sand substrates with water velocities less than 0.8 m/s. Young-of-the-year fish remain in their natal streams for up to 15 months, where ice conditions permit.

6.1.2.1.2 Arctic Char

Arctic Char exhibit both anadromous and non-anadromous life histories. Anadromous char spend at least part of their adult lives feeding in marine water and making migrations into freshwater lakes to overwinter and reproduce. Non-anadromous char spend their entire lives in freshwater (Babaluk et al. 1997). Non-anadromous Arctic Char, such as those in the Baseline Study Area for the Project, live in lakes and rivers and overwinter in water deep enough to not freeze to the bottom (Stewart and Watkinson, 2004). Spawning occurs in the fall, over gravel beds or rocky shoals in lakes and in quiet pools below rapids in rivers, where water depth is sufficient to prevent the embryos from freezing over the winter (McPhail and Lindsey, 1970; Scott and Crossman, 1998). Spawning habitat for Arctic Char in lakes is very similar to that of Lake Trout and Round Whitefish. During spawning, females construct redds (spawning nests) in shallow heterogeneous substrates (mixture of sand, gravel, and cobble), but have also been found to spawn in boulder rubble substrate without constructing redds (Evans et al. 2002). Eggs hatch in late winter and fry emerge from the gravel in July, when planktonic food is abundant. Young-of-the-year have been observed predominantly along shorelines of lakes and find refuge and protection by hiding among stones. In general, Arctic char use channels, streams, and rivers mainly as migratory corridors (Evans et al. 2002).

6.1.2.1.3 Lake Trout

Lake Trout are found throughout northern Canada (Scott and Crossman 1998). Although they occur primarily in large, deep lakes, they occasionally inhabit large, clear rivers. The extent to which Lake Trout dwell in riverine habitat is unknown. In northern populations, Lake Trout are especially long-lived and fish older than 20 years old are common. In northern populations, Lake Trout typically mature between the ages of 6 and 13 years (Scott and Crossman 1998).

Lake Trout spawn in the fall (September or October) when water temperatures fall below approximately 10°C (Scott and Crossman 1998; Richardson et al. 2001; McPhail 2007). Spawning occurs at night, and females deposit eggs over beds of large boulder or rubble at depths up to 12 metres (m). The fertilized eggs settle into the interstitial spaces within the substrate to incubate. Lake Trout eggs are relatively large (4 to 5 mm), and fecundity is low compared to other fish species in the Local Study Area (LSA) (McPhail 2007). Eggs remain in the substrate over winter, and hatch during spring. Young Lake Trout feed in shallows for several months before they are large enough to venture into deeper water. There is evidence that adults in some populations return to their natal spawning sites.

Small Lake Trout primarily feed on plankton and aquatic insect larvae until they reach adequate size to prey on other fish, such as Cisco, juvenile Lake Whitefish, and juvenile Round Whitefish (Scott and Crossman 1998; Richardson et al. 2001; McPhail 2007). Seasonal changes in diet are common and are often associated with water temperature. For example, in the spring, adults may feed on forage fish and terrestrial insects in shallow water. If the lake warms and stratifies, Lake Trout can be separated from these sources by a thermal barrier (i.e., temperatures above 15°C in the upper layer of the lake). Under these conditions in lakes, they can switch back to planktivory.

6.1.2.1.4 Round Whitefish

Round Whitefish populations can be fluvial, adfluvial, or anadromous, and are commonly found in large rivers and lakes in Northwest Territories and Nunavut (reviewed in Scott and Crossman 1998; Richardson et al. 2001; Stewart et al. 2007a). Northern populations of Round Whitefish spawn in summer to fall (Stewart 2007b). Gravel and cobble-sized rubble substrates are preferred for spawning (Normandeau 1969; Richardson et al. 2001). Round

Whitefish broadcast their eggs over the substrate, typically in water less than 1.5 m in rivers and 15 m in lakes (Stewart et al. 2007b).

Hatching time will vary, depending on water temperatures, but generally occurs from March to May (Goodyear et al. 1982). After emerging from the eggs, the young are generally found near the bottom and are associated with rock, sand, and gravel substrates (Goodyear et al. 1982). Adult Round Whitefish tend to be found over rocky substrates and often in association with boulders (McPhail and Lindsey 1970). They are commonly found in shallow areas of lakes or slow-flowing rivers and streams, and in brackish waters (McPhail and Lindsey 1970; Scott and Crossman 1998). Preferred habitats include areas with currents, such as outlets of lakes.

The diet of Round Whitefish consists of a variety of benthic invertebrates, primarily mayfly, caddisfly, chironomid larvae, small crustaceans, fishes, and molluscs (Scott and Crossman 1998). Round Whitefish are suspected to feed on the eggs of other fish species (Scott and Crossman 1998). They are known to be a key component of the diet of Lake Trout in northern environments (Scott and Crossman 1998).

6.1.2.2 Assessment Endpoints and Measurement Indicators

Assessment endpoints and measurement indicators are described in Volume 3, Section 3.2. Assessment endpoints represent the key properties of the VC that should be protected for their use by future human generations (i.e., incorporates sustainability). Assessment endpoints are general statements about what is being protected. For the freshwater assessment, assessment endpoints identified for water quality and fish and fish habitat included key properties of the freshwater environment that should be protected for future generations. For fish and fish habitat, ongoing fisheries productivity was identified as an important property of ecosystem that should be protected and consideration of ongoing fisheries productivity as an assessment endpoint is consistent with Fisheries and Oceans Canada's (DFO's) scientific framework for environmental assessments (DFO 2014). Arctic Char, Arctic Grayling, Lake Trout, and Round Whitefish are part of a CRA fishery, and therefore, the consideration of these four species as VCs in the environmental assessment of the Project is consistent with DFO's legislation and policy (i.e., *Fisheries Act* [2012] and Fisheries Protection Policy [DFO 2013]). Assessment endpoints and measurement indicators for the freshwater environment are provided in Volume 3, Table 3.2-1.

For the water quality VC, measurement indicators are concentrations of constituents in the water and concentrations of constituents in the sediment. These concentrations (or predictions) are compared to guidelines and baseline concentrations to determine if the water can support a healthy aquatic ecosystem or traditional and non-traditional uses.

For fish and fish habitat VCs, measurement indicators for any changes to the productivity of the fishery included the quality and quantity of habitat for various life history stages, which would include foraging habitat (i.e., areas that support forage fish species for fish feeding) and the status of lower trophic levels. Direct changes to habitat quantity are often assumed to have a direct proportional impact on assessment endpoints as a conservative approach to an environmental assessment (DFO 2014).

6.1.3 Spatial and Temporal Boundaries

6.1.3.1 Spatial Boundaries

6.1.3.1.1 Hydrogeology and Groundwater

The hydrogeology baseline study area (BSA) also forms the LSA and regional study area (RSA) for the Project. The hydrogeology BSA forms an irregular polygon approximately 24,000 hectares (ha) in area (Figure 6.1-1). Whale Tail Lake and the site of the proposed Whale Tail Pit are located in the central-eastern area of the hydrogeology BSA.

The elevations of large lakes within the hydrogeology BSA range from approximately 99.8 metres above sea level (masl) at Lake DS1, located over 5 km to the north of Lake A17 (Whale Tail Lake), to 170.5 masl at Lake A60, located approximately 750 m southeast of Lake A17 (Whale Tail Lake).

6.1.3.1.2 Surface Water Quantity

Spatial boundaries were defined to assess potential effect of the Project on the surface water quantity. The LSA is the area where there exists the potential for measurable effects due to Project activities Figure 6.1-2). The RSA is the area within which there exists the potential for residual effects, including direct and indirect effects, as well as incremental effects from the Project and cumulative effects from historical, existing, and reasonably foreseeable developments, including the Project.

The surface water quantity LSA includes the A and C watersheds, and watersheds of each watercourse crossed by the haul road. The Project, and specifically the haul road, is located within the Meadowbank River, Quoich River, and Thelon River watersheds, and the surface water quantity RSA was defined to consider the effects of the Project with other developments, activities, and natural factors that influence surface water quantity within these watersheds. However, due to the size of these watersheds, the surface water quantity RSA was limited to the following drainage areas, downstream of which potential effects would no longer be measurable:

- Lake 2.1: Lake 2.1 has an approximate drainage area of 21.5 square kilometres (km^2) at its outlet. It is located just downstream of Crossing 2.1, and drains southeast to Quoich River;
- Lake 23.9 (i.e., Tasirjuaraajuk / Pipedream Lake): Lake 23.9 (i.e., Tasirjuaraajuk / Pipedream Lake) has an approximate drainage area of 1,570 km^2 at its outlet. It is located just downstream of Crossing 23.9, and drains north to the Meadowbank River;
- Lake 56.9: Lake 56.9 has an approximate drainage area of 112 km^2 at its outlet. It is located just downstream of Crossing 56.9, and drains southwest to the Thelon River; and
- Lake DS1: Lake DS1 has an approximate drainage area of 898 km^2 at its outlet and drains north to the Meadowbank River.

The surface water quantity LSA and RSA are shown on Figure 6.1-2.

6.1.3.1.3 Water Quality and Fish and Fish Habitat

The Whale Tail Pit LSA for water quality and fish and fish habitat are the same and was selected to include all areas of direct physical disturbance from Project activities and facilities, such as the personnel camp, maintenance shop, tank farm, waste rock storage facility, pit, and water treatment plant. The LSA also considered the boundaries of local watersheds and the spatial extent of the potential direct and indirect changes from the Project to the

physical and biological properties of hydrology, surface water quality, and fish. Thus, the LSA includes headwater lakes and streams near the Whale Tail Pit in upper sections of the A and C watersheds. The LSA for the 62.5 km long haul road is a 100 m buffer on either side of the road alignment. The proposed road surface will include three bridges and culverts to direct flows within affected watercourses. The LSA associated with the road alignment (200 m corridor) is anticipated to be large enough to capture the residual effects from the haul road on adjacent aquatic areas and potential fishery units; therefore no RSA for the road has been defined.

There are many waterbodies and watercourses within the Whale Tail Pit LSA (highlighted on Figure 6.1-3), the large waterbodies directly or indirectly affected by the Project include the following:

- Lake C38 (Nemo Lake);
- Lake A17 (Whale Tail Lake); and
- Lake A16 (Mammoth Lake).

The Whale Tail Pit RSA for water quality is within the RSA for surface water quantity (Figure 6.1-2), extends to the downstream end of Lake DS1, and includes areas downstream of the Project, along the flow path of water, with consideration effects of the Project with other developments, activities, and natural factors that influence water quality.

As a means to reduce uncertainty in the assessment predictions that can then be interpreted at the full scale of the fishery in the region, the RSA for fish and fish habitat is divided into assessment areas to reflect the potential number of fishery (or population) units that may be affected by the Project (Table 6.1-3). The key assessment boundaries within the aquatics RSA includes waterbodies and watercourses within subsections of the A and C watersheds of the Meadowbank River Watershed, and considers stream connections (i.e., barriers to fish passage) within each watershed. For example, a large boulder field with dispersed flows (approximately 500 m in length) was identified in the A watershed at Stream A76-A75, which is expected to prevent fish passage between Lake A76 and Lake A75 at any time of the year. Therefore, the assessment area in the A watershed is further divided, where the lakes and streams downstream of Stream A76-A75 and above Lake A69 are include in an assessment area, defined as the A69 assessment area, and the lakes and streams upstream of Stream A76-A75 and above Lake A1 are included in an assessment area, defined as the A1 assessment area (Figure 6.1-3).

The C watershed is also divided into two assessment areas as determined by the Lake C38 (Nemo Lake) outlet (i.e., Stream C38-C12) (Table 6.1-3). The outlet stream is characterized by a steep slope (approximately 2.5%), dispersed flows, and a boulder garden, and therefore, the stream is expected to prevent or impede upstream passage of fish, geographically isolating populations above this point. The resulting assessment areas are defined as the C38 assessment area, and the C1 assessment area (Figure 6.1-3).

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590000 595000 600000 605000 610000 615000

7265000 7260000 7255000 7250000 7245000

N

DS1

DS2

A81

A16

A60

A65

Nemo Lake

Whale Tail Pit

Mammoth Lake

Whale Tail Lake

LEGEND

- HYDROGEOLOGY BASELINE STUDY AREA
- LAKES WITH TALIK
- WATERBODY (NO TALIK OR OUTSIDE STUDY AREA)
- WATERCOURSE

WHALE TAIL

- BORROW SOURCE
- INFRASTRUCTURE
- PROPOSED HAUL ROAD
- GROUNDWATER FLOW DIRECTION



REFERENCE

1. WHALE TAIL INFRASTRUCTURE OBTAINED FROM AGNICO EAGLE MINES LIMITED ON DECEMBER 21, 2015.
3. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
4. INSET MAP DATA OBTAINED FROM ESRI

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

2 0 2

KILOMETRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

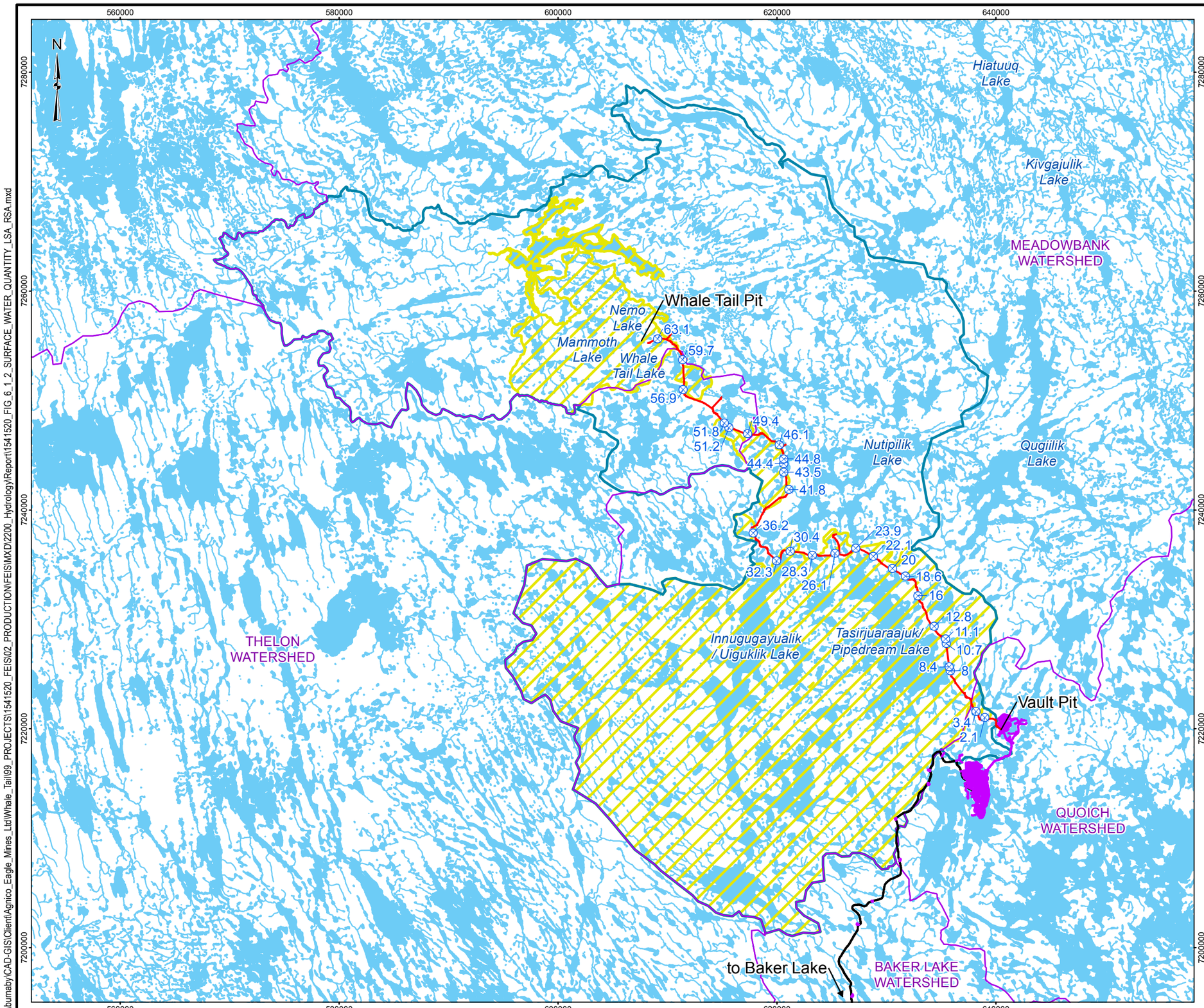
TITLE

HYDROGEOLOGY BASELINE STUDY AREA

Golder Associates

PROJECT		1541520	FILE No.	
DESIGN	JL	06 Apr. 2016	SCALE AS SHOWN	REV. A
GIS	MH	06 Apr. 2016		
CHECK	JL	14 Jun. 2016		
REVIEW	DC	14 Jun. 2016		

FIGURE 6.1-1



LEGEND

- WATER CROSSING LOCATION
- SURFACE WATER QUANTITY REGIONAL STUDY AREA
- SURFACE WATER QUANTITY LOCAL STUDY AREA
- WATERSHED BOUNDARY
- PROPOSED HAUL ROAD
- ALL WEATHER ROAD
- MEADOWBANK INFRASTRUCTURE
- WATERCOURSE
- WATERBODY

REFERENCE

1. MEADOWBANK INFRASTRUCTURE AND PROPOSED WHALE TAIL HAUL ROAD ALIGNMENT OBTAINED FROM AGNICO EAGLE MINES LIMITED.
2. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

7000 0 7000
METRES

PROJECT
AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

SURFACE WATER QUANTITY LOCAL AND REGIONAL STUDY AREAS

Golder Associates

PROJECT		1541520	FILE No.	
DESIGN	CP	01 Jun. 2016	SCALE AS SHOWN	REV. 0
GIS	CDB	01 Jun. 2016		
CHECK	JL	14 Jun. 2016		
REVIEW	JR	14 Jun. 2016		

FIGURE 6.1-2

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595000 600000 605000 610000

7265000 7260000 7255000 7250000

INSET MAP 1

INSET MAP 2

SEE INSET MAP 1

SEE INSET MAP 2

Nemo Lake

Mammoth Lake

Whale Tail Lake

Whale Tail Pit

800 m

N

LEGEND

- PROPOSED HAUL ROAD
- WHALE TAIL PIT
- PROPOSED HAUL ROAD LOCAL STUDY AREA
- AQUATICS LOCAL STUDY AREA
- FISH ASSESSMENT AREA
- WATERSHED BOUNDARY FOR REGIONAL STUDY AREA
- STREAM
- LAKE/POND

REFERENCE

1. HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200_R0.dwg
2. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

1600 0 1600
METRES

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

AQUATICS LOCAL AND REGIONAL STUDY AREAS

Golder Associates

PROJECT		1541520	FILE No.		
DESIGN	CP	01 Jun. 2016	SCALE AS SHOWN	REV.	0
GIS	CDB	01 Jun. 2016			
CHECK	CP	14 Jun. 2016			
REVIEW	JR	14 Jun. 2016			

FIGURE 6.1-3

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Table 6.1-3: Baseline Summary of Surface Water in Drainage Basins Potentially Affected by the Project

Assessment Areas within Aquatic RSA	Total Sub-Basin Area (ha)	Total Stream Length (km)	Number of Lakes				Lake Area (ha)			
			<1 ha	1 to 10 ha	10 to 100 ha	>100 ha	<1 ha	1 to 10 ha	10 to 100 ha	>100 ha
A1	6,748.9	26.5	22	34	21	2	12.2	119.5	579.1	314.0
A69	4,266.2	24.3	7	24	10	1	3.4	87.9	205.8	131.1
C38	354.6	0.8	8	1	0	1	2.3	1.0	-	118.0
C1	1,407.8	7.3	15	16	4	0	3.9	47.5	135.3	-
A and C combined	12,777.5	59.0	52	75	35	4	21.8	255.9	920.2	563.0

Note: The RSA excludes shallow ponds with no upstream or downstream connection to other waterbodies and excludes Lake DS1 where fish assemblages and populations processes are expected to be different from smaller waterbodies located further upstream.

RSA = regional study area; ha = hectare; <= less than; >= greater than; km = kilometre.

6.1.3.2 Temporal Boundaries

The Project will result in effects to which will vary over time. Potential effects are projected to occur during the construction, operations, closure, and post-closure phases.

Although not identified as a standalone Project phase in Volume 3, dewatering activities can potentially affect surface water quantity and were grouped into the “dewatering” phase as part of the surface water quantity assessment. Dewatering was considered part of construction for other aspects of the assessment.

6.2 Hydrogeology and Groundwater Quantity and Quality

6.2.1 Incorporation of Inuit Qaujimajatuqangit

A review of the traditional knowledge documents indicates that there is no IQ specific information on groundwater or hydrogeology.

6.2.1.1 Existing Environment and Baseline Information

Collection of baseline information and development of the existing environment for groundwater and hydrogeology was informed by the traditional knowledge collected on VCs such as surface water quality and fish habitat.

6.2.1.2 Valued Component Selection

Groundwater and hydrogeology is not considered a VC because groundwater it is not currently used and is unlikely to be used in the future. However, groundwater provides pathway/links to VCs, such as surface water quantity (hydrology), surface water quality, and fish habitat and IQ related to those VCs are provided in subjects are provided in sections 6.3, 6.4, and 6.5.

6.2.1.3 Mitigation and Monitoring

Although groundwater is not a VC and there is no IQ specific for groundwater and hydrogeology, IQ for VCs affected by groundwater pathways were considered in the development of monitoring plans.

6.2.2 Existing Environment and Baseline Information

6.2.2.1 Baseline Study Methods

Existing conditions were described to provide context for groundwater quantity and quality assessment within the 2016 Hydrogeology Baseline Report (Volume 6, Appendix 6-A). Methods are described in Section 2 of the 2016 Hydrogeology Baseline Report. The baseline study presented in Appendix 6-A is an update to a previous conceptual model and preliminary estimate of groundwater inflows completed by Knight Piésold (2015a, b). Primary changes that were made to Knight Piésold's conceptual model included the expansion of the conceptual model to the regional study limits and some modification to the hydrostratigraphy. Modifications to the hydrostratigraphy included the incorporation of overburden, from which groundwater storage can significantly affect groundwater inflow/outflow predictions during pit dewatering and pit refilling, and refinement in the estimated hydraulic conductivity of the competent bedrock with depth. Where changes were made to the hydrostratigraphy, these changes were designed to provide conservative estimates with respect to the prediction of groundwater inflow and the prediction of potential project impacts on groundwater during closure.

The hydrogeology baseline study included characterization of the hydrogeological setting, hydrostratigraphy, and groundwater quality. Available hydrogeological data collected at the site by Knight Piésold (2015a, b), together with the information collected elsewhere in the Canadian Shield, were used to develop a conceptual hydrogeological model of the Project site. A conceptual hydrogeological model is a pictorial and descriptive representation of the groundwater regime that organizes and simplifies the site conditions so they can be readily quantitatively modelled. The conceptual model must retain sufficient complexity so that the analytical or numerical models developed from it adequately simulate the actual components of the groundwater flow system to the degree necessary to satisfy the objectives of the modelling study. The baseline conceptual model was developed to describe key features of the hydrogeological regime in the baseline study area before mining. The key features include the groundwater flow, groundwater quality, and dominant groundwater flow direction.

6.2.2.2 Conceptual Hydrogeological Model

The following describes the conceptual hydrogeological model and baseline hydrogeology conditions at the Project. Additional detail is presented in the 2016 Hydrogeology Baseline Report (Volume 6, Appendix 6-A).

The Project site is located within a region of continuous permafrost. In this region, the layer of permanently frozen subsoil and rock is generally deep and overlain by an active layer that thaws during summer. The depth of the active layer is estimated to range between 1 and 3 m. Permafrost thickness (defined by the depth of the zero degree isotherm) in the baseline study area is expected to be approximately 425 m below ground surface.

Below Whale Tail Lake, a talik is expected to form a continuous channel that is closed in the northern portion of Whale Tail Lake below the open pit and becomes open towards the south and central portion of the lake. Circular lakes with a radius greater than 300 m, or elongated lakes with a half-width of at least 150 m, are assumed to be connected to the deep groundwater flow regime through open taliks.

The base case conceptual model for the site consists of three hydrostratigraphic units composed of overburden, weathered rock, and competent rock. Zones of enhanced permeability (EPZs) associated with structures, such as fault zones, may also be present, although present packer test data do not indicate the permeability of the structures intersected to date are higher than the surrounding competent bedrock. In developing the conceptual model, a reasonably conservative approach was taken so that the actual magnitudes of groundwater inflows (quantity and quality) to the open pits during mining are expected to be less than simulated by the model. The uncertainty in the predictions was captured in the developed of an Environmental Assessment (EA) Conservative Scenario that evaluated potential inflows to the pit if the hydraulic properties of the hydrostratigraphic units were near the upper bound of their expected uncertainty range, and if EPZs were present in bedrock.

Overburden and weathered bedrock are limited to the near surface, while relatively competent bedrock is assumed to comprise the majority of the rock domain. The hydraulic conductivity of competent rock is assumed to decrease with depth.

The assumed hydraulic properties of hydrostratigraphy units near the Whale Tail Pit, and the potential EPZs, are summarized in Table 6.2-1 for the Base Case and in Table 6.2-2 for the EA Conservative Scenario. Permafrost is assumed to be essentially impermeable.

Table 6.2-1: Hydrogeological Parameters for Base Case Scenario

Hydrostratigraphic Unit	Depth Interval (m)	Base Case Hydraulic Conductivity (m/s)[a]	Specific Storage (1/m)[b]	Specific Yield (-)[b]	Effective Porosity (-)[b]	Longitudinal Dispersivity (m)[c]	Transverse Dispersivity (m)[c]	Effective Diffusion Coefficient (m^2/s)
Overburden	0 to 6	2×10^{-6}	1×10^{-4}	0.2	0.2	10	1	2×10^{-10}
Weathered bedrock	6 to 34	1×10^{-7}	2×10^{-4}	0.03	0.03	10	1	2×10^{-10}
Competent bedrock	34 to 60	3×10^{-8}	1×10^{-05}	0.0006	0.001	10	1	2×10^{-10}
Competent bedrock	>60	1×10^{-8}	1×10^{-05}	0.0006	0.001	10	1	2×10^{-10}

[a] Derived from hydraulic testing results as presented in the 2016 Hydrogeology Baseline Report (Volume 6, Appendix 6-A). Ratio of vertical to horizontal hydraulic conductivity assumed to be 1:1.

[b] Parameter values within ranges documented in literature (Maidment 1992; Stober and Bucher 2007).

[c] Values are consistent with literature values (Schulze-Makuch 2005).

m = metre; m/s = metres per second; m^2/s = metres squared per second.

Table 6.2-2: Hydrogeological Parameters for EA Conservative Scenario

Hydrostratigraphic Unit	Depth Interval (m)	Base Case Hydraulic Conductivity (m/s)[a]	Specific Storage (1/m)[b]	Specific Yield (-)[b]	Effective Porosity (-)[b]	Longitudinal Dispersivity (m)[d]	Transverse Dispersivity (m)[d]	Effective Diffusion Coefficient (m^2/s)
Overburden	0 to 6	2×10^{-6}	1×10^{-4}	0.2	0.2	10	1	2×10^{-10}
Weathered bedrock	6 to 34	3×10^{-7}	2×10^{-4}	0.03	0.03	10	1	2×10^{-10}
Competent bedrock	34 to 60	1×10^{-7}	1×10^{-05}	0.0006	0.001	10	1	2×10^{-10}
Competent bedrock	>60	3×10^{-8}	1×10^{-05}	0.0006	0.001	10	1	2×10^{-10}
EPZ[c]	-	5×10^{-7}	1×10^{-4}	0.01	0.01	10	1	2×10^{-10}

[a] Derived from hydraulic testing results as presented in the 2016 Hydrogeology Baseline Report (Volume 6, Appendix 6-A). Ratio of vertical to horizontal hydraulic conductivity assumed to be 1:1.

[b] Parameter values within ranges documented in literature (Maidment 1992; Stober and Bucher 2007).

[c] Two EPZs were assumed to be potentially present, both vertical and 10 m wide. One EPZ was assumed to strike northwest – southeast and hydraulically connect the Whale Tail Pit to Whale Tail Lake. The second EPZ was assumed to strike northeast – southwest. The EPZs were assumed to be continuous and hydraulically connected over large distance (km) from the Project area. Hydraulic conductivity estimated from maximum packer test value of 5×10^{-8} m/s and the width of the fault within the tested interval.

[d] Values are consistent with literature values (Schulze-Makuch 2005).

EPZ = enhanced permeability zones; m = metre; m/s = metres per second; m^2/s = metres squared per second.

Groundwater quality at the Project has been inferred to be similar to the Meadowbank Mine based on the similar geology and permafrost conditions (Knight Piésold 2015b). Groundwater quality at the Meadowbank Mine is generally described as being hard to very hard, with neutral to slightly basic pH and good buffering capacity. Total dissolved solids (TDS) concentrations range from 193 to 1,900 milligrams per litre (mg/L). Concentrations of fluoride, copper, iron, and selenium are elevated in comparison to guidelines for the protection of aquatic life and drinking water. Only the higher percentile values for nitrogen-containing compounds, aluminum, arsenic, boron, hexavalent chromium, molybdenum, and zinc exceed the CEQGs. Additionally, several of these parameters as well as chloride, manganese and sodium exceed aesthetic drinking water guidelines.

Consistent with other sites in the Canadian Shield, concentrations of TDS in groundwater are inferred to increase with depth, primarily in response to upward diffusion of deep-seated brines. The Meadowbank Mine TDS profile is

considered applicable to the Project and is based on the site-specific data from the Meadowbank Mine up to depths of 177 m, and parallels the Diavik profile at deeper depths (Volume 6, Appendix 6-A).

Two groundwater flow regimes occur at the Project: a deep groundwater flow regime beneath permafrost, and a shallow groundwater flow regime located in the active (seasonally thawed) layer near the ground surface. With the exception of areas of taliks beneath lakes, the two groundwater regimes are isolated from one another by thick permafrost.

The shallow groundwater regime is active only seasonally during the summer months, and the magnitude of the flow in this layer is expected to be several times less than runoff from snowmelt (Woo 2011). Groundwater in the active layer primarily flows to local depressions and ponds that drain to larger lakes; therefore, the total travel distance would generally extend only to the nearest pond, lake, or stream. Water in the active layer is stored in ground ice during the cold season, and is then released with the ice thaws in late spring or early summer, thus providing flow to surface waterbodies (Woo 2011). During the warm season, groundwater in the active layer is recharged primarily by precipitation.

Groundwater flow within the deep groundwater flow regime is limited to the sub-permafrost zone. This deep groundwater flow regime is connected to the ground surface by open taliks underlying larger lakes. The elevations of these lakes are expected to be the primary control of groundwater flow directions in the deep groundwater flow regime, with density gradients providing a secondary control on groundwater flow directions. The elevations of these lakes in the baseline study area indicate that Whale Tail is likely both a groundwater recharge and discharge zone. Hydraulic gradients are expected to range from slightly downward to slightly upward. The TDS of groundwater (or salinity) is expected to increase with depth, resulting in increased density of groundwater with depth. This increase in density with depth will result in fluid density gradients which will tend to lessen the upward flow of denser groundwater water due to the buoyancy effect.

6.2.3 Groundwater Quantity and Quality and Project Interactions

A comprehensive analysis of the potential pathways for effects on groundwater and hydrogeology during the construction, dewatering, operations, closure, and post-closure phases, is provided in Volume 3, Appendix 3-C.

Pathway analysis for groundwater and hydrogeology identifies and assesses the linkages between the Project components or activities (Volume 3, Appendix C). No primary pathways were identified. Changes in hydrogeology and groundwater quantity and quality were evaluated in the context of how these changes in turn may result in changes to VCs (i.e., surface water hydrology and surface water quality). Therefore, no effects analysis was made for hydrogeology and groundwater quantity and quality as impacts to these components directly influence, and therefore are captured in, the assessment of impacts on VCs.

The Project related effects to surface water quantity from groundwater and surface water interaction is examined under surface water hydrology. The Project related effects to surface water quality from interaction of surface and groundwater is examined under the site-wide water quality. These interactions were predicted through the use of a numerical hydrogeological model that is described in Appendix 6-B.

Model predictions were completed for two scenarios:

- Base Case Scenario, which is based primarily on site specific measurements of hydrogeological parameters controlling groundwater conditions near the open pit, as presented in Table 6.2-1. Where measurements were not made, the estimates were supplemented by published data and experience at Meadowbank; and

- EA Conservative Scenario, which represents a reasonable upper bound of conditions that could be encountered during mining considering the uncertainty in the hydraulic properties controlling groundwater inflow. Results of the sensitivity analysis used to evaluate uncertainty are presented in Appendix 6-B.

Results of the EA Conservative Scenario are presented in the following section for the purpose of evaluating the Project related effects to surface water quantity and quality. Results of the Base Case Scenario are provided in Appendix 6-B.

6.2.3.1 Predicted Groundwater Inflow and Groundwater Quality over Mine Life

Groundwater inflow and groundwater quality to the Whale Tail Pit, the Attenuation Pond, and diked area within Whale Tail Lake were predicted using the numerical model for the EA Conservative Scenario. These results are presented in Table 6.2-3 to Table 6.2-5.

Table 6.2-3: Predicted Groundwater Inflow and Groundwater Quality Over the Mine Life - Whale Tail Pit (EA Conservative Scenario)

Phase	Period	Whale Tail Pit – EA Conservative Scenario			
		Groundwater Inflow (m^3/day)	TDS Concentration (mg/L)	Lakewater or Pondwater in Total Inflow (%)	Pit Lake Outflow to Groundwater (m^3/day)
Dewatering	Mar 2019 to Oct 2019	-	-	-	-
Mining	Q4 2019 to 2020	275	415	<5%	-
	2021	100	410	<5%	-
Filling	2022	65	370	<5%	10
	2023	55	365	<5%	1
	2024	30	370	<5%	2
	Jan to Oct 2025	15	370	<5%	5
	Nov 2025 to Oct 2028	1	370	<5%	18

Note: Mining prior to Q4 2019 is within permafrost and groundwater inflow will be negligible.
TDS = total dissolved solids; m^3/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

Table 6.2-4: Predicted Groundwater Inflow and Groundwater Quality Over the Mine Life – Attenuation Pond (EA Conservative Scenario)

Phase	Period	Attenuation Pond – EA Conservative Scenario			
		Groundwater Inflow (m^3/day)	TDS Concentration (mg/L)	Lakewater or Pondwater in Total Inflow (%)	Pit Lake Outflow to Groundwater (m^3/day)
Dewatering	Mar 2019 to Oct 2019	-	-	-	-
Mining	Q4 2019 to 2020	4	175	<5	2
	2021	2	200	<5	10
Filling	2022	2	220	<5	15
	2023	1	215	<5	20
	2024	1	215	<5	25
	Jan to Oct 2025	1	215	<5	25
	Nov 2025 to Oct 2028	-	-	-	-

TDS = total dissolved solids; m^3/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

Table 6.2-5: Predicted Groundwater Inflow and Groundwater Quality over the Mine Life – Diked Area Outside of Whale Tail Pit and Attenuation Pond (EA Conservative Scenario)

Phase	Period	Diked Area – EA Conservative Scenario			
		Groundwater Inflow (m^3/day)	TDS Concentration (mg/L)	Lakewater or Pondwater in Total Inflow (%)	Pit Lake Outflow to Groundwater (m^3/day)
Dewatering	Mar 2019 to Oct 2019	140	145	<5%	-
Mining	Q4 2019 to 2020	75	295	<5%	-
	2021	70	280	15	-
Filling	2022	60	250	25	-
	2023	40	225	35	-
	2024	40	210	40	-
	Jan to Oct 2025	40	195	45	-
	Nov 2025 to Oct 2028	40	180	50	160

TDS = total dissolved solids; m^3/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

Budget analyses were performed to estimate the changes to pre-mining groundwater inflows and outflows from Lakes within the hydrogeology BSA (Volume 6, Appendix 6-A) during mining and following closure (i.e., after the pit and Whale Tail Lake is flooded back to 152.5 m). Table 6.2-6 presents a summary of lakes within the hydrogeology BSA that had a predicted change (greater than 1 cubic metre per day [m^3/day]) in groundwater inflow and outflow relative to pre-Project (current) conditions. Long-term closure conditions considers the potential formation of an open talik below the pit footprint, as a result of the widening / deepening of the lake in this area.

Table 6.2-6: Predicted Groundwater Inflows and Outflows from Lakes at End of Mining and Following Closure

Lake	Pre-Project (Current) Conditions	End of Mining (2021)		Post-closure	
	(m^3/day)	(m^3/day)	(% change of Pre-Project)	(m^3/day)	(% change of Pre-Project)
A16	16	15	-6	16	0
A60	29	28	-3	29	0
A65	3	2	-33	3	0
A81	-47	-42	-11	-47	0
DS1	-171	-140	-18	-171	0
DS2	-25	-21	-16	-21	0

Note: Positive number denotes that the lake is a source of groundwater recharge. Negative number denotes that the lakes is a groundwater discharge zone.

m^3/day = cubic metres per day; % = percent.

Following closure, near to pre-mining hydraulic gradients and groundwater flow directions will be re-established once the open pit and dewatered portion of Whale Tail Lake are flooded. Consistent with pre-development conditions, groundwater from Whale Tail Lake and the open pit is predicted to discharge to Lake DS1. Groundwater inflow to the southern portion of Whale Tail Lake will occur from Lake A60 to the southeast. Hydraulic gradients following closure were used to estimate groundwater travel times from the Whale Tail Lake and the open pit to DS1. Based on the shortest travel time, water from Whale Tail Lake or the open pit was predicted to take over 1,000 years to reach Lake DS1.

6.2.4 Uncertainty

Sensitivity analysis conducted as part of the numerical modelling indicate that the quantity of groundwater inflow predicted for the Whale Tail Pit is most sensitive to the hydrogeological parameters assigned to bedrock (specific storage, specific yield, and hydraulic conductivity) and to the presence of permafrost below Whale Tail Pit. Considering the range of the properties simulated, the predicted groundwater inflow to the pit could be between 33% and 62% higher than the Base Case Scenario results (presented in Volume 6, Appendix 6-A) depending on the simulated year of mining. This sensitivity analysis was then used to develop the EA Conservative Scenario, which represents a reasonable upper bound of conditions that could be encountered during mining and therefore an upper bound estimate of groundwater inflow to the pit.

Results of the sensitivity analysis also indicate that the predicted TDS concentration of mine inflows is directly related to the TDS depth profile. The TDS profile for the Project is based on data collected at the Meadowbank Mine, as presently site-specific data has not been collected at the Project. Uncertainty related to the TDS profile and groundwater quality will be addressed through additional groundwater quality monitoring by Agnico Eagle at the Project site.

6.2.5 Monitoring and Follow-up

A monitoring plan applicable to groundwater quantity and quality is addressed in the addendum to the Groundwater Monitoring Plan (Volume 8, Appendix 8-E.3).

The Meadowbank Groundwater Monitoring Plan was amended to include the Whale Tail Pit. Monitoring of groundwater will use methods equivalent to those in the Meadowbank plan, such as sampling of seeps in the walls of the pit and sampling of flowing production wells. The groundwater will be analyzed for the equivalent water quality parameters to the Meadowbank Mine, and the equivalent water quality assessment and quality control measures will be employed. The exception is that a Westbay multi-level well system was installed and will be used instead of monitoring wells consisting of conventional standpipes composed of stainless steel or PVC. The Westbay multi-level well system was installed in April 2016 in the talik below the Central portion of Whale Tail Lake and well development is currently underway It is approximately 500 m deep and installed in a borehole with a plunge of 65 degrees. There are six primary sampling intervals installed below the permafrost. This monitoring device will be used to provide long-term monitoring of groundwater quality over the life of the mine and during closure and post-closure.

6.3 Surface Water Hydrology

6.3.1 Incorporation of Inuit Qaujimajatuqangit

The effect assessment relies on the IQ baseline information that came from a variety of sources, including a literature review of publicly available sources, public consultation, focus group meetings, government engagement, and information provided directly by Elders, land users, women, and youth. To the extent possible, available IQ information was incorporated into the evaluation of potential effects of the Project on surface water quantity. The following reports were reviewed for specific information related to surface water quantity:

- Whale Tail Pit Project IQ Baseline Report (Volume 7, Appendix 7-A);
- Meadowbank Mine Baseline Traditional Knowledge Report (Cumberland 2005a);
- Proposed All-weather Exploration Road from the Meadowbank Mine to the Project Site-Baseline Traditional Knowledge Report (Agnico Eagle 2014a);
- Community Consultations/Public Information Meeting Summary Reports for 2014 and 2015 (NIRB 2014, 2015).

6.3.1.1 Existing Environment and Baseline Information

Inuit Qaujimajatuqangit relevant to surface water quantity is primarily related to knowledge and concerns regarding the impact of weather and climate change on water levels, and the resulting indirect effects on fish and fish habitat, caribou habitat and behaviour at water crossings, and travel routes. The following IQ related to surface water quantity was considered as part of the existing environment and baseline information:

- lakes and rivers in the region that were used as important travel routes to access caribou harvesting areas may be influenced by short-term temperature fluctuations, causing a repetitive and sporadic freeze-thaw cycle which can occur in the spring and fall, during times of break-up and freeze-up;
- changing snow and ice conditions, including decreased snowfall, the delayed and slower freezing of lakes, rivers, and oceans, earlier and more rapid melting of ice and snow, and the occurrence of many spots on the land with thin ice and open water, even in the winter;
- more frequent severe storms in the fall; and
- lower water levels in rivers and lakes.

6.3.1.2 Valued Component Selection

Inuit Qaujimajatuqangit has been integrated in the selection of surface water quantity as a VC for this assessment and identification of potential Project effects. Inuit Qaujimajatuqangit highlighted the cultural significance of water to the Inuit, including rivers and lakes, which were considered important travel routes during the winter, areas adjacent to lakes were considered preferred locations for camping and caching, critical in providing habitat for fish and important secondary source of traditional food for Baker Lake community members, and prime harvesting sites where caribou crossings were located. Inuit Qaujimajatuqangit related to knowledge and observations of changing weather and climate and its effects on water levels in rivers and lakes was identified as a key concern. Concerns were also raised regarding specific project activities, including restricted water flow and dewatering of waterbodies and watercourse crossings. Concerns were also raised about the protection of lakes from disturbance

due to construction activities and the potential impact to rivers, streams and lakes that caribou rely on for migrating. Therefore surface water quantity was maintained as a VC.

6.3.1.3 Effect Assessment

The following IQ concerns were related to the following:

- concerns with restricted water flow, dewatering of waterbodies and watercourse crossings; and
- concerns with the protection of lakes from disturbance due to construction activities, and the potential impact to rivers, streams and lakes that caribou rely on for migrating.

Concerns related to changes in water levels in river and lakes were incorporated into the pathway analysis, to assess and classify potential effects of the Project on discharges and corresponding water levels. During 2011 interviews, the Elders emphasized that all the lakes and rivers in the region were used to access caribou harvesting areas; therefore, changes in surface water quantity considered the impact to travel routes. The impacts related to the changes in surface water quantity to caribou and fisheries are discussed in the respective sections, including the cultural significance of water to the Inuit. The impact assessment was completed by Project phase to address specific concerns of changes during to surface water quantity due to activities during construction.

Concerns related to climate change, relevant to surface water quantity, were incorporated into the discussion of uncertainty.

6.3.1.4 Mitigation and Monitoring

Concerns related weather and climate change were incorporated into monitoring programs to provide input to ongoing water management. Mitigations have been included in the Water Management Plan (Volume 8, Appendix 8-B.2) that specifically address concerns related to the protection of lakes from disturbance due to construction activities, including timing of dewatering.

6.3.2 Existing Environment and Baseline Information

Existing conditions were described to provide context for the surface water quantity assessment in the 2015 Hydrology Baseline Report (Volume 6, Appendix 6-C), the 2015 Haul Road Baseline Report (Volume 6, Appendix 6-D), and the Meadowbank Mine baseline physical ecosystem report (Cumberland 2005b), as follows:

- The 2015 Hydrology Baseline Report provides a review of existing surface water quantity conditions in watersheds potentially affected by water management activities at the proposed Whale Tail Pit.
- The 2015 Haul Road Baseline Report provides a review of watercourse crossings and recommended crossing methods based on conveyance needs and the potential for effects on fish productivity.
- The Meadowbank Mine baseline physical ecosystem report provides regional baseline hydrology information.

6.3.2.1 Baseline Study Methods

6.3.2.1.1 Proposed Whale Tail Pit

Methods are described in detail in Section 2.0 of the 2015 Hydrology Baseline Report (Volume 6, Appendix 6-C), and in baseline reports referenced in the Meadowbank Mine baseline physical ecosystem report (Cumberland 2005b).

The surface water quantity baseline study included characterization of local watersheds and drainage patterns, flow regimes, and lake shoreline and outlet channel geomorphology, based on a desktop review of available data and five field visits in May (during frozen conditions), June, July, August, and in September 2015.

A water balance model was developed and calibrated using runoff coefficients for land surfaces, lake outlet stage-discharge rating curves, degree-day models for snowmelt and formation of ice in outlet channels, and long-term derived climate data representative of the Whale Tail Pit site. The water balance model generates daily time series datasets of lake stages and lake outlet discharges for lakes in the A, B, and C watersheds and Lake DS1, which may be used to derive long-term flow regimes, water yields, and flood zones.

6.3.2.1.2 Proposed Haul Road

Methods are described in detail in Section 2.0 of the 2015 Haul Road Baseline Report (Volume 6, Appendix 6-D).

Watercourse crossings were identified based on a review of desktop data, and a field program consisting of an aerial reconnaissance and ground-truthing exercise in late August 2014 and late June 2015.

Cross-drainage structures were recommended based on conveyance needs and the potential for effects on fish productivity.

The potential for navigability was determined based on identified crossings and available data from the 2015 Haul Road Baseline Report, and Transport Canada's schedule of navigable waters (Transport Canada 2012).

6.3.2.2 Baseline Surface Water Quantity

6.3.2.2.1 Proposed Whale Tail Pit

The proposed Whale Tail Pit is located in the A watershed (i.e., where Lake A17 [Whale Tail Lake] and Lake A16 [Mammoth Lake] are located), and water management activities are planned in the A watershed, and the C watershed (i.e., where Lake C38 [Nemo Lake] is located); these two watersheds drain into Lake DS1, which drains north to the Meadowbank River. These watersheds comprise an extensive network of lakes, ponds, and interconnecting streams, and have lake water surface fractions (i.e., the ratio of lake surface area to watershed area) of 16% (A watershed) and 23% (C watershed).

Shorelines in the LSA exhibit a consistent terrain type related to shorelines that have developed in morainal material. These morainal shorelines were observed at all lakes visited during the field survey. Limited areas of bedrock and shallowly sloped sandy shorelines were also observed. As a general characteristic for the surveyed shorelines, the predominant materials are boulder gardens mixed with cobble with very limited soils or organic materials on top. The outlet channels are short relative to lake dimensions, with a low sinuosity (i.e., close to 1.0), and exhibit the same characteristics for streambed materials. This results in interstitial flow between large boulders or below the surface likely close to the bedrock, making low and moderate flows difficult to observe and measure.

Discharges of watercourses in the LSA typically peak in late-May to mid-June from snowmelt, rapidly decline in July, and low discharges prevail until frozen conditions in October to November, with a secondary peak in September from rainfall events. Watercourses in the LSA are frozen over the winter.

Derived long-term mean annual water yield for selected lakes in the LSA are presented in Table 6.3-1 and vary between 86 mm at Lake C38 (Nemo Lake) to 230 mm at Lake A69. These water yields are similar to regional water yields reported at the Meadowbank Mine (Cumberland 2005b) and that have been found at Meadowbank since operations began in 2010.

Additional baseline information relevant to the proposed Whale Tail Pit is provided in the 2015 Hydrology Baseline Report (Volume 6, Appendix 6-C), and the Meadowbank Mine environmental impact statement (Cumberland 2005b).

Table 6.3-1: Derived Long-Term Mean Annual Water Yields in the Local Study Area

Parameter	Lake A5	Lake A15	Lake A17 (Whale Tail Lake)	Lake A18	Lake A69	Lake C8	Lake C38 (Nemo Lake)
Drainage Area (km^2)	57.6	40.8	28.1	8.89	43.4	11.8	3.54
Mean Annual Water Yield (mm)	146	159	136	208	230	158	86.3

km^2 = square kilometre; mm = millimetre.

6.3.2.2.2 Proposed Haul Road

The proposed haul road is located in the Meadowbank River, Quoich River, and Thelon River watersheds, and crosses a total of 28 watercourses, including three rivers, and 25 smaller watercourses. None of the watercourse crossings are located on Transport Canada's schedule of navigable waters; however, crossings 23.9 (i.e., just downstream of Pipedream Lake) and 32.3 (i.e., just downstream of Innugugayualik Lake) are potentially large enough to support navigability, based on field observations. These two crossings have been traditionally used as travel routes (Volume 7, Appendix 7-A).

Cross-drainage structures were recommended in the 2015 Haul Road Baseline Report (Volume 6, Appendix 6-D) and/or installed according the DFO letter of advice (DFO 2016) as follows:

- For crossings of rivers, a bridge was recommended as the preferred crossing method.
- For crossings of watercourses, other than rivers, considered to be potential migration routes and/or to potentially provide spawning or nursery habitat for large-bodied fish, embedded culverts or clear span bridges were installed according to the DFO letter of advice (DFO 2016) as the preferred crossing method.
- For crossings of watercourses considered to potentially support only small-bodied fish, embedded corrugated steel culverts were installed according to the DFO letter of advice (DFO 2016) as the preferred crossing method.

Additional baseline information relevant to the Haul Road is provided in the 2015 Haul Road Baseline Report (Volume 6, Appendix 6-D).

6.3.2.2.3 General

As discussed in Section 6.3.1.1, Inuit in the region have expressed concerns about warmer temperature throughout the year, short-term temperature fluctuations, changing snow and ice conditions, more frequent severe storms in the fall, and lower water levels in rivers and lakes.

6.3.3 Potential Project-related Effects Assessment

A comprehensive analysis of the potential pathways for effects on surface water quantity during the construction, dewatering, operational, closure, and post-closure phases, is provided in Volume 3, Appendix 3-C.

Primary pathways are those where effects from the Project will likely result in a measurable change to measurement indicators that could contribute to residual effects on a VC relative to the Baseline Case or guideline values. Pathways determined to have no linkage or those that are considered secondary are not predicted to result in environmentally significant effects on surface water quantity and are not carried through the effects assessment. Secondary effects pathways and effects pathways with no linkage are summarized in the Pathway Analysis table in Volume 3, Appendix 3-C. The following are the primary pathways that require further effects analysis to determine the environmental significance from the Project on surface water quantity:

- Project footprint, which will physically alter watershed areas and drainage patterns, may change downstream discharges, water levels, and channel/bank stability in streams, and affect water quality, fish habitat, and fish;
- Dewatering of lakes may change discharges, water levels, and channel/bank stability in receiving and downstream waterbodies, and affect water quality, fish and fish habitat; and
- Alteration of watershed flow paths may change discharges, water levels, and channel/bank stability in diverted and receiving waterbodies, and affect water quantity, water quality, fish and fish habitat.

6.3.3.1 Primary Pathways Effect Analysis

6.3.3.1.1 Methods

The water balance model described in the 2015 Hydrology Baseline Report (Volume 6, Appendix 6-C) was modified to model the effects of the Project on LSA watersheds during Project phases, including the construction, dewatering, operational, closure, and post-closure phases. Effect analysis results considered primary pathways as identified in Section 6.3.3. Because these primary pathways overlap with a varying degree through time, effect analysis results were presented by Project phase, in terms of change in discharge and water level regimes, from which additional information can be derived (e.g., flood zones).

Project activity relevant to surface water quantity, and effect analysis results, are summarized by Project phase in the following sub-sections. Additional details on methods and assumptions are presented in Volume 6, Appendix 6-E.

6.3.3.1.2 Construction Phase

6.3.3.1.2.1 Project Activities and Potential Effects to Surface Water Quantity

Project activities and potential effects to surface water quantity during the construction phase are summarized as follows:

- Construction of the Whale Tail Dike will prevent runoff from Whale Tail Lake (South Basin) to Whale Tail Lake (North Basin), and downstream lakes, from June 2018 until the end of the closure phase. The Whale Tail Dike will reduce the drainage area of Whale Tail Lake (North Basin) by 79%, from 28.1 km^2 (baseline conditions) to 5.8 km^2 (following construction of the Whale Tail Dike), resulting in reduced discharges at the outlet of Lake A17 (Whale Tail Lake), and downstream lakes.
- Rock placement to construct the Whale Tail Dike will displace water which may result in an increase in water level and discharge in Whale Tail Lake (North Basin) until the Mammoth Dike is constructed. A similar

increase in water level is possible from the construction of the Mammoth Dike in Lake A16 (Mammoth Lake); however, the Mammoth Dike will be constructed near the eastern shoreline of the lake resulting in a less significant increase in water level.

- Construction of the Whale Tail Waste Rock Storage Facility (WRSF) Dike will prevent runoff upstream of the dike to Lake A16 (Mammoth Lake), and downstream lakes, from June 2018 until the end of the post-closure phase (not discussed herein). The Whale Tail WRSF Dike will reduce the drainage area of Lake A16 (Mammoth Lake) by 1.16 km^2, resulting in reduced discharges at the outlet of Lake A16 (Mammoth Lake), and downstream lakes.
- Construction of the Mammoth Dike will prevent runoff from Whale Tail Lake (North Basin) to Lake A16 (Mammoth Lake), and downstream lakes, from September 2018 until the end of the closure phase (not discussed herein). The Mammoth Dike will reduce the discharge of Lake A17 (Whale Tail Lake) to Lake A16 (Mammoth) watershed by 100%. The Mammoth Dike will also encroach on the local watershed of Lake A16 (Mammoth Lake) by approximately 5%, including 0.012 km^2 in lake area, and 0.357 km^2 in land area. The total Lake A16 (Mammoth Lake) watershed will be reduced by 77% from 38.7 km^2 to 9.0 km^2 from the Whale Tail WRSF Dike and the Mammoth Dike, resulting in reduced discharges at the outlet of Lake A16 (Mammoth Lake), and downstream lakes. The construction schedule of the Mammoth Dike is dependent on Project approval and may be subsequently initiated in winter of 2018-2019.
- The freshwater intake at Lake C38 (Nemo Lake) will be installed during summer 2018 to withdraw up to 8,760 m^3 per year (based on a complete year of withdrawal) and may result a reduction in discharges at Lake C38 (Nemo Lake) and downstream lakes.

6.3.3.1.2.2 Assessment Results

Construction activities are expected to reduce discharges and water levels at Lake A16 (Mammoth Lake), primarily from the reduction in drainage area from the Whale Tail WRSF Dike, from the Whale Tail Dike from June to August (inclusive), and from an additional reduction in drainage area from the Mammoth Dike. Effects on discharges and water levels diminish with increases in drainage area, and are not expected to be measurable at Lake A69. Slightly reduced discharges and water levels are expected at Lake A5, are assumed to occur at Lake A4, Lake A3, Lake A2, and Lake A1, and are not expected to be measurable at Lake DS1. Effects on discharges and water levels at Lake C38 (Nemo Lake) and downstream lakes from water withdrawal are expected to be negligible.

Changes in discharge and water level are presented in Table 6.3-2 for Lake A16 (Mammoth Lake) under peak and mean monthly discharge conditions during the construction phase. Additional statistics and results for other lakes are presented in Volume 6, Appendix 6-E.

Table 6.3-2: Changes in Discharge and Water Level at Lake A16 (Mammoth Lake) during the Construction Phase

Change	Peak Daily		Mean Monthly				
	2-Year	100-Year	June	July	August	September[a]	October[a]
Discharge (%)	-50	-47	-55	-65	-59	-66	-68
Water Level (m)	-0.19	-0.24	-0.16	-0.16	-0.11	-0.14	-0.13

[a] Results are based on construction of the Mammoth Dike in September 2018 and may be conservative if construction of the Mammoth Dike is delayed until winter conditions.

m = metre; % = percent.

6.3.3.1.3 Dewatering Phase

6.3.3.1.3.1 Project Activities and Potential Effects to Surface Water Quantity

Project activities and potential effects to surface water quantity during the dewatering phase are summarized as follows:

- Cumulative effects are expected at Lake A16 (Mammoth Lake) and downstream lakes from the following activities:
  - The Mammoth Dike, built during the construction phase, will reduce the watershed area of Lake A16 (Mammoth Lake) and downstream lakes, resulting in reduced discharges;
  - The Whale Tail WRSF Dike will reduce the land area of the Lake A16 (Mammoth Lake) and downstream lake watersheds, resulting in reduced discharges;
  - The road to the north of Whale Tail Pit, or if deemed necessary, the construction of the North Channel will divert runoff from the Whale Tail Lake watershed (i.e., approximately 0.277 km^2) to Lake A16 (Mammoth Lake) and will augment discharges at Lake A16 (Mammoth Lake) and downstream lakes in 2019; and
  - Dewatering through Lake A16 (Mammoth Lake) will augment discharges at Lake A16 (Mammoth Lake) and downstream lakes.
- The Whale Tail Dike will divert discharges from the Whale Tail Lake (South Basin) watershed to the Lake A16 (Mammoth Lake) watershed, through Lake A45, and will augment discharges at Lake A45 and downstream lakes. The diversion is not expected to affect the Lake A45 watershed until the operational phase in 2020, because it will take some time for the Whale Tail Lake (South Basin) water level to increase to the spill elevation (Volume 6, Appendix 6-F). Therefore, potential effects to Lake A45 and downstream lakes from the diversion are not expected during the dewatering phase.
- The Northeast Dike will divert discharges from the Lake A46 watershed to the Lake C38 (Nemo Lake) watershed, and will augment discharges at Lake C38 (Nemo Lake) and downstream lakes. The diversion is not expected to affect the Lake C38 (Nemo Lake) watershed until the operational phase in 2020, because it will take some time for the Lake A46 and upstream lake water levels to increase to the spill elevation (Volume 6, Appendix 6-F). Therefore, effects to Lake C38 (Nemo Lake) and downstream lakes from the diversion are not expected during the dewatering phase.
- No direct effects are expected to the receiving environment (i.e., Lake A16 [Mammoth Lake] and downstream lakes) from the construction of the East channel.
- The freshwater intake at Lake C38 (Nemo Lake), installed during the construction phase in summer 2018 to withdraw up to 8,760 m^3 per year and may result a reduction in discharges at Lake C38 (Nemo Lake) and downstream lakes.

6.3.3.1.3.2 Assessment Results

Dewatering activities are expected to reduce discharges and water levels at Lake A16 (Mammoth Lake), primarily from the reduction in drainage area from the Mammoth Dike and the Whale Tail WRSF dike, in 2019. Effects on discharges and water levels diminish with increases in drainage area, and are expected to be hardly measurable

at Lake A5, and not measurable at Lake A69. Dewatering through Lake A16 (Mammoth) Lake during open water conditions minimizes the potential for reduced discharges and water levels and acts as a mitigation measure. Effects on discharges and water levels at Lake C38 (Nemo Lake) and downstream lakes from water withdrawal are expected to be negligible.

Changes in discharge and water level are presented in Table 6.3-3 for Lake A16 (Mammoth Lake) under peak and mean monthly discharge conditions during the dewatering phase. Additional statistics and results for other lakes are presented in Volume 6, Appendix 6-E.

Table 6.3-3: Changes in Discharge and Water Level at Lake A16 (Mammoth Lake) during the Dewatering Phase

Change	Peak Daily		Mean Monthly				
	2-Year	100-Year	June	July	August	September	October
Discharge (%)	-38	-36	-43	-19	-30	-48	-57
Water Level (m)	-0.14	-0.17	-0.12	-0.04	-0.05	-0.09	-0.10

m = metre; % = percent.

6.3.3.1.4 Operational Phase

6.3.3.1.4.1 Project Activities and Potential Effects to Surface Water Quantity

Project activities and potential effects to surface water quantity during the operational phase are summarized as follows:

- Lake A45 will become part of the South Whale Tail diversion channel until the South Whale Tail diversion is decommissioned at closure.
- Cumulative effects are expected at Lake A16 (Mammoth Lake) and downstream lakes from the following activities:
  - The Mammoth Dike, built during the construction phase, will reduce the watershed area of Lake A16 (Mammoth Lake) and downstream lakes, resulting in reduced discharges;
  - The Whale Tail Dike will result in the diversion of the Whale Tail Lake (South Basin) watershed to the Lake A16 (Mammoth Lake) watershed, thereby augmenting discharges at Lake A16 (Mammoth Lake) and downstream lakes;
  - The Whale Tail WRSF Dike will reduce the land area of the Lake A16 (Mammoth Lake) and downstream lake watersheds, resulting in reduced discharges;
  - The road to the north of Whale Tail Pit, or if deemed necessary, the operation of the North Channel will divert runoff from the Whale Tail Lake watershed (i.e., approximately 0.277 km^2) to Lake A16 (Mammoth Lake) and will augment discharges at Lake A16 (Mammoth Lake) and downstream lakes starting in August 2019; and
  - Treated water from the Water Treatment Plant discharged to Lake A16 (Mammoth Lake) will augment the discharges at Lake A16 (Mammoth Lake) and downstream lakes.

- Cumulative effects are expected at Lake C38 (Nemo Lake) and downstream lakes from the following activities:
  - The Northeast Dike will divert discharges from the Lake A46 watershed to the Lake C38 (Nemo Lake) watershed (through Lake C44), and will augment discharges at Lake C44 and downstream lakes; and
  - The freshwater intake at Lake C38 (Nemo Lake) will withdraw up to 118,625 m^3/year and will result a reduction in discharges at Lake C38 (Nemo Lake) and downstream lakes.

6.3.3.1.4.2 Assessment Results

The diversion of Whale Tail Lake (South Basin) to the Lake A16 (Mammoth Lake) watershed is expected from July 2020 to May 2022 (Volume 6, Appendix 6-F) and will increase the water surface elevation of Whale Tail Lake (South Basin) by 3.5 m (i.e., from 152.50 masl to 156.00 masl). This increase will result in flooding of tributary lakes, including Lake A18, Lake A19, Lake A20, Lake A21, Lake A22, Lake A55, Lake A62, Lake A63, Lake A65, Pond A-P1, and Pond A-P53, increasing the lake water surface fraction of the Whale Tail Lake (South Basin) watershed by approximately 6% (Table 6.3-4).

Table 6.3-4: Comparison of Lake Water Surface Area in the Whale Tail Lake (South Basin) Watershed during Baseline and the Operational Phase

Parameter	Total Watershed Area	Lake Water Surface Area	
		Baseline	Operational Phase
Area (km^2)	22.3	3.69	5.13
Watershed Proportion (%)	100	16.5	23.0

km^2 = square kilometre; % = percent.

The diversion of the Northeast sector to the Lake C38 (Nemo Lake) watershed is expected from July 2020 to May 2022 (Volume 6, Appendix 6-F) and will increase the water surface elevation of Lake A46 (i.e., the most downstream lake under baseline conditions) by 3.5 m (i.e., from 154.43 masl to 156.66 masl). This increase will result in flooding of tributary lakes, including Lake A47, Lake A48, Lake A113, Pond A-P38, and Pond A-P68, increasing the lake water surface fraction of the Lake A46 watershed by approximately 10% (Table 6.3-5).

Table 6.3-5: Comparison of Lake Water Surface Area in the Northeast Sector Watershed during Baseline and the Operational Phase

Parameter	Total Watershed Area	Lake Water Surface Area	
		Baseline	Operational Phase
Area (km^2)	1.85	0.15	0.34
Watershed Proportion (%)	100	7.9	18.2

km^2 = square kilometre; % = percent.

Operational activities are expected to increase flood discharges and water levels slightly at Lake A16 (Mammoth Lake) from the combination of diverted Whale Tail Lake (South Basin) and discharge from the Water Treatment Plant, in 2020 and 2021. Effects on discharges and water levels diminish with increases in drainage area, and are not expected to be measurable at Lake A5 and Lake A69. Lake A45 will become part of the South Whale Tail diversion channel until the South Whale Tail diversion is decommissioned at closure.

Operational activities are expected to increase discharges and water levels at receiving lakes, including Lake C38 (Nemo Lake), Lake C43, and Lake C44 from the diversion of the Northeast Sector, in 2020 and 2021. Effects on discharges and water levels diminish with increases in drainage area, and are not expected to be measurable at Lake C8. Field inspections, water level and water quality monitoring will follow monitoring and mitigation plans.

Changes in discharge and water level are presented in Table 6.3-6 for Lake A16 (Mammoth Lake), and in Table 6.3-7 for Lake C38 (Nemo Lake) under peak and mean monthly discharge conditions during the operational phase. Additional statistics and results for other lakes are presented in Volume 6, Appendix 6-E.

Table 6.3-6: Changes in Discharge and Water Level at Lake A16 (Mammoth Lake) during the Operational Phase

Change	Peak Daily		Mean Monthly				
	2-Year	100-Year	June	July	August	September	October
Discharge (%)	+13	+8	+7%	-12%	-3%	+8%	+3%
Water Level (m)	+0.04	+0.03	+0.01	-0.02	0.00	+0.01	0.00

km^2 = square kilometre; % = percent.

Table 6.3-7: Changes in Discharge and Water Level at Lake C38 (Nemo Lake) during the Operational Phase

Change	Peak Daily		Mean Monthly				
	2-Year	100-Year	June	July	August	September	October
Discharge (%)	+22%	+36%	+17%	+24%	+27%	+26%	+26%
Water Level (m)	+0.09	+0.24	+0.05	+0.08	+0.07	+0.07	+0.04

m = metre; % = percent.

6.3.3.1.5 Closure Phase

6.3.3.1.5.1 Project Activities and Potential Effects to Surface Water Quantity

Project activities and potential effects to surface water quantity during the closure phase are summarized as follows:

- Cumulative effects are expected at Lake A16 (Mammoth Lake) and downstream lakes from the following activities:
  - The Mammoth Dike, built during the construction phase, will reduce the watershed area of Lake A16 (Mammoth Lake) and downstream lakes, resulting in reduced discharges; and
  - The Whale Tail WRSF Dike, built during the construction phase, will reduce the land area of Lake A16 (Mammoth Lake) and downstream lakes, resulting in reduced discharges.
- Whale Tail Lake (South Basin) will be drawn-down by November 2022. As such, lakes previously affected by the South Whale Tail diversion (i.e., Lake A18, Lake A19, Lake A20, Lake A21, Lake A22, Lake A55, Lake A62, Lake A63, Lake A65, Pond A-P1, and Pond A-P53), located upstream of Whale Tail Lake (South Basin), will return to baseline conditions by November 2022. This will also remove the diversion to Lake A16 (Mammoth Lake).

- The Northeast Sector will be drawn-down by May 2022. As such, lakes previously affected by the Northeast Sector diversion (i.e., Lake A47, Lake A48, Lake A113, Pond A-P38, and Pond A-P68), located upstream of Whale Tail Lake (North Basin), will return to baseline conditions by May 2022. This will also remove the diversion to Lake C38 (Nemo Lake).

6.3.3.1.5.2 Assessment Results

Closure activities are expected to reduce discharges and water levels at Lake A16 (Mammoth Lake), primarily from the reduction in drainage area from the Mammoth Dike, and the Whale Tail WRSF Dike, from 2022 to 2032. Effects on discharges and water levels diminish with increases in drainage area, and are not expected to be measurable at Lake A69. A slight reduction in discharges and water levels is expected at Lake A5, are assumed to occur at Lake A4, Lake A3, Lake A2, and Lake A1, and are not expected to be measurable at Lake DS1.

Changes in discharge and water level are presented in Table 6.3-8 for Lake A16 (Mammoth Lake) under peak and mean monthly discharge conditions during the closure phase. Additional statistics and results for other lakes are presented in Volume 6, Appendix 6-E.

Table 6.3-8: Changes in Discharge and Water Level at Lake A16 (Mammoth Lake) during Closure

Change	Peak Daily		Mean Monthly				
	2-Year	100-Year	June	July	August	September	October
Discharge (%)	-58%	-55%	-65%	-76%	-69%	-66%	-68%
Water Level (m)	-0.24	-0.29	-0.20	-0.20	-0.14	-0.14	-0.13

m = metre; % = percent.

6.3.3.1.6 Post-Closure Phase

6.3.3.1.6.1 Project Activities and Potential Effects to Surface Water Quantity

The end pit lake will increase the surface area of Lake A17 (Whale Tail Lake) by 13% from 1.66 km^2 (baseline conditions) to 1.87 km^2 (post-closure conditions), resulting in proportionate increases in direct precipitation and evaporative losses, and decreases in runoff from adjacent land areas. All other lakes will be returned to baseline conditions.

6.3.3.1.6.2 Assessment Results

At post-closure, the end pit lake will increase the surface area of Lake A17 (Whale Tail Lake) by 13%, resulting in a proportionate increase in direct precipitation and evaporative loss; however, discharge and water level regimes are expected to remain similar to baseline conditions. Statistics and results are presented in Volume 6, Appendix 6-E.

6.3.4 Residual Effect Classification

Infrastructure development, dewatering, and diversion activities will result in effects on discharges, water levels, and channel/bank stability in watersheds of the surface water quantity LSA only, including watersheds A, and C, which will vary over the construction, dewatering, operational, and closure phases. The effects are projected to be negligible following the closure phase. The effects are projected to be negligible beyond the LSA at all times.

Infrastructure development will modify the configuration of a watershed, including drainage area, and lake water surface fractions. Dewatering of waterbodies will augment discharges and water levels of receiving lakes.

Diversion of waterbodies will augment discharges of receiving lakes. Resulting effects on discharges, water levels, and channel/bank stability are summarized below by Project phases, just downstream of the Project:

- Construction Phase: discharge and water level regimes from Lake A16 (Mammoth Lake) and downstream lakes are expected to decrease from the baseline values, and no effects are expected on channel/bank stability, in 2018.
- Dewatering Phase: discharge and water level regimes from Lake A16 (Mammoth Lake) and downstream lakes are expected to decrease from the baseline values, and no effects are expected on channel/bank stability, in 2019.
- Operational Phase:
  - The Whale Tail Lake (South Basin) diversion to the Lake A16 (Mammoth Lake) watershed, and the Northeast sector diversion to the Lake C38 (Nemo Lake) watershed, are expected to increase water levels in Whale Tail Lake (South Basin) and in the Northeast sector, from July 2020 to May 2022;
  - Flood discharge and water level regimes are expected to increase slightly from the baseline values at Lake A16 (Mammoth Lake), and no effects are expected on channel/bank stability at Lake A16 (Mammoth Lake), in 2020 and 2021; and
  - Discharge and water level regimes are expected to increase from the baseline values at Lake C38 (Nemo Lake), and negligible effects are expected on channel/bank stability, in 2020 and 2021.
- Closure Phase: discharge and water level regimes from Lake A16 (Mammoth Lake) and downstream lakes are expected to decrease from the baseline values, and no effects are expected on channel/bank stability, from 2022 to 2029.
- Post-Closure Phase: discharge and water level regimes are expected to remain similar to the baseline values, and no effects are expected on channel/bank stability.

These effects are classified in Table 6.3-9, following methods described in Volume 3, Appendix 3-E, and the definition of terms used in the residual effect classification for vegetation, terrestrial wildlife and birds, surface water quality, and fish and fish habitat (Table 3.E-2). Since the assessment endpoint of the surface water quantity VC is the availability of the spatial and temporal distribution of water quantity for aquatic and terrestrial ecosystems, the effect direction was classified and significance was determined in Section 5.0 (Terrestrial Environment) and Section 6.5 (Fish and Fish Habitat).

Effects summarized above will result in change of state from baseline conditions, and were assigned magnitude of High. The effects are expected to remain confined to the LSA, and were classified as Local. The effects are expected to be reversible following the closure phase and classified as Medium-term. The effects will continue over the assessment period and were classified as continuous. The effects are probable and were classified as highly likely.

Table 6.3-9: Residual Effect Classification for Surface Water Quantity

Residual Effect	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood
Change in discharge rate and the spatial distribution of water	High	Local	Medium-term	Continuous	Reversible	Highly Likely

6.3.5 Cumulative Effects Assessment

The Project is anticipated to have negligible effects on surface water quantity outside of the LSA. The database of reasonably foreseeable future developments (Volume 3, Appendix 3-D) indicates that there are no planned development in the RSA, and the cumulative effect is expected to be negligible.

6.3.6 Uncertainty

6.3.6.1 Proposed Whale Tail Pit

6.3.6.1.1 Water Balance Model Inputs

Effects were primarily assessed using a water balance model, based on long-term derived meteorological input representative of the Whale Tail Pit, and hydrological parameters from one year of site-specific hydrological baseline data in 2015 supplemented by regional data (Cumberland 2005b).

As described in the 2015 Hydrology Baseline Report (Volume 6, Appendix 6-C), long-term meteorological data were derived based on a correlation of regional meteorological data available from the Baker Lake A meteorological station (Station ID 2300500) operated by the Government of Canada (2015), and of local meteorological data from the Meadowbank Mine from 1997 to 2003 and from 2013 to 2015. The quality of this correlation is directly proportionate the concurrent period of record of local and regional sources, and can be refined based on newly available local and regional data.

Hydrological parameters, including stage-discharge outlet rating curves, runoff coefficients for land surfaces, and degree-day models for snowmelt and formation of ice in outlet channels, were based on one year of hydrological baseline data. These parameters can be validated and/or refined based on additional monitoring.

Thus, uncertainty related to input parameters described above can be addressed through additional monitoring. Refinement of these parameters may affect the magnitude of effects on surface water quantity presented herein; however, conclusions are expected to remain unaffected.

6.3.6.1.2 Effects of Long-Term Warming Trends

Climate change predictions are in their nature uncertain. The atmospheric processes involved are complex, as are the models used to develop climate change predictions. Inuit in the region have expressed concerns about warmer temperature throughout the year, short-term temperature fluctuations, changing snow and ice conditions, more frequent severe storms in the fall, and lower water levels in rivers and lakes.

In general, the climate in the Project region is projected to be warmer with increased precipitation in the long-term when compared to the observed historic values. Increases in temperatures may result in an increase in the open water season characterized by earlier outlet openings and later outlet freeze-ups, and increased evaporative

losses. Increases in precipitation is expected to augment water yields; however, the net effects of long-term warming trends on flow regimes are uncertain.

For the short duration of the Project, conditions are unlikely to deviate significantly from baseline (Volume 4, Section 4). Environment Canada monitors weather and climate in the Kivalliq Region of Nunavut, and monitoring results will be reviewed periodically to verify conclusions outlined herein and to review operating procedures during the life of the Project, if and as required.

6.3.6.2 Proposed Haul Road

The uncertainty of watercourse crossings identification is primarily related to the presence of water during field investigations. Field investigations were completed during dry conditions in 2014, and throughout the year, including wet conditions, in 2015, and the uncertainty of watercourse crossing identification is low.

The ongoing sizing of culvert and bridge crossings are based on standard design methods, which do not create a source of major uncertainty. There is, however, a minor source of uncertainty that arises from the lack of available detailed topographic data resulting in error in calculated drainage areas for these watercourse crossings. Given the magnitude of these drainage areas, the error may result in some minor and short-term surcharging of culvert head ponds if these areas were underestimated.

6.3.7 Monitoring and Follow-up

Monitoring of flows and water levels at key locations in the LSA during all phases of the Project is considered necessary to determine actual runoff and discharge rates.

To address concerns related to water levels, hydrometric monitoring that provides measurements of lake water levels and lake outlet discharges during open water conditions at key locations (e.g., diversion channels at lake outlets; lake outlets augmented by dewatering discharges), will be undertaken using surveying, hydrometric stations or gauging collection processes similar to those currently used at the Meadowbank Mine and used as part of the baseline program.

All piped and/or pumped discharges to waterbodies will be monitored continuously.

Climate monitoring, including continuous measurements of rainfall and temperature, will be performed to allow validation of the hydrological model, assessment of seasonal conditions and to provide input to water management.

In addition, a monitoring plan applicable to the haul road is addressed in the Whale Tail Pit Haul Road Management Plan (Volume 8, Appendix 8-C.1). The monitoring plan specifically addresses hydrology monitoring prior to spring freshet and after major precipitation events.

6.4 Surface Water Quality

6.4.1 Incorporation of Inuit Qaujimajatuqangit

The effect assessment relies on the IQ baseline information that came from a variety of sources, including a literature review of publicly available sources, public consultation, focus group meetings, government engagement, and information provided directly by Elders, land users, women, and youth. To the extent possible, available IQ information was incorporated into the water quality effects assessment. The following reports were reviewed for specific information related to water quality:

- Whale Tail Pit Project IQ Baseline Report (Volume 7, Appendix 7-A);
- Meadowbank Gold Project Baseline Traditional Knowledge Report (Cumberland 2005a);
- Proposed All-weather Exploration Road from the Meadowbank Mine to the Project Site-Baseline Traditional Knowledge Report (Agnico Eagle 2014a);
- Community Consultations/Public Information Meeting Summary Reports for 2014 and 2015 (NIRB 2014, 2015).

The following sections summarize the IQ information incorporated into the baseline studies, VC selection, and recommendations for mitigation and adaptive management, where applicable.

6.4.1.1 Existing Environment and Baseline Information

Inuit Qaujimajatuqangit provides information about the importance of water and the aquatic ecosystem to the local Inuit communities. As a healthy aquatic ecosystem is dependent on good water quality, IQ information on fish, waterfowl, and geese was used to identify and confirm important areas of focus for water quality studies.

For the residents of Baker Lake, fish, and waterfowl, including geese, provide an important alternate source of food, after caribou. Fishing is a year round activity that occurs throughout the area (Agnico Eagle 2014a, 2016a; IDS 1978; NIRB 2015). Most fishing, and waterfowl harvesting, occurs close to Baker Lake, but outlying areas have also been used (IDS 1978). Important fishing sites included Whitehills Lake, Tehek Lake, Baker Lake, and the mouth of the Thelon River and Kazan River (IDS 1978; Riewe 1992). Other lakes used in the past for fishing include Innugugayualik (Uiguklik) Lake and Pipedream (Tasirjuaraajuk) Lake (Volume 7, Appendix 7-A). Tehek, Innugugayualik, and Pipedream lakes are regularly sampled as part of the Meadowbank Core Receiving Environment Monitoring Program (CREMP) (Azimuth 2016) and data from Innugugayualik and Pipedream were included to describe existing environmental conditions; Lakes in the Whale Tail Pit area are smaller than lakes such as Innugugayualik and Pipedream lakes. During the 2014 traditional knowledge workshop, Baker Lake Elders indicated that fishing occurs in both lakes and rivers, depending on the season and the availability of fish (Agnico Eagle 2014a). Good fishing sites identified near the Project area are located to the east of the footprint, including at Nutipilik, Qugiilik, and Tahinajuk lakes (Agnico Eagle 2014a). Lakes and harvesting sites that have been identified as culturally important are illustrated in the baseline IQ report (Volume 7, Appendix 7-A, Figures 3-1 and 3-2).

For purposes of baseline studies, or an EIS, IQ is used to identify waterbodies and watercourses that have cultural importance. In the absence of this type of information, it is assumed that any waterbody or watercourse in the study area could be used for traditional and non-traditional uses, and could be used by future generations. The whole region between Baker Lake and the Back River was used frequently in the past, and opportunistically today,

as a travel corridor. As not all waterbodies and watercourses in a study area can be sampled, a selection of them were sampled for baseline water and sediment quality using standard methodology (Volume 6, Appendix 6-G, Section 6.4.2).

6.4.1.2 Valued Component Selection

Inuit Qaujimajatuqangit has been integrated in the selection of water quality as a VC for this assessment and identification of potential Project effects. Inuit Qaujimajatuqangit highlighted the cultural significance of water to the Inuit, including rivers and lakes as travel corridors to caribou harvesting areas, lake shorelines as preferred areas for camping and caching of food supplies, and lakes and rivers for preferred fishing areas. Good water quality is important for maintaining healthy aquatic ecosystems including healthy fish and waterfowl which are resources harvested by the local people. Inuit classify water quality through visual and other cues as a means to understand the health of an aquatic ecosystem and the suitability of water for consumption. Specific lakes or rivers have not been identified to date as traditional source drinking water, but for purposes of the assessment, it has been assumed that any lake or river could be used to supply drinking water for traditional travel or camping activities.

The local communities have used the Project area in the past, and continue to use it opportunistically today.

Concerns have been raised regarding the effect of specific project activities that could affect water quality (e.g., restricted water flow, dewatering of waterbodies, dust, and effluent deposition), fish, waterfowl, and aquatic ecosystems. Therefore water quality was maintained as a VC.

6.4.1.3 Impact Assessment

Inuit Qaujimajatuqangit was also considered in the evaluation of project effects on water quality. Predicted changes to water quality were evaluated in a similar manner in all downstream waterbodies and watercourses regardless of whether they were specifically identified through IQ (i.e., all waterbodies and watercourses were considered to have equal value). Water quality results were evaluated with respect to aquatic life guidelines (i.e., a healthy aquatic ecosystem) but also with respect to drinking water guidelines (i.e., that any waterbody or watercourse on the landscape could be used for drinking water).

Specific IQ raised through community consultation related to potential effects of the Project on water quality are as follows:

- spills and accidents;
- dust deposition;
- disturbance of lakes from construction activities;
- dewatering of waterbodies; and
- accumulation of toxic substances.

Good quality drinking water is determined based on temperature, clarity, and other factors (Agnico Eagle 2016a). Baker Lake Youth identified that they are concerned with the effects of the Meadowbank Mine on water quality and are hesitant to drink water if it has a different colour, or if it may have been affected by dust deposition (Agnico Eagle 2016a).

The issues and concerns identified through IQ were considered in the impact assessment and identification of mitigation. Secondary and primary pathways specific to water quality are included in Volume 3, Appendix 3-C, Table 3-C-6. Further analysis of the primary pathways for water quality is provided in Section 6.4.3.

6.4.1.4 Mitigation and Monitoring

Concerns raised through IQ on the potential effects of mining to water quality was also considered in the selection of mitigation and best management practices. For example, at the public information meeting for the Meadowbank Mine, a concern was raised about the protection of lakes from disturbance due to construction activities, the protection of water from spills and accidents along the all-weather access road (AWAR), and the potential impact to rivers, streams and lakes that caribou rely on for migrating (NIRB 2015).Mitigation related to protection of water quality has been included in various plans to specifically address concerns regarding quality of water for protection of aquatic life and traditional uses (e.g., monitoring and management of effluent discharge quality) and water clarity due to disturbance and construction (e.g., management of total suspended solids [TSS], and turbidity). Plans that include water quality monitoring and mitigation are identified in Section 6.4.7.

6.4.2 Existing Environment and Baseline Information

Baseline water and sediment quality studies were completed in 2014 and 2015 for the Whale Tail Pit study area and the haul road study area (formerly called Amaruq Exploration Access Road). Selection of locations for collection of data took into account concerns raised regarding potential effects of the Project on water quality. These data were combined and presented in the Whale Tail Pit CREMP baseline study report (Volume 6, Appendix 6-G). In addition, the data for the Whale Tail Pit study area and the haul road study area were supplemented with water and sediment data collected from the Meadowbank Mine CREMP reference lakes.

This section provides a summary of the methods and results presented in the baseline study report; the detailed data and quality assurance/quality control information is provided in the baseline report (Volume 6, Appendix 6-G).

6.4.2.1 Methods

Water Sample Collection

Baseline water quality sampling was conducted at lakes and tributaries in the study area (summarized in Table 6.4-1; details in Volume 6, Appendix 6-G, Tables 1-1 and 1-2) as follows:

- Whale Tail Lake (Lake A17), Mammoth Lake (Lake A16), and Nemo Lake (Lake C38);
- tributaries within the Whale Tail Pit Study Area;
- tributaries along the proposed haul road; and
- Reference lakes (Innugayualik Lake and Pipedream Lake).

Innugayualik and Pipedream lakes have been identified as culturally important for fishing and as a travel route. The other lakes in the Whale Tail Pit study area have not been specifically identified as culturally important.

Table 6.4-1: Baseline Water and Sediment Quality Sampling Summary

Area	Lake or Tributary	Name	# Stations		Sampling Effort Summary			
			2014	2015	Sep-14	Jul-15	Aug-15	Sep-15
Whale Tail Pit Area	Lake	Whale Tail North (Lake A17)	1 to 3	5	Profile, WQ, SQ	Profile, WQ	Profile, WQ, SQ	Profile, WQ
		Whale Tail South (Lake A17)	1 to 2	5	Profile, WQ, SQ	Profile, WQ	Profile, WQ, SQ	Profile, WQ
		Mammoth (Lake A16)	3 to 5	5	Profile, WQ, SQ	Profile, WQ	Profile, WQ, SQ	Profile, WQ
		Nemo (Lake C38)	3 to 5	5	Profile, WQ, SQ	Profile, WQ	Profile, WQ, SQ	Profile, WQ
	Tributary	A21-A20	-	1	-	-	Field, WQ	-
		A18-A17	-	1	-	-	Field, WQ	Field, WQ
		A55-A17	-	1	-	-	Field, WQ	Field, WQ
		Whale Tail Outlet (A17-A16)	-	1	-	-	-	Field, WQ
		A15-A14	-	1	-	-	-	Field, WQ
		A14-A13	-	1	-	-	Field, WQ	
		A76-A75	-	1	-	-	Field, WQ	-
		A81-A80	-	1	-	-	Field, WQ	-
		A69-DS1	-	1	-	-	Field, WQ	Field, WQ
		A5-A4	-	1	-	-	Field, WQ	-
		DS1	-	1	-	-	Field, WQ	-
		Nemo Outlet (C38-C12)	-	1	-	-	Field, WQ	Field, WQ
		C8-C7	-	1	-	-	Field, WQ	-
Haul Road	Tributary	C2	-	1	-	Profile, WQ	Profile, WQ	Profile, WQ
		C14	-	1	-	Profile, WQ	Profile, WQ	Profile, WQ
		C17	-	1	-	Profile, WQ	Profile, WQ	Profile, WQ
		C20	-	1	-	Profile, WQ	Profile, WQ	Profile, WQ
		C41	-	1	-	Profile, WQ	Profile, WQ	Profile, WQ
Reference	Lake	Inuggugayualik Lake	-	6	-	Profile, WQ	Profile, WQ	Profile, WQ
		Pipedream Lake	-	6	-	Profile, WQ	Profile, WQ	Profile, WQ

Note: Summary of stations as reported in Volume 6, Appendix 6-G.

WQ = samples collected for laboratory analysis of water quality parameters; SQ = samples collected for laboratory analysis of sediment quality parameters; profile = limnological profile data collected.

Methods used to collect and validate the water samples are documented in the baseline report (Volume 6, Appendix 6-G, Section 2). Water quality samples were analyzed for the following constituents:

- physical constituents (i.e., conductivity, hardness, laboratory pH, TDS, TSS, and turbidity);

- major ions (i.e., bicarbonate, calcium, chloride, fluoride, magnesium, potassium, sodium, and sulphate) and nutrients (i.e., total organic carbon, dissolved organic carbon, total Kjeldahl nitrogen, total ammonia, nitrate, nitrite, total phosphorus, total dissolved phosphorus, orthophosphate, and silicate);
- plant pigments (chlorophyll *a*); and
- total and dissolved metals, metalloids, and non-metals[1] (i.e., aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, selenium, silicon, silver, strontium, thallium, tin, titanium, uranium, vanadium, and zinc).

Sediment Sample Collection

Baseline sediment sampling of Whale Tail Lake, Nemo Lake, and Mammoth Lake was completed in September 2014 and in August 2015. The sampling locations for the 2014 baseline study were consistent with the benthic invertebrate stations (i.e., stations 1, 3, and 5) in Whale Tail Lake, Nemo Lake, and Mammoth Lake. For 2015, sediment and benthic invertebrate samples were collected from five areas; two areas Whale Tail Lake (North Basin), one area Whale Tail Lake (South Basin), one area in Nemo Lake, and one area in Mammoth Lake. Sample collection and sample validation is provided in the baseline report (Volume 6, Appendix 6-G, Section 3).

Sediment samples were collected after the benthic invertebrate sampling. Samples were collected using a Petite Ponar grab sampler and assessed for acceptability before processing. Sediment samples were analyzed by ALS for the following constituents:

- physical constituents (i.e., organic content, particle size distribution [gravel, greater than 2 mm; sand, 0.063 to 2.0 mm; silt, 0.004 to 0.063 mm; and clay, less than 0.004 mm]);
- nutrients (total organic carbon and phosphorus); and
- metals (i.e., aluminum, antimony, arsenic, barium, beryllium, bismuth, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, thallium, tin, titanium, uranium, vanadium, and zinc).

Data Screening and Analysis

Water chemistry data collated for the baseline report were screened against the Canadian Council of Ministers of the Environment (CCME) Canadian water quality guidelines (CWQG) for the protection of freshwater aquatic life (CCME 1999) and Canadian drinking water quality guidelines (CDWQG; Health Canada 2014). Health-based standards were given priority over aesthetic and operational guidelines. For additional context, the results were also qualitatively compared to the chemistry data from the reference lakes and compared against trigger and threshold values developed for the Meadowbank CREMP (Azimuth 2015). For context, thresholds are considered regulatory guidelines or benchmarks below which adverse effects are not expected; triggers are early warning levels and are less than threshold vales. The trigger and threshold values were included in the screening to help put the baseline water quality data in context with screening values applied to the lakes impacted by the Meadowbank Mine. Data are compared to guidelines and benchmarks as a means to evaluate the quality of water and determine the suitability of the water for aquatic life, including fish, waterfowl, and as a drinking water source.

[1] Henceforth, metals, metalloids (e.g., arsenic), and non-metals (e.g., selenium) will be referred to as metals.

Sediment data from 2014 and 2015 were screened against the CCME interim sediment quality guidelines (ISQGs) and probable effect level (PEL) concentrations (CCME 2002). The results were also qualitatively compared to the chemistry data from the reference lakes for additional context and the triggers/thresholds developed for the Meadowbank CREMP lakes (Azimuth 2015).

6.4.2.2 Results

This section provides a high-level summary of the water and sediment quality results; for more details please see the baseline report (Volume 6, Appendix 6-G).

Water Quality

The majority of water chemistry constituent concentrations were below the analytical detection limit for samples collected in 2014 and 2015. Constituents that were below the detection limit across all samples included carbonate, hydroxide, nitrite, total cyanide, four total metals (boron, lithium, selenium, and silver), and eight dissolved metals (antimony, bismuth, boron, selenium, silver, thallium, vanadium, and zirconium). The following sections provide a summary of results by study area.

Lakes – Whale Tail Pit Study Area and Reference Lakes

Water temperature in lakes ranged from 9 to 11.5°C during the summer months in 2015 with minor thermal stratification evident at some deeper locations (Volume 6, Appendix 6-G, Appendix B Tables B1-1 and B2-1). The water column was generally well mixed with uniform specific conductivity (generally less than 25 µS/cm) and sufficient oxygen to support aquatic life (i.e., above the CWQG threshold). Lakewater pH was circum-neutral (6.4 to 7.6) in all lakes. Surface water collected during the open water season was characteristic of low productivity headwater lakes in the Arctic; soft, with low alkalinity, low TDS (less than 25 mg/L), low turbidity (and corresponding high Secchi depth) and low TSS (less than 2 mg/L) (Volume 6, Appendix 6-G, Tables 2-1 and 2-2).

Nutrient concentrations were low in the lakes with results less than the detection limit in most samples. Ammonia was less than the detection limit in most samples, with highest concentration detected in Whale Tail (0.1 mg-N/L) and lowest detected concentration in Nemo Lake (0.006 mg-N/L); ammonia was not detected in the reference lakes. Total phosphorus was less than the detection limit in most samples with maximum concentration of 0.004 mg-P/L detected in Nemo Lake and maximum concentration of 0.003 mg-P/L detected in Whale Tail and Mammoth; maximum total phosphorus in the reference lakes was 0.006 mg-P/L.

Metals were below the analytical detection limit in most samples, and when they were detected, concentrations were below the CDWQG and CWQG.

There were a small number of constituents with concentrations that exceeded the Meadowbank trigger values (i.e., conductivity, hardness, calcium, magnesium, and potassium); however, triggers for these constituents were based on baseline/reference data from the Meadowbank project lakes and were provided for context only. Overall, the 2015 water quality results from the lakes in the Whale Tail Pit study area were similar to results from the reference lakes.

Tributaries – Whale Tail Pit and Haul Road Study Areas

In situ water quality measurements taken at the tributary stations in the Whale Tail Pit study area and the haul road study area show the water to be well oxygenated with dissolved oxygen concentrations consistently above

9.5 mg/L and low specific conductivity at all stations (i.e., less than or equal to 34 µS/cm). Tributary pH was circum-neutral (6.2 to 7.3) across all stations (Volume 6, Appendix 6-G, Tables 2-3 and 2-4).

Nutrient concentrations were low in the tributaries with results less than the detection limit in most samples. Ammonia was less than the detection limit in most samples with a higher maximum concentration detected in a tributary from the Whale Tail Pit study area (0.007 mg-N/L) as compared to the maximum detected in the haul road study area (0.005 mg-N/L). Phosphorus was detected more frequently in the tributary samples as compared to the lake samples. In the Whale Tail Pit study area, total phosphorus ranged from less than the detection limit to 0.004 mg-P/L and ranged from less than the detection limit to 0.007 mg-P/L in the haul road study area. The median value in tributaries (in both study areas) was 0.002 mg-P/L while the median was less than the detection limit in the lakes.

Metals were below the analytical detection limit in most samples, and when they were detected, concentrations were below the CDWQG and CWQG, with two exceptions. Aluminum was above the CWQG at two stations (A55-A17 and A5-A4) in August; all other detectable metal concentrations were less than the CWQG and the CDWQG.

Concentrations in the tributary samples did not exceed the Meadowbank triggers and thresholds.

Sediment Quality

Sediments were collected from lakes in the Whale Tail Pit study area and from the reference lakes. Concentrations were generally similar between lakes and concentrations were less than the ISQG and PEL guidelines for cadmium, copper, lead, and mercury in all samples (Volume 6, Appendix 6-G, Tables 3-1 and 3-2).

The particle size distribution in the top 3 to 5 cm of sediment from south Whale Tail Lake, Mammoth Lake, Pipedream Lake, and Inuggugayualik Lake was predominantly silt/clay, and characteristic of depositional areas in lakes from this region (Azimuth 2015). A coarser particle size distribution was evident in samples collected from Nemo Lake and north Whale Tail Lake with sediment collected at similar depth (i.e., 8 m ± 1.5 m) being predominantly silt/sand.

Arsenic and chromium concentrations exceeded the ISQG and PEL in sediment samples collected in 2014 and 2015 from all lakes in the Whale Tail Pit study area (Whale Tail Lake, Mammoth Lake, Nemo Lake) and in the references lakes (Inuggugayualik Lake and Pipedream Lake). Sediment chromium concentrations were also above Meadowbank trigger values at Pipedream Lake, Mammoth Lake, and select locations in Whale Tail Lake. Sediment arsenic concentrations were above Meadowbank trigger values at Inuggugayualik Lake, Mammoth Lake, and Whale Tail Lake. Maximum sediment arsenic and chromium concentrations were observed at Whale Tail Lake (i.e., 1,760 mg/kg arsenic dry weight and 210 mg/kg chromium dry weight). Sediment copper concentrations were above the ISQG in all lakes sampled during 2014 and 2015. Sediment zinc concentrations were above the ISQG, PEL and Meadowbank trigger values at Mammoth Lake.

Sediment concentrations of hydrocarbons and polycyclic aromatic hydrocarbons were consistently low at all lakes sampled and below analytical detection limits.

6.4.3 Potential Project-related Effects Assessment

Methodology for the effects assessment for the Project is outlined in Volume 3, Section 3.5. Pathway analysis with identification of no linkage, secondary, and primary pathways for water quality (with links to sediment quality where appropriate) is provided in Volume 3, Appendix 3-C, Table 3-C-6. Pathway analysis identifies and assesses the linkages between Project components or activities, and the corresponding potential residual effects to the VCs. A comprehensive analysis of the potential pathways for effects on water quality during the construction, dewatering, operational, closure, and post-closure phases, is provided in Volume 3, Appendix 3-C, Table 3-C-6. This pathway analysis includes the use of environmental design features and mitigation to remove a pathway (i.e., no linkage) or to limit (i.e., mitigate) the effects of the pathway and reduce it to a secondary pathway (i.e., minor measureable change). Primary pathways (i.e., those pathways likely to result in a measurable change to measurement indicators that could contribute to residual effects on a VC relative to the Baseline Case or guideline values) are carried through for further evaluation of effects.

Primary pathways that require further effects analysis to determine the environmental significance from the Project on water quality are grouped into effects statements that link Project activities with a change in water quality (Table 6.4-2).

Table 6.4-2: Effects Statements for Water Quality

Effects Statement	Pathway	Phase
Air emissions and the deposition of dust and acidifying air emissions to waterbodies	Activities from construction activities and mining operations (e.g., equipment, vehicles, buildings, open-pit mining, blasting) can create fugitive dust and alter air emissions (including sulphur dioxide, nitrogen oxides, and particulate matter) and subsequent deposition may cause a change in water and sediment quality.	Construction through operations
Water management and flooding	Water management activities (dams, drainage, diversion, discharge, and dewatering) that will alter watershed areas, natural drainage paths, and create a reservoir may cause a change in water quality (mercury cycling and bioaccumulation).	Construction through closure, but primarily operations
Development of the Project footprint, water management and effluent discharge	Project footprint will physically alter watershed areas and drainage patterns, rates and quantities of diverted non-contact water to new watersheds, change downstream flows through flooding and dewatering, water levels, channel/bank stability in streams and may affect water and sediment quality.	Operations and closure
	Activities from mining operations (e.g., open-pit mining, blasting, collection of runoff from the WRSF, sewage treatment effluent) that will generate effluent and the subsequent discharge of effluent may cause a change in water and sediment quality.	Operations

WRSF = waste rock storage facility.

The analyses of residual effects from the Project on water quality are quantitative, where possible, and included data from field studies, scientific literature, monitoring programs at existing mines, government publications, and personal communications. Traditional knowledge and community information were incorporated where available. Sediment quality is considered a measurement indicator for the water quality assessment endpoint; analyses of residual effects on sediment quality are qualitative. Due to the amount and type of data available, some analyses of residual effects were qualitative and included professional judgement or experienced opinion. Analyses of each effects statement are provided in Sections 6.4.3.1, 6.4.3.2, and 6.4.3.3.

6.4.3.1 Effects of Air Emissions and Deposition

Project related air emissions have the potential to deposit to local terrestrial and aquatic ecosystems. Atmospheric deposition of acidic gases and fugitive dust therefore have the potential to affect soil and water quality, local flora and fauna, and the Inuit communities that depend on these resources for their cultural, social, and economic well-being.

The effect of air emissions and deposition on water quality was determined through the air quality assessment (Volume 4, Appendix 4-C, Section 4.3,) and review of monitoring results for the Meadowbank Mine (Volume 6, Appendix 6-G). The air quality assessment provided predictions of emissions and deposition of total suspended particulate (TSP) matter and particulate matter smaller than 10 micrometres (PM_{10}) for the haul road and the Whale Tail Pit, and compared these predictions to baseline concentrations and air quality criteria. Effect of air emissions and deposition on water quality was retained as a primary pathway because the IQ identified water quality that could be affected by dust deposition as a concern.

Measured dust deposition (TSP) at the Meadowbank Mine site was less than the Government of Nunavut standard of 120 µg/m^3 in all samples except one (Agnico Eagle 2016b). Background concentrations of NO_2 reach values 5% to 10% of the 24-hour Nunavut air quality standard; average $PM_{2.5}$ concentrations can reach 25% of the 24-hour air quality standard (Volume 4, Section 4.3.2).

Along the haul road, the predictions suggest the deposition will be less than the British Columbia dustfall standard within 300 m of the road and less than the Ontario standard within 25 m from the road, and appear comparable to the Meadowbank observations. (Volume 4, Section 4.3.3). The maximum annual TSP concentrations and the maximum 24-hr and annual average concentrations at the selected receptors (Volume 4, Appendix 4-C, Table 4-C-15) are all lower than the respective air quality standards.

At the Whale Tail Pit study area, the air quality predictions suggest that the effects of mining activities at the Whale Tail Pit on regional air quality are limited in spatial extent and occur primarily on dry windy days in summer. For TSP, the worst year of the 5-year simulation includes three 24-hour TSP exceedances. These effects are reversible because emissions will no longer affect air quality once the Whale Tail Pit is decommissioned and the haul road become inactive.

The deposition of acidifying air emissions can change water quality in receiving lakes if deposition is high and lakes have high acid sensitivity (based on the rating scale of Saffran and Trew 1996). Emissions of nitrogen oxide and sulfur dioxide were modeled. The maximum 1-hour, 24-hour, and annual nitrogen oxide concentrations and the concentrations at the selected receptors (Volume 4, Appendix 4-C, Table 4.C-11) are all lower than the respective air quality standards. Likewise, the maximum 1-hour, 24-hour, and annual SO_2 concentrations and the concentrations at the selected receptors (Volume 4, Appendix 4-C, Table 4-C-13) are all lower than the respective air quality standards. Acid deposition modelling was not conducted because results of the air quality emissions did not suggest there would be significant deposition, nor measurable effects to receptors.

The air quality assessment concluded that the effects of the Project on air quality are limited in spatial extent and temporal extent.

Mitigation will be applied to manage the generation of dust and acidifying air emissions. Mitigation will include measures such as:

- Dust control systems will be used to limit dust emissions.

- Compliance with regulatory emission requirements are expected to be met based on modelling.
- Exhaust emissions from non-road vehicles will be managed through regular and routine maintenance of vehicles.
- If effects on water quality due to dust deposition are observed from water quality monitoring at upstream and downstream locations, then other dust abatement measures at sensitive watercourses or waterbodies will be implemented.

At the Ekati Mine, aquatic monitoring data are evaluated with dust deposition data to evaluate potential effects. Results from Ekati show that dust is generated from both waste rock storage areas and the haul roads, but that levels are comparable to background levels past 90 m from a facility (Rescan 2012). Deposition of dust to water, as compared to effluent, has a negligible effect on water quality concentrations (Rescan 2010; DDMI 2011).

In addition, a study conducted for De Beers (Golder 2012) showed that winter conditions provide a high level of natural mitigation (approximately 96%) to suppress dust generation and dust fall, and that haul road watering or suppression during summer months will result in approximately 80% suppression of dust generation, and for periods between four to six hours after watering.

Water quality is routinely measured at Meadowbank Mine through the CREMP (Azimuth 2016) and as part of general site monitoring (Agnico Eagle 2016c). Through the CREMP, changes in water quality have been identified for alkalinity, conductivity, hardness, major cations, TDS, and total Kjeldahl nitrogen at one or more near-field station. While concentrations have changed since baseline due to dewatering and operations, the changes are localized, concentrations are still low, and thus the change is not ecologically relevant. This suggests that mitigation, such as dust suppression on haul roads and on the airstrip, used at Meadowbank Mine is sufficient to reduce or eliminate effects of dust and air quality emissions on water quality. Changes to water quality can cause a change to sediment quality. Management of dust to minimize effects to water quality will also minimize effects to sediment quality. The effect of dust and air quality emissions on sediment quality are expected to be negligible.

The Inuit are concerned about the effects of dust from the Project and how it can change the colour and quality of water as a drinking source and to support the aquatic ecosystem. Based on the results of the air quality predictions, water quality monitoring at Meadowbank, and monitoring at other mines in the North, and the use of best management practices and mitigation (Volume 3, Appendix 3-C, Table 3-C-6), the generation of dust and acidifying air emissions can be managed.

6.4.3.2 Effects of Water Management and Flooding

The planned diversion of Whale Tail Lake (South Basin) to the Mammoth Lake watershed will increase the surface water elevation of Whale Tail Lake (South Basin), resulting in flooding of tributary lakes and an increase to the lake water surface fraction of the Whale Tail Lake (South Basin) watershed (Section 6.3.3.1.4.2). This pathway considers Project activities in construction and operations that could disturb lakes and that could result in the accumulation of toxic substances. The anticipated effects of flooding as part of the planned diversion on water quality are erosion along new shorelines with mobilization of TSS, and mobilization of mercury from decomposition of newly flooded vegetation with subsequent increases in the water column and biota (particularly piscivorous fish, such as lake trout). A literature review was completed to assess the potential impact of mercury mobilization and the potential for methylmercury increases in the water column and biota. The literature review was limited to studies on reservoirs to evaluate how mercury concentrations may change as a result of impoundment.

Flooding of Whale Tail Lake (South Basin) will be temporary during the Project. In Year 1 (2019), construction of the Whale Tail Dike, which will divert discharges to the South Basin, and construction of the South Whale Tail Diversion Channel will be completed (Volume 1, Table 1.4-1). Whale Tail Lake (South Basin) will slowly flood and eventual spill-over to Mammoth Lake through the South Whale Tail Diversion Channel by July 2020 through to May 2022. This diversion will increase the surface elevation of Whale Tail Lake (South Basin) by 3.5 m (i.e., from 152.50 metres above sea level [masl] to 156.00 masl) and increase the lake water surface fraction of the Whale Tail Lake (South Basin) watershed by approximately 6% (Volume 6, Section 6.3.3.1.4). As part of the closure phase, there will be draw-down of Whale Tail Lake (South Basin) to natural elevations by November 2022.

Background

Mercury is a naturally occurring element found at low concentrations in air, soil, animals, and vegetation, as well as in lakes and rivers. It can be released into the air naturally, by volcanoes and forest fires, or as a result of human activities such as coal burning and waste incineration. The vast majority of mercury in the environment occurs as inorganic mercury. Inorganic mercury has limited bioavailability and is generally bound to soil and sediment. As a consequence, it is not readily absorbed by plants or animals and typically does not pose a significant health risk to biota.

In lakes and rivers, inorganic mercury is converted into methylmercury through methylation by bacteria. Methylmercury is readily absorbed by biota and can become toxic in sufficient concentrations. Bacterial methylation of mercury is enhanced by the decomposition of flooded vegetation and organic carbon in soils (Hecky et al. 1991). Flooding of soils and vegetation provides a new source of food for the bacteria that convert inorganic mercury to methylmercury in the flooded environment. The decomposition of organic matter from flooded soils and increased bacterial methylation of inorganic mercury to methylmercury after impoundment, or creation of new reservoirs, are believed to be responsible for the elevation of methylmercury in fish (Furutani 1980; Ramlal et al. 1987; Hall et al. 2005; Tremblay and Lucotte 1997). Bacterial decomposition of this new organic material increases the natural rate of methylmercury production in the new reservoir which can last for several years. However, the increase in methylmercury concentrations are temporary, and generally ends eight to ten years after impoundment because the detritus, and the source of the organic matter, are quickly decomposed by the bacteria. Submerged tree trunks and branches do not release mercury because decomposition of them is minimal (Lucotte et al. 1999). For the Project, the impoundment, or flooding period, will be temporary, so the typical cycle of mercury increase and decrease may not be observed, or the changes will lower than reported in the literature for permanently flooded reservoirs.

Methylmercury both bioaccumulates and biomagnifies, increasing in concentration with organism size and trophic position. For example, concentrations of methylmercury are generally greater in fish when compared to macroinvertebrates or plankton. Among fish species, larger, piscivorous fishes such as Northern Pike, Walleye, Lake Trout, and Bull Trout have greater concentrations of mercury than smaller planktivorous, or benthivorous fishes such as Lake Whitefish, Kokanee, Rainbow Trout, and Brook Trout. Of these fish species, Lake Trout occurs in the study area and has been identified through IQ as an important species. The main fish species in reviewed literature were piscivorous fish (Northern Pike and Walleye) and planktivorous/insectivorous fish (Lake Whitefish). Lake Trout, a culturally important, piscivorous fish, found in the Whale Tail study area was not a fish of focus in the reviewed literature. For the purposes of this assessment, Lake Trout are grouped as larger piscivorous fish, and thus data on mercury bioaccumulation and biomagnification in Northern Pike and Walleye may be used to interpret potential changes to mercury concentration in Lake Trout.

Magnitude of increase in fish mercury concentrations and the duration of this increase vary greatly from one reservoir to another and depend on specific characteristics of each reservoir, such as flooded area relative to pre-flooded area, amount of terrestrial vegetation in the flooded area (Yao et al. 2011), and other sources of mercury to the terrestrial soils and vegetation. Reservoirs created over large areas with large stores of organics with a long residence time of water (~months) will always produce more methylmercury for a longer time than reservoirs with minimal flooding, short residence time (~days/weeks) and less organic soils.

Observed Mercury Concentrations in Flooded Reservoirs

Generally, methylmercury can be expected to increase 10 to 20 times in water and zooplankton, two to three times in benthic invertebrates, and two to nine times in fish relative to background conditions (Bodaly et al. 1997) in a flooded reservoir as compared to baseline conditions; however, this increase is related to the full lifecycle of a reservoir.

Concentrations of mercury in water can within the first year of impoundment (e.g., Kelly et al. 1995) (Table 6.4-3). Organic mercury concentrations in zooplankton and benthic invertebrates increased within two months of impoundment (Bodaly et al. 1997; Kelly et al. 1995). Fish tissue mercury concentrations are higher post-impoundment as compared to pre-impoundment, with concentrations peaking between two to 13 years after impoundment (Brouard et al. 1990; Schetagne and Verdon 1999; Wakelin 2008). Harris et al. (2009) reported that fish mercury concentrations tend to increase two to seven times in reservoirs relative to baseline concentrations. In addition, mercury concentrations tend to be higher in piscivorous fish as compared to smaller planktivorous or benthivorous fish.

Evidence to date suggests that elevated mercury concentrations (in water and fish) in reservoir ecosystems are temporary. Mercury levels in fish increase shortly after impoundment then decline as the reservoir ages (French et al. 1998). Generally, the time required for mercury concentrations to return to background conditions is less than 10 years in water; 10 to 20 years for non-piscivorous fish; and 20 to 30 years for piscivorous species (Bodaly et al. 1997; Brouard et al. 1990; Schetagne and Verdon 1999).

The results of a study conducted by Bodaly et al. (1993) indicate that the mean mercury concentrations in Northern Pike and Walleye (both piscivores), Cisco (a planktivore), and Yellow Perch (an omnivore) are inversely related to lake size. They observed no lake-size-related variation in the mercury concentrations in benthivorous fish (White Sucker and Lake Whitefish). They reported that fish mercury concentrations were unrelated to ratios of drainage basin area to lake size and to ratios of epilimnetic area to lake size.

Table 6.4-3: Literature Review of Mercury Concentrations in Reservoirs

Sample Type		Baseline Conditions	Flooded Reservoir	Reference	Time to Return to Baseline	Reference
Water		0.1 ng/L	1.4 ng/L (Year 1) to 2.2 ng/L (Year 3) and up to 2.3 ng/L	Kelly et al. 1995; Verta et al. 1994	5 to 12 years	Bodaly et al. 1997
Invertebrates		0.283 µg/g	0.691 µg/g	Surma-Aho et al. 1986	-	-
Fish	Planktivorous/ Benthivorous	0.06 to 0.14 µg/g ww	0.2 to 0.4 µg/g ww	Brouard et al. 1990	10 to 20 years	Bodaly et al. 1997
		-	0.11 to 0.52 µg/g	Schetagne and Verdon 1999	10 to 25 years	Schetagne and Verdon 1999
		-	-	-	7 years	Scruton et al. 1994
	Piscivorous	0.19 to 0.47 µg/g	0.7 to 2.6 µg/g ww	Brouard et al. 1990	10 to 23 years	Bodaly et al. 1997
		-	1.1 to 2.6 µg/g	Wakelin 2008	20 to 30 years	Schetagne and Verdon 1999
		-	0.60 to 3.33 µg/g	Schetagne and Verdon 1999	12 to 26 years or longer	Porvari and Verta 1995

ng/L = nanogram per litre; µg/g ww = microgram per gram wet weight; - = no data.

Conclusions

The literature review focused on studies of flooded reservoirs in northern environments; specific studies with culturally important fish for the study area were not available. A review of findings presented in the literature suggests that flooding associated with the Project has the potential to result in an increase in aqueous methylmercury production and an increase if fish tissue mercury concentrations.

Limited data exist that report on the mechanism for methylation and demethylation in sediments. Thus, there is currently no reliable means of predicting mercury methylation rates specific to a particular waterbody. Currently, the optimum approach for anticipating potential change is to draw on experience from other flooding situations, as provided in this literature review. These literature-based findings provide a range of rates of increase and time periods over which mercury levels change.

Flooding and impoundment phase is temporary for the Project. The diversion of Whale Tail Lake (South Basin) to the Lake A16 (Mammoth Lake) watershed is expected from July 2020 to May 2022 (Volume 6, Appendix 6-F). The drawdown period of Whale Tail Lake (South Basin) will start in May 2022 and all lakes previously affected will return to baseline elevations by November 2022 (Section 6.3.3.1.5.1). Based on these Project-specific conditions, it is expected that there would be some increase in methylmercury in water and fish tissue but that increases would not be as high as the literature references since data from the literature was based on permanent reservoirs (i.e. Bodaly et al 1997 considered 10 to 30 years post flooding) and not temporary reservoirs.

Based on the literature for permanent reservoirs, methylmercury concentrations could increase 10 to 20 times in water and two to nine times in fish, relative to baseline. Maximum baseline total mercury in water in Whale Tail Lake was less than the detection limit (i.e., <0.005 µg/L) (Volume 6, Appendix 6-G, Tables 2-1 and 2-2). Assuming a literature based increase (for permanently flooded reservoirs, which is a highly conservative assumption given

that the flooding will occur for two years), maximum total mercury could increase to a maximum of 0.05 to 0.1 µg/L which is above the aquatic life guideline (0.026 µg/L; CCME 1999) but below the drinking water quality guideline (1 µg/L; Health Canada 2014). Baseline total mercury in Lake Trout (not adjusted for size), in Whale Tail Lake, ranged from 0.077 to 2.19 µg/g ww, with an average of 0.49 µg/g ww (just below the guideline of 0.5 µg/g; CFIA 2014) (Volume 6, Appendix 6-K, Appendix C). Assuming a literature based increase (for permanently flooded reservoirs, which is a highly conservative assumption given that the flooding will occur for two years), maximum total mercury in Lake Trout could range from 4.4 to 19.7 µg/g ww, with an average ranging from 1.0 to 4.41 µg/g ww. It is assumed that any increases would be temporary.

Despite the short duration, flooding of the Whale Tail Lake (South Basin) has the potential to increase mercury concentrations in the flooded basin. Management of the flooding activities (including management of the amount of organic material present in the flooded basin) may decrease the effect of mercury mobilization. Monitoring of mercury in water and fish will be used to guide further management actions.

6.4.3.3 Effects of Project Footprint Development, Water Management, and Effluent Discharge

This pathway considers water management related Project activities in operations through post-closure that could disturb lakes and result in the accumulation of toxic substances both of which have been identified through consultation as Inuit concerns. This pathway provides an interpretation of the potential effects to downstream waterbodies from the management of water around the Whale Tail Pit and the release of effluent to Mammoth Lake.

6.4.3.3.1 Methods

Mine effluent will be discharged to Mammoth Lake via a diffuser. Water quality predictions for the Project (mine site and receiving environment) were developed with a GoldSim mass balance model for operations through post-closure. A summary of the predictions, and how they were used in the assessment are provided in this Section and Section 6.4.4, while the details of the model and generation of predictions are provided in Volume 6, Appendix 6-H.

Water quality predictions were developed for locations within the mine footprint (Whale Tail Attenuation Pond, flooded Whale Tail Pit, Whale Tail Lake [North Basin], and the WRSF Pond) and for the downstream receiving environment (Mammoth Lake, Lake A15, Lake A12, Downstream Node 1, and Downstream Node 2) (Table 6.4-4 and Figure 6.4-1).

The sensitivity of water quality to an added TSS load was evaluated outside of the GoldSim mass balance model. Concentrations of total metals were predicted for locations that discharge to the receiving environment (i.e., Whale Tail Attenuation Pond during operations, and Whale Tail WRSF and Whale Tail Lake [North Basin] during post-closure) based on an addition of 15 mg/L TSS; results of this sensitivity analysis are presented in Volume 6, Appendix 6-H. Given the uncertainties associated with the modelling exercise (i.e., the development stage of the Project, laboratory-based input values, assumptions where data do not exist and consideration of an average climate year), the predicted concentrations are considered to be order-of-magnitude estimates. The estimates are sensitive to the assumptions and design elements considered.

Y:\burnaby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Whale_Tail\99_PROJECTS\1541520_FEIS\02_PRODUCTION\FEIS\MXD\2200_Hydrology\Report\1541520_FIG_6_4_1_WATER_QUALITY_PREDICTION.mxd

597500 600000 602500 605000 607500

7260000 7257500 7255000 7252500

N

Downstream Node 2

Downstream Node 1

A5 A6 A8 A9 A10 A11 A12 A15 A16 Mammoth Lake A17 Whale Tail Lake (South Basin) A69 A76

Downstream Path 1

Downstream Path 2

A B C

NEMO FRESHWATER INTAKE

NORTHEAST POND

ORE STOCKPILE 1

ORE STOCKPILE 2

WATER TREATMENT PLANT

WHALE TAIL WASTE ROCK STORAGE FACILITY

WHALE TAIL ATTENUATION POND

WHALE TAIL PIT

WRSF POND

NORTH CHANNEL

MAMMOTH DIKE

ORE STOCKPILE 3

WHALE TAIL DIKE

WHALE TAIL DIVERSION CHANNEL

ELEVATION ZONE EL. 156m

LEGEND

- MINE SITE PREDICTION LOCATION
- RECEIVING ENVIRONMENT PREDICTION LOCATION
- FLOW PATH
- WATERCOURSE
- WATERSHED
- WATERBODY

REFERENCE

1. INFRASTRUCTURE OBTAINED FROM AGNICO EAGLE MINES LIMITED FROM 6108-600-210-002_R2(2019)s.dwg
2. WATERCOURSE AND WATERBODY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

750 0 750

METRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

WATER QUALITY PREDICTION MODELLING NODES

Golder Associates

PROJECT		1541520	FILE No.	
DESIGN	CP	28 Apr. 2016	SCALE AS SHOWN	REV. 0
GIS	CD/GI	02 Jun. 2016		
CHECK	JR	06 Jun. 2016		
REVIEW	LY	06 Jun. 2016		

FIGURE 6.4-1

Table 6.4-4: Water Quality Modelling Prediction Locations

Mine or Downstream	Prediction Location	Operations (Year 1 to Year 3; 2019 to 2021)	Closure (Year 4 to Year 10; 2022 to 2028)	Post-closure[d] (Year 11 and Year 21; 2029 and 2039)
Whale Tail Mine Site	Whale Tail Attenuation Pond[a]	Represents water pumped from WRSF, Whale Tail Pit sump, runoff from the catchment. Water is treated and then discharge to Mammoth Lake	-[b]	-
	Flooded Whale Tail Pit	-	No inflows, no exchanges with overlying Whale Tail Lake (North Basin) Flooding of pit	No inflows, no exchanges with overlying Whale Tail Lake (North Basin) Fully mixed conditions
	Whale Tail Lake (North Basin)	-	Represents runoff and inflow from watersheds to north, northeast, east of pit, and flooded Attenuation Pond. Modelled separately from the flooded Whale Tail Pit and assumes pit lake does not mix with Whale Tail Lake (North Basin)	After dike breach, mixes with Whale Tail Lake (South Basin) to become Whale Tail Lake, and is discharged to Mammoth Lake through dike breach; assumed to not mix with the flooded Whale Tail Pit
	WRSF Pond[c]	Represents WRSF contact runoff Water pumped to Attenuation Pond	Complete cover of WRSF Represents WRSF contact runoff Water pumped to Attenuation Pond Whale Tail Lake (North Basin)	Represents WRSF contact runoff Discharge to Mammoth Lake
Downstream Receiving Environment	Mammoth Lake (Lake A16)	Receives pumped (treated) flows from the attenuation pond mixed with background water quality	Receives natural flow from surrounding watershed	Receives natural flow from Whale Tail Lake and runoff from WRSF
	Lake A15	Receives flow from Mammoth Lake	Receives flow from Mammoth Lake	Receives flow from Mammoth Lake
	Lake A12	Receives flow from Lake A15	Receives flow from Lake A15	Receives flow from Lake A15
	Downstream Node 1	Receives flow from Lake A12 via downstream path 1	Receives flow from Lake A12 via downstream path 1	Receives flow from Lake A12 via downstream path 1
	Downstream Node 2	Receives flow from Lake A12 via downstream path 2	Receives flow from Lake A12 via downstream path 2	Receives flow from Lake A12 via downstream path 2

[a] Treated effluent from the Whale Tail Attenuation Pond; effluent will be discharged from the pond to Mammoth Lake during operations.

[b] Starting in closure, the Whale Tail Attenuation Pond is modelled as Whale Tail Lake (North Basin).

[c] During operations, water from the WRSF Pond is pumped to the Whale Tail Attenuation Pond; during closure, water from the WRSF Pond is treated and pumped to Whale Tail Lake (North Basin); during post-closure, water from the WRSF Pond is directed to Mammoth Lake.

[d] For post-closure, results are summarized for early post-closure (i.e., Year 11) and late post-closure (i.e., Year 21).

WRSF = waste rock storage facility; WTP = water treatment plant.

Water quality predictions were generated for the operational, closure, and post-closure phases for groups of constituents including major ions, nutrients, and metals. The predictions were compared to various standards; for purposes of this assessment, the standards included the following:

- Portage effluent limits (Part F, Item 3 for Portage Effluent; NWB 2015);
  - Used to evaluate the Attenuation Pond predictions.
- Site-specific water quality objective developed for the Project (Volume 6, Appendix 6-N), protection of aquatic life guidelines (CCME 1999), and protection of drinking water quality guidelines (Health Canada 2014);
  - Used to evaluate predictions at all locations.
- Triggers and thresholds developed for the Meadowbank CREMP (Azimuth 2015);
  - Used to evaluate predictions at the downstream locations.
- Baseline concentrations (Volume 6, Appendix 6-G);
  - Used to evaluate predictions at the downstream locations and the post-closure predictions for flooded Whale Tail pit, Whale Tail Lake (North Basin), and the WRSF pond.

Prediction results are summarized as average and maximum concentrations representing each phase as follows: operations (2019 to 2021), closure (2022 to 2028), early post-closure (2029), and late post-closure (2039). The average and maximum concentrations as compared to the standards are in Appendix 6-I with results discussed in Section 6.4.3.3.2.

The water quality predictions were compared to various combinations of these standards to identify constituents of potential concern (COPCs) for the water quality assessment. The screening process to identify COPCs was as follows:

- Whale Tail Attenuation Pond (operations only):
  - If average and/or maximum concentrations in the effluent are more than the Portage effluent limits (NWB 2015), the constituent is retained as a COPC for further evaluation.
  - If average and/or maximum concentrations in the effluent are less than the Portage effluent limits (NWB 2015) but more than aquatic life (CCME 1999) and drinking water quality (Health Canada 2014) guidelines, the constituent is retained as a COPC for further evaluation.
  - If average and/or maximum concentrations in the effluent are less than Portage effluent limits (NWB 2015) and less than aquatic life (CCME 1999) and drinking water quality (Health Canada 2014) guidelines, the constituent is not retained as a COPC and no further evaluation further action is required.
- Site Ponds (post-closure only) and Downstream Receiving Environment (all phases)
  - If average and/or maximum concentrations are more than aquatic life (CCME 1999) and drinking water quality (Health Canada 2014) guidelines, the constituent is retained as a COPC and may be carried forward into an aquatic health risk assessment [Volume 3, Appendix 3-B]).

- If average and maximum concentrations are less than aquatic life (CCME 1999) or drinking water quality (Health Canada 2014) guidelines, no further action is required.

The Portage effluent limits (NWB 2015) were the main criterion to determine if the predicted water quality in the Attenuation Pond was suitable for discharge. Agnico Eagle is applying to the NWB to treat effluent discharges to the receiving environment to levels stipulated in Meadowbank Type A Water Licence Type 2AM-MEA1525 (NWB 2015) Part F, Item 3 for Portage Effluent. In the model, concentration limits were imposed on parameters that exceeded the Portage Effluent limits (NWB 2015). The second step of comparison of the Whale Tail Attenuation Pond water quality to aquatic life (CCME 1999) and drinking water quality (Health Canada 2014) guidelines was to identify potential COPCs in the downstream environment. Aquatic life and drinking water quality guidelines were the main criterion to determine COPCs in the post-closure site water and in the downstream receiving environment because water quality guidelines are designed to provide a high level of protection to aquatic life, or human health. Thus constituents at or less than guidelines can be excluded as no impacts to aquatic life, or human health, are anticipated. Predictions for the downstream receiving environment were developed for the dissolved constituents but guidelines for the total constituent were applied. Water quality predictions were also compared to Meadowbank triggers and thresholds (Azimuth 2015), but these were not used to define COPCs. Finally, water quality predictions were also compared to baseline conditions to evaluate the amount of potential change. If a constituent has an aquatic life or drinking water guideline, the guideline was the main driver in the identification of COPCs because a change from background alone is not enough to identify a COPC. For constituents without guidelines, the comparison to baseline conditions was included in the screening but the screening was applied with limitations because if the constituent does not have a guideline, there is no scientific evidence to suggest that the constituent (at any concentration) could have a negative effect.

6.4.3.3.2 Results

This sections provides a summary of the water quality predictions for the site and downstream receiving environment. A summary of the water quality predictions (average and maximum), for each prediction location is provided in Appendix 6-I.

6.4.3.3.2.1 Site Water Quality

Site water quality predictions were developed for operations (Whale Tail Attenuation Pond) and post-closure (flooded Whale Tail Pit, Whale Tail Lake [North Basin], and WRSF Pond). This section provides a review of predictions and discharges that could influence the downstream receiving environment.

Predicted water quality concentrations produced for the Whale Tail Attenuation Pond during operations includes input from the WRSF. Water quality in the Whale Tail Attenuation Pond is predicted to be below the Portage Effluent limits for all parameters (Appendix 6-I, Table 6-I-1). The only COPCs identified for the Attenuation Pond were for those constituents with predicted average and maximum concentrations above the aquatic life and/or drinking water quality guidelines. These COPCs included fluoride, nitrate, phosphorus, aluminum, antimony, cadmium, chromium, copper, iron, lead, mercury, nickel, and selenium. These constituents were carried forward into the evaluation of the downstream water quality predictions for the operations phase.

Predictions are not discussed for the site water management ponds at post-closure as no water will be released to downstream environment during this phase.

Water quality predictions were produced for the flooded Whale Tail Pit, Whale Tail Lake (North Basin), and the WRSF Pond for the post-closure (early and late) phase. Once the pit and Whale Tail Lake (North Basin) are

flooded, the elevation of the top of the flooded Whale Tail Pit will be 138.2 m (i.e., the bottom of Whale Tail Lake [North Basin]) and the elevation of the top of Whale Tail Lake (North Basin) will be 152.5 m; it is assumed that water in the pit will not mix with water in Whale Tail Lake (North Basin) (Volume 6, Appendix 6-H).

During the post-closure phase, it is assumed that there will be no discharge of pit water to the receiving environment; however, the predicted pit water quality was still compared to the screening criteria. The COPC identified for the flooded Whale Tail Pit was dissolved phosphorus (Volume 6, Appendix 6-I, Table 6-I-2). In the flooded Whale Tail Pit, post-closure (early and late), average and maximum concentrations of dissolved phosphorus are predicted to be above the mesotrophic trigger.

Once water quality in Whale Tail Lake (North Basin) meets discharge criteria, the dikes will be breached and the North and South basins of Whale Tail Lake will be joined, and water will be allowed to flow downstream to Mammoth Lake.

Predicted water quality for Whale Tail Lake (North Basin) was compared to the arsenic site-specific water quality objective, aquatic life and drinking water guidelines, Meadowbank CREMP triggers and thresholds, and baseline water quality in Whale Tail Lake. The COPCs identified for Whale Tail Lake (North Basin) include dissolved phosphorus, aluminum, chromium, and iron (Volume 6, Appendix 6-I, Table 6-I-3). Concentrations of other constituents (e.g., major ions, nitrate, and metals such as antimony, cadmium, copper, and selenium) are predicted to be higher than baseline concentrations recorded in Whale Tail Lake, but at concentrations less than the guidelines, where guidelines are available. Concentrations are predicted to decrease through the post-closure phase.

Predicted post-closure water quality for the WRSF Pond was compared to the site-specific water quality objective, aquatic life, and drinking water guidelines. The COPCs for the WRSF Pond included those constituent predicted to exceed aquatic life and/or drinking water quality guidelines and were fluoride, phosphorus, aluminum, antimony, cadmium, chromium, copper, iron, lead, mercury, molybdenum, nickel, selenium, uranium, and zinc (Volume 6, Appendix 6-I, Table 6-I-4).

In post-closure, once the dikes are breached, water from Whale Tail Lake (North Basin), and water from the WRSF Pond will flow into Mammoth Lake. These combined loads contribute to the predicted water quality in Mammoth Lake during the post-closure phase.

6.4.3.3.2.2 Downstream Receiving Environment

For the downstream receiving environment, water quality predictions were produced for the operations, closure, and post-closure (early and late) phases for Mammoth Lake, Lake A15, and Lake A12 and two Downstream Nodes (1 and 2). Lakes that have been identified as culturally important (e.g., Innugugayualik and Pipedream lakes; Section 6.4.1.1; Volume 7, Appendix 7-A) will not be affected by water discharged from the Whale Tail Pit area. Average and maximum concentrations for each phase are provided in Appendix 6-I. Predicted water quality for the downstream environment was compared to aquatic life and drinking water guidelines, Meadowbank CREMP triggers and thresholds, and baseline water quality. As noted above, COPCs were not identified if the constituent only exceeded the Meadowbank triggers and thresholds as it has yet to be determined if these triggers and thresholds are applicable to the Project. This screening was included for information purposes only.

For operations, the COPCs carried forward from the Whale Tail Attenuation Pond include fluoride, nitrate, phosphorus, aluminum, antimony, cadmium, chromium, copper, iron, lead, mercury, nickel, and selenium.

Site water quality was not predicted for the closure phase, so the COPCs from the operations phase (i.e., fluoride, nitrate, phosphorus, aluminum, antimony, cadmium, chromium, copper, iron, lead, mercury, nickel, and selenium) were carried forward.

For post-closure, the COPCs carried forward from Whale Tail Lake include dissolved phosphorus, aluminum, chromium, and iron, and the COPCs carried forward from the WRSF Pond include fluoride, phosphorus, aluminum, antimony, cadmium, chromium, copper, iron, lead, mercury, molybdenum, nickel, selenium, uranium, and zinc.

Of the COPCs identified from the site water quality predictions for the operations to post-closure phases, and those identified as COPCs in Mammoth Lake, the COPCs retained for Mammoth Lake include dissolved phosphorus (concentrations predicted to be above the meso-eutrophic trigger [more than 35 µg/L]) (Volume 6, Appendix 6-I, Table 6-I-5). Phosphorus is predicted to decrease after closure and by late post-closure, return to concentrations similar to background levels, with the average and maximum concentration just above the ultra-oligotrophic trigger level (4 µg/L). Other constituents are predicted to change from baseline conditions, but concentrations are not predicted to exceed guidelines.

Dissolved phosphorus is also COPCs for Lake A15 with a similar pattern of highest concentrations in operations to closure and decreased concentrations through post-closure (Volume 6, Appendix 6-I, Table 6-I-6). Average dissolved phosphorus is predicted to exceed the meso-eutrophic trigger in operations, decrease to the meso-eutrophic level in closure, and continue decreasing through the post-closure phase with average and maximum just above the ultra-oligotrophic trigger level. Concentrations of other constituents are predicted to change through the phases, but with concentrations lower than the guidelines.

This same pattern continues for Lake A12 with dissolved phosphorus as the only COPC (Volume 6, Appendix 6-I, Table 6-I-7). Average concentrations are predicted to be highest in operations and closure and decrease through post-closure. The values predicted for Lake A12 are lower than those predicted for Lake A15 which are lower than those predicted for Mammoth Lake.

As illustrated on Figure 6.4-1, the water flow path downstream of Lake A12 splits. There are two outlets in Lake A12 and Lake A76. The main outlet of Lake A12 is to Lake A11 (northeast) with a secondary outlet to Lake A77 (northwest); the main outlet of Lake A76 is to Lake A10 (northeast) with a secondary outlet to Lake A75 (west) (Volume 6, Appendix 6-C). Downstream Node 1 receives water from Lake A76 via the secondary drainage pathway. Downstream Node 2 receives water from the main drainage pathways of Lake A12 and Lake A76.

For Downstream Node 1, dissolved phosphorus was identified as a COPC for operations and closure, but only for maximum concentrations which were predicted to be higher than the ultra-oligotrophic trigger level (Volume 6, Appendix 6-I, Table 6-I-8). Average concentrations of dissolved phosphorus in operations and closure, and average and maximum concentrations in post-closure, were predicted to be lower than the ultra-oligotrophic trigger level.

The COPC identified for Downstream Node 2 was dissolved phosphorus (Volume 6, Appendix 6-I, Table 6-I-9). Phosphorus was predicted to be within the mesotrophic range for operations, decreasing to the oligotrophic range for closure and early post-closure, and within the ultra-oligotrophic range by late post-closure.

Water flows from Downstream Nodes 1 and 2 into the larger lake DS1 where it is anticipated that these loads will have a negligible effect on nutrient concentrations in a large lake.

6.4.3.3.2.3 Summary

The COPCs identified for each location and mining phase modelled are summarized in Table 6.4-5.

These constituents were modelled in the downstream receiving environment and compared to aquatic life and drinking water guidelines to identify COPCs. At all prediction locations in the receiving environment, dissolved phosphorus was the only identified COPC. A conceptualized figure to illustrate the spatial and temporal changes in dissolved phosphorus in the site and downstream prediction locations was developed. The figure illustrates average concentrations at each assessment location across the mining phases. The summary tables (Volume 6, Appendix 6-I, Tables 6-I-1 to 6-I-9) highlighted the average and maximum predicted values for each phase with notation to indicate if the predicted value was higher than the comparison standard.

Table 6.4-5: Summary of Constituents of Potential Concern by Mining Phase and Location

Mining Phase	Operations (Year 1 to 3)	Closure (Year 4 to 10)	Post-closure (Year 11)	Post-closure (Year 21)
Attenuation Pond	Fluoride, nitrate, phosphorus, aluminum, antimony, cadmium, chromium, copper, iron, lead, mercury, nickel, and selenium	[a]	[a]	[a]
Flooded Whale Tail Pit	[a]	[a]	Dissolved phosphorus	Dissolved phosphorus
Whale Tail Lake (North Basin)	[a]	[a]	Phosphorus, aluminum, chromium, and iron	Phosphorus, aluminum, chromium, and iron
WRSF Pond	[a]	[a]	Total dissolved solids[b], flouride, phosphorus, aluminum, antimony, cadmium, chromium, copper, iron, lead, mercury, molybdenum, nickel, selenium, uranium, zinc	Total dissolved solids[b], flouride, phosphorus, aluminum, antimony, cadmium, chromium, copper, iron, lead, mercury, molybdenum, nickel, selenium, uranium, zinc
Mammoth Lake (Lake A16)	Dissolved phosphorus	Dissolved phosphorus	Dissolved phosphorus	Dissolved phosphorus
Lake A15	Dissolved phosphorus	Dissolved phosphorus	Dissolved phosphorus	Dissolved phosphorus
Lake A12	Dissolved phosphorus	Dissolved phosphorus	Dissolved phosphorus	Dissolved phosphorus
Downstream Node 1	Dissolved phosphorus	Dissolved phosphorus	-	-
Downstream Node 2	Dissolved phosphorus	Dissolved phosphorus	Dissolved phosphorus	-

Note: Constituents listed exceed CCME guideline for the protection of aquatic life (CCME 1999). Constituents listed and underlined exceed of Health Canada guideline for the protection of drinking water (Health Canada 2014).

[a] No predictions.

[b] Total dissolved solids above the Portage effluent limits.

WRSF = waste rock storage facility; CCME = Canadian Council of Ministers of the Environment; - = no constituents of potential concern.

As discussed in Section 6.4.3.3.2.2, dissolved phosphorus was compared to the CCME (2004) triggers developed for total phosphorus. As illustrated on Figure 6.4-2, average dissolved phosphorus is predicted to be higher than the meso-eutrophic trigger value in Mammoth Lake, Lake A15, and Lake A12 in operations. Concentrations are predicted to decrease through closure with average values in the mesotrophic range and down to the oligotrophic by late closure. It is predicted there could be a small pulse in early post-closure but that concentrations will continue to decrease through the post-closure phase with average concentrations returning to similar to baseline conditions.

Dissolved phosphorus concentrations follow a similar pattern at Downstream Nodes 1 and 2, but with average concentrations at Downstream Node 2 within the oligotrophic range in early closure and early post-closure, and average concentrations at Downstream Node 1 always within the ultra-oligotrophic range.

These modelling results suggest there will be temporal and spatial variability of phosphorus concentrations within the local and regional study areas due to the Project with potential changes from an unproductive to a productive system at least in Mammoth Lake and lakes A15 and A12. Change to water quality can cause a change to sediment quality. An increase in aqueous phosphorus can lead to an increase in biological productivity and subsequently, through decomposition of organic material, an increase in sediment bound phosphorus. Based on these predictions there is the potential for an effect to aquatic health and traditional and non-traditional use. The changes are predicted to be reversible, and the predictions were based on conservative assumptions.

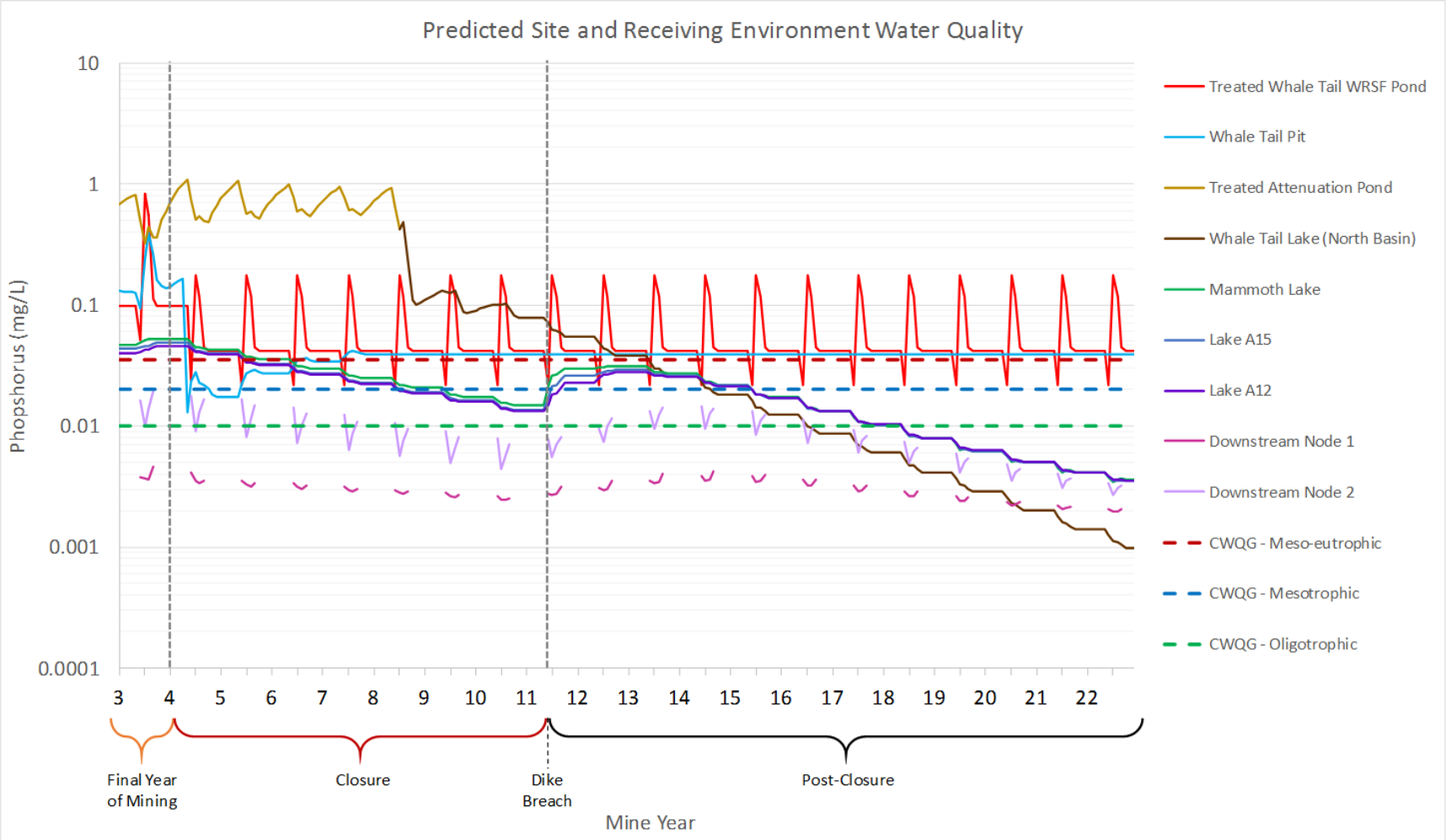


Figure 6.4-2: Predicted Total Dissolved Phosphorus Concentration by Mining Phase and Downstream Path

6.4.4 Residual Impact Classification

6.4.4.1 Methods

The impacts that remain following mitigation, or residual impacts to the measurement indicators, for the assessment endpoint of the VC were classified using criteria to determine the overall effect, termed the environmental consequence (i.e., significant or not significant). For water quality, the measurement endpoint was concentration of a particular constituent, but the assessment endpoint was protection of surface water quality for aquatic and terrestrial ecosystems, and human use (Section 6.1.2). Measurement endpoints are quantifiable, while assessment endpoints are properties of the valued component that should be protected for use by future human generations or to support an aquatic ecosystem.

The purpose of the residual effect classification is to describe the residual effects from the Project on water quality using a scale of common words, rather than numbers or units. The seven criteria used include direction, magnitude, geographic extent, duration, reversibility, frequency, and likelihood. These criteria as they apply to water quality are defined in Volume 3, Appendix 3-E.

Results from the residual impact classification for water quality, plus results from the fish and fish habitat assessment (Section 6.5), the human health and ecological risk assessment (Volume 3, Appendix 3-B), and the traditional land use/IQ assessment (Volume 7, Section 7.3) were used to determine the environmental significance of the Project and other developments on the assessment endpoint of water quality (i.e., protection of surface water quality for other users). The evaluation of significance for water quality considered the entire set of pathways that influence the opportunity for traditional and non-traditional use of fish, species health, and the continued opportunity for use of surface water for traditional and non-traditional uses. Changes in concentration of water quality constituents relative to aquatic life and water quality guidelines does not provide the full context to evaluate the standalone significance of change. Thus, changes to water quality were evaluated in the framework of how changes could affect the end receptors (i.e., aquatic life, and traditional and non-traditional uses of water).

The key drivers to determining significance are magnitude, duration, and geographic extent. Other criteria, such as the conservative nature of the predictions were also considered when determining significance.

The evaluation of significance for water quality considers the entire set of primary pathways (Table 6.4-2) that influence the assessment endpoint. Thus, the relative contribution of each pathway is used to determine the significance of the Project on water quality; the pathways are not rated for significance in isolation.

The outcome is either a rating of Not Significant or Significant which, for purpose of this assessment, are defined as follows:

- Not Significant – impacts are measureable but are not likely to increase the risk to aquatic health, and traditional and non-traditional use. Impacts occur at the local scale and may extend to the regional scale. Impacts are reversible within the timeline of the Project.
- Significant – impacts are measureable (i.e., high magnitude) with likely effects to aquatic health, and traditional and non-traditional use. Effects may not be reversible within the timeline of the Project.

6.4.4.2 Results

Through evaluation and classification of the residual impacts of the three primary pathways on water quality, a single classification of significance of the Project on water quality was developed. As the pathways and Project activities overlap, and cumulatively contribute to potential changes in water quality, a classification that encompasses all pathways and activities is appropriate. Based on the predicted magnitude rating, which incorporates water quality, and effects to end users (i.e., fish and people) , duration of effect, and geographic extent, the Project is not expected to have a significant effect on water quality, aquatic health, and traditional and non-traditional use (Table 6.4-6).

Air Emissions

Project related air emissions have the potential to affect local terrestrial and aquatic ecosystems. The Inuit are concerned about the effects of dust from the Project and how it can change the colour and quality of water as a drinking source and to support the aquatic ecosystem. To address this concern, the potential effects of dust and air emissions deposition were evaluated. Generation of dust and air emissions are linked to Project activities such as operation of diesel powered equipment, blasting, and transportation along the haul roads. The duration of these effects are predicted to be short to medium-term in length, primarily restricted to operations, with some pathways in construction and closure. As based on monitoring data from other Northern mines including Meadowbank Mine operations to date, the spatial extent of dust deposition is expected to be local, and measureable changes in water quality from deposition of dust and acidifying air emissions is expected to be low. Based on the results of the air quality predictions for the Project, the use of mitigation such as low-sulfur diesel fuel, the effects of deposition of dust and acidifying air emissions is predicted to have a negligible effect on water quality, and thus a negligible effect on aquatic ecosystems and traditional and non-traditional uses.

Flooding

The planned diversion of Whale Tail Lake (South Basin) to the Mammoth Lake watershed will increase the surface water elevation of Whale Tail Lake (South Basin), resulting in flooding of tributary lakes and the potential for erosion along new shorelines, with mobilization of TSS, and increased concentrations of mercury in the water and biota, from decomposition of newly flooded vegetation. The Project activities related to water diversion and flooding have the potential to disturb lakes and result in the accumulation of toxic substances. The literature evidence suggests that the amount of organic matter in a flooded reservoir can influence the amount of mercury and methylmercury that is liberated to the water column. Given the short duration of flooding, collection of water and biota samples for mercury analysis can be used to inform the effects of flooding.

The effects of flooding on mercury cycling will be limited to the period of time when Whale Tail Lake (South Basin) is flooding. Based on the Project schedule, Whale Tail Lake (South Basin) will flood and reach maximum elevation by approximately July 2020 and it will stay in the maximum elevation stage until approximately May 2022. The drawdown period will last from about May to November 2022 at which time the lakes will return to baseline elevation. Based on the literature, mercury concentrations in water and biota can start to increase one to two years after flooding; the time to return to baseline conditions is unknown, but it is assumed that the time will be less than the time observed in naturally flooded reservoirs since the flooded state will be temporary. Based on these assumptions, the duration of effects was rated as medium-term and the geographical extent of effects was considered local because effects will be limited to Whale Tail Lake. The potential magnitude of the effect was rated as moderate because some parameters may increase above guidelines, but not to a level that could affect the sustainability of the ecosystem or the continued traditional and non-traditional uses.

Effluent Discharge

Management of water in the Whale Tail Pit area and the discharge of effluent to the downstream environment has the potential to change water quality through disturbance of lakes and release of toxic substances. There is the potential to change Mammoth Lake and the downstream receiving environment from the Project activities related to this pathway. Lakes that have been identified as culturally important (e.g., Innugugayualik and Pipedream lakes; Section 6.4.1.1; Volume 7, Appendix 7-A) will not be affected by this pathway.

Management of water on site (e.g., reuse of water, separation of contact and non-contact water, treatment if required) will be necessary to manage and minimize downstream effects. Discharge of effluent will be limited to the operations phase, but the potential effects may extend through to early post-closure. It is predicted that there will be a change in downstream water quality due to the Project but that changes will be limited to one constituent: phosphorus. The predictions are conservative but suggest there could be large increases in phosphorus in the downstream lakes which could change productivity.

The duration of the effect was rated as long-term but not permanent because the model predicts a return to baseline conditions in post-closure. The geographic extent was rated as regional as there is the potential for changes in nutrients as far as Downstream Node 2. Finally, the magnitude was rated as moderate to high because there is a high degree of conservatism in the predictions, increased phosphorus could affect sustainability of the ecosystem, in a select system of lakes, but may not affect aquatic health.

Summary

The determination of significance considers all the primary pathways that may affect water quality and the assessment endpoint (protection of surface water quality for aquatic and terrestrial ecosystems and human use). The assessment endpoint considers effects to aquatic health and continued use for traditional and non-traditional use. As identified through IQ, water and health aquatic ecosystems are important, and larger regional lakes such as Innugugayualik, and Pipedream lakes are used for fishing, but lakes near the Whale Tail Pit study area are not commonly fished. This means that lakes such as Whale Tail and Mammoth may have importance from a general healthy ecosystem perspective but not as high importance as those that are used for fish or waterfowl harvesting.

Based on the ratings assigned for duration, geographic extent, and magnitude for the three primary pathways, and the potential effects to the assessment endpoint, which includes a healthy ecosystem and continued traditional use, it was concluded that the Project will not have a significant effect to water quality.

Table 6.4-6: Residual Impact Classification and Determination of Significance on Surface Water Quality

Effects Statement	Direction	Magnitude[a]	Geographic Extent	Duration[b]	Frequency	Reversibility	Likelihood	Significance for Assessment Endpoint
Effects of acidifying air emissions and the deposition of dust and metals from air emissions to waterbodies	Negative	Low	Local	Short-term to Medium-term	Isolated	Reversible	Possible	Not Significant
Effects of water management and flooding	Negative	Moderate	Local	Medium-term	Continuous	Reversible	Possible	
Effects of Project footprint development, water management, and effluent discharge	Negative	Moderate to High	Regional	Long-term	Continuous	Reversible	Likely	

[a] Takes into account variability in water quality, conservative nature of generic guidelines, and interpretations from aquatic health.

[b] Takes into account scientific information and expert opinion, and resiliency of an ecosystem to recover after a disturbance.

6.4.5 Cumulative Effects Assessment

The Project is anticipated to have negligible effects on water quality outside of the LSA. The database of reasonably foreseeable future developments (Volume 3, Appendix 3-D) indicates that there are no planned development in the RSA, and the cumulative effect is expected to be negligible.

6.4.6 Uncertainty

Uncertainty with respect to the water quality assessment is related to data used in the models, and conservatism applied within the water balance and water quality models developed for the Project.

- Baseline data
  - Baseline water quality data were used to characterize existing conditions in the study area and to calibrate the water quality model.
  - Field data collection programs were initiated, and completed prior to the water balance and water quality models being developed. Thus programs were guided based on anticipated data needs for the model. Professional judgement based on northern gold mining experience was used to fill data gaps.
- Water Quality Model Limitations
  - The prediction of water quality is based on inputs such as mine site water flows (Volume 8, Appendix 8-B.2), geochemical characterization (Volume 5, Appendix 5-E), and baseline water quality (Volume 6, Appendix 6-G) all of which have their own sets of variability and uncertainty.
  - The water quality model predictions reflect this variability and uncertainty and the results are considered appropriate for the impact assessment.
  - Best practices and professional judgement were used to make interpretations about the predictions.
  - As per NWB Type A Water Licence Part E Item 7 and 8 requirements, a site wide water balance will be updated as part of the annual water management plan and end pit water quality modelling will be conducted to update these predictions.
  - Further limitations related to the water quality predictions are provided in Volume 6, Appendix 6-H.

6.4.7 Monitoring and Follow-up

Water quality monitoring during all phases of the Project will be conducted to validate the water quality predictions and assessment conclusions. Water quality monitoring will be conducted within the Mine site and the downstream receiving environment through a variety of monitoring plans. More details are provided in the individual plans, but those applicable to water quality include the following:

- Dike Construction and Monitoring Plan (Volume 8, Section 8.3.1 and Appendix 8-A.2)
  - The Water Quality Monitoring and Management Plan for Dike Construction and Dewatering was developed in accordance with the Type A Water Licence for the Meadowbank Gold Project (Water Licence 2AM-MEA0815 Part D, Item 11.).

- The Plan provides details of water quality monitoring and management actions specifically related to the dike construction and dewatering activities at the Meadowbank Mine which will be applied at the Whale Tail Pit area.

- Water Quality and Flow Monitoring Plan (Volume 8, Section 8.3.2, and Appendix 8-B.3)
  - As part of the Type A Water Licence renewal application (specified under Part I, Item 2 of the license), the Meadowbank Water Quality and Flow Monitoring Plan, has been revised.
  - The Water Quality and Flow Monitoring Plan summarizes the monitoring locations, sampling frequency, monitored parameters, compliance discharge criteria and an adaptive management plan for water quality at the Meadowbank Gold Project, with updates to include monitoring in the Whale Tail Pit area.
- Water Management Plan (Volume 8, Appendix 8-B.2)
  - The purpose of the Water Management Plan is to provide consolidated information on water management, required water management infrastructure, water balance, water quality predictions, and water quality monitoring.
  - The Water Management Plan was developed in support of the Type A Water Licence Application for the Project.
  - As per NWB Type A Water Licence Part E Item 7 requirements, a site wide water balance will be updated as part of the annual water management plan.
- Core Receiving Environment Monitoring Plan (Volume 8, Appendix 8-E.2)
  - The Core Receiving Environment Monitoring Plan was developed in accordance with the renewed Type A Water Licence to monitor mining-related processes that could potentially impact the aquatic receiving environment surrounding the Project.
  - The Plan includes routine and pit flood monitoring for the Meadowbank Gold Project.
  - The Plan was amended to include monitoring in the Whale Tail Pit area.

6.5 Fish and Fish Habitat

6.5.1 Incorporation of Inuit Qaujimajatuqangit

Available IQ was included throughout the environmental assessment of fish, beginning with the identification of the valued component fish species, such as Lake Trout and Arctic Char, which are the preferred fish species harvested for food that occur in several of the lakes located in the Project Area. Round Whitefish, and Arctic Grayling are also harvested (Volume 7, Appendix 7-A). Fish provide an important secondary source of food after caribou to the residents of Baker Lake, and fishing is a year round activity that occurs throughout the area. During the famine times when caribou were scarcely available, some families were completely dependent on fish for sustenance (Mannik 1998). The IQ Baseline Report was considered when evaluating the project effects for the impact assessment (Volume 7, Appendix 7-A).

6.5.1.1 Baseline

Baseline information was collected using western scientific methods (Section 6.5.2) and information provided through consultations and engagement with Inuit Elders and local community members. Traditional IQ on local fish populations, abundance, behavior, and life histories were collected, where available, and incorporated into the baseline reports (Volume 7, Appendix 7-A). A Local Inuit Field Assistant accompanied field crews on some of the baseline collection surveys for the Project in summer of 2015, providing supplemental IQ field data that were integrated into the baseline report and considered in the VC selection as described in Section 6.1.2. Inuit Qaujimajatuqangit was used in conjunction with western data to characterize fish populations in lakes and streams in the RSA. Inuit Qaujimajatuqangit was also used to better understand the fish populations and habitat in the assessment areas to predict the impacts to lakes and streams as a result of the Project.

6.5.1.2 Environmental Assessment

Inuit Qaujimajatuqangit was also considered in the identification and classification of pathways (Volume 3; Section 3.4), for example, any concerns related to mining development were captured within an appropriate pathway, and then analyzed as no linkage, secondary, or primary. Key concerns related to fish and fish habitat are summarized in Section 6.5.3.

6.5.1.3 Mitigation and Monitoring

Through the pathway analysis, IQ informed mitigation related to any potential effects on fish and fish habitat for the Project (Volume 3; Appendix 3-C). For example, the Spill Contingency Plan (Volume 8, Appendix 8-D.6) will be implemented to prevent effects from emergency spills, a key concern for local Inuit, and the Water Management Plan (Volume 8, Appendix 8-B.2) will address Inuit concerns related to decreased downstream flows and dewatering. Losses to fish and fish habitat from dewatering, diversions, and flooding will also be managed.

6.5.2 Existing Environment and Baseline Information

The overall objective of the baseline studies was to collect data in sufficient detail to describe fish and fish habitat in lakes and streams near the proposed Project for the environmental assessment.

Standard methods for fisheries inventories and lower trophic communities were deployed in the streams and lakes sampled in the RSA (Volume 6, Appendix 6-D; Appendix 6-J; Appendix 6-K). Fishing efforts were also recorded with catch data to calculate catch-per-unit effort per study site. Results were summarized in Section 6.5.2 (with additional details provided in Volume 6, Appendix 6-L).

Fish and fish habitat baseline studies were completed in 2014 and 2015 in the RSA including the areas in close proximity to the proposed haul road (formerly called Amaruq Exploration Access Road) (Volume 6, Appendix 6-D; Appendix 6-J) and Whale Tail Pit (Volume 6, Appendix 6-K). Lower trophic community (phytoplankton, zooplankton, benthic invertebrates, and periphyton) baseline studies were completed in close proximity to the Whale Tail Pit (Volume 6, Appendix 6-G; Appendix 6-K).

Based on IQ, Baker Lake Elders have noted that fishing occurs in both lakes and rivers, depending on the season and the availability of fish (Agnico Eagle 2014b). Good fishing sites are located to the east of the footprint, including at Nutipilik Lake, Qugiilik Lake and Tahinajuk Lake (Figure 6.1-3). Elders noted that although trout are found throughout the region, the lakes near Whale Tail Pit are not commonly fished as there are other preferred lakes. Several lakes were also identified as areas used in the past for fishing, including Hiatuuq Lake, Kivgajulik Lake, Haninajuq Lake, Uiguklik Lake, and Tasirjuaraajuk Lake (Pipedream Lake) (Volume 7, Appendix 7-A) (Figure 6.1-3). Several Elders noted that they or other community members used the area along the proposed haul road for fishing with their families when they were younger. Youth stated that fishing occurs throughout the year, in open water and in ice, and sometimes using nets (Volume 7, Appendix 7-A).

Elders noted that Arctic Char run from the middle to the end of August, and spawn later in October after the ice forms. Historically, the Elders noted that there were many fish in the area between the Meadowbank River and the Meadowbank Mine (Volume 7, Appendix 7-A), knowledge reinforced by the following story a land user heard when he was younger about a lake in the Project area: “even a blind man could catch fish by scooping them out of the lake, because there were so many fish”. Whitefish (spp.) were observed to migrate up the river after trout had finished migrating, and the presence of small birds around camp was an indication that the whitefish would be coming soon (Mannik 1998). Burbot and Northern Pike were also observed near the community, and lamprey was potentially found in Baker Lake (Agnico Eagle 2014b).

6.5.2.1 Haul Road

6.5.2.1.1 Methods

General methods deployed during the 2014 and 2015 baseline studies were consolidated in the baseline summary, additional details can be found in the Amaruq Exploration Access Road Baseline Reports (Volume 6, Appendix 6-D; Appendix 6-J). Baseline data collection in August and September 2014 was completed at watercourses intersected by an initial alignment (Volume 6, Appendix 6-J). In 2015, the haul road alignment was modified to avoid 13 lakes and ponds (Figure 6.5-1). Six of the 2014 watercourse crossing locations that were assessed for fish and fish habitat were reassessed in 2015 (Volume 6, Appendix 6-D). All of the watercourses sampled for fish are in the Meadowbank River drainage basin, with the exception of the km 3.4 crossing, which is in the Quoich basin.

In both 2014 and 2015, fish and fish habitat surveys were completed at watercourses determined to have suitable fish habitat. Suitable fish habitat was determined to be watercourses where fish can carry out one or more of their life history processes (i.e., spawning, rearing, foraging, or migration). This includes watercourses that have surface water flows (at least seasonally), upstream connectivity to fish-bearing waterbodies, and channels with defined bed and banks. The length of the stream assessed for fish habitat assessment in each watercourse was determined by its potential for Arctic Grayling spawning habitat (i.e., gravel substrates) (Volume 6, Appendix 6-D).

The baseline summary reported in the following sections are for watercourses crossed by the 2015 road alignment and do not include watercourses that were eliminated due to the re-route. Additional information on the watercourses evaluated during 2014 baseline studies can be found in Appendix 6-J.

6.5.2.1.2 Results

The results focus on those presented in the 2015 Road Baseline Report (Volume 6, Appendix 6-D), which emphasized fish and fish habitat data for the 2015 haul road alignment.

6.5.2.1.2.1 Fish Habitat

Fish habitat was evaluated at 28 watercourses proposed to be crossed by the haul road. Watercourse descriptions are provided in Appendix 6-D, Section 3.5. Three watercourses (at crossing km 16.0, km 23.9, and km 32.3) were classified as rivers (large, flowing open channels) with potential habitat for VCs, such as Arctic Char and Arctic Grayling. These large rivers provide spawning, rearing, and foraging habitat for small-bodied fish, and provide migratory corridors and various habitat functions for large-bodied fish (e.g., Arctic Char, Arctic Grayling).

Five streams (at km 3.4, km 10.7, km 20.0, km 26.1, and km 43.5) may also provide potential corridors for large-bodied fish. However, the majority of the crossing locations (n = 20) only had the potential for seasonal use by small-bodied fish such as Ninespine Stickleback or Slimy Sculpin. Six watercourses (at km 2.1, km 26.1, km 28.3, km 36.2, km 41.8, km 51.2) are unlikely to support fish due to lack of surface water flows (Volume 6, Appendix 6-D), all of which were characterized by contributing drainage areas of less than 4 km^2 in size. Sixteen crossing locations were on boulder-dominant stream sections, potentially restricting fish passage to upstream locations. Potential spawning habitat for Arctic Grayling (i.e. areas of gravel substrate) was identified at two watercourse crossings: km 16.0 and km 44.8.

6.5.2.1.2.2 Fish Populations

A total of 52 fish were captured using 186 minutes of fishing effort at 11 watercourse crossing locations along the haul road alignment (Figure 6.5-1). Fish capture summaries are provided in Table 6.5-1. Arctic Char were captured at three watercourses upstream of Pipedream Lake (Tasirjuaraajuk Lake), a lake that supports Arctic Char based on IQ (Volume 7, Appendix 7-A).

A Local Inuit Field Assistant worked with field crews during the 2015 baseline data collection. As part of an archaeological survey, he noted an Arctic Grayling at km 16.0 where a river would potentially be crossed by the Haul Road (Local Inuit Field Assistant pers. comm. 2015a). Fisheries field crews did not capture any Arctic Grayling at this location, and the electrofishing results were shared with the Local Inuit Field Assistant.

Table 6.5-1: Fish Captured at Watercourse Crossings for the Haul Road, 2014-2015

Location (km)	Drainage Basin	Electrofishing Effort (s)	ARCH	ARGR	BURB	SLSC	NNST	Total
3.4	Quoich	846	0	0	0	2	0	**2**
10.7	Meadowbank	621	0	0	0	1	0	**1**
11.1	Meadowbank	1,436	4	0	0	0	0	**4**
16.0	Meadowbank	3,807	3	0[a]	1	7	0	**11**
20.0	Meadowbank	818	1	0	0	15	0	**16**
22.1	Meadowbank	368	0	0	0	0	0	**0**
23.9	Meadowbank	590	0	0	0	5	1	**6**
26.1	Meadowbank	466	0	0	0	0	0	**0**
32.3	Meadowbank	626	0	0	0	2	0	**2**
43.5	Meadowbank	403	0	0	0	0	0	**0**
44.8	Meadowbank	1,195	0	2	0	8	0	**10**
Grand Total		**11,176**	**8**	**2**	**1**	**40**	**1**	**52**

Note: electrofishing catch-per-unit values are summarized in Appendix 6-L.

[a] One Arctic Grayling was observed at km 16.0 by an Inuit assistant working with the Archaeology crew on July 9, 2015 (Inuit assistant pers.comm 2015a).

ARCH = Arctic Char, ARGR = Arctic Grayling, BURB = Burbot, SLSC = Slimy Sculpin, NNST = Ninespine Stickleback.



LEGEND

- WATER CROSSING LOCATION
- PROPOSED HAUL ROAD
- WATERCOURSE
- WATERBODY

FISH SPECIES CAUGHT

- ARCTIC CHAR
- ARCTIC GRAYLING
- BURBOT
- SLIMY SCULPIN
- NINESPINE STICKLEBACK
- NO FISH CAUGHT

REFERENCE

1. PROPOSED WHALE TAIL HAUL ROAD ALIGNMENT OBTAINED FROM AGNICO EAGLE MINES LIMITED.
2. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

3500 0 3500
METRES

PROJECT
AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

FISH PRESENCE IN WATERCOURSES SAMPLED FOR THE HAUL ROAD ALIGNMENT

Golder Associates

PROJECT	1541520	FILE No.		
DESIGN	BF	14 Apr. 2016	SCALE AS SHOWN	REV. 0
GIS	CD	14 Apr. 2016		
CHECK	BF	14 Jun. 2016		
REVIEW	CES	14 Jun. 2016		

FIGURE 6.5-1

Y:\burnaby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Whale_Tail\99_PROJECTS\1541520_FEIS\02_PRODUCTION\FEIS\MXD\2400_FisheriesReport\1541520_2400_FIG_6_5_1_HAUL_ROAD_PRESENCE.mxd

6.5.2.2 Whale Tail Pit

6.5.2.2.1 Methods

6.5.2.2.1.1 Fish and Fish Habitat

Fish and fish habitat baseline studies were completed in the headwaters of the A and C watershed in the vicinity of the Whale Tail Pit during 2014 and 2015. Detailed baseline data collection methods, dates, and locations can be found in the Whale Tail Pit Baseline Report (Volume 6, Appendix 6-K) and the CREMP Report (Volume 6, Appendix 6-G). The 2014 baseline program focused on Lake A16 (Mammoth Lake), Lake A17 (Whale Tail Lake), and Lake C38 (Nemo Lake). Baseline data collection began in September 2014 and included aerial reconnaissance and photographs of all potentially affected watercourses and waterbodies in the entire study area (i.e., headwater lakes and streams in the A and C watersheds). Appendix 6-K provides sampling location maps and detailed methods used in 2014 and 2015.

The 2015 baseline program focused on the same lakes from the 2014 program, with the addition of tributary streams and lakes in the A and C watersheds. Lakes and streams were photographed by helicopter downstream from the outlet of Lake A16 (Mammoth Lake) to Lakes A10 and A9 in June 2015, and to the outlets of Lake A75 in July 2015. Air reconnaissance also included an evaluation of fish passage conditions downstream of Lake A16 (Mammoth Lake). Lake C38 (Nemo Lake) outlet was assessed in the summer of 2015 as part of the Hydrology Baseline (Volume 6, Appendix 6-C). Fish habitat was visually evaluated at 29 streams (Table 6.5-4). Side-scan sonar was used to record georeferenced images of bottom substrate in 16 lakes, including Lake A16 (Mammoth Lake) and Lake A17 (Whale Tail Lake). A total of 19 lakes in the regional study area (14 in the LSA) were also surveyed for the collection of bathymetric data, including Lake A16 (Mammoth Lake) and Lake A17 (Whale Tail Lake) (Volume 6, Appendix 6-M).

6.5.2.2.1.2 Lower Trophic Communities

Baseline sampling for lower trophic aquatic communities (phytoplankton, zooplankton, benthic invertebrates, and periphyton) was completed in 2014 and in 2015 (Volume 6, Appendix 6-K; Appendix 6-G) to characterize baseline conditions for lower trophic communities. An overview of the sampling locations and methods used during these programs is provided below. Additional details related to sampling locations and methods are provided in Appendix 6-G.

Baseline sampling was completed in September 2014 in Mammoth Lake, Whale Tail Lake, and Nemo Lake. Five sampling locations were selected throughout each lake at a target depth of eight metres. Whale Tail Lake, Nemo Lake, and Mammoth Lake were also sampled in 2015 throughout the open water period with five stations established over a smaller spatial area (approximately 100 m radius). During the 2015 sampling program, Whale Tail Lake was divided into north and south areas of the lake (referred to as Whale Tail Lake [North Basin] and Whale Tail Lake [South Basin]). Five shallow sampling stations (referred to as Whale Tail Lake [North Basin]-Ex) were also added to the North Basin. Reference lakes Inuggugayualik Lake and Pipedream Lake were also sampled as part of the Meadowbank CREMP (Volume 8, Appendix 8-E.2).

A summary of lakes and components sampled in the 2014 and 2015 baseline programs are summarized in Table 6.5-2. Maps with specific sampling locations can be found in the Whale Tail Pit CREMP (Volume 6, Appendix 6-G).

Table 6.5-2: Lakes Sampled for Lower Trophic Communities, 2014 and 2015

Lake	Year[a]	Phytoplankton	Zooplankton	Benthic Invertebrates	Periphyton
Whale Tail[b]	2014	✓	-	✓	-
	2015	✓	✓	✓	✓
Nemo	2014	✓	-	✓	-
	2015	✓	✓	✓	✓
Mammoth	2014	✓	-	✓	-
	2015	✓	✓	✓	✓
Lake A53	2015	-	-	-	✓

[a] The 2014 sampling program included on sampling event in September. The 2015 sampling program included three sampling events during the open water period (July, August, September).

[b] In 2015 Whale Tail Lake was divided into two basins, the Whale Tail Lake (North Basin) and Whale Tail Lake (South Basin) with five replicates sampled within each basin.

"-" indicates sampling not completed.

Baseline phytoplankton, zooplankton, and benthic invertebrate sampling was completed according to the Meadowbank CREMP standard operating procedures (SOP) (Volume 6, Appendix 6-G). Phytoplankton samples were analyzed for taxonomy and biomass measurements, as well as for chlorophyll *a* (as part of the water quality monitoring program). Density and biomass were presented at the major taxonomic group level. Zooplankton samples were analyzed for abundance, biomass, and biovolume measurements as per methods described in the Whale Tail Pit CREMP (Volume 6, Appendix 6-G). Abundance and biomass results were converted to density measures and presented at the major taxonomic group level of zooplankton. Finally, benthic invertebrate samples were submitted for taxonomic analysis, and then summarized for benthic invertebrate abundance and richness per major taxa.

Periphyton surveys were also completed to provide a qualitative assessment of the abundance and distribution of periphyton in the lakes. Periphyton surveys were completed by Azimuth during three sampling events in 2015 (Volume 6, Appendix 6-G). Periphyton survey were also completed by Portt and Associates in coordination with fish surveys in 2015 during four monitoring occasions on Whale Tail Lake, two in Mammoth Lake and three in Lake A53 (Volume 6, Appendix 6-C). Qualitative surveys included a visual estimate of percent periphyton cover, identifying substrate type and proportion, and a description of the periphyton community, including colour, thickness, and texture.

6.5.2.2.2 Results

6.5.2.2.2.1 Fish Habitat

Lakes

Bathymetric surveys of 19 lakes (3 large [>100ha] and 16 small [<100 ha]) in the LSA identified Lake A17 (Whale Tail Lake) as the largest lake by both surface area and volume. Coarse substrates (i.e., gravel, cobble, boulder, and bedrock) dominated the littoral zone of both Lake A16 (Mammoth Lake) and Lake A17 (Whale Tail Lake).The 16 small lakes surveyed for bathymetry ranged in maximum depths from 1.8 m in Lake A55 to 25.0 m in Lake A20. Surface areas ranged from 3.0 ha in each Lakes A47 and A49 to 63.0 ha in Lake A65 (Volume 6, Appendix 6-M).

Streams

Fish habitat was assessed at 31 headwater streams of the A watershed, 28 of which are in the LSA. Stream measurements were also taken at 12 of these streams during the Hydrology Baseline Study in June 2015 (Volume 6, Appendix 6-C). Stream drainage areas and wetted widths are provided in Volume 6, Appendix 6-C, Appendix A. One potential stream (A49-A17) was deemed not to be a watercourse when investigated in the field. Of the remaining 30 streams, 19 were coarse-substrate (i.e., boulder, cobble, or gravel) dominant, and 11 were fine-substrate (i.e., peat, tundra, or sand) dominant. Most streams (*n* = 17) had interstitial flow (i.e., water flowing through the interstitial spaces among boulders and cobbles) at some time during the year. Eight streams had surface flow (i.e., water present above the substrate) year-round. Five streams had ephemeral flows and would likely be dry in late summer (Volume 6; Appendix 6-K, Table 5-1).

Potential Arctic Grayling spawning habitat (i.e. gravel substrate) was observed at two locations in Stream A63-A18, however, no Arctic Grayling eggs or adults were observed nor collected (Volume 6, Appendix 6-K). At a tributary stream to Whale Tail Lake, a Local Inuit Field Assistant stated that “Arctic Grayling can use streams of that size, but not much smaller” (Local Inuit Field Assistant, pers. comm. 2015b). He also identified the juvenile salmonid that was captured as an Arctic Char because “it was lighter in color than a Lake Trout”. He also stated that “Arctic Grayling may come into the streams more once the insects come out.” and that “to the Inuit people, rivers were not just rivers, they were survival” (Local Inuit Field Assistant, pers. comm. 2015b).

Appendix 6-C describes the Mammoth Lake and Whale Lake outlet channels. For both channels, surface flows are highest when lake levels are high in the spring, with water primarily flowing under boulders during summer and fall, as water levels decline (Volume 6, Appendix 6-K). Passage of large-bodied fish (e.g., Lake Trout) between Lake A16 (Mammoth Lake) and Lake A17 (Whale Tail Lake) is possible, but only during spring conditions.

There are two routes whereby water flows between Mammoth Lake and Lake DS1. Downstream flows branch off at Lake A12 and flow to Lake DS1 via both Lake A11 and Lake A77. No upstream barrier to fish movement (e.g., waterfall or vertical barrier) was observed between Lake DS1 and Lake A16 (Mammoth Lake) via Lake A11. However, passage of large-bodied fish is unlikely between Lake A76 and Lake A75 due to a large boulder field (> 500 m) on Stream A76-A75.

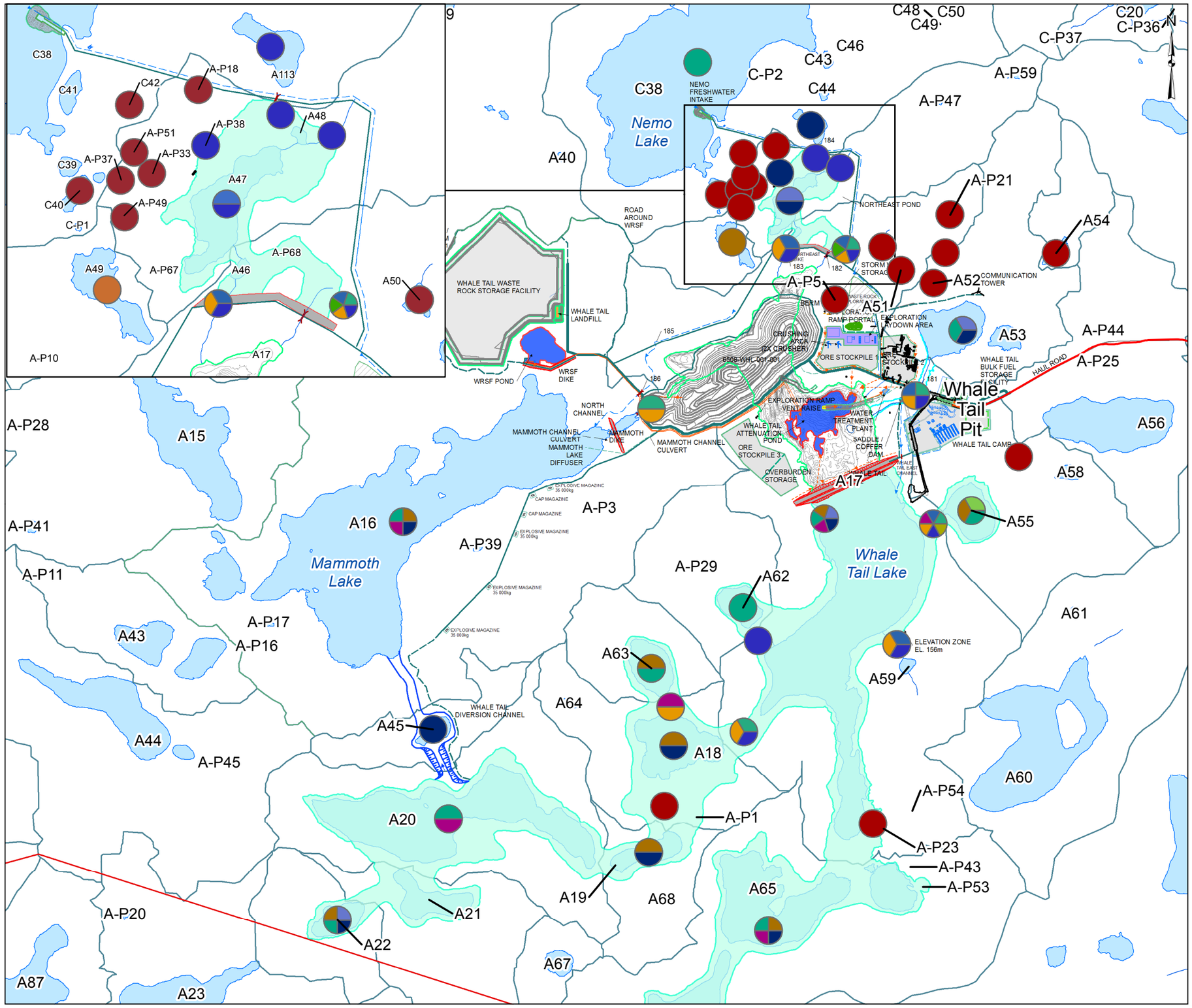
6.5.2.2.2.2 Fish Populations

A total of 1,223 fish were captured in lakes and streams in the regional study area near the Whale Tail Pit (Figure 6.5-2). Six species were captured in total: Lake Trout, Arctic Char, Round Whitefish, Burbot, Slimy Sculpin, and Ninespine Stickleback.

Lakes

In Lake A17 (Whale Tail Lake) and Lake A16 (Mammoth Lake) combined, Ninespine Stickleback was the most abundant species captured in the catches (n = 97, 40%), followed by Lake Trout (n = 84, 35%) (Table 6.5-3). Arctic Char were captured in Whale Tail Lake, but not in Mammoth Lake. In Lake C38 (Nemo Lake), only Lake Trout were captured (Table 6.5-3). In small lakes overall, Ninespine Stickleback were the most abundant species in the catches (n = 149, 69%) (Table 6.5-3).

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LEGEND

- FINAL WHALE TAIL WASTE ROCK STORAGE FACILITY
- WHALE TAIL LAKE (SOUTH BASIN) FLOODED LIMIT (WATER LEVEL 156.0m)
- DIKE
- POND/SUMP
- ROAD
- TEMPORARY ROAD
- DIVERSION CHANNEL
- COLLECTION CHANNEL
- CULVERT
- INTAKE WATER PIPE
- CONTACT WATER PIPE
- FRESHWATER PIPE
- PROPOSED HAUL ROAD
- STREAM
- LAKE/POND

FISH SPECIES CAUGHT

- ARCTIC CHAR
- BURBOT
- SLIMY SCULPIN
- LAKE TROUT
- ROUND WHITEFISH
- NINESPINE STICKLEBACK
- NO FISH CAUGHT

REFERENCE

1. INFRASTRUCTURE OBTAINED FROM AGNICO EAGLE MINES LIMITED FROM 6108-600-210-002_R2(2019)S.DWG.
2. PROPOSED WHALE TAIL HAUL ROAD ALIGNMENT OBTAINED FROM AGNICO EAGLE MINES LIMITED.
3. WATERCOURSE AND WATERBODY DATA OBTAINED FROM PHOTOSAT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

500 0 500
METRES

PROJECT
AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE
FISH PRESENCE IN LAKES AND STREAMS IN THE A AND C WATERSHEDS OF THE MEADOWBANK RIVER

Golder Associates

PROJECT		1541520	FILE No.	
DESIGN	BF	14 Apr. 2016	SCALE AS SHOWN	REV. 0
GIS	MH	08 Jun. 2016		
CHECK	BF	14 Jun. 2016		
REVIEW	CES	14 Jun. 2016		

FIGURE 6.5-2

Table 6.5-3: Fish Captured in Lakes in the A and C Watershed of the Meadowbank River, 2014-2015

Lake	GN Effort (h-soak time)	EF Effort (s)	LKTR	ARCH	RNWH	BURB	SLSC	NNST	UNID	Total
Large Lakes (> 100 ha)										
Lake A16 (Mammoth)	90.32	3,922	49	0	20	0	13	42	1	125
Lake A17 (Whale Tail)	91.45	3,403	35	4	7	0	16	55	2	119
Lake C38 (Nemo)	27.31	-	22	0	0	0	0	0	0	22
Small Lakes or Ponds (< 100 ha)[a]										
Lake A113	16.6	252	0	0	0	0	0	16	0	16
Lake A18	2.3	483	0	0	0	0	3	16	0	19
Lake A19	1.9	437	0	0	0	0	1	7	0	8
Lake A20	17.53	324	11	0	6	0	0	0	0	17
Lake A22	1.6	409	2	1	0	0	10	1	0	14
Lake A45	1.98	239	0	0	0	0	0	3	0	3
Lake A47	2.25	244	0	1	0	0	0	100[b]	0	101
Lake A49	2.52	893	0	0	0	0	3	0	0	3
Lake A50	-	284	0	0	0	0	0	0	0	0
Lake A51	-	200	0	0	0	0	0	0	0	0
Lake A52	-	360	0	0	0	0	0	0	0	0
Lake A53	2.38	1,334	1	2	0	0	0	2	0	5
Lake A54	-	301	0	0	0	0	0	0	0	0
Lake A55	16.17	417	5	0	0	1	2	0	0	8
Lake A62	1.95	-	3	0	0	0	0	0	0	3
Lake A63	1.6	332	1	0	0	0	3	0	0	4
Lake A65	3.33	342	2	0	2	0	6	3	0	13
Lake A-P38	-	306	0	0	0	0	0	1	0	1
Lake C40	-	181	0	0	0	0	0	0	0	0
Lake C42	-	207	0	0	0	0	0	0	0	0
Grand Total	**281.19**	**13,337**	**131**	**8**	**35**	**1**	**57**	**246**	**3**	**481**

Note: Catches are for all gear types combined, Effort is only reported in table for gill net and backpack electrofishing; hoop net and minnow trap efforts were not included in the table, but are provided in Appendix 6-L; no fish were captured in any of the other ponds that were sampled, see additional details in Appendix 6-L.

[a] Ponds where no fish were caught (e.g., Lake A-P5, Lake A-P18, Lake A-P21, Lake A-P33, Lake A-P37, Lake A-P49, and Lake A-P51) were not included in the table.

[b] In Lake A47, greater than 100 Ninespine Stickleback were captured. However, field enumeration ceased at 100 individuals. For the purpose of this species summary, only 100 individuals were used in species composition calculations.

GN=gill net, EF=backpack electrofishing, h = hours, s=seconds, LKTR = Lake Trout, ARCH = Arctic Char, RNWH = Round Whitefish, BURB = Burbot, SLSC = Slimy Sculpin, NNST = Ninespine Stickleback, UNID = Unidentified salmonid.

Streams

In streams, Ninespine Stickleback were the most abundant species (n = 469, 63%), followed by Slimy Sculpin (n = 246, 33%), and Arctic Char (n = 14, 2%) (Table 6.5-4). The majority of the fish were captured by electrofishing. Stream A55-A17, a tributary to Whale Tail Lake, had the highest diversity of fish species (Lake Trout, Arctic Char,

Round Whitefish, Slimy Sculpin, and Ninespine Stickleback). Large mesh hoop nets set between June 19 and July 13, 2015, and at locations where there was thought to be potential for fish movement between lakes (e.g., streams A17-A16 and A16-A15), caught one Lake Trout and one Arctic Char in 3,000 hours of soak time (Volume 6, Appendix 6-K).

Table 6.5-4: Fish Captured in Streams in the A Watershed of the Meadowbank River, 2014-2015

Stream	EF Effort (s)	LKTR	ARCH	RNWH	BURB	SLSC	NNST	UNID	Total
Stream A0-A48	196	0	0	0	0	0	2	0	2
Stream A113-A47	68	0	0	0	0	0	1		1
Stream A16-A15	690	1	0	0	0	5	2	0	8
Stream A17-A16	950	1	0	0	0	4	0	0	5
Stream A18- A17	2,736	1	0	0	0	6	6	0	13
Stream A19-A18	423	0	0	0	0	0	0	0	0
Stream A46-A17	2,059	0	2	0	0	19	264	0	285
Stream A47-A46	136	0	0	0	0	1	0	0	1
Stream A50-A17	1,649	1	3	0	1	10	63	0	78
Stream A53-A17	4,324	4	5	0	0	105	85	0	199
Stream A55-A17	4,809	1	2	1	0	51	43	1	99
Stream A56-A55	634	0	0	0	0	0	0	0	0
Stream A59-A17	2,709	0	2	0	0	37	2	0	41
Stream A62-A17	1,025	0	0	0	0	0	1	0	1
Stream A63-A18	1,641	0	0	1	0	6	0	0	7
Stream A-P21-A52	78	0	0	0	0	0	0	0	0
Stream A-P23-A17	582	0	0	0	0	2	0	0	2
Grand Total	**23,574**	**9**	**14**	**2**	**1**	**246**	**469**	**1**	**742**

Note: Catches are for all gear types combined. Effort was reported in table for backpack electrofishing; hoop net and minnow trap efforts were not included in the table, but are provided in Appendix 6-L.

EF=backpack electrofishing, s=seconds, ARCH = Arctic Char, ARGR = Arctic Grayling, BURB = Burbot, SLSC = Slimy Sculpin, NNST = Ninespine Stickleback, UNID = Unidentified salmonid.

6.5.2.2.2.3 Lower Trophic Communities

The results of the baseline sampling programs are presented in the Appendix 6-G. A brief summary of the results is provided in the sections below.

Phytoplankton

Six major groups of phytoplankton were present in the lakes, which included Cyanophyta (blue-green algae), Chlorophyta (green algae), Chrysophyta (golden-brown algae), Bacillariophyceae (diatoms), Cryptophyta (cryptomonads) and Dinoflagellata. Chrysophytes were observed to be the dominant taxonomic group in terms of density and biomass during both years of sampling. Temporally, the highest densities and biomass were typically observed during the July sampling event.

Phytoplankton taxonomic richness was somewhat variable among sampling events but was generally observed to be between 30 and 40 during baseline surveys. These values were similar to long-term observations of between

35 and 40 taxa at the reference lakes (Pipedream Lake and Inuggugayualik Lake) during open water sampling events.

Phytoplankton density was typically greater than 1.5 million individuals per liter with total biomass ranging from 100 mg/m^3 to 440 mg/m^3 during the open water period. Density and biomass were lowest in Nemo Lake and higher in Whale Tail and Mammoth lakes, which was consistent with trends in chlorophyll *a* concentrations.

Zooplankton

Overall, rotifers were the most abundant major taxonomic group at most locations in 2015 with the exception of Nemo Lake where Copepods were the most abundant zooplankton taxa. Cladocerans made up a relatively small proportion of the zooplankton community during the summer months. Spatial variability was observed in zooplankton density particularly in samples collected at Mammoth Lake. High variability in zooplankton biomass was also observed in samples from this lake. Temporal variability in zooplankton biomass was also observed throughout the open water period with the community composition alternatively dominated by calanoid copepods, cyclopoid copepods or rotifers.

Benthic Invertebrates

Benthic invertebrate abundance and richness were low at most locations sampled in 2014 and 2015. Dominant taxa were primarily chironomids in the subfamilies Chironominae and Tanypodinae and fingernail clams (Sphaeriidae). Within-lake variability was observed in abundance in 2014 despite sampling within similar water depths. Abundance was generally higher in the lake stations in 2015 compared to the reference areas; however, abundance was still within the historical reported for these areas. Average taxonomic richness in 2014 ranged from 9 to 12 and in 2015 taxonomic richness ranged from 11 to 16.

The highest abundances were observed for Mammoth Lake, which also had the highest within lake spatial variability in abundance. High average abundances were also observed at shallow stations in the north basin of Whale Tail Lake (i.e., Whale Tail Lake [North Basin]-Ex stations), which was due primarily to increased abundance of chironomids in the genus Corynocera and fingernail clams Cyclocalyx/Neopisidium.

Periphyton

Qualitative periphyton survey were done in July and September in the same general locations in each lake. A different area was surveyed in August. Periphyton growth in July was generally considered sparse to moderate with periphyton cover more noticeable at deeper depths. In August, periphyton growth was generally considered low to moderate with green filamentous algae observed at most locations. In September, lake levels were lower, relative to the July survey, and below 10 cm water depth, periphyton growth was rated as moderate to high.

Qualitative periphyton surveys were also completed in streams. During these surveys periphyton coverage was considered to be spatially heterogeneous. In areas of low flow and adequate depth, dense mats of periphyton growth were observed. Lower water levels were observed in September relative to July and dense periphyton growth was noted.

6.5.2.3 Baseline Summary

The fish and fish habitat baseline summary for the Project is very similar to that described for the Meadowbank Mine. Baseline data have been collected throughout the life of the Meadowbank Mine and are summarized in Annual Reports (Agnico Eagle 2009, 2010, 2011, 2012a, 2013, 2014b, and 2015), fish-out reports (Agnico Eagle 2009, Appendix C6; Agnico Eagle 2011, Appendix H; and Agnico Eagle 2014c, Appendix G14),

Meadowbank Baseline Aquatic Ecosystem Report (Cumberland 2005d), Whale Tail Core Receiving Environment Monitoring Program (Appendix 6-G), Phaser Lake Fish Offsetting Plan (Agnico Eagle 2016d), and the Meadowbank No-Net-Loss Report (Agnico Eagle 2012b).

Lake Trout and Round Whitefish are the dominant large-bodied species followed by Arctic Char in the lakes surveyed in the A and C watersheds. Ninespine Stickleback and Slimy Sculpin commonly occur across habitats sampled. Burbot is uncommon, and Arctic Grayling are not found in the RSA and are restricted to downstream locations outside of the RSA. The nature of the connecting channels (i.e., channel dimensions are wide and flat, flows are shallow or subsurface, extensive boulder fields are common) may prevent fish access to headwater lakes, as similarly described for the fish distributions at the Meadowbank Mine (Cumberland 2005d). Movements of large-bodied fish (e.g., adult VC fish species) between lakes may be limited to the spring freshet period; however, juveniles may use stream connections for foraging and migration habitat.

6.5.3 Effects Assessment

A comprehensive analysis of the potential pathways for effects on surface water quantity, water quality, and fish and fish habitat during the construction, dewatering, operational, closure, and post-closure phases, is provided in Volume 3, Appendix 3-C. The pathways include those that address Inuit concerns on the potential effects of mining development on fish and fish habitat.

Elders have expressed concern for fish populations and in the declining condition of fish (i.e., “skinnier”) since drilling activity had commenced in the area of Baker Lake (Volume 7, Appendix 7-A). A concern was raised about the protection of lakes from disturbances from construction activities, the protection of water from spills, and accidents along the road and the potential impacts to rivers and streams (NIRB 2015). Concerns were also expressed related to watercourse crossings and the potential effects of the mine. In particular, how dust generated from haul roads will affect fish. Similar concerns regarding fish populations and their habitat were also expressed during consultation for the Meadowbank Mine (Cumberland 2005a), including concern over the effects of siltation, spills, the accumulation of toxic substances, habitat loss, restricted water flow and dewatering of waterbodies, and the potential overharvesting of fish species near construction sites or camps (Cumberland 2005a).

The identified primary pathways carried into the effects assessment are those where effects from the Project will likely result in a measurable change to measurement indicators, with the potential to contribute to residual effects on a VC relative to the Baseline Case or guideline values. Pathways determined to have no linkage or those that are considered secondary are not predicted to result in environmentally significant effects on surface water quantity and are not carried through the effects assessment. Secondary effects pathways and effects pathways with no linkage are summarized in the Pathway Analysis table in Volume 3, Appendix 3-C.

The scale of the assessment area for the primary pathways is the A watershed, which includes lakes and streams above Lake A1, but does not include lakes and streams above Stream A76-75 (see rationale provided in Section 6.1.3.1). The Project activities that may result in residual effects to fish and fish habitat are located entirely in the A watershed of the Meadowbank River, specifically the A1 assessment area. The Project is anticipated to have negligible residual effects on fish and fish habitat outside of the A1 assessment area. The A1 watershed assessment area does not support Arctic Grayling (Section 6.5.2.2.2), and therefore, the primary pathways under examination for the Project include those for Arctic Char, Lake Trout, and Round Whitefish. The following are the primary pathways that require further effects analysis to determine the environmental significance from the Project on surface water quantity:

- The construction of the Northeast, Whale Tail, and Mammoth dikes, and Whale Tail Pit will result in the direct loss of fish habitat.
- The construction of the Northeast, Whale Tail, and Mammoth dikes will alter access to tributary streams and lakes (i.e., habitat connectivity), and may result in habitat loss for Lake Trout, Arctic Char, and Round Whitefish.
- During the construction of the Whale Tail, Mammoth, and WRSF dikes, water diversions will result in a reduction of water levels in Lake A16 (Mammoth Lake) and downstream locations, affecting fish and fish habitat.
- The dewatering of the diked area in Lake A17 (Whale Tail Lake) and Lake A16 (Mammoth Lake) will result in the direct loss or alteration of fish habitat in both lakes.
- The dewatering of the diked area in Lake A17 (Whale Tail Lake) and Lake A16 (Mammoth Lake) will result in the removal and subsequent mortality of fish from the area.
- Water diversions for the Whale Tail and Northeast dikes during construction and operations will flood tributary lakes and streams, and will result in the alteration of fish habitat.
- Refilling of the diked area in Lake A17 (Whale Tail Lake) and Lake A16 (Mammoth Lake) at closure will affect water levels in Lake A16 (Mammoth Lake) and downstream locations, resulting in effects to fish and fish habitat.
- Operational activities and discharge (e.g., discharge of treated domestic wastewater, altered drainage, runoff from facilities, including waste rock storage areas, pit inflows, dike seepage, release of nitrogen compounds from blasting residues) may change trophic status, affecting fish and fish habitat in Lake A16 (Mammoth Lake) and downstream waterbodies.
- Reconnection of the refilled area of Mammoth Lake and Whale Tail Lake to the remaining watershed and post-closure releases of water (e.g., seepage, waste rock storage area runoff) may change long-term trophic status in Whale Tail Lake, Lake A16 (Mammoth Lake) and downstream waterbodies, affecting fish and fish habitat.

6.5.3.1 General Approach

The general approach for effects assessment for primary pathways is provided in Volume 3, Sections 3.5 to 3.7. For fish and fish habitat, the residual impact classification focuses on the assessment endpoints of ongoing fisheries productivity and ongoing support for fisheries productivity.

The analyses of residual effects from the proposed Project on fish were quantitative, where possible, and included data from field studies, scientific literature, IQ and community information, monitoring programs at existing mines, government publications, and personal communications. Due to the amount and type of data available, some analyses were qualitative and included professional judgement or experienced opinion. Where possible, the analyses considered conservative inputs and methods such that effects would be over-estimated as an approach to reduce uncertainty in predictions.

The effects analysis for primary pathways related to direct or indirect loss or alteration of fish habitat is described in detail below. Analyses of primary pathways related to surface hydrology are based on methods and results

described in detail in Section 6.3.3, and those related to water quality are based on methods and results described in detail in Section 6.4.3. The effects analysis for primary pathways related to fish health is described in detail in Volume 3, Appendix 3-B.

6.5.3.2 Direct Effects to Fish

Inuit concerns regarding fish populations and their habitat at mining developments include effects from habitat losses and the dewatering of waterbodies (Cumberland 2005a). The following primary pathways on the direct effects to fish and fish habitat from the Project are evaluated:

- The construction of the Northeast, Whale Tail, and Mammoth dikes, and Whale Tail Pit will result in the direct loss of fish habitat.
- The dewatering of the diked area in Lake A17 (Whale Tail Lake) and Lake A16 (Mammoth Lake) will result in the direct loss or alteration of fish habitat in both lakes.
- The dewatering of the diked area in Lake A17 (Whale Tail Lake) and Lake A16 (Mammoth Lake) will result in the removal and subsequent mortality of fish from the area during the proposed fish-out.
- The construction of the Northeast, Whale Tail, and Mammoth dikes will alter access to tributary streams and lakes (i.e., habitat connectivity), and may result in habitat loss for Lake Trout, Arctic Char, and Round Whitefish.
- Water diversions for the Whale Tail and Northeast dikes during construction and operations will flood tributary lakes and streams, and may result in the alteration of fish habitat.

6.5.3.2.1 Methods

Changes in available habitat may affect fisheries productivity (e.g., yield) when a loss of habitat area causes a reduction in carrying capacity, resulting in a reduction of fish production; where fish production reflect vital rates (e.g., growth, survival, reproduction) and life history characteristics (e.g., fecundity, age at maturity) (DFO 2014). Key measurement indicators for the assessment of fisheries productivity were both absolute measurements (e.g., hectares, metres) and relative values (%) of lost or altered habitat for lakes and streams. Use of both absolute and relative values can provide complementary information in the assessment to habitat; for example, a prediction of high relative change may not necessarily mean that a large area is affected by the development.

The development of the Project is expected to directly affect the availability of habitat through losses or alterations of fish habitat incurred by footprints in Mammoth Lake and Whale Tail Lake and adjacent flooded lakes and streams. The greatest changes will be a result of the construction of the Mammoth dike, Whale Tail Dike, and Northeast dike and the dewatering of the diked area in Whale Tail Lake where the pit will be located. As conservative approach to the assessment, it is assumed that the effect to both available habitat and the abundance of fish are proportional to the loss in fisheries productivity Whale Tail Lake and Mammoth Lake (DFO 2014).

Habitat Calculations

The assessment of fish and fish habitat valued components relied on a baseline database of species distributions in the LSA (Section 6.5.2; Volume 6, Appendix 6-D; Appendix 6-J; Appendix 6-K), combined with available spatial data on existing and proposed developments with surface waters (NTS 1:50,000) within the LSA. First, the biological database was used to characterize the fish assemblage of A1 assessment area, with an emphasis on Mammoth Lake, Whale Tail Lake, and surrounding stream and lake tributaries. In some cases, where a valued

fish species was not recorded but potentially present and undetected during sampling, for the purposes of this assessment, the lake under examination was deemed to support that species. Specifically, if a lake or stream upstream of given location supported Arctic Char or Lake Trout, the downstream waterbodies were all characterized as Arctic Char or Lake Trout habitat even if the species was undetected during sampling at the downstream location, adding a safety factor and increasing the level of conservatism in this assessment.

The assessment then quantified habitat changes in a GIS platform by intersecting available spatial data on existing and proposed developments with surface waters (NTS 1:50,000) within the LSA. The assessment of habitat losses in Lake A16 (Mammoth Lake) and Lake A17 (Whale Tail Lake) were based on substrate type (fines, mixed, and coarse), as described by side-scan sonar data, falling into each of the four depth strata (0 to 2 m, 2 to 6 m, 6 to 10 m, and greater than 10 m). The following substrate types were quantified:

- Fines – consisted of sand, silt, and organics; generally considered the lowest habitat quality of the three categories for the VC species in terms of cover, but provides habitat for macroinvertebrate food items (e.g., chironomids) for species that are primarily benthic feeding species, such as Round Whitefish (forage species);
- Mixed – considered a mix of fines and coarse substrates; mixed habitat may provide some of the functions described in both fines and coarse categories; and
- Coarse – included all coarse substrates (i.e., gravel, cobble, and boulder); generally considered to be the highest habitat quality of the three categories because of the cover provided by coarse substrates, for example, for spawning, rearing, and foraging by Lake Trout, Arctic Char, and Round Whitefish.

The following depth strata were characterized for Lake A16 (Mammoth Lake) and Lake A17 (Whale Tail Lake):

- Shallow (less than 2 m) – expected to be productive foraging and rearing littoral areas during open water season because of warmer temperatures, light penetration, and substrates characterized by coarse substrate types or a mix of fines and coarse substrates; but includes areas that may have low oxygen during mid-summer when temperatures are warm, precluding use by large-bodied fish and includes areas most likely to freeze to bottom during winter. Arctic Char and Lake Trout may spawn in water depths less than 2 m (Scott and Crossman 1998; Callaghan et al. 2015);
- Moderate (2 to 6 m) – potentially productive foraging and rearing areas for most species during open water season because of warmer temperatures, light penetration, and the occurrence of mixed substrates, and may include areas with higher levels of dissolved oxygen under-ice; likely preferred depths for spawning substrates for Arctic Char (Scott and Crossman 1998), Lake Trout (reviewed in Marsden et al. 1995) and Round Whitefish (Stewart et al. 2007b); areas may have reduced or potentially inadequate dissolved oxygen levels to support use by large-bodied fish species during mid-summer when temperatures are warmest;
- Deep (6 to 10 m) – areas likely to support most species and age-classes year-round; assumed to be less productive for VC fish species than shallower locations because of the dominance of fine substrates at this stratum and as depths may be below the range of effective light penetration; some locations may support spawning substrates for salmonids depending on local wave action and currents; and
- Very Deep (greater than 10 m) – areas likely to support VC fish species and age-classes year-round, but can be the least productive stratum for foraging during summer because of the lack of coarse substrates and

because depths are often below the range of effective light penetration; areas may be below the thermocline if present mid-summer, providing thermal refugia.

Any effects on habitat from the Whale Tail Lake and Northeast dikes and diversions (e.g., flooding) were also quantified. Changes to the depth and surface area of affected lakes were calculated and mapped in a GIS platform to understand the potential change in fish habitat. Predicted changes were based on a mean annual water balance for the South Whale Tail Lake Diversion and the Northeast Diversion and are presented in Appendix 6-D, Attachment A.

Biomass Estimation

Dewatering of the diked area is required to allow mining of the gold deposits located under the lake bed. The diked area will be physically isolated from South Lake A17 (Whale Tail Lake) and from most of Lake A16 (Mammoth Lake). The fish remaining in the diked area following dike construction (between Mammoth and Whale Tail dikes) will be targeted for removal before dewatering, resulting in the direct mortality of fish. Mortality or removal of fish in the diked area may affect fisheries productivity (e.g., yield) through a reduction in fish production (DFO 2014).

The abundance of fish to be removed from the dewatered areas was estimated. First, the amount of fish biomass in Lake A17 (Whale Tail Lake) and Lake A16 (Mammoth Lake) was calculated using the relationship between lake area (ha), species richness (i.e., number of species in lake) and mean annual air temperature (°C) using the following equation (Samarasin et al. 2014):

$$log_{10}(biomass) = 1.08 + 1.04\ [log_{10}(lake\ area)] + 0.05 * (species\ in\ lake) + 0.03 * (mean\ annual\ air\ temperature)$$

Using the biomass result, and an overall mean weight of 0.26 kg derived from the calculated mean weights of three fish-outs at the Meadowbank Mine (Agnico Eagle 2014c; Appendix G14), the total number of fish in the drawdown area was estimated. Species abundances were generated by multiplying the expected number of fish to be removed from the dewatered area by the species relative abundances reported in Section 6.5.2.2.2.2.

6.5.3.2.2 Results

Habitat Losses[2]

The total in-lake footprint in Mammoth Lake during construction and operations is estimated to be 0.07 ha from the dike and 0.93 ha from the dewatering of the diked area, resulting in a total loss of 1.00 ha, or 0.74% of the aquatic habitat in Mammoth Lake. The total in-lake footprint of the Project in Whale Tail Lake during construction and operations is estimated to be 3.98 ha from the dike and 64.58 ha from the diked area, resulting in a total loss of 68.56 ha, or 43.5% of the aquatic habitat in Whale Tail Lake (Table 6.5-5). The dewatering of the diked area will result in the loss of Stream A16-A17, a total of 173 m of habitat, and the construction of the Northeast Dike will result in the loss of approximately 150 m of Stream A46-A17 and 133 m of Stream A50-A17 (includes losses under the dike and downstream of dike to Whale Tail Lake).

[2] The habitat losses and area calculations herein are used for the purposes of the FEIS assessment and may differ from the offsetting plan (which will be finalized in consultation with DFO in the authorization phase of the Project).

Table 6.5-5: Relative Changes in Fish habitat in Whale Tail Lake and Mammoth Lake from the Dike and Dewatered Area Footprint3

Depth of Habitat	Substrate type	Before Dike Construction (ha)	After Dike Construction					
			Dike footprint	Dike Footprint Change (%) from Before to After Construction	Dewatered Area Footprint (ha)	Dewatered Area Footprint Change (%) from Before to After Construction	Total Footprint (ha)	Total Footprint Change (%) from Before to After Construction
0-2 m	Coarse	59.76	2.59	-4.33	13.74	-22.99	16.33	-27.32
	Fines	0.10	0.00	0.00	0.00	-4.79	0.00	-4.79
	Mixed	2.09	0.11	-5.04	1.26	-60.54	1.37	-65.59
	All	61.95	2.69	-4.35	15.01	-24.22	17.70	-28.57
2-6 m	Coarse	44.72	1.25	-2.79	8.67	-19.40	9.92	-22.19
	Fines	53.45	0.07	-0.13	14.55	-27.22	14.62	-27.35
	Mixed	36.02	0.03	-0.08	4.96	-13.77	4.99	-13.86
	All	134.19	1.35	-1.00	28.18	-21.00	29.53	-22.01
6-10 m	Coarse	0.31	0.00	-1.42	0.15	-47.66	0.15	-49.08
	Fines	66.05	0.00	-0.01	13.45	-20.37	13.46	-20.38
	Mixed	8.29	0.00	-0.00	1.98	-23.89	1.98	-23.89
	All	74.65	0.01	-0.01	15.58	-20.87	15.59	-20.88
>10 m	Coarse	0.01	0.00	0.00	0.01	-85.77	0.01	-85.77
	Fines	19.38	0.00	0.00	6.29	-32.44	6.29	-32.44
	Mixed	2.04	0.00	0.00	0.44	-21.82	0.44	-21.82
	All	35.07	10.19	-29.06	10.19	-29.06	20.38	-58.12
All depths	Coarse	104.79	3.84	-3.67	22.57	-21.53	26.41	-25.20
	Fines	138.98	0.07	-0.05	34.29	-24.68	34.37	-24.73
	Mixed	48.44	0.14	-0.28	8.65	-17.86	8.79	-18.14
	All	292.22	4.05	-1.39	65.51	-22.42	69.56	-23.81

[3] The habitat losses and area calculations herein are used for the purposes of the FEIS assessment and may differ from the offsetting plan (which will be finalized in consultation with DFO in the authorization phase of the Project)

Using the baseline data for substrate determination in Mammoth Lake (Volume 6, Appendix 6-K), habitat changes will occur only in areas of existing coarse substrates (1.0 ha), resulting in a relative loss of 0.74% of the available coarse substrate areas in the lake at shallow and moderate depths (Table 6.5-5). In Whale Tail Lake habitat changes will occur in areas dominated by fine substrate types (34.4 ha), resulting in a relative loss of 43.8% of fine substrates in the lake. Losses of coarse substrate habitat will be primarily at shallow (0 to 2 m) and moderate depths (2 to 6 m) resulting in a relative overall loss of 25.2 ha or 49.4% of the coarse substrate habitat in Whale Tail Lake. Losses to mixed substrates will be primarily at moderate depths (2 to 6 m), resulting in a relative overall loss of 5.0% of mixed substrate in the lake.

In Mammoth and Whale Tail lakes and combined, habitat changes will occur in areas dominated by fine substrate types (34.4 ha), resulting in a relative loss of 24.7% of fine substrates in both lakes combined. Losses of coarse substrate habitat will be primarily at shallow (0 to 2 m) and moderate depths (2 to 6 m) resulting in a relative overall loss of 26.4 ha or 25.2% of the coarse substrate habitat in Mammoth and Whale Tail Lakes combined. Losses to mixed substrates will be primarily at moderate depths (2 to 6 m), resulting in a relative overall loss of 13.9% of mixed substrate in both lakes combined (Table 6.5-5). The loss of fine substrate habitat is expected to result in losses of macroinvertebrate habitat (i.e., food items) for species, such as Round Whitefish. The losses of the coarse substrate at moderate depths will have direct effects on Lake Trout, and Round Whitefish who are expected to use these substrates for spawning, rearing, and foraging in Whale Tail Lake. The total in-lake footprint in Mammoth Lake and Whale Tail Lake during construction and operations is expected to have a moderate effect on the abundance and distribution of VC fish species.

During closure, the draw-down of South Whale Tail Lake to natural elevation will begin in 2022 to contribute to the refilling of the open pit. The dewatered area of Whale Tail Lake (North Basin) will be refilled and the 68.56 ha of aquatic habitat will be returned to Whale Tail Lake in an altered state. Whale Tail Dike and Mammoth Dike are breached when i) the South side and the North side of the Whale Tail Dike are at the same water level (i.e., at natural water level) and ii) the water quality monitoring results meet pre-determined discharge criteria to allow water to naturally flow to the receiving environment. The physical and chemical environment of the area will allow re-establishment of a healthy functioning aquatic ecosystem. Natural currents and fish in the water will be able to move in and out of the area.

The area of the Whale Tail Pit within the dewatered area will be 43.5 ha, which will increase the surface area of Lake A17 (Whale Tail Lake) by 13%. The Whale Tail Pit represents a permanent loss of lake-bottom substrate habitat for benthic feeding or bottom dwelling species such as Round Whitefish and forage species such as Slimy Sculpin, but will include an extended water column as habitat for pelagic species such as Lake Trout and forage species. The upper level of the Whale Tail Pit may remain well-oxygenated through the winter due to its depth and may provide additional overwintering refugia for fish and thermal refugia for fish in summer.

The recovery or reversibility of effects from habitat losses on VC fish species will begin following closure when the diked area is breached. Most habitat functions will be recovered at the completion of refilling and before opening the dike, allowing for a quick return of the productivity, abundance and distribution of fish within the refilled area. The refilled area will initially be populated by most species and life-stages from adjacent habitat areas in Whale Tail Lake and Mammoth Lake. Full use of the habitat by VC fish species is expected to occur quickly and within a few years given the highly mobile behaviour of the species in the assessment area. Density-dependent compensatory effects may result in small, initial increases in population growth (i.e., fish production) because of new access to habitat behind the dike (Rose et al. 2001). Access to previously unavailable

habitat reduces overall population density, which can result in increases in vital rates, such as growth and reproduction, followed by increases in population size until densities are at carrying capacity. The maximum period for populations to approach densities of fish similar to other areas of Mammoth Lake and Whale Tail Lake is likely within one generation time[4] of VC fish species.

Fish-Out

Dewatering activities will take place in North Whale Tail Lake and a small portion of Mammoth Lake at the narrows between Whale Tail Lake and Mammoth Lake. Dewatering of the diked area will result in the temporary loss of fish production from Whale Tail and Mammoth lakes. Five species of fish are expected to be affected (Lake Trout, Arctic Char, Round Whitefish, Slimy Sculpin, and Ninespine Stickleback). Before the dewatering, a fish-out will be conducted to remove fish from the dewatered area.

Based on the equation provided in Samarasin et al. (2014), total fish biomass in Mammoth Lake (total area of 148 ha) was estimated to be 1,604 kg. The fish biomass in the dewatered area (including 0.067 ha for the dike footprint) was estimated to be 9.5 kg or 0.59% of Mammoth Lake's total fish biomass. Total fish biomass in Whale Tail Lake (total area of 166 ha) was estimated to be approximately 2,028 kg. The fish biomass in the dewatered area (including 3.98 ha for the dike footprint) was estimated to be 857 kg or 42.27% of Whale Tail Lake's total fish biomass.

For the two lakes combined, the total fish biomass was estimated to be approximately 3,936 kg using a total area of 314 ha in the Samarasin et al. (2014) equation. Fish biomass in the dewatered area was estimated using the combined dewatered area of both lakes (73.6 ha) and the presence of five species in that area into the biomass calculation equation (Section 6.5.3.2.1). The fish biomass in the dewatered area (including the dike footprints) was estimated to be 870 kg or 22.1 % the total fish biomass in both lakes combined. Assuming a mean overall fish weight of 0.26 kg (Agnico Eagle 2014c) and the baseline species composition in Whale Tail and Mammoth lakes, the fish-out would capture 1,168 Lake Trout, 57 Arctic Char, 375 Round Whitefish, 401 Slimy Sculpin, and 1,345 Ninespine Stickleback (3,346 total). Small numbers of Burbot may also be captured during the fish-out of the diked area.

The direct mortality from the fish-out in the assessment area is expected to result in measurable effects to the abundance and distribution of fish species in Mammoth and Whale Tail lakes. The recovery or reversibility of mortality effects from removal of fish during the fish-out on Mammoth and Whale Tail lake fish populations will begin during the operations phase, assuming environmental conditions are favourable in Whale Tail Lake South and in Mammoth Lake for high recruitment. If the density of fish remains unchanged in unaffected areas outside the dike, density-dependent responses should initially be minor, and vital rates, such as growth, survival, and reproduction should not change relative to baseline. A Conceptual Fish-Out Plan has been developed in consultation with DFO and presented in the FEIS (Volume 8; Appendix 8-E.4). DFO and affected Inuit communities will continue to be consulted during the DFO authorization phase of the Project to ensure measures and standards to avoid and mitigate serious harm to fish are approved, are of benefit to Inuit stakeholders and successful. The Final Fish-Out Work Plan may include a fish salvage (or transfer) to mitigate effects to fish mortality.

[4] Generation time can be defined as the average length of time for a sexually mature fish to be replaced by offspring with the same spawning capacity.

Habitat Fragmentation

Construction and operation of the Mammoth, Whale Tail, and Northeast dikes and diversions will result in effects to habitat connectivity in the A1 assessment area. The presence of the dikes will impede fish passage between Whale Tail Lake (Lake A17) and Mammoth Lake (Lake A16), and between these lakes and affected tributary habitats.

The Northeast dike will be constructed across two streams (Stream A46-A17 and Stream A50-A17), which are potential migratory corridors and foraging habitat for Arctic Char and Lake Trout. Stream and lake habitats, and any fish remaining above the Northeast Dike will effectively be isolated from Whale Tail and Mammoth lakes during the construction of the dike in 2019 until its removal in 2022. Although the productivity of the fishery may be affected, it is expected that fish populations above the Northeast Dike will be maintained because of continued access to habitats with the potential to provide overwintering, spawning, rearing, and foraging functions.

Habitat fragmentation will also occur between Whale Tail and Mammoth Lakes with the construction of the Mammoth dike. Fish passage between the two lakes will be eliminated while the dikes are in place from the beginning of their construction in 2018 to the breach of dikes in 2029. Each of the VC fish species (i.e., Arctic Char, Lake Trout, and Round Whitefish) are expected to function as two separate population units during the isolation of the dewatered area. Although the abundance of VC fish species may be initially affected by habitat fragmentation, any effects are expected to minor because of potentially low rates of movement of fish between lakes in the LSA (Section 6.5.2.2.2; Volume 6, Appendix 6-K). It is also expected that populations of VC fish species will be maintained in Mammoth and Whale Tail lakes during the construction and operation of the mine. Fish above and below the dewatered area will continue to have access to tributary streams and lakes (e.g., Lake A22, Stream A55-A17) that have the potential to function as spawning, rearing, and foraging habitat. At post-closure, the dikes will be breached, connecting habitats for populations in Whale Tail and Mammoth Lakes.

Habitat Alteration from Flooding

The construction of the Northeast Dike in 2019 will intersect with Streams A46-A17 and A50-A17, tributaries of Lake A17 (Whale Tail Lake). The dike and subsequent diversion of water will physically alter the configuration of watersheds and existing flow paths, affecting fish habitat within the LSA. Flooded tributary lakes from the Northeast Diversion include Lake A47, Lake A48, Lake A113, Pond A-P38, and Pond A-P68. Lake A46 is the most downstream lake under baseline conditions and will increase in elevation by 3.5 m and increase in surface area from 15 ha to 34 ha (Section 6.3.3.1.4.2). The result will be the incorporation of the upstream lakes into Lake A46, potentially providing access to new habitat for individual fish in Lake A46. Fish communities may become homogeneous between all lakes while the flooding is in place. Although fish composition varied between lakes (i.e., forage species only in some lakes) at baseline conditions, none of the flooded lakes were devoid of fish populations.

The alteration of fish habitat from the flooding above the Northeast Dike will affect five streams (total flooded length = 412 m), three of which are streams where Arctic Char were captured or are expected to occur (Table 6.5-6). Stream habitat losses, especially those used by forage fish species and juveniles of VC fish species, could affect the abundance of Arctic Char, Lake Trout, and forage fish species above the dike. Furthermore, species distributions have the potential to shift (i.e., expand distributions) as piscivorous fish (e.g., Lake Trout) gain access to forage fish populations in small lakes and ponds. The draw-down of the flooded area and subsequent breach of the dike will occur in 2022.

Table 6.5-6: Flooded Stream Habitat Resulting from the Northeast Dike Diversion

Stream Name	Total Length (m)	Flooded Length (m)	Percentage (%) of Stream Flooded	Fish Species Captured or Expected to Occur
A113-A47	205	156	76.2	NNST, SLSC[c]
A46-A17[a]	196	53	26.9	ARCH, NNST, SLSC
A47-A46	43	43	100.0	ARCH[c], NNST[c], SLSC
A48-A47[b]	65	65	100.0	NNST, SLSC
A50-A17[a]	485	95	19.6	ARCH, BURB, LKTR, NNST, SLSC

[a] Approximately 150 m of A46-A17 and 133 m of A50-A17 will be diverted because of the dike.

[b] Not fished; species expected to occur at this location are those at high flows (e.g., spring conditions) based on sampling performed in watershed.

[c] Species expected to occur at this location during high flow conditions based on sampling performed in watershed.

ARCH = Arctic Char, BURB = Burbot, SLSC = Slimy Sculpin, NNST = Ninespine Stickleback; LKTR = Lake Trout.

The Project footprint will also physically alter the configuration of the Lake A17 (Whale Tail Lake) watershed and existing flow paths during construction and operations. South Lake A17 (Whale Tail Lake) will increase in elevation by 3.5 m and increase in surface area from 369 ha to 513 ha during operations (Section 6.3.3.1.4.2). This increase in lake habitat for fish was one of the main reasons that the 'flooding' concept was chosen in the Multiple Account Analysis (Volume 1; Appendix 1-E). Flooded tributary lakes for the South Whale Tail Diversion Channel include Lake A18, Lake A19, Lake A20, Lake A21, Lake A22, Lake A55, Lake A62, Lake A63, Lake A65, Pond A-P1, and Pond A-P53.

Lake flooding will fully connect lakes that were partially isolated waterbodies prior to flooding (Table 6.5-7). The result will be the incorporation of the tributary lakes into Whale Tail Lake, potentially providing access to new habitat for individual fish in Whale Tail Lake. Fish communities may become homogeneous between all lakes while the flooding is in place. Although fish composition varied between lakes (i.e., forage species only in some lakes) at baseline conditions, none of the flooded lakes were devoid of fish populations.

The operation of the South Whale Tail Diversion Channel will also result in the flooding of tributary streams. Seven streams will be partially flooded and 10 streams will be completely flooded as a result of the diversion into and flooding of South Whale Tail Lake. A total of 1,988 m of stream habitat will be flooded (Table 6.5-7). Species that use these streams include Arctic Char, Lake Trout, Round Whitefish, Burbot, Slimy Sculpin, and Ninespine Stickleback (Table 6.5-7). Stream habitat losses, especially those inhabited by forage fish species and juveniles of large-bodied fish species, are expected to have a measurable effect on the abundance of Arctic Char, Lake Trout, Round Whitefish, and forage fish species that support the fishery. With flooding, most of the stream habitat would be eliminated with the increase in area of Whale Tail Lake (South Basin). Species distributions will have the potential to shift (i.e., expand distributions) as piscivorous fish (e.g., Lake Trout) gain access to forage fish populations in small lakes and ponds. At closure, Whale Tail Lake (South Basin) will be drawn-down by November 2022 when all tributary lakes and streams affected by the diversion will return to baseline conditions at this time.

Table 6.5-7: Flooded Stream Habitat Resulting from the Whale Tail Lake Diversion during Operations

Stream Name	Total Length (m)	Flooded Length (m)	Percentage (%) of Stream Flooded	Fish Species Captured or Expected to Occur
A18-A17	296	296	100.0	ARCH[b], LKTR, NNST, RNWH[b], SLSC
A19-A18	338	338	100.0	ARCH[b], LKTR[b], NNST[b], RNWH[b], SLSC[b]
A20-A19[a]	78	78	100.0	ARCH, LKTR, NNST, RNWH, SLSC
A21-A20[a]	40	40	100.0	ARCH, LKTR, NNST, RNWH, SLSC
A22-A21[a]	285	285	100.0	NNST, SLSC
A23-A22[a]	396	21	5.4	NNST, SLSC
A55-A17	197	197	100.0	ARCH, BURB[b], LKTR, NNST, RNWH, SLSC
A56-A55	610	30	4.9	BURB[b], LKTR[b], NNST[b], SLSC[b]
A59-A17	205	107	52.2	ARCH, NNST, SLSC
A62-A17	123	123	100.0	LKTR[b], NNST, SLSC[b]
A63-A18	122	122	100.0	LKTR[b], NNST[b], RNWH, SLSC
A64-A18[a]	416	52	12.4	NNST, SLSC
A65-A17[a]	176	176	100.0	LKTR, NNST, RNWH, SLSC
A66-A65[a]	290	67	23.0	LKTR, NNST, RNWH, SLSC
A67-A65[a]	588	14	2.4	LKTR, NNST, RNWH, SLSC
A68-A19[a]	195	22	11.2	NNST, SLSC
A-P53-A65[a]	20	20	100.0	NNST, SLSC

[a] Not fished; species expected to occur at this location during high flows (e.g., spring conditions) based on sampling performed in watershed.
[b] Species expected to occur at this location during high flow conditions based on sampling performed in watershed.
ARCH = Arctic Char, BURB = Burbot, SLSC = Slimy Sculpin, NNST = Ninespine Stickleback; LKTR = Lake Trout; RNWH = Round Whitefish.

6.5.3.3 Indirect Effects to Fish

Inuit concerns regarding fish populations and their habitat at mining developments include effects from changes to water quality and water flows (Cumberland 2005a). The following primary pathways on the indirect effects to fish and fish habitat from the Project are evaluated:

- During the construction of the Whale Tail, Mammoth, and WRSF dikes, water diversions will result in a reduction of water levels in Lake A16 (Mammoth Lake) and downstream locations, affecting fish and fish habitat.
- Refilling of the diked area in Lake A17 (Whale Tail Lake) and Lake A16 (Mammoth Lake) at closure will affect water levels in Lake A16 (Mammoth Lake) and downstream locations, resulting in effects to fish and fish habitat.
- Operational activities and discharge (e.g., discharge of treated domestic wastewater, altered drainage, runoff from facilities, including waste rock storage areas, pit inflows, dike seepage, release of nitrogen compounds from blasting residues) may change trophic status, affecting fish and fish habitat in Lake A16 (Mammoth Lake) and downstream waterbodies.

- Reconnection of the refilled area of Mammoth Lake and Whale Tail Lake to the remaining watershed and post-closure releases of water (e.g., seepage, waste rock storage area runoff) may change long-term trophic status in Whale Tail Lake, Lake A16 (Mammoth Lake) and downstream waterbodies, affecting fish and fish habitat.

6.5.3.3.1 Methods

Downstream Flows

Downstream changes to flows (i.e., habitat quantity) during both construction of the dikes and the flooding of the diked areas may affect the productivity of the fishery. Any effects are expected to occur through a process similar to that described for habitat loss (Section 6.5.3.2.1): changes in available habitat may affect fisheries productivity (e.g., yield) when a loss of habitat area causes a reduction in carrying capacity, resulting in a reduction of fish production, where fish production reflect vital rates (e.g., growth, survival, reproduction) and life history characteristics (e.g., fecundity, age at maturity) (DFO 2014).

The assessment of the effects of downstream changes in flows relied on a baseline database of species distributions in the LSA (Section 6.5.2; Volume 6, Appendix 6-D; Appendix 6-J; Appendix 6-K), combined with water level and discharge predictions reported in Hydrology Section 6.3.4. Details of the methods for predicting changes in downstream flows can be found in the Hydrology Baseline Report (Volume 6, Appendix 6-C).

Lake Ecosystem Productivity

Downstream changes to water quality can result in changes to the lower tropic community, affecting the productivity of the fishery. The fish and fish habitat section examines the potential indirect effects of nutrients inputs. Numerous studies (commonly referred to as “fertilization” studies or experiments) have documented changes in plankton and benthic community structure in sub-Arctic and northern temperate lakes in response to nutrient additions (Morgan 1966; Smith 1969; Welch et al. 1988; Hershey 1992; Jorgenson et al. 1992; Clarke et al. 1997; Johnston et al. 1999).

During construction through post-closure phase, the mine site will be a closed system with all contact water contained through ditches, berms, and dikes. All water running off the Whale Tail WRSF, and any water pumped from the open pits, will be collected through sumps and diverted to the Whale Tail Attenuation Pond, treated, then discharged to Mammoth Lake. All non-contact water that is diverted around the mine facilities will be drained through the natural flows in the LSA.

Mine effluent will be discharged to Mammoth Lake via a diffuser. Water quality predictions for the Project (mine site and receiving environment) were developed with a GoldSim™ mass balance model for Operations through Post-closure (for additional details see Section 6.4.3; Appendix 6-H). Water quality predictions were then compared to various standards (Section 6.4.3.3.1).

The analysis of potential effects related to predicted changes in water quality in Whale Tail Lake, Mammoth Lake, Lake A15, and Lake A12 considered the following components of fish and fish habitat:

- lower trophic communities, including phytoplankton, zooplankton, and benthic invertebrates;
- food base changes for fish production; and
- changes to physical habitat, including the availability of spawning habitat.

Effects on lower trophic communities from changes in water quality were predicted using qualitative methods, including an assessment of trophic classification of aquatic ecosystems based on nutrient concentrations (CCME 2004; Environment Canada 2004; Wetzel 2001), experience from effects monitoring at operating northern diamond mines, and the scientific literature on the effects of nutrient enrichment in lakes. Quantitative relationships between the physical/chemical features of sub-Arctic lakes and lower trophic community characteristics are not available; however, the relationship between nutrient concentrations and aquatic productivity has been well studied (Wetzel 2001; Environment Canada 2004). Lakes can be classified as oligotrophic, mesotrophic, or eutrophic based on low, moderate, and high levels of productivity. Evaluation of trophic status in Lake A16 (Mammoth Lake) and Lake A17 (Whale Tail Lake) considered predicted concentrations of dissolved phosphorus. The general trophic classification of lakes in relation to phosphorus based on CCME (2004; trigger values for phosphorus) is presented in Table 6.5-8.

Table 6.5-8: A General Trophic Classification of Lakes

Trophic Classification	Total Phosphorous (µg/L)
Oligotrophic	4-10
Mesotrophic	10-20
Eutrophic	35-100

Source: CCME (2004); Wetzel (2001).

6.5.3.3.2 Results

Downstream Changes to Flows

The greatest changes in downstream water quantity are expected during the construction of Whale Tail Dike and Mammoth Dike, and during the refilling of the diked area at closure (see Section 6.3.3). Potential effects to fisheries productivity include those from a reduction in water levels in downstream lakes and changes in the natural flow regime in stream connections within the A1 assessment area. Changes in flow can alter fish habitat through loss of available habitat area from reductions in channel width, or changes in habitat characteristics and fish passage through changes to flow depth and velocity conditions

Construction of the Whale Tail Dike and Mammoth Dike will occur over an 8-month period, continuing into the dewatering phase. During this period, construction activities are expected to reduce discharges and water levels at Lake A16 (Mammoth Lake), primarily from the reduction in drainage area from the Whale Tail Dike from June to August (inclusive), and from an additional reduction in drainage area from the Mammoth Dike (Table 6.5-9); also see Section 6.3.3.1.2.2). Effects on discharges and water levels diminish with increases in drainage area (i.e., at downstream locations). Discharges and water levels are expected to be slightly reduced at Lake A5, and changes are not expected to be measurable at Lake DS1.

Table 6.5-9: Changes in Discharge and Water Level at Lake A16 (Mammoth Lake) during the Construction Phase

Change	Peak Daily		Mean Monthly				
	2-Year	100-Year	June	July	August	September[a]	October[a]
Discharge (%)	-50	-47	-55	-65	-59	-66	-68
Water Level (m)	-0.19	-0.24	-0.16	-0.16	-0.11	-0.14	-0.13

[a] Results are based on construction of the Mammoth Dike in September 2018 and may be conservative if construction of the Mammoth Dike is delayed until winter conditions.

m = metre; % = percent.

The closure phase will occur over the period of refilling of Whale Tail Lake to baseline level, prior to breaching of the Whale Tail Dike and Mammoth Dike. Refilling of the diked area (open Whale Tail Pit and Whale Tail Lake [North Basin]) will be by pumping water from Whale Tail Lake (South Basin) and the Northeast area (Volume 6, Appendix 6-F). During the refilling period, water levels and discharges are expected to be reduced in Mammoth Lake from 2022 to 2029 (Table 6.5-10) and effects on discharges and water levels diminish with increases in drainage area (i.e., at downstream locations). A slight reduction in discharges and water levels is expected at Lake A5, and are not expected to be measurable at Lake DS1 (Section 6.3.3.1.5.2).

Table 6.5-10: Changes in Discharge and Water Level at Lake A16 (Mammoth Lake) during Closure

Change	Peak Daily		Mean Monthly				
	2-Year	100-Year	June	July	August	September	October
Discharge (%)	-58%	-55%	-65%	-76%	-69%	-66%	-68%
Water Level (m)	-0.24	-0.29	-0.20	-0.20	-0.14	-0.14	-0.13

m = metre; % = percent.

The water balance results for the Lake A16 (Mammoth Lake) and downstream lakes described in the hydrology assessment (Section 6.3.3) show that during construction and closure phases, monthly mean water levels will decrease from baseline values. The duration of the effects on lake habitats and the functions they provide (particularly rearing and foraging habitat) will persist up to 8 months during construction (from June 2018 to January 2019) and up to 8 years during closure (from 2022 to 2029). However, it is expected that the seasonal timing and pattern of lake level fluctuation will be maintained during construction and closure phases of the Project. Changes in water levels in Lake A16 (Mammoth Lake) and downstream locations are expected to have a moderate effect to population abundance and distribution for Arctic Char, Lake Trout, and Round Whitefish.

The water balance results for the Lake A16 (Mammoth Lake) outlet and downstream locations described in the hydrology assessment (Section 6.3.3) show that during construction and closure phases, monthly mean flows will decrease from baseline values. The duration of the effects on stream habitats and the functions they provide (including migration, rearing, and foraging habitat) will persist up to 8 months during construction (June 2018 to January 2019) and up to 8 years during closure (from 2022 to 2029).The timing window for fish use of affected streams may be limited to periods of high flow, such as the spring freshet period in June. Changes in flows in Lake A16 (Mammoth Lake) and downstream locations, particularly during the closure phase, are expected to have a moderate effect to population abundance and distribution for Arctic Char, Lake Trout, Round Whitefish, and forage species.

Changes to Lake Ecosystem Productivity

The effect of increased nutrient concentrations during operations and closures Lake A16 (Mammoth Lake) and downstream lakes (Section 6.4.3) may include a general increase in productivity at lower trophic levels, and shifts in composition of plankton and benthic invertebrate communities. Biomass of phytoplankton, zooplankton, and benthic invertebrates may also increase, as these communities take advantage of the increased nutrient supply. Shifts to overall community structure and dominant taxonomic groups may result. The increased nutrient concentrations may also affect fish growth and production from the increase in the food base, as well as potentially causing habitat effects (e.g., changes to conditions of spawning habitat). Therefore, primary pathways for fish and fish habitat include those related to indirect effects to support for fisheries productivity through changes in nutrient concentrations. Any residual effects of the Project on fish and fish habitat in Lake A17 (Whale Tail Lake), Lake A16 (Mammoth Lake), Lake A15 and Lake A12 during operations and closure are evaluated and described below. Any observed effects to the lake ecosystem through changes to water quality are expected to be reversible during post-closure, following the breach of the dikes. As described in Section 6.5.3, the majority of water quality parameters are expected to return to near baseline values in the LSA lakes during post-closure.

Phytoplankton

Phytoplankton biomass is expected to increase in Lake A16 (Mammoth Lake) and downstream lakes due to predicted increases in nutrient concentrations during operations and closure, but return to baseline conditions in post-closure. In general, increased concentrations of the limiting nutrient results in increased primary productivity and phytoplankton biomass. Arctic lakes can be limited by nitrogen or phosphorus, or be co-limited by both nutrients (Ogbego et al. 2009). As such, the phytoplankton community will typically be more responsive to additions of both phosphorus and nitrogen (Ogbego et al. 2009; O'Brien et al. 2005).

Based on conservative predictions of dissolved phosphorus concentrations, the meso-eutrophic trigger value will be exceeded in Mammoth Lake, Lake A15, and Lake A12 during operations and closure with a subsequent return to oligotrophic conditions expected to occur by 2039. The increase in lake productivity may result in altered species composition and shifts in dominance at the level of major phytoplankton group (Reynolds 1998). The observed dominance by chrysophytes in Mammoth Lake under baseline conditions may change to dominance by other groups, such as diatoms, chlorophytes, and dinoflagellates that usually dominate mesotrophic and eutrophic lakes (Wetzel 2001; Watson et al. 1997).

The functional size of algal species and the taxonomic division are known to be strongly correlated. Small algal species are generally more abundant in oligotrophic lakes, and the size of dominant algae often increases with trophic status (Wetzel 2001). As a lake becomes increasingly eutrophic, a potential increase in dominance by inedible algal species can be observed (Watson et al. 1997).

The magnitude of the increase in biomass and potential shift in community structure in Mammoth Lake, Lake A15, and Lake A12 will depend on nutrient concentrations, as well as environmental factors, such as light, temperature, mixing regime, and predation, which interact to regulate spatial and seasonal growth and succession of phytoplankton populations (Wetzel 2001). These interactions introduce potential uncertainty but, as they are not expected to change substantially over time, would not contribute to an under-prediction of effects.

Phytoplankton biomass is expected to decrease during the post-closure period due to decreases in nutrient concentrations. Phytoplankton communities would likely begin returning to baseline conditions during the post-closure period.

Zooplankton

The predicted increase in primary productivity in Mammoth and downstream lakes is expected to result in increased secondary productivity and biomass of the zooplankton community, reflecting the increased amount of available food for zooplankton. However, because energy transfer between trophic levels is inefficient (McCauley and Kalff 1981; Kalff 2002), the proportional increase in zooplankton biomass caused by increased nutrient concentrations will likely be lower than the increases in phytoplankton biomass. The coupling between zooplankton and phytoplankton interactions tend to be strongest in lakes of intermediate productivity (Elser and Goldman 1991) suggesting that a concomitant increase in zooplankton biomass may occur from the increase in total phosphorus concentrations (i.e., into the eutrophic range) in Mammoth Lake, Lake A15, and Lake A12.

Zooplankton biomass has been frequently found to be enhanced by nutrient enrichment of lakes. For example, LeBrasseur et al. (1978) found that whole-lake annual fertilizer treatment resulted in a five-fold increase in mean summer primary production and a nine fold increase in zooplankton standing stock. Other studies have also found that phosphorus enrichment can increase zooplankton biomass indirectly through enhanced food availability (Hanson and Peters 1984; Shortreed and Stockner 1986).

The composition of the baseline zooplankton community, which includes a dominance of rotifers in Mammoth Lake (Section 6.5.2.2.2.3), may also change. However, changes are difficult to predict because zooplankton species composition can be controlled by predation (i.e., top-down processes; McQueen et al. 1986; Carpenter 1989; Carpenter et al. 2001), resource availability (i.e., bottom-up processes; Clarke et al. 1997; O'Brien et al. 2005), or potentially a combination of these factors. An increase in productivity has the potential to alter size-dependent predatory interactions (Johnston et al. 1999). The potential for an increase in overall algal size could give larger zooplankton a competitive advantage. O'Brien et al. (2005) found that macro-zooplankton (*Daphnia*) were found to respond to enrichment in Arctic lakes with a two-fold increase in abundance, but micro-zooplankton (cyclopoid copepods) showed no response.

As noted for phytoplankton, a decrease in zooplankton biomass will likely occur through the post-closure period, as nutrient concentrations and phytoplankton production decrease.

Benthic Invertebrates

The response of the benthic invertebrate community to increased concentrations of nutrients is less predictable than that of plankton. Nutrient enrichment has sometimes been found to result in increased benthic invertebrate biomass (Rasmussen and Kalff 1987; Jorgenson et al. 1992; Clarke et al. 1997), but in some cases, no response to enrichment has also been documented (Dinsmore et al. 1999). O'Brien et al. (2005) found increased phytoplankton growth during nutrient addition, but mixed responses in macrozooplankton and benthic invertebrates, indicating that other factors (e.g., predation) also play a role in the Arctic food web.

Predicted increases in nutrient concentrations and primary productivity during operations and closure may result in an increase in benthic invertebrate abundance and biomass, reflecting the increased food supply. The response by invertebrates may be delayed by several years relative to the response by plankton, as observed by Hershey (1992) in an experimentally fertilized lake. The increase in biomass may also be less pronounced because invertebrates, such as chironomids, are also regulated by predation (Hershey 1992).

The benthic invertebrate community in Mammoth Lake consisted mostly of chironomids in the subfamilies Chironominae and Tanypodinae and fingernail clams during baseline studies conducted in 2014 and 2015 (Section 6.5.2.2.2.3), and the different taxonomic groups in the baseline community may respond differently to

increases in nutrients during operations. Taxonomic shifts in benthic invertebrate communities have been observed in studies of artificially fertilized lakes. For example, Jorgenson et al. (1992) observed varying responses by different invertebrate taxa to enrichment, ranging from two-fold increases in caddisfly biomass, to five to ten-fold increases in the biomass of amphipods. Some groups (e.g., snails) are able to take advantage of the increased food supply in fertilized lakes in the absence of predators, while abundances of others (e.g., chironomids) may be effectively controlled by predation (Hershey 1992). The timing and magnitude of benthic invertebrate response in whole-lake enrichment has been linked to life cycle duration and trophic role (Clarke et al. 1997). Clarke et al. (1997) found that short-lived herbivores such as chironomids, pisidiid clams, and gastropods exhibited faster and more pronounced responses to enrichment compared to longer-lived predatory taxa such as leeches and dragonflies. Studies have also shown that as lakes become increasingly eutrophic, there is a general reduction in the abundances of chironomids and other benthic animals, and a concomitant increase in oligochaete worm abundance (Wetzel 2001).

A decrease in benthic invertebrate biomass and a community shift back to near baseline conditions may accompany the ecosystem response during the post-closure period, as nutrient concentrations return to near baseline conditions. The accumulation of food resources in the benthic zone during operations and closure may cause a delayed recovery for benthic invertebrates, compared to the responses of zooplankton and phytoplankton communities.

Implications for Fish

The effect of increased primary and secondary production on fish in lakes is complex and is dependent on several factors including the physical and chemical conditions of the water and lake sediments (Schindler 1974), the complexity of the food web (Schindler 1974; Carpenter et al. 1985; Elser et al. 1990), the efficiency of energy transfers between trophic levels (McQueen et al. 1990; Micheli 1999), and the relative importance of “bottom-up” (i.e., resource availability) or “top-down” (i.e., predation) control of lake productivity (Power 1992; Carpenter et al. 1985; McQueen et al. 1986). Top-down and bottom-up controls both operate in aquatic ecosystems (McQueen et al. 1986; Power 1992) but the relative importance of top-down effects increases in oligotrophic systems (McQueen et al. 1986).

Studies have shown that nutrients, and in particular total phosphorus, control the rate of fish production in lakes (Colby et al. 1972; Plante and Downing 1993), including cold-water fish production (Dillon et al. 2004). For example, in fertilization experiments in Norway, Johannessen et al. (1984, cited in Dillon et al. 2004) found that the length and weight of Brown Trout (*Salmo trutta*) increased during the three seasons of fertilization (Johannessen et al. 1984 cited in Dillon et al. 2004). Whole lake fertilization experiments were also performed at small, oligotrophic lakes in Saqvaqjuac, in the Canadian central Arctic (1978 to 1983), where total phosphorus concentration was raised two to three-fold baseline concentrations depending on lake, starting from 0.005 to 0.007 mg/L. The Saqvaqjuac studies found increases in primary production and secondary production (i.e., macrobenthos) (Jorgenson et al. 1992; Welch et al. 1988, 1989), and increases in the abundance of fish populations in one of the experimental lakes as a result of the fertilization (Jorgenson et al. 1992). During whole-lake experimental fertilization of a small, oligotrophic Arctic lake in Alaska, the researchers found increased primary productivity, chlorophyll *a,* and snail density; Lake Trout density was not affected by the manipulation, but growth and average size increased (Lienesch et al. 2005). The increased growth during the period of fertilization was considered to be due to the increased food availability (Lienesch et al. 2005).

As a result of the increased nutrients in Lake A16 (Mammoth Lake) and downstream lakes during operations and closure, it is expected that there will be increases in the lower trophic food base for fish, potentially resulting in numerical increases in forage fish such as Slimy Sculpin (through increases in growth and reproduction rates). Because of the increased food base (lower trophic levels and forage fish), there may also be a minor increase in growth and reproduction rates for Arctic Char, Lake Trout, and Round Whitefish. Other environmental factors associated with the potential change in trophic status during operations and closure will also play a role in the response of the fishery in the assessment area

There may be challenges for coldwater species, such as Lake Trout and Arctic Char, in shallow lakes in the Arctic with respect to oxygen depletion during winter due to the length of the season with ice cover, the depth of the ice, and potential lack of inflows. With increased nutrient levels during operations and constructions, and related increases in phytoplankton production, winter respiration rates may increase and DO concentrations may decline (Lienesch et al. 2005).

However, habitat quality is only one of many factors that may affect reproduction rates. Marsden et al. (1995) indicated that Lake Ontario is eutrophic and yet, under certain conditions, supports relatively high Lake Trout egg survival. In studies of interstitial water quality at Lake Trout spawning sites, Sly (1988) found that although some of the spawning habitats studied were degraded, the extent to which this affected reproductive success was uncertain. Lake Trout also were proven to be highly adaptable to spawning habitat disturbances and repeatedly selected new sites in lakes in northern Ontario when previous spawning sites were covered with opaque plastic sheeting. The new sites were also found to produce alevins (i.e., newly hatched fish with yolk sac) indicating that recruitment was not eliminated by the habitat disturbances (Gunn and Sein 2004).

For most of operations and closure, winter DO concentrations in Mammoth Lake and downstream lakes are expected to be within the range of baseline values, and at levels that meet the criteria for optimum habitat for fish spawning and nursery (i.e., that levels remain above 6.5 mg/L; CCME 1999a). A moderate reduction in available overwintering habitat though oxygen depletion is expected in late winter for Mammoth Lake and downstream lakes, and most likely occurring during closure when lake water levels are affected from refilling of the diked areas. It is anticipated that changes to winter habitat conditions may affect populations of Arctic Char, Lake Trout, and Round Whitefish. However, effects will be reversible during post-closure when nutrient levels return to baseline conditions. It is predicted that residual effects to VC fish species through changes to food resources and available habitat will either not be measurable or will be measurable but minor at post-closure.

6.5.4 Residual Impact Classification

The assessment and classification of residual impacts was based on the predicted cumulative changes from reference conditions through application of the Project and into the future case, which was not considered for fish and fish habitat because there are no other reasonably foreseeable developments in the assessment area where residual effects are predicted. All sources of information (i.e., existing and collected data, new analyses, existing publications, and IQ) were considered equally in the classification of residual impacts. The spatial boundary of the assessment for Project impacts is at the assessment scale of the regional study area. The incremental effects from the Project relative to current baseline conditions are classified, and there are no differences in the outcome of impact criteria between cumulative and incremental effects from the Project given that there are no existing or reasonably foreseeable developments in the assessment area. For fish and fish habitat, the magnitude for cumulative impacts, which involves changes from reference conditions through application of the Project and into the future case, is the same as described for incremental impacts, which are based on changes from the Project

relative to baseline values. Specific definitions for the criteria used for residual impact classification are provided in Volume 3, Appendix 3-E.

Project-related effects on fish and fish habitat (Section 6.5.3) will primarily be a result from direct habitat losses (i.e., footprint changes) from the construction of the Mammoth and Whale Tail dikes, the Whale Tail Pit, the dewatering and fish out of the diked area in Mammoth Lake and Whale Tail Lake (where the pit will be located), and the flooding of Whale Tail Lake from the diversion (Table 6.5-11). The total footprint of the diked area in Mammoth and Whale Tail lakes is approximately 69.6 ha (22.1% of the area for the two lakes combined, and 6.8% of total lake area in the assessment area). Habitat losses for Arctic Char, Lake Trout, and Round Whitefish will include reductions in coarse substrate habitat at both shallow depths (0 to 2 m) and moderate depths (2 to 6 m), resulting in a relative overall loss of 25.2% of the coarse substrate habitat in Mammoth and Whale Tail Lakes combined. These changes are expected to have a measurable effect on Arctic Char, Lake Trout, and Round Whitefish, species that rely on coarse substrate habitat for spawning, and rearing in Mammoth and Whale Tail lakes.

Table 6.5-11: Summary of Residual Effects from Direct Changes to Habitat in the Assessment Area

Effect	Number of Lakes	Total Area of Lakes Affected (ha)	% Lake Area Affected in Assessment Area	Number of Streams	Total Length of Streams Affected (m)	% Stream Length Affected in Assessment Area
Dikes	2[a]	4.1	0.4	2[b]	283[b]	1.1
Dewatering	2[a]	65.5	6.4	1[c]	173	0.7
Flooding	17	267.6	25.7	22	2,402	9.1

[a] Whale Tail and Mammoth lakes.

[b] Streams A46-A17 and A50-A17 where 97 m will be under the dike footprint and 183 m downstream of the dike will be diverted.

[c] Whale Tail Lake outlet (Stream A17-A16).

The construction of the dike and the fish-out and subsequent dewatering of the diked areas is expected to have a moderate impact on the fishery (Arctic Char, Lake Trout, and Round Whitefish), occurring on a regional scale. Most of the residual effects from direct changes in habitat will be long-term in duration and reversible following refilling, breach of dikes, and reconnection of habitats. Residual effects from the fish-out are expected to be short-term in duration. Residual effects from direct losses of lake habitat from the dike (sections remaining at post-closure) and the open pit development are expected to be permanent, but are expected to be low in magnitude and occur at the local scale (Table 6.5-12).

The construction and operation of the Northeast Dike and Whale Tail Dike and their associated diversions will result in the flooding of tributary streams, affecting the abundance and distribution of VC fish species. Five streams will be flooded from the Northeast Dike and Diversion, and 17 streams will be flooded as a result of the diversion into and flooding of Whale Tail Lake (South Basin) for a total of approximately 2,402 m of stream habitat altered (Table 6.5-12). Species that use these streams include Arctic Char, Lake Trout, Round Whitefish, Burbot, Slimy Sculpin, and Ninespine Stickleback. With flooding, most of the stream habitat would be eliminated with the increase in elevation (and area) of Whale Tail Lake (South Basin). Species distributions also have the potential to shift (i.e., expand distributions) as piscivorous fish (e.g., Lake Trout) gain access to forage fish populations in small lakes and ponds.

The effects of flooding from the Project dikes and diversions are possible, and effects, if any, are expected to be low in magnitude, medium-term in duration, and occur at the local scale (Table 6.5-12). It is important to note that flooding will result in an overall increase in fish habitat with the increase in elevation (and area) for the affected lakes (i.e., lakes above the Northeast and Whale Tail dikes).

Construction and operation of the Mammoth, Whale Tail, and Northeast dikes and diversions will also result in effects to habitat connectivity. The presence of the dikes will impede fish passage between Whale Tail Lake and Mammoth Lakes, and between these lakes and affected tributary habitats. Although effects to VC fish species are expected, fish populations above and below any barriers are expected to be maintained. Habitats with the potential to provide overwintering, spawning, rearing, and foraging functions will remain available for populations during construction through post-closure. Fragmentation effects related to the Project dikes are expected to be low in magnitude, long-term in duration, and occur at the regional scale. Any effects would be reversible when the dikes are breached at closure (Table 6.5-12).

The amount of direct changes to fish habitat and biomass from the Project is expected to result in moderate residual effects to Arctic Char, Lake Trout, and Round Whitefish, and the forage species that support the fishery. The effects to the fishery are expected to be moderate. Although the relationship between habitat quantity and productivity is assumed to be linear, it is expected that the relationship is curvilinear starting with an upper plateau followed by a sharp decline in productivity beyond a certain threshold (DFO 2014). The expected threshold of habitat loss where the upper plateau breaks may be in the range of 20 to 30% for fish VCs because abundant habitat remains for VC fish species and operational flooding will increase lake habitat in Whale Tail Lake (South basin).

The geographic extent of all direct effects combined are regional (i.e., measurable at the scale of the assessment area). Although some habitat losses will be permanent (e.g., as recently determined by DFO the open pit in Whale Tail Lake (North Basin) is presently assumed to provide zero habitat value during closure), most, if not all residual effects to the fishery will be reversible. Following closure, recovery may occur within one generation time for populations of VC fish species to approach densities in other regions of the assessment area. The predicted short recovery period assumes environmental conditions are favourable for high recruitment during post-closure, and that density-dependent compensatory mechanisms play a key role in recovery (Rose et al. 2001). Rapid increases in population growth (i.e., fish production) are expected because of new access to habitat behind the dikes.

Residual effects to fish and fish habitat will result from the Project though indirect pathways (Section 6.5.3) related to hydrology (Section 6.3) and water quality (Section 6.4). The water balance results for the Lake A16 (Mammoth Lake) and downstream lakes (Section 6.3.3) show that lake water levels and outlet discharges will decrease from baseline values during construction and closure phases as described in Section 6.5.3.3.2. The main effects of reduced water depths and volumes of Mammoth Lake and downstream lakes include a reduction in available foraging and rearing habitat. A similar effect is expected for streams below Mammoth Lake where the timing window for fish use of affected streams may be limited to periods of high flow, such as the spring freshet period in June.

Project activities resulting in downstream reductions in flows during construction and closure phases are expected to have a moderate impact on Arctic Char, Lake Trout, and Round Whitefish, occurring on a regional scale. Residual effects will be short-term in duration for the construction pathway and medium-term in duration for the refilling pathway (Table 6.5-12).

The effect of increased nutrient concentrations to Mammoth Lake, and downstream lakes during operations and closure may result in a general increase in productivity at lower trophic levels. Biomass of phytoplankton, zooplankton, and benthic invertebrates will likely increase during this period, as described in Section 6.5.3.3.2. In addition, possible shifts in overall community structure and dominant taxonomic groups may result due to the meso-eutrophic trigger value being exceeded in Mammoth Lake, Lake A15, and Lake A12 during operations and closure with a subsequent return to oligotrophic conditions expected by 2039. Due to the increased food base (lower trophic levels and forage fish), there may also be a minor increase in growth and reproduction rates in the VC fish species, and the forage fish that support the fishery.

An increase in nutrient levels in Mammoth Lakes and downstream lakes may also result in a moderate increase in algae or sediment on lake habitats, including spawning shoals, leading to possible reductions in oxygen levels. Reductions in oxygen levels are expected during closure after conservative estimates of multiple years of accumulation of organic debris and when lake water levels are reduced during refilling of Whale Tail Lake. Reductions in oxygen levels may affect egg survival and the availability of suitable habitat for spawning and rearing Arctic Char, Lake Trout, and Round Whitefish.

A general increase in nutrient levels is expected to result in negative residual effects to the fishery in response to any changes in trophic status during closure and operations (Table 6.5-12). During the post-closure period, plankton and benthic invertebrate communities are expected to return to baseline conditions. The physical and chemical environment of the diked area will allow re-establishment of a healthy functioning aquatic ecosystem. Natural currents, fish, and other aquatic life in the water will be able to move in and out of the area, connecting habitat for fish and lower trophic communities in Whale Tail and Mammoth Lakes. Residual effects from changes in nutrient levels are expected to have a moderate impact on fish and fish habitat, occur at the regional scale, and be long-term in duration with effects being reversible during post-closure (Table 6.5-12).

Table 6.5-12: Residual Impacts Classification for Arctic Char, Lake Trout, and Round Whitefish (Fishery) Valued Components

Effects Pathway	Direction	Magnitude		Geographic Extent		Duration	Frequency	Reversibility	Likelihood
		Incremental	Cumulative	Incremental	Cumulative				
Construction of the dikes and Whale Tail Pit will result in the direct loss of fish habitat	Negative	Low	Low	Local	Local	Long-term to Permanent	Continuous	Reversible to Irreversible	Likely
Dewatering of the diked area will result in the direct loss or alteration of fish habitat	Negative	Moderate	Moderate	Regional	Regional	Long-term	Continuous	Reversible	Likely
Dewatering of the diked area will result in the removal and subsequent mortality of fish	Negative	Moderate	Moderate	Regional	Regional	Short-term	Infrequent	Reversible	Highly likely
The construction of the dikes will alter access to tributary streams and lakes (i.e., habitat connectivity), resulting in habitat loss	Negative	Low	Low	Regional	Regional	Long-term	Continuous	Reversible	Likely
Flooding from the Whale Tail and Northeast dikes will alter habitat in tributary lakes and streams	Negative	Low	Low	Local	Local	Medium-term	Continuous	Reversible	Possible
Water diversions during construction will result in a reduction of water levels and flows at downstream locations	Negative	Moderate	Moderate	Regional	Regional	Short-term	Continuous	Reversible	Likely
Refilling of the diked area will affect water levels and flows at downstream locations	Negative	Moderate	Moderate	Regional	Regional	Medium-term	Continuous	Reversible	Likely
Operational activities and discharge may change trophic status in downstream waterbodies	Negative	Moderate	Moderate	Regional	Regional	Long-term	Continuous	Reversible	Likely
Reconnection of the refilled area of Mammoth Lake and Whale Tail Lake to the remaining watershed and post-closure releases of water may change long-term trophic status at downstream locations	Negative	Moderate	Moderate	Regional	Regional	Long-term	Continuous	Reversible	Likely

Note: The Project is anticipated to have negligible residual effects on fish and fish habitat outside of the A1 assessment area.

6.5.5 Cumulative Effects Assessment

The database of existing and reasonably foreseeable future developments (Volume 3, Appendix 3-D) indicates that there are no existing or planned developments (other than the Project) that would contribute to cumulative effects to fish and fish habitat within the RSA. Any measurable effects of the Project to the productivity of the fishery (or support for the productivity of the fishery) will be restricted to the A1 assessment area within the RSA.

6.5.6 Assessment of Significance

The effects from the Project are expected to not have a significant adverse effect on fish and fish habitat VCs based on the weight of evidence from the analysis of primary pathways. Although Project-related effects are expected to be measurable at the population level for Arctic Char, Lake Trout, and Round Whitefish, the likelihood of any risk to the ongoing productivity of the fishery (or ongoing support for the productivity of the fishery) in the RSA are low. The Project is anticipated to have negligible effects on fish and fish habitat outside of the A1 assessment area. Furthermore, loss or alteration of habitat is not expected to cause permanent adverse changes to survival or reproduction at a population level. Loss or alteration of habitat is also not expected to cause permanent adverse changes to survival or reproduction at a population level through any effects to fish movement and population connectivity that would otherwise disrupt the potential for demographic rescue between adjacent lakes. Any unavoidable effects to the productivity of the fishery, for example, from the construction of dikes and subsequent fish-out and dewatering of the dike area, will include offsetting measures, described in the offsetting plan (Volume 8, Appendix 8-E.4), with the goal of maintaining or improving the productivity of a fishery. The resilience of the regional fishery will be maintained through the implementation of environmental design features and mitigation for the Project.

6.5.7 Uncertainty

The purpose of this section is to identify the key sources of uncertainty and to discuss how uncertainty has been addressed to increase the level of confidence that impacts are not worse than predicted. Confidence in the assessment of environmental significance is related to the following elements:

- water balance modelling inputs and results (Volume 6, Appendix 6-C);
- water quality modelling inputs and results (Volume 6, Appendix 6-H);
- adequacy of baseline data for understanding current conditions and future changes unrelated to the Project (e.g., extent of future developments, climate change, catastrophic events);
- understanding of Project-related impacts on complex ecosystems that contain interactions across different scales of time and space (e.g., exactly how the Project will influence fish and fish habitat); and
- knowledge of the effectiveness of the environmental design features and mitigation for reducing or removing impacts (e.g., best management practices).

The procedure for addressing uncertainty in scientific study is the same procedure in environmental assessment. All scientific predictions must be tempered with uncertainty associated with the data and the current knowledge of the system while recognizing that ecosystems are inherently complex. Describing variation and understanding factors that underlie variation in the ecology of VC fish species through time can be a common challenge in environmental assessment, particularly when there is a lack of information. Factors underlying variation might

include stochastic processes (e.g., sampling biases) or deterministic processes (e.g., climate change influences, overharvesting).

For the Project, the fish and fish habitat data collected in the RSA provides the necessary baseline knowledge of species biology and environmental conditions for an environmental assessment. Any trends in fisheries data described in the baseline summary are consistent with other baseline programs in the region, including those conducted for the Meadowbank Mine including:

- Annual Reports (Agnico Eagle 2009, 2010, 2011, 2012a, 2013, 2014c, 015);
- Fish-Out Reports (Agnico Eagle 2009, Appendix C6; Agnico Eagle 2011, Appendix H; Agnico Eagle 2014c, Appendix G14);
- Meadowbank Baseline Aquatic Ecosystem Report (Cumberland 2005d);
- Whale Tail Core Receiving Environment Monitoring Program (Volume 6, Appendix 6-G); and
- Phaser Lake Fish Offsetting Plan (Agnico Eagle 2016d).

Furthermore, baseline data was collected over a wide spatial scale, and includes information on fish relative abundance, species distributions, habitat, species life history, and lower trophic communities for a region where there is very little historical and existing development.

There is some uncertainty of the behavioral response of VC fish species to the construction of the dikes and the degree to which individuals will adapt to changes in the access to historical spawning locations or to changes in the condition of historical spawning locations (e.g., related to flooding). There is also some uncertainty in habitat functions of features of the Whale Tail Pit or remnants of the dike at post-closure. However, direct disturbance to habitat was calculated to be a small proportion of the effects assessment area, and there is a high level of confidence that the calculation represents a reasonable estimate of the aquatic footprint. The relative loss of habitat (in terms of percentages) compared to that available within the assessment area will remain similar even if the footprint area is refined as the Project advances the detailed design. Effects to fishery productivity will remain moderate in magnitude under the conservative assumption that the relationship between habitat quantity and productivity is assumed to be linear.

There is a high level of confidence that any effects from the alteration of fish habitat due to flooding has not been overestimated. Although fish habitat for tributary streams for Whale Tail Lake will be altered (most of which is ephemeral), there will be an increase in elevation (and area) of lake habitat above the Northeast Dike and the Whale Tail Dike (e.g., Whale Tail Lake [South Basin]). For this pathway, the environmental assessment has conservatively assumed that effects will be negative and low in magnitude despite the predicted increase in available lake habitat during construction and operations.

Although there is a moderate to high level of certainty that the productivity of the fishery will recover when the diked area is reconnected to Mammoth and Whale Tail lakes, there is a level of uncertainty with respect to the duration of effects post-closure. Key factors to consider include the capacity of the population to recover (i.e., resiliency), potential functions of reclaimed habitat for fish, and future environmental conditions. It is expected that most species and life stages of fish in Mammoth and Whale Tail lakes will be able to move into and exploit the recovered habitat immediately after the dike has been breached initiating the population recovery. Furthermore, a compensatory density-dependent response is expected to underlie the recovery of species

(i.e., increasing growth and reproduction rates) beginning when the dike is breached (e.g., Rose et al. 2001). This is a typical response when population densities are reduced and new habitat becomes accessible, which in turn promotes a numerical increase in populations.

Quantifying changes to habitat provides a static assessment of a species' environment, ignoring change that may occur over time as a result of ecological succession and climate change. Thus, there is less certainty in long-term predictions (e.g., over periods of up to 10 to 20 years post-closure), compared to near-term predictions. There is a high level of confidence that the plankton, benthic invertebrate, and fish populations and communities in the study area will be different with or without the Project in future decades, mainly because of climate change (Walther et al. 2002; Mawdsley et al. 2009), and that the magnitude of effects and spatial scales associated with climate change are much greater than those related to interactions between the Project and fisheries productivity.

6.5.8 Monitoring and Follow-up

Aquatic ecosystem monitoring during all phases of the Project will be conducted to validate assessment conclusions. This Amendment includes plans where monitoring activities for evaluating the short-term and long-term effects on the physical, chemical, and biological components of the aquatic ecosystems will provide the necessary input for the implementation of adaptive management through the lifespan of the Project. Section 6.47 describes the monitoring and management plans applicable to water quality. Aquatic ecosystem monitoring will be implemented through a variety of monitoring plans. More details are provided in the individual plans, but those applicable to fish and fish habitat include the following:

- Dike Construction Monitoring Plan (Section 6.4.7; Volume 8, Appendix 8-A.2);
- Water Management Plan (Section 6.4.7; Volume 8, Appendix 8-B.2);
- Water Quality and Flow Monitoring Plan (Section 6.4.7; Volume 8, Section 8.3.2, Appendix 8-B.3);
- Spill Contingency Plan (Volume 8, Appendix 8-D.6), which will be implemented to prevent effects from emergency spills and help address Inuit concerns related to effects to fish and fish habitat;
- Core Receiving Environment Monitoring Plan (Volume 8, Appendix 8-E.2), developed in accordance with the renewed Type A Water Licence to monitor mining-related processes that could potentially impact the aquatic receiving environment surrounding the Project, including fish;
- Habitat Compensation Monitoring Plan) developed in consultation with DFO during the Phaser Lake authorization phase (Agnico Eagle 2016d); and
- Conceptual Fisheries Offsetting Plan (Volume 8, Appendix 8-E.4), which will include a commitment to discuss with Fisheries and Oceans Canada any requirements for follow-up monitoring of potential impacts to the fishery from the Project.

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APPENDIX 6-A

Hydrogeology Baseline Report

June 2016
Report No. 1541520

AGNICO EAGLE

Golder Associates

June 2016

AGNICO EAGLE MINES LIMITED: MEADOWBANK DIVISION

Hydrogeology Baseline Report - Whale Tail Project

Submitted to:
Agnico Eagle Mines Limited
Ryan Vanengen
Environment Superintendent

REPORT

Report Number: Doc 055-1541520

Distribution:

1 copy: Agnico Eagle Mines Limited
1 copy: Golder Associates Ltd.

Golder Associates

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1.0 INTRODUCTION

Agnico Eagle Mines Limited – Meadowbank Division (Agnico Eagle) is proposing to develop Whale Tail Pit, a satellite deposit located on the Amaruq property, in continuation of mine operations and milling of the Meadowbank Mine. The Amaruq Exploration property is a 408 square kilometre (km^2) site located on Inuit Owned Land approximately 150 kilometres (km) north of the hamlet of Baker Lake and approximately 50 km northwest of the Meadowbank Mine in the Kivalliq region of Nunavut (Figure 1-1). The property was acquired by Agnico Eagle in April 2013 subject to a mineral exploration agreement with Nunavut Tunngavik Incorporated.

The Meadowbank Mine is an approved mining operation and Agnico Eagle is looking to extend the life of the mine by constructing and operating Whale Tail Pit and Haul Road (the Project), which is located on the Amaruq Exploration property. As an amendment to the existing operations at the Meadowbank Mine, the Project is subject to an environmental review established by Article 12, Part 5 of the *Nunavut Land Claims Agreement* (NLCA). Baseline data have been collected in support of the Environmental Review to document existing conditions and to provide the foundation for a qualitative and quantitative assessment of Project operations and the extension of the mine development, to be evaluated in the Environmental Impact Statement (EIS) for the Project.

This report presents the results of the hydrogeology baseline conditions for the Project. The baseline conditions presented in this report represent an update to the initial characterization conducted by Knight Piésold (2015a, b).

1.1 Hydrogeology Study Area

The hydrogeology baseline study area (Hydrogeology BSA) for the Project forms an irregular polygon approximately 24,000 hectares in area (Figure 1-2). Whale Tail Lake and the site of the proposed Whale Tail Pit are located in the central-eastern area of the Hydrogeology BSA.

The elevations of large lakes within the Hydrogeology BSA range from approximately 99.8 metres above sea level (masl) at DS1, located over 5 km to the north of Whale Tail Lake, to 170.5 masl at A60, located approximately 750 metres (m) southeast of Whale Tail Lake.

Whale Tail Pit

Meadowbank Mine to Whale Tail (71.5 km)

Vault Pit

Baker Lake to Meadowbank Mine (107.5 km)

Baker Lake

Pipedream Lake

Tehek Lake

Schultz Lake

Baker Lake

7012

7014

7001

7009

7013

7016

7912

N

560000 580000 600000 620000 640000 660000 680000 700000 720000

7260000 7240000 7220000 7200000 7180000 7160000 7140000

LEGEND

- COMMUNITY
- PROPOSED HAUL ROAD
- ALL WEATHER ROAD
- WHALE TAIL PIT
- MEADOWBANK OPERATION AND INFRASTRUCTURE
- CLAIM BOUNDARY
- WATERCOURSE
- WATERBODY



REFERENCE

1. HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200_R0.dwg
2. CLAIM BOUNDARIES OBTAINED FROM AGNICO EAGLE MINES LIMITED.
3. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
4. INSET MAP DATA OBTAINED FROM ESRI.

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

12 0 12

KILOMETRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

PROJECT LOCATION

Golder Associates

PROJECT		1541520	FILE No.	
DESIGN	JR	24 Mar. 2016	SCALE AS SHOWN	REV. 0
GIS	CDB	24 Mar. 2016		
CHECK	JR	09 May 2016		
REVIEW	LY	09 May 2016		

FIGURE 1.1

Y:\burnaby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Whale_Tail\99_PROJECTS\1541520_FEIS\02_PRODUCTION\FEIS\MXD\1300_Documentation\1340_Project_Description\Report\1541520_FIG_1.1-1_PROJECT_LOCATION.mxd

Y:\burnaby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Whale_Tail\99_PROJECTS\1541520_FEIS\02_PRODUCTION\FEIS\MXD\2100_Hydrogeology\Report\1541520_FIG_01_HYDROGEOLOGY_LSA.mxd

590000 595000 600000 605000 610000 615000

7265000 7260000 7255000 7250000 7245000

N

DS1

DS1

DS2

A81

A16

A60

A65

Nemo Lake

Whale Tail Pit

Mammoth Lake

Whale Tail Lake

LEGEND

- HYDROGEOLOGY BASELINE STUDY AREA
- LAKES WITH TALIK
- WATERBODY (NO TALIK OR OUTSIDE STUDY AREA)
- WATERCOURSE

WHALE TAIL

- BORROW SOURCE
- INFRASTRUCTURE
- PROPOSED HAUL ROAD
- GROUNDWATER FLOW DIRECTION



REFERENCE

1. WHALE TAIL INFRASTRUCTURE OBTAINED FROM AGNICO EAGLE MINES LIMITED ON DECEMBER 21, 2015.
3. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
4. INSET MAP DATA OBTAINED FROM ESRI

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

2 0 2

KILOMETRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

HYDROGEOLOGY BASELINE STUDY AREA

Golder Associates

PROJECT		1541520	FILE No.	
DESIGN	JL	06 Apr. 2016	SCALE AS SHOWN	REV. A
GIS	MH	06 Apr. 2016		
CHECK	JR	06 Jun. 2016		
REVIEW	JL	08 Jun. 2016		

FIGURE 1-2

2.0 METHODS

The baseline study presents the hydrogeological conditions before Project initiation. Baseline conditions are also used for future reference in identifying environmental changes and for qualitative and quantitative evaluation of potential changes to groundwater regimes. The methods used to characterize the baseline conditions consisted of the following:

- compilation and review of hydrogeological testing data collected near the Project area;
- review existing baseline studies;
- review available data collected at the Meadowbank Mine because these operations provide relevant site analogues;
- review pertinent studies published in the literature; and
- interpretation of information to develop the conceptual hydrogeological model of the area surrounding the Whale Tail Pit.

2.1 Data Review

2.1.1 Review of Existing Baseline Studies

Knight Piésold (2015a, b) completed an initial assessment of permafrost and hydrogeological conditions in the area of the Whale Tail Pit and developed a conceptual model to provide preliminary predictions of groundwater inflow in the open pit during operations. Data collected by Knight Piésold and used in this updated baseline study included hydraulic conductivity test results, depth to permafrost, and groundwater quality, as documented in Sections 2.1.3, 2.1.4, and 3.1, respectively.

Primary changes that were made to Knight Piésold's conceptual model included the expansion of the conceptual model to the regional study limits and some modification to the hydrostratigraphy. Modifications to the hydrostratigraphy included the incorporation of overburden, from which groundwater storage can significantly affect groundwater inflow/outflow predictions during pit dewatering and pit refilling, and refinement in the estimated hydraulic conductivity of the competent bedrock with depth. Where changes were made to the hydrostratigraphy, these changes were designed to provide conservative estimates with respect to the prediction of groundwater inflow and the prediction of potential project impacts on groundwater during closure.

2.1.2 Lake Elevations and Bathymetry Data

Where available, approximate elevations of lakes near the Project were obtained from the local topographic survey data as documented in the Whale Tail Baseline Hydrology Report (Golder 2016a). Where local survey data were not available, approximate lake elevations were obtained from the National Topographic System (NTS) map sheets published by the Government of Canada.

Lake bathymetric data (measured as lake bottom depth below water surface) for select lakes were provided by Agnico Eagle.

2.1.3 Hydrogeologic Testing

Knight Piésold (2015a, b) completed a site investigation program to characterise the hydrogeological and thermal regime in the vicinity of the proposed open pit. The program consisted of the following installations/tests:

- Three 200 m long multi-point thermistor strings targeting the potential talik below Whale Tail Lake in the immediate vicinity of the open pit. A vibrating wire piezometer was installed at the base of the each thermistor.
- One 450 m long multi-port thermistor string installed in an area approximately 350 m away from the influence of the lake. This instrument was installed to assess the baseline permafrost conditions.
- Two 500 m long multi-port thermistor strings targeting the potential talik below the centre of Whale Tail Lake and the expected base of permafrost.
- An electrical conductivity (EC) data logger installed in conjunction with one of the 200 m thermistor strings in drillhole AMQ15-349A. The EC logger was installed to attempt to measure in-situ Total Dissolved Solids (TDS) and salinity.
- Three wells targeting the potential talik below Whale Tail Lake in the immediate vicinity of the open pit. The wells ranged in length from approximately 180 to 255 m.
- Eighteen constant head hydraulic conductivity packer tests were completed in six drill holes. Testing was completed using an HQ-sized standard wireline packer system.

Results of the 2015 field program are documented in Knight Piésold (2015a, b; included in Attachment A). In addition, a subsequent summary table was provided by Knight Piésold that indicated which of the packer tests potentially intersected faults. This summary table, which provides details on the wells, packer test intervals, and reported hydraulic conductivity, is included in Attachment A.

2.1.4 Groundwater Quality

Knight Piésold (2015b) installed three drill holes to collect representative groundwater samples from the Project. One well was developed following installation, but the heat trace was damaged, the drill hole froze, and sampling could not be conducted. Despite repeated well development from the other two drill holes, inflow rates were low and therefore groundwater samples collected from these locations had high salinity concentrations that are attributed to the brine solution used to install the monitoring wells. The samples collected, therefore, are not representative of the natural groundwater quality, likely due to the low permeability and frozen conditions in areas presumed to be an active talik.

Based on the similar geology and permafrost conditions, Knight Piésold considered the groundwater quality data from the Meadowbank Mine are likely to be similar to the groundwater conditions in the vicinity of the Whale Tail Pit; although, it is recognized that on a parameter-by-parameter basis, groundwater quality at Whale Tail may differ from Meadowbank Mine due to site-specific geology.

Agnico Eagle began a new groundwater sampling program during the winter of 2016. To improve the chance of successfully recovery of representative groundwater samples, a Westbay multi-level well system was installed in April 2016 and is currently being developed. This monitoring device will be used to provide long-term monitoring of groundwater quality over the life of mine and following closure.

3.0 HYDROGEOLOGICAL SETTING

The information presented in this section incorporates information presented in Knight Piésold (2015a, b) and the Terrain, Permafrost, and Soils Baseline Report (Golder 2016b).

3.1 Permafrost

The Project is located in an area of continuous permafrost. In this region, the layer of permanently frozen subsoil and rock is generally deep and overlain by an active layer that thaws during summer. The depth of the active layer is typically expected to range between one and three metres (Golder 2012). Depending on lake size, depth, and thermal storage capacity, the talik beneath lakes may fully penetrate the permafrost layer resulting in an open talik. The thickness of the permanently frozen permafrost was estimated to be 425 m (Knight Piésold 2015b). Knight Piésold further estimated that a layer of perennially cryotic but unfrozen ground at the base of the permafrost that could extend to a depth of 460 m; however, this analysis was partially based on a TDS measurement from a well impacted by brine used during well installation. Considering the uncertainty in the analysis of the basal cryopeg and to be conservative with respect to predictions of groundwater quantity and quality, a permafrost thickness of 425 m was used in hydrogeological assessment of the Project.

In areas of continuous permafrost, there are two groundwater flow regimes: a deep groundwater flow regime beneath permafrost, and a shallow groundwater flow regime located in the active (seasonally thawed) layer near the ground surface. Because of the thick layer of low permeability permafrost, there is little to no hydraulic connection between these two flow regimes in areas where there are no open taliks.

3.2 Shallow Groundwater Regime

The shallow groundwater flow regime is active only seasonally during summer, and the magnitude of the flow in this layer is expected to be several times less than runoff from snowmelt (Woo 2011). Within the active layer, the water table is expected to be generally a subdued replica of topography and roughly parallel to the topographic surface. Hydraulic gradients in the Project area are estimated from topography to range from approximately 0.005 to 0.09 m/m and the annual groundwater velocities are in the order of 0.004 to 0.08 m per day. Groundwater in the active layer primarily flows to local depressions and ponds that drain to larger lakes; therefore, the total travel distance would generally extend only to the nearest pond, lake, or stream.

During winter, land is underlain by seasonal frost, which is in turn underlain by permafrost. From late spring to early autumn, when temperatures are above 0^0C, the seasonal frost in the active layer becomes thawed. Water in the active layer is stored in ground ice during the cold season, and then released when it thaws in late spring or early summer, thus providing flow to surface waterbodies (Woo 2011). During the warm season, groundwater in the active layer is recharged primarily by infiltration of precipitation falling on the land surface.

The thickness of the active layer is variable and depends on several factors. The most important factors are the thaw index, thermal resistance of the vegetative cover, moisture content, and composition of soil or rock. In general the active layer thickness at the end of the summer season is expected to range from 1 to 3 m of the ground surface.

Permafrost reduces the hydraulic conductivity of the bedrock by several orders of magnitude (Burt and Williams 1976; McCaultey et al. 2002). Consequently, the permafrost in the rock would be virtually impermeable to groundwater flow. The shallow groundwater flow regime, therefore, has little to no hydraulic connection with the deep groundwater regime which is overlain by massive and continuous permafrost.

3.3 Deep Groundwater Regime

Water levels in lakes overlying open taliks provides the driving force for groundwater flow in the deep groundwater regime. Taliks (areas of unfrozen ground) exist beneath lakes that have sufficient depth so that they do not freeze to the bottom over the winter. If the lake is sufficiently large and deep, the talik can extend down to the deep groundwater regime. These taliks are referred to as open taliks. If the talik does not extend down to the deep groundwater, it is referred to as a closed or an isolated talik. Recharge to the deep groundwater flow regime is predominantly limited to open taliks.

Generally, deep groundwater will flow from higher-elevation lakes with open taliks to lower-elevation lakes with open taliks. To a lesser degree, groundwater beneath the permafrost is influenced by density differences due to saline water conditions (density-driven flow).

Taliks are to be expected where lake depths are greater than 2 m. Formation of an open-talik, which penetrates through the permafrost, would be expected for lakes that exceed a critical depth and size. The salinity of groundwater also influences the temperature at which the groundwater will freeze.

The permafrost and talik conditions below Whale Tail Lake and near the Whale Tail Open Pit have been characterised by Knight Piésold (2015a, b). Thermistors were installed in six drillholes around the periphery of the proposed open pit and Whale Tail Lake to collect data on the ground thermal regime. Knight Piésold concluded the following:

- Permafrost is expected below the land and the shallowest parts of Whale Tail Lake. The depth of the permafrost is estimated to be approximately 425 m.;
- Based on data for Baker Lake (120 km to the south), and from experience ice auguring within the Meadowbank Project Lakes in the winter, the mean maximum lake ice thickness over Whale Tail Lake is expected to be 2.25 m. During the winter collection of water quality baseline data in Whale Tail Lake in April 2016, ice thickness was confirmed to be 2.0m (Eric Franz of Azimuth pers. comm).
- A talik is expected below the central portions of Whale Tail Lake. In the shallower and narrower parts of Whale Tail Lake, the talik is likely underlain by permafrost (closed talik).
- Talik conditions within the vicinity of the proposed open pit are likely to be between 100 to 200 m in depth and underlain by permafrost.
- The talik is expected to form a continuous channel that is closed in the northern portion of Whale Tail Lake below the open pit and becomes open towards the south and central portion of the lake.

The width and shape of other lakes in the Hydrogeology BSA were reviewed to estimate if open taliks could be present below the lakes. Based on 1-D analytical solutions presented in Burn (2002), Golder estimated that open taliks could be present for circular lakes with a radius of approximately 300 m and for elongated lakes with a half-width of approximately 150 m. Beneath smaller lakes that do not freeze to the bottom over the winter, a talik bulb may form; however the talik bulb is not expected to extend to the deep groundwater flow system (i.e., a closed talik will form). Based on these criteria, all lakes in the Hydrogeology BSA meeting the minimum radius or half width are assumed to be underlain by open taliks that connect these lakes to the deep groundwater flow regime. This assumption is conservative as some lakes within sufficient radius/width may be shallow and, therefore, may not be underlain by taliks. Figure 1-2 presents the assumed locations of lakes with open taliks.

3.4 Groundwater Usage

Groundwater sources from the active layer and from the deep groundwater below the permafrost are not currently used for drinking water or a project-related use in the Project area; nor are they currently used in other continuous permafrost regions in Canada. Due to the presence of deep permafrost, the seasonal nature of the active layer, and the availability of good-quality drinking water from surface water sources near the Project, groundwater will not be used as a drinking water source in the future.

4.0 HYDROSTRATIGRAPHY

The Project is underlain by three main hydrostratigraphic units composed of overburden, weathered rock, and competent rock. In addition to these three units, enhanced permeability zones (EPZs) may potentially be present. Relatively competent bedrock is assumed to comprise the majority of the rock domain, and the hydraulic conductivity of the competent rock is assumed to decrease with depth.

The information presented in this section incorporates information presented in Knight Piésold (2015a, b) and the Terrain, Permafrost, and Soils Baseline Report (Golder 2016b).

4.1 Overburden

The Project area is dominated by veneers and blankets of till overlying undulating bedrock. The till has a silty sand matrix and clasts that range from granule gravel to large boulders in size. Glaciofluvial deposits in the form of eskers and terraces are found in the northeast section of the satellite deposit study area and they continue in a southeast direction intersecting the haul road study area in several locations. The deposits are composed of well sorted fine- to coarse-grained sand and varying amounts of granule, pebble and cobble gravel. These deposits tend to be thick but are often found adjacent to exposures of bedrock. Organic and fluvial deposits are rare, but where they do exist, they are thin (less than 1 m) and overlie till (Golder 2016b).

Overburden thickness in test holes completed by Knight Piésold near the peripheral of Whale Tail Lake ranged from approximately 4 to 13 m, as inferred from the reported depth to bedrock relative to the top of the borehole casing. In the area of the planned dikes, the combined thickness of lakebed sediments and the glacial till ranges from less than 1 m and up to 5 m (Agnico Eagle 2015b). An average thickness of 6 m was estimated based on both sets of data.

Hydraulic conductivity testing of the overburden has not been conducted in the Project area. The hydraulic conductivity of the shallow overburden beneath Whale Tail was estimated to be 2×10^{-6} metres per second (m/s) (Cumberland 2005) based on testing in the Meadowbank area. Overall, this assumed hydraulic conductivity is greater than the underlying bedrock and, therefore, is not expected to restrict groundwater flow from the overlying lakes.

4.2 Bedrock

The bedrock geology in the Project region consists of Archean and Proterozoic supercrustal sequences and plutonic rocks. In the study area, the Woodburn Lake Group (Archean supercrustal sequence) was intruded by orogenic granites, which in turn were unconformably overlain by a Proterozoic basin deposit known as the Amer Group (Sherlock et al. 2001; Zaleski 2005).

The Woodburn Lake Group is a sequence of Archean supercrustal rocks which are thought to have been deposited in a continental rift setting (Zaleski 2005). The group is composed of:

- a variety of ultramafic to felsic volcanic and volcaniclastic rocks, iron-formation, and related sedimentary rocks;
- quartz arenite, conglomerate, and related sedimentary rocks; and
- arkosic wacke and mudstone that are interlayered with iron formation (NRCAN 2015).

Although the Woodburn Lake Group is Archean, several phases of deformation have affected the stratigraphy, with four events recognised regionally (Sherlock et al. 2001).

The Amer Group was formed during the Early Proterozoic and is a succession of terrestrial and marine sedimentary rocks which outcrop in the north part of the study area near the satellite deposit. This group is composed of quartzarenite, carbonate rock, carbonaceous shale, siltstone, mudstone and sandstone, and tectonized mafic volcanic rock. It overlies the Neoarchean granite and lesser supercrustal rocks of the Woodburn Lake Group (NRCAN 2015).

4.3 Shallow Bedrock

In the Canadian Shield, the uppermost 10 to 30 m of bedrock is generally more highly fractured and correspondingly has greater hydraulic conductivity than the deeper underlying more competent rock, as has been observed where hydrogeologic testing data have been collected in shallow unfrozen bedrock (De Beers 2010; Golder 2005). This greater level of fracturing in the shallow rock is present as a result of the formation of stress relief joints due to isostatic rebound following glacial retreat. These stress relief joints are preferentially oriented horizontally, likely resulting in greater horizontal than vertical hydraulic conductivity in shallow rock.

The hydraulic conductivity of the shallow bedrock was assumed to be 1 x 10^{-7} m/s; one order of magnitude higher than the competent bedrock, where testing has been conducted (Section 4.4).

4.4 Competent Bedrock

Results of the packer testing conducted by Knight Piésold (2015a) indicate the hydraulic conductivity of the bedrock ranges from less than 1 x 10^{-9} m/s (the reported precision of the packer tests) to 5 x 10^{-8} m/s. Knight Piésold reported that there was uncertainty as to whether all of the tests were completed in talik and indicated that two of the packer tests (completed in AMQ15-349A) were thought to be completely within the talik. These two tests had a reported hydraulic conductivity estimate of 1 x 10^{-8} m/s and 5 x 10^{-8} m/s. The latter of these tests, 5 x 10^{-8} m/s, was also reported to be conducted in a depth interval that may have intersected a fault (NW / EW Brittle Fault; Table 1 of Attachment A). Two other packer tests that potentially intersected faults had reported hydraulic conductivity estimates of 1 x 10^{-9} m/s.

The geometric mean of all packer tests with measurable hydraulic conductivity values was 4 x 10^{-9} m/s (i.e., excluding tests with a reported hydraulic conductivity below the precision of the test method [1 x 10^{-9} m/s]). In general, single-well response tests have been found to underestimate large-scale hydraulic conductivity. This effect is observed as singe single-well response tests are conducted over a small-scale volume of rock near the well screen and are more often representative of the lower-permeability rock composed of poorly connected and small aperature discontinuities. It was therefore considered reasonable to conservatively assume the hydraulic conductivity of the competent bedrock was up to three times higher (approximately 1 x 10^{-8} m/s). This value is also the maximum of the measured packer test results that were not inferred to intersect faults or potential EPZs.

The shallowest hydraulic conductivity measurement was between 50 and 100 m along hole; whereas, the deepest measurement was between approximately 328 and 425 m along hole. Further reduction in hydraulic conductivity with depth is expected below the tested intervals, however, the hydraulic conductivity of competent bedrock has been assumed to remain constant at greater depths. Based on experience at Meadowbank, potential higher hydraulic conductivities could be present at shallower depths. Between the base the weathered bedrock and 60 mbgs, the hydraulic conductivity of the bedrock was therefore assumed to be up to three times higher (3×10^{-8} m/s).

4.5 Enhanced Permeability Zones with Associated Faults

In crystalline rocks, fault zones may act as groundwater flow conduits, barriers, or a combination of the two in different regions of the fault depending on the direction of groundwater flow and the fault zone architecture (Gleeson and Novakowski 2009). Agnico Eagle has identified evidence of large scale structures at the Project based on the results of geophysical surveys, exploration drilling, surface mapping and topographic interpretation. The dominant structural orientation is east north east (ENE) – west south west (WSW), which is the trend of the deposit lithologies. Knight Piésold (2015a) also identified the presence of a series of diffuse ductile structures that trend northeast (NE) – southwest (SW), which offset both the lithologies and the mineralization near the Project, and a sub-horizontal set of structures.

The faults are typically less than one metre thick (though some may be in the order of ten metres thick) and consist of zones of broken rock and fault gouge. Limited hydraulic conductivity testing has been conducted to assess the continuity and permeability of these structures, and it is unknown if these features would act as EPZs. Although multiple EPZs associated with structural features may be present near the Project, it is expected that the hydrogeologic importance of each individual EPZ will be variable. Of the three tests that may have intersected structures, the hydraulic conductivity ranged between 1×10^{-9} m/s and 5×10^{-8} m/s, which does not indicate enhanced permeability above the surrounding competent bedrock.

For the purpose of assessing the potential groundwater quality and quantity of inflow to the Whale Tail Pit, the potential impact of EPZs will be assessed on groundwater inflow and quality. Two EPZs generally trending in a similar direction to the observed structure will be incorporated in the analysis. The faults will be assumed to be vertical and 10 metres wide with a hydraulic conductivity of 2×10^{-7} m/s. One fault is assumed to strike northwest – southeast and hydraulically connect Whale Tail Lake to the Whale Tail Pit. The second fault was assumed to strike northeast – southwest. The EPZs were assumed to be continuous and hydraulically connected over large distances (kilometres) from the open pit.

4.6 Summary of Hydrostratigraphy and Estimated Hydraulic Properties

The conceptual model for the site consists of three hydrostratigraphic units composed of overburden, weathered rock and competent rock. Areas of enhanced permeability associated with structures such as fault zones may also be present, although present packer test data do not indicate the permeability of the structures intersected to date are higher than the surrounding competent bedrock. In developing the conceptual model, a reasonably conservative approach was taken so that the actual magnitudes of groundwater inflows (quantity and quality) to the open pits during operations are expected to be less.

Overburden and weathered bedrock are limited to the near surface, whereas relatively competent bedrock is assumed to comprise the majority of the rock domain. The hydraulic conductivity of competent rock is assumed

to decrease with depth. The assumed hydraulic properties of hydrostratigraphy units near the Whale Tail Pit, and the potential EPZs, are summarized in the Table 4-1. Permafrost is assumed to be essentially impermeable.

Table 4-1: Hydrogeological Parameters

Hydrostratigraphic Unit	Depth Interval (m)	Base Case Hydraulic Conductivity (m/s)[a]	Specific Storage (1/m)[b]	Specific Yield (-)[b]	Effective Porosity (-)[b]	Longitudinal Dispersivity (m)[d]	Transverse Dispersivity (m)[d]	Effective Diffusion Coefficient (m^2/s)
Overburden	0 to 6	2×10^{-6}	1×10^{-4}	0.2	0.2	10	1	2×10^{-10}
Weathered bedrock	6 to 34	1×10^{-7}	2×10^{-4}	0.03	0.03	10	1	2×10^{-10}
Competent bedrock	34 to 60	3×10^{-8}	1×10^{-05}	0.0006	0.001	10	1	2×10^{-10}
Competent bedrock	>60	1×10^{-8}	1×10^{-05}	0.0006	0.001	10	1	2×10^{-10}
EPZ[c]	-	5×10^{-7}	1×10^{-4}	0.01	0.01	10	1	2×10^{-10}

a) Derived from hydraulic testing results as presented in Golder (2016). Ratio of vertical to horizontal hydraulic conductivity assumed to 1:1.

b) Parameter values within ranges documented in literature (Maidment 1992; Stober and Bucher 2007).

c) The EPZs are included as their effect, if present, on groundwater inflow quantity and quality will be assessed as part the Environmental Assessment for the Project. Two EPZs are assumed to be potentially present, both are assumed to be vertical and 10 m wide. One EPZ was assumed to strike northwest – south east and hydraulically connect the Whale Tail Pit to Whale Tail Lake. The second EPZ was assumed to strike northeast – southwest. The EPZs were assumed to be continuous and hydraulically connected over large distance (kilometres) from the Project area. Hydraulic conductivity estimated from maximum packer test value of 5×10^{-8} m/s and the width of the packer test within the tested interval.

d) Values are consistent with literature values (Schulze-Makuch 2005).

m = metre; m/s = metres per second; m^2/s = metres squared per second.

5.0 GROUNDWATER QUALITY

5.1 Water Quality Summary

Groundwater quality was evaluated by Knight Piésold; however, the water quality was contaminated by drilling fluids and deemed to not be representative of the formation water. Knight Piésold used the dataset from Meadowbank to infer groundwater quality, until site specific groundwater samples can be collected. The following water quality information is summarized from Knight Piésold (2015b), which is included in Attachment A.

Knight Piésold (2015b) extracted groundwater chemistry data from Appendix A of the Meadowbank Gold Mine – 2014 Groundwater Monitoring Report (Agnico Eagle 2015a). The Meadowbank groundwater data have been collected since 2003 from monitoring wells targeting talik zones in the vicinity of the mine facilities. Summary statistics are provided in Table 2 of Knight Piésold (2015b) for general parameters (pH, conductivity, alkalinity, sulphate, hardness and total dissolved solids [TDS]), dissolved metals, dissolved anions, nutrients, and cyanide. The groundwater data were compared to the Canadian Environmental Quality Guidelines for the Protection of Freshwater Aquatic Life (CEQG; CCME 2015) and the Health Canada Guidelines for Canadian Drinking Water (HC-DW; Health Canada 2014).

Groundwater quality at the Meadowbank Mine is generally described as being hard to very hard, with neutral to slightly basic pH and good buffering capacity. TDS concentrations range from 193 to 1,900 mg/L. Concentrations of fluoride, copper, iron, and selenium were elevated in comparison to guidelines for the protection of aquatic life and drinking water. Only the higher percentile values for nitrogen-containing compounds, aluminum, arsenic, boron, hexavalent chromium, molybdenum, and zinc exceeded the CEQGs.

Additionally, several of these parameters, as well as chloride, manganese and sodium, exceeded aesthetic drinking water guidelines.

5.2 Total Dissolved Solids

In the Canadian Shield, TDS in groundwater increase with depth, primarily in response to upward diffusion of deep-seated brines. The chemicals that contribute to TDS in shield brines are typically chloride and calcium, with sodium to a lesser degree. By comparison, sea water is mostly composed of chloride and sodium.

At the Project, a representative sample of deep groundwater has not been collected; data collected at the Meadowbank Mine was used to infer the TDS profile at the Project. Figure 5-1 presents the TDS profiles with depth from sites in the Canadian Shield and that of the Meadowbank Mine. The Frape and Fritz profile (1987) was developed based on chemical analyses of deep saline water collected by various investigators from several sites in the Canadian Shield. The Diavik Profile is based on site-specific data from Diavik, supplemented by information from the Lupin Mine site located about 200 km north of Diavik (Blowes and Logsdon 1997). The assumed Meadowbank profile presented in Figure 5-1 is based on site-specific data collected from depths up to 177 m and parallels the Diavik profile at deeper depths (Golder 2006).

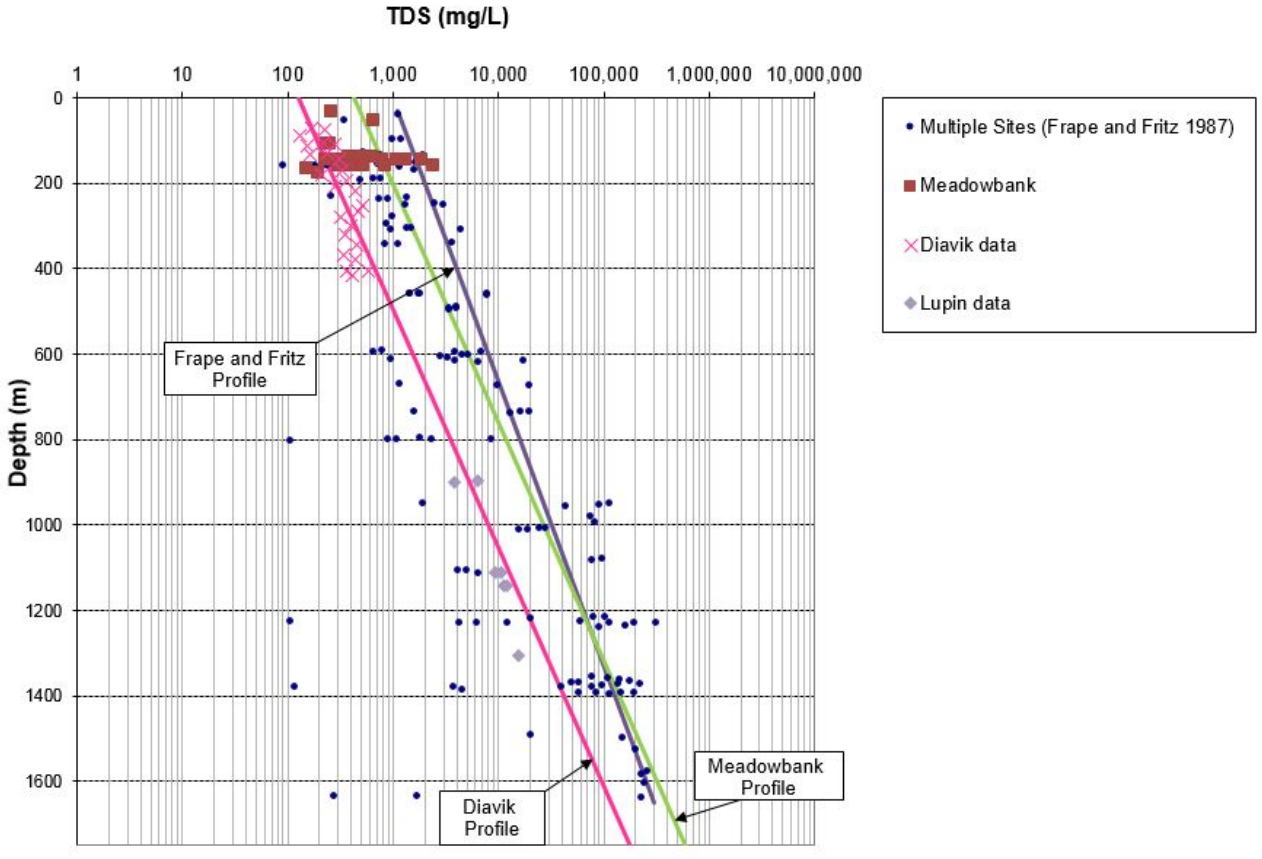


Figure 5-1: Baseline TDS versus Depth

6.0 SUMMARY OF CONCEPTUAL HYDROGEOLOGICAL MODEL

Available hydrogeological data collected at the site, together with the information collected elsewhere in the Canadian Shield, were used to develop a conceptual understanding of groundwater conditions at the Project site. A conceptual hydrogeological model is a pictorial and descriptive representation of the groundwater regime that organizes and simplifies the site conditions so they can be readily modelled. The conceptual model must retain sufficient complexity so that the analytical or numerical models developed from it adequately reproduce or simulate the actual components of the groundwater flow system to the degree necessary to satisfy the objectives of the modelling study. The baseline conceptual model has been developed to describe key features of the hydrogeological regime in the baseline study area before mining. The key features include the groundwater flow, groundwater quality, and dominant groundwater flow direction, all of which are described in more detail below. The baseline conceptual model is presented in Figure 6-1 and described below.

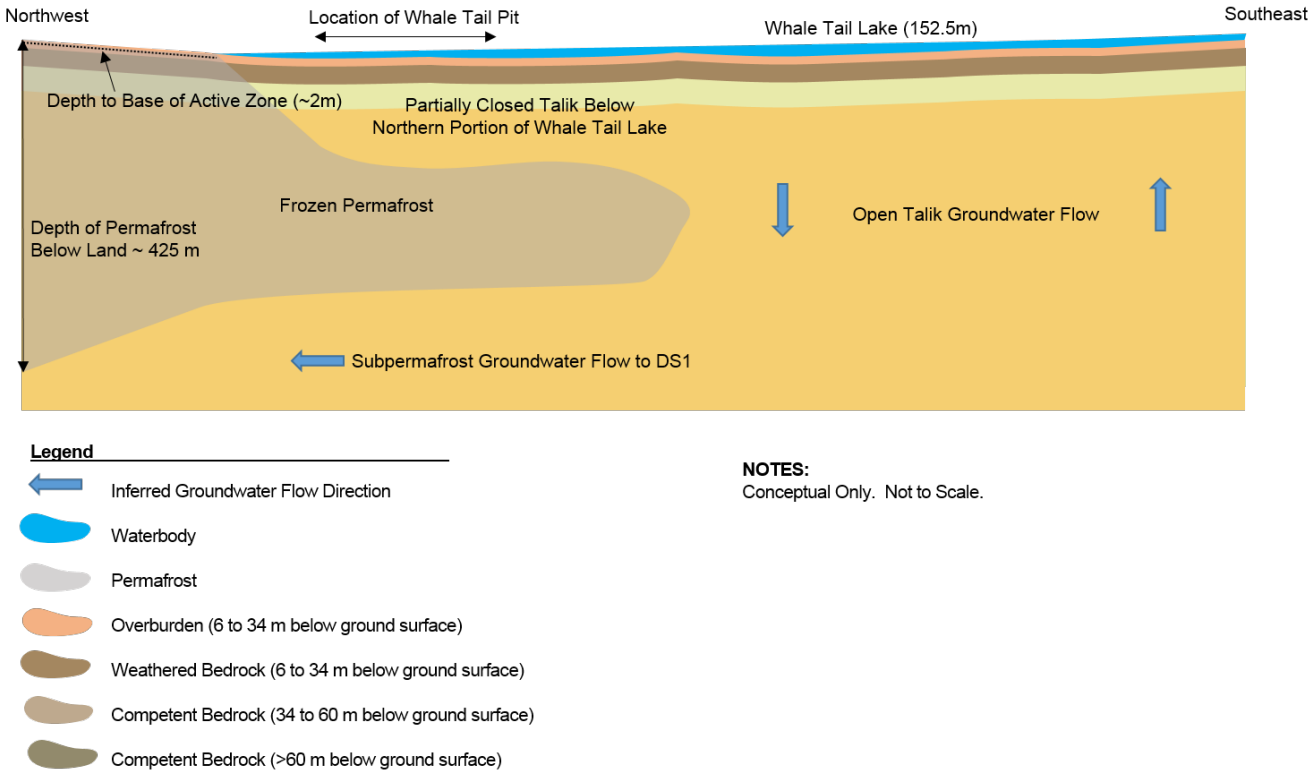


Figure 6-1: Conceptual Model of Deep Groundwater Flow Regime - Pre-mining Cross-Section View

The conceptual model for the site consists of three hydrostratigraphic units composed of overburden, weathered rock and competent rock. Areas of enhanced permeability associated with structures such as fault zones may also be present. Overburden and weathered bedrock are limited to the near surface, while relatively competent bedrock is assumed to comprise the majority of the rock domain.

Two groundwater flow regimes occur at the Project: a deep groundwater flow regime beneath permafrost, and a shallow groundwater flow regime located in the active (seasonally thawed) layer near the ground surface. With the exception of areas of taliks beneath lakes, the two groundwater regimes are isolated from one another by

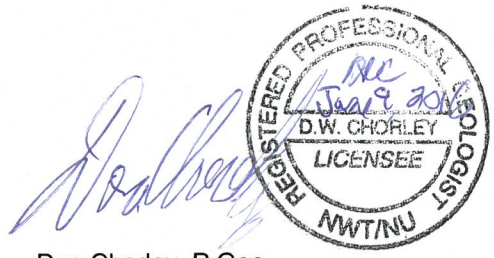
thick permafrost. The depth of the active layer is estimated to range between 1 to 3 m. Permafrost thickness in the baseline study area is expected to be approximately 425 m. Below Whale Tail Lake, the talik is expected to form a continuous channel that is closed at the base of the talik in the northern portion of Whale Tail Lake below the open pit and becomes an open talik towards the south and central portion of the lake.

Groundwater flow within the deep groundwater flow regime is limited to the sub-permafrost zone. This deep groundwater flow regime is connected to the ground surface by open taliks underlying larger lakes. The elevations of these lakes are expected to be the primary control of groundwater flow directions in the deep groundwater flow regime, with density gradients providing a secondary control. The elevations of these lakes in the baseline study area indicate that Whale Tail Lake is likely both a groundwater recharge and discharge zone.

Groundwater quality at the Project has been inferred to be similar to the Meadowbank Mine based on the similar geology and permafrost conditions (Knight Piésold 2015b); however, it is recognized that on a parameter-by-parameter basis, groundwater quality at the Project may differ from the Meadowbank Mine due to site-specific geology. Consistent with other sites in the Canadian Shield, concentrations of TDS in groundwater are inferred to increase with depth, primarily in response to upward diffusion of deep-seated brines. The Meadowbank TDS profile is considered applicable to the Project and is based on the site-specific data from the Meadowbank Mine up to depths of 177 m, and parallels the Diavik profile at greater depths (Golder 2006). Agnico Eagle began a new groundwater sampling program during the winter of 2016. A Westbay multi-level well system was installed in April 2016 and is currently under development. The water samples taken for this instrument will allow the development of a site specific TDS profile and confirmation of inferred groundwater quality for the Project.

Report Signature Page

GOLDER ASSOCIATES LTD.



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JL/DC

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.https://capws.golder.com/sites/p1524321amaruqwhaletailbaselineandeis/eis/documentation/vol_6_freshwater/appendices/appendix 6-a baseline hydrogeology.docx

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ATTACHMENT A

Knight Piésold Reports and Packer Test Summary Table

Knight Piésold CONSULTING

TABLE 1

AGNICO EAGLE MINES LTD. MEADOWBANK DIVISION
WHALE TAIL PIT

2015 GEOMECHANICAL AND HYDROGEOLOGICAL SITE INVESTIGATION SUMMARY
DRILLHOLE PACKER TESTING SUMMARY

Print Jan/29/16 17:07:42

Drillhole Name	Surveyed Drillhole Details						Hydraulic Testing				
	Collar Coordinates [1]			Azimuth [2] (Average)	Dip [2] (Average)	Final Length	Along-Hole Packer Testing Interval		Constant Head Test Results [3]	Test Interval Lithology	Fault Intersection
	Easting	Northing	Elevation								
	(m)	(m)	(m)	(°)	(°)	(m)	From (m)	To (m)	(m/s)		
AMQ15-294	607,073.2	7,255,676.1	10,155.9	321	-46	221	100.3	150.0	1×10^{-9}	Altered Ultramafics, Ultramafics, Quartz Veins	Yes (RQD Corridor)
							201.8	220.5	9×10^{-9}	Ultramafics, Graphitic Chert and Chert	No
AMQ15-306	606,714.8	7,255,363.8	10,154.9	98	-47	201	52.3	100.5	$< 1 \times 10^{-9}$	Greywacke	Yes
							103.3	162.0	$< 1 \times 10^{-9}$	Greywacke	No
							178.3	201.0	$< 1 \times 10^{-9}$	Greywacke	Yes
AMQ15-316	606,655.1	7,255,428.2	10,154.1	5	-55	189	181.3	189.0	$< 1 \times 10^{-9}$	Ultramafics	No
AMQ15-326A	606,430.9	7,255,330.8	10,154.6	288	-57	180	160.3	180.0	No Take	Ultramafics	No
AMQ15-349A	607,064.9	7,255,627.5	10,155.3	202	-47	203	97.3	141.0	5×10^{-8}	Ultramafics and Greywacke	Yes (NW/East Brittle Fault)
							136.3	180.0	1×10^{-8}	Mafic Volcanics, Greywacke and Ultramafics	Yes
							178.3	202.5	$< 1 \times 10^{-9}$	Mafic Volcanics	Yes
AMQ15-421	607,098.3	7,255,490.8	10,155.1	283	-49	501	94.3	150.0	1×10^{-9}	Diorite and Greywacke	Yes (NW/ East Brittle Fault)
							148.3	201.0	$< 1 \times 10^{-9}$	Greywacke and Ultramafics	Yes
							199.3	225.0	$< 1 \times 10^{-9}$	Greywacke	Yes
							298.3	330.0	1×10^{-9}	Ultramafics	No
							328.3	455.6	$< 1 \times 10^{-9}$	Ultramafics and Quartz Veins	Yes
							469.3	501.0	$< 1 \times 10^{-9}$	Greywacke and Ultramafics	No
AMQ15-452	606,627.2	7,255,687.9	10,156.2	165	-49	501	127.3	177.0	$< 1 \times 10^{-9}$	Greywacke	Yes
							469.3	501.0	$< 1 \times 10^{-9}$	Graphitic Chert, Ultramafics, and Greywake	No

\\NB4\project$\1\01\00622\04\A\Data\Packer Testing Across Faults\[AEM - Amaruq - Packer Testing Summary.xlsx]Table 1 Packer Testing Summary

NOTES:

1. COLLAR COORDINATES SURVEYED AND PROVIDED BY AEM. COORDINATES ARE IN UTM ZONE 14N; ELEVATIONS ARE TRANSLATED TO THE MINE GRID.
2. REPORTED AZIMUTH AND DIPS ARE BASED ON AN AVERAGE FOR THE DRILLHOLE.
3. 1E-09 m/s IS LOWER LIMIT OF SWiPS PACKER TESTING PRECISION.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	29JAN'16	ISSUED FOR INFORMATION	ATJ	BDP

November 24, 2015

File No.:NB101-00622/04-A.01
Cont. No.:VA15-03393

bsi. ISO 9001 ISO 14001 OHSAS 18001
FS 64925
EMS 550121
OHS 550122

Mr. Serge Ouellet
Senior Project Engineer
Agnico Eagle Mines Ltd. Meadowbank Division
10 - 200 Route de Preissac
Rouyn-Noranda, Québec
Canada, J0Y 1C0

Dear Serge,

Re: Agnico Eagle Mines Ltd.: Meadowbank Division – Whale Tail Pit – Permafrost and Hydrogeological Characterization

1 – INTRODUCTION

Agnico Eagle Mines Ltd. Meadowbank Division (AEM) is developing the Whale Tail Pit (the Project) in Nunavut, Canada. The Project is located 50 km northwest of AEM's Meadowbank Mine and 160 km northwest of Baker Lake. AEM is currently evaluating the potential for mining the satellite Whale Tail deposit using open pit mining methods.

Knight Piésold Ltd. (KP) was retained to conduct a geomechanical and hydrogeological site investigation to support permitting and engineering for the open pit mine design. The deposit lies within the northern section of Whale Tail Lake, as shown on Figure 1. A key objective of this work was to characterize the permafrost and talik conditions below the lake by:

- Planning and conducting a site investigation program to characterize the hydrogeological and permafrost conditions in the vicinity of the proposed open pit.
- Reviewing the collected data and using it to develop a conceptual permafrost / talik model.
- Using analytical and numerical methods to confirm the conceptual model and predict the potential for talik to develop both spatially and with depth below Whale Tail Lake.
- Installing, developing, and sampling groundwater monitoring wells that were targeted to intercept the talik, if present, in the vicinity of the open pit.

The results of the permafrost and hydrogeological assessment as well as the supporting data and analyses are summarized in this letter. It is important to note that the permafrost and talik characterization was conducted using a preliminary dataset (<4 months of monitoring) and that the interpretation will be refined as additional data becomes available. The results of the groundwater quality characterization of the talik are also summarized in this letter and supplemented with available data from the AEM Meadowbank Gold Mine.

606 000 E
606 200 E
606 400 E
606 600 E
606 800 E
607 000 E
607 200 E
7 255 800 N
7 255 600 N
7 255 400 N
7 255 200 N
7 255 000 N

AMQ15-413
AMQ15-452
AMQ15-288
AMQ15-294
AMQ15-349
AMQ15-349A
AMQ15-421
AMQ15-403
AMQ15-316
AMQ15-306
AMQ15-393
AMQ15-499
AMQ15-326
AMQ15-326A
AMQ15-332
AMQ15-271
AMQ15-481
AMQ15-337
AMQ15-307A
AMQ15-324

LEGEND:

- BATHYMETRY (SHALLOW – DEEP)
- GEMECHANICAL DRILLHOLE FOR OPEN PIT
- PROPOSED GEOMECHANICAL DRILLHOLE FOR UNDERGROUND
- EXPLORATION DRILLHOLE
- GROUNDWATER WELL
- EXPLORATION DRILLHOLE WITH GEOMECHANICAL LOGGING
- INSTRUMENTATION INSTALLED IN DRILLHOLE
- 30 m BUFFER FROM WHALE LAKE
- ULTIMATE PIT BOUNDARY

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 14N.
2. PIT DESIGN, TOPOGRAPHY AND BATHYMETRY PROVIDED BY AEM (SEPTEMBER, 2015).
3. CONTOUR INTERVAL IS 1 METRE.
4. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE A: 40 20 0 40 80 120 160 200 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	20NOV'15	ISSUED WITH LETTER	BDP	SIR	BDP

AGNICO EAGLE MINES LTD. MEADOWBANK DIVISION

WHALE TAIL PIT

PERMAFROST AND TALIK CHARACTERIZATION STUDY

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB101-622/4	VA15-03393

FIGURE 1 REV 0

SAVED: \\1\01\0062\04\A\cad\FIGS\B06_r0_11/20/2015 3:36:46 PM_ASIMPSON, PRINTED: 11/20/2015 3:37:13 PM, FIG_2_ ASIMPSON
XREF FILE(S): X_C_TOPO_WATR' X_C_SR---2015-07-28' X_C_SR---2015-07-29' GW' X_C_SR---2015-09-29_UG_IMAGE FILE(S):

2 – PROJECT SETTING

2.1 CLIMATE

The Project is located in the Canadian Sub-Arctic and cold winter conditions predominate for the majority of the year. There is an on-site meteorological station at the Meadowbank mine located approximately 50 km to the south. Three years of hourly and daily data (2013 to 2015) are available to characterize the meteorological conditions at the Project site, including temperature, pressure, relative humidity, wind speed and direction, and precipitation. The annual daily average temperature is -11.4°C. The annual average daily maximum and minimum temperatures are 2.7°C and -22.4°C, respectively.

2.2 TOPOGRAPHY AND LAKE CHARACTERISTICS

The topography surrounding the Project is generally flat with local surface relief of up to 20 m. The low terrain of the area has resulted in a diffuse drainage pattern. High flows are observed during spring runoff, while low flows and dry stream channels are typical in late summer. Whale Tail Lake drains to the south via a network of low lying lakes.

The following characteristics of Whale Tail Lake are based on a bathymetry survey completed in 2015 (provided by Groupe Conseil Nutshimit-Nippour, 2015). The bathymetry is shown on Figure 1.

- The lake elevation was measured at 152.4 meters above sea level (masl) in August 2015.
- The depth of the lake in the northwest end of the lake, in the vicinity of the open pit, ranges from 1 to 16 m.
- The lake bottom is terraced. The terraces extend out from the shoreline for a distance of between 1 m and 150 m. Beyond the terrace is an abrupt drop-off.

Mean annual temperatures from the bottom of the lakes in Nunavut and North West Territories (that do not freeze in winter) are 4°C (Burn, 2002).

Regional lake ice characteristics were reviewed using the Canadian Ice Database (Lenormand et al., 2002). The closest reference to Whale Tail Lake is Baker Lake (120 km to the south), which records a mean maximum lake ice thickness of 2.25 m (data from 1957 to 1990). It is expected that the mean ice thickness over Whale Tail Lake is within this range.

2.3 REGIONAL PERMAFROST CONDITIONS

The land surface near the project is underlain by continuous permafrost, with the exception of waterbodies in the area that are too deep to freeze to the bottom in the winter. Taliks (see glossary included as Appendix A) are expected beneath a waterbody where the water depth is greater than the ice thickness. Formation of open taliks that penetrate through the permafrost may be expected for relatively deeper and larger lakes in the Project area.

Site characteristics of specific interest to the current study include:

- The permafrost is expected to be at least 300 m deep and may be over 400 m deep in locations that are not affected by waterbodies (Golder, 2012). The base of the permafrost is expected to be irregular and spatially variable.
- Open or closed taliks are expected below large and deep lakes.
- The permafrost is overlain by an active layer that thaws during summer. The depth of the active layer is typically expected to range between 1 m and 3 m (Golder, 2012).

The conceptual cross section presented on Figure 2 demonstrates the interaction of surface water bodies and groundwater systems in a continuous permafrost environment.

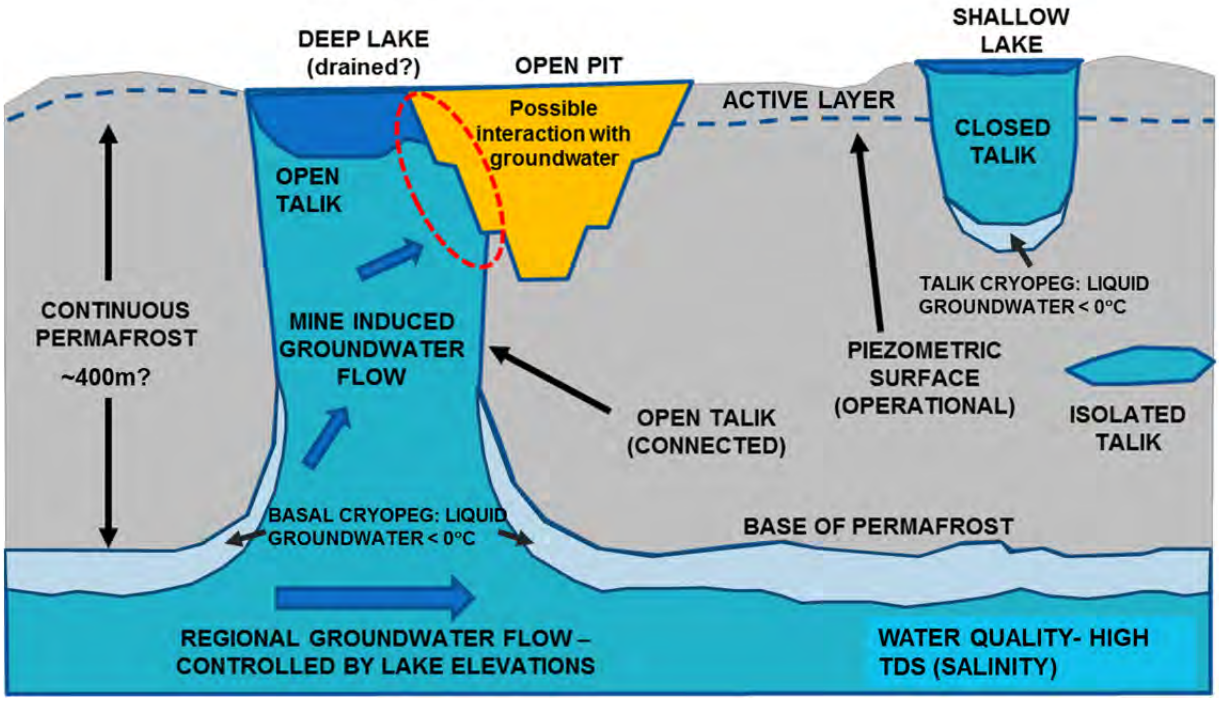


Figure 2 Conceptual Cross Section Presenting the Components of a Permafrost Region

3 – SITE INVESTIGATION PROGRAM

A geomechanical and hydrogeological site investigation program was completed by KP at the Project site between June and October, 2015. As part of the program, instrumentation was installed in six drillholes around the periphery of the proposed open pit and Whale Tail Lake in order to collect data on the ground thermal regime. Groundwater monitoring wells were also installed in three drillholes. The installed instrumentation is summarized in Table 1 and Figure 1 and includes:

- Three 200 m long multi-point thermistor strings targeting the potential talik below Whale Tail Lake in the immediate vicinity of the open pit. A vibrating wire piezometer (VWP) was installed at the base of each thermistor string to record changes in water pressure and to help assess the cryopeg-permafrost boundary.
- One 450 m long multi-point thermistor string installed in an area approximately 350 m away from the influence of the lake. This instrument was installed to assess the baseline permafrost conditions.
- Two 500 m long multi-point thermistor strings targeting the potential talik below the centre of Whale Tail Lake and the expected base of permafrost. These thermistors were installed later in the program, once the initial results of the other instruments had been reviewed.
- An electrical conductivity (EC) data logger installed in conjunction with one of the 200 m thermistor strings in drillhole AMQ15-349A. The EC logger was installed to allow the in-situ Total Dissolved Solids (TDS) and salinity to be estimated.
- Three groundwater quality monitoring wells were installed, targeting the potential talik below Whale Tail Lake in the immediate vicinity of the open pit. The wells ranged in length from approximately 180 m to 255 m.

Bathymetry data were used to identify the wider and deeper sections of Whale Tail Lake where talik development is expected to be greatest.

The instrumentation was installed by attaching the thermistor string, vibrating wire piezometer cable and/or EC logger cable to a 1-inch schedule 80 PVC guide-pipe that was lowered into the drillhole. This ensured that the instruments reached their intended depths. The drillhole, initially filled with brine to prevent freezing, was then flushed with freshwater through the PVC pipe to encourage freezing of the water around the thermistor string. A

data logger was then installed at each drillhole so that regular measurements could be taken. Initially, the data was used to confirm that the instruments were working properly and that the readings stabilized to reasonable in-situ temperatures.

The groundwater monitoring wells installed in AMQ15-393 and AMQ15-403 were constructed with external heat trace clamped to 1.5-inch schedule 80 stainless steel riser pipe. The monitoring well installed in AMQ15-413 was constructed with continuous HDPE pipe with an integrated self-regulating heating cable. Two 3 m lengths of standard 1.5-inch schedule 40 PVC slotted screen were used to construct the screened interval. Two 1.5 m lengths of schedule 80 PVC bentonite pre-packs (3 m total length) were attached above the screened interval in order to isolate it from the remainder of the drillhole. The drillholes were drilled with hot water, but were flushed with a brine solution (50% $CaCl_2$) prior to installation in order to ensure that they remained unfrozen during the installation process. A known concentration of uranine (a fluorescent dye tracer) was added to the brine solution in AMQ15-393 and AMQ15-413 (it was unavailable for the installation of AMQ15-403). The dye was added to the brine solution to monitor the progress of well development (removal of residual water from drilling and installation). The monitoring wells were developed using an airlift methods and the objective was to purge as much water as possible from the well in order to reduce the effects of the brine used for installation on the future groundwater samples. Samples were collected using a double valve pump installed at the top of the screened interval and low-flow sampling techniques. The monitoring well installation depths required that the pump control system be manually over-ridden.

Table 1 Summary of Instrumentation Installations

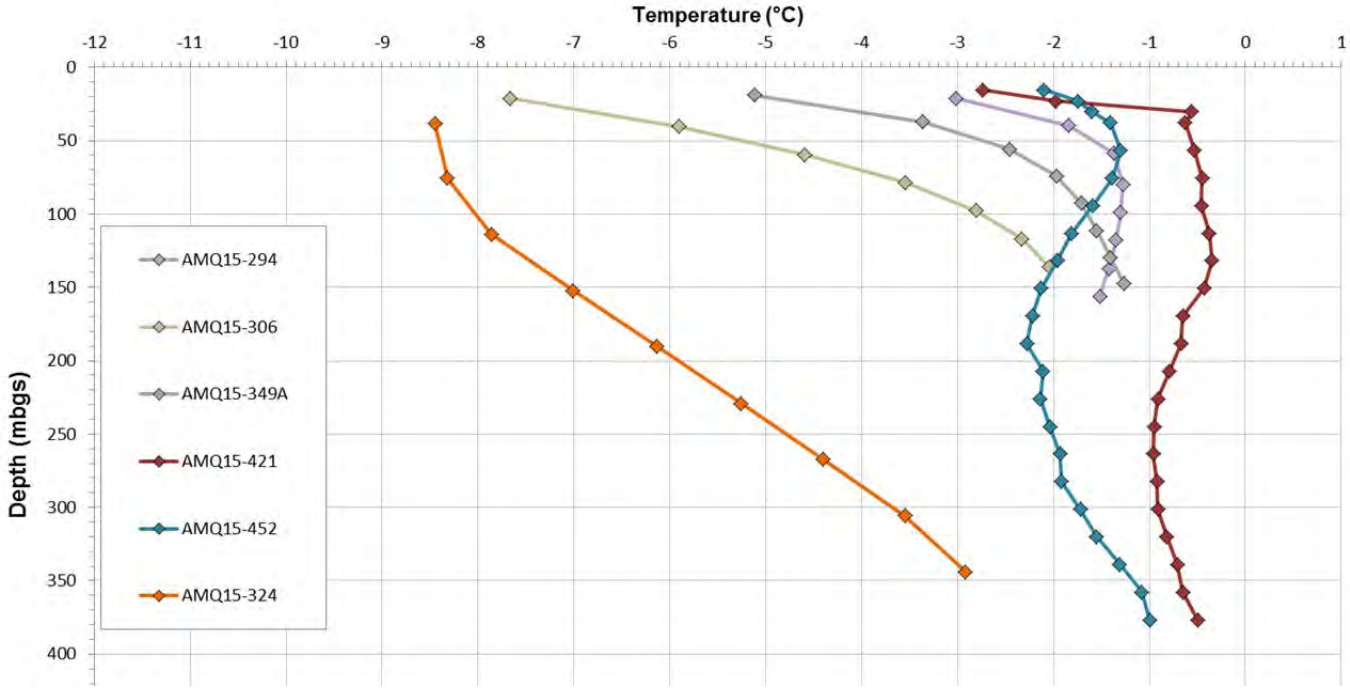
Drillhole ID	Drillhole Details					Target	Instrumentation Type
	Northing (m)	Easting (m)	Length (m)	Azimuth (°)	Dip (°)		
AMQ15-294	607,073	7,255,676	323	221	-45	Lake Talik	Thermistor & VWP
AMQ15-349A	607,065	7,255,628	203	204	-45	Lake Talik	Thermistor, VWP & EC
AMQ15-306	606,715	7,255,364	201	96	-45	Lake Talik	Thermistor & VWP
AMQ15-324	606,497	7,254,995	501	300	-45	Permafrost base	Thermistor & VWP
AMQ15-421	607,098	7,255,491	501	274	-51	Deep talik. Permafrost base	Thermistor & VWP
AMQ15-452	606,627	7,255,688	501	106	-50	Deep talik. Permafrost base	Thermistor & VWP
AMQ15-393	607,193	7,255,368	261	147	-65.3	Lake Talik	Monitoring Well
AMQ15-403	607,120	7,255,461	261	260	-65.3	Lake Talik	Monitoring Well
AMQ15-413	606,757	7,255,790	210	139	-65.4	Lake Talik	Monitoring Well

NOTES:
1. ALL UTM COORDINATES ON MINE GRID.
2. ALL DEPTHS ARE PRESENTED AS DOWNHOLE.
3. METERS DOWN HOLE IS REPRESENTED AS “mdh”.
4. DRILLHOLE ID REFERENCES ON FIGURE 1: AMQ15-393 is PDH15-03; AMQ15-403 is PDH15-02; AMQ15-393 is PDH15-01.

The full details of the instrumentation and groundwater well installations are included in Appendix B.

4 – INSTRUMENTATION DATA

The most recent temperature data from the thermistor installations (collected on September 30, 2015) is plotted on Figure 3.



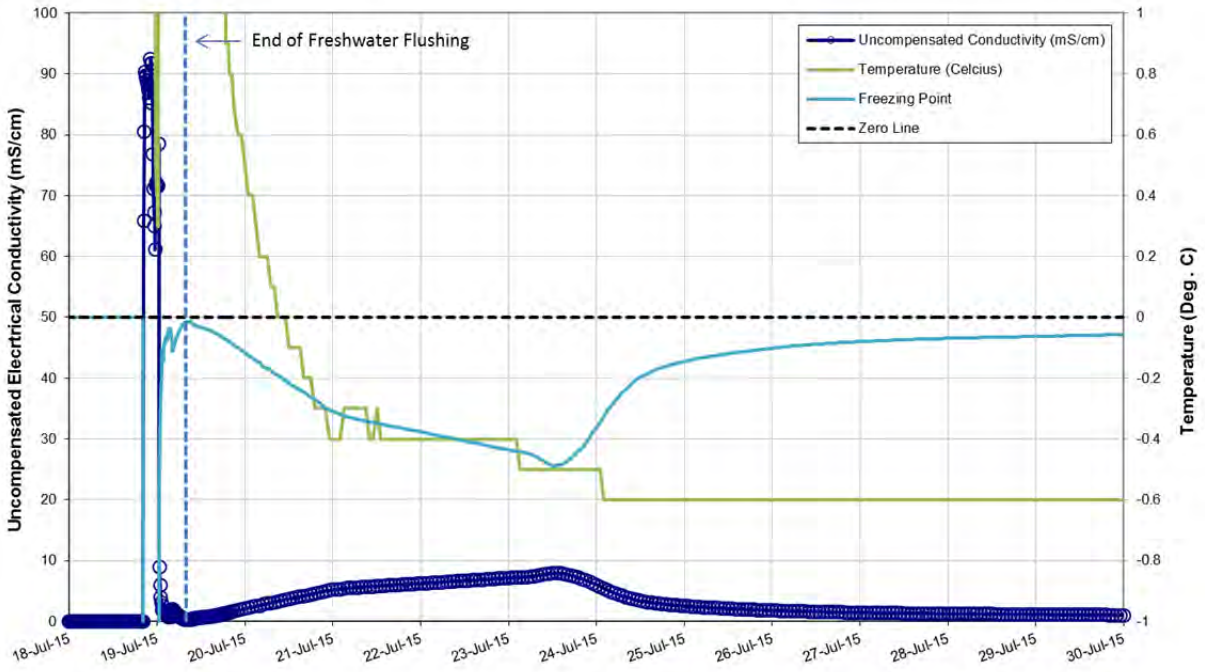
Source: I:\1\01\00622\04\A\Data\Work Item 1020.1000 - Talik Characterization

Figure 3 September 30, 2015 Thermistor Data

The data generally show cold near-surface conditions, followed by a warming geothermal gradient with increasing depth. It should be noted that the drillholes are drilled at an incline towards a water body, complicating the interpretation of the data.

Drillhole AMQ15-324 is located away from the influence of the lake. The geothermal gradient from the thermistor in drillhole AMQ15-324 was used to estimate the depth to permafrost. The temperature profiles from the other thermistors were used to characterize the conditions beneath different sections of the lake and to help calibrate the analytical and numerical models.

The data from the EC logger installed in drillhole AMQ15-349A are shown on Figure 4. High salinity was initially measured as the logger was lowered into the brine in the drillhole. This is followed by an abrupt reduction in salinity as the drillhole was flushed with fresh water. Over time, the temperature gradually falls and the salinity increases. The increasing salinity may be due to the influx of saline groundwater from the talik. However, given the low temperatures, it may also be evidence of a gradual phase change from water to ice, with the salinity concentration increasing as less water is available as liquid. The highest conductivity recorded by the EC logger prior to freezing was 7.96 mS/cm. This can be converted a freezing point of approx. -0.35°C at the instrument depth of 150 mbgs.



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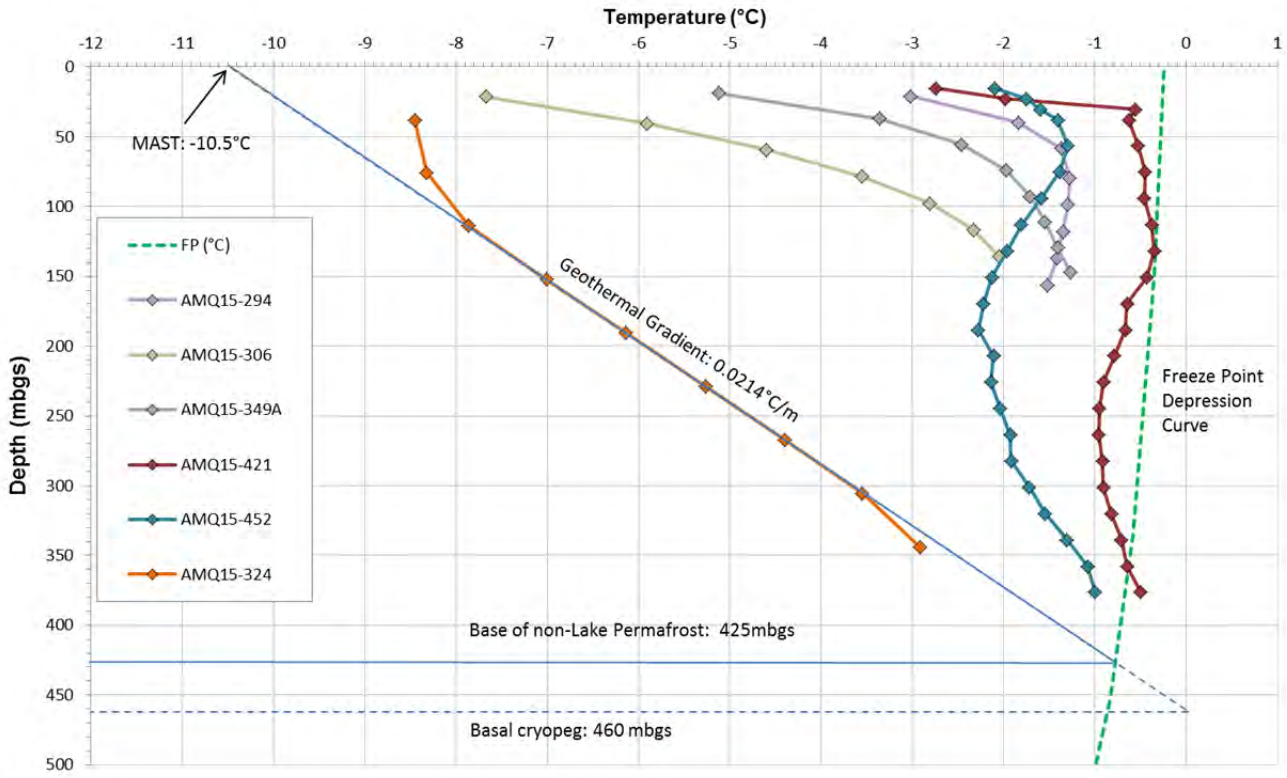
Figure 4 EC Logger Data (Drillhole AMQ15-349A)

5 – GEOTHERMAL PROPERTIES

The following geothermal properties were estimated from the instrumentation data or regional studies:

- A baseline regional geothermal gradient of 0.0214°C/m was estimated using the thermistor data from AMQ15-324. The gradient is shown on Figure 5.
- The Mean Annual Surface Temperature (MAST) of -10.5 °C was estimated using the geothermal gradient from AMQ15-324 and extrapolating the temperature data to surface. This was compared to the MAST of -11.4°C recorded by the climate station at the Meadowbank Mine. As the thermistor data is still considered to be stabilizing and has not yet recorded data from the winter period, the lower MAST from Meadowbank was used for this assessment.
- A freezing point depression curve was developed to estimate permafrost depth for the Project using data from the EC logger installed in drillhole AMQ15-349A and TDS and temperature vs depth relationship curves developed for other studies completed in the region. The developed relationship defines a freezing point of -0.35 °C at 150 m and a freezing point of -1.0 °C at 500 m. A detailed discussion of the approach used to estimate the freezing point depression curve is presented in Appendix C.

The regional geothermal gradient and the estimated freezing point depression line for the site are shown on Figure 5. The intersection point of these two curves suggests that the base of the permafrost is approximately 425 mbgs outside of the influence of waterbodies. The intersection of the geothermal gradient with the 0°C isotherm suggests that the basal cryopeg is at a depth of approximately 460 mbgs.



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Figure 5 Geothermal Properties Derived from AMQ15-324

6 – ANALYSIS OF LAKE TALIK FORMATION

6.1 ANALYSIS APPROACH

The initial approach used to assess the potential for talik development under Whale Tail Lake was an empirical analysis carried out to support the early planning for the geomechanical and hydrogeological site investigation program. The approach assumed that lakes with a half width of 100 m or more and with depths of greater than 1 m had the potential to form a talik. This approach was not able to discern whether the talik would be open or closed.

This initial assessment was refined once the data from the installed instrumentation became available. Two different types of analyses were completed: analytical solutions and numerical models. Each method is briefly described below and described in detail in Appendix D.

- **Analytical Solution:** Burn (2002) developed a series of 1D analytical solutions to describe talik development under surface water bodies. The solutions were developed to match the lake shape (circular or elongate), and to acknowledge the presence of a shallow terrace around the lake perimeter.
- **Numerical Models:** 2D numerical modeling was carried out using the finite element code Temp/W (Geo-Slope, 2014). This model was used to further assess the potential for an open talik beneath sections across and along Whale Tail Lake. The modelling estimates represent a first-order assessment of ground temperatures under equilibrium conditions and assume no transient (time-dependent) conditions, such as the timing of lake formation and temporal changes in water and ground temperature.

Three cross sections across Whale Tail Lake, shown on Figure 6, were analyzed using both methods. The results are summarized below and described in detail in Appendix D.

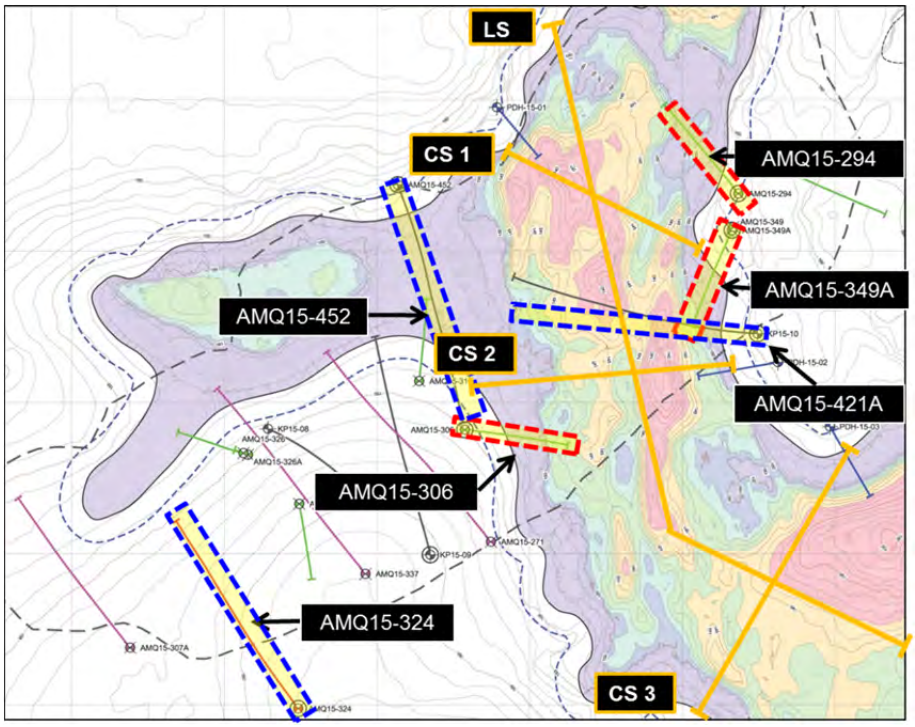
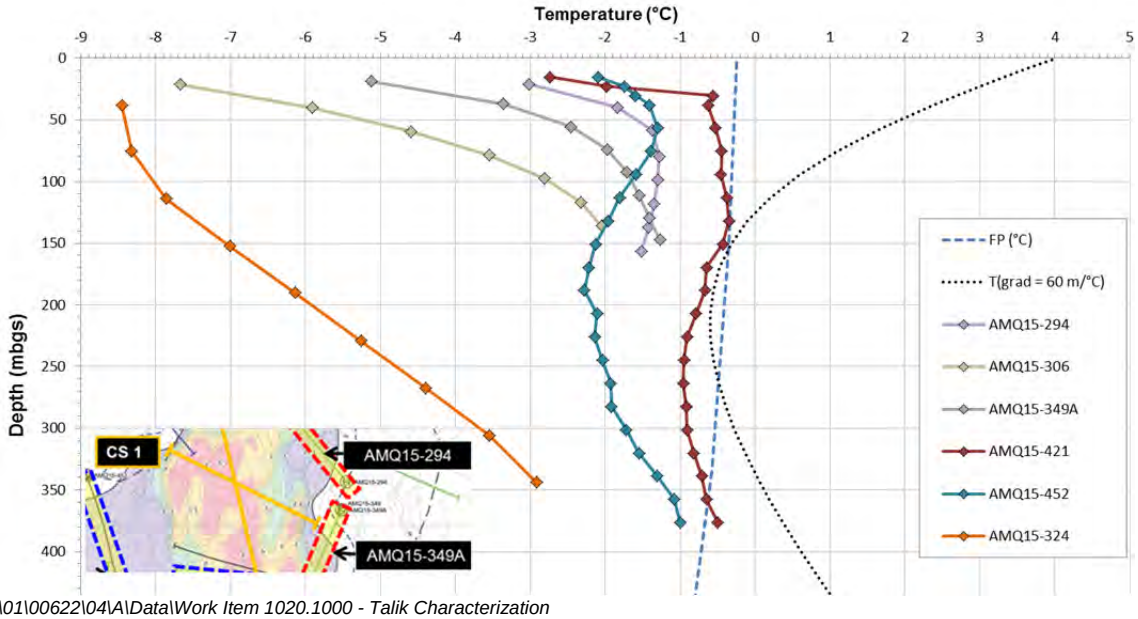


Figure 6 Location of Cross Sections for Analytical and Numerical Models

6.2 ANALYSIS RESULTS

6.2.1 Cross Section 1

Cross section 1 (CS1) lies across the northern section of Whale Tail Lake and cuts through the central-northern section of the proposed final open pit. The section is across a relatively narrow portion of the lake with a wide variation in depth.



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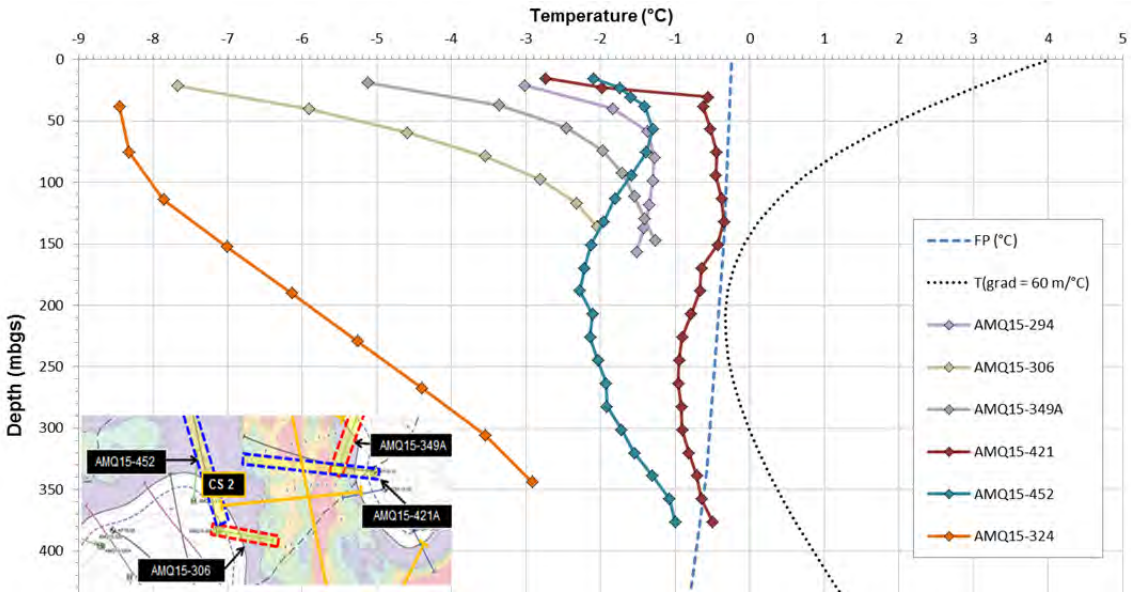
Figure 7 Results of Analytical and Numerical Solutions for CS1

The analytical solution for this section (Figure 7) suggests that talik is present, but that it is likely underlain by permafrost between 150 and 250 mbgs (i.e., where the analytical solution is to the left of the freezing point depression curve). This is supported by the results of the 2D numerical model, which suggests permafrost will be present between 100 and 280 mbgs (see Appendix C for details). The talik along this section is thought to represent a shallow channel underlain by permafrost rather than a depression. Both to the north and to the west of this section, where the lake is shallower, permafrost is more likely to dominate.

6.2.2 Cross Section 2

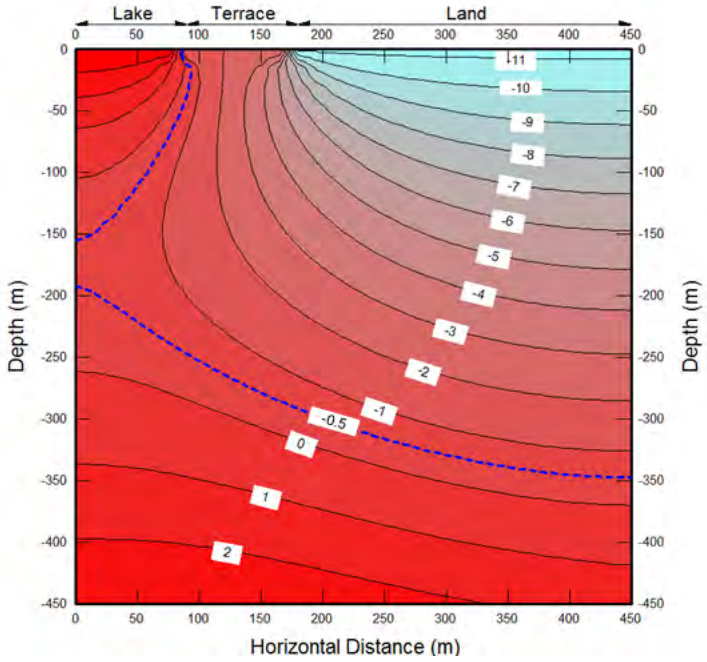
Cross Section 2 (CS2) roughly coincides with the southern limit of the proposed open pit as well as the path of the proposed exploration decline. CS2 is in close proximity to the thermistor installed in drillholes AMQ15-306, AMQ15-349A and AMQ15-421, allowing the results of the analyses to be compared to the instrument data.

The interpretation of the results of the analytical solution (Figure 8) and numerical model (Figure 9) is inconclusive. Whether or not the talik is open to depth is sensitive to a change of less than 0.5 °C in the freezing point depression. The analytical solution suggests the talik is just open, while the numerical modelling suggests that there may be 40 m of permafrost beneath the talik. This section is thought to approximate the southern limit of the talik channel before it becomes open to the sub-permafrost aquifer.



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Figure 8 Results of Analytical and Numerical Solutions for CS2

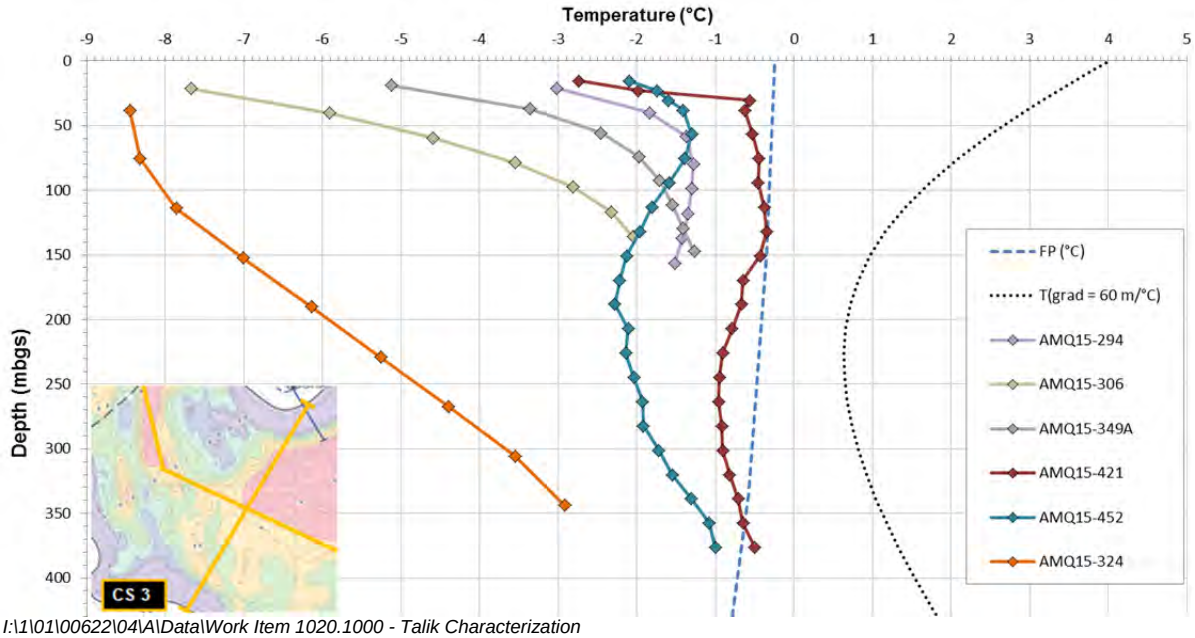


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Figure 9 Temp-W Thermal Model of CS2

6.2.3 Cross Section 3

Cross Section 3 (CS3) was selected to assess the wider, deeper portion of the lake, south of the proposed open pit and exploration decline. The results of the analytical solution (Figure 10) and numerical model (Appendix C) are in agreement and suggest that the talik is open and connected to the sub-permafrost aquifer in this portion of the lake.



Source: I:\1\01\00622\04\A\Data\Work Item 1020.1000 - Talik Characterization

Figure 10 Results of Analytical and Numerical Solutions for CS3

6.3 SUMMARY OF RESULTS

A progressive modeling approach was used for the study. An initial empirical assessment of talik potential identified that talik was likely to develop under parts of Whale Tail Lake where the lake was greater than 200 m in width and was deeper than 1 m. The initial assessment was followed by 1 D analytical solutions and 2D steady-state thermal modelling. The results of the 1D analytical solutions and the 2D numerical models are in general agreement and suggest that:

- Permafrost is expected below the land and in the shallowest areas of Whale Tail Lake.
- Talik is expected below the central portions of the lake.
- The talik is most likely underlain by permafrost in the shallower, narrower parts of Whale Tail Lake. This is expected to include most of the lake in the immediate vicinity of the proposed open pit.
- The talik is expected to connect vertically with the sub-permafrost aquifer in the deeper, wider parts of the lake, such as section CS3.
- Overall, the likely talik is expected to form a continuous channel that is closed in the northern portion of Whale Tail Lake below the open pit and becomes open as it moves to the south towards the central portion of the lake (Figure 11).

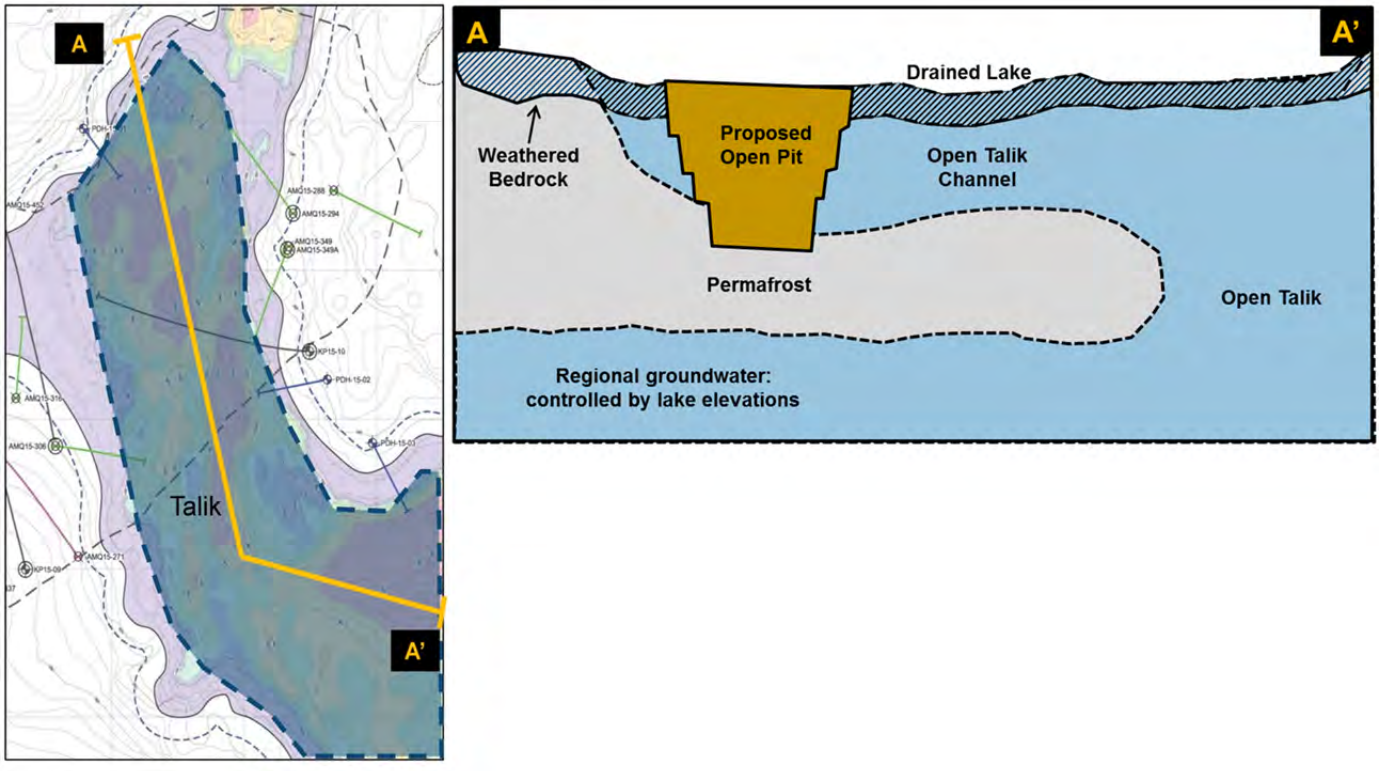


Figure 11 Interpretation of Permafrost and Talik Distribution through Whale Tail Lake

The thermal modeling does not account for transient conditions or complex subsurface stratigraphy, both of which may influence talik formation beneath Whale Tail Lake.

7 – TALIK WATER QUALITY CHARACTERIZATION

7.1 GROUNDWATER SAMPLING

Monitoring wells were installed in three drillholes (AMQ15-393, AMQ15-403 and AMQ15-413). Monitoring well AMQ15-403 was developed following installation, but the heat trace was damaged, the drillhole froze, and no further development or sampling could be completed. Water quality samples were collected from monitoring wells AMQ15-393 and AMQ15-413 for the purposes of characterizing the chemistry of the groundwater, following two rounds of well development.

Despite repeated well development, the groundwater samples collected to date from these monitoring wells have high salinity concentrations that are due to residuals of the brine solution used to install the monitoring wells. The samples are not representative of the natural groundwater quality. The continued presence of brine residuals in the groundwater wells following extensive purging has occurred at the Meadowbank Mine and at other northern sites. Repeated purging and monitoring over time at these sites has eventually allowed the collection of representative groundwater quality results. This approach will be used at the Whale Tail Pit Study Area.

In the interim, a larger groundwater quality dataset from the Meadowbank Mine has been reviewed and is believed to provide a reasonable representation of groundwater conditions within the talik beneath Whale Tail Lake. The Project and AEM's Meadowbank Mine are underlain by the same sequence of Archean supra crustal rocks of the Woodburn Lake Group (AEM, 2015a). Based on the similar geology and permafrost conditions (i.e., within taliks), the groundwater quality data from the Meadowbank Mine are likely to be similar to the groundwater conditions in the vicinity of the Whale Tail Open Pit.

7.2 GROUNDWATER QUALITY CHARACTERIZATION

Groundwater chemistry data was extracted from Appendix A of the *Meadowbank Gold Mine - 2014 Groundwater Monitoring Report* (AEM, 2015b). The groundwater quality data for this mine have been collected since 2003 from monitoring wells targeting talik zones in the vicinity of the mine facilities. The data have been collected for the purposes of characterizing groundwater quality. The number of samples represented in the dataset ranges from 18 to 43, depending on the parameter considered.

Summary statistics calculated using the Meadowbank Mine groundwater quality dataset for general parameters (pH, conductivity, alkalinity, sulphate, hardness, and TDS), dissolved metals, dissolved anions, nutrients, and cyanide are presented in Table 2. In order, to calculate the summary statistics presented in Table 2, KP removed all of the high non-detect values from the dataset so that the statistics were not biased high. All remaining non-detect values were incorporated into the statistics based on a value equal to half the method detection limit (MDL). Several parameters were consistently below the MDL or that had only one value reported above the MDL. These parameters were assigned a single value equivalent to half of the lowest MDL. The original and adjusted sample sizes for each parameter are listed in Table 2.

Quality assurance and quality control (QA/QC) of the dataset was conducted by AEM (2015b). In addition to the AEM data quality assessment, an ion balance check was conducted on the individual sample results and the summary data. The ion balance check was inconclusive for many of the individual samples because specific parameters such as sodium and potassium were not included in all of the analytical results. The ion balance results for the summary statistics are as follows: Less than a10% error for the average, median (50^{th} P), 70^{th} P, 75^{th} P, and maximum summary data; between 10% and 20% for the minimum, 80^{th} P, and 95^{th} P summary data; and between 20% and 35% difference for the 25^{th} P, 85^{th} P and 90^{th} P summary data. There are excess cations in the upper percentile summary data and excess anions in the lower percentile summary data.

There are no specific water quality guidelines for groundwater in Nunavut. The groundwater data have been compared to the Canadian Environmental Quality Guidelines for the Protection of Freshwater Aquatic Life (CEQG) (CCME, 2105) and the Health Canada Guidelines for Canadian Drinking Water Quality (HC-DW)

(Health Canada, 2014), for reference. Hardness dependent guidelines were calculated using the hardness for the same statistical category as summarized in Table 2.

The following is a summary of the parameters with statistical values that exceed the CEQG:

- Fluoride – all but the minimum values exceed the 0.12 mg/L CEQG.
- Nitrate, Nitrite, and Ammonia – the upper 95th P results for these nitrogen-based parameters exceed their respective CEQGs. However, these results may be influenced by residual nitrogen associated with explosives residues originating in the operating open pits of the Meadowbank Mine. It is also important to note that the ammonia exceedances are strongly influenced by the pH conditions. The ammonia guideline is 12.56 mg/L N for pH of 7 and temperature of 5^{o}C and 1.27 mg/L N for pH of 8 at the same temperature; there would be no exceedances in the current dataset if the *in situ* pH was assumed to be 7.The upper percentile values for nitrate, nitrite, and ammonia are not expected for the Project baseline groundwater quality.
- Aluminum – the upper 90th P of the data for aluminum exceed the 0.1 mg/L CEQG.
- Arsenic - the upper 90th P of the data for arsenic exceed the 0.005 mg/L CEQG.
- Boron – the maximum data for boron exceed the 1.5 mg/L long-term exposure CEQG for boron (95th P are below the guideline), but all remain well below the 29 mg/L short-term exposure value.
- Chromium – none of the measured chromium concentrations exceed the 0.0089 mg/L CEQG for trivalent chromium, which is the most likely form of chromium to be found in deep groundwater (reducing conditions). The upper 70th P of the chromium results exceeded the 0.001 mg/L CEQG for hexavalent chromium.
- Copper – the upper 80th P of the copper data exceed the hardness dependent CEQG.
- Iron – the upper 95th P of the iron data exceed the 0.3 mg/L CEQG.
- Molybdenum – the upper 95th P of the molybdenum data exceed the 0.073 mg/L CEQG.
- Selenium – the mean and the upper 80th P selenium results exceed the 0.001 mg/L CEQG.
- Zinc – maximum zinc concentrations just exceed the 0.03 mg/L CEQG; however, the 95th P data are below the guideline.

The following are the parameters with statistical values that exceed the HC-DW guidelines:

- Chloride – the upper 75th P of the chloride data exceed the 250 mg/L HC-DW aesthetic objective.
- TDS – the upper 70th P of the TDS data exceed the 500 mg/L HC-DW aesthetic objective.
- Nitrate and Nitrite – the upper percentile results for nitrite and nitrate exceed their respective heath-based HD-DW guidelines; however, the results are from an operating mine as noted above, and therefore should not be considered representative of the baseline groundwater quality for the Project
- Arsenic – the maximum measured arsenic concentrations exceed the 0.01 mg/L HD-DW guideline, though the 95th P results do not.
- Iron - the upper 95th P of the iron data exceed the 0.3 mg/L HC-DW aesthetic objective.
- Manganese – the majority of the manganese data exceed the 0.05 mg/L HC-DW aesthetic objective.
- Selenium – the maximum measured selenium concentration exceeds the 0.01 mg/L HC-DW guideline, though the 95th P value does not.
- Sodium – the upper 95th P of the sodium data exceed the 200 mg/L HC-DW aesthetic objective.

In summary, the groundwater quality at the Meadowbank Mine is generally described as being hard to very hard, with neutral to slightly basic pH and good buffering capacity. TDS concentrations range from 193 mg/L to 1,900 mg/L (mean 625 mg/L; median 496 mg/L). Concentrations of fluoride, copper, iron, and selenium were elevated in comparison to guidelines for the protection of aquatic life and drinking water. Only the higher percentile values for nitrogen-containing compounds, aluminum, arsenic, boron, hexavalent chromium, molybdenum and zinc exceeded the CEQGs. Additionally, several of these parameters as well as chloride, manganese and sodium exceeded aesthetic drinking water guidelines.

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TABLE 2

AGNICO EAGLE MINES LIMITED - MEADOWBANK DIVISION
WHATE TAIL PIT

PERMAFROST AND HYDROGEOLOGICAL CHARACTERIZATION
GROUNDWATER QUALITY DATASET

Print Nov/24/15 14:07:30

Parameters	Units	Sample Size: Number of Samples	Number of Samples After High Non-Detect Values	Number of Samples Below MDL	% Below MDL	Summary Statistics: Minimum	25th Percentile	Mean	Median	70th Percentile	75th Percentile	80th Percentile	85th Percentile	90th Percentile	95th Percentile	Maximum	Water Quality Guidelines: CEQG[1]	HC-DW[2]
General Parameters																		
pH	s.u.	38	38	0	0%	6.71	7.26	7.51	7.55	7.75	7.81	7.87	7.95	7.97	8.10	8.20	6.5 to 9.0	6.5 to 8.5
Conductivity	uS/cm	21	21	0	0%	281	583	1322	930	1270	1280	2900	3100	3200	3300	3400		
Total Alkalinity	mg/L	40	40	0	0%	15	42.6	71.9	76	95.66	102.25	103	104.15	105.5	111.15	147		
Bicarbonate Alkalinity HCO3		18	18	0	0%	33.3	46.3	88.7	61.55	104.8	108	111.6	118.95	136.1	189.45	345		
Carbonate Alkalinity CO3		***18***	***16***	***15***	***94%***	***0.25***	***0.25***	***0.25***	***0.25***	***0.25***	***0.25***	***0.25***	***0.25***	***0.25***	***0.25***	***0.25***		
Hydroxide Alkalinity OH		29	29	15	52%	0.25	0.3	71.7	0.25	52	113	176.4	245.9	301.4	308.5	317		
Dissolved Sulphate	mg/L	33	33	0	0%	3	5.9	45.9	15.9	43.04	46.4	52.08	64.19	130.2	210	263		*500 AO*
Hardness CaCO3	mg $CaCO_3$/L	20	20	0	0%	75.9	107.5	200.5	166	266.5	284.25	300.8	324.65	345.6	351.95	380		
Hardness (Total)	mg $CaCO_3$/L	38	38	0	0%	77	170.0	258.6	240	313	316	318	324	388	440	850		
Total Dissolved Solids	mg/L	30	30	0	0%	193	391.5	625.1	495	650	680	793	907.25	1217.5	1758.75	1900		*500 AO*
Dissolved Metals																		
Aluminum	mg/L	39	29	6	21%	0.00005	0.0041	0.0740	0.011	0.03	0.04	0.0456	0.0526	0.3	0.402	0.71	0.1 (pH > 6.5)	
Antimony	mg/L	16	6	3	50%	0.0001	0.0001	0.0005	0.00015	0.00025	0.000275	0.0003	0.000725	0.00115	0.001575	0.002		0.006
Arsenic	mg/L	39	33	12	36%	0.00005	0.0005	0.0024	0.002	0.003	0.003	0.0035	0.00384	0.00504	0.007	0.013	0.005	0.01
Barium	mg/L	39	39	2	5%	0.015	0.029	0.107	0.045	0.086	0.125	0.1628	0.25	0.318	0.42	0.44		1
Beryllium	***mg/L***	***16***	***5***	***5***	***100%***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***		
Bismuth	***mg/L***	***16***	***5***	***5***	***100%***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***		
Boron	mg/L	16	16	2	13%	0.025	0.095	0.434	0.205	0.405	0.4625	0.53	0.8375	0.985	1.37	2.39	1.5 / 29 (short-term/long-term exposure)	5
Cadmium	mg/L	39	12	4	33%	0.00001	0.00002	0.00007	0.00004	0.000105	0.00012	0.00012	0.000134	0.000156	0.000178	0.0002	0.000036 to $10^{(0.83*(log(H)-2.46)}$/1000 to 0.000373 [9]	0.005
Calcium	mg/L	35	35	0	0%	17.6	37.45	61.10526	49	67.9	72.875	73.3	79.635	89.23	99.15	340		
Chromium	mg/L	16	6	0	0%	0.0002	0.0003	0.0007	0.0007	0.0011	0.00115	0.0012	0.0012	0.0012	0.0012	0.0012	0.0089/0.001 (Cr III/Cr VI)	0.05
Cobalt	mg/L	16	8	0	0%	0.0003	0.0004	0.0017	0.0009	0.001	0.00175	0.0028	0.00385	0.0046	0.0053	0.006		
Copper	mg/L	39	24	2	8%	0.0002	0.0010	0.0039	0.0016	0.00309	0.003925	0.0044	0.00665	0.008	0.0097	0.033	$e^{(0.8545*ln(H)-1.465)}$ 0.2/1000 to 0.004 [9]	*1 AO*
Iron	mg/L	39	34	21	62%	0.005	0.020	0.145	0.025	0.032	0.05	0.074	0.2	0.2	0.8435	1.91	0.3	*0.3 AO*
Lead	mg/L	39	16	5	31%	0.00005	0.0001	0.0008	0.00027	0.001	0.001025	0.0011	0.001175	0.0013	0.002325	0.0051	$e^{((1.273*ln(H)-4.705))}$ /1000 to 0.007 [9]	0.01
Lithium	mg/L	16	16	2	13%	0.002	0.0027	0.0119	0.00755	0.017	0.0175	0.019	0.0235	0.0265	0.02925	0.033		
Magnesium	mg/L	35	35	1	3%	0.5	12.70	22.21	23.8	27	30.15	31	32.045	35.22	37.16	47		
Manganese	mg/L	37	37	2	5%	0.0015	0.0602	0.2480	0.153	0.2984	0.32	0.3768	0.436	0.5752	0.768	0.98		*0.05 AO*
Mercury	***mg/L***	***37***	***21***	***19***	***90%***	***0.000005***	***5E-06***	***5E-06***	***5E-06***	***5E-06***	***5E-06***	***5E-06***	***5E-06***	***5E-06***	***5E-06***	***0.000005***	0.000026	0.001
Molybdenum	mg/L	39	35	6	17%	0.00025	0.0063	0.0258	0.012	0.02382	0.0265	0.0406	0.0457	0.0628	0.105	0.14	0.073	
Nickel	mg/L	39	34	8	24%	0.0005	0.0019	0.0081	0.0025	0.005	0.00575	0.009	0.01729	0.019	0.038105	0.05	$e^{((0.76*ln(H)+1.06))}$ /1000 to 0.15 [9]	
Phosphorus	mg/L	16	16	7	44%	0.015	0.03	0.19	0.075	0.155	0.195	0.3	0.3	0.55	0.825	0.9		
Potassium	mg/L	35	35	0	0%	1.3	2.20	4.58	4.3	5.92	6.35	7.504	7.98	8.46	9.292	11		
Selenium	mg/L	39	39	32	82%	0.0001	0.0005	0.0013	0.0005	0.0005	0.00075	0.0022	0.0025	0.003	0.0051	0.011	0.001	0.01
Silicon	mg/L	16	16	0	0%	0.32	1.975	3.3	2.985	3.845	3.9425	4.1	5.3	5.79	6.405	7.98		
Silver	***mg/L***	***38***	***6***	***5***	***83%***	***0.000025***	***2.5E-05***	***2.5E-05***	***2.5E-05***	***2.5E-05***	***2.5E-05***	***2.5E-05***	***2.5E-05***	***2.5E-05***	***2.5E-05***	***0.000025***	0.00025	
Sodium	mg/L	29	29	0	0%	1.8	15.60	68.24	32	49.18	55.9	58.52	60.6	137	382.8	430		*200 AO*
Strontium	mg/L	16	16	0	0%	0.111	0.215	0.452	0.265	0.585	0.6225	0.72	0.732	0.748	0.935	1.46		
Tellurium	***mg/L***	***16***	***16***	***16***	***100%***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***		
Thallium	***mg/L***	***38***	***16***	***16***	***100%***	***0.00001***	***0.00001***	***0.00001***	***0.00001***	***0.00001***	***0.00001***	***0.00001***	***0.00001***	***0.00001***	***0.00001***	***0.00001***		
Thorium	***mg/L***	***16***	***16***	***14***	***88%***	***0.00005***	***0.00005***	***0.00005***	***0.00005***	***0.00005***	***0.00005***	***0.00005***	***0.00005***	***0.00005***	***0.00005***	***0.00005***	0.0008	
Tin	***mg/L***	***16***	***16***	***16***	***100%***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***	***0.0001***		
Titanium	mg/L	16	16	10	63%	0.0003	0.00050	0.00421	0.0005	0.0005	0.000575	0.0008	0.0137	0.0185	0.02025	0.024		
Uranium	mg/L	16	16	3	19%	0.00025	0.00053	0.00326	0.00095	0.00465	0.007775	0.008	0.008	0.00835	0.009525	0.012	0.015	0.02
Vanadium	mg/L	16	16	12	75%	0.0001	0.00050	0.00050	0.0005	0.0005	0.000525	0.0006	0.0006	0.0008	0.001	0.001		
Zinc	mg/L	39	39	16	41%	0.001	0.0025	0.0072	0.0035	0.009	0.012	0.013	0.014	0.0146	0.0191	0.033	0.03	5
Zirconium	***mg/L***	***16***	***16***	***16***	***100%***	***0.0005***	***0.0005***	***0.0005***	***0.0005***	***0.0005***	***0.0005***	***0.0005***	***0.0005***	***0.0005***	***0.0005***	***0.0005***		
Anions																		
Dissolved Fluoride	mg/L	43	43	6	14%	0.01	0.145	0.281	0.3	0.354	0.37	0.392	0.448	0.54	0.597	1.1	0.12	1.5
Dissolved Chloride	mg/L	43	43	0	0%	3.3	33.6	233.0	127	173.4	255	297.2	534	801.2	950	990	120 / 640 (short-term/long-term exposure)	*250 AO*
Nutrients																		
Total Nitrogen	mg/L	4	4	1	25%	0.1	0.25	0.36	0.395	0.494	0.5	0.506	0.512	0.518	0.524	0.53		
Nitrate and Nitrite	mg/L	28	28	19	68%	0.005	0.01	2.14	0.0375	0.195	0.21	0.43	0.57	1.723	18.1555	27		45
Nitrate	mg/L	33	33	19	58%	0.005	0.01	1.74	0.025	0.122	0.125	0.192	0.316	1.468	11.42	26	3	10
Nitrite	mg/L	32	28	9	32%	0.001	0.003	0.093	0.005	0.0097	0.0125	0.026	0.03	0.06	0.736	1.2	0.06	1
Ammonia Nitrogen	mg/L	30	30	2	7%	0.005	0.063	0.527	0.16	0.213	0.3325	0.406	0.5295	2	2.99	3.8	0.017 to 192 (temperature and pH specific)	
Total Kjeldahl Nitrogen	mg/L	12	12	1	8%	0.1	0.2	0.375	0.3	0.54	0.6	0.6	0.6	0.6	0.645	0.7		
Total Phosphorus	mg/L	13	13	0	0%	0.01	0.040	0.085	0.07	0.088	0.1	0.1	0.126	0.204	0.238	0.25		
Cyanide																		
WAD Cyanide (CN-)	***mg/L***	***2***	***2***	***1***	***50%***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***		
Total Cyanide	***mg/L***	***12***	***12***	***11***	***92%***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***		
Free Cyanide	***mg/L***	***22***	***22***	***22***	***100%***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	***0.0025***	0.005	

I:\1\01\00622\04\A\Correspondence\VA15-03393 - Permafrost and Hydrogeology Baseline Summary\Final\Tables and Figures\[Table 2 GWQ Dataset Rev 0.xlsx]Table 2 KP Format

NOTES:

1. CEQG - CANADIAN ENVIRONMENTAL QUALITY GUIDELINE FOR THE PROTECTION OF FRESHWATER AQUATIC LIFE (CCME 2015); AO - AESTHETIC OBJECTIVE.
2. HC-DW - HEALTH CANADA - GUIDELINES FOR CANADIAN DRINKING WATER QUALITY.
3. DATA SOURCED FROM MEADOWBANK GOLD MINE 2014 GROUNDWATER MONITORING REPORT. PREPARED BY AGNICO EAGLE MINES LIMITED - MEADOWBANK DIVISION, MARCH 2015.
4. DATA EXCLUDED FROM SUMMARY STATISTICS: MW-08-03 SAMPLE COLLECTED 23-SEP-13 (SALT ADDED TO THAW WELL), MW-03-04 SAMPLE COLLECTED 18-SEP-03 (SINGLE SAMPLE FOR THIS MONITORING WELL), MW11-01 AND MW14-01 (ALL SAMPLES) DUE TO SUSPECT SAMPLING OF BRINE RESIDUALS FROM MONITORING WELL INSTALLATIONS, AND OUTLIER DATA POINT FOR MW08-02 FOR DISSOLVED LEAD 20-AUG-14.
5. VALUES REPRESENTED IN BOLD ITALICS ARE INDICATIVE OF PARAMETERS THAT WERE NEVER MEASURED ABOVE THE MDL OR HAD ONLY ONE SAMPLE (INCLUDING A DUPLICATE PAIR) MEASURED ABOVE THE MDL: A VALUE EQUIVALENT TO HALF THE LOWEST MDL WAS SELECTED TO REPRESENT THE DATA WHEN ALL OF THE RESULTS WERE BELOW THE MDL
6. GREEN SHADING INDICATES THAT THE VALUE EXCEEDS THE CANADIAN ENVIRONMENTAL QUALITY GUIDELINE FOR THE PROTECTION OF FRESHWATER AQUATIC LIFE.
7. BLUE SHADING INDICATES THAT THE VALUE EXCEEDS THE HEALTH CANADA GUIDELINES FOR CANADIAN DRINKING WATER.
8. PURPLE SHADING INDICATES THAT THE VALUE EXCEEDS BOTH OF THE REFERENCE GUIDELINES.
9. HARDNESS (H) DEPENDENT GUIDELINE.

REV	DATE	DESCRIPTION	PREP	RVWD
0	23NOV15	ISSUED WITH LETTER VA15-03393	JEM	RAC

8 – SUMMARY AND CONCLUSIONS

The general characteristics of the permafrost in the vicinity of Whale Tail Lake are summarized below:

- A freezing point depression curve was developed for this site using data from the EC logger installed in drillhole AMQ15-349A and TDS and temperature vs depth relationship curves developed for other studies completed in the region. The developed relationship defines a freezing point of -0.35 °C at 150 m and a freezing point of -1.0 °C at 500 m.
- A mean annual surface temperature (MAST) of -11.4°C was used based on data from the Meadowbank Mine climate station. This is similar to the MAST of -10.4°C estimated from the thermistor installed in drillhole AMQ15-324.
- The geothermal gradient was calculated as 0.021°C/m based on the data from the thermistor installed in drillhole AMQ15-324.
- The depth of permafrost beneath the land mass at the Project is estimated to be approximately 425 m, based on the intersection of the geothermal gradient and the freeze point depression curve.

The available data and the results of thermal modeling suggest that the pre-mining permafrost and talik conditions in the vicinity of the deposit are as follows:

- The majority of the proposed open pit is expected to be in permafrost
- A talik is expected in the central section of Whale Tail Lake, where lake half-widths are greater than 300 m and the water is >5 m deep.
- Talik conditions within the vicinity of the proposed open pit are likely to be between 100 to 200 m in depth and underlain by permafrost. The talik takes the form of a channel, running along the middle of the lake to the southern limit of the open pit. The southern portions of the talik are expected to be vertically open to depth as the lake broadens and deepens.

It is important to note that the permafrost and talik characterization was conducted using a preliminary dataset, as the temperature data are still stabilizing and cooling. The current permafrost and talik interpretation should be refined as the data stabilizes and as additional data are collected.

The likely groundwater quality for the Project has been based on a long-term dataset from groundwater wells installed in the talik zone at the AEM Meadowbank Mine. The Meadowbank Mine is underlain by the same sequence of Archean supra crustal rocks of the Woodburn Lake Group as the Project area. The groundwater quality at the Meadowbank Mine is generally described as hard to very hard with neutral to slightly basic pH and good buffering capacity. The groundwater quality data have been compared against the CEQG and the HC-DW guidelines for reference purposes, as there are no specific guidelines for groundwater quality in Nunavut. Aquatic life guideline exceedances were noted for fluoride, nitrate, nitrite, ammonia, aluminum, arsenic, boron, chromium, copper, iron, molybdenum, selenium, and zinc. The upper percentile nitrate, nitrite and ammonia concentrations are likely a result of explosive residues and are therefore not considered representative of baseline groundwater quality for the Project. The aquatic life guideline exceedances were typically limited to the upper 85th to 90th percentile concentrations for the majority of these parameters. However, fluoride and selenium concentrations were more frequently above the guidelines. Aesthetic objectives for drinking water quality were exceeded for chloride, TDS, iron, manganese, and sodium and health-based drinking water guidelines were exceeded for nitrate, nitrite, arsenic and selenium.

Please direct any questions or comments to the undersigned.

Yours truly,
Knight Piésold Ltd.

REGISTERED PROFESSIONAL ENGINEER
S.R. AIKEN
LICENSEE
Nov 25/15
NWT/NU

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25 NOV 2015

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Specialist Engineer

Approval that this document adheres to Knight Piésold Quality Systems: _____

PERMIT TO PRACTICE
KNIGHT PIESOLD LTD.
Signature _____
Date NOV 25 / 2015
PERMIT NUMBER: P 547
The Association of Professional Engineers, Geologists and Geophysicists of NWT/NU

Attachments:

Appendix A	Permafrost Terminology
Appendix B	Thermistor Installations & EC Logger
Appendix C	Calculation of Freezing Point Depression Point
Appendix D	Analytical and Numerical Thermal Modeling

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APPENDIX A

PERMAFROST TERMINOLOGY

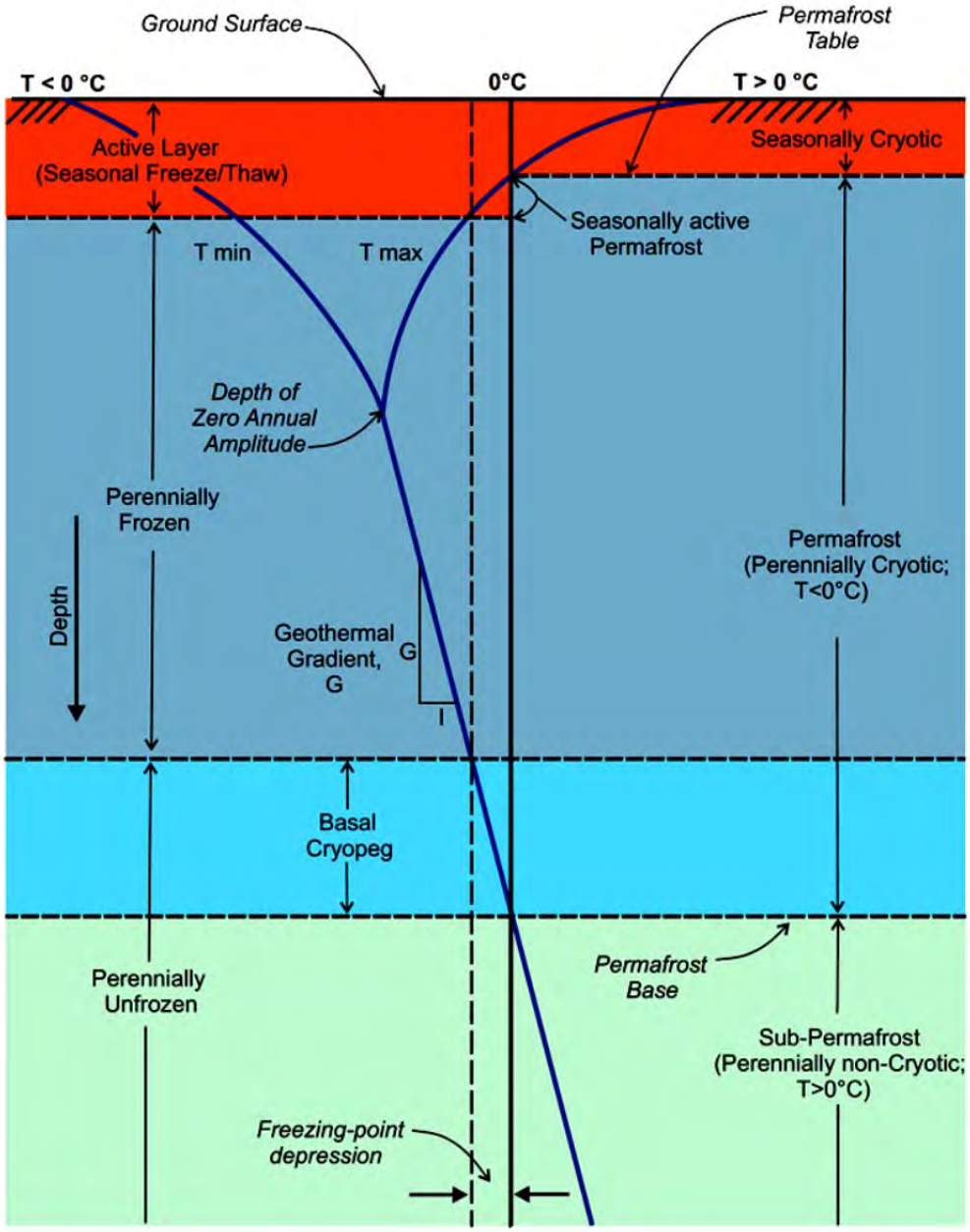
(Pages A-1 to A-2)

APPENDIX A- PERMAFROST TERMINOLOGY

Permafrost refers to subsurface soil or rock where temperatures remain at or below 0°C for two or more consecutive years. This condition is synonymous with perennially cryotic ground, which may be frozen, partially frozen, or non-frozen depending on the ice or water content of the ground and on the salinity of the included water. Permafrost is typically described throughout this baseline study by the following terminology, which relates to the ground temperature profile (Harris et al, 1988):

- Active layer: The active layer is the layer of ground subject to annual freezing and thawing in areas underlain by permafrost. The depth of the active layer can vary based on material type and water content, presence or absence of vegetation, proximity to water, and general topographic aspect.
- Permafrost table: The permafrost table is the upper boundary of permafrost, at the base of the active layer. The ground temperature above the permafrost table is above 0°C for at least a portion of each year; the ground temperature below the permafrost table is less than 0°C year-round.
- Permafrost base: The permafrost base is the lower boundary of permafrost, and its surface is typically undulating and uneven. The ground temperature above the permafrost base is less than 0°C, and below the permafrost base the ground temperature is above 0°C. The depth of the permafrost base varies with latitude, elevation, and proximity to large bodies of water. The depth of the permafrost base also depends on the thermal history of an area.
- Geothermal gradient: The geothermal gradient is the increase in ground temperature with depth, below the depth of zero annual amplitude. The geothermal gradient is typically a linear relationship. The permafrost base can be estimated if the geothermal gradient is known at a given temperature by projecting the linear relationship down until it crosses from negative ground temperature to positive ground temperature.
- Mean annual ground temperature: The mean annual ground temperature is the temperature at the ground surface. It can be measured or estimated based on a projection upward of the geothermal gradient to intersect the ground surface and compared with weather station data.
- Basal cryopeg: Basal cryopeg is layer of perennially cryotic (temperature less than 0°C) ground with liquid saline or pressurized pore water that forms the base of permafrost. The thickness of this layer is related to the salinity of the groundwater regime, which can result in depression of the freezing point several degrees below zero.
- Talik: A talik is defined as a layer or body of unfrozen ground in a permafrost area, and includes several types based on the relationship to the permafrost and the mechanism related to the unfrozen conditions (Harris et al. 1988). The three most common types of talik are defined as follows:
    - closed talik: a talik occupying a depression in the permafrost table below a lake or river (also called lake talik and river talik); its temperature remains above 0°C because of the heat storage effect of the surface water;
    - open talik: a talik that penetrates the permafrost completely, connecting a waterbody above the permafrost to the sub-permafrost aquifer (e.g., below large rivers and lakes); and,
    - isolated talik: a talik entirely surrounded by perennially frozen ground.

Figure 1: Typical Ground Thermal Profile in Permafrost



T = temperature; min = minimum; max = maximum; °C = degrees Celsius; <= less than; >= greater than.

(Martin, 2013)

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APPENDIX B

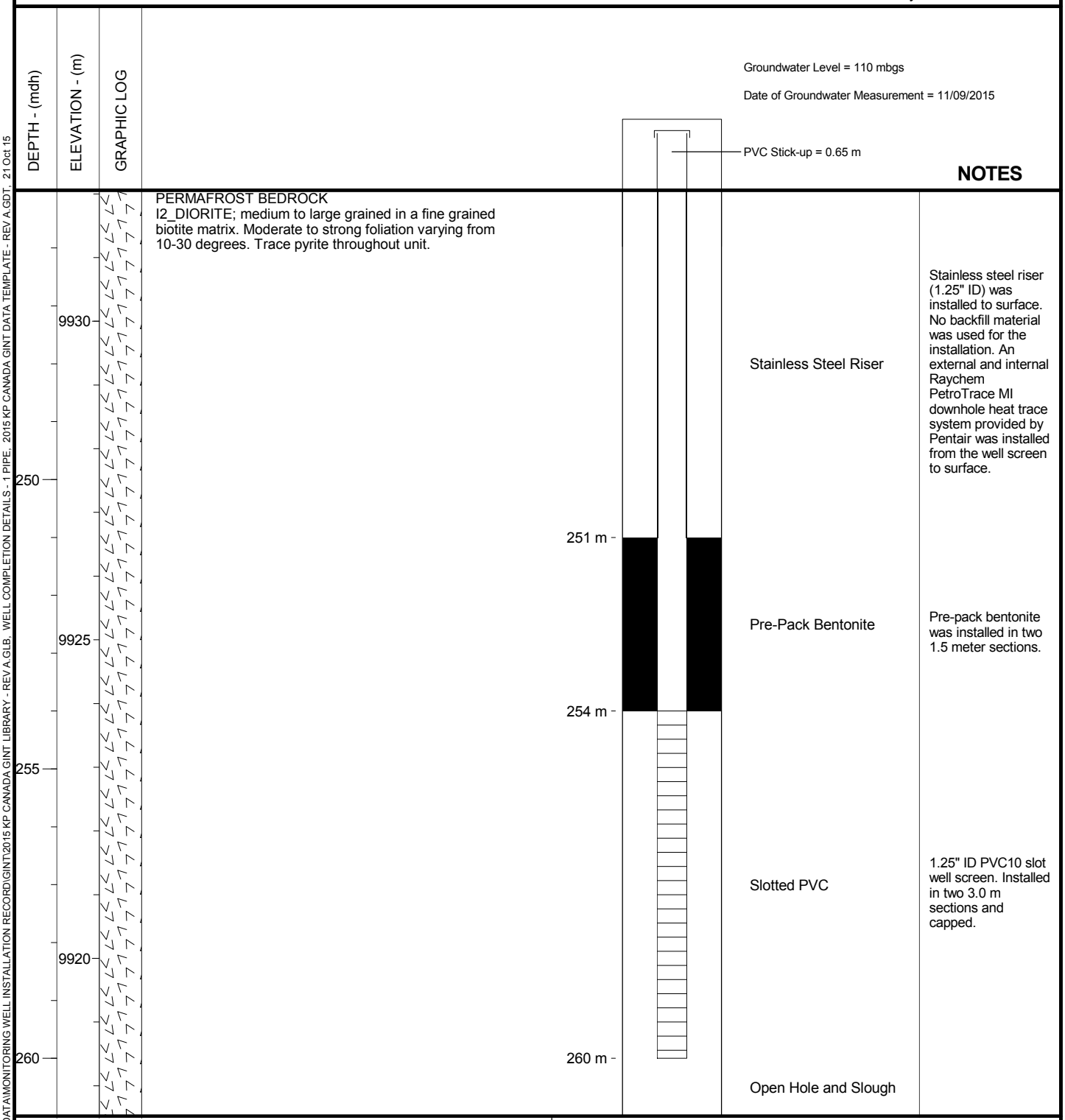
THERMISTOR INSTALLATIONS & EC LOGGER

(Pages B-1 to B-47)

Contractor: Orbit Garant
Location: Whale Tail Lake, East of Pit
Coordinates: 607,193 E , 7,255,368 N
Coordinate System: Mine Grid NAD 83 UTM Zone 14N

Drillhole No.: AMQ15-393
Drill Type: Fly 4 Duralite 1000
Total Depth: 261.0m
Elevation: 10154.643 m
Azimuth , Inclination: 146.48 , -65.3

Page: 1 of 1
Date Started: 31 Jul 15
Date Completed: 5 Aug 15
Logged by: AMB
Reviewed by: BG



GENERAL REMARKS:

All measurements are from ground surface. Depths are represented as meters downhole (mdh). The monitoring well was installed in an HQ (96.1 mm) drillhole inclined at approximately 65°.

AGNICO EAGLE MINES LTD. MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
NB101-00622/4	VA15-03393	0

FIGURE - B1

File:I:\101\00622\04\DATA\MONITORING WELL INSTALLATION RECORD\GINT\MONITORING WELL INSTALLATION LOGS.GPJ
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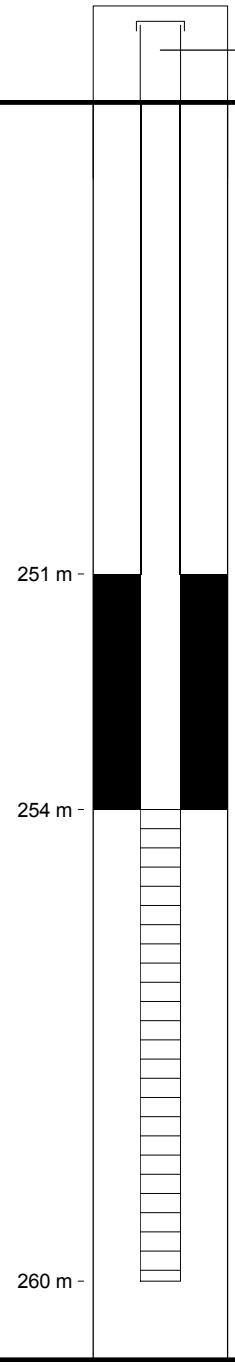
Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Orbit Garant
Location: Whale Tail Lake, East of Pit
Coordinates: 607,120 E , 7,255,461 N
Coordinate System: Mine Grid NAD 83 UTM Zone 14N

Drillhole No.: AMQ15-403
Drill Type: Fly 4 Duralite 1000
Total Depth: 261.0m
Elevation: 10155.86 m
Azimuth , Inclination: 259.73 , -65.3

Page: 1 of 1
Date Started: 5 Aug 15
Date Completed: 9 Aug 15
Logged by: AMB
Reviewed by: BG

DEPTH - (mdh)	ELEVATION - (m)	GRAPHIC LOG	
			PERMAFROST BEDROCK V4A_KOMATIITE; fine to coarse grained. Strong talc, carbonate and cloritization alteration. Trace pyrite mineralization.
250	9930		
255	9925		
260	9920		



NOTES

Stainless steel riser (1.25" ID) was installed to surface. No backfill material was used for the installation. An external and internal Raychem PetroTrace MI downhole heat trace system provided by Pentair was installed from the well screen to surface.

Pre-pack bentonite was installed in two 1.5 meter sections.

1.25" ID PVC10 slot well screen. Installed in two 3.0 m sections and capped.

GENERAL REMARKS:

All measurements are from ground surface. Depths are represented as meters downhole (mdh). The monitoring well was installed in an HQ (96.1 mm) drillhole inclined at approximately 65°.

AGNICO EAGLE MINES LTD. MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
NB101-00622/4	VA15-03393	0

FIGURE - B2

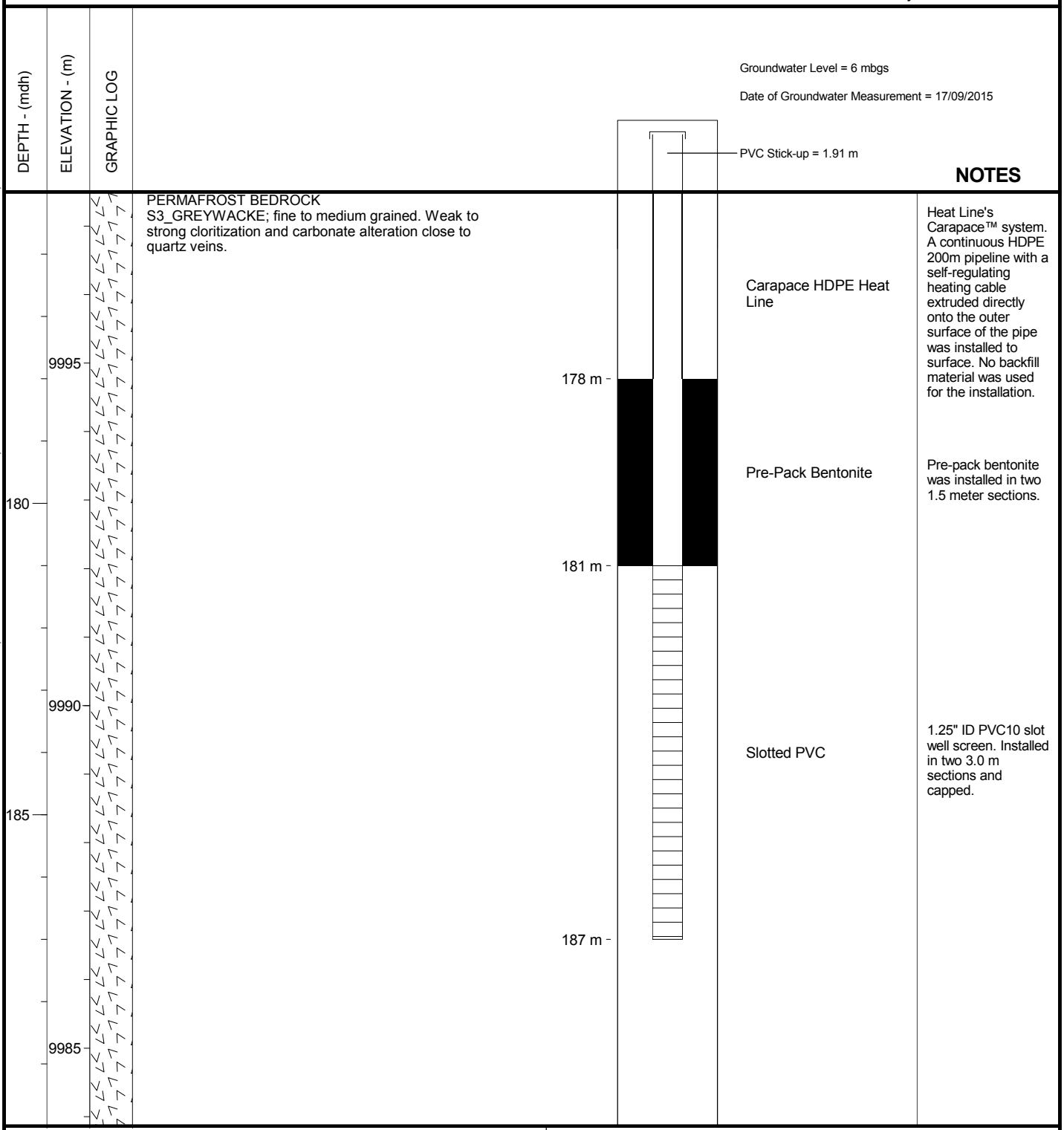
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Library: I:\101\00622\04\DATA\MONITORING WELL INSTALLATION RECORD\GINT\2015 KP CANADA GINT LIBRARY - REV A.GLB, WELL COMPLETION DETAILS - 1 PIPE, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, 21 Oct 15

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Orbit Garant
Location: Whale Tail Lake, North of Pit
Coordinates: 606,757 E , 7,255,790 N
Coordinate System: Mine Grid NAD 83 UTM Zone 14N

Drillhole No.: AMQ15-413
Drill Type: Fly 4 Duralite 1000
Total Depth: 210.0m
Elevation: 10156.616 m
Azimuth , Inclination: 138.77 , -65.4

Page: 1 of 1
Date Started: 9 Aug 15
Date Completed: 13 Aug 15
Logged by: AMB
Reviewed by: BG



GENERAL REMARKS:

All measurements are from ground surface. Depths are represented as meters downhole (mdh). The monitoring well was installed in an HQ (96.1 mm) drillhole inclined at approximately 65°.

AGNICO EAGLE MINES LTD. MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
NB101-00622/4	VA15-03393	0

FIGURE - 4

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:I:\101\00622\04\DATA\MONITORING WELL INSTALLATION RECORD\GINT\MONITORING WELL INSTALLATION LOGS.GPJ
Library: I:\101\00622\04\DATA\MONITORING WELL INSTALLATION RECORD\GINT\2015 KP CANADA GINT LIBRARY - REV A.GLB, WELL COMPLETION DETAILS - 1 PIPE, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, 21 Oct 15

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Appendix B1

AGNICO EAGLE MINES LTD. MEADOWBANK DIVISION
WHALE TAIL PROJECT

THERMISTOR INSTALLATION DEPTHS

Print Oct-22-15 12:16:59

Drillhole ID	Thermistor Number	Thermistor Depth (m along hole)	Thermistor Depth (mbgs)	Comments
AMQ15-294	1	8.9	6.3	
	2	27.5	19.4	
	3	51.9	36.7	
	4	76.4	54.0	
	5	104.1	73.6	
	6	129.0	91.2	
	7	154.0	108.9	
	8	179.0	126.5	
	9	204.2	144.4	
AMQ15-306	1	-0.5	-0.4	Installed above ground
	2	27.7	19.6	
	3	52.7	37.2	
	4	77.6	54.9	
	5	102.5	72.5	
	6	127.5	90.1	
	7	152.4	107.8	
	8	177.4	125.5	
	9	200.1	141.5	
AMQ15-324	1	1.3	0.9	
	2	49.7	35.1	
	3	98.7	69.8	
	4	148.7	105.1	
	5	198.8	140.6	
	6	248.3	175.6	
	7	298.9	211.4	
	8	348.9	246.7	
	9	398.9	282.1	
	10	448.8	317.4	
AMQ15-349A	1	0.5	0.4	
	2	25.4	17.9	
	3	50.2	35.5	
	4	75.3	53.3	
	5	100.3	70.9	
	6	125.2	88.5	
	7	150.2	106.2	
	8	175.1	123.8	
	9	198.9	140.6	
AMQ15-421	1	10.3	8.0	
	2	20.3	15.8	
	3	30.3	23.5	
	4	40.3	31.3	
	5	50.3	39.1	
	6	75.2	58.5	
	7	100.2	77.8	
	8	125.1	97.2	
	9	150.1	116.6	
	10	175.0	136.0	
	11	199.9	155.4	
	12	224.9	174.8	
	13	249.9	194.2	
	14	274.8	213.6	
	15	299.8	233.0	
	16	324.8	252.4	
	17	349.7	271.8	
	18	374.7	291.2	
	19	399.6	310.6	
	20	424.6	330.0	
	21	449.6	349.4	
	22	474.6	368.8	
	23	499.6	388.3	
AMQ15-452	1	9.8	7.5	
	2	19.9	15.2	
	3	29.8	22.8	
	4	39.8	30.5	
	5	49.8	38.1	
	6	74.7	57.2	
	7	99.6	76.3	
	8	124.5	95.4	
	9	149.4	114.5	
	10	174.4	133.6	
	11	199.4	152.7	
	12	224.4	171.9	
	13	249.4	191.1	
	14	274.4	210.2	
	15	299.4	229.3	
	16	324.3	248.4	
	17	349.3	267.5	
	18	374.2	286.7	
	19	399.2	305.8	
	20	424.2	324.9	
	21	449.1	344.1	
	22	474.1	363.2	
	23	499.1	382.3	

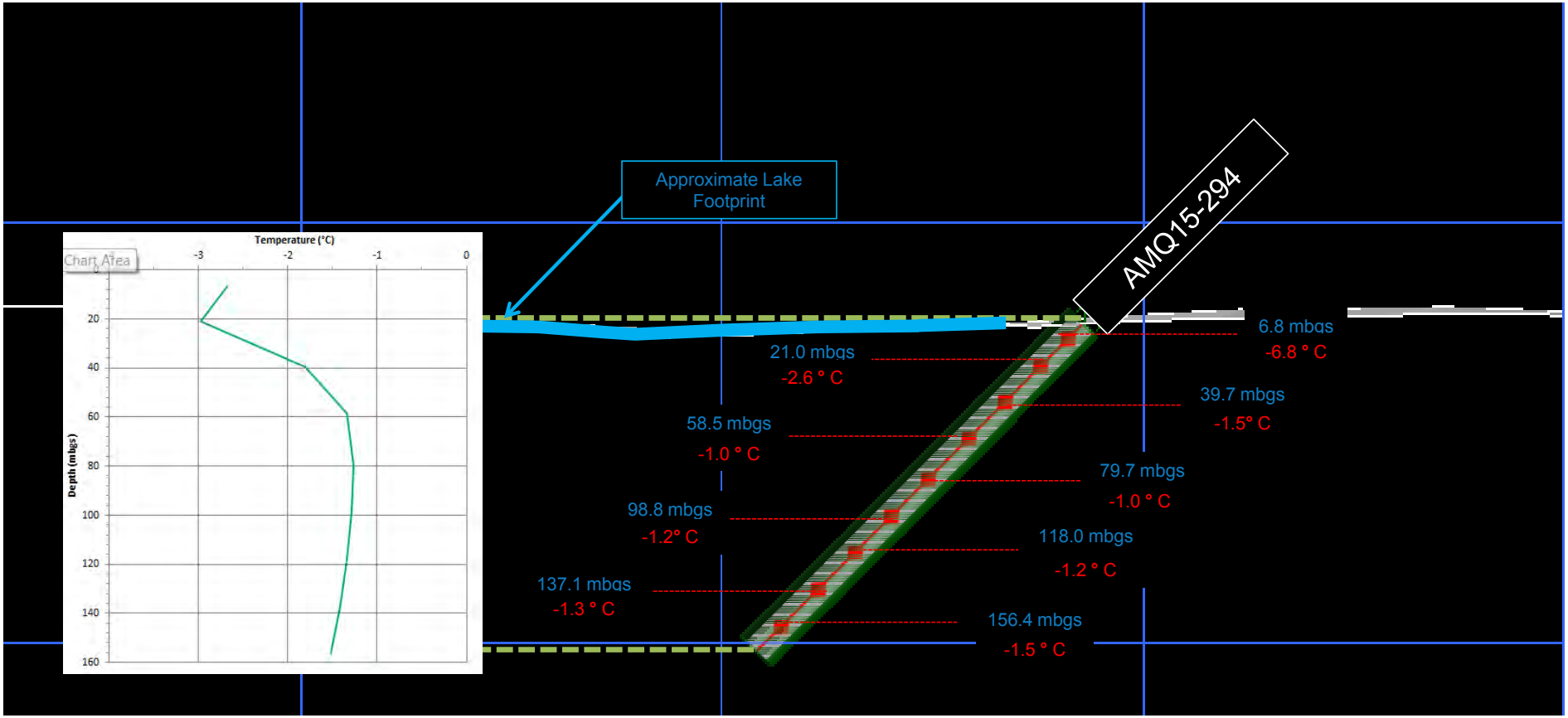
I:\1\01\00622\04\A\Correspondence\VA15-03249- Permafrost Characterization\Appendices\Appendix B\SS\[B1c_Amaruq Thermistor Installation Depth Summary.xlsx]ALONG-HOL

NOTES:
1. Thermsitor holes are all inclined: AMQ15-295 (-45 deg); AMQ15-306 (-45 deg); AMQ15-324 (-45 deg); AMQ15-349A (-45 deg); AMQ15-421 (-51 deg); AMQ15-452 (-50 deg);

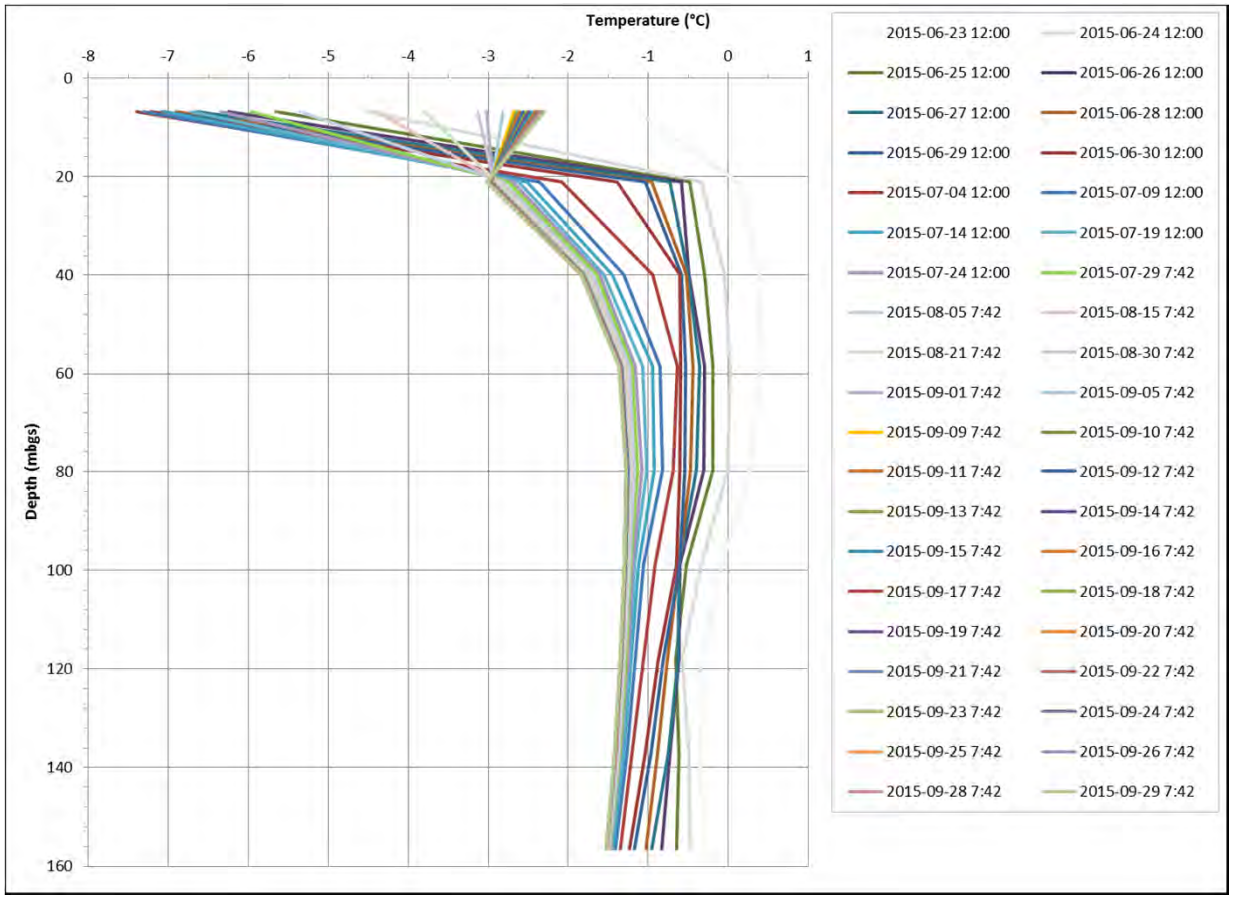
REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	23SEPT'15	ISSUED WITH LETTER	REW	MBG

Knight Piésold

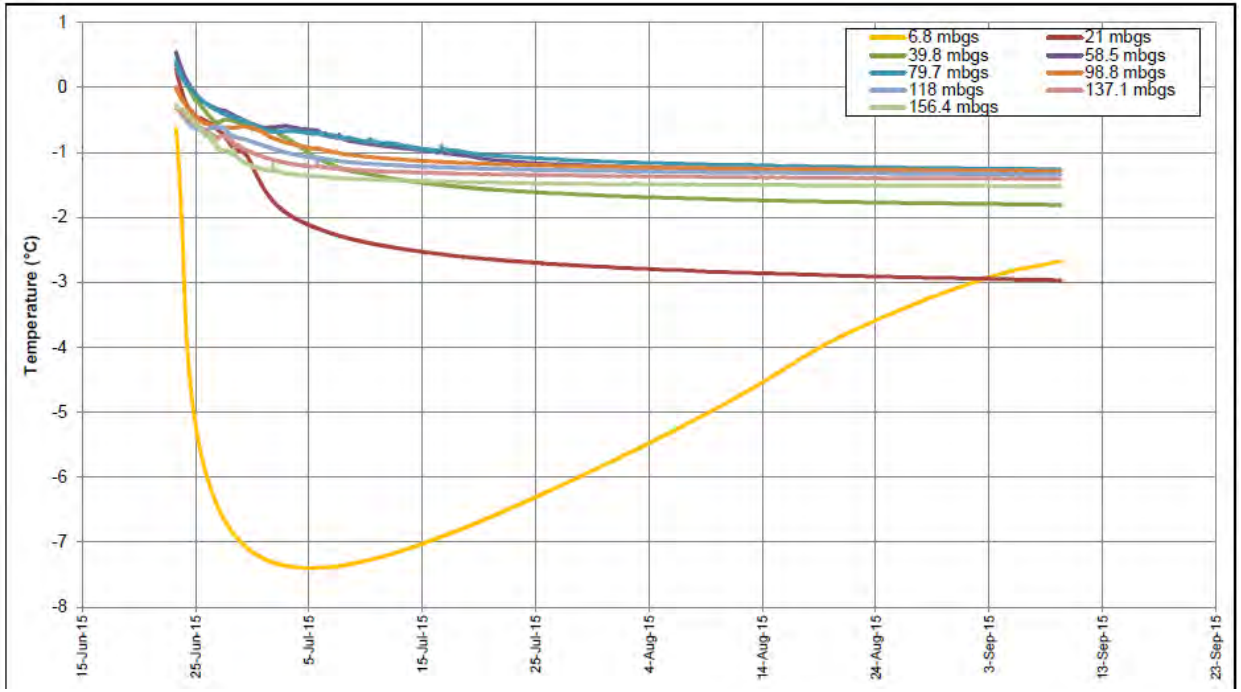
AMQ15-294 – Ground Temperature Profile



AMQ15-294 – Ground Temperature with Depth

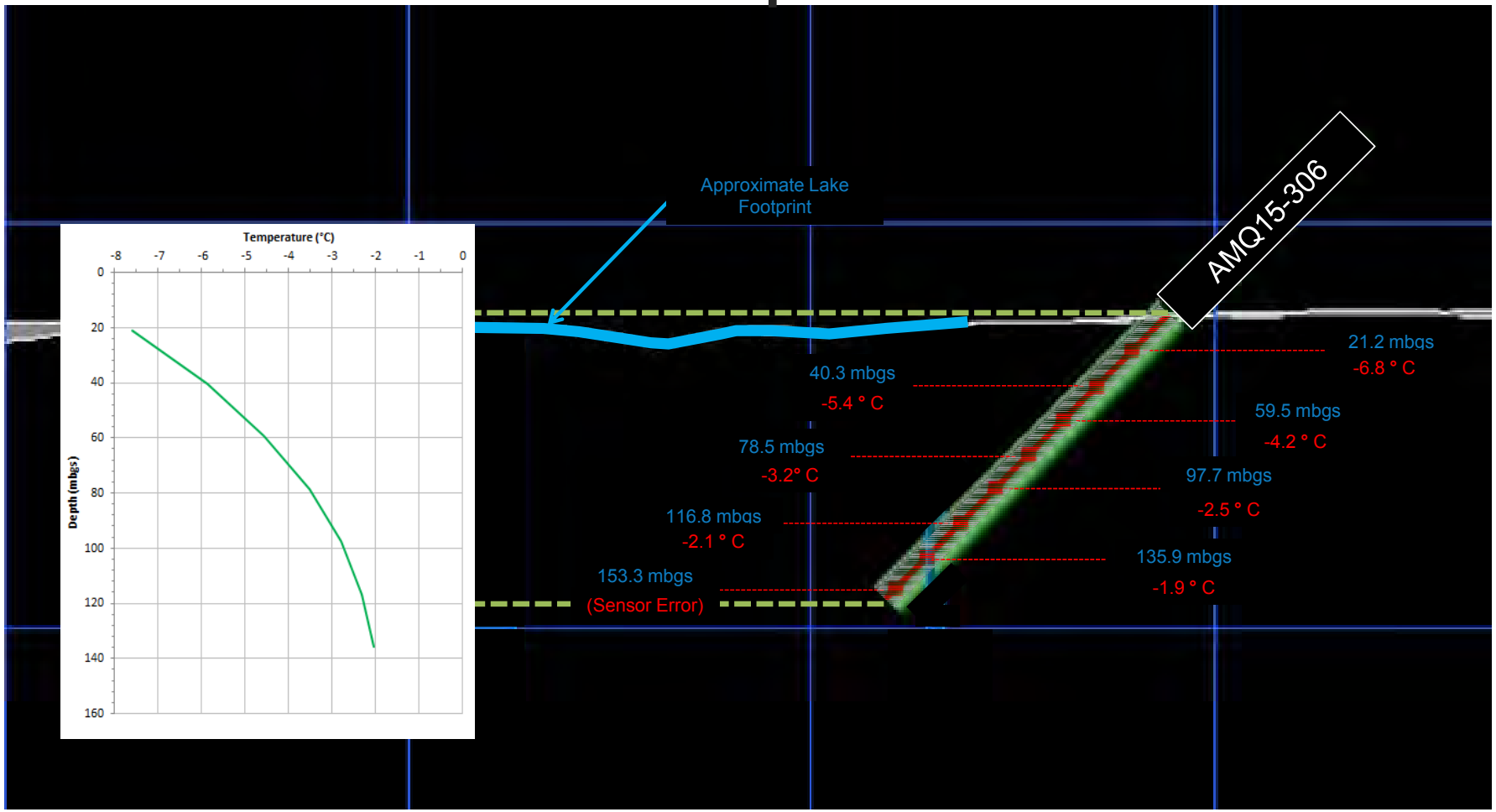


AMQ15-294 – Ground Temperature with Time

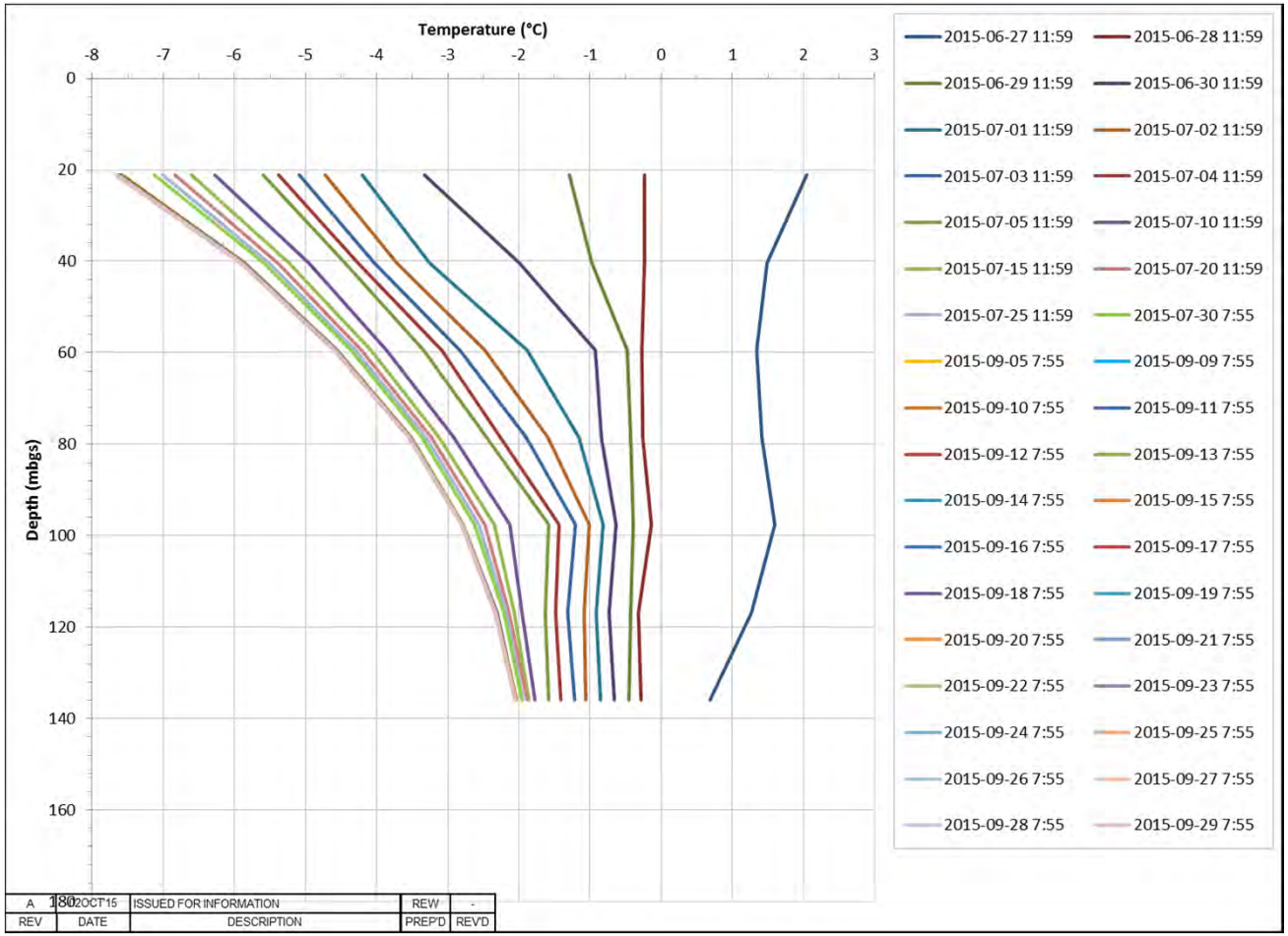


Knight Piésold

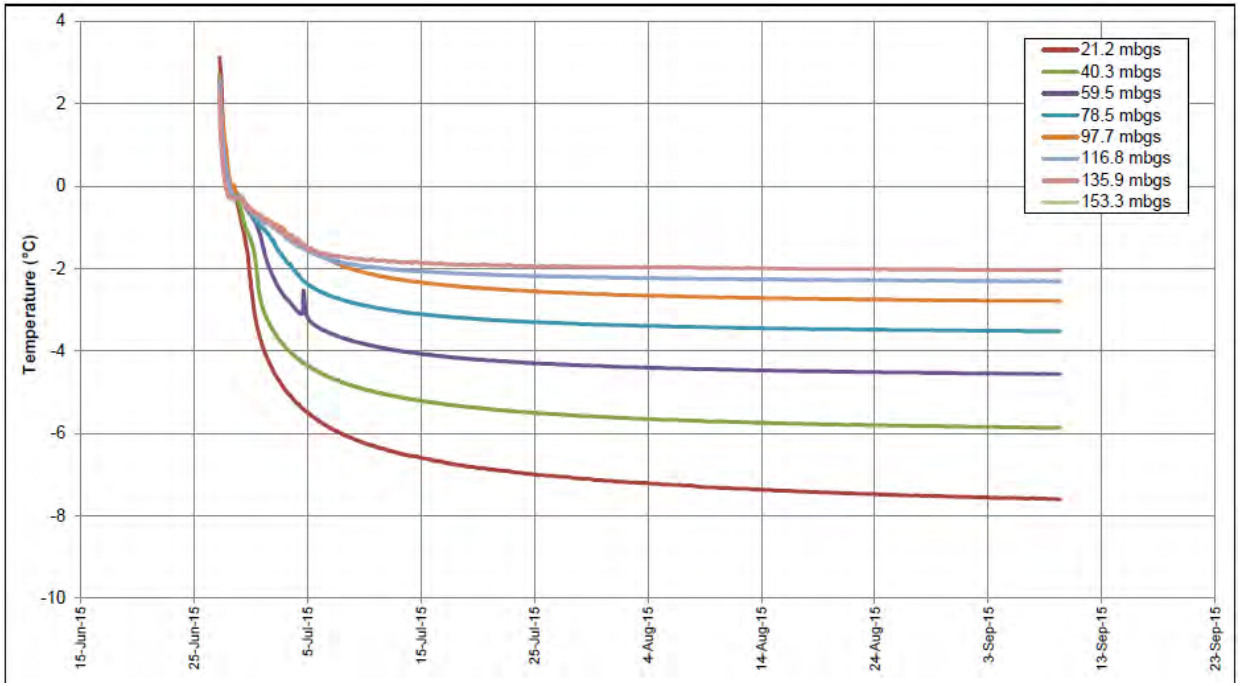
AMQ15-306 – Ground Temperature Profile



AMQ15-306 – Ground Temperature with Depth

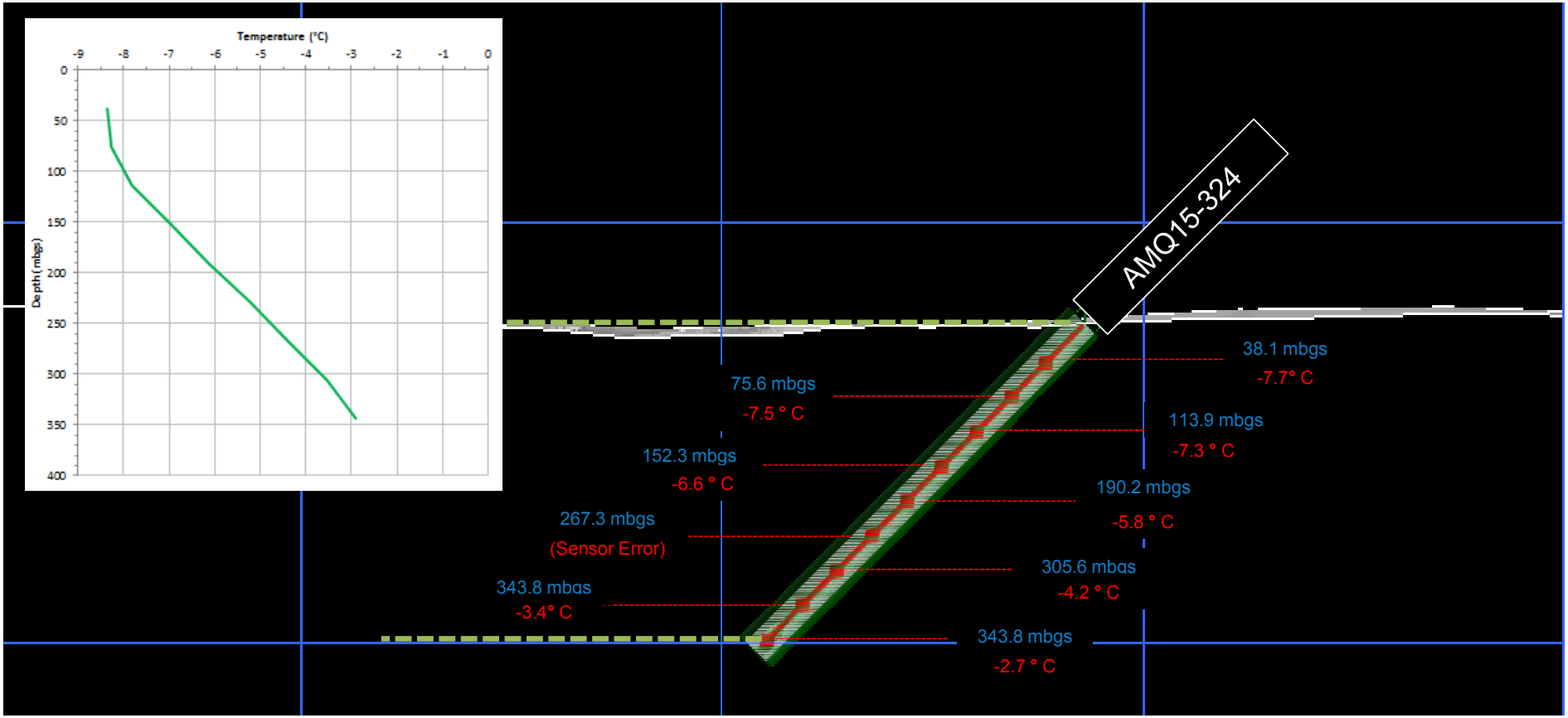


AMQ15-306 – Ground Temperature with Time

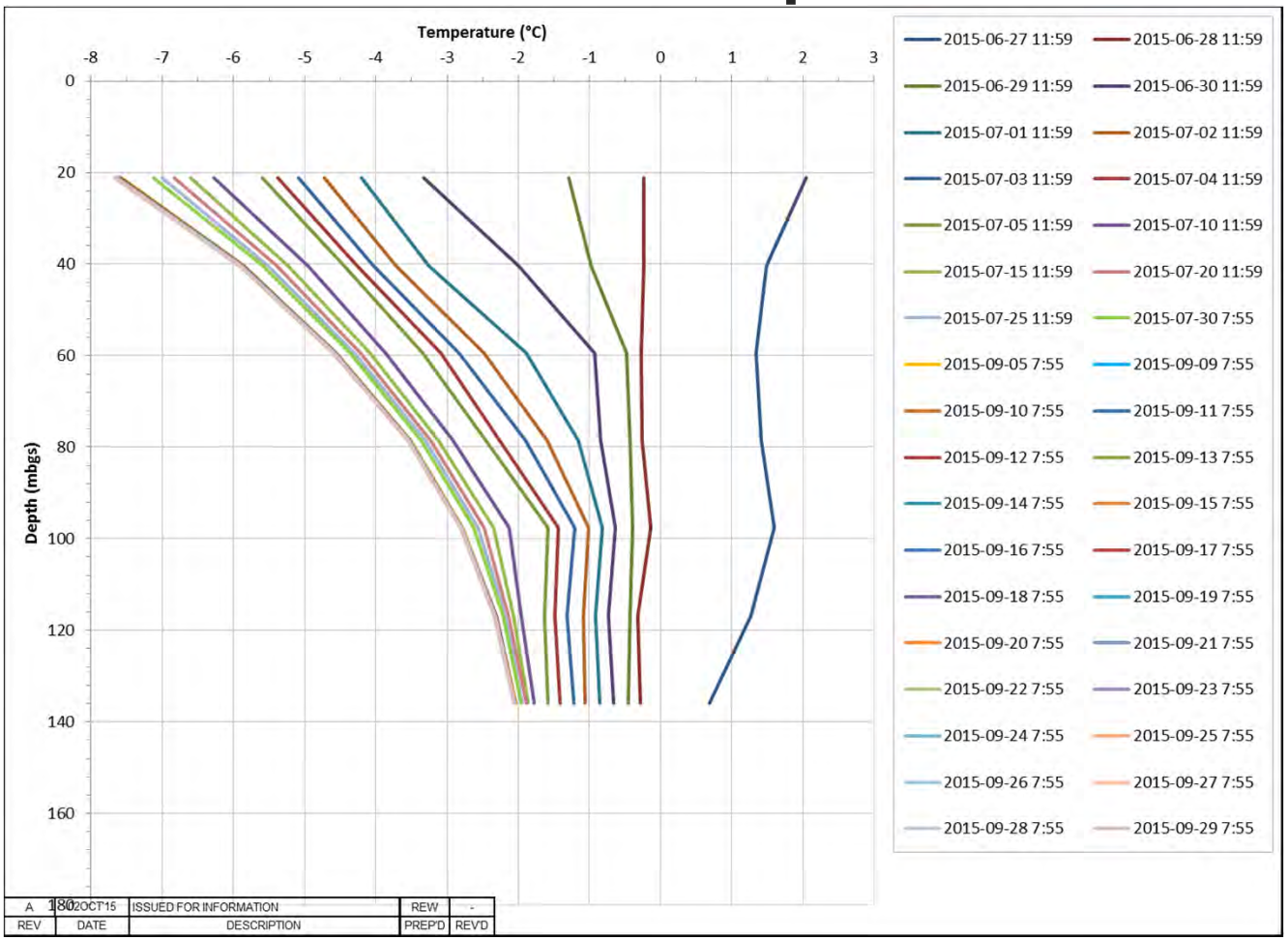


Knight Piésold

AMQ15-324 – Ground Temperature Profile

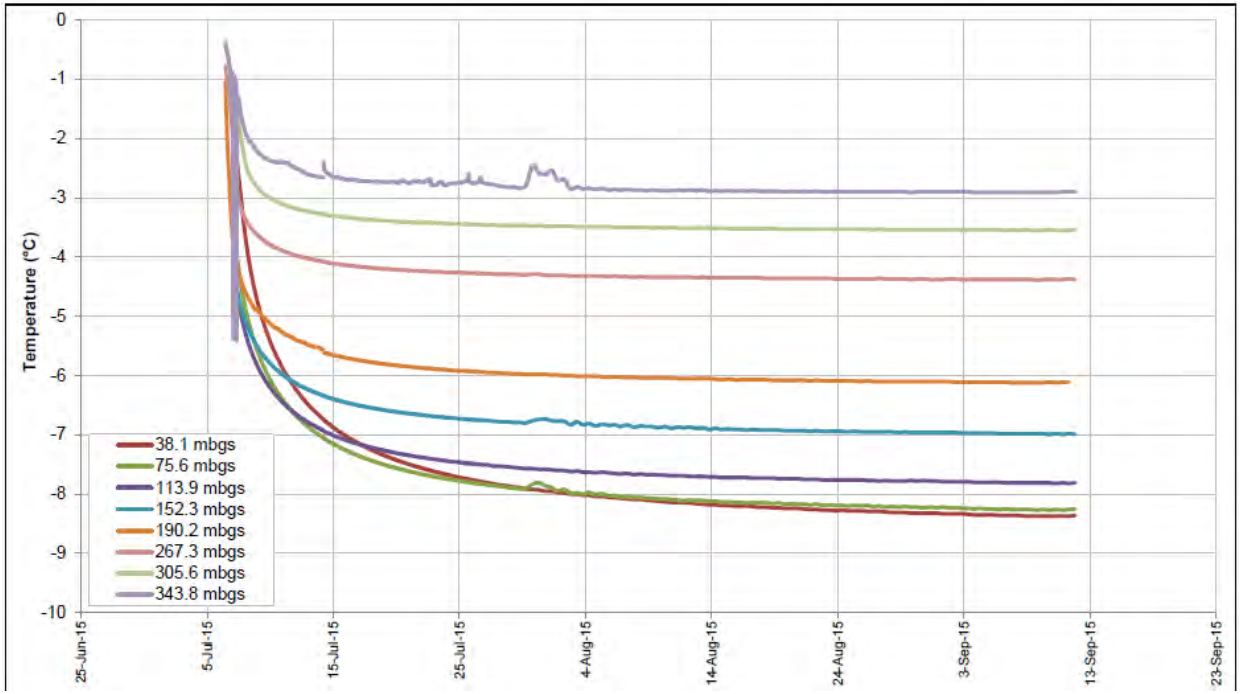


AMQ15-324 – Ground Temperature Profile

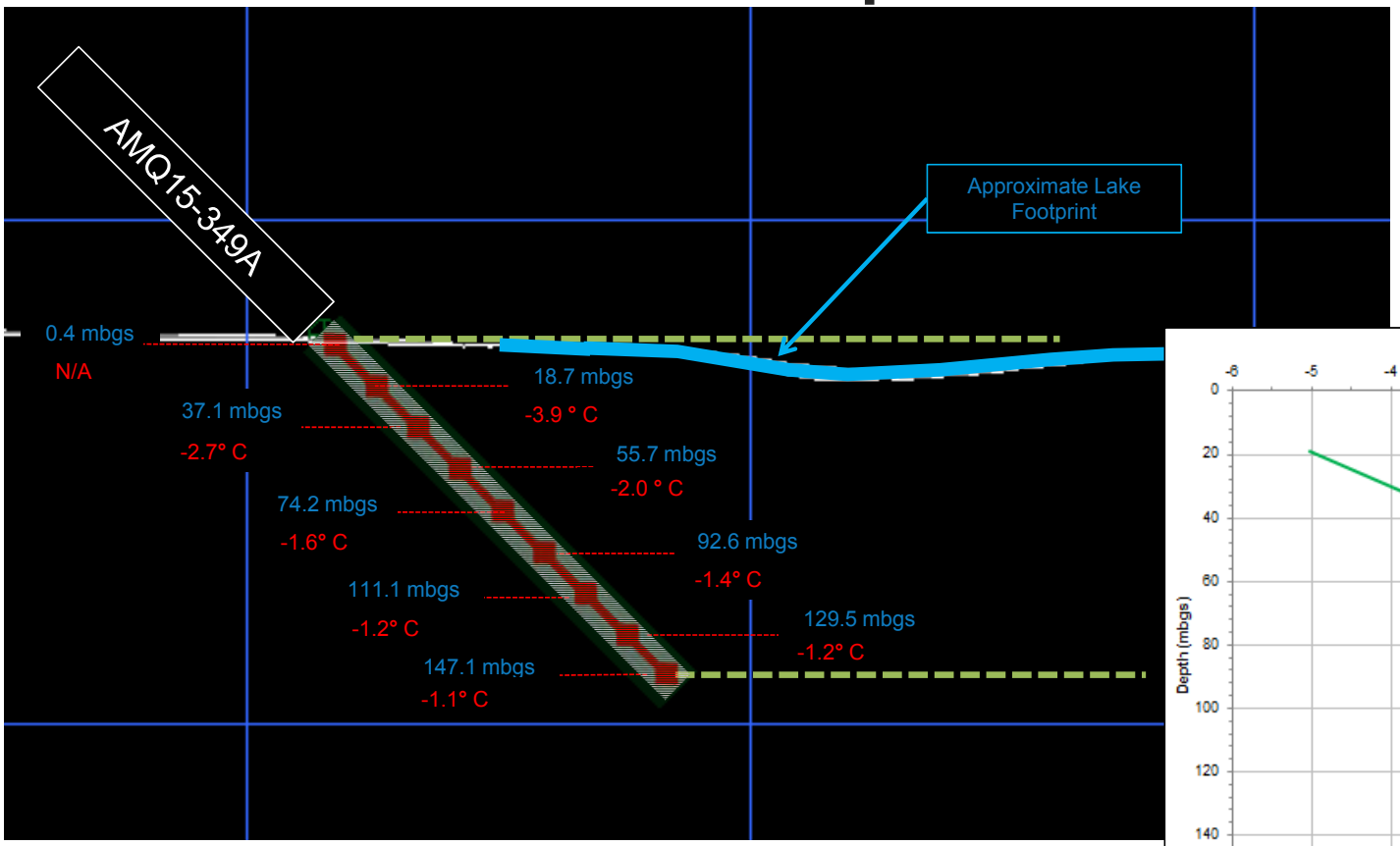


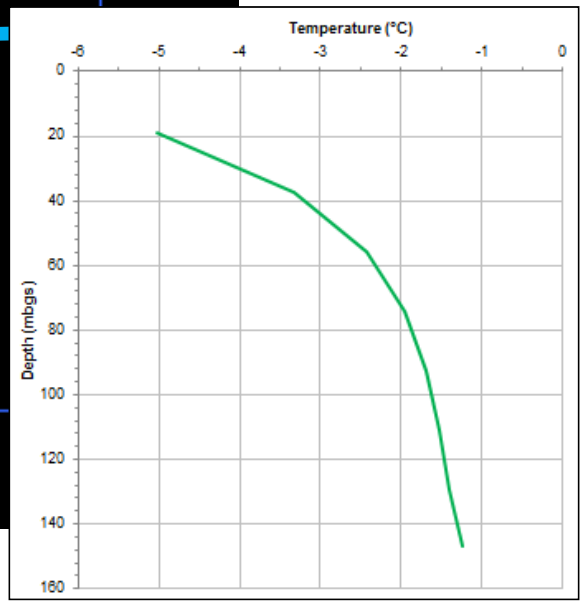
AMQ15-324 – Ground Temperature with Time

BP2

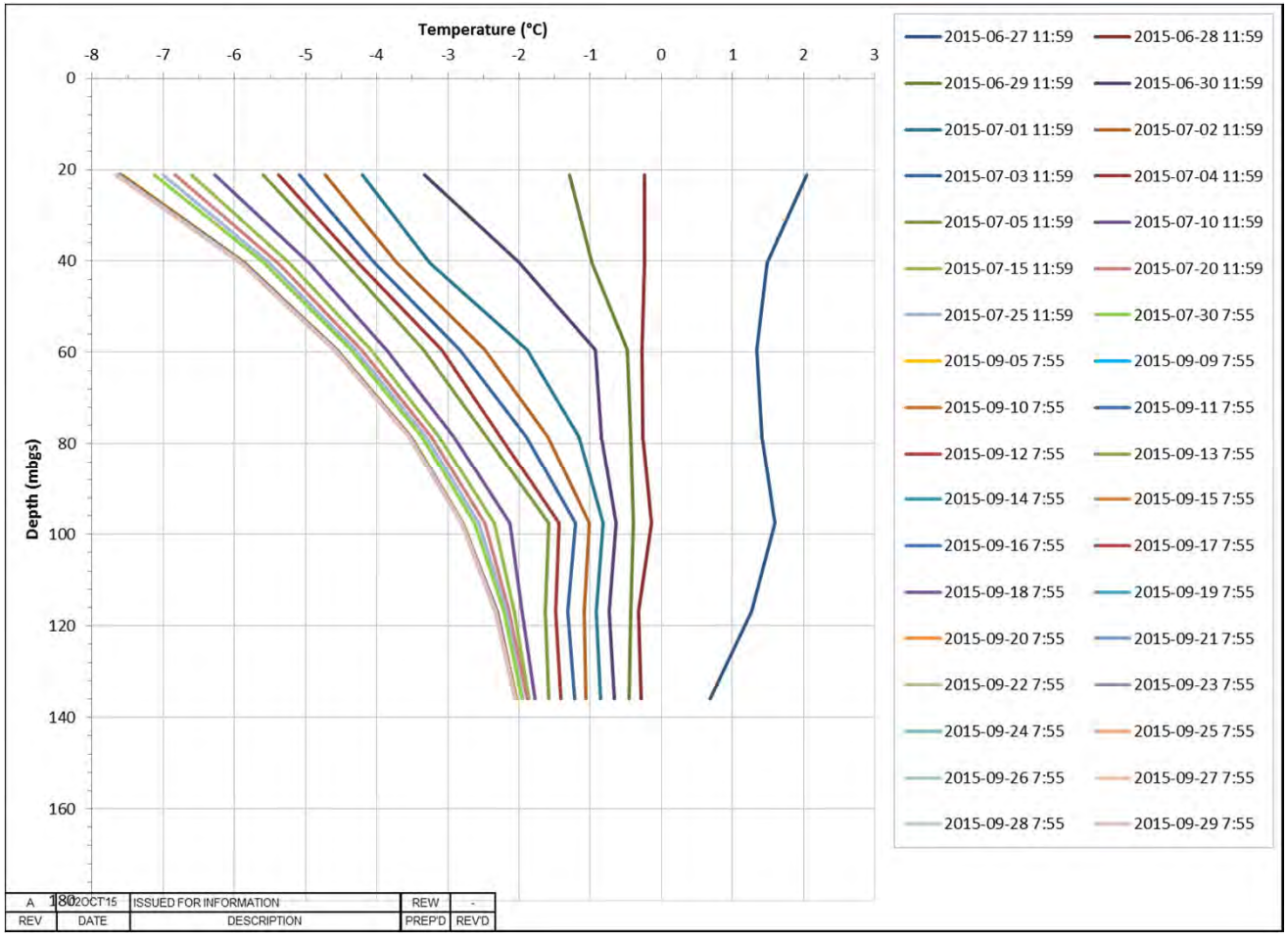


AMQ15-349A – Ground Temperature Profile

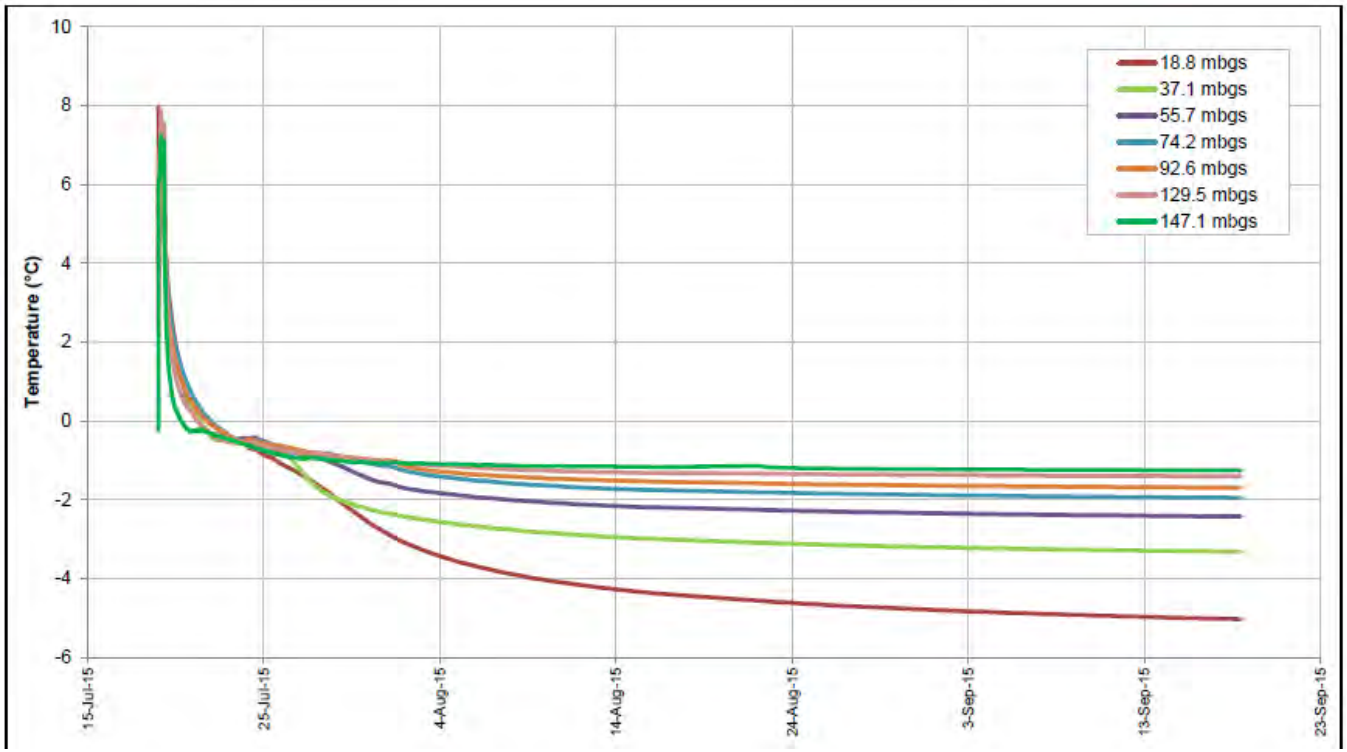




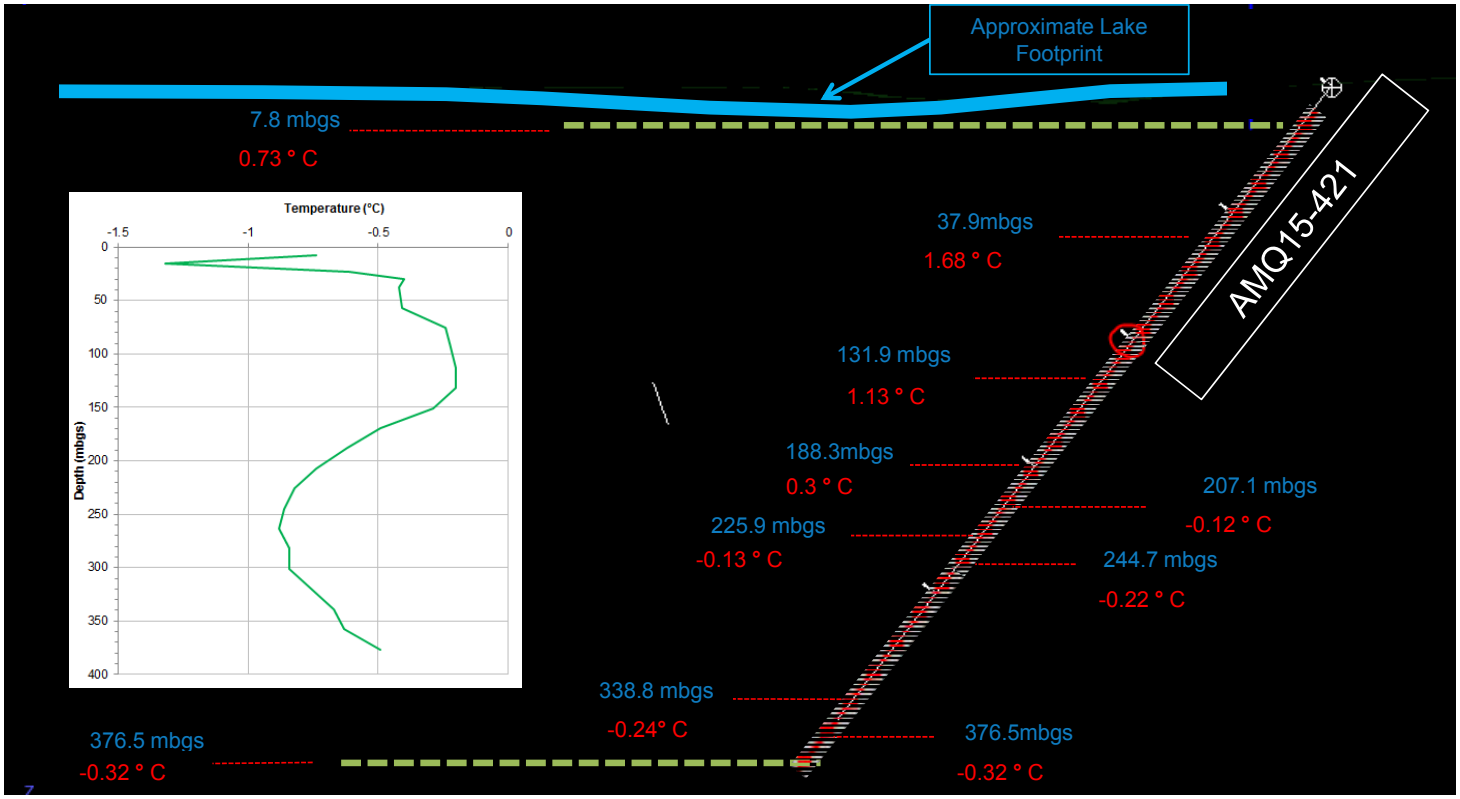
AMQ15-349A – Ground Temperature Profile



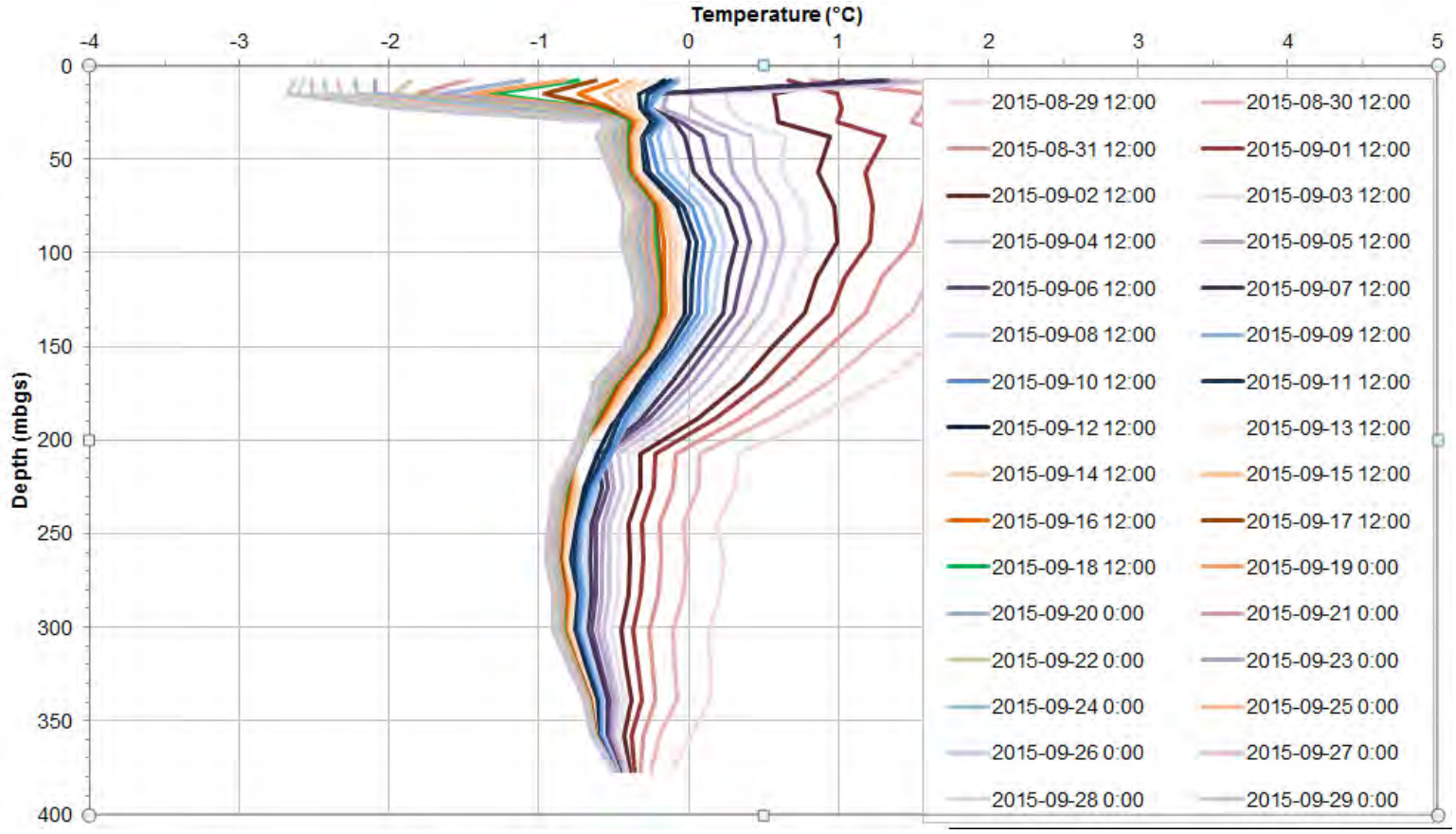
AMQ15-349A – Ground Temperature with Time



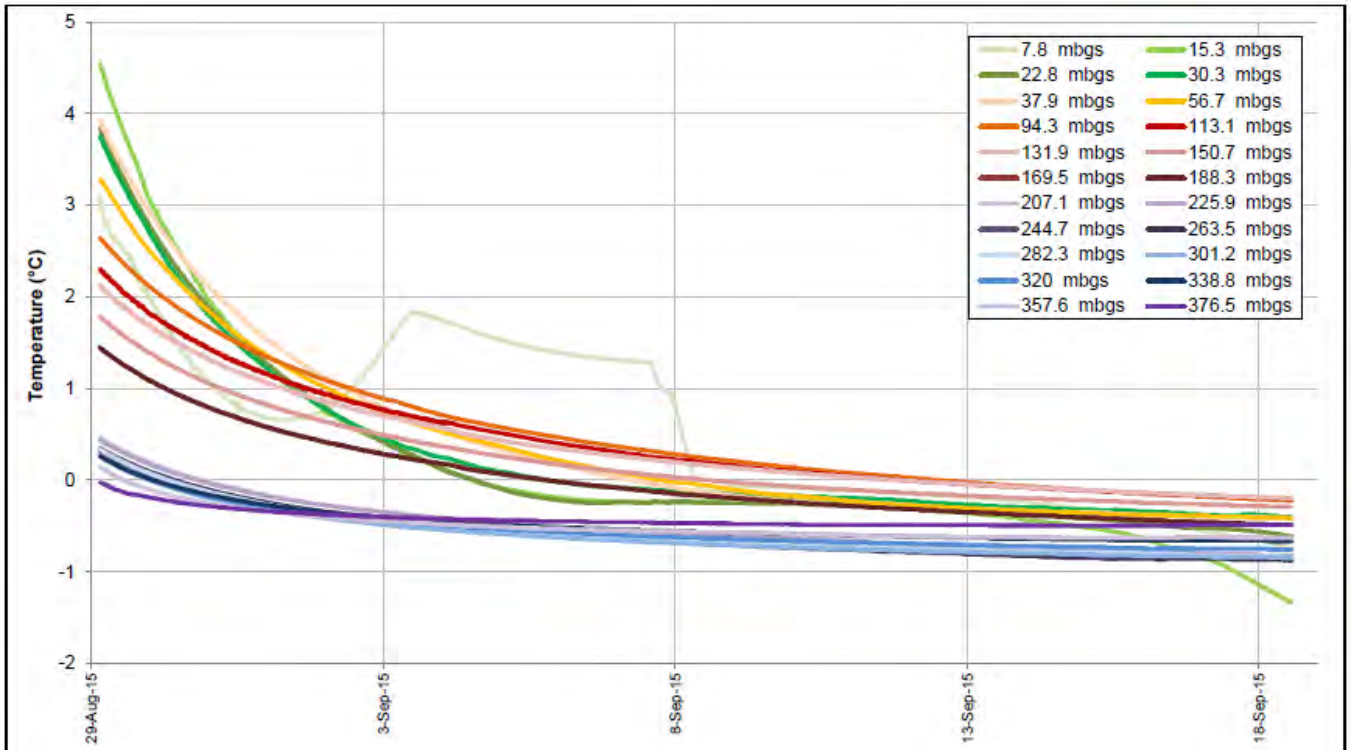
AMQ15-421 – Ground Temperature Profile



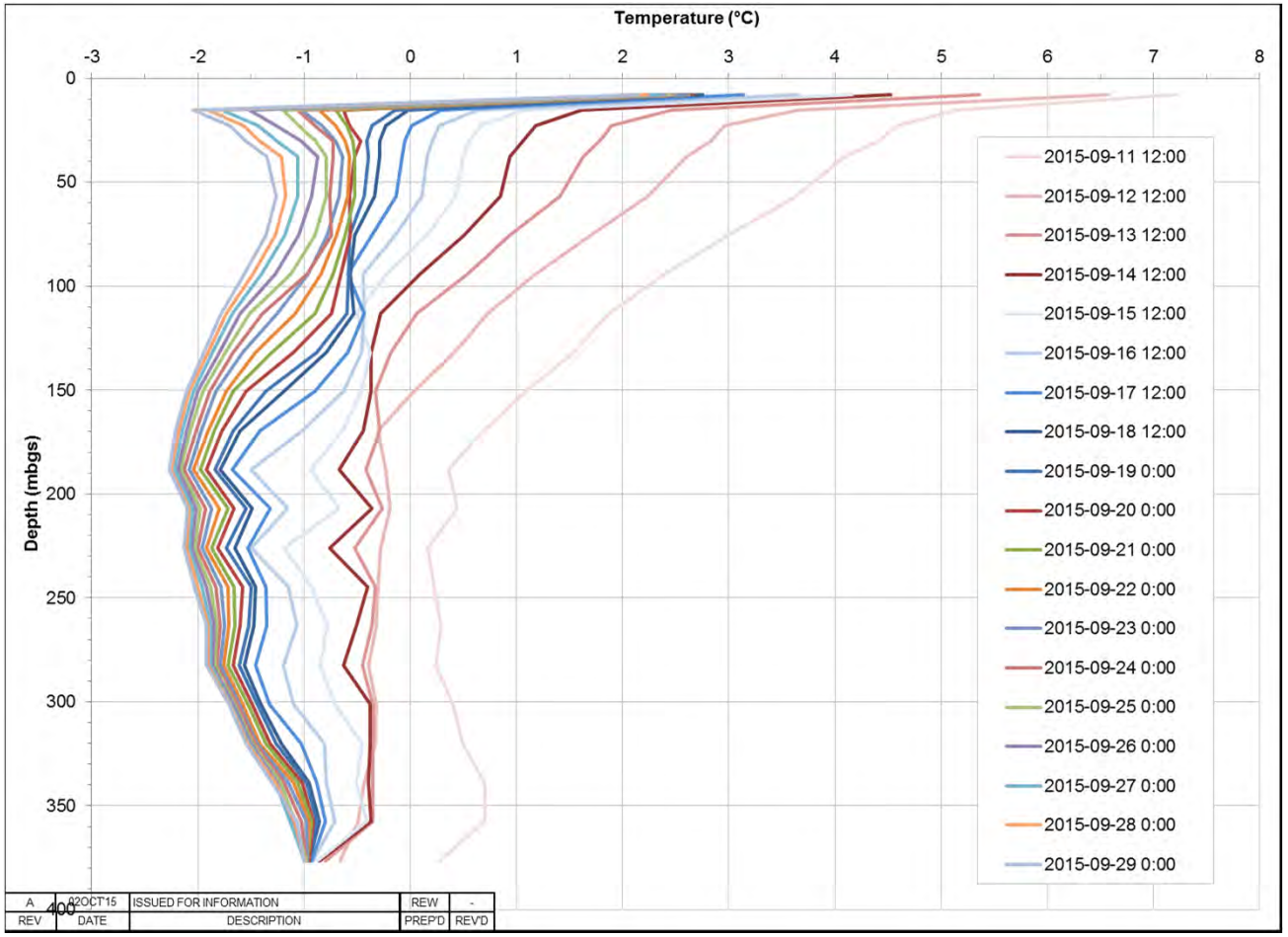
AMQ15-421 – Ground Temperature Profile



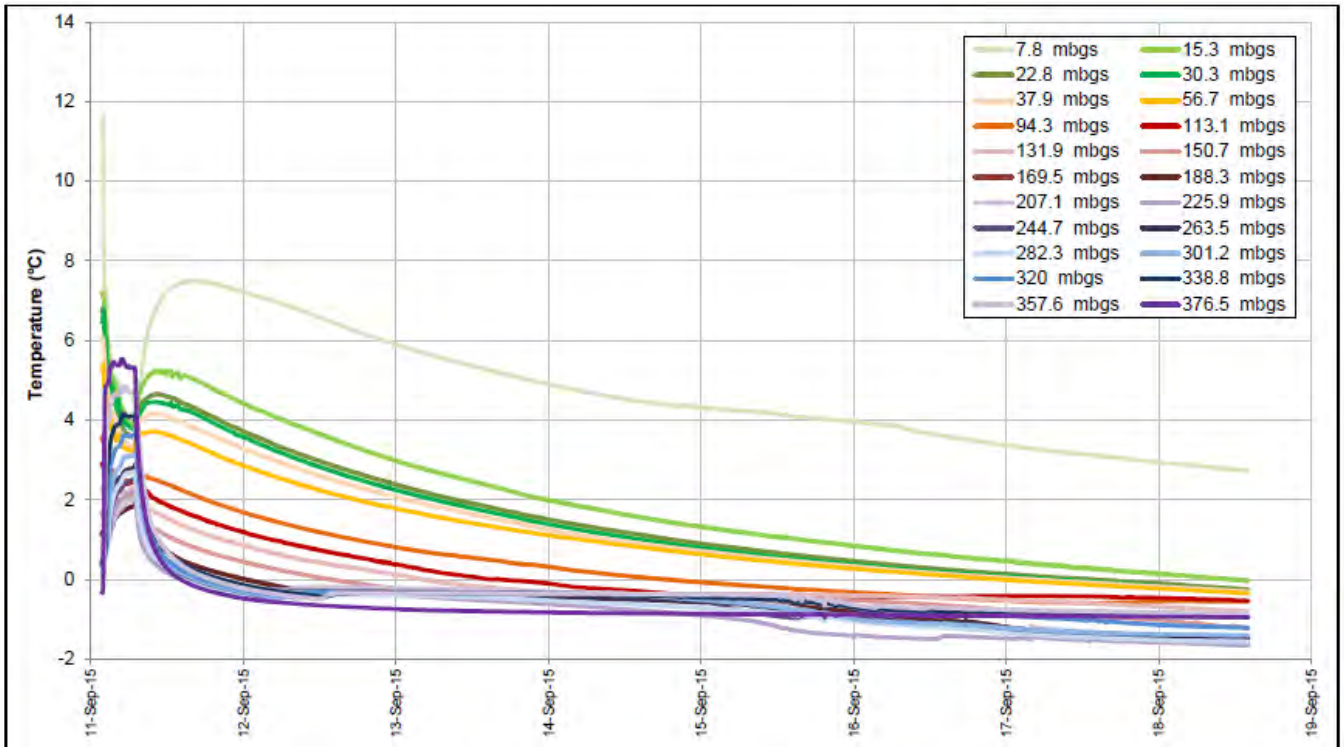
AMQ15-421 – Ground Temperature with Time



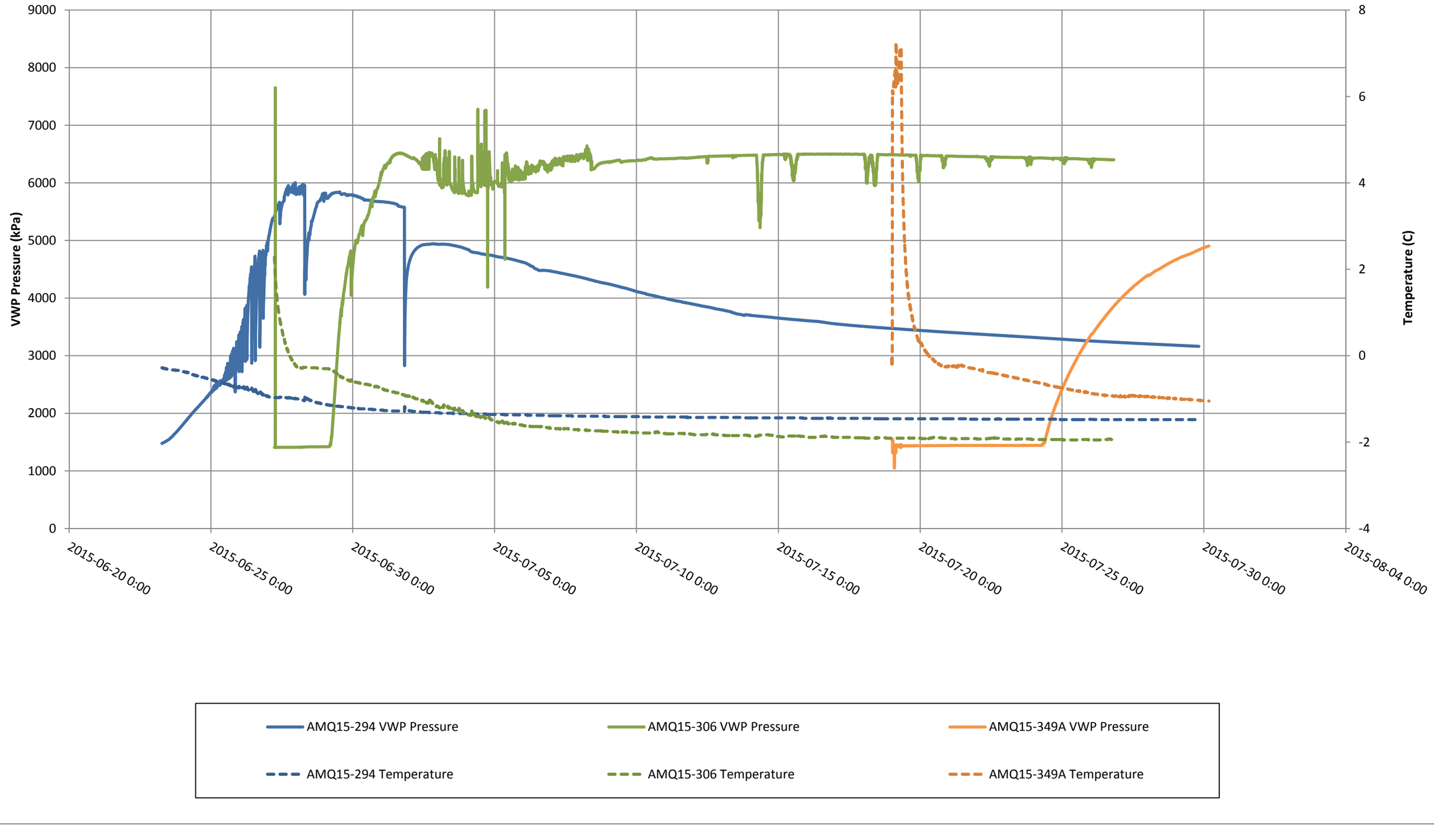
AMQ15-452 – Ground Temperature Profile



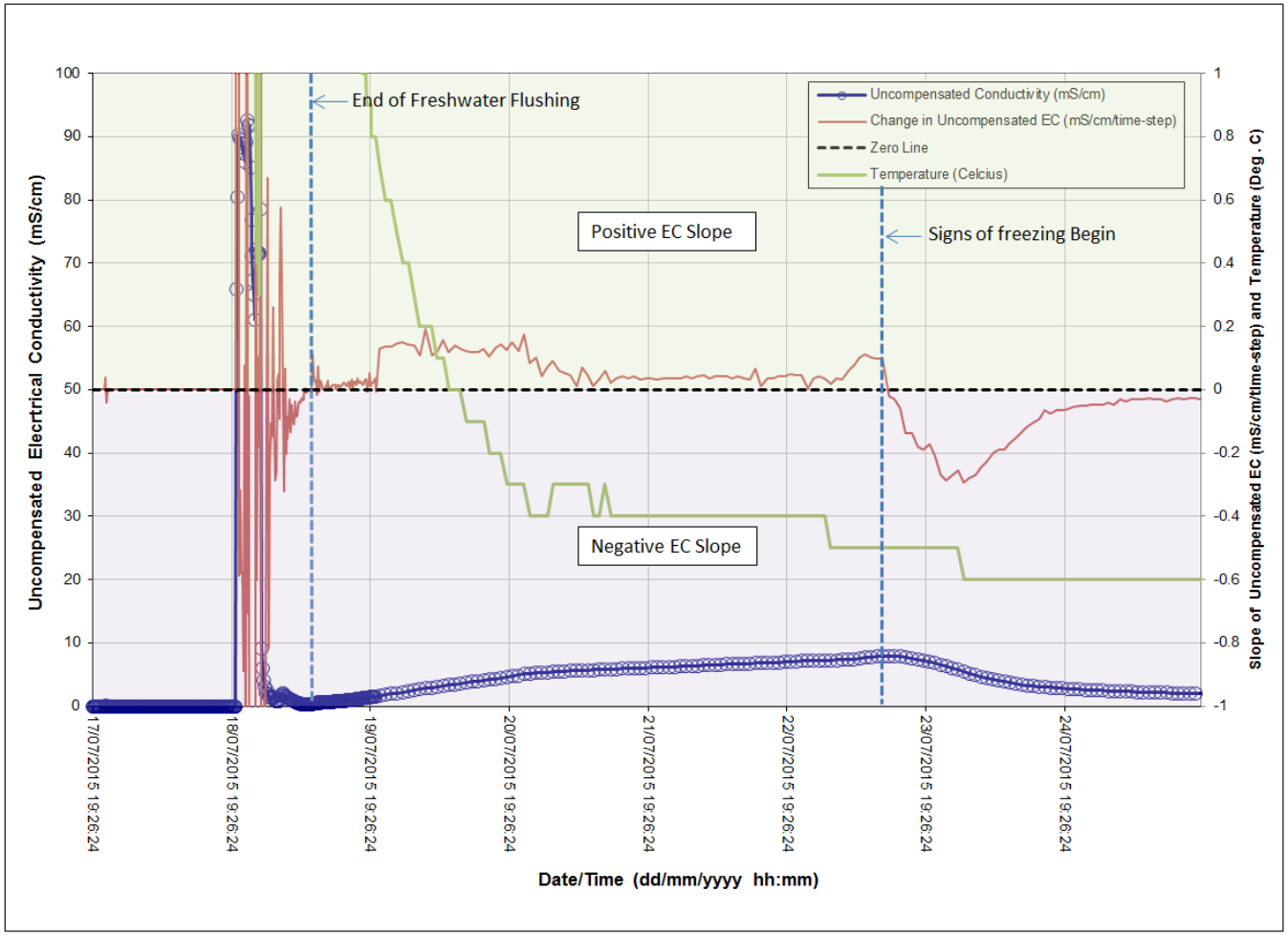
AMQ15-452 – Ground Temperature with Time



VWP Pressure Data and Corresponding Thermistor Temperature Reading



AMQ15-349A – Electrical Conductivity with Time



Thermistor Strings



RST Instruments manufactures thermistor string assemblies that are environmentally hardened to provide accurate and reliable long-term measurements under demanding geotechnical conditions. The strings incorporate interchangeable, curve tracking, negative temperature coefficient (NTC) thermistors. As the thermistors are curve matched to desired temperature tolerance over selected temperature ranges, this permits the use of multiple sensors with a single readout or data logger, eliminating costly calibration procedures.

RST thermistor strings are custom manufactured to user specifications: cable length, thermistor number, accuracy, and location on the string. Resistance to the ingress of water is insured by a triple encapsulation procedure. Standard cable employed is a heavy duty, direct burial rated 22 gauge water blocked instrumentation cable. Thermistor strings with piezometers are also available and custom made to order. Contact RST Sales for complete details.

Other cable types are available to suit site-specific requirements. Readout instruments are available, ranging from hand held devices to complete data logger systems.

A bussed digital version is also available, please see RST's Digital ThermArray brochure.

specifications

ITEM	DESCRIPTION
Interchangeability Tolerance	±0.1°C
Interchangeability Temp. Range	0°C to +75°C
Operating Temp. Range	-80°C to +75°C
Stability	0.01°C or better /100 months at 0°C
Resistance at 25º	2252, 3k, 5k, 10k ohms

RST Instruments Ltd.
11545 Kingston St.,
Maple Ridge, BC
Canada V2X 0Z5

Telephone: 604 540 1100
Facsimile: 604 540 1005
Toll Free: 1 800 665 5599

info@rstinstruments.com

www.rstinstruments.com

features

- High reliability, ensured by triple encapsulation.
- Precision matched, interchangeable thermistors.
- Pre-assembled to specific length and spacing.
- Heavy duty, direct burial cable standard.

ordering info

- Accuracy required.
- Cable length.
- Cable termination enclosures.
- Readout and datalogger.
- Quantities and required thermistor spacing per string.
- Method of cable termination.
- Special environmental conditions which may require non-standard cable, such as acidic mine tailings.

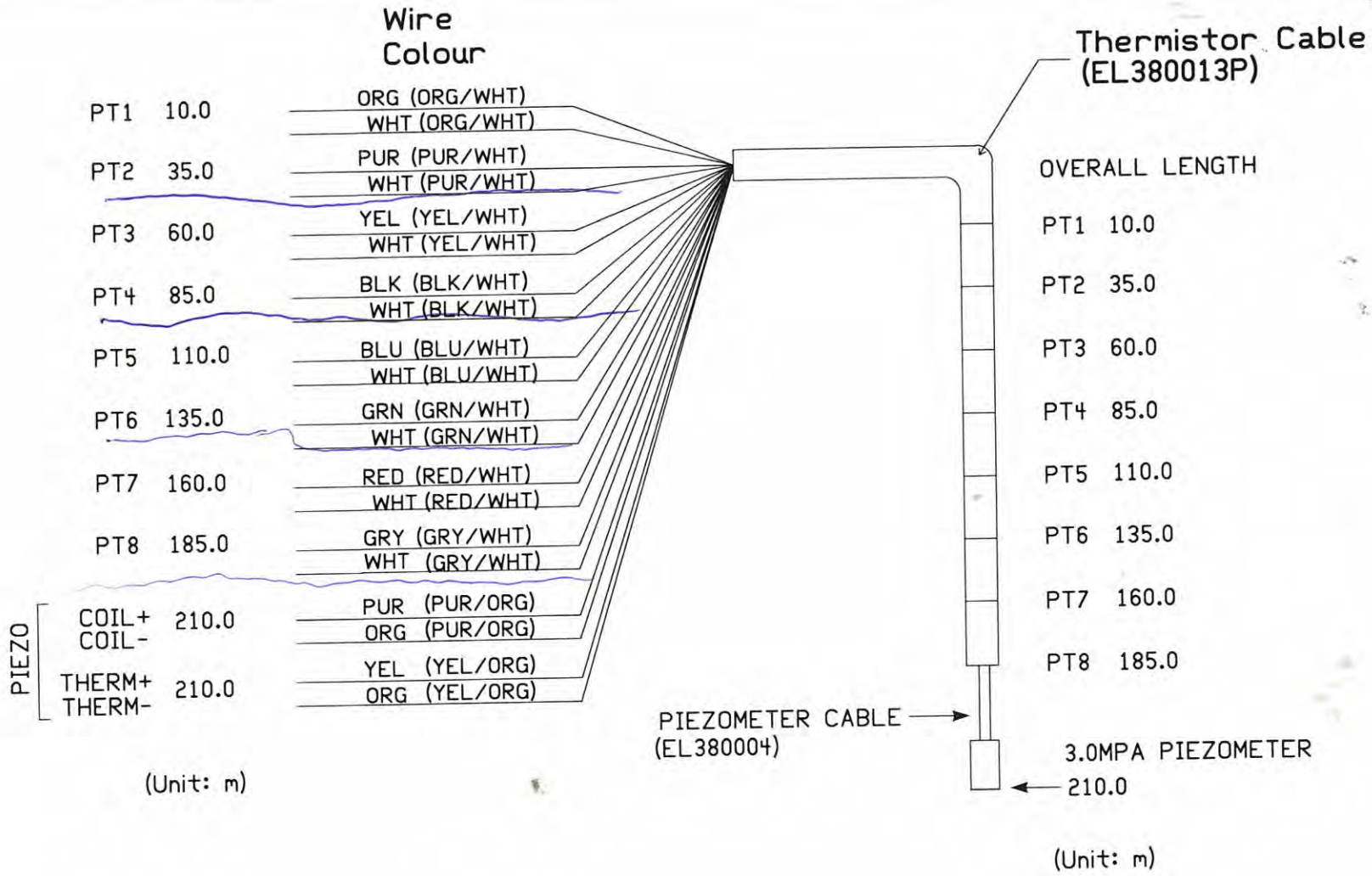
dimensions + ordering info

THERMISTOR POINTS		CABLE DIA.		BEAD* DIA.		CABLE
POINTS	PAIRS	MM.	IN.	MM.	IN.	PART #
1	1			13.97	0.55	EL380002S
2	2	6.35	0.25	13.97	0.55	EL380004
3-5	3	6.35	0.25	13.97	0.55	EL380006
4-7	4	8.128	0.32	13.97	0.55	EL380008
6-10	6	10.41	0.41	19.05	0.75	EL380012C
13-20	13	10.41	0.41	19.05	0.75	EL380013P
26-48	26	15.24	0.60	24.13	0.95	EL380026

* Please check with RST Sales for accurate dimensions of string assembly.

*Kevlar® is a registered trademark of E.I. du Pont de Nemours and Company.
RST Instruments Ltd. reserves the right to change specifications without notice.

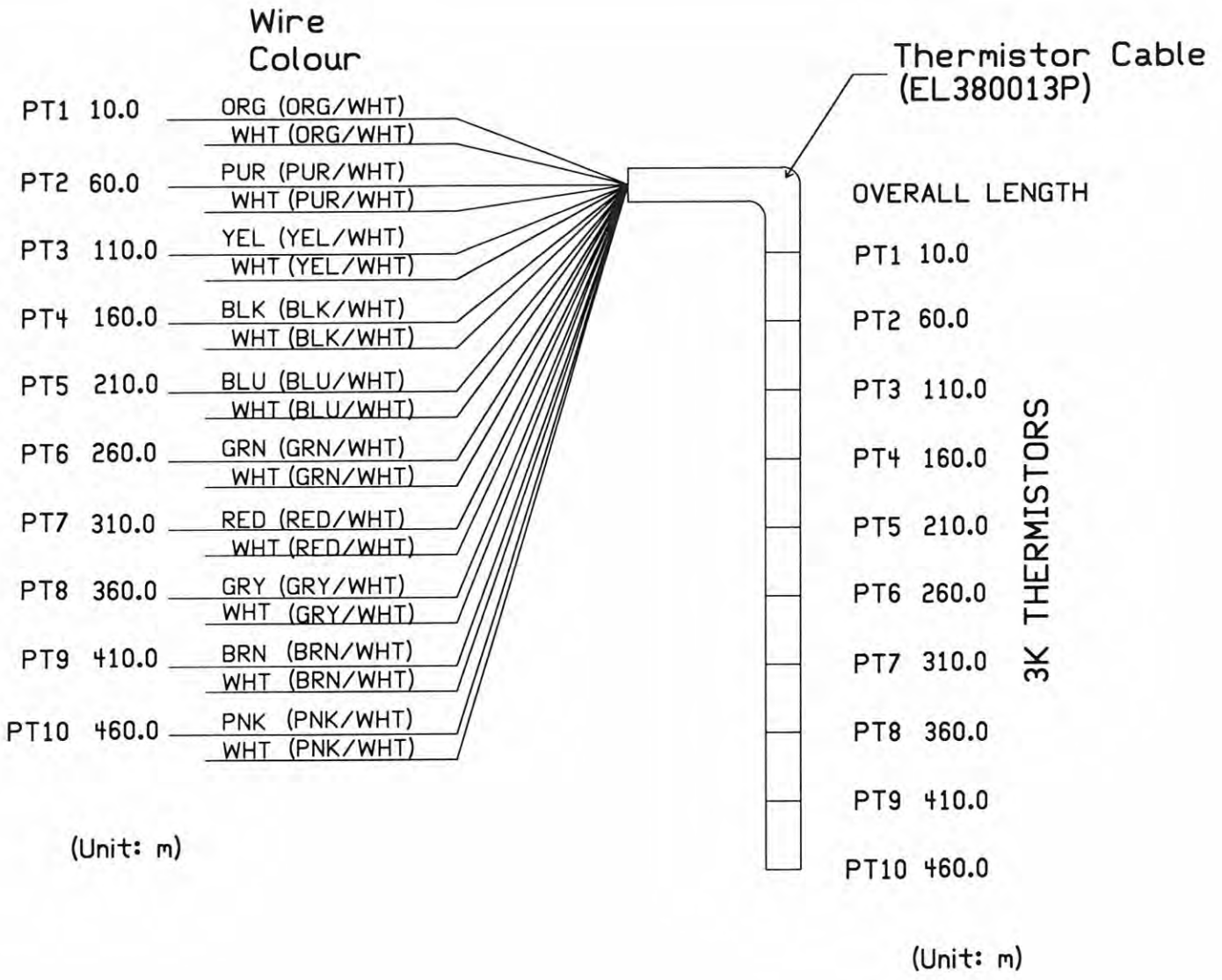
GEOTECHNICAL . MINING . ENVIRONMENTAL . STRUCTURAL
EPB0013G
Certified System
ISO 9001



SPLICE COLOR EL380013P	EL380004
PUR (PUR/ORG)	RED
ORG (PUR/ORG)	BLK
YEL (YEL/ORG)	GRN
ORG (YEL/ORG)	WHT

S/N: TS3972-TS3974
PIEZOMETER S/N: VW32656-VW32658

Co:	RST INSTRUMENTS LTD
Title:	THERMISTOR CABLE
J/N:	THW0218_WO206818-1 Revision: A
Author:	CB Size: A
Date:	2015/04/27 Sheet 1 of 2



rst INSTRUMENTS	Co:	RST INSTRUMENTS LTD	
	Title:	THERMISTOR CABLE	
	J/N:	THW0218/WO206818-2	Revision: A
	Author:	CB	Size: A
	Date:	2015/04/27	Sheet 2 of 2

S/N: TS3975

Resistance versus Temperature Relationship 3000 Ohm NTC Thermistors

Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp
201.1K	-50	16.60K	-10	2417	30	525.4	70	153.2	110
187.3K	-49	15.72K	-9	2317	31	507.8	71	149.0	111
174.5K	-48	14.90K	-8	2221	32	490.9	72	145.0	112
162.7K	-47	14.12K	-7	2130	33	474.7	73	141.1	113
151.7K	-46	13.39K	-6	2042	34	459.0	74	137.2	114
141.6K	-45	12.70K	-5	1959	35	444.0	75	133.6	115
132.2K	-44	12.05K	-4	1880	36	429.5	76	130.0	116
123.5K	-43	11.44K	-3	1805	37	415.6	77	126.5	117
115.4K	-42	10.86K	-2	1733	38	402.2	78	123.2	118
107.9K	-41	10.31K	-1	1664	39	389.3	79	119.9	119
101.0K	-40	9796	0	1598	40	376.9	80	116.8	120
94.48K	-39	9310	1	1535	41	364.9	81	113.8	121
88.46K	-38	8851	2	1475	42	353.4	82	110.8	122
82.87K	-37	8417	3	1418	43	342..2	83	107.9	123
77.99K	-36	8006	4	1363	44	331.5	84	105.2	124
72.81K	-35	7618	5	1310	45	321.2	85	102.5	125
68.30K	-35	7252	6	1260	46	311.3	86	99.9	126
64.09K	-33	6905	7	1212	47	301.7	87	97.3	127
60.17K	-32	6576	8	1167	48	282.4	88	94.9	128
56.51K	-31	6265	9	1123	49	283.5	89	92.5	129
53.10K	-30	5971	10	1081	50	274.9	90	90.2	130
49.91K	-29	56.92	11	1040	51	266.6	91	87.9	131
46.94K	-28	5427	12	1002	52	258.6	92	85.7	132
44.16K	-27	5177	13	965	53	250.9	93	83.6	134
39.13K	-25	4714	15	895.8	55	236.2	95	79.6	135
36.86K	-24	4500	16	863.3	56	229.3	96	77.6	136
34.73K	-23	4297	17	832.2	57	222.6	97	75.8	137
32.74K	-22	4105	18	802.3	58	216.1	98	73.9	138
30.87K	-21	3922	19	773.7	59	209.8	99	72.2	139
29.13K	-20	3748	20	746.3	60	203.8	100	70.4	140
27.49K	-19	3583	21	719.9	61	197.9	101	68.8	141
25.95K	-18	3426	22	694.7	62	192.2	102	67.1	142
24.51K	-17	3277	23	670.4	63	186.8	103	65.5	143
23.16K	-16	3135	24	647.1	64	181.5	104	64.0	144
21.89K	-15	3000	25	624.7	65	176.4	105	62.5	145
20.70K	-14	2872	26	603.3	66	171.4	106	61.1	146
19.58K	-13	2750	27	582.6	67	166.7	107	59.6	147
18.52K	-12	2633	28	562.8	68	162.0	108	58.3	148
17.53K	-11	2523	29	543.7	69	157.6	109	56.8	149
								55.6	150

Temperature calculated using:

Steinhart-Hart Linearization

$$T_C = \frac{1}{C_0 + C_1(\ln R) + C_3(\ln R)^3} - 273.15$$

3000 Ohm @ 25C NTC Thermistor

C_0= 0.0014051
C_1= 0.0002369
C_3= 0.0000001019
lnR= Natural Log of Resistance
T_c= Temperature in °C

Certificate of Compliance

innovation in geotechnical instrumentation

RST Instruments Ltd., 11545 Kingston St., Maple Ridge, British Columbia, Canada V2X 0Z5
Tel: 604 540 1100 • Fax: 604 540 1005 • Toll Free: 1 800 665 5599 (North America only)
e-mail: info@rstinstruments.com • Website: www.rstinstruments.com

Thermistor Strings

Customer: Hoskin Scientifique Ltee.
Work Order: 206818
Thermistor Type: 3 kΩ

Number of Points: 8
Length: 210 m

This is to certify that Thermistor Strings S/N: TS3972-TS3974 meet the RST Instruments specifications for the product.

Technician: I. Barua / J. Somphanthabansouk IB / JS As per

Date: 7 May 2015

THM0008B

Applied Science Technologists and Technicians of British Columbia
26732
JAMES CHU
CTech

Certificate of Compliance

innovation in geotechnical instrumentation

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Tel: 604 540 1100 • Fax: 604 540 1005 • Toll Free: 1 800 665 5599 (North America only)
e-mail: info@rstinstruments.com • Website: www.rstinstruments.com

Thermistor Strings

Customer: Hoskin Scientifique Ltee.
Work Order: 206818
Thermistor Type: 3 kΩ

Number of Points: 10
Length: 460 m

This is to certify that Thermistor String S/N: TS3975 meets the RST Instruments specifications for the product.

Technician: I. Barua / I. Kurchavov IB / IK

Date: 11 May 2015

THM0008B

Applied Science Technologists and Technicians of British Columbia
26732
JAMES CHU
CTech

innovation in geotechnical instrumentation

RST Instruments Ltd., 11545 Kingston St., Maple Ridge, British Columbia, Canada V2X 0Z5
Tel: 604 540 1100 • Fax: 604 540 1005 • Toll Free: 1 800 665 5599 (North America only)
e-mail: info@rstinstruments.com • Website: www.rstinstruments.com

Calibration Record

Vibrating Wire Piezometer

Customer:	Hoskin Scientifique Ltee	
Model:	VW2100-3.0	
Serial Number:	**VW32656**	
Mfg Number:	1506812	
Range:	3.0	MPa
Temperature:	21.9	°C
Barometric Pressure:	1010.1	millibars
Work Order Number:	206818	
Cable Length:	210	meters
Cable Markings:	n/a	
Cable Colour Code:	Purple / Orange (Coil)	Yellow / Orange (Thermistor)
Cable Type:	EL380013P / EL380004	
Thermistor Type:	3	kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8845	8846	8846	0.006	0.18	-0.01
0.6	8144	8145	8145	0.599	-0.02	0.02
1.2	7441	7441	7441	1.195	-0.15	0.00
1.8	6733	6734	6734	1.795	-0.17	-0.02
2.4	6020	6021	6021	2.399	-0.04	0.00
3.0	5304	5304	5304	3.006	0.20	0.00
				Max. Error (%):	0.20	0.02

Linear Calibration Factor:	**C.F.=**	**0.00084720 MPa/B unit**
Regression Zero:	**At Calibration =**	**8852.0 B unit**
Temperature Correction Factor:	**Tk =**	**0.0007665 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -3.4838E-09 **B:** -0.00079791 **C:** 7.3302

Pressure is calculated with the following equations:
Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$
Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	8-May-15	8853	22.4	1019.0

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = $Hz^2 / 1000$ ie: 1700Hz = 2890 B units

Technician: J. Chu Date: 8-May-15

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This instrument has been calibrated using standards traceable to the NIST in compliance with ANSI Z540-1

Document Number: ELL0143H

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Tel: 604 540 1100 • Fax: 604 540 1005 • Toll Free: 1 800 665 5599 (North America only)
e-mail: info@rstinstruments.com • Website: www.rstinstruments.com

Calibration Record

Vibrating Wire Piezometer

Customer:	Hoskin Scientifique Ltee	
Model:	VW2100-3.0	
Serial Number:	**VW32657**	
Mfg Number:	1506386	
Range:	3.0	MPa
Temperature:	22.7	°C
Barometric Pressure:	986.0	millibars
Work Order Number:	206818	
Cable Length:	210	meters
Cable Markings:	n/a	
Cable Colour Code:	Purple / Orange (Coil)	Yellow / Orange (Thermistor)
Cable Type:	EL380013P / EL380004	
Thermistor Type:	3	kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8956	8957	8957	0.006	0.20	-0.01
0.6	8255	8255	8255	0.599	-0.02	0.02
1.2	7551	7551	7551	1.195	-0.17	0.00
1.8	6842	6842	6842	1.794	-0.19	-0.01
2.4	6128	6128	6128	2.398	-0.06	-0.01
3.0	5409	5408	5409	3.007	0.23	0.01
			Max. Error (%):		0.23	0.02

Linear Calibration Factor:	**C.F.=**	**0.00084573 MPa/B unit**
Regression Zero:	**At Calibration =**	**8963.7 B unit**
Temperature Correction Factor:	**Tk =**	**0.0007243 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -3.9008E-09 **B:** -0.00078970 **C:** 7.3854

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	8-May-15	8959	22.5	1019.0

Li, Lc = initial (at installation) and current readings
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Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
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Technician: J. Chu Date: 8-May-15

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Model:	VW2100-3.0	
Serial Number:	**VW32658**	
Mfg Number:	1506385	
Range:	3.0	MPa
Temperature:	22.7	°C
Barometric Pressure:	986.0	millibars
Work Order Number:	206818	
Cable Length:	210	meters
Cable Markings:	n/a	
Cable Colour Code:	Purple / Orange (Coil)	Yellow / Orange (Thermistor)
Cable Type:	EL380013P / EL380004	
Thermistor Type:	3	kΩ

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0.0	8569	8569	8569	0.007	0.24	0.00
0.6	7861	7862	7862	0.599	-0.04	0.00
1.2	7149	7149	7149	1.194	-0.19	0.00
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3.0	4980	4980	4980	3.007	0.24	0.00
			Max. Error (%):		0.24	0.01

Linear Calibration Factor:	**C.F.=**	**0.00083588 MPa/B unit**
Regression Zero:	**At Calibration =**	**8577.7 B unit**
Temperature Correction Factor:	**Tk =**	**0.0008603 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -4.3022E-09 **B:** -0.00077759 **C:** 6.9790

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	8-May-15	8569	22.4	1019.0

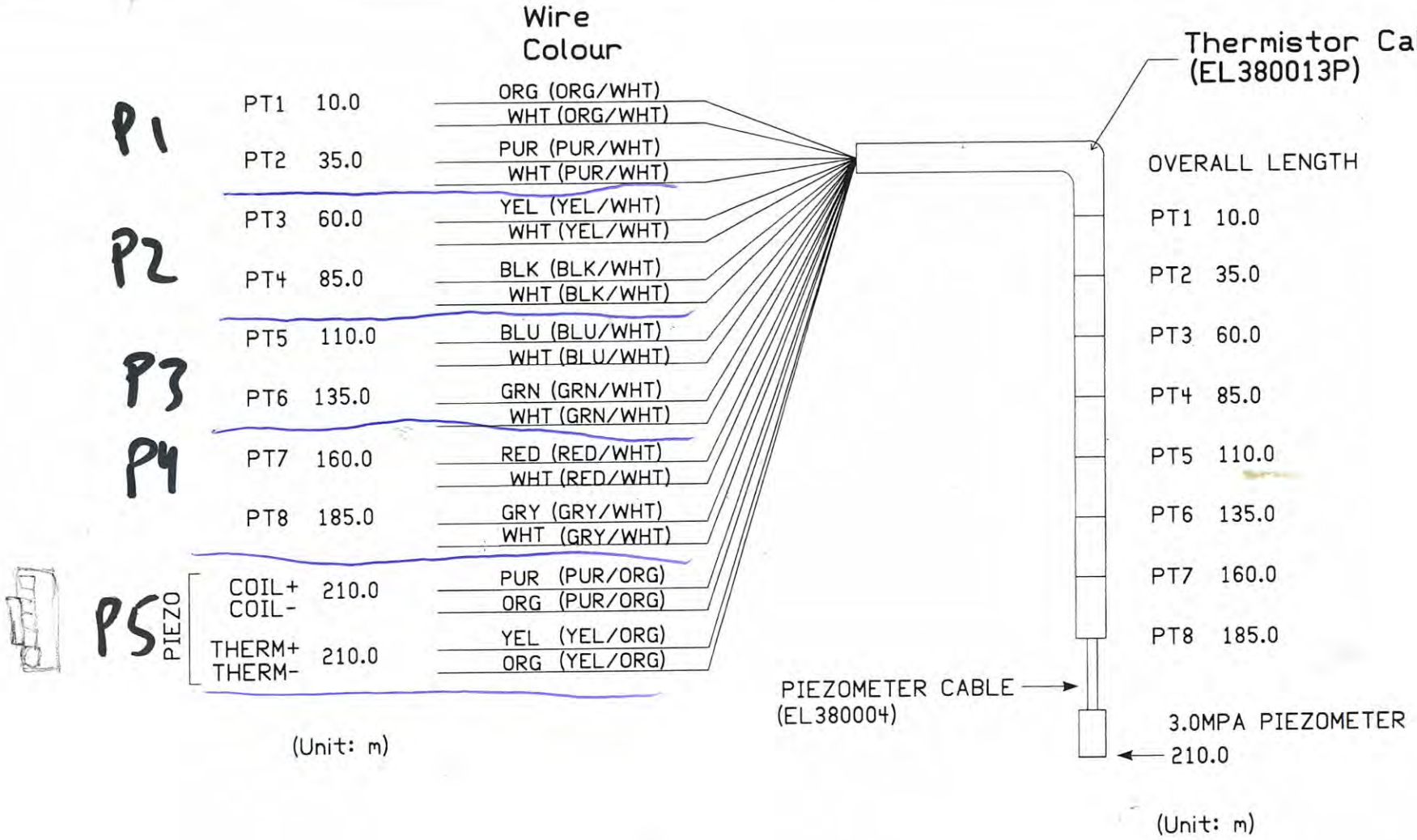
Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
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B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = $Hz^2 / 1000$ ie: 1700Hz = 2890 B units

Technician: J. Chu Date: 8-May-15

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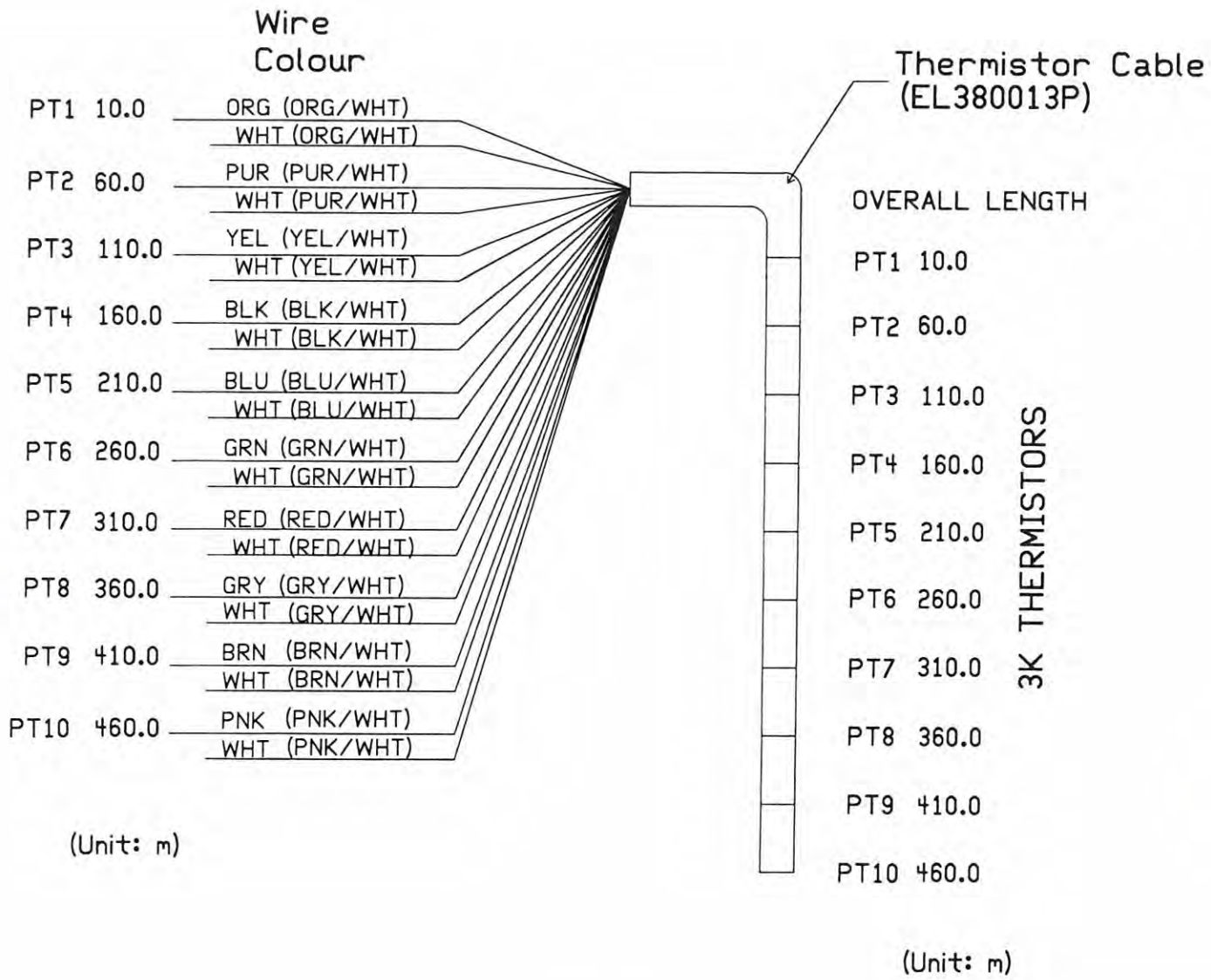
Document Number: ELL0143H



SPLICE COLOR EL380013P	EL380004
PUR (PUR/ORG)	RED
ORG (PUR/ORG)	BLK
YEL (YEL/ORG)	GRN
ORG (YEL/ORG)	WHT

S/N: TS3972-TS3974
PIEZOMETER S/N: VW32656-VW32658

Co:	RST INSTRUMENTS LTD
Title:	THERMISTOR CABLE
J/N:	THW0218_WO206818-1 Revision: A
Author:	CB Size: A
Date:	2015/04/27 Sheet 1 of 2



Co:	RST INSTRUMENTS LTD
Title:	THERMISTOR CABLE
J/N:	THW0218/WO206818-2 Revision: A
Author:	CB Size: A
Date:	2015/04/27 Sheet 2 of 2

S/N: TS3975

Resistance versus Temperature Relationship 3000 Ohm NTC Thermistors

Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp
201.1K	-50	16.60K	-10	2417	30	525.4	70	153.2	110
187.3K	-49	15.72K	-9	2317	31	507.8	71	149.0	111
174.5K	-48	14.90K	-8	2221	32	490.9	72	145.0	112
162.7K	-47	14.12K	-7	2130	33	474.7	73	141.1	113
151.7K	-46	13.39K	-6	2042	34	459.0	74	137.2	114
141.6K	-45	12.70K	-5	1959	35	444.0	75	133.6	115
132.2K	-44	12.05K	-4	1880	36	429.5	76	130.0	116
123.5K	-43	11.44K	-3	1805	37	415.6	77	126.5	117
115.4K	-42	10.86K	-2	1733	38	402.2	78	123.2	118
107.9K	-41	10.31K	-1	1664	39	389.3	79	119.9	119
101.0K	-40	9796	0	1598	40	376.9	80	116.8	120
94.48K	-39	9310	1	1535	41	364.9	81	113.8	121
88.46K	-38	8851	2	1475	42	353.4	82	110.8	122
82.87K	-37	8417	3	1418	43	342..2	83	107.9	123
77.99K	-36	8006	4	1363	44	331.5	84	105.2	124
72.81K	-35	7618	5	1310	45	321.2	85	102.5	125
68.30K	-35	7252	6	1260	46	311.3	86	99.9	126
64.09K	-33	6905	7	1212	47	301.7	87	97.3	127
60.17K	-32	6576	8	1167	48	282.4	88	94.9	128
56.51K	-31	6265	9	1123	49	283.5	89	92.5	129
53.10K	-30	5971	10	1081	50	274.9	90	90.2	130
49.91K	-29	56.92	11	1040	51	266.6	91	87.9	131
46.94K	-28	5427	12	1002	52	258.6	92	85.7	132
44.16K	-27	5177	13	965	53	250.9	93	83.6	134
39.13K	-25	4714	15	895.8	55	236.2	95	79.6	135
36.86K	-24	4500	16	863.3	56	229.3	96	77.6	136
34.73K	-23	4297	17	832.2	57	222.6	97	75.8	137
32.74K	-22	4105	18	802.3	58	216.1	98	73.9	138
30.87K	-21	3922	19	773.7	59	209.8	99	72.2	139
29.13K	-20	3748	20	746.3	60	203.8	100	70.4	140
27.49K	-19	3583	21	719.9	61	197.9	101	68.8	141
25.95K	-18	3426	22	694.7	62	192.2	102	67.1	142
24.51K	-17	3277	23	670.4	63	186.8	103	65.5	143
23.16K	-16	3135	24	647.1	64	181.5	104	64.0	144
21.89K	-15	3000	25	624.7	65	176.4	105	62.5	145
20.70K	-14	2872	26	603.3	66	171.4	106	61.1	146
19.58K	-13	2750	27	582.6	67	166.7	107	59.6	147
18.52K	-12	2633	28	562.8	68	162.0	108	58.3	148
17.53K	-11	2523	29	543.7	69	157.6	109	56.8	149
								55.6	150

Temperature calculated using:

Steinhart-Hart Linearization

$$T_C = \frac{1}{C_0 + C_1(\ln R) + C_3(\ln R)^3} - 273.15$$

3000 Ohm @ 25C NTC Thermistor

C_0= 0.0014051
C_1= 0.0002369
C_3= 0.0000001019
lnR= Natural Log of Resistance
T_c= Temperature in °C

Document THL0006A

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e-mail: info@rstinstruments.com • Website: www.rstinstruments.com

Thermistor Strings

Customer: Hoskin Scientifique Ltee.
Work Order: 206818
Thermistor Type: 3 kΩ

Number of Points: 8
Length: 210 m

This is to certify that Thermistor Strings S/N: TS3972-TS3974 meet the RST Instruments specifications for the product.

Technician: I. Barua / J. Somphanthabansouk IB / JS As per JS Date: 7 May 2015

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JAMES CHU
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e-mail: info@rstinstruments.com • Website: www.rstinstruments.com

Thermistor Strings

Customer: Hoskin Scientifique Ltee.
Work Order: 206818
Thermistor Type: 3 kΩ

Number of Points: 10
Length: 460 m

This is to certify that Thermistor String S/N: TS3975 meets the RST Instruments specifications for the product.

Technician: I. Barua / I. Kurchavov IB / IK Date: 11 May 2015

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Calibration Record

Vibrating Wire Piezometer

Customer:	Hoskin Scientifique Ltee	
Model:	VW2100-3.0	
Serial Number:	**VW32656**	
Mfg Number:	1506812	
Range:	3.0	MPa
Temperature:	21.9	°C
Barometric Pressure:	1010.1	millibars
Work Order Number:	206818	
Cable Length:	210	meters
Cable Markings:	n/a	
Cable Colour Code:	Purple / Orange (Coil)	Yellow / Orange (Thermistor)
Cable Type:	EL380013P / EL380004	
Thermistor Type:	3	kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8845	8846	8846	0.006	0.18	-0.01
0.6	8144	8145	8145	0.599	-0.02	0.02
1.2	7441	7441	7441	1.195	-0.15	0.00
1.8	6733	6734	6734	1.795	-0.17	-0.02
2.4	6020	6021	6021	2.399	-0.04	0.00
3.0	5304	5304	5304	3.006	0.20	0.00
			Max. Error (%):		0.20	0.02

Linear Calibration Factor:	**C.F.=**	**0.00084720 MPa/B unit**
Regression Zero:	**At Calibration =**	**8852.0 B unit**
Temperature Correction Factor:	**Tk =**	**0.0007665 MPa/°C rise**

Polynomial Gage Factors (MPa) A: -3.4838E-09 B: -0.00079791 C: 7.3302

Pressure is calculated with the following equations:
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Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	8-May-15	8853	22.4	1019.0

Li, Lc = initial (at installation) and current readings
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Technician: J. Chu Date: 8-May-15

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Document Number: ELL0143H

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Vibrating Wire Piezometer

Customer:	Hoskin Scientifique Ltee	
Model:	VW2100-3.0	
Serial Number:	**VW32657**	
Mfg Number:	1506386	
Range:	3.0	MPa
Temperature:	22.7	°C
Barometric Pressure:	986.0	millibars
Work Order Number:	206818	
Cable Length:	210	meters
Cable Markings:	n/a	
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Technician: J. Chu Date: 8-May-15

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	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	8-May-15	8569	22.4	1019.0

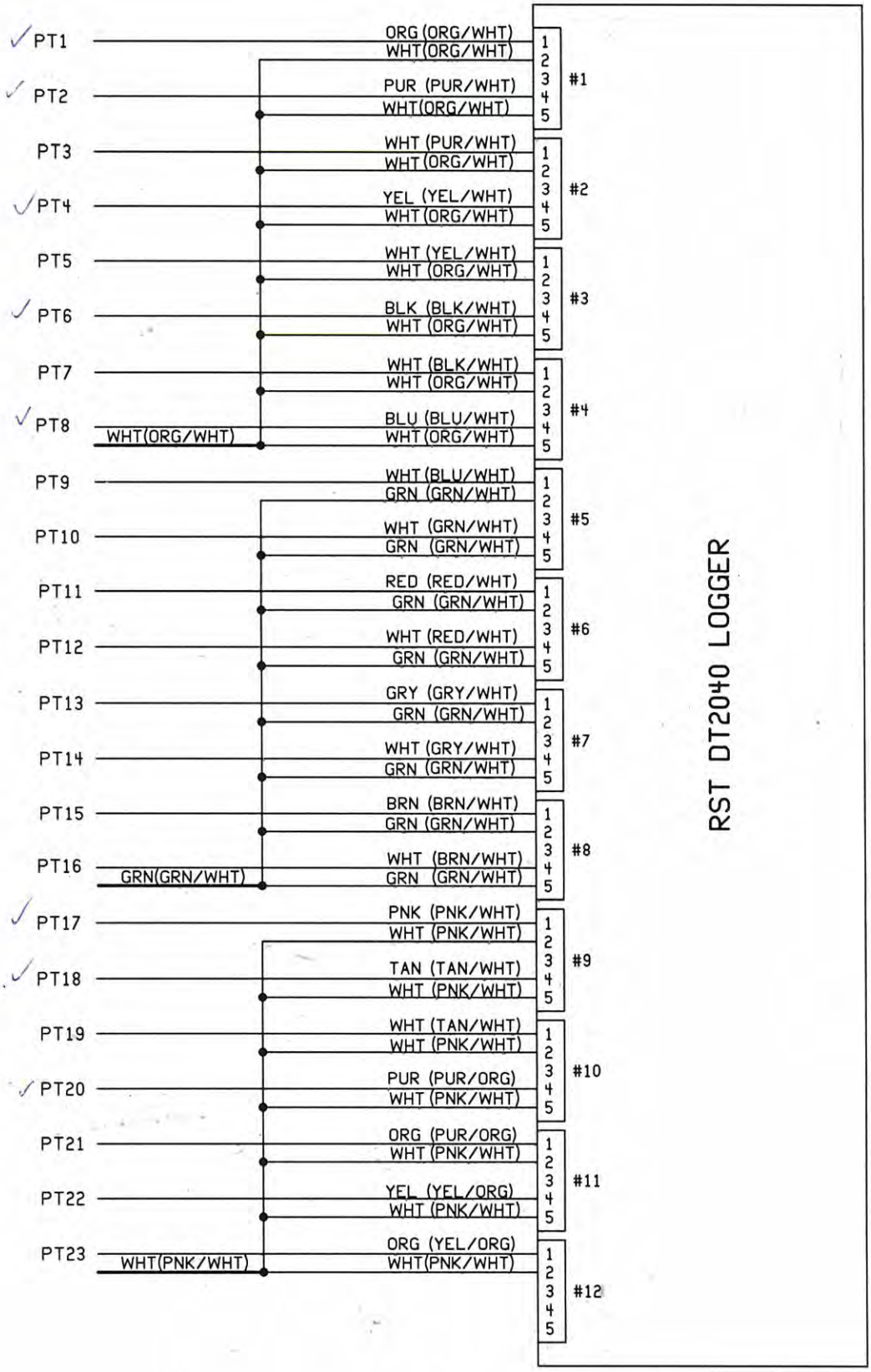
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Technician: J. Chu Date: 8-May-15

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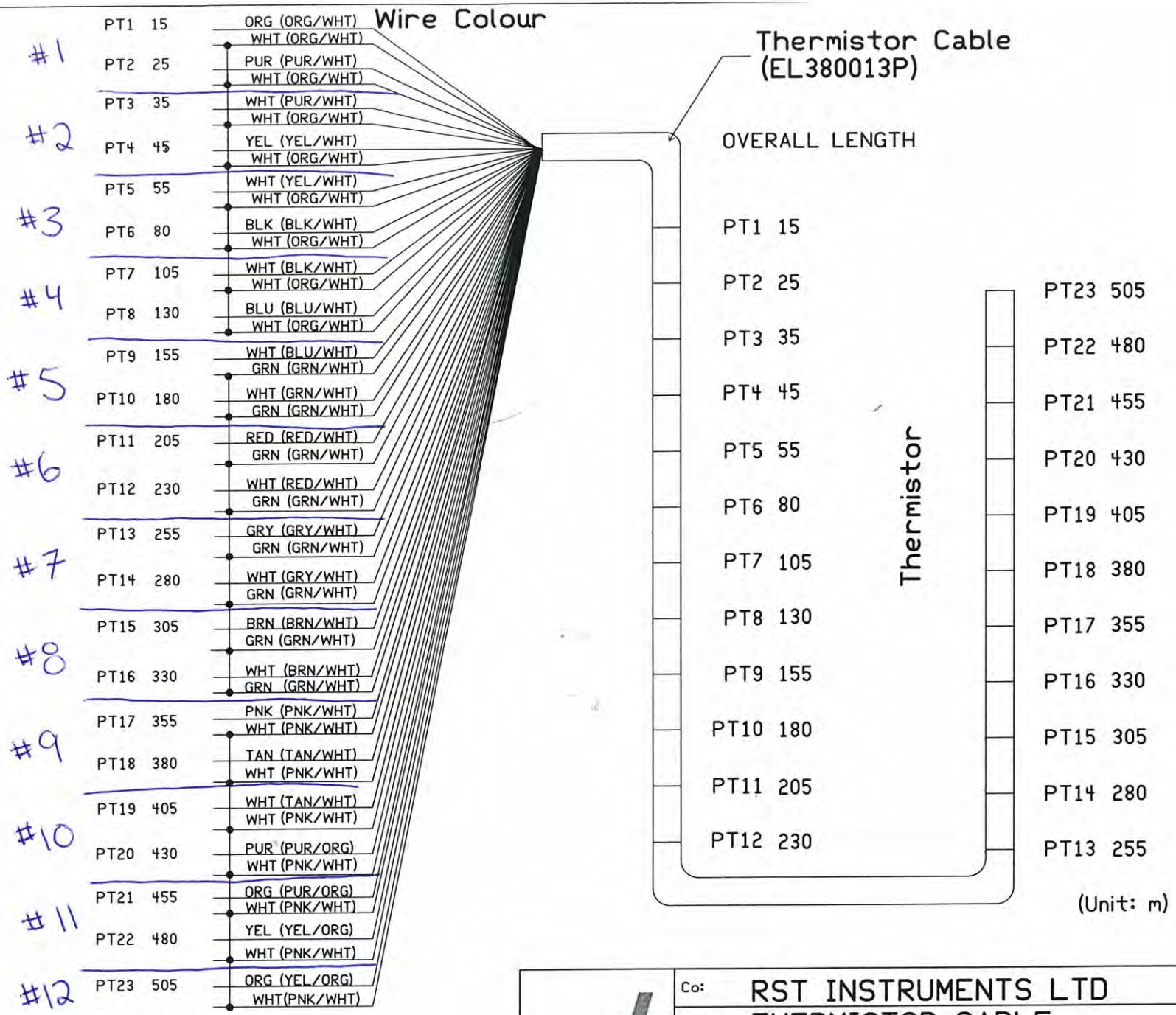
This instrument has been calibrated using standards traceable to the NIST in compliance with ANSI Z540-1

Document Number: ELL0143H



Co:	RST INSTRUMENTS LTD	
Title:	THERMISTOR CABLE	
J/N:	THW0226/WO207693	Revision: A
Author:	CB	Size: A
Date:	2015/07/27	Sheet 2 of 2

SN: TS4005-TS4006



SN: TS4005-TS4006

Co:	RST INSTRUMENTS LTD
Title:	THERMISTOR CABLE
J/N:	THW0226/W0207693 Revision: A
Author:	CB Size: A
Date:	2015/07/27 Sheet 1 of 1

innovation in geotechnical instrumentation

RST Instruments Ltd., 11545 Kingston St., Maple Ridge, British Columbia, Canada V2X 0Z5
Tel: 604 540 1100 • Fax: 604 540 1005 • Toll Free: 1 800 665 5599 (North America only)
e-mail: info@rstinstruments.com • Website: www.rstinstruments.com

Certificate of Compliance

Thermistor Strings

Customer: Hoskin Scientifique LTEE.
Work Order: 207693
Thermistor Type: 3 kΩ

Number of Points: 23
Length: 505 m

This is to certify that Thermistor Strings S/N: TS4005 and TS4006 meet the RST Instruments specifications for the product.

Technician: I. Kurchavov IK Date: 11 August 2015

THM0008B

Applied Science Technologists and Technicians of British Columbia
22724
A.C.
AL CULLEY
AScT

Resistance versus Temperature Relationship 3000 Ohm NTC Thermistors

Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp
201.1K	-50	16.60K	-10	2417	30	525.4	70	153.2	110
187.3K	-49	15.72K	-9	2317	31	507.8	71	149.0	111
174.5K	-48	14.90K	-8	2221	32	490.9	72	145.0	112
162.7K	-47	14.12K	-7	2130	33	474.7	73	141.1	113
151.7K	-46	13.39K	-6	2042	34	459.0	74	137.2	114
141.6K	-45	12.70K	-5	1959	35	444.0	75	133.6	115
132.2K	-44	12.05K	-4	1880	36	429.5	76	130.0	116
123.5K	-43	11.44K	-3	1805	37	415.6	77	126.5	117
115.4K	-42	10.86K	-2	1733	38	402.2	78	123.2	118
107.9K	-41	10.31K	-1	1664	39	389.3	79	119.9	119
101.0K	-40	9796	0	1598	40	376.9	80	116.8	120
94.48K	-39	9310	1	1535	41	364.9	81	113.8	121
88.46K	-38	8851	2	1475	42	353.4	82	110.8	122
82.87K	-37	8417	3	1418	43	342..2	83	107.9	123
77.99K	-36	8006	4	1363	44	331.5	84	105.2	124
72.81K	-35	7618	5	1310	45	321.2	85	102.5	125
68.30K	-35	7252	6	1260	46	311.3	86	99.9	126
64.09K	-33	6905	7	1212	47	301.7	87	97.3	127
60.17K	-32	6576	8	1167	48	282.4	88	94.9	128
56.51K	-31	6265	9	1123	49	283.5	89	92.5	129
53.10K	-30	5971	10	1081	50	274.9	90	90.2	130
49.91K	-29	56.92	11	1040	51	266.6	91	87.9	131
46.94K	-28	5427	12	1002	52	258.6	92	85.7	132
44.16K	-27	5177	13	965	53	250.9	93	83.6	134
39.13K	-25	4714	15	895.8	55	236.2	95	79.6	135
36.86K	-24	4500	16	863.3	56	229.3	96	77.6	136
34.73K	-23	4297	17	832.2	57	222.6	97	75.8	137
32.74K	-22	4105	18	802.3	58	216.1	98	73.9	138
30.87K	-21	3922	19	773.7	59	209.8	99	72.2	139
29.13K	-20	3748	20	746.3	60	203.8	100	70.4	140
27.49K	-19	3583	21	719.9	61	197.9	101	68.8	141
25.95K	-18	3426	22	694.7	62	192.2	102	67.1	142
24.51K	-17	3277	23	670.4	63	186.8	103	65.5	143
23.16K	-16	3135	24	647.1	64	181.5	104	64.0	144
21.89K	-15	3000	25	624.7	65	176.4	105	62.5	145
20.70K	-14	2872	26	603.3	66	171.4	106	61.1	146
19.58K	-13	2750	27	582.6	67	166.7	107	59.6	147
18.52K	-12	2633	28	562.8	68	162.0	108	58.3	148
17.53K	-11	2523	29	543.7	69	157.6	109	56.8	149
								55.6	150

Temperature calculated using:

Steinhart-Hart Linearization

$$T_C = \frac{1}{C_0 + C_1(\ln R) + C_3(\ln R)^3} - 273.15$$

3000 Ohm @ 25C NTC Thermistor

C_0= 0.0014051

C_1= 0.0002369

C_3= 0.0000001019

lnR= Natural Log of Resistance

T_c= Temperature in °C

Document THL0006A

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Certificate of Compliance

Model DT2040 Vibrating Wire Data Logger **FW Ver: 3.09**

This is to certify that s/n 02065 meets RST Instruments specifications for this product.

Technician: S. Kim SK Date: July 27, 2015

ELL0229A

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Certificate of Compliance

Model DT2055B Vibrating Wire Data Logger FW Ver: 3.12

This is to certify that s/n 04511 meets RST Instruments specifications for this product.

Technician: S. Kim SK Date: July 6, 2015

ELL0220B

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Certificate of Compliance

Model DT2040 Vibrating Wire Data Logger **FW Ver: 3.09**

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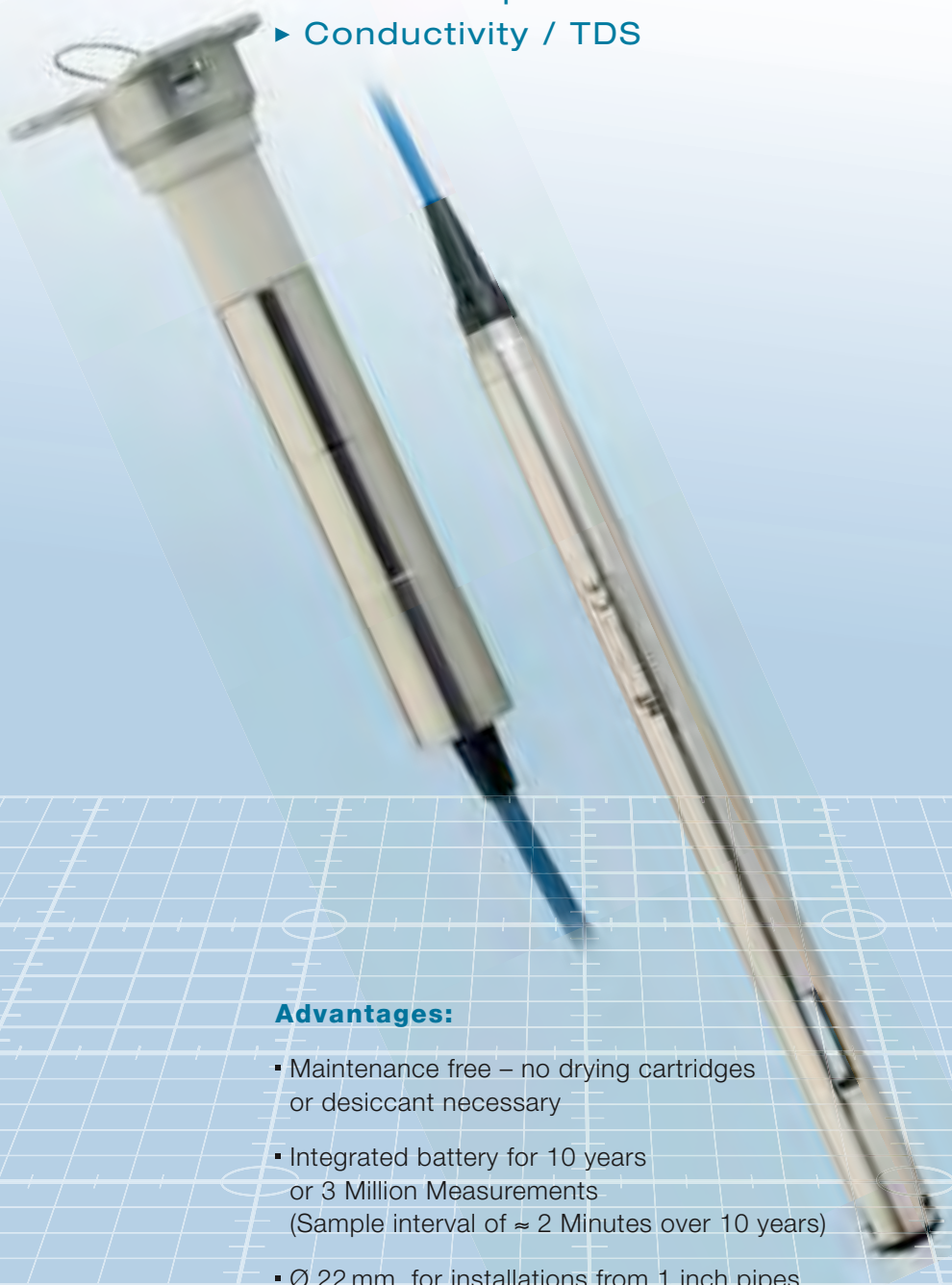
Technician: S. Kim SK Date: July 27, 2015

ELL0229A

Datalogger Type 575-LTC

Measuring and Recording of:

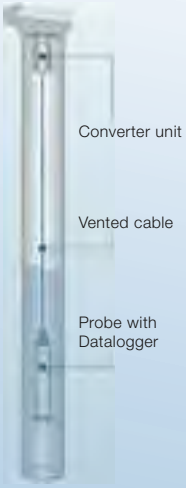
- Water Level
- Water Temperature
- Conductivity / TDS



Advantages:

- Maintenance free – no drying cartridges or desiccant necessary
- Integrated battery for 10 years or 3 Million Measurements (Sample interval of ≈ 2 Minutes over 10 years)
- Ø 22 mm, for installations from 1 inch pipes
- Highest precision and long term stability by 4-pol conductivity sensor
- Particular, convenient operation by touch operation
- Flood protected – durable seal until 3 m water column
- Robust stainless steel design

Datalogger Type 575-LTC



Description

The Datalogger type 575- LTC is a compact analysing instrument for the documentation of water level, temperature and electrical conductivity. Additionally, from the conductivity values the TDS can be calculated if needed.

The built-in lithium battery powers the Datalogger over the guaranteed period of 10 years or 3 million measurements. A battery replacement is performed at HT, which always includes a general equipment check-up and a recalibration of the sensors.

Highest data security is achieved through the used non-volatile flash memory, which can record at least 253,000 data sets.

The Datalogger type 575- LTC is designed for the practical user, installation can be executed very quickly and without training, the menu is clearly structured. An exchange of the desiccant or other maintenance work is not necessary.

Highest quality standards for conductivity measurements will be fulfilled with this Datalogger, the complete design is based on over 20 years of experience in the field of water quality measurements.



Typical Applications

- Measuring and Recording of salt water intrusion in coastal areas
- Measurement of Water level, Temperature and Conductivity / TDS during Pumping Tests
- Monitoring of production and observation wells
- Tracer measurements
- Level- and quality monitoring of surface water
- Remediation of contaminated areas
- Monitoring of landfills



Optimized power consumption, 50% more measurements

This Datalogger Type 575-II was developed with new power-optimized components. For you as an user it means that we can dramatically extend the guaranteed battery-lifetime.

The new guarantee conditions are: 10 years or 3 million measurements! That is a lifetime over a period of 10 years at a recording interval of ≈ 2 Minutes without replacing the battery.

After that time the battery exchange will be done fast and uncomplicated in our factory service department inclusive recalibration and exchanging of seals.

Highest precision and especially long-term-stable conductivity values

A highly accurate 4-electrode conductivity sensor with integrated temperature sensor is used. Over many years, stable and accurate conductivity values will be given without the need for a re-calibration. The Datalogger 575-LTC offers the possibility of an automatic temperature compensation to the reference temperature of 25°C.

The following settings are available:

- Sets an automatic temperature compensation based on 25°C according to DIN EN 27888
- Adjustment of an individual coefficient in % / °C for individual liquids
- Measurement without compensation, it will output the conductivity at the current temperature

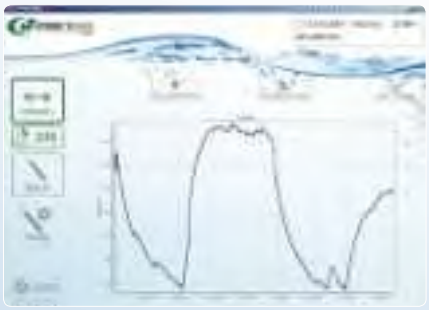
Datalogger configuration and data transfer – modified operating software

So far, we hear from customers that the operation of HT Dataloggers is quite simple. It requires no training when you operate the first time or if you do not regularly work with the devices you can operate the systems very quickly again without mistakes.

Actually, exactly the words you want to hear as the manufacturer. Nevertheless, we put time and manpower into a new operating concept that aims not only to a more attractive design of the operating program. In particular, it was important for us to respond with a new operating concept on innovations in the PC market, means for the user a wider selection of PCs and control-devices.



Touch-enabled is not synonymous with touch-friendly! As currently the first manufacturer of groundwater Dataloggers we have adjusted the operating program also to touch PCs. This means on the one hand, that possibly cherished menu structures disappear. On the other hand, the Datalogger can now be easily operated without a touch pen and especially without a PC mouse which is during sunlight always a difficulty to move from one point to the next. The operating program is operated with a finger, which is known not to forget in the office, disappears in the tall grass or falling into the borehole. With this new operating concept, we are sure that we will make your job easier! Conventional devices, be it laptop or Pocket PC can of course still be used and are also supported by HT.









Datalogger installation – simple, conveniently and safely from 1 inch wells

Secure Installation

Supreme motto for the installation of HT Dataloggers, all possible precautions are taken so that the device can not fall into the borehole. By the standard fixing-ring of 2 inch (DN50) the Datalogger can be easily adapted to HT well caps. Check measurements with the Water Level Meter can be performed directly without removal of the Datalogger.





For smaller pipes HT can provide suitable fixing-rings, for check measurements, the converter unit of the Datalogger needs to be moved a few Centimetres.

For observation wells with a diameter of 2.5 inch or larger, intermediate rings are used to secure the fixing of the Datalogger. In cause of the design of the diameters it is not possible that the Datalogger can fall into the borehole.





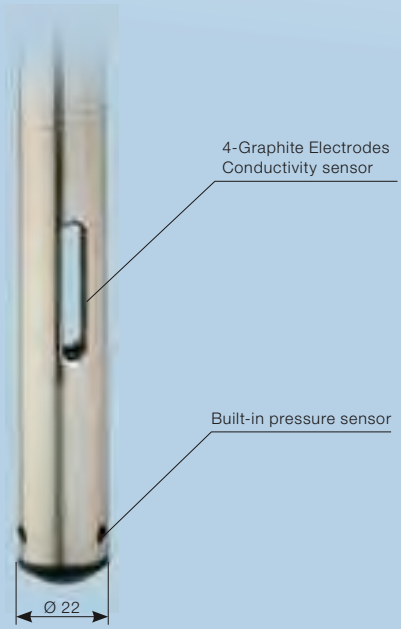
Please contact us if you have special sizes or special conditions of use. We can draw from an extensive archive of already implemented mounting options for Dataloggers.

Datalogger Type 575-LTC

Water Level	
Water Level	Relative pressure
Measuring range	selectable from 1 ... 300 m water column
Accuracy	< 0,05% of selected range
Long-term stability	< 0,05% of selected range / year
Resolution	Standard: 1 cm / Optional: 1 mm
Temperature correction	0 ... +50°C / Optional: 0 ... +70°C

Temperature	
Measuring range	-5 ... +50°C / Optional: -5 ... +70°C (Ice-free area)
Accuracy	< 0,1°C
Long-term stability	< 0,02°C / year
Resolution	0,1°C; Optional: 0,01°C

Conductivity	
Measuring range	0 ... 200.000 µS/cm
Accuracy	< 0,5% of current value, min. 2 µS/cm (0,002 mS/cm)
Resolution	0,001 mS/cm until value of 2 mS/cm 0,01 mS/cm until value of 20 mS/cm 0,1 mS/cm until value of 200 mS/cm



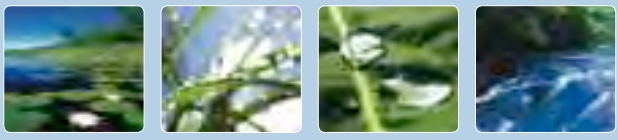
Device data	
Memory	Flash-memory 4MB for min. 253,000 recordings = 759,000 values
Power supply	Integrated Lithium-battery; guaranteed lifetime for 10 years or 3,000,000 measurements; Factory replaceable
Sample interval	Adjustable: 1 minute to 99 days Optional: from 1 second, 10 sample intervals pre-selectable
Interface	RS232, communication via serial and USB-interface
Accuracy clock	< 2 minutes / year

Mechanical Data	
Length of cable	Freely selectable until max. 500 m
Sensor immersion depth	max. 300 m water column
Vented cable	Ø 6 mm flexible, UV-resistant PUR coating; Kevlar strengthen to avoid cable-stretching; integrated tube for compensation of barometric fluctuation
Pressure transducer	Membrane made from Titan; Overload max. 4 fold FS, stability max. 2 fold FS
Conductivity sensor	4-Graphite electrodes; long-term stable and insensitive to contamination or dirt
Materials	Stainless steel 316Ti; POM fibreglass reinforced; Viton
Dimensions probe	Ø 22x315 mm
Dimensions conv. unit	Ø 24x140 mm
Protection class	IP 68, converter unit permanent seal until max. 3 m water column

Operating software	
Operating software Notebook / PC / Touch	Touch-friendly PC user interface; for XP, Vista, Win 7, Win 8 / 8.1
Operating software Pocket PC	Full functionality for operating program Win Mobile 5.0; 6.0; 6.1
Data file-format	Files are available as directly readable ASCII– files
Available formats	HT-Standard, Excel; *.zrxp; Labdüs; *.lgd; *.uvf; and many more Not the correct format there? Our software department can create the desired file-format

Manufacturer

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Instruments and Monitoring for ground- and surface water

HT MM/LA-04.2014 - Modifications in cause of technical progresses are reserved;

Knight Piésold
CONSULTING

APPENDIX C

CALCULATION OF FREEZING POINT DEPRESSION POINT

(Pages C-1 to C-3)

APPENDIX C
DEVELOPMENT OF SITE-SPECIFIC FREEZING POINT DEPRESSION OF GROUNDWATER

A number of factors affect the freezing point depression of the groundwater, predominantly the salinity (or total dissolved solids, TDS) and hydraulic pressure. The freezing point depression used for the permafrost and talik characterization was based on the following site-specific data:

- The electrical conductivity (EC) logger installed in AMQ15-349A at a depth of approximately 150 m below ground surface (mbgs) froze at a temperature of approximately -0.4 to -0.6°C
- Vibrating wire piezometers installed in AMQ15-294, AMQ15-306 and AMQ15-349A at depths of approximately 150 mbgs froze at temperatures of approximately -0.3 to -0.5°C.
- The highest conductivity recorded by the EC logger prior to freezing was 7.96 mS/cm. Using a conversion factor of 0.67 gives a TDS of approximately 5300 ppm and a freezing point of approximately -0.35°C.

The TDS recorded by the EC logger was compared to values observed at other operating mines and mining projects in Nunavut and the Northwest Territories using data from Golder (2014) and Frape & Fritz (1987). The TDS value of 5300 ppm at a depth of 150 mbgs was extrapolated to depth using the Frape & Fritz relationship and a best-fit relationship developed for the Meadowbank Mine (Golder, 2014), as shown on Figure C.1.

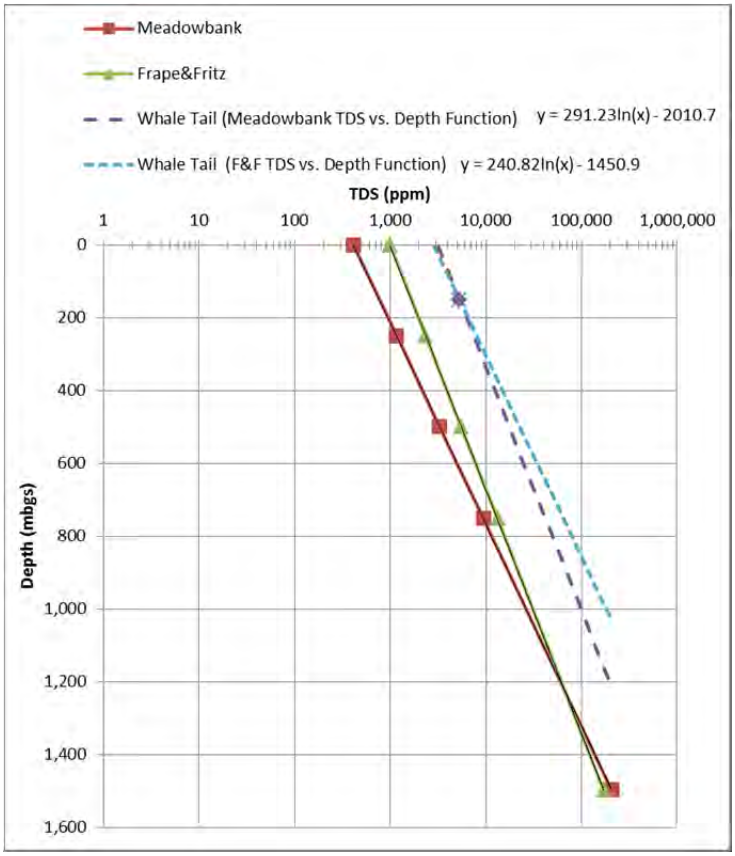


Figure C.1 Regional TDS Data vs Depth

The freezing point depressions associated with the TDS relationships presented in Figure C.1 were calculated using a relationship developed by Golder and AEM (Golder, 2014). Given the close proximity of the Meadowbank Mine to the Project, the Meadowbank TDS relationship was ultimately used. The

relationship suggests a freezing point depression of approximately -1°C at a depth of 500 mbgs, as shown in Figure C.2.

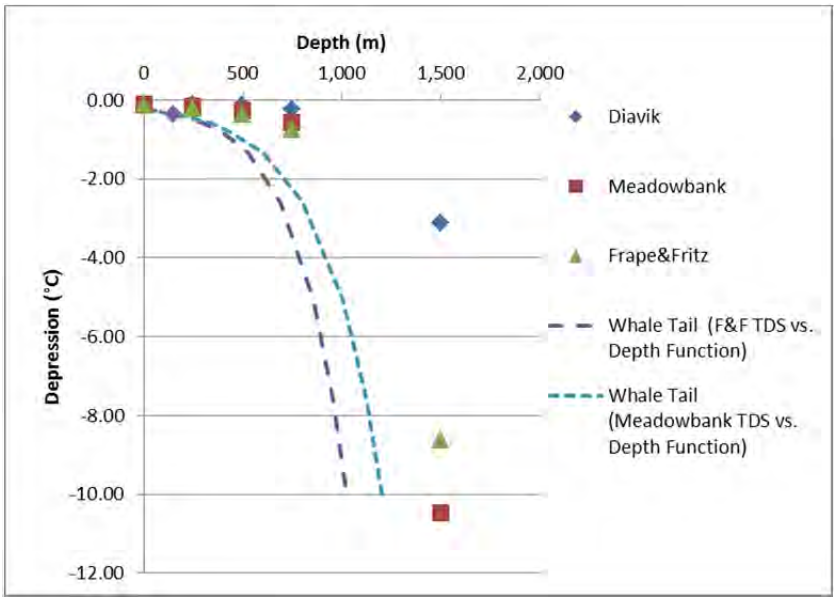


Figure C.2 Regional Freezing Point Depression vs Depth

The observed TDS and the calculated freezing point depression for the Project were compared to other operating mines and mining projects in Nunavut and the Northwest Territories:

- The TDS of 5300 ppm recorded by the EC logger is higher than TDS reported from similar depths at the Meadowbank Mine and the Diavik Mine but is less than the values seen at the Hope Bay Project and Lupin Mine.
- The calculated freezing point depression is lower than the data from the Meadowbank, Lupin and Diavik mines, but is higher than the data reported for numerous other mines and projects such as Meliadine, Back River and Hope Bay, as shown in Table C.1 below.

Table C.1 Summary of TDS and Freeze Point Depression data from cold climate mining studies

Site	Depth (mbgs)	TDS (mg/L)	Associated FP (deg C, [calculated])	Reference
Back River	515	47,000	-2.43	Sabina DEIS Vol 6, Sec 2.1.2.2
	620	76,000	-3.88	
Diavik	400	550	-0.11	Clayton et al 2013
Kiggavik	250	3500	-0.26	Kiggavik FEIS Vol 5-5B, 6.2 Results
Hope Bay	63 to 550	23,000 – 48,000	-1.2 to -2.5	Sabina DEIS Vol 6, Sec 2.1.1.3
	548	47,800	-2.47	Hope Bay Phase 2 Project Proposal
Lupin	250	39600	-2.06	Stotler, 2008
	570	4000	-0.28	
Meliadine	454	60,000 – 70,000	-3.1 to -3.6	Sabina DEIS Vol 6, Sec 2.1.1.3

The freezing point depression used in the permafrost and talik assessment was based on the data specific to the Project (-0.35°C at 150 mbgs) and the Meadowbank TDS vs depth relationship. The

freezing point depression should be considered preliminary and will be re-evaluated as additional data is collected.

Note that the TDS of 5300 ppm recorded by the EC logger has been used solely for the purposes of estimating the freezing point depression. The recorded TDS should not be used for assessing groundwater quality until it can be confirmed through the collection of representative groundwater quality samples at the Project.

Knight Piésold
CONSULTING

APPENDIX D

ANALYTICAL AND NUMERICAL THERMAL MODELING

(Pages D-1 to D-8)

ANALYTICAL SOLUTION: FORMATION OF OPEN TALIKS UNDER ELONGATE LAKES

Burn (2002) developed a series of analytical solutions to describe talik development under surface water bodies. The solutions were developed to match the lake shape (circular or elongate), and to acknowledge the presence of a shallow terrace around the lake perimeter. In the case of the elongate nature of Whale Tail lake, the analytical equations of temperature profiles under lakes with terraces are presented by Burn (2002), can be estimated using the following equation:

Equation 1: Elongate Lake with Terrace

$$T_z = T_g + \frac{z}{l} + \frac{(T_t - T_g)}{\pi}\left(2tan^{-1}\frac{H_{p+t}}{z}\right) + \frac{(T_p - T_t)}{\pi}\left(2tan^{-1}\frac{H_p}{z}\right)$$

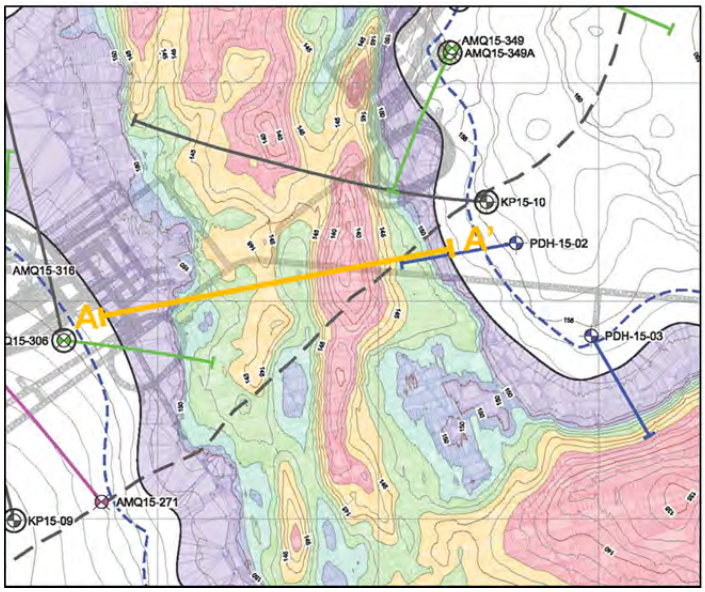
where:
z = depth (metres);
H_l = half-width of the lake (m);
T_z = temperature (°C) at depth z (m);
T_g = mean annual ground surface temperature (°C);
T_p = mean annual temperature at the bottom of the central pool (°C);
T_t = mean annual temperature of the terrace (°C);
H_p = half-width of the central pool (m);
H_{p+t} = half-width of the lake (pool and terrace) (m); and,
l = inverse of geothermal gradient (m/°C).

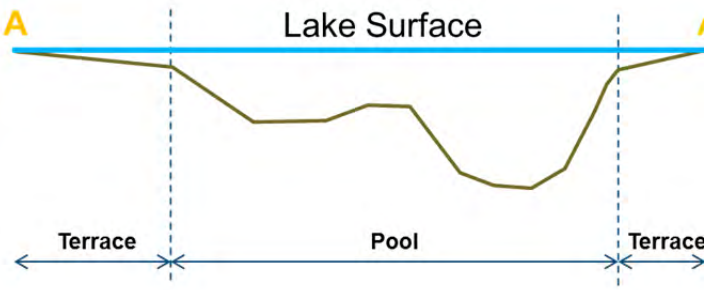
The input parameters for the equation are presented in the table below. Figure 1 presents one of the cross sections (CS1) showing the bathymetry of the lake and the interpretation of lake terraces (depth of <2 m).

Parameter	Value	Source
T_z =	Temperature at depth(z, °C);	Calculated
T_g =	Mean annual ground surface temperature (°C);	Extrapolated from AMQ15-324 geothermal gradient
z =	Depth (m);	From bottom of lake (1-10 m) to *below* base of permafrost (500 m)
l =	Inverse of geothermal gradient (m/°C);	Estimated From AMQ15-324
T_t =	Mean annual temperature of the terrace (°C);	Literature value used (-2°C, Burn 2002)
T_p =	Mean annual temperature at the bottom of the central pool (°C);	Literature value used (4°C, Burn 2002)
H_{p+t} =	Half-width of the lake (pool and terrace, m);	Measured off S.I. Plan
H_p =	Half-width of the central pool (m);	Measured off S.I. Plan

Table 1: Summary of input Parameters to Analytical and Numerical modeling

Figure 1: Cross section 1 (CS1) bathymetry





NUMERICAL SOLUTION: FORMATION OF OPEN TALIKS UNDER ELONGATE LAKES- TEMP - W

The finite element code Temp-W was used to simulate the ground temperature conditions through the cross sections of Whale Tail Lake. The model setup for each of the three sections can be viewed in the figures below. The input parameters can be summarized in **Error! Reference source not found.**.

Parameter	Value	Source
MAST	Mean annual ground surface temperature (°C);	Meadowbank Weather Station
Depth	Depth (m);	From bottom of lake (1-10 m) to *below* base of permafrost (500 m)
Geothermal Heat Flux	Geothermal gradient (m/°C);	Estimated From AMQ15-324
T_t	Mean annual temperature of the terrace (°C);	Literature value used (-2°C, Burn 2002)
T_p	Mean annual temperature at the bottom of the central pool (°C);	Literature value used (4°C, Burn 2002)
H_{p+t}	Half-width of the lake (pool and terrace, m);	Measured off S.I. Plan
H_p	Half-width of the central pool (m);	Measured off S.I. Plan

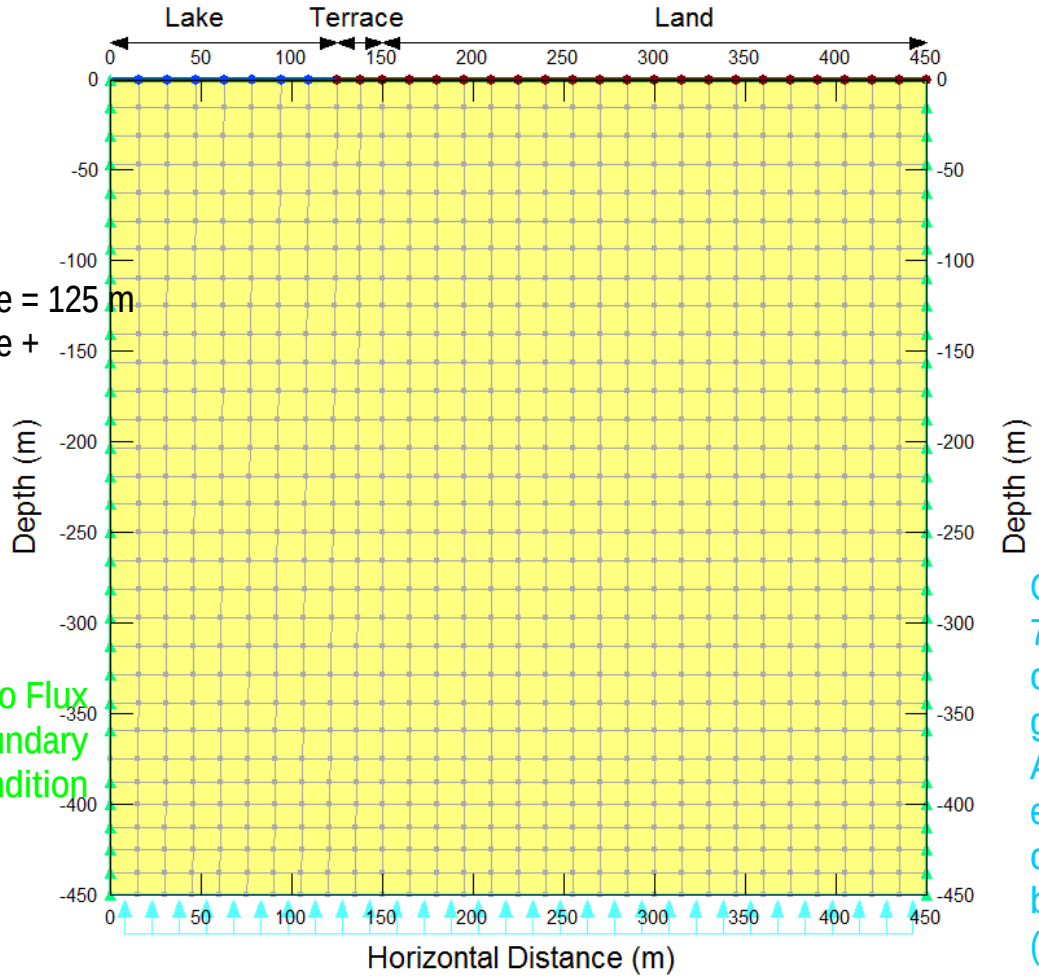
Table 2: **Summary of input Parameters to Temp-W Numerical model**

CS1 – TEMP/W Model

Mean Annual Lake-Bottom Temperature = 4°C (Literature Study)

Mean Annual Ground Surface Temperature = -11.3° C (Meadowbank Weather Station)

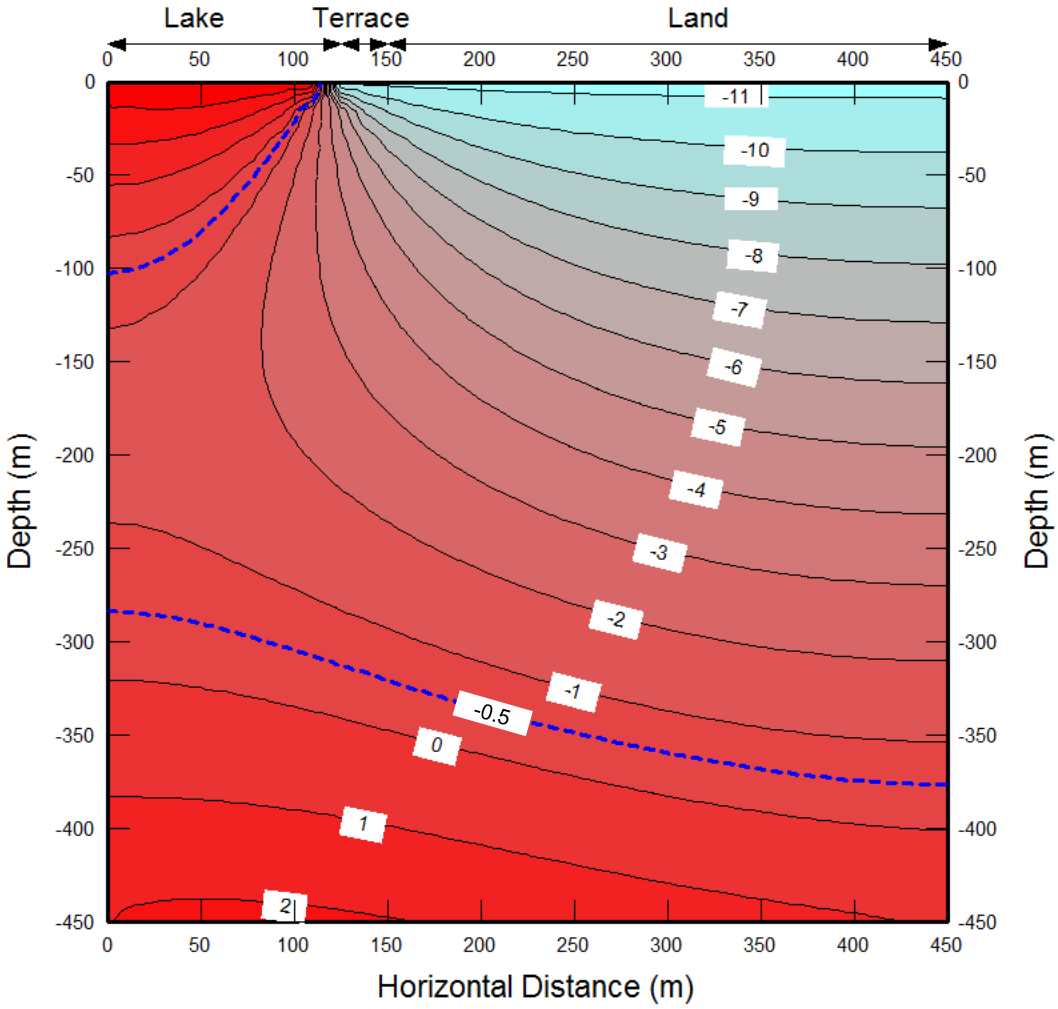
Dimensions:
Half Width of Lake = 125 m
Half Width of Lake + Terrace = 140m
(From SI Plan)



Zero Flux Boundary Condition

Geothermal Heat Flux = 7.26 kJ/days/m² based on local geothermal gradient (0.021°C/m-AMQ15-324) and estimated thermal conductivity of the bedrock (Greywacke (USGS, 1988))

CS1 – TEMP/W Results



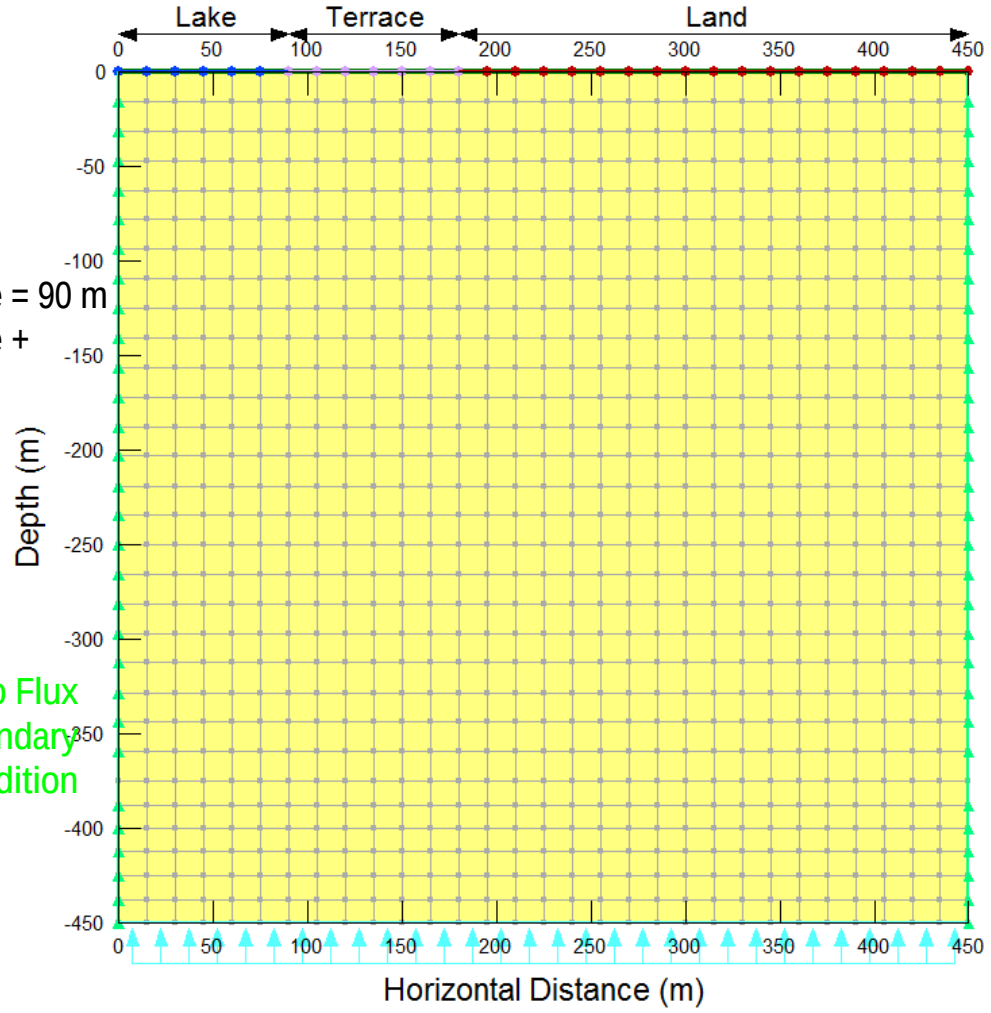
CS2 – TEMP/W Model

Mean Annual Lake-Bottom Temperature = 4°C (Literature Study)

Mean Annual Terrace Temperature = -2°C (Literature Study)

Mean Annual Ground Surface Temperature = -11.3° C (Meadowbank Weather Station)

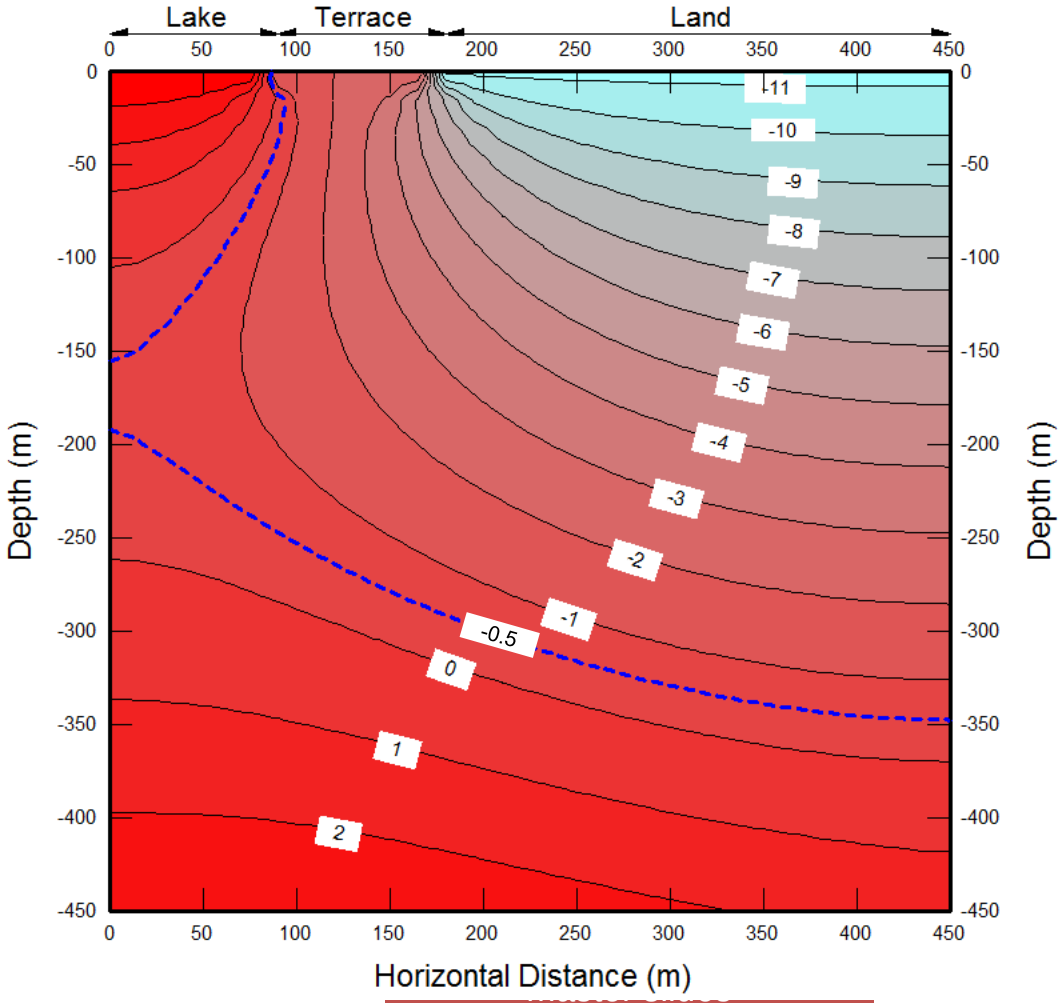
Dimensions:
Half Width of Lake = 90 m
Half Width of Lake + Terrace = 180m
(From SI Plan)



Zero Flux Boundary Condition

Geothermal Heat Flux = 7.26 kJ/days/m² based on local geothermal gradient (0.021°C/m-AMQ15-324) and estimated thermal conductivity of the bedrock (Greywacke (USGS, 1988))

CS2 – TEMP/W Results

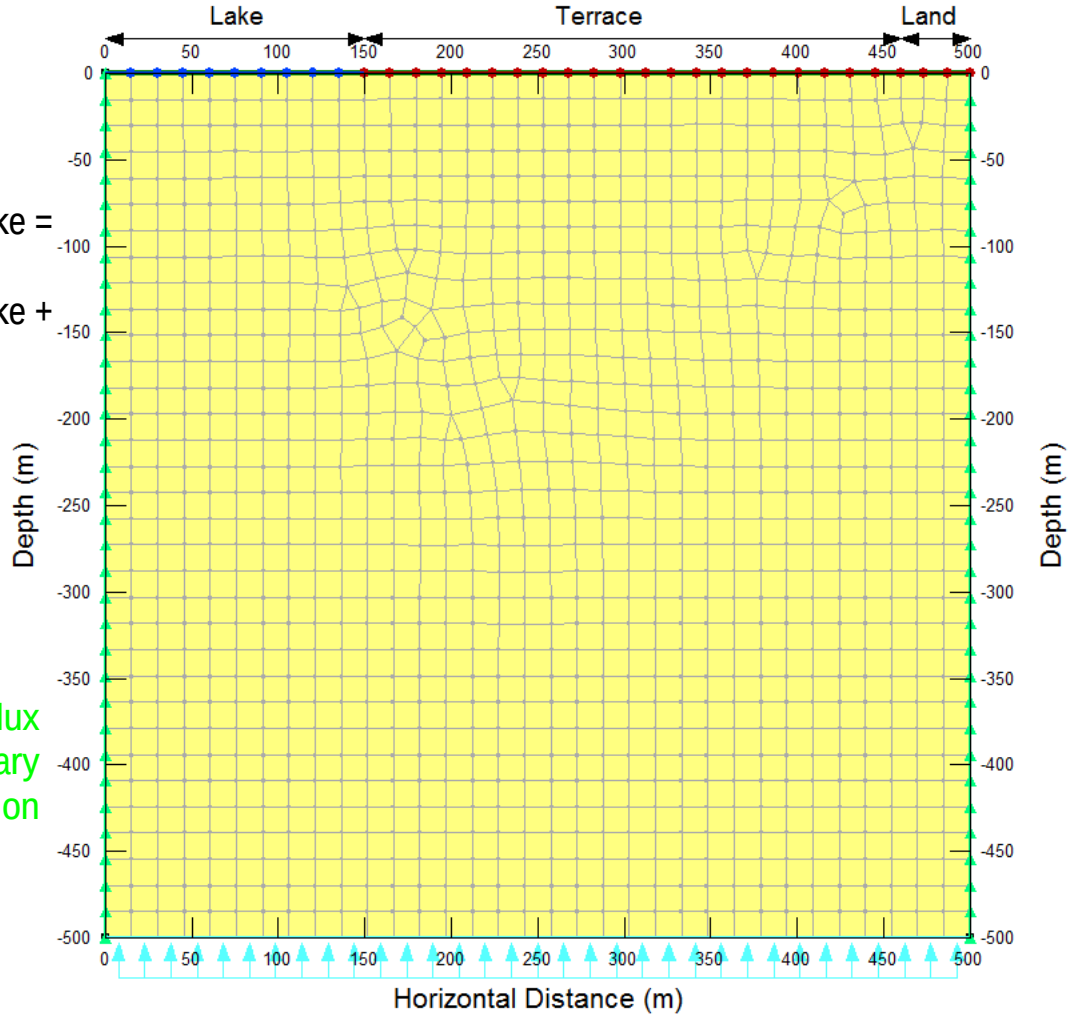


CS3 – TEMP/W Model

Mean Annual Lake-Bottom Temperature = +4°C (Literature Study)

Mean Annual Ground Surface Temperature = -11.3°C (Meadowbank Weather Station)

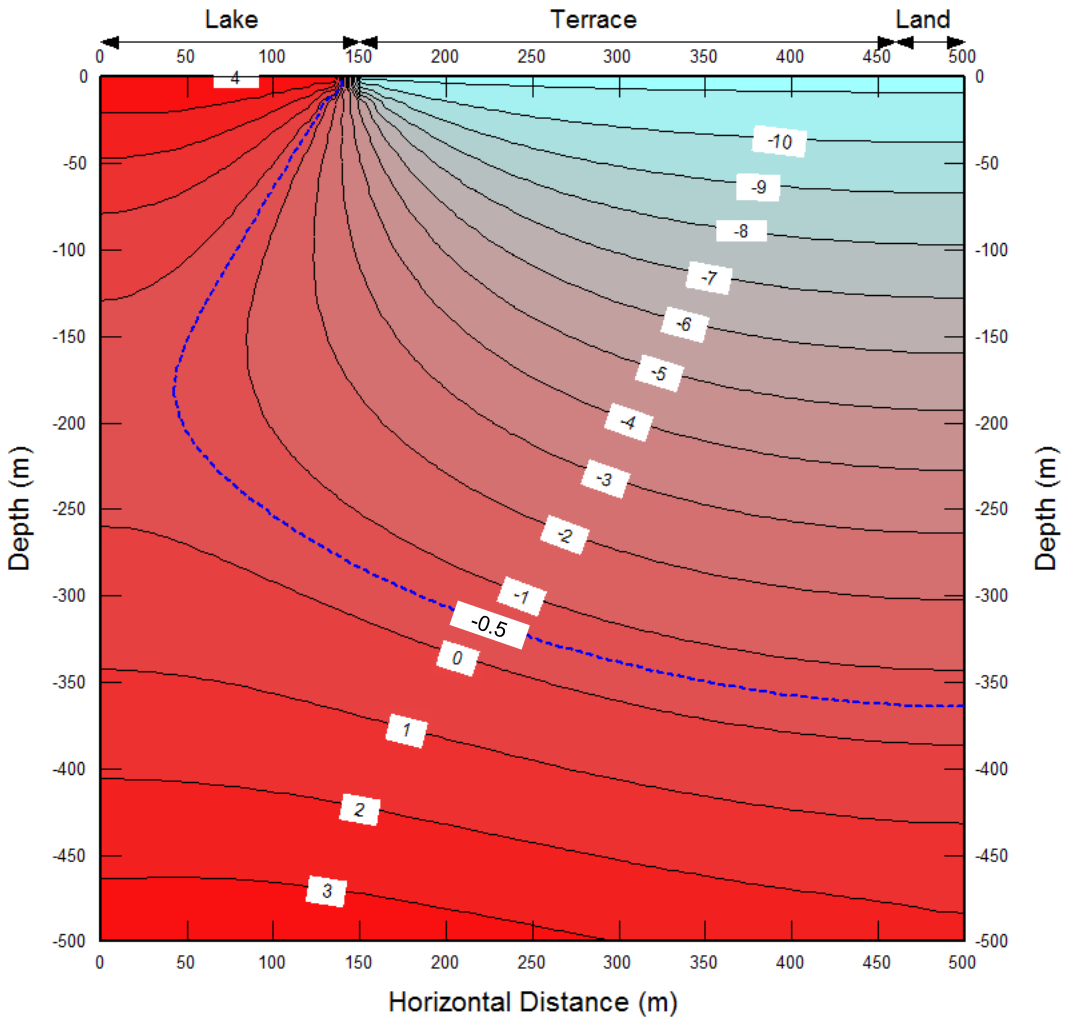
Dimensions:
Half Width of Lake = 150 m
Half Width of Lake + Terrace = 460m
(From SI Plan)



Zero Flux Boundary Condition

Geothermal Heat Flux = 7.26 kJ/days/m² based on local geothermal gradient (0.021°C/m-AMQ15-324) and estimated thermal conductivity of the bedrock (Greywacke (USGS, 1988))

CS3 – TEMP/W Results



MEMORANDUM

To:	Mr. Serge Ouellet	Date:	November 20, 2015
Copy To:	Ben Peacock	File No.:	NB101-00622/04-A.01
From:	Ben Green	Cont. No.:	VA15-03382
Re:	Agnico Eagle Mines Ld.: Meadowbank Division – Whale Tail Pit - Groundwater Inflow Assessment		

1 – INTRODUCTION

Agnico Eagle Mines Ltd. (AEM) is developing the Whale Tail Pit in Nunavut, Canada. The Project is located 50 km northwest of AEM's Meadowbank Mine and 160 km northwest of Baker Lake. AEM is currently evaluating the potential for mining the satellite Whale Tail deposit using open pit mining methods.

Knight Piésold Ltd. (KP) was retained to provide geomechanical and hydrogeological services to support permitting and pre-feasibility level open pit mine design for the Project. One of the objectives of this scope of work is to characterize the quantity and quality of groundwater that could be expected to flow into the open pit. The groundwater quality is covered in (KP, 2015a).

The proposed open pit has a maximum depth of 120 m and is approximately 1,300 m long and 490 m wide. AEM plan to build a dam to the south and drain the northern portion of the lake. The current mine plan details the open pit extraction beginning in the last quarter of 2018 and continuing until the end of 2021.

This memorandum focuses on the quantity of groundwater inflows to the proposed open pit. A brief description of the deposit geology, as well as the permafrost and talik conditions expected in the vicinity of the deposit, is also provided. The permafrost and talik characterization is described in detail in (KP, 2015a).

2 – AVAILABLE RESOURCES

Information reviewed as part of the groundwater inflow assessment included:

- Staged open pit designs from 2018 Q4 until the end of 2021 (AEM, 2015b)
- Whale Tail Lake bathymetry (Groupe Conseil Nutshimit-Nippour, 2015)
- Lithology and structural, models (AEM, 2015a)
- Hydraulic conductivity data from eighteen packer tests conducted during the 2015 site investigation program completed by KP
- Ground temperature data from thermistors installed in six geotechnical boreholes during the 2015 site investigation program completed by KP
- Rock mass quality data collected during the 2015 site investigation program completed by KP, and
- The expected permafrost and talik conditions beneath Whale Tail Lake (KP, 2015a).

3 – GEOLOGY

The following summary of the deposit geology is summarised from AEM (2014) unless otherwise noted. The main lithologies encountered at the Project are summarized below:

- **Overburden:** The overburden layer in the vicinity of the pit is generally expected to be thin, with observed thicknesses of approximately 10 m.
- **Greywacke (S3):** The Greywacke is the most common lithology at the Project. This unit hosts the deposit and is also internal to it. The Greywacke is fine to medium grained and can be altered and/or deformed in the vicinity of the mineralized zones.

- **Mafic Volcanics (V3):** The Mafic Volcanics are present along the southern limit of the deposit and primarily consist of basalt. This package has been heavily folded and is characterized by a schistose or chaotic texture. Biotite and chlorite alteration are common within the Mafic Volcanics.
- **Ultramafics (Komatiite, V4):** The ultramafic volcanic unit, or Komatiite, bounds the northern and southern limits of the deposit. This unit is commonly altered to a chlorite-talc-carbonate schist (soapstone) with chaotic carbonate veining. The Komatiite is characterised by variable rock mass quality and can be faulted.
- **Altered Ultramafics (V3F):** The Komatiite can be locally altered and deformed, notably along the contact with the sedimentary units. The Altered Ultramafics are more competent and have more consistent rock mass quality than the Komatiite. The unit is often mineralized with disseminated sulphides and is one of the primary mineralized zones identified within the deposit.
- **Chert (S10):** A sedimentary unit consisting of interbedded bands of Chert, sediments and thin beds of iron formation. The Chert both hosts and forms many of the mineralized zones identified within the deposit. The Chert can be flooded with silica and has been locally heavily folded.
- **Graphitic Chert (S10E):** In some areas, the Chert has been interlayered with graphitic mudstone, resulting in a unit known as the Graphitic Chert. The Graphitic Chert has been intensely deformed causing it to appear chaotic and brecciated.
- **Mudstone (S6):** Well-banded fine grained sedimentary rock. This unit is often transitional with the Chert and Graphitic Chert.
- **Diorite (I2):** The Diorite is an intrusive unit located to the south of the Whale Tail deposit. The diorite is unmineralized.

A typical cross-section of the deposit is shown on Figure 1. Stratigraphy strikes towards the southwest and dips, at least initially, towards the south.

Structurally, the deposit lithologies trend ENE-WSW, which may represent the axis of an anticline or syncline. This is the dominant structural orientation. A series of diffuse ductile structures do exist that trend NE-SW, which offsets both the lithologies and the mineralization. A sub-horizontal set of structures has also been identified during the geomechanical site investigation program.

4 – PACKER TESTING

Eighteen (18) constant head hydraulic conductivity packer tests were completed in six geotechnical boreholes that were drilled during the geomechanical and hydrogeological site investigations undertaken between June 8 and October 4, 2015. Testing was completed using an HQ sized Standard Wireline Packer System (SWiPS) system manufactured by Inflatable Packers International (IPI). The results of the packer testing estimated relatively low hydraulic conductivities between less than 1 $x10^{-9}$ m/s (the achievable precision of the SWiPS) and 5 $x10^{-8}$ m/s. The results are summarized in Table 1.

Some uncertainty as to whether all of the tests were completed in talik exists due to the preliminary nature of the thermistor data used to define the extent of the talik (KP, 2015b). Two packer tests were completed in AMQ15-349A that were thought to be completely within the talik. These tests resulted in horizontal conductivity estimates of 1 $x10^{-8}$ m/s and 5 $x10^{-8}$ m/s.

5 – PERMAFROST AND TALIK CHARACTERIZATION

Groundwater regimes in permafrost regions are characterized as two systems separated by permafrost; the active layer and the deep regional groundwater system. A talik is a region of unfrozen ground that can form beneath large lakes. Fluids within a talik may remain in a liquid phase at temperatures below zero due to freezing point depression caused by high total dissolved solids (TDS) and hydrostatic pressure. An open talik is one which extends from the lakebed down through the surrounding permafrost to the regional groundwater table.

Open taliks form beneath large lakes and represent the primary connecting pathway for groundwater flow between the active layer and the regional groundwater system.

KP characterized the permafrost and potential for talik formation beneath Whale Tail Lake using the thermistor and hydraulic conductivity data from the geomechanical and hydrogeological site investigation program. The characterization is detailed in KP (2015a) and is summarised below:

- The depth to the base of continuous permafrost is expected to be approximately 420 metres below ground surface (mbgs).
- Freezing point depression beneath Whale Tail Lake ranges from -0.23°C beneath the lake to -0.75°C at 420 mbgs. These estimates are based upon an exponential freezing point depression vs. TDS function developed for the Meadowbank Mine (Golder, 2012) and on an exponentially increasing TDS relationship with depth (Golder, 2014) that has been calibrated to the Project TDS data.
- The western "fluke" of Whale Tail Lake is shallow and likely overlies permafrost. The eastern fluke is deeper and likely overlies a talik. Preliminary thermistor data and I-D analytical solutions from Burn (2002) indicate that the talik below the eastern fluke does not connect vertically through to the regional groundwater system (Figure 2).
- Whale Tail Lake is large and deep beneath the proposed attenuation pond and it overlies a talik that may connect through to the regional sub-permafrost groundwater system (Figure 2).

6 – CONCEPTUAL HYDROGEOLOGICAL MODEL

The hydrogeological conceptual model at the Project is largely a function of the permafrost and talik characterization described in KP (2015a). Other input data and assumptions used to develop the conceptual model include:

- For the purposes of the inflow assessment the vertical and horizontal hydraulic conductivities of permafrost are assumed to be zero.
- The horizontal hydraulic conductivity within the Whale Tail Lake talik zone is conservatively estimated to be $1x10^{-8}$ m/s based on the results of the packer testing summarized in Table 1.
- The vertical hydraulic conductivity is typically estimated to be considerably less than horizontal hydraulic conductivity (in lieu of sufficient data to indicate otherwise). This relationship may not be valid at the Project where both stratigraphy and structure are steeply dipping to sub-vertical, and where horizontal flow within talik zones is restricted by the areal extent of the talik. As a result, the vertical hydraulic conductivity was conservatively assumed to be equal to the horizontal hydraulic conductivity ($1 x10^{-8}$ m/s).
- The active layer is estimated to average 3 m thick, with a horizontal hydraulic conductivity of $1 x10^{-7}$ m/s while thawed based on the thickness of the active layer at other Projects in Northern Canada (Rescan, 2014).
- The available geomechanical data indicate that the bedrock close to surface is weathered and more fractured than the deeper bedrock. This is likely due to successive freeze/thaw cycles. The horizontal hydraulic conductivity of this weathered bedrock cap is estimated to be $1x10^{-7}$ m/s within the talik zone and zero within the surrounding permafrost. The thickness of this weathered bedrock cap is estimated to be 30 m.
- In-situ hydraulic head data is not currently available for the deposit. As a result, the direction and magnitude of the hydraulic gradients at the Project are unknown. Hydraulic gradients prior to the development of the open pit are expected to be small, since the lake elevations in the project area are all reasonably similar due to the flat topography.

Key aspects of the hydrogeological regime relevant to the groundwater inflow assessment are summarized below:

- The regional groundwater gradient is controlled by the elevations of large lakes in the area that are connected to the sub-permafrost groundwater system through a series of open taliks.
- Groundwater flow (through taliks from lakes to sub-permafrost groundwater and vice versa) will be along open fractures, faults, and joint systems conduits as defined by the regional structural orientations.

7 – GROUNDWATER INFLOW ESTIMATES

An estimate of groundwater inflows to Whale Tail Pit has been completed based on the available data and the conceptual hydrogeological model. Groundwater inflow estimates to the open pit were calculated every 3 months for the life of the open pit (years 2018 to 2021) based on the open pit designs provided by AEM. Proposed pit floor depths for the years where the pit will intersect the talik range from 15 to 137 meters below ground surface (mbgs).

KP expects there to be three main sources of inflows to the proposed open pit based on the hydrogeological conceptual model above:

- Seasonal inflows from the active layer.
- Perennial leakage inflows induced by the hydraulic gradient which will develop between the dammed portion of Whale Tail Lake and the floor of the open pit.
- Perennial inflows from the talik induced by the hydraulic gradient between nearby lakes connected to the regional groundwater system and the floor of the open pit, once the pit intersects the footprint of the talik in 2019 Q3.

A schematic diagram of expected inflows is provided in Figure 3.

Two analytical equations were selected to calculate an estimate of groundwater inflows as the open pit develops:

- The Dupuit (1863) equation for horizontal groundwater flow was used to simulate inflow to the open pit from the active layer and leakage from Whale Tail Lake, and
- The Hvorslev (1951) Type D equation was used to estimate inflows from the talik intersected by the open pit.

These analytical methods were used to estimate the inflows from three different sources. These methods are summarized below:

- **Dupuit Equation – Active Layer Inflows:** Development of Whale Tail Pit will result in a seepage face along the perimeter of the pit. Active layer inflows to the pit will cause a drawdown and a gradient for groundwater flow within the active layer. The rate of flow in the active layer is a function of the hydraulic conductivity of the active layer and of the gradient which develops. Recharge to the active layer will include thawed groundwater, snowmelt, precipitation, and leakage from nearby lakes and rivers. Inflows from the active layer will only occur during months with average air temperatures above 0°C. Inflows will occur along the entire perimeter of the open pit.
- **Dupuit Equation – Whale Tail Lake Dam Induced Inflows:** KP understands that the portion of Whale Tail Lake overlying the proposed open pit is to be drained and the southern extent of the lake retained behind a dam. This will create a hydraulic gradient between the surface of the lake behind the dam and the floor depth of the open pit. Inflows will occur through the weathered bedrock cap below the drained portion of the lake towards the pit, when the pit intersects the talik. This inflow is expected to be first encountered in Q3 of 2019 when the open pit will first intersect the lake and underlying talik. The inflow rate will depend on the hydraulic conductivity of the weathered bedrock zone (assumed 1×10^{-7} m/s), the hydraulic gradient which develops in the weathered bedrock unit, and the area through which flow occurs.
- **Hvorslev Type D Equation – Inflows through the Talik:** The hydraulic head of the regional sub-permafrost groundwater is controlled by the surface elevation of large lakes with open taliks. Once the open pit intersects the talik in Q3 of 2019, a hydraulic gradient between regional lakes (approximately ground surface) and the floor of the open pit will develop. Groundwater will begin to discharge from the talik beneath the open pit. This flow will utilize open fractures and joints as preferred conduits; however, inflows are expected to be limited by the vertical hydraulic conductivity (1×10^{-8} m/s, 0.32 m/yr). Therefore although the regional hydraulic gradient provides the driving force for groundwater inflows from the talik, the actual discharge over the life of the open pit is expected to be limited to groundwater immediately below the pit.

Calculated inflows do not account for the possibility of intersecting higher conductivity fault or fracture systems during pit development than has been encountered during drilling and packer testing thus-far.

Inflows in the fourth quarter of 2021 from dam leakage and the underlying talik are expected to be 0.12 L/s and 0.29 L/s, respectively, for a total inflow rate of 0.41 L/s (35 m^3/day). The estimated groundwater inflows to the open pit from the active layer, Whale Tail Lake, and the regional groundwater system is summarised on a quarterly basis in Table 2.

Prepared: for:
Eric Westberg, M.Sc., GIT
Staff Hydrogeologist

Reviewed: PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. B. GREEN 40877 GEO SCIENTIST 20 Nov 2015
Ben Green, M.Sc., P.Geo.
Senior Hydrogeologist

Approval that this document adheres to Knight Piésold Quality Systems:

Attachments:

Table 1 Rev 0	Drillhole Packer Testing Summary
Table 2 Rev 0	Estimated Groundwater Inflows
Figure 1 Rev 0	Typical Deposit Cross-Section
Figure 2 Rev 0	Assumed Talik Footprint beneath Whale Tail Lake
Figure 3 Rev 0	Conceptual Sources of Groundwater Inflow

References:

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Knight Piésold CONSULTING

TABLE 1

AGNICO EAGLE MINES LTD. MEADOWBANK DIVISION
WHALE TAIL PIT

GROUNDWATER INFLOW ASSESSMENT
DRILLHOLE PACKER TESTING SUMMMARY

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Planning Drillhole Name	Actual Drillhole Name	Surveyed Drillhole Details[2]						Hydraulic Testing			
		Collar Coordinates[1]			Azimuth	Dip	Final Length	Along-Hole Packer Testing Interval		Constant Head Test Results[3]	Test Interval Lithology
		Easting	Northing	Elevation							
		(m)	(m)	(m)	(°)	(°)	(m)	From (m)	To (m)	(m/s)	
KP15-01A	AMQ15-326A	606,430.9	7,255,330.8	10,154.6	287	-58	180	160.3	180.0	No Take	ULTRAMAFIC
KP15-02	AMQ15-316	606,655.1	7,255,428.2	10,154.1	7	-54	189	181.3	189.0	$< 1 \times 10^{-9}$	GREYWACKE
KP15-04	AMQ15-349A	607,064.9	7,255,627.5	10,155.3	204	-45	203	97.3	141.0	5×10^{-8}	GREYWACKE, ALTERED ULTRAMAFICS
								136.3	180.0	1×10^{-8}	GREYWACKE, ALTERED ULTRAMAFICS
								178.3	202.5	$< 1 \times 10^{-9}$	GREYWACKE, ALTERED ULTRAMAFICS
KP15-05	AMQ15-306	606,714.8	7,255,363.8	10,154.9	96	-45	201	52.3	100.5	$< 1 \times 10^{-9}$	GREYWACKE
								103.3	162.0	$< 1 \times 10^{-9}$	GREYWACKE
								178.3	201.0	$< 1 \times 10^{-9}$	GREYWACKE
KP15-07	AMQ15-294	607,073.2	7,255,676.1	10,155.9	323	-45	221	100.3	150.0	1×10^{-9}	ULTRAMAFICS, ALTERED ULTRAMAFICS, QUARTZ VEINS
								201.8	220.5	9×10^{-9}	GREYWACKE
KP15-09	AM15-452	606,627	7,255,688	10,156	160	-50	501	127.3	177.0	$< 1 \times 10^{-9}$	GREYWACKE
KP15-10	AMQ15-421	607,098	7,255,491	10,155	274	-51	501	94.3	150.0	1×10^{-9}	DIORITE, GREYWACKE, ALTERED ULTRAMAFICS
								148.3	201.0	$< 1 \times 10^{-9}$	ALTERED MAFICS
								199.3	225.0	$< 1 \times 10^{-9}$	ALTERED ULTRAMAFICS
								298.3	330.0	1×10^{-9}	ULTRAMAFICS
								328.3	455.6	$< 1 \times 10^{-9}$	ULTRAMAFICS
								469.3	501.0	$< 1 \times 10^{-9}$	GRAPHIC CHERT

I:\1\01\00622\04\A\Correspondence\VA15-03382 - Pit Inflows Rev. 3\Tables\Working\[Table 1.xlsx]Table 1 Packer Testing Summary

NOTES:

1. COLLAR COORDINATES SURVEYED AND PROVIDED BY AEM. COORDINATES ARE IN UTM ZONE 14W; ELEVATIONS ARE TRANSLATED FROM THE MINE GRID.
2. REPORTED AZIMUTH AND DIPS ARE THE DRILLHOLE AVERAGE.
3. 1E-09 m/s IS LOWER LIMIT OF SWiPS PACKER TESTING PRECISION.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	20OCT'15	ISSUED WITH MEMO VA15-03382	REW	MBG

Knight Piésold CONSULTING

TABLE 2

AGNICO EAGLE MINES LTD. MEADOWBANK DIVISION
WHALE TAIL PIT

GROUNDWATER INFLOW ASSESSMENT
ESTIMATED GROUNDWATER INFLOWS

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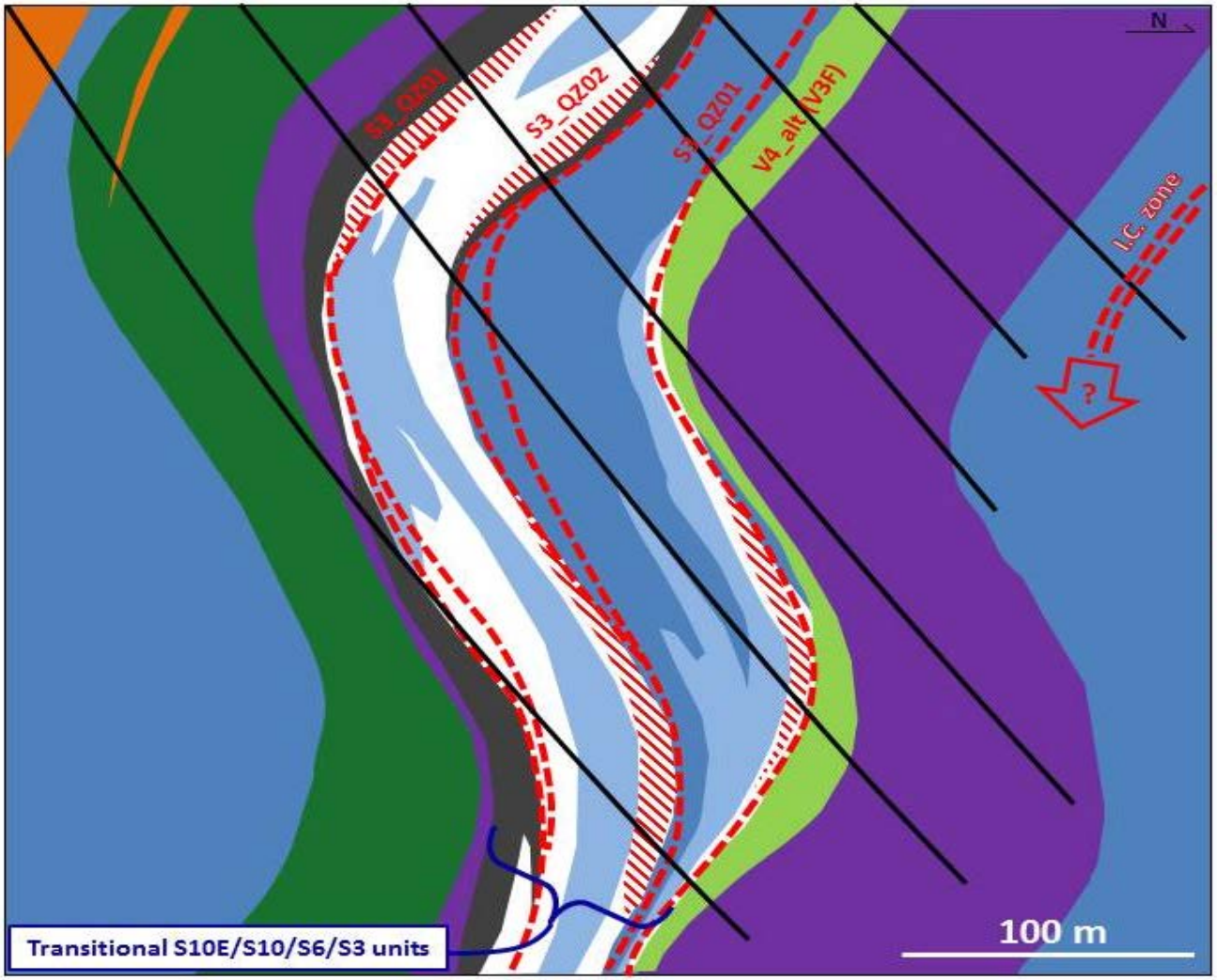
Pit Year	Cumulative Quarter	Talik Intersection (yes/no)	Active Layer Inflows (L/s)	Dam Leakage (L/s)	Talik Inflows (L/s)	Total Inflows (L/s)	Total Inflows (m^3/day)
2018 Q4[1]	1	no	-	-	-	-	-
2019 Q1[1]	2	no	-	-	-	-	-
2019 Q2[1]	3	no	0.06	-	-	0.06	5
2019 Q3[1]	4	yes	0.11	0.12	0.06	0.30	26
2019 Q4[1]	5	yes	-	0.12	0.06	0.18	16
2020 Q1	6	yes	-	0.12	0.06	0.18	16
2020 Q2[1]	7	yes	0.11	0.12	0.11	0.34	29
2020 Q3[1]	8	yes	0.11	0.12	0.15	0.38	33
2020 Q4[1]	9	yes	-	0.12	0.17	0.29	25
2021 Q1[1]	10	yes	-	0.12	0.29	0.41	35
2021 Q2	11	yes	0.11	0.12	0.29	0.52	45
2021 Q3	12	yes	0.11	0.12	0.29	0.52	45
2021 Q4	13	yes	-	0.12	0.29	0.41	35

I:\1\01\00622\04\A\Correspondence\VA15-03382 - Pit Inflows Rev. 3\Tables\Working\[Table 2.xlsx]Table 2

NOTES:

1. OPEN PIT DIMENSIONS PROVIDED IN AEM DEVELOPMENT SCHEDULE (AEM 2015b). ADDITIONAL QUARTERS CONSIDERED TO ALLOW EXPRESSION OF ACTIVE LAYER INFLOWS. PIT DIMENSIONS OF ADDED QUARTERS ASSUMED THE SAME AS PREVIOUS QUARTER PIT DIMENSIONS PROVIDED BY AEM.
2. ACTIVE LAYER INFLOWS ONLY OCCUR DURING SUMMER (Q2 AND Q3).
3. BEDROCK INFLOWS DO NOT OCCUR UNTIL THE OPEN PIT INTERSECTS THE LAKE AND UNDERLYING TALIK IN Q3 2019.
4. (-) DENOTES NO INFLOW OCCURING.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	12NOV'15	ISSUED WITH MEMO VA15-03382	REW	MBG



- Diorite (I2)
- Mafic volcanic/Intrusive (V3/I3)
- Graphitic Chert (S10E)
- Chert (S10)
- Mudstone (S6)
- Greywacke (S3)
- Ultramafic Volcanic (V4)
- Altered and mineralized ultramafic (V4_alt or V3F)
- Quartz Vein
- Chert silica flooded (S10 Si+)

NOTES:
1. CROSS-SECTION PROVIDED BY AEM (MARCH 5, 2015).

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	20OCT'15	ISSUED WITH MEMO	MJR	BDP

AGNICO EAGLE MINES LTD. MEADOWBANK DIVISION

WHALE TAIL PIT

TYPICAL DEPOSIT CROSS-SECTION

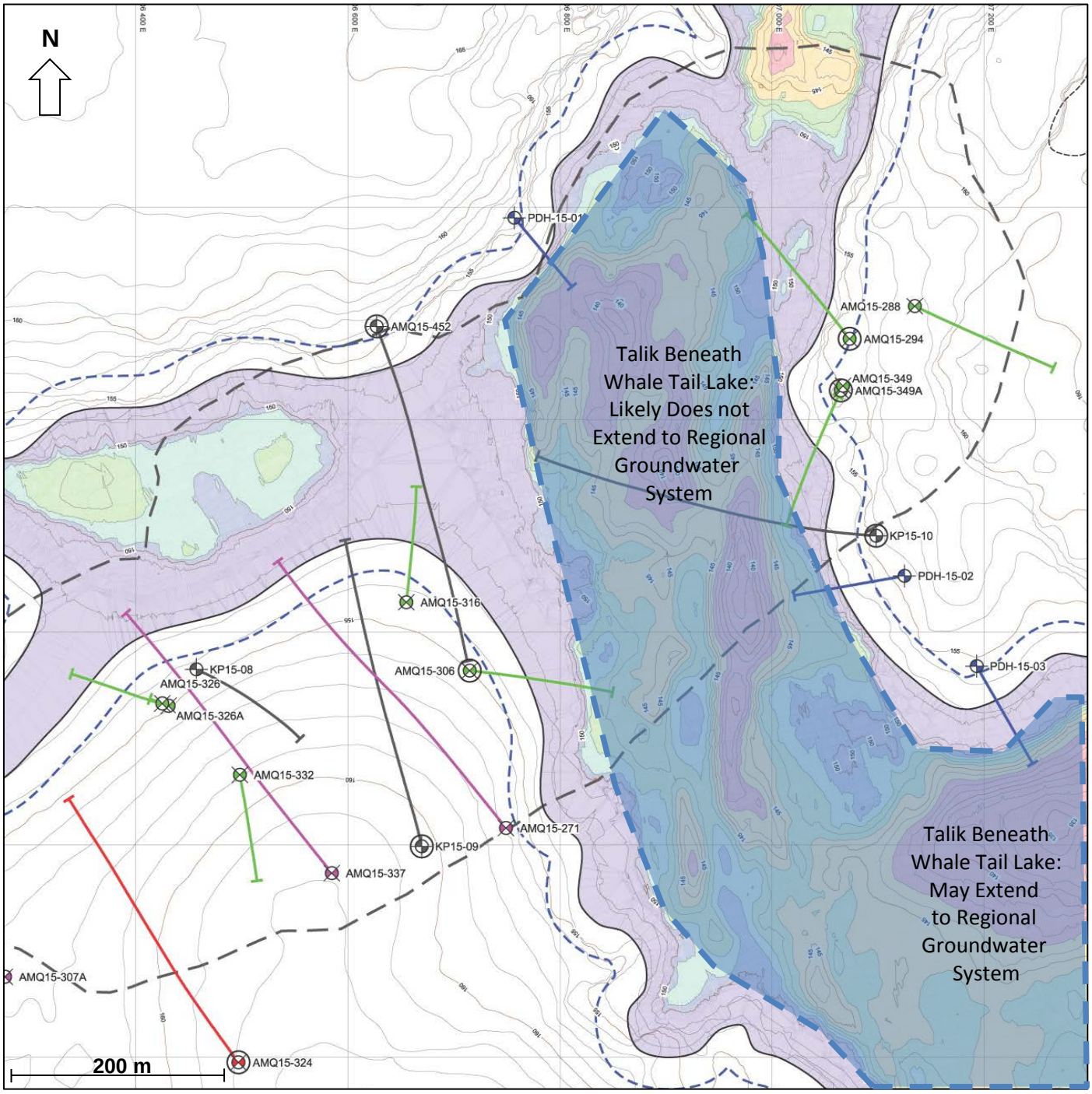
Knight Piésold CONSULTING

P/A NO. NB101-622/4

REF. NO. VA15-03382

FIGURE 1

REV 0



AGNICO EAGLE MINES LTD. MEADOWBANK DIVISION

WHALE TAIL PIT

ASSUMED TALIK FOOTPRINT BENEATH WHALE TAIL LAKE

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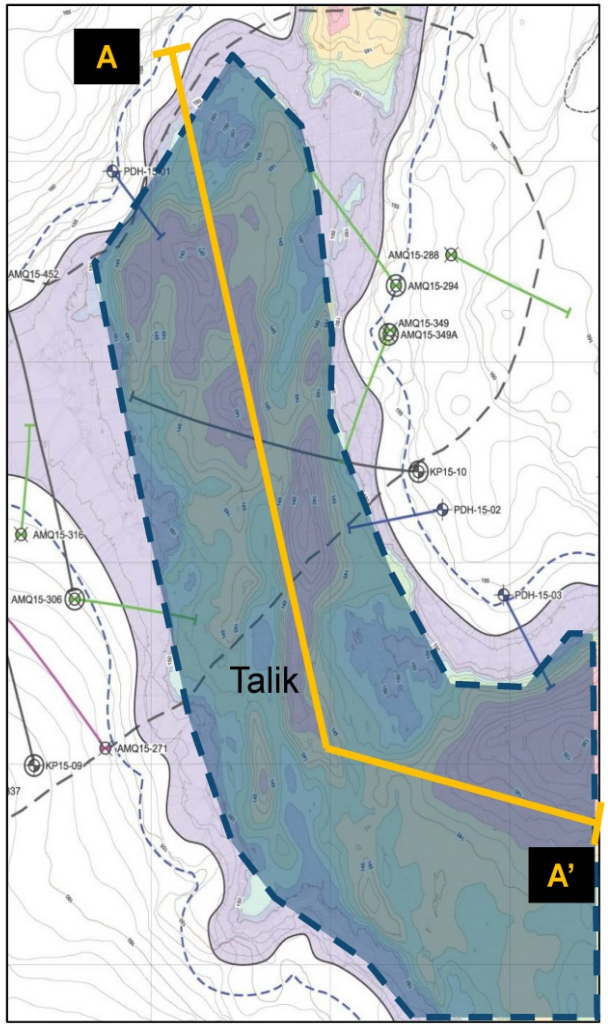
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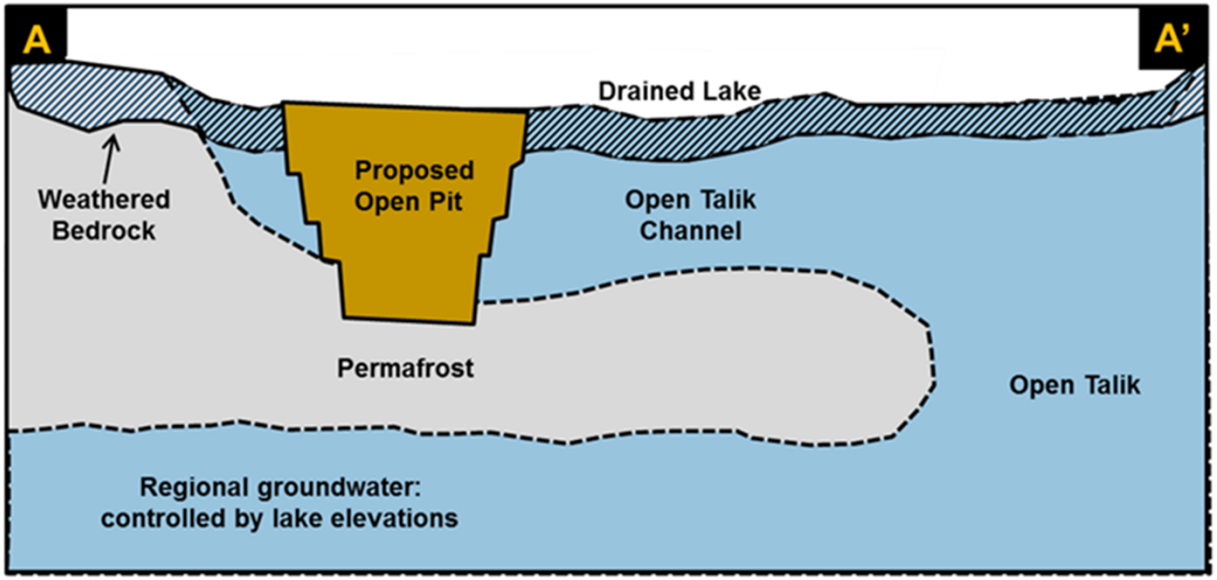
REF. NO. VA15-03382

FIGURE 2

REV 0

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	20OCT'15	ISSUED WITH MEMO	REW	MBG





- **Inflow 1**: Seasonal inflows from the active layer
- **Inflow 2**: Leakage from beneath dam
- **Inflow 3**: Groundwater from talik driven by regional groundwater gradients

32

REV	DATE	DESCRIPTION	PREP'D	RVW'D
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AGNICO EAGLE MINES LTD. MEADOWBANK DIVISION

WHALE TAIL PIT

CONCEPTUAL SOURCES OF GROUNDWATER INFLOW

Knight Piésold CONSULTING

P/A NO. NB101-622/4

REF. NO. VA15-03382

FIGURE 3

REV 0

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APPENDIX 6-B

Hydrogeological Model Pre-Mining, During Mining and Closure

June 2016
Report No. 1541520

AGNICO EAGLE

Golder Associates

6.B-1 OBJECTIVES

The following presents the results of a hydrogeological assessment of groundwater conditions that are expected to develop in the area of the Whale Tail Pit (the Project) during mining and closure of the mine facilities. Specifically, it addresses the approaches and assumptions adopted in the estimate of the potential groundwater inflow quantity and groundwater quality (total dissolved solids [TDS] only) associated with the development of the Whale Tail Pit. In this assessment, a three-dimensional numerical groundwater model representing the Whale Tail Pit and the surrounding areas was developed using FEFLOW (Diersch 2016). This model incorporates the mine plan described in the Project Description (Volume 1).

During mining, the open pit will act as a sink for groundwater flow. Water originating from Whale Tail Lake and other nearby lakes, the attenuation pond, and from bedrock will be induced to flow through the bedrock to the mine workings. The groundwater quality of mine inflow will be the result of the mixing of fresh groundwater flowing from Whale Tail Lake and other nearby lakes, brackish water (connate water) flowing up from deep bedrock, and groundwater flowing from the attenuation pond.

6.B-2 CONCEPTUAL HYDROGEOLOGICAL MODEL

A conceptual hydrogeological model was developed to aid in the construction of the numerical groundwater model. A conceptual hydrogeological model is a pictorial and descriptive representation of the groundwater regime that organizes and simplifies the site conditions so they can be readily modelled. The conceptual model must retain sufficient complexity so that the analytical or numerical models developed from it adequately reproduce or simulate the actual components of the groundwater flow system to the degree necessary to satisfy the objectives of the modelling study.

This conceptual model that has been developed to describe key features of the pre-mining hydrogeological regime in the environmental study area is discussed in the Hydrogeology Baseline Report (Volume 6, Appendix 6-A). The key features included in this conceptual model are the groundwater flow quantity and quality and dominant groundwater flow direction. The following sections describe the conceptual hydrogeological models during mining and closure. These conceptual models were used as a basis for the construction of the numerical hydrogeological model.

6.B-2.1 Groundwater Flow – Mining

The conceptual hydrogeological model for groundwater flow conditions near the Project during mining is presented in Figure 6-B-2. The location of the conceptual cross-section is shown in Figure 6-B-1.

The talik below Whale Tail Lake is expected to form a continuous talik channel that is closed at the base in the northern portion of Whale Tail Lake below the open pit and becomes open at the base towards the south and central portion of the lake. The proposed Whale Tail Pit is planned to extend approximately 115 metres (m) below current water level of Whale Tail Lake (152.5 m), with the pit bottom at 37 metres above sea level (masl). The pit is located partially within permafrost and partially within the talik below Whale Tail Lake.

During mining, the open pit will act as a sink for groundwater flow, with seepage faces developing along the pit walls. In response to the deepening of the open pit, groundwater will be induced to flow through bedrock and potentially through enhanced permeability zones (EPZ) to the open pit. Mine inflow will originate from Whale Tail Lake and other nearby lakes with open taliks beneath them, the attenuation pond between the pit and Whale Tail dike, and deep bedrock. The quality of mine inflow will be a result of the mixing from each of these sources.

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590000 595000 600000 605000 610000 615000

7265000 7260000 7255000 7250000 7245000

N

DS1

DS1

DS2

A81

A16

A60

A65

Nemo Lake

Whale Tail Pit

Mammoth Lake

Whale Tail Lake

LEGEND

- HYDROGEOLOGY BASELINE STUDY AREA
- LAKES WITH TALIK
- WATERBODY (NO TALIK OR OUTSIDE STUDY AREA)
- WATERCOURSE

WHALE TAIL

- BORROW SOURCE
- INFRASTRUCTURE
- PROPOSED HAUL ROAD
- GROUNDWATER FLOW DIRECTION



REFERENCE

1. WHALE TAIL INFRASTRUCTURE OBTAINED FROM AGNICO EAGLE MINES LIMITED ON DECEMBER 21, 2015.
3. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
4. INSET MAP DATA OBTAINED FROM ESRI

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

2 0 2

KILOMETRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

HYDROGEOLOGY BASELINE STUDY AREA

Golder Associates

PROJECT		1541520	FILE No.	
DESIGN	JL	06 Apr. 2016	SCALE AS SHOWN	REV. A
GIS	MH	06 Apr. 2016		
CHECK	JR	08 Jun. 2016		
REVIEW	JL	08 Jun. 2016		

FIGURE 6-B-1

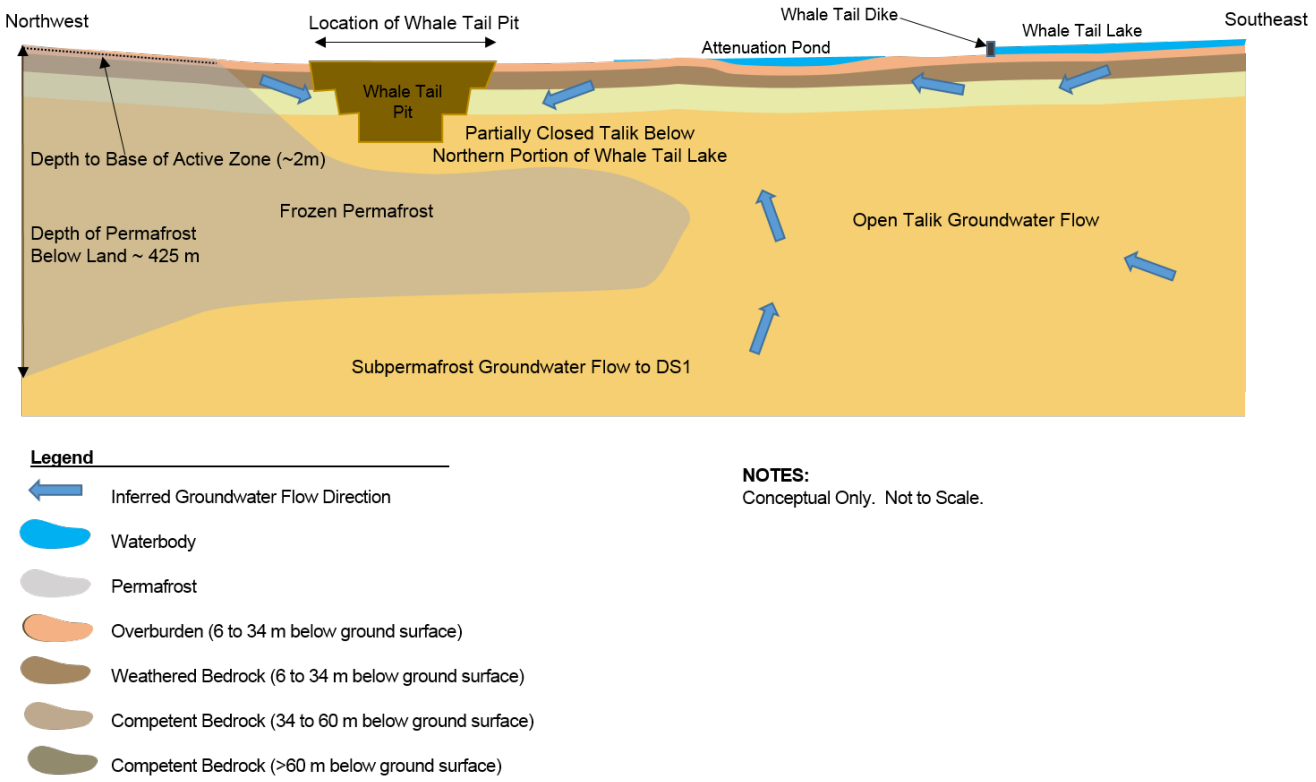


Figure 6-B-2: Conceptual Model of Deep Groundwater Flow Regime during Mining - Cross-Section View

6.B-2.2 Groundwater Flow – Closure

The conceptual hydrogeological model for groundwater flow conditions near the proposed Project during closure is presented in Figure 6-B-3.

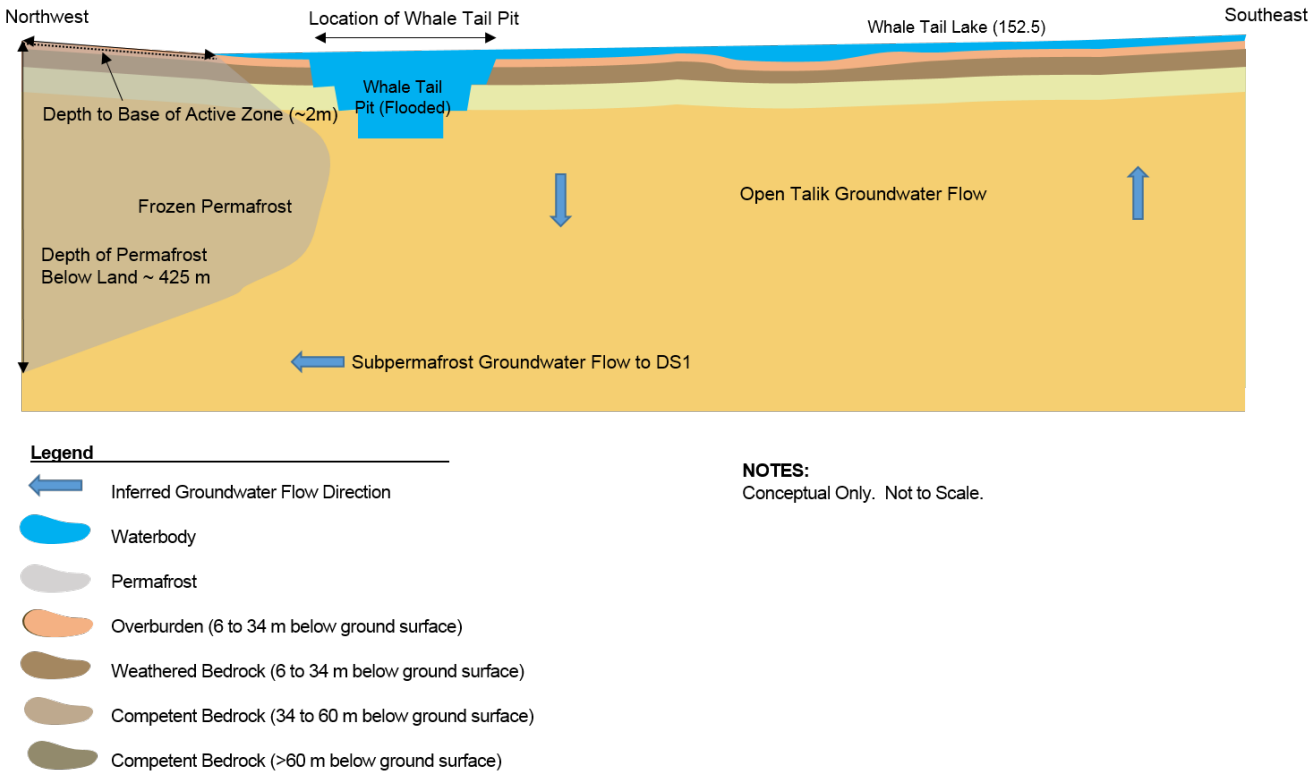


Figure 6-B-3: Conceptual Model of Deep Groundwater Flow Regime during Closure - Cross-Section View

During closure, the open pit will be flooded with water from a variety of sources including: water pumped from the flooded South Whale Tail watershed (shown in Volume 6, Appendix 6-C) until the original Whale Tail Lake level is reached (152.5 m), the north-east watershed (shown in Volume 6, Appendix 6-C) following the breach of the North-East dike, groundwater originating from nearby lakes underlain by open taliks, connate water and water pumped from the attenuation pond (Volume 8, Appendix 8.F-1). This process will dissipate the large hydraulic head differences established during mine operations in the vicinity of the mine workings. The rate of groundwater inflow will decrease as the water level in the open pit rises.

It is estimated that the open pit and dewatered area of Whale Tail Lake surrounding the open pit will be back-flooded over period of approximately seven years.

6.B-3 NUMERICAL HYDROGEOLOGICAL MODEL

A numerical hydrogeological model was constructed based on the conceptual hydrogeological models presented in the previous sections and in the Hydrogeology Baseline Study Area (Volume 6, Appendix 6-A). The purpose of the numerical hydrogeological model is to evaluate the baseline hydrogeological conditions before mining and to estimate the quantity and quality of potential inflows to the open pit during the operations and closure phases of the Project.

6.B-3.1 Model Selection

The numerical code used for the development of a hydrogeological model should be capable of simulating key characteristics and features included in the site conceptual model. Consequently, FEFLOW, a finite-element code from DHI-WASY (Diersch 2016) was chosen for the development of the groundwater model. This code is capable of simulating transient, saturated-unsaturated groundwater flow, and density-coupled solute transport in heterogeneous and anisotropic porous media under a variety of hydrogeologic boundaries and stresses. FEFLOW is particularly well suited for development of the site model because it allows for simultaneous predictions of groundwater flow and solute transport.

6.B-3.2 Model Extent and Mesh Configuration

The extent of the numerical model is based on the understanding of groundwater flow conditions near the Project site, with lateral model boundaries set sufficiently far from the location of the open pit to allow adequate representation of pre-development conditions and potential seepage pathways during operations. The extent of the model corresponds to the extent of the Hydrogeology Baseline Study Area (Volume 6, Appendix 6-A). The mesh is presented on Figure 6-B-4.

Horizontally, the model extends approximately 21 km in an east-west direction and 17 km in a north-south direction, and is roughly centered on the Project. The planar area of the model domain is approximately 242 km^2. In the north and west, the model follows Lake DS1. In the south, the model follows the group of lakes south of watershed A.

The mesh consists of approximately one million triangular elements with uniform spacing of 25 m in the area around Whale Tail Lake where strong hydraulic gradients are expected to develop during mine operations. Elements expand to a size of approximately 350 m along the model perimeter. Overall, the mesh spacing is considered to be of appropriate detail for simulation of hydrogeological conditions at the Project site.

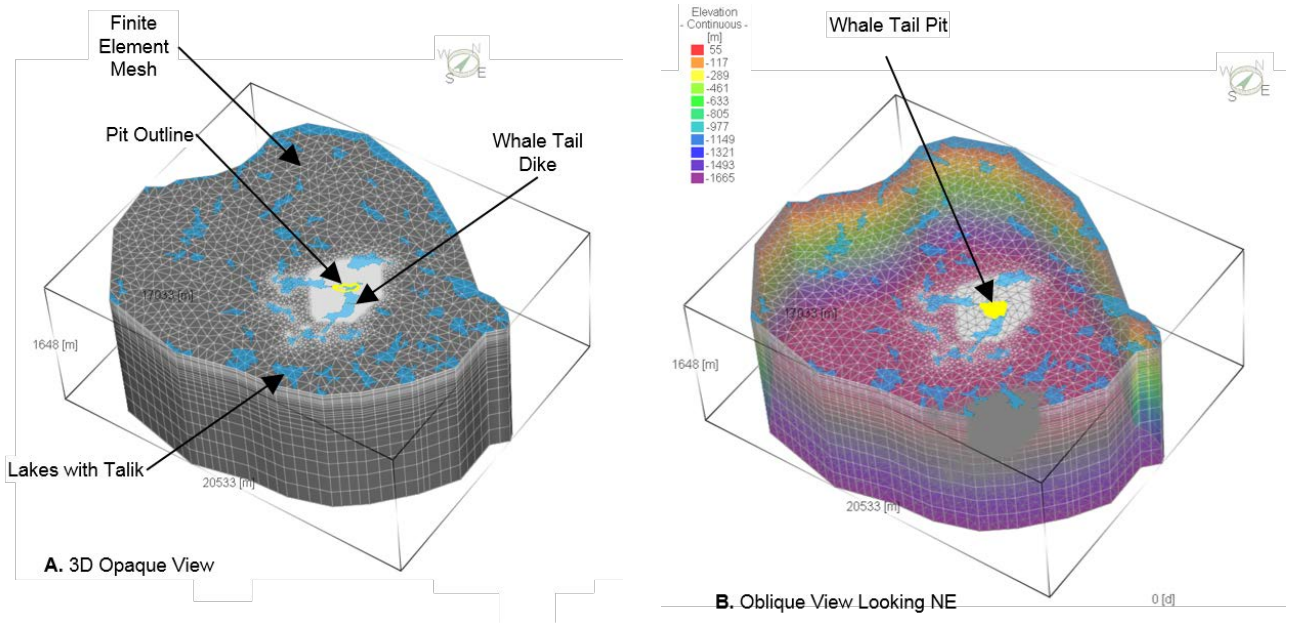


Figure 6-B-4: Hydrogeological Model Finite Element Mesh

Vertically, the model domain is discretized into 29 layers. The top of Layer 1 was set equal to the average planned elevation of dewatering for the area around the open pit during operations (148 masl). The bottom of Layer 29 was set to a constant elevation of -1,500 masl, which is approximately 1,500 m below the ultimate depth of the deepest planned open pit mine level at the Whale Tail Pit (37 masl).

6.B-3.3 Hydrostratigraphy and Model Parameters

Three hydrostratigraphic units, consisting of overburden, weathered bedrock and competent rock were represented in the model as a Base Case Scenario. A summary of the hydrogeological properties of each unit is provided in Table 6-B-1. The Base Case scenario reflects the most likely estimate of hydrogeological conditions that are expected to be encountered during mining. Values of hydrogeological parameters were obtained from in-situ hydrogeologic testing, where available, as discussed in the Hydrogeology Baseline Report (Volume 6, Appendix 6-A). Where in-situ values were not available, values were derived from testing near open pits at the Meadowbank Mine, from other nearby mining sites, and from typical values published in literature. Conservative assumptions have been made for model parameters such that they result in conservative (i.e., high) predictions of mine inflow quantity and quality, including travel times and saline upwelling. For example, the hydraulic conductivity of the competent bedrock below 60 m depth was conservatively assumed to be three times higher than the geometric mean of the packer test results (Volume 6, Appendix 6-A).

Table 6-B-1: Hydrogeological Parameters Used in Model

Hydrostratigraphic Unit	Depth Interval (m)	Reference Case Hydraulic Conductivity (m/s)[a]	Specific Storage (1/m)[b]	Specific Yield (-)[b]	Effective Porosity (-)[b]	Longitudinal Dispersivity (m)[d]	Transverse Dispersivity (m)[d]	Effective Diffusion Coefficient (m^2/s)
Overburden	0 to 6	2×10^{-6}	1×10^{-4}	0.2	0.2	10	1	2×10^{-10}
Weathered bedrock	6 to 34	1×10^{-7}	2×10^{-4}	0.03	0.03	10	1	2×10^{-10}
Competent bedrock	34 to 60	3×10^{-8}	1×10^{-05}	0.0006	0.001	10	1	2×10^{-10}
Competent bedrock	>60	1×10^{-8}	1×10^{-05}	0.0006	0.001	10	1	2×10^{-10}
EPZ[c]	-	5×10^{-7}	1×10^{-4}	0.01	0.01	10	1	2×10^{-10}

[a] Derived from hydraulic testing results as presented in Golder (2016). Ratio of vertical to horizontal hydraulic conductivity assumed to 1:1.

[b] Parameter values within ranges documented in literature (Maidment 1992; Stober and Bucher 2007).

[c] The enhanced permeability zones were included in the sensitivity and in the EA Conservative Scenario presented in Section 6.B-4a. The EPZs were assumed to be vertical and 10 m wide. One EPZ was assumed to strike northwest – south east and hydraulically connect the Whale Tail Pit to Whale Tail Lake. The second EPZ was assumed to strike northeast – southwest. The EPZs were assumed to be continuous and hydraulically connected over the width of the model (approximately 17 kilometres).

[d] Values are consistent with literature values (Schulze-Makuch 2005).

m = metre; m/s = metres per second; m^2/s = squared metres per second.

In-situ hydrogeological testing was inconclusive as to the presence of enhanced permeability zones (EPZs), as indicated by relatively low hydraulic conductivity measurements in packer test intervals that insected potential faults (1×10^{-9} m/s to 5×10^{-8} m/s; Volume 6, Appendix 6-A). Enhanced permeability zones were therefore not included in the Base Case Scenario but their potential effect on groundwater inflow quantity and quality were assessed through sensitivity analysis.

An overall summary of the assumptions and limitations of the numerical modelling is provided in Table 6-B-2, including those associated with the underlying modelling codes.

Table 6-B-2: Assumption and Limitations of the Groundwater Model

Groundwater flow in the bedrock was simulated as “equivalent porous media.” Flow in bedrock is assumed to be laminar, steady, and governed by Darcy’s Law.
Horizontal mesh discretization of approximately 25 m, and vertical mesh discretization between 6 and 20 m, were used to provide sufficient spatial resolution for simulation of groundwater flow and transport near the open pit.
Values assigned to model input parameters were based on hydrogeological investigations conducted by Knight Piésold (2015), values published for nearby pits at the Meadowbank project, other nearby mining projects, or published in the literature where site-specific data were not available.
Surface waterbodies were simulated using specified head boundaries. It was assumed that the permeability of sediments beneath these waterbodies is similar to the underlying geologic strata. Thus, no restriction of flow between the surface water and individual hydrostratigraphic units was simulated.
Groundwater flow deeper than approximately 1.5 km below ground surface was assumed to be negligible and to have negligible influence on model predictions.

m = metres; km = kilometres.

6.B-3.4 Mine Schedule

The mine schedule discussed in the Project Description (Volume 1, Section 1.4) is summarized in this section. Mining on land is expected to be initiated in approximately June 2018, with active mining in talik below dewatered portions of Whale Tail Lake expected to start in approximately the third quarter (Q3) of 2019. Mining is expected to finish in Q4 of 2021.

Dewatering of pool behind the dike is expected to be initiated and finished in 2019. Pit flooding will commence in 2022 and is expected to reach the top of the pit / base of Whale Tail Lake (138 masl) in 2025. Subsequent re-flooding of Whale Tail Lake (North Basin) will continue until 2028.

6.B-3.5 Model Boundary Conditions

Model boundary conditions provide a link between the model domain and the surrounding hydrologic and hydrogeologic systems. Two types of flow boundary conditions were used in the model; specified head and no-flow (zero-flux) boundaries. The locations of these boundaries are shown in Figure 6-B-5 and are summarized below.

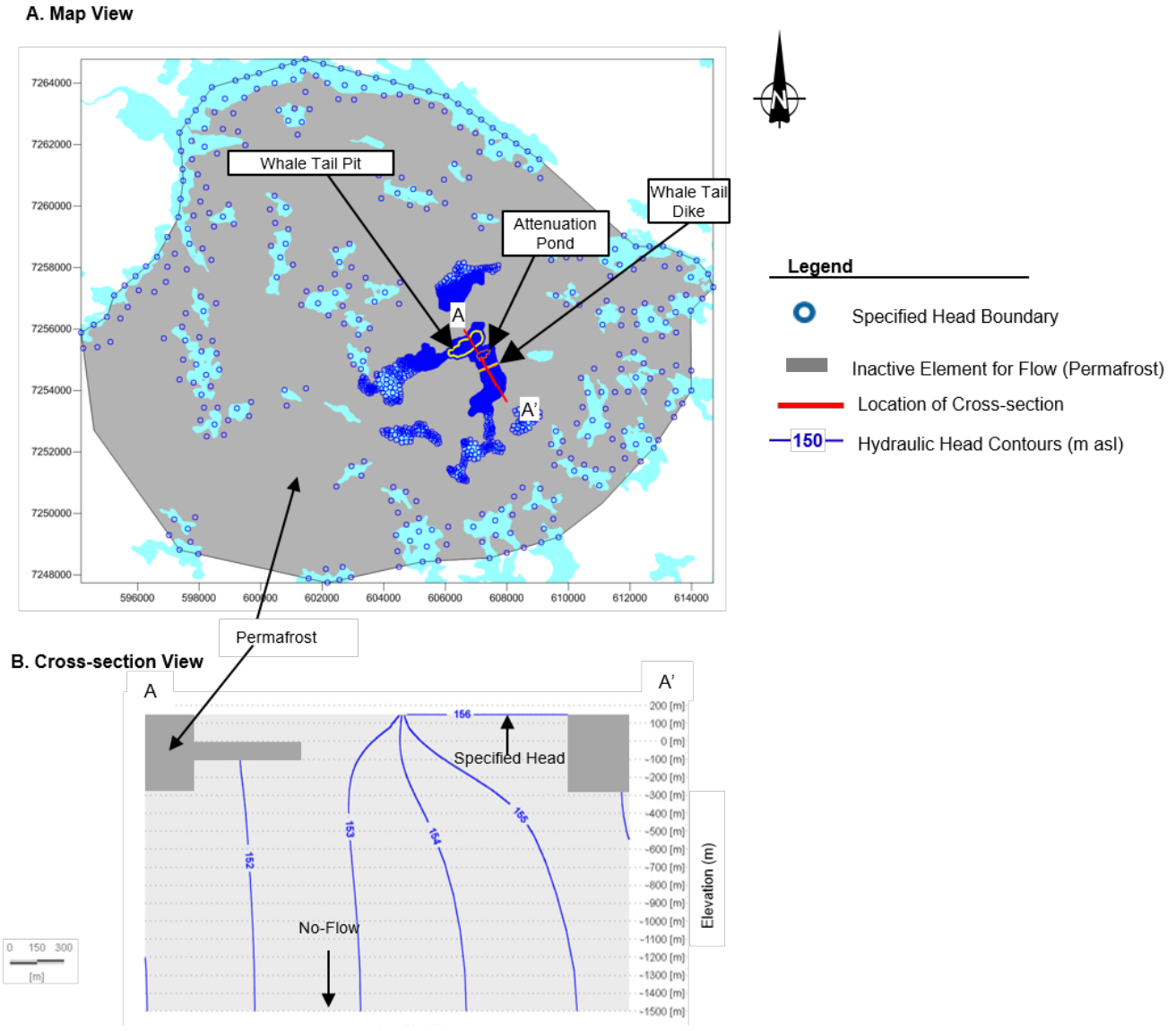


Figure 6-B-5: Boundary and Initial Conditions - Groundwater Flow Hydrogeological Model

Specified head boundaries are assigned to Layer 1 of the model to represent all lakes assumed to have open taliks connected to the deep groundwater flow regime. Each of these boundaries was set to the surveyed average lake elevation. It was conservatively assumed that the surface water/groundwater interaction at all lakes is not impeded by lower-permeability lakebed sediments that may exist on the bottom of some of these lakes.

Specified head boundaries are assigned to Layer 1 of the model to represent the attenuation pond which was conservatively assumed to be unlined. For simplicity this boundary was set to 148 m, the average elevation of the base of dewatered portion of Whale Tail Lake. This hydraulic head is higher than the anticipated operating level of the pond by 3 to 5 m, and this assumption will result in conservatively high gradients between the attenuation pond and the open pit.

During operations, time-variable specified head boundaries were assigned to Layer 1 of the model to represent the lake dewatering and back-flooding in the area within the dike. In the dewatering period, the water level was varied from the original water elevation of Whale Tail Lake (152.5 masl) to the average bottom of lake elevation (148 masl), which varies from approximately 138 masl to 152.5 masl. At the end of mining and after the back-flooding of the open pit during closure, these boundaries were modified such that they represented lake water level recovery to the original elevation of 152.5 masl.

Mine workings (i.e., the open pit) were simulated in the model using time-variable specific head boundaries. At each mesh node within the perimeter of the open pit, a specified head boundary was assigned and the head value at this boundary was varied over time to represent progress of pit excavation according to the mine schedule described in Section 6.B-3.4. In addition, all boundaries representing mine workings during mining were constrained to allow only outflow from surrounding sediments/bedrock into the mine (i.e., these boundaries act as seepage faces). Furthermore, mesh elements inside the open pit in a given model layer were deactivated over time as the mine reached the bottom of the model layer. During closure, these boundaries were modified to reflect the pit lake elevation, with the seepage face constraint removed once the pit lake was above the nodal elevation.

No-flow boundaries were used to represent inferred groundwater flow divides and flow lines along the perimeter of the model. These boundaries were located sufficiently far from the mine to have only a negligible impact on model predictions. The effect of these no-flow boundaries on model predictions was assessed as part of the sensitivity analysis discussed in Section 6.B-3.7.3. A no-flow boundary was also applied along the bottom of the model at a depth of 1.6 km below ground surface (-1,500 masl). Flow at greater depth is expected to be negligible, and therefore, to have negligible impact on model predictions. No-flow boundaries were also assigned along the edges of the permafrost as the permafrost is essentially impermeable. Mesh elements representing permafrost were deactivated in all model simulations.

Initial groundwater flow conditions represent the pre-mining flow regime described in the Hydrogeology Baseline Report (Volume 6, Appendix 6-A), where the groundwater flow pattern is controlled by the water elevations of the large lakes in the hydrogeology study area. The groundwater flow pattern predicted by the hydrogeologyical model simulating pre-mining conditions was evaluated qualitatively to assess if it was in agreement with the conceptual understanding of baseline groundwater conditions. This groundwater flow pattern was then used as initial conditions in the hydrogeological model.

6.B-3.6 Transport Boundary Conditions and Initial Conditions

Three types of boundary conditions were used to simulate transport of TDS in groundwater: specified concentration boundaries, zero flux boundaries, and exit (Cauchy type) boundaries. The location of these boundaries is shown in Figure 6-B-6.

Specified concentration boundaries of zero milligrams per litre (mg/L) (freshwater) were assigned along the bottom of all lakes assumed to have open taliks in connection with the deep groundwater flow regime.

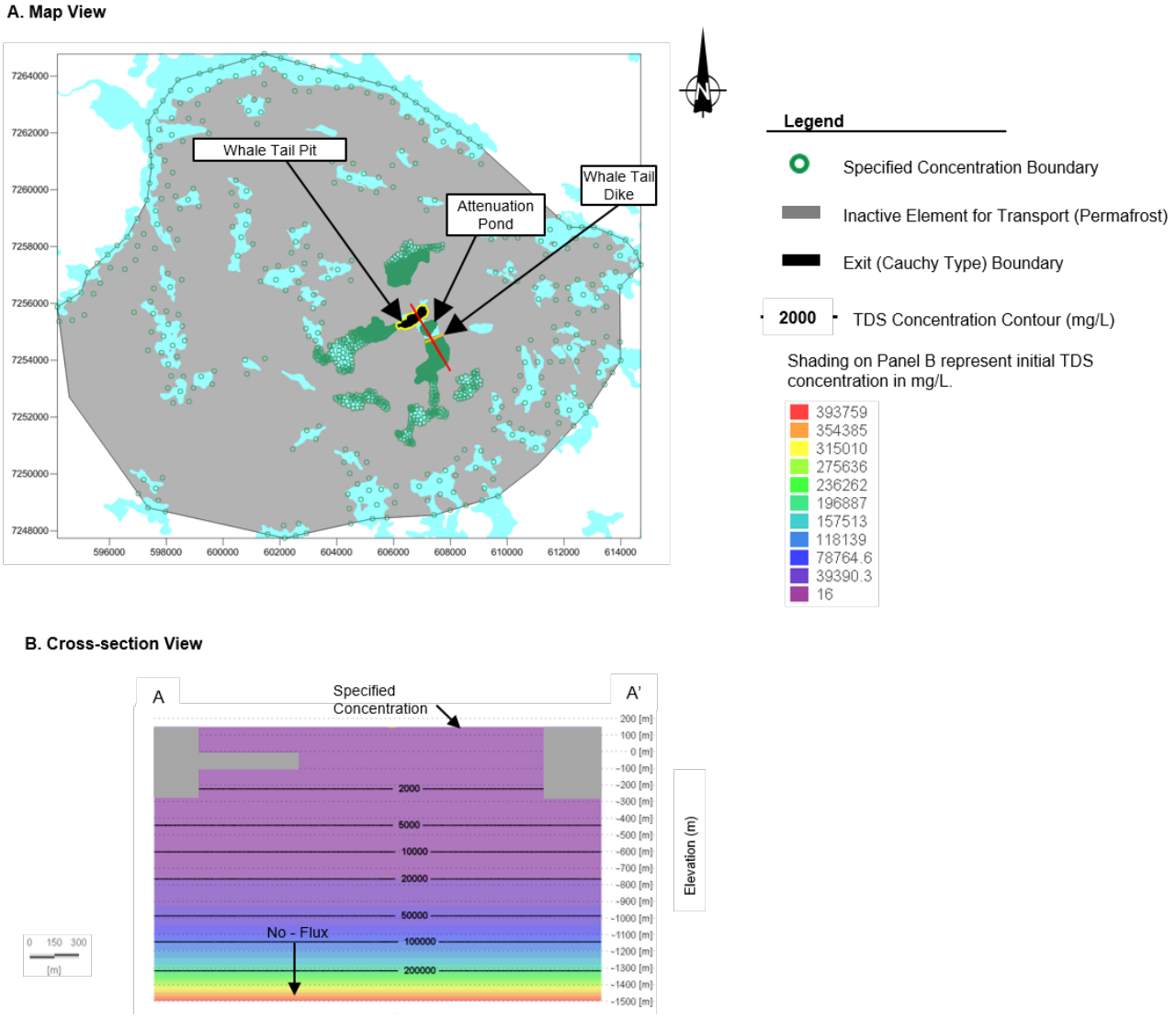


Figure 6-B-6: Boundary and Initial Conditions - Solute Transport Hydrogeological Model

A specified concentration boundary of 499 mg/L was assigned along the bottom of the attenuation pond, to represent the TDS concentration in pond water seeping into the groundwater flow system. The specified concentration was constrained such that if groundwater was predicted to discharge to the pond, the boundary switches to an Exit (Cauchy type) boundary, which simulates the movement of TDS out of the surrounding groundwater flow system and into the pond. Groundwater inflow pumped from Whale Tail Pit will be placed in the attenuation pond and was assumed to control the TDS concentration of seepage loss from the pond to the groundwater flow system. A concentration of 499 mg/L represents the average TDS concentration within the talik in the area of the open pit, and therefore represents a conservative estimate of the potential TDS concentration in the attenuation pond water. In reality the TDS concentration will likely be lower as the pond receives some fresh water sources, and because initially the pit intersects less saline water.

Zero-flux boundaries were applied along the bottom of Layer 23, 1.6 km below ground surface. Mass flux from beneath this depth was considered to have negligible impact on model predictions.

Exit (Cauchy type) boundaries were assigned to the nodes representing the pit walls. These boundaries simulated the movement of TDS mass out of the surrounding groundwater system and into the mine workings.

Initial TDS concentrations in each model layer were assigned based on the assumed Whale Tail TDS depth profile discussed in the Hydrogeology Baseline Report (Volume 6, Appendix 6-A) and shown in Figure 6-B-6.

6.B-3.7 Model Predictions – Base Case

The following sections presents predicted hydrogeological conditions for the Project based on the hydrogeological parameters discussed in Section 6.B-3.3 and presented in Table 6-B-1. These predictions are hereafter referred to as Base Case predictions. Uncertainty in the predicted groundwater quantity and quality resulting from the uncertainty in these parameters is discussed Section 6.B-3.7.3.

6.B-3.7.1 Current Conditions

Predicted hydrogeological conditions for pre-mining flow are presented in Figure 6-B-7. The predominant groundwater flow direction in the deep groundwater flow regime is to the northwest to Lake DS1. During pre-mining the northern portion of Whale Tail Lake represents a groundwater recharge zone, with water discharging from the Lake to DS1. The southern portion of the lake represents a groundwater discharge zone, with water discharging to Whale Tail Lake from A60 to the southeast.

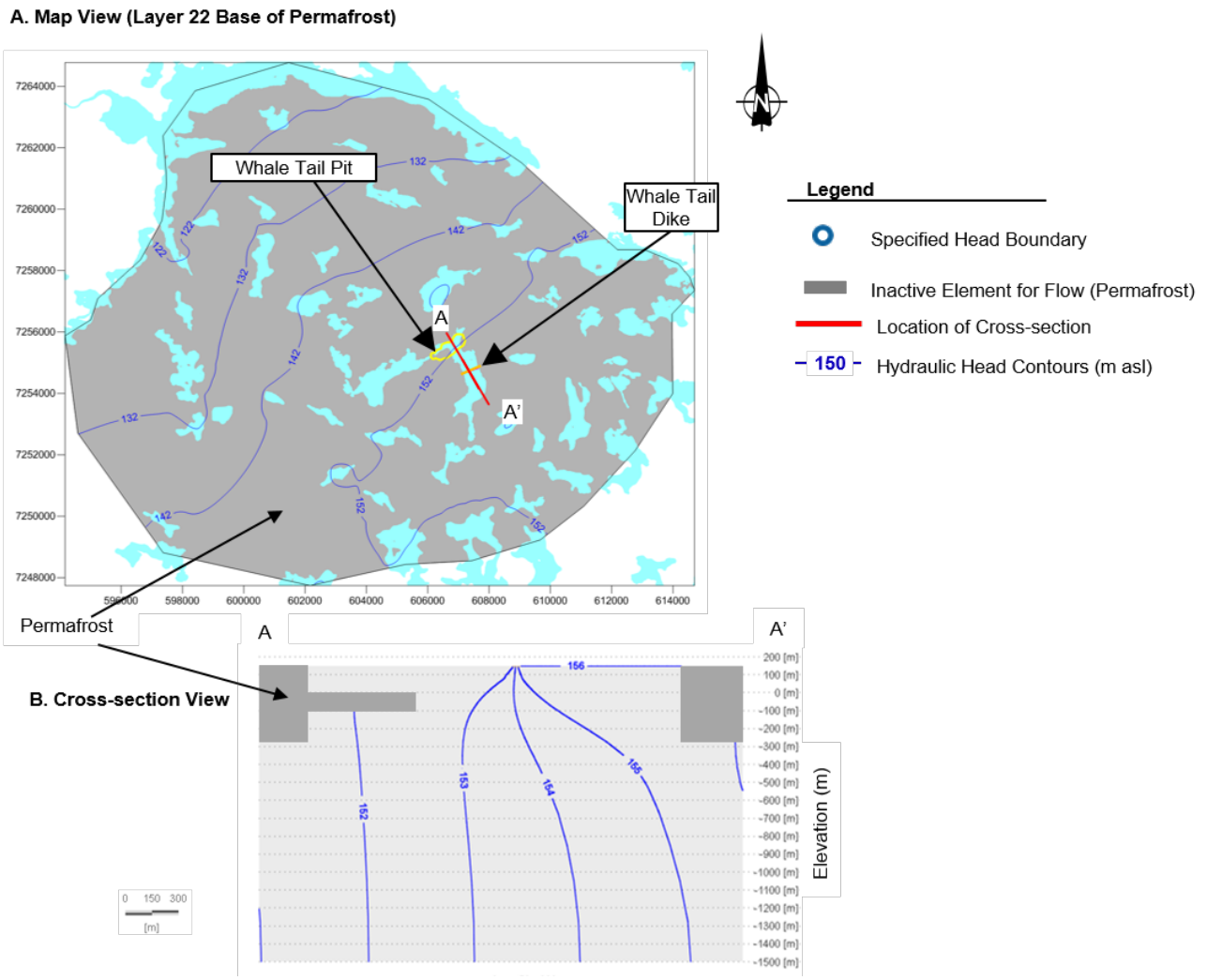


Figure 6-B-7: Predicted Hydraulic Heads - Pre-mining Conditions Hydrogeological Model

6.B-3.7.2 Mining and Closure

Predicted hydrogeological conditions when the open pit reaches its ultimate depth (37 masl) are presented in Figure 6-B-8 and Figure 6-B-9 for the Base Case. Predicted groundwater inflow quantity and quality over the mine life including closure are presented in Table 6-B-3. Initial mining outside of the in-water area (i.e., within the permafrost) in 2018 and 2019 is excluded as groundwater flow through permafrost is expected to be negligible.

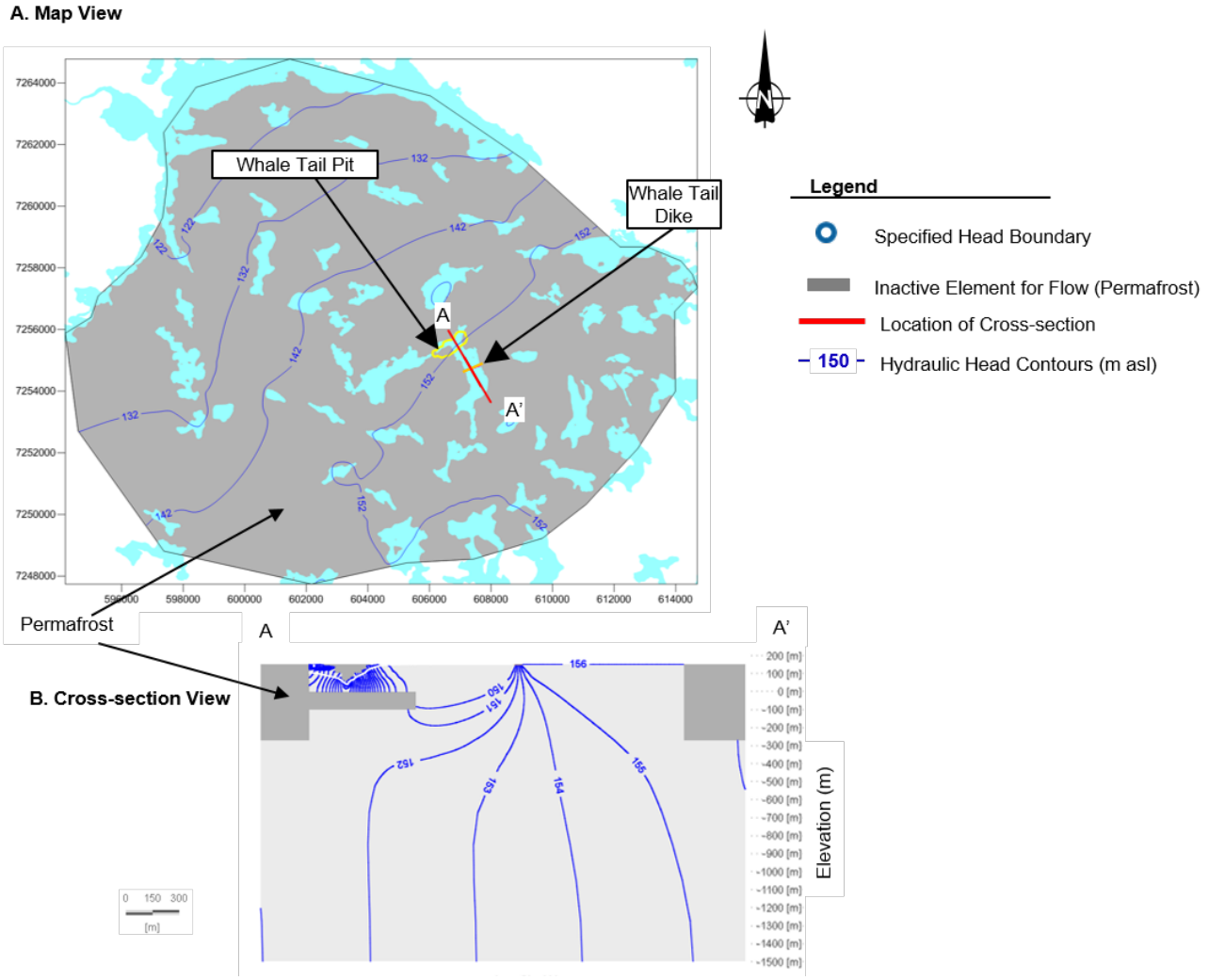


Figure 6-B-8: Predicted Hydraulic Heads - End of Mining - Base Case Scenario

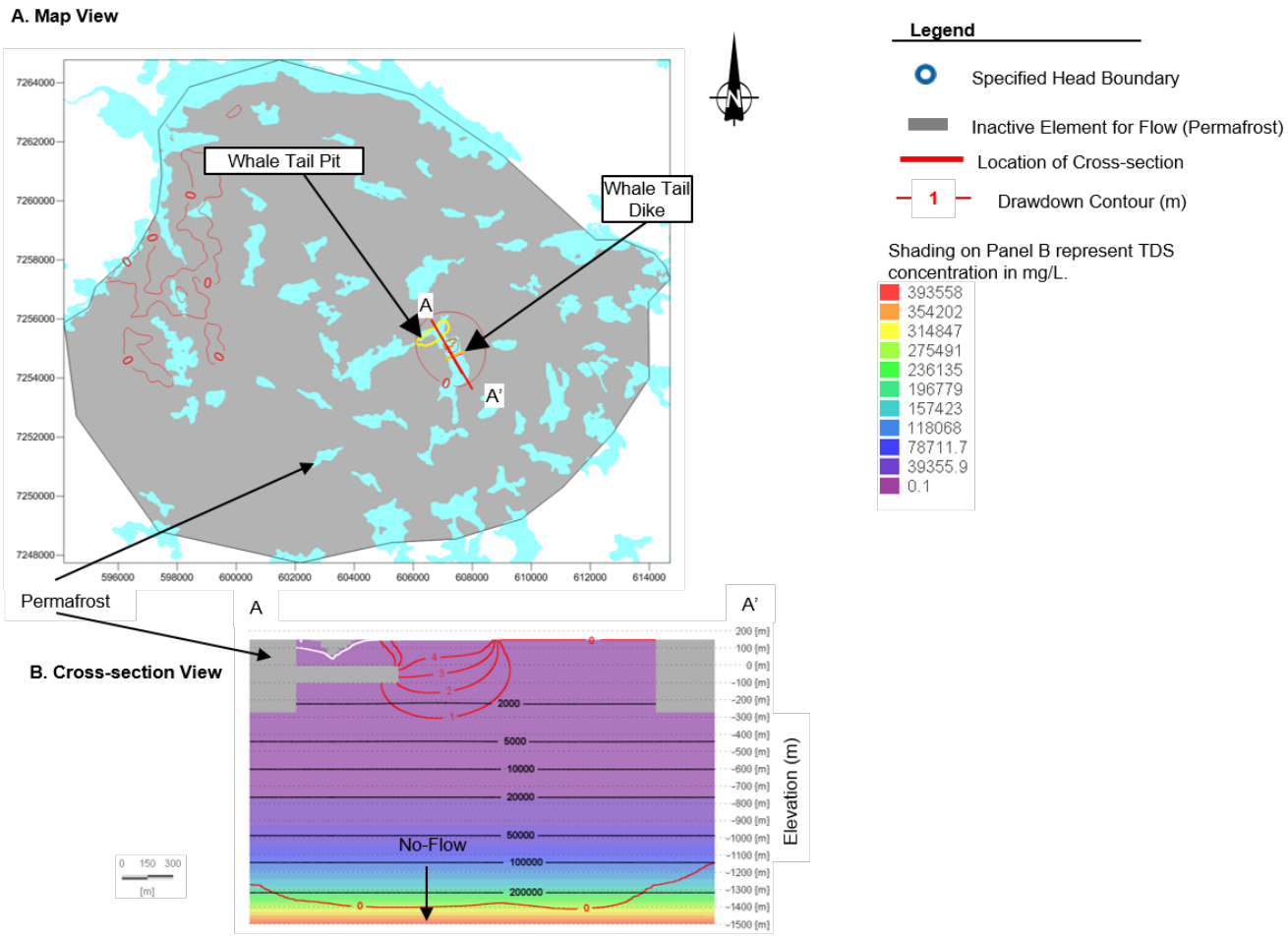


Figure 6-B-9: Predicted Drawdown and Total Dissolved Solids - End of Mining - Base Case Scenario

Table 6-B-3: Predicted Groundwater Inflow and Groundwater Quality Over the Mine Life - Whale Tail Pit (Base Case)

Phase	Period	Whale Tail Pit – Base Case Scenario			
		Groundwater Inflow (m^3/day)	TDS Concentration (mg/L)	Lakewater or Pondwater in Total Inflow (%)	Pit Lake Outflow to Groundwater (m^3/day)
Dewatering	Mar 2019 to Oct 2019	-	-	-	-
Mining	Q4 2019 to 2020	195	390	<5%	-
	2021	65	440	<5%	-
Filling	2022	30	380	<5%	5
	2023	20	350	<5%	5
	2024	15	350	<5%	5
	Jan to Oct 2025	5	345	<5%	5
	Nov 2025 to Oct 2028	0	340	<5%	30

Note: Mining prior to Q4 2019 is within permafrost and groundwater inflow will be negligible.
TDS = total dissolved solids; m^3/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

In the first year of mining within the talik (Q4 2019 to end of 2020), much of the groundwater inflow to the pit is attributed to water released from storage in the overburden and shallow bedrock beneath Whale Tail Lake but within the footprint of the dike. In the second year of mining within the talik (2021), these units will have generally dewatered, and groundwater inflow to the pit is through the surrounding bedrock. As shown in Table 6-B-3, groundwater inflow to the Whale Tail Pit is therefore predicted to decrease from 195 m^3/day (Q4 2019 – 2020) to 65 m^3/day at the end of mining (pit bottom of 37 masl; 2021).

Predictions of groundwater inflow only consider groundwater inflow to the proposed open pit, and do not include potential inputs from direct precipitation within the footprint of the open pit and/or surface water runoff from the surrounding areas. Therefore, dewatering rates may be higher than the groundwater inflow rates described in this section. The site wide water balance assumes a runoff coefficient of one for the area surrounding Whale Tail Lake and the open pit (Volume 6, Appendix 6-H). The water balance therefore accounts for the potential flow of water through the active layer (which is hydraulically driven by snow melt and precipitation), and this flow is not included in this analysis.

Predictions of TDS concentration in mine inflow were based on the Whale Tail TDS depth profile presented in the Hydrogeology Baseline Report (Volume 6, Appendix 6-A). Based on this profile, the groundwater model predicts that the TDS concentration in inflow to the open pit would increase during mining from approximately 390 mg/L to 440 mg/L once the pit reaches its ultimate configuration in 2021 (Table 6-B-3). The limited increase in TDS reflects the short mine life within the talik and the minimal upwelling of higher salinity waters at depth.

Groundwater inflow to the open pit during the refilling is predicted to gradually decrease from 20 m^3/day to near zero in the final year of filling. The majority of this inflow originates from the bedrock between the Whale Tail Dike and the pit. To the north of the Whale Tail Pit, where the bedrock is somewhat isolated from the diked Whale Tail Lake, the pit lake recharges the groundwater flow system. The groundwater recharge during the pit

refilling is approximately 5 m^3/day. During the refilling of the dewatered area of Whale Tail Lake, the recharge to the groundwater flow system from this reflooding increases to 30 m^3/day as the overburden and remaining weathered bedrock is re-saturated. The TDS level in the groundwater inflow to the pit during refiling is predicted to decrease to an average of 340 mg/L at the end of filling.

Contribution to groundwater inflow to the pit from lake water or from the attenuation pond during mining and closure is predicted to be negligible (less than 5%; Table 6-B-3). This is attributed to the relatively short period of mining within the talik (Q4 2019 to the end of 2020) with majority of the groundwater originating from these sources not reaching the open pit within the mine life. Table 6-B-4 and Table 6-B-5 present the predicted groundwater inflow quantity and quality to the attenuation pond and diked area between the pit and the diked Whale Tail Lake during mining and closure.

Table 6-B-4: Predicted Groundwater Inflow and Groundwater Quality Over the Mine Life – Attenuation Pond (Base Case)

Phase	Period	Attenuation Pond – Base Case Scenario			
		Groundwater Inflow (m^3/day)	TDS Concentration (mg/L)	Lakewater or Pondwater in Total Inflow (%)	Pit Lake Outflow to Groundwater (m^3/day)
Dewatering	Mar 2019 to Oct 2019	-	-	-	-
Mining	Q4 2019 to 2020	2	160	<5	1
	2021	1	170	<5	1
Filling	2022	1	195	<5	3
	2023	1	175	<5	4
	2024	1	175	<5	5
	Jan to Oct 2025	1	175	<5	6
	Nov 2025 to Oct 2028	-	-	-	-

m^3/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

Table 6-B-5: Predicted Groundwater Inflow and Groundwater Quality Over the Mine Life – Diked Area Outside of Whale Tail Pit and Attenuation Pond (Base Case)

Phase	Period	Diked Area – Base Case Scenario			
		Groundwater Inflow (m^3/day)	TDS Concentration (mg/L)	Lakewater or Pondwater in Total Inflow (%)	Pit Lake Outflow to Groundwater (m^3/day)
Dewatering	Mar 2019 to Oct 2019	100	115	<5%	-
Mining	Q4 2019 to 2020	30	270	<5%	-
	2021	30	290	5	-
Filling	2022	25	285	10	-
	2023	20	275	10	-
	2024	20	265	15	-
	Jan to Oct 2025	20	260	20	-
	Nov 2025 to Oct 2028	20	250	20	100

m^3/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

At the end of pit filling, the hydraulic gradient between the flooded pit and the surrounding surface water is expected to be negligible. An open talik would likely form below the footprint of the open pit, based on the depth and radius of the mine workings. Predictive simulations with an open talik below the pit lake indicate that the post closure groundwater flow directions would be similar to pre-mining conditions.

6.B-3.7.3 Sensitivity Analysis

Due to the inherent uncertainty in the subsurface conditions and parameters controlling groundwater flow, uncertainty exists in the model predictions such that the actual inflow could be higher or lower than the Base Case values. This uncertainty was evaluated using sensitivity analysis. As part of this analysis, selected model parameters were systematically varied from the Base Case values, and the results were used to identify the parameters to which predicted groundwater inflow was most sensitive.

Six model input parameters were included in the sensitivity analysis. These included:

- **Bedrock Hydraulic Conductivity** – Hydraulic conductivity of weathered and competent bedrock was increased by a factor of three from Base Case Values.
- **Presence of Enhanced Permeability Zones** – Two EPZs were inferred to be present based on the review of the structural features of the Project Area (Volume 6, Appendix 6-A). The EPZs were assumed to be vertical and 10 m wide with a hydraulic conductivity of 5 x 10^{-7} m/s. One fault was assumed to strike northwest – south east and hydraulically connect the Whale Tail Pit to Whale Tail Lake. The second fault was assumed to strike northeast – southwest. The EPZs were assumed to be continuous and hydraulically connected over the width of the model (approximately 17 km).
- **TDS** – The TDS profile was increased by a factor of two at all depths.

- **Specific Yield and Specific Storage** – Specific storage was increased by a factor of 5 and specific yield (was increased by a factor of 2.5 in weathered and competent bedrock.
- **Boundary Conditions** – Constant head boundary conditions were set along the perimeter of the model in all layers to assess the potential effect of lateral boundaries on predicted inflow.
- **Permafrost** – The permafrost present below the open pit was removed and an open talik was assumed to be present.

The sensitivity factors summarized above were selected to adequately represent potential uncertainty in each model parameter. During analysis, six simulations were completed (one adjustment for each parameter considered). At the end of each simulation, predicted maximum average groundwater inflow and maximum TDS concentrations in the open pit were compared to the values predicted in the Base Case (Table 6-B-6).

Table 6-B-6: Hydrogeological Model - Results of Sensitivity Analysis

Sensitivity Simulation	Groundwater Inflow				TDS Concentration			
	m^3/day		% change		m^3/day		% change	
	Q4 2019 to 2020	2021	Q4 2019 to 2020	2021	Q4 2019 to 2020	2021	Q4 2019 to 2020	2021
Base Case	195	65	NA	NA	390	440	NA	NA
Bedrock Hydraulic Conductivity	260	90	33	39	405	395	4	-10
Presence of EPZs	205	75	5	15	410	460	5	5
TDS	195	65	0	0	780	880	100	100
Sy and Ss	285	105	46	62	440	500	13	14
Boundary Conditions	195	65	0	0	390	440	0	0
Permafrost	210	95	8	46	420	660	8	50

EPZs = enhanced permeability zones; Ss = specific storage; Sy = specific yield; NA = not applicable; m^3/day = cubic metres per day; % = percent; TDS = Total Dissolved Solids; Q4 = Fourth Quarter.

Results of the sensitivity analysis indicate that the quantity of groundwater inflow predicted for the Whale Tail Pit is most sensitive to the hydrogeological parameters assigned to bedrock (specific storage, specific yield and hydraulic conductivity), and to the presence of permafrost below Whale Tail Pit. Considering the range of these properties simulated, the predicted groundwater inflow to the pit could be between 33 and 62% higher than the Base Case depending on the simulated year of mining. Predicted groundwater inflow to the pit was somewhat sensitive to the presence of EPZs. With the inclusion of the two EPZs, the predicted groundwater inflow to the pit was predicted 5 to 15% higher than the Base Case predictions depending on the simulated year of mining. Other parameters considered in the sensitivity analysis had negligible influence on predicted groundwater inflow quantity.

Results of the sensitivity analysis indicate that the predicted TDS concentration of mine inflows is directly related to the TDS depth profile. When the TDS concentrations were increased by a factor of two at all depths, the maximum concentration in groundwater inflow was also predicted to double (100% higher than the Base Case). Predicted mine inflow quality was also sensitive to the presence of permafrost at the base of the pit. If an open talik is assumed below the pit, the predicted TDS concentration in the groundwater inflow to the pit was

predicted to increase to 660 mg/L at the end of mining (or 49% higher than the Base Case) because of increased saline upwelling.

6.B-4 MODEL PREDICTIONS – ENVIRONMENTAL ASSESSMENT CONSERVATIVE SCENARIO

The Base Case predictions discussed in the preceding section provide the most likely predictions of groundwater inflow quantity and quality for the Project and the associated sensitivity analyses quantify the uncertainty in these predictions. Based on these results, a model scenario was prepared that provides a reasonable upper bound of potential groundwater inflow to the mine. This scenario, hereafter referred to as the Environmental Assessment (EA) Conservative Scenario, results in a sufficient level of conservatism to provide a high level of confidence that the potential effects on the environment have not been underestimated.

In the EA Conservative Scenario, the following changes were made to the model parameters adopted in the Base Case.

- the hydraulic conductivity of the weathered bedrock and competent bedrock was assumed to be approximately three times higher than the base case values; and
- the two theoretical EPZs included in the Base Case sensitivity analysis were assumed to be present.

6.B-4.1 Predicted Groundwater Inflow Quantity and Quality

Predicted groundwater inflow quantity and quality over the mine life for the EA Conservative Scenario are presented in Table 6-B-7 to Table 6-B-9. Predicted hydrogeological conditions when the mine workings reach the ultimate depth are presented on Figure 6-B-10 and Figure 6-B-11.

Table 6-B-7: Predicted Groundwater Inflow and Groundwater Quality Over the Mine Life - Whale Tail Pit (EA Conservative Scenario)

Phase	Period	Whale Tail Pit – EA Conservative Scenario			
		Groundwater Inflow (m^3/day)	TDS Concentration (mg/L)	Lakewater or Pondwater in Total Inflow (%)	Pit Lake Outflow to Groundwater (m^3/day)
Dewatering	Mar 2019 to Oct 2019	-	-	-	-
Mining	Q4 2019 to 2020	275	415	<5%	-
	2021	100	410	<5%	-
Filling	2022	65	370	<5%	10
	2023	55	365	<5%	1
	2024	30	370	<5%	2
	Jan to Oct 2025	15	370	<5%	5
	Nov 2025 to Oct 2028	1	370	<5%	18

Note: Mining prior to Q4 2019 is within permafrost and groundwater inflow will be negligible.
TDS = total dissolved solids; m^3/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

Table 6-B-8: Predicted Groundwater Inflow and Groundwater Quality Over the Mine Life – Attenuation Pond (EA Conservative Scenario)

Phase	Period	Attenuation Pond – EA Conservative Scenario			
		Groundwater Inflow (m^3/day)	TDS Concentration (mg/L)	Lakewater or Pondwater in Total Inflow (%)	Pit Lake Outflow to Groundwater (m^3/day)
Dewatering	Mar 2019 to Oct 2019	-	-	-	-
Mining	Q4 2019 to 2020	4	175	<5	2
	2021	2	200	<5	10
Filling	2022	2	220	<5	15
	2023	1	215	<5	20
	2024	1	215	<5	25
	Jan to Oct 2025	1	215	<5	25
	Nov 2025 to Oct 2028	-	-	-	-

m^3/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

Table 6-B-9: Predicted Groundwater Inflow and Groundwater Quality Over the Mine Life – Diked Area Outside of Whale Tail Pit and Attenuation Pond (EA Conservative Scenario)

Phase	Period	Diked Area – EA Conservative Scenario			
		Groundwater Inflow (m^3/day)	TDS Concentration (mg/L)	Lakewater or Pondwater in Total Inflow (%)	Pit Lake Outflow to Groundwater (m^3/day)
Dewatering	Mar 2019 to Oct 2019	140	145	<5%	-
Mining	Q4 2019 to 2020	75	295	<5%	-
	2021	70	280	15	-
Filling	2022	60	250	25	-
	2023	40	225	35	-
	2024	40	210	40	-
	Jan to Oct 2025	40	195	45	-
	Nov 2025 to Oct 2028	40	180	50	160

m^3/day = cubic metres per day; mg/L = milligrams per litre; % = percent.

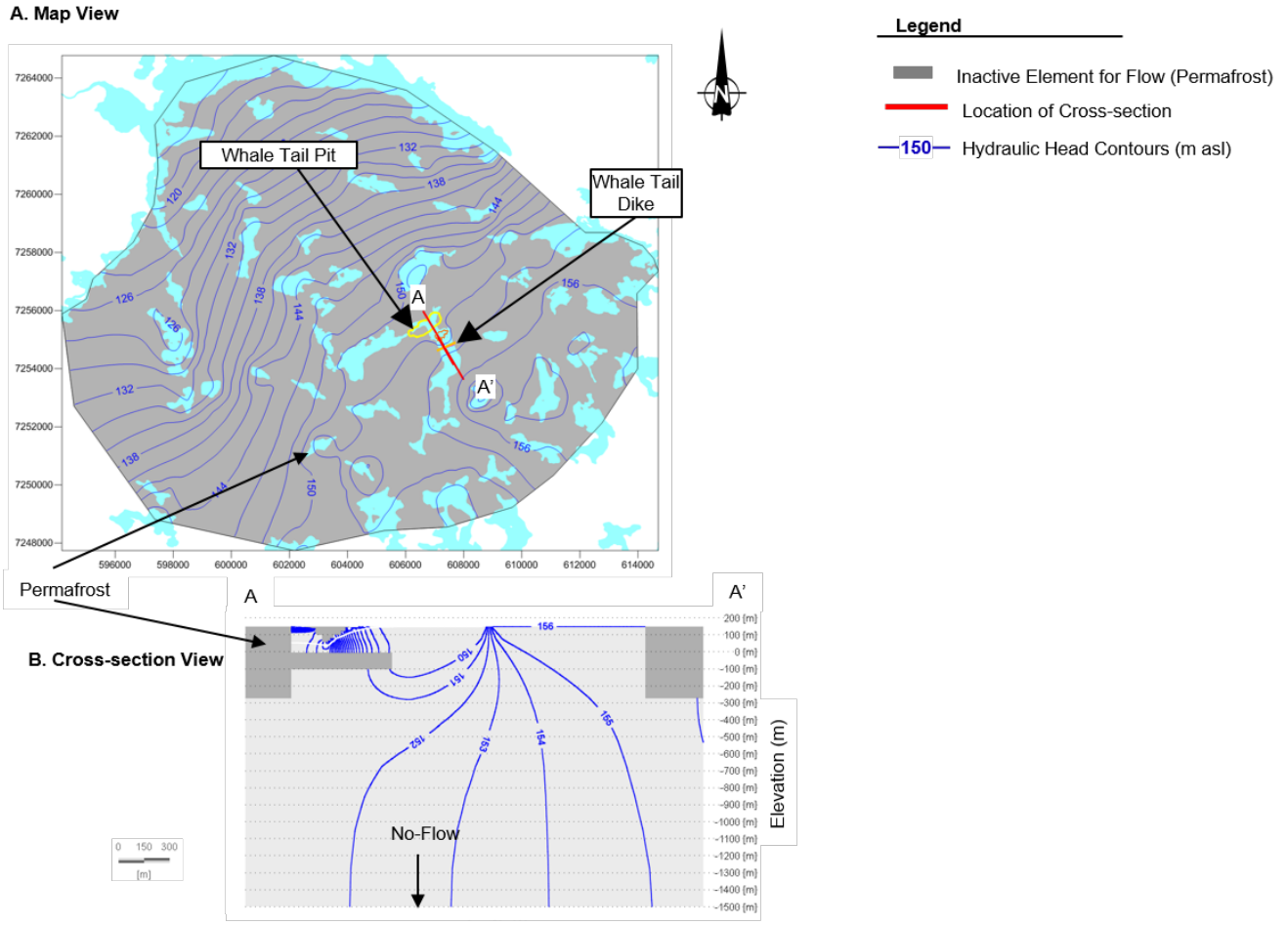


Figure 6-B-10: Predicted Hydraulic Heads - End of Mining – Environmental Assessment Conservative Scenario

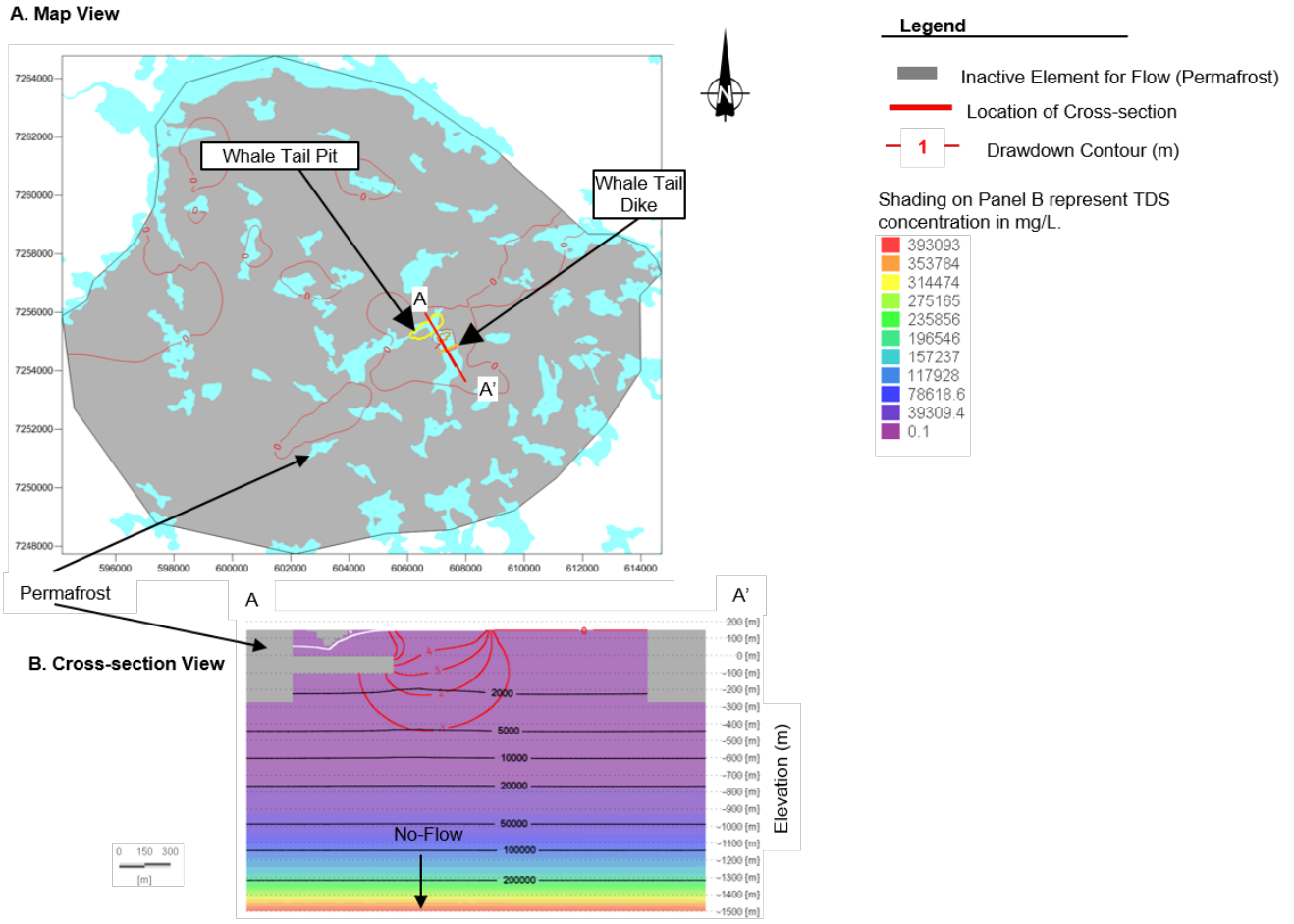


Figure 6-B-11: Predicted Drawdown and Total Dissolved Solids End of Mining - Environmental Assessment Conservative Scenario

The quantity of groundwater inflow predicted in the EA Conservative Scenario over the mine life is overall higher than the Base Case. For the EA Conservative Scenario, the groundwater inflow to the open pit was predicted decrease from an average of 275 m^3/day (Q4 2019 – 2020) to 100 m^3/day (2022). These groundwater inflow rates are 41% and 54% higher than the Base Case values respectively for the same period of mining.

The predicted TDS concentrations in inflow are generally similar to the Base Case values; however, the TDS mass loading into the open pit is predicted to increase by approximately 41% to 54% compared to the Base Case predictions due to higher groundwater inflow quantity predicted tin the EA Conservative Scenario.

6.B-4.2 Predicted Changes to Groundwater Inflows and Outflows from Lakes

Budget analyses were performed to estimate the changes to pre-mining groundwater inflows and outflows from lakes within the Hydrogeology Baseline Study area during mining and following closure (i.e., after the pit and Whale Tail Lake is flooded back to 152.5 m).

Table 6-B-10 presents a summary of lakes within the Hydrogeology Baseline Study area that had a predicted change (greater than 1 m^3/day) in groundwater inflow and outflow relative to pre-Project (current) conditions. Long-term closure conditions considers the potential formation of an open talik below the pit footprint, as a result of the widening/deepening of the lake in this area.

Table 6-B-10: Predicted Groundwater Inflows and Outflows from Lakes at End of Mining and Following Closure

Lake	Pre-Project (Current) Conditions	End of Mining (2021)		Post-closure	
	(m^3/day)	(m^3/day)	(% change of Pre-Project)	(m^3/day)	(% change of Pre-Project)
A16	16	15	-6	16	0
A60	29	28	-3	29	0
A65	3	2	-33	3	0
A81	-47	-42	-11	-47	0
DS1	-171	-140	-18	-171	0
DS2	-25	-21	-16	-21	0

Note: Positive number denotes that the lake is a source of groundwater recharge. Negative number denotes that the lake is a groundwater discharge zone.

m^3/day = cubic metres per day; % = percent.

As presented in Table 6-B-10, groundwater inflow/outflow to these six lakes was predicted to decrease during mining relative to pre-mining conditions by between 3 to 33% depending on the lake. Following closure, near to pre-mining hydraulic gradients and groundwater flow directions will be re-established once the open pit and dewatered portion of Whale Tail Lake are flooded during closure. Consistent with pre-development conditions, groundwater from Whale Tail Lake and the open pit is predicted to discharge to Lake DS1. Groundwater inflow to southern portion of Whale Tail Lake will also occur from Lake A60 to the southeast.

Hydraulic gradients following closure were used to estimate groundwater travel times from the Whale Tail Lake and the open pit to DS1. Based on the shortest travel time, water from Whale Tail Lake or the open pit was predicted to take over 1,000 years to reach Lake DS1.

6.B-5 CONCLUSION

The results of hydrogeological modelling were used to estimate the quantity and quality (TDS) of groundwater inflow to the Whale Tail Pit. In the Base Case, which is based on conservative estimates of hydrogeological parameters controlling groundwater conditions near the open pit, the average groundwater inflow is predicted to decrease over the approximate two years of mining from 195 m^3/day (Q4 2019 to 2020) to 65 m^3/day (2021). Over these same periods, the predicted TDS concentration in the groundwater inflow to the pit was predicted to increase from 390 mg/L to 440 mg/L.

In the EA Conservative Scenario, which represents a reasonable upper bound of conditions that could be encountered during mining, the groundwater inflow to the proposed pit is predicted to decrease from 275 m^3/day (Q4 2019 to 2020) to 100 m^3/day (2022), or approximately 41% to 55% higher than the Base Case. As the TDS in groundwater mine inflow predicted in the EA Conservative Scenario is similar to the one predicted in the Base Case, this corresponds to an approximate 41% to 55% increase in TDS mass loading to the open pit. The EA

Conservative Scenario results in a sufficient level of conservatism to provide a high level of confidence that the potential effects on the environment from changes to groundwater have not been underestimated.

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APPENDIX 6-C

Hydrology Baseline

June 2016
Report No. 1541520

AGNICO EAGLE

Golder Associates

January 2016

AGNICO EAGLE MINES: MEADOWBANK DIVISION - WHALE TAIL PIT PROJECT

2015 Hydrology Baseline Report

Submitted to:
Agnico Eagle Mines Limited
Ryan Vanengen
Environment Superintendent

REPORT

Report Number: Doc 037-1524321.1300 Ver 1

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Golder Associates

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APPENDICES

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Hydrometric Stations

APPENDIX B
Shoreline Baseline Characterization

APPENDIX C
Water Balance Model

1.0 INTRODUCTION

Agnico Eagle Mines Limited: Meadowbank Division (Agnico Eagle) is proposing to develop Whale Tail Pit, a satellite deposit on the Amaruq property, in continuation of mine operations and milling of the Meadowbank Mine. The Amaruq Exploration property is a 408 square kilometre (km^2) site located on Inuit Owned Land approximately 150 kilometres (km) north of the hamlet of Baker Lake and approximately 50 km northwest of the Meadowbank Mine in the Kivalliq region of Nunavut (Figure 1-1). The property was acquired by Agnico Eagle in April 2013 subject to a mineral exploration agreement with Nunavut Tunngavik Incorporated.

The Meadowbank Mine is an approved mining operation and Agnico Eagle is looking to extend the life of the mine by constructing and operating Whale Tail Pit and Haul Road (referred to in this document as the Project), which is located on the Amaruq Exploration property. As an amendment to the existing operations at the Meadowbank mine, it is subject to an environmental review established by Article 12, Part 5 of the *Nunavut Land Claims Agreement* (NLCA). Baseline data have been collected in support of the Environmental Review to document existing conditions and to provide the foundation for a qualitative and quantitative assessment of project operations and the extension of the mine development, to be evaluated in the Environmental Impact Statement (EIS) for the Project.

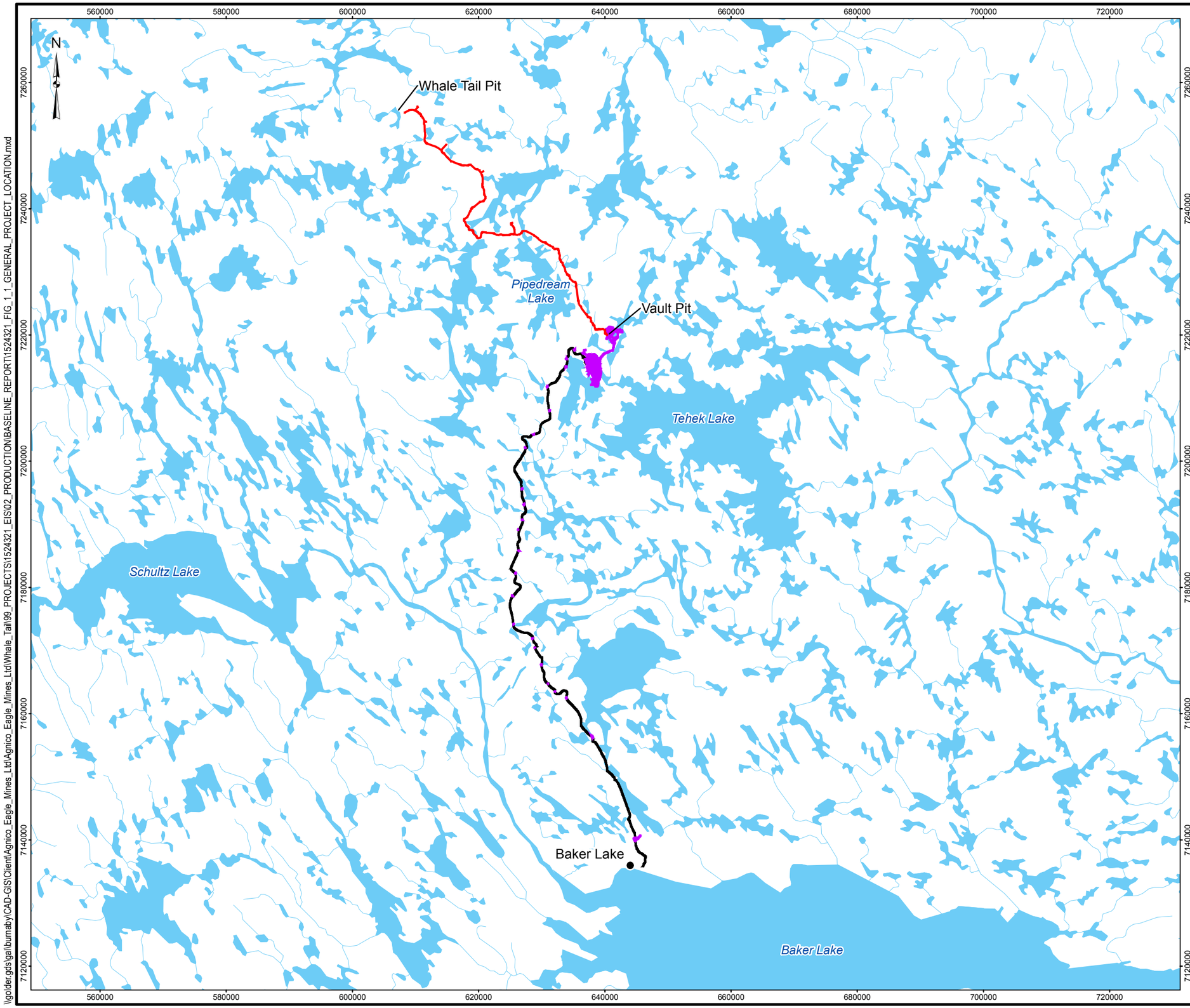
This report presents the results of a baseline hydrology study completed by Golder Associates Ltd. (Golder) for the area associated with the Project. Specifically, this report provides a review of existing hydrology conditions in watersheds potentially affected by the Project.

1.1 Physical Setting

The Project is located at the southern limit of the Northern Arctic terrestrial ecozone, which is one of the coldest and driest regions of Canada, with a Low Arctic ecoclimate. This ecozone extends over most of the non-mountainous areas of the Arctic Islands, northeastern portions of the Kivalliq region of Nunavut, western Baffin Island, and a portion of northern Québec.

1.2 Hydrology Baseline Study Area

The Project is located in the Meadowbank River, Quoich River, and Thelon River watersheds. The hydrology baseline study area (Hydrology BSA) for the Project is the area within which Project activities could potentially have direct or cumulative effects on aquatic biological receptors. The Hydrology BSA consists of the A, B, and C watersheds, and Lake DS1 (i.e., the receiving lake of the A, B, and C watersheds), the outlet of which marks the downstream boundary of the Hydrology BSA. The Hydrology BSA only considers the Whale Tail Pit portion of the Project; the Haul Road was assessed by others. Thus, the Hydrology BSA is solely located in the upper Meadowbank River watershed, which flows north into the Back River prior to draining into the Arctic Ocean. The Hydrology BSA is shown on Figure 1-2.



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LEGEND

- COMMUNITY
- PROPOSED HAUL ROAD
- ALL WEATHER ROAD
- MEADOWBANK INFRASTRUCTURE
- WATERCOURSE
- WATERBODY



REFERENCE

1. HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200_R0.dwg
2. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
3. INSET MAP DATA OBTAINED FROM ESRI

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

12 0 12
KILOMETRES

PROJECT
AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

PROJECT LOCATION

Golder Associates

PROJECT		1524321	FILE No.	
DESIGN	JR	24 Sept. 2015	SCALE AS SHOWN	REV. A
GIS	CD	13 Nov. 2015		
CHECK	JR	16 Dec. 2015		
REVIEW	DRW	16 Dec. 2015		

FIGURE 1-1

\\golder.gds\gallburnaby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Whale_Tail\99_PROJECTS\1524321_EIS\02_PRODUCTION\BASELINE_REPORT\HYDROLOGY\1524321_FIG_1_2_HYDROLOGY_STUDY_AREA.mxd

595000 600000 605000 610000

7265000 7260000 7255000 7250000

N

INSET MAP 1

INSET MAP 2

SEE INSET MAP 1

SEE INSET MAP 2

Nemo Lake

Mammoth Lake

Whale Tail Lake

Whale Tail Pit

DS1

A A A B C C C

800 m

LEGEND

- CONTINUOUS STATION
- MANUAL STATION
- PROPOSED HAUL ROAD
- WATERSHED
- STREAM
- WATERCOURSE (CANVEC)
- WATERBODY (CANVEC)

REFERENCE

1. HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200_R0.dwg
2. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

1600 0 1600
METRES

PROJECT
AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

HYDROLOGY BASELINE STUDY AREA

Golder Associates

PROJECT		1524321	FILE No.	
DESIGN	JL	21 Oct. 2015	SCALE AS SHOWN	REV. 0
GIS	CD	21 Oct. 2015		
CHECK	JL	14 Jan. 2016		
REVIEW	DRW	14 Jan. 2016		

FIGURE 1-2

2.0 METHODS

2.1 Data Sources

This report is based on the following data sources:

- potential direct Project aquatic and terrestrial disturbances provided by Agnico Eagle;
- 1 metre (m) Digital Elevation Model (DEM) and 50 centimetre (cm) precision imagery, produced from stereo satellite photos acquired on 28 August 2015 (PhotoSat 2015);
- 1:20,000 scale spatial public watercourse and waterbody datasets (CanVec 2013);
- regional climate data (Government of Canada 2015);
- previous hydrology baseline information available for the Meadowbank Gold Project (AMEC 2003);
- hydrometric data collection by other disciplines and Agnico Eagle on-site in 2015; and
- four site-specific field visits from 28 to 31 May 2015, 8 to 15 June 2015, 4 to 9 August 2015, and 16 to 21 September 2015, respectively.

Inuit Qaujimajatuqangit was collected by field crews from local assistants during their participation in the 2015 field programs, as it was provided. Inuit Qaujimajatuqangit information was only recorded by field crews if permission was granted.

2.2 Watersheds and Drainage Patterns

Watersheds potentially affected by, or relevant to, future effect assessments of the Project, were delineated based on a review of available DEM data and imagery (PhotoSat 2015), and field observations in 2015 (Figure 1-2).

Lakes (i.e., waterbodies with one or several well-defined outlet channels) and ponds (i.e., waterbodies without defined outlet channels), relevant to this report and other environmental studies, were assigned an identifier under the following criteria:

- The downstream extent of the Hydrology BSA is a large lake, and was assigned an identifier of DS1.
- Three distinct watersheds within the Hydrology BSA were defined as:
  - the A watershed (i.e., where Whale Tail and Mammoth Lake are located);
  - the B watershed (i.e., located just north of the A watershed, and west of Nemo Lake); and
  - the C watershed (i.e., where Nemo Lake is located).
- The three distinct watersheds A, B and C each drain to Lake DS1.
- Within each watershed, lakes were assigned a unique alphanumeric identifier, comprised of the name of the watershed (e.g., A), and a unique numeric value. When possible, the unique numeric value was increased in the upstream direction (e.g., Lake A3 drains to Lake A2, which drains to Lake A1).

- Within each watershed, ponds (i.e. a waterbody without defined outlet channels which freezes to the bottom in winter) were assigned a unique alphanumeric identifier, comprised of the name of the watershed (e.g., A), followed by "-P", and a unique numeric value (e.g., A-P1).
- Lake outlets (i.e., streams) were assigned a unique alphanumeric identifier, comprised of the identifier of the upstream (i.e., source) lake, and of the identifier of the lake it is draining to, directly downstream. While this situation was not yet encountered, a prefix of "0" was proposed for cases where a stream does not originate from a lake. This convention is applied in the following examples:
  - Example: For a stream draining from Lake A2 to Lake A1, the stream is identified as Stream A2-A1.
  - Example: For a stream draining to Lake A1 without a source lake, the stream is identified as Stream 0-A1.

2.3 Hydrometry

Two types of hydrometric stations were installed in 2015, including continuous hydrometric stations (i.e., those equipped with data loggers) and manual hydrometric stations (i.e., those without data loggers, and primarily reliant on discrete discharge and water level measurements, and visual observations) (Figure 1-2). Photographs at each station are shown in Appendix A.

2.3.1 Continuous Hydrometric Stations

Six continuous hydrometric stations were installed during the second field visit, between 8 and 15 June 2015, at Lake A15, Lake A17 (Whale Tail Lake), Lake A18, Lake A69, Lake C38 (Nemo Lake), and Lake DS1. Two additional continuous hydrometric stations were installed during the third field visit between 4 and 9 August 2015 at Lake A5 and Lake C8. The locations of the continuous hydrometric stations are shown on Figure 1-2. These stations were equipped with water level loggers. Manual discharge and water level data measurements were also recorded at these stations during each field visit.

Hydrographs for all eight locations were derived using the following methods:

- Onset HOBO U20-001-04 Loggers were installed at each hydrometric station. Each data logger was programmed to record water pressure measurements at 10-minute intervals, and referenced to a local benchmark tied to the geodetic datum established by a mine surveyor.
- Two Onset HOBO U20-001-04 Loggers were installed on land at central locations to all eight sites to provide barometric pressure corrections.
- The data loggers were installed at the start of spring melt, as permitted by ice conditions and site access (excluding A5 and C8 which were installed in August).
- During each site visit, water surface elevations were surveyed using a high accuracy Real Time Kinematic (RTK) GPS Altus APS-3 system, and the pressure transducer readings were recorded during selected data logger downloads.
- Stream discharge measurements were performed during each site visit at stations with flowing water according to the Water Survey of Canada standard described by Terzi et al. (1981). Velocity and depth

measurements, which were used to calculate discharge, were collected using a Swoffer Model 2100™ or using a Marsh McBirney 2000 Flo-Mate™ velocity meter and a top-setting wading rod.

- Data loggers at each station were downloaded during each site visit and pressure transducer readings corresponding to each discharge measurement were recorded.
- Data loggers were removed during the last site visit in September prior to freeze-up.
- A stage-discharge rating curve was derived for each station based on measured water surface elevations and discharges. This rating curve was applied to the continuous record of water surface elevations, as measured and recorded by the water level logger at each station, to derive a continuous record of discharges.

2.3.2 Manual Hydrometric Stations

Following the discharge and water level data collection methods described above, additional discrete discharge and water level measurements were also collected opportunistically at the following 16 locations:

- Lake A12;
- Lake A16;
- Lake A19;
- Lake A21;
- Lake A22;
- Lake A45;
- Lake A53;
- Lake A55;
- Lake A60;
- Lake A62;
- Lake A63;
- Lake A65;
- Lake A72;
- Lake A76;
- Lake A81; and
- Lake B3.

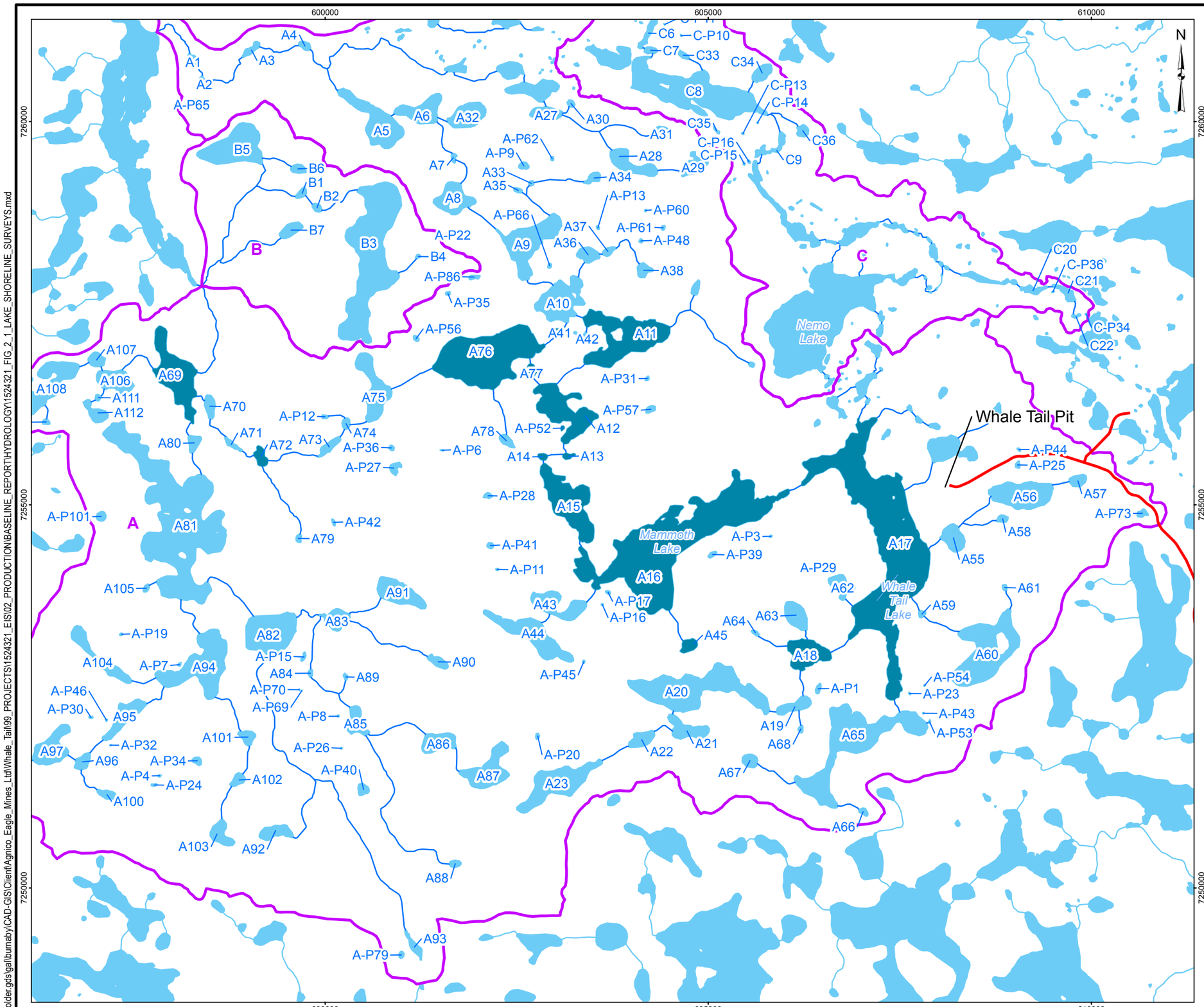
The locations of the manual hydrometric stations are shown on Figure 1-2.

2.4 Lake Shoreline Surveys

A 2015 field survey program was completed to collect geomorphological field data to characterize baseline conditions of the lake shorelines and outlet channels potentially affected by the Project (Figure 2-1). The lake shorelines were surveyed between 16 and 21 September 2015 at those lakes where baseline water levels nearest to the proposed mine operations, including: Lake A12, Lake A15, Lake A16 (Mammoth Lake), Lake A17 (Whale Tail Lake), Lake A18, Lake A45, Lake A69, Lake A72 and Lake A76.. The shorelines were accessed on foot, or by helicopter, depending on the site visit opportunity.

The methods used in the field surveys were as follows:

- For each surveyed lake, shore-normal transects were surveyed to represent typical sections of shoreline with similar slope, soil, and wave exposure.
- Lakeshore survey locations were determined based on information available from the hydrology program field trips, Project information provided by Agnico Eagle, and topographical information for the area at the time of planning (CanVec 2013).



LEGEND

- PROPOSED HAUL ROAD
- WATERSHED
- STREAM
- WATERCOURSE (CANVEC)
- SHORELINE SURVEY
- WATERBODY (CANVEC)

REFERENCE

1. HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200_R0.dwg
2. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

1600 0 1600
METRES

PROJECT
AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

LAKE SHORELINE SURVEYS

Golder Associates

PROJECT		1524321	FILE No.	
DESIGN	JL	21 Oct. 2015	SCALE AS SHOWN	REV. 0
GIS	DC	27 Oct. 2015		
CHECK	JL	14 Jan. 2016		
REVIEW	DRW	14 Jan. 2016		

FIGURE 2-1

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- At each transect, a shore-normal topographic profile was surveyed using a SOKKIA GNSS GSR 2700ISX (Global Navigation Satellite System) with RTK capabilities to provide accurate position and elevation data. The transect profiles typically extended from below the existing water level to above the high water level, estimated based on visual observation while on-site.
- Lake outlet channel cross-sections were also surveyed to provide typical channel geometry data.
- Additional data for the surveyed lakes were derived using GIS software and spatial baseline data (CanVec 2013).
- A more detailed lake shoreline description was prepared based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015).
- The digital elevation data provided by Agnico Eagle (PhotoSat 2015) was used within GIS software to derive a terrain slope dataset.
- Photographic documentation was carried out simultaneously with the field surveys for each homogeneous section of the shoreline. Representative photographs are presented in Appendix B.
- Shoreline sections were delineated in the field based on the visually observable characteristics of aspect, wave exposure (a combination of prevailing wind and fetch length), slope gradient, and terrain and sediment types (gradation and origin). Ice thrust effects (e.g., ice-push berms at the shoreline) were considered as evidence of thermal erosion at existing water level elevations.

The shoreline parameters measured for the lakeshore characterization at each transect were: bank features (elevations, bank height, bank slope), bank materials, and exposure characteristics such as shore orientation and fetch length. A more detailed description of the parameters used in shoreline transect characterization is presented in Table 2-1.

Table 2-1: Shoreline Transect Parameters Description

Parameter	Description
Length	The total length of the surveyed transect
Elevations	Maximum and minimum surveyed elevations
Bank materials	The following materials classes have been used for characterization: - Fines and organics; - Sand; - Gravel; - Cobbles; - Boulders; and - Bedrock. A combination of 2 or more materials may be found at a particular transect location.
Bank height	The average bank height at the transect location
Bank slope	The average bank slope at the transect location, classified for the purposes of this study in the following 3 classes: - <10% as flat to shallow; - 10% to 30% as moderate; and - >30% as steep.
Shoreline geometry	The general shape of the shoreline at the survey location, classified as: - Coves or bays; - Irregular or straight; and - Headland or islands.
Shoreline orientation	The general exposure of the shoreline, in geographic degrees similar to wind direction.
Fetch length	The length of open water perpendicular to the shoreline over which the wind blows generating waves.

2.5 Water Balance Model

A water balance model was developed for the BSA to assess mean characteristics and natural variability of discharge and water levels of lake outlets in the baseline area.

The water balance model was developed using the GoldSim software with a 1-hour time step and input data for the period of 1950 to 2015. Model output results were obtained for all years, with the exception of years with meteorological input data gaps, including years 1951, 1979, 1993, and 2010, which were not modeled. The basic water balance elements for each modeled lake reservoir considered rainfall and snowmelt runoff, lake evaporation, changes in lake storage, and outflow to downstream basins.

The model was calibrated using runoff coefficients for land surfaces, lake outlet stage-discharge rating curves, and degree-day models for snowmelt and formation of ice in outlet channels. Runoff coefficients for land surfaces account for water losses to ground infiltration and summer evapotranspiration. The runoff coefficients were calibrated to the calculated annual water yield of hydrometric stations with available data for most of the 2015 open water season (i.e., stations with a period of record of 97 days or greater). Lake outlet stage-discharge rating curves and degree-day models were calibrated to site-specific data.

The calibrated model was used to generate daily time series datasets of lake stages and lake outlet discharges for the BSA. Frequency analyses were completed for key sites to provide a historical baseline of lake stage and lake outlet discharge regimes.

Further details on the water balance model, including input data, model structure, calibration, and preliminary validation, are presented in Appendix C.

3.0 RESULTS

3.1 Watersheds and Drainage Patterns

Watersheds within the Hydrology BSA comprise an extensive network of lakes, ponds, and interconnecting streams (Figure 1-2).

Characteristics of the A, B, and C watersheds are summarized in Table 3-1. As an example the A watershed has a drainage area of 110 km^2, and lake water surface fraction (i.e., the ratio of lake area to land area) of 16%. Watersheds and general drainage patterns are shown in Figure 3-1 to Figure 3-4.

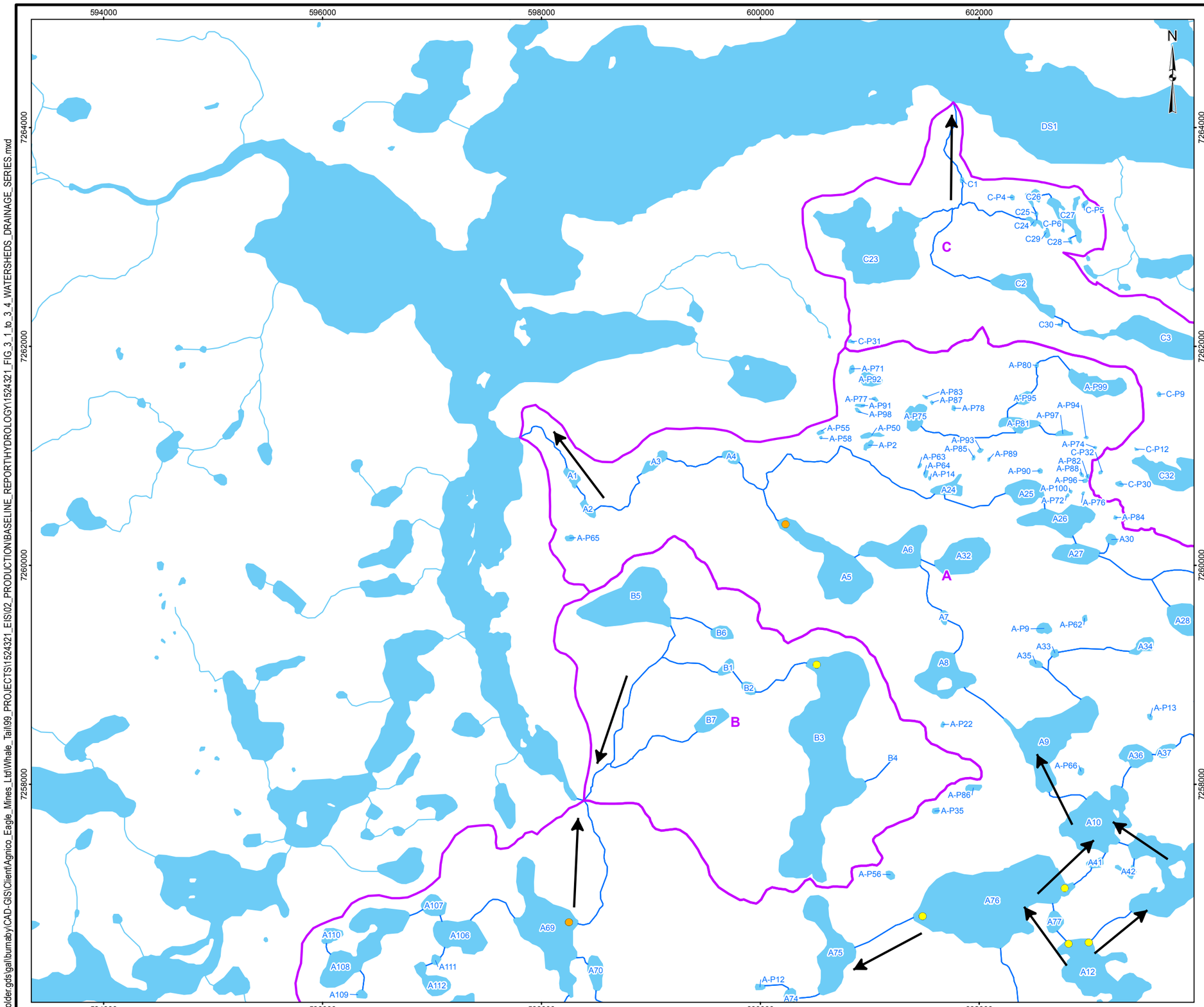
It should be noted that the boundary separating the A watershed from the C watershed just north of Lake A113 is associated with a degree of uncertainty due to the local flat topography. Field observations noted discharge from Lake A113 both to the north (i.e., within the C watershed) and to the south (i.e., within the A watershed). Based on visual observations, Lake A113 is thought to drain primarily to the south (i.e., within the A watershed) and Lake A113 was included in the A watershed.

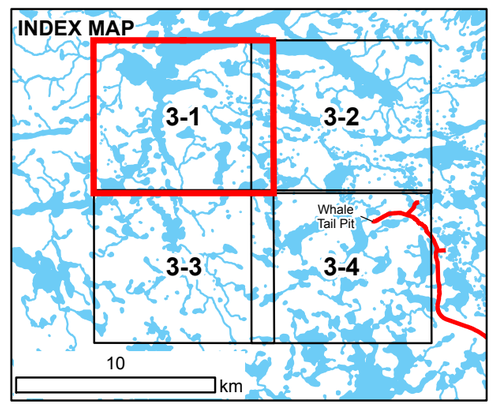
Table 3-1: Characteristics of Watersheds in the Hydrology Baseline Study Area

Watershed	Land Surface Area (km^2)	Lake Surface Area (km^2)	Total Area (km^2)	Lake Water Surface Fraction
A	95.6	14.8	110	0.155
B	5.95	1.19	7.14	0.200
C	14.4	3.24	17.6	0.226

km^2 = square kilometre

\\golder.gds\gal\burnaby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Whale_Tail\99_PROJECTS\1524321_EIS\02_PRODUCTION\BASELINE_REPORT\HYDROLOGY\1524321_FIG_3_1_to_3_4_WATERSHEDS_DRAINAGE_SERIES.mxd





LEGEND

- CONTINUOUS STATION
- MANUAL STATION
- PROPOSED HAUL ROAD
- DRAINAGE PATTERN
- WATERSHED
- STREAM
- WATERCOURSE
- WATERBODY

REFERENCE

1. HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200_R0.dwg
2. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

700 0 700
METRES

PROJECT
AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

WATERSHEDS AND DRAINAGE PATTERNS (NORTH WEST)

Golder Associates

PROJECT		1524321	FILE No.	
DESIGN	JL	21 Oct. 2015	SCALE AS SHOWN	REV. 0
GIS	CD	21 Oct. 2015		
CHECK	JL	14 Jan. 2016		
REVIEW	DRW	14 Jan. 2016		

FIGURE 3-1

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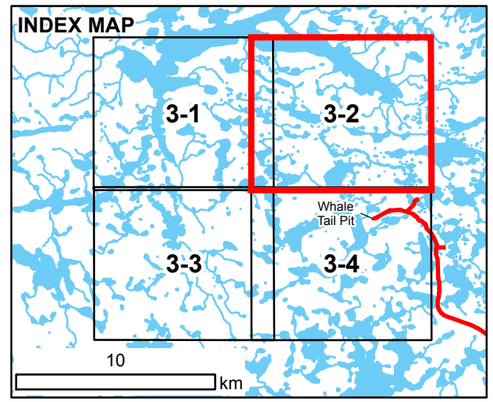
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LEGEND

- CONTINUOUS STATION
- MANUAL STATION
- PROPOSED HAUL ROAD
- DRAINAGE PATTERN
- WATERSHED
- STREAM
- WATERCOURSE
- WATERBODY

INDEX MAP



REFERENCE

1. HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200_R0.dwg
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DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

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METRES

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

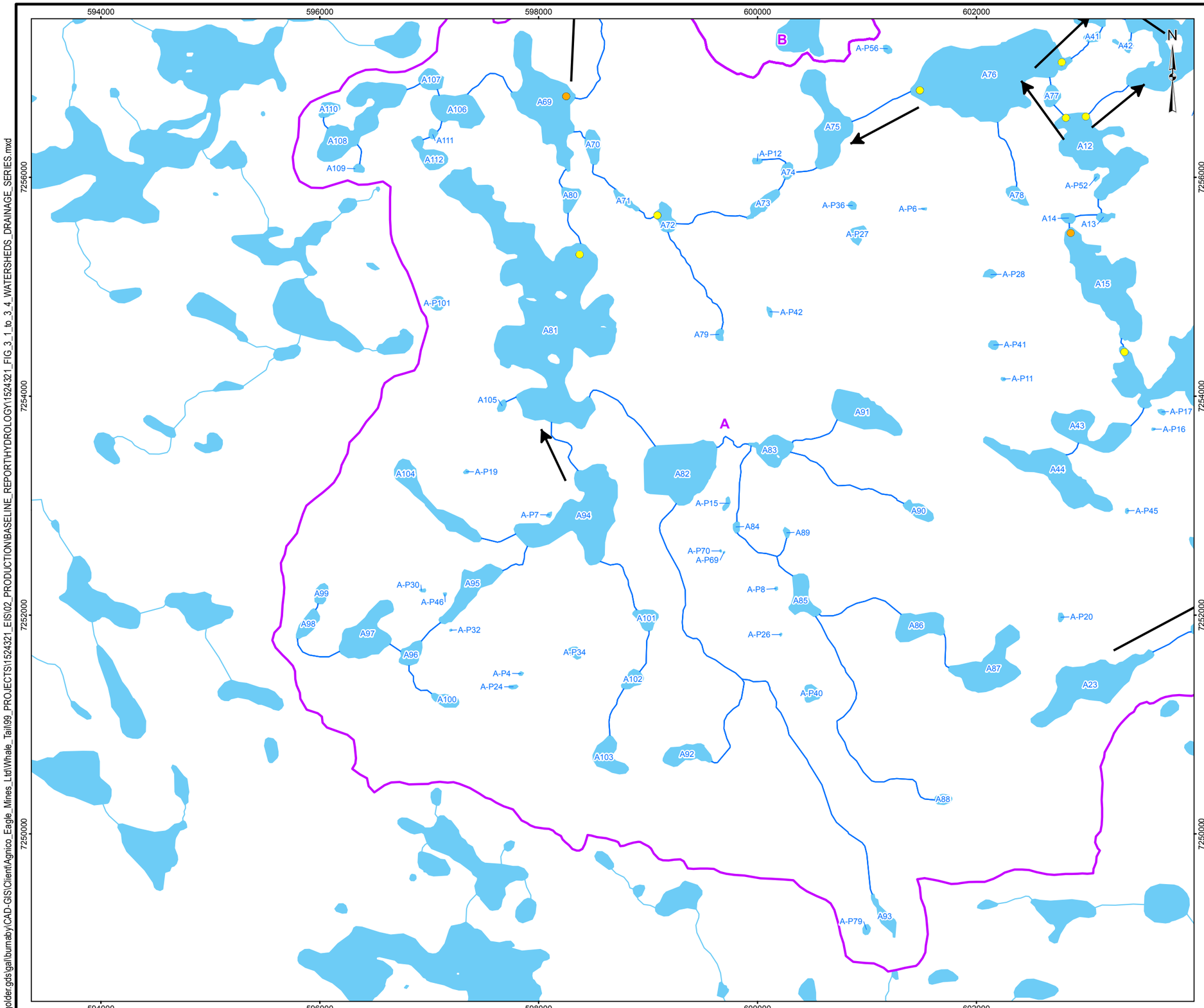
WATERSHEDS AND DRAINAGE PATTERNS (NORTH EAST)

Golder Associates

PROJECT		1524321	FILE No.	
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GIS	CD	21 Oct. 2015		
CHECK	JL	14 Jan. 2016		
REVIEW	DRW	14 Jan. 2016		

FIGURE 3-2

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REFERENCE

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DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

700 0 700
METRES

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

WATERSHEDS AND DRAINAGE PATTERNS (SOUTH WEST)

Golder Associates

PROJECT		1524321	FILE No.	
DESIGN	JL	21 Oct. 2015	SCALE AS SHOWN	REV. 0
GIS	CD	21 Oct. 2015		
CHECK	JL	14 Jan. 2016		
REVIEW	DRW	14 Jan. 2016		

FIGURE 3-3

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602000 604000 606000 608000 610000

7256000 7254000 7252000 7250000

Nemo Lake
Mammoth Lake
Whale Tail Lake
Whale Tail Pit

A11 A12 A13 A14 A15 A16 A17 A18 A19 A20 A21 A22 A23
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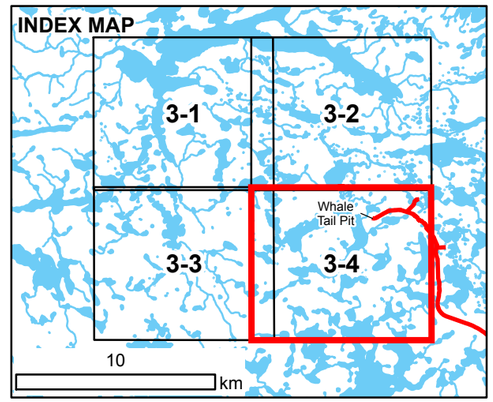
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A-P31 A-P57 A-P52 A-P6 A-P28 A-P41 A-P11 A-P17 A-P16 A-P45 A-P3 A-P39 A-P29 A-P44 A-P25 A-P73 A-P1 A-P54 A-P23 A-P43 A-P53 A-P20

N

LEGEND

- CONTINUOUS STATION
- MANUAL STATION
- PROPOSED HAUL ROAD
- DRAINAGE PATTERN
- WATERSHED
- STREAM
- WATERCOURSE
- WATERBODY

INDEX MAP



REFERENCE

1. HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200_R0.dwg
2. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

700 0 700
METRES

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

WATERSHEDS AND DRAINAGE PATTERNS (SOUTH EAST)

Golder Associates

PROJECT		1524321	FILE No.	
DESIGN	JL	21 Oct. 2015	SCALE AS SHOWN	REV. 0
GIS	CD	21 Oct. 2015		
CHECK	JL	14 Jan. 2016		
REVIEW	DRW	14 Jan. 2016		

FIGURE 3-4

\\golder.gds\gal\burnaby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Whale_Tail\99_PROJECTS\1524321_EIS\02_PRODUCTION\BASELINE_REPORT\HYDROLOGY\1524321_FIG_3_1_to_3_4_WATERSHEDS_DRAINAGE_SERIES.mxd

3.2 Hydrometry

3.2.1 Continuous Hydrometric Stations

As stated in Section 2.3.1, continuous hydrometric stations were installed at Lake A5, Lake A15, Lake A17 (Whale Tail Lake), Lake A18, Lake A69, Lake C8, Lake C38 (Nemo Lake), and Lake DS1. Hydrographs for all eight locations and field survey results are summarized below. In addition, Appendix A includes factsheets describing the location of each hydrometric station and the equipment installed (when applicable); photographs; measured stage-discharge data; derived stage-discharge rating curve based on data collected in 2015; tabulated mean daily discharge and water level data; manual discharge measurement data; and related calculation sheets for each station.

3.2.1.1 Lake A5

The Lake A5 hydrometric station was visited twice in 2015, and a continuous hydrograph was derived for the period of 6 August to 17 September 2015, based on continuous logger data. Details of each site visit are provided in Table 3-2. The hydrographs for Lake A5 are presented in Figure 3-5. The water surface elevation of the lake was also captured by the DEM dataset (PhotoSat 2015) and was added to the table and figure.

It should be noted that the DEM elevation (PhotoSat 2015) is approximately 25 cm higher than the derived water surface elevation. This difference in elevation falls within the accuracy of the DEM data of ± 30 cm (PhotoSat 2015).

Table 3-2: Surveys at Lake A5 Hydrometric Station, 2015

Date	Activities	Lake	Lake Water Surface Elevation (masl)	Outlet	Discharge (m^3/s)
6 Aug	Measured discharge and water surface elevation, and installed data logger.	✓	132.30	✓	0.434
28 Aug	From DEM (PhotoSat 2015)	✓	132.50	-	-
17 Sep	Measured discharge and water surface elevation. Removed and downloaded data logger.	✓	132.16	✓	0.112

masl = metres above sea level, m^3/s = cubic metres per second.

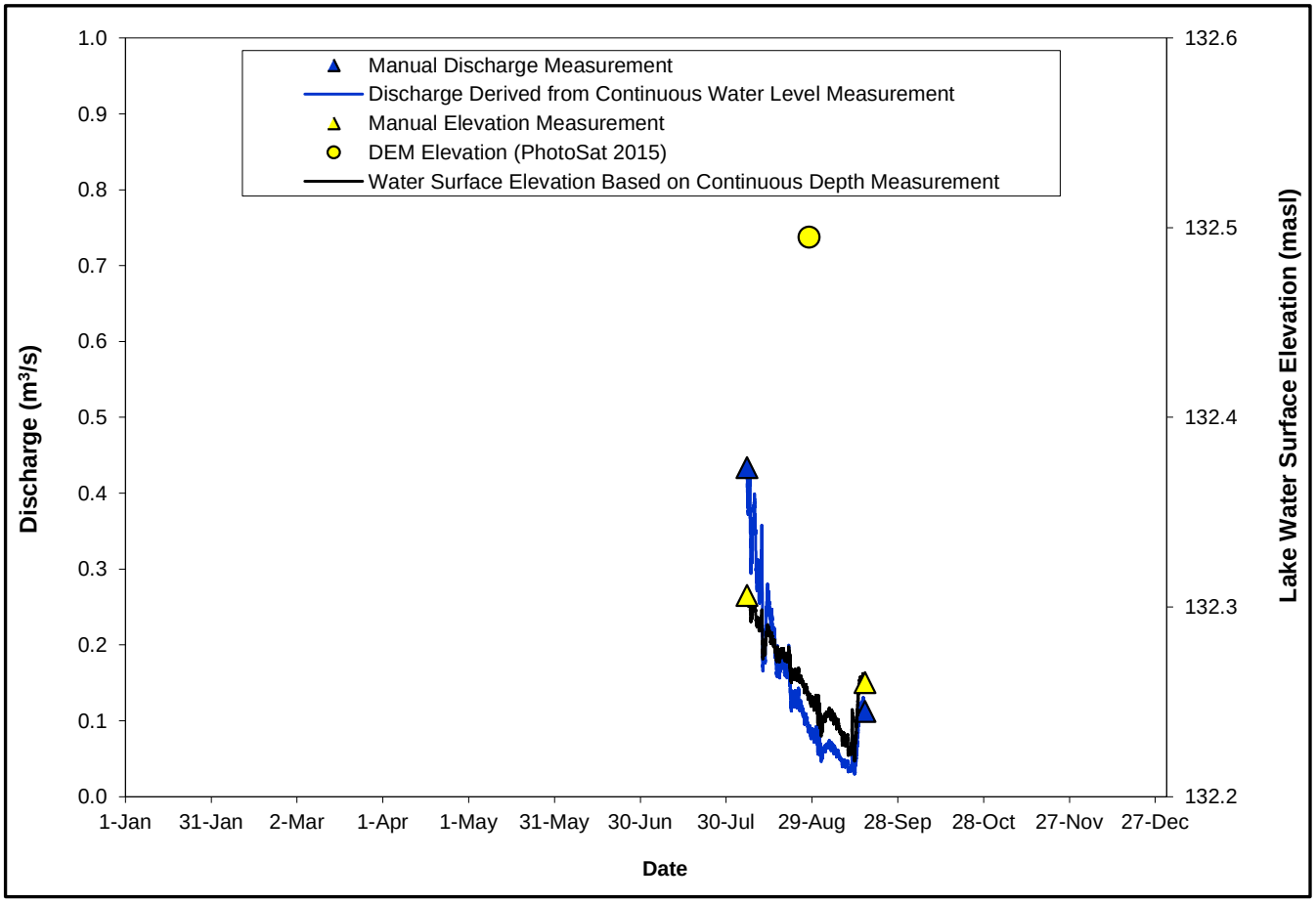


Figure 3-5: Hydrograph for Lake A5 in 2015

3.2.1.2 Lake A15

The Lake A15 hydrometric station was visited six times in 2015, and a continuous hydrograph was derived for the period of 13 June to 18 September 2015, based on continuous logger data. Details of each site visit are provided in Table 3-3. The hydrographs for Lake A15 are presented in Figure 3-6. The water surface elevation of the lake was also captured by the DEM dataset (PhotoSat 2015) and was added to the table and figure.

Table 3-3: Surveys at Lake A15 Hydrometric Station, 2015

Date	Activities	Lake	Lake Water Surface Elevation (masl)	Outlet	Discharge (m^3/s)
30 May	None - Lake A15 and outlet frozen.	-	-	-	Frozen
8 Jun	None - Lake A15 and outlet frozen.	-	-	-	Frozen
13 Jun	Installed data logger. Measured water surface elevation.	✓	152.06	-	Trickle (Ice Present)
15 Jun	Measured discharge and water surface elevation.	✓	152.09	✓	5.68
4 Aug	Measured discharge and water surface elevation, and downloaded data logger.	✓	151.65	✓	0.233
28 Aug	From DEM (PhotoSat 2015)	✓	151.46	-	-
18 Sep	Measured discharge and water surface elevation; removed and downloaded data logger.	✓	151.43	-	Not measurable

masl = metres above sea level, m^3/s = cubic metres per second

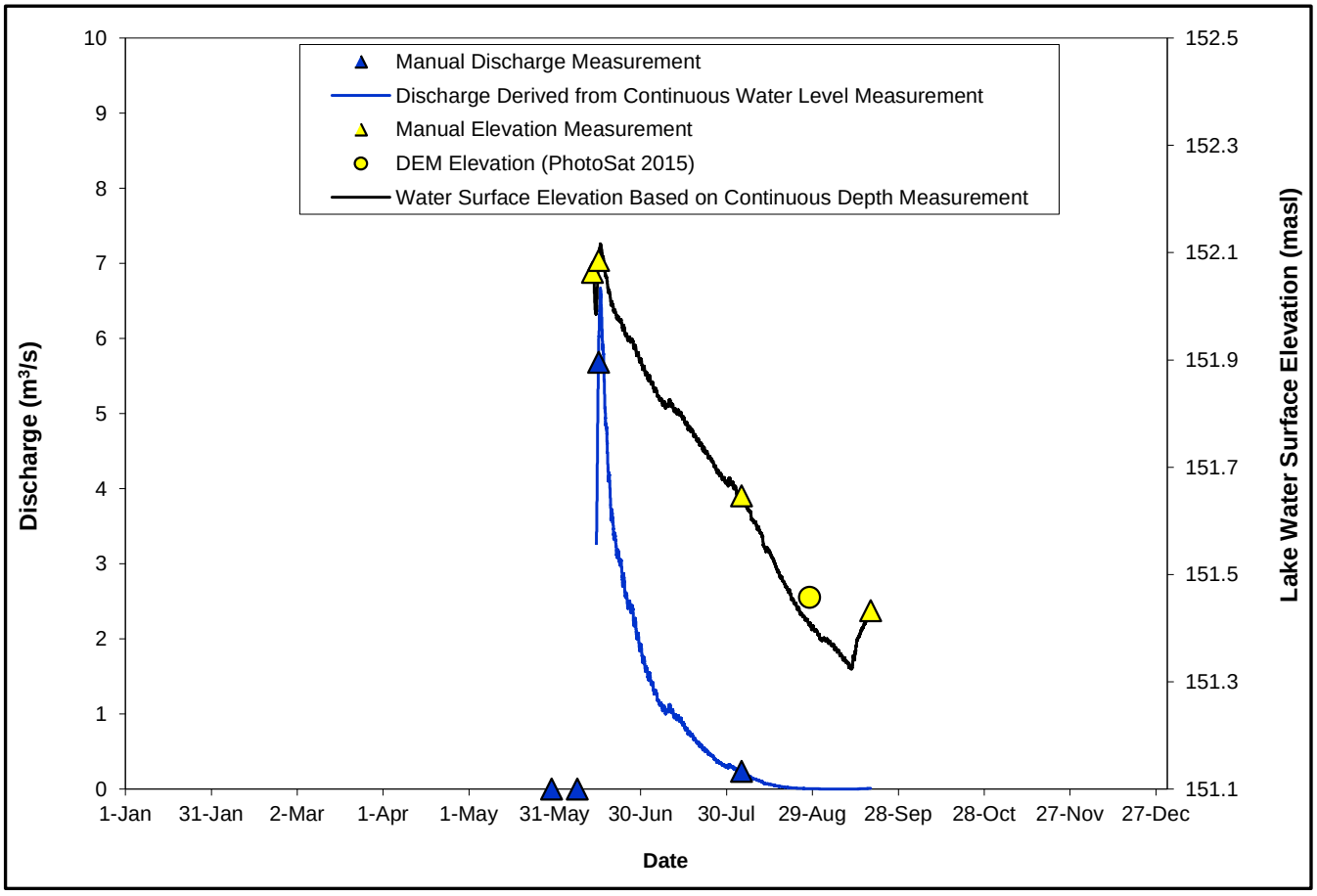


Figure 3-6: Hydrograph for Lake A15 in 2015

3.2.1.3 Lake A17 (Whale Tail Lake)

The Lake A17 (Whale Tail Lake) hydrometric station was visited six times in 2015, and a continuous hydrograph was derived for the period of 12 June to 16 September 2015, based on continuous logger data. Details of each site visit are provided in Table 3-4. The hydrographs for Lake A17 and Outlet are presented in Figure 3-7. The water surface elevation of the lake was also captured by the DEM dataset (PhotoSat 2015) and was added to the table and figure.

Table 3-4: Surveys at Lake A17 (Whale Tail Lake) Hydrometric Station, 2015

Date	Activities	Lake	Lake Water Surface Elevation (masl)	Outlet	Discharge (m^3/s)
30 May	None - Lake A17 and outlet are frozen.	-	-	-	Frozen
8 Jun	None - Lake A17 and outlet are frozen.	-	-	-	Frozen
12 Jun	Installed data logger. Measured water surface elevation.	✓	153.11	-	Frozen
14 Jun	Measured discharge and water surface elevation.	✓	153.38	✓	4.23
7 Aug	Measured discharge and water surface elevation, and downloaded data logger.	✓	152.65	✓	0.190
28 Aug	From DEM (PhotoSat 2015)	✓	152.50	-	-
16 Sep	Measured discharge and water surface elevation; removed and downloaded data logger.	✓	152.46	✓	0.012

masl = metres above sea level, m^3/s = cubic metres per second

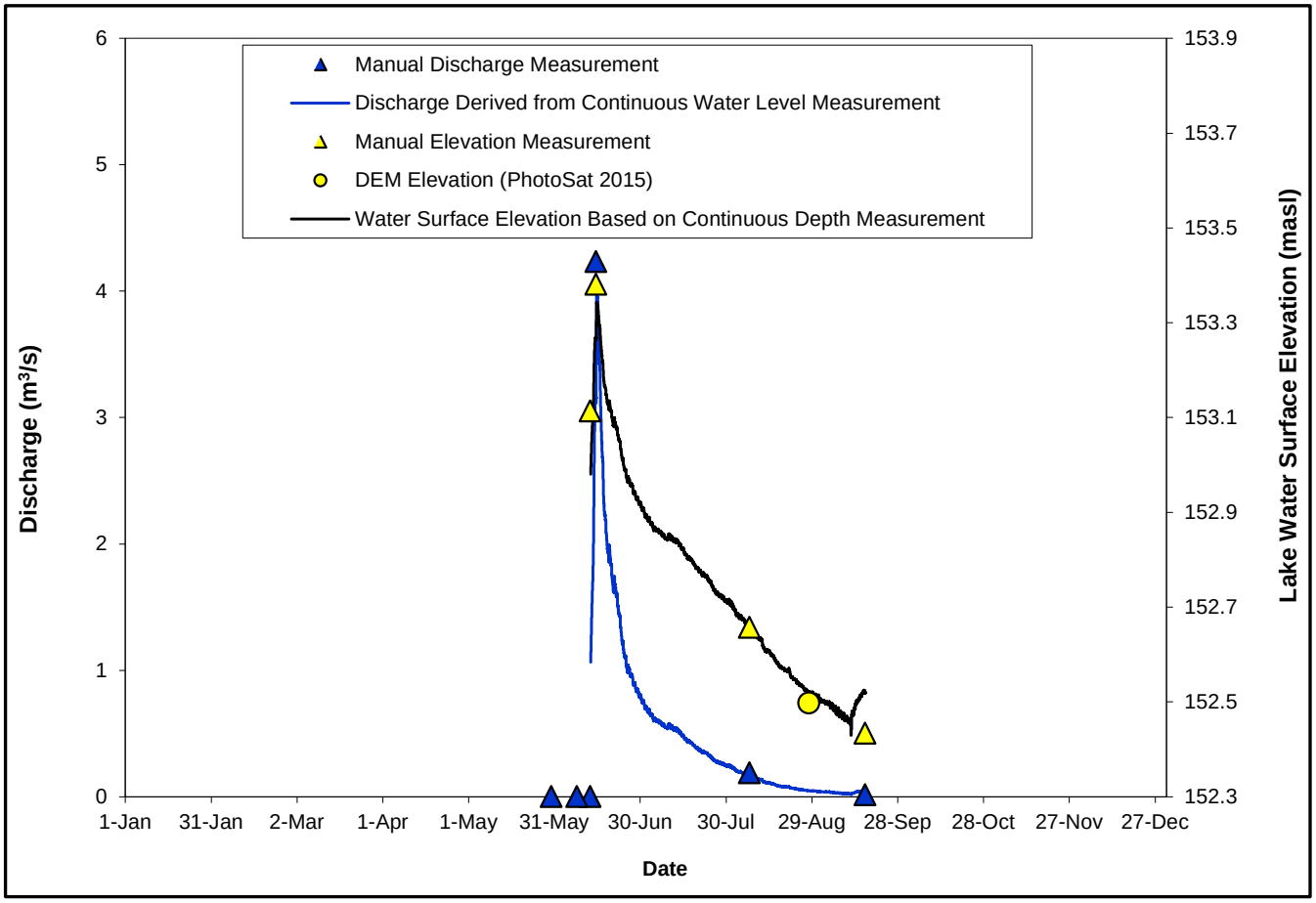


Figure 3-7: Hydrograph for Lake A17 (Whale Tail Lake) in 2015

3.2.1.4 Lake A18

The Lake A18 hydrometric station was visited six times in 2015, and a continuous hydrograph was derived for the period of 11 June to 16 September 2015, based on continuous logger data. Details of each site visit are provided in Table 3-5. The hydrographs for Lake A18 and Outlet are presented in Figure 3-8. The water surface elevation of the lake was also captured by the DEM dataset (PhotoSat 2015) and was added to the table and figure.

It should be noted that the DEM elevation (PhotoSat 2015) is approximately 8 cm higher than the derived water surface elevation. This difference in elevation falls within the accuracy of the DEM data of ± 30 cm (PhotoSat 2015).

Table 3-5: Surveys at Lake A18 Hydrometric Station, 2015

Date	Activities	Lake	Lake Water Surface Elevation (masl)	Outlet	Discharge (m^3/s)
30 May	None - Lake A18 and outlet are frozen.	-	-	-	Frozen
8 Jun	None - Lake A18 and outlet are frozen.	-	-	-	Frozen
11 Jun	Installed data logger. Measured water surface elevation.	✓	154.16	-	Frozen
14 Jun	Measured discharge and water surface elevation.	✓	154.22	✓	2.48
4 Aug	Measured discharge and water surface elevation, and downloaded data logger.	✓	153.89	✓	0.129
28 Aug	From DEM (PhotoSat 2015)	✓	153.86	-	-
16 Sep	Measured discharge and water surface elevation; removed and downloaded data logger.	✓	153.81	✓	0.004

masl = metres above sea level, m^3/s = cubic metres per second

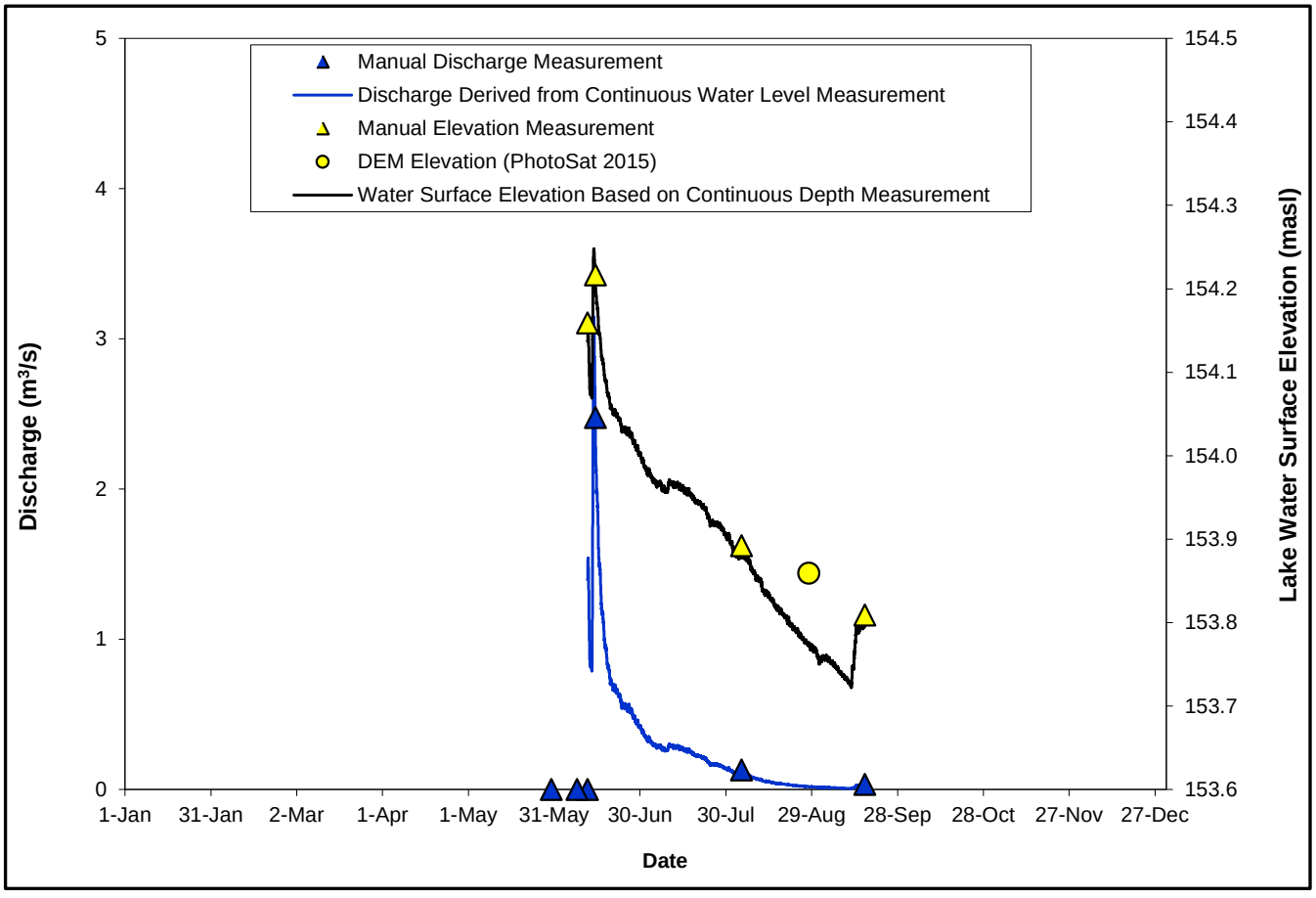


Figure 3-8: Hydrograph for Lake A18 in 2015

3.2.1.5 Lake A69

The Lake A69 hydrometric station was visited six times in 2015, and a continuous hydrograph was derived for the period of 11 June to 16 September 2015, based on continuous logger data. Details of each site visit are provided in Table 3-6. The hydrographs for Lake A69 are presented in Figure 3-9. The water surface elevation of the lake was also captured by the DEM dataset (PhotoSat 2015) and was added to the table and figure.

Table 3-6: Surveys at Lake A69 and Outlet Hydrometric Station, 2015

Date	Activities / Data Source	Lake	Lake Water Surface Elevation (masl)	Outflow	Discharge (m^3/s)
30 May	None - Lake A69 and outlet are frozen.	-	-	-	Frozen
8 Jun	None - Lake A69 and outlet are frozen.	-	-	-	Frozen
11 Jun	Installed data logger. Measured discharge and water surface elevation.	✓	112.47	✓	3.00
15 Jun	Measured discharge and water surface elevation.	✓	112.60	✓	6.73
4 Aug	Measured discharge and water surface elevation, and downloaded data logger.	✓	112.21	✓	0.398
28 Aug	From DEM (PhotoSat 2015)	✓	112.21	-	-
16 Sep	Measured discharge and water surface elevation; removed and downloaded data logger.	✓	112.17	✓	0.206

masl = metres above sea level, m^3/s = cubic metres per second

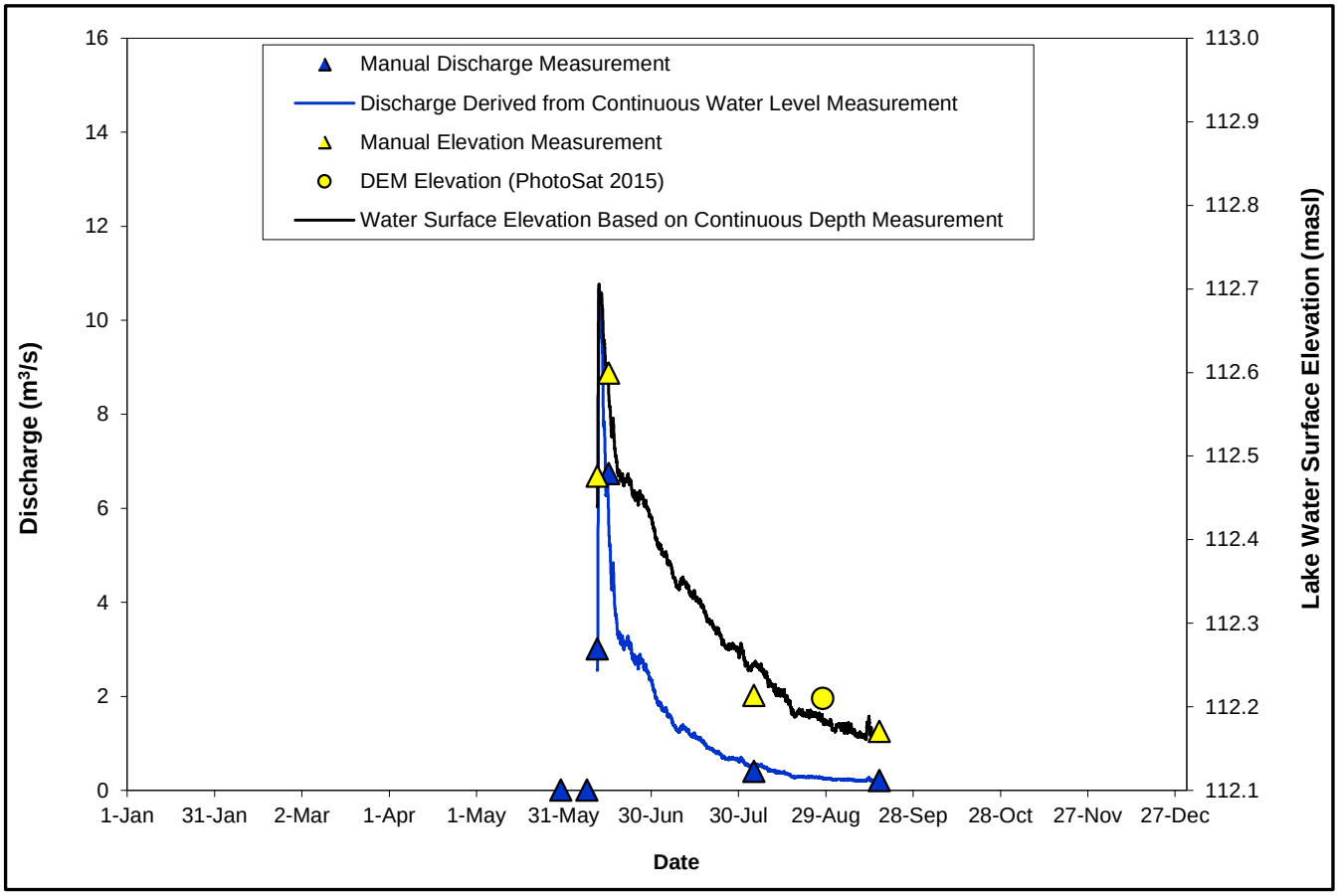


Figure 3-9: Hydrograph for Lake A69 in 2015

3.2.1.6 Lake C8

The Lake C8 hydrometric station was visited twice in 2015, and a continuous hydrograph was derived for the period of 8 August to 16 September 2015, based on continuous logger data. Details of each site visit are provided in Table 3-7. The hydrographs for Lake C8 are presented in Figure 3-10. The water surface elevation of the lake was also captured by the DEM dataset (PhotoSat 2015) and was added to the table and figure.

It should be noted that the DEM elevation (PhotoSat 2015) is approximately 25 cm lower than the derived water surface elevation. This difference in elevation falls within the accuracy of the DEM data of ± 30 cm (PhotoSat 2015).

Table 3-7: Surveys at Lake C8 Hydrometric Station, 2015

Date	Activities	Lake	Lake Water Surface Elevation (masl)	Outlet	Discharge (m^3/s)
8 Aug	Measured discharge and water surface elevation, and installed data logger.	✓	139.02	✓	0.087
28 Aug	From DEM (PhotoSat 2015)	✓	138.74	-	-
16 Sep	Measured discharge and water surface elevation; removed and downloaded data logger.	✓	139.02	✓	0.101

masl = metres above sea level, m^3/s = cubic metres per second

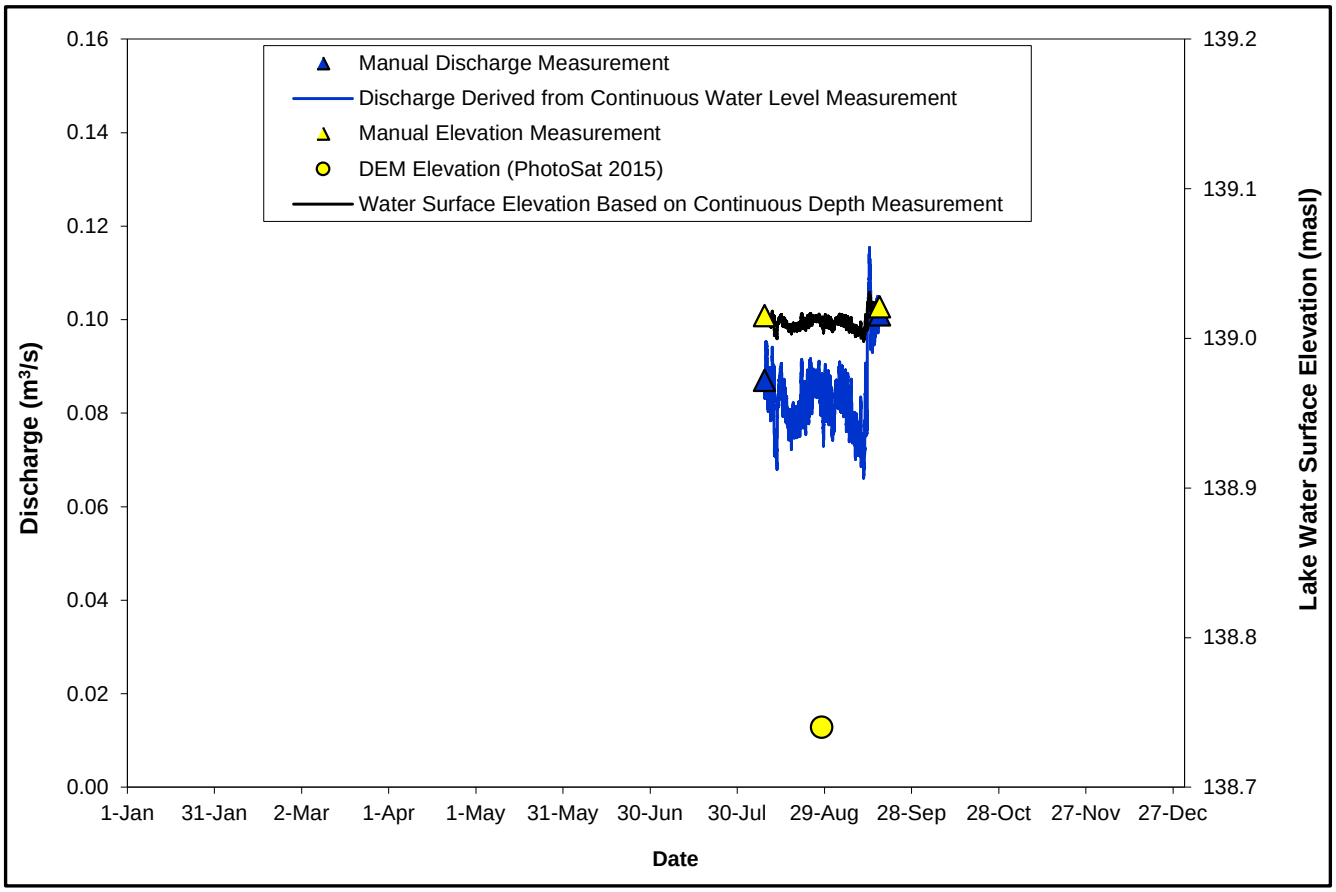


Figure 3-10: Hydrograph for Lake C8 in 2015

3.2.1.7 Lake C38 (Nemo Lake)

The Lake C38 (Nemo Lake) hydrometric station was visited six times in 2015, and a continuous hydrograph was derived for the period of 13 June to 17 September 2015, based on continuous logger data. Details of each site visit are provided in Table 3-8. The hydrographs for Lake C38 (Nemo Lake) are presented in Figure 3-11. The water surface elevation of the lake was also captured by the DEM dataset (PhotoSat 2015) and was added to the table and figure.

Table 3-8: Surveys at Lake C38 (Nemo Lake) Hydrometric Station, 2015

Date	Activities	Lake	Lake Water Surface Elevation (masl)	Outlet	Discharge (m^3/s)
30 May	None - Lake C38 and outlet are frozen.	-	-	-	Frozen
8 Jun	None - Lake C38 and outlet are frozen.	-	-	-	Frozen
13 Jun	Installed data logger. Measured water surface elevation.	✓	155.99	-	Frozen
14 Jun	Measured discharge and water surface elevation.	✓	156.01	✓	0.046
4 Aug	Measured discharge and water surface elevation, and downloaded data logger.	✓	155.85	✓	0.019
28 Aug	From DEM (PhotoSat 2015)	✓	155.70	-	-
17 Sep	Measured discharge and water surface elevation; removed and downloaded data logger.	✓	155.69	✓	0.007

masl = metres above sea level, m^3/s = cubic metres per second

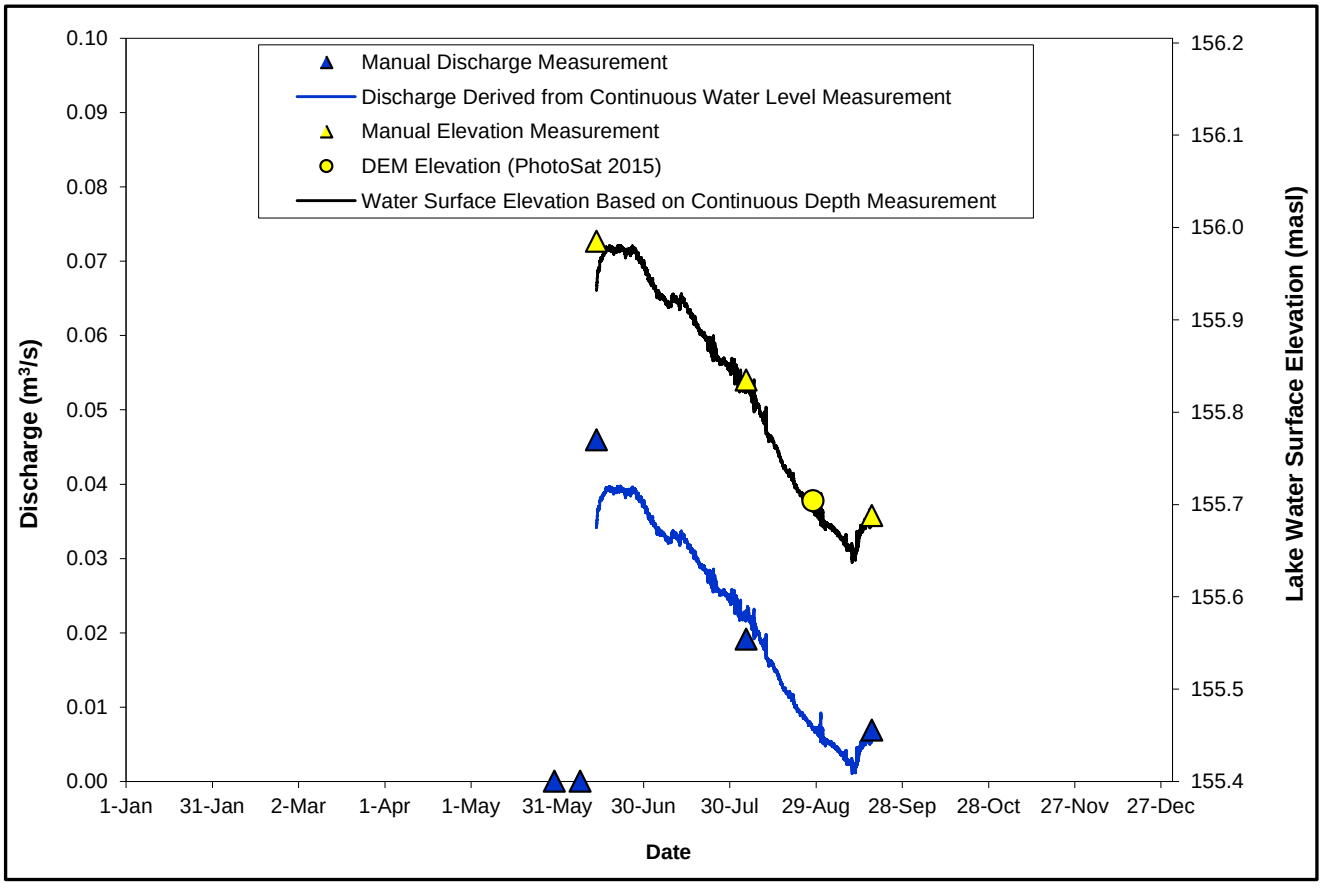


Figure 3-11: Hydrograph for Lake C38 (Nemo Lake) in 2015

3.2.1.8 Lake DS1

The Lake DS1 hydrometric station was visited three times in 2015, and a continuous hydrograph was derived for the period of 12 June to 16 September 2015, based on continuous logger data. Details of each site visit are provided in Table 3-9. The hydrographs for Lake DS1 are presented in Figure 3-12.

No discharge was measured on 12 June 2015 due to unsafe wading conditions. The estimate provided was based on velocity measurements along wadeable sections near the banks, and estimated wetted width. DEM data did not extend to the Lake DS1 hydrometric station.

Table 3-9: Surveys at Lake DS1 and Outlet Hydrometric Station, 2015

Date	Activities	Lake	Lake Water Surface Elevation (masl)	Outlet	Discharge (m^3/s)
12 Jun	Installed data logger. Measured water surface elevation and estimated discharge due to unsafe wading conditions.	✓	99.66	-	-
5 Aug	Measured discharge and water surface elevation, and downloaded data logger.	✓	99.47	✓	12.3
16 Sep	Measured discharge and water surface elevation; removed and downloaded data logger.	✓	99.21	✓	4.82

masl = metres above sea level, m^3/s = cubic metres per second

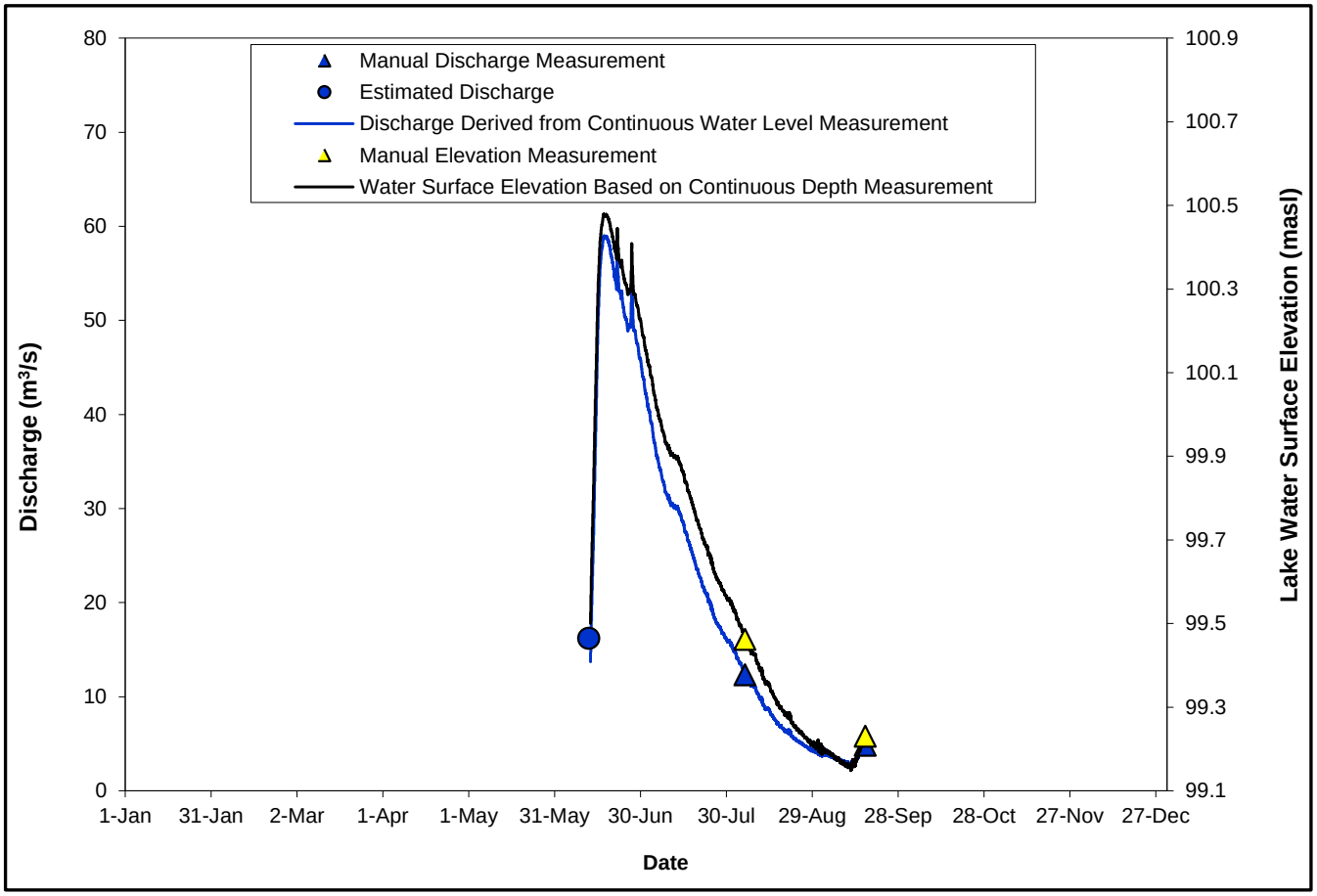


Figure 3-12: Hydrograph for Lake DS1 in 2015

3.2.1.9 Water Yields

Water yields for the open water season were calculated based on derived daily discharge values for stations with continuous hydrographs, and are presented in Table 3-10.

Derived water yields for lakes with similar periods of record (i.e., with 97 and 98 days of record) varied between 52.3 mm (Lake C38 [Nemo Lake]) and 267 mm (Lake A18). The lower water yields at Lake A17 and Lake C38 may be attributed to proportions of ineffective areas in the watersheds, and the potential for shallow subsurface flow to convey water outside of the assumed drainage boundaries. Tributaries of Lake A17 (Whale Tail Lake) and Lake C38 (Nemo Lake) were opportunistically observed to drain poorly, with ponded water.

Lake A5 and Lake 69 are both located downstream of Lake A76. As shown on the drainage pattern map (Figure 1-2), Lake A12 and Lake A76 each have two lake outlets. Based on field observations (with further information on the elevations of each lake outlet provided in Section 3.3), Lake A12 primarily drains to Lake A11, and its secondary outlet drains to Lake A77. Lake A76 primarily drains to Lake A41, and its secondary outlet to Lake A75. It was therefore assumed that Lake A76 only drained to Lake A41 during periods of record for water yields derived for Lake A5 and Lake A69.

Table 3-10: Water Yield Values for the Continuous Stations over the Period of Record in 2015

Sub-Watershed	Watershed Area (km^2)	Hydrograph Period and Duration (number of days)	Runoff Volume (m^3)	Water Yield (mm)
Lake A5	57.6[a]	6 August to 16 September 2015 (42)	518,000	9.0[a,c]
Lake A15	40.8	13 June to 18 September 2015 (98)	7,880,000	193
Lake A17 (Whale Tail Lake)	28.1	12 June to 16 September 2015 (97)	4,290,000	152
Lake A18	8.89	11 June to 15 September 2015 (97)	2,380,000	267
Lake A69	43.4[b]	11 June to 16 September 2015 (98)	11,400,000	276[b]
Lake C8	11.8	8 August to 16 September 2015 (40)	283,000	24.0[c]
Lake C38 (Nemo Lake)	3.54	13 June to 17 September 2015 (97)	185,000	52.3
Lake DS1	897.6	12 June to 16 September 2015 (97)	179,000,000	199.2

[a] inclusive of the Lake A76 sub-watershed (i.e., over the period of the record, it was assumed that all runoff from Lake A76 drained to Lake A41)

[b] exclusive of the Lake A76 sub-watershed (i.e., over the period of the record, it was assumed that all runoff from Lake A76 drained to Lake A41)

[c] late open-water season flows only; does not include freshet

km^2 = square kilometres; m^3 = cubic metres; mm = millimetres

3.2.2 Manual Hydrometric Stations

Manual hydrometric measurements are summarized in Table 3-11.

Table 3-11: Manual Hydrometric Measurements

Lake Name	Date	Discharge (m^3/s)	Water Level (masl)	Comment
Lake A12-A11	06-Aug-15	0.316	148.82	northeast outlet of Lake A12
	28-Aug-15	-	148.61	PhotoSat 2015
	18-Sep-15	(a)	148.73	northeast outlet of Lake A12
Lake A12-A77	06-Aug-15	0.133	148.82	northwest outlet of Lake A12
	28-Aug-15	-	148.61	PhotoSat 2015
	18-Sep-15	(a)	148.73	northwest outlet of Lake A12
Lake A16	13-Jun-15	2.07	152.61	
	28-Aug-15	-	152.24	PhotoSat 2015
	18-Sep-15	-	152.09	
Lake A19	08-Aug-15	(a)	154.69	
	28-Aug-15	-	154.62	PhotoSat 2015
Lake A21	06-Aug-15	0.015	157.77	Water level measured on 8 August 2015
	28-Aug-15	-	154.63	PhotoSat 2015
Lake A22	08-Aug-15	(a)	154.92	
	28-Aug-15	-	154.79	PhotoSat 2015
Lake A45	28-Aug-15	-	156.27	PhotoSat 2015
	19-Sep-15	(a)	156.42	
Lake A53	12-Jul-15	0.048	-	Measured by Agnico Eagle
	7-Aug-15	0.005	161.655	
	28-Aug-15	-	161.73	PhotoSat 2015

Table 3-11: Manual Hydrometric Measurements (continued)

Lake Name	Date	Discharge (m^3/s)	Water Level (masl)	Comment
Lake A55	12-Jul-15	0.110	-	Measured by Agnico Eagle
	07-Aug-15	0.020	155.00	
	28-Aug-15	-	155.01	PhotoSat 2015
	17-Sep-15	0.042	154.97	
Lake A60	12-Jul-15	0.077	170.67	Measured by Agnico Eagle; discharge measured downstream of Lake A26
	09-Aug-15	0.004	170.51	
	28-Aug-15	-	170.44	PhotoSat 2015
	17-Sep-15	0.002	-	
Lake A62	12-Jul-15	-	-	Sheet flow observed by Agnico Eagle
	08-Aug-15	0	155.29	
	28-Aug-15	-	155.41	PhotoSat 2015
Lake A63	08-Aug-15	(a)	154.41	
	28-Aug-15	-	154.45	PhotoSat 2015
Lake A65	12-Jul-15	-	-	Observed flow by Agnico Eagle
	09-Aug-15	(a)	154.38	
	28-Aug-15	-	154.79	PhotoSat 2015
Lake A72	28-Aug-15	-	117.36	PhotoSat 2015
	18-Sep-15	0.117	117.39	
Lake A76-A41	06-Aug-15	0.079	147.69	East outlet of Lake A76; water level measured on 5 August 2015
	28-Aug-15	-	147.56	PhotoSat 2015
	18-Sep-15	(a)	147.48	East outlet of Lake A76
Lake A76-A75	12-Jul-15	(a)	-	Measured by Agnico Eagle
	06-Aug-15	(a)	147.69	West outlet of Lake A76; water level measured on 5 August 2015
	28-Aug-15	-	147.56	PhotoSat 2015
	18-Sep-15	(a)	147.48	West outlet of Lake A76
Lake A81	12-Jul-15	1.09	119.92	Measured by Agnico Eagle
	08-Aug-15	0.124	119.86	
	28-Aug-15	-	119.31	PhotoSat 2015
Lake B3	12-Jul-15	0	-	Measured by Agnico Eagle
	08-Aug-15	0.036	-	
	28-Aug-15	-	161.73	PhotoSat 2015

masl = metres above sea level, m^3/s = cubic metres per second, (a) = discharge too low to measure, - = not available

3.3 Lake Shoreline Surveys

Shorelines were surveyed at those lakes where baseline water levels are anticipated to be affected by mine operations, including: Lake A12, Lake A15, Lake A16 (Mammoth Lake), Lake A17 (Whale Tail Lake), Lake A18, Lake A45, Lake A69, Lake A72 and Lake A76 (Figure 2-1; Appendix B). The shorelines were accessed on foot, or by helicopter, depending on the site visit opportunity. The surveys were completed using the methods described in Section 2.4.

The majority of the shorelines surveyed exhibit a consistent terrain type related to shorelines that have developed in morainal material. These morainal shorelines were observed at all lakes visited during the field survey. Limited areas of bedrock and shallowly sloped sandy shorelines were also observed. As a general characteristic for the surveyed shorelines, the predominant materials are boulder gardens mixed with cobble with very limited soils or organic materials on top. The outlet channels exhibit the same characteristics for streambed materials, which results in interstitial flow through large boulders or below the surface and likely close to the bedrock, making flow difficult to observe and measure.

3.3.1 Lake A12

The survey of Lake A12 focused on the lake shoreline and outlet channel. Lake A12 has a surface area of approximately 28.9 ha, and drains into Lake A11 through a main outlet at average and below average water levels. At water levels above average, Lake A12 has a secondary outlet that drains into Lake A77. The proportion of flow to each outlet may also be influenced by outlet channel ice conditions during freshet. Section 3.1 provides further details on the drainage patterns.

The field surveys at Lake A12 included: outlet channel cross-section, outlet channel water surface slope, lake shore normal transects and existing and ordinary high lake water levels.

Both outlet channel cross-sections were surveyed. The main outlet channel is approximately 35 m wide and the secondary outlet channel is approximately 40 m wide (Figure 3-13). The outlet channels are similar, with a poorly defined channel, mainly comprised of a boulder field. The water flows mostly through the boulders for almost the entire width of the main outlet channels. Further downstream, the flow becomes entirely subsurface and is only visible at times through the boulders. No flowing water was observed in the secondary outlet channel at the time of visit.

The slope of the water surface in the main outlet channel could not be measured during the survey because no water was observed and the flow was determined to be interstitial flow (through the boulders and below the surface).

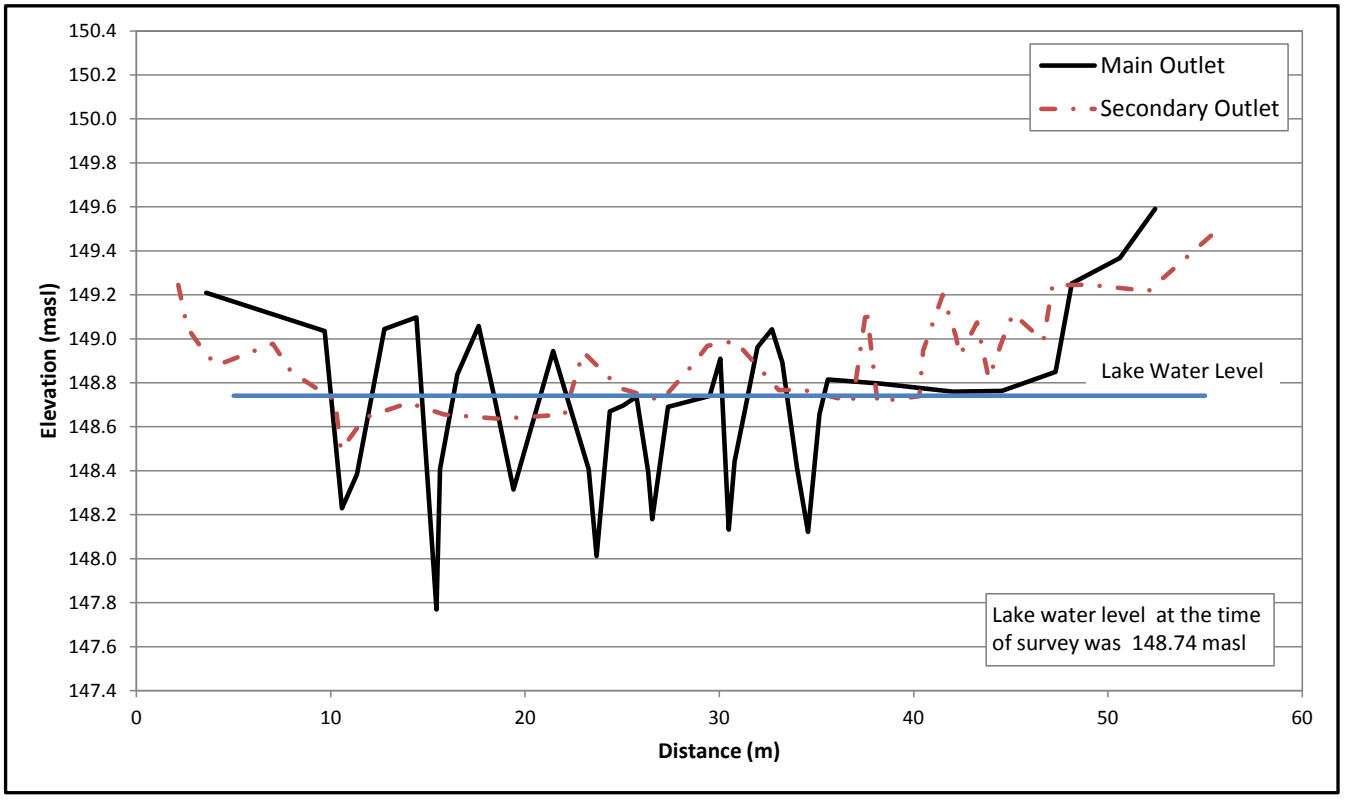


Figure 3-13: Lake A12 Main and Secondary Outlet Channel Cross-Sections, 2015

The water surface elevation at Lake A12 at the time of survey (i.e., 18 September 2015) was measured as 148.74 masl, and the ordinary high water level was estimated at 149.01 masl. A more detailed description of the lake shoreline is presented in Table 3-12, and is based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015). Terrain slopes calculated for the Lake A12 shoreline are shown in Figure 3-14.

Table 3-12: Lake A12 Shoreline Description

Criteria	Description
Bank materials	The majority of the shoreline is composed of large boulders and cobble. Bedrock is present as well on the northwest shore in a shallow area.
Typical bank slopes	Most of the shoreline has shallow slopes, typically less than 5% gradient. Several small sections on the west shoreline have higher slopes between 10% and 30% gradient. The bedrock shore from the northwest is abrupt with slope gradients greater than 100%.
Typical shoreline geometry	Mostly irregular shoreline with several smaller and shallow bays.
Fetch	Maximum fetch length was estimated in GIS at approximately 0.85 km, on a northwest – southeast direction.

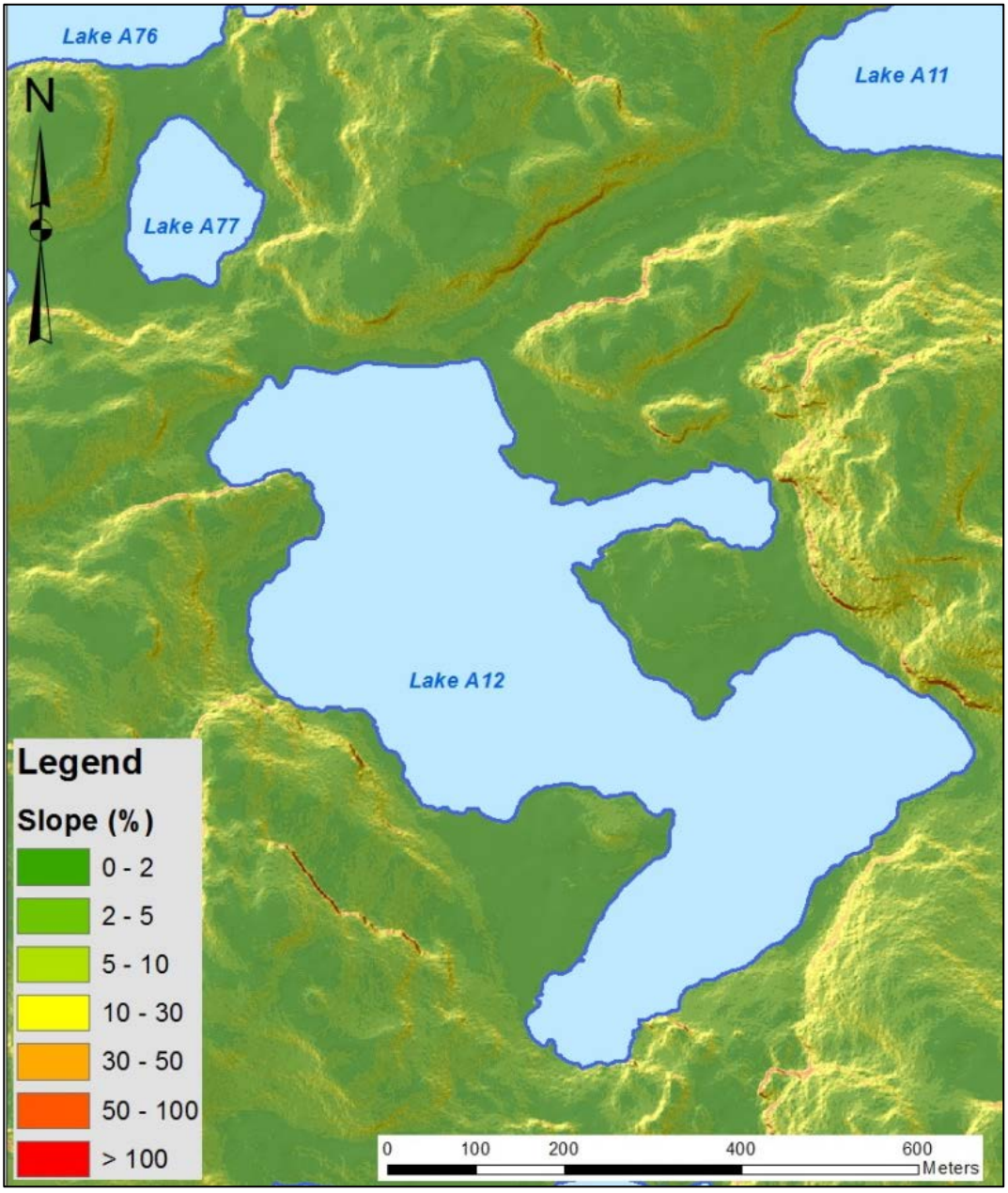


Figure 3-14: Lake A12 Shoreline Slopes (Based on available DEM data [PhotoSat 2015])

Two shore-normal transects were surveyed, one closer to the lake inlet (South Transect), and a second one closer to the lake outlet (North Transect) (Figure 3-15). At both locations, the shoreline is composed of boulders intercalated (cobble inserted between boulders) with cobble. The terrain slopes are similar, at typically less than 5% gradient.

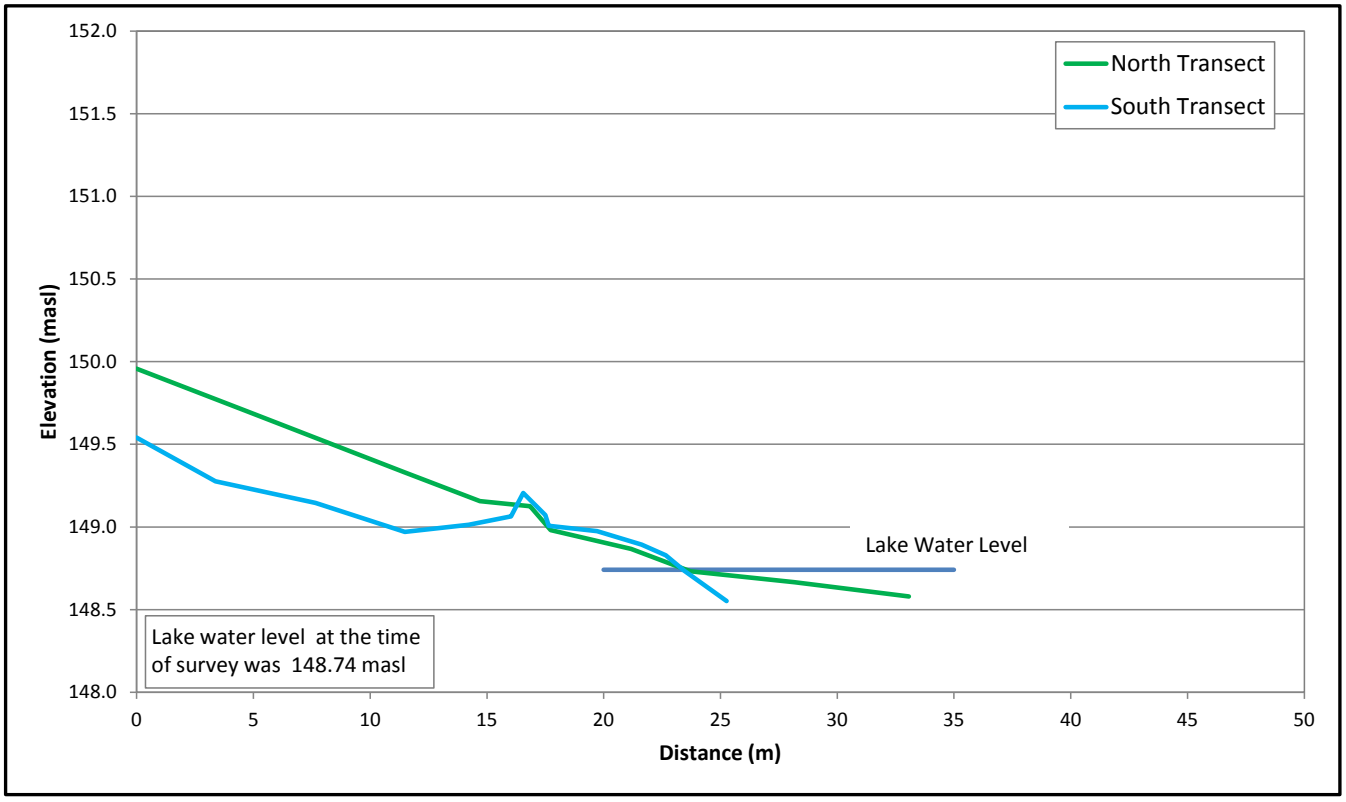


Figure 3-15: Cross-section Profiles of the Surveyed Transects, Lake A12

3.3.2 Lake A15

The survey of Lake A15 focused on the lake shoreline and outlet channel. Lake A15 has a surface area of approximately 33.3 ha, and drains into Lake A14. The Lake A15 field surveys included: outlet channel cross-section, outlet channel water surface slope, lake shore normal transects and existing and ordinary high lake water levels.

The outlet channel is approximately 50 m wide (Figure 3-16), with a poorly defined channel that is mainly comprised of large boulders. The water flows through or under the boulders for almost the entire width of the channel. The slope of the water surface in the channel could not be measured because no water was observed and the flow was determined to be through the boulders and below the surface.

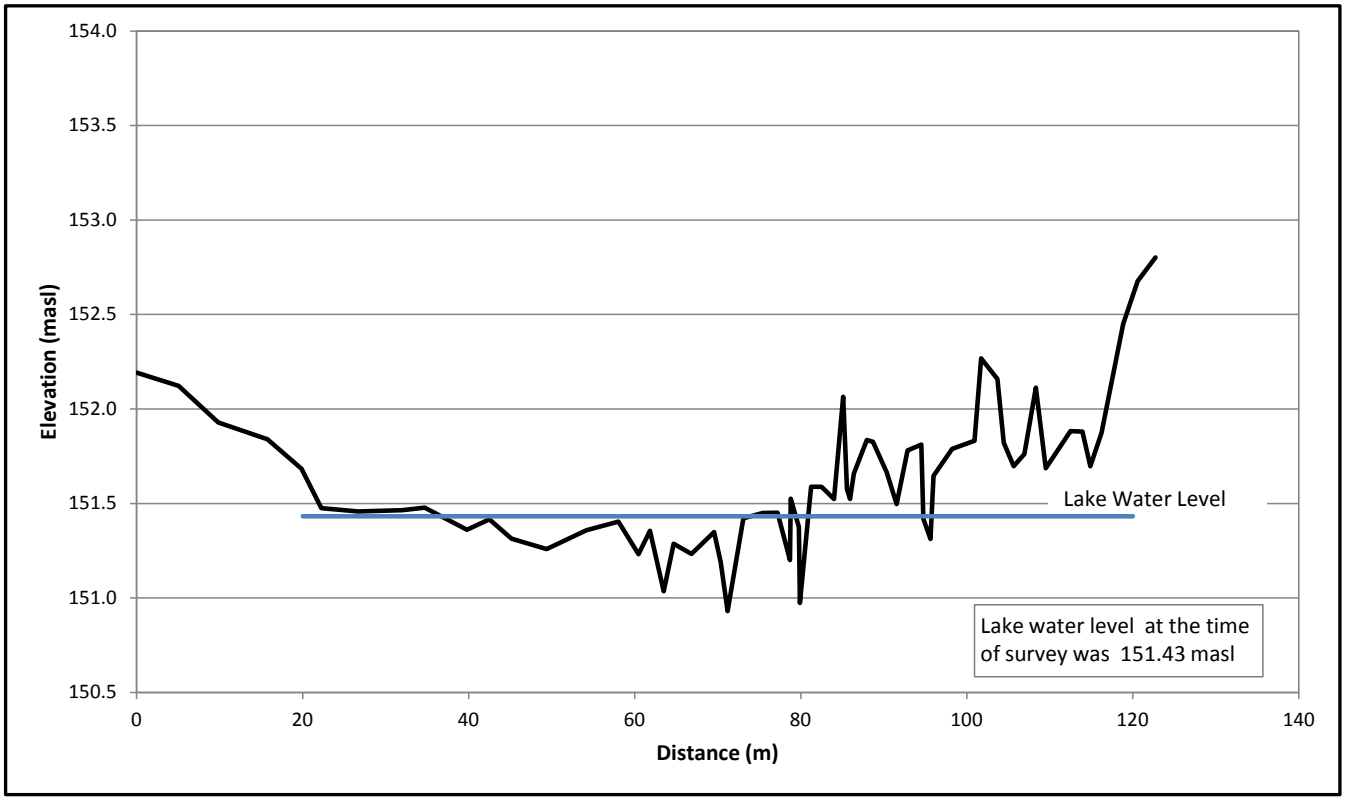


Figure 3-16: Lake A15 Outlet Channel Cross-Section, 2015

The water surface elevation at Lake A15 at the time of survey (i.e., 18 September 2015) was measured as 151.43 masl, and the ordinary high water level was estimated as 151.71 masl. A more detailed description of the lake shoreline is presented in Table 3-13, and is based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015). Terrain slopes calculated for the Lake A15 shoreline are shown in Figure 3-17.

Table 3-13: Lake A15 Shoreline Description

Criteria	Description
Bank materials	Almost the entire shoreline is composed of large boulders and coble.
Typical bank slopes	Most of the shoreline has shallow slopes, typically less than 5% gradient. Only two small sections on the west shoreline have slopes between 10% and 30% gradient.
Typical shoreline geometry	Mostly straight shoreline with several smaller bays.
Fetch	Maximum fetch length was estimated in GIS at approximately 1.2 km, on an approximate north – south direction.

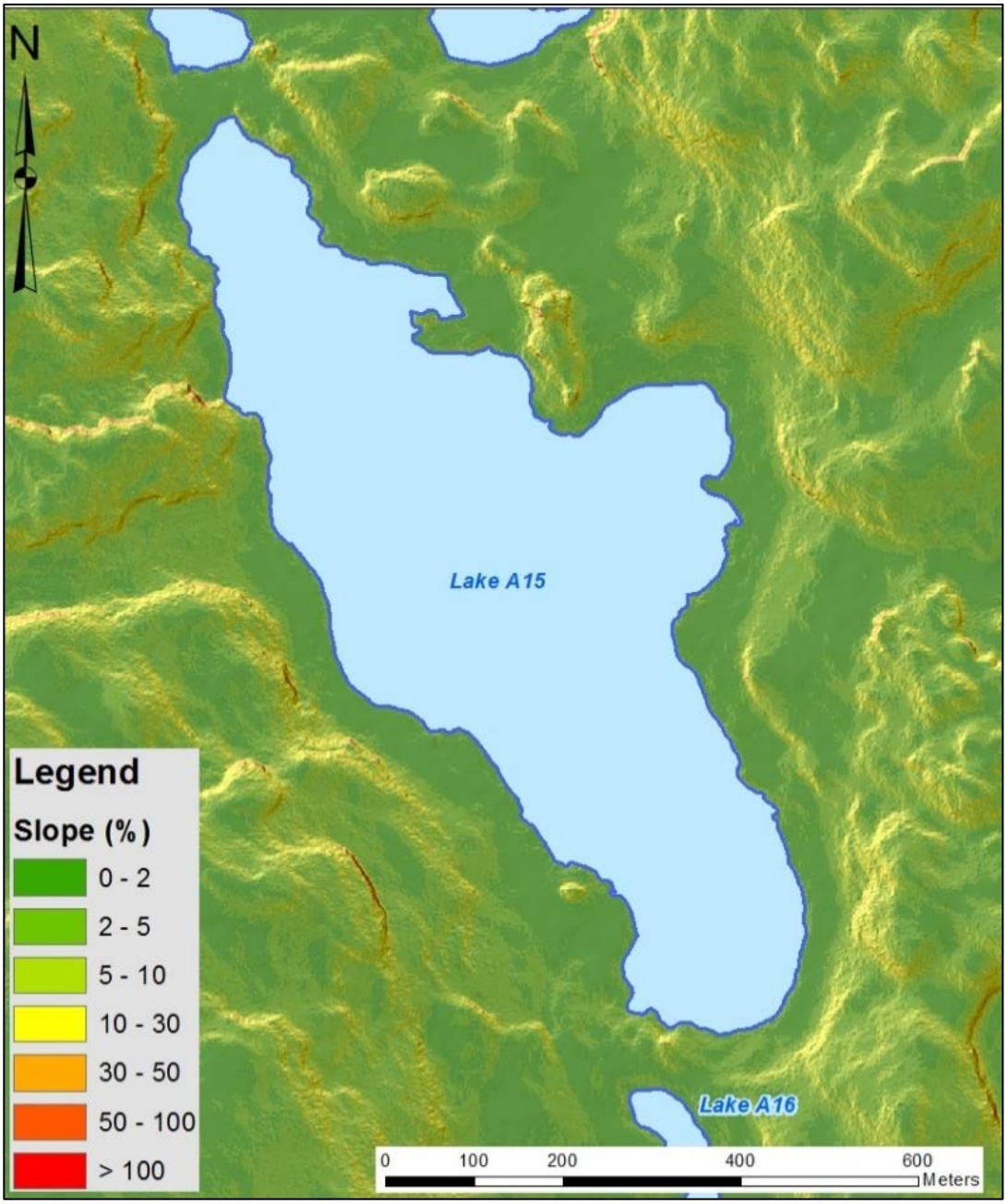


Figure 3-17: Lake A15 Shoreline Slope (Based on available DEM data [PhotoSat 2015])

Two shore-normal transects were surveyed, one closer to the lake inlet (South Transect), and a second one closer to the lake outlet (North Transect). For both locations the shoreline is composed of boulders intercalated with cobble. The terrain slopes are similar, at typically less than 5% gradient (Figure 3-18).

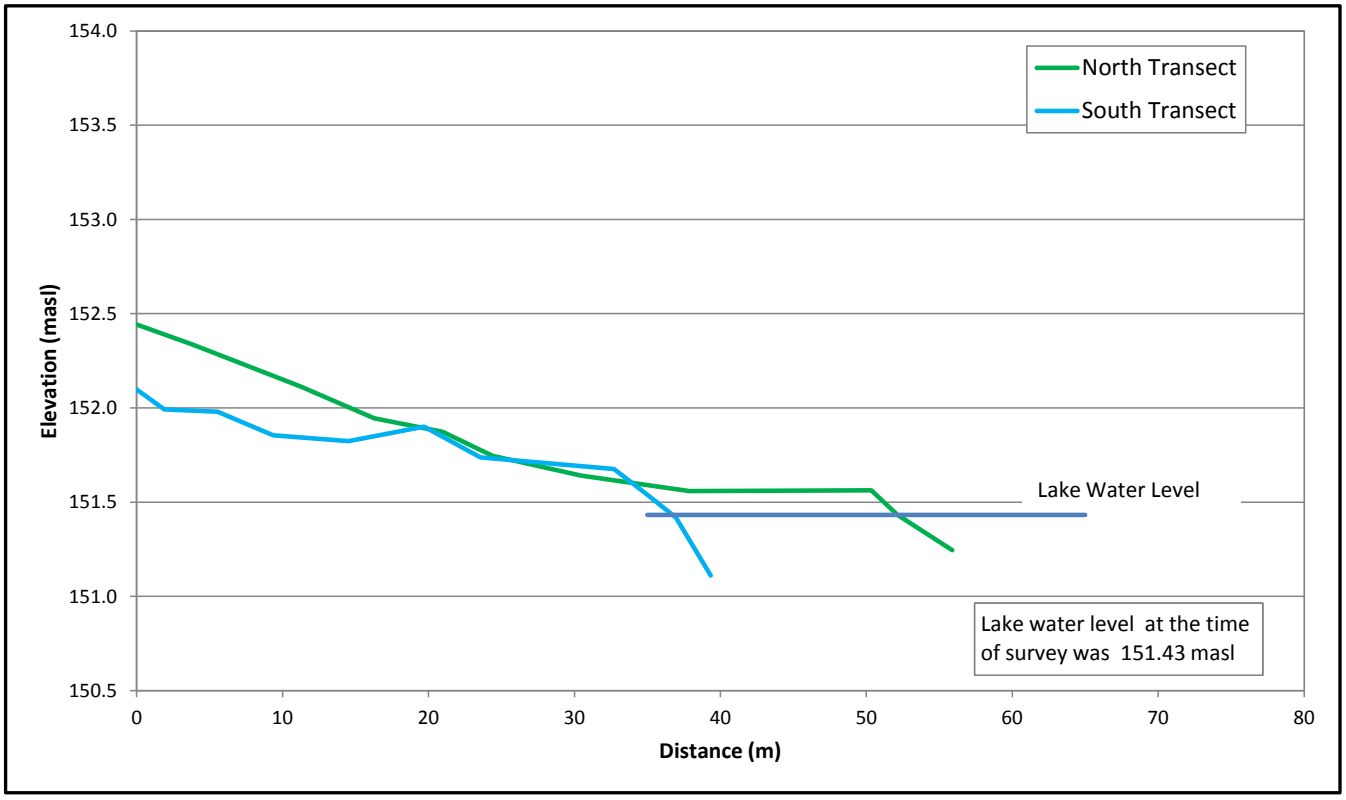


Figure 3-18: Cross-section Profiles of the Surveyed Transects, Lake A15

3.3.3 Lake A16 (Mammoth Lake)

The survey of Lake A16 (Mammoth Lake) focused on the lake outlet channel. Lake A16 has a surface area of approximately 148 ha, and drains into Lake A15. At this location, the field surveys included: outlet channel cross-section, outlet channel water surface slope, and existing and ordinary high lake water levels.

The outlet channel is approximately 45 m wide (Figure 3-19), with a poorly defined channel that is mainly comprised of large boulders. The water flows through or under the boulders for almost the entire length of the channel. A secondary channel was observed to the west of the main channel and it appears to function only during the high water levels, with the flow mostly through boulders and below surface. The slope of the water surface in the channel could not be measured because no water was observed. It was determined that the flow was through the boulders and below the surface.

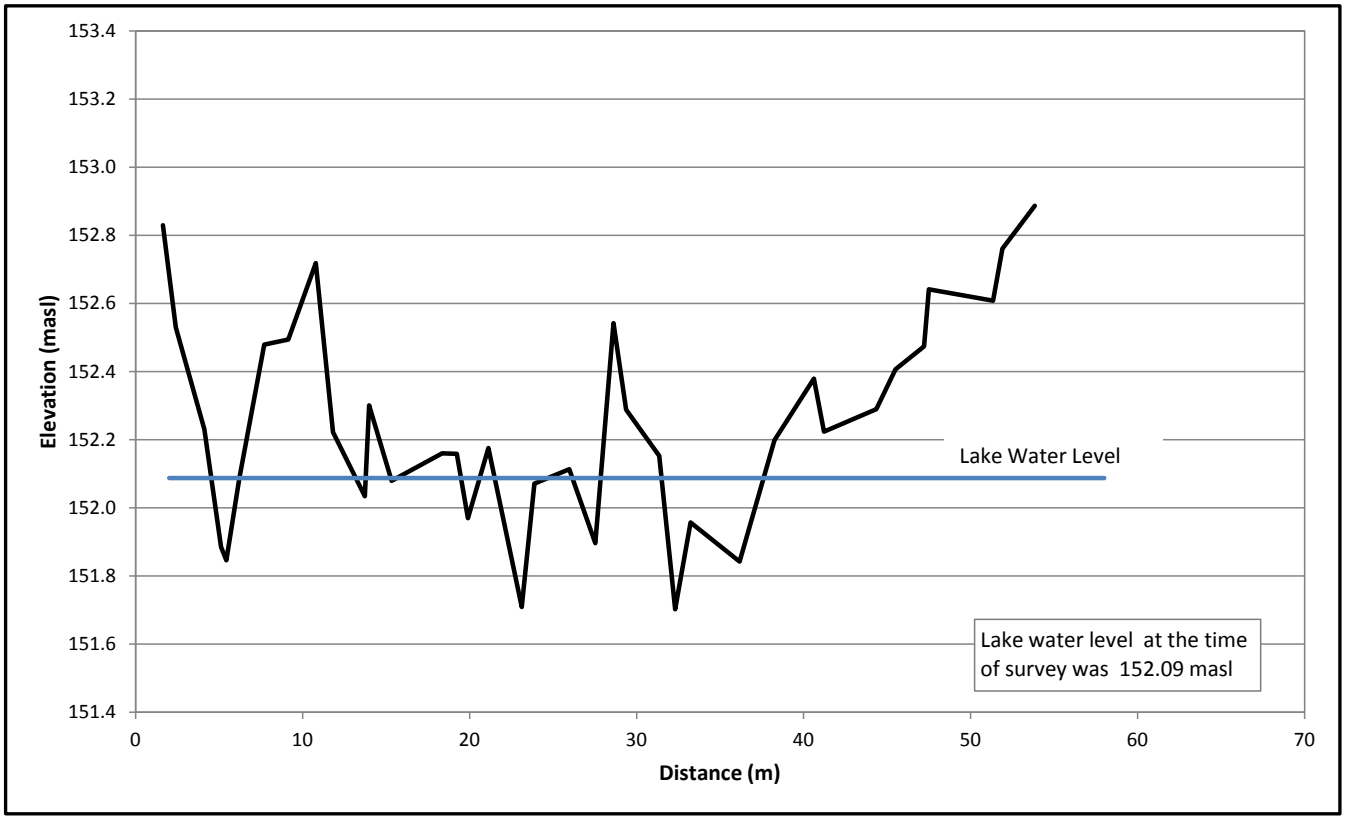


Figure 3-19: Lake A16 (Mammoth Lake) Outlet Channel Cross-Section, 2015

The water surface elevation at Lake A16 at the time of survey (i.e., 18 September 2015) was measured as 152.09 masl, and the ordinary high water level was estimated as 152.49 masl. A more detailed description of the lake shoreline is presented in Table 3-14, and is based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015). Terrain slopes calculated for the Lake A16 shoreline are shown in Figure 3-20.

Table 3-14: Lake A16 (Mammoth Lake) Shoreline Description

Criteria	Description
Bank materials	Mostly large boulders and cobble with very limited vegetation.
Typical bank slopes	Most of the shoreline has shallow slopes, typically less than 2%. Only the northeast and southeast shoreline show some sections with slopes between 5% and 10%.
Typical shoreline geometry	Mostly straight shoreline with sections with smaller bays.
Fetch	Maximum fetch length was estimated in GIS at approximately 2.8 km, on a southwest – northeast direction.

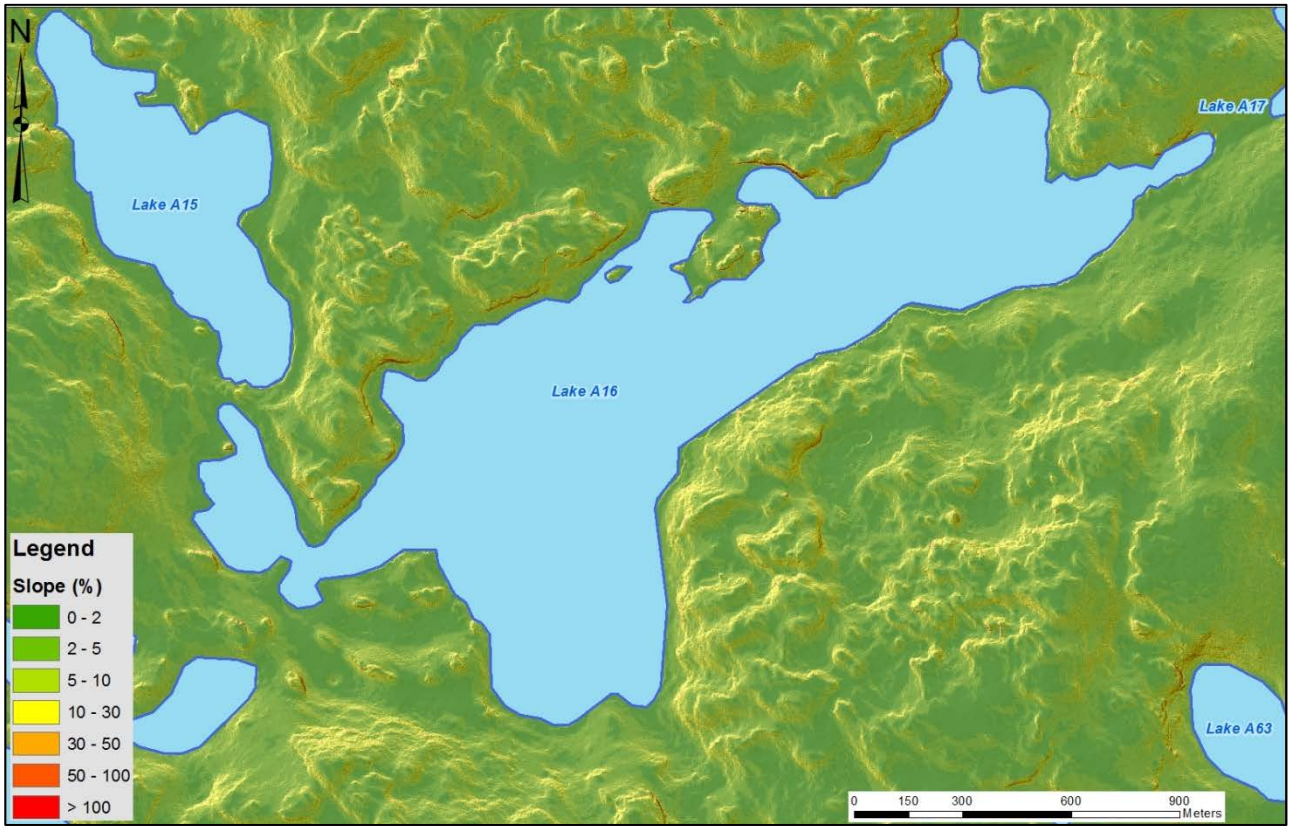


Figure 3-20: Lake A16 (Mammoth Lake) Shoreline Slope (Based on available DEM data [PhotoSat 2015])

3.3.4 Lake A17 (Whale Tail Lake)

The survey of Lake A17 focused on the lake outlet channel. Lake A17 has a surface area of approximately 166 ha, and drains into Lake A16 (Mammoth Lake). The Lake A17 field surveys included: outlet channel cross-section, outlet channel water surface slope, and existing and ordinary high lake water levels.

The outlet channel is approximately 60 m wide (Figure 3-21), with a poorly defined channel that is mainly comprised of boulders. The water flows through or under the boulders for almost the entire length of the channel. The slope of the water surface in the channel was measured and indicated a typical gradient of 0.18%.

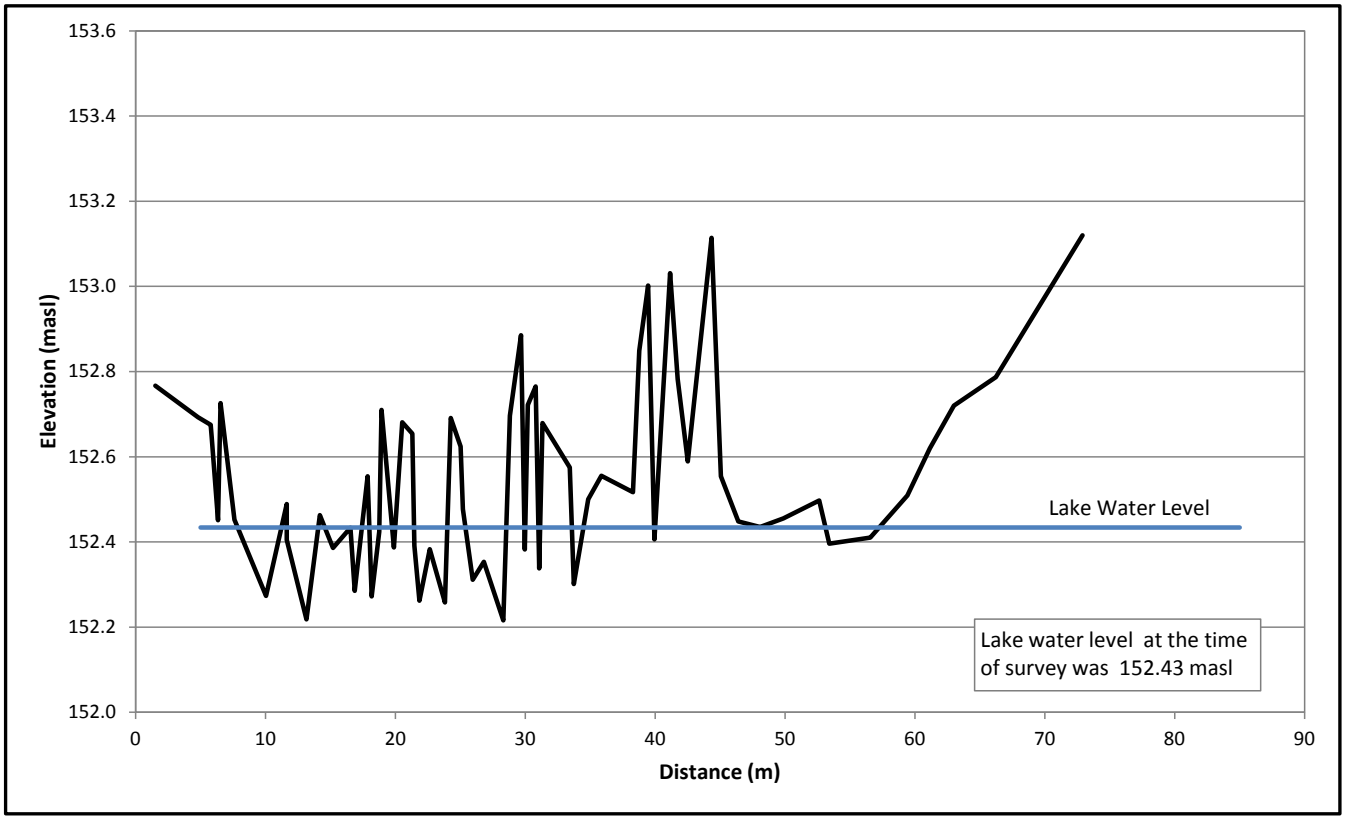


Figure 3-21: Lake A17 Outlet Channel Cross-Section, 2015

The water surface elevation at Lake A17 at the time of survey (i.e., 16 September 2015) was measured as 152.43 masl, and the ordinary high water level was estimated as 153.38 masl. A more detailed description of the lake shoreline is presented in Table 3-15, and is based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015). Terrain slopes calculated for the Lake A17 shoreline are shown in Figure 3-22.

Table 3-15: Lake A17 (Whale Tail Lake) Shoreline Description

Criteria	Description
Bank materials	Mostly boulders and cobble with limited vegetation. Vegetation along the shoreline is present only at the inlet from the smaller Lake A62, A59, A55, A53, A50, and A46.
Typical bank slopes	Most of the shoreline has shallow slopes, typically less than 2%. Only the northeast and southeast shorelines include some sections with slopes between 5% and 10%.
Typical shoreline geometry	Relatively straight shoreline with little sections with small and narrow bays.
Fetch	Maximum fetch length was estimated in GIS at approximately 2.3 km, on an approximate north – south direction.

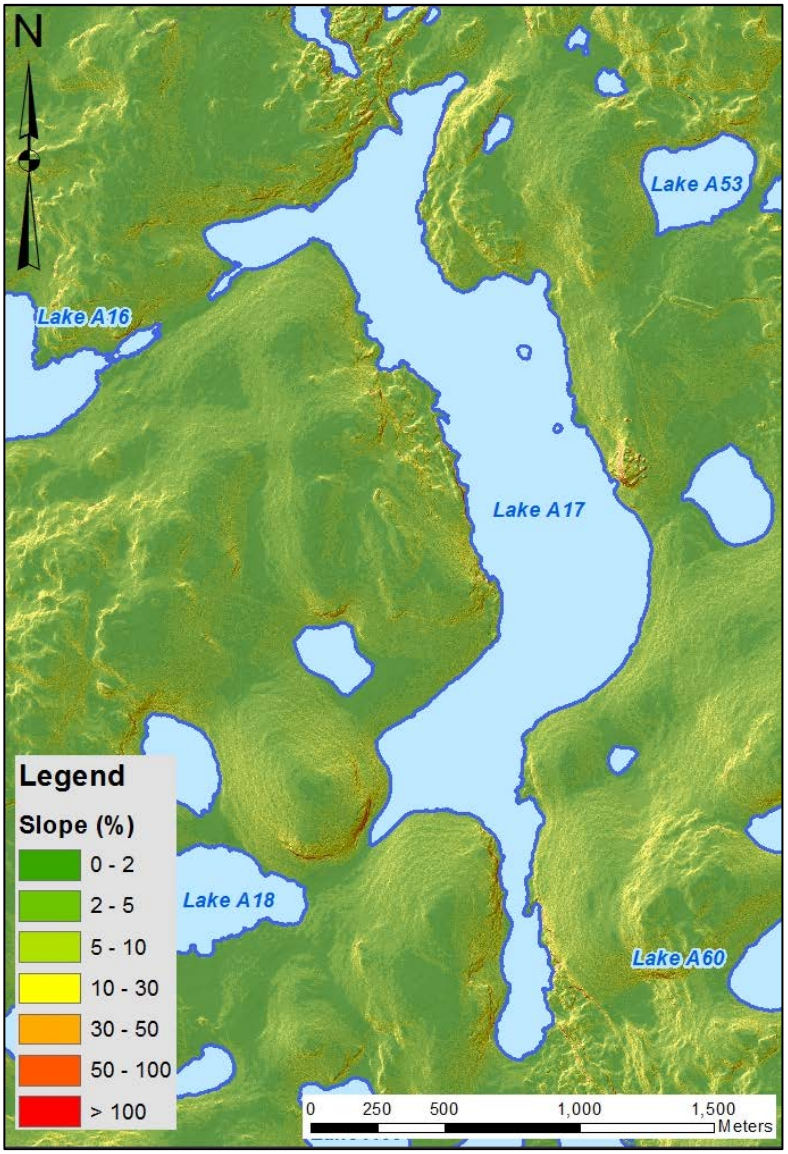


Figure 3-22: Lake A17 (Whale Tail Lake) Shoreline Slope (Based on available DEM data [PhotoSat 2015])

3.3.5 Lake A18

The survey of Lake A18 focused on the lake outlet channel. Lake A18 has a surface area of approximately 15.8 ha, and drains into Lake A17 (Whale Tail Lake). At this location, the field surveys included: outlet channel cross-section, outlet channel water surface slope, and existing and ordinary high lake water levels.

The outlet channel is approximately 45 m wide (Figure 3-23), with a poorly defined channel mainly comprised of boulders. The water flows through or under the boulders for almost the entire length of the channel. The slope of the water surface in the channel was measured and indicated a typical gradient of 0.42%.

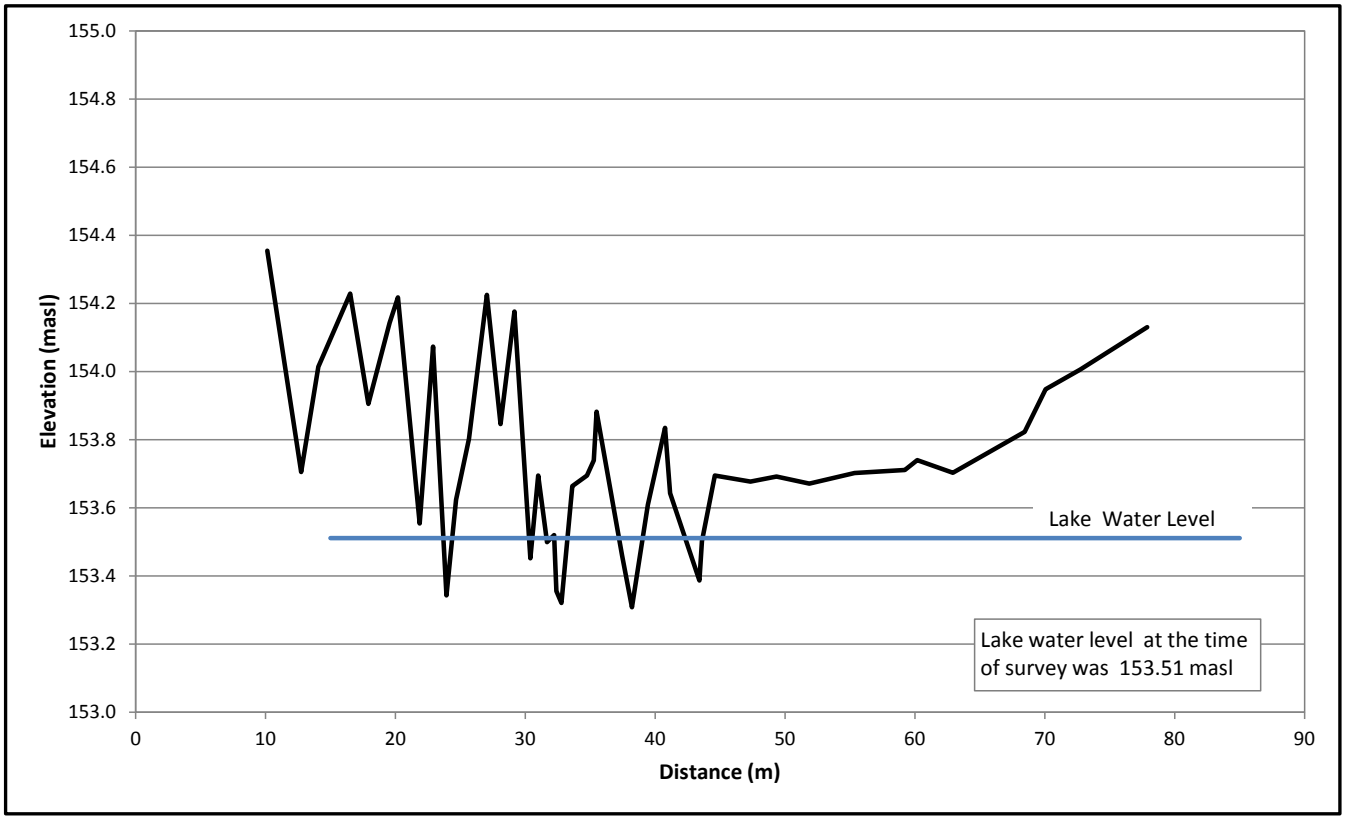


Figure 3-23: Lake A18 Outlet Channel Cross-Section, 2015

The water surface elevation at Lake A18 at the time of survey (i.e., 16 September 2015) was measured as 153.71 masl, and the ordinary high water level was estimated as 153.97 masl. A more detailed description of the lake shoreline is presented in Table 3-16, and is based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015). Terrain slopes calculated for the Lake A18 shoreline are shown in Figure 3-24.

Table 3-16: Lake A18 Shoreline Description

Criteria	Description
Bank materials	Mostly boulders and cobble with limited vegetation. The northeast shoreline and the inlet channel from Lake A63 have vegetation.
Typical bank slopes	Most of the shoreline has shallow slopes, typically less than 2%. Only the northeast and southeast shorelines show some sections with slopes between 5% and 10%.
Typical shoreline geometry	Irregular shoreline with little sections with small bays.
Fetch	Maximum fetch length was estimated in GIS at approximately 0.6 km, on an east-west direction.

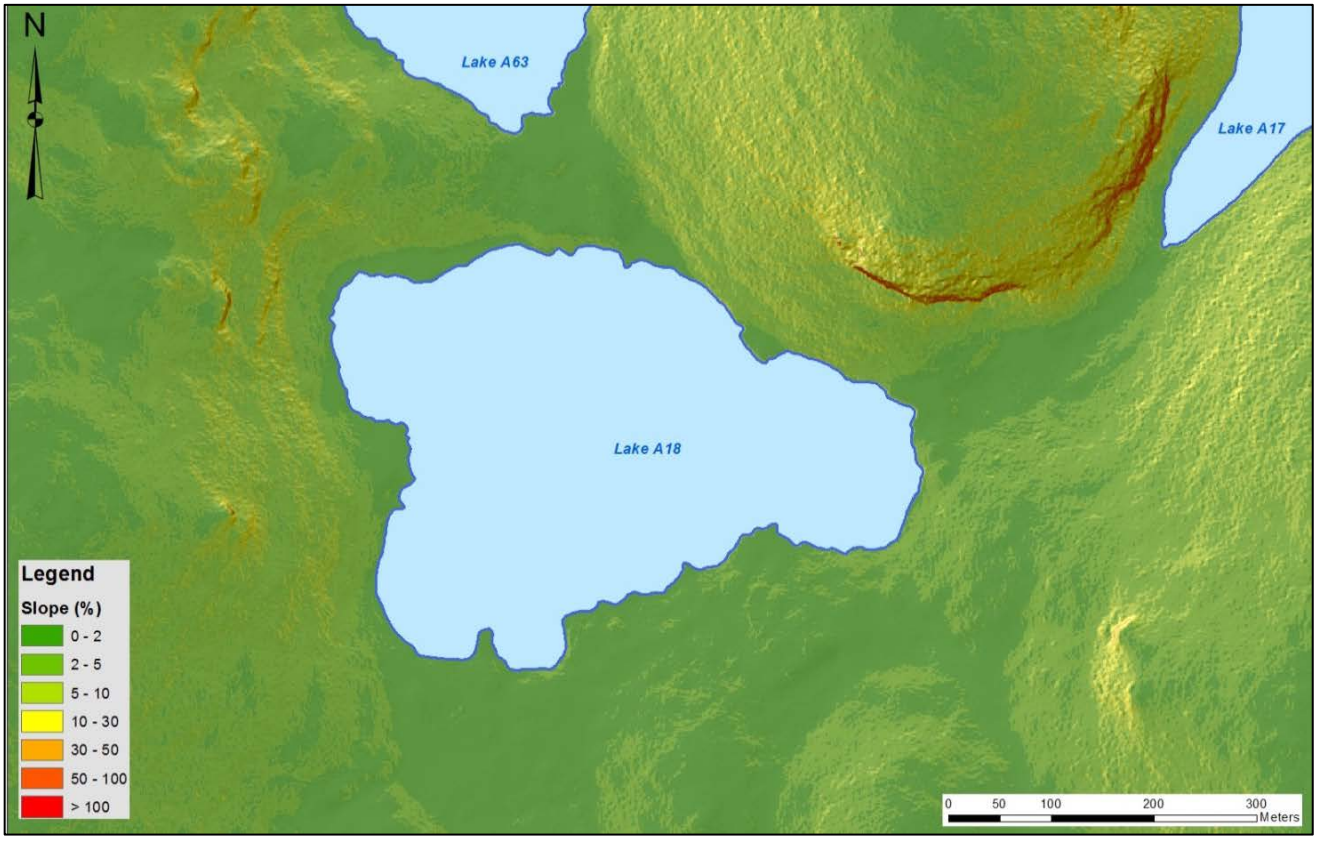


Figure 3-24: Lake A18 Shoreline Slope (Based on available DEM data [PhotoSat 2015])

3.3.6 Lake A45

The survey of Lake A45 focused on the lake outlet channel. Lake A45 has a surface area of approximately 2.9 ha, and drains into Lake A16. The Lake A45 field surveys included outlet channel cross-section, outlet channel water surface slope, and existing and ordinary high lake water levels.

The lake outlet channel is approximately 35 m wide, poorly defined and composed of a boulder garden. Its banks have organic materials with vegetation on top of the boulders Figure 3-25. The slope of the water surface in the outlet channel could not be measured because no water was observed and the flow was determined to be through the boulders and below the surface.

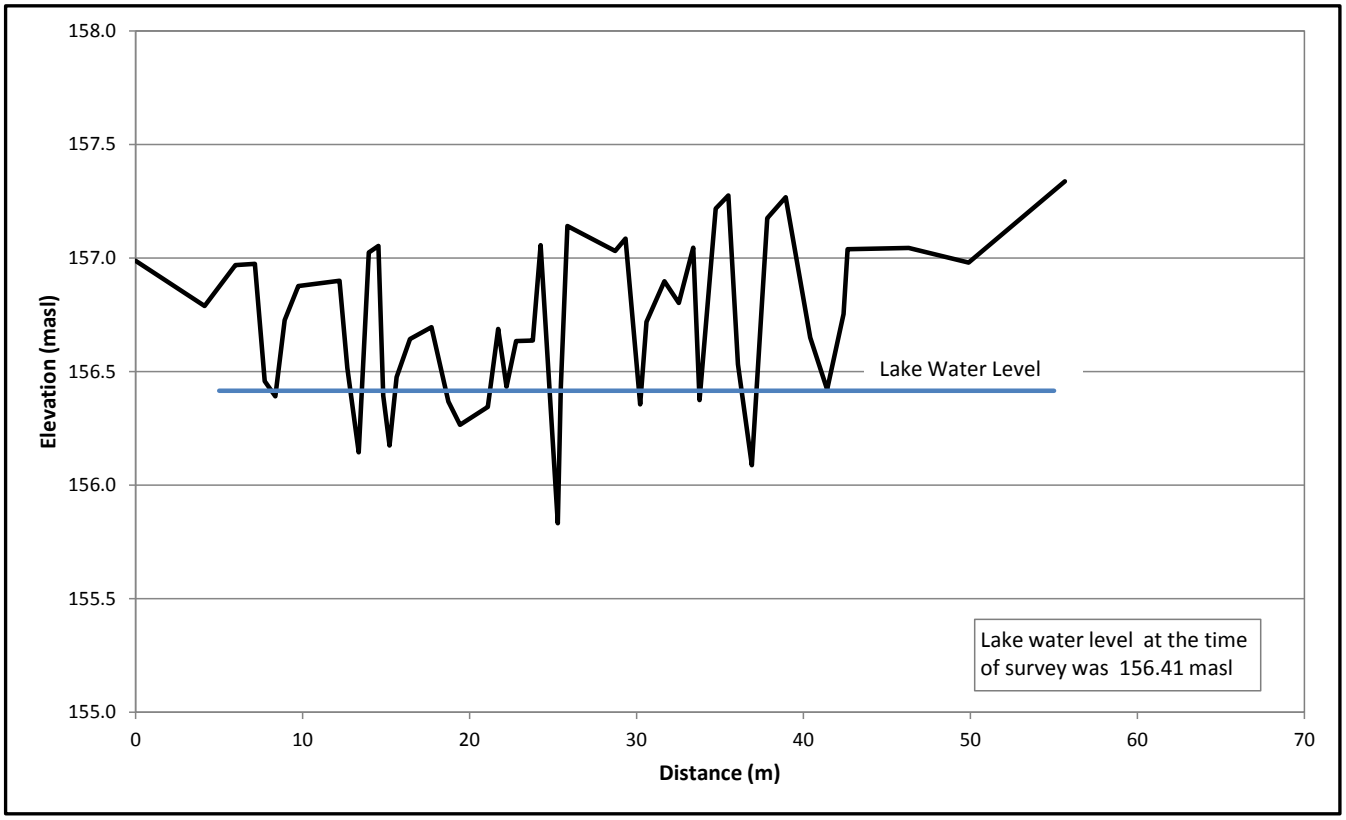


Figure 3-25: Lake A45 Outlet Channel Cross-Section, 2015

The water surface elevation at Lake A45 at the time of survey (i.e., 19 September 2015) was measured as 156.42 masl, and the ordinary high water level was estimated as 156.50 masl. A more detailed description of the lake shoreline is presented in Table 3-17, and is based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015). Terrain slopes calculated for the Lake A45 shoreline are shown in Figure 3-26.

Table 3-17: Lake A45 Shoreline Description

Criteria	Description
Bank materials	The majority of the shoreline is made of large boulders and cobble.
Typical bank slopes	Most of the shoreline has shallow slopes, typically less than 5%.
Typical shoreline geometry	Relatively straight shoreline with small and shallow bays.
Fetch	Maximum fetch length was estimated in GIS at approximately 0.26 km, on an approximate northeast – southwest direction.

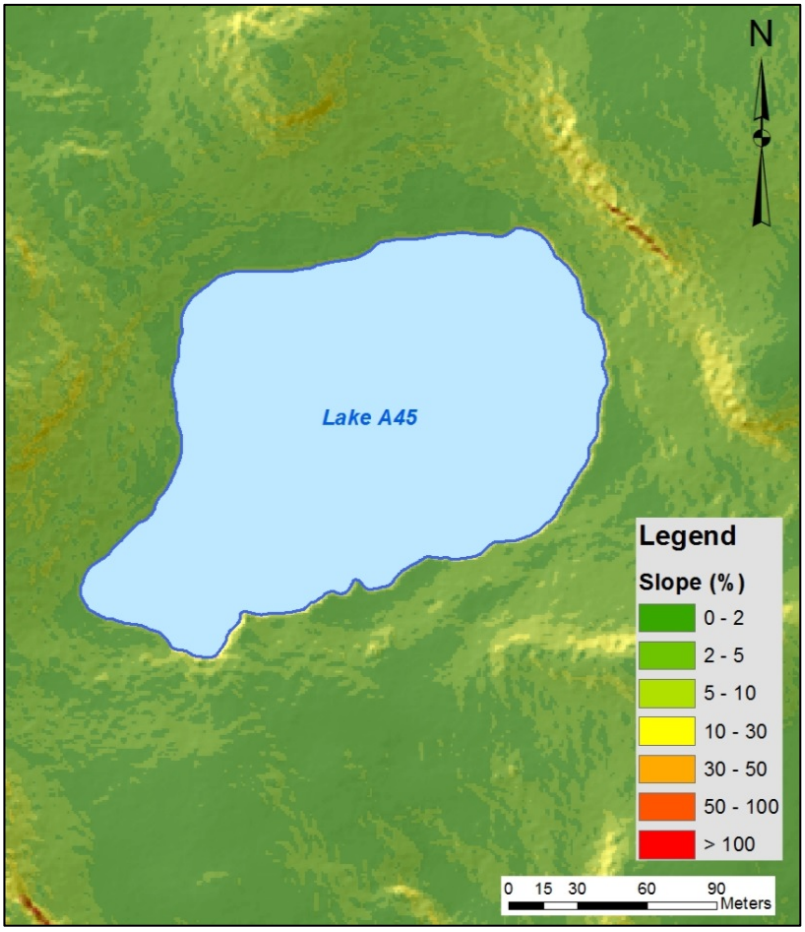


Figure 3-26: Lake A45 Shoreline Slope (Based on available DEM data [PhotoSat 2015])

3.3.7 Lake A69

The survey of Lake A69 focused on the lake outlet channel. Lake A69 has a surface area of approximately 31.8 ha, and drains into Lake DS1. At this location, the field surveys included outlet channel cross-section, and outlet channel water surface slope.

The lake outlet channel is approximately 35 m wide, well defined with mostly cobble and some boulders as streambed materials and with soils and organics on both banks Figure 3-27. The water surface slope in the outlet channel was estimated from the PhotoSat (2015) elevation data as 0.85%.

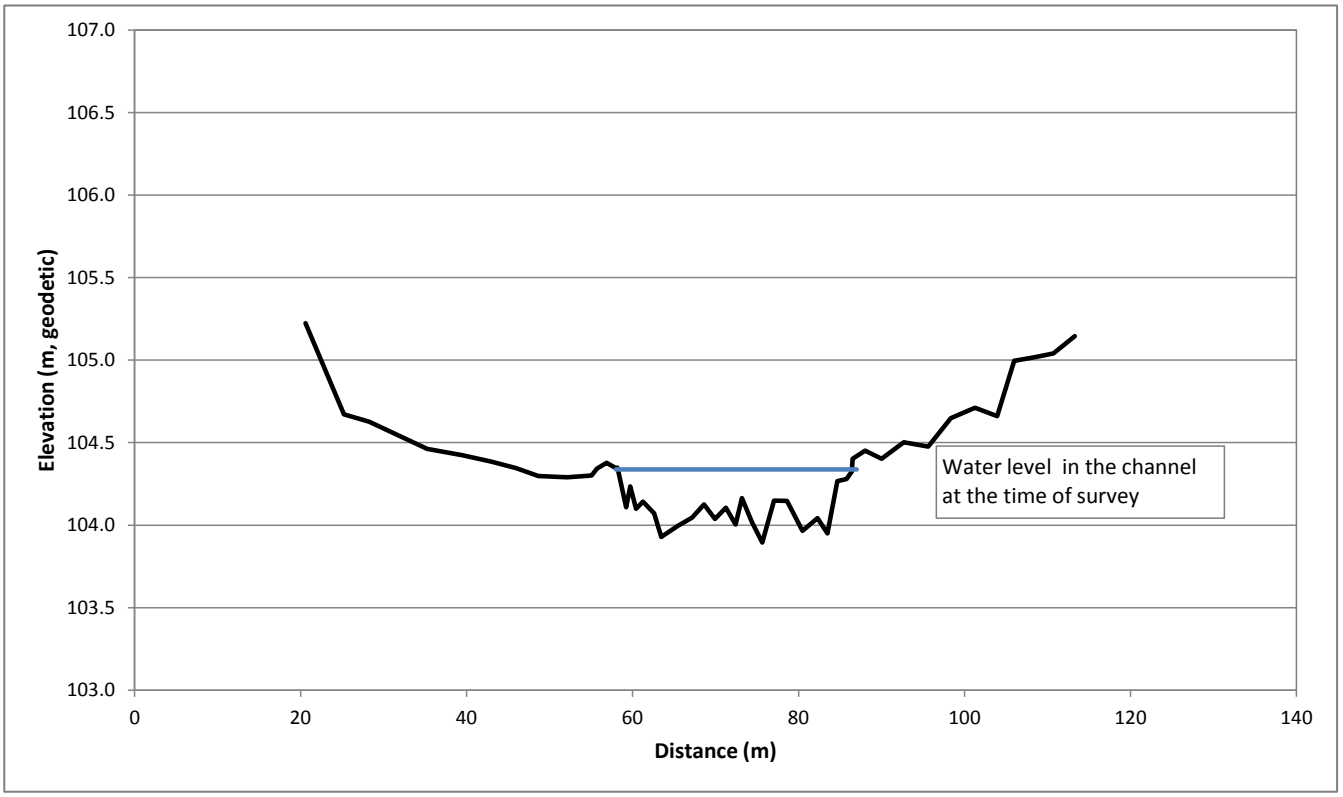


Figure 3-27: Lake A69 Outlet Channel Cross-Section, 2015

A more detailed description of the lake shoreline is presented in Table 3-18, and is based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015). Terrain slopes calculated for the Lake A69 shoreline are partially shown in Figure 3-28 based on available DEM data (PhotoSat 2015) (i.e., only partial DEM data were available for Lake A69).

Table 3-18: Lake A69 Shoreline Description

Criteria	Description
Bank materials	A mix of sand and gravel intercalated with smaller sections of cobble and boulders. Soils and vegetation are present on top of the bank, above the typical high water level elevation.
Typical bank slopes	Most of the shoreline has shallow slopes, typically less than 5%.
Typical shoreline geometry	Irregular shoreline with small and shallow bays.
Fetch	Maximum fetch length was estimated in GIS at approximately 1.3 km, on an approximate north – south direction.

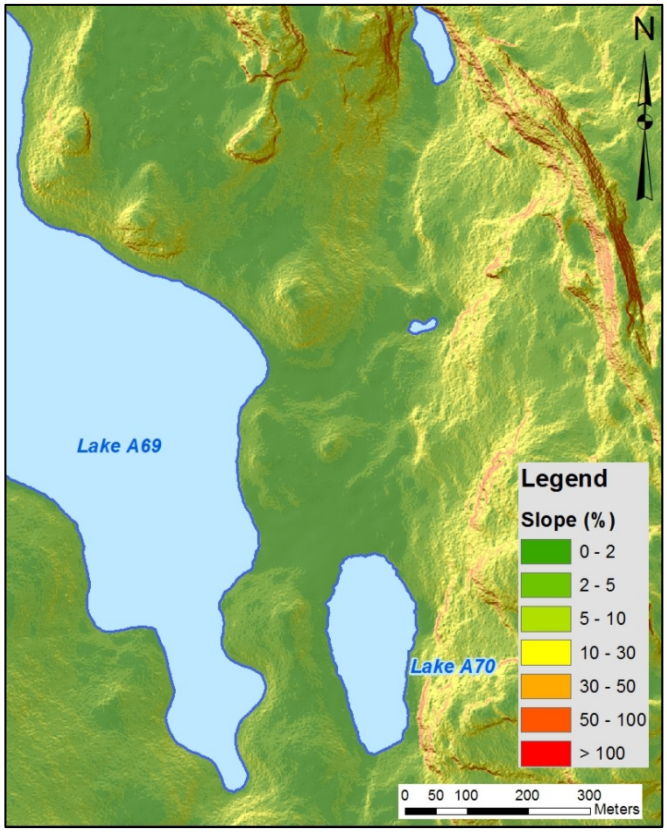


Figure 3-28: Lake A69 Shoreline Slope (Based on available DEM data [PhotoSat 2015])

3.3.8 Lake A72

The survey of Lake A72 focused on the lake outlet channel. Lake A72 has a surface area of approximately 3.2 ha, and drains into Lake A71. At this location, the field surveys included outlet channel cross-section, and outlet channel water surface slope.

The lake outlet channel is approximately 15 m wide, well defined with mostly sand and fines as streambed materials, and with soils and organics on both banks Figure 3-29. The measured water surface slope was 0.03%.

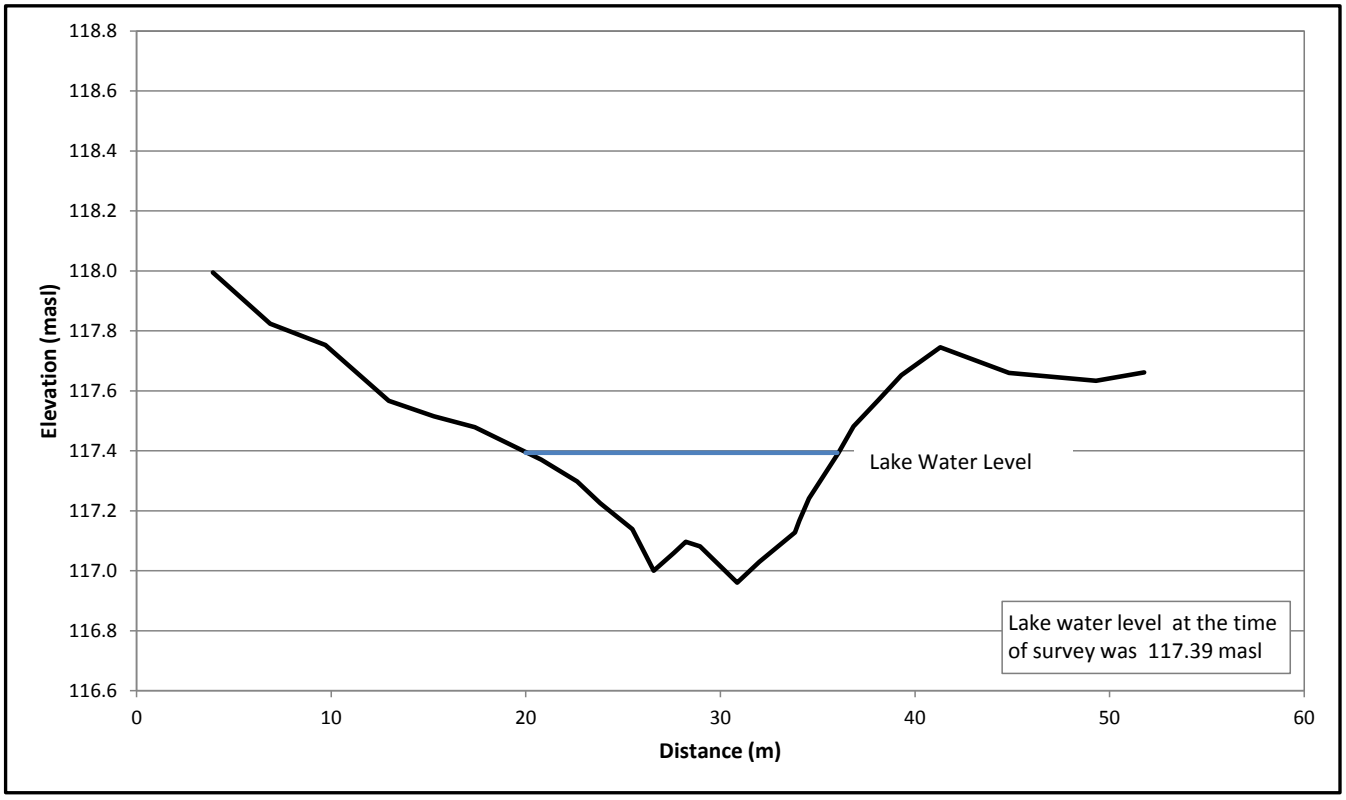


Figure 3-29: Lake A72 Outlet Channel Cross-Section, 2015

A more detailed description of the lake shoreline is presented in Table 3-19, and is based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015). Terrain slopes calculated for the Lake A72 shoreline are shown in Figure 3-30.

Table 3-19: Lake A72 Shoreline Description

Criteria	Description
Bank materials	Mostly sand and fines with vegetation on top. The inlet channel from upstream Lake A73 is comprised of boulders and cobble.
Typical bank slopes	Most of the shoreline has shallow slopes, typically less than 2%.
Typical shoreline geometry	Relatively straight shoreline with small sections of small and shallow bays.
Fetch	Maximum fetch length was estimated in GIS at approximately 0.3 km, on an approximate north – south direction.

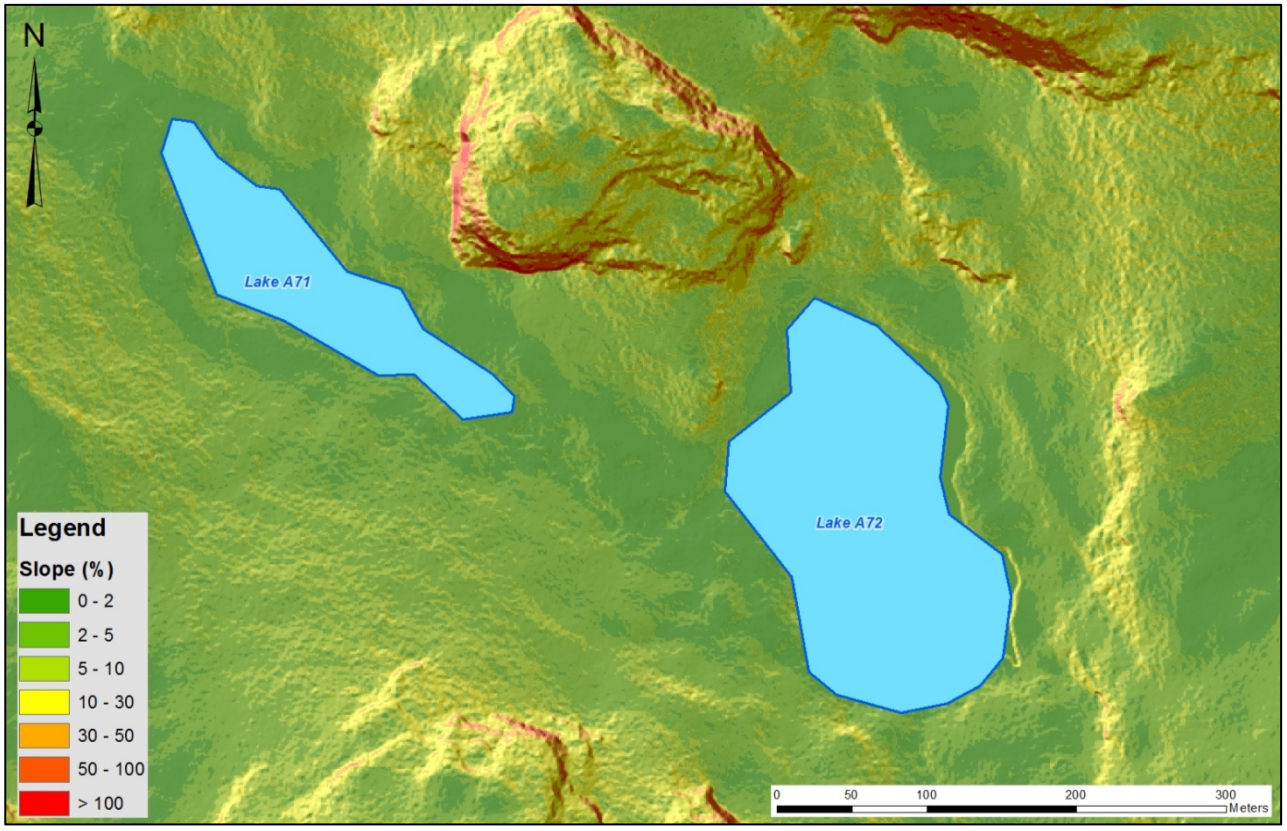


Figure 3-30: Lake A72 Shoreline Slope (Based on available DEM data [PhotoSat 2015])

3.3.9 Lake A76

The survey of Lake A76 focused on the lake shoreline and outlet channel. Lake A76 has a surface area of approximately 71 ha, and drains into Lake A10 through a main outlet at average and below average water levels. At water levels above average, Lake A12 has a secondary outlet that drains into Lake A75. Section 3.1 provides further details regarding these drainage patterns. The Lake A76 field surveys included: outlet channel cross-section, outlet channel water surface slope, lake shore normal transects and existing and ordinary high lake water levels.

The cross-section data for the main outlet was obtained from the RTK survey, and the cross-section data for the secondary channel was obtained from the PhotoSat (2015) elevation data. The main outlet channel is approximately 55 m wide and flows east, and the secondary outlet channel is approximately 35 m wide and flows west (Figure 3-31). The main outlet channel comprises a boulder garden with the majority of the flow through the boulders or below the surface. Further downstream, the flow becomes almost entirely subsurface with only higher flows reaching the surface. During the site visit, the flow was below the surface and no discharge measurement was possible.

The secondary channel flows west and is located at the opposite side of the lake. The channel was visually surveyed. The channel is a boulder garden with very large boulders. No signs of flow (neither low nor high flows) were visible and it was assumed that the flow occurs only at high lake water levels and only below the surface.

This may be confirmed by additional investigations during the high water season. The secondary channel is approximately 580 m long to Lake A75. It should be noted that the profile shown on Figure 3-31 is based on available DEM data (PhotoSat 2015), representative of the top of boulders rather than the actually channel bed.

The slope of the water surface in the main outlet channel could not be measured because no water was observed and the flow was determined to be through the boulders and below the surface. The next lake downstream along the main outlet channel is Lake A41, with the water surface elevation measured as 146.36 masl.

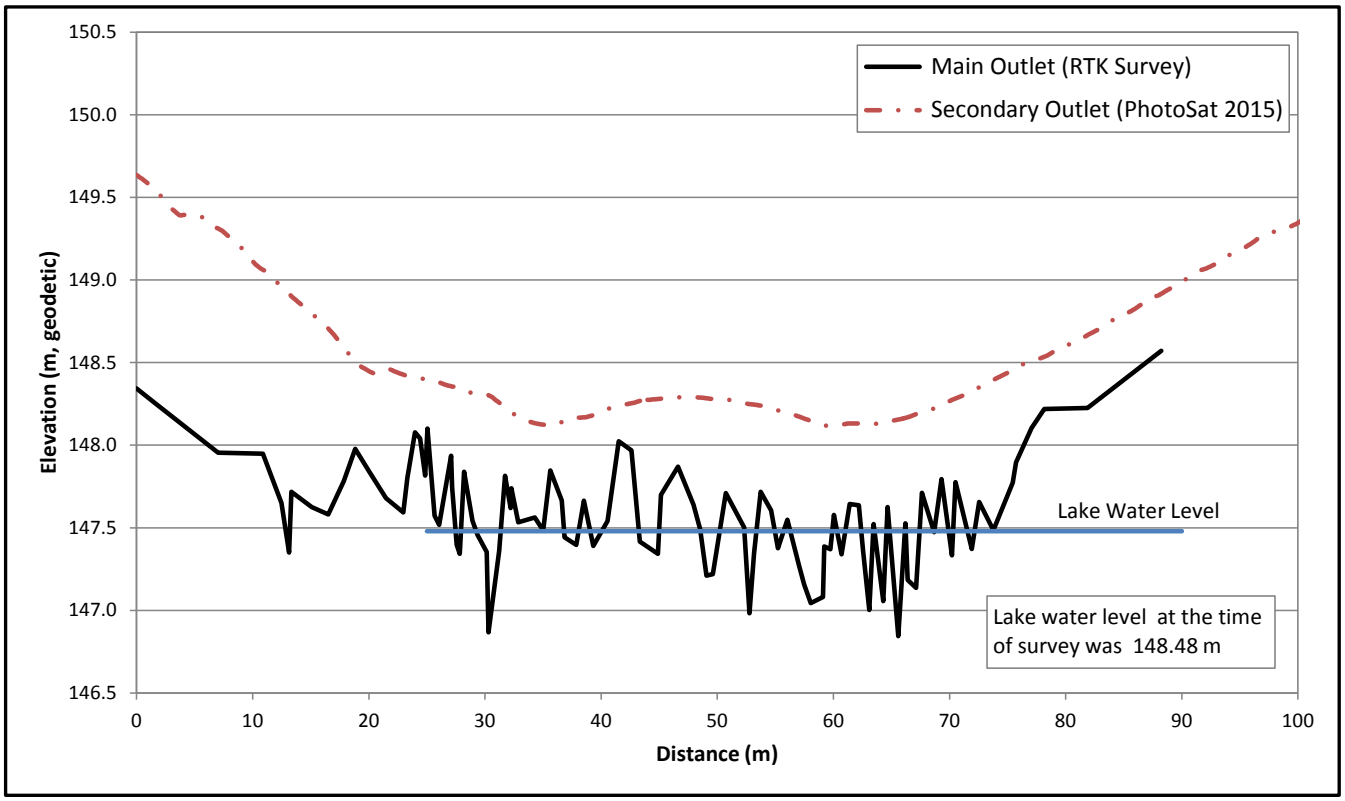


Figure 3-31: Lake A76 Main and Secondary Outlet Channel Cross-Sections, 2015

The water surface elevation at Lake A76 at the time of survey (i.e., 18 September 2015) was measured as 147.48 masl, and the ordinary high water level was estimated as 147.70 masl. A more detailed description of the lake shoreline is presented in Table 3-20, and is based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015). Terrain slopes calculated for the Lake A76 shoreline are shown in Figure 3-32.

Table 3-20: Lake A76 Shoreline Description

Criteria	Description
Bank materials	The majority of the shoreline is comprised of large boulders and cobble. Limited areas at the west part of the lake have sections with organic materials on top of the boulders and cobble. Small sections of bedrock are found at the main outlet, on the east side of the lake.
Typical bank slopes	Most of the shoreline has shallow slopes, typically less than 5% gradient. Several small sections on the west shoreline have higher slopes between 10% and 30% gradient. The bedrock shore from the east side is abrupt with slope gradients greater than 100% and near-vertical at some locations (limited visibility on Figure 3-32 due to figure scale).
Typical shoreline geometry	Mostly straight shoreline.
Fetch	Maximum fetch length was estimated in GIS at approximately 1.4 km, on a northeast – southwest direction.

Two shore-normal transects were surveyed on the south shoreline, one closer to the lake inlet (East Transect), and a second one closer to the secondary outlet (West Transect) (Figure 3-33). At both locations, the shoreline is composed of boulders intercalated with cobble. The terrain slopes at the transects are similar, typically less than 5% gradient.

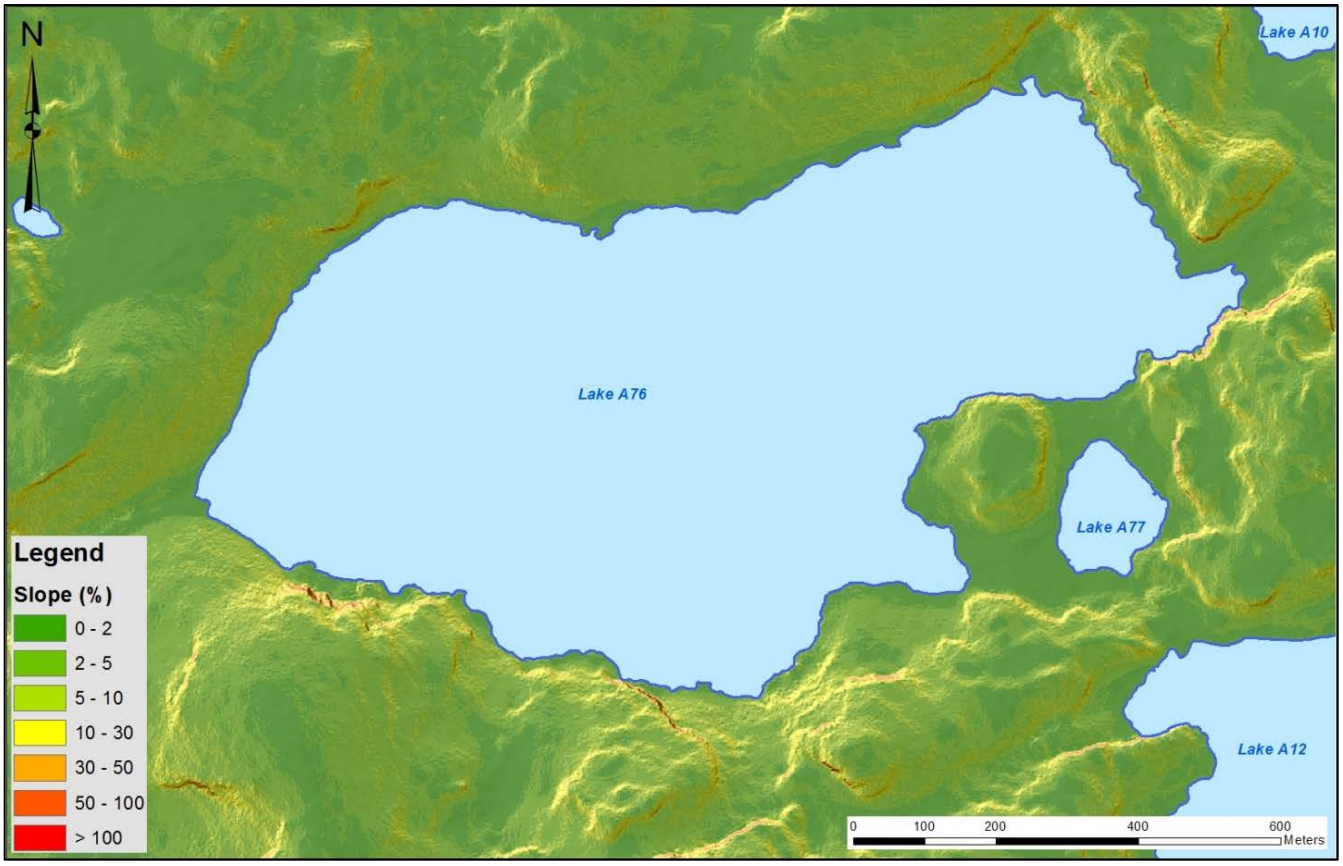


Figure 3-32: Lake A76 Shoreline Slope (Based on available DEM data [PhotoSat 2015])

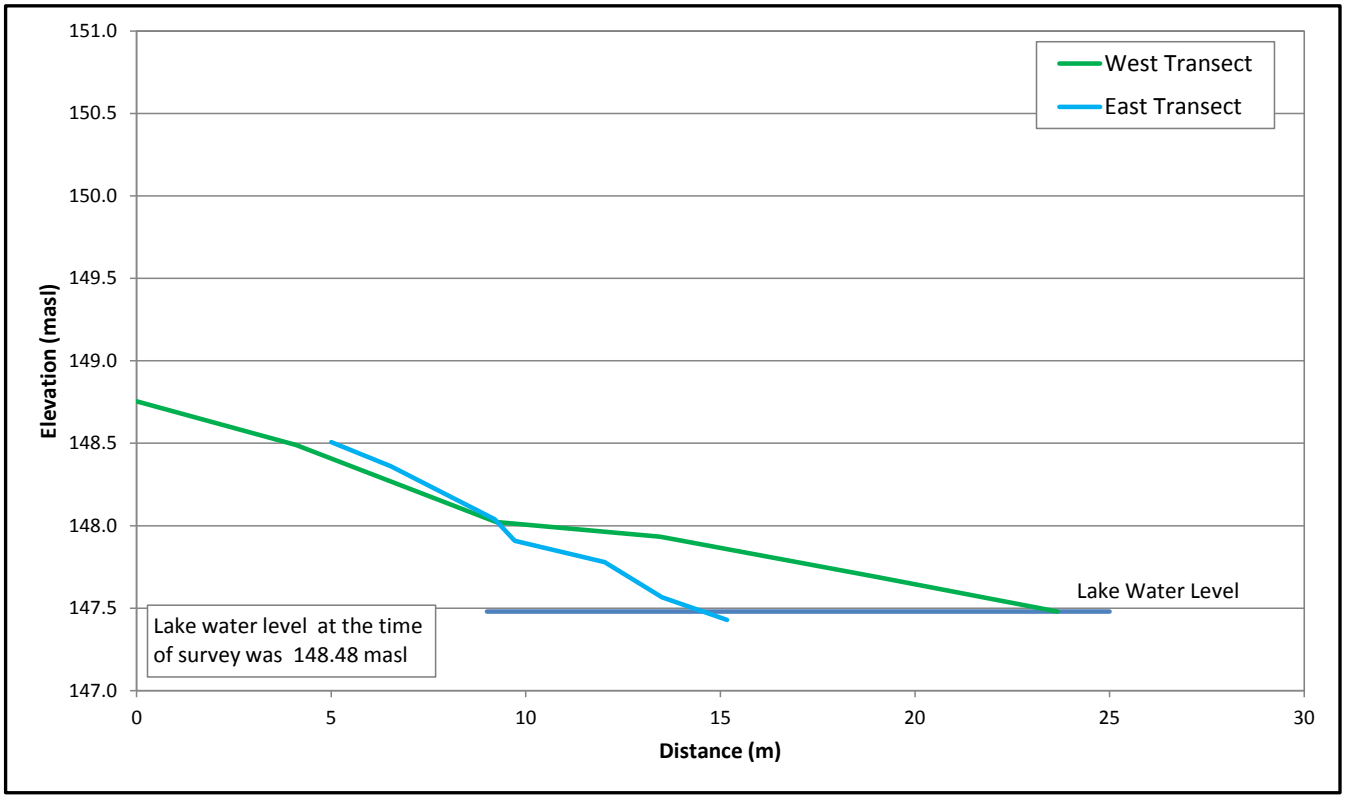


Figure 3-33: Cross-section Profiles of the Surveyed Transects, Lake A76

3.4 Water Balance Model

Frequency analyses of the hydrology model results (floods and droughts) were completed for key lakes in the Hydrology BSA to provide a basis for environmental impact assessment and engineering design. The following parameters were examined:

- maximum and mean daily outflow volumes for open water months, and corresponding stages;
- annual 7-day and 14-day flood discharges, and corresponding stages; and
- annual 30-day, 60-day, and 90-day low flow discharges for the period of July, August, and September, and corresponding stages.

While results are available at all modeled lakes (Appendix B), results are only presented herein at key locations, including Lake A5, Lake A15, Lake A17 (Whale Tail Lake), Lake A18, Lake A69, Lake C8, Lake C38, and Lake DS1.

3.4.1 Lake A5

Results for Lake A5 are presented in Table 3-21 (monthly mean discharges), Table 3-22 (peak and low flow discharges), Table 3-23 (monthly mean stages), and Table 3-24 (peak and low flow stages). Results are summarized in Figure 3-34 (flow regimes) and Figure 3-35 (stage regimes).

Table 3-21: Monthly Mean Discharges at the Lake A5 Outlet

Condition	Return Period (years)	Monthly Mean Discharge (m^3/d)					
		May	June	July	August	September	October
Wet	100	56,200	271,000	148,000	84,700	108,000	55,100
	50	44,700	254,000	128,000	77,100	97,800	49,900
	20	30,300	228,000	102,000	66,200	82,700	42,500
	10	20,200	205,000	82,900	56,900	70,300	36,200
	5	10,800	177,000	64,300	46,400	56,500	29,100
Median	2	122	128,000	41,100	29,000	34,400	17,400
Dry	5	0	84,400	30,100	15,800	18,800	8,680
	10	0	65,500	27,600	10,900	13,400	5,420
	20	0	52,400	26,500	7,800	10,200	3,410
	50	0	40,600	25,900	5,350	7,750	1,820
	100	0	34,400	25,800	4,220	6,700	1,090

m^3/d= cubic metres per day.

Table 3-22: Peak and Low Flow Discharges at the Lake A5 Outlet

Condition	Return Period (years)	Peak Daily Q (m^3/s)	7-Day Mean Peak Q (m^3/d)	14-Day Mean Peak Q (m^3/d)	30-Day Low Flow Q (m^3/d)	60-Day Low Flow Q (m^3/d)	90-Day Low Flow Q (m^3/d)
Wet	100	15.8	828,000	566,000	65,400	70,400	84,700
	50	13.8	757,000	521,000	57,200	65,100	78,500
	20	11.3	655,000	456,000	46,700	57,200	69,600
	10	9.5	570,000	401,000	38,900	50,500	61,900
	5	7.73	474,000	338,000	31,200	42,500	53,100
Median	2	5.27	315,000	233,000	20,100	28,600	38,100
Dry	5	3.59	197,000	153,000	12,300	17,100	26,200
	10	2.91	154,000	122,000	9,120	12,400	21,500
	20	2.42	127,000	102,000	6,810	9,190	18,500
	50	1.94	106,000	86,700	4,500	6,460	16,000
	100	1.65	96,900	79,400	3,110	5,100	14,800

Q= discharge; m^3/s= cubic metres per second; m^3/d= cubic metres per day.

Table 3-23: Monthly Mean Stages at the Lake A5 Outlet

Condition	Return Period (years)	Monthly Mean Stage (m)					
		May	June	July	August	September	October
Wet	100	0.368	0.571	0.482	0.413	0.442	0.366
	50	0.345	0.561	0.463	0.402	0.430	0.356
	20	0.309	0.544	0.435	0.385	0.410	0.340
	10	0.276	0.529	0.410	0.369	0.392	0.325
	5	0.232	0.507	0.382	0.349	0.368	0.306
Median	2	0.066	0.463	0.337	0.306	0.321	0.265
Dry	5	-	0.412	0.309	0.258	0.271	0.218
	10	-	0.384	0.301	0.232	0.246	0.191
	20	-	0.361	0.298	0.212	0.228	0.168
	50	-	0.336	0.296	0.190	0.211	0.141
	100	-	0.321	0.296	0.178	0.203	0.122

m= metres.

Table 3-24: Peak and Low Flow Stages at the Lake A5 Outlet

Condition	Return Period (years)	Peak Daily Stage (m)	7-Day Mean Peak Stage (m)	14-Day Mean Peak Stage (m)	30-Day Low Flow Stage (m)	60-Day Low Flow Q Stage (m)	90-Day Low Flow Stage (m)
Wet	100	0.899	0.781	0.702	0.384	0.392	0.413
	50	0.865	0.762	0.686	0.370	0.383	0.404
	20	0.818	0.732	0.661	0.349	0.370	0.391
	10	0.779	0.704	0.638	0.332	0.357	0.378
	5	0.736	0.668	0.608	0.312	0.340	0.362
Median	2	0.661	0.596	0.548	0.276	0.304	0.330
Dry	5	0.594	0.523	0.487	0.240	0.264	0.297
	10	0.560	0.488	0.457	0.221	0.241	0.281
	20	0.531	0.462	0.435	0.204	0.221	0.269
	50	0.500	0.439	0.415	0.181	0.201	0.259
	100	0.477	0.428	0.405	0.164	0.188	0.253

m= metres.

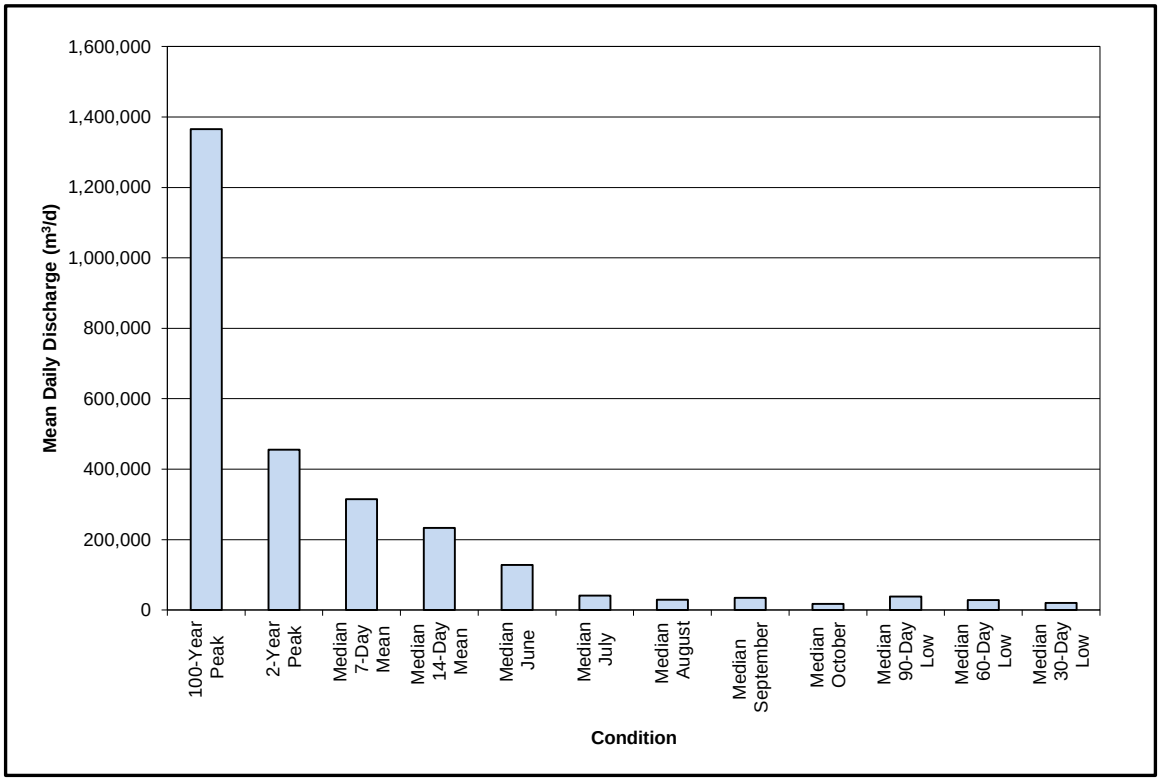


Figure 3-34: Derived Flow Regimes at Lake A5

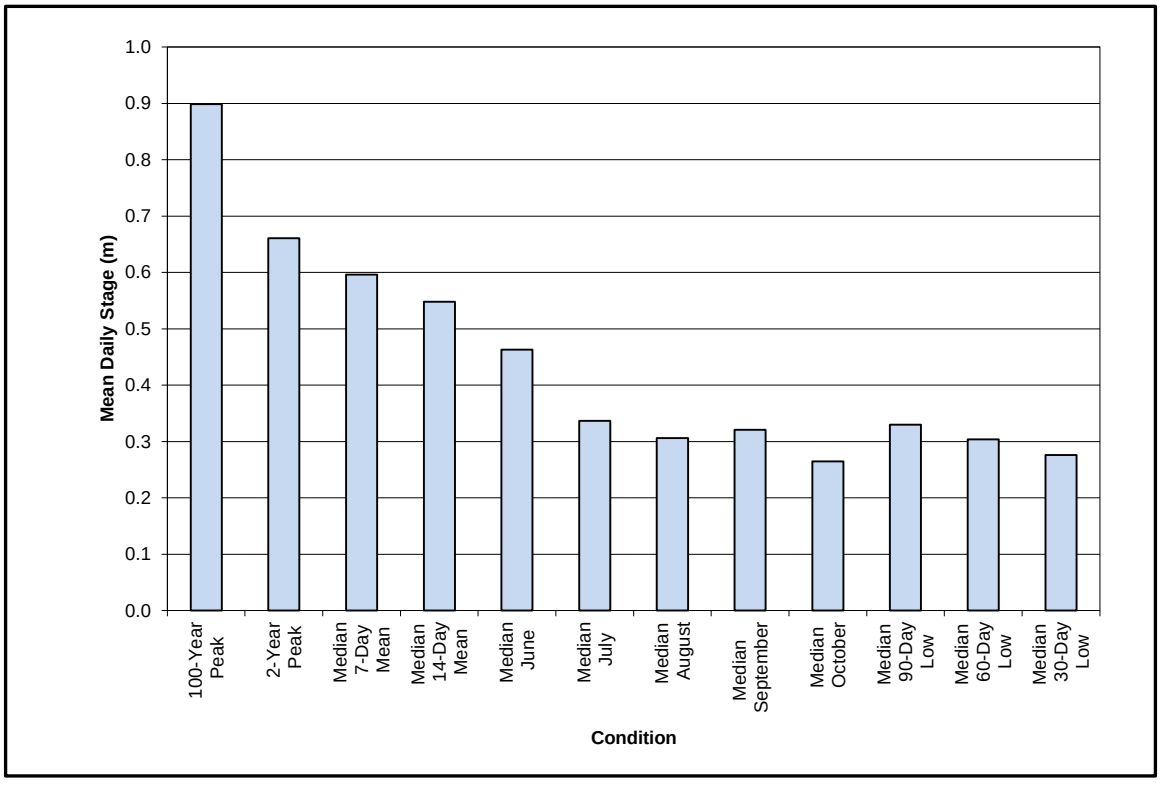


Figure 3-35: Derived Stage Regimes at Lake A5

3.4.2 Lake A15

Results for Lake A15 are presented in Table 3-25 (monthly mean discharges), Table 3-26 (peak and low flow discharges), Table 3-27 (monthly mean stages), and Table 3-28 (peak and low flow stages). Results are summarized in Figure 3-36 (flow regimes) and Figure 3-37 (stage regimes).

Table 3-25: Monthly Mean Discharges at the Lake A15 Outlet

Condition	Return Period (years)	Monthly Mean Discharge (m^3/d)					
		May	June	July	August	September	October
Wet	100	29,700	201,000	127,000	65,700	85,100	44,800
	50	23,200	188,000	109,000	59,500	76,700	40,600
	20	15,300	169,000	86,400	50,800	64,700	34,700
	10	9,940	152,000	69,700	43,400	54,800	29,600
	5	5,120	132,000	53,800	35,200	43,900	23,900
Median	2	0	95,400	34,500	21,800	26,400	14,300
Dry	5	0	62,800	25,900	11,900	14,000	7,030
	10	0	48,400	24,100	8,390	9,630	4,290
	20	0	38,400	23,300	6,240	7,070	2,580
	50	0	29,200	23,000	4,570	5,130	1,220
	100	0	24,300	22,800	3,830	4,290	583

m^3/d= cubic metres per day.

Table 3-26: Peak and Low Flow Discharges at the Lake A15 Outlet

Condition	Return Period (years)	Peak Daily Q (m^3/s)	7-Day Mean Peak Q (m^3/d)	14-Day Mean Peak Q (m^3/d)	30-Day Low Flow Q (m^3/d)	60-Day Low Flow Q (m^3/d)	90-Day Low Flow Q (m^3/d)
Wet	100	9.37	593,000	414,000	51,800	54,600	68,300
	50	8.51	541,000	380,000	45,300	50,500	63,200
	20	7.29	467,000	332,000	37,000	44,400	55,800
	10	6.26	405,000	291,000	30,800	39,200	49,500
	5	5.11	334,000	245,000	24,700	33,000	42,400
Median	2	3.22	218,000	168,000	16,000	22,200	30,300
Dry	5	1.82	131,000	110,000	9,840	13,300	20,900
	10	1.32	98,700	88,000	7,320	9,530	17,300
	20	1.01	78,900	74,500	5,500	7,040	15,100
	50	0.77	63,300	63,700	3,690	4,890	13,200
	100	0.66	56,200	58,700	2,590	3,810	12,400

Q= discharge; m^3/s= cubic metres per second; m^3/d= cubic metres per day.

Table 3-27: Monthly Mean Stages at the Lake A15 Outlet

Condition	Return Period (years)	Monthly Mean Stage (m)					
		May	June	July	August	September	October
Wet	100	0.485	0.731	0.663	0.575	0.608	0.530
	50	0.460	0.721	0.641	0.563	0.595	0.519
	20	0.421	0.704	0.610	0.544	0.573	0.502
	10	0.384	0.689	0.583	0.526	0.553	0.485
	5	0.333	0.668	0.551	0.503	0.528	0.463
Median	2	-	0.623	0.501	0.454	0.473	0.415
Dry	5	-	0.570	0.471	0.399	0.413	0.356
	10	-	0.539	0.464	0.370	0.381	0.320
	20	-	0.513	0.461	0.347	0.357	0.287
	50	-	0.483	0.459	0.325	0.333	0.245
	100	-	0.465	0.458	0.313	0.320	0.209

m= metres.

Table 3-28: Peak and Low Flow Stages at the Lake A15 Outlet

Condition	Return Period (years)	Peak Daily Stage (m)	7-Day Mean Peak Stage (m)	14-Day Mean Peak Stage (m)	30-Day Low Flow Stage (m)	60-Day Low Flow Q Stage (m)	90-Day Low Flow Stage (m)
Wet	100	0.986	0.922	0.854	0.547	0.553	0.580
	50	0.966	0.904	0.838	0.531	0.544	0.570
	20	0.934	0.876	0.814	0.509	0.529	0.555
	10	0.904	0.850	0.792	0.489	0.515	0.541
	5	0.866	0.815	0.763	0.466	0.496	0.524
Median	2	0.784	0.744	0.704	0.425	0.456	0.487
Dry	5	0.694	0.667	0.642	0.383	0.408	0.450
	10	0.647	0.628	0.612	0.359	0.380	0.432
	20	0.611	0.598	0.591	0.338	0.356	0.420
	50	0.576	0.571	0.571	0.310	0.329	0.408
	100	0.557	0.556	0.561	0.287	0.312	0.402

m= metres.

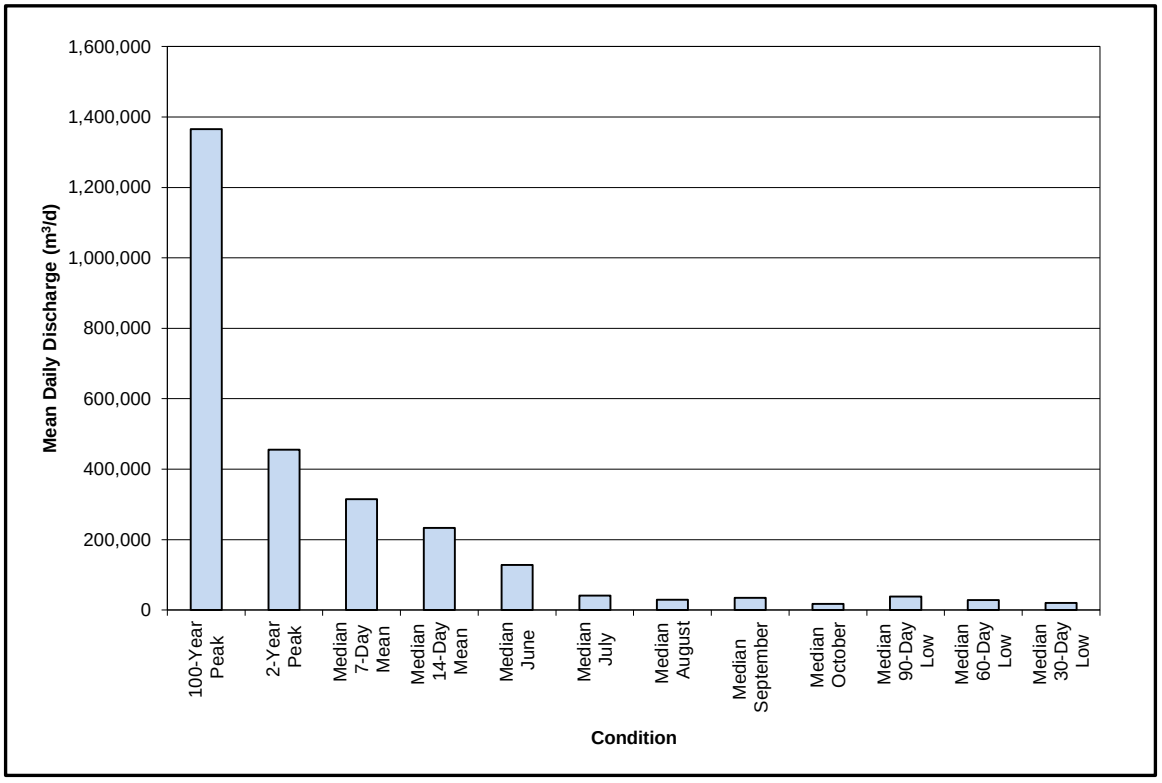


Figure 3-36: Derived Flow Regimes at Lake A15

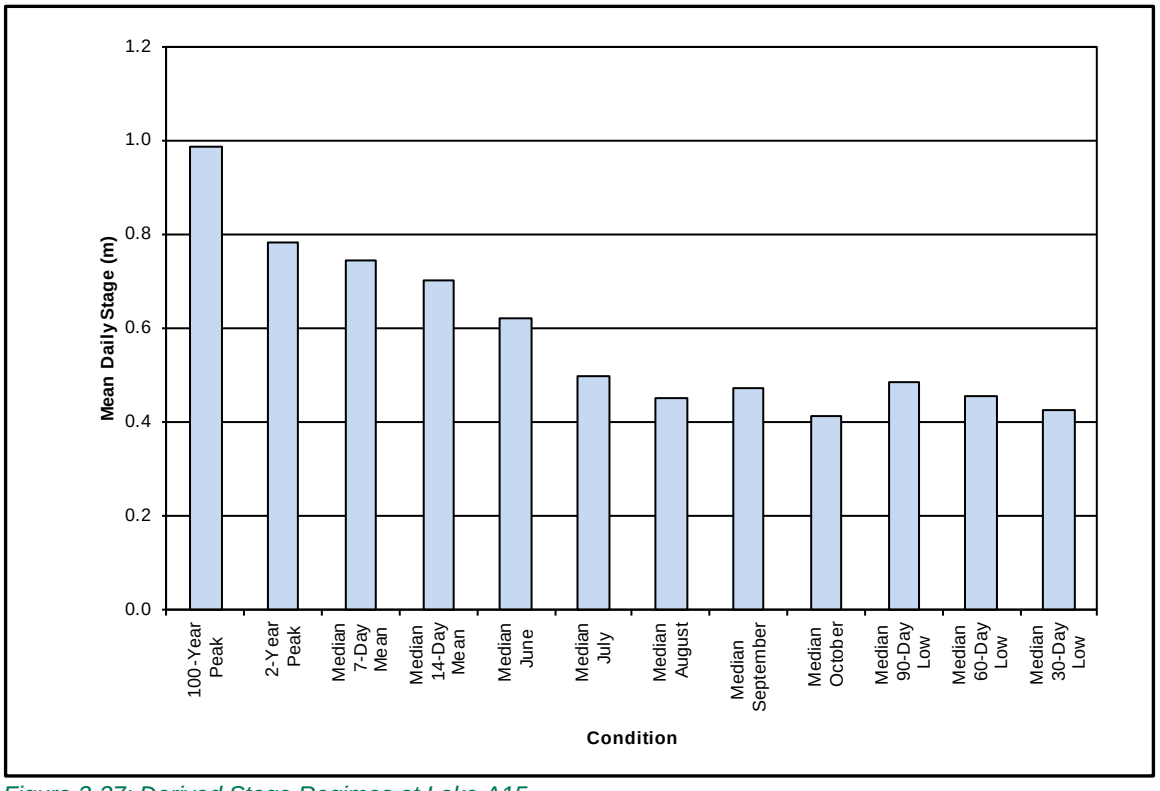


Figure 3-37: Derived Stage Regimes at Lake A15

3.4.3 Lake A17 (Whale Tail Lake)

Results for Lake A17 (Whale Tail Lake) are presented in Table 3-29 (monthly mean discharges), Table 3-30 (peak and low flow discharges), Table 3-31 (monthly mean stages), and Table 3-32 (peak and low flow stages). Results are summarized in Figure 3-38 (flow regimes) and Figure 3-39 (stage regimes).

Table 3-29: Monthly Mean Discharges at the Lake A17 (Whale Tail Lake) Outlet

Condition	Return Period (years)	Monthly Mean Discharge (m^3/d)					
		May	June	July	August	September	October
Wet	100	14,400	122,000	75,200	39,500	56,700	30,200
	50	11,100	114,000	63,700	35,600	49,500	26,900
	20	7,070	102,000	50,200	29,900	40,100	22,300
	10	4,420	92,300	41,100	25,200	33,100	18,500
	5	2,140	80,200	32,600	19,900	25,900	14,300
Median	2	0	57,800	21,600	11,400	15,400	8,090
Dry	5	0	37,700	14,600	5,280	7,810	4,100
	10	0	28,700	11,900	3,090	4,660	2,780
	20	0	22,400	9,980	1,780	2,360	2,030
	50	0	16,600	8,140	784	59	1,450
	100	0	13,400	7,050	343	0	1,200

m^3/d= cubic metres per day.

Table 3-30: Peak and Low Flow Discharges at the Lake A17 (Whale Tail Lake) Outlet

Condition	Return Period (years)	Peak Daily Q (m^3/s)	7-Day Mean Peak Q (m^3/d)	14-Day Mean Peak Q (m^3/d)	30-Day Low Flow Q (m^3/d)	60-Day Low Flow Q (m^3/d)	90-Day Low Flow Q (m^3/d)
Wet	100	6.17	355,000	250,000	31,100	32,100	40,800
	50	5.58	324,000	230,000	26,500	29,500	37,700
	20	4.74	281,000	202,000	20,900	25,700	33,200
	10	4.04	245,000	177,000	16,900	22,500	29,300
	5	3.26	203,000	150,000	13,000	18,600	24,900
Median	2	2.01	134,000	104,000	7,790	11,900	17,400
Dry	5	1.10	81,700	68,600	4,280	6,320	11,500
	10	0.78	62,000	55,200	2,880	4,020	9,210
	20	0.59	49,700	46,900	1,890	2,480	7,750
	50	0.44	39,900	40,200	906	1,150	6,550
	100	0.38	35,400	37,100	320	489	5,980

Q= discharge; m^3/s= cubic metres per second; m^3/d= cubic metres per day.

Table 3-31: Monthly Mean Stages at the Lake A17 (Whale Tail Lake) Outlet

Condition	Return Period (years)	Monthly Mean Stage (m)					
		May	June	July	August	September	October
Wet	100	0.458	0.847	0.737	0.612	0.679	0.566
	50	0.424	0.831	0.702	0.594	0.653	0.548
	20	0.373	0.804	0.656	0.565	0.615	0.519
	10	0.326	0.782	0.619	0.538	0.582	0.492
	5	0.264	0.751	0.579	0.502	0.542	0.457
Median	2	-	0.683	0.514	0.428	0.466	0.387
Dry	5	-	0.604	0.459	0.343	0.384	0.319
	10	-	0.558	0.433	0.294	0.331	0.285
	20	-	0.520	0.412	0.250	0.272	0.260
	50	-	0.477	0.388	0.198	0.094	0.236
	100	-	0.448	0.372	0.156	-	0.224

m= metres.

Table 3-32: Peak and Low Flow Stages at the Lake A17 (Whale Tail Lake) Outlet

Condition	Return Period (years)	Peak Daily Stage (m)	7-Day Mean Peak Stage (m)	14-Day Mean Peak Stage (m)	30-Day Low Flow Stage (m)	60-Day Low Flow Q Stage (m)	90-Day Low Flow Stage (m)
Wet	100	1.296	1.152	1.042	0.571	0.576	0.618
	50	1.259	1.122	1.017	0.545	0.563	0.604
	20	1.201	1.077	0.979	0.509	0.541	0.582
	10	1.147	1.035	0.943	0.479	0.520	0.561
	5	1.078	0.981	0.899	0.444	0.493	0.536
Median	2	0.938	0.870	0.809	0.383	0.433	0.483
Dry	5	0.788	0.755	0.717	0.323	0.361	0.429
	10	0.714	0.697	0.674	0.288	0.317	0.402
	20	0.659	0.654	0.643	0.255	0.276	0.383
	50	0.606	0.614	0.615	0.206	0.221	0.365
	100	0.579	0.593	0.601	0.153	0.173	0.355

m= metres.

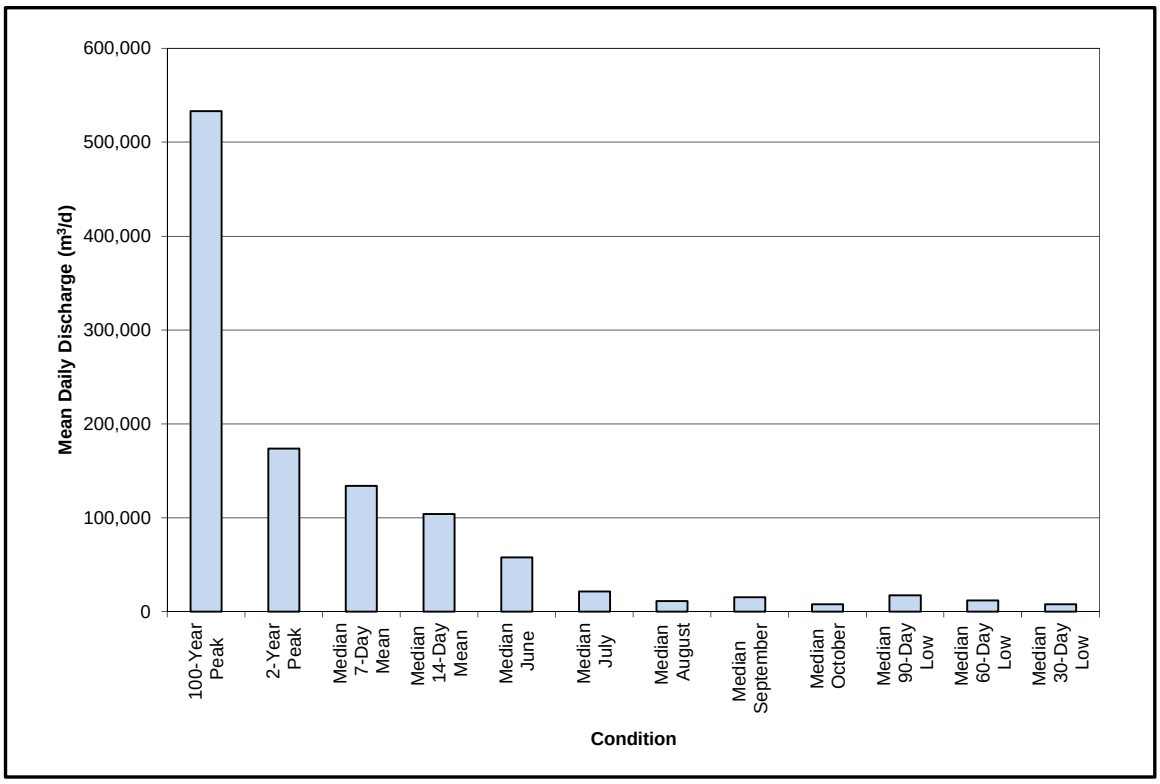


Figure 3-38: Derived Flow Regimes at Lake A17 (Whale Tail Lake)

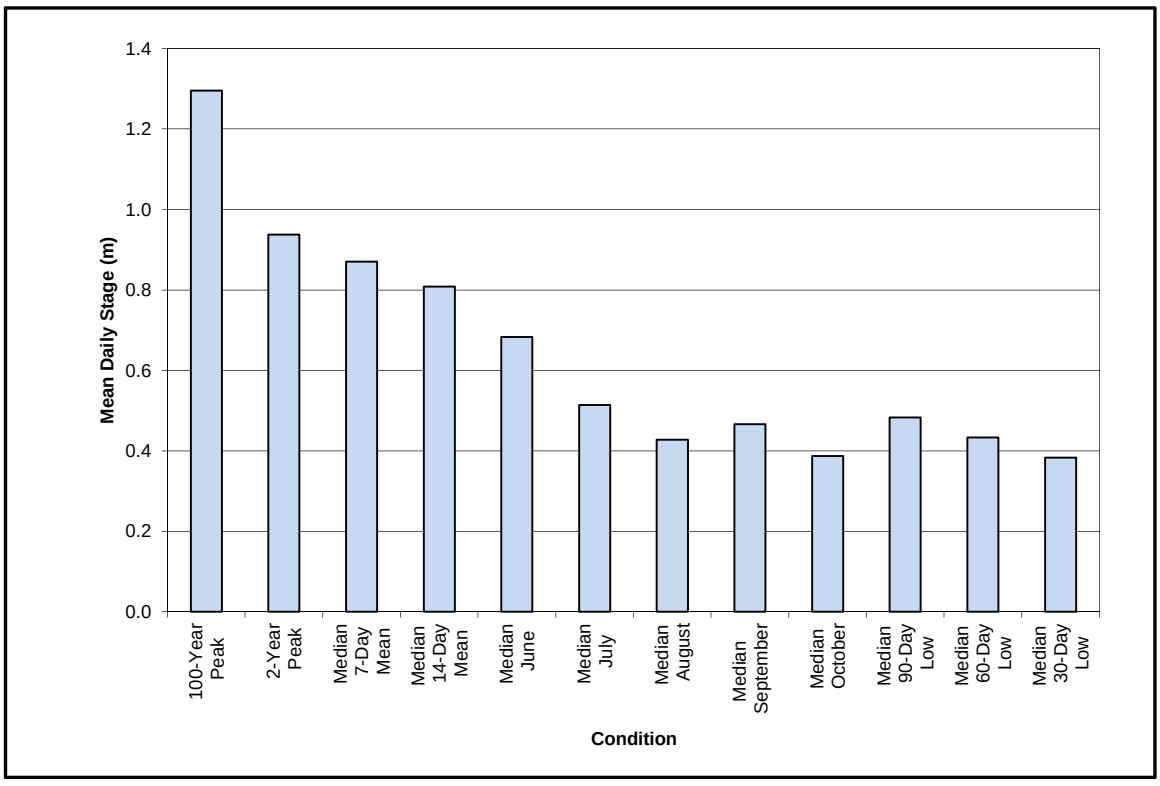


Figure 3-39: Derived Stage Regimes at Lake A17 (Whale Tail Lake)

3.4.4 Lake A18

Results for Lake A18 are presented in Table 3-33 (monthly mean discharges), Table 3-34 (peak and low flow discharges), Table 3-35 (monthly mean stages), and Table 3-36 (peak and low flow stages). Results are summarized in Figure 3-40 (flow regimes) and Figure 3-41 (stage regimes).

Table 3-33: Monthly Mean Discharges at the Lake A18 Outlet

Condition	Return Period (years)	Monthly Mean Discharge (m^3/d)					
		May	June	July	August	September	October
Wet	100	12,200	57,000	32,600	23,000	24,900	13,700
	50	9,870	53,500	28,300	20,200	22,700	11,600
	20	6,910	48,200	22,700	16,600	19,500	9,080
	10	4,760	43,500	18,700	13,700	16,700	7,300
	5	2,700	38,100	14,600	10,700	13,600	5,580
Median	2	190	28,400	8,930	6,220	8,310	3,230
Dry	5	0	20,100	5,150	2,870	4,160	0
	10	0	16,700	3,720	1,440	2,540	0
	20	0	14,300	2,750	388	1,510	0
	50	0	12,100	1,840	0	662	0
	100	0	11,100	1,330	0	261	0

m^3/d= cubic metres per day.

Table 3-34: Peak and Low Flow Discharges at the Lake A18 Outlet

Condition	Return Period (years)	Peak Daily Q (m^3/s)	7-Day Mean Peak Q (m^3/d)	14-Day Mean Peak Q (m^3/d)	30-Day Low Flow Q (m^3/d)	60-Day Low Flow Q (m^3/d)	90-Day Low Flow Q (m^3/d)
Wet	100	3.38	146,000	112,000	12,000	16,700	18,400
	50	2.92	135,000	103,000	10,500	15,200	17,200
	20	2.36	119,000	91,400	8,570	13,000	15,300
	10	1.97	106,000	81,200	7,090	11,200	13,700
	5	1.61	90,300	69,700	5,560	9,160	11,800
Median	2	1.11	64,400	50,700	3,300	5,840	8,490
Dry	5	0.81	44,600	36,300	1,650	3,130	5,680
	10	0.70	37,100	30,900	953	1,920	4,500
	20	0.63	32,300	27,600	446	997	3,710
	50	0.57	28,500	25,000	0	42	3,020
	100	0.54	26,700	23,800	0	0	2,670

Q= discharge; m^3/s= cubic metres per second; m^3/d= cubic metres per day.

Table 3-35: Monthly Mean Stages at the Lake A18 Outlet

Condition	Return Period (years)	Monthly Mean Stage (m)					
		May	June	July	August	September	October
Wet	100	0.405	0.549	0.492	0.459	0.466	0.415
	50	0.389	0.543	0.478	0.448	0.458	0.401
	20	0.362	0.531	0.458	0.431	0.444	0.382
	10	0.336	0.521	0.441	0.415	0.431	0.366
	5	0.301	0.507	0.420	0.395	0.414	0.347
Median	2	0.178	0.479	0.381	0.355	0.376	0.312
Dry	5	-	0.447	0.342	0.304	0.328	-
	10	-	0.431	0.320	0.266	0.297	-
	20	-	0.418	0.302	0.205	0.268	-
	50	-	0.405	0.279	-	0.228	-
	100	-	0.398	0.262	-	0.190	-

m= metres.

Table 3-36: Peak and Low Flow Stages at the Lake A18 Outlet

Condition	Return Period (years)	Peak Daily Stage (m)	7-Day Mean Peak Stage (m)	14-Day Mean Peak Stage (m)	30-Day Low Flow Stage (m)	60-Day Low Flow Q Stage (m)	90-Day Low Flow Stage (m)
Wet	100	0.759	0.662	0.628	0.404	0.431	0.439
	50	0.737	0.651	0.617	0.393	0.423	0.434
	20	0.707	0.635	0.603	0.378	0.410	0.424
	10	0.682	0.621	0.589	0.364	0.398	0.415
	5	0.655	0.602	0.572	0.347	0.383	0.403
Median	2	0.609	0.563	0.537	0.313	0.350	0.377
Dry	5	0.572	0.523	0.503	0.273	0.310	0.348
	10	0.555	0.505	0.487	0.245	0.281	0.333
	20	0.544	0.491	0.476	0.211	0.247	0.320
	50	0.533	0.479	0.467	-	0.132	0.308
	100	0.527	0.473	0.462	-	-	0.300

m= metres.

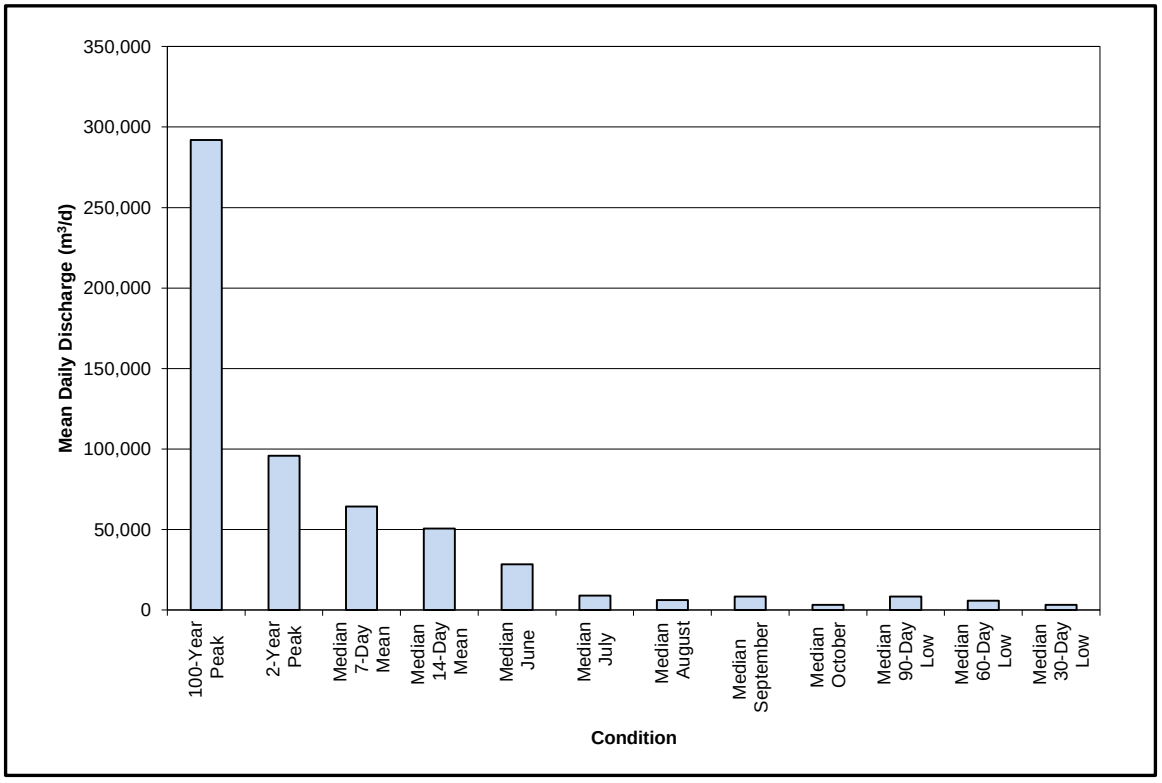


Figure 3-40: Derived Flow Regimes at Lake A18

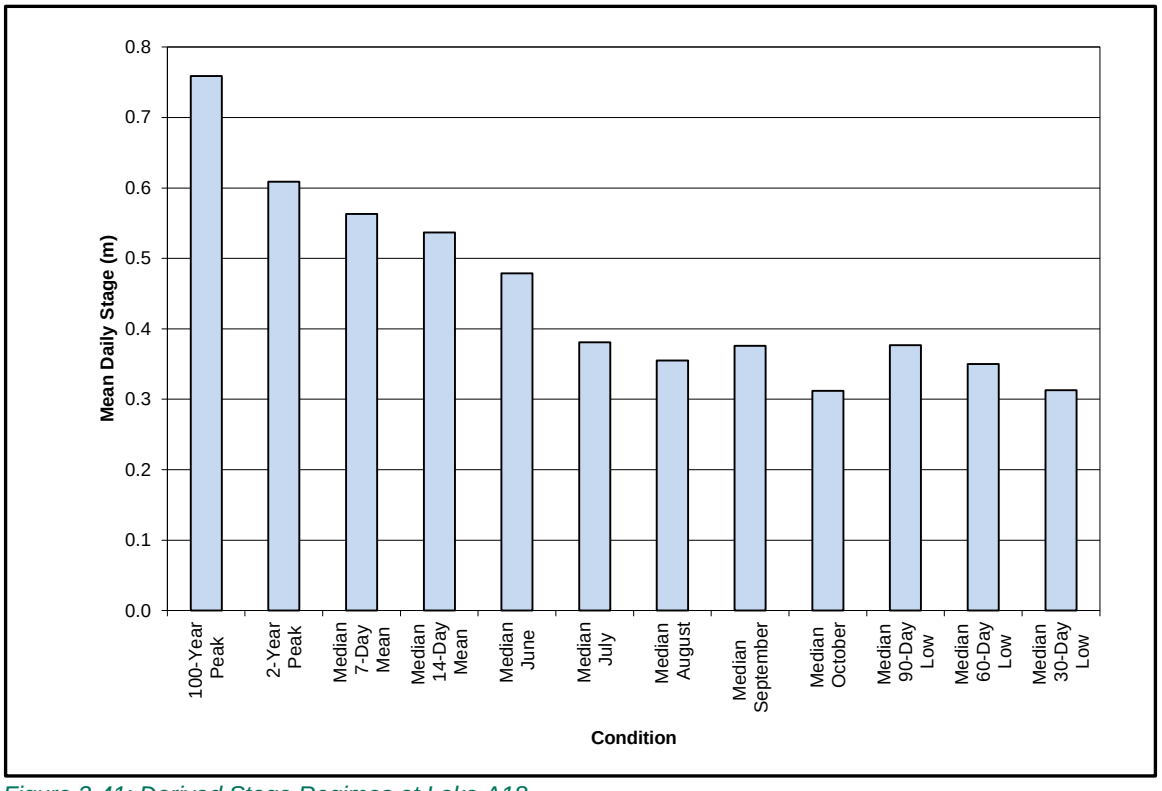


Figure 3-41: Derived Stage Regimes at Lake A18

3.4.5 Lake A69

Results for Lake A69 are presented in Table 3-37 (monthly mean discharges), Table 3-38 (peak and low flow discharges), Table 3-39 (monthly mean stages), and Table 3-40 (peak and low flow stages). Results are summarized in Figure 3-42 (flow regimes) and Figure 3-43 (stage regimes).

Table 3-37: Monthly Mean Discharges at the Lake A69 Outlet

Condition	Return Period (years)	Monthly Mean Discharge (m^3/d)					
		May	June	July	August	September	October
Wet	100	65,000	285,000	182,000	109,000	129,000	69,300
	50	53,300	269,000	159,000	99,700	118,000	59,400
	20	38,000	245,000	127,000	86,600	102,000	46,900
	10	26,600	224,000	103,000	75,200	87,700	38,000
	5	15,600	199,000	78,900	61,900	71,900	29,300
Median	2	1,570	151,000	46,600	38,300	44,900	17,200
Dry	5	0	107,000	29,800	18,500	23,800	8,940
	10	0	86,700	25,500	10,200	15,500	5,620
	20	0	72,200	23,500	4,580	10,200	3,240
	50	0	58,600	22,300	0	5,910	883
	100	0	51,200	21,900	0	3,840	0

m^3/d= cubic metres per day.

Table 3-38: Peak and Low Flow Discharges at the Lake A69 Outlet

Condition	Return Period (years)	Peak Daily Q (m^3/s)	7-Day Mean Peak Q (m^3/d)	14-Day Mean Peak Q (m^3/d)	30-Day Low Flow Q (m^3/d)	60-Day Low Flow Q (m^3/d)	90-Day Low Flow Q (m^3/d)
Wet	100	14.5	710,000	571,000	65,100	86,000	99,100
	50	13.3	659,000	529,000	57,900	79,600	92,500
	20	11.6	584,000	468,000	48,200	70,100	82,800
	10	10.1	521,000	417,000	40,700	61,800	74,400
	5	8.58	448,000	359,000	32,700	52,000	64,600
Median	2	6.15	327,000	264,000	20,500	34,400	47,300
Dry	5	4.51	233,000	192,000	11,300	19,300	32,700
	10	3.95	196,000	165,000	7,400	12,900	26,600
	20	3.64	174,000	149,000	4,500	8,540	22,600
	50	3.41	155,000	136,000	1,550	4,650	19,000
	100	3.31	146,463	129,974	0	2,655	17,263

Q= discharge; m^3/s= cubic metres per second; m^3/d= cubic metres per day.

Table 3-39: Monthly Mean Stages at the Lake A69 Outlet

Condition	Return Period (years)	Monthly Mean Stage (m)					
		May	June	July	August	September	October
Wet	100	0.383	0.580	0.511	0.443	0.464	0.390
	50	0.362	0.570	0.492	0.432	0.453	0.374
	20	0.330	0.556	0.462	0.415	0.435	0.350
	10	0.298	0.542	0.436	0.399	0.417	0.330
	5	0.257	0.524	0.404	0.378	0.394	0.306
Median	2	0.135	0.485	0.349	0.330	0.345	0.264
Dry	5	-	0.441	0.308	0.269	0.289	0.220
	10	-	0.415	0.295	0.228	0.256	0.193
	20	-	0.395	0.288	0.182	0.228	0.165
	50	-	0.372	0.284	-	0.196	0.115
	100	-	0.358	0.282	-	0.173	-

m= metres.

Table 3-40: Peak and Low Flow Stages at the Lake A69 Outlet

Condition	Return Period (years)	Peak Daily Stage (m)	7-Day Mean Peak Stage (m)	14-Day Mean Peak Stage (m)	30-Day Low Flow Stage (m)	60-Day Low Flow Q Stage (m)	90-Day Low Flow Stage (m)
Wet	100	0.877	0.748	0.704	0.383	0.414	0.431
	50	0.857	0.733	0.689	0.371	0.405	0.423
	20	0.824	0.709	0.666	0.352	0.391	0.410
	10	0.793	0.686	0.645	0.336	0.378	0.398
	5	0.758	0.658	0.618	0.316	0.360	0.382
Median	2	0.690	0.602	0.567	0.277	0.321	0.350
Dry	5	0.633	0.548	0.519	0.235	0.273	0.316
	10	0.610	0.522	0.497	0.208	0.244	0.298
	20	0.596	0.505	0.483	0.181	0.217	0.285
	50	0.585	0.489	0.471	0.135	0.183	0.271
	100	0.580	0.481	0.465	-	0.156	0.264

m = metres.

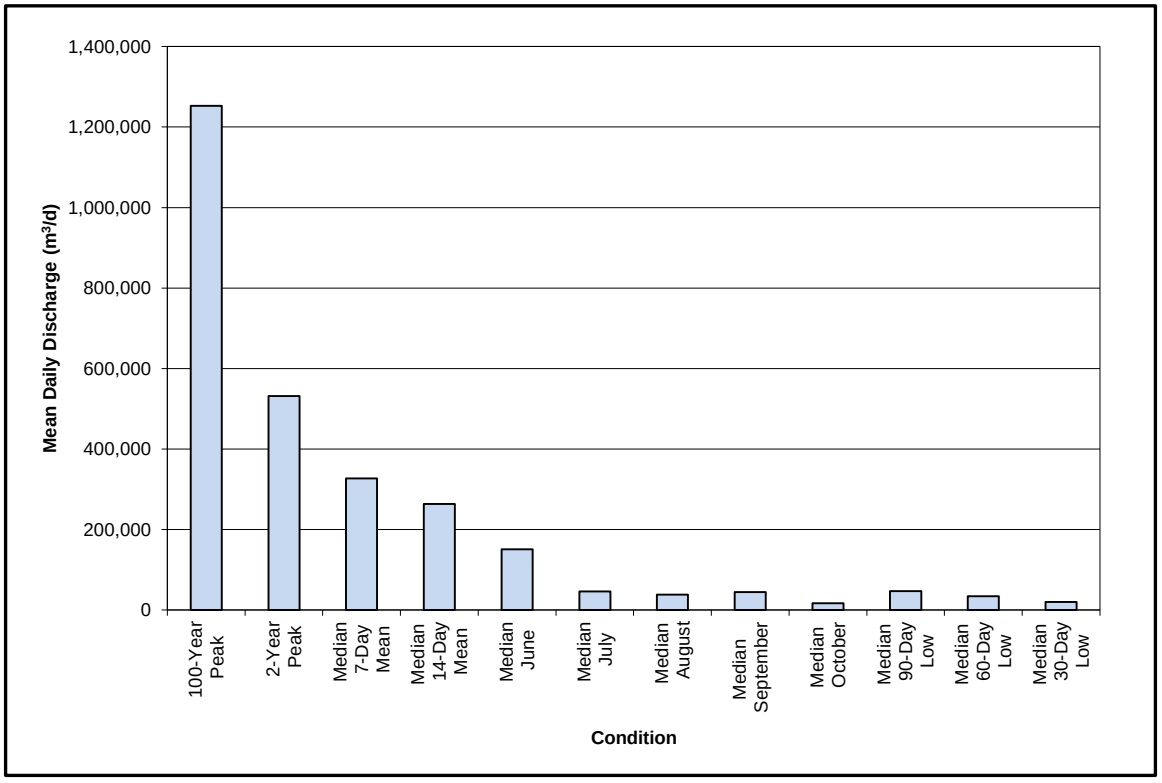


Figure 3-42: Derived Flow Regimes at Lake A69

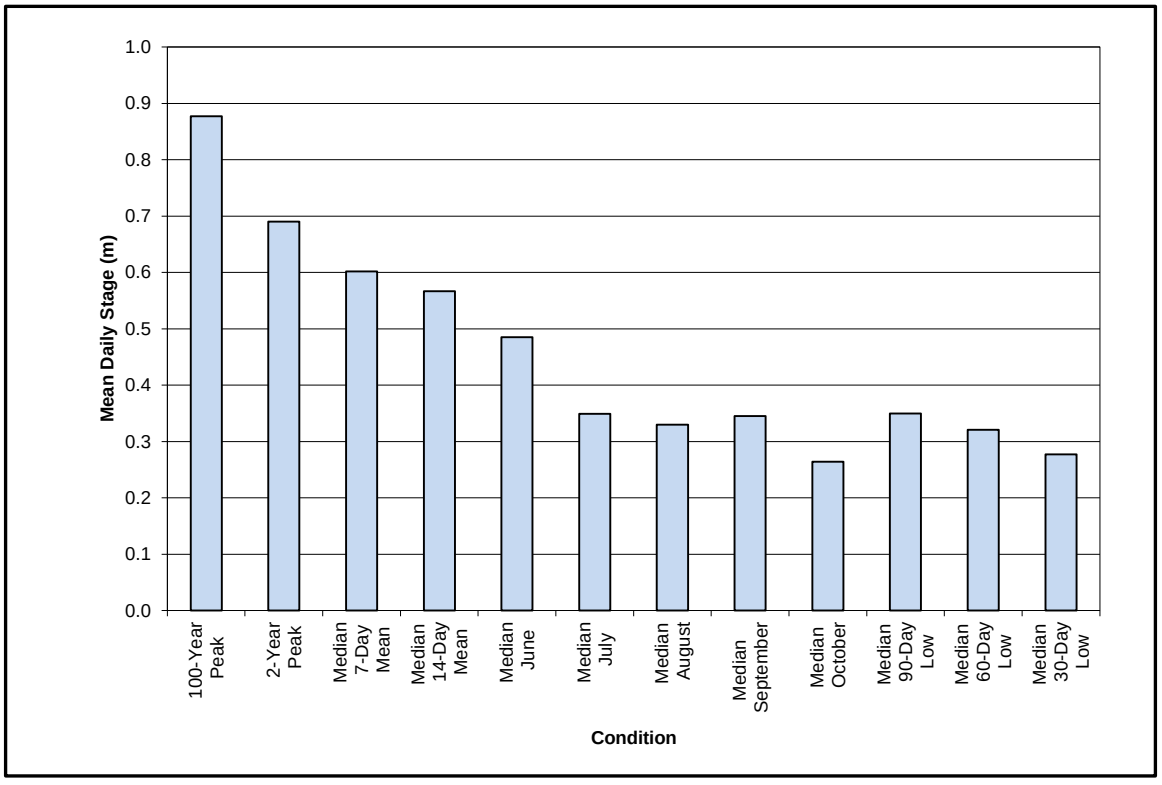


Figure 3-43: Derived Stage Regimes at Lake A69

3.4.6 Lake C8

Results for Lake C8 are presented in Table 3-41 (monthly mean discharges), Table 3-42 (peak and low flow discharges), Table 3-43 (monthly mean stages), and Table 3-44 (peak and low flow stages). Results are summarized in Figure 3-44 (flow regimes) and Figure 3-45 (stage regimes).

Table 3-41: Monthly Mean Discharges at the Lake C8 Outlet

Condition	Return Period (years)	Monthly Mean Discharge (m^3/d)					
		May	June	July	August	September	October
Wet	100	22,500	56,400	22,200	20,600	24,100	13,500
	50	18,200	53,300	19,700	19,000	22,200	11,900
	20	12,600	48,600	16,400	16,600	19,400	9,690
	10	8,610	44,300	13,800	14,400	17,000	8,040
	5	4,810	39,100	11,200	11,900	14,200	6,350
Median	2	241	29,100	7,180	7,420	9,240	3,870
Dry	5	0	19,400	4,240	3,560	5,150	2,070
	10	0	14,800	3,030	1,910	3,460	1,320
	20	0	11,300	2,170	784	2,340	770
	50	0	7,920	1,320	0	1,370	218
	100	0	6,000	831	0	890	0

m^3/d= cubic metres per day.

Table 3-42: Peak and Low Flow Discharges at the Lake C8 Outlet

Condition	Return Period (years)	Peak Daily Q (m^3/s)	7-Day Mean Peak Q (m^3/d)	14-Day Mean Peak Q (m^3/d)	30-Day Low Flow Q (m^3/d)	60-Day Low Flow Q (m^3/d)	90-Day Low Flow Q (m^3/d)
Wet	100	5.33	202,000	120,000	11,600	16,100	17,600
	50	4.80	190,000	113,000	10,600	14,900	16,300
	20	4.09	170,000	101,000	9,130	13,100	14,500
	10	3.53	154,000	91,300	7,870	11,600	13,000
	5	2.94	134,000	79,700	6,420	9,740	11,300
Median	2	2.09	99,500	59,300	3,950	6,410	8,290
Dry	5	1.60	69,700	42,200	1,980	3,520	5,690
	10	1.45	57,100	35,000	1,210	2,280	4,460
	20	1.38	48,500	30,200	711	1,420	3,500
	50	1.33	40,900	26,100	296	648	2,490
	100	1.31	37,000	24,000	98	249	1,850

Q= discharge; m^3/s= cubic metres per second; m^3/d= cubic metres per day.

Table 3-43: Monthly Mean Stages at the Lake C8 Outlet

Condition	Return Period (years)	Monthly Mean Stage (m)					
		May	June	July	August	September	October
Wet	100	0.457	0.548	0.456	0.449	0.463	0.413
	50	0.438	0.542	0.445	0.442	0.456	0.403
	20	0.408	0.532	0.430	0.431	0.444	0.387
	10	0.378	0.523	0.415	0.419	0.433	0.373
	5	0.337	0.510	0.398	0.403	0.417	0.356
Median	2	0.187	0.481	0.365	0.367	0.384	0.323
Dry	5	-	0.444	0.329	0.318	0.342	0.285
	10	-	0.421	0.308	0.281	0.316	0.261
	20	-	0.399	0.288	0.236	0.292	0.235
	50	-	0.372	0.261	-	0.263	0.183
	100	-	0.352	0.238	-	0.242	-

m= metres.

Table 3-44: Peak and Low Flow Stages at the Lake C8 Outlet

Condition	Return Period (years)	Peak Daily Stage (m)	7-Day Mean Peak Stage (m)	14-Day Mean Peak Stage (m)	30-Day Low Flow Stage (m)	60-Day Low Flow Q Stage (m)	90-Day Low Flow Stage (m)
Wet	100	0.830	0.705	0.636	0.401	0.428	0.436
	50	0.813	0.697	0.629	0.394	0.421	0.429
	20	0.788	0.682	0.615	0.383	0.411	0.419
	10	0.765	0.669	0.603	0.372	0.401	0.410
	5	0.738	0.650	0.587	0.357	0.388	0.399
Median	2	0.690	0.613	0.554	0.324	0.357	0.375
Dry	5	0.654	0.572	0.518	0.283	0.317	0.349
	10	0.642	0.550	0.499	0.257	0.291	0.332
	20	0.636	0.532	0.485	0.231	0.265	0.317
	50	0.631	0.515	0.471	0.194	0.227	0.296
	100	0.629	0.504	0.463	0.156	0.188	0.279

m= metres.

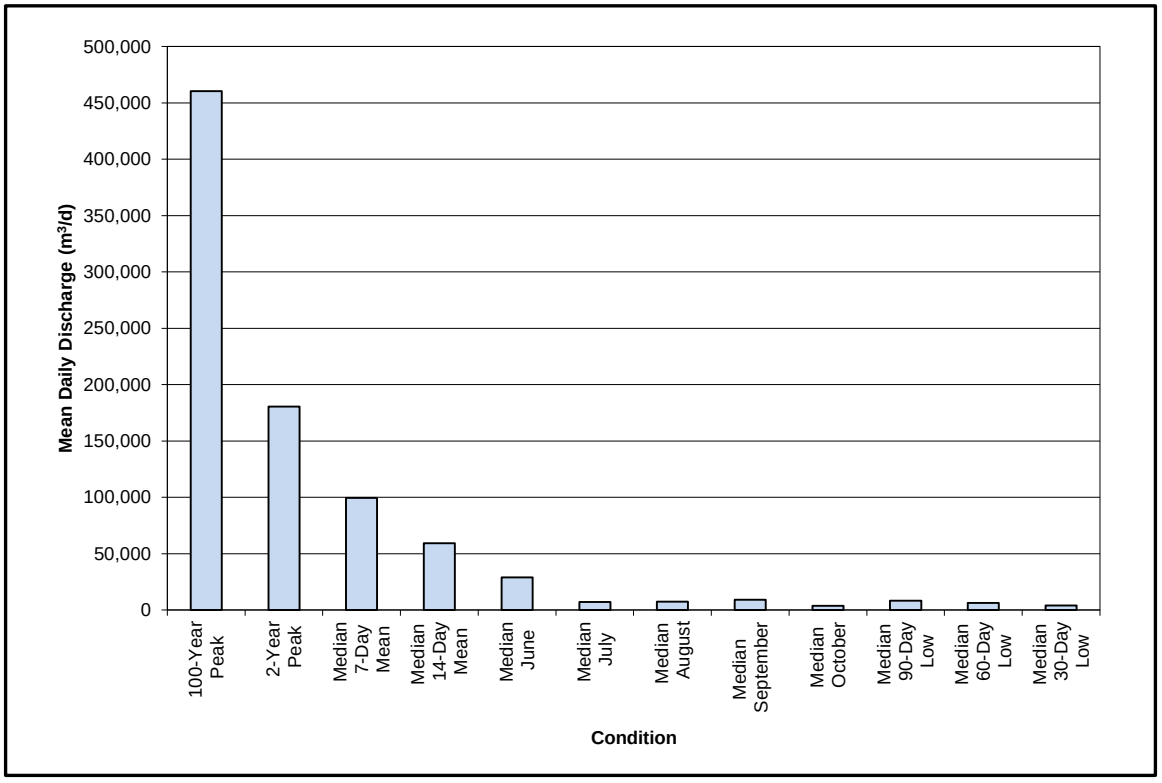


Figure 3-44: Derived Flow Regimes at Lake C8

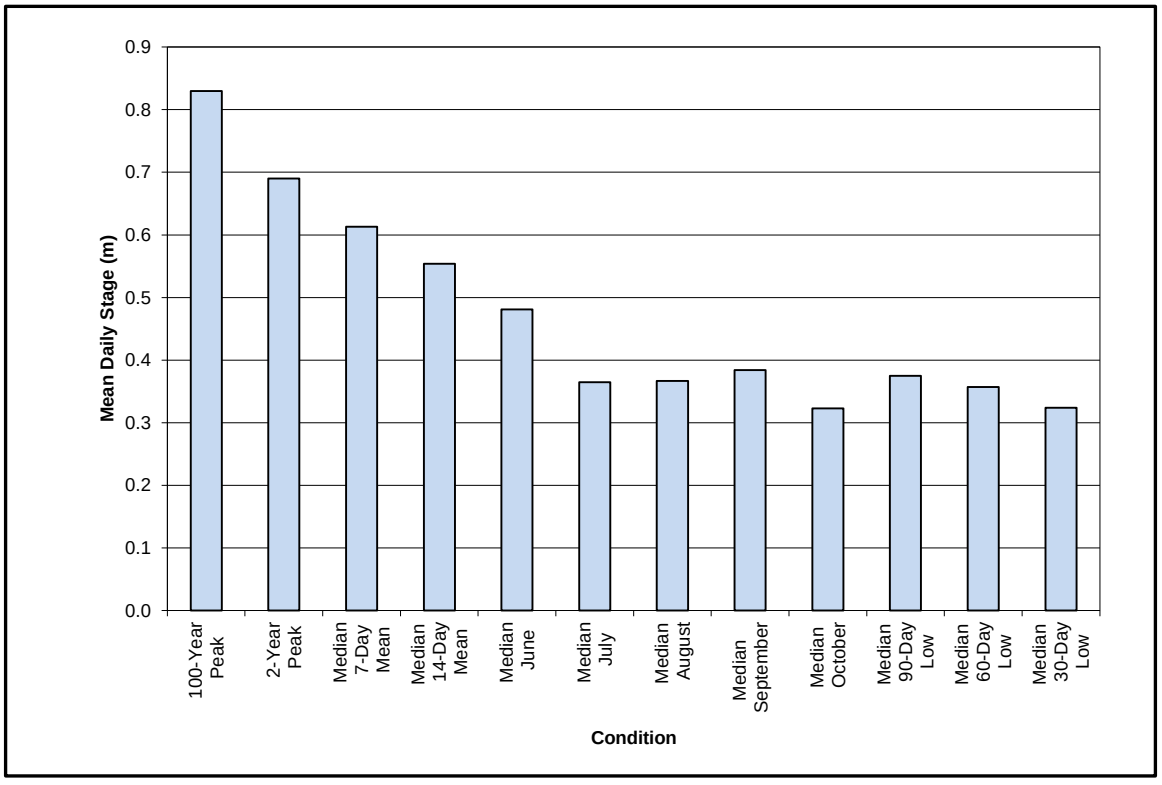


Figure 3-45: Derived Stage Regimes at Lake C8

3.4.7 Lake C38 (Nemo Lake)

Results for Lake C38 (Nemo Lake) are presented in Table 3-45 (monthly mean discharges), Table 3-46 (peak and low flow discharges), Table 3-47 (monthly mean stages), and Table 3-48 (peak and low flow stages). Results are summarized in Figure 3-46 (flow regimes) and Figure 3-47 (stage regimes).

Table 3-45: Monthly Mean Discharges at the Lake C38 (Nemo Lake) Outlet

Condition	Return Period (years)	Monthly Mean Discharge (m^3/d)					
		May	June	July	August	September	October
Wet	100	396	4,380	5,330	4,100	3,800	2,520
	50	305	4,140	4,960	3,820	3,560	2,340
	20	199	3,780	4,430	3,410	3,190	2,080
	10	131	3,450	3,990	3,060	2,880	1,850
	5	72	3,050	3,490	2,650	2,510	1,580
Median	2	3	2,270	2,650	1,920	1,840	1,070
Dry	5	0	1,470	1,910	1,250	1,210	621
	10	0	1,050	1,570	929	898	421
	20	0	692	1,300	672	645	280
	50	0	288	1,020	393	368	151
	100	0	17	847	215	188	82

m^3/d= cubic metres per day.

Table 3-46: Peak and Low Flow Discharges at the Lake C38 (Nemo Lake) Outlet

Condition	Return Period (years)	Peak Daily Q (m^3/s)	7-Day Mean Peak Q (m^3/d)	14-Day Mean Peak Q (m^3/d)	30-Day Low Flow Q (m^3/d)	60-Day Low Flow Q (m^3/d)	90-Day Low Flow Q (m^3/d)
Wet	100	0.075	6,380	6,200	3,560	3,870	4,310
	50	0.072	6,050	5,880	3,340	3,610	4,030
	20	0.066	5,570	5,400	3,000	3,240	3,610
	10	0.061	5,150	4,990	2,700	2,920	3,260
	5	0.055	4,650	4,500	2,350	2,550	2,860
Median	2	0.044	3,730	3,610	1,700	1,870	2,150
Dry	5	0.034	2,850	2,760	1,070	1,240	1,510
	10	0.029	2,410	2,330	743	921	1,200
	20	0.025	2,060	1,990	481	670	953
	50	0.020	1,670	1,620	190	396	690
	100	0.017	1,410	1,370	0	219	523

Q= discharge; m^3/s= cubic metres per second; m^3/d= cubic metres per day.

Table 3-47: Monthly Mean Stages at the Lake C38 (Nemo Lake) Outlet

Condition	Return Period (years)	Monthly Mean Stage (m)					
		May	June	July	August	September	October
Wet	100	0.041	0.447	0.543	0.418	0.388	0.258
	50	0.032	0.422	0.506	0.390	0.364	0.239
	20	0.021	0.386	0.452	0.348	0.326	0.213
	10	0.014	0.352	0.407	0.313	0.294	0.190
	5	0.007	0.312	0.356	0.271	0.257	0.162
Median	2	0.000	0.232	0.271	0.197	0.189	0.110
Dry	5	-	0.151	0.196	0.128	0.124	0.064
	10	-	0.108	0.161	0.096	0.092	0.043
	20	-	0.071	0.133	0.069	0.066	0.029
	50	-	0.030	0.105	0.041	0.038	0.016
	100	-	0.002	0.087	0.022	0.020	0.009

m= metres.

Table 3-48: Peak and Low Flow Stages at the Lake C38 (Nemo Lake) Outlet

Condition	Return Period (years)	Peak Daily Stage (m)	7-Day Mean Peak Stage (m)	14-Day Mean Peak Stage (m)	30-Day Low Flow Stage (m)	60-Day Low Flow Q Stage (m)	90-Day Low Flow Stage (m)
Wet	100	0.660	0.649	0.631	0.364	0.395	0.440
	50	0.633	0.616	0.599	0.341	0.369	0.411
	20	0.581	0.567	0.550	0.307	0.331	0.369
	10	0.537	0.525	0.509	0.276	0.298	0.333
	5	0.485	0.474	0.459	0.241	0.261	0.292
Median	2	0.388	0.381	0.369	0.174	0.192	0.220
Dry	5	0.300	0.291	0.282	0.110	0.127	0.155
	10	0.256	0.247	0.238	0.077	0.095	0.123
	20	0.221	0.211	0.204	0.050	0.069	0.098
	50	0.177	0.171	0.166	0.020	0.041	0.071
	100	0.151	0.145	0.141	-	0.023	0.054

m= metres.

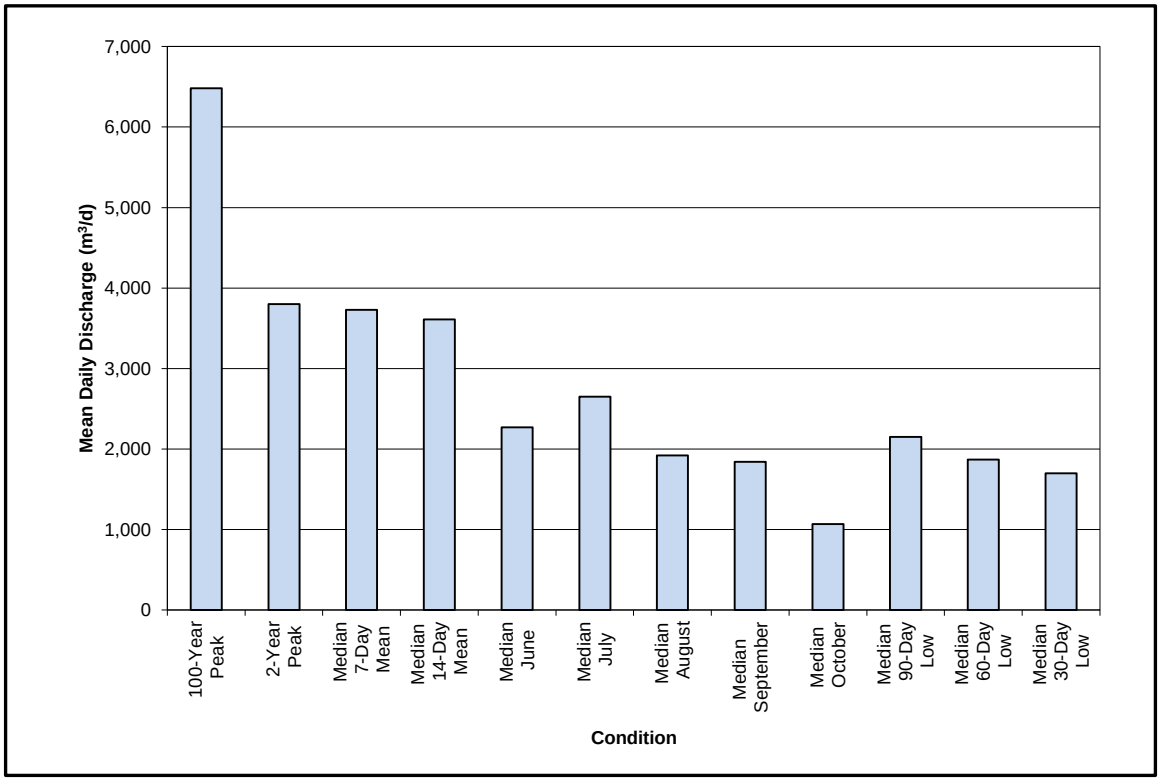


Figure 3-46: Derived Flow Regimes at Lake C38 (Nemo Lake)

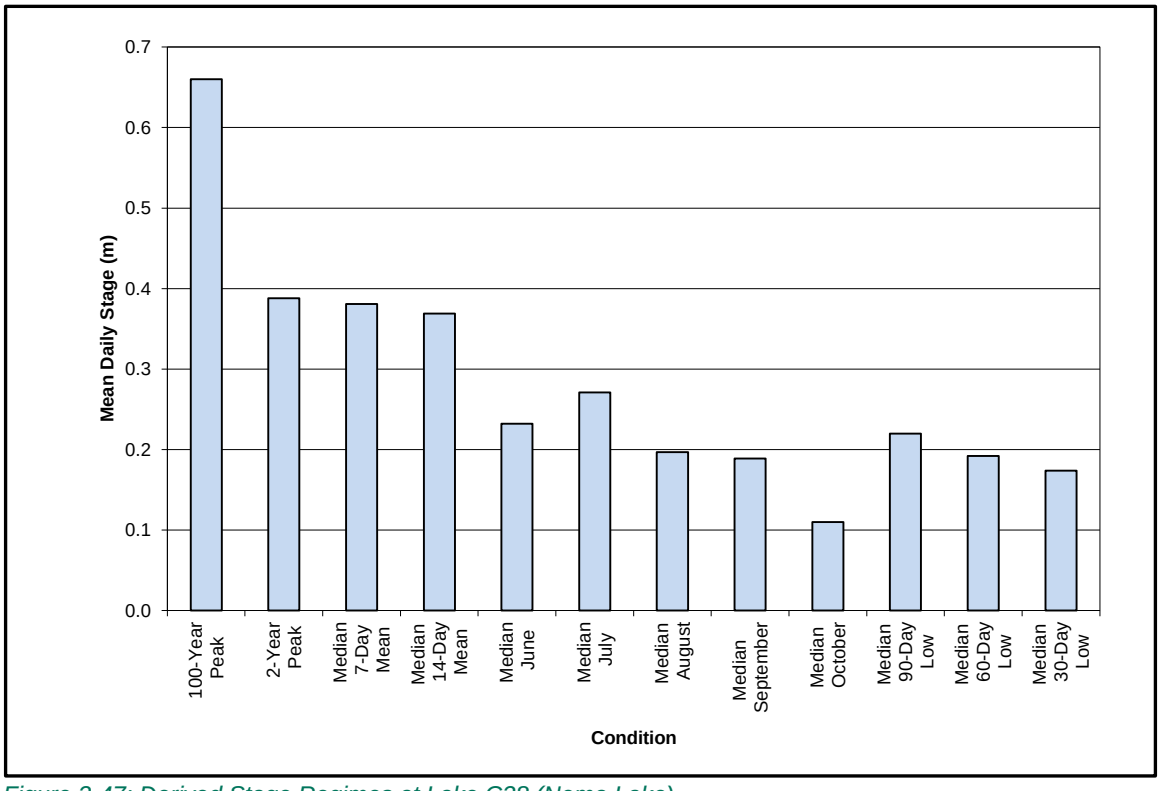


Figure 3-47: Derived Stage Regimes at Lake C38 (Nemo Lake)

3.4.8 Lake DS1

Results for Lake DS1 are presented in Table 3-49 (monthly mean discharges), Table 3-50 (peak and low flow discharges), Table 3-51 (monthly mean stages), and Table 3-52 (peak and low flow stages). Results are summarized in Figure 3-48 (flow regimes) and Figure 3-49 (stage regimes).

Table 3-49: Monthly Mean Discharges at the Lake DS1 Outlet

Condition	Return Period (years)	Monthly Mean Discharge (m^3/d)					
		May	June	July	August	September	October
Wet	100	329,000	3,510,000	5,120,000	1,890,000	2,280,000	1,980,000
	50	224,000	3,230,000	4,390,000	1,720,000	2,100,000	1,810,000
	20	130,000	2,810,000	3,500,000	1,480,000	1,830,000	1,560,000
	10	82,800	2,450,000	2,860,000	1,270,000	1,600,000	1,360,000
	5	48,500	2,040,000	2,250,000	1,020,000	1,330,000	1,140,000
Median	2	15,800	1,320,000	1,390,000	604,000	874,000	780,000
Dry	5	1,090	716,000	816,000	266,000	485,000	491,000
	10	0	436,000	584,000	130,000	306,000	363,000
	20	0	221,000	419,000	42,300	169,000	266,000
	50	0	0	256,000	0	24,400	165,000
	100	0	0	158,000	0	0	103,000

m^3/d= cubic metres per day.

Table 3-50: Peak and Low Flow Discharges at the Lake DS1 Outlet

Condition	Return Period (years)	Peak Daily Q (m^3/s)	7-Day Mean Peak Q (m^3/d)	14-Day Mean Peak Q (m^3/d)	30-Day Low Flow Q (m^3/d)	60-Day Low Flow Q (m^3/d)	90-Day Low Flow Q (m^3/d)
Wet	100	80.8	6,870,000	6,540,000	1,640,000	1,720,000	2,340,000
	50	73.6	6,260,000	5,960,000	1,410,000	1,570,000	2,150,000
	20	63.8	5,420,000	5,160,000	1,120,000	1,350,000	1,880,000
	10	56.0	4,750,000	4,530,000	906,000	1,160,000	1,660,000
	5	47.6	4,050,000	3,850,000	693,000	956,000	1,420,000
Median	2	34.7	2,950,000	2,810,000	388,000	623,000	1,010,000
Dry	5	24.8	2,100,000	2,010,000	174,000	353,000	686,000
	10	20.5	1,740,000	1,660,000	86,100	233,000	540,000
	20	17.3	1,470,000	1,410,000	22,800	142,000	431,000
	50	14.0	1,190,000	1,140,000	0	48,100	317,000
	100	12.0	1,020,000	984,000	0	0	246,000

Q= discharge; m^3/s= cubic metres per second; m^3/d= cubic metres per day.

Table 3-51: Monthly Mean Stages at the Lake DS1 Outlet

Condition	Return Period (years)	Monthly Mean Stage (m)					
		May	June	July	August	September	October
Wet	100	0.193	1.122	1.485	0.708	0.814	0.733
	50	0.145	1.054	1.324	0.660	0.766	0.686
	20	0.097	0.951	1.119	0.590	0.691	0.614
	10	0.069	0.859	0.963	0.527	0.626	0.554
	5	0.047	0.749	0.806	0.448	0.545	0.486
Median	2	0.020	0.542	0.563	0.303	0.399	0.367
Dry	5	0.003	0.344	0.379	0.165	0.258	0.260
	10	-	0.238	0.296	0.097	0.183	0.208
	20	-	0.144	0.231	0.042	0.118	0.165
	50	-	-	0.160	-	0.028	0.116
	100	-	-	0.112	-	-	0.081

m= metres.

Table 3-52: Peak and Low Flow Stages at the Lake DS1 Outlet

Condition	Return Period (years)	Peak Daily Stage (m)	7-Day Mean Peak Stage (m)	14-Day Mean Peak Stage (m)	30-Day Low Flow Stage (m)	60-Day Low Flow Q Stage (m)	90-Day Low Flow Stage (m)
Wet	100	1.869	1.847	1.781	0.637	0.660	0.830
	50	1.744	1.724	1.662	0.569	0.617	0.779
	20	1.568	1.549	1.493	0.480	0.551	0.705
	10	1.424	1.404	1.356	0.410	0.493	0.643
	5	1.262	1.247	1.201	0.336	0.427	0.572
Median	2	0.998	0.986	0.951	0.218	0.310	0.444
Dry	5	0.777	0.766	0.741	0.120	0.203	0.333
	10	0.675	0.666	0.643	0.071	0.149	0.279
	20	0.595	0.587	0.569	0.027	0.103	0.236
	50	0.508	0.502	0.486	-	0.046	0.188
	100	0.453	0.448	0.436	-	-	0.156

m= metres.

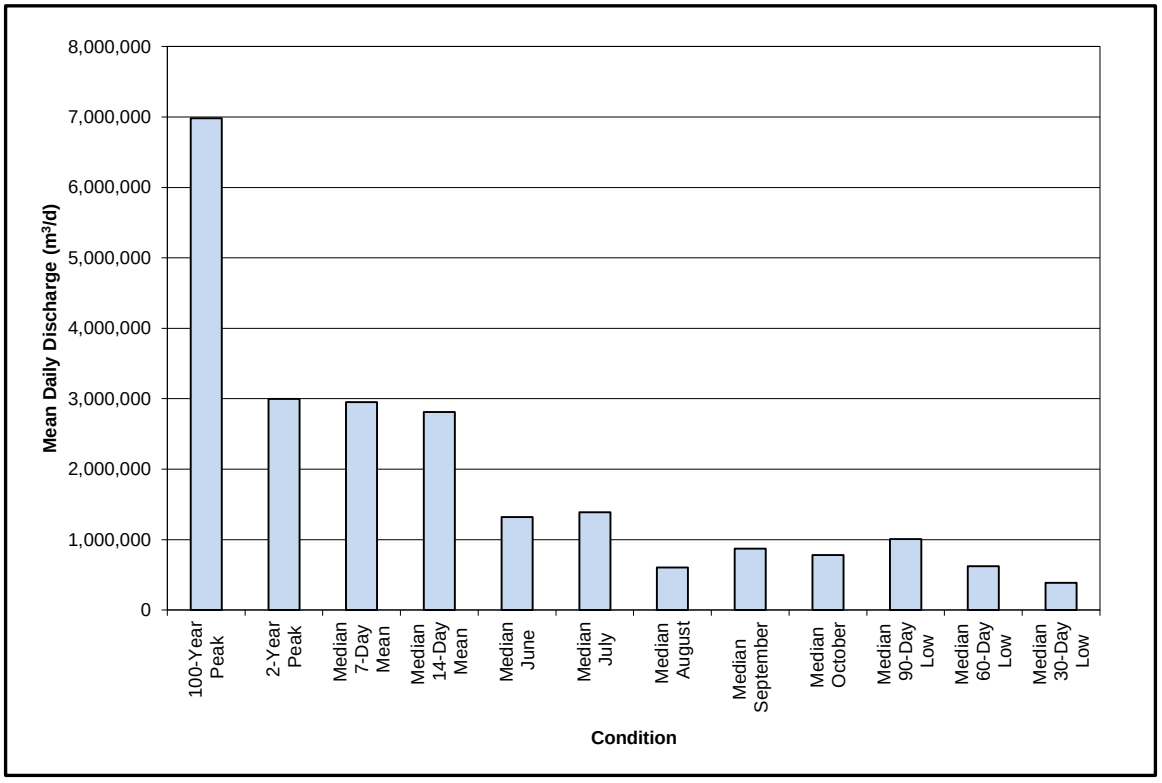


Figure 3-48: Derived Flow Regimes at Lake DS1

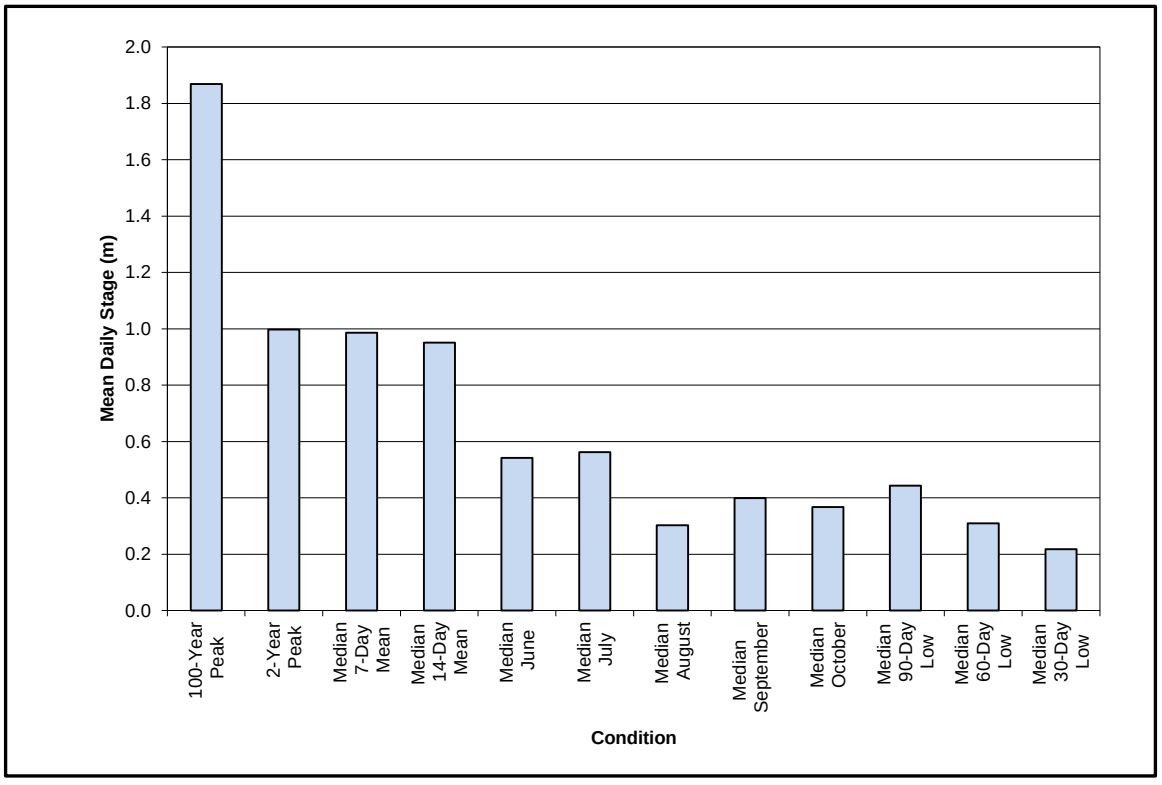


Figure 3-49: Derived Stage Regimes at Lake DS1

4.0 CONCLUSION

This study provides a review of existing hydrology conditions in watersheds potentially affected by the Project, based on available Project information. The Study included characterization of local watersheds and drainage patterns, flow regimes, and lake shoreline and outlet channel geomorphology, based on a review of available desktop data and four field visits in 2015 spanning from early June (during frozen conditions), to July, August and finishing in September, and is intended to provide a basis for future impact assessments of the Project.

Three distinct watersheds within the Hydrology BSA were defined as the A watershed (i.e., where Whale Tail and Mammoth Lake are located), the B watershed (i.e., located just north of the A watershed, and west of Nemo Lake), and the C watershed (i.e., where Nemo Lake is located); these three watersheds each drain into Lake DS1. Drainage patterns were initially defined based on a desktop exercise and refined and/or validated on the ground. In general, ground-truthed drainage patterns were in agreement with those derived from the desktop exercise, with the exception of Lake A12 and Lake A76, which were found to discharge through two lake outlets. Lake A12 was found to discharge northward to Lake A77, and eastward to Lake A11. Lake A76 was found to discharge westward to Lake A75, and eastward to Lake A41. The proportion of flow through each outlet of Lake A12 and Lake A76 was only assessed during low flow conditions, and may vary during high flow conditions. Derived water yields for lakes with similar periods of record (i.e., with 97 and 98 days of record) varied between 52 mm (i.e., Lake C38 [Nemo Lake]) and 267 mm (Lake A18). The lower water yields at Lake A17 and Lake C38 may be attributed to proportions of ineffective areas in the watersheds, and the potential for shallow subsurface flow to convey water outside of the assumed drainage boundaries.

The majority of the shorelines surveyed exhibit a consistent terrain type related to shorelines that have developed in morainal material. These morainal shorelines were observed at all lakes visited during the field survey. Limited areas of bedrock and shallowly sloped sandy shorelines were also observed. As a general characteristic for the surveyed shorelines, the predominant materials are boulder gardens mixed with cobble with very limited soils or organic materials on top. The outlet channels exhibit the same characteristics for streambed materials, which results in interstitial flow through large boulders or below the surface likely close to the bedrock, making flow difficult to observe and measure.

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APPENDIX A

Hydrometric Stations

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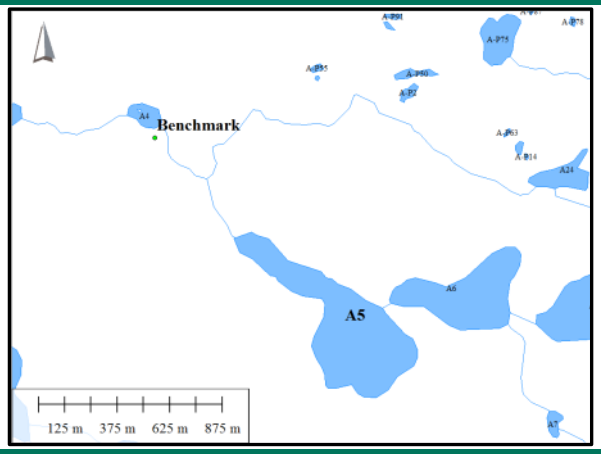
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A1.0 LAKE A5 & OUTLET (STREAM A5-A4)

Parameter	Value	Note
Drainage Area (km^2)	57.6	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	65	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	0.4	Measured in the field, based on vegetation
Wetted Width (m)	59.0	Measured in the field on 6 August 2015
Max. Wetted Depth (m)	0.26	Measured in the field on 6 August 2015
Channel Length (km)	0.70	Measured from CanVec data
Outlet Channel Slope (m/m)	0.026	Average slope, measured in the field
Bed Material	Boulders, cobbles	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	599782 m E, 7260885 m N, 129.77 masl	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	598325 m E, 7256756 m N	
Comment	Poorly defined boulder channel. Sub-surface flow present. Cross-sectional data are available in discharge calculation sheets.	



Lake A5: Benchmark location.



6 August 2015. View looking east at Lake A5 and staff gauge.



6 August 2015. View from watercourse at Lake A5 (southeast).



6 August 2015. Downstream view of the watercourse (northwest).

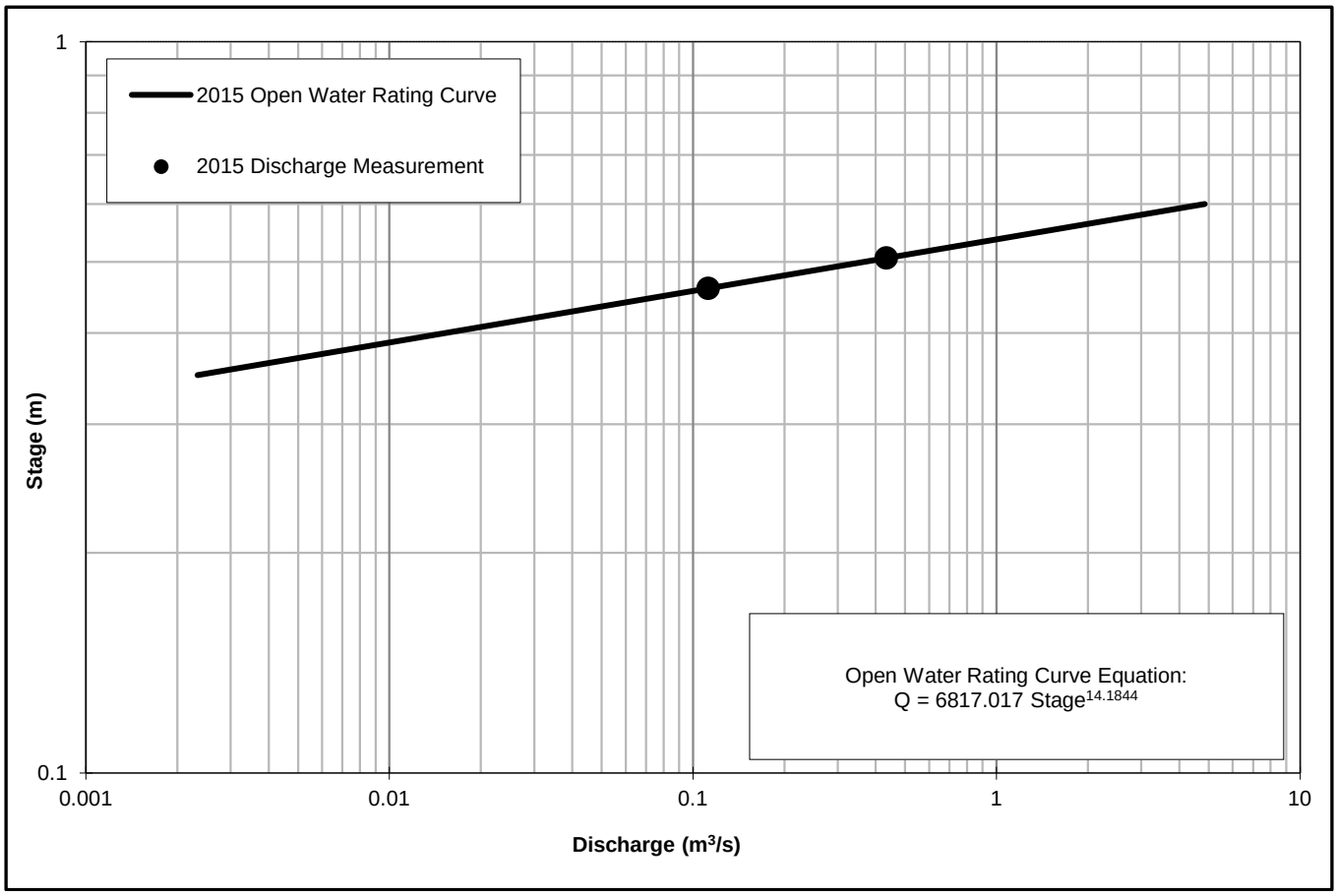


Figure 1: 2015 Stage-Discharge Rating Curve (Lake A5)

Lake A5 - 2015

MEAN DAILY DISCHARGE (m^3/s)

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	-	-	-	-	-	-	-	-	0.06	-	-	-
2	-	-	-	-	-	-	-	-	0.06	-	-	-
3	-	-	-	-	-	-	-	-	0.07	-	-	-
4	-	-	-	-	-	-	-	-	0.07	-	-	-
5	-	-	-	-	-	-	-	-	0.06	-	-	-
6	-	-	-	-	-	-	-	0.39 P	0.06	-	-	-
7	-	-	-	-	-	-	-	0.38	0.06	-	-	-
8	-	-	-	-	-	-	-	0.35	0.05	-	-	-
9	-	-	-	-	-	-	-	0.34	0.04	-	-	-
10	-	-	-	-	-	-	-	0.28	0.04	-	-	-
11	-	-	-	-	-	-	-	0.28	0.04	-	-	-
12	-	-	-	-	-	-	-	0.19	0.05	-	-	-
13	-	-	-	-	-	-	-	0.25	0.05	-	-	-
14	-	-	-	-	-	-	-	0.24	0.09	-	-	-
15	-	-	-	-	-	-	-	0.22	0.12	-	-	-
16	-	-	-	-	-	-	-	0.19	0.12 P	-	-	-
17	-	-	-	-	-	-	-	0.18	-	-	-	-
18	-	-	-	-	-	-	-	0.18	-	-	-	-
19	-	-	-	-	-	-	-	0.17	-	-	-	-
20	-	-	-	-	-	-	-	0.17	-	-	-	-
21	-	-	-	-	-	-	-	0.15	-	-	-	-
22	-	-	-	-	-	-	-	0.13	-	-	-	-
23	-	-	-	-	-	-	-	0.13	-	-	-	-
24	-	-	-	-	-	-	-	0.13	-	-	-	-
25	-	-	-	-	-	-	-	0.12	-	-	-	-
26	-	-	-	-	-	-	-	0.10	-	-	-	-
27	-	-	-	-	-	-	-	0.10	-	-	-	-
28	-	-	-	-	-	-	-	0.09	-	-	-	-
29	-	-	-	-	-	-	-	0.08	-	-	-	-
30	-	-	-	-	-	-	-	0.08	-	-	-	-
31	-	-	-	-	-	-	-	0.07	-	-	-	-
MIN	-	-	-	-	-	-	-	0.072	0.036	-	-	-
MEAN	-	-	-	-	-	-	-	0.191	0.064	-	-	-
MAX	-	-	-	-	-	-	-	0.393	0.119	-	-	-

NOTES: P - PARTIAL DAILY AVERAGE

Water Yield (m^3) =	518,371	429,907	88,464
Water Yield (mm) =	9.0	83%	17%

Lake A5 - 2015

MEAN DAILY WATER SURFACE ELEVATION (masl) BASED ON BENCHMARK ELEVATION 129.77 masl

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	-	-	-	-	-	-	-	-	132.238	-	-	-
2	-	-	-	-	-	-	-	-	132.241	-	-	-
3	-	-	-	-	-	-	-	-	132.243	-	-	-
4	-	-	-	-	-	-	-	-	132.244	-	-	-
5	-	-	-	-	-	-	-	-	132.242	-	-	-
6	-	-	-	-	-	-	-	132.302 P	132.240	-	-	-
7	-	-	-	-	-	-	-	132.301	132.238	-	-	-
8	-	-	-	-	-	-	-	132.298	132.232	-	-	-
9	-	-	-	-	-	-	-	132.297	132.230	-	-	-
10	-	-	-	-	-	-	-	132.291	132.229	-	-	-
11	-	-	-	-	-	-	-	132.290	132.224	-	-	-
12	-	-	-	-	-	-	-	132.277	132.232	-	-	-
13	-	-	-	-	-	-	-	132.286	132.231	-	-	-
14	-	-	-	-	-	-	-	132.285	132.254	-	-	-
15	-	-	-	-	-	-	-	132.282	132.261	-	-	-
16	-	-	-	-	-	-	-	132.277	132.262 P	-	-	-
17	-	-	-	-	-	-	-	132.275	-	-	-	-
18	-	-	-	-	-	-	-	132.275	-	-	-	-
19	-	-	-	-	-	-	-	132.274	-	-	-	-
20	-	-	-	-	-	-	-	132.273	-	-	-	-
21	-	-	-	-	-	-	-	132.269	-	-	-	-
22	-	-	-	-	-	-	-	132.264	-	-	-	-
23	-	-	-	-	-	-	-	132.265	-	-	-	-
24	-	-	-	-	-	-	-	132.265	-	-	-	-
25	-	-	-	-	-	-	-	132.261	-	-	-	-
26	-	-	-	-	-	-	-	132.257	-	-	-	-
27	-	-	-	-	-	-	-	132.256	-	-	-	-
28	-	-	-	-	-	-	-	132.252	-	-	-	-
29	-	-	-	-	-	-	-	132.251	-	-	-	-
30	-	-	-	-	-	-	-	132.249	-	-	-	-
31	-	-	-	-	-	-	-	132.245	-	-	-	-
MIN	-	-	-	-	-	-	-	132.245	132.224	-	-	-
MEAN	-	-	-	-	-	-	-	132.274	132.240	-	-	-
MAX	-	-	-	-	-	-	-	132.302	132.262	-	-	-

NOTES: P - PARTIAL DAILY AVERAGE

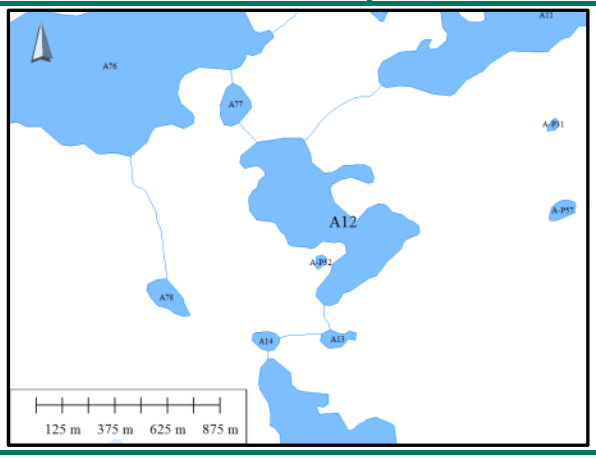
OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		Amaruq - trip 2			**Date**		06-Aug-15	
Waterbody:		A5			**Start Time**		9:45	
Crossing ID:		A5-A4			**End Time**		10:05	
Left Downstream Bank (LDB) UTM Location		**Survey**			**Datalogger SN:**			
East	600184	BM_read			**Transducer SN:**			
North	7260409	WL_read			**Meter Type/SN:**		Marsh McBirney	
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL & JN		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.00	0.10		0.00				**0.180**
2	1.50	0.14		0.06			**0.011**	**0.084**
3	2.70	0.00		0.00			**0.000**	**0.000**
4	3.70	0.00		0.00			**0.000**	**0.032**
5	4.50	0.08		0.12			**0.011**	**0.090**
6	6.00	0.04		0.15			**0.009**	**0.098**
7	7.50	0.09		0.23			**0.031**	**0.143**
8	9.00	0.10		0.10			**0.014**	**0.060**
9	10.20	0.00		0.00			**0.000**	**0.000**
10	11.10	0.00		0.00			**0.000**	**0.099**
11	12.00	0.22		0.03			**0.006**	**0.110**
12	13.00	0.00		0.00			**0.000**	**0.000**
13	13.50	0.00		0.00			**0.000**	**0.015**
14	13.70	0.15		0.10			**0.011**	**0.202**
15	15.00	0.16		0.26			**0.042**	**0.056**
16	15.70	0.00		0.00			**0.000**	**0.000**
17	17.00	0.00		0.00			**0.000**	**0.020**
18	17.20	0.20		0.10			**0.015**	**0.169**
19	18.50	0.06		0.11			**0.008**	**0.030**
20	19.50	0.00		0.00			**0.000**	**0.000**
21	19.80	0.00		0.00			**0.000**	**0.040**
22	20.20	0.20		0.20			**0.034**	**0.286**
23	21.50	0.24		0.17			**0.055**	**0.168**
24	22.90	0.00		0.00			**0.000**	**0.000**
25	23.40	0.00		0.00			**0.000**	**0.132**
26	24.50	0.24		0.03			**0.009**	**0.255**
27	26.00	0.10		0.21			**0.032**	**0.263**
28	27.50	0.25		0.15			**0.056**	**0.330**
29	29.00	0.19		0.11			**0.031**	**0.203**
30	30.50	0.08		0.09			**0.011**	**0.060**
31	32.00	0.00		0.00			**0.000**	**0.000**
32	32.30	0.00		0.00			**0.000**	**0.012**
33	32.50	0.12		0.05			**0.002**	**0.018**
34	32.80	0.00		0.00			**0.000**	**0.000**
35	33.10	0.00		0.00			**0.000**	**0.040**
36	33.50	0.20		0.03			**0.006**	**0.345**
37	35.00	0.26		0.00			**0.000**	**0.140**
38	35.70	0.14		0.04			**0.007**	**0.198**
39	37.50	0.08		0.06			**0.033**	**0.484**
40	49.60	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.434**	
						A(m2)	**4.36**	
						B(m)	**49.6**	

OPEN WATER DISCHARGE CALCULATION SPREADSHEET							
Project Name, Number:		1524321 - Amaruq Trip 3			**Date**	16-Sep-15	
Waterbody:		A5			**Start Time**	12:45	
Crossing ID:		A5-A4			**End Time**	13:05	
LDB UTM Location		**Survey**			**Datalogger SN:**		
East	600182	BM_read			**Transducer SN:**		
North	7260409	WL_read			**Meter Type/SN:**		
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, DC	
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)	Qi (m3/s)	Ai (m2)
1	0.00	0.00		0			**0.030**
2	0.50	0.12		0.02		**0.001**	**0.030**
3	1.00	0.00		0		**0.000**	**0.000**
4	1.00	0.15		0.01		**0.001**	**0.105**
5	1.70	0.15		0.01		**0.001**	**0.001**
6	1.71	0.00		0		**0.000**	**0.000**
7	1.71	0.10		0.06		**0.001**	**0.025**
8	1.96	0.10		0.06		**0.001**	**0.001**
9	1.97	0.00		0		**0.000**	**0.000**
10	1.97	0.08		0.02		**0.000**	**0.024**
11	2.27	0.08		0.02		**0.000**	**0.000**
12	2.28	0.00		0		**0.000**	**0.000**
13	2.28	0.13		0.16		**0.006**	**0.078**
14	2.88	0.13		0.16		**0.006**	**0.001**
15	2.89	0.00		0		**0.000**	**0.000**
16	2.89	0.06		0.15		**0.002**	**0.021**
17	3.24	0.06		0.15		**0.002**	**0.000**
18	3.25	0.00		0.00		**0.000**	**0.000**
19	3.25	0.10		0.01		**0.000**	**0.040**
20	3.65	0.10		0.01		**0.000**	**0.000**
21	3.65	0.00		0.00		**0.000**	**0.000**
22	3.65	0.00		0.00		**0.000**	**0.018**
23	3.85	0.18		0.15		**0.011**	**0.060**
24	4.45	0.02		0.01		**0.000**	**0.060**
25	5.45	0.10		0.06		**0.007**	**0.119**
26	6.85	0.07		0.03		**0.003**	**0.063**
27	8.65	0.00		0.00		**0.000**	**0.000**
28	8.65	0.00		0.00		**0.000**	**0.064**
29	9.45	0.16		0.03		**0.004**	**0.153**
30	10.35	0.18		0.05		**0.009**	**0.216**
31	11.55	0.18		0.03		**0.006**	**0.176**
32	12.45	0.21		0.07		**0.014**	**0.105**
33	13.45	0.00		0.00		**0.000**	**0.000**
34	13.45	0.20		0.08		**0.006**	**0.150**
35	14.20	0.20		0.08		**0.006**	**0.001**
36	14.21	0.00		0.00		**0.000**	**0.000**
37	14.21	0.10		0.15		**0.003**	**0.040**
38	14.61	0.10		0.15		**0.003**	**0.000**
39	14.62	0.00		0.00		**0.000**	**0.000**
40	14.62	0.08		0.11		**0.002**	**0.032**
41	15.02	0.08		0.11		**0.002**	**0.000**
42	15.03	0.00		0.00		**0.000**	**0.000**
43	15.03	0.07		0.08		**0.000**	**0.014**
44	15.23	0.07		0.08		**0.001**	**0.000**
45	15.24	0.00		0.00		**0.000**	**0.000**
46	15.24	0.12		0.02		**0.001**	**0.108**
47	16.14	0.12		0.02		**0.001**	**0.001**
48	16.15	0.00		0.00		**0.000**	**0.000**
49	16.15	0.12		0.03		**0.001**	**0.048**
50	16.55	0.12		0.03		**0.001**	**0.000**
51	16.55	0.00		0.00		**0.000**	**0.040**
52	17.35	0.10		0.02		**0.002**	**0.110**
53	18.45	0.10		0.06		**0.006**	**0.040**
54	19.25	0.00		0.00		**0.000**	**0.035**
55	19.95	0.10		0.01		**0.001**	**0.030**
56	20.55	0.00		0.00		**0.000**	**0.000**
57	20.55	0.08		0.02		**0.000**	**0.040**
58	21.05	0.08		0.02		**0.000**	**0.000**
59	21.06	0.00		0.00		**0.000**	**0.000**
60	21.06	0.06		0.07		**0.001**	**0.030**
61	21.56	0.06		0.07		**0.001**	**0.000**

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		1524321 - Amaruq Trip 3			**Date**		16-Sep-15	
Waterbody:		A5			**Start Time**		12:45	
Crossing ID:		A5-A4			**End Time**		13:05	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	600182	BM_read			**Transducer SN:**			
North	7260409	WL_read			**Meter Type/SN:**			
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, DC		
STATION	DISTANCE		Velocity		Optional			
Start	FROM LDB	DEPTH	0.2 DEPTH	0.6/0.8 DEPTH	ANGLE OF FLOW		Qi	Ai
LDB	(m)	(m)	(m/s)	(m/s)	(º)		(m3/s)	(m2)
62	21.57	0.00		0.00			**0.000**	**0.000**
NOTES:	Discharge measurement was separated into sections that contained flow. In some cases, sections were estimated as an average depth and velocity. Therefore, the distance from LDB, A and B values are not applicable to this measurement. RDB un-measurable low flow area accounting for ~5% of flow				**RESULTS:**	**Q (m3/s)**	**0.112**	
						A(m2)	**2.11**	
						B(m)	**21.6**	

A2.0 LAKE A12 & NORTHWEST OUTLET (STREAM A12-A11)

Parameter	Value	Note
Drainage Area (km^2)	42.4	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	44	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	0.9	Measured in the field, based on vegetation and high water marks
Wetted Width (m)	42.0	Measured in the field August 6, 2015
Max. Wetted Depth (m)	0.31	Measured in the field August 6, 2015
Channel Length (km)	0.50	Measured from CanVec data
Outlet Channel Slope (m/m)	0.004	Average slope, based on DEM (PhotoSat 2015)
Bed Material	Boulders, cobbles	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	N/A	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	N/A	
Comment	Poorly defined boulder channel. Sub surface flows present. Cross-sectional data are available in discharge calculation sheets and Section 3.3.	



Lake A12.



6 August 2015. Looking north from Lake A12 to Lake A77 and Lake A11.



6 August 2015. Upstream view from the watercourse towards Lake A12 (southwest).

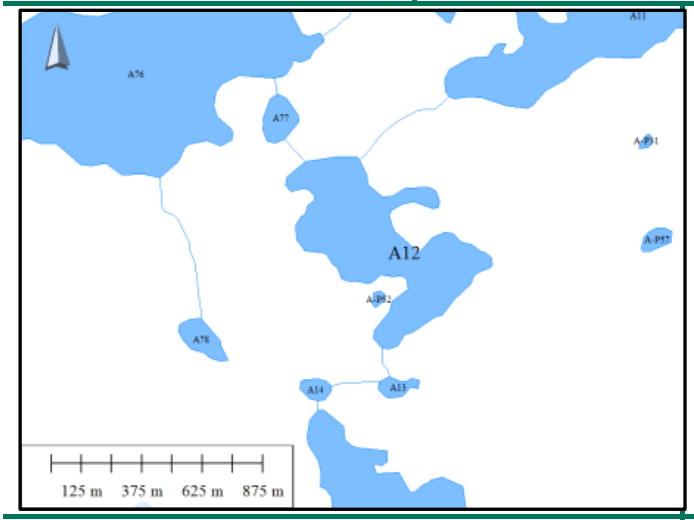


19 September 2015. Downstream view of the watercourse (northeast).

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		Amaruq - Trip 2			**Date**		06-Aug-15	
Waterbody:		A12			**Start Time**		12:05	
Crossing ID:		A12-A11			**End Time**		12:40	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	603052	BM_read			**Transducer SN:**			
North	7256600	WL_read			**Meter Type/SN:**		Marsh McBirney	
Elevation, Zone	156, 14W	WL_Elev			**Crew:**	JRL & JN		
STATION	DISTANCE		Velocity		Optional			
Start	FROM LDB	DEPTH	0.2 DEPTH	0.6/0.8 DEPTH	ANGLE OF FLOW		Qi	Ai
LDB	(m)	(m)	(m/s)	(m/s)	(º)		(m3/s)	(m2)
1	0.00	0.00		0.00				**0.114**
2	1.20	0.19		0.00			**0.000**	**0.148**
3	2.00	0.18		0.02			**0.004**	**0.353**
4	3.50	0.29		0.02			**0.008**	**0.358**
5	4.80	0.26		0.00			**0.000**	**0.442**
6	6.50	0.26		0.00			**0.000**	**0.195**
7	8.00	0.00		0.00			**0.000**	**0.044**
8	8.40	0.22		0.06			**0.013**	**0.176**
9	10.00	0.00		0.00			**0.000**	**0.038**
10	11.90	0.04		0.23			**0.009**	**0.002**
11	12.00	0.00		0.00			**0.000**	**0.027**
12	12.60	0.09		0.02			**0.001**	**0.018**
13	13.00	0.00		0.00			**0.000**	**0.117**
14	14.30	0.18		0.00			**0.000**	**0.180**
15	15.50	0.12		0.16			**0.016**	**0.030**
16	16.00	0.00		0.00			**0.000**	**0.600**
17	22.00	0.20		0.09			**0.059**	**0.050**
18	22.50	0.00		0.00			**0.000**	**0.078**
19	23.00	0.31		0.00			**0.000**	**1.785**
20	31.50	0.11		0.02			**0.011**	**0.083**
21	33.00	0.00		0.00			**0.000**	**0.162**
22	35.70	0.12		0.36			**0.194**	**0.378**
23	42.00	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.316**	
						A(m2)	**5.38**	
						B(m)	**42.0**	

A3.0 LAKE A12 & NORTHEAST OUTLET (STREAM A12-A77)

Parameter	Value	Note
Drainage Area (km^2)	42.4	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	45	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	0.45	Measured in the field, based on vegetation
Wetted Width (m)	16.8	Measured in the field on 6 August 2015
Max. Wetted Depth (m)	0.39	Measured in the field on 6 August 2015
Channel Length (km)	0.12	Measured from CanVec data
Outlet Channel Slope (m/m)	0.020	Average slope, based on DEM (PhotoSat 2015)
Bed Material	Boulders, cobbles	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass, bushes	
Benchmark Coordinates	N/A	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	N/A	
Comment	Poorly defined braid-like boulder channels. Cross-sectional data are available in discharge calculation sheets and Section 3.3.	



Lake A12.



6 August 2015. Upstream view from Lake A76 to Lake A12 (south).



6 August 2015. Upstream view at Lake A12 to A77 outlet (south).

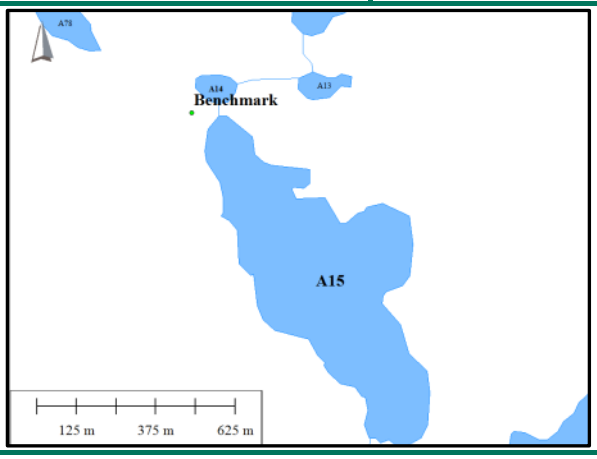
OPEN WATER DISCHARGE CALCULATION SPREADSHEET							
Project Name, Number:		Amaruq - Trip 2			**Date**		06-Aug-15
Waterbody:		A12			**Start Time**		11:20
Crossing ID:		A12-A77			**End Time**		11:45
LDB UTM Location		**Survey**			**Datalogger SN:**		
East	602772	BM_read			**Transducer SN:**		
North	7256632	WL_read			**Meter Type/SN:**		Marsh McBirney
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, JN	

STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)	Qi (m3/s)	Ai (m2)
1	1.60	0.00		0.00			**0.011**
2	1.90	0.07		0.13		**0.003**	**0.074**
3	2.30	0.30		0.18		**0.030**	**0.203**
4	3.00	0.28		0.27		**0.064**	**0.235**
5	4.00	0.19		0.02		**0.003**	**0.099**
6	4.60	0.14		0.10		**0.007**	**0.052**
7	5.00	0.12		0.02		**0.003**	**0.120**
8	7.00	0.00		0.00		**0.000**	**0.000**
9	7.01	0.00		0.00		**0.000**	**0.000**
10	10.00	0.00		0.00		**0.000**	**0.002**
11	10.01	0.36		0.11		**0.010**	**0.176**
12	10.50	0.36		0.11		**0.010**	**0.002**
13	10.51	0.12		0.11		**0.003**	**0.047**
14	10.90	0.12		0.04		**0.001**	**0.001**
15	10.91	0.00		0.00		**0.000**	**0.000**

NOTES:	**RESULTS:**	**Q (m3/s)**	**0.133**
		A(m2)	**1.02**
		B(m)	**9.3**

A4.0 LAKE A15 & OUTLET (STREAM A15-A14)

Parameter	Value	Note
Drainage Area (km^2)	40.8	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	100	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	0.95	Measured in the field, based on vegetation
Wetted Width (m)	87.7	Measured in the field on 15 June 2015
Max. Wetted Depth (m)	0.55	Measured in the field on 15 June 2015
Channel Length (km)	0.35	Measured from CanVec data
Outlet Channel Slope (m/m)	0.002	Average slope, based on DEM (PhotoSat 2015)
Bed Material	Boulders, cobbles	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	603366 m E 7254484 m N, 153.67 masl	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	603151 m E 7255313 m N	
Comment	Poorly defined boulder channel. During spring freshet, Lake A14 and Lake A15 have similar water elevations and may form one lake. Discharges were measured between Lake A14 and Lake A13. Cross-sectional data are available in discharge calculation sheets and Section 3.3.	



Lake A14: Benchmark location.



13 June 2015. View looking west of Lake A15 and staff gauge.



18 September 2015. View looking west of Lake 15 and staff gauge.



4 August 2015. Upstream view of the watercourse (west).



13 June 2015. Downstream view of the watercourse (east).

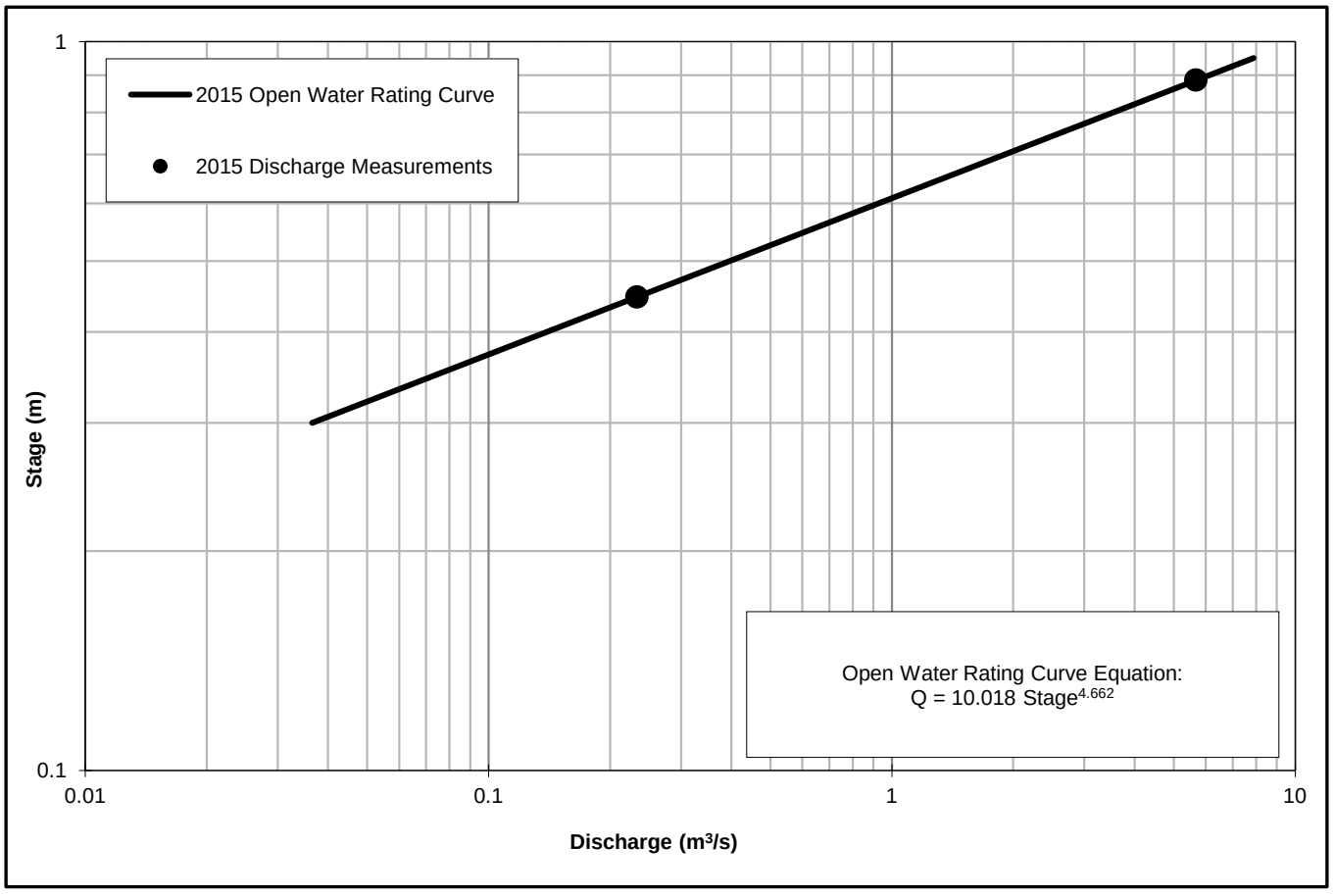


Figure 2: 2015 Stage-Discharge Rating Curve (Lake A15)

Lake A15 - 2015

MEAN DAILY DISCHARGE (m^3/s)

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	-	-	-	-	-	-	1.68	0.29	0.00	-	-	-
2	-	-	-	-	-	-	1.55	0.26	0.00	-	-	-
3	-	-	-	-	-	-	1.48	0.24	0.00	-	-	-
4	-	-	-	-	-	-	1.36	0.22	0.00	-	-	-
5	-	-	-	-	-	-	1.29	0.20	0.00	-	-	-
6	-	-	-	-	-	-	1.16	0.18	0.00	-	-	-
7	-	-	-	-	-	-	1.10	0.16	0.00	-	-	-
8	-	-	-	-	-	-	1.06	0.14	0.00	-	-	-
9	-	-	-	-	-	-	1.04	0.13	0.00	-	-	-
10	-	-	-	-	-	-	1.09	0.11	0.00	-	-	-
11	-	-	-	-	-	-	1.02	0.10	0.00	-	-	-
12	-	-	-	-	-	-	0.96	0.08	0.00	-	-	-
13	-	-	-	-	-	5.01 P	0.94	0.07	0.00	-	-	-
14	-	-	-	-	-	3.52	0.90	0.06	0.00	-	-	-
15	-	-	-	-	-	5.68	0.84	0.06	0.01	-	-	-
16	-	-	-	-	-	6.30	0.78	0.05	0.01	-	-	-
17	-	-	-	-	-	5.38	0.73	0.04	0.01	-	-	-
18	-	-	-	-	-	4.54	0.70	0.03	0.01 P	-	-	-
19	-	-	-	-	-	3.93	0.64	0.03	-	-	-	-
20	-	-	-	-	-	3.53	0.60	0.02	-	-	-	-
21	-	-	-	-	-	3.26	0.57	0.02	-	-	-	-
22	-	-	-	-	-	3.11	0.53	0.02	-	-	-	-
23	-	-	-	-	-	2.92	0.50	0.01	-	-	-	-
24	-	-	-	-	-	2.72	0.46	0.01	-	-	-	-
25	-	-	-	-	-	2.50	0.43	0.01	-	-	-	-
26	-	-	-	-	-	2.43	0.39	0.01	-	-	-	-
27	-	-	-	-	-	2.33	0.36	0.01	-	-	-	-
28	-	-	-	-	-	2.14	0.34	0.01	-	-	-	-
29	-	-	-	-	-	1.97	0.31	0.01	-	-	-	-
30	-	-	-	-	-	1.83	0.30	0.00	-	-	-	-
31	-	-	-	-	-	-	0.31	0.00	-	-	-	-
MIN	-	-	-	-	-	1.825	0.303	0.004	0.001	-	-	-
MEAN	-	-	-	-	-	3.506	0.821	0.083	0.003	-	-	-
MAX	-	-	-	-	-	6.296	1.685	0.286	0.010	-	-	-

NOTES: P - PARTIAL DAILY AVERAGE

Water Yield (m^3) =	7,878,483	5,452,441	2,197,845	222,881	5,316
Water Yield (mm) =	193.1	69%	28%	3%	0.05%

Lake A15 - 2015

MEAN DAILY WATER SURFACE ELEVATION (masl) BASED ON BENCHMARK ELEVATION 155.17 masl

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	-	-	-	-	-	-	151.882	151.666	151.379	-	-	-
2	-	-	-	-	-	-	151.870	151.657	151.380	-	-	-
3	-	-	-	-	-	-	151.863	151.647	151.377	-	-	-
4	-	-	-	-	-	-	151.851	151.642	151.372	-	-	-
5	-	-	-	-	-	-	151.844	151.634	151.367	-	-	-
6	-	-	-	-	-	-	151.830	151.624	151.361	-	-	-
7	-	-	-	-	-	-	151.823	151.613	151.355	-	-	-
8	-	-	-	-	-	-	151.818	151.600	151.347	-	-	-
9	-	-	-	-	-	-	151.816	151.593	151.341	-	-	-
10	-	-	-	-	-	-	151.821	151.583	151.335	-	-	-
11	-	-	-	-	-	-	151.812	151.572	151.328	-	-	-
12	-	-	-	-	-	-	151.805	151.550	151.340	-	-	-
13	-	-	-	-	-	152.061 P	151.802	151.547	151.368	-	-	-
14	-	-	-	-	-	151.999	151.797	151.539	151.386	-	-	-
15	-	-	-	-	-	152.084	151.787	151.528	151.398	-	-	-
16	-	-	-	-	-	152.105	151.778	151.514	151.409	-	-	-
17	-	-	-	-	-	152.075	151.771	151.502	151.423	-	-	-
18	-	-	-	-	-	152.044	151.764	151.492	151.428 P	-	-	-
19	-	-	-	-	-	152.018	151.755	151.482	-	-	-	-
20	-	-	-	-	-	151.999	151.747	151.472	-	-	-	-
21	-	-	-	-	-	151.986	151.740	151.462	-	-	-	-
22	-	-	-	-	-	151.978	151.732	151.451	-	-	-	-
23	-	-	-	-	-	151.968	151.725	151.442	-	-	-	-
24	-	-	-	-	-	151.956	151.717	151.434	-	-	-	-
25	-	-	-	-	-	151.943	151.708	151.425	-	-	-	-
26	-	-	-	-	-	151.938	151.697	151.419	-	-	-	-
27	-	-	-	-	-	151.931	151.690	151.413	-	-	-	-
28	-	-	-	-	-	151.918	151.683	151.405	-	-	-	-
29	-	-	-	-	-	151.905	151.676	151.400	-	-	-	-
30	-	-	-	-	-	151.894	151.672	151.395	-	-	-	-
31	-	-	-	-	-	-	151.675	151.385	-	-	-	-
MIN	-	-	-	-	-	151.894	151.672	151.385	151.328	-	-	-
MEAN	-	-	-	-	-	151.983	151.773	151.519	151.372	-	-	-
MAX	-	-	-	-	-	152.105	151.882	151.666	151.428	-	-	-

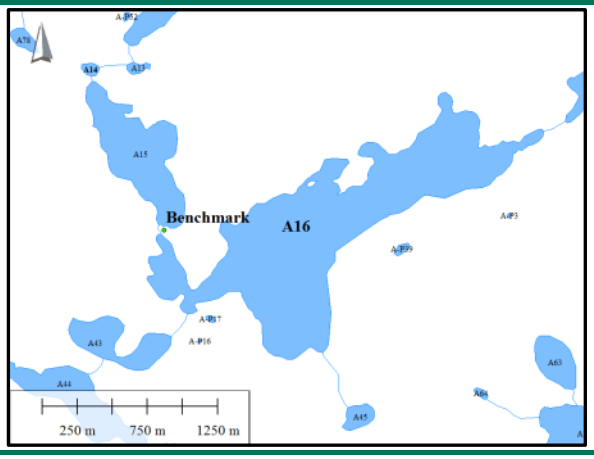
NOTES: P - PARTIAL DAILY AVERAGE

OPEN WATER DISCHARGE CALCULATION SPREADSHEET							
Project Name, Number:		1524321 - Amaruq			**Date**	15-Jun-15	
Waterbody:		A15			**Start Time**	14:10	
Crossing ID:		A14-A13			**End Time**	1520	
LDB UTM Location		**Survey**			**Datalogger SN:**		
East	603046	BM_read			**Transducer SN:**		
North	7255689	WL_read			**Meter Type/SN:**	Swoffer	
Elevation, Zone	14W	WL_Elev			**Crew:**	CJ, JRL	
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)	Qi (m3/s)	Ai (m2)
1	0.00	0.00		0.00			**0.036**
2	0.60	0.12		0.27		**0.028**	**0.198**
3	1.70	0.24		0.10		**0.032**	**0.341**
4	3.25	0.20		0.03		**0.009**	**0.320**
5	4.85	0.20		0.01		**0.003**	**0.566**
6	8.75	0.09		0.04		**0.011**	**0.341**
7	10.95	0.22		0.00		**0.000**	**0.851**
8	15.55	0.15		0.25		**0.111**	**0.156**
9	16.85	0.09		0.16		**0.023**	**0.314**
10	18.75	0.24		0.09		**0.029**	**0.136**
11	19.55	0.10		0.17		**0.015**	**0.145**
12	20.55	0.19		0.07		**0.015**	**0.202**
13	21.85	0.12		0.12		**0.017**	**0.175**
14	22.85	0.23		0.23		**0.071**	**0.408**
15	24.55	0.25		0.13		**0.057**	**0.621**
16	26.35	0.44		0.08		**0.062**	**0.544**
17	28.05	0.20		0.09		**0.026**	**0.264**
18	29.25	0.24		0.08		**0.030**	**0.527**
19	31.20	0.30		0.34		**0.186**	**0.476**
20	32.90	0.26		0.36		**0.220**	**0.990**
21	35.90	0.40		0.06		**0.058**	**0.657**
22	37.70	0.33		0.20		**0.139**	**0.696**
23	40.10	0.25		0.46		**0.270**	**0.518**
24	42.40	0.20		0.36		**0.119**	**0.215**
25	43.40	0.23		0.30		**0.090**	**0.248**
26	45.00	0.08		0.45		**0.049**	**0.280**
27	46.10	0.43		0.23		**0.168**	**1.024**
28	48.40	0.46		0.21		**0.164**	**0.440**
29	49.50	0.34		0.37		**0.157**	**0.553**
30	50.90	0.45		0.37		**0.241**	**0.563**
31	52.40	0.30		0.25		**0.101**	**0.510**
32	53.60	0.55		0.56		**0.755**	**1.628**
33	57.30	0.33		0.33		**0.283**	**0.510**
34	58.80	0.35		0.65		**0.432**	**0.713**
35	61.10	0.27		0.68		**0.376**	**0.576**
36	62.90	0.37		0.30		**0.266**	**1.155**
37	65.90	0.40		0.35		**0.350**	**0.720**
38	67.90	0.32		0.26		**0.146**	**0.353**
39	69.40	0.15		0.06		**0.012**	**0.186**
40	70.60	0.16		0.32		**0.056**	**0.130**
41	71.60	0.10		0.49		**0.129**	**0.213**
42	75.85	0.00		0.00	end main channel	**0.000**	**0.000**
43	76.00	0.00		0.00	start side channel	**0.000**	**0.028**
44	76.80	0.07		0.25		**0.025**	**0.221**
45	78.90	0.14		0.48		**0.155**	**0.275**
46	81.40	0.08		0.46		**0.155**	**0.325**
47	87.30	0.03		0.42		**0.040**	**0.006**
48	87.70	0.00		0.00		**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**5.680**
						A(m2)	**20.35**
						B(m)	**87.7**

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		Amaruq - trip 2			**Date**		04-Aug-15	
Waterbody:		A15			**Start Time**		11:45	
Crossing ID:		A14-A13			**End Time**		12:10	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	6030112	BM_read			**Transducer SN:**			
North	7255650	WL_read			**Meter Type/SN:**		Marsh McBirney	
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, JN		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.00	0.00		0.00				**0.885**
2	35.40	0.05		0.00			**0.000**	**0.015**
3	35.50	0.25		0.06			**0.002**	**0.013**
4	35.60	0.00		0.00			**0.000**	**0.000**
5	36.10	0.00		0.00			**0.000**	**0.000**
6	36.10	0.20		0.00			**0.000**	**0.020**
7	36.20	0.20		0.00			**0.000**	**0.000**
8	36.20	0.00		0.00			**0.000**	**0.000**
9	36.80	0.00		0.00			**0.000**	**0.020**
10	37.00	0.20		0.06			**0.002**	**0.020**
11	37.20	0.00		0.00			**0.000**	**0.000**
12	37.90	0.00		0.00			**0.000**	**0.009**
13	38.00	0.17		0.04			**0.004**	**0.185**
14	39.00	0.20		0.04			**0.008**	**0.210**
15	40.00	0.22		0.07			**0.015**	**0.170**
16	41.00	0.12		0.04			**0.003**	**0.012**
17	41.20	0.00		0.00			**0.000**	**0.000**
18	41.70	0.00		0.00			**0.000**	**0.024**
19	42.00	0.16		0.01			**0.001**	**0.140**
20	43.00	0.12		0.10			**0.009**	**0.030**
21	43.50	0.00		0.00			**0.000**	**0.000**
22	44.40	0.00		0.00			**0.000**	**0.105**
23	45.00	0.35		0.05			**0.007**	**0.035**
24	45.20	0.00		0.00			**0.000**	**0.000**
25	46.80	0.00		0.00			**0.000**	**0.021**
26	47.00	0.21		0.06			**0.003**	**0.021**
27	47.20	0.00		0.00			**0.000**	**0.000**
28	47.50	0.00		0.00			**0.000**	**0.053**
29	48.00	0.21		0.10			**0.016**	**0.305**
30	49.00	0.40		0.05			**0.020**	**0.345**
31	50.00	0.29		0.05			**0.015**	**0.375**
32	51.00	0.46		0.11			**0.051**	**0.380**
33	52.00	0.30		0.14			**0.032**	**0.075**
34	52.50	0.00		0.00			**0.000**	**0.000**
35	53.60	0.00		0.00			**0.000**	**0.076**
36	54.00	0.38		0.10			**0.011**	**0.043**
37	54.20	0.05		0.14			**0.004**	**0.144**
38	55.00	0.31		0.03			**0.008**	**0.300**
39	56.00	0.29		0.05			**0.015**	**0.180**
40	57.00	0.07		0.11			**0.005**	**0.010**
41	57.30	0.00		0.00			**0.000**	**0.000**
42	58.00	0.00		0.00			**0.000**	**0.003**
43	58.10	0.06		0.06			**0.000**	**0.072**
44	58.90	0.12		0.09			**0.005**	**0.006**
45	59.00	0.00		0.00			**0.000**	**0.000**
46	59.01	0.05		0.00			**0.000**	**0.650**
47	85.01	0.00		0.00			**0.000**	**0.000**
NOTES:	First and last row approximated. Depth <5cm.				**RESULTS:**	**Q (m3/s)**	**0.233**	
						A(m2)	**4.95**	
						B(m)	**85.0**	

A5.0 LAKE A16 (MAMMOTH LAKE) & OUTLET (STREAM A16-A15)

Parameter	Value	Note
Drainage Area (km^2)	38.7	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	45	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	0.95	Measured in the field, based on vegetation
Wetted Width (m)	39.3	Measured in the field on 13 June 2015
Max. Wetted Depth (m)	0.48	Measured in the field on 13 June 2015
Channel Length (km)	0.07	Measured from CanVec data
Outlet Channel Slope (m/m)	0.009	Average slope, measured in the field
Bed Material	Boulders, cobbles	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	602765 m E, 7255549 m N, 155.17 masl	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	N/A	
Comment	Poorly defined boulder channel. Subsurface flow present. Cross-sectional data are available in discharge calculation sheets and Section 3.3.	





18 September 2015. View looking southeast towards Lake A16 and outlet.



13 June 2015. Upstream view of the watercourse (south).

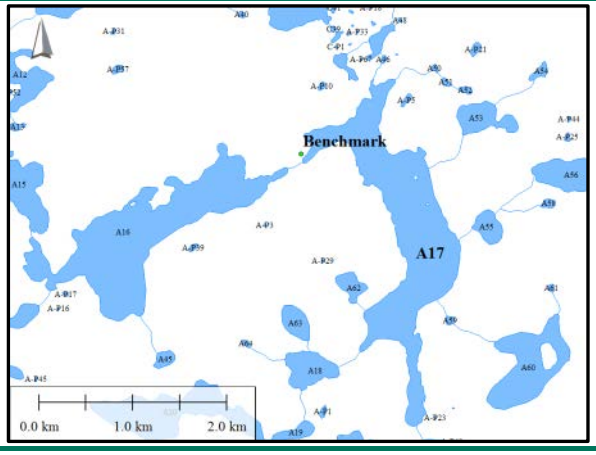


18 September 2015. Downstream view from watercourse towards Lake A15 (northeast).

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		154321			**Date**		13-Jun-15	
Waterbody:		A16			**Start Time**		1245	
Crossing ID:		A16-A15			**End Time**		1305	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	6023386	BM_read			**Transducer SN:**			
North	7254474	WL_read			**Meter Type/SN:**		Swoffer	
Elevation, Zone	14W	WL_Elev			**Crew:**	CJ, JRL		
STATION	DISTANCE		Velocity		Optional			
Start	FROM LDB	DEPTH	0.2 DEPTH	0.6/0.8 DEPTH	ANGLE OF FLOW		Qi	Ai
LDB	(m)	(m)	(m/s)	(m/s)	(º)		(m3/s)	(m2)
1	0.00	0.00		0.00				**0.052**
2	0.80	0.13		0.05			**0.006**	**0.225**
3	1.80	0.32		0.20			**0.256**	**1.645**
4	8.80	0.15		0.11			**0.067**	**0.220**
5	9.90	0.25		0.22			**0.099**	**0.638**
6	12.40	0.26		0.40			**0.182**	**0.210**
7	13.40	0.16		0.15			**0.029**	**0.196**
8	14.80	0.12		0.42			**0.055**	**0.124**
9	15.60	0.19		0.55			**0.157**	**0.297**
10	17.80	0.08		0.40			**0.054**	**0.222**
11	19.00	0.29		0.00			**0.000**	**0.308**
12	20.40	0.15		0.35			**0.118**	**0.496**
13	23.50	0.17		0.40			**0.221**	**0.561**
14	26.90	0.16		0.36			**0.282**	**1.408**
15	33.30	0.28		0.40			**0.423**	**0.236**
16	34.45	0.13		0.42			**0.055**	**0.157**
17	35.30	0.24		0.30			**0.031**	**0.000**
18	35.30	0.09		0.11			**0.007**	**0.188**
19	36.80	0.16		0.05			**0.028**	**0.440**
20	42.30	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**2.070**	
						A(m2)	**7.62**	
						B(m)	**42.3**	

A6.0 LAKE A17 (WHALE TAIL LAKE) & OUTLET (STREAM A17-A16)

Parameter	Value	Note
Drainage Area (km^2)	28.1	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	75	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	0.80	Measured in the field, based on vegetation
Wetted Width (m)	75.3	Measured in the field on 14 June 2015
Max. Wetted Depth (m)	0.80	Measured in the field on 14 June 2015
Channel Length (km)	0.50	Measured from CanVec data
Outlet Channel Slope (m/m)	0.002	Average slope, measured with DEM
Bed Material	Boulders, cobbles	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	606209 m E, 7255347 m N, 156.35 masl	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	606646 m E, 7255513 m N	
Comment	Poorly defined boulder channel. Cross-sectional data are available in discharge calculation sheets and Section 3.3.	



Lake H17: Benchmark location.



14 June 2015. View looking north at Lake A17.



7 August 2015. Upstream view of the watercourse (northwest).



14 June 2015. Downstream view of the watercourse (southwest).

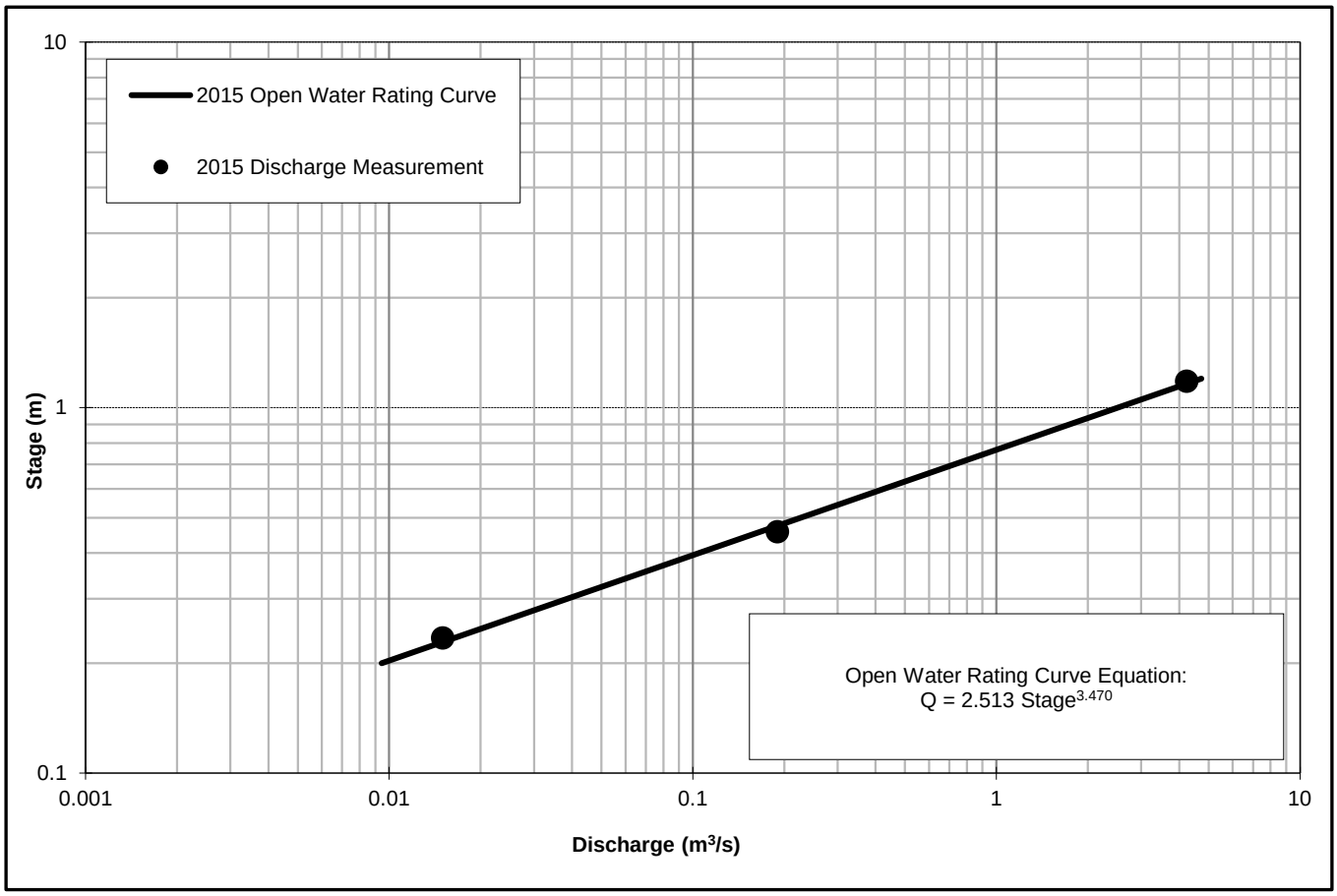


Figure 3: 2015 Stage-Discharge Rating Curve (Lake A17)

Lake A17 - 2015

MEAN DAILY DISCHARGE (m^3/s)

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	-	-	-	-	-	-	0.72	0.23	0.04	-	-	-
2	-	-	-	-	-	-	0.69	0.21	0.04	-	-	-
3	-	-	-	-	-	-	0.66	0.20	0.04	-	-	-
4	-	-	-	-	-	-	0.62	0.19	0.04	-	-	-
5	-	-	-	-	-	-	0.61	0.18	0.03	-	-	-
6	-	-	-	-	-	-	0.59	0.17	0.03	-	-	-
7	-	-	-	-	-	-	0.58	0.16	0.03	-	-	-
8	-	-	-	-	-	-	0.56	0.16	0.03	-	-	-
9	-	-	-	-	-	-	0.55	0.15	0.03	-	-	-
10	-	-	-	-	-	-	0.56	0.14	0.02	-	-	-
11	-	-	-	-	-	-	0.54	0.13	0.02	-	-	-
12	-	-	-	-	-	1.26 P	0.53	0.11	0.03	-	-	-
13	-	-	-	-	-	2.04	0.52	0.11	0.04	-	-	-
14	-	-	-	-	-	3.47	0.49	0.11	0.04	-	-	-
15	-	-	-	-	-	3.56	0.46	0.10	0.05	-	-	-
16	-	-	-	-	-	2.82	0.44	0.09	0.05 P	-	-	-
17	-	-	-	-	-	2.26	0.43	0.08	-	-	-	-
18	-	-	-	-	-	1.98	0.41	0.08	-	-	-	-
19	-	-	-	-	-	1.88	0.39	0.08	-	-	-	-
20	-	-	-	-	-	1.67	0.38	0.08	-	-	-	-
21	-	-	-	-	-	1.62	0.36	0.07	-	-	-	-
22	-	-	-	-	-	1.45	0.35	0.07	-	-	-	-
23	-	-	-	-	-	1.26	0.34	0.06	-	-	-	-
24	-	-	-	-	-	1.12	0.32	0.06	-	-	-	-
25	-	-	-	-	-	1.02	0.30	0.06	-	-	-	-
26	-	-	-	-	-	0.98	0.28	0.05	-	-	-	-
27	-	-	-	-	-	0.91	0.27	0.05	-	-	-	-
28	-	-	-	-	-	0.86	0.26	0.05	-	-	-	-
29	-	-	-	-	-	0.81	0.25	0.05	-	-	-	-
30	-	-	-	-	-	0.77	0.25	0.04	-	-	-	-
31	-	-	-	-	-	-	0.24	0.04	-	-	-	-
MIN	-	-	-	-	-	0.768	0.241	0.042	0.023	-	-	-
MEAN	-	-	-	-	-	1.671	0.450	0.108	0.035	-	-	-
MAX	-	-	-	-	-	3.563	0.723	0.226	0.049	-	-	-

NOTES: P - PARTIAL DAILY AVERAGE

Water Yield (m^3) =	4,285,347	2,742,373	1,205,254	289,947	47,773
Water Yield (mm) =	152.3	64%	28%	7%	1%

Lake A17 - 2015

MEAN DAILY WATER SURFACE ELEVATION (masl) BASED ON BENCHMARK ELEVATION 156.35 masl

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	-	-	-	-	-	-	152.898	152.699	152.502	-	-	-
2	-	-	-	-	-	-	152.888	152.688	152.500	-	-	-
3	-	-	-	-	-	-	152.880	152.681	152.498	-	-	-
4	-	-	-	-	-	-	152.869	152.676	152.493	-	-	-
5	-	-	-	-	-	-	152.863	152.670	152.489	-	-	-
6	-	-	-	-	-	-	152.860	152.663	152.483	-	-	-
7	-	-	-	-	-	-	152.854	152.656	152.479	-	-	-
8	-	-	-	-	-	-	152.848	152.650	152.472	-	-	-
9	-	-	-	-	-	-	152.846	152.640	152.467	-	-	-
10	-	-	-	-	-	-	152.848	152.634	152.463	-	-	-
11	-	-	-	-	-	-	152.843	152.626	152.457	-	-	-
12	-	-	-	-	-	153.018 P	152.840	152.611	152.479	-	-	-
13	-	-	-	-	-	153.138	152.834	152.608	152.498	-	-	-
14	-	-	-	-	-	153.296	152.825	152.602	152.508	-	-	-
15	-	-	-	-	-	153.305	152.815	152.595	152.517	-	-	-
16	-	-	-	-	-	153.233	152.806	152.585	152.522 P	-	-	-
17	-	-	-	-	-	153.169	152.801	152.577	-	-	-	-
18	-	-	-	-	-	153.133	152.793	152.572	-	-	-	-
19	-	-	-	-	-	153.119	152.784	152.568	-	-	-	-
20	-	-	-	-	-	153.089	152.778	152.566	-	-	-	-
21	-	-	-	-	-	153.081	152.771	152.557	-	-	-	-
22	-	-	-	-	-	153.054	152.767	152.549	-	-	-	-
23	-	-	-	-	-	153.020	152.761	152.544	-	-	-	-
24	-	-	-	-	-	152.992	152.752	152.538	-	-	-	-
25	-	-	-	-	-	152.970	152.739	152.533	-	-	-	-
26	-	-	-	-	-	152.962	152.731	152.527	-	-	-	-
27	-	-	-	-	-	152.947	152.726	152.522	-	-	-	-
28	-	-	-	-	-	152.933	152.722	152.518	-	-	-	-
29	-	-	-	-	-	152.922	152.716	152.517	-	-	-	-
30	-	-	-	-	-	152.911	152.712	152.513	-	-	-	-
31	-	-	-	-	-	-	152.709	152.508	-	-	-	-
MIN	-	-	-	-	-	152.922	152.709	152.508	152.457	-	-	-
MEAN	-	-	-	-	-	153.060	152.803	152.593	152.489	-	-	-
MAX	-	-	-	-	-	153.305	152.898	152.699	152.522	-	-	-

NOTES: P - PARTIAL DAILY AVERAGE

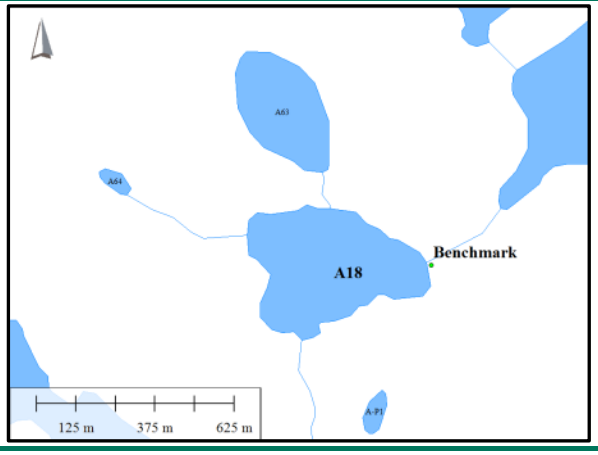
OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		Amaruq - 154321			**Date**		14-Jun-15	
Waterbody:		A17			**Start Time**		1538	
Crossing ID:		A17-A16			**End Time**		1613	
LDB UTM Location					**Datalogger SN:**			
East	606273	BM_read			**Transducer SN:**			
North	7255251	WL_read			**Meter Type/SN:**		Swoffer	
Elevation, Zone	14W	WL_Elev			**Crew:**	CJ, JRL		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	2.50	0.00		0.00				**0.018**
2	3.00	0.07		0.01			**0.000**	**0.063**
3	3.60	0.14		0.01			**0.001**	**0.171**
4	4.50	0.24		0.10			**0.023**	**0.300**
5	5.50	0.36		0.14			**0.050**	**0.370**
6	6.50	0.38		0.11			**0.063**	**0.830**
7	8.50	0.45		0.22			**0.149**	**0.325**
8	9.50	0.20		0.24			**0.048**	**0.335**
9	10.50	0.47		0.18			**0.085**	**0.485**
10	11.50	0.50		0.27			**0.135**	**0.485**
11	12.50	0.47		0.26			**0.122**	**0.475**
12	13.50	0.48		0.22			**0.106**	**0.485**
13	14.50	0.49		0.30			**0.147**	**0.465**
14	15.50	0.44		0.38			**0.167**	**0.450**
15	16.50	0.46		0.28			**0.129**	**0.530**
16	17.50	0.60		0.34			**0.204**	**0.620**
17	18.50	0.64		0.26			**0.166**	**0.685**
18	19.50	0.73		0.31			**0.226**	**0.720**
19	20.50	0.71		0.35			**0.249**	**0.685**
20	21.50	0.66		0.36			**0.238**	**0.705**
21	22.50	0.75		0.31			**0.233**	**0.745**
22	23.50	0.74		0.31			**0.229**	**0.720**
23	24.50	0.70		0.31			**0.217**	**0.715**
24	25.50	0.73		0.41			**0.299**	**0.715**
25	26.50	0.70		0.33			**0.231**	**0.665**
26	27.50	0.63		0.45			**0.284**	**0.615**
27	28.50	0.60		0.38			**0.228**	**0.585**
28	29.50	0.57		0.36			**0.205**	**0.555**
29	30.50	0.54		0.00			**0.000**	**0.135**
30	31.00	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**4.233**	
						A(m2)	**14.65**	
						B(m)	**28.5**	

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		Amaruq - Trip 2			**Date**		07-Aug-15	
Waterbody:		A17 (Whale Tail Lake)			**Start Time**		8:35	
Crossing ID:		A17-A15			**End Time**		8:55	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	606301	BM_read			**Transducer SN:**			
North	7255289	WL_read			**Meter Type/SN:**		Marsh McBirney	
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, JN		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.00	0.05		0.00				**0.240**
2	3.00	0.11		0.01			**0.003**	**0.364**
3	5.80	0.15		0.01			**0.005**	**0.624**
4	9.00	0.24		0.01			**0.007**	**0.870**
5	12.00	0.34		0.00			**0.000**	**0.810**
6	15.00	0.20		0.00			**0.000**	**0.528**
7	17.40	0.24		0.01			**0.007**	**0.576**
8	21.00	0.08		0.00			**0.000**	**0.120**
9	24.00	0.00		0.00			**0.000**	**0.065**
10	25.30	0.10		0.00			**0.000**	**0.323**
11	27.00	0.28		0.01			**0.007**	**0.555**
12	30.00	0.09		0.00			**0.000**	**0.451**
13	32.65	0.25		0.00			**0.000**	**0.504**
14	34.75	0.23		0.00			**0.000**	**0.570**
15	36.75	0.34		0.01			**0.009**	**1.500**
16	39.75	0.66		0.02			**0.040**	**1.845**
17	42.75	0.57		0.01			**0.017**	**1.470**
18	45.75	0.41		0.05			**0.062**	**1.440**
19	48.75	0.55		0.01			**0.017**	**1.335**
20	51.75	0.34		0.00			**0.000**	**0.810**
21	54.75	0.20		0.03			**0.018**	**0.450**
22	57.75	0.10		0.00			**0.000**	**0.450**
23	62.25	0.10		0.00			**0.000**	**3.113**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.190**	
						A(m2)	**19.01**	
						B(m)	**62.3**	

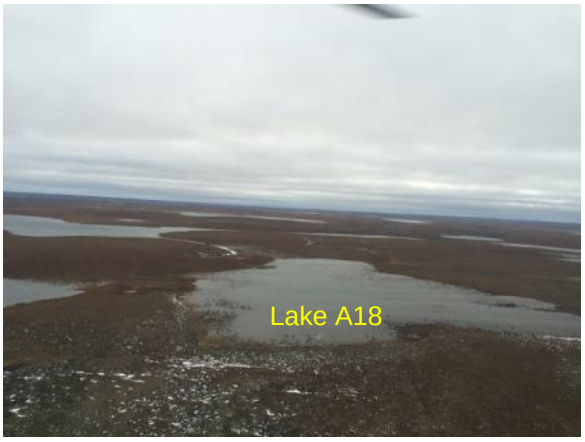
OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		1524321 - Amaruq Trip 3			**Date**		16-Sep-15	
Waterbody:		A17			**Start Time**		17:00	
Crossing ID:		A17-A16			**End Time**		17:25	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	606189	BM_read			**Transducer SN:**			
North	7255256	WL_read			**Meter Type/SN:**			
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, DC		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.00	0.00		0.00				**0.012**
2	0.30	0.08		0.04			**0.001**	**0.013**
3	0.50	0.05		0.05			**0.001**	**0.005**
4	0.70	0.00		0.00			**0.000**	**0.002**
5	0.90	0.02		0.02			**0.000**	**0.001**
6	1.00	0.00		0.00			**0.000**	**0.000**
7	1.00	0.05		0.10			**0.001**	**0.020**
8	1.40	0.05		0.10			**0.001**	**0.000**
9	1.41	0.00		0.00			**0.000**	**0.000**
10	1.41	0.06		0.09			**0.001**	**0.030**
11	1.91	0.06		0.09			**0.001**	**0.000**
12	1.92	0.00		0.00			**0.000**	**0.000**
13	1.92	0.06		0.04			**0.000**	**0.018**
14	2.22	0.06		0.04			**0.000**	**0.000**
15	2.23	0.00		0.00			**0.000**	**0.000**
16	2.23	0.10		0.09			**0.001**	**0.030**
17	2.53	0.10		0.09			**0.001**	**0.000**
18	2.54	0.00		0.00			**0.000**	**0.000**
19	2.54	0.10		0.06			**0.001**	**0.040**
20	2.94	0.10		0.06			**0.001**	**0.001**
21	2.95	0.00		0.00			**0.000**	**0.000**
NOTES:	Discharge measurement was separated into sections that contained flow. In some cases, sections were estimated as an average depth and velocity. Therefore, the distance from LDB, A and B values are not applicable to this measurement. 20-40% of flow not measurable between boulders.				**RESULTS:**	**Q (m3/s)**	**0.012**	
						A(m2)	**0.17**	
						B(m)	**3.0**	

A7.0 LAKE A18 & OUTLET (STREAM A18-A17)

Parameter	Value	Note
Drainage Area (km^2)	8.9	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	45	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	0.6	Measured in the field, based on vegetation
Wetted Width (m)	50	Measured in the field on 14 June 2015
Max. Wetted Depth (m)	0.56	Measured in the field on 14 June 2015
Channel Length (km)	0.35	Measured from Canvec data
Outlet Channel Slope (m/m)	0.004	Average slope, measured in the field
Bed Material	Boulders, cobbles	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass, bushes	
Benchmark Coordinates	606615 m E, 7253064 m N, 154.60 masl	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	606599 m E, 7253067 m N	
Comment	Poorly defined boulder channel. Cross-sectional data are available in discharge calculation sheets and Section 3.3.	



Lake A18: Benchmark location.



17 September 2015. View looking east at Lake A18.



7 August 2015. Upstream view of the watercourse and Lake (southwest).



16 September 2015. Downstream view of the watercourse (north).

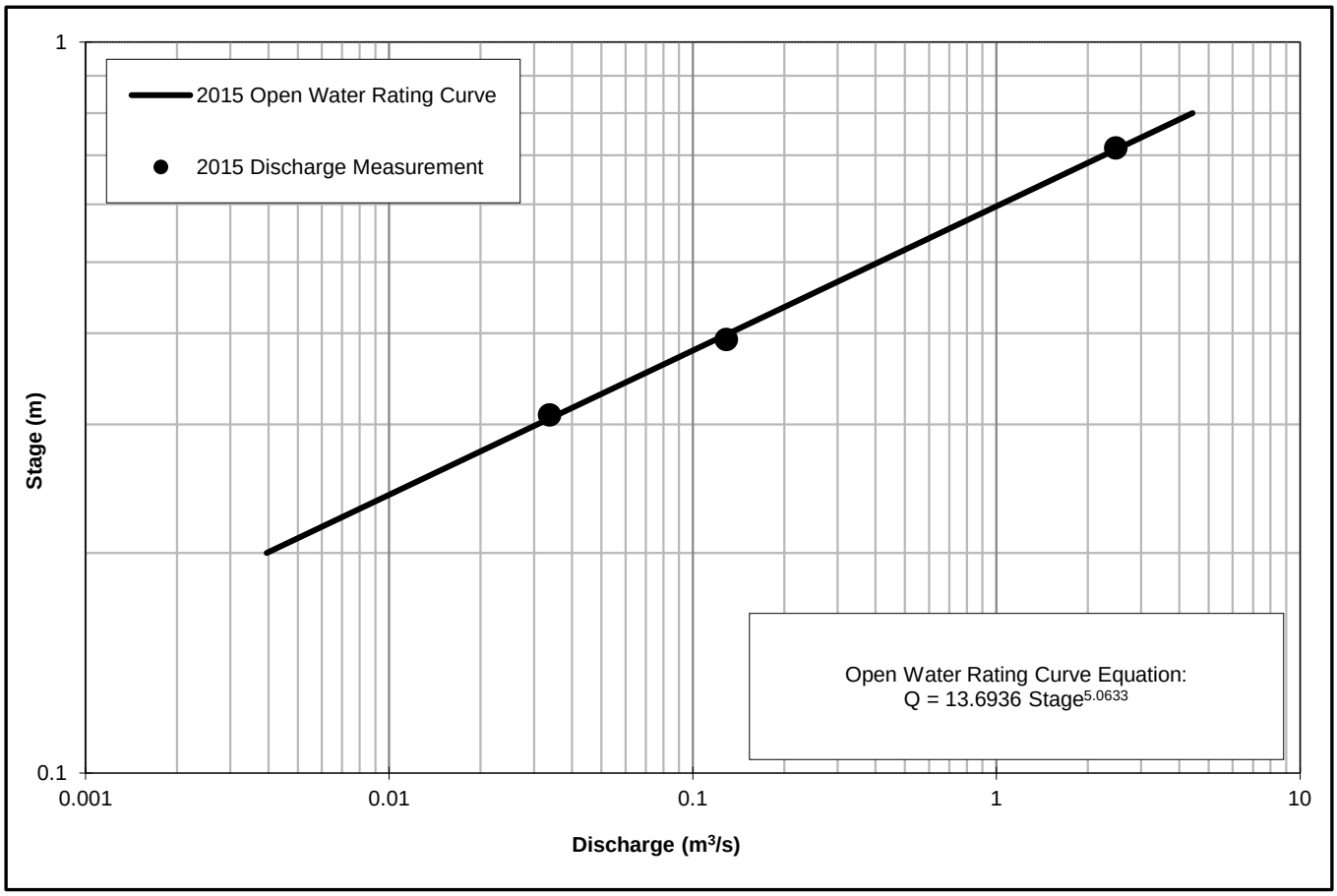


Figure 4: 2015 Stage-Discharge Rating Curve (Lake A18)

Lake A18 - 2015

MEAN DAILY DISCHARGE (m^3/s)

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	-	-	-	-	-	-	0.36	0.11	0.01	-	-	-
2	-	-	-	-	-	-	0.34	0.10	0.01	-	-	-
3	-	-	-	-	-	-	0.33	0.10	0.01	-	-	-
4	-	-	-	-	-	-	0.30	0.10	0.01	-	-	-
5	-	-	-	-	-	-	0.29	0.10	0.01	-	-	-
6	-	-	-	-	-	-	0.29	0.10	0.01	-	-	-
7	-	-	-	-	-	-	0.28	0.09	0.01	-	-	-
8	-	-	-	-	-	-	0.27	0.08	0.01	-	-	-
9	-	-	-	-	-	-	0.27	0.07	0.01	-	-	-
10	-	-	-	-	-	-	0.29	0.07	0.01	-	-	-
11	-	-	-	-	-	1.45 P	0.29	0.06	0.01	-	-	-
12	-	-	-	-	-	0.92	0.28	0.06	0.01	-	-	-
13	-	-	-	-	-	2.18	0.28	0.05	0.02	-	-	-
14	-	-	-	-	-	2.25	0.27	0.05	0.03	-	-	-
15	-	-	-	-	-	1.62	0.27	0.05	0.03 P	-	-	-
16	-	-	-	-	-	1.24	0.26	0.04	-	-	-	-
17	-	-	-	-	-	1.01	0.25	0.04	-	-	-	-
18	-	-	-	-	-	0.85	0.24	0.04	-	-	-	-
19	-	-	-	-	-	0.74	0.23	0.04	-	-	-	-
20	-	-	-	-	-	0.68	0.22	0.03	-	-	-	-
21	-	-	-	-	-	0.67	0.22	0.03	-	-	-	-
22	-	-	-	-	-	0.63	0.21	0.03	-	-	-	-
23	-	-	-	-	-	0.57	0.19	0.03	-	-	-	-
24	-	-	-	-	-	0.56	0.17	0.02	-	-	-	-
25	-	-	-	-	-	0.54	0.17	0.02	-	-	-	-
26	-	-	-	-	-	0.53	0.17	0.02	-	-	-	-
27	-	-	-	-	-	0.49	0.16	0.02	-	-	-	-
28	-	-	-	-	-	0.46	0.16	0.02	-	-	-	-
29	-	-	-	-	-	0.43	0.14	0.02	-	-	-	-
30	-	-	-	-	-	0.40	0.14	0.02	-	-	-	-
31	-	-	-	-	-	-	0.13	0.01	-	-	-	-
MIN	-	-	-	-	-	0.398	0.130	0.014	0.008	-	-	-
MEAN	-	-	-	-	-	0.911	0.240	0.052	0.015	-	-	-
MAX	-	-	-	-	-	2.249	0.362	0.115	0.029	-	-	-

NOTES: P - PARTIAL DAILY AVERAGE

Water Yield (m^3) =	2,376,562	1,574,018	643,735	139,983	18,826
Water Yield (mm) =	267.2	66%	27%	6%	1%

Lake A18 - 2015

MEAN DAILY WATER SURFACE ELEVATION (masl) BASED ON BENCHMARK ELEVATION 154.60 masl

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	-	-	-	-	-	-	153.988	153.889	153.757	-	-	-
2	-	-	-	-	-	-	153.981	153.882	153.758	-	-	-
3	-	-	-	-	-	-	153.978	153.880	153.757	-	-	-
4	-	-	-	-	-	-	153.970	153.880	153.753	-	-	-
5	-	-	-	-	-	-	153.967	153.880	153.751	-	-	-
6	-	-	-	-	-	-	153.967	153.876	153.747	-	-	-
7	-	-	-	-	-	-	153.963	153.869	153.742	-	-	-
8	-	-	-	-	-	-	153.959	153.861	153.738	-	-	-
9	-	-	-	-	-	-	153.961	153.854	153.734	-	-	-
10	-	-	-	-	-	-	153.968	153.852	153.731	-	-	-
11	-	-	-	-	-	154.142 P	153.966	153.844	153.727	-	-	-
12	-	-	-	-	-	154.086	153.965	153.837	153.751	-	-	-
13	-	-	-	-	-	154.183	153.964	153.834	153.787	-	-	-
14	-	-	-	-	-	154.199	153.962	153.829	153.793	-	-	-
15	-	-	-	-	-	154.155	153.959	153.825	153.797 P	-	-	-
16	-	-	-	-	-	154.122	153.957	153.819	-	-	-	-
17	-	-	-	-	-	154.098	153.954	153.815	-	-	-	-
18	-	-	-	-	-	154.078	153.949	153.812	-	-	-	-
19	-	-	-	-	-	154.062	153.945	153.808	-	-	-	-
20	-	-	-	-	-	154.053	153.944	153.803	-	-	-	-
21	-	-	-	-	-	154.051	153.941	153.798	-	-	-	-
22	-	-	-	-	-	154.045	153.937	153.794	-	-	-	-
23	-	-	-	-	-	154.034	153.930	153.791	-	-	-	-
24	-	-	-	-	-	154.031	153.920	153.786	-	-	-	-
25	-	-	-	-	-	154.029	153.919	153.782	-	-	-	-
26	-	-	-	-	-	154.027	153.919	153.778	-	-	-	-
27	-	-	-	-	-	154.018	153.916	153.775	-	-	-	-
28	-	-	-	-	-	154.011	153.913	153.772	-	-	-	-
29	-	-	-	-	-	154.005	153.907	153.768	-	-	-	-
30	-	-	-	-	-	153.997	153.904	153.765	-	-	-	-
31	-	-	-	-	-	-	153.898	153.755	-	-	-	-
MIN	-	-	-	-	-	153.997	153.898	153.755	153.727	-	-	-
MEAN	-	-	-	-	-	154.067	153.947	153.823	153.755	-	-	-
MAX	-	-	-	-	-	154.199	153.988	153.889	153.797	-	-	-

NOTES: P - PARTIAL DAILY AVERAGE

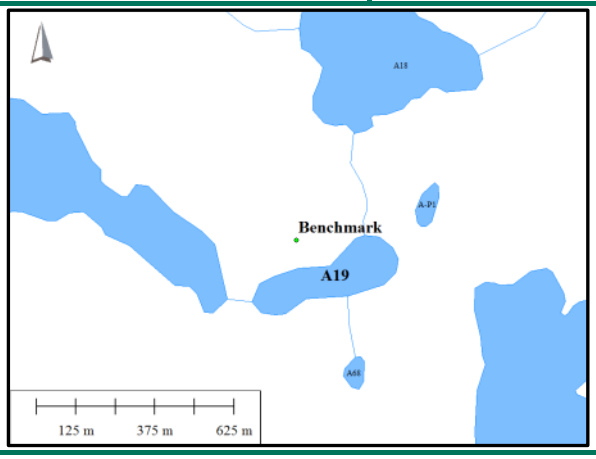
OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		Amaruq - 154321			**Date**		14-Jun-15	
Waterbody:		A18			**Start Time**		1148	
Crossing ID:		A18-A17			**End Time**		1213	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	606650	BM_read			**Transducer SN:**			
North	7253107	WL_read			**Meter Type/SN:**		Swoffer	
Elevation, Zone	14W	WL_Elev			**Crew:**	CJ, JRL		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	3.00	0.00		0.00				**0.072**
2	3.60	0.24		0.20			**0.055**	**0.519**
3	5.30	0.37		0.12			**0.062**	**0.309**
4	6.40	0.19		0.10			**0.034**	**0.442**
5	8.85	0.17		0.08			**0.027**	**0.256**
6	10.40	0.16		0.23			**0.056**	**0.263**
7	11.90	0.19		0.34			**0.126**	**0.648**
8	14.30	0.35		0.65			**0.489**	**0.599**
9	16.20	0.28		0.44			**0.253**	**0.649**
10	18.40	0.31		0.50			**0.357**	**0.768**
11	20.80	0.33		0.16			**0.092**	**0.302**
12	21.90	0.22		0.41			**0.153**	**0.621**
13	24.20	0.32		0.30			**0.163**	**0.308**
14	25.30	0.24		0.10			**0.037**	**0.340**
15	27.30	0.10		0.37			**0.085**	**0.533**
16	29.90	0.31		0.21			**0.153**	**0.536**
17	32.00	0.20		0.16			**0.077**	**0.581**
18	34.70	0.23		0.19			**0.098**	**0.450**
19	36.50	0.27		0.14			**0.089**	**0.725**
20	39.40	0.23		0.10			**0.054**	**0.387**
21	41.20	0.20		0.04			**0.011**	**0.185**
22	42.20	0.17		0.01			**0.003**	**0.196**
23	44.50	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**2.475**	
						A(m2)	**9.69**	
						B(m)	**41.5**	

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		Amaruq - trip 2			**Date**		04-Aug-15	
Waterbody:		A18			**Start Time**		13:20	
Crossing ID:		A18-A17			**End Time**		13:45	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	606637	BM_read			**Transducer SN:**			
North	7253084	WL_read			**Meter Type/SN:**		Marsh McBirney	
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, JN		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.00	0.00		0.00				**0.000**
2	3.00	0.00		0.00			**0.000**	**0.018**
3	4.20	0.03		0.00			**0.000**	**0.033**
4	5.30	0.03		0.00			**0.000**	**0.198**
5	7.10	0.19		0.08			**0.015**	**0.019**
6	7.30	0		0.00			**0.000**	**0.055**
7	8.40	0.1		0.00			**0.000**	**0.125**
8	10.90	0		0.00			**0.000**	**0.006**
9	11.00	0.12		0.12			**0.013**	**0.255**
10	12.70	0.18		0.02			**0.005**	**0.112**
11	13.50	0.1		0.04			**0.007**	**0.336**
12	16.30	0.14		0.08			**0.020**	**0.091**
13	17.00	0.12		0.21			**0.014**	**0.046**
14	17.40	0.11		0.07			**0.007**	**0.158**
15	18.90	0.1		0.07			**0.009**	**0.132**
16	20.00	0.14		0.03			**0.006**	**0.221**
17	21.70	0.12		0.11			**0.030**	**0.280**
18	24.50	0.08		0.03			**0.004**	**0.020**
19	25.00	0		0.00			**0.000**	**0.000**
20	37.00	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.129**	
						A(m2)	**2.10**	
						B(m)	**37.0**	

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		1524321 - Amaruq Trip 3			**Date**		16-Sep-15	
Waterbody:		A18			**Start Time**		16:10	
Crossing ID:		A18-A17			**End Time**		16:20	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	606635	BM_read			**Transducer SN:**			
North	7253081	WL_read			**Meter Type/SN:**			
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, DC		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.00	0.03		0.01				**0.009**
2	0.30	0.03		0.01			**0.000**	**0.000**
3	0.31	0.00		0.00			**0.000**	**0.000**
4	0.31	0.01		0.02			**0.000**	**0.005**
5	0.81	0.01		0.02			**0.000**	**0.000**
6	0.82	0.00		0.00			**0.000**	**0.000**
7	0.82	0.10		0.02			**0.001**	**0.085**
8	1.67	0.10		0.02			**0.001**	**0.001**
9	1.68	0.00		0.00			**0.000**	**0.000**
10	1.68	0.12		0.02			**0.001**	**0.096**
11	2.48	0.12		0.02			**0.001**	**0.001**
12	2.49	0.00		0.00			**0.000**	**0.000**
NOTES:	Discharge measurement was separated into sections that contained flow. In some cases, sections were estimated as an average depth and velocity. Therefore, the distance from LDB, A and B values are not applicable to this measurement.				**RESULTS:**	**Q (m3/s)**	**0.004**	
						A(m2)	**0.20**	
						B(m)	**2.5**	

A8.0 LAKE A19 & OUTLET (STREAM A19-A18)

Parameter	Value	Note
Drainage Area (km^2)	7.4	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	N/A	
Max. Bankfull Depth (m)	N/A	
Wetted Width (m)	0	Observed no flow in field 8 August 2015
Max. Wetted Depth (m)	0	Observed no flow in field 8 August 2015
Channel Length (km)	0.35	Measured from CanVec data
Outlet Channel Slope (m/m)	0.004	Not measured in the field or covered by DEM
Bed Material	Boulders, cobbles	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	606023 m E, 7252491 m N, 157.51 masl	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	N/A	
Comment	Boulder channel. No observed flow in August 2015.	



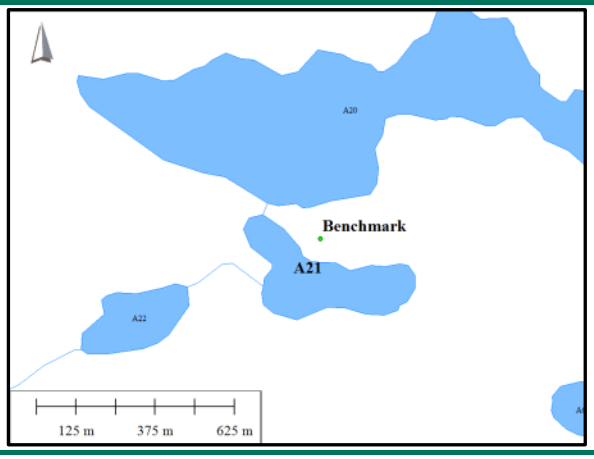
Lake A19: Benchmark location.



8 August 2015. Looking northwest at Lake A18.

A9.0 LAKE A21 & OUTLET (STREAM A21-A20)

Parameter	Value	Note
Drainage Area (km^2)	5.1	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	20	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	0.45	Measured in the field, based on vegetation
Wetted Width (m)	17.3	Measured in the field 3 August 2015
Max. Wetted Depth (m)	0.32	Measured in the field 3 August 2015
Channel Length (km)	0.05	Measured from CanVec data
Outlet Channel Slope (m/m)	0.001	Average slope, measured in the field
Bed Material	Boulders, cobbles	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	604715 m E, 7252196 m N, 155.95 masl	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	N/A	
Comment	Poorly defined boulder channel. Cross-sectional data are available in discharge calculation sheets.	



Lake A21: Benchmark location.



8 August 2015. Downstream view of the watercourse (north).

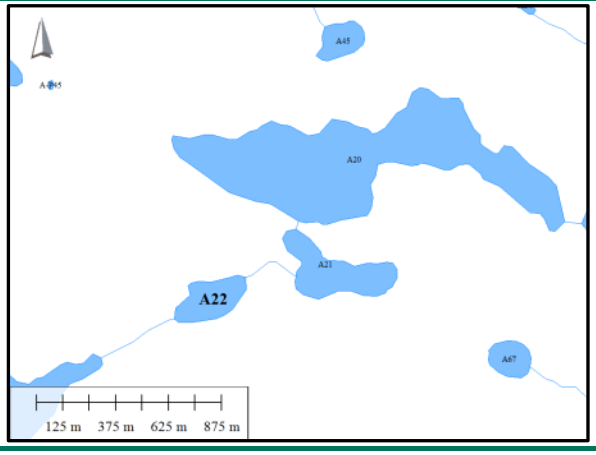


8 August 2015. View looking east of the watercourse.

OPEN WATER DISCHARGE CALCULATION SPREADSHEET							
Project Name, Number:		Amaruq - trip 2			**Date**	06-Aug-15	
Waterbody:		A21			**Start Time**	14:00	
Crossing ID:		A21-A20			**End Time**	14:25	
LDB UTM Location		**Survey**			**Datalogger SN:**		
East	604557	BM_read			**Transducer SN:**		
North	7252299	WL_read			**Meter Type/SN:**	Marsh McBirney	
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, JN	
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)	Qi (m3/s)	Ai (m2)
1	0.00	0.00		0.00			**0.048**
2	0.40	0.24		0.00		**0.000**	**0.042**
3	0.70	0.04		0.00		**0.000**	**0.041**
4	1.60	0.05		0.01		**0.001**	**0.096**
5	2.80	0.11		0.02		**0.002**	**0.017**
6	3.10	0.00		0.00		**0.000**	**0.000**
7	9.30	0.00		0.00		**0.000**	**0.015**
8	9.60	0.10		0.00		**0.000**	**0.120**
9	10.80	0.10		0.00		**0.000**	**0.100**
10	12.80	0.00		0.00		**0.000**	**0.000**
11	13.50	0.00		0.00		**0.000**	**0.076**
12	14.30	0.19		0.02		**0.003**	**0.255**
13	15.30	0.32		0.02		**0.010**	**0.580**
14	17.30	0.26		0.00		**0.000**	**0.001**
15	17.29	0.00		0.00		**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.015**
						A(m2)	**1.39**
						B(m)	**17.3**

A10.0 LAKE A22 & OUTLET (STREAM A22-A21)

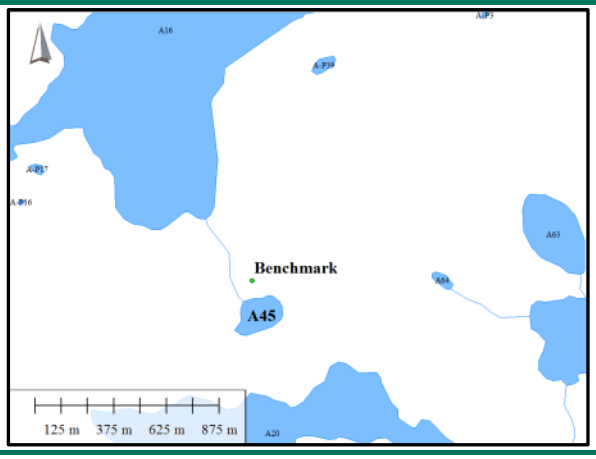
Parameter	Value	Note
Drainage Area (km^2)	4.0	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	N/A	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	N/A	Measured in the field, based on vegetation
Wetted Width (m)	0	Observed in the field 3 August 2015
Max. Wetted Depth (m)	0	Observed in the field 3 August 2015
Channel Length (km)	0.3	Measured from CanVec data
Outlet Channel Slope (m/m)	0.001	Not measured in the field or covered by DEM
Bed Material	Boulders, cobbles	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	N/A	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	N/A	
Comment	Poorly defined boulder channel. No observed flow in August 2015.	



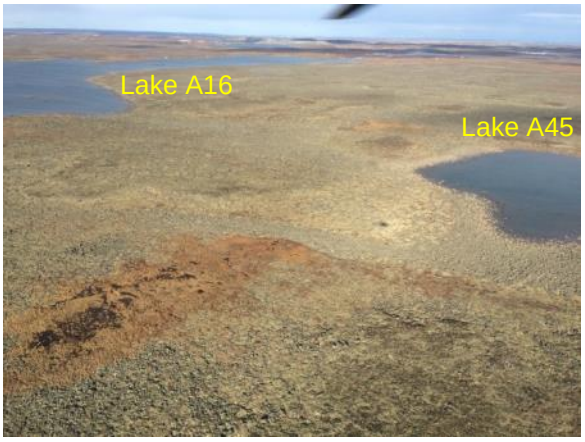
Lake A22.

A11.0 LAKE A45 & OUTLET (STREAM A45-A16)

Parameter	Value	Note
Drainage Area (km^2)	0.2	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	35	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	N/A	Not measureable; deep boulder garden
Wetted Width (m)	0	Observed no surface flow in field 8 August 2015
Max. Wetted Depth (m)	0	Observed no surface flow in field 8 August 2015
Channel Length (km)	0.45	Measured from CanVec data
Outlet Channel Slope (m/m)	0.009	Average slope, measured in the field
Bed Material	Boulders, cobbles	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	604716 m E, 7253325 m N, 159.66 masl	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	N/A	
Comment	Deep boulder garden channel with predominantly subsurface flows especially later in the open water season. Cross-sectional data are available in Section 3.3.	



Lake A45: Benchmark location.



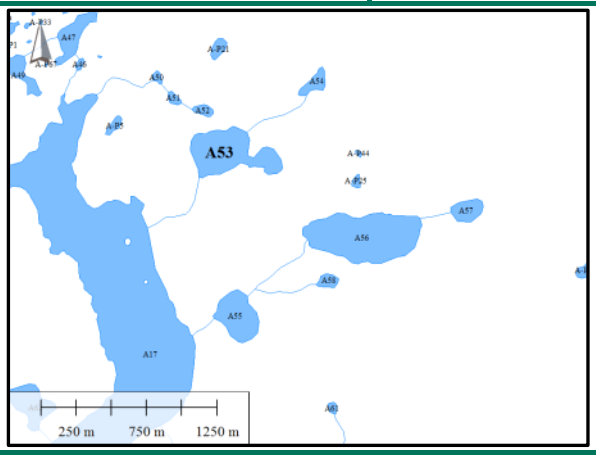
19 September 2015. View looking north towards Lake A45 (right) and outlet.



8 August 2015. Upstream view of outlet to Lake A45 (southeast).

A12.0 LAKE A53 & OUTLET (STREAM A53-A17)

Parameter	Value	Note
Drainage Area (km^2)	1.3	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	N/A	Poorly defined channel, no visible bankfull dimensions
Max. Bankfull Depth (m)	N/A	Poorly defined channel, no visible bankfull dimensions
Wetted Width (m)	3.5	Measured in the field on 6 August 2015
Max. Wetted Depth (m)	0.16	Measured in the field on 6 August 2015
Channel Length (km)	0.60	Measured from CanVec data
Outlet Channel Slope (m/m)	0.017	Average slope, measured in the field
Bed Material	Cobbles, sand, silt, organics	
Bank Material	Grass, sand, silt, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	N/A	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	N/A	
Comment	Well defined channel, with a high width to depth ratio. Cross-sectional data are available in discharge calculation sheets.	



Lake A53.



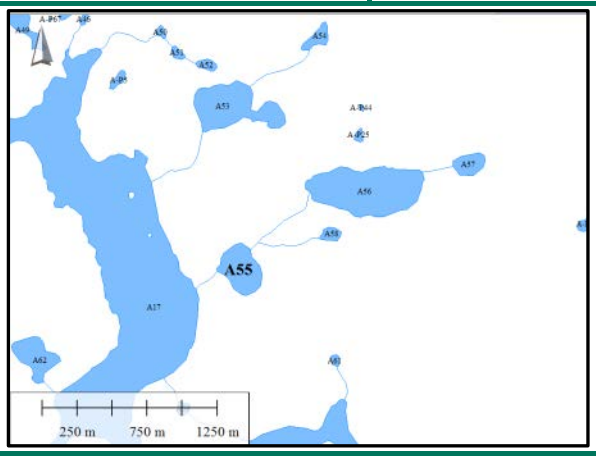
7 August 2015. Upstream view of the watercourse (north).

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		1524321 - Amaruq			**Date**		12-Jul-15	
Waterbody:		A53			**Start Time**		11:30	
Crossing ID:		A53-A17			**End Time**			
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	607754	BM_read			**Transducer SN:**			
North	725526	WL_read			**Meter Type/SN:**		Swoffer	
Elevation, Zone	14W	WL_Elev			**Crew:**	AEM: RV, RD, JM		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.00	0.00		0.00				**0.008**
2	0.20	0.08		0.35			**0.005**	**0.018**
3	0.40	0.10		0.33			**0.007**	**0.021**
4	0.60	0.11		0.33			**0.007**	**0.031**
5	0.80	0.20		0.70			**0.028**	**0.037**
6	1.00	0.17		0.01			**0.000**	**0.016**
7	1.10	0.15		0.00			**0.000**	**0.015**
8	1.20	0.14		0.02			**0.000**	**0.028**
9	1.40	0.14		0.00			**0.000**	**0.025**
10	1.75	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.048**	
						A(m2)	**0.20**	
						B(m)	**1.8**	

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		Amaruq - Trip 2			**Date**		07-Aug-15	
Waterbody:		A53			**Start Time**		9:00	
Crossing ID:		A53-A17			**End Time**		9:20	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	607914	BM_read			**Transducer SN:**			
North	7255484	WL_read			**Meter Type/SN:**		Marsh McBirney	
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, JN		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.00	0.08		0.00				**0.090**
2	1.00	0.10		0.00			**0.000**	**0.132**
3	2.10	0.14		0.01			**0.001**	**0.030**
4	2.30	0.16		0.04			**0.001**	**0.032**
5	2.50	0.16		0.04			**0.002**	**0.042**
6	2.80	0.12		0.03			**0.001**	**0.022**
7	3.00	0.10		0.02			**0.001**	**0.027**
8	3.30	0.08		0.00			**0.000**	**0.008**
9	3.50	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.005**	
						A(m2)	**0.38**	
						B(m)	**3.5**	

A13.0 LAKE A55 & OUTLET (STREAM A55-A17)

Parameter	Value	Note
Drainage Area (km^2)	4.2	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	15	No visible bankfull dimensions
Max. Bankfull Depth (m)	0.3	No visible bankfull dimensions
Wetted Width (m)	8.9	Measured in the field 7 August 2015
Max. Wetted Depth (m)	0.14	Measured in the field 7 August 2015
Channel Length (km)	0.23	Measured from CanVec data
Outlet Channel Slope (m/m)	0.011	Average slope, measured in the field
Bed Material	Boulders, cobbles	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	N/A	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	N/A	
Comment	Well defined channel. Cross-sectional data are available in discharge calculation sheets.	



Lake A55.



17 September 2015. Aerial view looking north towards Lake A55 (right) and Lake A17 (Whale Tail Lake) (left)



17 September 2015. Upstream view of the watercourse and Lake A55 (northeast).



17 September 2015. Downstream view of the watercourse (southwest).

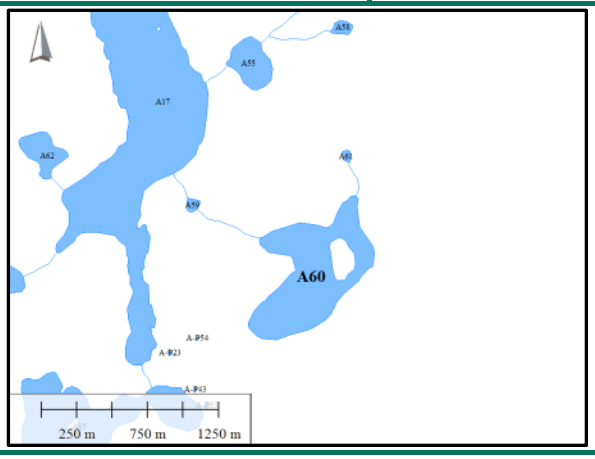
OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		1524321 - Amaruq			**Date**		12-Jul-15	
Waterbody:		A55			**Start Time**		11:00	
Crossing ID:		A55-A17			**End Time**		11:10	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	607990	BM_read			**Transducer SN:**			
North	7254505	WL_read			**Meter Type/SN:**		Swoffer	
Elevation, Zone	14W	WL_Elev			**Crew:**	AEM: RV, LG		
STATION	DISTANCE		Velocity		Optional			
Start	FROM LDB	DEPTH	0.2 DEPTH	0.6/0.8 DEPTH	ANGLE OF FLOW		Qi	Ai
LDB	(m)	(m)	(m/s)	(m/s)	(º)		(m3/s)	(m2)
1	0.00	0.00		0.00				**0.030**
2	0.50	0.12		0.01			**0.000**	**0.063**
3	1.00	0.13		0.00			**0.000**	**0.063**
4	1.50	0.12		0.00			**0.000**	**0.065**
5	2.00	0.14		0.19			**0.013**	**0.070**
6	2.50	0.14		0.19			**0.013**	**0.068**
7	3.00	0.13		0.20			**0.013**	**0.068**
8	3.50	0.14		0.27			**0.019**	**0.070**
9	4.00	0.14		0.24			**0.017**	**0.066**
10	4.50	0.13		0.36			**0.023**	**0.051**
11	5.00	0.08		0.28			**0.011**	**0.020**
12	5.50	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.110**	
						A(m2)	**0.63**	
						B(m)	**5.5**	

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		Amaruq - Trip 2			**Date**		07-Aug-15	
Waterbody:		A55			**Start Time**		15:30	
Crossing ID:		A55-A17			**End Time**		15:50	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	608009	BM_read			**Transducer SN:**			
North	7254529	WL_read			**Meter Type/SN:**		Marsh McBirney	
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, JN		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.60	0.00		0.00				**0.017**
2	0.90	0.11		0.00			**0.000**	**0.038**
3	1.20	0.14		0.05			**0.003**	**0.081**
4	1.80	0.13		0.06			**0.004**	**0.020**
5	2.10	0.00		0.00			**0.000**	**0.012**
6	2.30	0.12		0.06			**0.005**	**0.143**
7	3.60	0.10		0.02			**0.002**	**0.099**
8	4.50	0.12		0.05			**0.004**	**0.060**
9	5.00	0.12		0.00			**0.000**	**0.070**
10	5.70	0.08		0.01			**0.002**	**0.152**
11	9.50	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.020**	
						A(m2)	**0.69**	
						B(m)	**8.9**	

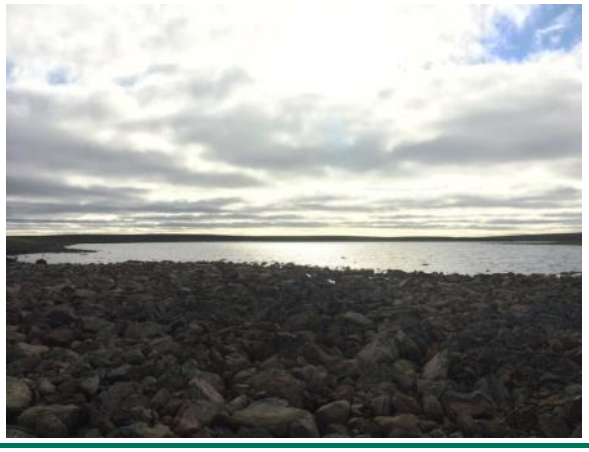
OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		1524321 - Amaruq Trip 3			**Date**		17-Sep-15	
Waterbody:		A55			**Start Time**		15:00	
Crossing ID:		A55-A17			**End Time**		15:10	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	607986	BM_read			**Transducer SN:**			
North	7254508	WL_read			**Meter Type/SN:**			
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, DC		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.00	0.00		0.00				**0.008**
2	0.20	0.08		0.20			**0.003**	**0.020**
3	0.40	0.12		0.08			**0.002**	**0.020**
4	0.60	0.08		0.29			**0.005**	**0.014**
5	0.80	0.06		0.27			**0.003**	**0.012**
6	1.00	0.06		0.18			**0.002**	**0.016**
7	1.20	0.10		0.25			**0.005**	**0.022**
8	1.40	0.12		0.16			**0.005**	**0.021**
9	1.75	0.00		0.00			**0.000**	**0.000**
10	2.10	0.00		0.00			**0.000**	**0.008**
11	2.30	0.08		0.35			**0.007**	**0.018**
12	2.60	0.04		0.21			**0.003**	**0.020**
13	3.00	0.06		0.24			**0.006**	**0.015**
14	3.50	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.042**	
						A(m2)	**0.19**	
						B(m)	**3.5**	

A14.0 LAKE A60 & OUTLET (STREAM A60-A59)

Parameter	Value	Note
Drainage Area (km^2)	2.1	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	30	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	0.45	Measured in the field
Wetted Width (m)	20.4	Measured in the field on 8 August 2015
Max. Wetted Depth (m)	0.23	Measured in the field on 8 August 2015
Channel Length (km)	0.50	Measured from CanVec data
Outlet Channel Slope (m/m)	0.040	Average slope, measured in the field
Bed Material	Boulders, cobbles	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	N/A	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	N/A	
Comment	Poorly defined boulder channel. Cross-sectional data are available in discharge calculation sheets.	



Lake A60.



8 August 2015. Upstream view of the watercourse and Lake A60 (east).



17 September 2015. Downstream view of the watercourse (west).

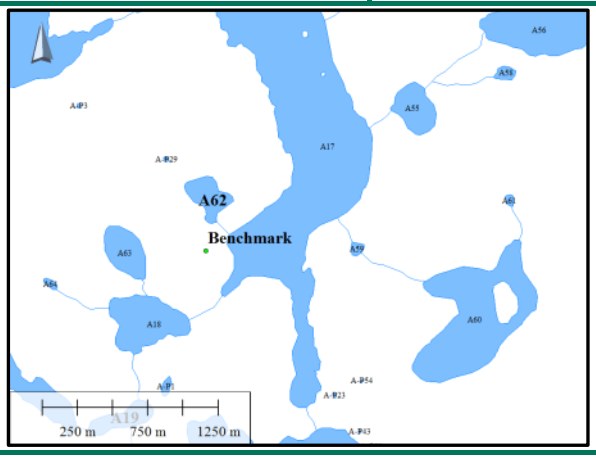
OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		1524321 - Amaruq			**Date**		12-Jul-15	
Waterbody:		A60			**Start Time**		-	
Crossing ID:		A60-A59			**End Time**		-	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	608264	BM_read			**Transducer SN:**			
North	72537278	WL_read			**Meter Type/SN:**		Swoffer	
Elevation, Zone	14W	WL_Elev			**Crew:**	AEM: RV, LG, RD		
STATION	DISTANCE		Velocity		Optional			
Start	FROM LDB	DEPTH	0.2 DEPTH	0.6/0.8 DEPTH	ANGLE OF FLOW		Qi	Ai
LDB	(m)	(m)	(m/s)	(m/s)	(º)		(m3/s)	(m2)
1	0.00	0.000		0.00				**0.016**
2	0.20	0.155		0.15			**0.005**	**0.031**
3	0.40	0.150		0.12			**0.004**	**0.030**
4	0.60	0.150		0.23			**0.007**	**0.030**
5	0.80	0.150		0.19			**0.006**	**0.030**
6	1.00	0.150		0.31			**0.007**	**0.016**
7	1.10	0.160		0.25			**0.004**	**0.016**
8	1.20	0.160		0.27			**0.006**	**0.032**
9	1.40	0.160		0.29			**0.009**	**0.034**
10	1.60	0.175		0.29			**0.010**	**0.033**
11	1.80	0.150		0.30			**0.009**	**0.024**
12	2.00	0.090		0.21			**0.004**	**0.018**
13	2.20	0.090		0.07			**0.001**	**0.020**
14	2.40	0.110		0.00			**0.000**	**0.025**
15	2.60	0.135		0.13			**0.004**	**0.025**
16	2.80	0.115		0.06			**0.001**	**0.020**
17	3.00	0.080		0.04			**0.000**	**0.004**
18	3.10	0.000		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.077**	
						A(m2)	**0.40**	
						B(m)	**3.1**	

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		Amaruq - Trip 2			**Date**		09-Aug-15	
Waterbody:		A60			**Start Time**		8:20	
Crossing ID:		A60-A59			**End Time**		8:40	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	608143	BM_read			**Transducer SN:**			
North	7253354	WL_read			**Meter Type/SN:**		Marsh McBirney	
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, JN		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	1.40	0.00		0.00				**0.014**
2	1.60	0.14		0.04			**0.001**	**0.022**
3	1.80	0.08		0.04			**0.001**	**0.018**
4	2.00	0.10		0.00			**0.000**	**0.015**
5	2.20	0.05		0.06			**0.001**	**0.009**
6	2.40	0.04		0.05			**0.000**	**0.004**
7	2.60	0.00		0.00			**0.000**	**0.000**
8	2.95	0.00		0.00			**0.000**	**0.017**
9	3.10	0.23		0.01			**0.000**	**0.040**
10	3.30	0.17		0.02			**0.001**	**0.026**
11	3.50	0.09		0.03			**0.001**	**0.023**
12	3.70	0.14		0.00			**0.000**	**0.007**
13	3.80	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.004**	
						A(m2)	**0.20**	
						B(m)	**2.4**	

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		1524321 - Amaruq Trip 3			**Date**		17-Sep-15	
Waterbody:		A60			**Start Time**		9:20	
Crossing ID:		A60-A59			**End Time**		9:25	
BM UTM Location		**Survey**			**Datalogger SN:**			
East	608143	BM_read			**Transducer SN:**			
North	7253354	WL_read			**Meter Type/SN:**			
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, DC		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.00	0.00		0.00				**0.006**
2	0.20	0.06		0.02			**0.000**	**0.014**
3	0.40	0.08		0.02			**0.000**	**0.014**
4	0.60	0.06		0.02			**0.000**	**0.022**
5	0.80	0.16		0.03			**0.001**	**0.026**
6	1.00	0.10		0.01			**0.000**	**0.023**
7	1.20	0.13		0.01			**0.000**	**0.031**
8	1.40	0.18		0.00			**0.000**	**0.022**
9	1.60	0.04		0.02			**0.000**	**0.004**
10	1.80	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.002**	
						A(m2)	**0.16**	
						B(m)	**1.8**	

A15.0 LAKE A62 & OUTLET (STREAM A62-A17)

Parameter	Value	Note
Drainage Area (km^2)	0.7	Measured with DEM
Bankfull Width (m)	N/A	No defined channel
Max. Bankfull Depth (m)	N/A	No defined channel
Wetted Width (m)	0	Observed no flow in the field 7 August 2015
Max. Wetted Depth (m)	0	Observed no flow in the field 7 August 2015
Channel Length (km)	0.13	Measured from CanVec data
Outlet Channel Slope (m/m)	0.020	Average slope, measured in the field
Bed Material	Boulders, cobbles, grass	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	606719 m E, 7253561 m N, 165.43 masl	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	N/A	
Comment	No defined channel. No flow in August 2015.	



Lake A62: Benchmark location.



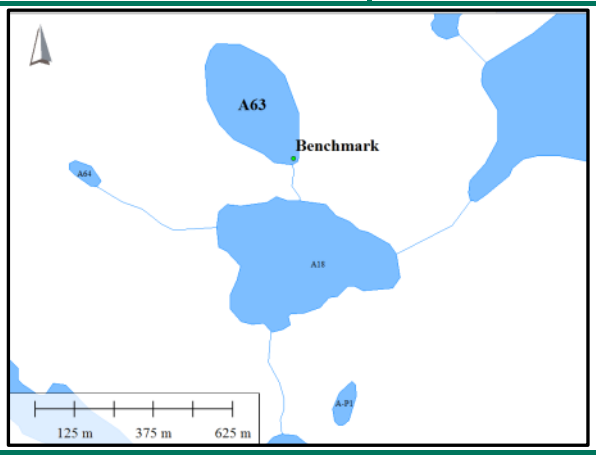
7 August 2015. View looking upstream towards Lake A62 (northwest).



7 August 2015. View looking southeast towards Lake A17 (Whale Tail Lake) from the watercourse.

A16.0 LAKE A63 & OUTLET (STREAM A63-A18)

Parameter	Value	Note
Drainage Area (km^2)	0.5	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	N/A	Not measured
Max. Bankfull Depth (m)	N/A	Not measured
Wetted Width (m)	0	Observed no surface flow in the field 7 August 2015
Max. Wetted Depth (m)	0	Observed no surface flow in the field 7 August 2015
Channel Length (km)	0.14	Measured from CanVec data
Outlet Channel Slope (m/m)	0.005	Average slope, measured in the field
Bed Material	Boulders, cobbles	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	606276 m E, 7253375 m N, 155.24 masl	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	N/A	
Comment	Poorly defined boulder channel. No observed surface flow in August 2015.	



Lake A63.



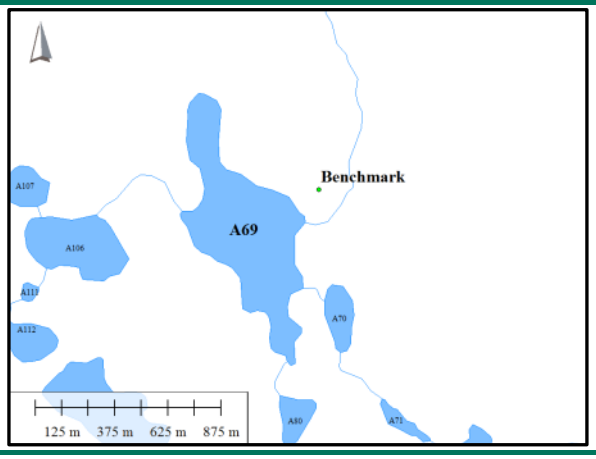
7 August 2015. Looking west towards Lake A63 (right) and Lake A18 (left). The channel had no surface flow at the time of this photo.



17 September 2015. View looking east at Lake A18 and A19

A17.0 LAKE A69 & OUTLET (STREAM A69-DS1)

Parameter	Value	Note
Drainage Area (km^2)	41.4	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	30 to 60	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	1.0	Measured in the field, based on vegetation
Wetted Width (m)	47.5	Measured in the field on 11 June 2015
Max. Wetted Depth (m)	0.98	Measured in the field on 11 June 2015
Channel Length (km)	1.35	Measured from CanVec data
Outlet Channel Slope (m/m)	0.0085	Average slope, measured with DEM
Bed Material	Boulders, cobbles	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	598399 m E, 7256880 m N, 115.62 masl	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	N/A	
Comment	Well defined boulder channel. Cross-sectional data are available in discharge calculation sheets and Section 3.3.	



Lake A69: Benchmark location.



11 June 2015. View looking west at Lake A69.



11 June 2015. West view of Lake A69.



11 June 2015. Upstream view of the watercourse (west).



5 August 2015. Looking south towards right downstream bank.

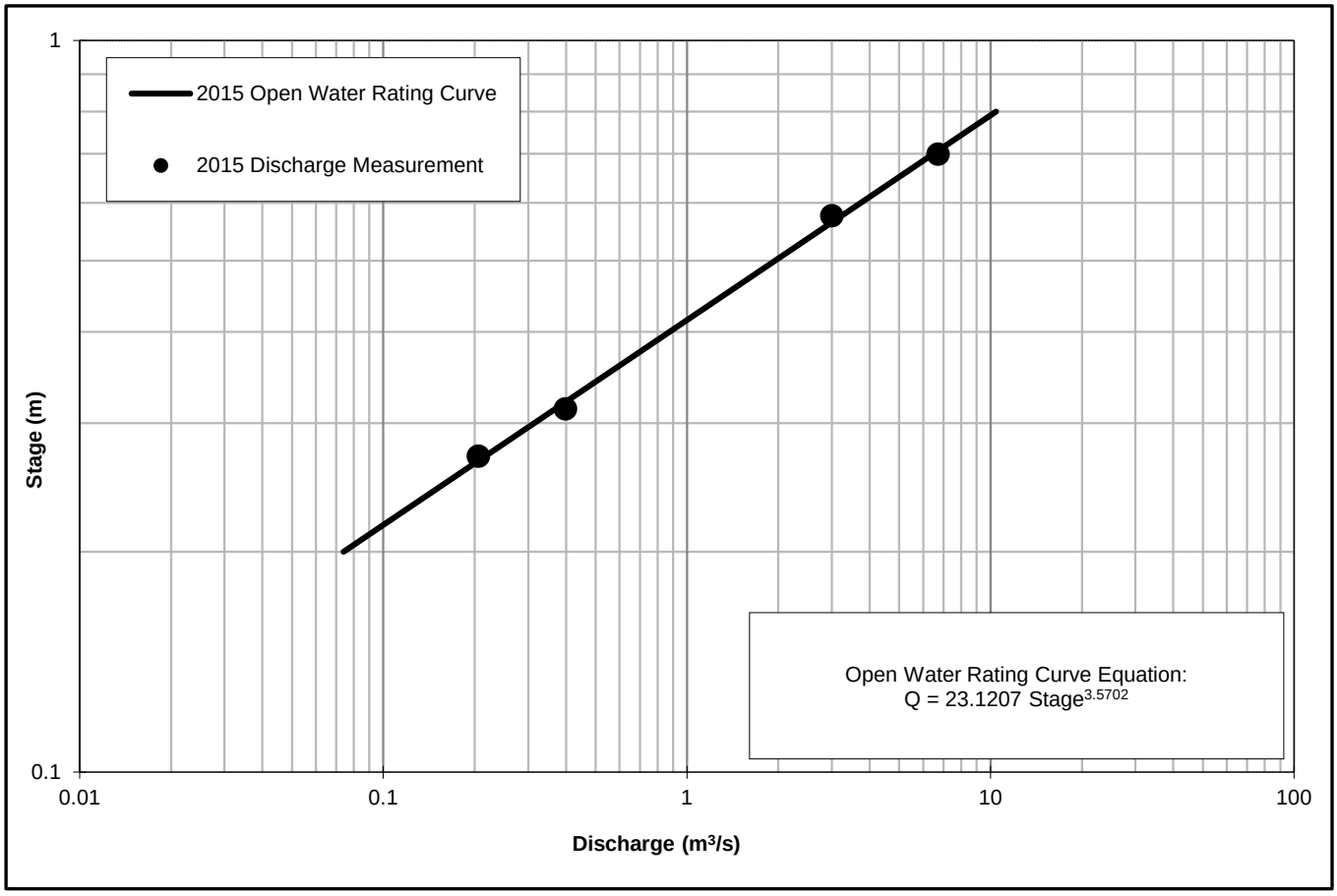


Figure 5: 2015 Stage-Discharge Rating Curve (Lake A69)

Lake A69 - 2015

MEAN DAILY WATER DISCHARGE (m^3/s)

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	-	-	-	-	-	-	2.03	0.56	0.23	-	-	-
2	-	-	-	-	-	-	1.86	0.53	0.24	-	-	-
3	-	-	-	-	-	-	1.80	0.53	0.23	-	-	-
4	-	-	-	-	-	-	1.72	0.55	0.23	-	-	-
5	-	-	-	-	-	-	1.66	0.54	0.23	-	-	-
6	-	-	-	-	-	-	1.58	0.53	0.23	-	-	-
7	-	-	-	-	-	-	1.44	0.51	0.22	-	-	-
8	-	-	-	-	-	-	1.33	0.48	0.21	-	-	-
9	-	-	-	-	-	-	1.26	0.44	0.21	-	-	-
10	-	-	-	-	-	-	1.34	0.42	0.20	-	-	-
11	-	-	-	-	-	4.96 P	1.33	0.40	0.20	-	-	-
12	-	-	-	-	-	10.12	1.28	0.38	0.24	-	-	-
13	-	-	-	-	-	8.76	1.19	0.38	0.22	-	-	-
14	-	-	-	-	-	6.82	1.18	0.38	0.20	-	-	-
15	-	-	-	-	-	5.83	1.14	0.35	0.20	-	-	-
16	-	-	-	-	-	4.59	1.11	0.33	0.21 P	-	-	-
17	-	-	-	-	-	4.13	1.06	0.29	-	-	-	-
18	-	-	-	-	-	3.44	0.99	0.28	-	-	-	-
19	-	-	-	-	-	3.23	0.91	0.29	-	-	-	-
20	-	-	-	-	-	3.13	0.89	0.29	-	-	-	-
21	-	-	-	-	-	3.14	0.85	0.28	-	-	-	-
22	-	-	-	-	-	3.14	0.82	0.28	-	-	-	-
23	-	-	-	-	-	2.91	0.79	0.28	-	-	-	-
24	-	-	-	-	-	2.81	0.73	0.28	-	-	-	-
25	-	-	-	-	-	2.73	0.68	0.28	-	-	-	-
26	-	-	-	-	-	2.78	0.67	0.27	-	-	-	-
27	-	-	-	-	-	2.66	0.68	0.27	-	-	-	-
28	-	-	-	-	-	2.57	0.68	0.25	-	-	-	-
29	-	-	-	-	-	2.41	0.67	0.25	-	-	-	-
30	-	-	-	-	-	2.25	0.64	0.25	-	-	-	-
31	-	-	-	-	-	-	0.64	0.23	-	-	-	-
MIN	-	-	-	-	-	2.25	0.64	0.23	0.20	-	-	-
MEAN	-	-	-	-	-	4.12	1.13	0.37	0.22	-	-	-
MAX	-	-	-	-	-	10.12	2.03	0.56	0.24	-	-	-

NOTES: P - PARTIAL DAILY AVERAGE

Water Yield (m^3) =	11,424,733	7,119,611	3,017,150	985,455	302,517
Water Yield (mm) =	276.1	62%	26%	9%	3%

Lake A69 - 2015

MEAN DAILY WATER SURFACE ELEVATION (masl) BASED ON BENCHMARK ELEVATION 115.62 masl

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	-	-	-	-	-	-	112.406	112.253	112.174	-	-	-
2	-	-	-	-	-	-	112.394	112.248	112.178	-	-	-
3	-	-	-	-	-	-	112.389	112.247	112.176	-	-	-
4	-	-	-	-	-	-	112.383	112.251	112.176	-	-	-
5	-	-	-	-	-	-	112.378	112.250	112.175	-	-	-
6	-	-	-	-	-	-	112.372	112.248	112.174	-	-	-
7	-	-	-	-	-	-	112.359	112.243	112.171	-	-	-
8	-	-	-	-	-	-	112.349	112.237	112.167	-	-	-
9	-	-	-	-	-	-	112.343	112.229	112.167	-	-	-
10	-	-	-	-	-	-	112.350	112.226	112.166	-	-	-
11	-	-	-	-	-	112.537 P	112.349	112.221	112.164	-	-	-
12	-	-	-	-	-	112.693	112.344	112.216	112.179	-	-	-
13	-	-	-	-	-	112.661	112.336	112.217	112.171	-	-	-
14	-	-	-	-	-	112.610	112.335	112.216	112.165	-	-	-
15	-	-	-	-	-	112.579	112.330	112.210	112.166	-	-	-
16	-	-	-	-	-	112.536	112.327	112.205	112.167 P	-	-	-
17	-	-	-	-	-	112.517	112.322	112.194	-	-	-	-
18	-	-	-	-	-	112.486	112.314	112.190	-	-	-	-
19	-	-	-	-	-	112.476	112.304	112.193	-	-	-	-
20	-	-	-	-	-	112.471	112.301	112.193	-	-	-	-
21	-	-	-	-	-	112.471	112.296	112.192	-	-	-	-
22	-	-	-	-	-	112.472	112.292	112.192	-	-	-	-
23	-	-	-	-	-	112.460	112.289	112.192	-	-	-	-
24	-	-	-	-	-	112.454	112.279	112.191	-	-	-	-
25	-	-	-	-	-	112.450	112.273	112.191	-	-	-	-
26	-	-	-	-	-	112.453	112.271	112.189	-	-	-	-
27	-	-	-	-	-	112.446	112.272	112.187	-	-	-	-
28	-	-	-	-	-	112.441	112.272	112.182	-	-	-	-
29	-	-	-	-	-	112.431	112.270	112.181	-	-	-	-
30	-	-	-	-	-	112.420	112.266	112.181	-	-	-	-
31	-	-	-	-	-	-	112.266	112.174	-	-	-	-
MIN	-	-	-	-	-	112.420	112.266	112.174	112.164	-	-	-
MEAN	-	-	-	-	-	112.498	112.324	112.211	112.171	-	-	-
MAX	-	-	-	-	-	112.693	112.406	112.253	112.179	-	-	-

NOTES: P - PARTIAL DAILY AVERAGE

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		Amaruq - 154321			**Date**		11-Jun-15	
Waterbody:		A69			**Start Time**		1148	
Crossing ID:		A69-DS1			**End Time**		1213	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	598584	BM_read			**Transducer SN:**			
North	7257210	WL_read			**Meter Type/SN:**		Swoffer	
Elevation, Zone	14W	WL_Elev			**Crew:**	CJ, JRL		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.70	0.00		0.00				**0.154**
2	2.10	0.22		0.25			**0.077**	**0.294**
3	3.50	0.20		0.15			**0.045**	**0.440**
4	5.10	0.35		0.20			**0.151**	**0.851**
5	7.80	0.28		0.60			**0.336**	**0.358**
6	9.10	0.27		0.64			**0.233**	**0.350**
7	10.50	0.23		0.45			**0.145**	**0.385**
8	11.90	0.32		0.34			**0.152**	**0.392**
9	13.30	0.24		0.10			**0.037**	**0.442**
10	15.00	0.28		0.60			**0.235**	**0.286**
11	16.10	0.24		0.28			**0.084**	**0.455**
12	17.50	0.41		0.24			**0.138**	**0.574**
13	18.90	0.41		0.45			**0.258**	**0.469**
14	20.30	0.26		0.14			**0.051**	**0.364**
15	21.70	0.26		0.50			**0.182**	**0.406**
16	23.10	0.32		0.53			**0.237**	**0.413**
17	24.50	0.27		0.50			**0.189**	**0.441**
18	25.90	0.36		0.70			**0.353**	**0.329**
19	27.30	0.11		0.70			**0.100**	**0.126**
20	28.50	0.10		0.00			**0.000**	**0.020**
21	28.90	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**3.004**	
						A(m2)	**7.55**	
						B(m)	**28.2**	

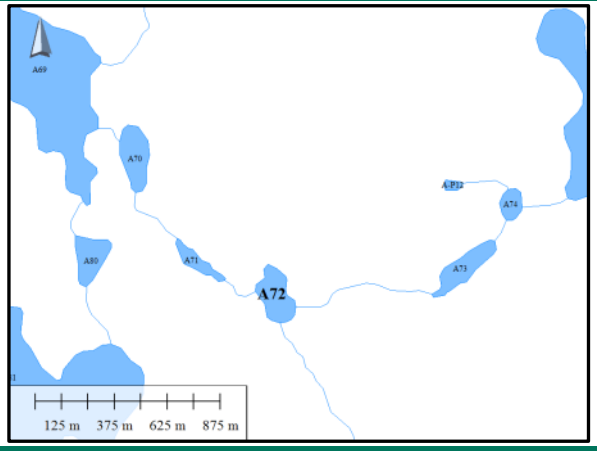
OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		Amaruq - 154321			**Date**		15-Jun-15	
Waterbody:		A69			**Start Time**		1040	
Crossing ID:		A69-DS1			**End Time**		1106	
LDB UTM Location					**Datalogger SN:**			
East	598497	BM_read			**Transducer SN:**			
North	7256995	WL_read			**Meter Type/SN:**		Swoffer	
Elevation, Zone	14W	WL_Elev			**Crew:**	CJ, JRL		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	3.10	0.00		0.00				**0.098**
2	4.60	0.13		0.10			**0.048**	**0.767**
3	10.50	0.13		0.16			**0.067**	**0.083**
4	11.00	0.20		0.37			**0.052**	**0.162**
5	11.90	0.16		0.40			**0.051**	**0.130**
6	12.60	0.21		0.77			**0.081**	**0.074**
7	12.90	0.28		0.57			**0.080**	**0.235**
8	13.60	0.39		0.56			**0.126**	**0.155**
9	14.05	0.30		0.88			**0.323**	**0.530**
10	16.05	0.23		0.69			**0.286**	**0.440**
11	17.65	0.32		0.94			**0.526**	**0.637**
12	19.55	0.35		1.15			**0.785**	**0.774**
13	21.55	0.42		0.96			**0.814**	**0.714**
14	23.55	0.29		0.35			**0.178**	**0.428**
15	25.05	0.28		0.93			**0.326**	**0.195**
16	26.05	0.11		0.27			**0.027**	**0.148**
17	26.85	0.26		0.81			**0.211**	**0.198**
18	28.05	0.07		0.00			**0.000**	**0.132**
19	29.25	0.15		0.85			**0.223**	**0.564**
20	31.55	0.34		0.31			**0.221**	**0.561**
21	33.45	0.25		0.72			**0.450**	**0.542**
22	36.55	0.10		0.45			**0.113**	**0.295**
23	38.45	0.21		0.20			**0.084**	**0.462**
24	40.55	0.23		0.58			**0.260**	**0.387**
25	42.35	0.20		0.42			**0.143**	**0.384**
26	43.95	0.28		0.52			**0.262**	**0.570**
27	45.95	0.29		0.52			**0.309**	**0.535**
28	48.05	0.22		0.61			**0.242**	**0.285**
29	49.55	0.16		0.49			**0.098**	**0.125**
30	50.55	0.09		0.49			**0.119**	**0.682**
31	54.95	0.22		0.22			**0.230**	**0.561**
32	60.05	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**6.732**	
						A(m2)	**11.85**	
						B(m)	**57.0**	

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		Amaruq - trip 2			**Date**		04-Aug-15	
Waterbody:		A69			**Start Time**		9:20	
Crossing ID:		A69-DS1			**End Time**		9:45	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	598452	BM_read			**Transducer SN:**			
North	7256756	WL_read			**Meter Type/SN:**		Marsh McBirney	
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, JN		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.00	0.00		0.00				**0.025**
2	1.00	0.05		0.00			**0.000**	**0.050**
3	2.00	0.05		0.00			**0.000**	**0.025**
4	2.50	0.05		0.08			**0.003**	**0.075**
5	3.50	0.10		0.12			**0.012**	**0.050**
6	4.50	0.00		0.00			**0.000**	**0.090**
7	5.50	0.18		0.15			**0.027**	**0.190**
8	6.50	0.20		0.11			**0.022**	**0.200**
9	7.50	0.20		0.22			**0.044**	**0.245**
10	8.50	0.29		0.00			**0.000**	**0.073**
11	9.00	0.00		0.00			**0.000**	**0.000**
12	9.40	0.00		0.00			**0.000**	**0.013**
13	9.50	0.25		0.16			**0.022**	**0.270**
14	10.50	0.29		0.09			**0.026**	**0.295**
15	11.50	0.30		0.09			**0.027**	**0.270**
16	12.50	0.24		0.10			**0.023**	**0.234**
17	13.40	0.28		0.10			**0.028**	**0.281**
18	14.50	0.23		0.05			**0.012**	**0.245**
19	15.50	0.26		0.04			**0.010**	**0.245**
20	16.50	0.23		0.04			**0.009**	**0.280**
21	17.50	0.33		0.03			**0.010**	**0.320**
22	18.50	0.31		0.02			**0.006**	**0.250**
23	19.50	0.19		0.06			**0.011**	**0.165**
24	20.50	0.14		0.15			**0.021**	**0.095**
25	21.50	0.05		0.14			**0.007**	**0.125**
26	22.50	0.20		0.15			**0.030**	**0.160**
27	23.50	0.12		0.12			**0.014**	**0.120**
28	24.50	0.12		0.11			**0.013**	**0.085**
29	25.50	0.05		0.14			**0.007**	**0.050**
30	26.50	0.05		0.11			**0.006**	**0.065**
31	27.50	0.08		0.07			**0.006**	**0.065**
32	28.50	0.05		0.00			**0.000**	**0.008**
33	28.80	0.00		0.00			**0.000**	**0.021**
34	29.50	0.06		0.04			**0.001**	**0.015**
35	30.00	0.00		0.00			**0.000**	**0.000**
36	35.00	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.398**	
						A(m2)	**4.70**	
						B(m)	**35.0**	

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		1524321 - Amaruq Trip 3			**Date**		16-Sep-15	
Waterbody:		A69			**Start Time**		9:30	
Crossing ID:		A69-DS1			**End Time**		9:50	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	598438	BM_read			**Transducer SN:**			
North	7256752	WL_read			**Meter Type/SN:**			
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, DC		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.00	0.00		0.000				**0.060**
2	2.00	0.06		0.070			**0.006**	**0.070**
3	3.00	0.08		0.079			**0.006**	**0.095**
4	4.00	0.11		0.073			**0.008**	**0.085**
5	5.00	0.06		0.101			**0.006**	**0.075**
6	6.00	0.09		0.070			**0.006**	**0.120**
7	7.00	0.15		0.061			**0.009**	**0.155**
8	8.00	0.16		0.076			**0.012**	**0.185**
9	9.00	0.21		0.052			**0.011**	**0.195**
10	10.00	0.18		0.046			**0.008**	**0.165**
11	11.00	0.15		0.073			**0.011**	**0.150**
12	12.00	0.15		0.101			**0.015**	**0.200**
13	13.00	0.25		0.061			**0.009**	**0.025**
14	13.20	0.00		0.000			**0.000**	**0.000**
15	13.21	0.00		0.000			**0.000**	**0.100**
16	14.21	0.20		0.021			**0.004**	**0.190**
17	15.21	0.18		0.055			**0.010**	**0.190**
18	16.21	0.20		0.061			**0.012**	**0.190**
19	17.21	0.18		0.061			**0.011**	**0.210**
20	18.21	0.24		0.034			**0.008**	**0.205**
21	19.21	0.17		0.058			**0.010**	**0.175**
22	20.21	0.18		0.070			**0.013**	**0.165**
23	21.21	0.15		0.055			**0.008**	**0.175**
24	22.21	0.20		0.052			**0.010**	**0.190**
25	23.21	0.18		0.049			**0.005**	**0.009**
26	23.31	0.00		0.000			**0.000**	**0.000**
27	23.32	0.00		0.000			**0.000**	**0.027**
28	23.62	0.18		0.073			**0.004**	**0.027**
29	23.92	0.00		0.000			**0.000**	**0.000**
30	23.93	0.00		0.000			**0.000**	**0.020**
31	24.73	0.05		0.046			**0.002**	**0.020**
32	25.53	0.00		0.000			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.206**	
						A(m2)	**3.47**	
						B(m)	**25.5**	

A18.0 LAKE A72 & OUTLET (STREAM A72-D71)

Parameter	Value	Note
Drainage Area (km^2)	7.1	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	15	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	0.75	Measured in the field, based on vegetation
Wetted Width (m)	14.2	Measured in the field on 11 June 2015
Max. Wetted Depth (m)	0.40	Measured in the field on 11 June 2015
Channel Length (km)	0.19	Measured from CanVec data
Outlet Channel Slope (m/m)	0.003	Average slope, measured in the field 18 September 2015
Bed Material	Sand, silt, organics	
Bank Material	Sand, silt, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	N/A	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	N/A	
Comment	Well defined channel. Cross-sectional data are available in discharge calculation sheets.	



Lake A72.

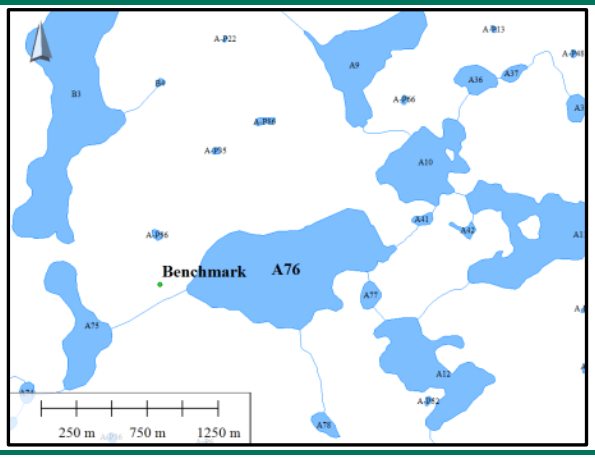
OPEN WATER DISCHARGE CALCULATION SPREADSHEET							
Project Name, Number:		1524321 - Amaruq Trip 3			**Date**	18-Sep-15	
Waterbody:		A72			**Start Time**	14:30	
Crossing ID:		A72-A71			**End Time**	14:50	
LDB UTM Location		**Survey**			**Datalogger SN:**		
East	598988	BM_read			**Transducer SN:**		
North	7255622	WL_read			**Meter Type/SN:**		
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, DC	

STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)	Qi (m3/s)	Ai (m2)
1	0.00	0.00		0.00			**0.112**
2	1.60	0.14		0.00		**0.000**	**0.111**
3	2.20	0.23		0.03		**0.003**	**0.068**
4	2.50	0.22		0.04		**0.003**	**0.065**
5	2.80	0.21		0.03		**0.002**	**0.068**
6	3.10	0.24		0.02		**0.001**	**0.072**
7	3.40	0.24		0.04		**0.003**	**0.071**
8	3.70	0.23		0.03		**0.002**	**0.072**
9	4.00	0.25		0.02		**0.002**	**0.086**
10	4.30	0.32		0.03		**0.003**	**0.101**
11	4.60	0.35		0.03		**0.003**	**0.083**
12	4.90	0.20		0.01		**0.001**	**0.089**
13	5.20	0.39		0.03		**0.004**	**0.113**
14	5.50	0.36		0.04		**0.004**	**0.108**
15	5.80	0.36		0.05		**0.005**	**0.097**
16	6.10	0.29		0.05		**0.004**	**0.087**
17	6.40	0.29		0.06		**0.005**	**0.083**
18	6.70	0.26		0.05		**0.004**	**0.084**
19	7.00	0.30		0.03		**0.003**	**0.090**
20	7.30	0.30		0.02		**0.002**	**0.096**
21	7.60	0.34		0.05		**0.006**	**0.148**
22	8.00	0.40		0.04		**0.006**	**0.156**
23	8.40	0.38		0.01		**0.002**	**0.150**
24	8.80	0.37		0.04		**0.006**	**0.150**
25	9.20	0.38		0.03		**0.005**	**0.152**
26	9.60	0.38		0.04		**0.006**	**0.144**
27	10.00	0.34		0.04		**0.005**	**0.136**
28	10.40	0.34		0.04		**0.005**	**0.140**
29	10.80	0.36		0.04		**0.006**	**0.136**
30	11.20	0.32		0.02		**0.003**	**0.124**
31	11.60	0.30		0.05		**0.006**	**0.104**
32	12.00	0.22		0.04		**0.004**	**0.092**
33	12.40	0.24		0.02		**0.002**	**0.072**
34	12.80	0.12		0.03		**0.001**	**0.042**
35	13.20	0.09		0.03		**0.001**	**0.030**
36	13.60	0.06		0.01		**0.000**	**0.018**
37	14.20	0.00		0.00		**0.000**	**0.000**

NOTES:		**RESULTS:**	**Q (m3/s)**	**0.117**
			A(m2)	**3.55**
			B(m)	**14.2**

A19.0 LAKE A76 & EAST OUTLET (STREAM A76-A11)

Parameter	Value	Note
Drainage Area (km^2)	2.9	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	65	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	1.0	Measured in the field, based on vegetation
Wetted Width (m)	60.0	Measured in the field 6 August 2015
Max. Wetted Depth (m)	0.31	Measured in the field 6 August 2015
Channel Length (km)	0.28	Measured from CanVec data
Outlet Channel Slope (m/m)	0.0035	Average slope, measured in the field
Bed Material	Boulders, cobbles	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	601213 m E, 7256820 m N, 154.00 masl	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	N/A	
Comment	Boulder channel. Cross-sectional data are available in discharge calculation sheets and Section 3.3. See Stream A12 for more photos relating to Lake A76.	



Lake A76: Benchmark location.



6 August 2015. Downstream view of the watercourse (northeast).



19 September 2015. Upstream view of the watercourse and Lake A76 (southwest)

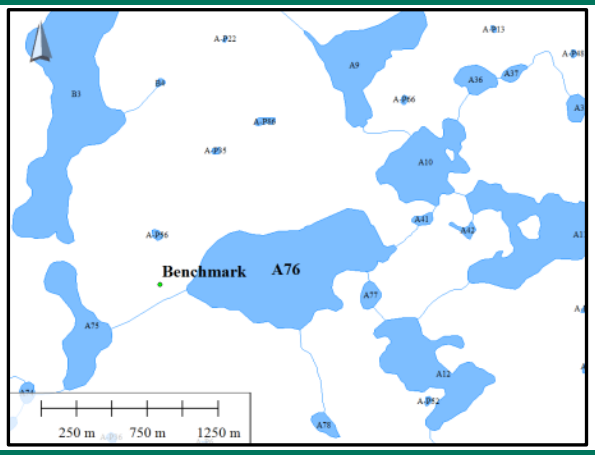
OPEN WATER DISCHARGE CALCULATION SPREADSHEET							
Project Name, Number:		Amaruq - Trip 2			**Date**		06-Aug-15
Waterbody:		A76			**Start Time**		1:15
Crossing ID:		A76-A41			**End Time**		1:45
LDB UTM Location		**Survey**			**Datalogger SN:**		
East	602921	BM_read			**Transducer SN:**		
North	7257158	WL_read			**Meter Type/SN:**		Marsh McBirney
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, JN	

STATION	DISTANCE		Velocity		Optional		
Start	FROM LDB	DEPTH	0.2 DEPTH	0.6/0.8 DEPTH	ANGLE OF FLOW	Qi	Ai
LDB	(m)	(m)	(m/s)	(m/s)	(º)	(m3/s)	(m2)
1	0.00	0.00		0.00			**0.051**
2	0.60	0.17		0.00		**0.000**	**0.243**
3	1.50	0.37		0.00		**0.000**	**0.123**
4	2.00	0.12		0.00		**0.000**	**0.036**
5	2.60	0.00		0.00		**0.000**	**0.000**
6	3.40	0.00		0.00		**0.000**	**0.027**
7	4.00	0.09		0.00		**0.000**	**0.014**
8	4.30	0.00		0.00		**0.000**	**0.000**
9	6.00	0.00		0.00		**0.000**	**0.007**
10	6.10	0.15		0.00		**0.000**	**0.030**
11	6.50	0.00		0.00		**0.000**	**0.000**
12	6.90	0.00		0.00		**0.000**	**0.012**
13	7.00	0.24		0.00		**0.000**	**0.495**
14	8.50	0.42		0.00		**0.000**	**0.750**
15	10.00	0.58		0.02		**0.017**	**0.855**
16	11.50	0.56		0.02		**0.011**	**0.112**
17	11.90	0.00		0.00		**0.000**	**0.000**
18	12.70	0.00		0.00		**0.000**	**0.074**
19	13.00	0.49		0.00		**0.000**	**0.264**
20	13.60	0.39		0.03		**0.012**	**0.560**
21	15.00	0.41		0.01		**0.006**	**1.029**
22	16.70	0.80		0.01		**0.012**	**0.722**
23	18.00	0.31		0.02		**0.009**	**0.330**
24	19.50	0.13		0.00		**0.000**	**0.323**
25	21.00	0.30		0.00		**0.000**	**0.488**
26	22.50	0.35		0.01		**0.005**	**0.503**
27	24.00	0.32		0.01		**0.005**	**0.360**
28	25.50	0.16		0.01		**0.001**	**0.008**
29	25.60	0.00		0.00		**0.000**	**0.000**
30	26.90	0.00		0.00		**0.000**	**0.064**
31	27.70	0.16		0.01		**0.001**	**0.232**
32	28.50	0.42		0.00		**0.000**	**0.380**
33	29.60	0.27		0.00		**0.000**	**0.054**
34	30.00	0.00		0.00		**0.000**	**0.000**

NOTES:	15 m of no/low depth wetted width on RDB & LDB	**RESULTS:**	**Q (m3/s)**	**0.079**
			A(m2)	**8.14**
			B(m)	**30.0**

A20.0 LAKE A76 & WEST OUTLET (STREAM A76-A75)

Parameter	Value	Note
Drainage Area (km^2)	2.9	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	35	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	N/A	Measured in the field, based on vegetation
Wetted Width (m)	N/A	Observed no surface flow in the field 5 August 2015
Max. Wetted Depth (m)	0	Observed no surface flow in the field 5 August 2015
Channel Length (km)	0.58	Measured from CanVec data
Outlet Channel Slope (m/m)	0.017	Average slope, measured in the field
Bed Material	Boulders, cobbles	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	601213 m E, 7256820 m N, 154.00 masl	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	N/A	
Comment	Boulder channel. Some visible flow through boulders but not measureable. See Section 3.3 and discharge sheets for cross-sections, and Stream A12 for more photos relating to Lake A76.	



Lake A76: Benchmark location.



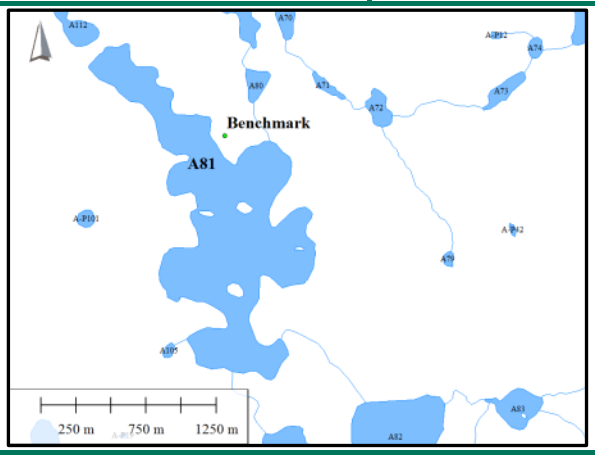
6 August 2015. Downstream view of watercourse (west). No visible flow through channel at time of photo.



17 September 2015. View looking west towards Lake A76 and watercourse.

A21.0 LAKE A81 & OUTLET (STREAM A81-A80)

Parameter	Value	Note
Drainage Area (km^2)	30.1	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	50	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	0.5	Measured in the field, based on vegetation
Wetted Width (m)	48.7	Measured in the field 8 August 2015
Max. Wetted Depth (m)	0.42	Measured in the field 8 August 2015
Channel Length (km)	0.30	Measured from CanVec data
Outlet Channel Slope (m/m)	0.011	Average slope, based on DEM (PhotoSat 2015)
Bed Material	Boulders, cobbles	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	598067 m E, 7255436 m N, 129.65 masl	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	N/A	
Comment	Poorly defined boulder channel. See discharge sheets for cross-sections.	



Lake A81: Benchmark location.



8 August 2015. Downstream view of the watercourse (north).



17 September 2015. View looking east at Lake A81 and watercourse.

OPEN WATER DISCHARGE CALCULATION SPREADSHEET							
Project Name, Number:		1524321 - Amaruq			**Date**	12-Jul-15	
Waterbody:		A81			**Start Time**		
Crossing ID:		A81-A80			**End Time**		
LDB UTM Location		**Survey**			**Datalogger SN:**		
East	598366	BM_read			**Transducer SN:**		
North	7255457	WL_read			**Meter Type/SN:**	Swoffer	
Elevation, Zone	14W	WL_Elev			**Crew:**	AEM: RV, LG, RD	
STATION	DISTANCE		Velocity		Optional		
Start	FROM LDB	DEPTH	0.2 DEPTH	0.6/0.8 DEPTH	ANGLE OF FLOW	Qi	Ai
LDB	(m)	(m)	(m/s)	(m/s)	(º)	(m3/s)	(m2)
1	0.00	0.00		0.00			**0.000**
2	0.50	0.00		0.00		**0.000**	**0.013**
3	1.00	0.05		0.18		**0.005**	**0.030**
4	1.50	0.07		0.26		**0.009**	**0.025**
5	2.00	0.03		0.15		**0.002**	**0.015**
6	2.50	0.03		0.15		**0.002**	**0.058**
7	3.00	0.20		0.40		**0.040**	**0.050**
8	3.50	0.00		0.00		**0.000**	**0.030**
9	4.00	0.12		0.39		**0.023**	**0.055**
10	4.50	0.10		0.41		**0.021**	**0.068**
11	5.00	0.17		0.14		**0.012**	**0.073**
12	5.50	0.12		0.62		**0.037**	**0.043**
13	6.00	0.05		0.25		**0.006**	**0.065**
14	6.50	0.21		0.44		**0.046**	**0.078**
15	7.00	0.10		0.37		**0.019**	**0.071**
16	7.50	0.19		0.10		**0.009**	**0.116**
17	8.00	0.28		0.44		**0.062**	**0.120**
18	8.50	0.20		0.41		**0.041**	**0.163**
19	9.00	0.45		0.12		**0.027**	**0.173**
20	9.50	0.24		0.26		**0.031**	**0.105**
21	10.00	0.18		0.42		**0.038**	**0.100**
22	10.50	0.22		0.37		**0.041**	**0.100**
23	11.00	0.18		0.05		**0.005**	**0.100**
24	11.50	0.22		0.25		**0.028**	**0.105**
25	12.00	0.20		0.02		**0.002**	**0.100**
26	12.50	0.20		0.00		**0.000**	**0.105**
27	13.00	0.22		0.28		**0.031**	**0.090**
28	13.50	0.14		0.02		**0.001**	**0.073**
29	14.00	0.15		0.00		**0.000**	**0.088**
30	14.50	0.20		0.06		**0.006**	**0.095**
31	15.00	0.18		0.27		**0.024**	**0.075**
32	15.50	0.12		0.12		**0.007**	**0.068**
33	16.00	0.15		0.43		**0.032**	**0.080**
34	16.50	0.17		0.65		**0.055**	**0.043**
35	17.00	0.00		0.00		**0.000**	**0.000**
36	17.50	0.00		0.00		**0.000**	**0.000**
37	18.00	0.00		0.00		**0.000**	**0.000**
38	18.50	0.00		0.00		**0.000**	**0.025**
39	19.00	0.10		0.00		**0.000**	**0.100**
40	19.50	0.30		0.57		**0.086**	**0.113**
41	20.00	0.15		0.12		**0.009**	**0.058**
42	20.50	0.08		0.23		**0.000**	**0.060**
43	21.00	0.16		0.71		**0.000**	**0.040**
44	21.50	0.00		0.00		**0.000**	**0.000**
45	22.00	0.00		0.00		**0.000**	**0.000**
46	22.50	0.00		0.00		**0.000**	**0.038**
47	23.00	0.15		0.41		**0.031**	**0.075**
48	23.50	0.15		0.22		**0.017**	**0.038**
49	24.00	0.00		0.00		**0.000**	**0.025**
50	24.50	0.10		0.33		**0.017**	**0.038**
51	25.00	0.05		0.01		**0.000**	**0.013**
52	25.50	0.00		0.00		**0.000**	**0.030**
53	26.00	0.12		0.08		**0.005**	**0.030**
54	26.50	0.00		0.00		**0.000**	**0.040**
55	27.00	0.16		0.39		**0.031**	**0.085**
56	27.50	0.18		0.33		**0.030**	**0.083**
57	28.00	0.15		0.19		**0.014**	**0.038**

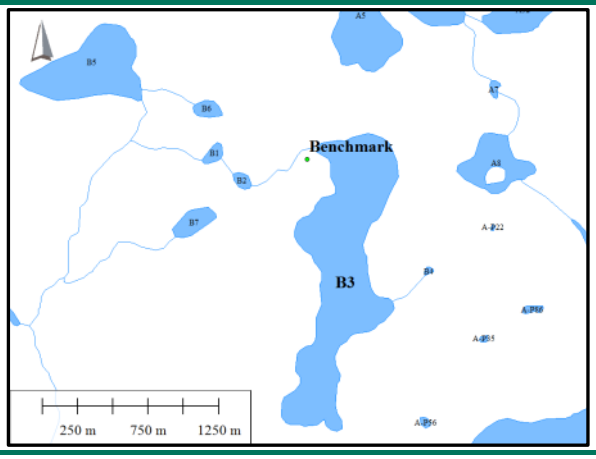
OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		1524321 - Amaruq			**Date**		12-Jul-15	
Waterbody:		A81			**Start Time**			
Crossing ID:		A81-A80			**End Time**			
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	598366	BM_read			**Transducer SN:**			
North	7255457	WL_read			**Meter Type/SN:**		Swoffer	
Elevation, Zone	14W	WL_Elev			**Crew:**	AEM: RV, LG, RD		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
58	28.50	0.00		0.00			**0.000**	**0.000**
59	29.00	0.00		0.00			**0.000**	**0.000**
60	29.50	0.00		0.00			**0.000**	**0.000**
61	30.00	0.00		0.00			**0.000**	**0.020**
62	30.50	0.08		0.22			**0.044**	**0.180**
63	31.00	0.00		0.00			**0.000**	**0.000**
64	31.50	0.10		0.15			**0.008**	**0.025**
65	32.00	0.00		0.00			**0.000**	**0.000**
66	33.00	0.08		0.10			**0.136**	**1.320**
67	34.00	0.00		0.00			**0.000**	**0.000**
68	35.00	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**1.088**	
						A(m2)	**5.04**	
						B(m)	**35.0**	

OPEN WATER DISCHARGE CALCULATION SPREADSHEET							
Project Name, Number:		Amaruq - Trip 2			**Date**	08-Aug-15	
Waterbody:		A81			**Start Time**	11:51	
Crossing ID:		A81-A80			**End Time**	12:20	
LDB UTM Location		**Survey**			**Datalogger SN:**		
East	598343	BM_read			**Transducer SN:**		
North	7255414	WL_read			**Meter Type/SN:**	Marsh McBirney	
Elevation, Zone	14W	WL_Elev			**Crew:**	JL, Laren (wildlife monitor took notes)	
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)	Qi (m3/s)	Ai (m2)
1	0.00	0.00		0.00			**0.000**
2	2.50	0.00		0.00		**0.000**	**0.006**
3	2.60	0.12		0.13		**0.002**	**0.006**
4	2.70	0.00		0.00		**0.000**	**0.000**
5	5.60	0.00		0.00		**0.000**	**0.002**
6	5.70	0.04		0.10		**0.000**	**0.002**
7	5.80	0.00		0.00		**0.000**	**0.000**
8	6.70	0.00		0.00		**0.000**	**0.003**
9	6.90	0.03		0.08		**0.000**	**0.001**
10	7.00	0.00		0.00		**0.000**	**0.000**
11	7.30	0.00		0.00		**0.000**	**0.002**
12	7.40	0.04		0.00		**0.000**	**0.004**
13	7.60	0.00		0.00		**0.000**	**0.000**
14	7.70	0.00		0.00		**0.000**	**0.002**
15	7.80	0.04		0.08		**0.000**	**0.001**
16	7.85	0.00		0.00		**0.000**	**0.000**
17	10.20	0.00		0.00		**0.000**	**0.003**
18	10.40	0.03		0.12		**0.001**	**0.036**
19	11.00	0.09		0.01		**0.001**	**0.057**
20	11.60	0.10		0.11		**0.012**	**0.165**
21	13.10	0.12		0.16		**0.017**	**0.018**
22	13.40	0.00		0.00		**0.000**	**0.004**
23	13.80	0.02		0.02		**0.000**	**0.022**
24	14.20	0.09		0.09		**0.002**	**0.000**
25	14.20	0.00		0.00		**0.000**	**0.010**
26	15.20	0.02		0.09		**0.001**	**0.003**
27	15.50	0.00		0.00		**0.000**	**0.000**
28	15.80	0.00		0.00		**0.000**	**0.010**
29	16.00	0.10		0.00		**0.000**	**0.063**
30	16.70	0.08		0.10		**0.004**	**0.008**
31	16.90	0.00		0.00		**0.000**	**0.000**
32	18.50	0.00		0.00		**0.000**	**0.004**
33	18.70	0.04		0.22		**0.004**	**0.096**
34	19.50	0.20		0.06		**0.009**	**0.080**
35	20.20	0.03		0.17		**0.003**	**0.009**
36	20.80	0.00		0.00		**0.000**	**0.000**
37	21.90	0.00		0.00		**0.000**	**0.006**
38	22.10	0.06		0.10		**0.002**	**0.040**
39	22.60	0.10		0.05		**0.002**	**0.005**
40	22.70	0.00		0.00		**0.000**	**0.000**
41	26.50	0.00		0.00		**0.000**	**0.030**
42	27.50	0.06		0.05		**0.000**	**0.035**
43	28.20	0.04		0.22		**0.000**	**0.006**
44	28.50	0.00		0.00		**0.000**	**0.000**
45	28.80	0.00		0.00		**0.000**	**0.003**
46	28.90	0.06		0.10		**0.001**	**0.006**
47	29.10	0.00		0.00		**0.000**	**0.000**
48	31.70	0.00		0.00		**0.000**	**0.006**
49	31.80	0.12		0.01		**0.000**	**0.018**
50	32.10	0.00		0.00		**0.000**	**0.000**
51	32.50	0.00		0.00		**0.000**	**0.004**
52	32.60	0.08		0.16		**0.009**	**0.098**
53	33.90	0.07		0.01		**0.001**	**0.084**
54	35.10	0.07		0.17		**0.011**	**0.042**
55	35.70	0.07		0.01		**0.000**	**0.049**
56	36.40	0.07		0.18		**0.009**	**0.036**
57	37.20	0.02		0.00		**0.000**	**0.018**
58	37.80	0.04		0.11		**0.018**	**0.370**
59	45.20	0.06		0.06		**0.014**	**0.015**
60	45.70	0.00		0.00		**0.000**	**0.000**

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		Amaruq - Trip 2			**Date**		08-Aug-15	
Waterbody:		A81			**Start Time**		11:51	
Crossing ID:		A81-A80			**End Time**		12:20	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	598343	BM_read			**Transducer SN:**			
North	7255414	WL_read			**Meter Type/SN:**		Marsh McBirney	
Elevation, Zone	14W	WL_Elev			**Crew:**	JL, Laren (wildlife monitor took notes)		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.124**	
						A(m2)	**1.49**	
						B(m)	**45.7**	

A22.0 LAKE B3 & OUTLET (STREAM B3-B2)

Parameter	Value	Note
Drainage Area (km^2)	2.8	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	15	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	0.3	Measured in the field, based on vegetation
Wetted Width (m)	12.8	Measured in the field 8 August 2015
Max. Wetted Depth (m)	0.25	Measured in the field 8 August 2015
Channel Length (km)	0.38	Measured from CanVec data
Outlet Channel Slope (m/m)	0.007	Average slope, based on DEM (PhotoSat 2015)
Bed Material	Boulders, cobbles, with some gravel, sand	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	600357 m E, 7259028 m N, 144.86 masl	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	N/A	
Comment	Poorly defined, braided bouldery channel. Cross-sectional data are available in discharge calculation sheets.	



Lake B3: Benchmark location.



8 August 2015. Upstream view of the Lake B3 outlet (east).

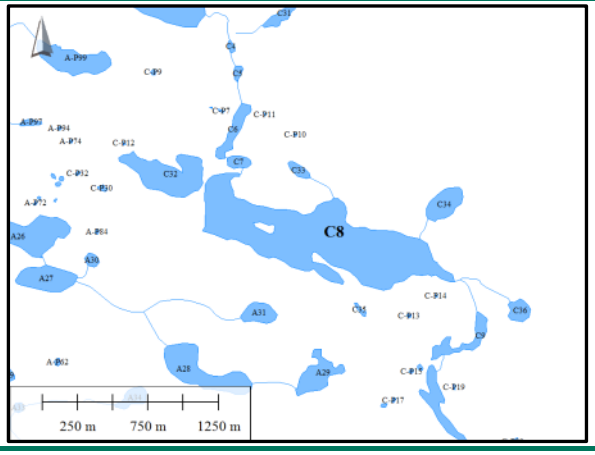


8 August 2015. Downstream view of the Lake B3 outlet (west).

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		Amaruq - trip 2			**Date**		08-Aug-15	
Waterbody:		B3			**Start Time**		7:45	
Crossing ID:		B3-B2			**End Time**		8:05	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	600126	BM_read			**Transducer SN:**			
North	7258966	WL_read			**Meter Type/SN:**		Marsh McBirney	
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, JN		
STATION	DISTANCE		Velocity		Optional			
Start	FROM LDB	DEPTH	0.2 DEPTH	0.6/0.8 DEPTH	ANGLE OF FLOW		Qi	Ai
LDB	(m)	(m)	(m/s)	(m/s)	(º)		(m3/s)	(m2)
1	0.00	0.00		0.00				**0.135**
2	1.50	0.18		0.04			**0.006**	**0.009**
3	1.60	0.00		0.00			**0.000**	**0.000**
4	2.00	0.00		0.00			**0.000**	**0.008**
5	2.10	0.15		0.03			**0.001**	**0.023**
6	2.40	0.00		0.00			**0.000**	**0.000**
7	3.10	0.00		0.00			**0.000**	**0.011**
8	3.30	0.11		0.04			**0.001**	**0.054**
9	3.70	0.16		0.03			**0.002**	**0.068**
10	4.20	0.11		0.09			**0.006**	**0.092**
11	5.00	0.12		0.06			**0.005**	**0.058**
12	5.50	0.11		0.02			**0.001**	**0.098**
13	6.20	0.17		0.03			**0.003**	**0.026**
14	6.50	0.00		0.00			**0.000**	**0.000**
15	7.80	0.00		0.00			**0.000**	**0.008**
16	7.90	0.16		0.05			**0.003**	**0.087**
17	8.50	0.13		0.02			**0.001**	**0.058**
18	9.00	0.10		0.02			**0.001**	**0.058**
19	9.50	0.13		0.09			**0.004**	**0.013**
20	9.70	0.00		0.00			**0.000**	**0.000**
21	11.10	0.00		0.00			**0.000**	**0.012**
22	11.20	0.24		0.01			**0.001**	**0.048**
23	11.60	0.00		0.00			**0.000**	**0.000**
24	12.60	0.00		0.00			**0.000**	**0.008**
25	12.70	0.16		0.03			**0.000**	**0.008**
26	12.80	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.036**	
						A(m2)	**0.88**	
						B(m)	**12.8**	

A23.0 LAKE C8 & OUTLET (STREAM C8-C7)

Parameter	Value	Note
Drainage Area (km^2)	11.2	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	30	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	0.3	Measured in the field, based on vegetation
Wetted Width (m)	16.6	Measured in the field on 8 August 2015
Max. Wetted Depth (m)	0.14	Measured in the field on 8 August 2015
Channel Length (km)	0.05	Measured from CanVec data
Outlet Channel Slope (m/m)	0.005	Average slope, measured in the field
Bed Material	Cobbles, gravel, sand	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	604219 m E, 7260840 m N	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	N/A	
Comment	Well defined channel. Cross-sectional data are available in discharge calculation sheets.	



Lake C8.



8 August 2015. Southwest view of Lake C8 flowing into C7.



8 August 2015. Upstream view of the watercourse (southwest).



8 August 2015. View looking south at Lake C8.

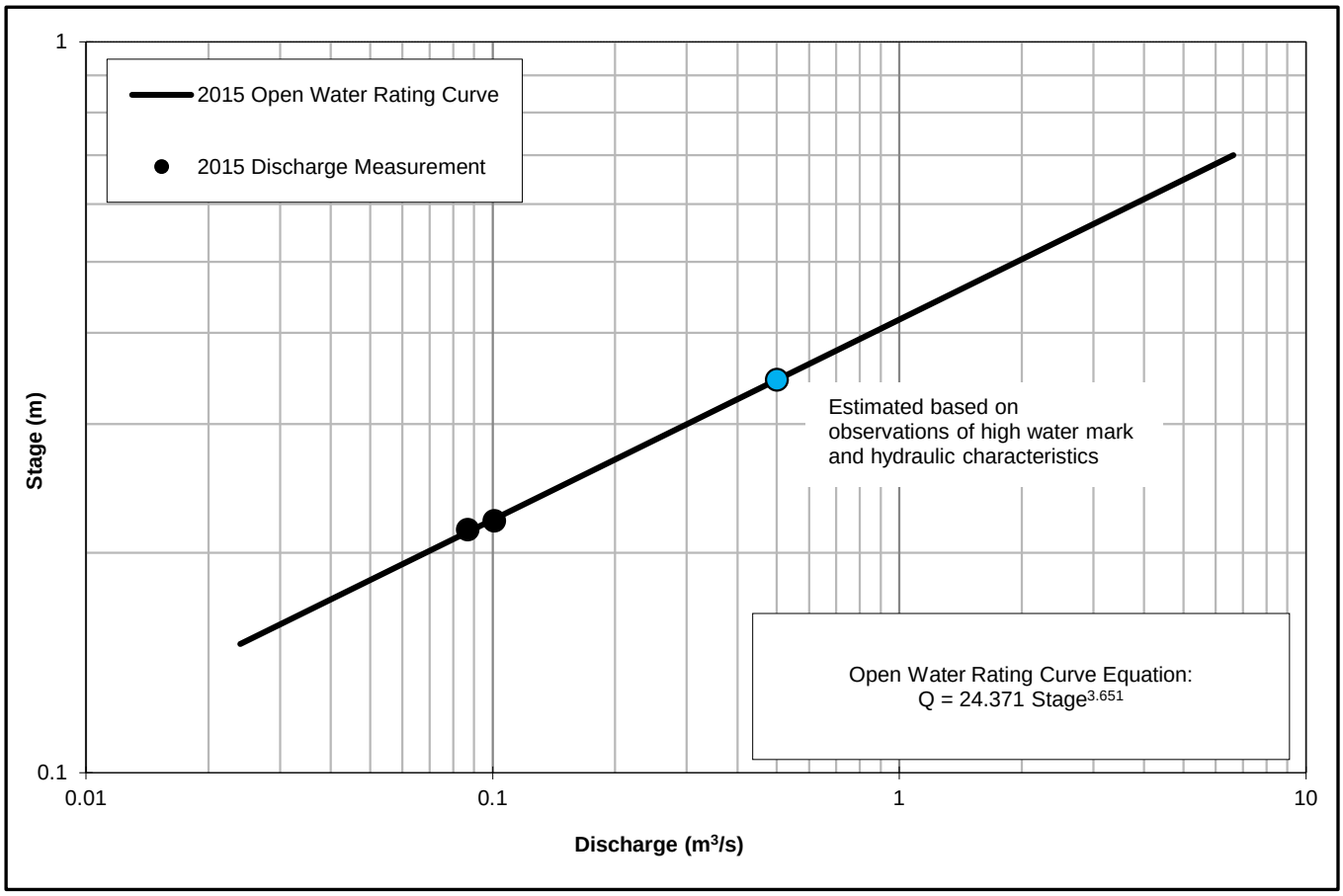


Figure 6: 2015 Stage-Discharge Rating Curve (Lake C8)

Lake C8 - 2015

MEAN DAILY DISCHARGE (m^3/s)

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	-	-	-	-	-	-	-	-	0.08	-	-	-
2	-	-	-	-	-	-	-	-	0.08	-	-	-
3	-	-	-	-	-	-	-	-	0.09	-	-	-
4	-	-	-	-	-	-	-	-	0.09	-	-	-
5	-	-	-	-	-	-	-	-	0.08	-	-	-
6	-	-	-	-	-	-	-	-	0.08	-	-	-
7	-	-	-	-	-	-	-	-	0.08	-	-	-
8	-	-	-	-	-	-	-	0.09 P	0.08	-	-	-
9	-	-	-	-	-	-	-	0.09	0.08	-	-	-
10	-	-	-	-	-	-	-	0.08	0.08	-	-	-
11	-	-	-	-	-	-	-	0.09	0.07	-	-	-
12	-	-	-	-	-	-	-	0.07	0.08	-	-	-
13	-	-	-	-	-	-	-	0.08	0.08	-	-	-
14	-	-	-	-	-	-	-	0.09	0.08	-	-	-
15	-	-	-	-	-	-	-	0.08	0.08	-	-	-
16	-	-	-	-	-	-	-	0.08	0.08 P	-	-	-
17	-	-	-	-	-	-	-	0.08	-	-	-	-
18	-	-	-	-	-	-	-	0.08	-	-	-	-
19	-	-	-	-	-	-	-	0.08	-	-	-	-
20	-	-	-	-	-	-	-	0.08	-	-	-	-
21	-	-	-	-	-	-	-	0.08	-	-	-	-
22	-	-	-	-	-	-	-	0.08	-	-	-	-
23	-	-	-	-	-	-	-	0.08	-	-	-	-
24	-	-	-	-	-	-	-	0.09	-	-	-	-
25	-	-	-	-	-	-	-	0.09	-	-	-	-
26	-	-	-	-	-	-	-	0.09	-	-	-	-
27	-	-	-	-	-	-	-	0.09	-	-	-	-
28	-	-	-	-	-	-	-	0.08	-	-	-	-
29	-	-	-	-	-	-	-	0.08	-	-	-	-
30	-	-	-	-	-	-	-	0.08	-	-	-	-
31	-	-	-	-	-	-	-	0.08	-	-	-	-
MIN	-	-	-	-	-	-	-	0.073	0.072	-	-	-
MEAN	-	-	-	-	-	-	-	0.083	0.080	-	-	-
MAX	-	-	-	-	-	-	-	0.089	0.086	-	-	-

NOTES: P - PARTIAL DAILY AVERAGE

Water Yield (m^3) =	282,794	171,934	110,860
Water Yield (mm) =	24.0	61%	39%

Lake C8 - 2015
MEAN DAILY WATER SURFACE ELEVATION (masl)

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	-	-	-	-	-	-	-	-	139.008	-	-	-
2	-	-	-	-	-	-	-	-	139.012	-	-	-
3	-	-	-	-	-	-	-	-	139.013	-	-	-
4	-	-	-	-	-	-	-	-	139.012	-	-	-
5	-	-	-	-	-	-	-	-	139.011	-	-	-
6	-	-	-	-	-	-	-	-	139.010	-	-	-
7	-	-	-	-	-	-	-	-	139.009	-	-	-
8	-	-	-	-	-	-	-	139.014 P	139.006	-	-	-
9	-	-	-	-	-	-	-	139.015	139.005	-	-	-
10	-	-	-	-	-	-	-	139.012	139.005	-	-	-
11	-	-	-	-	-	-	-	139.012	139.003	-	-	-
12	-	-	-	-	-	-	-	139.004	139.009	-	-	-
13	-	-	-	-	-	-	-	139.012	139.025	-	-	-
14	-	-	-	-	-	-	-	139.013	139.020	-	-	-
15	-	-	-	-	-	-	-	139.011	139.021	-	-	-
16	-	-	-	-	-	-	-	139.008	139.022 P	-	-	-
17	-	-	-	-	-	-	-	139.007	-	-	-	-
18	-	-	-	-	-	-	-	139.008	-	-	-	-
19	-	-	-	-	-	-	-	139.007	-	-	-	-
20	-	-	-	-	-	-	-	139.009	-	-	-	-
21	-	-	-	-	-	-	-	139.011	-	-	-	-
22	-	-	-	-	-	-	-	139.010	-	-	-	-
23	-	-	-	-	-	-	-	139.011	-	-	-	-
24	-	-	-	-	-	-	-	139.013	-	-	-	-
25	-	-	-	-	-	-	-	139.013	-	-	-	-
26	-	-	-	-	-	-	-	139.013	-	-	-	-
27	-	-	-	-	-	-	-	139.013	-	-	-	-
28	-	-	-	-	-	-	-	139.010	-	-	-	-
29	-	-	-	-	-	-	-	139.011	-	-	-	-
30	-	-	-	-	-	-	-	139.011	-	-	-	-
31	-	-	-	-	-	-	-	139.010	-	-	-	-
MIN	-	-	-	-	-	-	-	139.004	139.003	-	-	-
MEAN	-	-	-	-	-	-	-	139.011	139.012	-	-	-
MAX	-	-	-	-	-	-	-	139.015	139.025	-	-	-

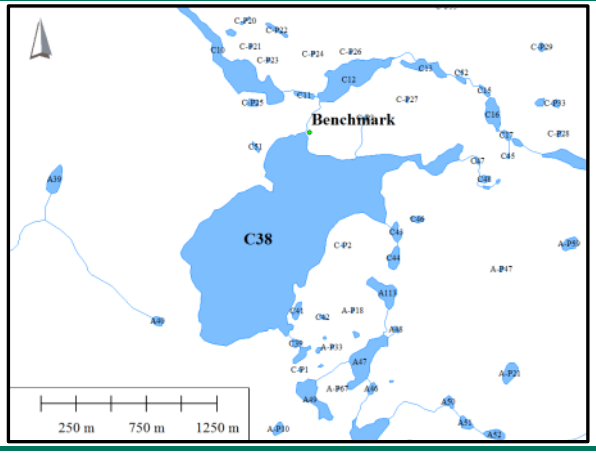
NOTES: P - PARTIAL DAILY AVERAGE

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		Amaruq - Trip 2			**Date**		08-Aug-15	
Waterbody:		C8			**Start Time**		9:45	
Crossing ID:		C8-C7			**End Time**		10:00	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	604259	BM_read			**Transducer SN:**			
North	7260865	WL_read			**Meter Type/SN:**		Marsh McBirney	
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, JN		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.40	0.00		0.00				**0.002**
2	0.50	0.04		0.00			**0.000**	**0.028**
3	1.20	0.04		0.00			**0.000**	**0.066**
4	2.40	0.07		0.01			**0.001**	**0.065**
5	3.40	0.06		0.05			**0.003**	**0.084**
6	4.60	0.08		0.06			**0.006**	**0.132**
7	5.80	0.14		0.08			**0.013**	**0.150**
8	7.00	0.11		0.07			**0.009**	**0.138**
9	8.20	0.12		0.08			**0.012**	**0.144**
10	9.40	0.12		0.07			**0.010**	**0.144**
11	10.60	0.12		0.04			**0.006**	**0.108**
12	11.80	0.06		0.07			**0.005**	**0.096**
13	13.00	0.10		0.05			**0.006**	**0.102**
14	14.20	0.07		0.05			**0.004**	**0.114**
15	15.40	0.12		0.08			**0.012**	**0.108**
16	16.60	0.06		0.01			**0.000**	**0.012**
17	17.00	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.087**	
						A(m2)	**1.49**	
						B(m)	**16.6**	

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		1524321 - Amaruq Trip 3			**Date**		16-Sep-15	
Waterbody:		C8			**Start Time**		11:40	
Crossing ID:		C8-C7			**End Time**		11:50	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	604255	BM_read			**Transducer SN:**			
North	7260877	WL_read			**Meter Type/SN:**			
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, DC		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.00	0.00		0				**0.100**
2	2.00	0.10		0.02			**0.003**	**0.080**
3	3.00	0.06		0.06			**0.004**	**0.090**
4	4.00	0.12		0.1			**0.012**	**0.135**
5	5.00	0.15		0.07			**0.011**	**0.135**
6	6.00	0.12		0.07			**0.008**	**0.145**
7	7.00	0.17		0.05			**0.009**	**0.180**
8	8.00	0.19		0.02			**0.004**	**0.195**
9	9.00	0.20		0.04			**0.008**	**0.180**
10	10.00	0.16		0.06			**0.010**	**0.160**
11	11.00	0.16		0.04			**0.006**	**0.150**
12	12.00	0.14		0.07			**0.010**	**0.130**
13	13.00	0.12		0.07			**0.008**	**0.125**
14	14.00	0.13		0.05			**0.007**	**0.115**
15	15.00	0.10		0.03			**0.002**	**0.030**
16	15.60	0.00		0			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.101**	
						A(m2)	**1.95**	
						B(m)	**15.6**	

A24.0 LAKE C38 (NEMO LAKE) & OUTLET (STREAM C38-C12)

Parameter	Value	Note
Drainage Area (km^2)	3.5	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	3	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	0.2	Measured in the field, based on vegetation
Wetted Width (m)	1.4	Measured in the field 4 August 2015
Max. Wetted Depth (m)	0.12	Measured in the field 4 August 2015
Channel Length (km)	0.22	Measured from CanVec data
Outlet Channel Slope (m/m)	0.024	Average slope, measured in the field
Bed Material	Boulders, cobble, gravel	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	606646 m E, 7258165 m N, 157.42 masl	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	606615 m E, 7258148 m N	
Comment	Poorly defined boulder channel with some well-defined portions. Cross-sectional data are available in discharge calculation sheets.	



Lake C38: Benchmark location.



14 June 2015. View from outlet looking south at Lake C38.



17 September 2015. Upstream view of the watercourse and Lake C38 (south)



4 August 2015. Upstream view of the watercourse and Lake C38 (south).



4 August 2015. Downstream view of the watercourse (north).

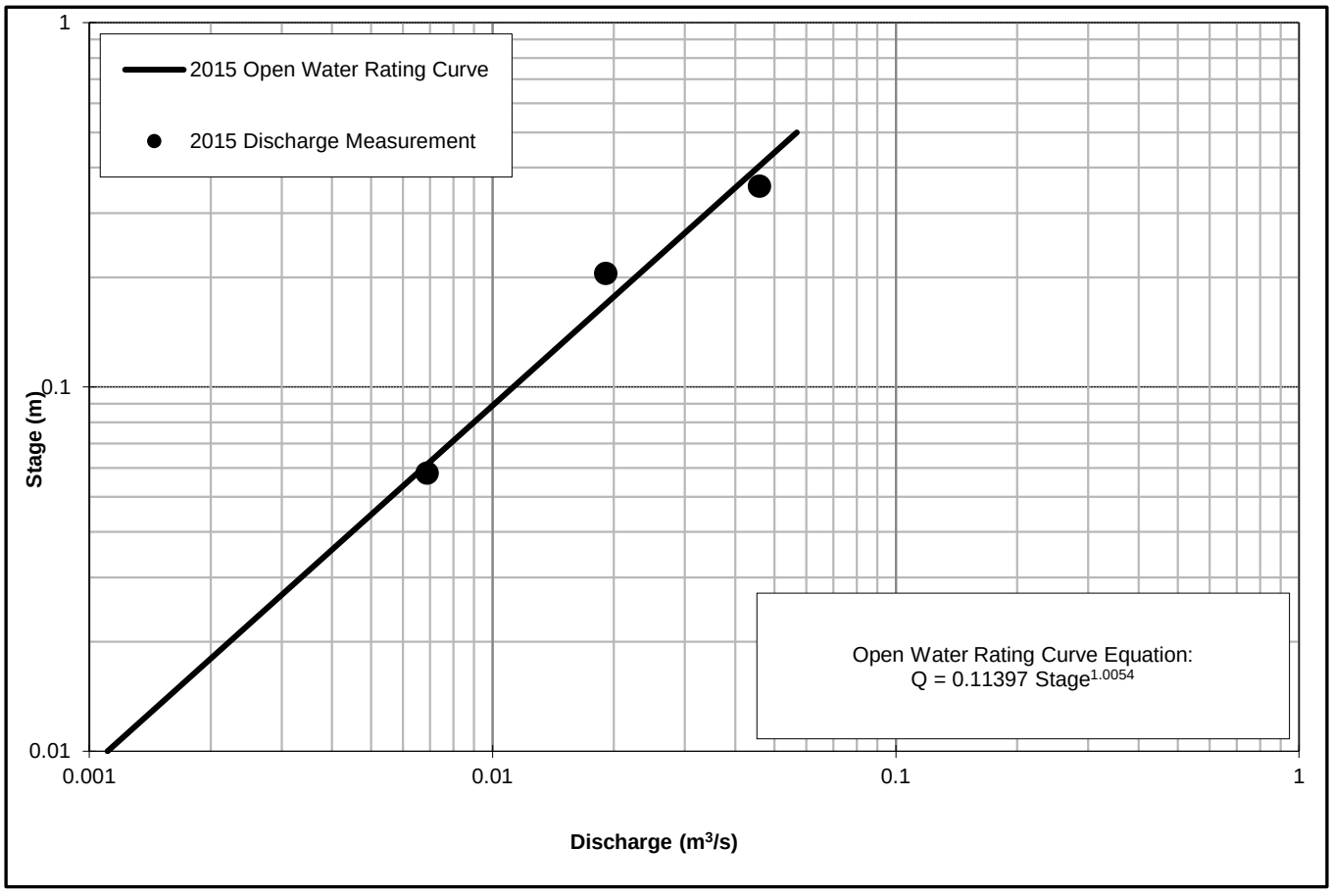


Figure 7: 2015 Stage-Discharge Rating Curve (Lake C38)

Lake C38 (Nemo Lake) - 2015

MEAN DAILY DISCHARGE (m^3/s)

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	-	-	-	-	-	-	0.04	0.02	0.01	-	-	-
2	-	-	-	-	-	-	0.04	0.02	0.01	-	-	-
3	-	-	-	-	-	-	0.03	0.02	0.01	-	-	-
4	-	-	-	-	-	-	0.03	0.02	0.00	-	-	-
5	-	-	-	-	-	-	0.03	0.02	0.00	-	-	-
6	-	-	-	-	-	-	0.03	0.02	0.00	-	-	-
7	-	-	-	-	-	-	0.03	0.02	0.00	-	-	-
8	-	-	-	-	-	-	0.03	0.02	0.00	-	-	-
9	-	-	-	-	-	-	0.03	0.02	0.00	-	-	-
10	-	-	-	-	-	-	0.03	0.02	0.00	-	-	-
11	-	-	-	-	-	-	0.03	0.02	0.00	-	-	-
12	-	-	-	-	-	-	0.03	0.02	0.00	-	-	-
13	-	-	-	-	-	0.04	0.03	0.02	0.00	-	-	-
14	-	-	-	-	-	0.04	0.03	0.02	0.01	-	-	-
15	-	-	-	-	-	0.04	0.03	0.01	0.01	-	-	-
16	-	-	-	-	-	0.04	0.03	0.01	0.01	-	-	-
17	-	-	-	-	-	0.04	0.03	0.01	0.01	-	-	-
18	-	-	-	-	-	0.04	0.03	0.01	-	-	-	-
19	-	-	-	-	-	0.04	0.03	0.01	-	-	-	-
20	-	-	-	-	-	0.04	0.03	0.01	-	-	-	-
21	-	-	-	-	-	0.04	0.03	0.01	-	-	-	-
22	-	-	-	-	-	0.04	0.03	0.01	-	-	-	-
23	-	-	-	-	-	0.04	0.03	0.01	-	-	-	-
24	-	-	-	-	-	0.04	0.03	0.01	-	-	-	-
25	-	-	-	-	-	0.04	0.03	0.01	-	-	-	-
26	-	-	-	-	-	0.04	0.03	0.01	-	-	-	-
27	-	-	-	-	-	0.04	0.03	0.01	-	-	-	-
28	-	-	-	-	-	0.04	0.03	0.01	-	-	-	-
29	-	-	-	-	-	0.04	0.02	0.01	-	-	-	-
30	-	-	-	-	-	0.04	0.02	0.01	-	-	-	-
31	-	-	-	-	-	-	0.02	0.01	-	-	-	-
MIN	-	-	-	-	-	0.035	0.025	0.006	0.002	-	-	-
MEAN	-	-	-	-	-	0.038	0.030	0.014	0.004	-	-	-
MAX	-	-	-	-	-	0.039	0.036	0.024	0.006	-	-	-

NOTES: P - PARTIAL DAILY AVERAGE

Water Yield (m^3) =	185,489	59,834	81,074	38,325	6,256
Water Yield (mm) =	52.3	32%	44%	21%	3%

Lake C38 (Nemo Lake) - 2015

MEAN DAILY WATER SURFACE ELEVATION (masl) BASED ON BENCHMARK ELEVATION 157.42 masl

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	-	-	-	-	-	-	155.949	155.841	155.677	-	-	-
2	-	-	-	-	-	-	155.942	155.833	155.677	-	-	-
3	-	-	-	-	-	-	155.938	155.827	155.675	-	-	-
4	-	-	-	-	-	-	155.930	155.827	155.672	-	-	-
5	-	-	-	-	-	-	155.928	155.828	155.669	-	-	-
6	-	-	-	-	-	-	155.925	155.821	155.664	-	-	-
7	-	-	-	-	-	-	155.921	155.815	155.661	-	-	-
8	-	-	-	-	-	-	155.917	155.808	155.657	-	-	-
9	-	-	-	-	-	-	155.918	155.800	155.654	-	-	-
10	-	-	-	-	-	-	155.924	155.794	155.650	-	-	-
11	-	-	-	-	-	-	155.922	155.787	155.647	-	-	-
12	-	-	-	-	-	-	155.918	155.773	155.660	-	-	-
13	-	-	-	-	-	155.940 P	155.923	155.772	155.671	-	-	-
14	-	-	-	-	-	155.957	155.917	155.765	155.676	-	-	-
15	-	-	-	-	-	155.967	155.911	155.760	155.679	-	-	-
16	-	-	-	-	-	155.973	155.906	155.750	155.683	-	-	-
17	-	-	-	-	-	155.977	155.901	155.743	155.684 P	-	-	-
18	-	-	-	-	-	155.977	155.895	155.738	-	-	-	-
19	-	-	-	-	-	155.976	155.888	155.734	-	-	-	-
20	-	-	-	-	-	155.976	155.885	155.730	-	-	-	-
21	-	-	-	-	-	155.978	155.881	155.723	-	-	-	-
22	-	-	-	-	-	155.977	155.876	155.716	-	-	-	-
23	-	-	-	-	-	155.973	155.873	155.712	-	-	-	-
24	-	-	-	-	-	155.974	155.866	155.709	-	-	-	-
25	-	-	-	-	-	155.974	155.860	155.705	-	-	-	-
26	-	-	-	-	-	155.977	155.856	155.700	-	-	-	-
27	-	-	-	-	-	155.972	155.855	155.696	-	-	-	-
28	-	-	-	-	-	155.966	155.853	155.692	-	-	-	-
29	-	-	-	-	-	155.962	155.849	155.691	-	-	-	-
30	-	-	-	-	-	155.956	155.847	155.690	-	-	-	-
31	-	-	-	-	-	-	155.847	155.683	-	-	-	-
MIN	-	-	-	-	-	155.940	155.847	155.683	155.647	-	-	-
MEAN	-	-	-	-	-	155.969	155.898	155.757	155.668	-	-	-
MAX	-	-	-	-	-	155.978	155.949	155.841	155.684	-	-	-

NOTES: P - PARTIAL DAILY AVERAGE

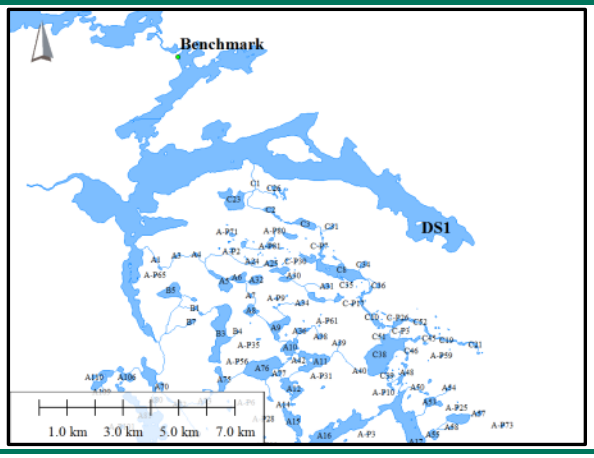
OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		1524321 - Amaruq			**Date**		14-Jun-15	
Waterbody:		C38			**Start Time**		13:00	
Crossing ID:		C38-C12			**End Time**		13:30	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	606634	BM_read			**Transducer SN:**			
North	7258188	WL_read			**Meter Type/SN:**		Swoffer	
Elevation, Zone	14W	WL_Elev			**Crew:**	CJ, JRL		
STATION	DISTANCE		Velocity		Optional			
Start	FROM LDB	DEPTH	0.2 DEPTH	0.6/0.8 DEPTH	ANGLE OF FLOW		Qi	Ai
LDB	(m)	(m)	(m/s)	(m/s)	(º)		(m3/s)	(m2)
1	1.40	0.00		0.00				**0.016**
2	1.60	0.16		0.23			**0.007**	**0.026**
3	1.80	0.10		0.38			**0.008**	**0.018**
4	2.00	0.08		0.40			**0.006**	**0.017**
5	2.20	0.09		0.05			**0.001**	**0.034**
6	2.60	0.08		0.30			**0.007**	**0.014**
7	2.80	0.06		0.20			**0.003**	**0.018**
8	3.05	0.08		0.30			**0.005**	**0.014**
9	3.20	0.10		0.30			**0.005**	**0.021**
10	3.40	0.11		0.03			**0.001**	**0.024**
11	3.60	0.13		0.09			**0.002**	**0.024**
12	3.80	0.11		0.00			**0.000**	**0.022**
13	4.00	0.11		0.01			**0.000**	**0.017**
14	4.30	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.046**	
						A(m2)	**0.26**	
						B(m)	**2.9**	

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		Amaruq - trip 2			**Date**		04-Aug-15	
Waterbody:		C38			**Start Time**		16:45	
Crossing ID:		C38-C12			**End Time**		17:00	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	606635	BM_read			**Transducer SN:**			
North	7258187	WL_read			**Meter Type/SN:**		Marsh McBirney	
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, JN		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.00	0.00		0.00				**0.003**
2	0.15	0.04		0.00			**0.000**	**0.011**
3	0.30	0.10		0.17			**0.003**	**0.022**
4	0.50	0.12		0.02			**0.000**	**0.015**
5	0.70	0.03		0.00			**0.000**	**0.000**
6	0.71	0.00		0.00			**0.000**	**0.010**
7	0.90	0.10		0.36			**0.005**	**0.010**
8	1.00	0.10		0.36			**0.005**	**0.020**
9	1.20	0.10		0.36			**0.004**	**0.001**
10	1.21	0.09		0.07			**0.001**	**0.017**
11	1.40	0.09		0.07			**0.001**	**0.000**
12	1.41	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.019**	
						A(m2)	**0.11**	
						B(m)	**1.4**	

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		1524321 - Amaruq Trip 3			**Date**		17-Sep-15	
Waterbody:		C38			**Start Time**		9:20	
Crossing ID:		C38-C12			**End Time**		9:25	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	606634	BM_read			**Transducer SN:**			
North	7258188	WL_read			**Meter Type/SN:**			
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, DC		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.00	0.00		0.00				**0.002**
2	0.20	0.02		0.11			**0.001**	**0.006**
3	0.50	0.02		0.12			**0.001**	**0.006**
4	0.80	0.02		0.12			**0.001**	**0.007**
5	1.00	0.05		0.17			**0.003**	**0.012**
6	1.40	0.01		0.15			**0.001**	**0.009**
7	1.70	0.05		0.13			**0.002**	**0.007**
8	2.00	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**0.007**	
						A(m2)	**0.05**	
						B(m)	**2.0**	

A25.0 LAKE DS1 & OUTLET (STREAM DS1)

Parameter	Value	Note
Drainage Area (km^2)	898	Based on DEM (PhotoSat 2015)
Bankfull Width (m)	77	Measured in the field, based on vegetation
Max. Bankfull Depth (m)	1.4	Measured in the field, based on vegetation
Wetted Width (m)	45.5	Measured in the field 5 August 2015
Max. Wetted Depth (m)	0.74	Measured in the field 5 August 2015
Channel Length (km)	0.10	Measured from CanVec data
Outlet Channel Slope (m/m)	0.006	Average slope, measured in the field
Bed Material	Boulders, cobbles	
Bank Material	Boulders, cobbles, organics	
Bank Vegetation	Grass	
Benchmark Coordinates	599092 m E, 7268034 m N, 107.31 masl	NAD83 Zone 14
Logger/ Staff Gauge Coordinates	599253 m E, 7268300 m N	
Comment	Well defined boulder channel. Cross-sectional data are available in discharge calculation sheets.	



Lake DS1: Benchmark location.



12 June 2015. View looking east at Lake DS1 and staff gauge.



16 September 2015. View looking south east at Lake DS1 and outlet.



5 August 2015. Looking north-west at the watercourse.



5 August 2015. Looking north at the watercourse.

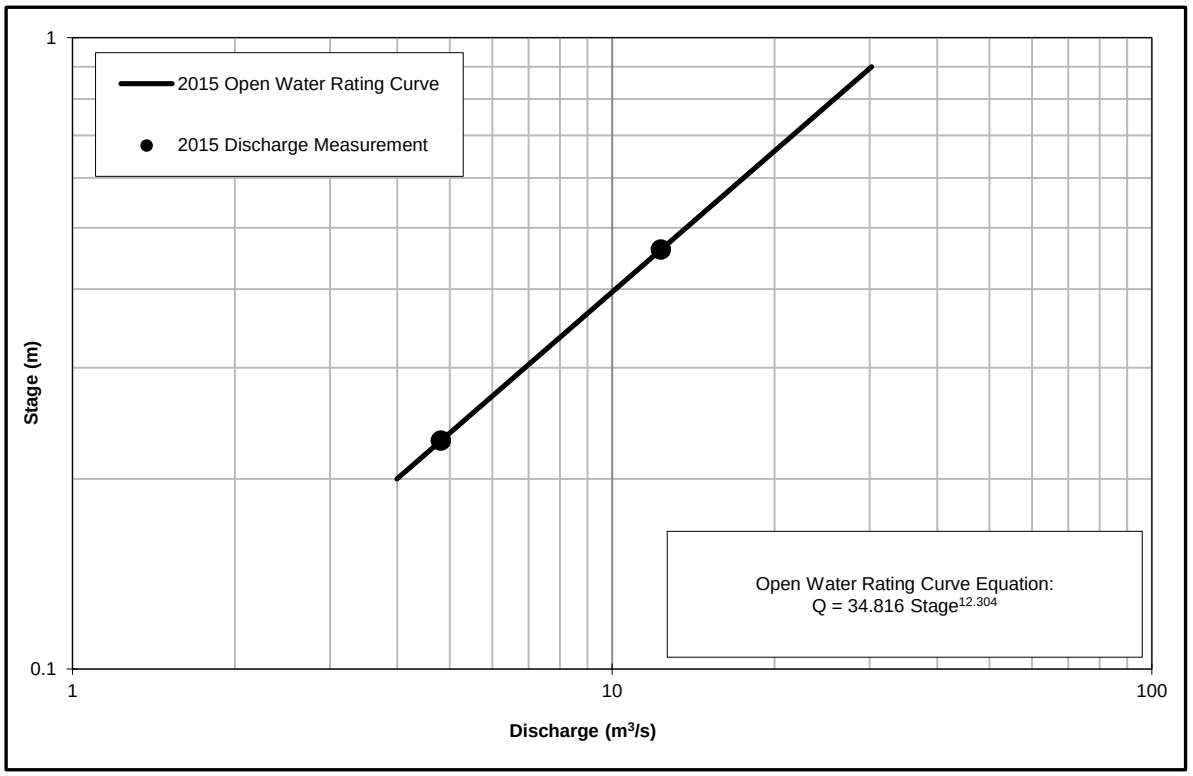


Figure 8: 2015 Stage-Discharge Rating Curve (Lake DS1)

Lake DS1 - 2015

MEAN DAILY DISCHARGE (m^3/s)

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	-	-	-	-	-	-	43.03	15.09	3.96	-	-	-
2	-	-	-	-	-	-	41.25	14.46	3.88	-	-	-
3	-	-	-	-	-	-	39.73	13.75	3.81	-	-	-
4	-	-	-	-	-	-	37.94	13.23	3.67	-	-	-
5	-	-	-	-	-	-	36.10	12.65	3.54	-	-	-
6	-	-	-	-	-	-	34.74	12.12	3.41	-	-	-
7	-	-	-	-	-	-	33.49	11.52	3.32	-	-	-
8	-	-	-	-	-	-	32.25	11.12	3.17	-	-	-
9	-	-	-	-	-	-	31.35	10.68	3.07	-	-	-
10	-	-	-	-	-	-	30.68	10.03	2.99	-	-	-
11	-	-	-	-	-	-	30.33	9.57	2.89	-	-	-
12	-	-	-	-	-	15.99 P	30.14	8.88	3.04	-	-	-
13	-	-	-	-	-	24.84	29.74	8.73	3.31	-	-	-
14	-	-	-	-	-	38.71	28.90	8.29	3.83	-	-	-
15	-	-	-	-	-	51.45	27.87	7.83	4.41	-	-	-
16	-	-	-	-	-	57.22	26.89	7.36	4.82 P	-	-	-
17	-	-	-	-	-	58.86	25.93	7.00	-	-	-	-
18	-	-	-	-	-	58.67	24.91	6.73	-	-	-	-
19	-	-	-	-	-	57.53	23.87	6.42	-	-	-	-
20	-	-	-	-	-	55.81	23.02	6.28	-	-	-	-
21	-	-	-	-	-	54.29	22.12	6.08	-	-	-	-
22	-	-	-	-	-	54.06	21.29	5.64	-	-	-	-
23	-	-	-	-	-	52.48	20.62	5.40	-	-	-	-
24	-	-	-	-	-	50.73	19.84	5.20	-	-	-	-
25	-	-	-	-	-	49.52	18.82	5.03	-	-	-	-
26	-	-	-	-	-	50.07	18.00	4.79	-	-	-	-
27	-	-	-	-	-	50.95	17.50	4.59	-	-	-	-
28	-	-	-	-	-	48.21	16.93	4.42	-	-	-	-
29	-	-	-	-	-	46.60	16.44	4.32	-	-	-	-
30	-	-	-	-	-	44.89	15.97	4.24	-	-	-	-
31	-	-	-	-	-	-	15.66	4.14	-	-	-	-
MIN	-	-	-	-	-	15.988	15.661	4.140	2.888	-	-	-
MEAN	-	-	-	-	-	48.468	26.947	8.245	3.570	-	-	-
MAX	-	-	-	-	-	58.864	43.030	15.093	4.821	-	-	-

NOTES: P - PARTIAL DAILY AVERAGE

Water Yield (m^3) =	178,758,458	79,565,618	72,173,563	22,083,501	4,935,776
Water Yield (mm) =	199.2	45%	40%	12%	3%

Lake DS1 - 2015

MEAN DAILY WATER SURFACE ELEVATION (m) BASED ON BENCHMARK ELEVATION 107.31 masl

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	-	-	-	-	-	-	100.170	99.537	99.199	-	-	-
2	-	-	-	-	-	-	100.134	99.520	99.196	-	-	-
3	-	-	-	-	-	-	100.102	99.501	99.193	-	-	-
4	-	-	-	-	-	-	100.065	99.487	99.188	-	-	-
5	-	-	-	-	-	-	100.027	99.471	99.183	-	-	-
6	-	-	-	-	-	-	99.998	99.456	99.178	-	-	-
7	-	-	-	-	-	-	99.971	99.439	99.174	-	-	-
8	-	-	-	-	-	-	99.944	99.428	99.168	-	-	-
9	-	-	-	-	-	-	99.925	99.415	99.164	-	-	-
10	-	-	-	-	-	-	99.910	99.397	99.161	-	-	-
11	-	-	-	-	-	-	99.902	99.383	99.157	-	-	-
12	-	-	-	-	-	99.560 P	99.898	99.362	99.163	-	-	-
13	-	-	-	-	-	99.776	99.889	99.357	99.174	-	-	-
14	-	-	-	-	-	100.080	99.870	99.344	99.194	-	-	-
15	-	-	-	-	-	100.336	99.847	99.330	99.215	-	-	-
16	-	-	-	-	-	100.446	99.825	99.315	99.230 P	-	-	-
17	-	-	-	-	-	100.477	99.803	99.303	-	-	-	-
18	-	-	-	-	-	100.473	99.779	99.295	-	-	-	-
19	-	-	-	-	-	100.452	99.755	99.285	-	-	-	-
20	-	-	-	-	-	100.419	99.735	99.280	-	-	-	-
21	-	-	-	-	-	100.390	99.713	99.273	-	-	-	-
22	-	-	-	-	-	100.386	99.694	99.259	-	-	-	-
23	-	-	-	-	-	100.356	99.677	99.250	-	-	-	-
24	-	-	-	-	-	100.322	99.658	99.243	-	-	-	-
25	-	-	-	-	-	100.299	99.633	99.237	-	-	-	-
26	-	-	-	-	-	100.309	99.612	99.229	-	-	-	-
27	-	-	-	-	-	100.326	99.599	99.222	-	-	-	-
28	-	-	-	-	-	100.273	99.585	99.216	-	-	-	-
29	-	-	-	-	-	100.241	99.572	99.212	-	-	-	-
30	-	-	-	-	-	100.207	99.560	99.209	-	-	-	-
31	-	-	-	-	-	-	99.552	99.205	-	-	-	-
MIN	-	-	-	-	-	99.560	99.552	99.205	99.157	-	-	-
MEAN	-	-	-	-	-	100.265	99.820	99.337	99.184	-	-	-
MAX	-	-	-	-	-	100.477	100.170	99.537	99.230	-	-	-

NOTES: P - PARTIAL DAILY AVERAGE

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		Amaruq - Trip 2			**Date**		05-Aug-15	
Waterbody:		DS1			**Start Time**		13:10	
Crossing ID:					**End Time**		13:45	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	599152	BM_read			**Transducer SN:**			
North	7268331	WL_read			**Meter Type/SN:**		Marsh McBirney	
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, JN		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.00	0.00		0.00				**1.000**
2	8.00	0.25		0.25			**0.297**	**0.293**
3	9.50	0.14		0.44			**0.092**	**0.330**
4	11.00	0.30		0.50			**0.225**	**0.488**
5	12.50	0.35		0.65			**0.341**	**0.578**
6	14.00	0.42		0.80			**0.504**	**0.765**
7	15.50	0.60		1.06			**0.954**	**0.915**
8	17.00	0.62		0.87			**0.809**	**0.953**
9	18.50	0.65		0.95			**0.926**	**0.968**
10	20.00	0.64		0.87			**0.835**	**0.945**
11	21.50	0.62		0.95			**0.884**	**0.990**
12	23.00	0.70		1.00			**1.050**	**1.080**
13	24.50	0.74		1.00			**1.110**	**0.960**
14	26.00	0.54		1.08			**0.875**	**0.885**
15	27.50	0.64		1.00			**0.960**	**0.810**
16	29.00	0.44		0.85			**0.561**	**0.630**
17	30.50	0.40		0.80			**0.480**	**0.698**
18	32.00	0.53		0.50			**0.331**	**0.470**
19	33.00	0.41		0.60			**0.308**	**0.660**
20	34.50	0.47		0.51			**0.360**	**0.615**
21	36.00	0.35		0.55			**0.289**	**0.375**
22	37.50	0.15		0.40			**0.090**	**0.150**
23	39.00	0.05		0.22			**0.017**	**0.068**
24	40.50	0.04		0.12			**0.016**	**0.100**
25	45.50	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**12.313**	
						A(m2)	**15.72**	
						B(m)	**45.5**	

OPEN WATER DISCHARGE CALCULATION SPREADSHEET								
Project Name, Number:		1524321 - Amaruq Trip 3			**Date**		16-Sep-15	
Waterbody:		DS1			**Start Time**		14:10	
Crossing ID:					**End Time**		14:35	
LDB UTM Location		**Survey**			**Datalogger SN:**			
East	599158	BM_read			**Transducer SN:**			
North	7268338	WL_read			**Meter Type/SN:**			
Elevation, Zone	14W	WL_Elev			**Crew:**	JRL, DC		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	Velocity 0.2 DEPTH (m/s)	Velocity 0.6/0.8 DEPTH (m/s)	Optional ANGLE OF FLOW (º)		Qi (m3/s)	Ai (m2)
1	0.00	0.00		0.00				**0.110**
2	1.00	0.22		0.34			**0.075**	**0.250**
3	2.00	0.28		0.37			**0.104**	**0.270**
4	3.00	0.26		0.59			**0.153**	**0.320**
5	4.00	0.38		0.56			**0.213**	**0.375**
6	5.00	0.37		0.71			**0.263**	**0.350**
7	6.00	0.33		0.43			**0.142**	**0.370**
8	7.00	0.41		0.60			**0.246**	**0.435**
9	8.00	0.46		0.61			**0.281**	**0.470**
10	9.00	0.48		0.60			**0.288**	**0.530**
11	10.00	0.58		0.61			**0.354**	**0.590**
12	11.00	0.60		0.70			**0.420**	**0.605**
13	12.00	0.61		0.75			**0.458**	**0.585**
14	13.00	0.56		0.56			**0.314**	**0.570**
15	14.00	0.58		0.58			**0.336**	**0.540**
16	15.00	0.50		0.50			**0.250**	**0.460**
17	16.00	0.42		0.42			**0.176**	**0.440**
18	17.00	0.46		0.46			**0.212**	**0.440**
19	18.00	0.42		0.42			**0.176**	**0.405**
20	19.00	0.39		0.39			**0.152**	**0.350**
21	20.00	0.31		0.31			**0.096**	**0.270**
22	21.00	0.23		0.23			**0.053**	**0.215**
23	22.00	0.20		0.20			**0.040**	**0.155**
24	23.00	0.11		0.11			**0.012**	**0.105**
25	24.00	0.10		0.10			**0.008**	**0.030**
26	24.60	0.00		0.00			**0.000**	**0.000**
NOTES:					**RESULTS:**	**Q (m3/s)**	**4.821**	
						A(m2)	**9.24**	
						B(m)	**24.6**	

APPENDIX B

Shoreline Baseline Characterization

B1.0 LAKE A12



Figure B-1: Shoreline with boulders (looking southwest)



Figure B-2: Lake A12 main outlet channel with boulder gardens (looking northeast)

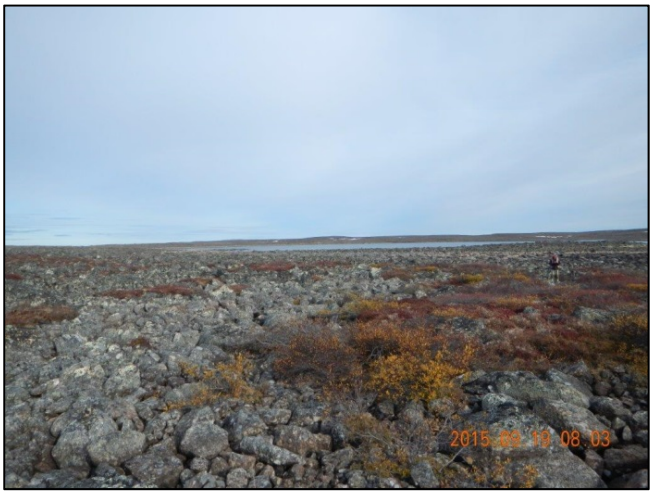


Figure B-3: Lake A12 main outlet towards Lake A11, mostly subsurface (looking northeast)



Figure B-4: Shoreline at the lake outlet with shallow and bouldery beach (looking west)

B2.0 LAKE A15



Figure B-5: Shoreline with boulder garden beaches (looking south)



Figure B-6: Eastern shoreline with boulder garden beaches (looking north)



Figure B-7: Lake A15 outlet channel, right bank looking downstream



Figure B-8: Shoreline with boulder gardens at the lake inlet (looking north)

B3.0 LAKE A16 (MAMMOTH LAKE)



Figure B-9: Lake A16 outlet channel, left bank looking upstream



Figure B-10: Lake A16 outlet channel, large boulders with the flow through the boulders, looking downstream

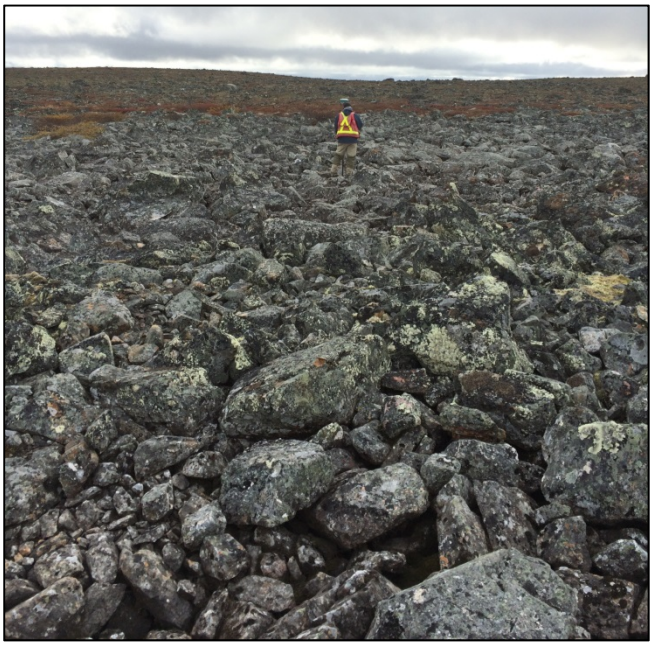


Figure B-11: Lake A16 outlet channel, with boulder gardens, view towards right bank

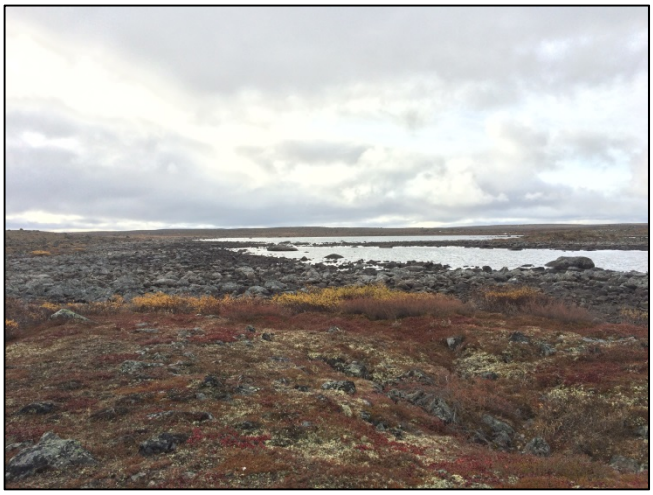


Figure B-12: Shallow shoreline extending into the lake with large boulders as the main material (looking south)

B4.0 LAKE A17 (WHALE TAIL LAKE)



Figure B-13: Shallow shoreline with gravel and cobble beach inserted with large boulders (looking northeast)



Figure B-14: Shallow shoreline with gravel and cobble beach inserted with large boulders (looking south)



Figure B-15: Lake A17 (Whale Tail Lake) outlet channel looking upstream



Figure B-16: Lake A17 (Whale Tail Lake) outlet channel aerial view looking upstream

B5.0 LAKE A18



Figure B-17: Lake A18 outlet channel with a boulder garden, looking downstream



Figure B-18: Lake A18 outlet channel with a boulder garden, looking upstream



Figure B-19: Shoreline with boulder materials partially covered by soils and organics (looking north)



Figure B-20: Lake A18 left bank floodplain (looking south)

B6.0 LAKE A45



Figure B-21: Lake A45 outlet channel looking upstream from the left bank



Figure B-22: Shoreline with large boulders relatively shallow (looking south)



Figure B-23: Shoreline with boulder garden at the lake outlet (looking north)

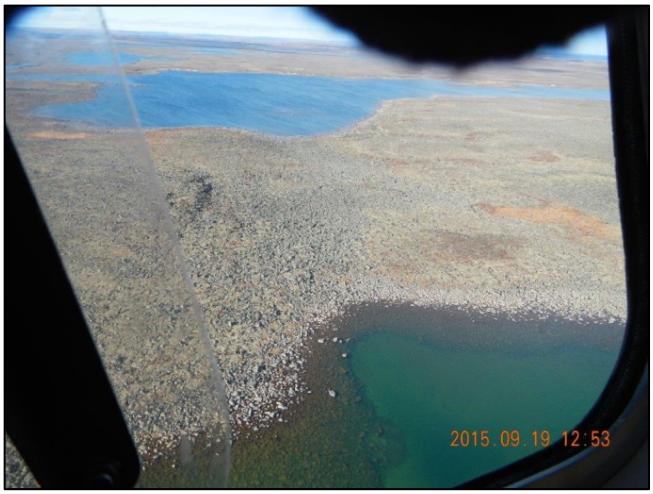


Figure B-24: Aerial view of Lake A45 outlet channel looking downstream. Undefined channel with boulder garden (looking north)

B7.0 LAKE A72



Figure B-25: Lake A72 Outlet channel, right bank looking upstream



Figure B-26: Lake A72 Outlet channel, left bank looking upstream



Figure B-27: Lake A72 Outlet channel view towards left bank at the cross section location



Figure B-28: Lake A72 Outlet channel view downstream

B8.0 LAKE A69



Figure B-29: Shoreline with large boulders (looking north)



Figure B-30: Shoreline with boulders in the shallow area (looking southeast)



Figure B-31: Shallow shoreline with larger boulders (looking west)



Figure B-32: Lakebed shoreline with gravel and cobble at the lake outlet

B9.0 LAKE A76



Figure B-33:Shoreline with large boulders and bedrock outcrop above the high water mark (looking northwest)



Figure B-34: Shoreline with boulder gardens (looking east)



Figure B-35: Shallow shoreline with cobble and boulders covered with soils and vegetation (south shore)



Figure B-36: Lake A76 main outlet channel looking upstream. Boulder gardens with shallow areas



Figure B-37: Lake A76 main outlet channel looking downstream. Boulder gardens with shallow areas and with the majority of the flow subsurface



Figure B-38: Lake A76 secondary outlet channel looking towards the right bank. Boulder gardens with no visible flow across the entire channel

APPENDIX C

Water Balance Model

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C1.0 INTRODUCTION

A water balance model was developed for the baseline study area (BSA) to assess mean characteristics and natural variability of discharge and water levels of lake outlets in the baseline area. This appendix describes the water balance model including input data, model structure, calibration, preliminary validation, and results.

The water balance model was developed using GoldSim software with a 1-hour time step and input data for the period of 1950 to 2015. Model output results were obtained for all years, with the exception of years with meteorological input data gaps, including years 1951, 1979, 1993, and 2010, which were not modeled. The basic water balance elements for each modeled lake reservoir considered rainfall and snowmelt runoff, lake evaporation, changes in lake storage, and outflow to downstream watersheds.

The model was calibrated using runoff coefficients for land surfaces, lake outlet stage-discharge rating curves, and degree-day models for snowmelt and formation of ice in outlet channels. Runoff coefficients for land surfaces account for water losses to storage and summer evapotranspiration. The runoff coefficients were calibrated to the calculated annual water yield of hydrometric stations with available data for most of the 2015 open water season (i.e., stations with a period of record of 97 days or greater). Lake outlet stage-discharge rating curves and degree-day models were calibrated to site-specific data.

The calibrated model was used to generate daily time series data sets of lake stages and lake outlet discharges for the BSA. Frequency analyses were completed for key sites to provide a derived historical baseline of lake stage and lake outlet discharge regimes.

C2.0 MODEL STRUCTURE

Each lake in the BSA with a surface area greater than 20 hectares (ha) was modeled as a reservoir as described in the schematic diagrams (Figure C-1; Figure C-2). Inflows to the reservoir consisted of inflows from upstream watersheds and local watershed rainfall and snowmelt, including a runoff coefficient to account for storage and evapotranspiration losses. Snow-water equivalents (SWE) were calculated based on a sublimation adjustment to account for snowpack losses, and snowmelt rates were calculated using a degree-day model. Outflows consisted of lake outlet discharges and evaporative losses. Modeled lakes accounted for differences between inputs and outputs by calculating corresponding changes in lake stages and storage volumes.

A key assumption of the model is that losses to deep groundwater and changes to shallow groundwater storage are not significant due to the local permafrost regime and the associated low connectivity of shallow and deep groundwater systems.

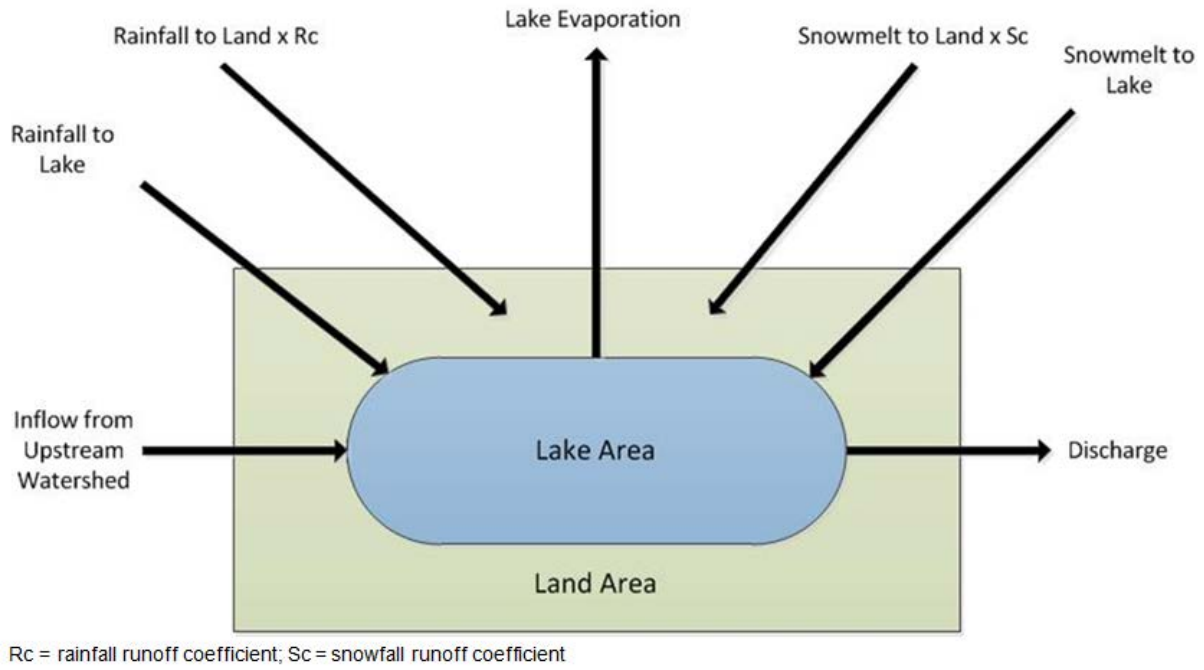
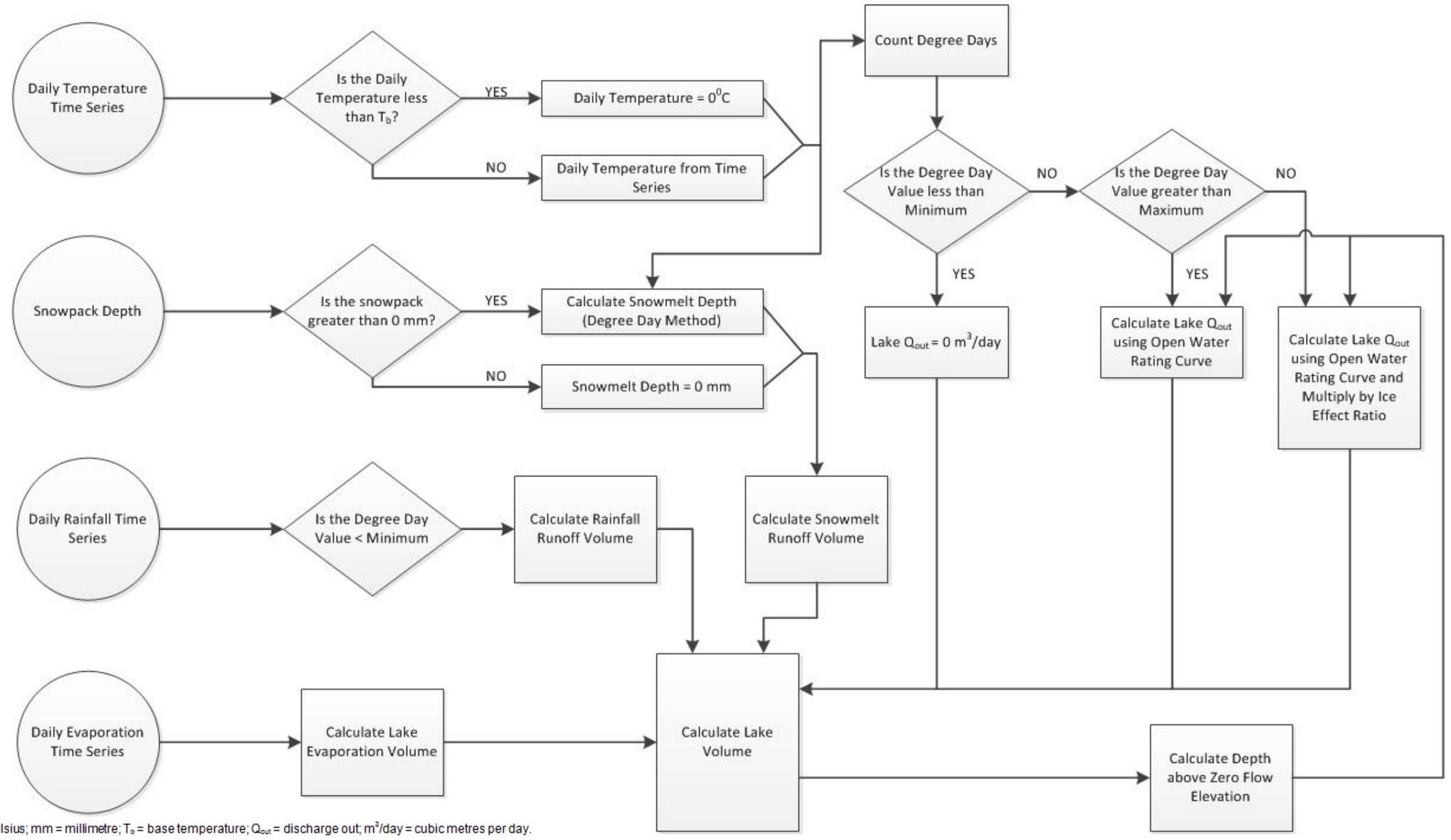


Figure C-1: Schematic of Typical Lake Reservoir Model



°C = degrees Celsius; mm = millimetre; T_b = base temperature; Q_{out} = discharge out; m^3/day = cubic metres per day.

Figure C-2: Water Balance Model Flowchart

C2.1 Meteorological Data

Meteorological data were available from the Baker Lake A meteorological station (Station ID 2300500) operated by the Government of Canada (2015) from 1946 to 2015, and from the Meadowbank Gold Mine (Meadowbank) from 1997 to 2003 (AMEC 2003) and from 2013 to 2015 (provided by Agnico Eagle).

Meteorological data were based on the following datasets:

- Temperature and precipitation from 1950 to 2013 were based on mean daily data available from Baker Lake A. Years with large data gaps (for the purpose of this model, defined as 20 or more days of missing data), including years 1946 to 1949, 1951, 1979, 1993, and 2010, were not considered in the model.

  Temperature was based on mean daily temperature, spatially adjusted using the following equation (AMEC 2003):

  *Mean Daily Temperature (Local) = 1.01 * Mean Daily Temperature (Baker Lake) – 0.63*

  Precipitation was based on mean daily rainfall and mean daily (SWE) derived from the difference between daily precipitation and mean daily rainfall. Precipitation was adjusted for undercatch as follows (AMEC 2003):

  *Adjusted Rainfall = Rainfall * 1.15*

  *Adjusted Snowfall = Snowfall * 1.55*

  *Adjusted Precipitation = Precipitation * 1.38*

  Temperature and rainfall data were only partially available from 1997 to 2003 at Meadowbank (AMEC 2003), and were not considered in the model.

- Temperature and precipitation from 2014 to 2015 were based on mean daily data available from Meadowbank. While data were also available for Year 2013, Year 2013 contains large data gaps (with 159 days missing) and was not considered in the model. Temperature was based on mean daily temperature data. Precipitation is collected by a rain gauge and a canister. Snowfall collected in the canister is melted at room temperature and poured into the rain gauge, and both rainfall and snowfall are recorded as precipitation. As such, the precipitation record was split between rainfall and SWE based on concurrent mean daily temperature data. Rainfall was assumed when mean daily temperatures were greater than 0ºC, and SWE was assumed when mean daily temperatures were equal to or less than 0ºC. Recorded trace events were assigned a value of 0 millimetres (mm) of precipitation. The precipitation record includes “large” (i.e., defined, for the purpose of this section, as exceeding 10 days per month) data gaps in November 2014 (13 days missing), January (16 days missing) and June (14 days missing) 2015. Gaps were assigned a value of 0 mm. Precipitation was adjusted for undercatch using the adjustment factors presented above.

- Evaporation was based on mean monthly evaporation derived from previous baseline studies (AMEC 2003), and was applied as a constant daily value for each month.

C2.2 Watershed Characteristics

Watershed delineation and analysis were based on available DEM data (PhotoSat 2015), as discussed in Section 2.2.

C2.2.1 Land and Lake Areas

Seventy-four lakes with surface areas greater than 20 ha were modeled, including 54 lakes in the A watershed, four lakes in the B watershed, 15 lakes in the C watershed, and Lake DS1. Lake DS1 has a large and complex watershed and the lake was modeled using a lumped area for its tributaries, other than the A, B, and C watersheds, which were modeled explicitly. Local watershed, lake, tributary, and land areas are presented in Table C-1 for each modeled lake.

Table C-1: Local Watershed, Lake, Tributary, and Land Areas of Modeled Lakes (km^2)

Name	Local Watershed	Lake	Tributary	Land	Name	Local Watershed	Lake	Tributary	Land
A10	0.578	0.230	0.00921	0.339	**A63**	0.480	0.0792	0	0.401
A103	0.692	0.0583	0	0.634	**A65**	3.28	0.589	0.0378	2.65
A104	1.44	0.108	0	1.33	**A69**	7.88	0.464	0.0313	7.38
A106	0.73	0.107	0.0820	0.541	**A75**	1.81	0.180	0.000553	1.63
A108	0.854	0.221	0.0241	0.609	**A76**	2.94	0.710	0.0471	2.18
A11	4.18	0.430	0.0385	3.71	**A8**	0.896	0.118	0.000992	0.777
A12	1.58	0.289	0.0211	1.27	**A81**	6.08	1.31	0.0191	4.75
A15	2.12	0.333	0.0114	1.77	**A82**	6.02	0.292	0.109	5.62
A16	7.45	1.48	0.00904	5.96	**A83**	2.98	0.0644	0.100	2.81
A17	6.14	1.66	0.0478	4.43	**A85**	2.64	0.0589	0.0111	2.57
A18	0.985	0.158	0.0111	0.816	**A86**	0.636	0.0878	0	0.548
A19	0.609	0.0553	0.00483	0.549	**A87**	1.04	0.176	0	0.860
A20	1.72	0.530	0	1.19	**A9**	2.21	0.278	0.049	1.88
A21	1.06	0.0874	0	0.972	**A91**	0.903	0.145	0	0.758
A22	0.730	0.0496	0	0.680	**A94**	2.33	0.366	0.0512	1.92
A23	3.31	0.273	0.00292	3.03	**A95**	3.75	0.0985	0.0649	3.59
A24	2.58	0.0266	0.162	2.39	**A97**	1.60	0.144	0.0471	1.41
A25	0.322	0.0574	0.00500	0.259	**B1**	0.388	0.0128	0.0108	0.364
A26	0.342	0.109	0.000609	0.232	**B3**	2.78	0.824	0.00262	1.96
A27	1.05	0.0576	0.00700	0.980	**B5**	1.26	0.282	0.0186	0.956
A28	0.791	0.102	0	0.690	**B7**	0.382	0.0388	0	0.343
A29	0.563	0.0492	0	0.514	**C1**	1.42	0.00116	0.0578	1.37
A31	0.204	0.0269	0	0.177	**C10**	1.84	0.134	0.0202	1.68
A32	0.721	0.117	0	0.604	**C12**	0.663	0.0743	0.000831	0.588
A36	1.45	0.0429	0.0451	1.36	**C13**	0.463	0.0173	0.00597	0.440

Table C-1: Local Watershed, Lake, Tributary, and Land Areas of Modeled Lakes (km^2) (continued)

Name	Local Watershed	Lake	Tributary	Land	Name	Local Watershed	Lake	Tributary	Land
A43	0.802	0.140	0.000864	0.661	**C16**	0.198	0.0170	0.00612	0.175
A44	2.30	0.229	0.000933	2.07	**C19**	0.611	0.0389	0.0101	0.562
A45	0.535	0.0295	0	0.505	**C2**	0.738	0.0707	0.000687	0.667
A47	1.23	0.0445	0.0359	1.15	**C20**	0.230	0.0232	0.00042	0.207
A49	0.252	0.0294	0.0048	0.218	**C21**	0.240	0.0268	0.00521	0.208
A5	1.24	0.234	0	1.01	**C23**	1.42	0.438	0	0.979
A53	1.34	0.141	0.0180	1.18	**C3**	2.61	0.200	0.0392	2.37
A55	1.37	0.0764	0.0111	1.28	**C34**	0.372	0.0406	0	0.332
A56	2.79	0.228	0.0427	2.52	**C38**	3.55	1.18	0.0451	2.32
A6	0.967	0.128	0.00633	0.832	**C8**	2.81	0.610	0.127	2.07
A60	2.11	0.427	0.00396	1.68	**C9**	0.222	0.0344	0	0.187
A62	0.737	0.0597	0.000867	0.676	**DS1**	766	24.2	115	627

C2.2.2 Outlet Rating Curves

Lake outlet stage-discharge rating curves were assigned for each modeled lake using one of the following five methods, with applicability as described:

1) Stage-discharge rating curves for lake outlets with available stage-discharge relationships for most of the 2015 open water season (i.e., for a period of record of 97 days or greater) were based on site-specific stage-discharge rating curves (Section 3.2.1; Appendix A). These include the lake outlets of Lake A15, Lake A17 (Whale Tail Lake), Lake A18, Lake A69, Lake C38 (Nemo Lake), and Lake DS1.

2) The stage-discharge rating curve for Lake A5 was based on the 2015 stage-discharge rating curve for Lake A69 which is similar to the stage-discharge rating curve of Lake A5 over the monitored period.

3) Lake A12 has two outlets. In the absence of site-specific stage-discharge data, both outlets were modeled using a single rating curve based on the stage-discharge rating curve of Lake A18. The outlet discharging to Lake A11 was assigned 60% of the discharge, and the remaining portion (40%) was assigned to discharge to Lake A77. These proportions were based on instantaneous discharge measurements from August 2015 (Section 3.2.2).

4) Lake A76 has two outlets which were modeled based on field observations using two separate stage-discharge rating curves to assign most of the discharge to Lake A41, while allowing discharge to Lake A75 at high flows. In the absence of continuous site-specific stage-discharge data at both outlets, the stage-discharge rating curve of the outlet discharging to Lake A41 is based on the stage-discharge rating curve of Lake A15. The stage-discharge rating curve of the outlet discharging to Lake A75 was assumed, and was calibrated to match measured water yields at Lake A69, located downstream of Lake A76. Stage-discharge rating curves of Lake A76 are presented in Figure C-3.

5) Stage-discharge rating curves for other lakes (with the exception of upstream lakes and lakes from the C watershed) were based on the stage-discharge rating curve of the closest upstream lake with a site-specific stage-discharge rating curve (e.g., the stage-discharge rating curve of Lake A16 was based on that of Lake A17; the stage-discharge rating curve of Lake A12 was based on that of Lake A15). Stage-discharge of upstream lakes and lakes from the C watershed (other than Lake C38 [Nemo Lake]) were based on the stage-discharge rating curve of Lake A18.

The method used to develop rating curves at each modeled lake is summarized in Table C-2.

Table C-2: Outlet Stage-Discharge Rating Curves

Modeled Lake	Method Used to Develop Outlet Rating Curve
Lake A5	Lake A69
Lake A12-A11	Lake A15*0.6
Lake A12-A77	Lake A15*0.4
Lake A15	Lake A15
Lake A17 (Whale Tail Lake)	Lake A17
Lake A18	Lake A18
Lake A69	Lake A69
Lake A76-A41	Lake A15 (Figure C-3)
Lake A76-A75	Assumed (Figure C-3)
Lake C38	Lake C38
Lake DS1	Lake DS1
All other lakes	Stage-discharge rating curve from the closest upstream lake with a site-specific stage-discharge rating curve, or Lake A18 for upstream lakes and lakes from the C watershed

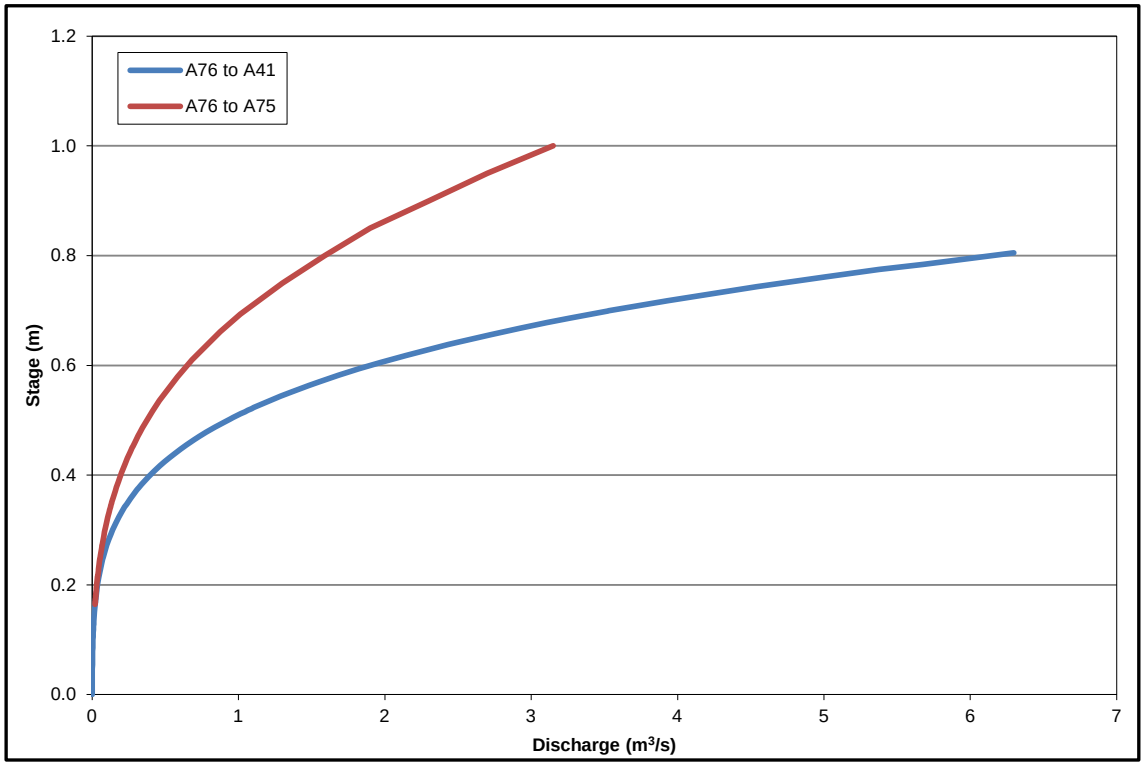


Figure C-3: Stage-Discharge Rating Curves for Lake A76

C2.3 Ice Effects on Lake Outlets

Based on field observations and general experience in the North, the opening of lake outlets during spring is generally a rapid process. This process is related to snowmelt runoff into the lake upstream of the outlet, as well as thaw of ice in the lake outlet. Flowing water provides additional thermal input, and melted or saturated snow on the outlet channel surface has a lower albedo and higher absorption of solar energy, which further accelerates melting. The change from frozen solid to fully open conditions has been observed to occur over a span of up to about four days. Lake outlets and borders are generally the first areas of open water during spring melt, while a floating ice cover may persist in the body of the lake for days or weeks after the outlet opens.

The formation of ice in winter constricts outflow channels and reduces lake discharge rates. The outlets for small lakes become constricted with ice and eventually freeze completely from approximately late October to early June each year.

A numerical relationship between lake outlet discharge and cumulative degree days was developed to account for ice effects during the freezing period in water balance modeling.

C2.3.1 Observations of Ice Formation and Degradation

Ice degradation was observed at several lake outlets during the 2015 baseline program, including outlets of Lake A15, Lake A17 (Whale Tail Lake), Lake A18, and Lake A69, as follows:

- Outlets of Lake A18 and Lake A69 were both observed to start discharging on 10 June 2015, followed by the outlet of Lake A17 on 11 June 2015, and the outlet of Lake A15 on 12 June 2015. It was noted that outlets of Lake A15 and Lake A17 may have started discharging earlier under the ice.
- The outlet of Lake A69 was free of ice on 11 June 2015. This was followed by the outlets of Lake A17 and A18 on 14 June 2015, and Lake A15 on 15 June 2015.

Ice formation was also observed by Agnico Eagle and was described in previous baseline studies (AMEC 2003) as follows:

- full ice cover was observed on small lakes on 2 October 2015;
- partial ice cover was observed on large lakes (e.g., Lake A16 [Mammoth Lake]; Lake A17 [Whale Tail]) on 2 October 2015;
- full ice cover was observed on large lakes on 12 October 2015; and
- previous baseline studies report ongoing discharge to the end of October, and to the end of November at larger lakes (AMEC 2003).

Ice formation and degradation depends on local meteorological conditions, with natural variability from year to year, but is most strongly linked to air temperature. Solar radiation also contributes to ice degradation, but historical data was not available, and air temperature may serve as a partial proxy.

C2.3.2 Method and Results

A degree-day method was developed to simulate the effect of ice conditions on discharge at each lake outlet. Degree-days were added above a base temperature of 0 degrees Celsius (°C) based on daily mean temperatures, which typically begin to exceed 0°C in early June.

The effect of ice on discharge was quantified by the following ratio:

$$\text{Ice Effect Ratio} = Q_{actual} / Q_{predicted}$$

where

Q_{actual} = Discharge measured at the outlet under ice conditions; and

$Q_{predicted}$ = Discharge predicted using an open-water rating curve for the specific outlet.

Thus, an ice effect ratio of 0 implies a frozen outlet, with no discharge, while an ice effect ratio of 1 implies an open outlet, free of ice, and fully discharging.

Ice effect ratios were developed for all modeled lakes, with the exception of Lake DS1 which was assumed to flow continuously over the winter, as follows based on observations of ice formation and ice degradation summarized in Section C2.3.1:

- For Lake A69, ice was assumed to start degrading when cumulative degree-days reach 7.8ºCd (i.e., corresponding to 10 June 2015), and the outlet was assumed to be free of ice when cumulative degree-

days reach 10.4ºCd (i.e., corresponding to 11 June 2015). This ice effect ratio is summarized in Table C-3 and shown on Figure C-4.

- For other lakes, ice was assumed to start degrading when cumulative degree-days reach 7.8ºCd (i.e., corresponding to 10 June 2015), and the outlet was assumed to be free of ice when cumulative degree-days reach 24.3ºCd (i.e., corresponding to 14 June 2015). This ice effect ratio is summarized in Table C-3 and shown on Figure C-4.
- Ice was assumed to start forming once mean daily temperatures fall below 0ºC, and outlets were assumed to be completely frozen at the end of October. As such, the ice effect ratio of 1 was assigned a negative degree day of 1ºCd, and the ice effect ratio of 0 was assigned a negative degree days of 270ºCd (corresponding to 31 October 2015), during the ice formation period. This ice effect ratio is summarized in Table C-3 and shown on Figure C-5.

Table C-3: Ice Effect Ratio Parameters

Parameter	Value
Outlet break-up – closed (Lake A69) (Ice effect ratio of 0)	7.8
Outlet break-up – open (Lake A69) (Ice effect ratio of 1)	10.4
Outlet break-up – closed (all other lakes) (Ice effect ratio of 0)	7.8
Outlet break-up – open (all other lakes) (Ice effect ratio of 1)	24.3
Outlet freeze-up – open (Ice effect ratio of 1)	1.0
Outlet freeze-up – closed (Ice effect ratio of 0)	270

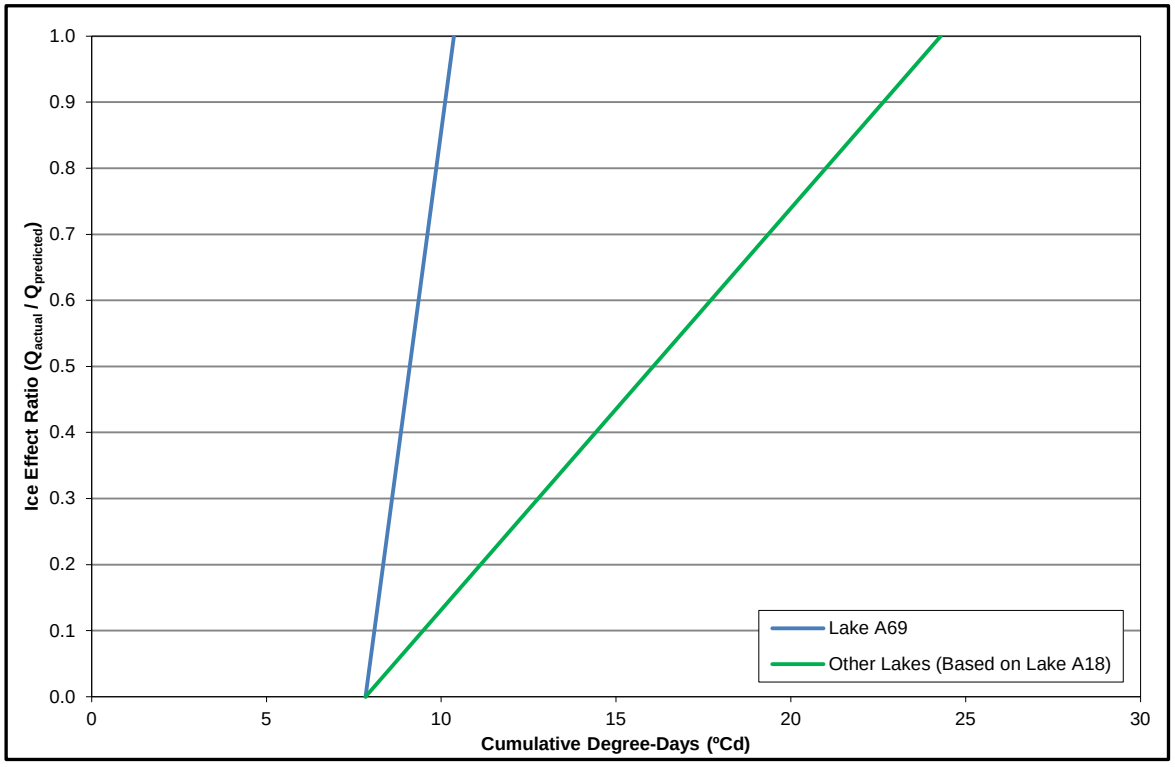


Figure C-4: Ice Degradation Period: Ice Effect Ratios and Cumulative Degree-Days

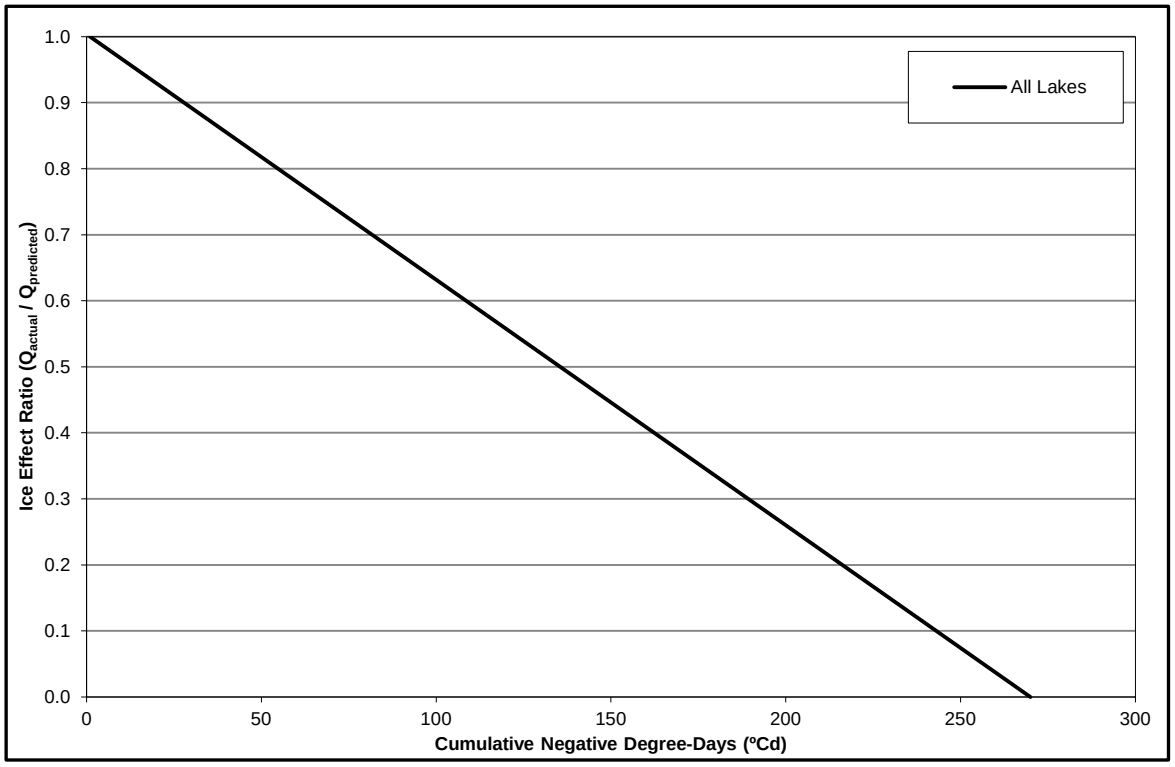


Figure C-5: Ice Formation Period: Ice Effect Ratios and Cumulative Degree-Days

C2.4 Snowmelt

Snowmelt is generated predominantly by the melting of the accumulated snowpack during the period of spring freshet. Based on experience, the spring freshet occurs over a period of several weeks and is a major contributor of overall annual precipitation and lake inflows in northern environments.

C2.4.1 Observations of Snowmelt

Snowmelt was observed during the first hydrometric field visit (from 8 to 15 June 2015). By 15 June 2015, most of the snow had melted, with any snow remaining largely located along steep slopes with lesser exposure to sunlight.

C2.4.2 Method

In the model, snowfall from the derived climate data accumulates as snowpack during fall and winter when temperatures are below freezing. A 26% reduction was applied to the modeled snowpack to represent sublimation losses based on previous baseline studies (AMEC 2003).

Snowmelt begins when the daily average temperature rises above the base temperature (T_b). The snowmelt rate is determined by Equation 1.

Equation 1: Snowmelt Equation

$$\text{Daily Snowmelt Runoff} = R_{cs} \times M_f \times (T - T_b)$$

Where

R_{cs}= Snowmelt runoff coefficient (dimensionless);

M_f = Melt factor (mm/°C);

T = Mean daily air temperature (°C); and

T_b = Base temperature (°C).

For consistency with observed snowmelt, the melt factor was set at 4.0 millimetres per degree Celsius (mm/ºC) and the base temperature at -1.0°C,. The snowmelt runoff coefficient R_{cs} was calibrated to expected freshet and annual watershed yields, and is further discussed in Section C2.5. These values resulted in a completely melted snowpack by 18 June 2015, consistent with field observations, and modeled peak discharges consistent with measured hydrographs, as shown in Section C2.5. Snowpack accumulation and melt are shown in Figure C-6 for the 2015 hydrological year (i.e., 1 October of the previous year to 30 September of the current year, as defined by previous baseline studies [AMEC 2003]).

A dispersed delay of 20 days was applied to the lumped tributaries of Lake DS1 to account for attenuations.

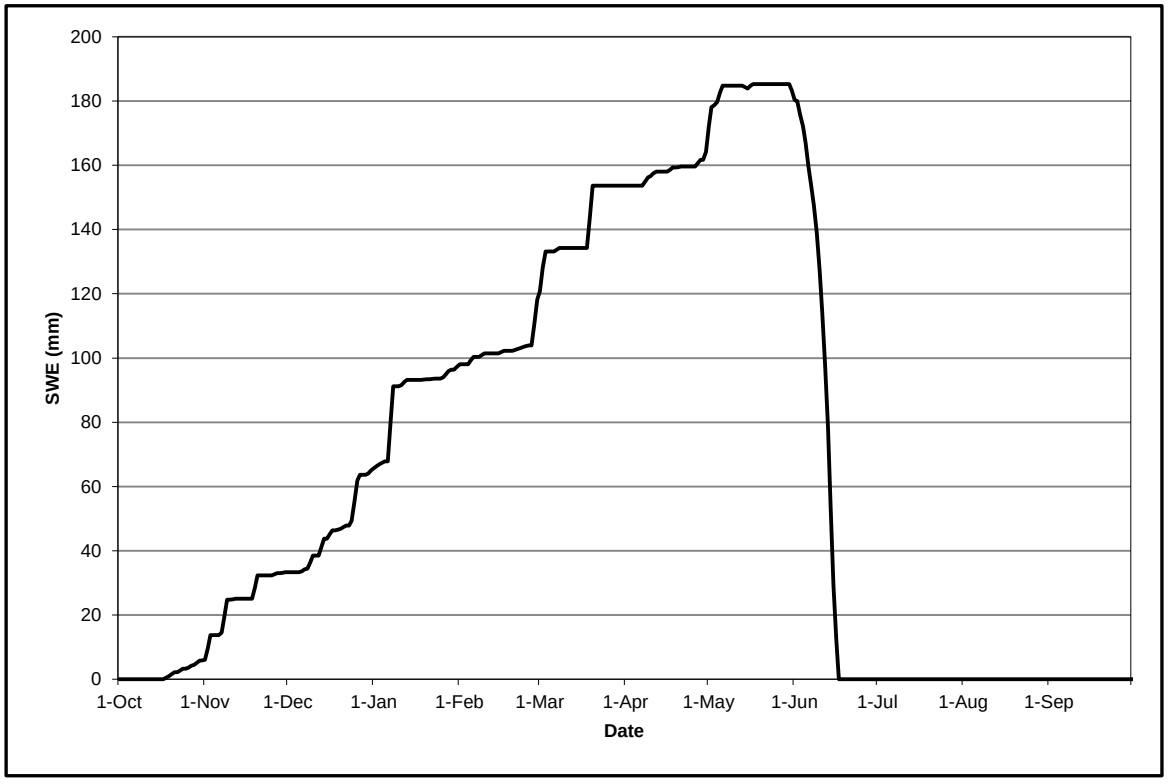


Figure C-6: 2015 Modeled Snowpack

C2.5 Model Calibration and Validation

Each modeled lake has a consistent structure and logic in the water balance. Physical characteristics of each modeled lake include local contributing lake and land areas, total discharge areas, and connectivity with other lakes.

The volume and timing of lake discharges are the predominant model outputs. The key calibration variables for the volume of water discharged are runoff coefficients, including rainfall and snowmelt runoff coefficients:

- Rainfall runoff coefficients were applied to rainfall runoff, separated by runoff on land and runoff on lake areas (i.e., direct runoff) to account for evapotranspiration and storage losses. Direct runoff coefficients were assigned a value of 1.0.
- Snowmelt runoff coefficients were applied to snowmelt runoff, separated by runoff on land and runoff on lake areas (i.e., direct runoff) to account for storage losses. Snowmelt runoff coefficients were considered separately from sublimation losses. Direct runoff coefficients were assigned a value of 1.0.

C2.5.1 Method

Rainfall and snowmelt runoff coefficients for land areas were calibrated to measured hydrographs and annual water yields. The snowmelt runoff coefficient primarily affects peak discharges, and was calibrated to measured hydrographs. The rainfall runoff coefficient was adjusted to reach measured annual water yields. There were three days of rainfall prior to peak discharges, which were considered during the calibration of the rainfall runoff coefficient.

The calibration process was as follows:

- **Calibration:** The model was run on a 1-hour time-step from 1950 to 2015 (exclusive of years 1951, 1979, 1993, and 2010) using the derived climate data set as input values. Both rainfall and snowmelt runoff coefficients were initially set to 1.0 and reduced incrementally to match the measured hydrograph and annual water yields at Lake A18 (i.e., the most upstream lake with a continuous data set).

  Derived annual water yields of Lake A17 (Whale Tail Lake) and Lake C38 (Nemo Lake) (Section 3.2.1.9) were significantly lower than those derived for Lake A18, Lake A15, Lake A69, and Lake DS1, and runoff coefficients of these local watersheds and local tributaries were reduced from those applied for Lake A18. As noted in Section 3.2.1.9, this reduction may be related to a proportion of ineffective drainage area in both local watersheds. Tributaries of Lake A17 (Whale Tail Lake) and Lake C38 (Nemo Lake) were opportunistically observed to drain poorly, with ponded water, and the potential exists for shallow subsurface flow to convey water outside of the assumed watershed boundaries.

- **Validation:** Runoff coefficients applied to Lake A18 were applied to all modeled lakes (other than Lake A17 [Whale Tail Lake] and local tributaries, and Lake C38 [Nemo Lake] and tributaries), and were verified by comparing modeled hydrographs and annual water yields to measured continuous data sets.

C2.5.2 Results

Rainfall runoff coefficients were calibrated as 1.0 for lake areas, 0.35 for land areas of local watersheds of Lake A17 (Whale Tail Lake), Lake C38 (Nemo Lake), and their tributaries, and 0.70 for land areas of all other lakes. Snowmelt runoff coefficients were calibrated as 1.0 for lake areas, 0.50 for land areas of local watersheds of Lake A17 (Whale Tail Lake), Lake C38 (Nemo Lake), and their tributaries, and 1.0 for land areas of all other lakes. A snowmelt coefficient of 1.0 is consistent with frozen ground conditions and low evaporation during the melt period; however, it may indicate that additional precipitation may not have been captured by the local climate station, or that sublimation losses may be slightly overestimated. This may only be confirmed with additional monitoring data.

The calibrated runoff coefficients result in good agreement between modeled and measured discharges, water levels, and annual water yields. Uncertainties are discussed below:

- Lake A5 appears to be well estimated at low flows; however, additional field data during the high flow period are required to validate the timing and magnitude of the peaks, and improve its stage-discharge rating curve, which, is based on that of Lake A69 in the model. Thus, peak discharges generated by the model at Lake A5 are associated with a degree of uncertainty.

- The model appears to slightly overestimate lake surface elevations of Lake A15 at low flows. This may result from its stage-discharge rating curve, which was based on two discharge measurements at high and lower flows, and a discharge estimate during the low flow season in September, which was not measurable.

- Local watersheds and tributaries of Lake A17 (Whale Tail Lake), Lake C38 (Nemo Lake) and their tributaries were assumed to be poorly drained with proportions of ineffective areas, and the potential for shallow subsurface flow to convey water outside of the assumed watershed boundaries. While consistent

with opportunistic field observations, areas of potential ineffective flows could be refined with additional observations and specifically targeted with lower runoff coefficients to improve the model.

- Stage-discharge rating curves of Lake A12 and Lake A76 were based on assumptions and calibration of water yields at Lake A69. Both lakes are comprised of two lake outlets, and assumed rating curves could be improved, and further validated, with additional field measurements.
- Recession discharges and water levels at Lake A69 are associated with a degree of uncertainty related to the timing of snowmelt runoff of upstream lakes. Thus, the recession period may be improved with additional field data at upstream lakes. Peak and low flows appear to be well matched.
- Lake DS1 was modeled coarsely with lumped tributary areas (other than the A, B, and C watersheds, which were modelled explicitly) based on physical parameters derived from available desktop data. Due its large watershed, Lake DS1 hydrology is complex and cannot accurately be reproduced by this baseline model; however the model results are considered fit for the purpose of this baseline study. Annual water yields are reasonably matched which further validate calibrated parameters. Finer scale parameters such as the timing of peaks and response to rainfall events may not be accurately estimated and should be used with caution.

Resulting runoff coefficients are presented in Table C-4.

Measured discharge data are plotted along with model output for qualitative comparison in Figure C-7 (Lake A5), Figure C-9 (Lake A15), Figure C-11 (Lake A17 [Whale Tail Lake]), Figure C-13 (Lake A18), Figure C-15 (Lake A69), Figure C-17 (Lake C8), Figure C-19 (Lake C38 [Nemo Lake]), and Figure C-21 (Lake DS1).

Comparisons of measured and modeled lake water surface elevations are presented in Figure C-8 (Lake A5), Figure C-10 (Lake A15), Figure C-12 (Lake A17 [Whale Tail Lake]), Figure C-14 (Lake A18), Figure C-16 (Lake A69), Figure C-18 (Lake C8), Figure C-20 (Lake C38 [Nemo Lake]), and Figure C-22 (Lake DS1) over the discharge period.

Comparisons of measured and modeled annual water yields are presented in Figure C-23.

Table C-4: Calibrated Runoff Coefficients

Lake	Rainfall Runoff Coefficient		Snowfall Runoff Coefficient	
	Land	Lake (Direct)	Land	Lake (Direct)
Lake A17 (Whale Tail Lake), Lake C38 (Nemo Lake)	0.35	1.0	0.50	1.0
All other lakes	0.70	1.0	1.0	1.0

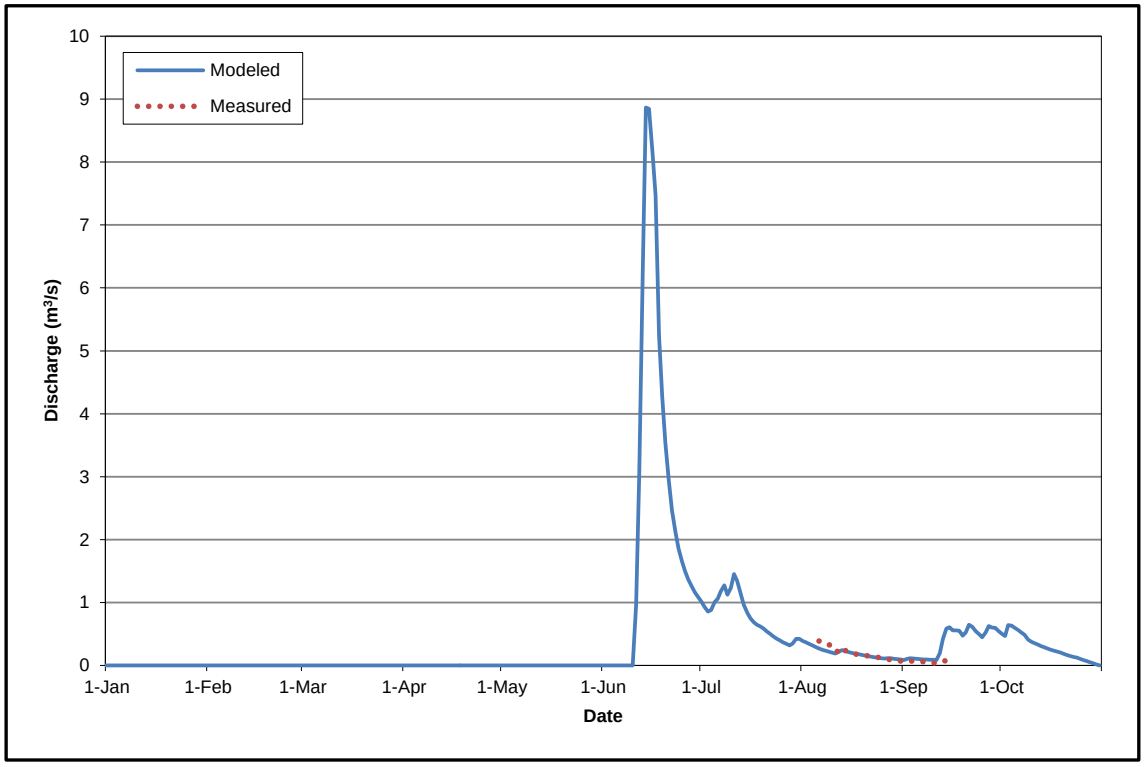


Figure C-7: Comparison of Modeled and Measured Discharge at Lake A5 in 2015

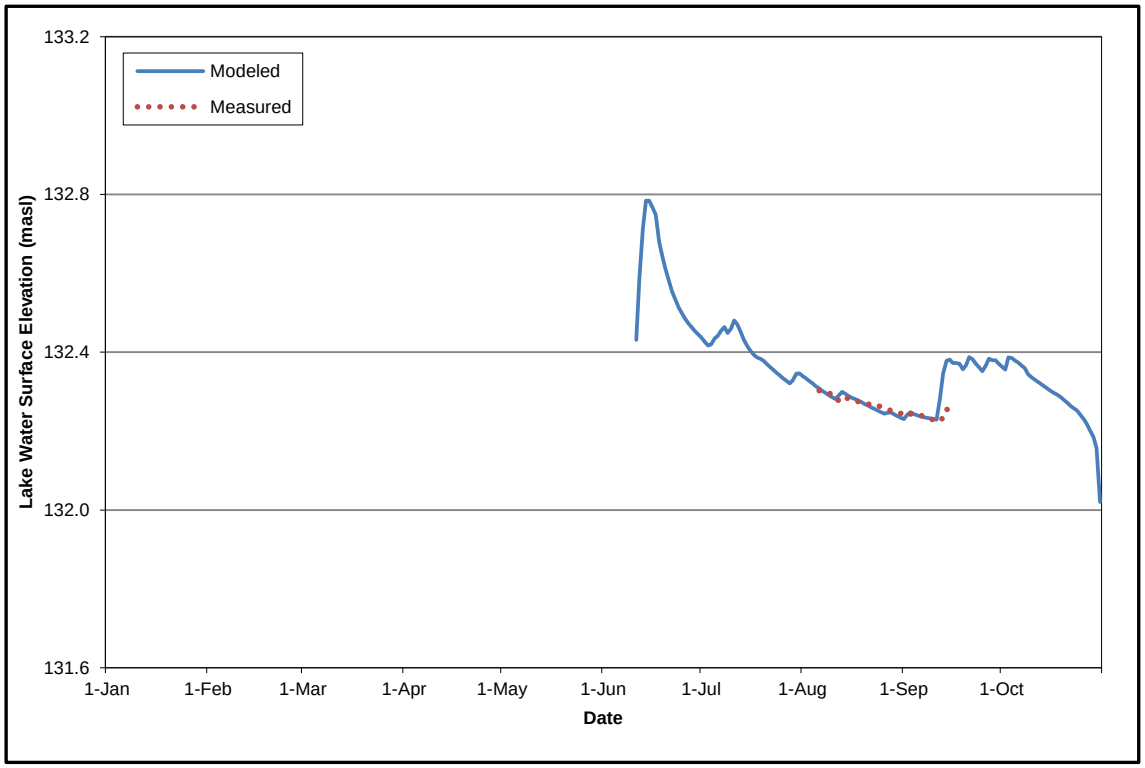


Figure C-8: Comparison of Modeled and Measured Lake Water Surface Elevation at Lake A5 in 2015

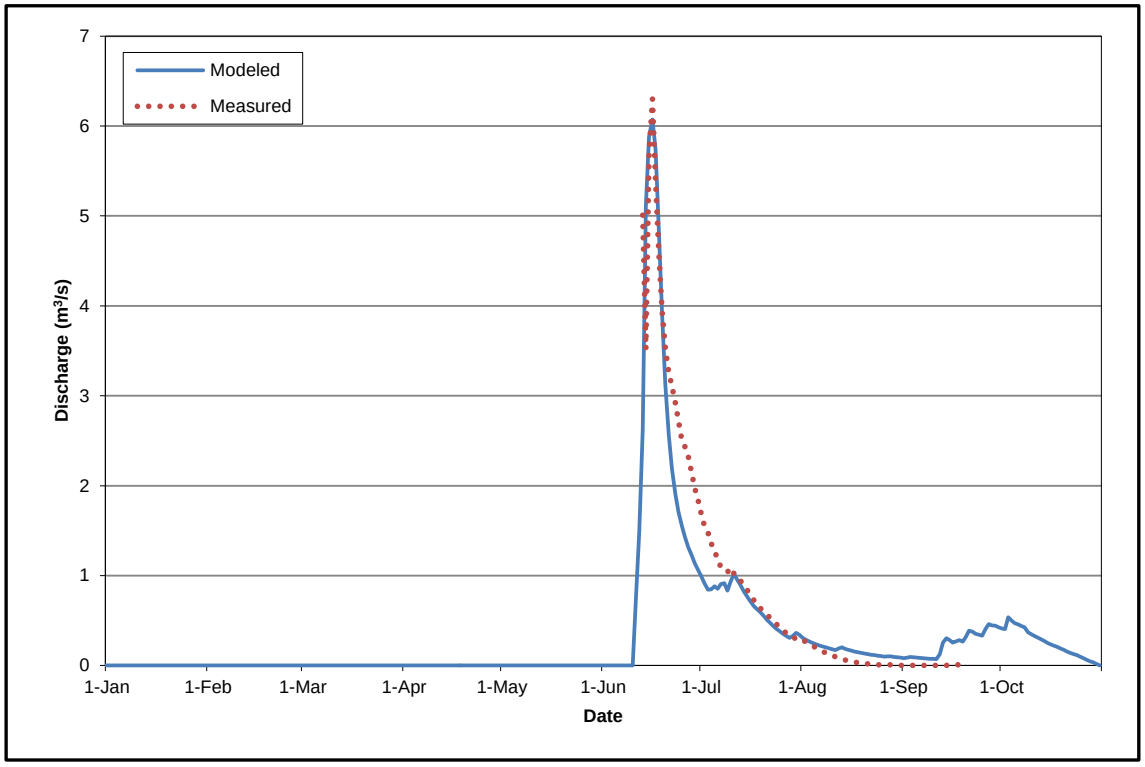


Figure C-9: Comparison of Modeled and Measured Discharge at Lake A15 in 2015

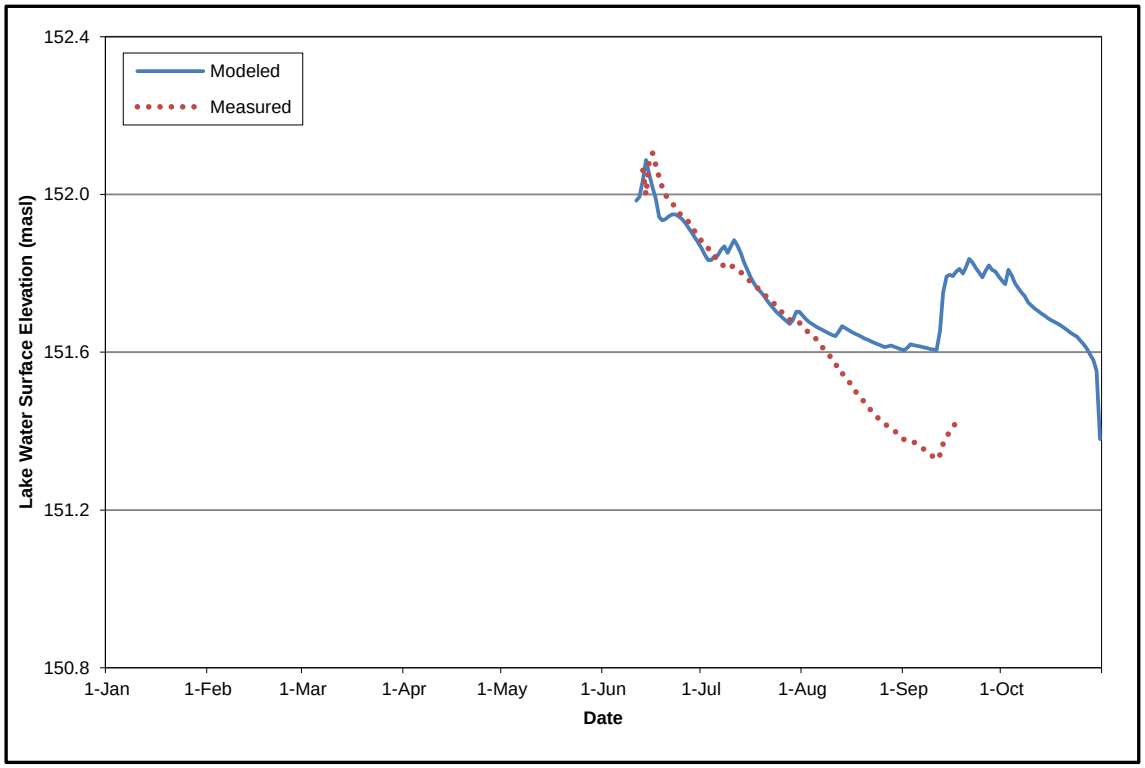


Figure C-10: Comparison of Modeled and Measured Lake Water Surface Elevation at Lake A15 in 2015

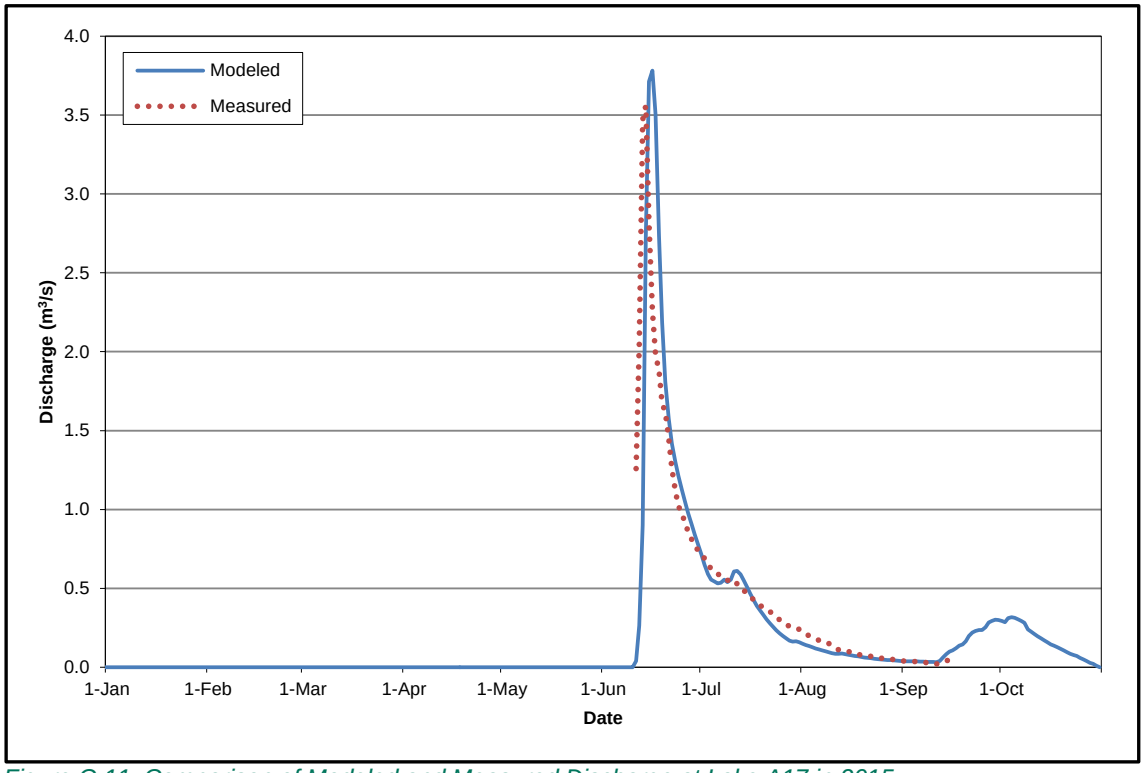


Figure C-11: Comparison of Modeled and Measured Discharge at Lake A17 in 2015

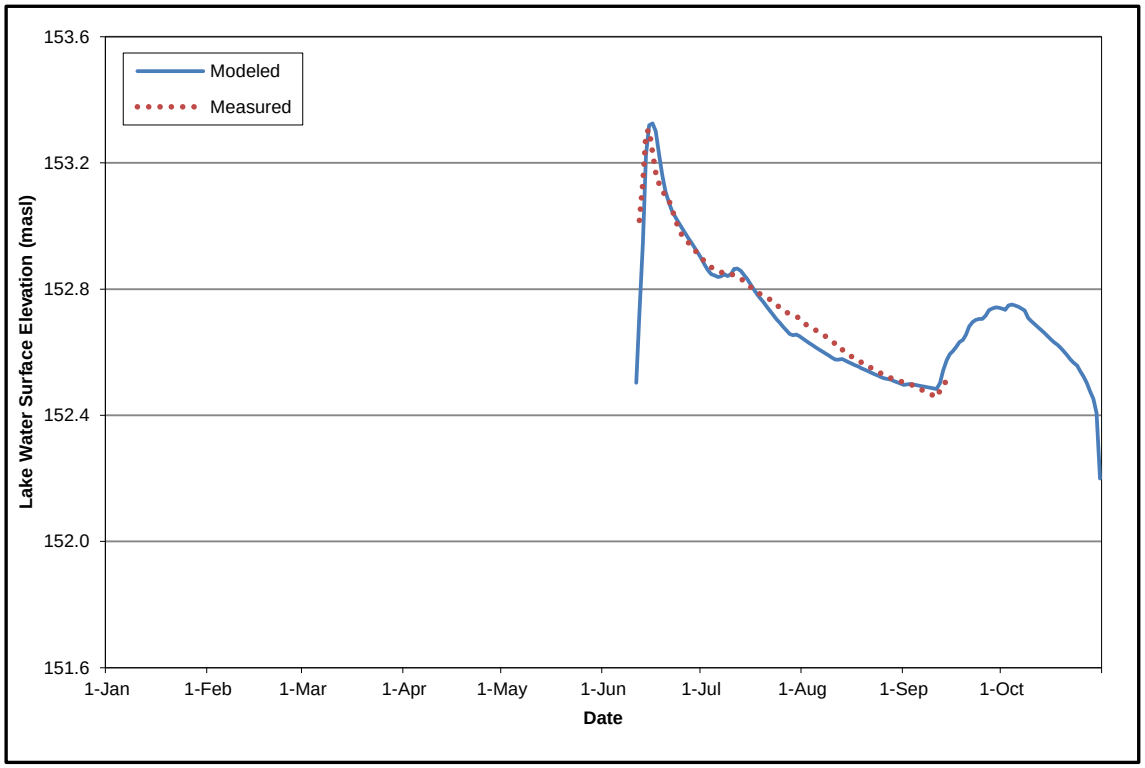


Figure C-12: Comparison of Modeled and Measured Lake Water Surface Elevation at Lake A17 in 2015

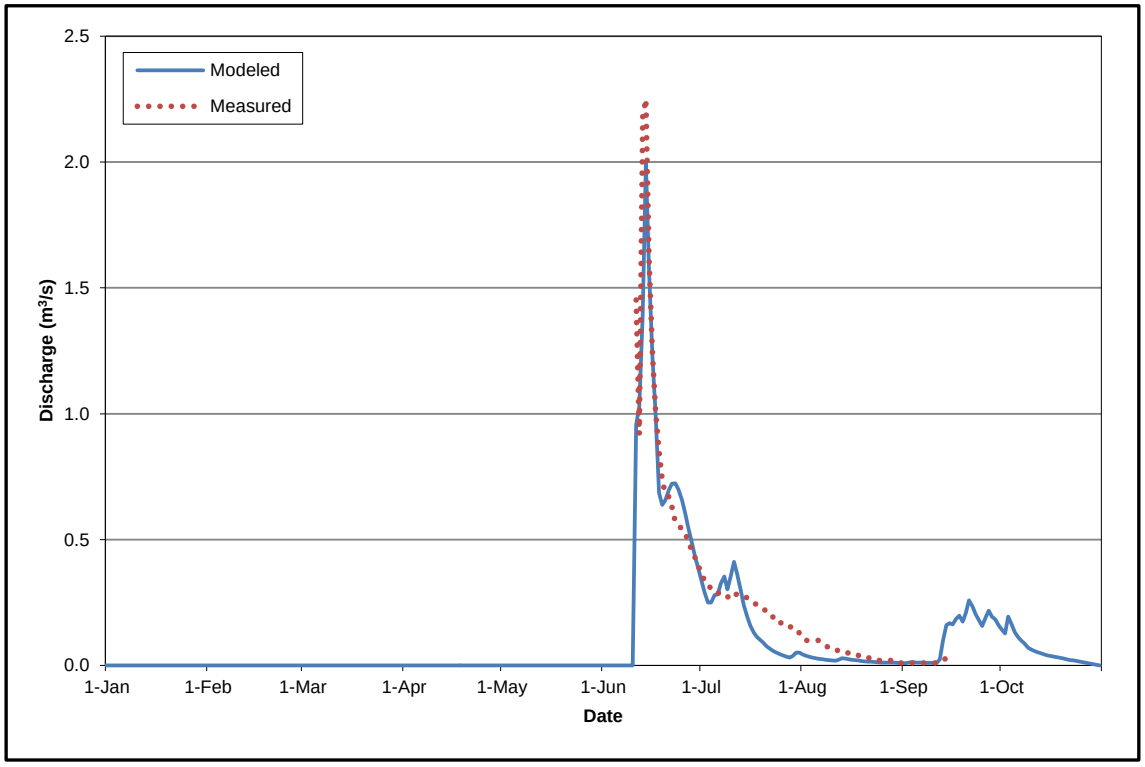


Figure C-13: Comparison of Modeled and Measured Discharge at Lake A18 in 2015

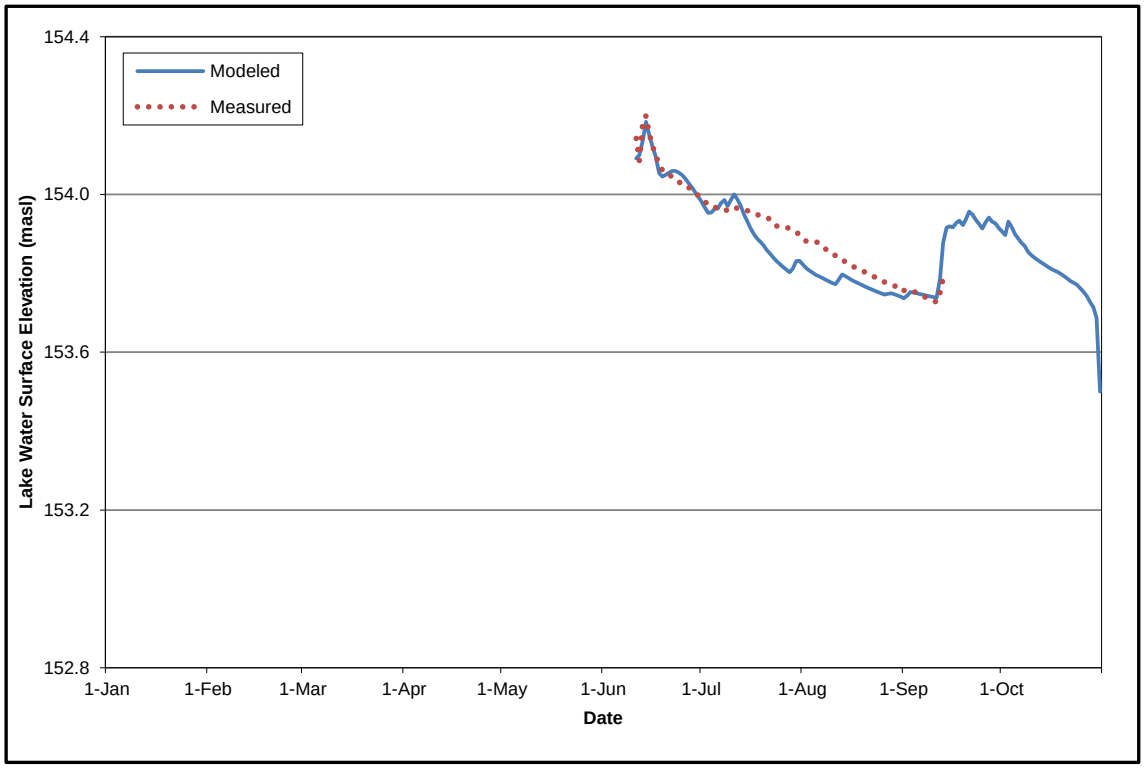


Figure C-14: Comparison of Modeled and Measured Lake Water Surface Elevation at Lake A18 in 2015

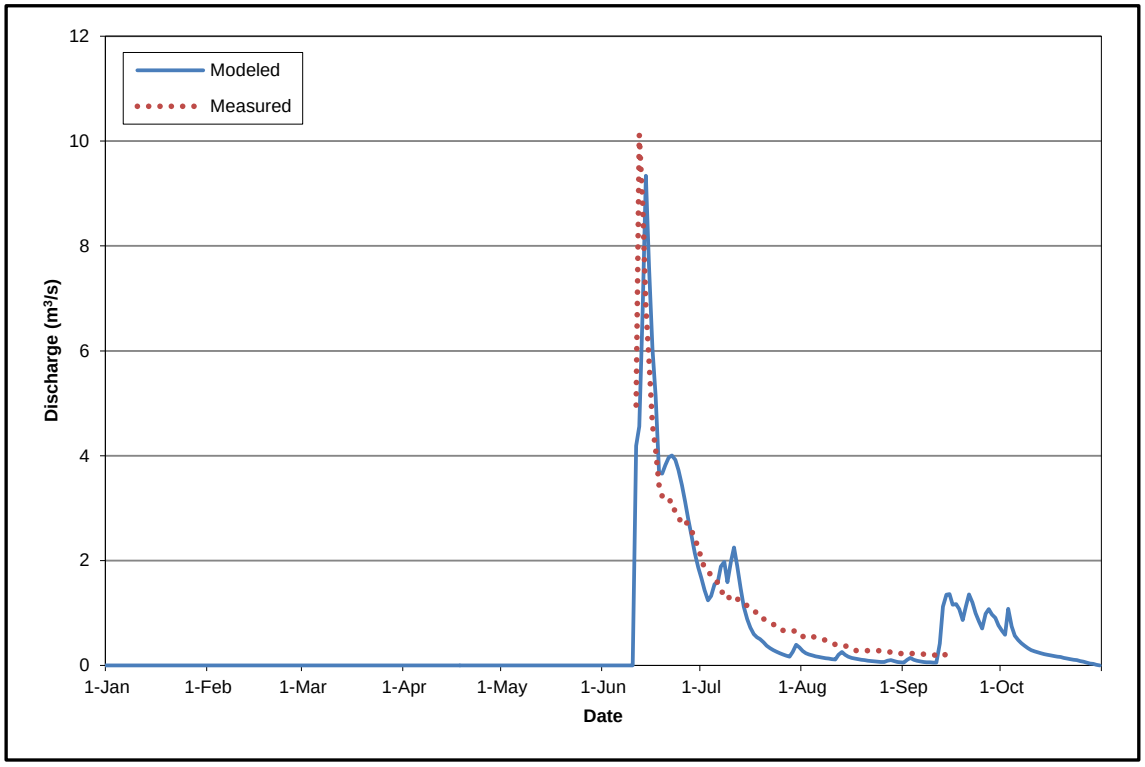


Figure C-15: Comparison of Modeled and Measured Discharge at Lake A69 in 2015

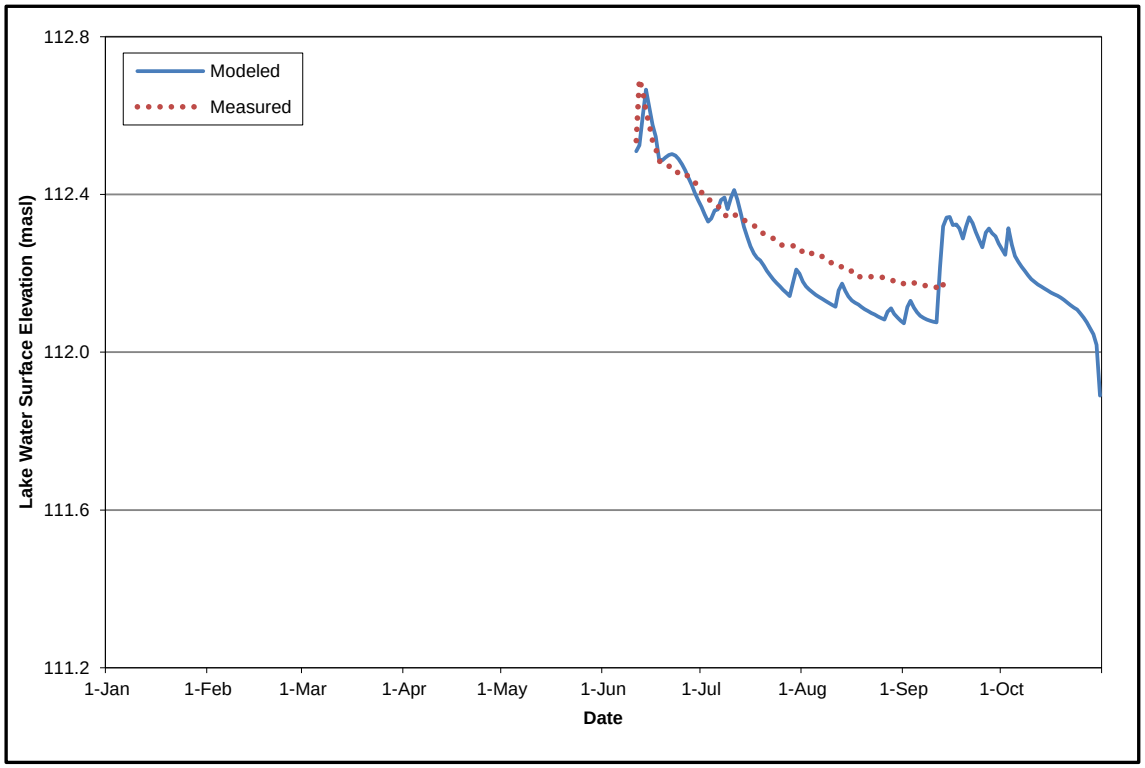


Figure C-16: Comparison of Modeled and Measured Lake Water Surface Elevation at Lake A69 in 2015

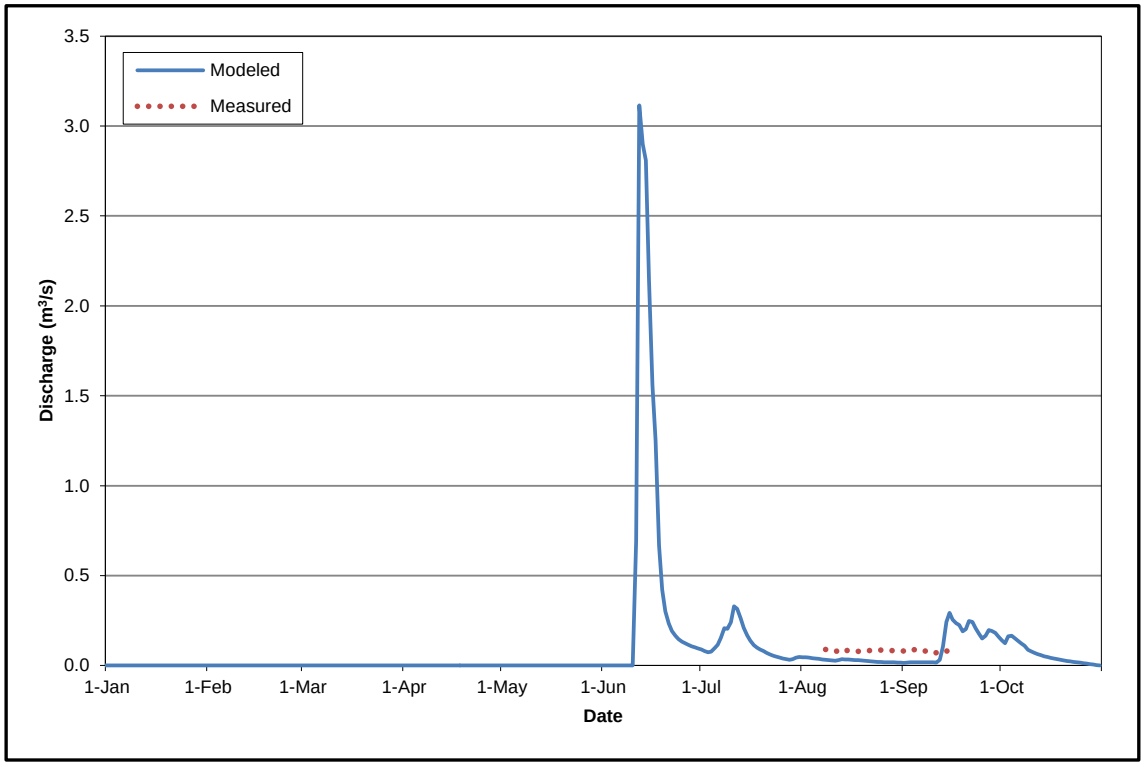


Figure C-17: Comparison of Modeled and Measured Discharge at Lake C8 in 2015

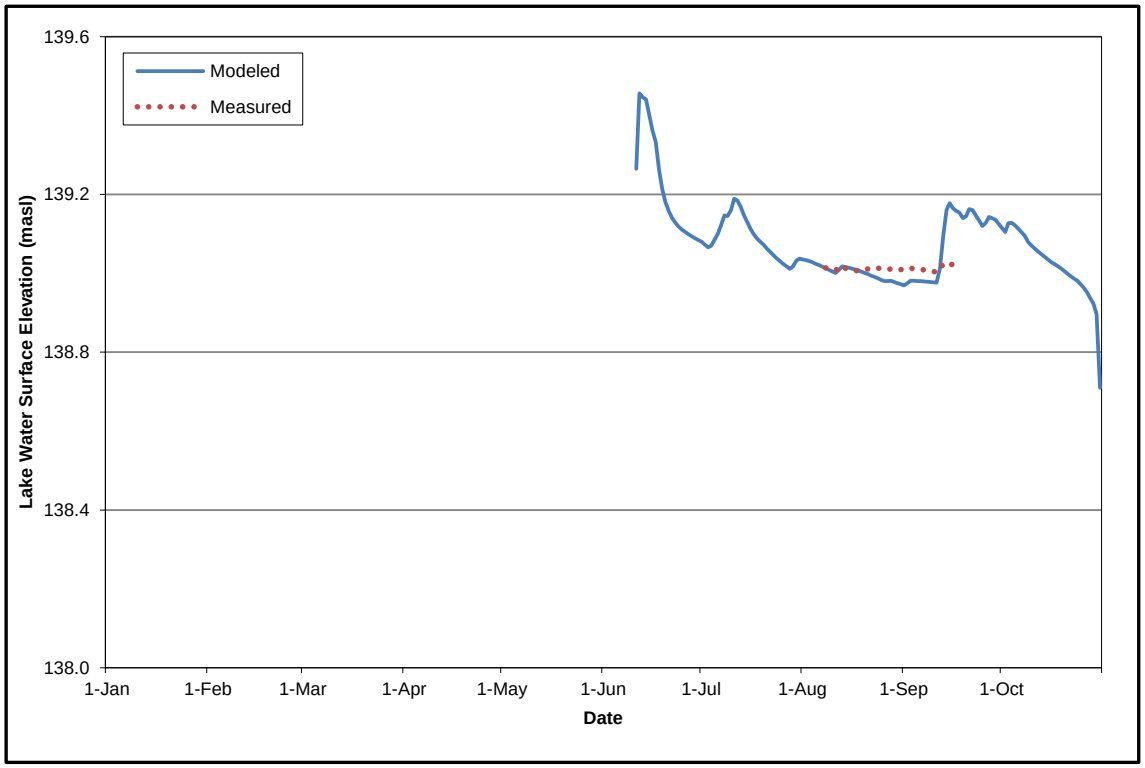


Figure C-18: Comparison of Modeled and Measured Lake Water Surface Elevation at Lake C8 in 2015

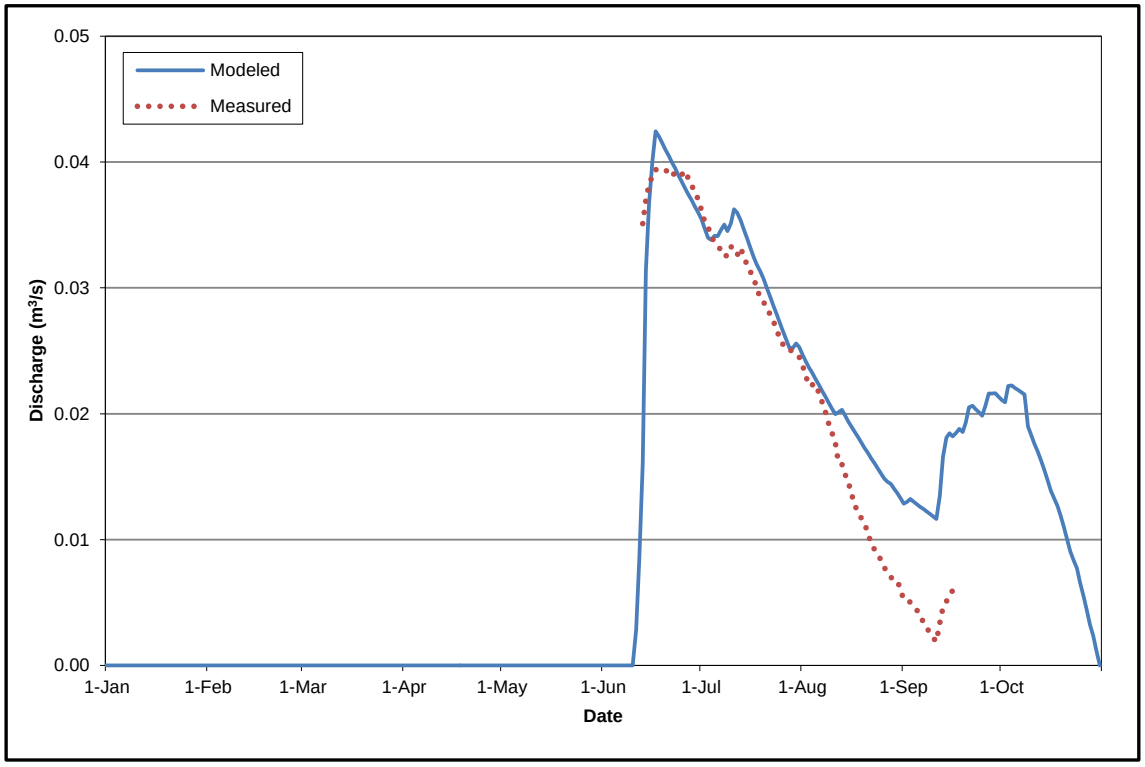


Figure C-19: Comparison of Modeled and Measured Discharge at Lake C38 in 2015

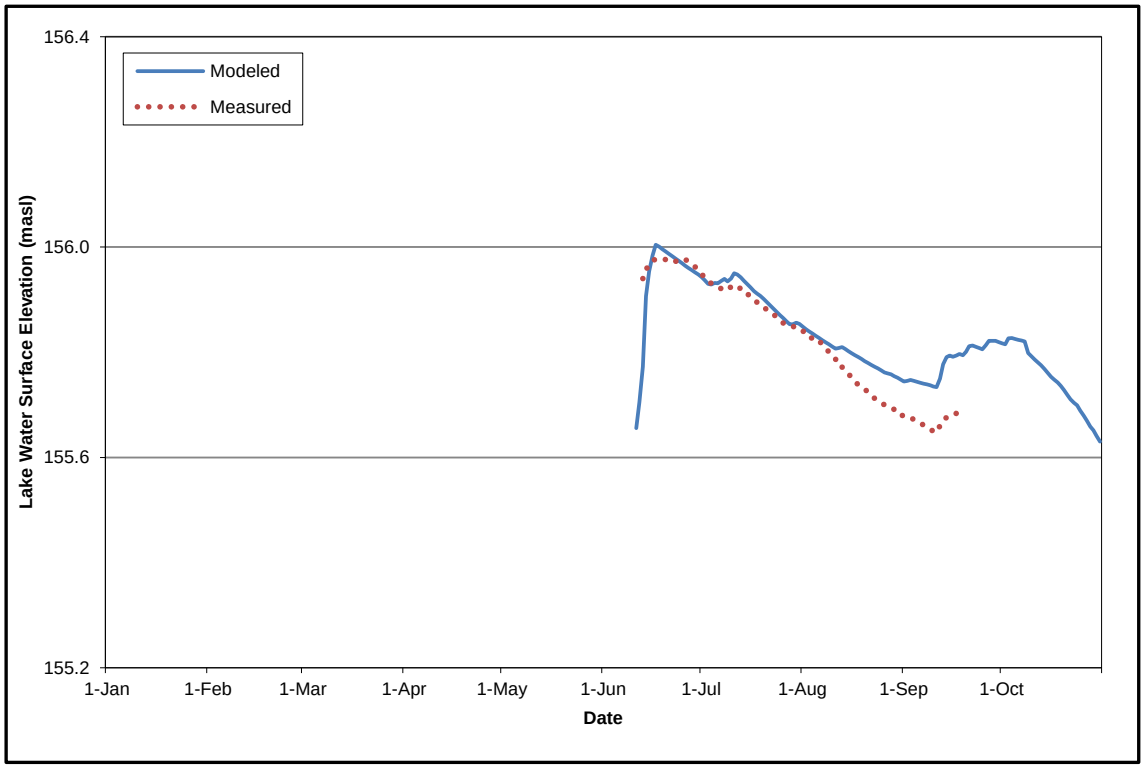


Figure C-20: Comparison of Modeled and Measured Lake Water Surface Elevation at Lake C38 in 2015

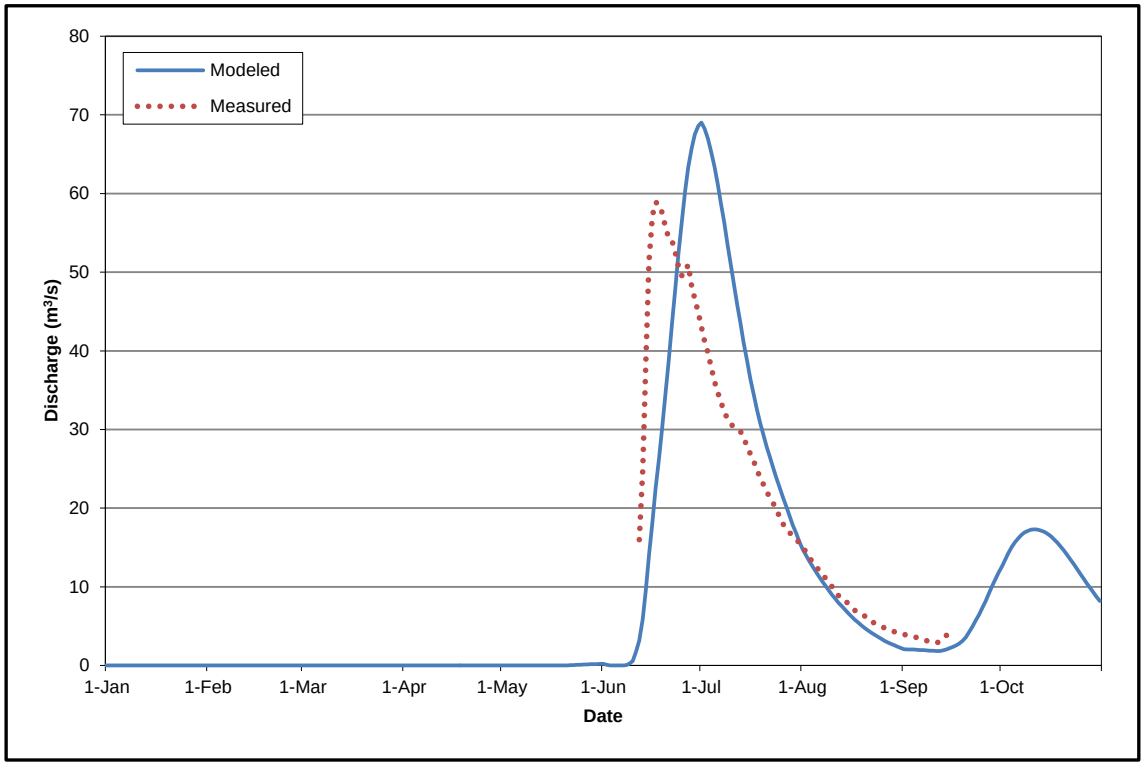


Figure C-21: Comparison of Modeled and Measured Discharge at Lake DS1 in 2015

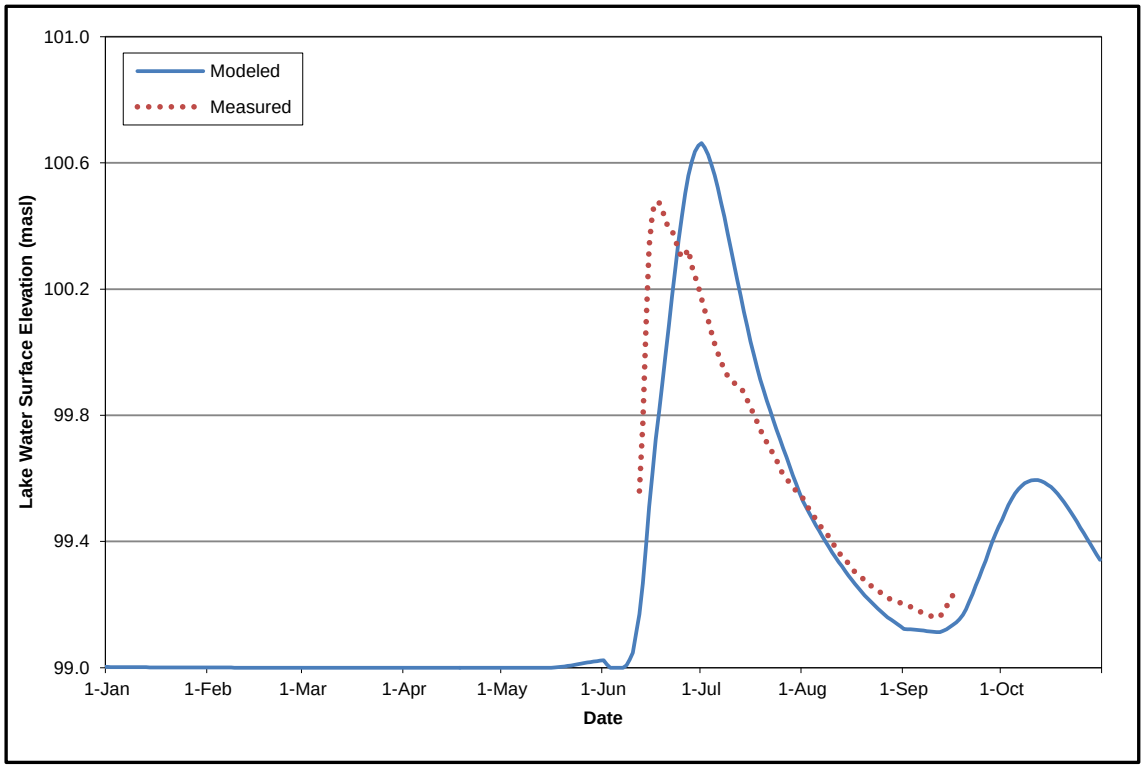


Figure C-22: Comparison of Modeled and Measured Lake Water Surface Elevation at Lake DS1 in 2015

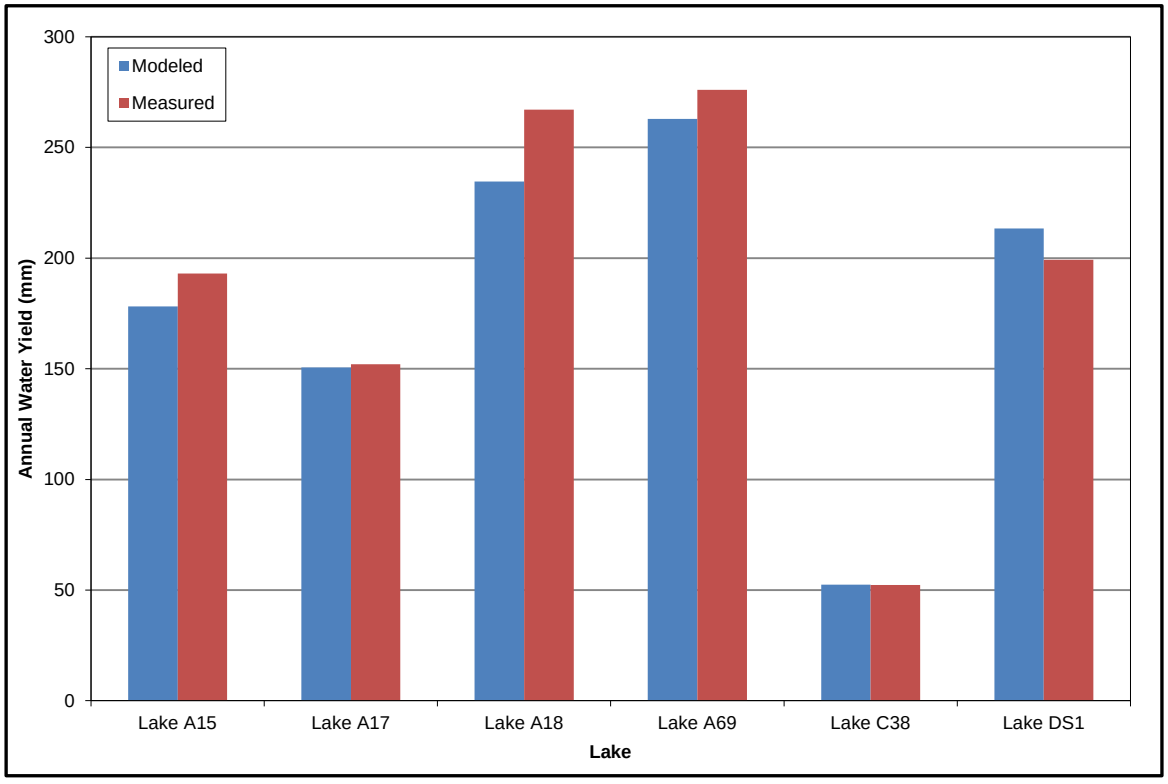


Figure C-23: Comparison of Modeled and Measured Water Yields in 2015

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APPENDIX 6-D

Portt 2015 Road Baseline Report

June 2016
Report No. 1541520

AMARUQ EXPLORATION ACCESS ROAD AQUATICS BASELINE REPORT
2015 AGNICO EAGLE MINES LTD. - MEADOWBANK DIVISION



Submitted to:

Agnico Eagle Mines Ltd: Meadowbank Division
Regional Office - 93, Rue Arseneault, suite 202,
Val-d'Or, Québec, J9P 0E9

November 25, 2015.

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EXECUTIVE SUMMARY

The Meadowbank Mine is one of Canada's most northerly operating mines, located approximately 75 km north of the Hamlet of Baker Lake, Kivalliq District, Nunavut. It has been in operation since 2009, with open pit mining activities underway since March 2010. The Amaruq project is a 408-square-kilometre exploration property located approximately 50 kilometres northwest of the Meadowbank Mine, where a drilling program started in July 2013 has revealed promising gold mineralization.

An all-weather access road is deemed necessary to facilitate year-round exploration activities. In 2014, an evaluation was initiated to look at possible locations of an all-weather exploration access road between the Meadowbank mine and the Amaruq exploration site. A desktop exercise to identify potential fish habitat and initial field investigations along an approximate road corridor were conducted in late August and early September, 2014. Field investigations included reconnaissance and photographing all locations where the approximate corridor intersected water bodies or watercourses from a helicopter, and on-the-ground investigations that included electrofishing at 8 watercourses that were considered to be the most likely to support fish. An assessment of fish habitat potential was based on the field investigations and aerial photography. Factors considered included the presence or absence of late summer flow, the presence or absence of reaches where only interstitial flow was occurring in late summer, and the potential that the watercourse provides a migration corridor to upstream habitats. Those investigations were documented, in a report entitled *Amaruq Exploration Access Road Aquatics Baseline Report 2014 Agnico Eagle Mines Ltd. – Meadowbank Division* (C. Portt and Associates, 2015).

A revised road alignment that avoided aquatic habitat at many of the locations identified during the 2014 field investigations was examined in the field in June and early July of 2015. Also, in late June, 2015, several locations were examined on the ground by with road engineers and crossing locations were 'field fit' to minimize impacts to fish habitat, taking into account engineering constraints. More refinements to the road alignment were made, based in part on the field-fit exercise. The current road alignment was provided to C. Portt and Associates by Agnico Eagle in October of 2015. The habitat characteristics and recommended crossing methods where fish habitat or potential fish habitat is intersected by the revised alignment reflect the changes to the road alignment and the findings of the 2015 field investigations.

Electrofishing was conducted at eleven locations deemed to be the most likely to support fish based on their habitat characteristics. Fish were captured at eight of those locations. In total, five fish species were captured at one or more locations. Slimy sculpin was the most commonly captured species; individuals were captured at seven of the eleven sites sampled. Juvenile Arctic Char were captured at three locations, two of which were large rivers. Ninespine Stickleback, Burbot and Arctic Grayling were each captured at one location. Based on their size, all of the Slimy Sculpin and Ninespine Stickleback were adults and the Burbot, Arctic Char and Arctic Grayling were all juveniles.

The total number of locations where fish habitat exists or may exist, based on the observed habitat conditions, along the road alignment is 28. The watercourses at three of the locations (km 16.0, km 23.9

and km 32.3) were characterized as rivers. These provide habitat for small-bodied fish, and potentially also for large-bodied fish, throughout the open-water period. Due to their depth and flow, these watercourses are also potential migration routes for large-bodied fish throughout the open water period. Clear-span bridges are recommended for these locations. One juvenile Arctic Grayling was captured in one watercourse in both 2014 and 2015 and there is gravel substrate suitable for Arctic Grayling spawning at numerous locations within this watercourse, although no Arctic Grayling or disturbed gravel that might be indicative of Arctic Grayling spawning were observed here in the spring of 2015. Due to the potential habitat significance, a clear-span bridge has also been recommended at this location. At another five locations, the presence of potential fish-bearing lakes upstream suggest that the watercourses could be important migration routes for large-bodied fish during the open water season. Open-bottom structures spawning at least a portion of the channel are recommended at those locations to ensure that such migrations, if they occur, are not impeded.

The remaining 19 locations are smaller watercourses that do not have fish-bearing lakes upstream and/or have sections where only interstitial flow occurs, preventing the movement of large fish. The dominant habitat type is boulder at 12 locations and graminoid at 7 locations. At 11 of the boulder watercourses most or all of the flow is interstitial. For those watercourses, it is recommended that the interstitial flow be maintained and if additional conveyance is required it may be provided by corrugated steel pipes on top of the boulders. For graminoid streams and the one boulder stream where surface flow predominates, at least one corrugated steel pipe embedded 0.3 m below the stream invert is recommended, with other unembedded corrugated steel pipes used for additional conveyance if required.

The approach taken with respect to crossing recommendations protects the most significant fish habitats and maintains the existing potential for fish movement at all watercourse crossings. A Pathways of Effects analysis will be undertaken to determine the nature and scale of any residual effects on fish and fish habitat.

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Figure 2-1. Route of the Amaruq Exploration Access Road and the 28 locations where the road intersects actual or potential fish habitat. 6

Figure 2-2. Examples of habitat types encountered. The top row are rivers. The middle row are boulder watercourses. The bottom row are graminoid watercourses, with the right photograph showing graminoid with coarse substrate, and the left photograph showing graminoid with organic substrate. 10

1.0 INTRODUCTION

The Amaruq project is an exploration property located approximately 50 kilometres northwest of the Meadowbank mine in Nunavut as shown in Figure 1-1. The 408-square-kilometre exploration property is located on Inuit Owned Land, and was acquired by Agnico Eagle in April 2013 subject to a mineral exploration agreement with Nunavut Tunngavik Incorporated.

A drilling program started in July 2013 has revealed promising gold mineralization. Given the size and scope of the discovery, studies are currently underway to evaluate how Amaruq could be incorporated into the Meadowbank mine operational plan.

An all-weather access road is deemed necessary to facilitate year-round exploration activities. A desktop exercise and initial field investigations to identify potential fish habitat along an approximate road corridor were conducted in late August and early September, 2014. Those investigations were documented in a report entitled *Amaruq Exploration Access Road Aquatics Baseline Report 2014 Agnico Eagle Mines Ltd. – Meadowbank Division* (C. Portt and Associates, 2015). The desktop evaluation of the approximate road corridor in 2014 identified 52 locations where fish habitat might be intersected by the road. Field investigations revealed that there was no fish habitat present at 11 of those locations. At another 13 locations the road intersected a lake or pond and the report recommended that these be avoided by realigning the road. For the remaining 28 locations, the report made preliminary recommendations with respect to crossing structures to avoid or mitigate effects on fish habitat.

A revised road alignment, established just prior to the 2015 field season, avoided lakes and ponds at the 13 locations identified along the approximate alignment in 2014. At three locations where the road alignment was adjusted to avoid a lake or pond, this necessitated crossing a new watercourse. However, at another three locations the proposed road was adjusted to eliminate a watercourse crossing. The new alignment was examined in the field in late June and early July, 2015. At that time a number of the water crossing locations were examined jointly with road engineers and crossings were ‘field fit’ to minimize fish habitat impacts, given other constraints. As a result of the ’field fitting’ and an engineering field survey of the proposed road route during the summer of 2015, a refined road alignment was provided in October 2015. While most adjustments were minor, at one location this resulted in the shifting of one crossing to a different watercourse. The total number of locations where fish habitat exists based on the observed habitat conditions, and is intersected by the revised road alignment, is 28.

This report consolidates the results of the 2014 and 2015 investigations as they apply to the October 2015 road alignment (hereafter referred to as the road alignment). It presents information for the 28 locations where fish habitat exists, or may exist based on the observed habitat conditions, and is intersected by the road alignment. It does not make reference to locations that were identified during the initial desktop study of the earlier alignment where it was subsequently determined in the field that there was no fish habitat present nor does it discuss locations where fish habitat is now avoided by the

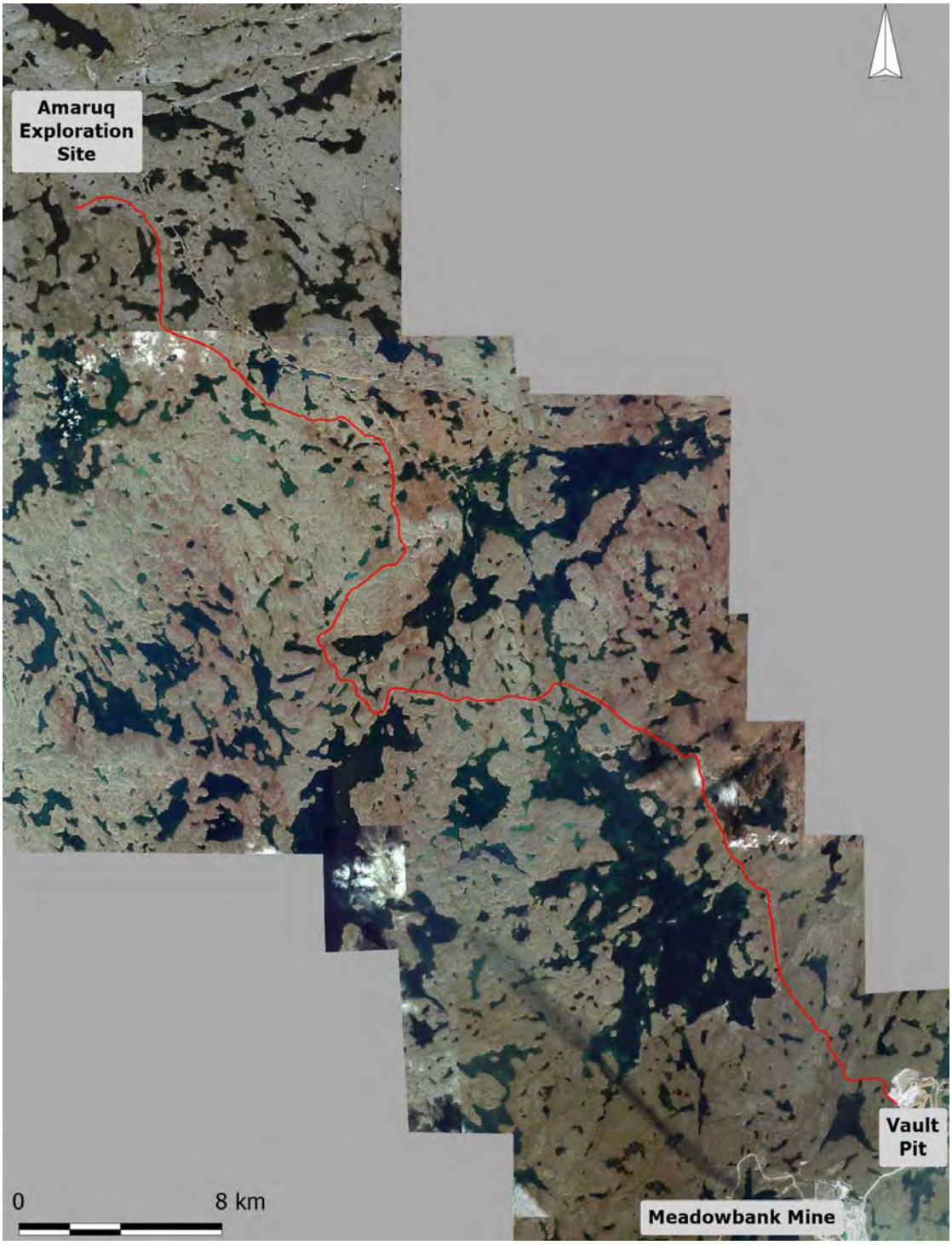


Figure 1-1. Location of the proposed Amaruq Exploration Access Road corridor.

road alignment. Crossing structure recommendations were re-evaluated based on the final, for construction alignment and the conditions observed in 2015.

1.1 Background

The Meadowbank Mine (65°N, 96°W) is one of Canada's most northerly operating mines, located approximately 75-km north of the Hamlet of Baker Lake, Kivalliq District, Nunavut (Figure 1-2). Mine construction began in 2008 under Nunavut Water Board Type A License 2AM-MEA0815 and Fisheries and Oceans Canada Authorization for Works or Undertaking Affecting Fish Habitat NU-03-0191.3 and NU-03-0191.4. Meadowbank has been in operation since 2009, with mining activities formally underway since March 2010, and projected to occur until February 2018. Meadowbank is an open pit operation, with most of the pit development located in close proximity to the mill, office and lodging infrastructure, with the exception of the Vault Pit which is approximately 10 km northeast of the main mine site. The southern terminus of the proposed Amaruq Exploration Access road is at the Vault Pit and the northern terminus is at the Amaruq exploration site.

1.2 Scope

This report presents an assessment of the watercourses along the proposed Amaruq Exploration Access Road corridor, based on field work conducted from August 29 to September 2, 2014 and from June 23 to July 11, 2015.

1.3 Objectives

- Characterize the existing fish and fish habitat conditions
- Identify potential impacts of the proposed access road on fish and fish habitat
- Recommend crossing structures to avoid or mitigate serious harm to fish and fish habitat

1.4 Physical Setting

The Meadowbank Mine is located on the Canadian Shield within a Low Arctic ecoclimate of continuous permafrost, which is one of the coldest and driest regions of Canada (Azimuth, 2010). The lakes within the Meadowbank project area are ultra-oligotrophic/oligotrophic (nutrient poor, unproductive) headwater lakes that are typical of the Arctic. The ice-free season on the lakes is very short. Ice break-up usually occurs during mid- to late-June, and ice begins to form again on the lakes in late September or early October. Complete ice cover is attained by late October, with maximum ice thickness of about 2 m occurring in March/April (Azimuth, 2013). Many small watercourses become dry once the land begins to freeze in the fall and, where water is present, most freeze to the bottom during the winter (BAER, 2005; Jones *et al*, 2010). Flows during the spring melt and the summer vary with drainage area.

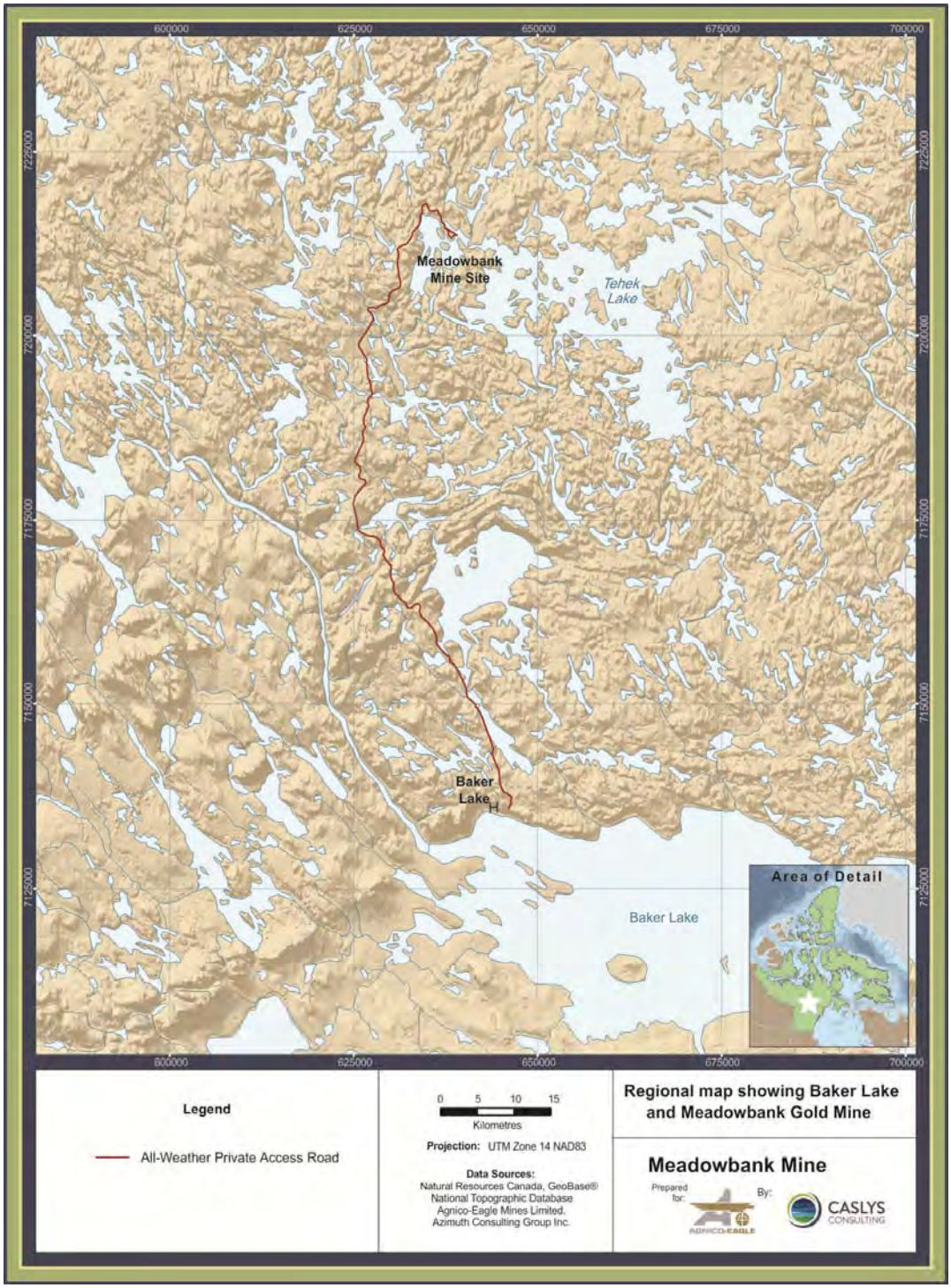


Figure 1-2. Location of the permitted and licensed Meadowbank Mine that includes an operational all-weather access road to Baker Lake.

The southern terminus of the proposed Amaruq Exploration Access road is at the Vault Pit and the northern terminus is at the Amaruq exploration site. The most southern watercourse crossing along the proposed road (km 2.1) is within the headwater area of the Chesterfield Inlet watershed that flows to Hudson Bay. All of the other locations examined along the proposed road alignment are within the Meadowbank River watershed which flows to the Back River and then to the Arctic Ocean.

There are no known anthropogenic influences between the Vault Pit and the Amaruq exploration site. The nearest community is Baker Lake, 75 km south of the Meadowbank Mine. At the present time, the only practical way of accessing most of the proposed road alignment is by helicopter, ATV or snowmobile.

2.0 METHODS

2.1 Preparation for Field Work

In 2014 the approximate road alignment, provided by Agnico Eagle Mines, was overlain on digital topographic mapping of the area (Garmin Topo Canada) and uploaded to a Garmin GPSmap76CSx hand-held GPS receiver. Potential watercourse crossings and waterbodies in close proximity to the road were identified on the topographic maps supplemented with examination of satellite images. These were located on printed copies of the same topographic mapping, which were also taken into the field. The same process was followed with the revised road alignment prior to the 2015 field investigations. Watercourse crossings and waterbodies in close proximity to the revised road alignment were identified based on the topographic maps supplemented with examination of satellite images, a photo mosaic, and the 2014 field investigations and photographs. The route was uploaded to a Garmin Oregon 650 hand-held GPS receiver that was used for orientation and to determine coordinates in the field.

The road route shown in Figure 2-1 and in the figures in Appendix A is the alignment provided by Agnico Eagle Mines Ltd. in November 2015, which reflects subsequent minor route refinements at some crossings.

2.2 Aerial Reconnaissance

The proposed access road alignment was examined from the air by helicopter on August 29 and 30, 2014. Each of the previously identified watercourse crossings and waterbodies was located and oblique aerial photographs were taken of each as well as upstream and downstream of watercourse crossings, to include the entire length of watercourse between lakes or to the watercourse's upstream limit. At some locations additional potential crossings were identified and documented in the same manner. The photographs taken during this reconnaissance and during the on-the-ground investigations (see below)

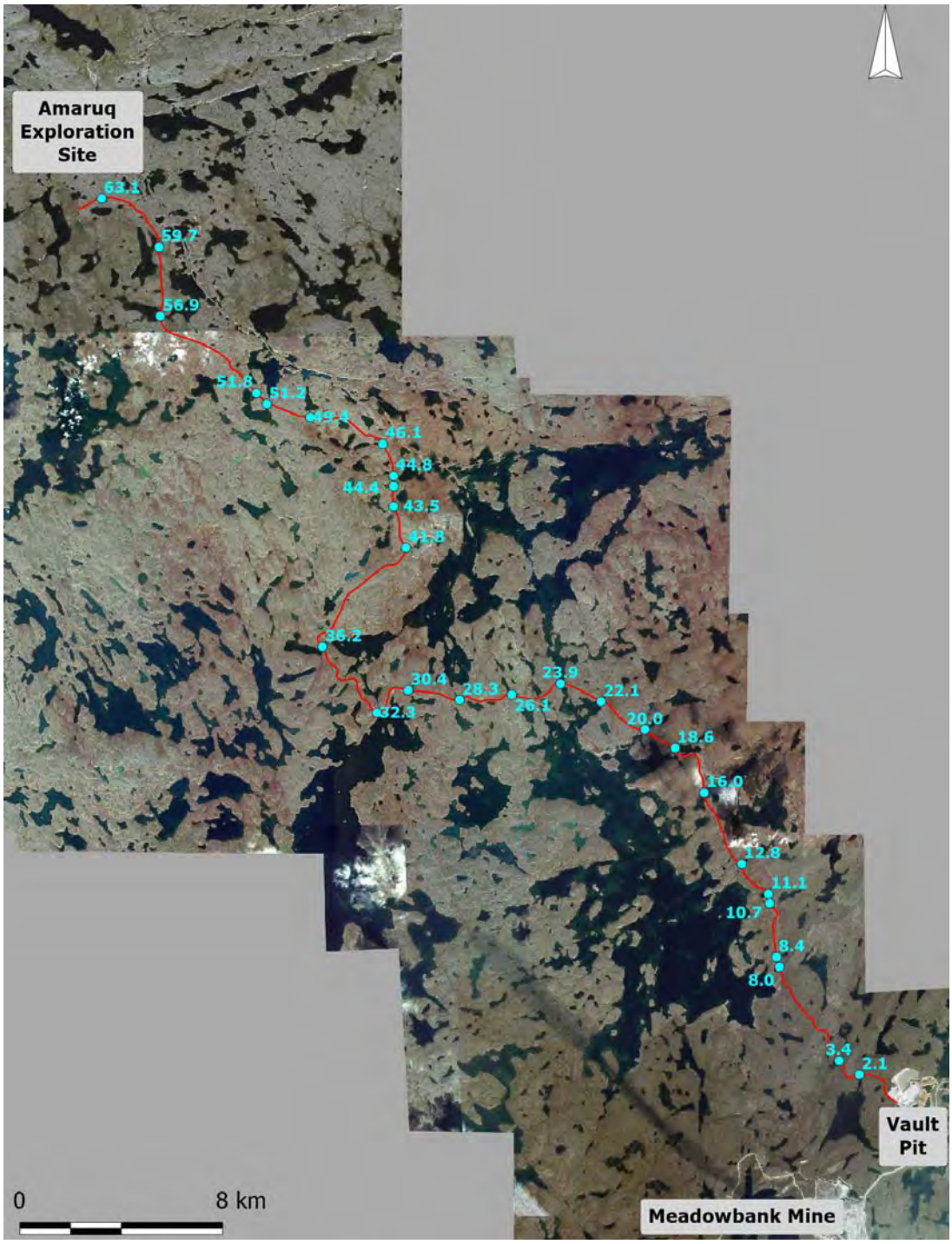


Figure 2-1. Route of the Amaruq Exploration Access Road and the 28 locations where the road intersects actual or potential fish habitat.

were reviewed and supplemental aerial photographs were taken on September 2, 2014, when the entire corridor was flown once more to ensure no important features were overlooked.

Observations were made by helicopter along the road alignment from km 3.4 to km 44.8 on June 23, 2015. On June 29, 2015, the entire alignment was flown again by helicopter and oblique aerial photographs were taken of the locations where fish habitat was considered to be present, or potentially present, based on the 2014 field investigations, the current conditions and the updated road alignment. At one location (km 41.8) the road alignment was shifted across a drainage divide subsequent to the 2015 field investigations. As a result, it crosses a watercourse that was not examined during the aerial reconnaissance. The assessment at that location is based on the aerial photomosaic.

2.3 Field Fitting of Crossings

On June 23, 2015 the road alignment was flown from crossing km 3.4 to km 44.8 with members of the road design team. The locations where bridges were recommended based on the 2014 field investigations were examined on the ground, and preferred crossing locations were identified based on the potential change to fish habitat, as well as engineering and construction considerations.

2.4 Fish Community Assessment

Each of the locations examined on the ground in 2014 was electrofished using a Halltech Model HT 2000 backpack electrofisher with a 47 cm diameter anode ring and a dipnet. Settings of 950 volts and 250 hertz, resulting in approximately 3-4 amperes of current, were used at all locations. Electrofishing was conducted with the two-person crew, one person using the electofisher and the second person netting the fish that were shocked, moving in an upstream direction, sampling as many habitat types as possible. In the smaller watercourses all of the habitat within the reach was eletrofished but in the large rivers only the shoreline could be safely sampled. The number of electroseconds (amount of time power was applied to the water) and the length of watercourse electrofished were recorded for each location that was sampled. Most fish were identified to species in-situ and released, but some were photographed and the photographs were used to confirm identity at a later time using keys in Scott and Crossman (1973) and McPhail and Lindsey (1970). The number of adults and juveniles captured, distinguished on the basis of size, was recorded for each species.

On June 23, 2015, site visits were conducted at km 3.4, 10.7, 16.0, 18.6, 20.0, 23.9, 26.1, 28.3, 32.3, 43.5, and 44.8. At the two largest crossings, km 23.9and 32.3, the entire length of watercourse between the lakes was examined for spawning Arctic Grayling, though dangerous shoreline conditions and the width of the river precluded close physical inspection at many places. At km 3.4, 16.0 and 44.8, more than half of the watercourse length between lakes was examined for spawning fish. Watercourses at the remaining crossings were examined in the vicinity of the proposed road.

The two largest watercourses (km 23.9 and km 32.3) could not be safely waded or electrofished in the spring of 2014 due to high flows and/or large slippery boulders dominating the shoreline habitats. They are assumed to be significant fish habitat.

On June 24 (km 16.0) and 25 (km 3.4, 20.0, 26.1, 43.5 and 44.8) visual surveys for Arctic Grayling and electrofishing were conducted at six locations where, based on the habitat conditions observed in 2014 or the June 23, 2015, inspection, it was thought there was potential for Arctic Grayling spawning. The watercourses were approached and examined carefully at and adjacent to the proposed crossing locations to try to observe adult Arctic Grayling or areas of disturbed gravel that could indicate Arctic Grayling spawning had occurred. At km 3.4, 16.0, and 44.8, where the habitat appeared most suitable, the entire length of the watercourse was examined. Following the visual search for Arctic Grayling each watercourse was electrofished using a Halltech Model HT 2000 backpack electrofisher (950 volts, 250 hertz). The number of electroseconds (amount of time power was applied to the water) and the length of watercourse electrofished were recorded for each location. The watercourse at km 16.0 was examined and electrofished again on July 5, 2015, after an Inuit field assistant to archaeologists reported seeing an Arctic Grayling in the stream a few metres upstream from the lake to which it drains on July 4. Electrofishing was also conducted, on July 11, 2015, at two additional locations (km 10.7 and km 11.1) where flows in 2015 suggested fish use might be greater than anticipated based on the 2014 observations. Most captured fish were identified to species in the field and released. Representative individuals were photographed.

2.5 Habitat Characterization

Watercourses which were considered to have the most potential to support fish were examined on the ground from August 30 to September 2, 2014, and/or from June 23 – July 11, 2015. These locations were selected based upon apparent flow and channel morphology and proximity to lakes that are deep enough to not freeze completely during the winter, as observed during the aerial reconnaissance. Each of these watercourses was examined visually in the immediate location of the proposed road crossing and, typically, for several hundred metres upstream and downstream. In most cases where watercourses joined lakes, the entire watercourse between the upstream and downstream lakes was examined. Observations of habitat characteristics including channel dimensions, channel form, and substrate, were recorded and photographs were taken.

A Garmin GPSmap76CSx (2014) or a Garmin Oregon 650 (2015) hand-held GPS was used to record the location of all observations and photographs, and aid in the stream width and distance measurements. The final habitat characterization for all watercourses was a desktop process that combined field observations with GIS analysis utilizing an orthorectified aerial photograph mosaic. If the 2015 crossing location changed from the earlier (2014) alignment, habitat was examined and characterized at the new location. The watercourses were characterized in terms of their flow condition, channel configuration, dominant habitat type in the vicinity of the proposed crossing location (which was approximate), active channel width and connection to potentially fish-bearing lakes upstream. Potential fish utilization was subsequently inferred based on the habitat characteristics.

Flow condition was characterized in 2014 as either surface flow or interstitial flow. Surface flow was considered to be present where surface water was visible in the watercourse either from the ground, from the helicopter, or in aerial photographs. "Interstitial flow" refers to flow through the interstitial spaces of the boulders and cobble that make up many of the streambeds along the proposed route, which was often not visible. Interstitial flow through boulder or cobble sections was assumed if surface water was visible elsewhere along the watercourse. Interstitial flow was deemed to be ”possible” if no surface water was detected anywhere along a boulder watercourse. Those watercourses may be dry, but this was not confirmed on the ground. Occasionally, if there did not appear to be a defined channel but at least seasonal flow was suspected, the flow was characterized as "potential diffuse". Flow condition was characterized again for boulder watercourses where flow was not observed in 2014 during the June 23 and 29, 2015, field investigations.

Channel configuration was characterized as single channel (one flow path), multiple channels (more than one flow path, or what is often termed a "braided" channel), or a diffuse channel (insufficient flow to form an obvious, defined flow path). For a few watercourses the additional descriptor "poorly defined" is used, which indicates that the edge or path of the active channel is unclear, suggesting that surface flow rarely occurs.

The watercourse habitats were divided into three categories, river, boulder, and graminoid. Examples of each are shown in Figure 2-2. River habitats were large, flowing, open channels, which occurred at only three locations. Boulder habitats typically appear in the aerial photographs as well-defined, linear, boulder fields associated with depressions on the landscape. Graminoid habitats are reaches of small watercourses whose banks are vegetated primarily by graminoids growing on peat. Often there are multiple smaller channels that branch and coalesce. Some of these habitats have a significant sand/gravel fraction in the substrate while others flow almost entirely over an organic peaty layer.

Approximate active channel width was measured using GIS with the orthorectified aerial photograph mosaic. Channels that were reasonably uniform in width were assigned a single number, while those channels of widely varying width have been assigned a range. The width of boulder channels was discerned in the aerial photography by the colouration of the boulders or the absence of vegetation. Rivers and graminoid single channels were measured directly in GIS. Multiple channel watercourses were measured from the outer edge of the first channel on one side, to the outer edge of the last channel on the opposite side. Width could not be accurately determined from the aerial photographs for diffuse channels.



Figure 2-2. Examples of habitat types encountered. The top row are rivers. The middle row are boulder watercourses. The bottom row are graminoid watercourses, with the right photograph showing graminoid with coarse substrate, and the left photograph showing graminoid with organic substrate.

2.6 Assessment of Fish Habitat Significance and Crossing Recommendation

The significance of fish habitat in each watercourse was evaluated based upon the habitat in the vicinity of the proposed road crossing, the potential for the watercourse being a migratory route for large-bodied or small-bodied fish between habitats upstream and downstream of the crossing, the life histories and habitat requirements of the fish species present in the study area, and the ecology of Arctic streams. The type of crossing structure recommended was selected to protect the habitat attributes and functions for the maintenance of existing fish populations. The recommended crossing structures are discussed in Section 4.0 (Mitigation and Impact Assessment) and listed for each watercourse crossing in Table 3-2.

3.0 RESULTS

3.1 Overview of Watercourses Intersected by the Proposed Access Road Corridor

The road alignment intersects watercourses at 28 locations where fish habitat exists, or may exist based on the observed habitat conditions (Figure 2-1). The watercourses at three of the locations were characterized as rivers. These provide habitat for small-bodied fish, and potentially also for large-bodied fish, throughout the open-water period. Due to their depth and flow, these watercourses are also potential migration routes for large-bodied fish throughout the open water period. The remaining 25 locations are smaller watercourses where the dominant habitat type is either boulder (16 locations) or graminoid (9 locations).

3.2 Fish Communities

The relatively recent glaciation and the harsh winters of northern Canada have resulted in a fairly short list of fishes that occur in the vicinity of the Meadowbank mine (McPhail and Lindsey, 1970; Scott and Crossman, 1973). The effect of long cold winters upon fish communities is further amplified in small streams and shallow lakes which freeze completely each winter (Haynes *et al*, 2014; Jones *et al*, 2010). In total, five fish species were captured in one or more of the eleven watercourses sampled during the field investigations.

3.2.1 Species Present

The number of individuals of each fish species collected in each watercourse sampled are provided in Table 3-1**Error! Reference source not found.**. The sampling effort, expressed as electroseconds, and the length of channel sampled are also provided. Five fish species were captured at one or more locations. Based on their size, all of the Slimy Sculpin and Ninespine Stickleback were adults and the Burbot, Arctic Char and Arctic Grayling were all juveniles. Fish were not captured at one location that was electrofished in 2014 (km 22.1) and at three locations that were electrofished in 2015 (km 3.4, km 26.1 and km 43.5).

Slimy sculpin was the most commonly captured species; individuals were captured at seven of the eleven sites sampled. Ninespine Stickleback, Burbot and Arctic Grayling were each captured at one location. The most species captured at a site on one occasion was three, at km 16.0 in 2014; this is a short river connecting two lakes.

Table 3-1. Electrofishing catch and effort. Locations are shown in Figure 2-1 and in more detail in Appendix A.

Location	Date dd/mm/yyyy	Electro-seconds (s)	Channel length sampled (m)	Slimy Sculpin (*Cottus cognatus*)	Ninespine Stickleback (*Pungitius pungitius*)	Burbot (*Lota lota*)	Arctic Char (*Salvelinus alpinus*)	Arctic Grayling (*Thymallus arcticus*)
km 3.4	30/08/2014	416	66	2	0	0	0	0
	25/06/2015	430	95	0	0	0	0	0
km 10.7	11/07/2015	621	76	1	0	0	0	0
km 11.1	11/07/2015	1436	204	0	0	0	4	0
km 16.0	01/09/2014	438	88	4	0	1	1	0
	24/06/2015	2156	248	1	0	0	1	0
	06/07/2015	1213	58	2	0	0	1	0
km 20.0	02/09/2014	353	20	13	0	0	1	0
	25/06/2015	465	47	2	0	0	0	0
km 22.1	31/08/2014	368	70	0	0	0	0	0
km 23.9	31/08/2014	590	95	5	1	0	0	0
km 26.1	25/06/2015	466	49	0	0	0	0	0
km 32.3	01/09/2014	626	135	2	0	0	0	0
km 43.5	25/06/2015	403	80	0	0	0	0	0
km 44.8	01/09/2014	249	47	7	0	0	0	1
	25/06/2015	946	207	1	0	0	0	1

3.2.2 Biological Characteristics

The following presents an overview of the fish species that were captured in this study. The natural history of these fishes was considered during the habitat assessment and in determining mitigation recommendations. In addition to these 5 species, lakes in the vicinity of the Meadowbank Mine that have been sampled also contain Lake Trout (*Salvelinus namaycush*) and Round Whitefish (*Prosopium cylindraceum*).

Slimy Sculpin

This species is widespread in rivers and streams of the north, and prefers running water with rocky, gravelly or sandy substrate (McPhail and Lindsey, 1970; Scott and Crossman, 1973). It spawns in the early spring under rocks in shallow shore areas of lakes or in streams (McPhail and Lindsey, 1970; Scott

and Crossman, 1973). Slimy Sculpin may be less tolerant of winter conditions than Ninespine Stickleback (Haynes *et al*. 2014), and may be restricted to areas with large amounts of overwintering habitat (Haynes *et al*. 2014; Hershey *et al*. 2006). Based upon the ecology of Slimy Sculpin in the Arctic, as presented in Haynes *et al*. (2014) and Hershey *et al*. (2006), it is speculated that they were captured at almost all electrofished locations because of those locations' close proximity to winter refugia in upstream and/or downstream lakes. The greater abundance of this species in the late summer, relative to the early summer, is consistent with it recolonizing stream habitats each year.

Ninespine Stickleback

The Ninespine Stickleback is found in the shallow bays of lakes, slow flowing streams, and tundra ponds. It apparently is most associated with aquatic vegetation, but is also found in lower numbers over sand and gravel. It spawns during the spring and summer, usually in dense vegetation (McPhail and Lindsey, 1970). Haynes *et al*. (2014) suggest that Ninespine Stickleback is widely distributed in the Arctic because it can tolerate low oxygen concentrations and high salinity which allows the species to overwinter in lakes where other fish species cannot, as well as its ability to rapidly recolonize de-populated waterbodies via shallow and ephemeral connections during the spring, and then build populations rapidly due to short generation time and rapid growth.

Burbot

Adult Burbot tend to inhabit lakes and large rivers (McPhail and Lindsey, 1970; Scott and Crossman, 1973), but are also known to occur in small streams in the north (McPhail and Lindsey, 1970). Burbot spawn under the ice in late winter, in streams or lake shallows (McPhail and Lindsey, 1970). In the study area spawning is probably limited to deeper lake habitats that do not freeze. The single Burbot captured in this study was in a short river joining two lakes.

Arctic Char

Freshwater Arctic Char are most commonly lake-dwellers, but they will also live in rivers (Stewart and Watkinson, 2004). They must overwinter in water deep enough to not freeze to the bottom (Stewart and Watkinson, 2004). Spawning occurs in the fall, over gravel beds or rocky shoals in lakes and in quiet pools below rapids in rivers, where water depth is sufficient to prevent the embryos from freezing over the winter (McPhail and Lindsey, 1970; Scott and Crossman, 1973).

Arctic Grayling

Arctic Grayling are typically found in schools in clear-water lakes, large rivers and streams (McPhail and Lindsey, 1970; Scott and Crossman, 1973). They spawn during the spring at about the time that the lake ice is breaking-up, usually in small streams over a gravel or rocky bottom (McPhail and Lindsey, 1970), but will spawn in larger rivers if smaller streams are not available (Scott and Crossman, 1973). Arctic Grayling is the only species captured in this study that spawns exclusively in streams.

3.2.3 Abundance

Fish abundance was low at all of the locations sampled. Slimy Sculpin was the most abundant of the fish species captured, and adults were collected in all but one of the watercourses where fish were captured (**Error! Reference source not found.**). Adult Ninespine Stickleback were collected at one location. Juvenile Arctic Char were captured at three locations, and juvenile Arctic Grayling and juvenile Burbot were each captured at one location. At the four locations that were electrofished in both the late summer of 2014 and the spring/early summer of 2015, catch per unit effort of Slimy Sculpin was always higher in the late summer which is consistent with the streams being recolonized each year.

3.3 Arctic Grayling Spawning Surveys

No Arctic Grayling were observed at any of the watercourses examined by visual survey, nor were there any areas of disturbed gravel substrate that might be indicative of Arctic Grayling spawning observed. There was little or no gravel substrate suitable for grayling spawning present in most of the watercourses. The exceptions were the watercourses at km 16.0 and km 44.8, both of which had substantial areas of gravel substrate. No Arctic Grayling or evidence of potential spawning was observed during intensive searching at either of those locations, however one Arctic Grayling was observed by an Inuit assistant working with the archaeology crew while crossing the watercourse at km 16.0 on July 5, 2015 (Michael Haqpi, personal communication with C. Portt). This fish was observed within a few metres of the downstream lake and no Arctic Grayling were observed during a visual examination or captured by electrofishing at that location on June 24 or July 6, 2015. As indicated above, a single juvenile Arctic Grayling was captured at km 44.8 both times that the watercourse was electrofished (Table 3-1).

3.4 Flow Characterization and Potential for Fish Movement

No attempt was made to investigate fish movement directly but, because most small arctic streams freeze down to the permafrost every winter (Jones *et al*, 2010), the fish in those streams are thought to be present as a consequence of either directed seasonal movement (i.e. spawning or feeding migrations) or non-directed seasonal dispersal which, in the case of Ninespine Stickleback, may include dispersal to sink habitats where individuals perish during the winter (Haynes *et al*, 2014). The movement of large-bodied fish may be precluded in the smaller streams by the shallow depth. Also, in many of the smaller streams examined in this study there are reaches where there is no surface flow, only interstitial flow among boulders and cobbles. The extent of movement by small-bodied fish through the interstitial spaces is not known but it is unlikely that there is movement through those spaces by large-bodied fish. Large fish passage might occur if there is flow on top of the boulders or around the boulders during the spring freshet.

It was estimated visually that flow in most of the watercourses during the spring melt of 2015 was approximately twice that observed in the fall of 2014. This increased flow was generally accommodated by wider wetted widths and modest increases in depth. In some locations flow was over ice or frozen ground in June. The greater spring flows appeared to make little difference to the potential for fish

passage through the boulder watercourses that have only interstitial flow, because the depth of the boulder/interstitial space layer accommodated the spring flow along at least part of the watercourses. In the watercourses where surface flow dominated, the somewhat greater water depths during higher flows may facilitate upstream migration by larger fish, if it occurs.

3.5 Habitat Characterization and Crossing Recommendations

The habitat characterizations for each of the locations where the road alignment impinges upon known or potential fish habitat are provided in Table 3-2. A close-up of the orthophoto at each location showing the road alignment, as well as oblique aerial photographs taken from a helicopter and on-the-ground photographs, where available, are presented in Appendix A. The orthophotos covering the route from approximately km 56.3 north were taken on July 21, 2011, while south of that location were taken at approximately the time of the field investigations in 2014.

The total number of locations where fish habitat exists or may exist, based on the observed habitat conditions along the road alignment, is 28. The watercourses at three of the locations (km 16.0, km 23.9 and km 32.3) were characterized as rivers. These provide habitat for small-bodied fish, and potentially also for large-bodied fish, throughout the open-water period. Due to their depth and flow, these watercourses are also potential migration routes for large-bodied fish throughout the open water period. Clear-span bridges are recommended for these locations.

A juvenile Arctic Grayling was captured in the watercourse at km 44.8 in both 2014 and 2015 and there is gravel substrate suitable for Arctic Grayling spawning at numerous places within this watercourse, although no Arctic Grayling or disturbed gravel that might be indicative of Arctic Grayling spawning were observed here in the spring of 2015. This watercourse also provides a connection to a series of upstream lakes and therefore could be an important migration corridor. Due to the potential habitat significance, a clear-span bridge is also recommended at this location.

The remaining 24 locations are smaller watercourses where the dominant habitat type is either boulder (16 locations) or graminoid (8 locations). The crossing recommendations at these locations were based primarily on the presence of potential fish-bearing lakes, that is lakes of sufficient depth to support fish year-round, upstream and, the probability that the watercourses could serve as migration corridors for large-bodied fish during the open-water period. At five locations (km 3.4, km 10.7, km 20.0, km 26.1 and km 43.5) the potential for the watercourses to serve as migration corridors for large-bodied fish to or from upstream habitats was deemed to warrant an open-bottom structure, either an open-bottom arch culvert or a bridge, across a portion of the watercourse to ensure that large fish passage is not impeded. For boulder watercourses, it is recommended that the interstitial flow be maintained on either side of the open-bottomed structure; if additional conveyance is required it may be provided by corrugated steel pipes on top of the boulders. For graminoid streams, corrugated steel pipes may be installed on either side of the open-bottomed structure if additional conveyance is required.

The watercourses at the remaining 19 locations are considered unlikely to be important migration corridors for large fish due to various factors which included shallow depths, the absence of suitable

habitat upstream and, in a number of boulder streams, sections of the watercourse where there is only interstitial flow. Some of these watercourses are used seasonally by small fish which include Slimy Sculpin, Ninespine Stickleback and juvenile Arctic Char. The electrofishing catches in the smaller watercourses were low, ranging from no catch to approximately 3 fish per 100 m of stream. The likelihood of small fish being present is likely related to the proximity to downstream lake habitat that is sufficiently deep to support fish over the winter. As it is not possible to determine with certainty which of these watercourses do and do not support small fish during the open water season, the crossing recommendations for all of them are intended to ensure that small fish movement can continue to occur. For graminoid watercourses (n=7) and for the one boulder watercourse where surface flow was present along its entire length, it is recommended that at least one culvert be embedded 0.3 m below the existing stream invert; additional culverts, if required, may be embedded or installed at the existing stream invert. For the boulder watercourses with interstitial flow in at least some sections (n=11), it is recommended that interstitial flow be maintained across the watercourse and at least one culvert be installed level with the top of the boulders at the lowest point in the channel. If additional culverts are required for conveyance, they may be installed at higher elevations.

Table 3-2. Habitat characterization and assessment and crossing recommendations where the road intersects known or potential fish habitat. Locations are shown in Figure 2-1. The road alignment at each location, super-imposed on the aerial photography, and photographs are presented in Appendix A. Location is the distance of each crossing from the southern terminus of the road.

Location (km)	Latitude	Longitude	Flow characteristics	Channel configuration	Dominant habitat	Approximate flood plain width (m)	Potential fish-bearing lake upstream	Examined on ground	Fish captured	Comment	Habitat assessment.	Minimum crossing type recommended to mitigate potential impacts to fish.
2.1	65.0838	-96.0420	No surface flow. May be interstitial flow	Single	Boulder	25	Yes	No		Surface flow is infrequent	May not provide fish habitat most of the time due to lack of flow. Fish passage also unlikely.	Corrugated steel pipe installed level with the top of the boulders at the lowest point in the crossing. Maintain interstitial flow across remainder of channel.
3.4	65.0891	-96.0587	Mainly surface flow, but short sections of interstitial flow near proposed crossing in both 2014 and 2015.	Single	Boulder	20-50	Yes	Yes (2014 and 2015)	2 Slimy Sculpin; no fish captured	Upstream of crossing is open with boulder and cobble, with some patches of graminoid. In boulder section, lichen suggest flow rarely covers boulders. Higher gradient.	Provides seasonal small-bodied fish habitat and a potential migration route for fish, but upstream lakes not extensive or deep and so may have limited fish habitat. No Arctic Grayling were observed.	Use an open-bottom structure to span open channel. Maintain interstitial flow across remainder of channel. If additional capacity required, can use corrugated steel pipe(s) on top of channel boulders.
8.0	65.1232	-96.1048	Surface flow, but diffuse in places.	Multiple/Diffuse	Graminoid	25	No	No		Was not crossed by earlier alignment	May provide seasonal small fish habitat.	Corrugated steel pipe inset 0.3 m below channel invert.
8.4	65.1267	-96.1071	Surface flow at crossing. Only interstitial flow in boulder section downstream in 2014 and 2015.	Multiple	Graminoid	Not determinable	Yes	No		Watercourse poorly defined, and upstream lake is small	May provide seasonal small-bodied fish habitat only. Upstream migration by large-bodied fish unlikely. Only small lake upstream.	Corrugated steel pipe inset 0.3 m below channel invert.
10.7	65.1458	-96.1108	Interstitial flow at crossing and surface flow in upstream bedrock sections during fall of 2014. Surface flow more widespread during spring 2015 but still sections with only interstitial flow.	Single	Boulder	25-90	Yes	Yes (2015)	1 Slimy Sculpin	Flow may rarely if ever cover boulders. Bedrock sections upstream of crossing. Channel features suggest that higher flows than observed may occur occasionally. No gravel observed.	May provide seasonal small fish habitat. Possible upstream migration route for fish during spring freshet or during other periods of high flow. No Arctic Grayling were observed.	Use an open-bottom structure to span open channel. Maintain interstitial flow across remainder of channel. If additional capacity required, can use corrugated steel pipe(s) on top of channel boulders.
11.1	65.1492	-96.1112	Surface flow	Single	Graminoid	01-Aug	No	Yes (2015)	4 Arctic Char (juveniles)	Substrate nearly all organic mat with about 5% gravel.	No Arctic Grayling were observed, but provides seasonal habitat for juvenile Arctic Char and likely also provides seasonal habitat for small-bodied fishes.	Corrugated steel pipe inset 0.3 m below channel invert.
12.8	65.1602	-96.1327	Surface flow, but diffuse in places.	Multiple/	Graminoid	30	No	No		Poorly defined channel resembles wetland. Upstream pond shallow	May provide seasonal small-bodied fish habitat only. No upstream migration of large fish likely, due to wetland character of connection and lack of upstream lake habitat.	Corrugated steel pipe inset 0.3 m below channel invert.

Location (km)	Latitude	Longitude	Flow characteristics	Channel configuration	Dominant habitat	Approximate flood plain width (m)	Potential fish-bearing lake upstream	Examined on ground	Fish captured	Comment	Habitat assessment.	Minimum crossing type recommended to mitigate potential impacts to fish.
16.0	65.1860	-96.1614	Surface flow	Single	River	71	Yes	Yes (2014) and 2015)	4 Slimy Sculpin, 1 Burbot, 1 Arctic Char; 1 Slimy Sculpin, 1 Arctic Char; 2 Slimy Sculpin, I Arctic Char	Wide, shallow, flowing watercourse with cobble/gravel/boulder substrate and graminoid patches	Watercourse provides seasonal small fish habitat and contains gravel substrate that may be suitable for Arctic Grayling spawning. Potential migration route between lakes. No Arctic Grayling were observed.	Span bankfull channel with bridge.
18.6	65.2022	-96.1844	Mainly interstitial flow in the fall of 2014. Substantial flow, but still only interstitial in places in the spring of 2015.	Single	Boulder	40	Yes	Yes (2015)	Not electro-fished	Boulder/cobble substrate. Tundra vegetation in parts of wide channel suggest surface flow is infrequent. Some sections may have high gradient.	Small wetted channel within the larger feature may provide seasonal habitat for small-bodied fishes only. High flows may be infrequent. Not an upstream migration route for large-bodied fish during spring freshet due to sections with only interstitial flowNo Arctic Grayling were observed.	Corrugated steel pipe installed level with the top of the boulders at the lowest point in the crossing. Maintain interstitial flow across remainder of channel.
20.0	65.2092	-96.2089	Surface flow at crossing location, but only interstitial flow in both 2014 and 2015 where boulders dominate downstream of proposed crossing.	Multiple	Graminoid	18-50	Yes	Yes (2014 and 2015)	13 Slimy Sculpin, 1 juvenile Arctic Char; 2 Slimy Sculpin	Steeper sections have shrubs and other tundra vegetation perched on top of boulders, with water flowing beneath. At crossing it is graminoid controlled, but with ample boulder and cobble. Crossing was shifted to location with lower gradient.	Provides seasonal small fish habitat, as well as potential spawning habitat with cobble/gravel substrate in places for Arctic Grayling. Migration between lakes by large-bodied fishes unlikely due to sections with only interstitial flow, but could occur during high flows. Joins two relatively large lakes. No Arctic Grayling were observed.	Use an open-bottom structure to span open channel. Maintain interstitial flow across remainder of channel. If additional capacity required, can use corrugated steel pipe(s) on top of channel boulders.
22.1	65.2198	-96.2451	Surface flow, but diffuse in some locations in 2014 and 2015.	Multiple/Diffuse	Graminoid	Not determinable	No	Yes (2014)	no fish captured	No invertebrates observed.	May provide seasonal small-bodied fish habitat only. Upstream migration likely not possible or important due to channel configuration and flow volume. Upstream pond is shallow.	Corrugated steel pipe inset 0.3 m below channel invert.
23.9	65.2268	-96.2785	Surface flow	Single	River	100-120	Yes	Yes (2014 and 2015)	5 Slimy Sculpin, 1 Ninespine Stickle-back (in 2014). Not electrofished in 2015.	Short watercourse between lakes. Flow from south to north. Some algae on rocks. Boulder/cobble substrate.	Fish habitat. Broad, short section of river between two large lake systems. Therefore fish passage may be an important function. No Arctic Grayling were observed.	Span bankfull channel with bridge.
26.1	65.2235	-96.3198	Surface flow in some sections and only interstitial flow in others in June 2015.	Single	Boulder	17-72	Yes	Yes (2015)	No fish captured		May not provide fish habitat most of the time, however, it appears as if flows may occasionally be substantial and fish passage may occur at that time, as this is a connection between two potentially fish-bearing lakes. No Arctic Grayling were observed.	Use an open-bottom structure to span open channel. Maintain interstitial flow across remainder of channel. If additional capacity required, can use corrugated steel pipe(s) on top of channel boulders.
28.3	65.2225	-96.3641	No surface flow in 2014 or 2015. Interstitial flow only in 2015.	Single	Boulder	21-135	Yes	Yes (2015)	Not possible to sample for fish		May not provide fish habitat due to lack of surface flow. Fish passage is unlikely.	Corrugated steel pipe installed level with the top of the boulders at the lowest point in the crossing. Maintain interstitial flow across remainder of channel.

Location (km)	Latitude	Longitude	Flow characteristics	Channel configuration	Dominant habitat	Approximate flood plain width (m)	Potential fish-bearing lake upstream	Examined on ground	Fish captured	Comment	Habitat assessment.	Minimum crossing type recommended to mitigate potential impacts to fish.
30.4	65.2267	-96.4070	No surface connection in 2014. Surface connection in 2015.	Single	Boulder	50	No	No			Provides seasonal fish habitat and seasonal fish passage between ponds. Migration of large-bodied fish unlikely due to shallow nature of small pond south of alignment.	Corrugated steel pipe installed level with the top of the boulders at the lowest point in the crossing. Maintain interstitial flow across remainder of channel.
32.3	65.2193	-96.4342	Surface flow	Single	River	13-25	Yes	Yes (2014 and 2015)	2 Slimy Sculpins (in 2014); not electrofished in 2015	Meadowbank River. Flowing south to north. Boulder/cobble/bedrock substrate	Large flowing river, with large lakes upstream and downstream. Important fish habitat. May provide spawning habitat for large-bodied fishes and likely is an important migration route for fishes. No Arctic Grayling were observed.	Span bankfull channel with bridge.
36.2	65.2433	-96.4778	No surface flow at crossing in 2014. May be interstitial flow.	Single	Boulder	22	Yes	No		Drainage feature appears to feed a downslope seepage area.	Likely does not provide fish habitat. Surface flow is unlikely except possibly during an extreme flow-generating event. Fish passage is likely not an issue due the lack of surface flow in the watercourse.	Corrugated steel pipe installed level with the top of the boulders at the lowest point in the crossing. Maintain interstitial flow across remainder of channel.
41.8	65.2772	-96.4042	Likely seasonal interstitial flow	Single	Boulder	41	No	No		Crossing relocated and therefore not examined during field investigations. Assessment is based on aerial photography. Small catchment. Upstream pond is approximately 170 m at widest point.	Likely does not provide fish habitat. Surface flow is unlikely except possibly during an extreme flow-generating event. Fish passage is likely not an issue due the lack of flow in the watercourse. Recommendation is precautionary.	Corrugated steel pipe installed level with the top of the boulders at the lowest point in the crossing. Maintain interstitial flow across remainder of channel.
43.5	65.2919	-96.4131	Surface flow at crossing and other discrete locations, but interstitial flow through much of watercourse in 2014. More surface flow in 2015.	Single	Boulder	50-90	Yes	Yes (2015)	No fish captured	Substrate primarily cobble and boulder.	May provide seasonal fish habitat. Fish passage may be possible during the spring freshet during some years, and may be important for the chain of upstream lakes. No Arctic Grayling were observed.	Use an open-bottom structure to span open channel. Maintain interstitial flow across remainder of channel. If additional capacity required, can use corrugated steel pipe(s) on top of channel boulders.
44.4	65.2991	-96.4123	Surface flow at crossing in 2014 and 2015, but diffuse at some downstream locations	Multiple/Diffuse	Graminoid	14-50	No	Yes (2014)	Not electro-fished	One channel examined had cobble/boulder substrate, but others had organic (peat) substrate.	May provide seasonal small-bodied fish habitat only. Upstream migration probably not important due shallowness of small upstream lake. No spawning habitat for large-bodied fish downstream of crossing due to lack of suitable substrate.	Corrugated steel pipe inset 0.3 m below channel invert.
44.8	65.3028	-96.4122	Surface flow	Multiple	Graminoid	30	Yes	Yes (2014 and 2015)	7 Slimy Sculpin, 1 juvenile Arctic Grayling; 1 Slimy Sculpin, 1 Arctic Grayling	Variety of substrate sizes (gravel/cobble). Caddisflies on rocks.	Seasonal small-bodied fish habitat and potential spawning habitat for Arctic Grayling. Likely provides fish passage upstream to a number of small lakes. No spawning Arctic Grayling were observed, but one juvenile was captured in 2014 and in 2015.	Span bankfull channel with bridge.

Location (km)	Latitude	Longitude	Flow characteristics	Channel configuration	Dominant habitat	Approximate flood plain width (m)	Potential fish-bearing lake upstream	Examined on ground	Fish captured	Comment	Habitat assessment.	Minimum crossing type recommended to mitigate potential impacts to fish.
46.1	65.3143	-96.4200	Surface flow at crossing but diffuse in some locations and interstitial section downstream in 2014 and 2015.	Single	Graminoid	Not determinable	No	No		Poorly defined channel.	May provide seasonal small-bodied fish habitat only, Upstream migration for large-bodied fishes unlikely due to section of interstitial flow downstream. Only shallow pond upstream.	Corrugated steel pipe inset 0.3 m below channel invert.
49.4	65.3246	-96.4805	Surface flow, but diffuse or interstitial in many locations in 2014 and 2015.	Single	Boulder	Not determinable	Yes	No		Poorly defined channel	May provide seasonal habitat for small-bodied fish. Migration of large-bodied fish unlikely due to nature of channel, and lack of surface flow in many places.	Corrugated steel pipe inset 0.3 m below channel invert.
51.2	65.3300	-96.5168	No surface flow in 2014 or 2015. May be interstitial flow.	Single	Boulder	65-100	Yes	No		May occasionally be a surface connection when lake levels are high	May not provide fish habitat most of the time. May never be sufficient water to allow large-bodied fish passage.	Corrugated steel pipe installed level with the top of the boulders at the lowest point in the crossing. Maintain interstitial flow across remainder of channel.
51.8	65.3342	-96.5255	No surface water in 2014. Surface water, but appears to be standing water, in 2015.	Single	Boulder	98	Yes	No		Does not appear to be a connection to lakes to north. Possible there is an interstitial connection.	Probably no connection to lakes to north. May provide seasonal habitat for small fishes when flooded in spring.	Corrugated steel pipe installed level with the top of the boulders at the lowest point in the crossing. Maintain interstitial flow across remainder of channel.
56.9	65.3626	-96.6040	Surface water at crossing in 2015, but appears to be due to high levels in adjacent lakes. Probably dry most of the year.	Single	Boulder	60-85	Yes	No		Connection between lakes when lake levels high	Provides small-bodied fish habitat and passage between lakes when flooded in spring.	Corrugated steel pipe installed level with the top of the boulders at the lowest point in the crossing. Maintain interstitial flow across remainder of channel.
59.7	65.3871	-96.6031	Some surface flow at crossing and other discrete location in 2015, but does not appear to be a surface connection to upstream ponds.	Single	Boulder	25	No	No		May occasionally connect two small shallow ponds to lake to west, but only during high lake water levels.	May provide seasonal habitat for small-bodied fishes.	Corrugated steel pipe installed level with the top of the boulders at the lowest point in the crossing. Maintain interstitial flow across remainder of channel.
63.1	65.4050	-96.6503	Some surface flow or standing water at crossing and other discrete locations in 2015. Probably seasonal flow only.	Single. Poorly defined	Boulder	27	No	No		New location in 2015 due to shift in alignment. Poorly defined boulder feature with some tundra vegetation. Very small drainage area	May provide seasonal habitat for small-bodied fishes. No upstream lake.	Corrugated steel pipe installed level with the top of the boulders at the lowest point in the crossing. Maintain interstitial flow across remainder of channel.

3.6 Summary and Conclusions

The Amaruq Exploration Access Road route is 64.1 km long, and runs from the Vault Pit of the Meadowbank Mine to the Amaruq project exploration property, which is located approximately 50 kilometres northwest of the Meadowbank mine. The Amaruq Exploration Access Road alignment intersects aquatic habitat that is or has the potential to be fish habitat at 28 locations. Some of the watercourses, based on their flow characteristics and habitats and/or connections to upstream waterbodies, are potential spawning habitat and/or potential migration routes for larger fish species. Many of the smaller watercourses provide seasonal habitat for Slimy Sculpin and Ninespine Stickleback. Some of these also provide seasonal habitat for juvenile Arctic Char. Based on the electrofishing results and their habitat characteristics, it is likely that some of the smaller watercourses do not support fish.

Clear-span bridges are recommended at four locations which are considered to be the most significant in terms of in-stream fish habitat. Open-bottom structures spanning a portion of the channel are recommended at five locations where there is the potential for the migration of large fish between suitable habitats during the open-water season. At 19 locations, where seasonal movement of small fish may occur, corrugated steel pipes are recommended. At each of those locations, at least one corrugated steel pipe is to be embedded 0.3 m below the stream invert where surface flow occurs or at the boulder surface where only interstitial flow occurs along part of the watercourse, to ensure that small fish passage can occur. A Pathways of Effect analysis will be undertaken to identify mitigation measures to avoid harm to fish and fish habitat and determine if residual effects will remain.

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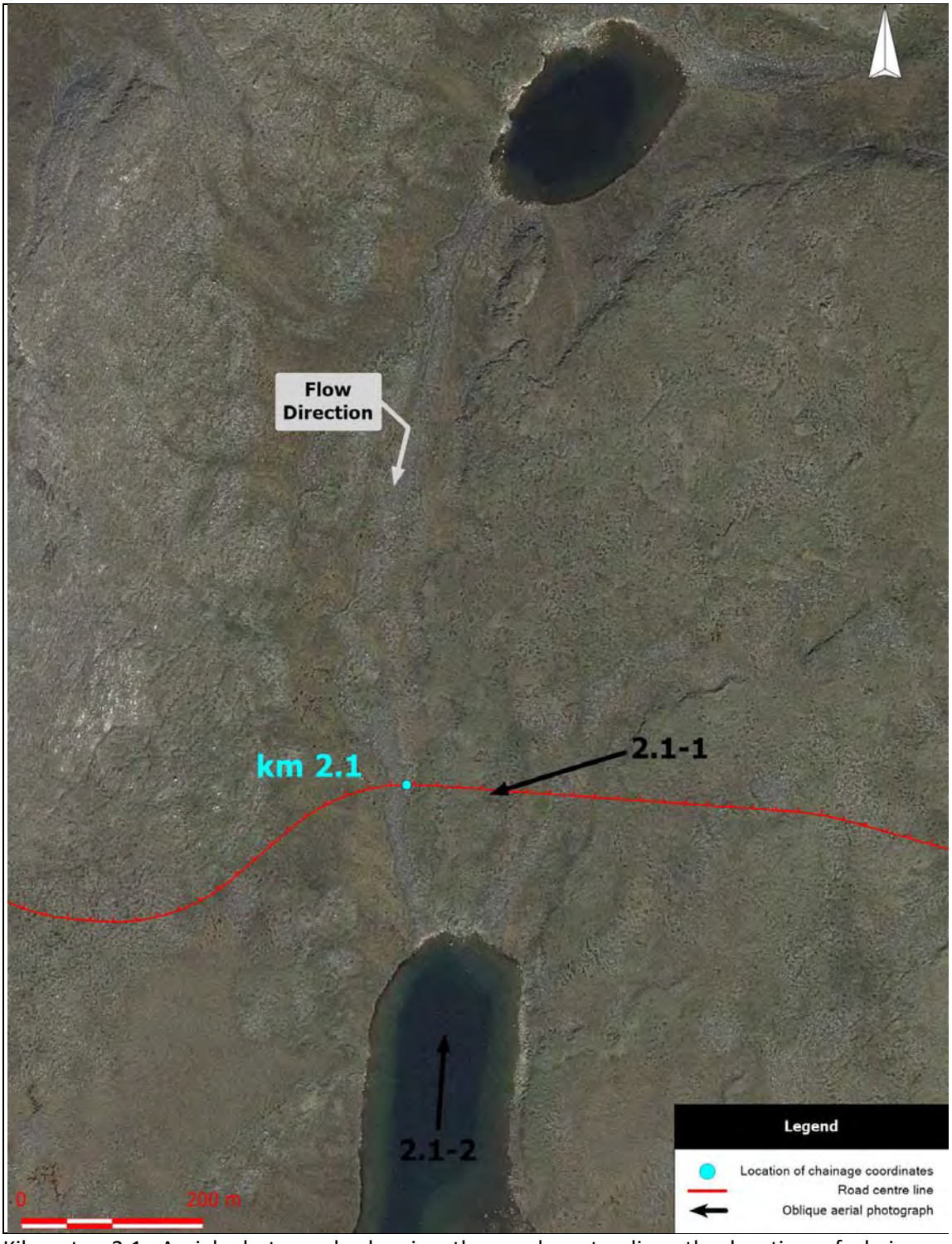
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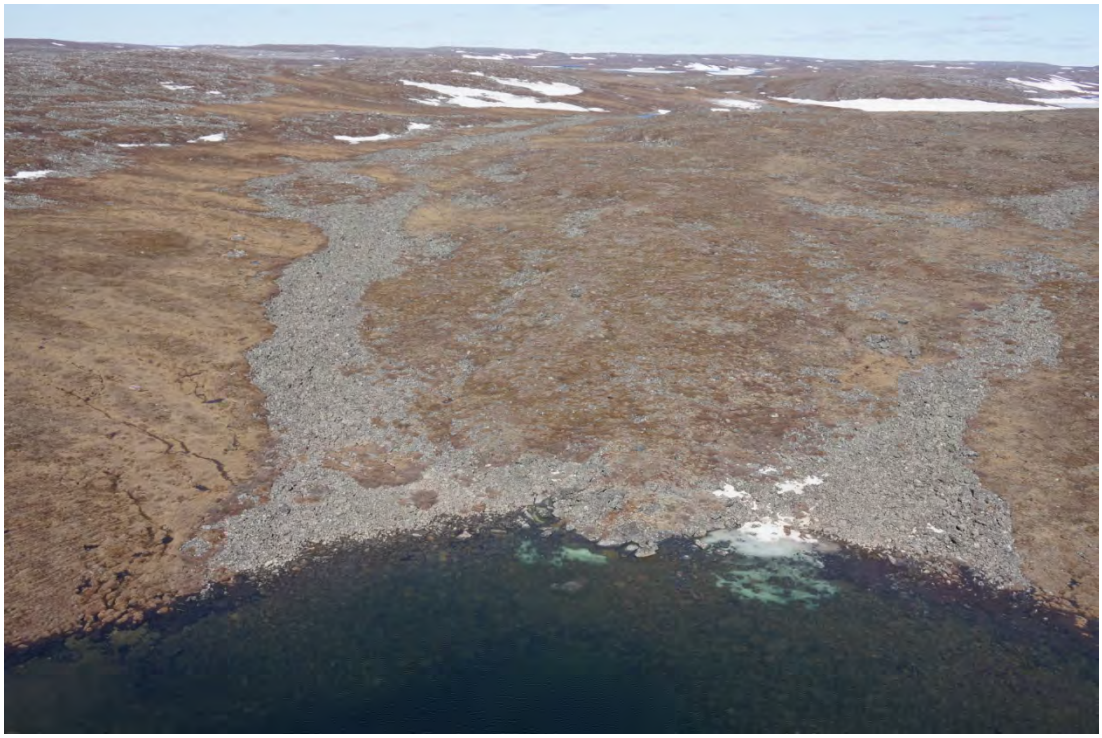
APPENDIX A - PHOTOGRAPHS



Kilometre 2.1. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



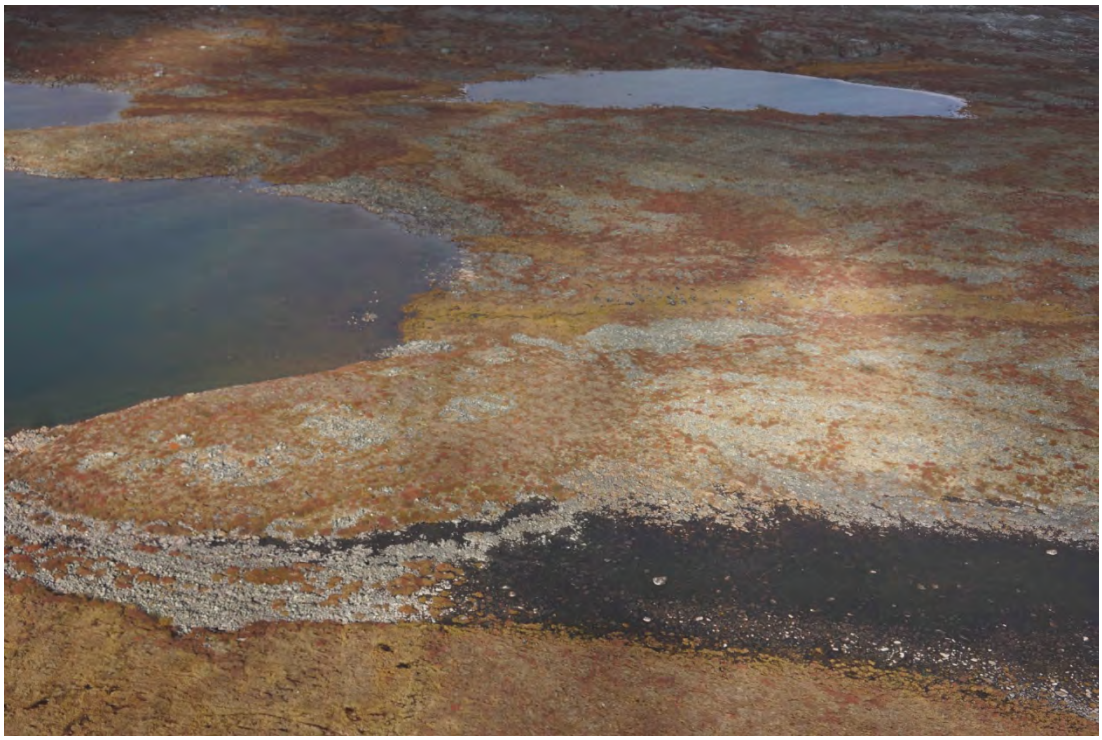
Kilometre 2.1. Oblique aerial photograph 2.1-1. August 30, 2014.



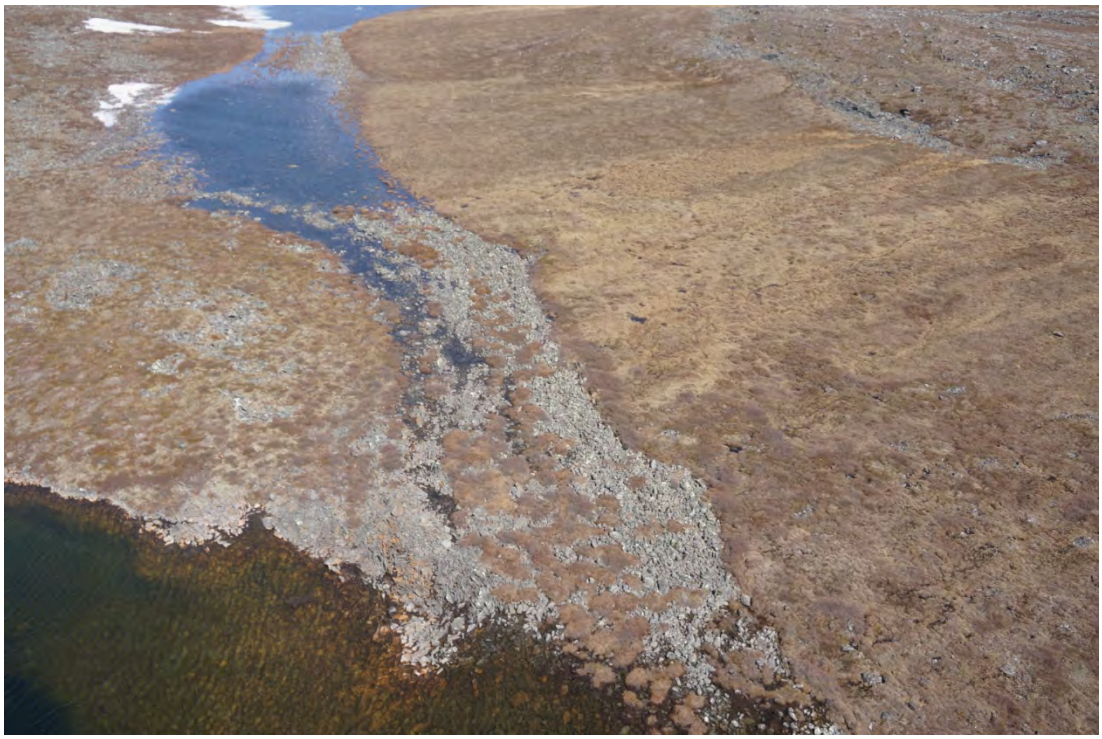
Kilometre 2.1. Oblique aerial photograph 2.1-2. June 29, 2015.



Kilometre 3.4. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



Kilometre 3.4. Oblique aerial photograph 3.4-1. August 30, 2014.



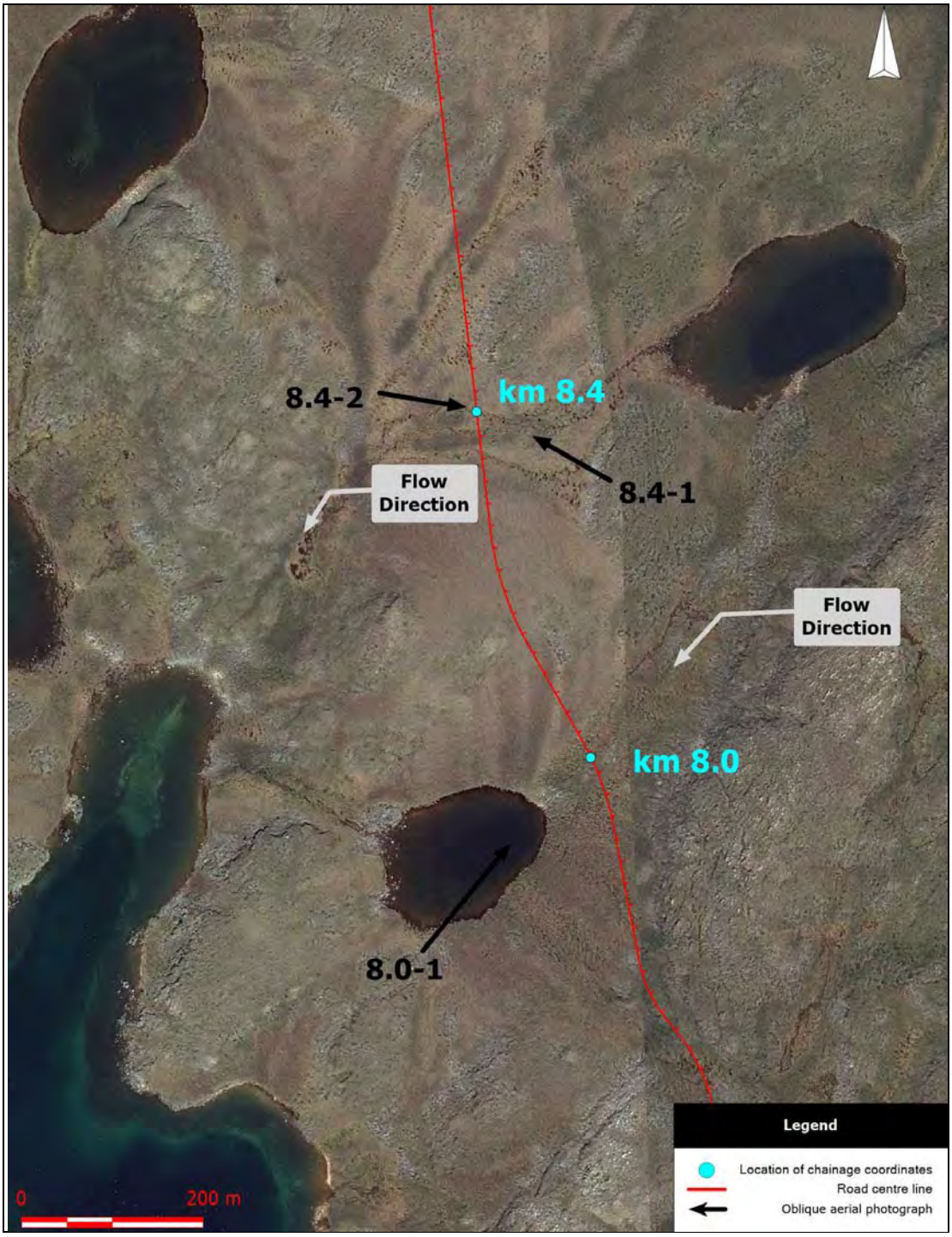
Kilometre 3.4. Oblique aerial photograph 3.4-2. June 29, 2015.



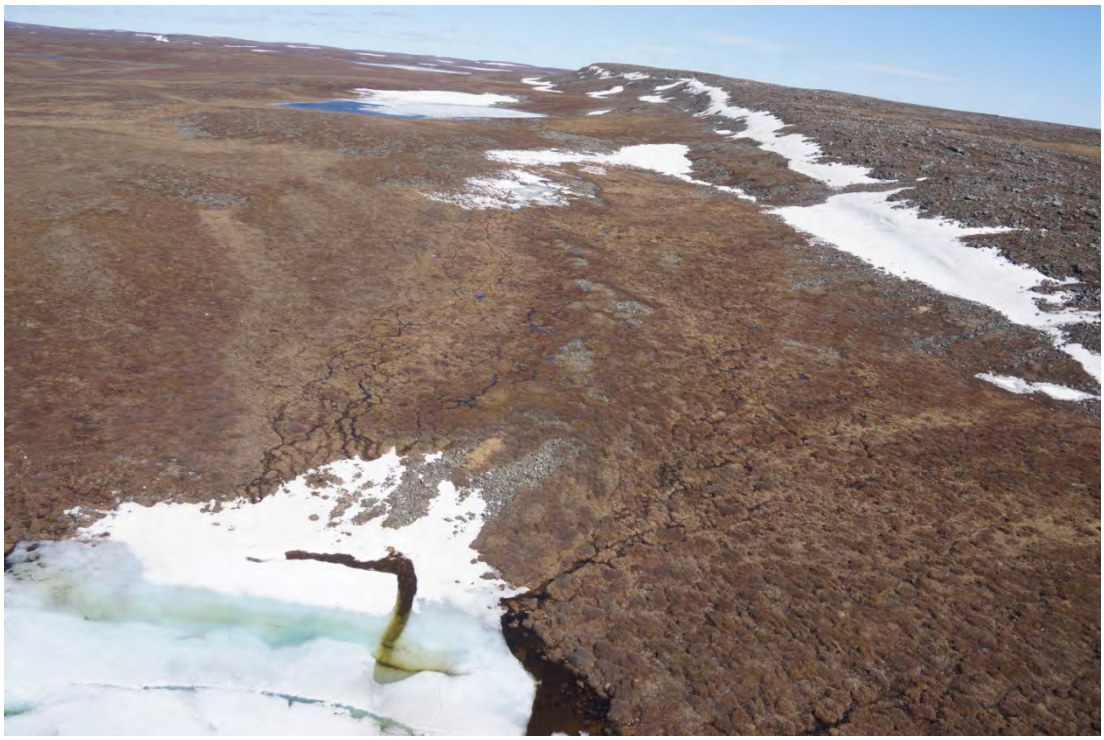
Kilometre 3.4. Photograph from the ground. Upstream view from the proposed road crossing. August 30, 2014.



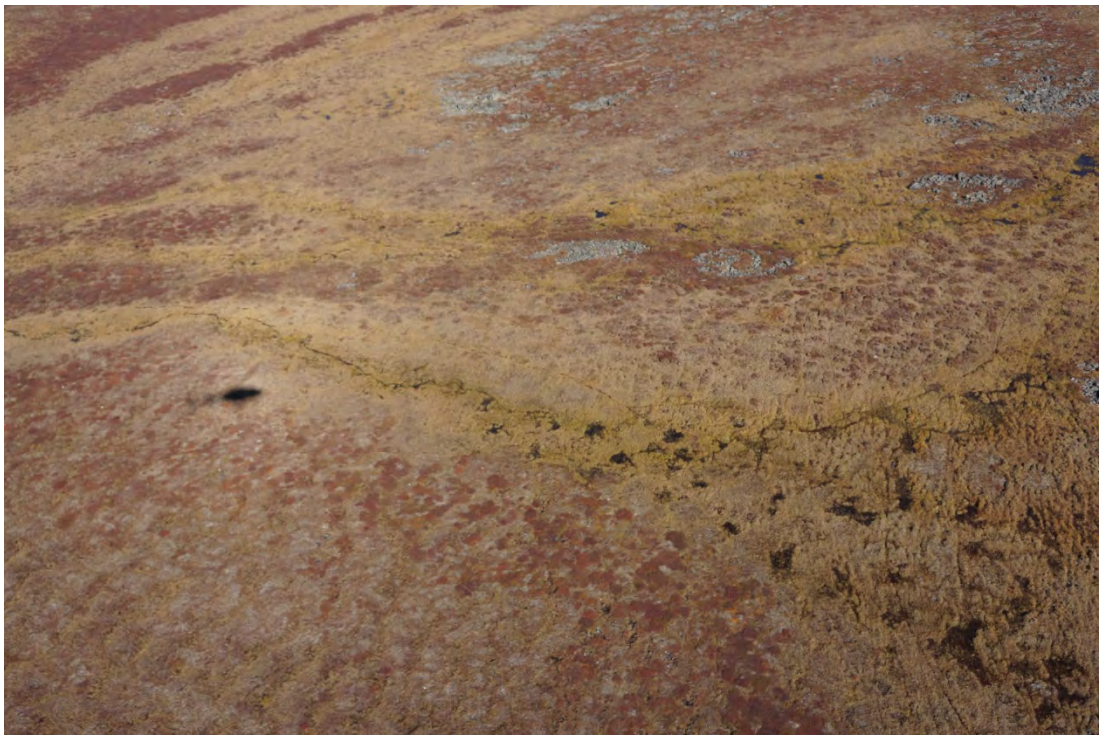
Kilometre 3.4. Photograph from the ground. Downstream view from approximately 30 m downstream from the proposed road crossing. June 23, 2015.



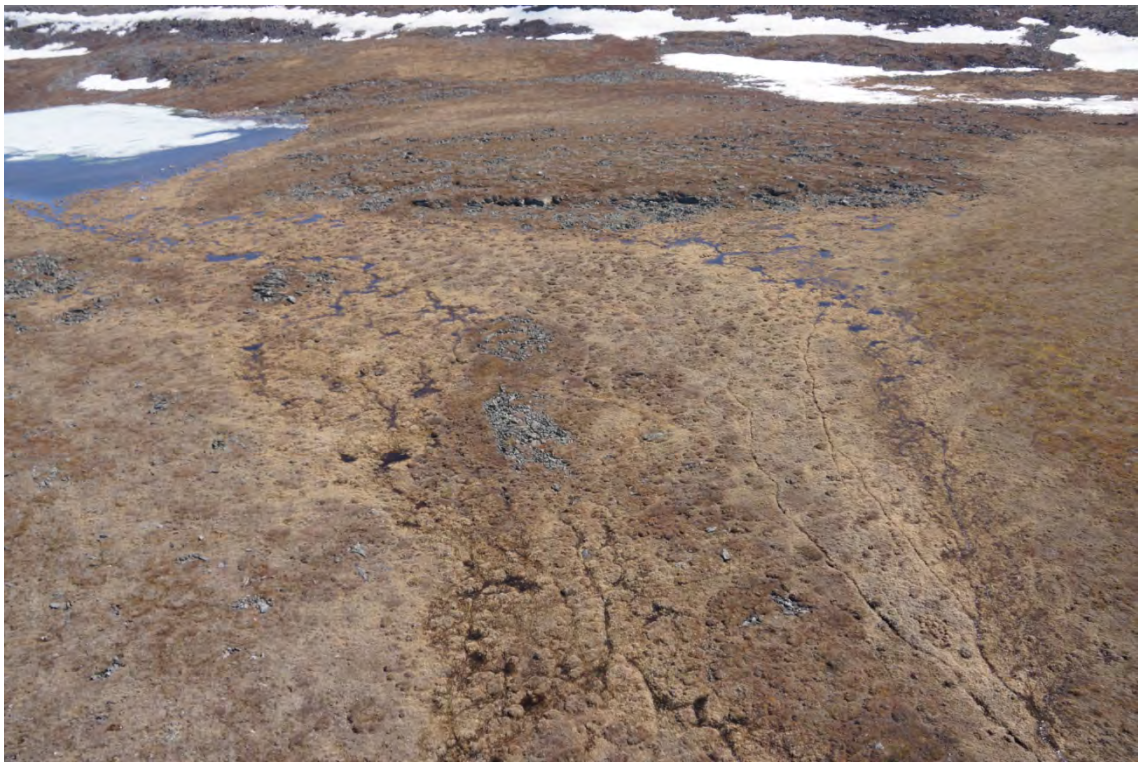
Kilometres 8.0 and 8.4. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



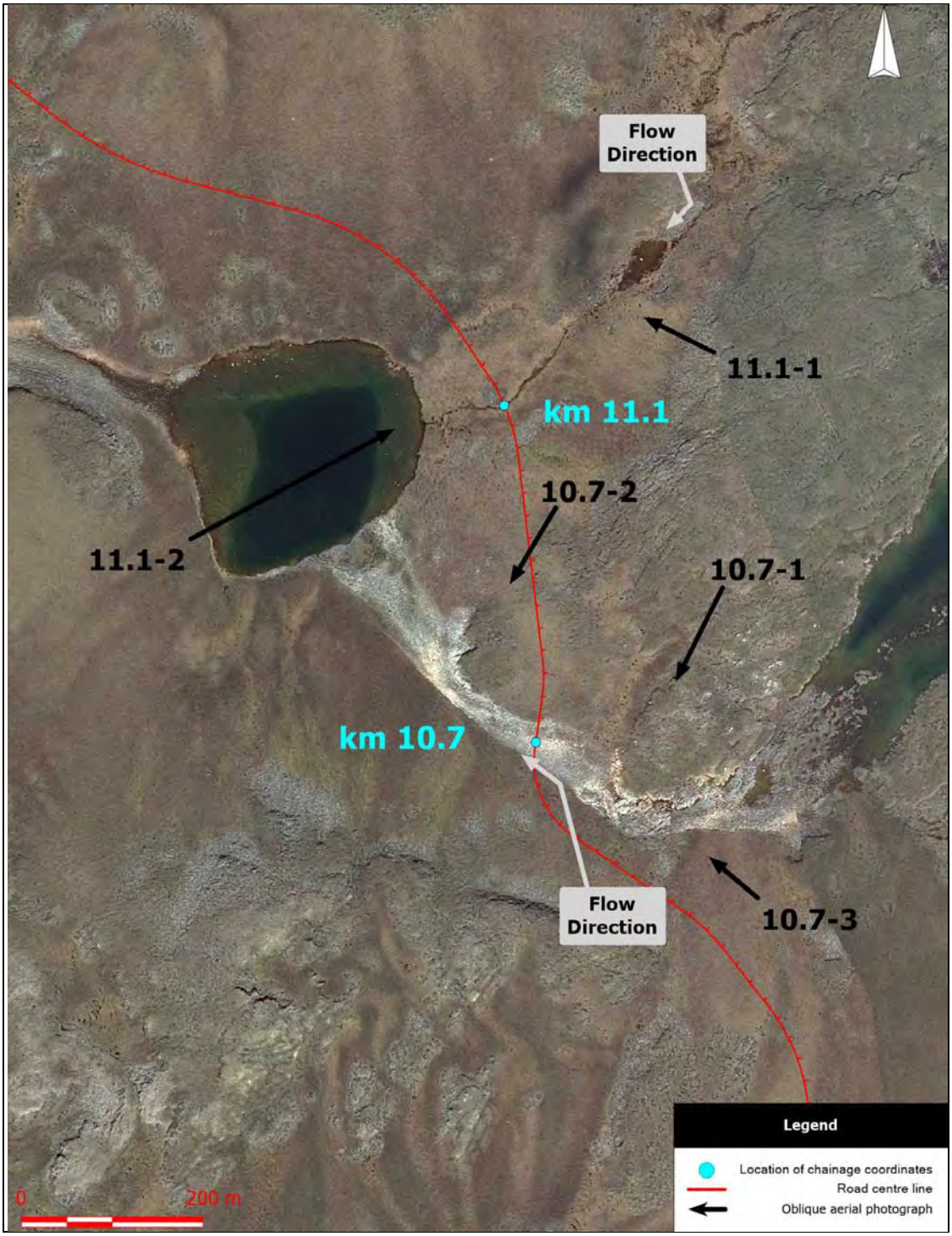
Kilometre 8.0. Oblique aerial photograph 8.0-1. June 29, 2015. There is no 2014 photograph.



Kilometre 8.4. Oblique aerial photograph 8.4-1. September 2, 2014.



Kilometre 8.4. Oblique aerial photograph 8.4-2. June 29, 2015.



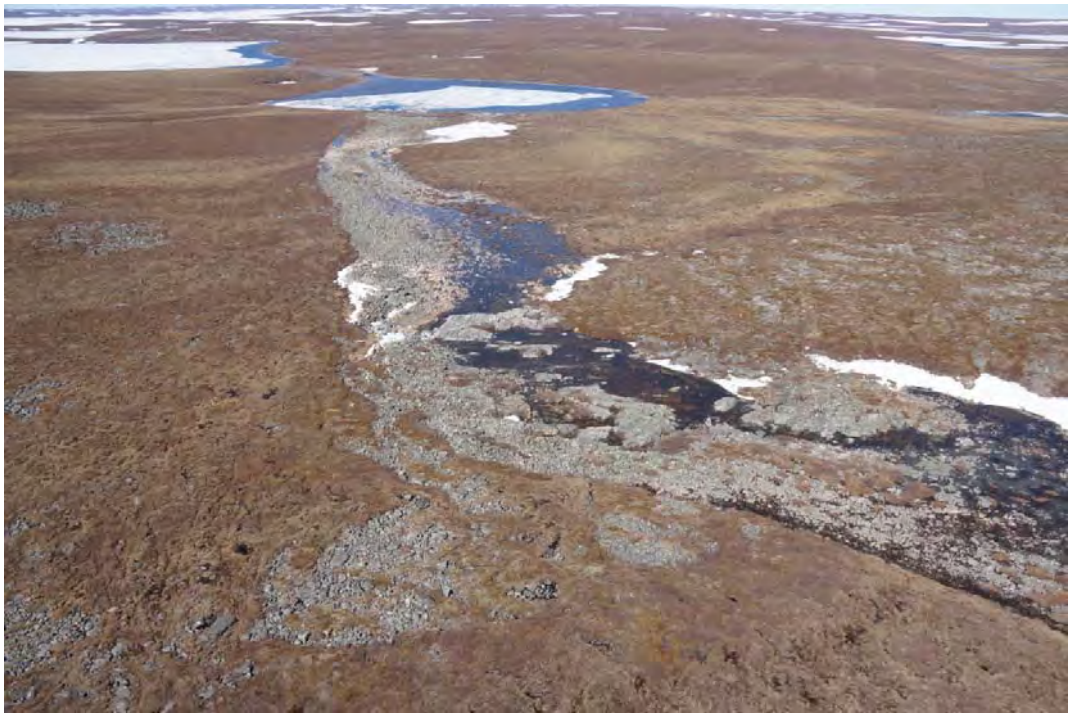
Kilometres 10.7 and 11.1. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



Kilometre 10.7. Oblique aerial photograph 10.7-1. August 30, 2014.



Kilometre 10.7. Oblique aerial photograph 10.7-2. August 30, 2014.



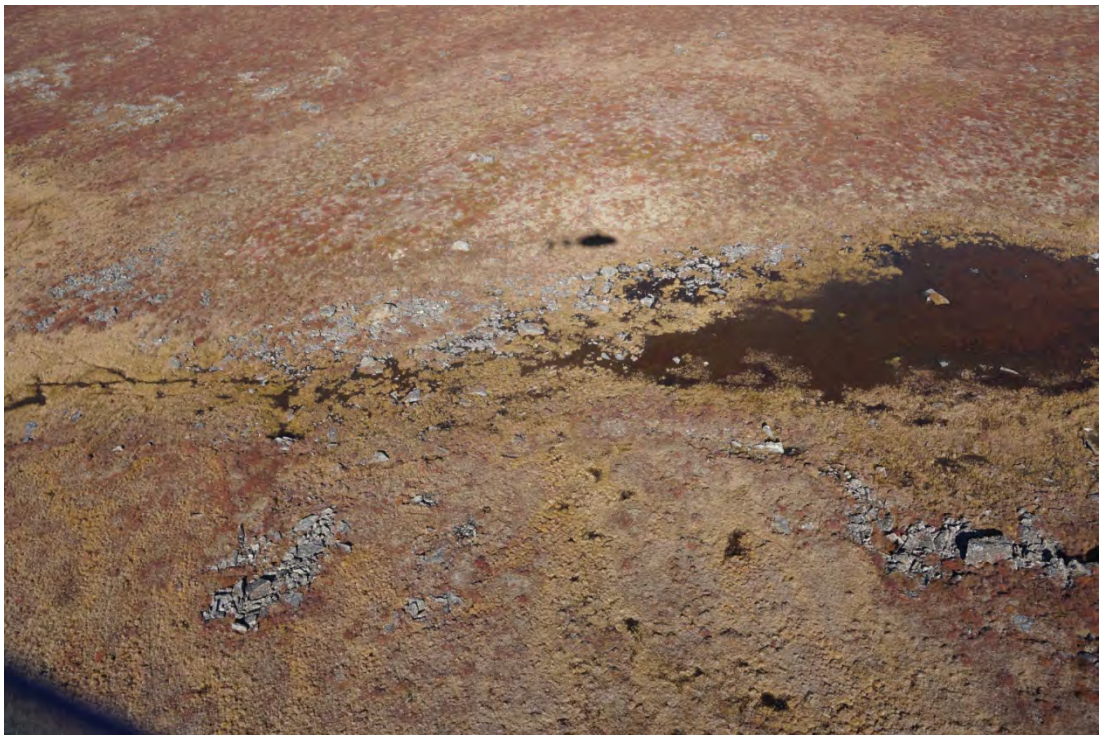
Kilometre 10.7. Oblique aerial photograph 10.7-3. June 29, 2015.



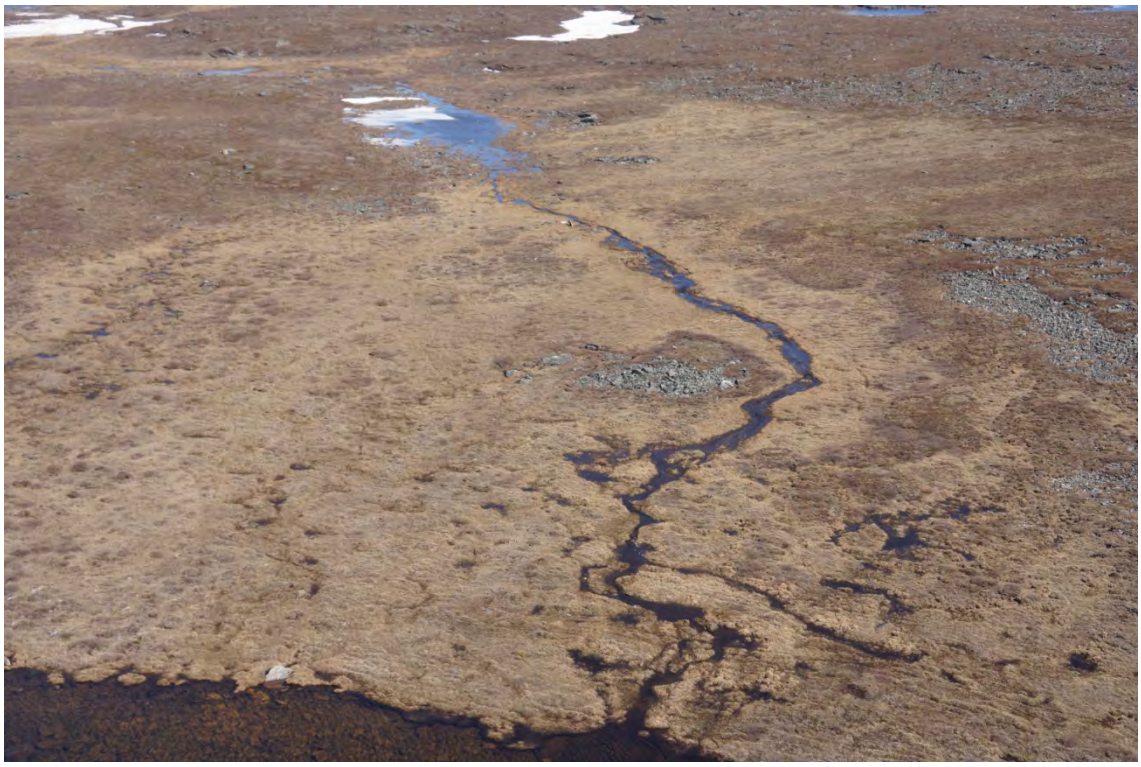
Kilometre 10.7. Photograph from the ground. View of the proposed road crossing. June 23, 2015.



Kilometre 10.7. Photograph from the ground. View downstream from the proposed road crossing. June 23, 2015.



Kilometre 11.1. Oblique aerial photograph 11.1-1. August 30, 2014.



Kilometre 11.1. Oblique aerial photograph 11.1-2. June 29, 2015.



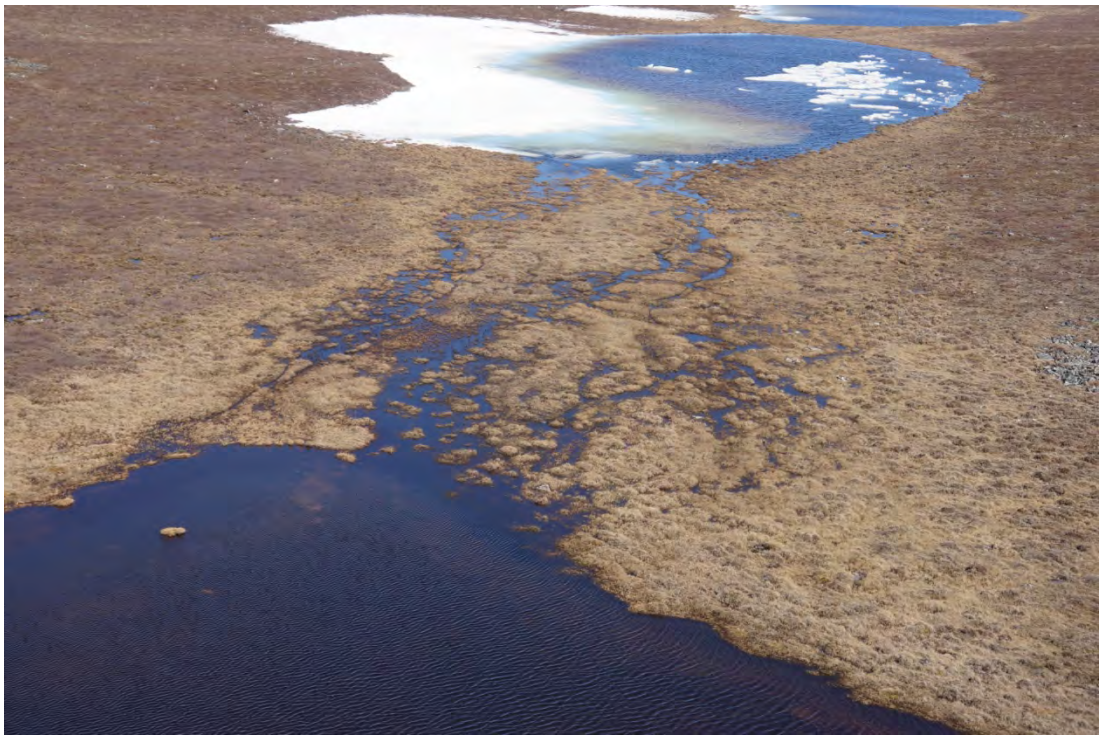
Kilometre 11.1. Photograph from the ground. View upstream from near the downstream lake. July 11, 2015.



Kilometre 12.8. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



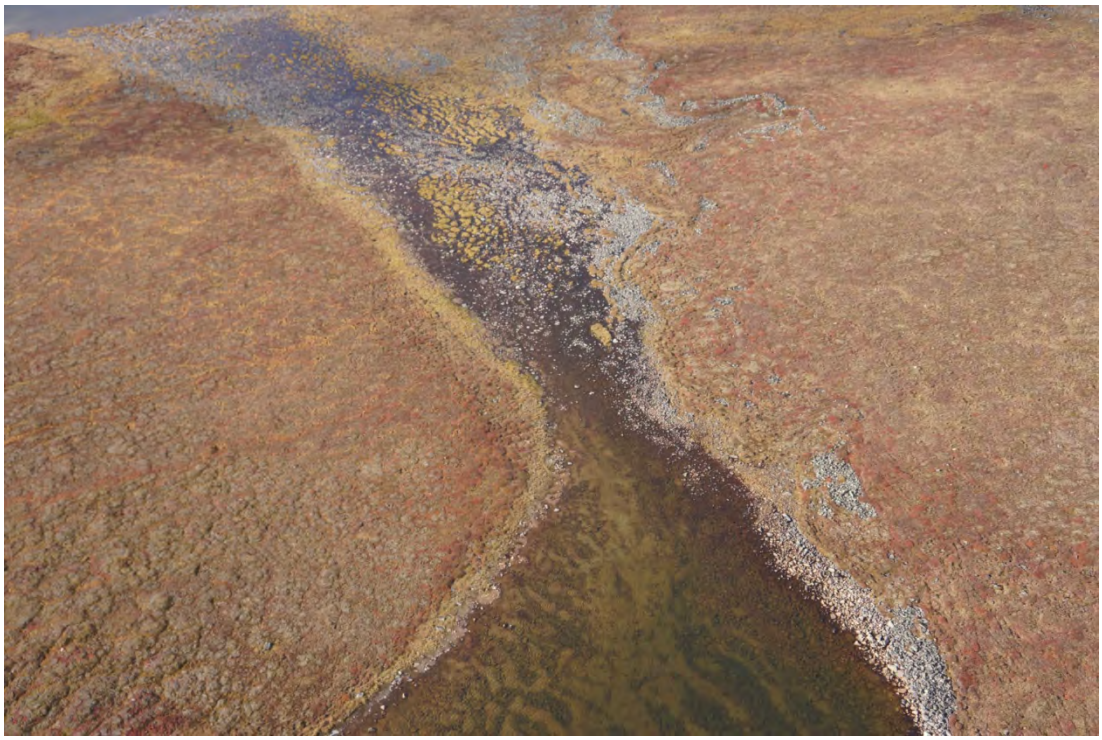
Kilometre 12.8. Oblique aerial photograph 12.8-1. August 30, 2014.



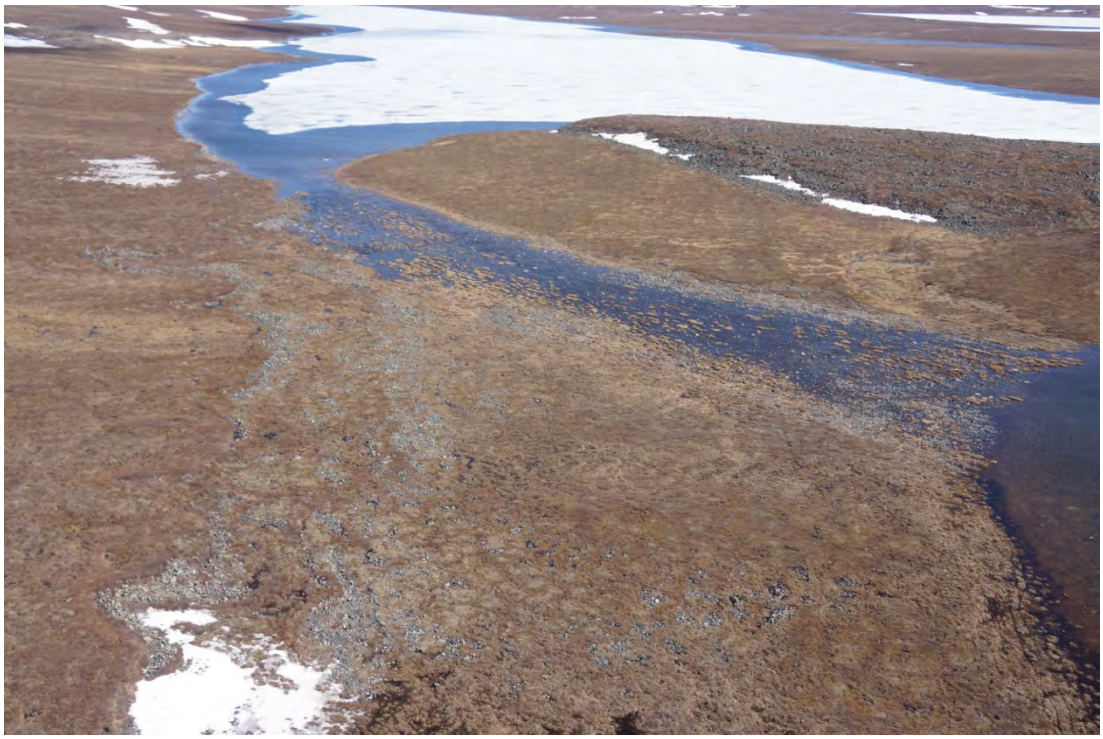
Kilometre 12.8. Oblique aerial photograph 12.8-2. June 29, 2015.



Kilometre 16.0. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



Kilometre 16.0. Oblique aerial photograph 16.0-1. August 30, 2014.



Kilometre 16.0. Oblique aerial photograph 16.0-2. June 29, 2015.



Kilometre 16.0. Photograph from the ground. Approximately 100 m upstream from lake.



Kilometre 16.0. Photograph from the ground. Upstream view from 37 m downstream of the proposed road crossing location. September 1, 2014.



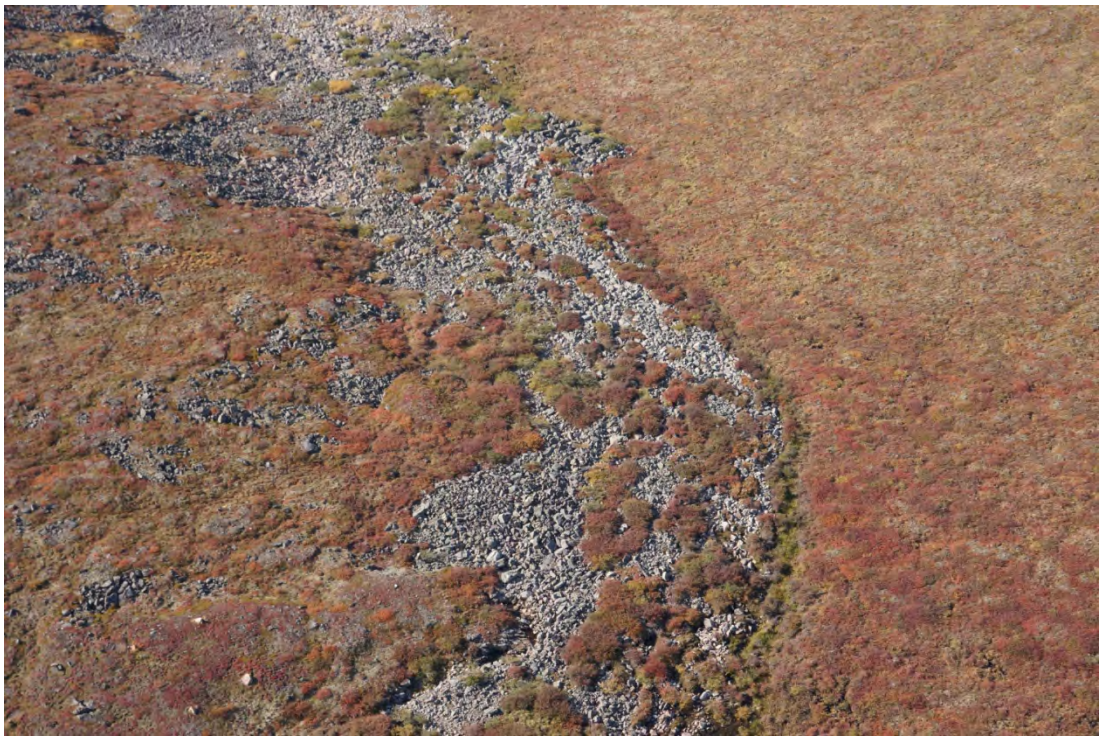
Kilometre 16.0. Photograph from the ground. Downstream view from 56 m upstream of the proposed road crossing location. September 1, 2014.



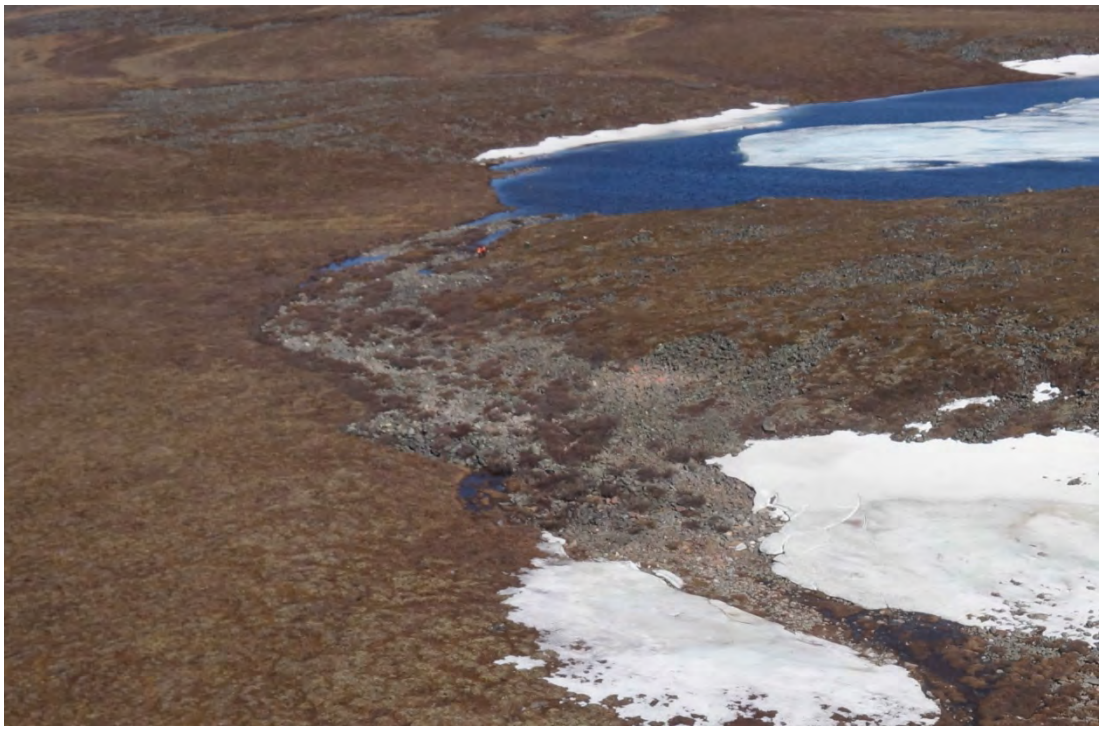
Kilometre 16.0. Photograph from the ground. Approximately 250 m upstream from lake at the proposed bridge location. June 23, 2015.



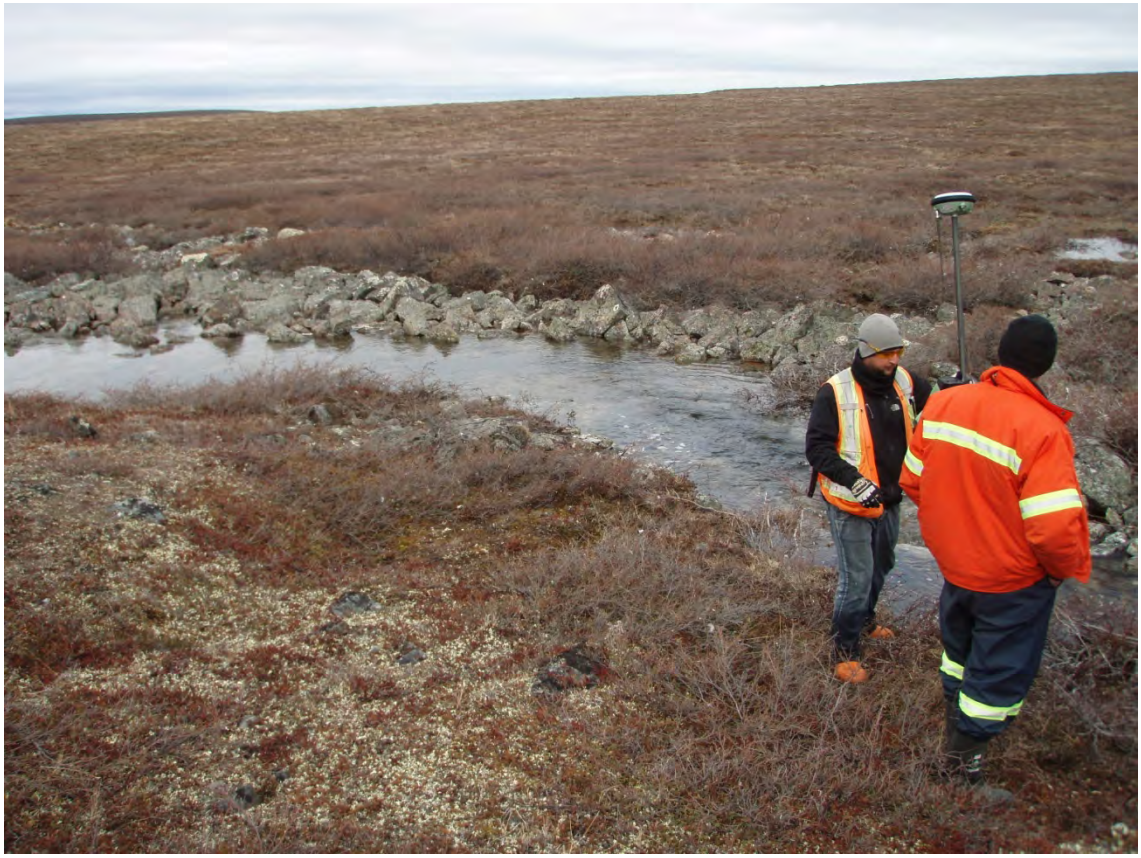
Kilometre 18.6. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



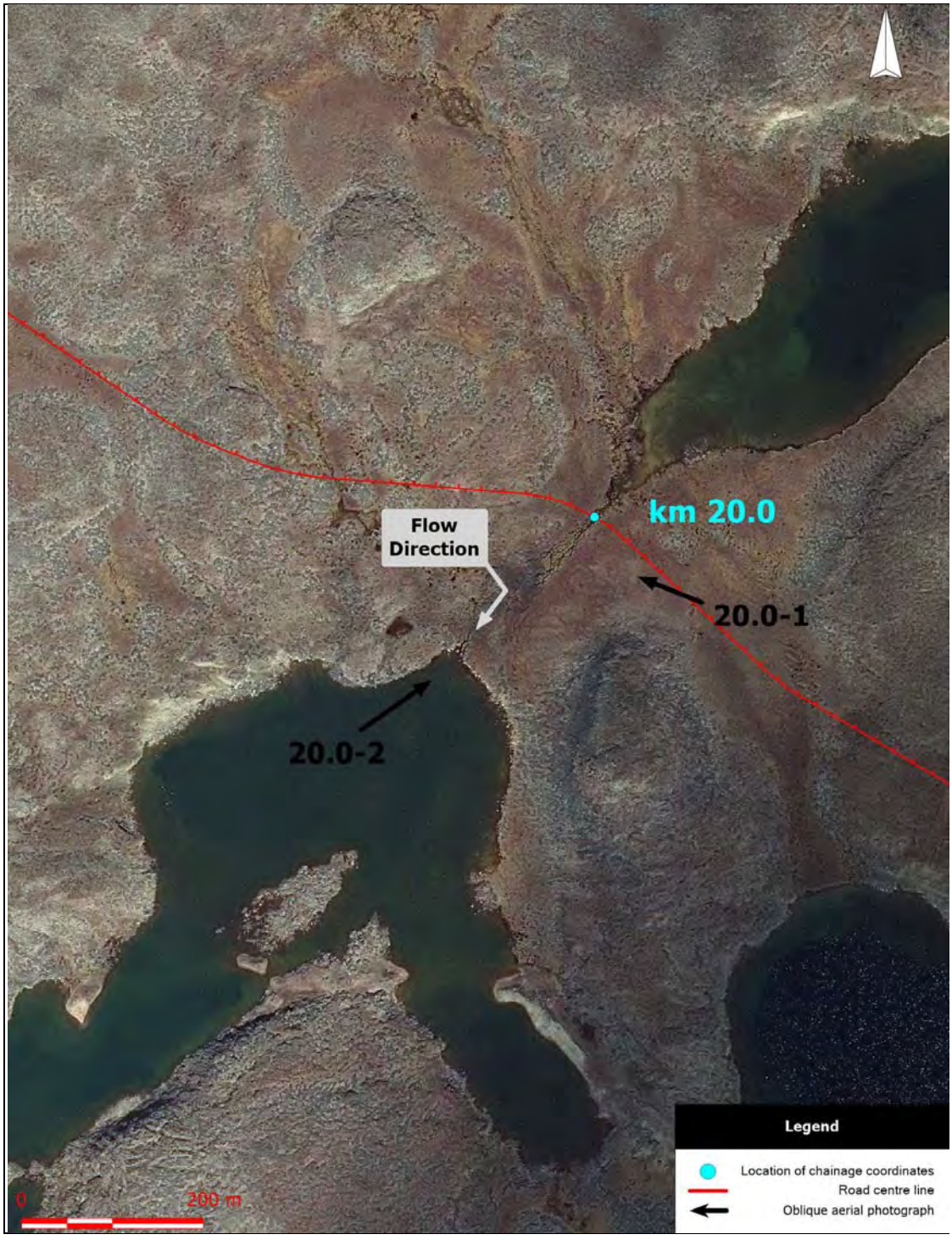
Kilometre 18.6. Oblique aerial photograph 18.6-1. August 30, 2014.



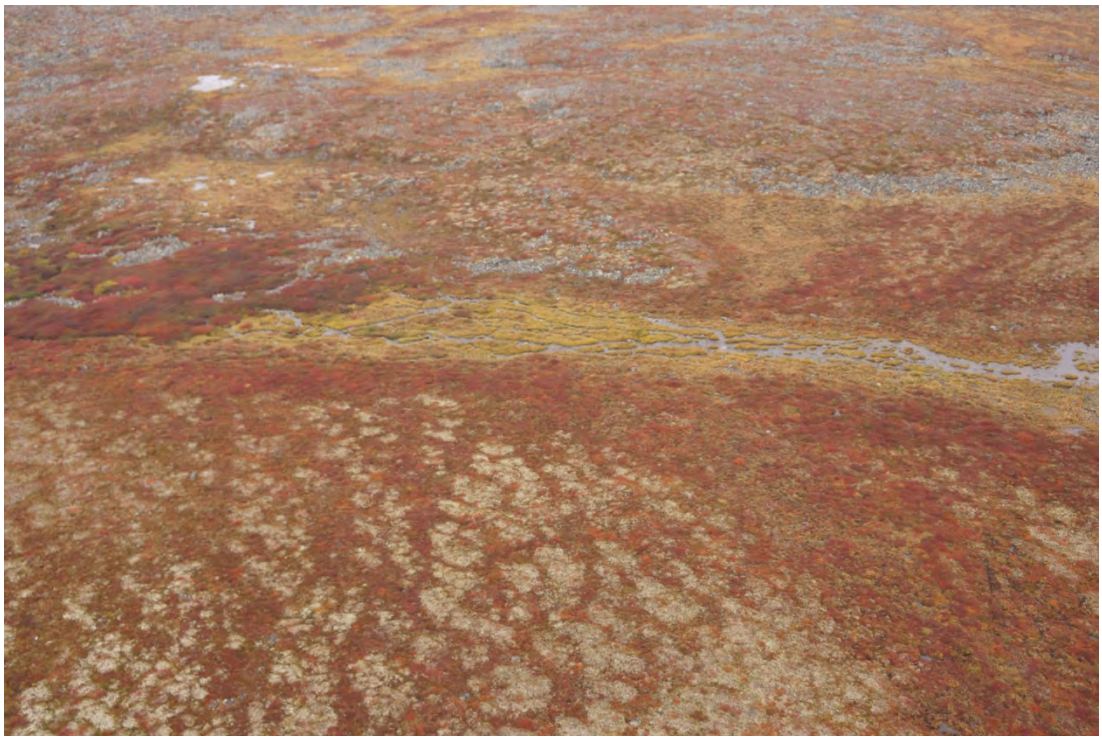
Kilometre 18.6. Oblique aerial photograph 18.6-2. June 29, 2015.



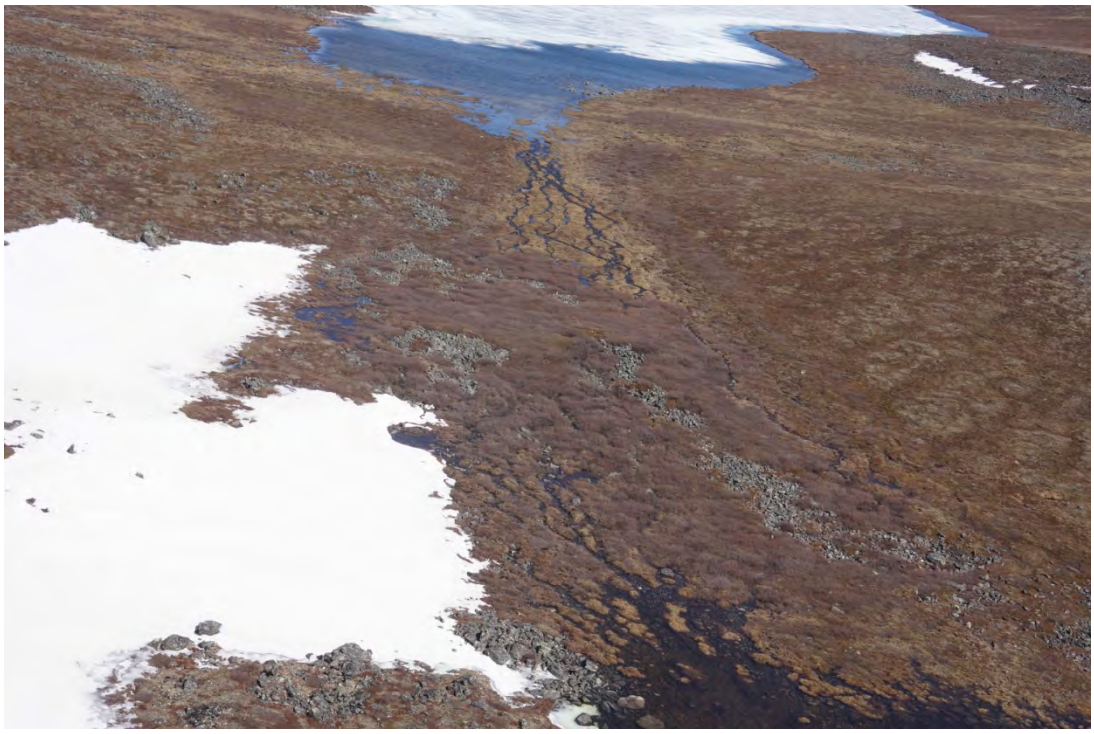
Kilometre 18.6. Photograph from the ground. Road crossing location. June 23, 2015.



Kilometre 20.0. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



Kilometre 20.0. Oblique aerial photograph 20.0-1. August 29, 2014.



Kilometre 20.0. Oblique aerial photograph 20.0-2. June 29, 2015.



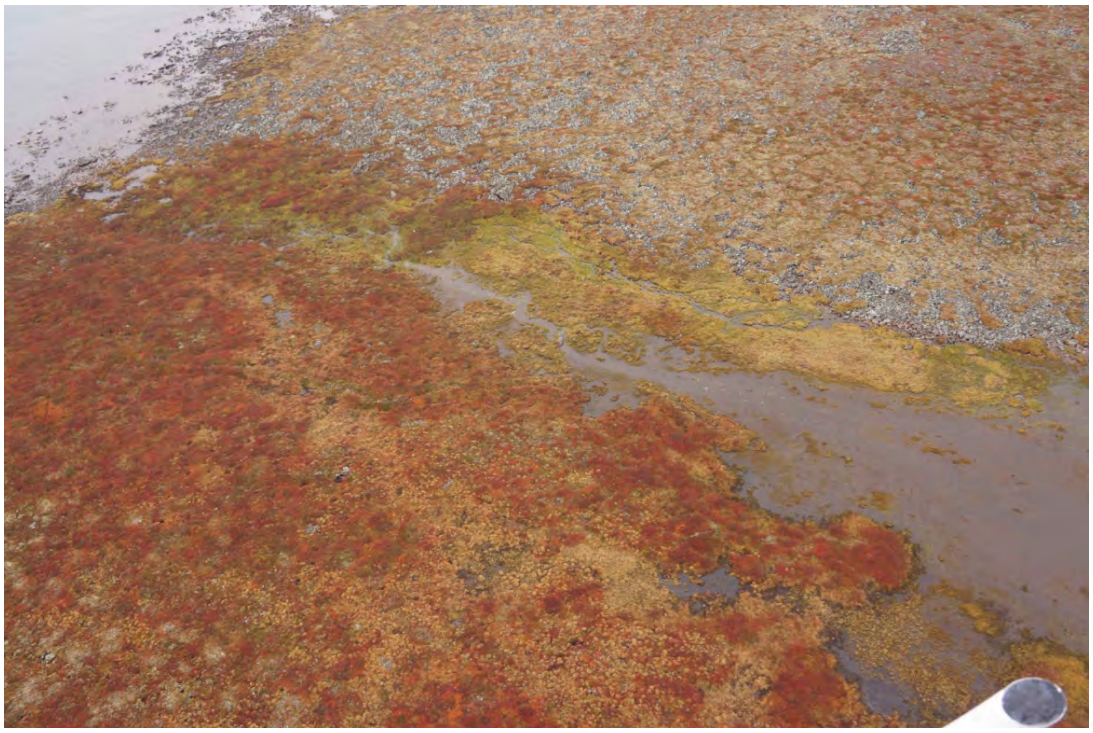
Kilometre 20.0. Photograph from the ground. Near watercourse mouth. September 2, 2014.



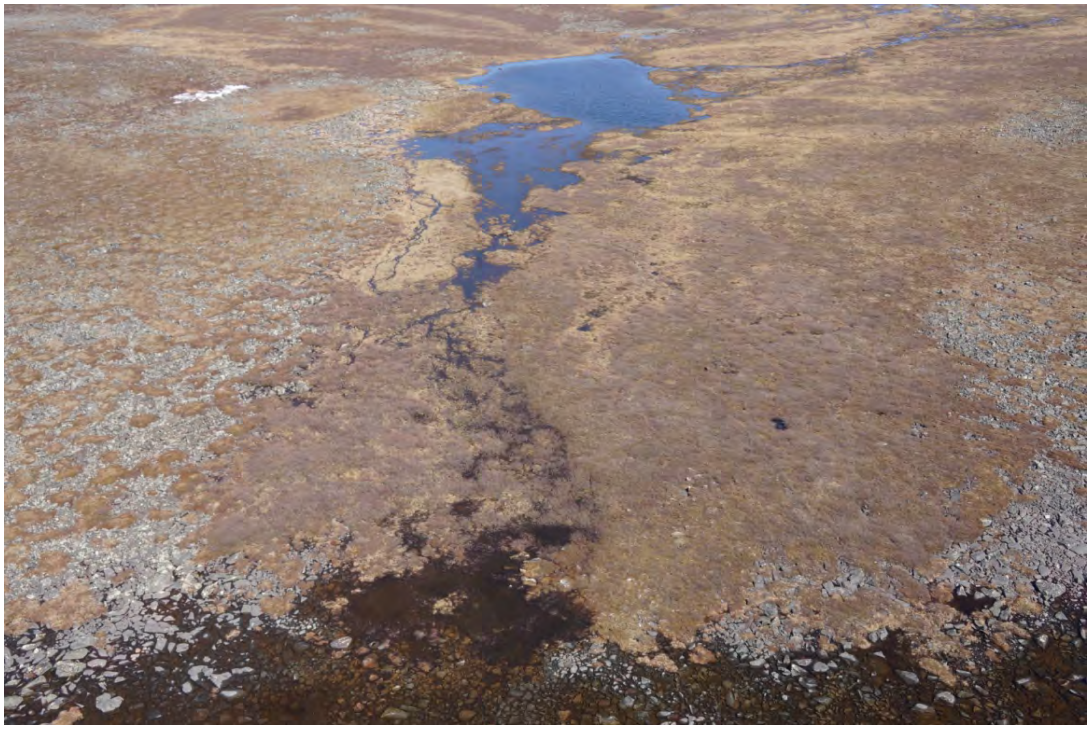
Kilometre 20.0. Photograph from the ground. Upstream view approximately 200 m upstream of watercourse mouth. September 2, 2014.



Kilometre 22.1. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



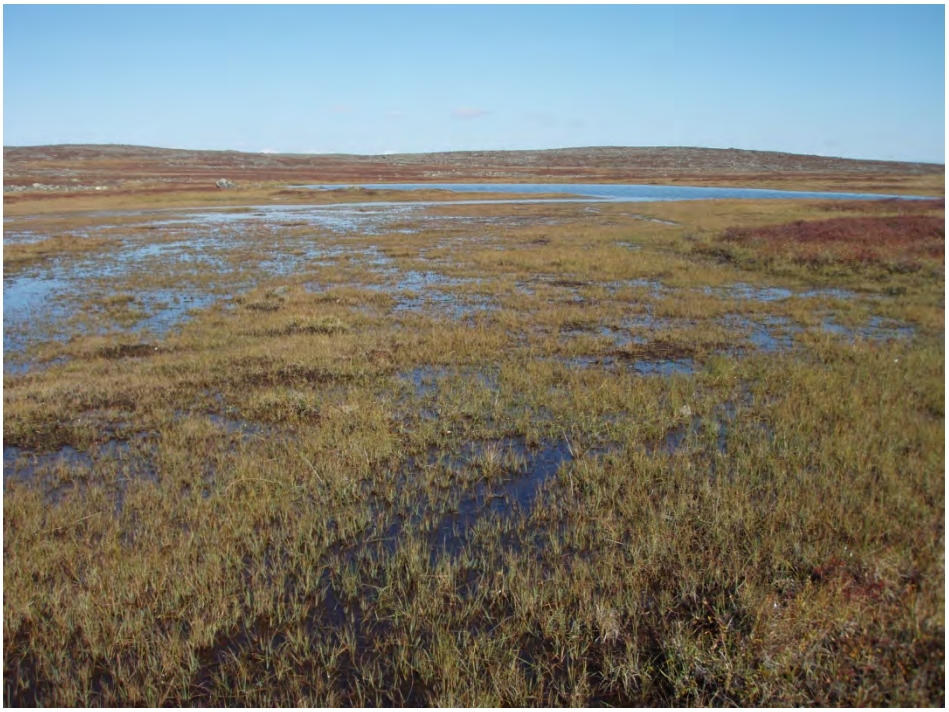
Kilometre 22.1. Oblique aerial photograph 22.1-1. August 29, 2014.



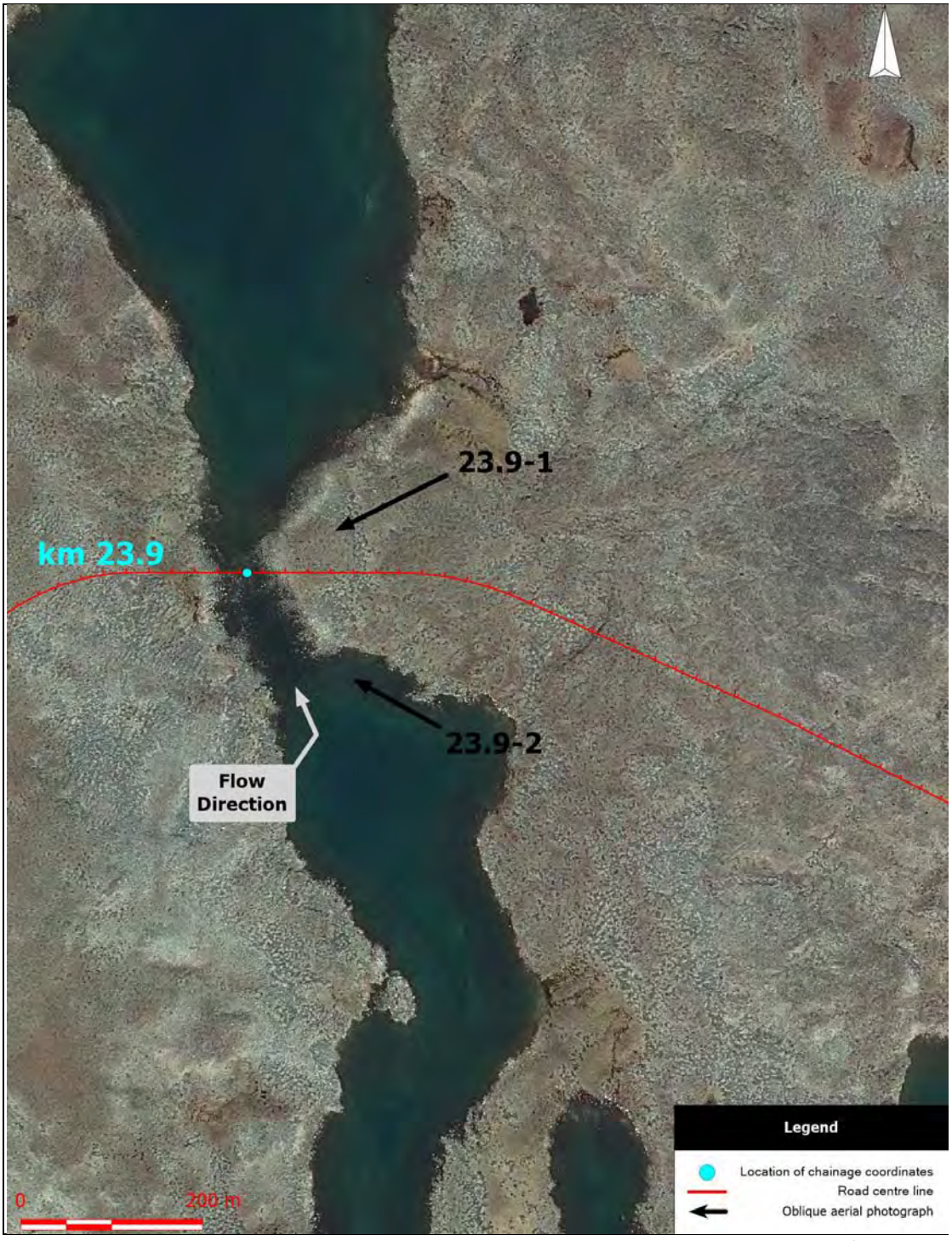
Kilometre 22.1. Oblique aerial photograph 22.1-2. June 29, 2015.



Kilometre 22.1. Photograph from the ground. Upstream view approximately 100 m upstream of watercourse mouth. August 31, 2014.



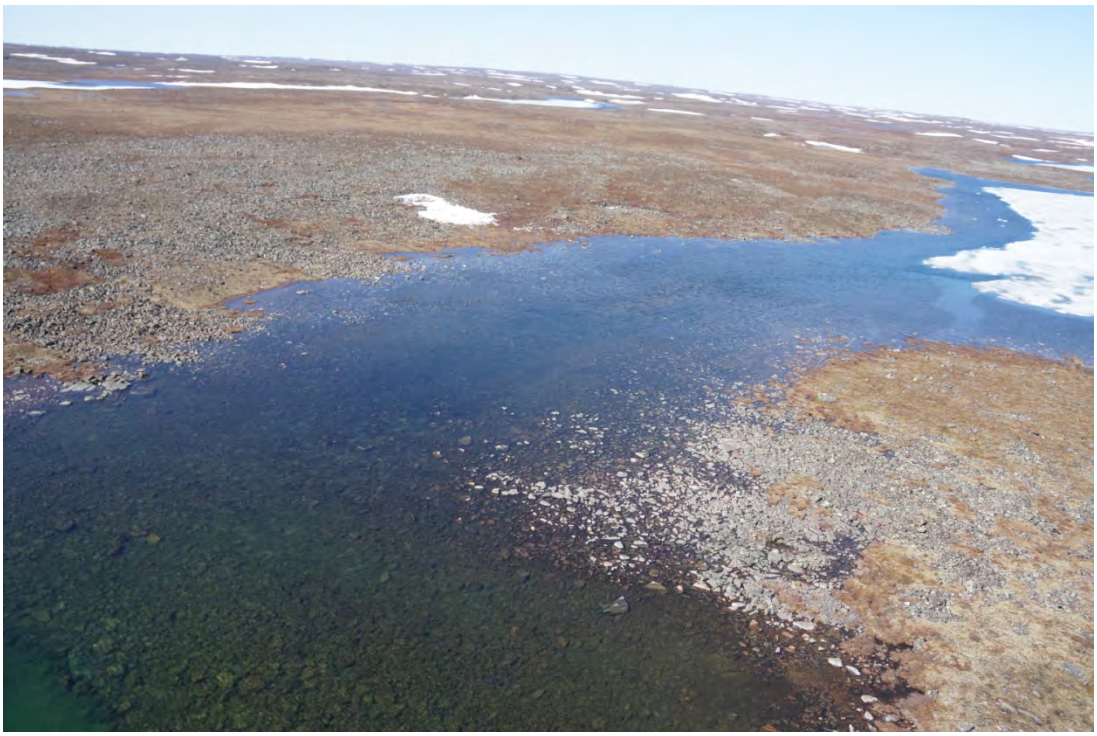
Kilometre 22.1. Photograph from the ground. Upstream view approximately 180 m upstream of watercourse mouth. August 31, 2014.



Kilometre 23.9. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



Kilometre 23.9. Oblique aerial photograph 23.9-1. August 29, 2014.



Kilometre 23.9. Oblique aerial photograph 23.9-2. June 29, 2015.



Kilometre 23.9. Photograph from the ground. Note flow through narrows. August 31, 2014.



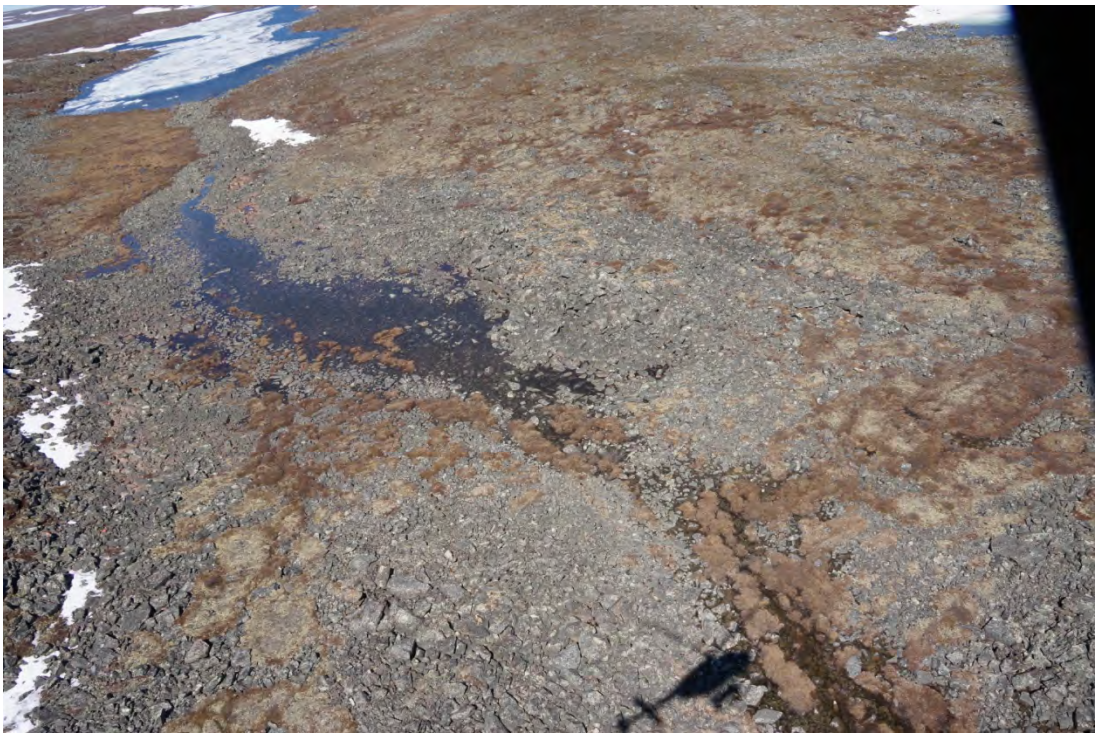
Kilometre 23.9. Photograph from the ground. June 23, 2015.



Kilometre 26.1. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



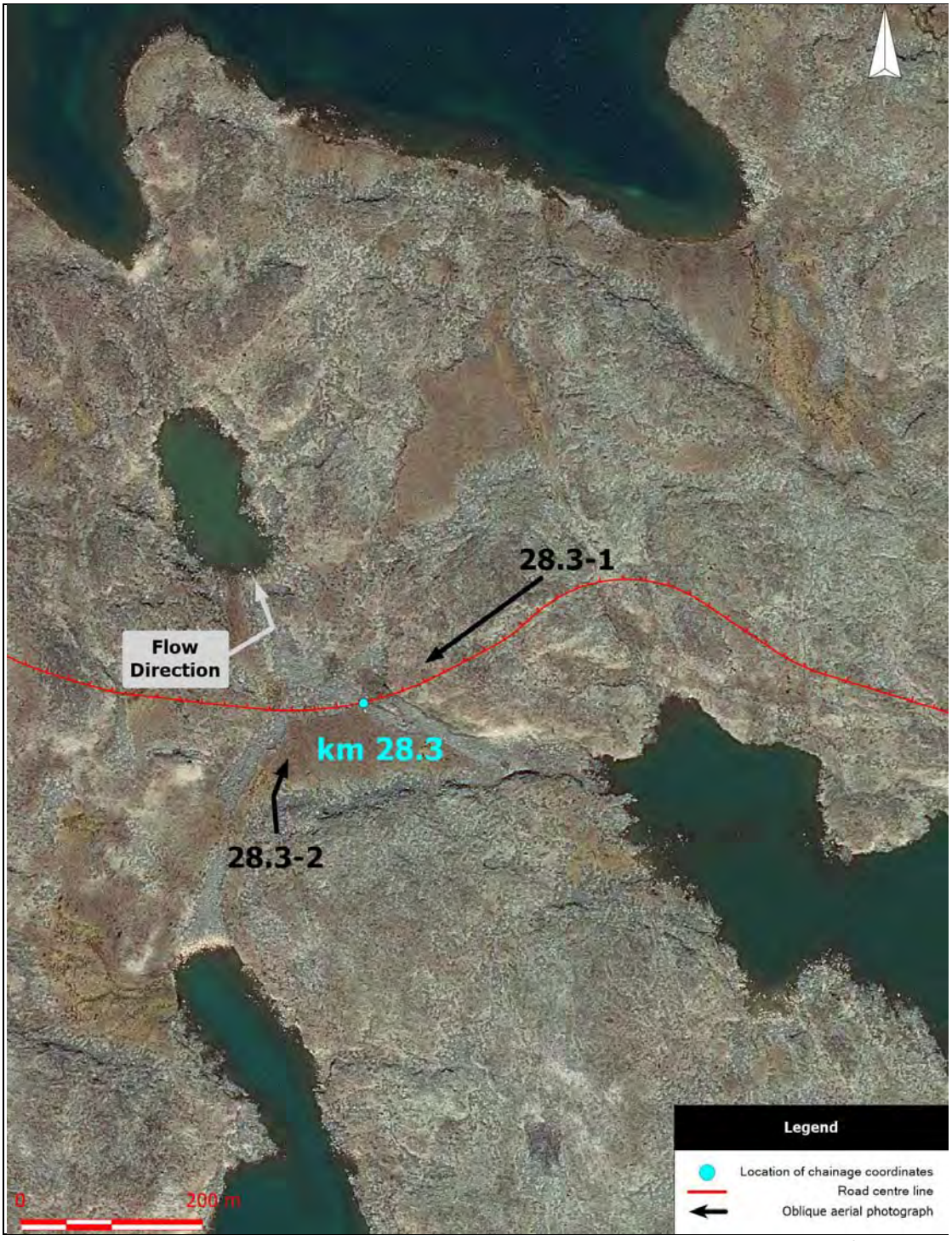
Kilometre 26.1. Oblique aerial photograph 26.1-1. August 29, 2014. Crossing at centre.



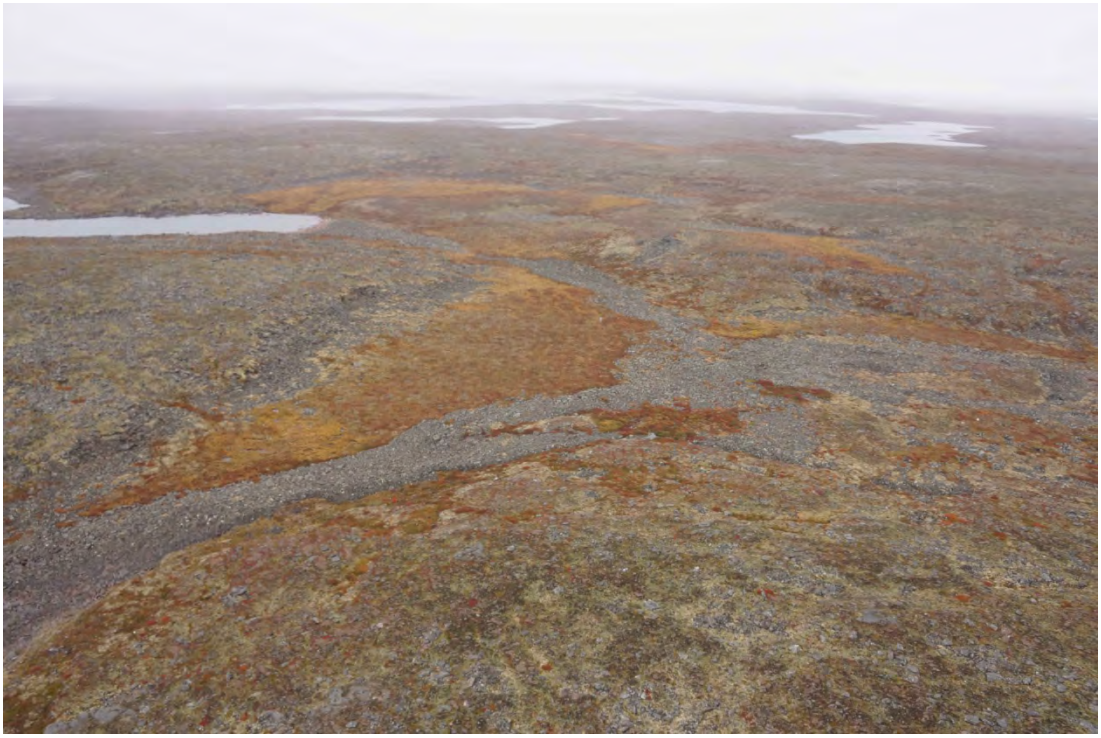
Kilometre 26.1. Oblique aerial photograph 26.1-2. June 29, 2015.



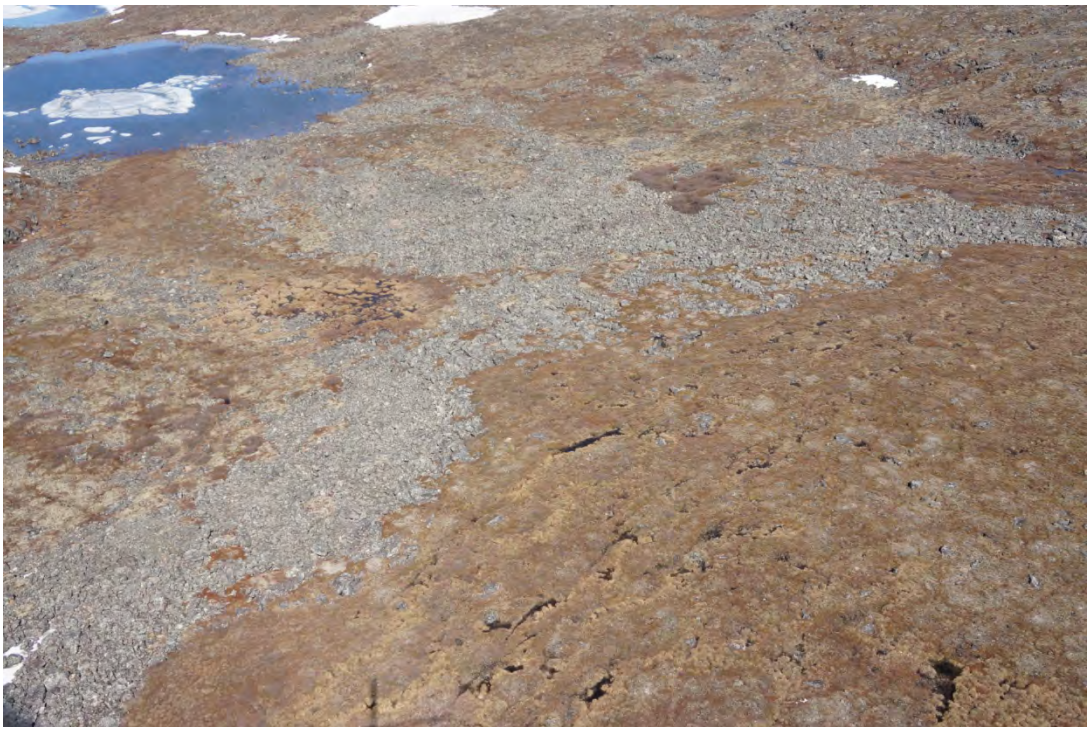
Kilometre 26.1. Photograph from the ground. Upstream view approximately 130 m downstream from road crossing location. June 23, 2015.



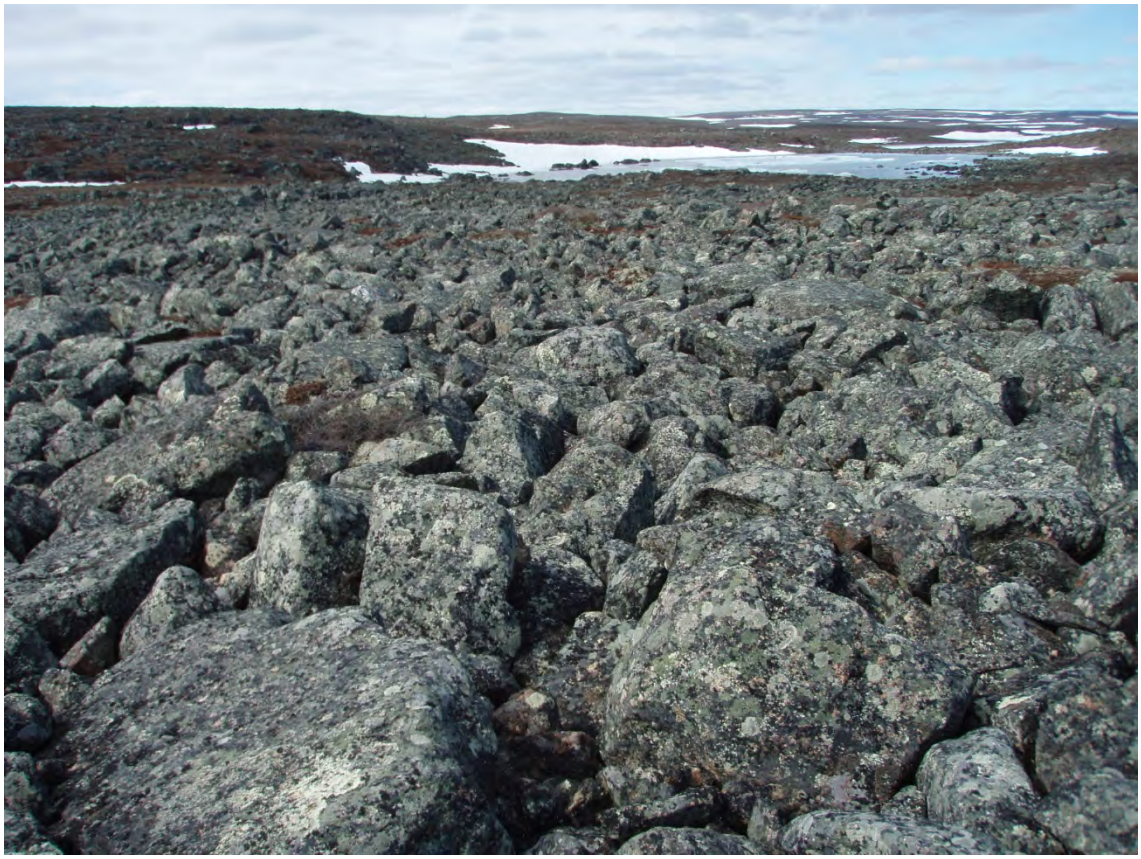
Kilometre 28.3. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



Kilometre 28.3. Oblique aerial photograph 28.3-1. August 29, 2014.



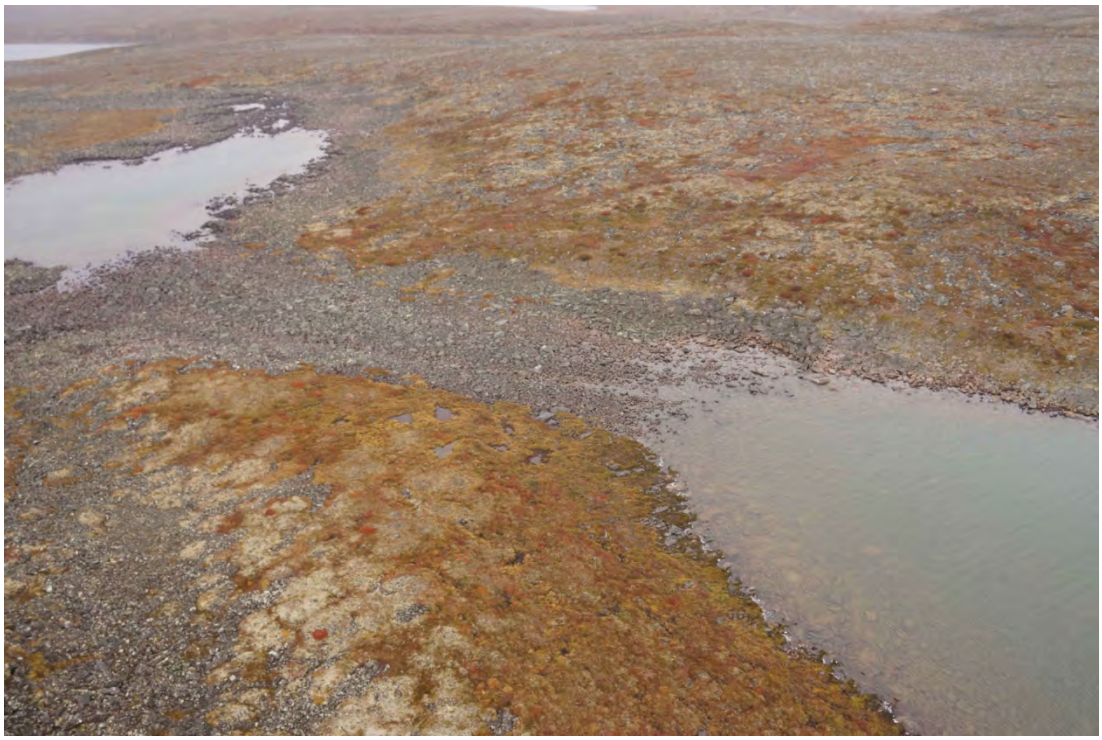
Kilometre 28.3. Oblique aerial photograph 28.3-2. June 29, 2015.



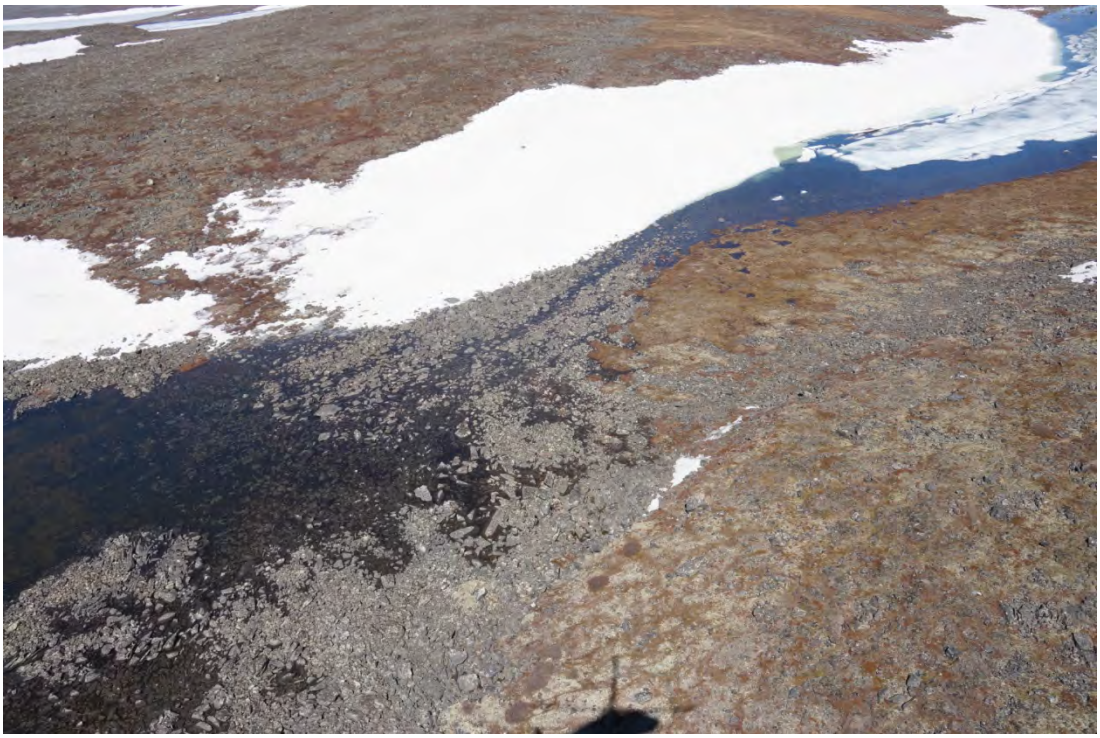
Kilometre 28.3. Photograph from the ground. Road crossing location. June 23, 2015.



Kilometre 30.4. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



Kilometre 30.4. Oblique aerial photograph 30.4-1. August 29, 2014.



Kilometre 30.4. Oblique aerial photograph 30.4-2. June 29, 2015.



Kilometre 32.3. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



Kilometre 32.3. Oblique aerial photograph 32.3-1. August 30, 2014. Crossing a photograph centre.



Kilometre 32.3. Oblique aerial photograph 32.3-2. June 29, 2015.



Kilometre 32.3. Photograph from the ground. Upstream view through approximate crossing located approximately 80 m from camera. September 1, 2014.



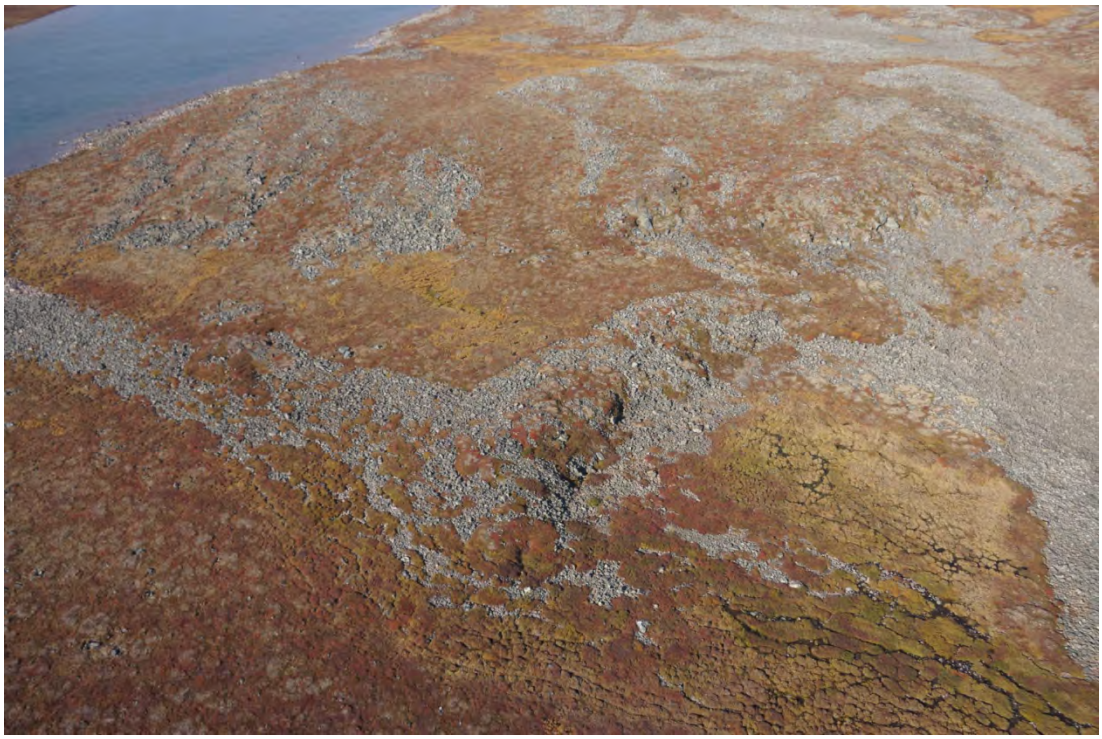
Kilometre 32.3. Photograph from the ground. Upstream view through approximate crossing located approximately 60 m from camera. June 23, 2015.



Kilometre 36.2. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



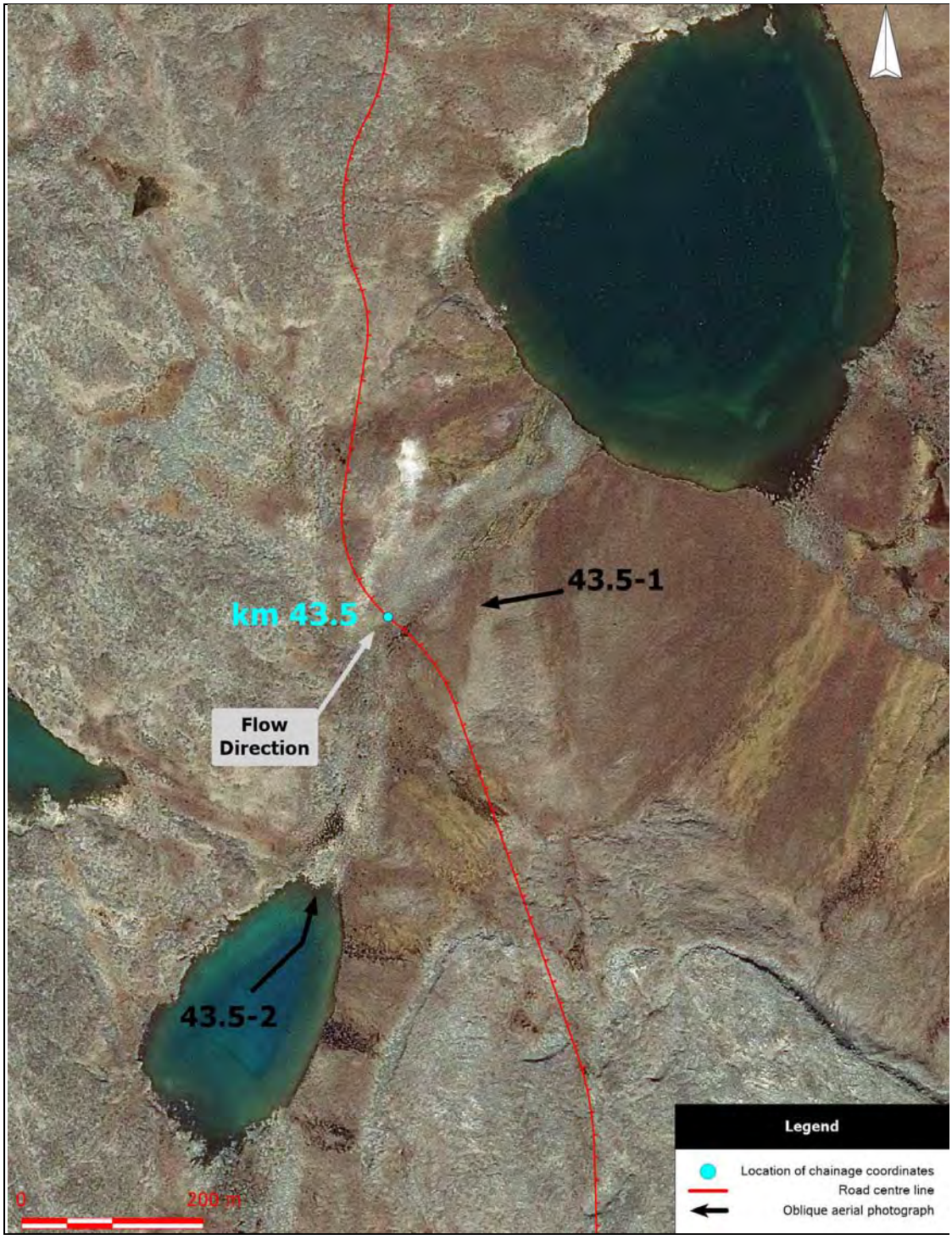
Kilometre 36.2. Oblique aerial photograph 36.2-1. August 30, 2014.



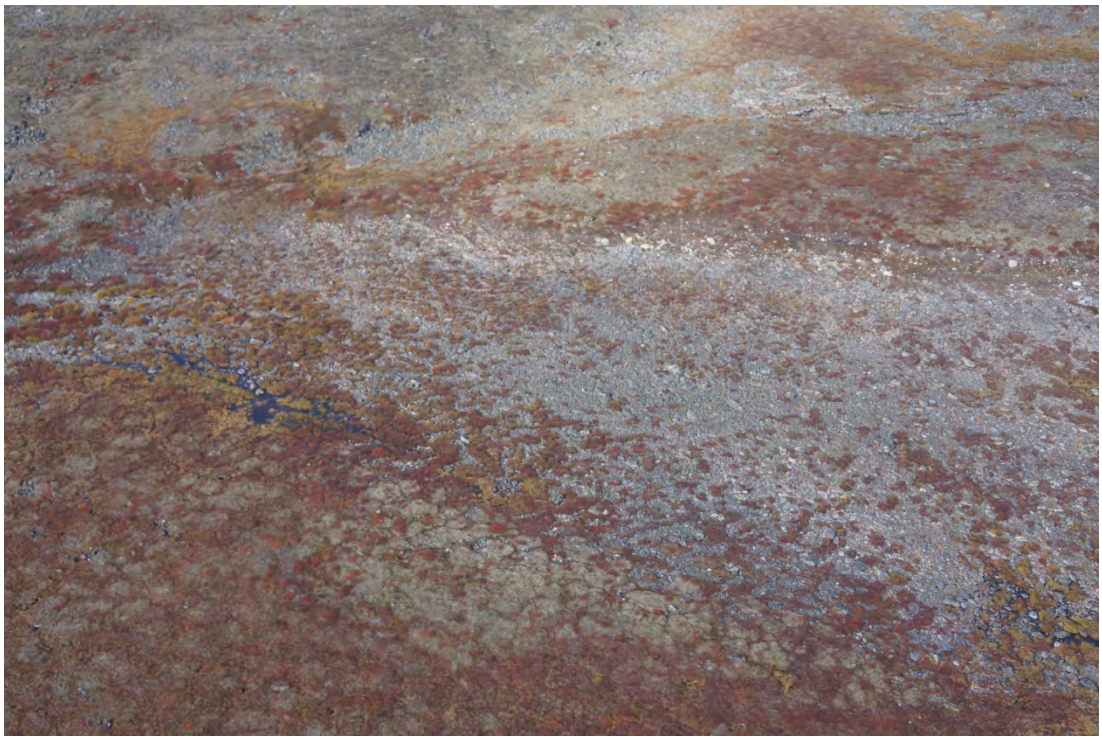
Kilometre 36.2. Oblique aerial photograph 36.2-2. August 30, 2014.



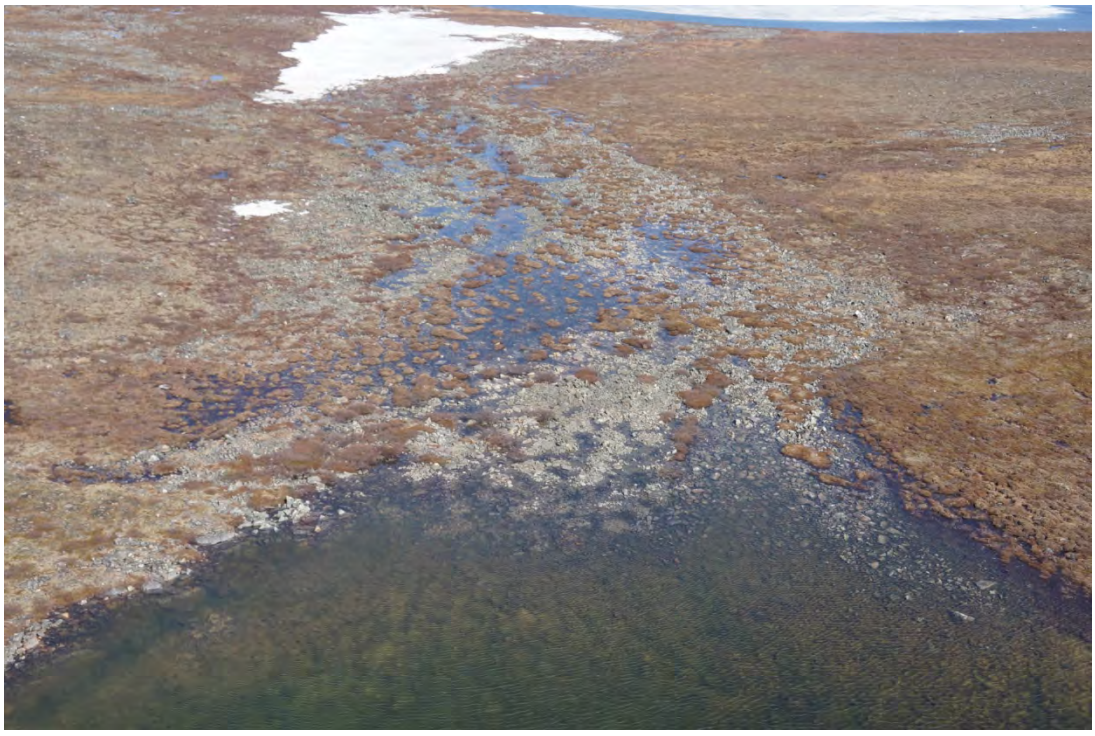
Kilometre 41.8. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, and the flow direction.



Kilometre 43.5. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



Kilometre 43.5. Oblique aerial photograph 43.5-1. August 30, 2014.



Kilometre 43.5. Oblique aerial photograph 43.5-2. June 29, 2015.



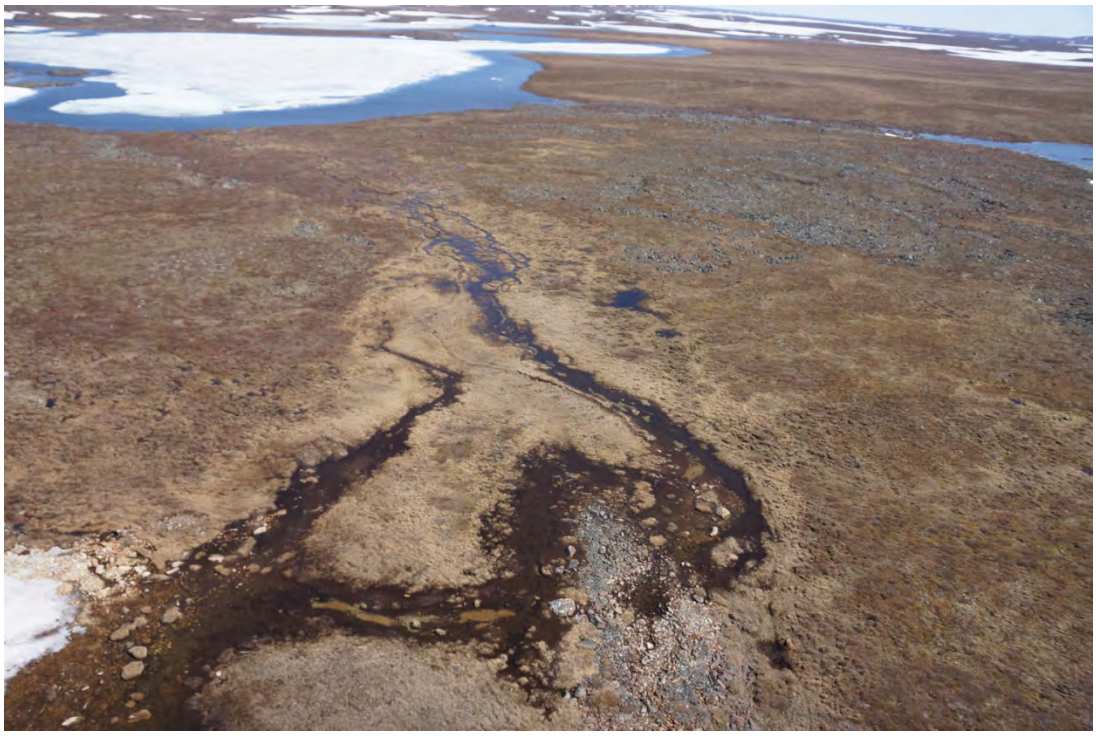
Kilometre 43.5. Photograph from the ground. Road crossing location. June 23, 2015.



Kilometres 44.4 and 44.8. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



Kilometre 44.4. Oblique aerial photograph 44.4-1. September 1, 2014.



Kilometre 44.4. Oblique aerial photograph 44.4-2. June 29, 2015.



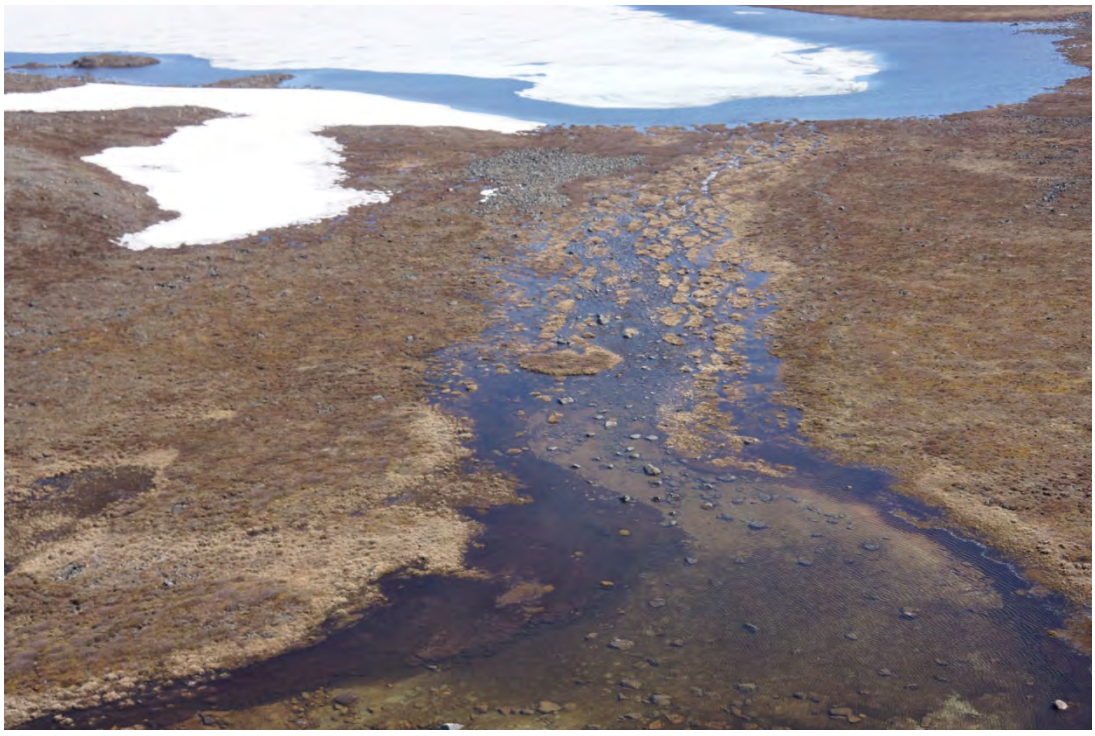
Kilometre 44.4. Photograph from the ground. Downstream view of one channel from 270 m downstream from the approximate crossing location. Rocky section of watercourse. September 1, 2014.



Kilometre 44.4. Photograph from the ground. Downstream view of one channel from 270 m downstream from the approximate crossing location. Diffuse flow through vegetation. September 1, 2014.



Kilometre 44.8. Oblique aerial photograph 44.8-1. August 30, 2014.



Kilometre 44.8. Oblique aerial photograph 44.8-2. June 29, 2015.



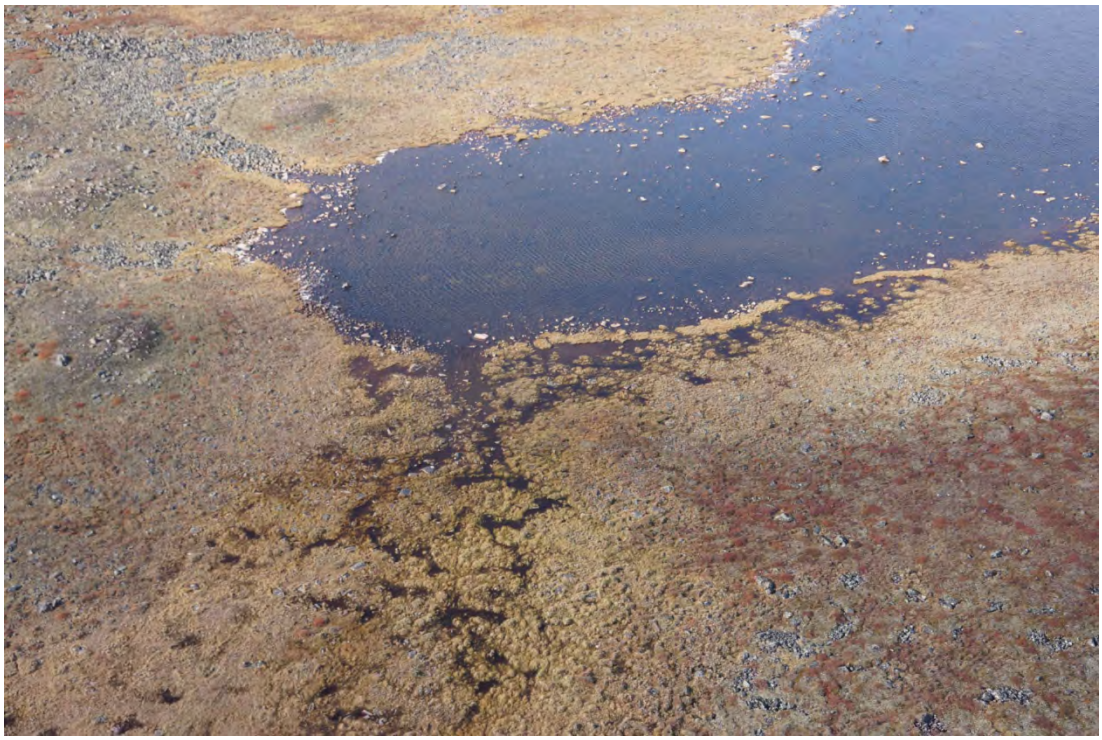
Kilometre 44.8. Photograph from the ground. Downstream view from downstream of the road crossing location. September 1, 2014.



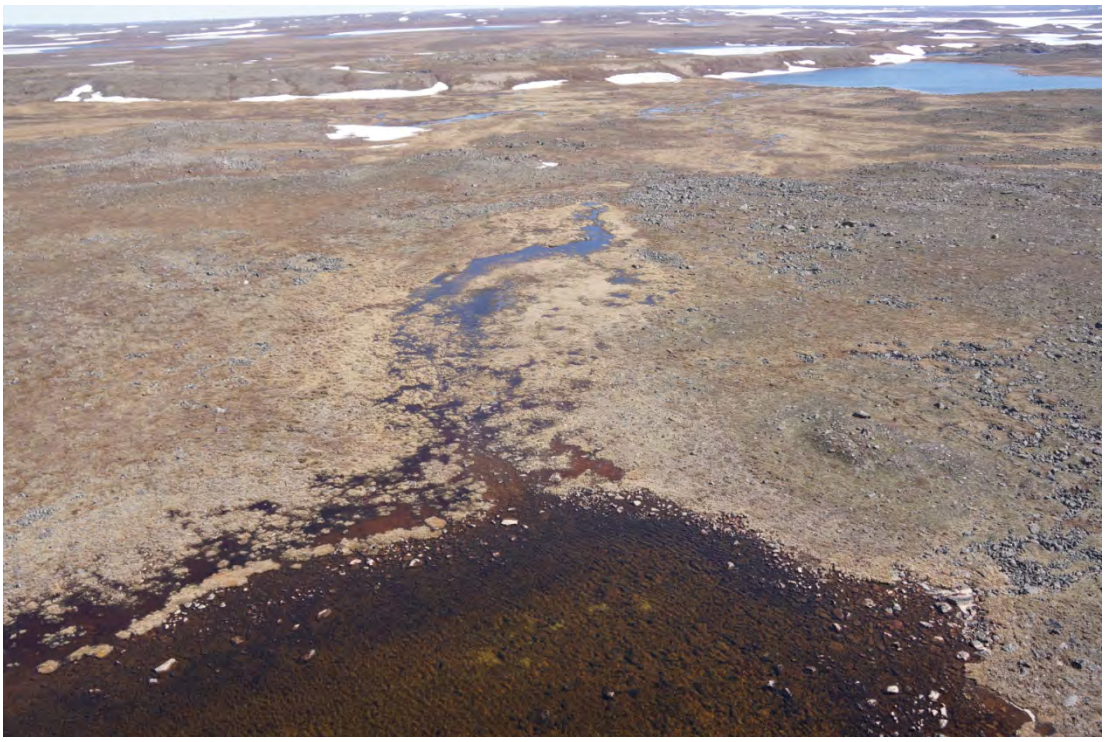
Kilometre 44.8. Photograph from the ground. Downstream view from downstream of the road crossing location. June 23, 2015.



Kilometre 46.1. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



Kilometre 46.1. Oblique aerial photograph 46.1-1. August 30, 2014.



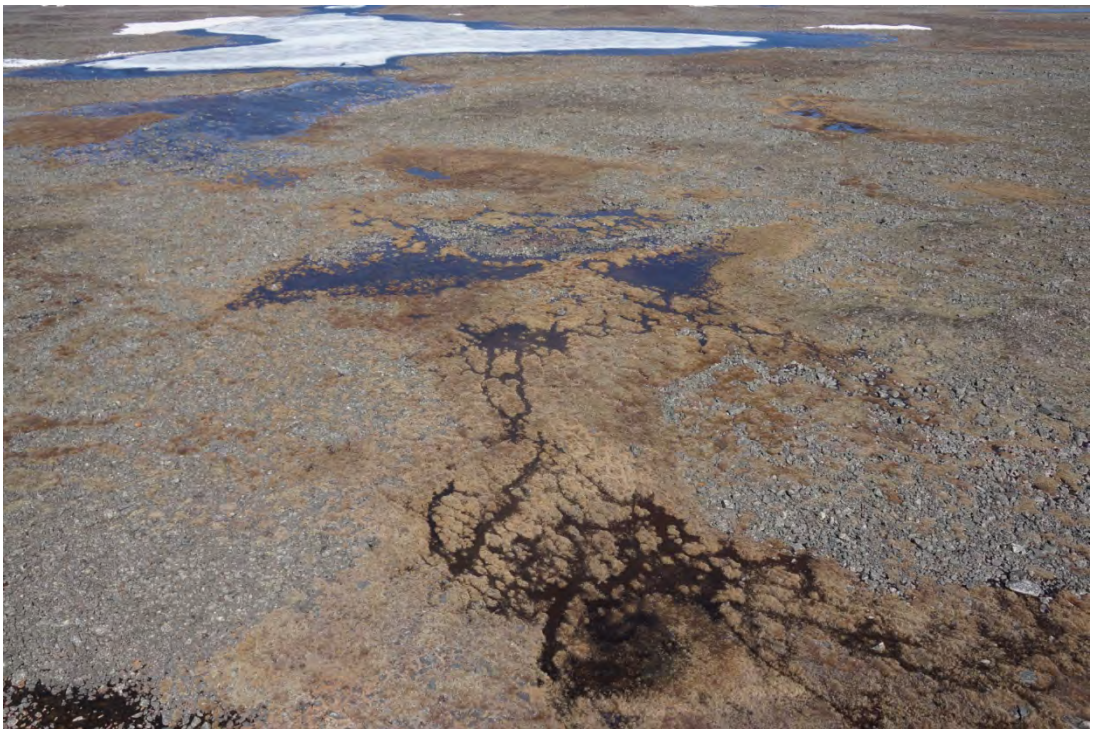
Kilometre 46.1. Oblique aerial photograph 46.1-2. June 29, 2015.



Kilometre 49.4. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



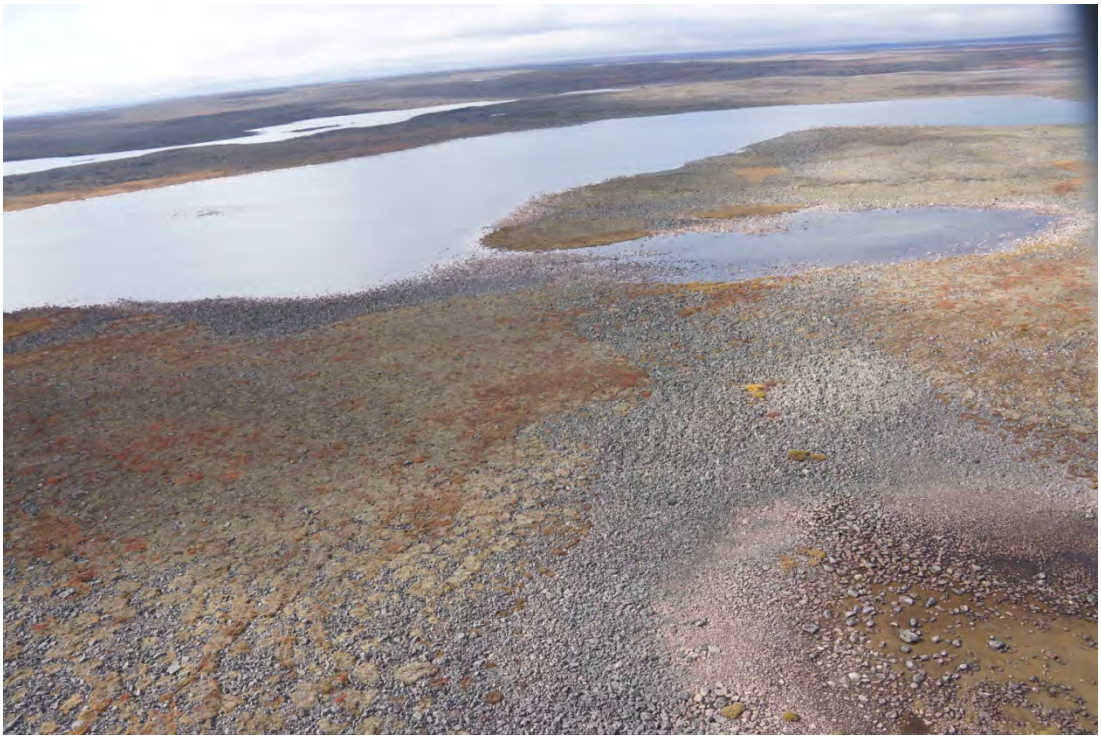
Kilometre 49.4. Oblique aerial photograph 49.4-1. August 30, 2014.



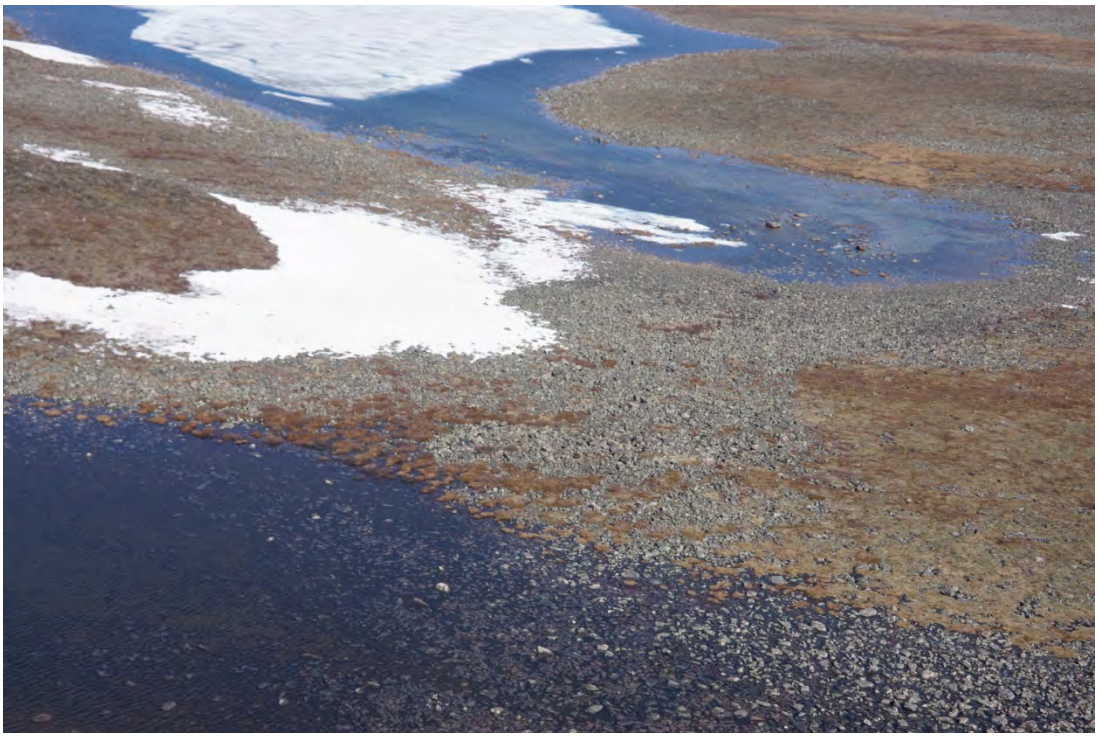
Kilometre 49.4. Oblique aerial photograph 49.4-2. June 29, 2015.



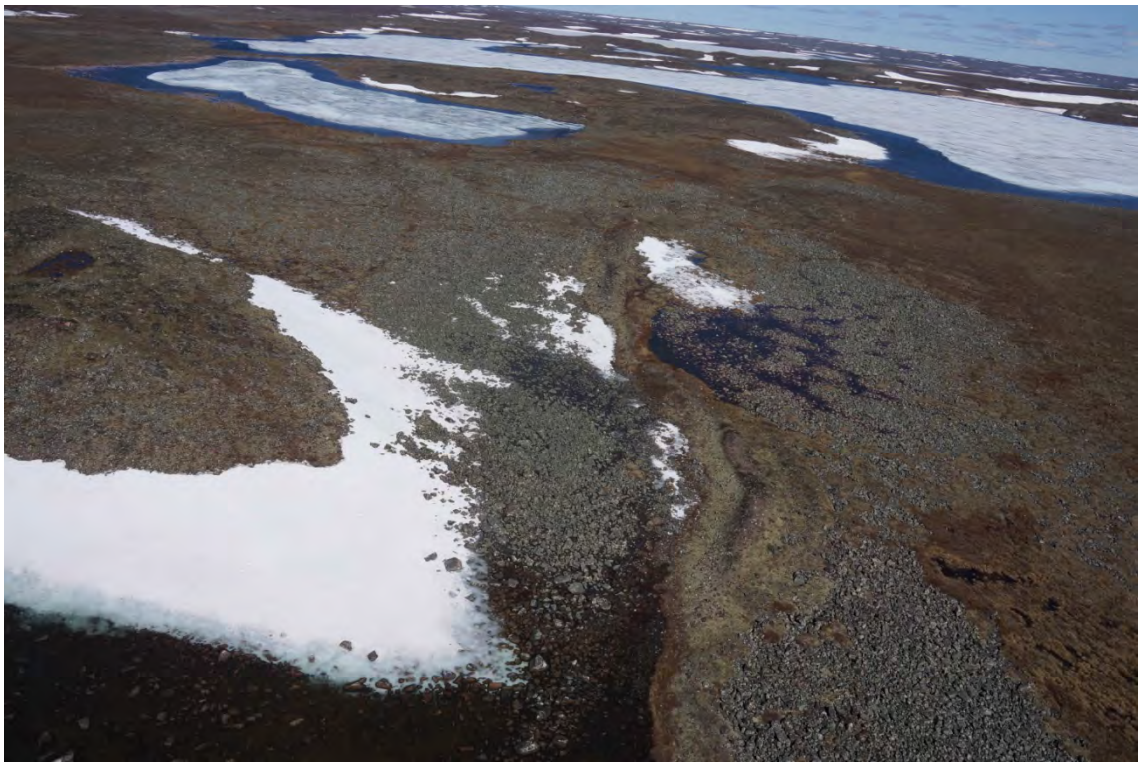
Kilometres 51.2 and 51.8. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



Kilometre 51.2. Oblique aerial photograph 51.2-1. August 30, 2014.



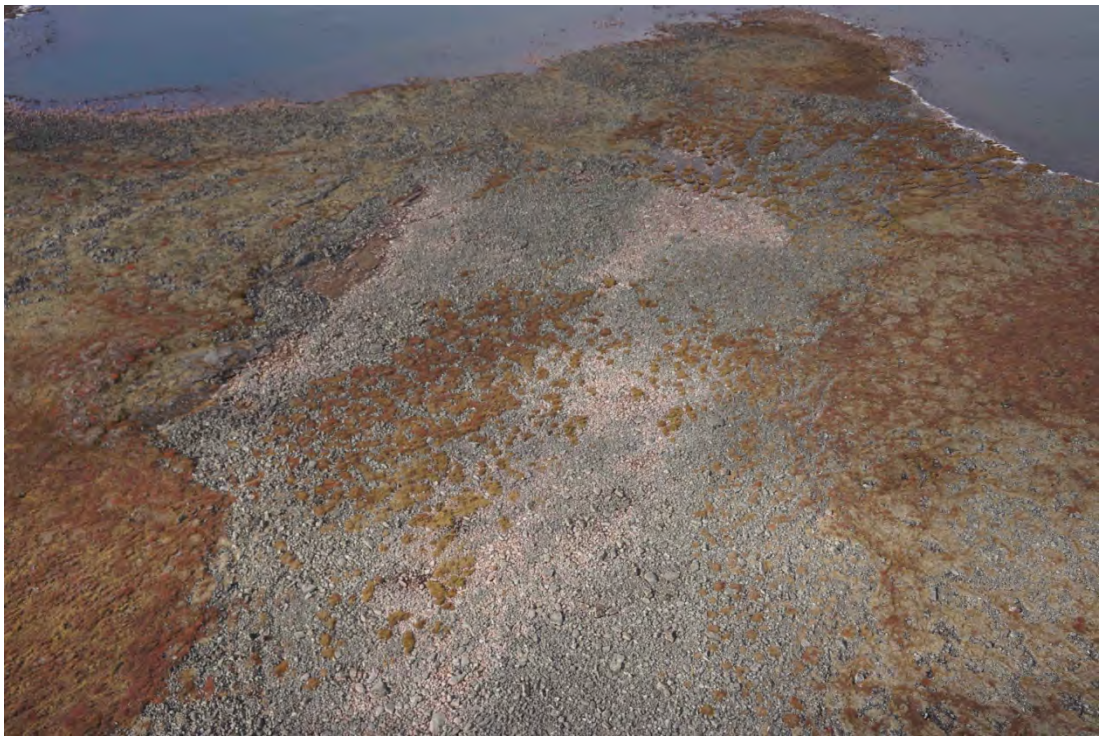
Kilometre 51.2. Oblique aerial photograph 51.2-2. June 29, 2015.



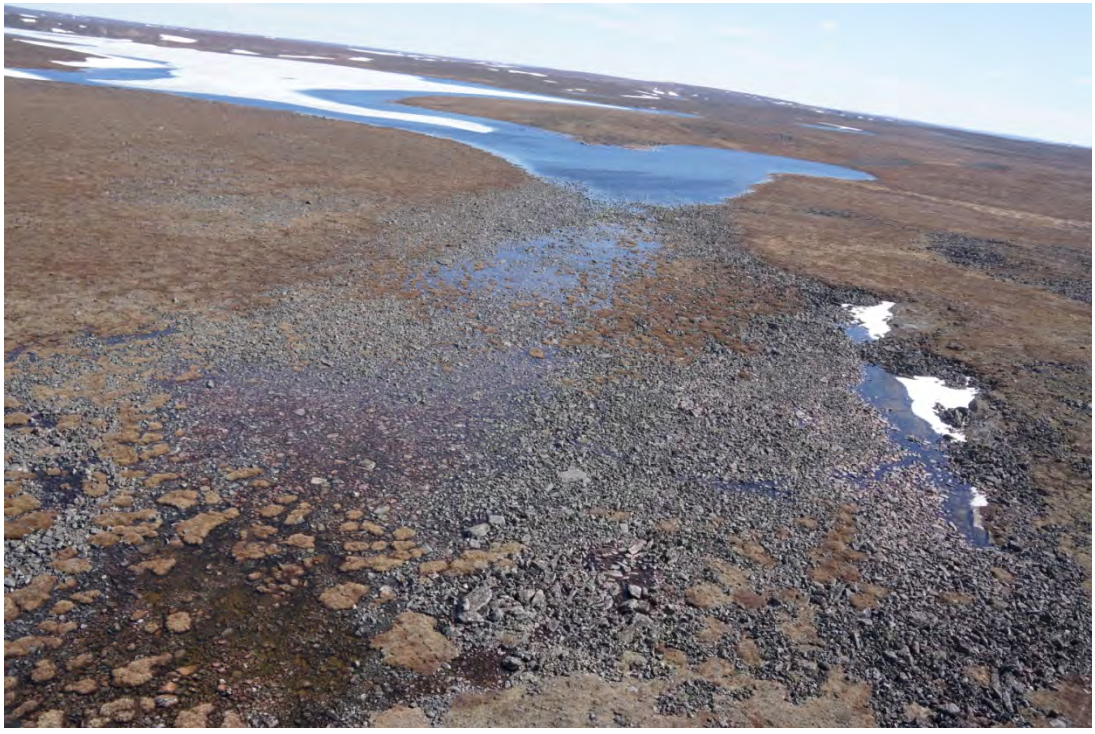
Kilometre 51.8. Oblique aerial photograph 51.8-1. June 29, 2015. There is no 2014 photograph.



Kilometre 56.9. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



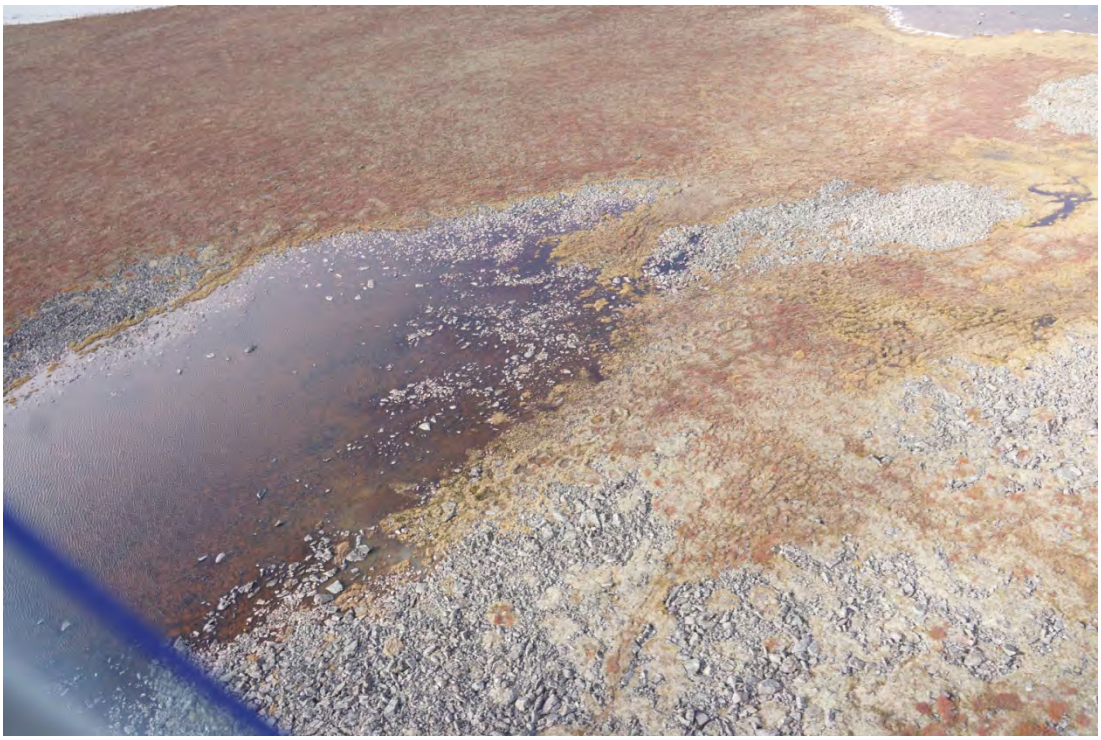
Kilometre 56.9. Oblique aerial photograph 56.9-1. August 30, 2014.



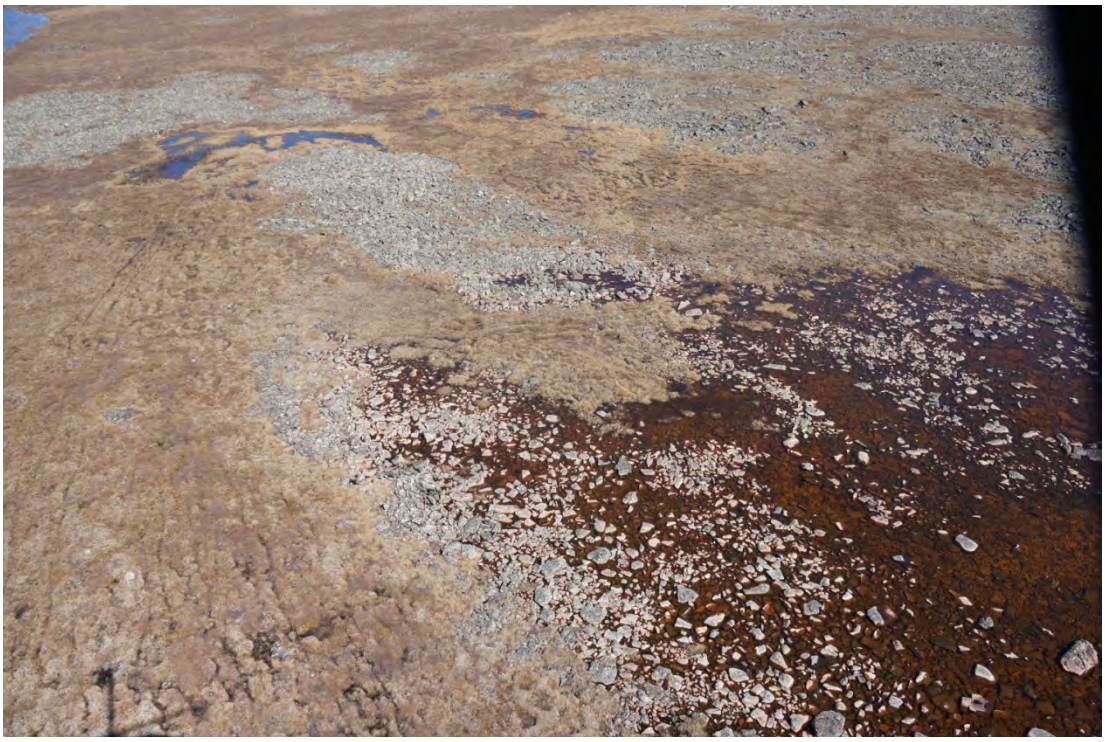
Kilometre 56.9. Oblique aerial photograph 56.9-2. June 29, 2015.



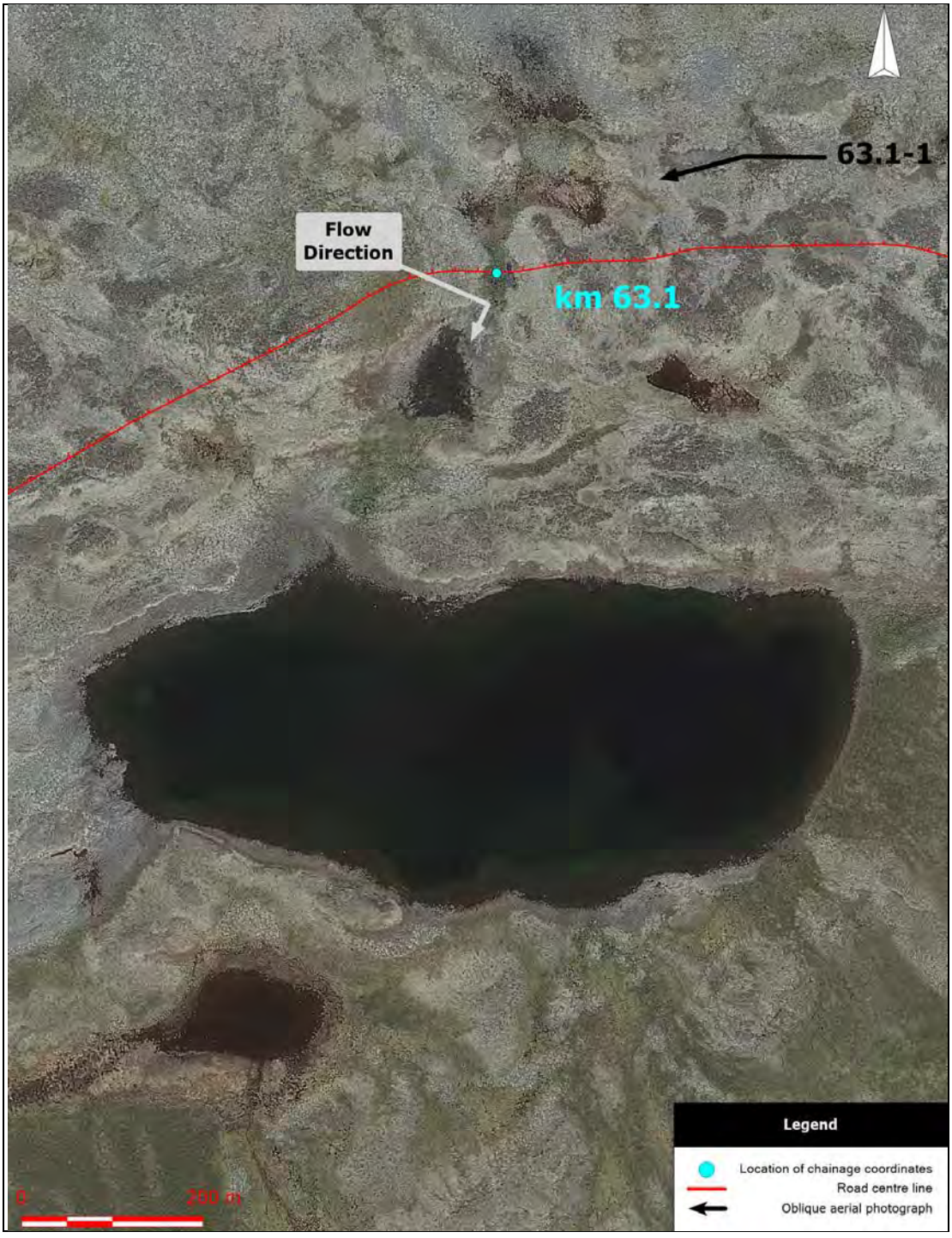
Kilometre 59.7. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



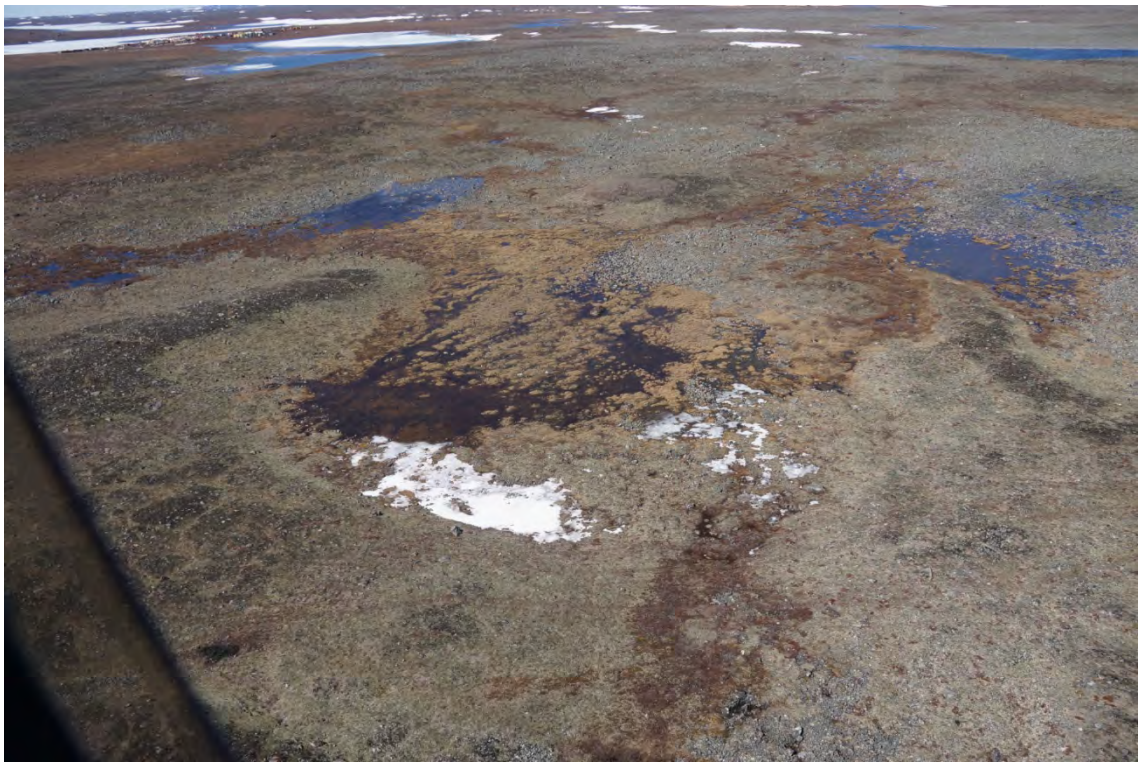
Kilometre 59.7. Oblique aerial photograph 59.7-1. August 30, 2014.



Kilometre 59.7. Oblique aerial photograph 59.7-2. June 29, 2015.



Kilometre 63.1. Aerial photograph showing the road centre line, the location of chainage coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



Kilometre 63.1. Oblique aerial photograph 63.1-1. June 29, 2015. Crossing near left side of photograph. There is no 2014 photograph.

APPENDIX 6-E

Supporting Evidence of the Hydrology Effects Assessment

June 2016
Report No. 1541520

AGNICO EAGLE

Golder Associates

6.E-1 BACKGROUND

The purpose of this appendix is to summarize water management activities of the Project relevant to surface water quantity during the construction, dewatering, operational, closure, and post-closure phases. Potential effects on hydrological indicators, including discharges and water levels, are also summarized herein.

6.E-2 AVAILABLE INFORMATION

Relevant information related to construction, dewatering, operational, closure, and post-closure phases was available from the water management plan (Volume 8, Appendix 8-B.2), and in flooding analyses (Volume 6, Appendix 6-F).

6.E-3 WATER MANAGEMENT ACTIVITIES DURING PROJECT PHASES

6.E-3.1 Construction Phase

Water management activities relevant to surface water quantity during the construction phase include the following, from June 2018 to January 2019:

- Construction of the Whale Tail Dike, from June 2018 to January 2019 (and continuing into the dewatering phase in February 2019);
- construction of the Mammoth Dike, from September to October 2018 (and continuing into the dewatering phase in February 2019), unless delayed until winter 2018;
- Construction of the Whale Tail Waste Rock Storage Facility (WRSF) Dike, from June to September 2018; and
- Freshwater intake from Lake C38 (Nemo Lake), to be constructed in the summer of 2018.

Water management activities during the construction phase are presented in Table 6-E-1 and illustrated in Figure 6-E-1. These activities encroach the dewatering phase.

Table 6-E-1: Water Management Activities during the Construction Phase

Activity	Construction Phase							Dewatering Phase					
	2018							2019					
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Whale Tail Dike													
Mammoth Dike													
WRSF Dike													
Freshwater Intake from Lake C38 (Nemo Lake)	Construction during summer 2018												

Note: Construction of the Mammoth Dike may be delayed until winter 2018-2019 and may not be relevant to the open water season of the construction phase.
WRSF = waste rock storage facility.

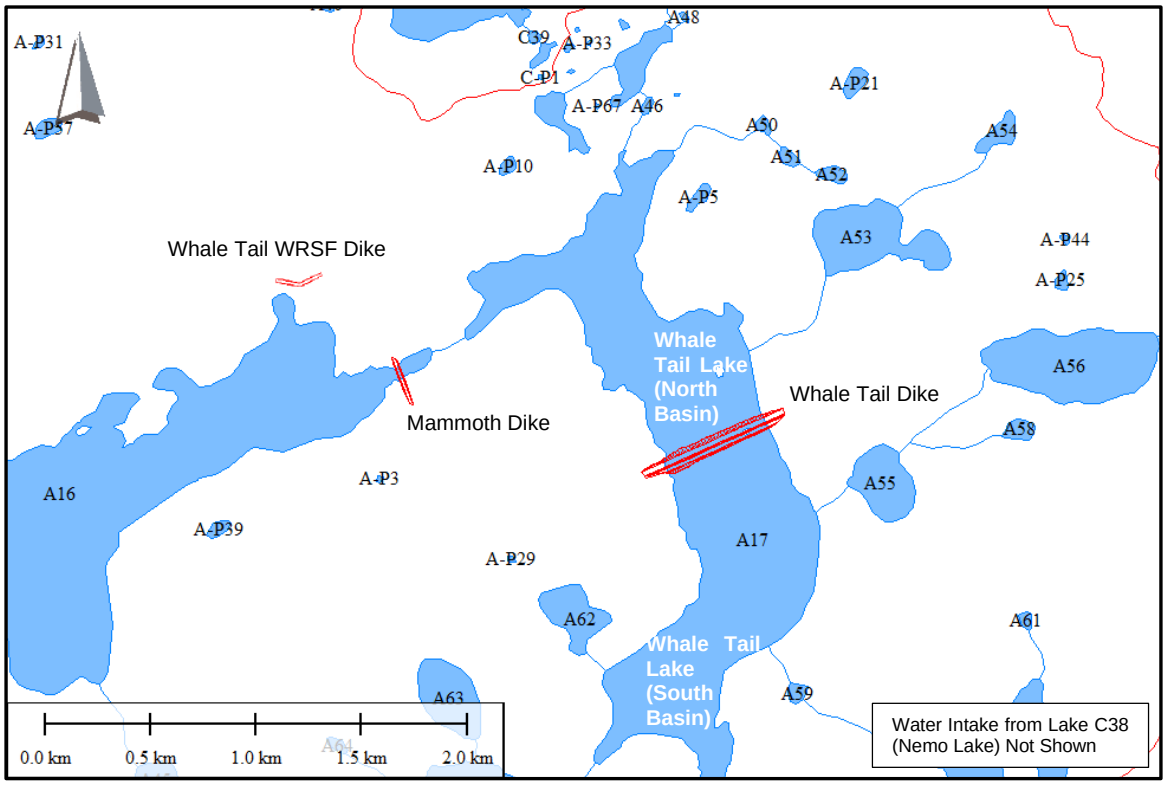


Figure 6-E-1: Construction Phase Activities

6.E-3.2 Dewatering Phase

Water management activities presented herein supplement dikes built during the construction phase (Section 6.E-3).

Dewatering activities include those listed below, from February to October 2019:

- Dewatering through Whale Tail Lake (South Basin) from February (may only start in March) to May 2019;
- Dewatering through Lake A16 (Mammoth Lake) from June to September 2019;
- Construction of the Northeast Dike from February to March 2019;
- Construction of the East Channel from December to April 2019;
- If deemed necessary, construction of the North Channel from in 2019; and
- Freshwater intake from Lake C38 (Nemo Lake).

Thus, for the purpose of the surface water quantity effect assessment, the dewatering phase was assumed to include dewatering activities listed above from February to October 2019.

Water management activities during the dewatering phase are presented in Table 6-E- and illustrated in Figure 6-E-2.

Table 6-E-2: Water Management Activities during the Dewatering Phase

Activity	Dewatering Phase[a]				Operational Phase[a]						
	2019										
	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dewatering through Whale Tail Lake (South Basin)	■	■	■	■							
Dewatering through Lake A16 (Mammoth Lake)					■	■	■	■			
Construction of the Northeast Dike	■	■									
Construction of the East Channel (December 2018 Start)	■	■	■								
If deemed necessary, the construction of the North Channel							■	■	■		
Freshwater Intake from Lake C38 (Nemo Lake)	■	■	■	■	■	■	■	■	■	■	■

[a] The dewatering phase was assumed to include water management activities listed above for the purpose of the surface water quantity effect assessment.

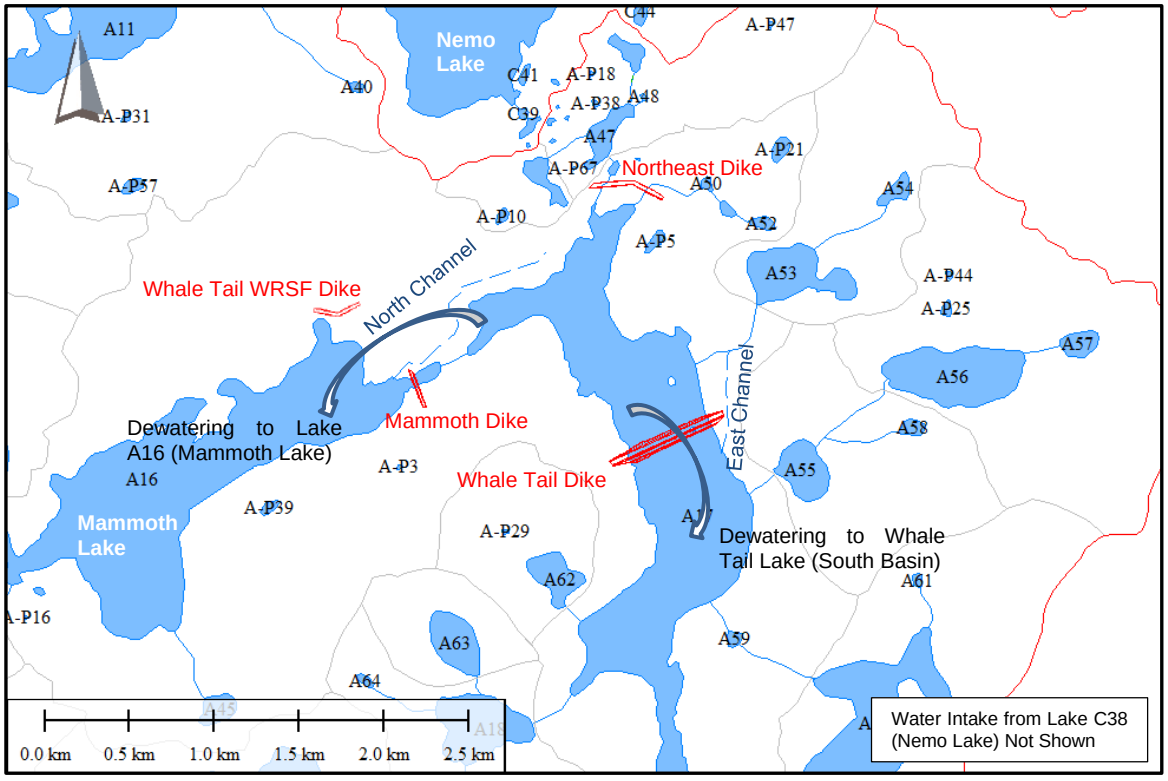


Figure 6-E-2: Dewatering Phase Activities

6.E-3.3 Operational Phase

Water management activities relevant to the surface water quantity of the receiving environment during the operational phase are listed below:

- treated water from the Water Treatment Plant discharged to Lake A16 (Mammoth Lake) during the months of June, July, August, and September 2020 and 2021;
- the diversion of Whale Tail Lake (South Basin) to Lake A16 (Mammoth Lake), through Lake A45;
- the diversion of the Northeast sector to Lake C38 (Nemo Lake), through Lake C44; and
- freshwater intake from Lake C38 (Nemo Lake).

Water management activities during the operational phase are presented in Table 6-E-3 and illustrated in Figure 6-E-3.

Table 6-E-3: Water Management Activities during the Operational Phase

Activity	Operational Phase																												
	2019						2020												2021										
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Discharge from the Water Treatment Plant to Lake A16 (Mammoth Lake)																														
Diversion from Whale Tail Lake (South Basin) to Lake A16 (Mammoth Lake)																														
Diversion from the Northeast Sector Lake to Lake C38 (Nemo Lake)																														
Freshwater Intake from Lake C38 (Nemo Lake)																														

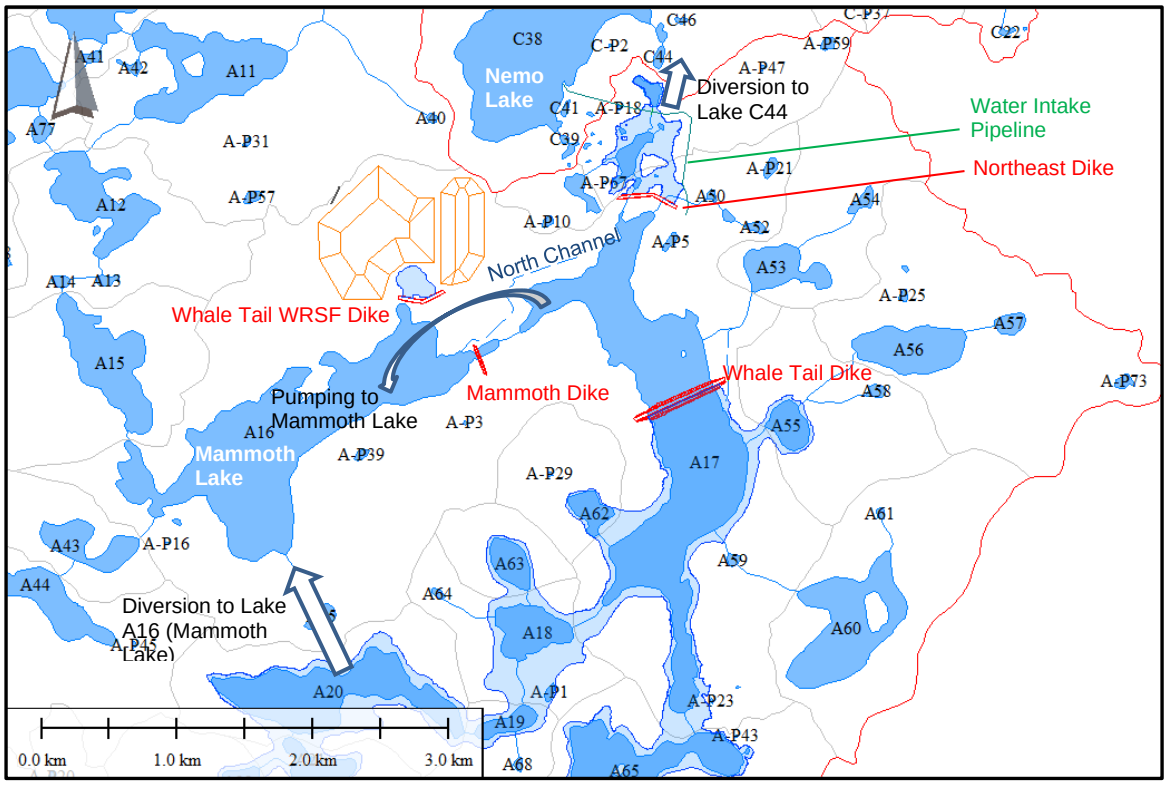


Figure 6-E-3: Operational Phase Activities

6.E-3.4 Closure Phase

The closure phase was defined as the period of refilling of Lake A17 (Whale Tail Lake) to baseline level, prior to breaching of the Whale Tail Dike and Mammoth Dike in 2029, for the purpose of this surface water quantity assessment. Relevant activities considered in this surface water quantity assessment during the closure phase include the following:

- ongoing closed-circuiting of Whale Tail Lake (North Basin) from the operational phase;
- draw-down of Whale Tail Lake (South Basin) to refill the open pit by pumping;
- draw-down of the Northeast sector to refill the open pit by pumping;
- re-establishment of natural drainage patterns of the North sector; and
- ongoing diversion of the Whale Tail WRSF runoff to the Water Treatment Plant.

Water management activities during the closure phase are presented in Table 6-E-4 and illustrated in Figure 6-E-4.

Table 6-E-4: Water Management Activities during the Closure Phase

Activity	Closure Phase (years)							
	2022	2023	2024	2025	2026	2027	2028	2029
Refilling of Open Pit	■	■	■	■				
Refilling of Whale Tail Lake (North Basin)					■	■	■	
Diversion of Waste Rock Storage Facility Runoff	■	■	■	■	■	■	■	■

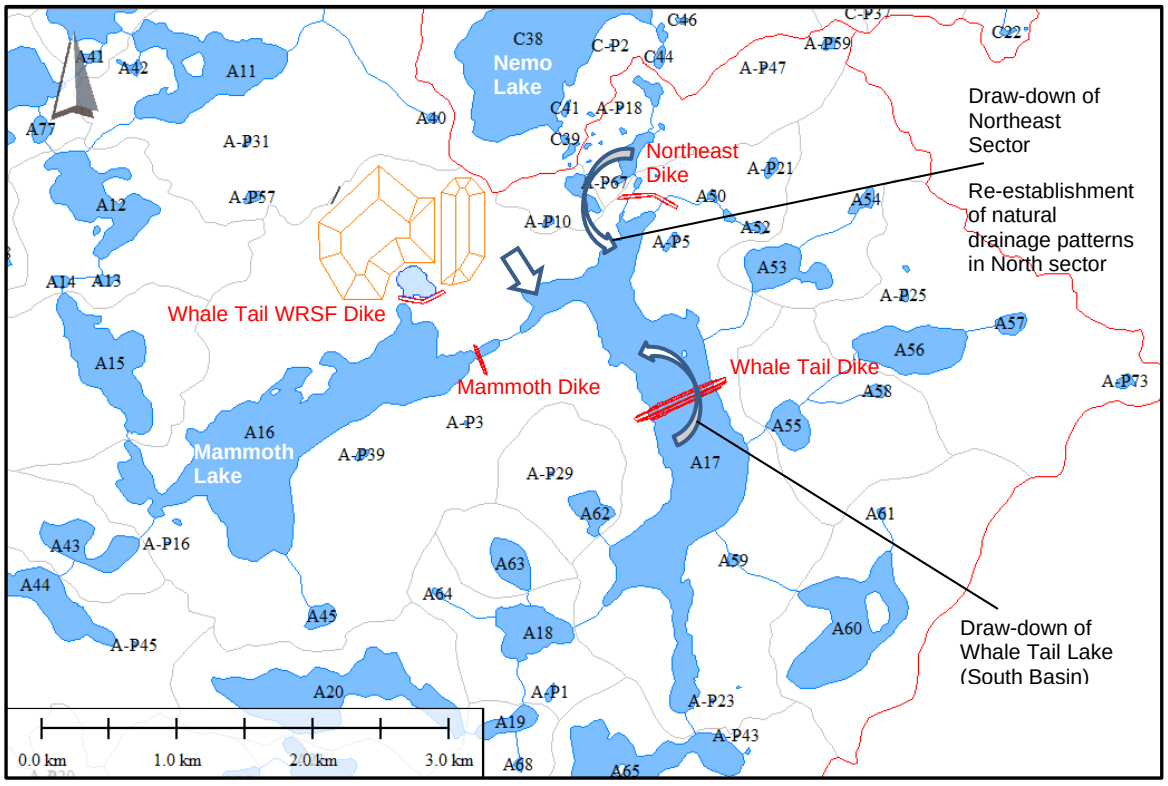


Figure 6-E-4: Closure Phase Activities

6.E-3.5 Post-closure Phase

All infrastructure will be decommissioned by the end the closure phase, and drainage patterns will be returned to baseline conditions.

6.E-4 POTENTIAL EFFECTS TO SURFACE WATER QUANTITY

6.E-4.1 Construction Phase

Potential effects to surface water quantity during the construction phase are summarized as follows:

- Construction of the Whale Tail Dike will prevent runoff from Whale Tail Lake (South Basin) to Whale Tail Lake (North Basin), and downstream lakes, from June 2018 until the end of the closure phase. The Whale Tail Dike will reduce the drainage area of Whale Tail Lake (North Basin) by 79%, from 28.1 km^2 (baseline conditions) to 5.8 km^2 (following construction of the Whale Tail Dike), resulting in reduced discharges at the outlet of Lake A17 (Whale Tail Lake), and downstream lakes.
- Rock placement to construct the Whale Tail Dike will displace water which may result in an increase in water level and discharge in North Whale Tail until the Mammoth Dike is constructed. A similar increase in water level is possible from the construction of the Mammoth Dike in Lake A16 (Mammoth Lake); however, the Mammoth Dike will be constructed near the eastern shoreline of the lake resulting in a less significant increase in water level.
- Construction of the Whale Tail WRSF Dike will prevent runoff upstream of the dike to Lake A16 (Mammoth Lake), and downstream lakes, from June 2018 until the end of the post-closure phase. The Whale Tail WRSF Dike will reduce the drainage area of Lake A16 (Mammoth Lake) by 1.16 km^2, resulting in reduced discharges at the outlet of Lake A16 (Mammoth Lake), and downstream lakes.
- Construction of the Mammoth Dike will prevent runoff from Whale Tail Lake (North Basin) to Lake A16 (Mammoth Lake), and downstream lakes, from September 2018 until the end of the closure phase. The Mammoth Dike will reduce the Lake A17 (Whale Tail Lake) watershed by 100%. The Mammoth Dike will also encroach on the local watershed of Lake A16 (Mammoth Lake) by approximately 5%, including 0.012 km^2 in lake area, and 0.357 km^2 in land area. The total Lake A16 (Mammoth Lake) watershed will be reduced by 77% from 38.7 km^2 to 9.0 km^2 from the Whale Tail WRSF Dike and the Mammoth Dike, resulting in reduced discharges at the outlet of Lake A16 (Mammoth Lake), and downstream lakes.
- The freshwater intake at Lake C38 (Nemo Lake) will be installed during summer 2018 to withdraw up to 8,760 m^3/year (based on a complete year of withdrawal) and may result a reduction in discharges at Lake C38 (Nemo Lake) and downstream lakes.

Watershed area modifications of Lake A17 (Whale Tail Lake) and Lake A16 (Mammoth Lake) are presented in Table 6-E-5.

Table 6-E-5: Watershed Area Modifications during the Construction Phase

Condition	Whale Tail Lake (km^2)			Mammoth Lake (km^2)		
	Lake	Land	Total	Lake	Land	Total
Baseline	4.70	23.4	28.1	6.59	32.1	38.7
Whale Tail Dike[a]	0.870	4.94	5.81	2.77	13.6	16.4
WRSF Dike[a]	--	--	--	2.77	12.4	15.2
Mammoth Dike[a, b]	--	--	--	1.88	7.1	9.0

[a] Modified area from construction of the dike.

[b] The Mammoth Dike may not be constructed until winter 2018-2019, or outside of the open water season of the construction phase.

WRSF = waste rock storage facility; km^2 = square kilometre.

6.E-4.2 Dewatering Phase

Potential effects to surface water quantity during the dewatering phase are summarized as follows:

- Cumulative effects are expected at Lake A16 (Mammoth Lake) and downstream lakes from the following activities:
  - The Mammoth Dike, built during the construction phase (Section 6.E-3), will reduce the watershed area of Lake A16 (Mammoth Lake) and downstream lakes, resulting in reduced discharges;
  - The Whale Tail WRSF Dike will reduce the land area of the Lake A16 (Mammoth Lake) and downstream lake watersheds, resulting in reduced discharges;
  - The road to the north of Whale Tail Pit, or if deemed necessary, the construction of the North Channel will divert runoff from the Whale Tail Lake watershed (i.e., approximately 0.277 km^2) to Lake A16 (Mammoth Lake) and will augment discharges at Lake A16 (Mammoth Lake) and downstream Lake starting in August 2019; and
  - Dewatering through Lake A16 (Mammoth Lake) will augment discharges at Lake A16 (Mammoth Lake) and downstream lakes.
- The Whale Tail Dike will divert discharges from the Whale Tail Lake (South Basin) watershed to the Lake A16 (Mammoth Lake) watershed, through Lake A45, and will augment discharges at Lake A45 and downstream lakes. The diversion is not expected to affect the Lake A45 watershed until the operational phase in 2020 (Volume 6, Appendix 6-F), because it will take some time for the Whale Tail Lake (South Basin) water level to increase to the spill elevation. Therefore, potential impacts to Lake A45 and downstream lakes from the diversion are not expected during the dewatering phase.
- The Northeast Dike will divert discharges from the Lake A46 watershed to the Lake C38 (Nemo Lake) watershed, and will augment discharges at Lake C38 (Nemo Lake) and downstream lakes. The diversion is not expected to affect the Lake C38 (Nemo Lake) watershed until the operational phase in 2020 (Volume 6, Appendix 6-F), because it will take some time for the Lake A46 and upstream lake water levels to increase to the spill elevation. Therefore, impacts to Lake C38 (Nemo Lake) and downstream lakes from the diversion are not expected during the dewatering phase.
- No direct impacts are expected to the receiving environment (i.e., Lake A16 [Mammoth Lake] and downstream lakes) from construction of the East channel.
- The freshwater intake at Lake C38 (Nemo Lake), installed during the construction phase in summer 2018 to withdraw up to 8,760 m^3/year and may result a reduction in discharges at Lake C38 (Nemo Lake) and downstream lakes.

6.E-4.3 Operational Phase

Potential effects to surface water quantity during the operational phase are summarized as follows:

- Lake A45 will become part of the South Whale Tail diversion channel until the South Whale Tail diversion is decommissioned at closure.

- Cumulative effects are expected at Lake A16 (Mammoth Lake) and downstream lakes from the following activities:
  - The Mammoth Dike, built during the construction phase, will reduce the watershed area of Lake A16 (Mammoth Lake) and downstream lakes, resulting in reduced discharges;
  - The Whale Tail Dike will result in the diversion of the Whale Tail Lake (South Basin) watershed to the Lake A16 (Mammoth Lake) watershed, thereby augmenting discharges at Lake A16 (Mammoth Lake) and downstream lakes;
  - The Whale Tail WRSF Dike will reduce the land area of the Lake A16 (Mammoth Lake) and downstream lake watersheds, resulting in reduced discharges;
  - The road to the north of Whale Tail Pit, or if deemed necessary, the operation of the North Channel will divert runoff from the Whale Tail Lake watershed (i.e., approximately 0.277 km^2) to Lake A16 (Mammoth Lake) and will augment discharges at Lake A16 (Mammoth Lake) and downstream lakes starting in August 2019; and
  - Treated water from the Water Treatment Plant discharged to Lake A16 (Mammoth Lake) will augment the discharges at Lake A16 (Mammoth Lake) and downstream lakes.
- Cumulative effects are expected at Lake C38 (Nemo Lake) and downstream lakes from the following activities:
  - The Northeast Dike will divert discharges from the Lake A46 watershed to the Lake C38 (Nemo Lake) watershed (through Lake C44), and will augment discharges at Lake C44 and downstream lakes; and
  - The freshwater intake at Lake C38 (Nemo Lake) will result a reduction in discharges at Lake C38 (Nemo Lake) and downstream lakes.

6.E-4.4 Closure Phase

Potential effects to surface water quantity during the closure phase are summarized as follows:

- Cumulative effects are expected at Lake A16 (Mammoth Lake) and downstream lakes from the following activities:
  - The Mammoth Dike, built during the construction phase (Section 6.E-3.1), will reduce the watershed area of Lake A16 (Mammoth Lake) and downstream lakes, resulting in reduced discharges; and
  - The Whale Tail WRSF Dike, built during the construction phase (Section 6.E-3.2), will reduce the land area of Lake A16 (Mammoth Lake) and downstream lakes, resulting in reduced discharges.
- The Whale Tail Lake (South Basin) diversion will be drawn-down by November 2022 (Volume 6, Appendix 6-F). As such, lakes previously affected by the South Whale Tail diversion, located upstream of Whale Tail Lake (South Basin), will return to baseline conditions by November 2022. This will also remove the diversion to Lake A16 (Mammoth Lake).
- The Northeast Sector will be drawn-down by May 2022 (Volume 6, Appendix 6-F). As such, lakes previously affected by the Northeast Sector diversion (i.e., Lake A47, Lake A48, Lake A113, Pond A-P38,

and Pond A-P68), located upstream of Whale Tail Lake (North Basin), will return to baseline conditions by May 2022. This will also remove the diversion to Lake C38 (Nemo Lake).

6.E-4.5 Post-Closure Phase

The end pit lake will increase the surface area of Lake A17 (Whale Tail Lake) by 13% from 1.66 km^2 (baseline conditions) to 1.87 km^2 (post-closure conditions) (Figure 6-E-5), resulting in proportionate increases in direct precipitation and evaporative losses. All other lakes will be returned to baseline conditions.

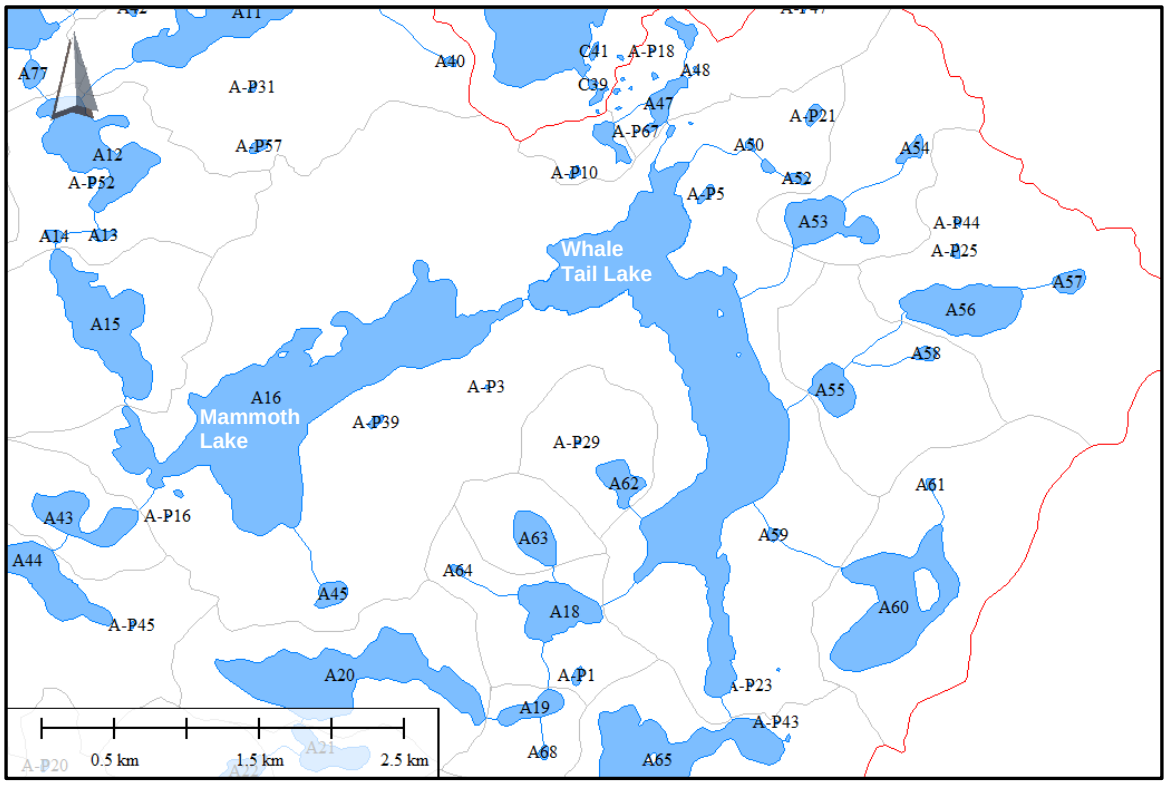


Figure 6-E-5: Post-Closure Phase Activities

6.E-5 EFFECTS ASSESSMENT

6.E-5.1 Construction Phase

Potential effects on hydrological indicators are presented below for Lake A16 (Mammoth Lake), Lake A15, Lake A5, and Lake A69. Methods are presented in Attachment A. For this assessment, construction of the Whale Tail Dike was assumed to be instantaneously completed in June, and the potential increase in water level from rock placement of the dike was not considered, resulting in conservative results.

Freshwater intake from Lake C38 (Nemo Lake) was assessed for the dewatering phase. A lower volume is required during the construction phase than during the dewatering phase, and effects from water withdrawal on discharge and water levels are expected to be negligible during the construction phase and not further discussed.

Water levels mentioned herein refer to water surface elevations. Stages presented in figures below represent water surface elevations referenced to an arbitrary datum.

6.E-5.1.1 Lake A16 (Mammoth Lake)

- Discharges: mean monthly discharges are expected to decrease from the baseline values during the entire open water season.

  The 2-year flood discharge is expected to decrease by 50% and the 100-year flood discharge is expected to decrease by 47% from the baseline values. Low discharges are expected to decrease from 62% to 64% from the baseline values. Derived discharge regimes are presented in Figure 6-E-6 for the baseline and construction phases.

- Water levels: mean monthly water levels are also expected to decrease from the baseline values during the entire open water season.

  The 2-year flood level is expected to decrease by 0.19 m, and the 100-year flood level is expected to decrease by 0.24 m from the baseline values. Mean monthly water levels are expected remain similar to baseline conditions in May, and decrease by 0.16 m in June, 0.16 m in July, 0.11 m in August, 0.14 m in September, and 0.13 m in October, from the baseline values. Derived water level regimes are presented in Figure 6-E-7 for the baseline and construction phases.

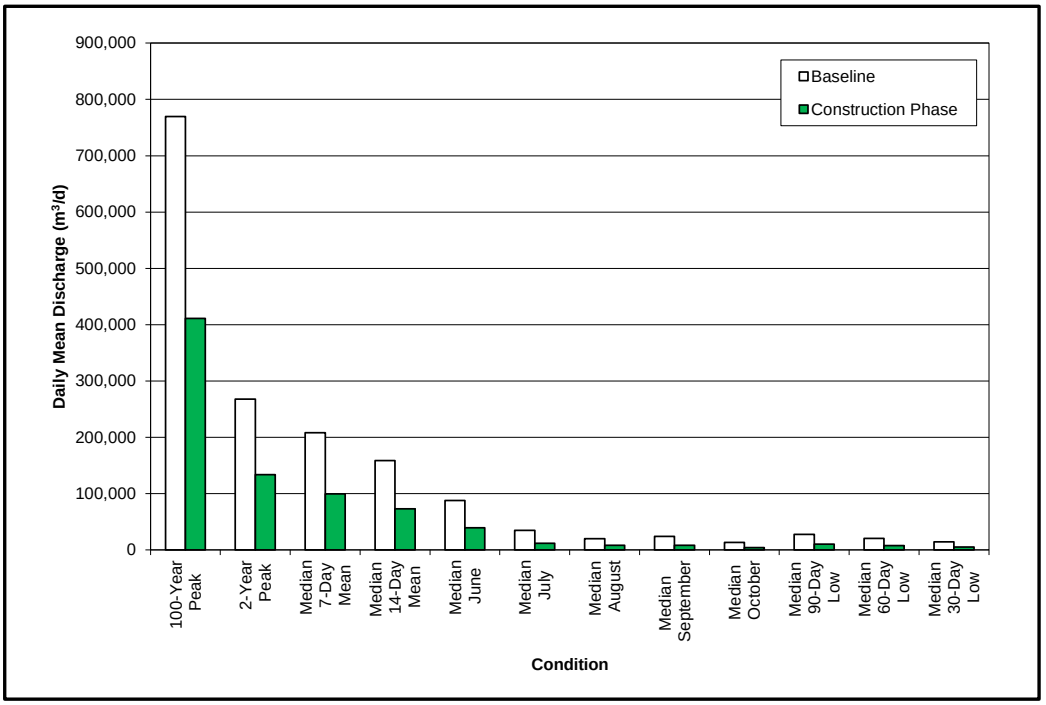


Figure 6-E-6: Derived Discharge Regimes at Lake A16 (Mammoth Lake) during the Construction Phase

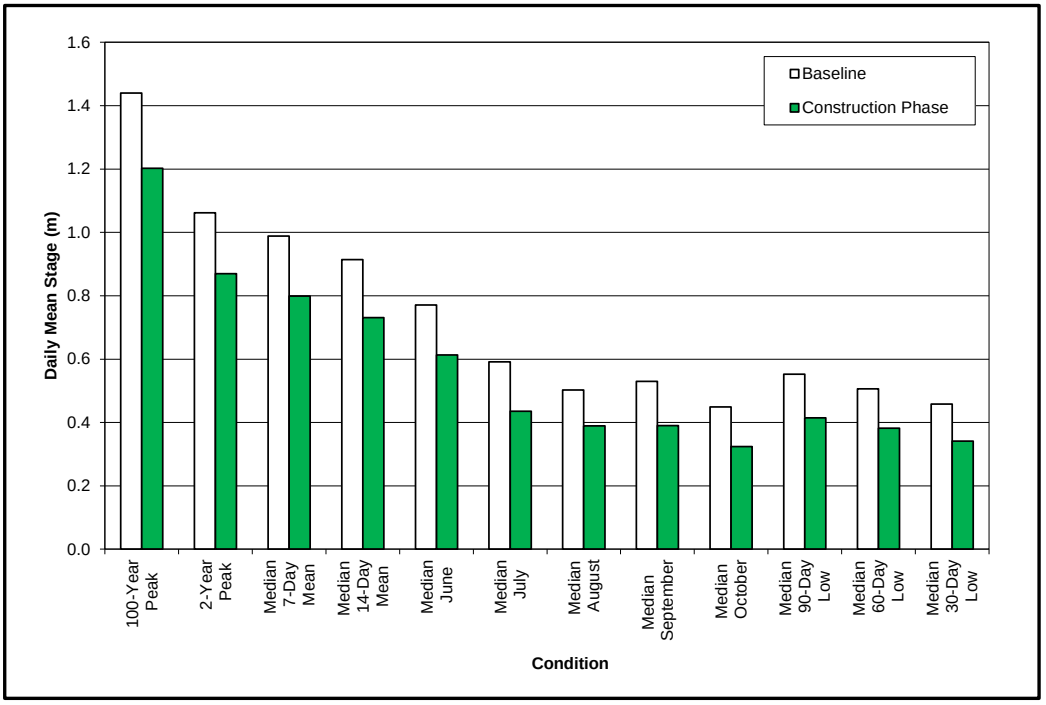


Figure 6-E-7: Derived Stage Regimes at Lake A16 (Mammoth Lake) during the Construction Phase

6.E-5.1.2 Lake A15

- Discharges: mean monthly discharges are expected to decrease from the baseline values during the entire open water season.

  The 2-year flood discharge is expected to decrease by 46% and the 100-year flood discharge is expected to decrease by 40% from the baseline values. Low discharges are expected to decrease from 58% to 61% from the baseline values. Derived discharge regimes are presented in Figure 6-E-8 for the baseline and construction phases.

- Water levels: mean monthly water levels are also expected to decrease from the baseline values during the entire open water season.

  The 2-year flood level is expected to decrease by 0.10 m, and the 100-year flood level is expected to decrease by 0.10 m from the baseline values. Mean monthly water levels are expected to remain similar in May, and decrease by 0.09 m in June, 0.09 m in July, 0.07 m in August, 0.09 m in September, and 0.08 m in October, from the baseline values. Derived water level regimes are presented in Figure 6-E-9 for the baseline and construction phases.

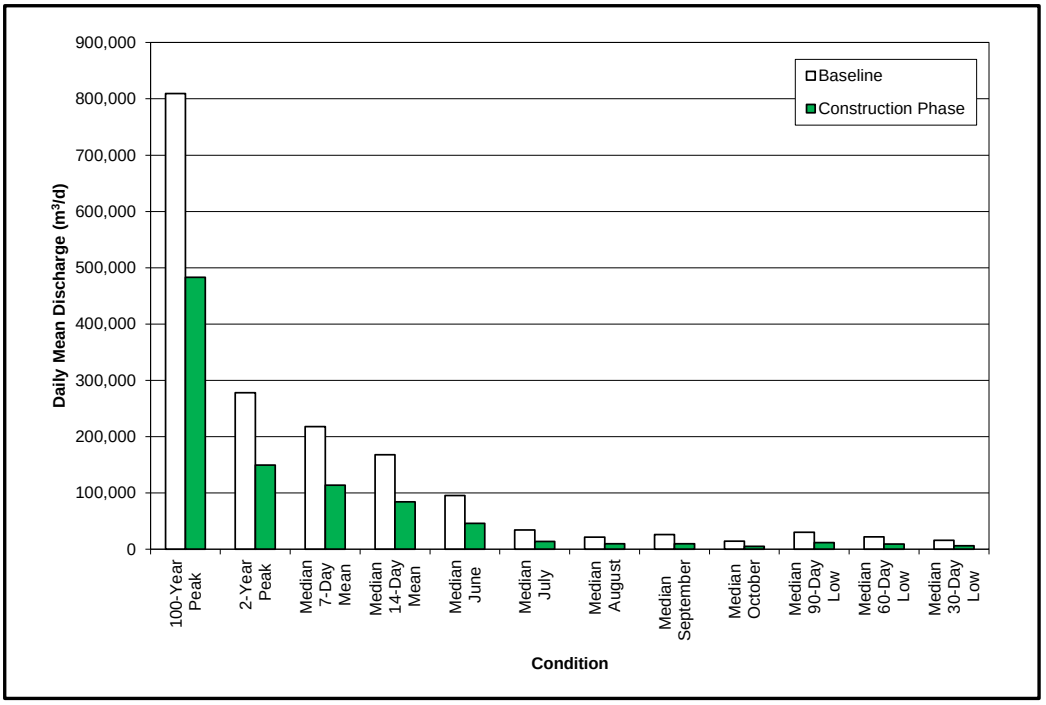


Figure 6-E-8: Derived Discharge Regimes at Lake A15 during the Construction Phase

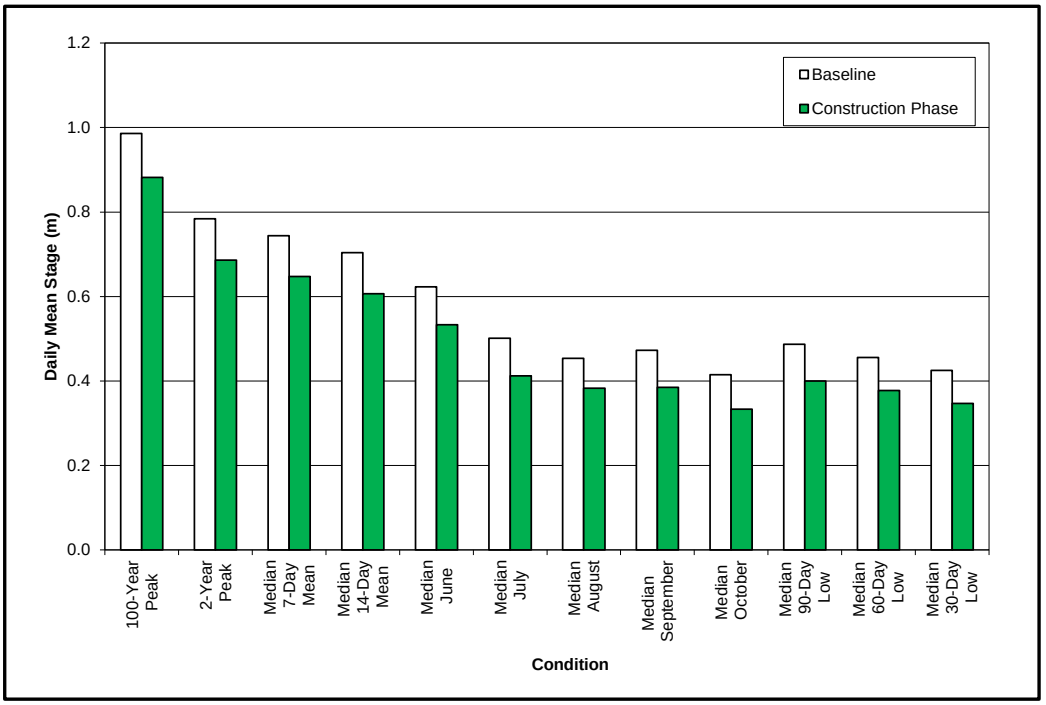


Figure 6-E-9: Derived Stage Regimes at Lake A15 during the Construction Phase

6.E-5.1.3 Lake A5

- Discharges: peak discharges are expected to decrease slightly and mean monthly discharges are expected to decrease from the baseline values during the entire open water season.

  The 2-year flood discharge is expected to decrease by 17% and the 100-year flood discharge is expected to decrease by 16% from the baseline values. Low discharges are expected to decrease from 42 to 47% from the baseline values. Derived discharge regimes are presented in Figure 6-E-10 for the baseline and construction phases.

- Water levels: mean monthly water levels are also expected to decrease from the baseline values during the open water season.

  The 2-year flood level is expected to decrease by 0.03 m, and the 100-year flood level is expected to decrease by 0.04 m from the baseline values. Mean monthly water levels are expected to remain similar in May, decrease slightly by 0.05 m in June, 0.05 m in July, 0.04 m in August, 0.04 m in September, and 0.04 m in October, from the baseline values. Derived water level regimes are presented in Figure 6-E-11 for the baseline and construction phases.

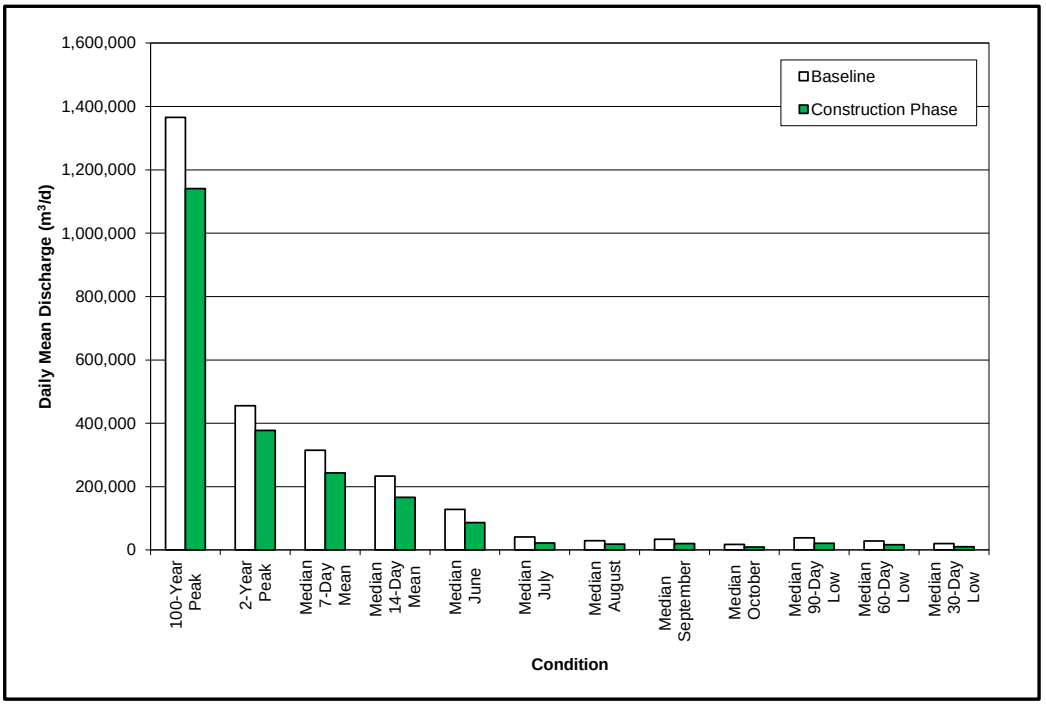


Figure 6-E-10: Derived Discharge Regimes at Lake A5 during the Construction Phase

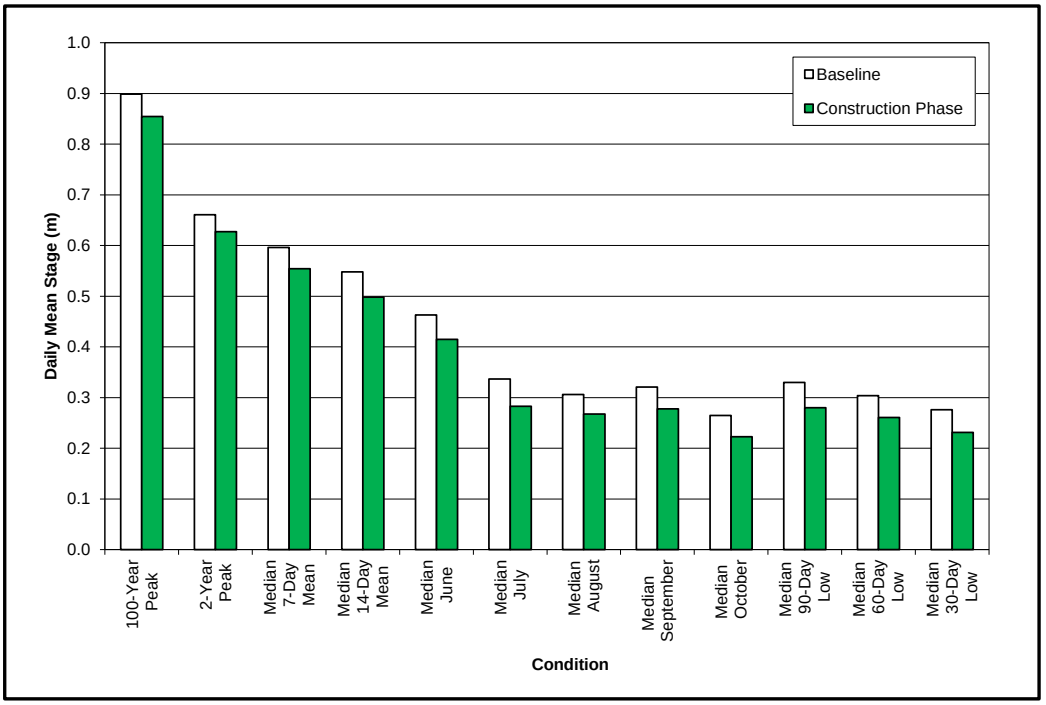


Figure 6-E-11: Derived Stage Regimes at Lake A5 during the Construction Phase

6.E-5.1.4 Lake A69

- Discharges: mean monthly discharges are expected to decrease slightly from the baseline values during the entire open water season.

  The 2-year flood discharge is expected to decrease by 1% from the baseline value and the 100-year flood discharge is expected to decrease by 1% from the baseline values. Low discharges are expected to decrease from 8% to 9% from the baseline values. Derived discharge regimes are presented in Figure 6-E-12 for the baseline and construction phases.

- Water levels: mean monthly water levels are also expected to decrease from the baseline values during the months of June, July, August, September, and October.

  The 2-year and 100-year flood levels are expected to be similar to the baseline values. Mean monthly water levels are expected to remain similar to baseline values throughout the entire open water season with less than 0.01 m decrease. Derived water level regimes are presented in Figure 6-E-13 for the baseline and construction phases.

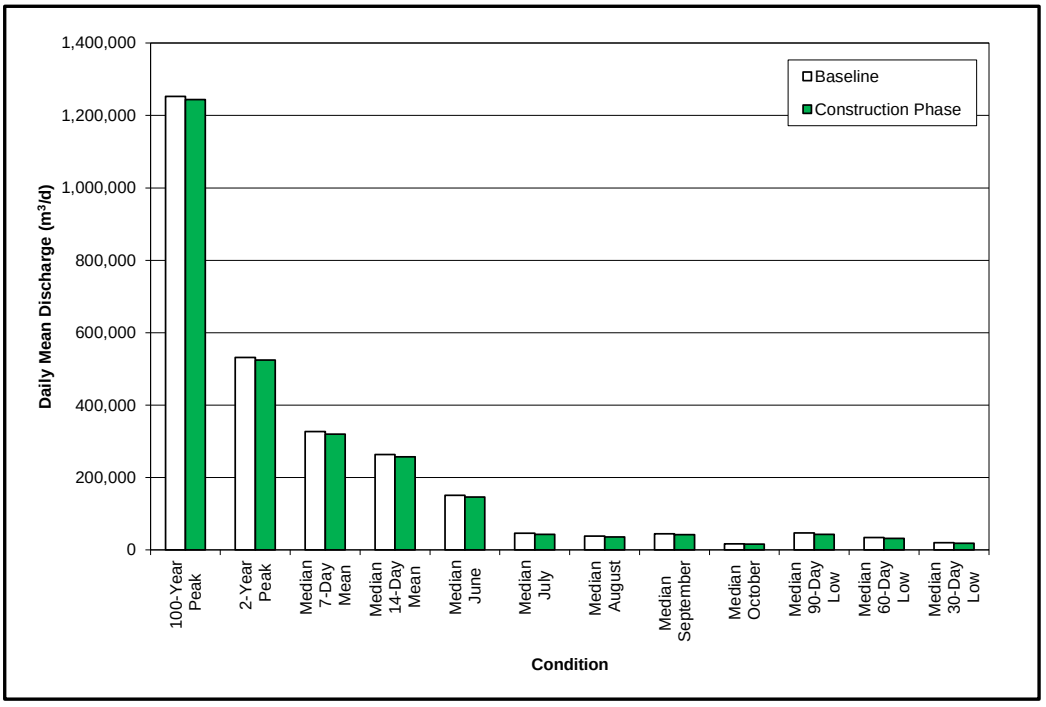


Figure 6-E-12: Derived Discharge Regimes at Lake A69 during the Construction Phase

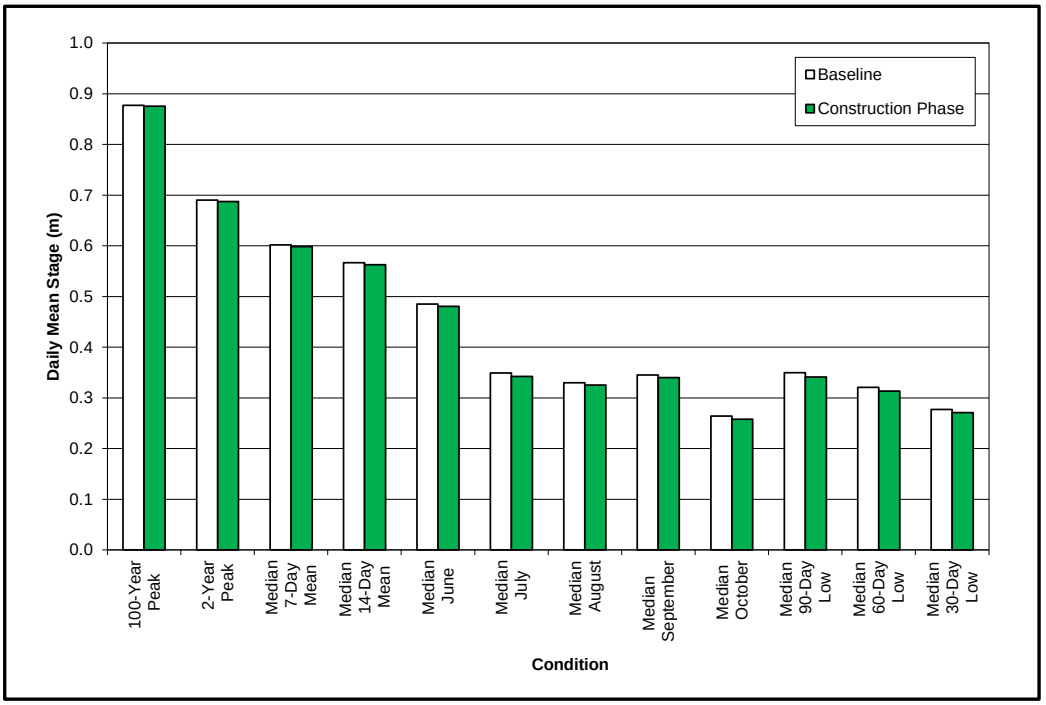


Figure 6-E-13: Derived Stage Regimes at Lake A69 during the Construction Phase

6.E-5.2 Dewatering Phase

Potential effects on hydrological indicators are presented below for Lake A16 (Mammoth Lake), Lake A15, Lake A5, Lake A69, and Lake C38 (Nemo Lake). Methods are presented in Attachment A.

Dewatering through Lake A16 (Mammoth Lake) during open water months minimizes the potential for effects on discharges and water levels which would be increased with a winter schedule.

Water levels mentioned herein refer to water surface elevations. Stages presented in figures below represent water surface elevations referenced to an arbitrary datum.

6.E-5.2.1 Lake A16 (Mammoth Lake)

- Discharges: mean monthly discharges are expected to decrease from the baseline values during the months of May, June, July, August, September, and October.

  The 2-year flood discharge is expected to decrease by 38% and the 100-year flood discharge is expected to decrease by 36% from the baseline values. Low discharges are expected to decrease from 31 to 34% from the baseline values. Derived discharge regimes are presented in Figure 6-E-14 for the baseline and dewatering phases.

- Water levels: mean monthly water levels are also expected to decrease from the baseline values during the months of May, June, July, August, September, and October. ,

  The 2-year flood level is expected to decrease by 0.14 m, and the 100-year flood level is expected to decrease by 0.18 m from the baseline values. Mean monthly water levels are expected to decrease slightly in May, by 0.12 m in June, 0.04 m in July, 0.05 m in August, 0.09 m in September, and 0.10 m in October,

from the baseline values. Derived water level regimes are presented in Figure 6-E-15 for the baseline and dewatering phases.

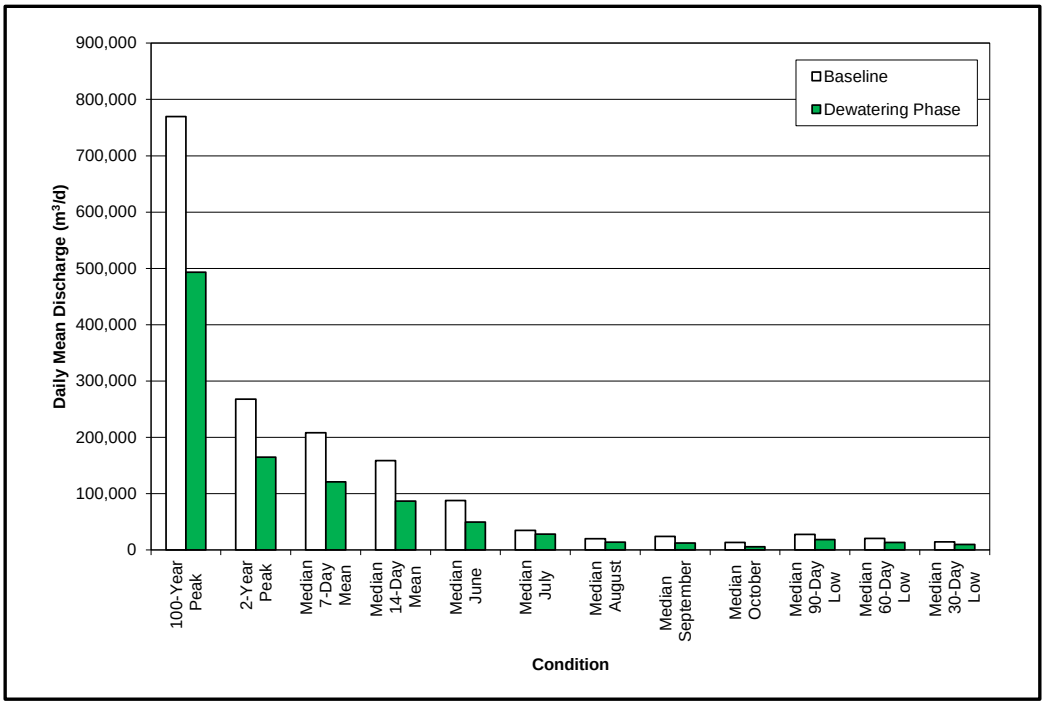


Figure 6-E-14: Derived Discharge Regimes at Lake A16 (Mammoth Lake) during the Dewatering Phase

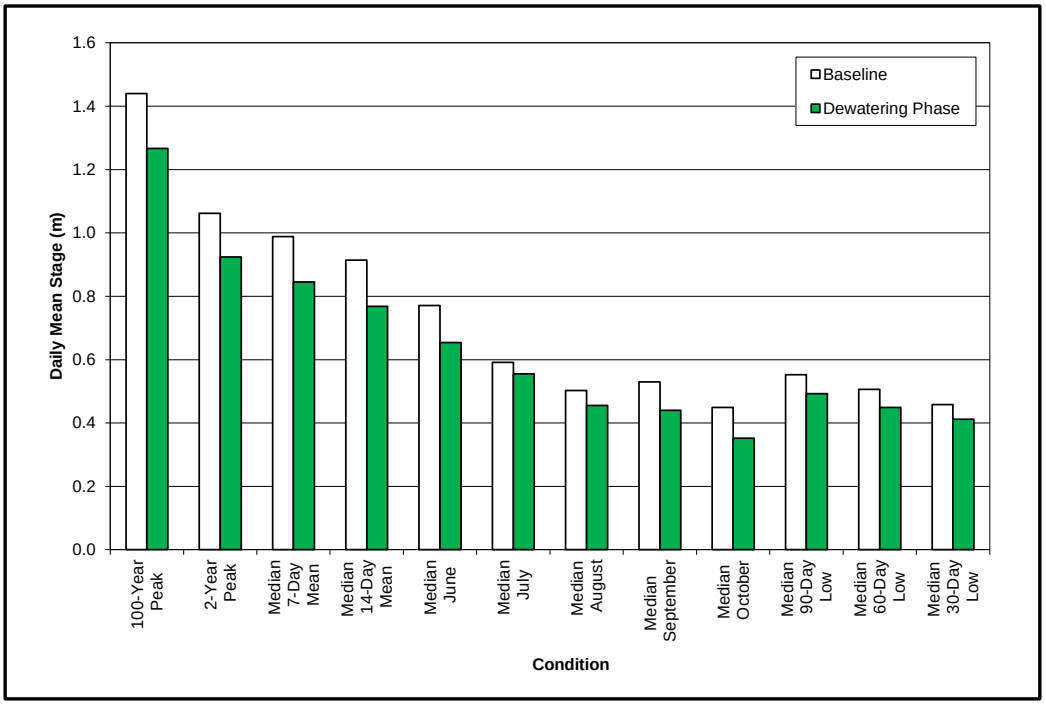


Figure 6-E-15: Derived Stage Regimes at Lake A16 (Mammoth Lake) during the Dewatering Phase

6.E-5.2.2 Lake A15

- Discharges: mean monthly discharges are expected to decrease from the baseline values during the months of May, June, July, August, September, and October.

  The 2-year flood discharge is expected to decrease by 33% and the 100-year flood discharge is expected to decrease by 27% from the baseline values. Low discharges are expected to decrease from 28 to 32% from the baseline values. Derived discharge regimes are presented in Figure 6-E-16 for the baseline and dewatering phases.

- Water levels: mean monthly water levels are also expected to decrease from the baseline values during the months of May, June, July, August, September, and October.

  The 2-year flood level is expected to decrease by 0.07 m, and the 100-year flood level is expected to decrease by 0.06 m from the baseline values. Mean monthly water levels are expected to decrease slightly in May, by 0.07 m in June, 0.02 m in July, 0.02 m in August, 0.06 m in September, and 0.06 m in October, from the baseline values. Derived water level regimes are presented in Figure 6-E-17 for the baseline and dewatering phases.

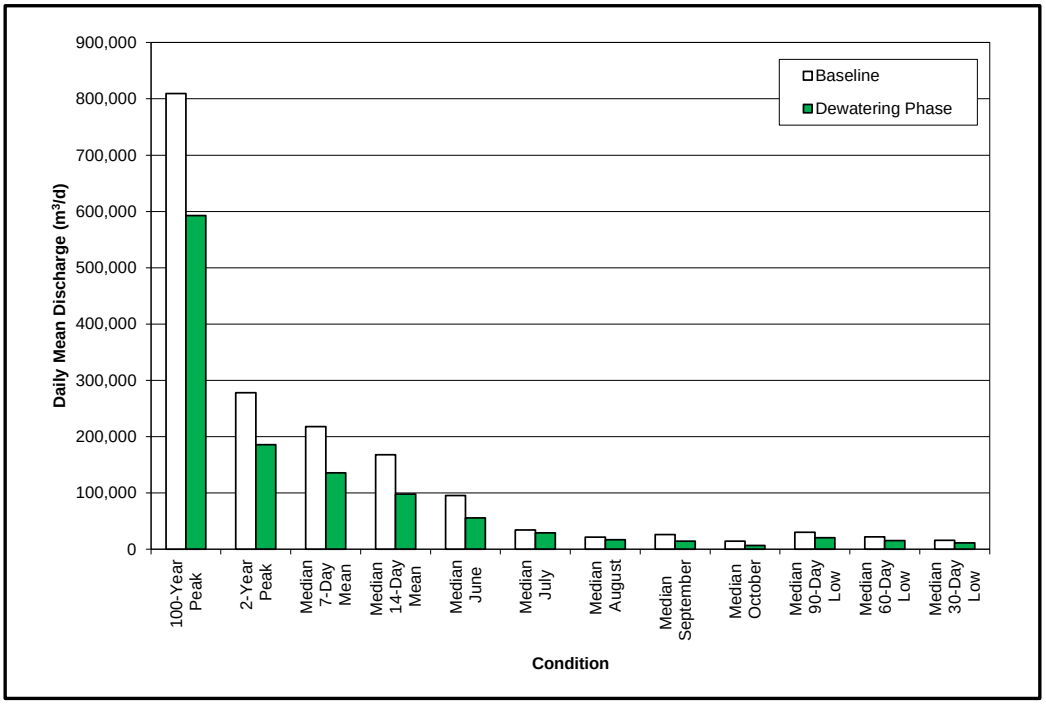


Figure 6-E-16: Derived Discharge Regimes at Lake A15 during the Dewatering Phase

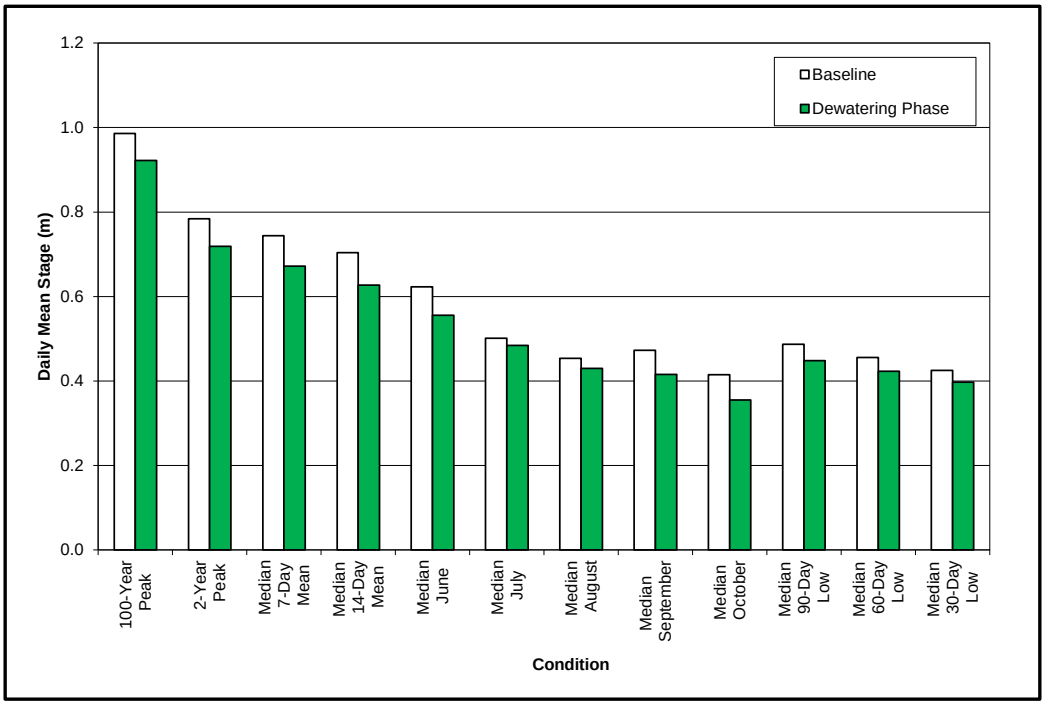


Figure 6-E-17: Derived Stage Regimes at Lake A15 during the Dewatering Phase

6.E-5.2.3 Lake A5

- Discharges: mean monthly discharges are expected to decrease slightly from the baseline values during the months of June, July, August, September, and October, and remain similar to the baseline value during the month of May.

  The 2-year flood discharge is expected to decrease by 12% and the 100-year flood discharge is expected to decrease by 9% from the baseline values. Low discharges are expected to decrease from 15 to 24% from the baseline values. Derived discharge regimes are presented in Figure 6-E-18 for the baseline and dewatering phases.

- Water levels: mean monthly water levels are also expected to decrease slightly from the baseline values during the months of June, July, August, September, and October, and remain similar to the baseline value during the month of May.

  The 2-year flood level is expected to decrease by 0.02 m, and the 100-year flood level is expected to decrease by 0.02 m from the baseline values. Mean monthly water levels are expected to remain similar to baseline values in May, decrease by 0.04 m in June, 0.02 m in July, 0.01 m in August, 0.03 m in September, and 0.03 m in October, from the baseline values. Derived water level regimes are presented in Figure 6-E-19 for the baseline and dewatering phases.

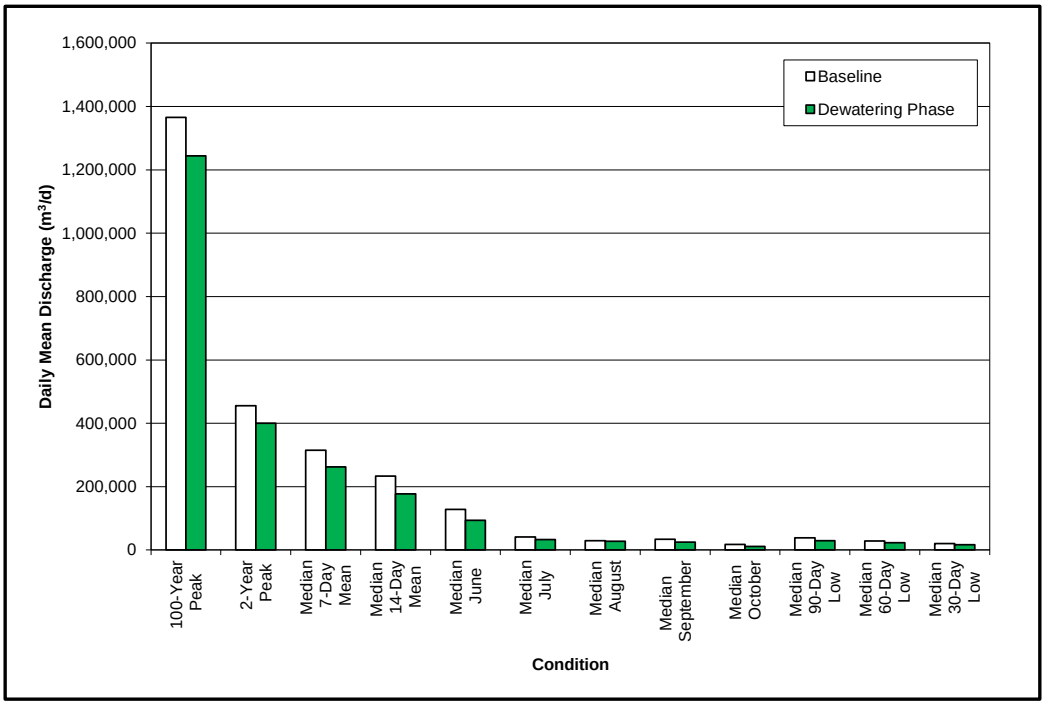


Figure 6-E-18: Derived Discharge Regimes at Lake A5 during the Dewatering Phase

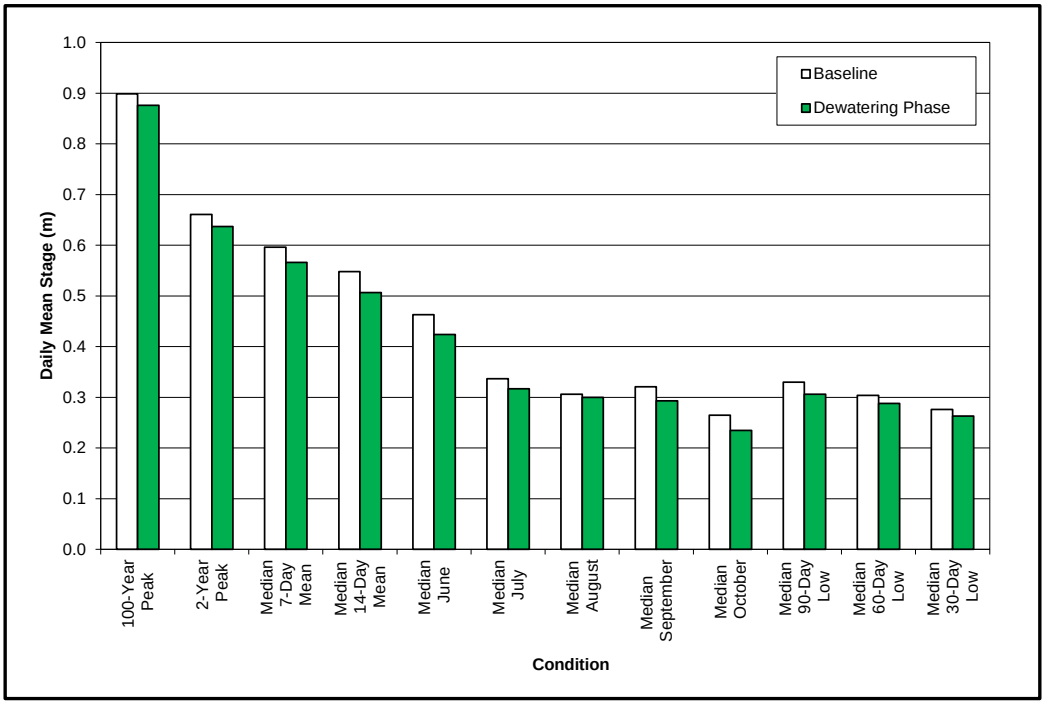


Figure 6-E-19: Derived Stage Regimes at Lake A5 during the Dewatering Phase

6.E-5.2.4 Lake A69

- Discharges: mean monthly discharges are expected to remain similar to the baseline values during the months of May, June, July, August, September, and October.

  The 2-year flood discharge is expected to decrease by 1% from the baseline value and the 100-year flood discharge is expected to remain similar to the baseline value. Low discharges are expected to decrease from 1 to 6% from the baseline values. Derived discharge regimes are presented in Figure 6-E-20 for the baseline and dewatering phases.

- Water levels: mean monthly water levels are also expected to remain similar to the baseline values during the months of May, June, July, August, September, and October.

- The 2-year and 100-year flood levels are expected to remain similar to the baseline values. Mean monthly water levels are expected to remain similar to baseline values in May, decrease by 0.004 m in June, decrease by 0.003 m in July, remain similar to baseline values in August, decrease by 0.003 m in September, and decrease by 0.004 m in October, from the baseline values. Derived water level regimes are presented in Figure 6-E-21 for the baseline and dewatering phases.

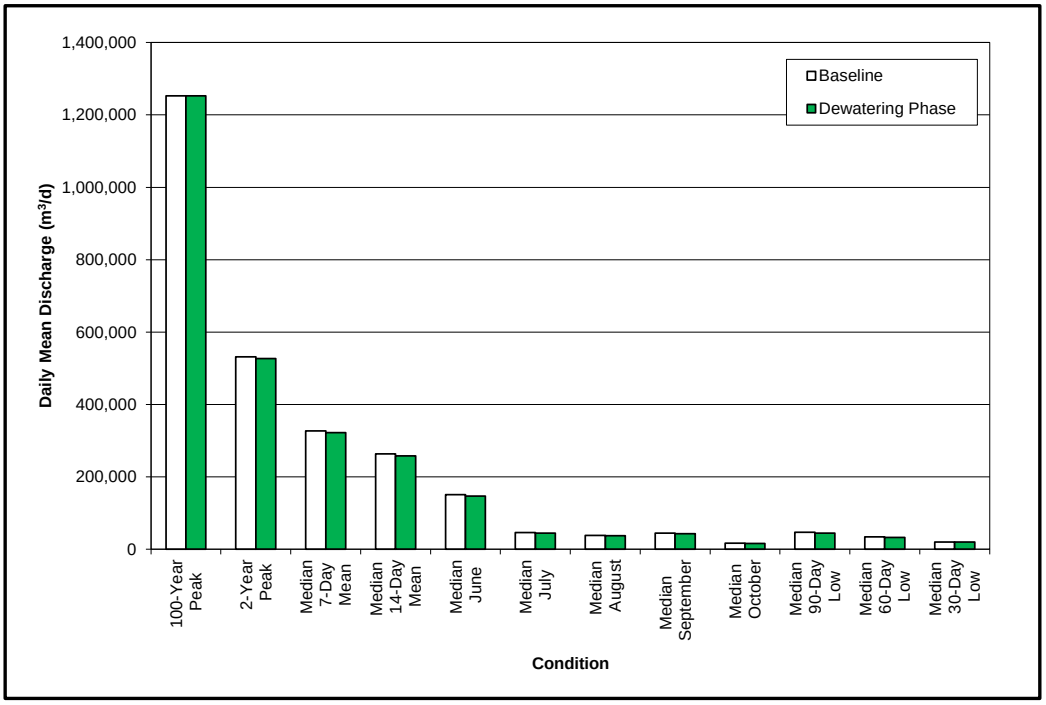


Figure 6-E-20: Derived Discharge Regimes at Lake A69 during the Dewatering Phase

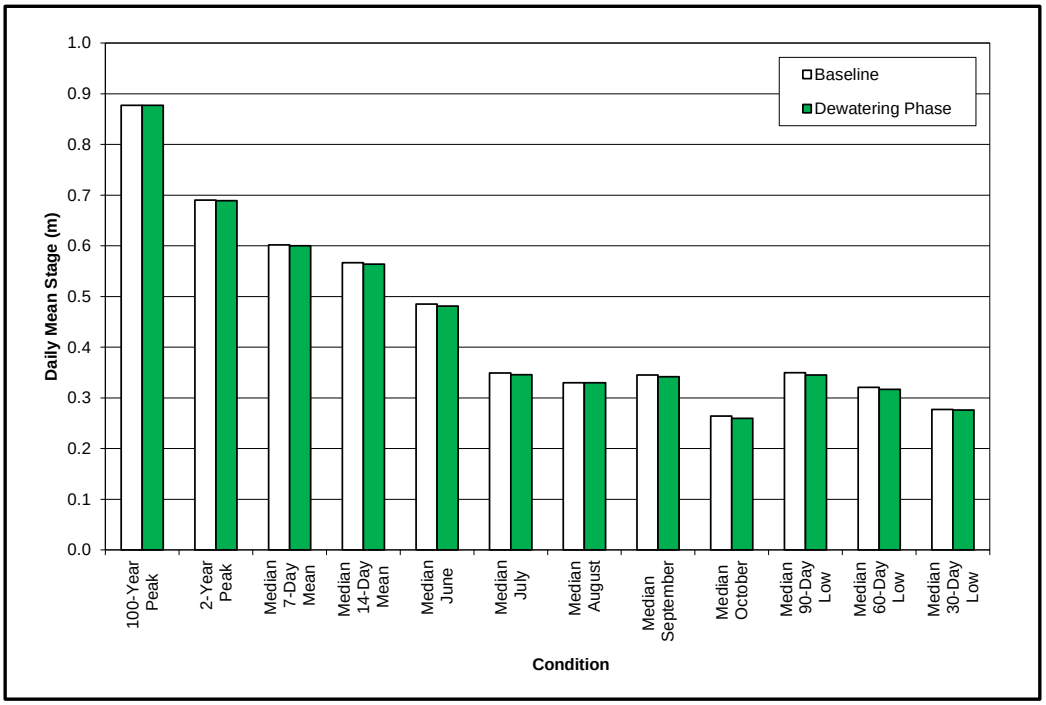


Figure 6-E-21: Derived Stage Regimes at Lake A69 during the Dewatering Phase

6.E-5.2.5 Lake C38 (Nemo Lake)

- Discharges: mean monthly discharges are expected to remain similar to the baseline values during the months of May, June, July, August, September, and October.

  The 2-year and 100-year flood discharges are expected to decrease by 1% from the baseline value. Low discharges are expected to decrease from 3 to 4% from the baseline values. Derived discharge regimes are presented in Figure 6-E-22 for the baseline and dewatering phases.

- Water levels: mean monthly water levels are also expected to remain similar to the baseline values during the months of May, June, July, August, September, and October.

- The 2-year and 100-year flood levels are expected to remain similar to the baseline values. Mean monthly water levels are expected to remain similar to baseline values in May, decrease by 0.006 m in June, decrease by 0.008 m in July, decrease by 0.007 m in August, decrease by 0.006 m in September, and decrease by 0.003 m in October, from the baseline values. Derived water level regimes are presented in Figure 6-E-23 for the baseline and dewatering phases.

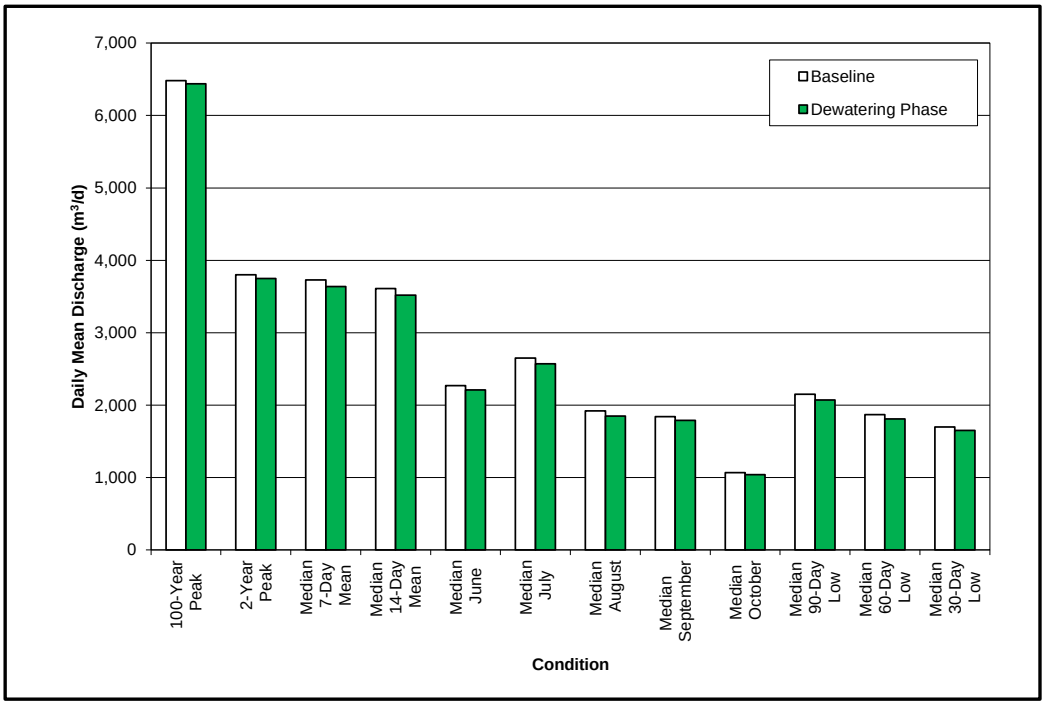


Figure 6-E-22: Derived Discharge Regimes at Lake C38 (Nemo Lake) during the Dewatering Phase

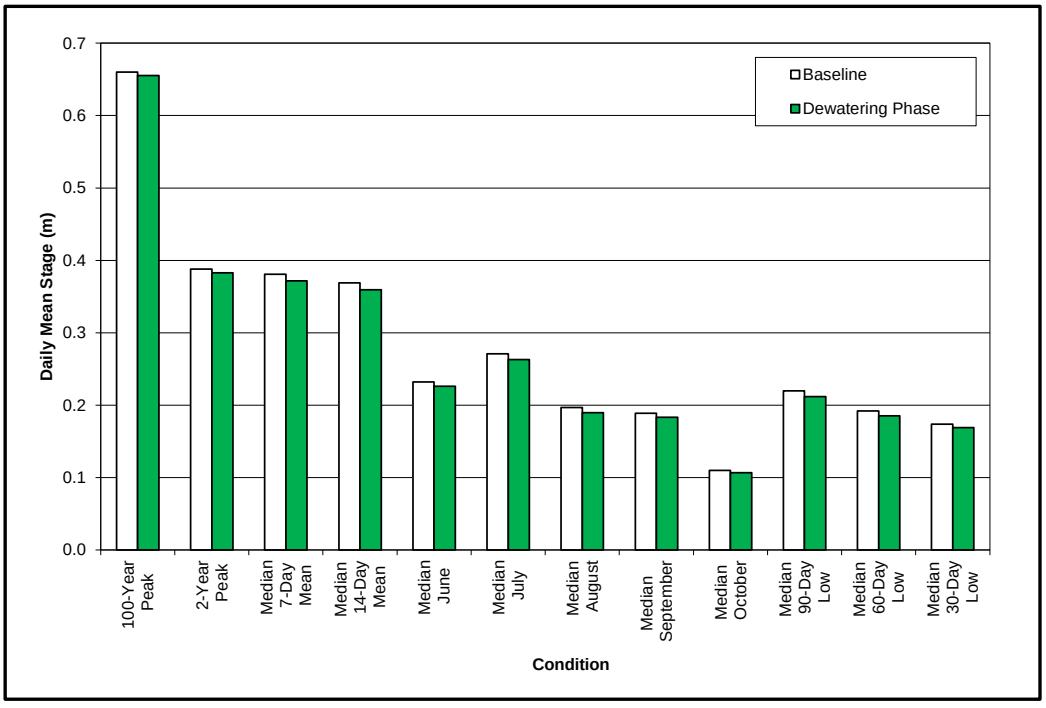


Figure 6-E-23: Derived Stage Regimes at Lake C38 (Nemo Lake) during the Dewatering Phase

6.E-5.3 Operational Phase

Potential effects on hydrological indicators are presented below for Lake A16 (Mammoth Lake), Lake A15, Lake A5, Lake A69, Lake C38 (Nemo Lake), and Lake C8. Methods are presented in Attachment A.

Lake A45 was not explicitly modeled. During the operational phase, the diversion of Whale Tail Lake (South Basin) will increase the drainage area of Lake A45 by approximately 44 times, from 0.535 km^2 under baseline conditions, to 23.7 km^2 under operational conditions. Lake A45 will become part of the Whale Tail Lake (South Basin) diversion channel and be permanently altered.

Water levels mentioned herein refer to water surface elevations. Stages presented in figures below represent water surface elevations referenced to an arbitrary datum.

6.E-5.3.1 Lake A16 (Mammoth Lake)

- Discharges: mean monthly discharges are expected to increase slightly from the baseline values during the months of June and September, and decrease slightly during the month of July, and remain similar to baseline values during the months of May, August, and October.

  The 2-year flood discharge is expected to increase by 13% and the 100-year flood discharge is expected to increase by 8% from the baseline values. Low discharges are expected to increase from 2 to 3% from the baseline values. Derived discharge regimes are presented in Figure 6-E-24 for the baseline and operational phases.

- Water levels: mean monthly water levels are also expected to increase slightly from the baseline values during the months of June and September, and decrease slightly during the month of July, and remain similar to baseline values during the months of May, August, and October.

  The 2-year flood level is expected to increase by 0.04 m, and the 100-year flood level is expected to increase by 0.03 m from the baseline values. Mean monthly water levels are expected to increase by 0.01 m in June, by 0.01 m in September, decrease by 0.02 m in July, and remain similar to the baseline values in May, August, and October. Derived water level regimes are presented in Figure 6-E-25 for the baseline and operational phases.

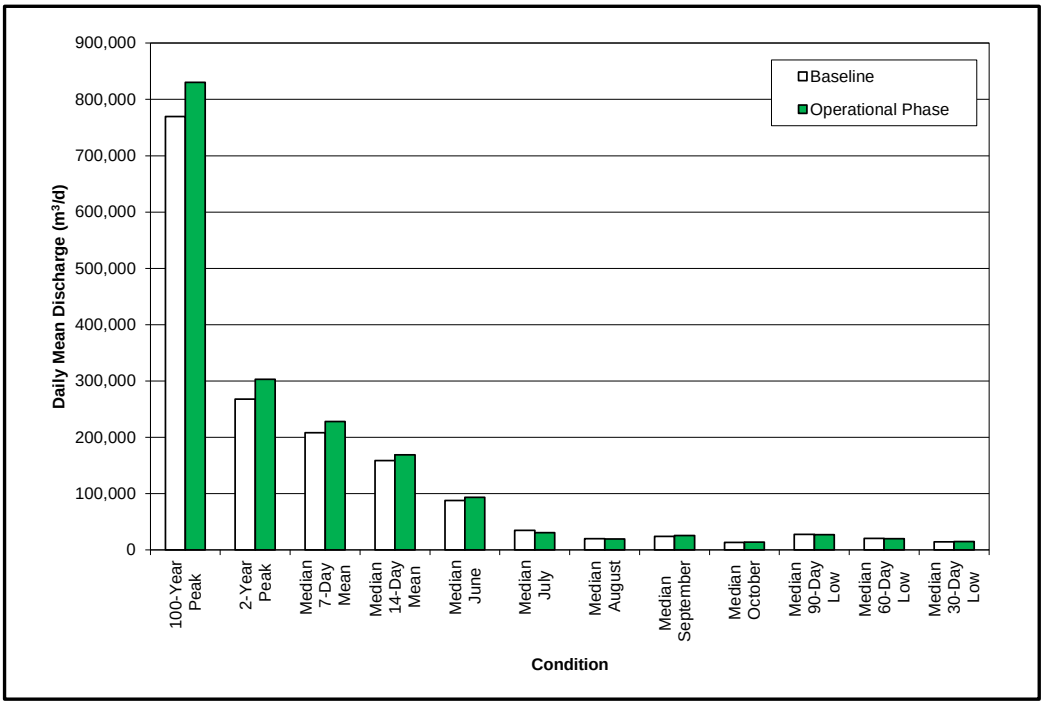


Figure 6-E-24: Derived Discharge Regimes at Lake A16 (Mammoth Lake) during the Operational Phase

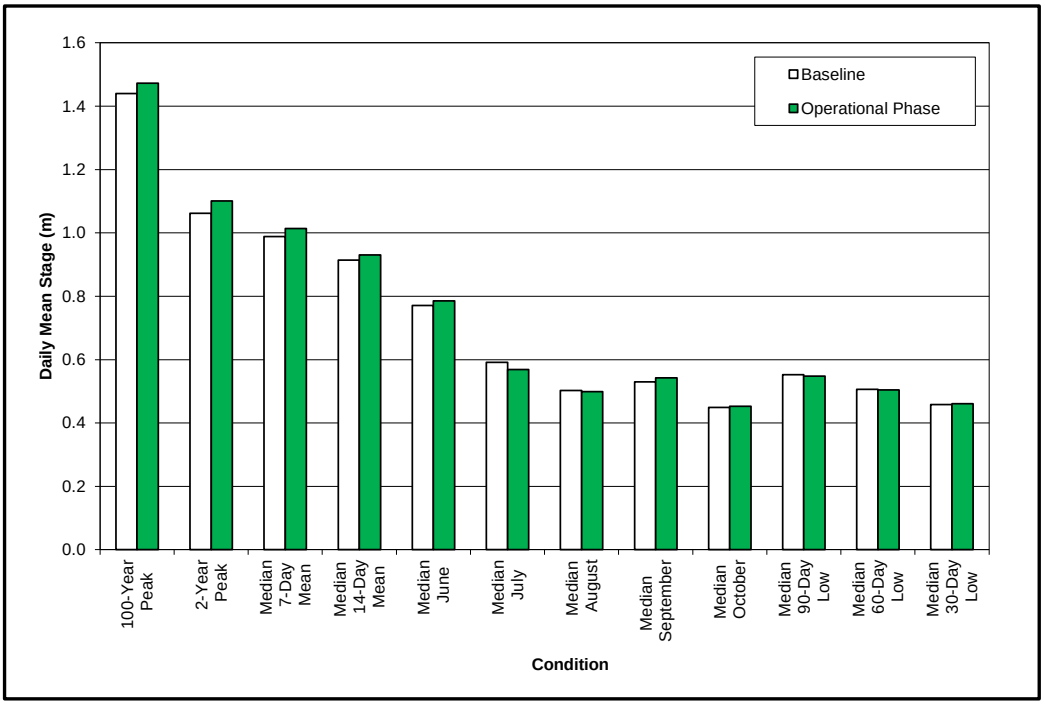


Figure 6-E-25: Derived Stage Regimes at Lake A16 (Mammoth Lake) during the Operational Phase

6.E-5.3.2 Lake A15

- Discharges: mean monthly discharges are expected to remain similar to the baseline values during the months of May, June, July, August, September, and October.

  The 2-year flood discharge is expected to increase by 12% and the 100-year flood discharge is expected to increase by 7% from the baseline values. Low discharges are expected to decrease by up to 5% from the baseline values. Derived discharge regimes are presented in Figure 6-E-26 for the baseline and operational phases.

- Water levels: mean monthly water levels are also expected to decrease from the baseline values during the months of May, June, July, August, September, and October.

  The 2-year flood level is expected to increase by 0.02 m, and the 100-year flood level is expected to increase by 0.01 m from the baseline values. Derived water level regimes are presented in Figure 6-E-27 for the baseline and operational phases.

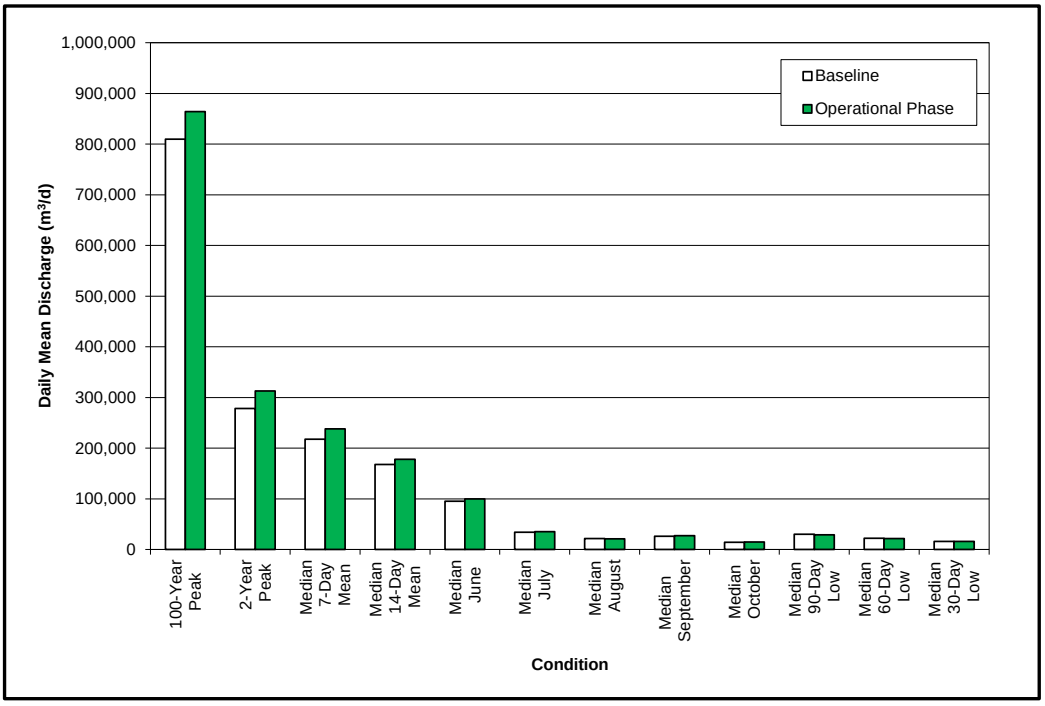


Figure 6-E-26: Derived Discharge Regimes at Lake A15 during the Operational Phase

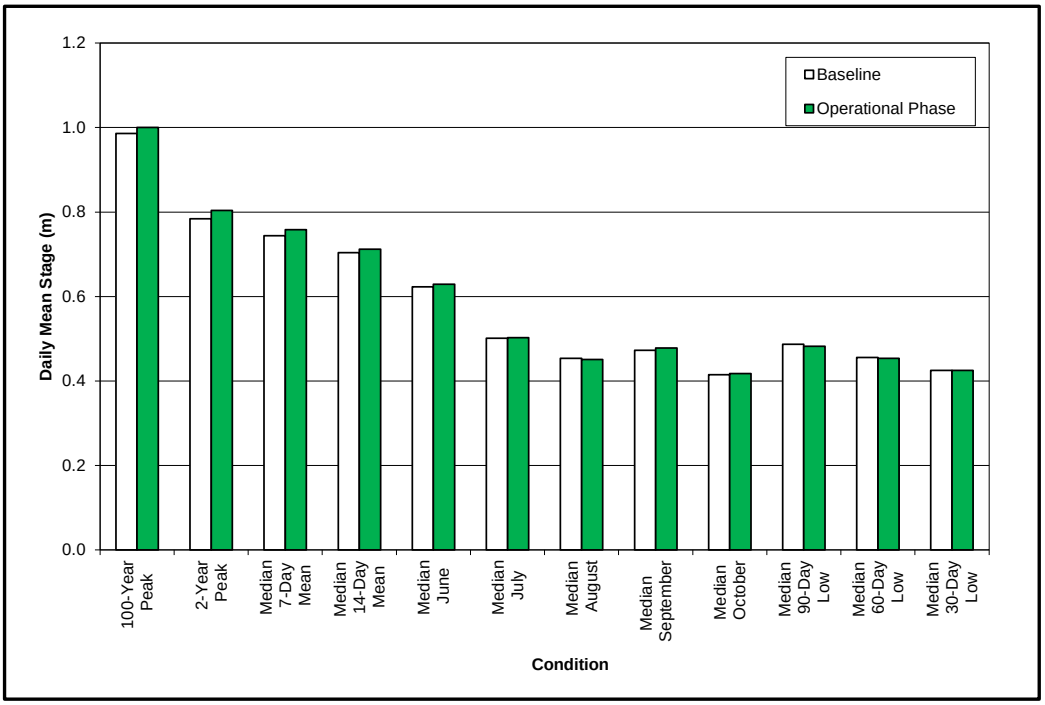


Figure 6-E-27: Derived Stage Regimes at Lake A15 during the Operational Phase

6.E-5.3.3 Lake A5

- Discharges: mean monthly discharges are expected to remain similar to the baseline values during the months of May, June, July, August, September, and October.

  The 2-year flood discharge is expected to increase by 2% and the 100-year flood discharge is expected to increase by 3% from the baseline values. Low discharges are expected to decrease from 3 to 5% from the baseline values. Derived discharge regimes are presented in Figure 6-E-28 for the baseline and operational phases.

- Water levels: mean monthly water levels are also expected to remain similar to the baseline values during the months of May, June, July, August, September, and October.

  The 2-year and 100-year flood level are expected to remain similar to the baseline values. Derived water level regimes are presented in Figure 6-E-29 for the baseline and operational phases.

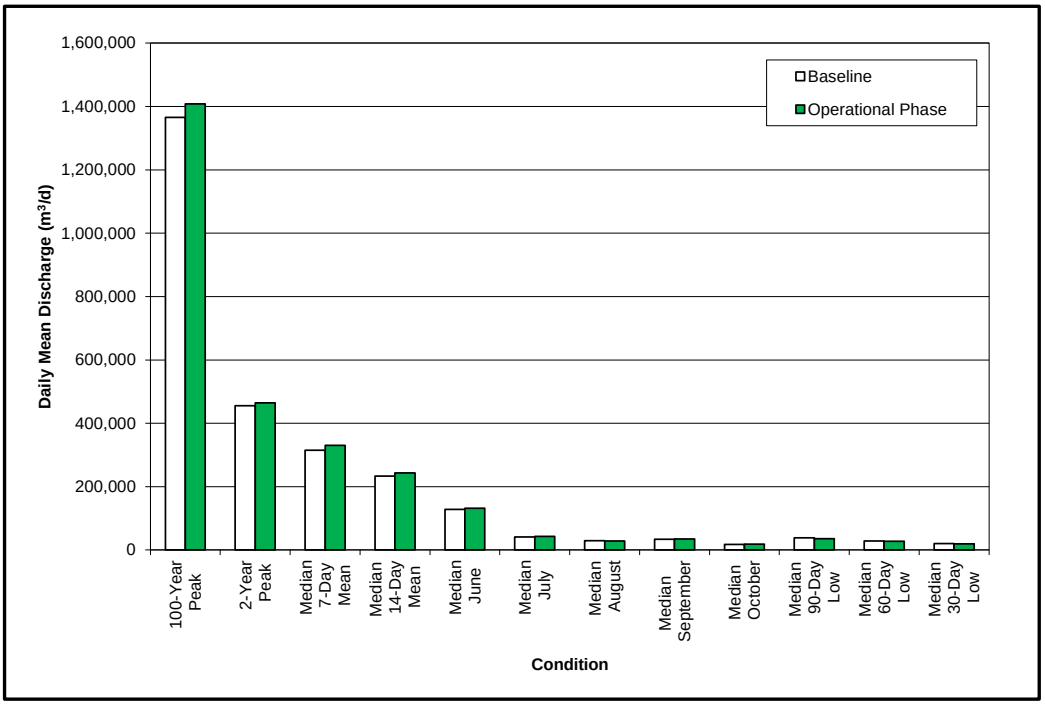


Figure 6-E-28: Derived Discharge Regimes at Lake A5 during the Operational Phase

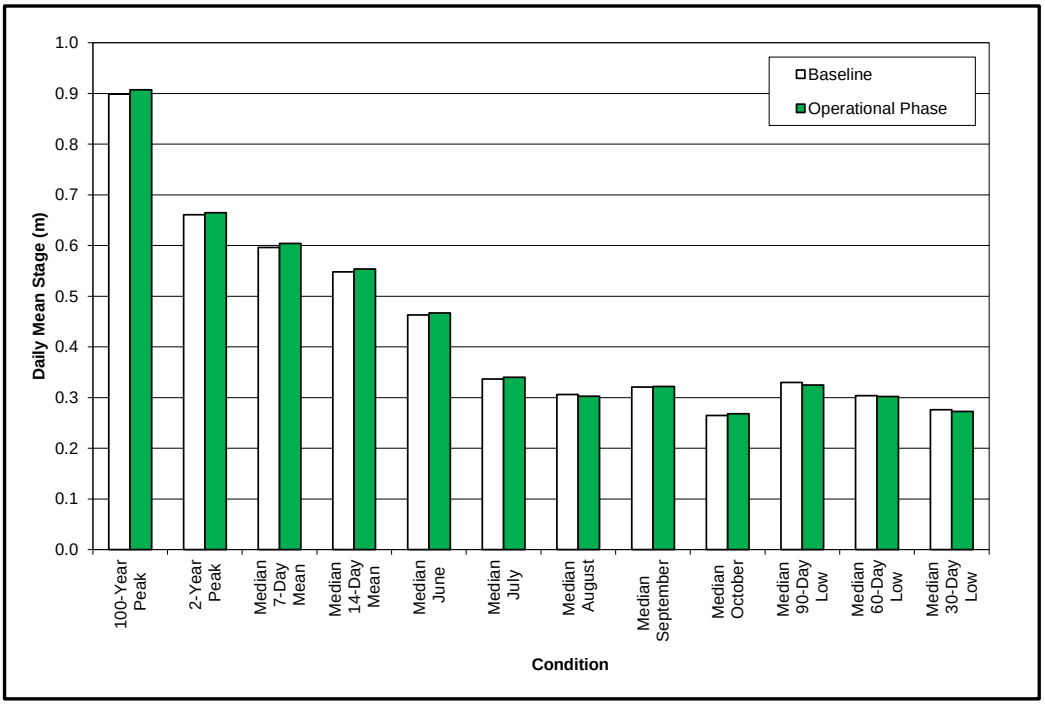


Figure 6-E-29: Derived Stage Regimes at Lake A5 during the Operational Phase

6.E-5.3.4 Lake A69

- Discharges: mean monthly discharges are expected to remain similar to the baseline values during the months of May, June, July, August, September, and October.

  The 2-year flood and 100-year flood discharges are expected to remain similar to the baseline value. Low discharges are expected to decrease from 1 to 4% from the baseline values. Derived discharge regimes are presented in Figure 6-E-30 for the baseline and operational phases.

- Water levels: mean monthly water levels are also expected to remain similar to the baseline values during the months of May, June, July, August, September, and October.

  The 2-year flood and 100-year level are expected to remain similar to baseline values. Derived water level regimes are presented in Figure 6-E-31 for the baseline and operational phases.

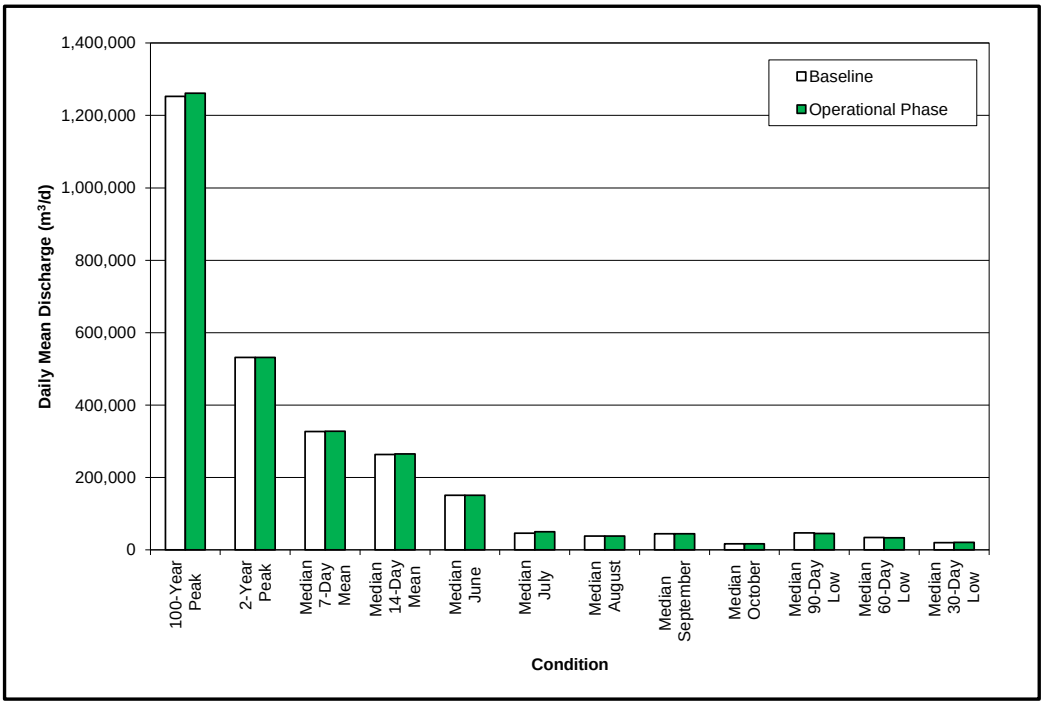


Figure 6-E-30: Derived Discharge Regimes at Lake A69 during the Operational Phase

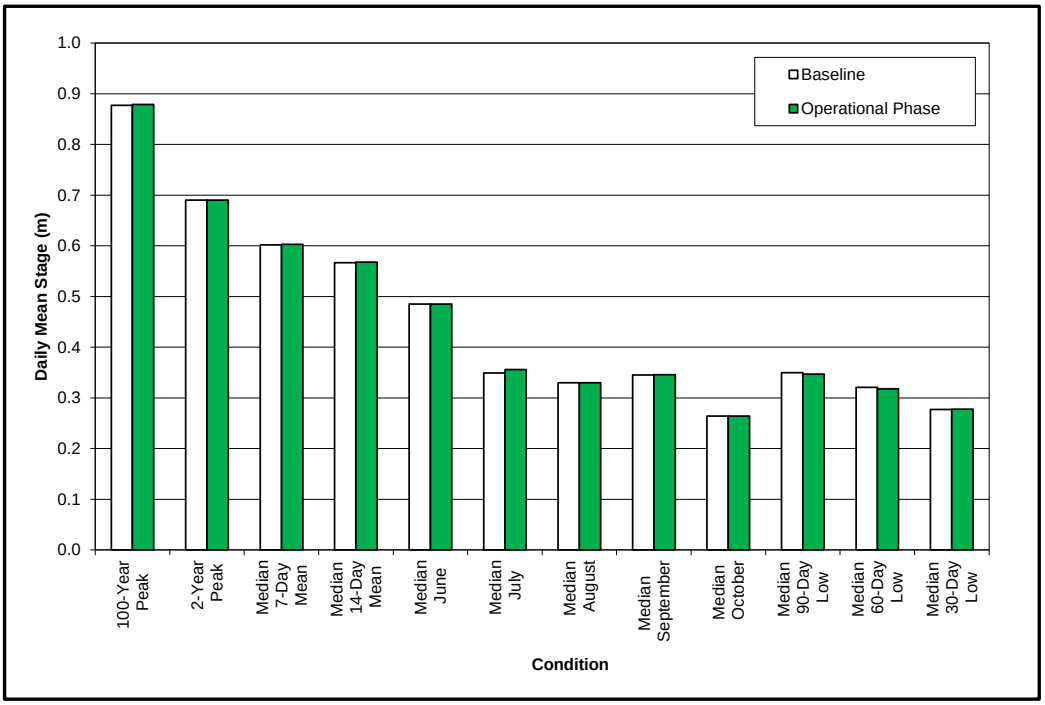


Figure 6-E-31: Derived Stage Regimes at Lake A69 during the Operational Phase

6.E-5.3.5 Lake C38 (Nemo Lake)

- Discharges: mean monthly discharges are expected to increase from the baseline values during the months of May, June, July, August, September, and October.

  The 2-year flood discharge is expected to increase by 22% and the 100-year flood discharge is expected to increase by 36% from the baseline values. Low discharges are expected to increase by 33 to 36% from the baseline values. Derived discharge regimes are presented in Figure 6-E-32 for the baseline and operational phases.

- Water levels: mean monthly water levels are also expected to increase from the baseline values during the months of May, June, July, August, September, and October.

The 2-year flood level is expected to increase by 0.09 m, and the 100-year flood level is expected to increase by 0.24 m from the baseline values. Mean monthly water levels are expected to remain similar to baseline values in May, increase by 0.05 m in June, 0.08 m in July, 0.07 m in August, 0.07 m in September, and 0.04 m in October, from the baseline values. Derived water level regimes are presented in Figure 6-E-33 for the baseline and operational phases.

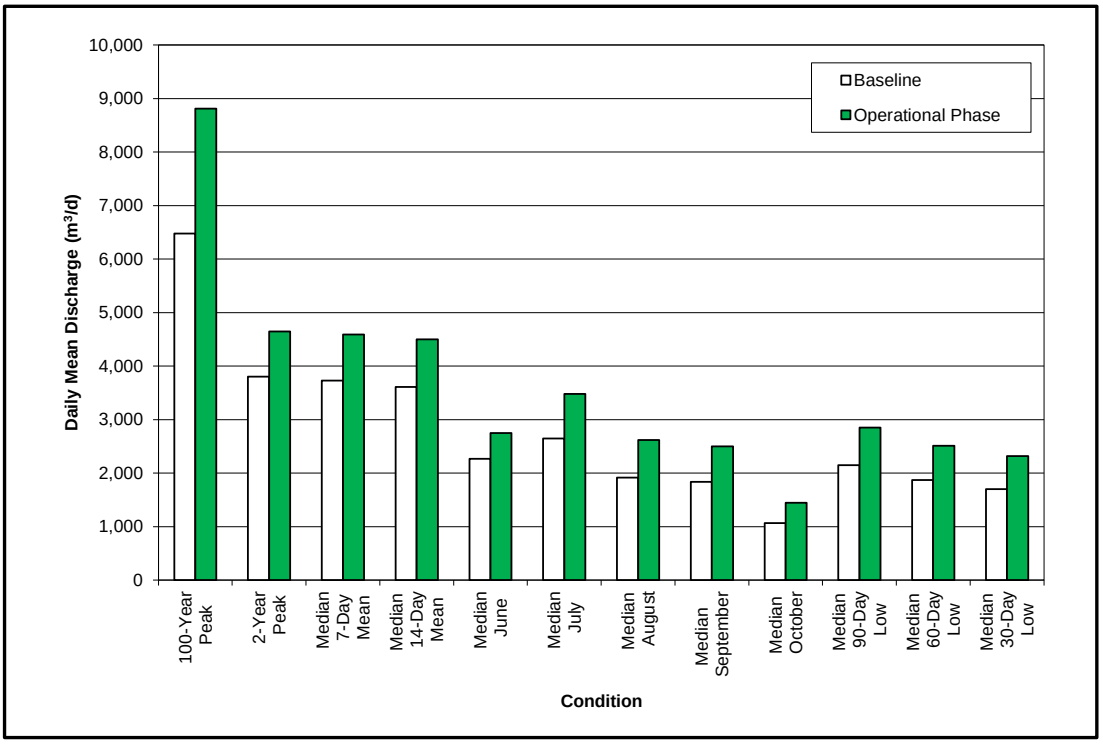


Figure 6-E-32: Derived Discharge Regimes at Lake C38 (Nemo Lake) during the Operational Phase

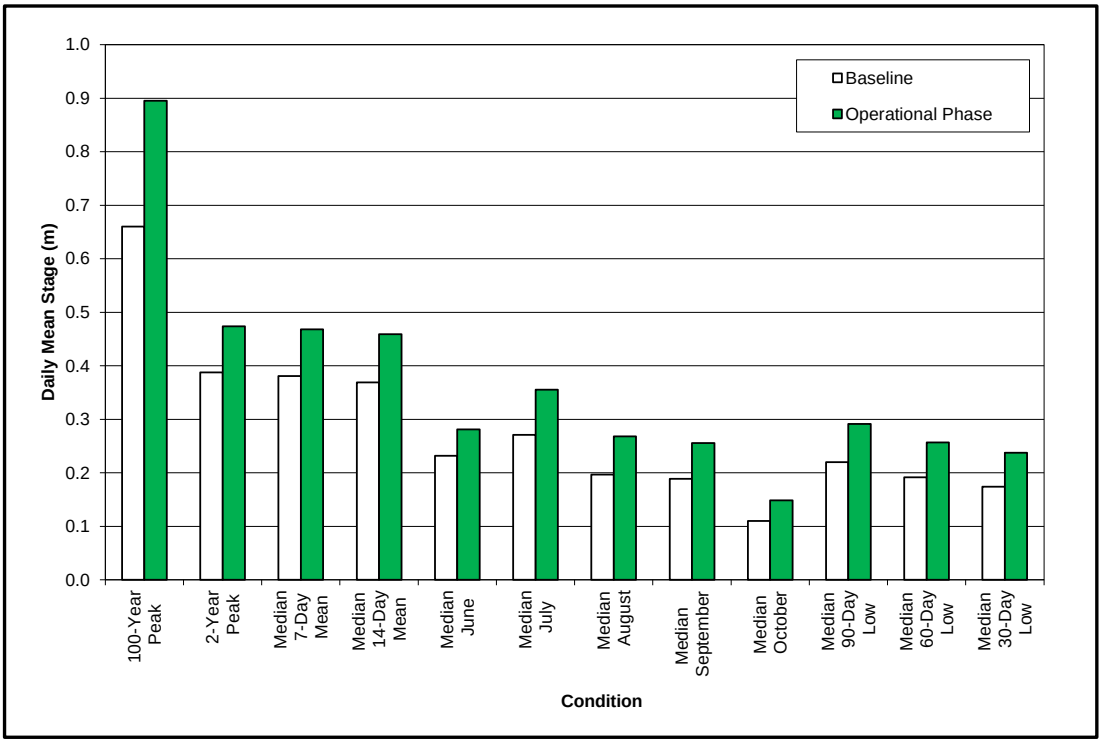


Figure 6-E-33: Derived Stage Regimes at Lake C38 (Nemo Lake) during the Operational Phase

6.E-5.3.6 Lake C8

- Discharges: mean monthly discharges are expected to increase slightly from the baseline values during the months of July, August, September, and October, and remain similar to the baseline values during the months of May and June.

  The 2-year flood discharge is expected to increase by 2% and the 100-year flood discharge is expected to increase by 1% from the baseline values. Low discharges are expected to increase by 12 to 24% from the baseline values. Derived discharge regimes are presented in Figure 6-E-34 for the baseline and operational phases.

- Water levels: mean monthly water levels are also expected to increase slightly from the baseline values during the months of July, August, September, and October, and remain similar to the baseline values during the months of May and June.

  The 2-year flood level is expected to increase by 0.002 m, and the 100-year flood level is expected to increase by 0.002 m from the baseline values. Mean monthly water levels are expected to increase by 0.01 m in July, 0.01 m in August, 0.01 m in September, and 0.01 m in October. Derived water level regimes are presented in Figure 6-E-35 for the baseline and operational phases.

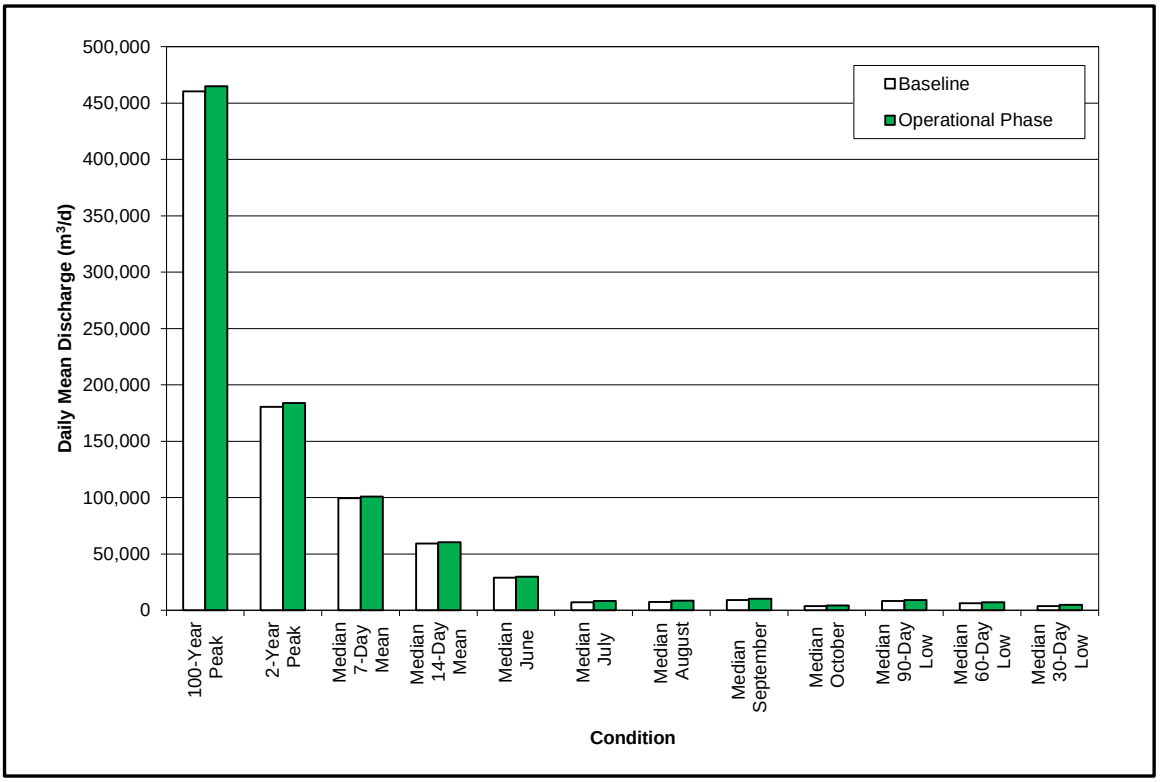


Figure 6-E-34: Derived Discharge Regimes at Lake C8 during the Operational Phase

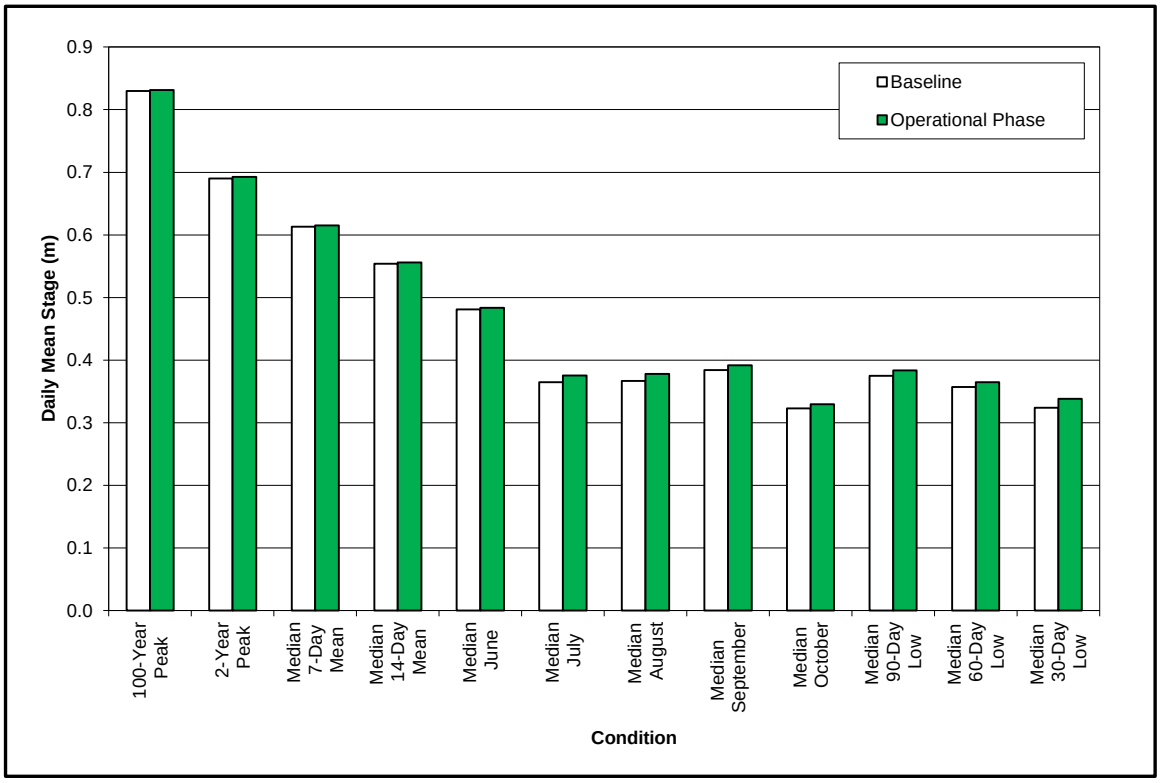


Figure 6-E-35: Derived Stage Regimes at Lake C8 during the Operational Phase

6.E-5.4 Closure Phase

Potential effects on hydrological indicators are presented below for Lake A16 (Mammoth Lake), Lake A15, Lake A5, and Lake A69. Methods are presented in Attachment A.

Water levels mentioned herein refer to water surface elevations. Stages presented in figures below represent water surface elevations referenced to an arbitrary datum.

6.E-5.4.1 Lake A16 (Mammoth Lake)

- Discharges: mean monthly discharges are expected to decrease from the baseline values during the months of May, June, July, August, September, and October.

  The 2-year flood discharge is expected to decrease by 56% and the 100-year flood discharge is expected to decrease by 53% from the baseline values. Low discharges are expected to decrease by approximately 69% from the baseline values for the entire season. Derived discharge regimes are presented in Figure 6-E-36 for the baseline and closure phases.

- Water levels: mean monthly water levels are also expected to decrease from the baseline values during the entire open water season.

  The 2-year flood level is expected to decrease by 0.23 m, and the 100-year flood level is expected to decrease by 0.28 m from the baseline values. Mean monthly water levels are expected to decrease slightly in May, by 0.20 m in June, 0.20 m in July, 0.14 m in August, 0.14 m in September, and 0.12 m in October,

from the baseline values. Derived water level regimes are presented in Figure 6-E-37 for the baseline and closure phases.

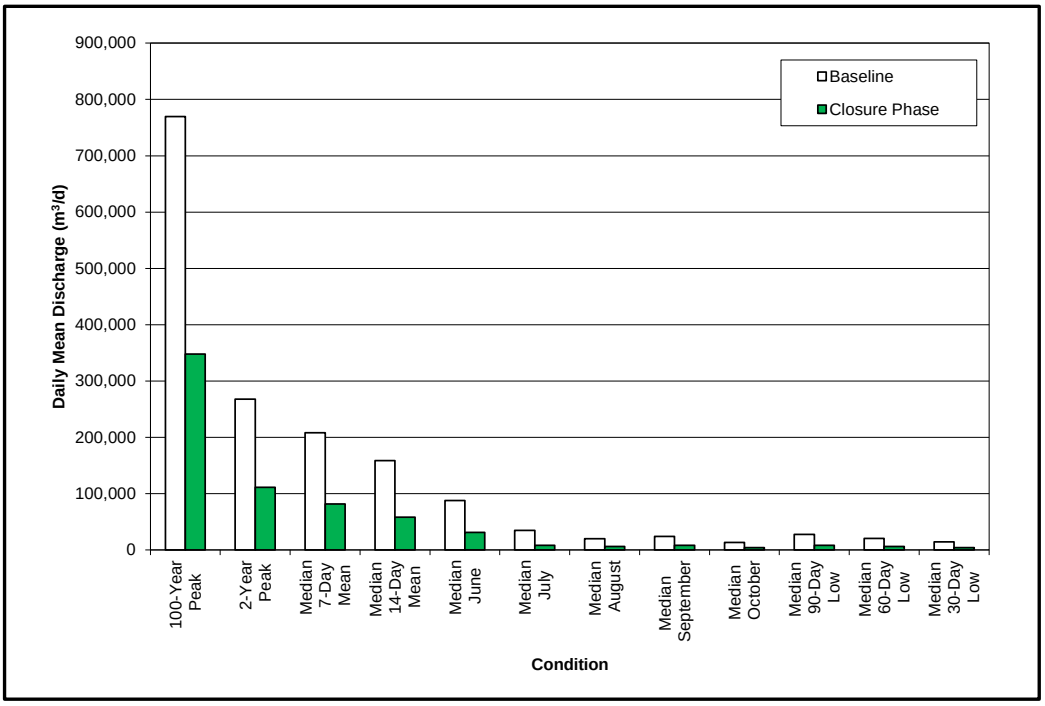


Figure 6-E-36: Derived Discharge Regimes at Lake A16 (Mammoth Lake) during the Closure Phase

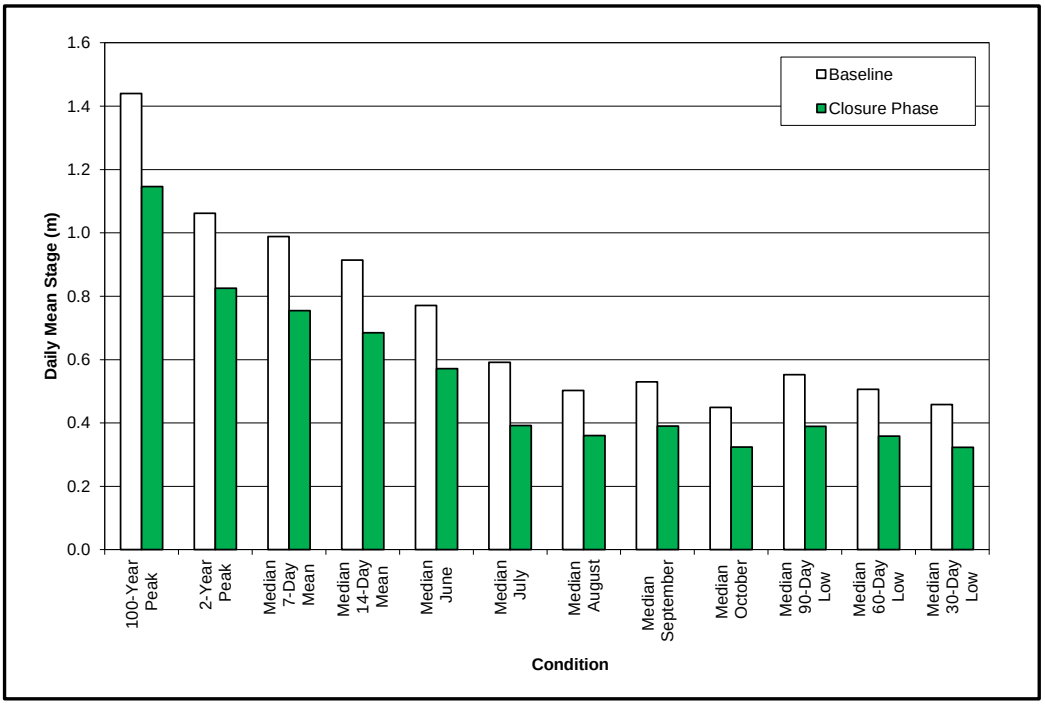


Figure 6-E-37: Derived Stage Regimes at Lake A16 (Mammoth Lake) during the Closure Phase

6.E-5.4.2 Lake A15

- Discharges: mean monthly discharges are expected to decrease from the baseline values during the months of June, July, August, September, and October.

  The 2-year flood discharge is expected to decrease by 49% and the 100-year flood discharge is expected to decrease by 43% from the baseline values. Low discharges are expected to decrease by approximately 63% from the baseline values for the entire season. Derived discharge regimes are presented in Figure 6-E-38 for the baseline and closure phases.

- Water levels: mean monthly water levels are also expected to decrease from the baseline values during the months of June, July, August, September, and October.

  The 2-year flood level is expected to decrease by 0.40 m, and the 100-year flood level is expected to decrease by 0.58 m from the baseline values. Mean monthly water levels are expected to decrease slightly in May, by 0.26 m in June, 0.20 m in July, 0.14 m in August, 0.14 m in September, and 0.11 m in October, from the baseline values. Derived water level regimes are presented in Figure 6-E-39 for the baseline and closure phases.

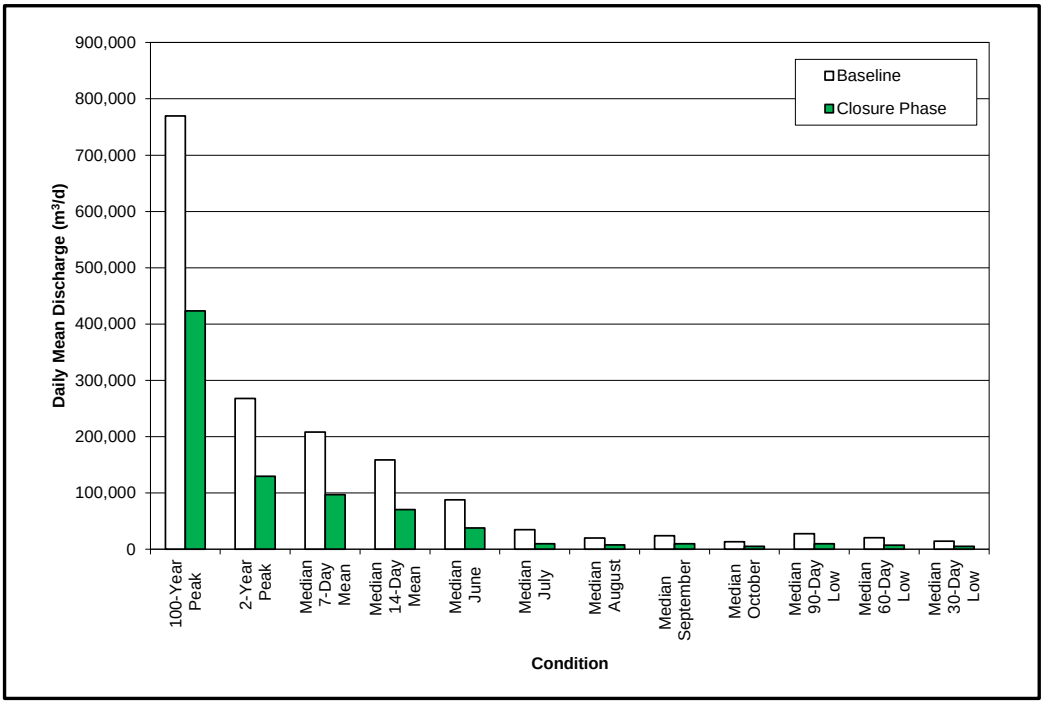


Figure 6-E-38: Derived Discharge Regimes at Lake A15 during the Closure Phase

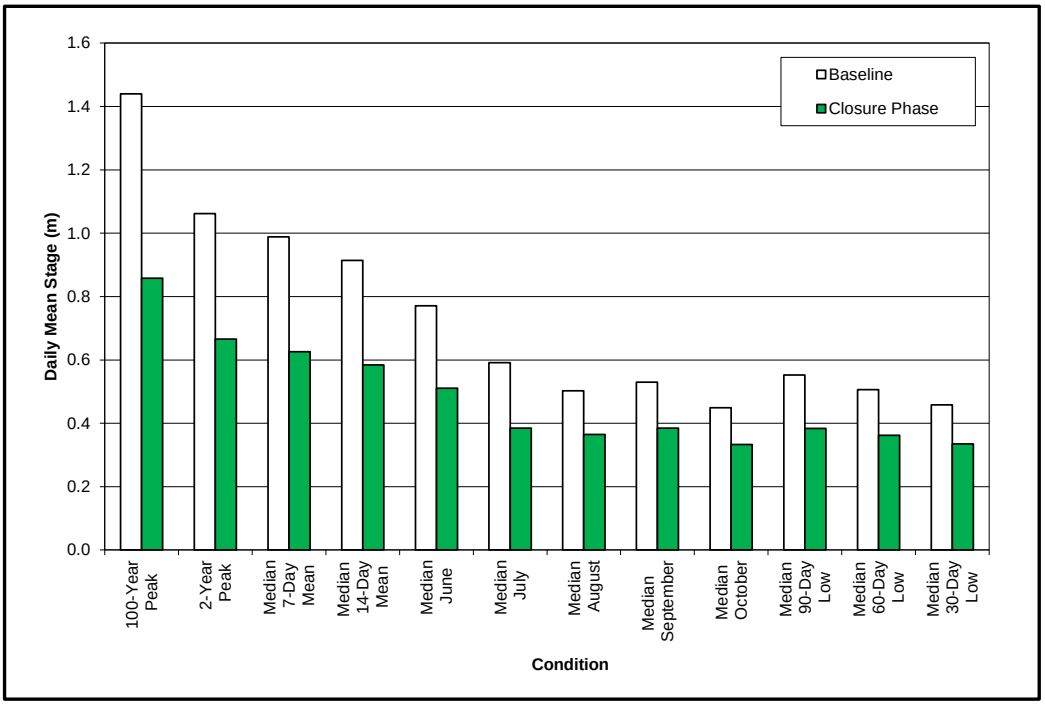


Figure 6-E-39: Derived Stage Regimes at Lake A15 during the Closure Phase

6.E-5.4.3 Lake A5

- Discharges: mean monthly discharges are expected to decrease from the baseline values during the months of June, July, August, September, and October.

  The 2-year flood discharge is expected to decrease by 22% and the 100-year flood discharge is expected to decrease by 20% from the baseline values. Low discharges are expected to decrease by 48 to 53% from the baseline values. Derived discharge regimes are presented in Figure 6-E-40 for the baseline and closure phases.

- Water levels: mean monthly water levels are also expected to decrease from the baseline values during the months of June, July, August, September, and October.

  The 2-year flood level is expected to decrease by 0.04 m, and the 100-year flood level is expected to decrease by 0.05 m from the baseline values. Mean monthly water levels are expected to remain similar in May, and decrease by 0.06 m in June, 0.07 m in July, 0.05 m in August, 0.04 m in September, and 0.04 m in October, from the baseline values. Derived water level regimes are presented in Figure 6-E-41 for the baseline and closure phases.

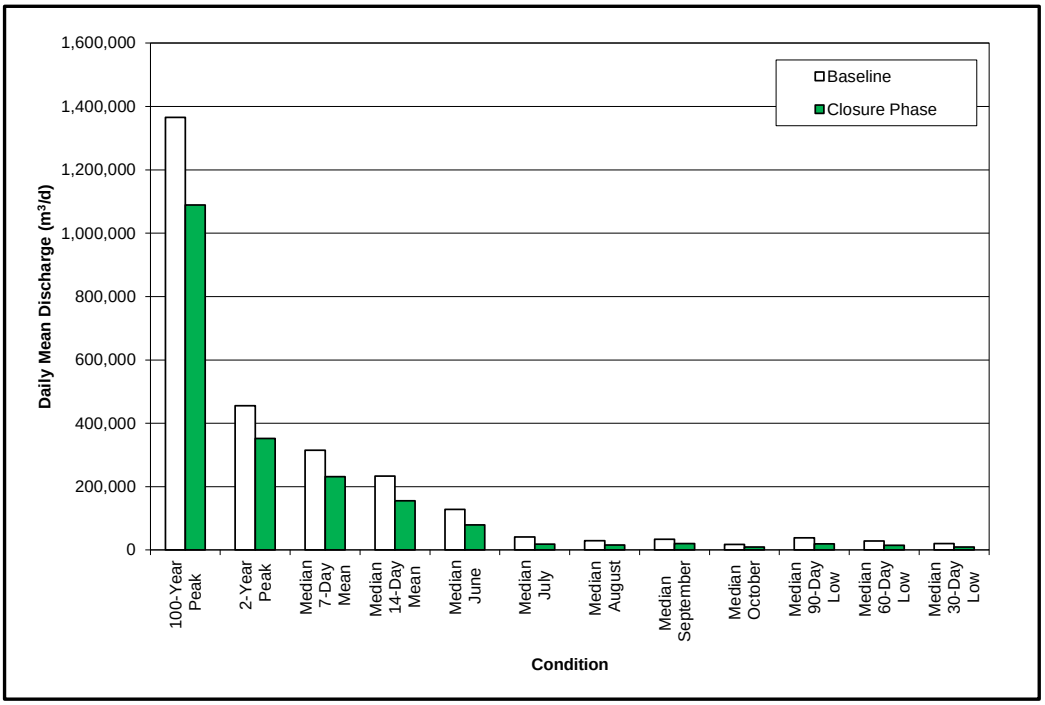


Figure 6-E-40: Derived Discharge Regimes at Lake A5 during the Closure Phase

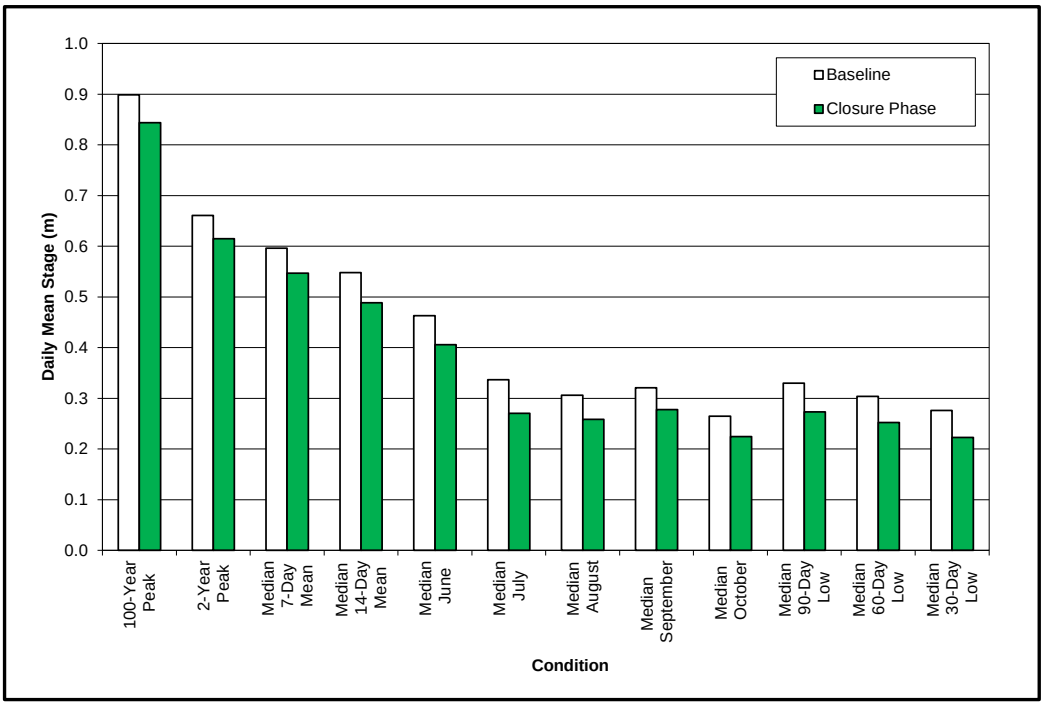


Figure 6-E-41: Derived Stage Regimes at Lake A5 during the Closure Phase

6.E-5.4.4 Lake A69

- Discharges: mean monthly discharges are expected to decrease from the baseline values during the months of June, July, August, September, and October.

  The 2-year and the 100-year flood discharges are expected to decrease by 1% from the baseline value. Low discharges are expected to decrease by 8% to 9% from the baseline values. Derived discharge regimes are presented in Figure 6-E-42 for the baseline and closure phases.

- Water levels: mean monthly water levels are also expected to decrease from the baseline values during the months of June, July, August, September, and October.

  The 2-year and 100-year flood levels are expected to be slightly below the baseline values. Mean monthly water levels are expected to remain similar to baseline values throughout the entire open water season, with less than 0.01 m decrease. Derived water level regimes are presented in Figure 6-E-43 for the baseline and closure phases.

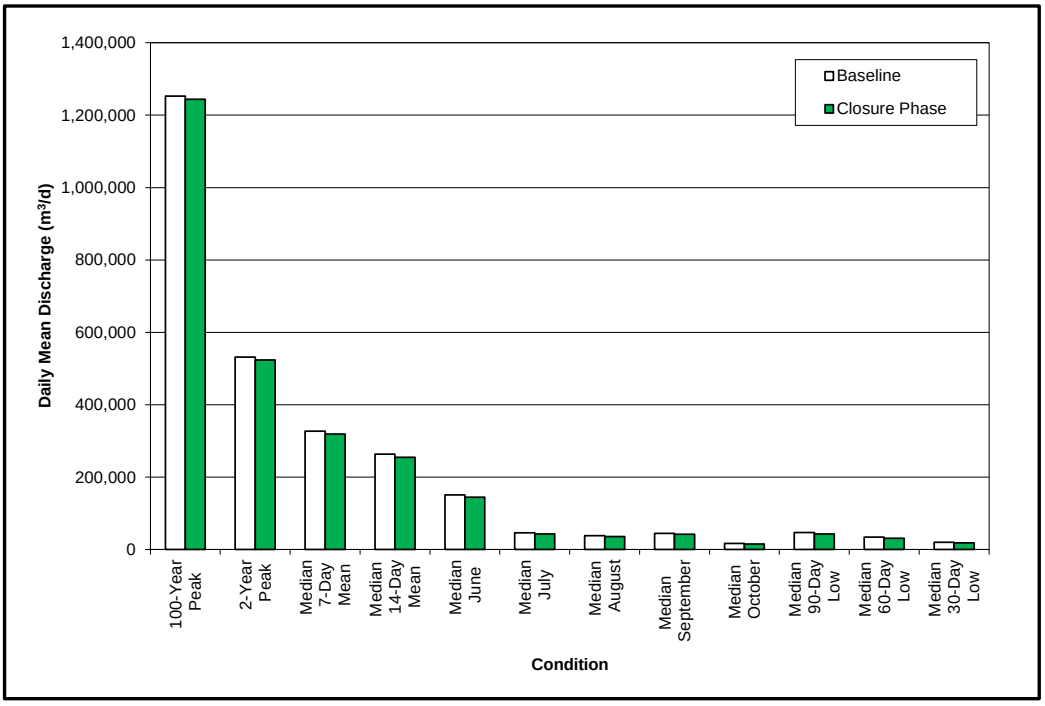


Figure 6-E-42: Derived Discharge Regimes at Lake A69 during the Closure Phase

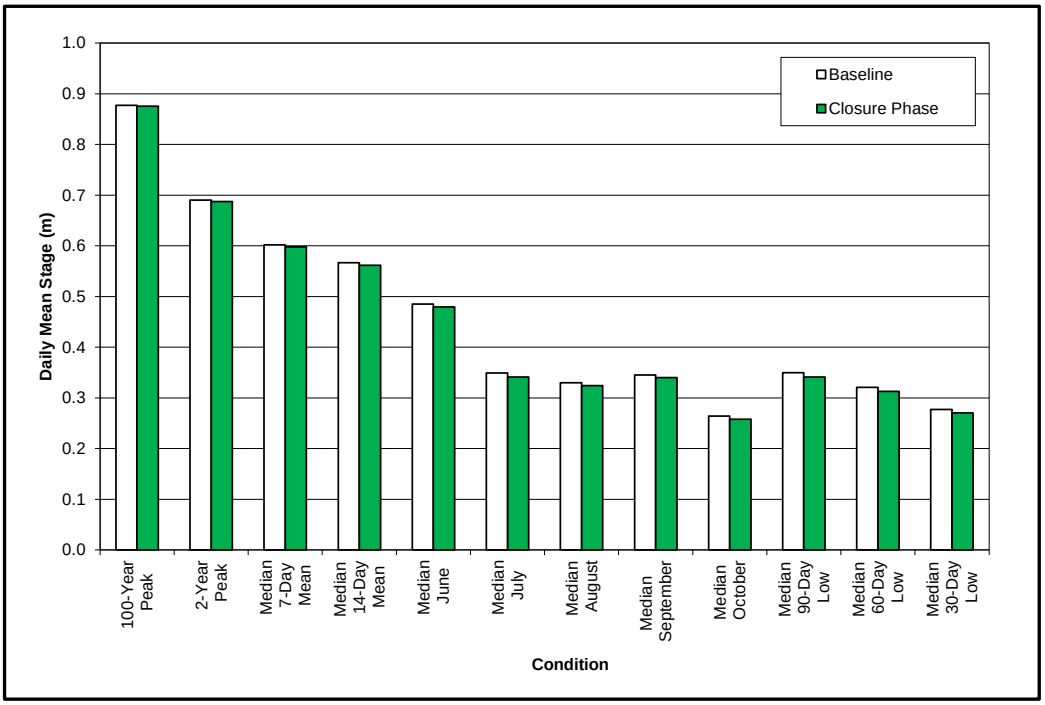


Figure 6-E-43: Derived Stage Regimes at Lake A69 during the Closure Phase

6.E-5.5 Post-Closure Phase

Potential effects on hydrological indicators are presented below for Lake A17 (Whale Tail Lake). Methods are presented in Attachment A.

Water levels mentioned herein refer to water surface elevations. Stages presented in figures below represent water surface elevations referenced to an arbitrary datum.

Discharge and water level regimes at post-closure are expected be similar to baseline conditions (Figure 6-E-44, Figure 6-E-45).

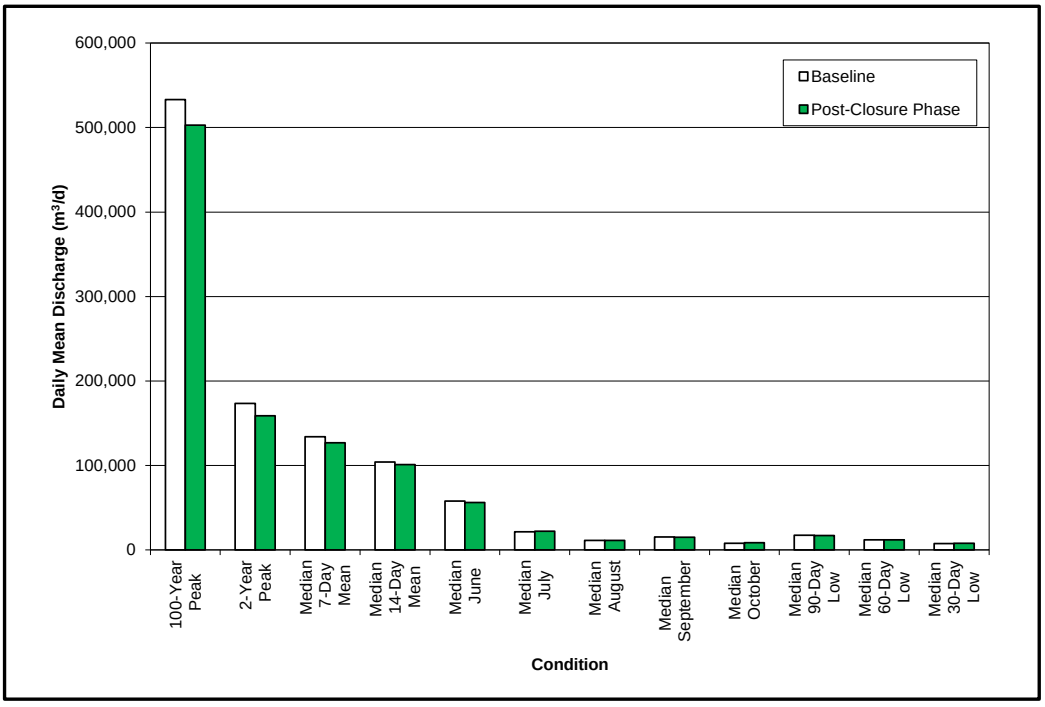


Figure 6-E-44: Derived Discharge Regimes at Lake A17 (Whale Tail Lake) during the Post-Closure Phase

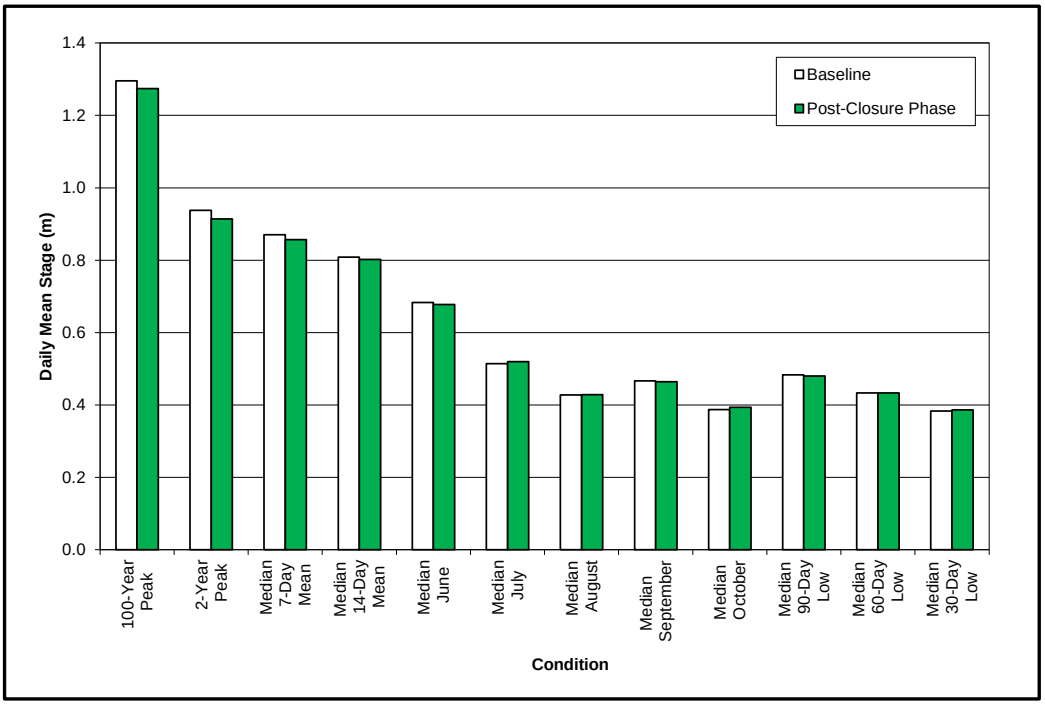


Figure 6-E-45: Derived Stage Regimes at Lake A17 (Whale Tail Lake) during the Post-Closure Phase

ATTACHMENT A

Construction Phase

The construction phase was assessed by modeling two reductions in drainage area, and modifying the baseline model, as follows:

- The local drainage area of Lake A17 (Whale Tail Lake) was reduced by the local drainage area of Whale Tail Lake (South Basin) (i.e., upstream of the Whale Tail Dike), shown in green in Figure A-1, and local tributaries of Whale Tail Lake (South Basin) over the modeling period. A first iteration of results was provided under this condition.
- The drainage area upstream of the Mammoth Dike was removed from the total drainage area of Lake A16 (Mammoth Lake), in September and October, over the modeling period. Water levels of Whale Tail Lake (North Basin) and downstream lakes prior to spring melt were re-set to the water level from the first iteration (described above) at the beginning of each year to prevent underestimation of water levels prior to the construction of the Mammoth Dike in September.

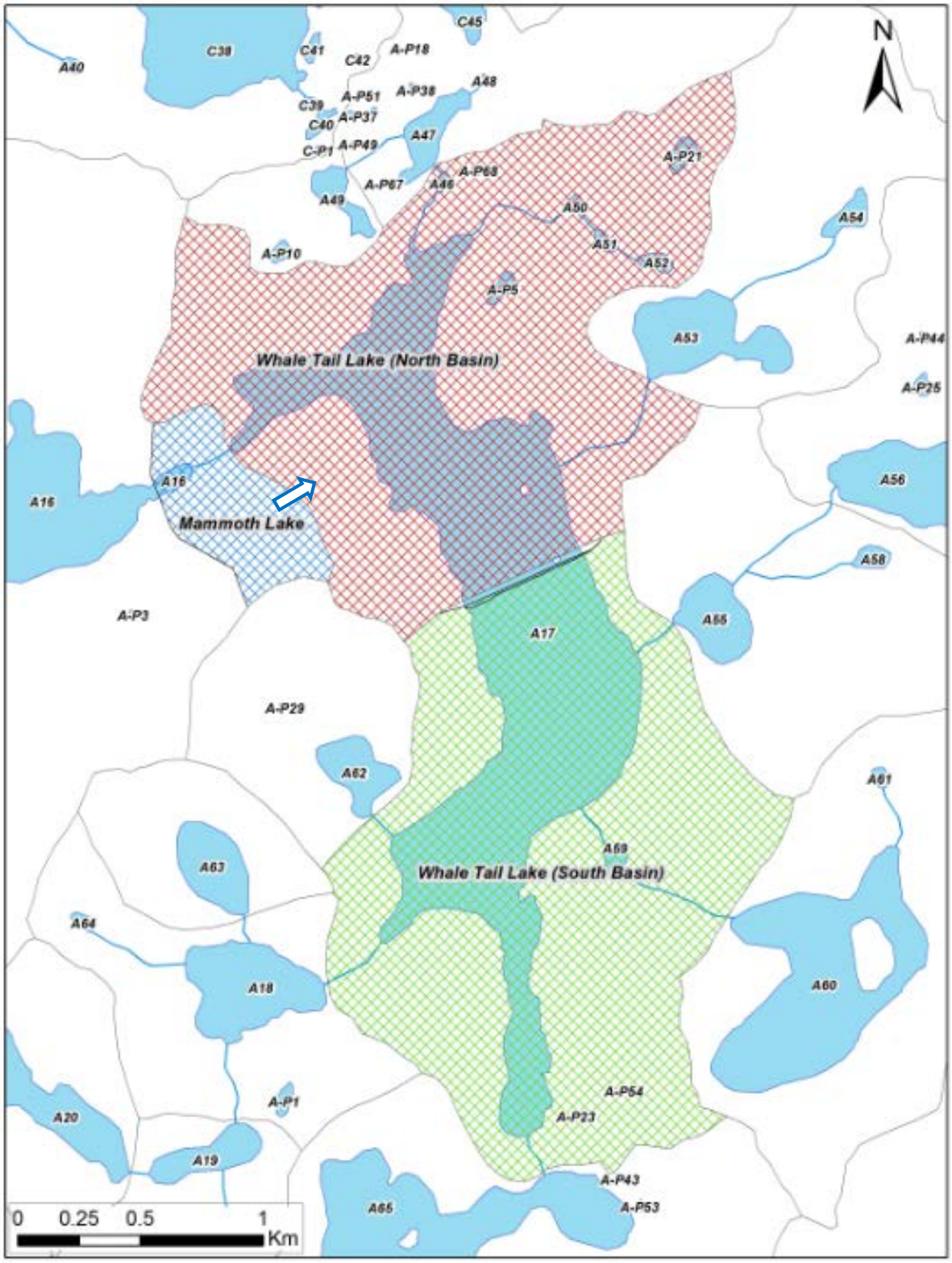


Figure A-1: Whale Tail Lake (South Basin) Local Watershed

Dewatering Phase

The dewatering phase was assessed by modifying the baseline model as follows:

- The Whale Tail Lake outlet was disconnected from Lake A16 (Mammoth Lake), to simulate the Mammoth Dike.
- The local lake area of the Lake A16 (Mammoth Lake) watershed was decreased by 0.012 km^2, to simulate the encroachment of the Mammoth Dike on the Lake A16 (Mammoth Lake) watershed.
- The local land area of the Lake A16 (Mammoth Lake) watershed was decreased by 1.229 km^2, to simulate the cumulative effects of the Whale Tail WRSF Dike (i.e., a loss of 1.162 km^2 in land area), the encroachment of the Mammoth Dike on the Lake A16 (Mammoth Lake) watershed (i.e., a loss of 0.344 km^2 in land area), and of the runoff diversion from the North Channel to Lake A16 (Mammoth Lake) (i.e., an increase of 0.277 km^2). While construction of the North Channel is scheduled in August 2019, this modification in land area was applied over the whole year. This may theoretically result in slightly overestimated discharges in June and July; however, this increase is not expected to significantly alter results or conclusions of the assessment.
- Inflows were added to Lake A16 (Mammoth Lake), following the pumping schedule presented in Table A-1, to simulate dewatering through Lake A16 (Mammoth Lake). Inflow volumes were obtained from the water management team on a monthly basis, and were distributed using a daily average rate for each month.
- 8,760 m^3 of water per year was pumped from Lake C38 (Nemo Lake), distributed using a daily average rate, to simulate freshwater intake from Lake C38 (Nemo Lake).

Table A-1: Dewatering Volumes to Lake A16 (Mammoth Lake) during the Dewatering Phase

Date	Volume (m^3)
June 2019	720,000
July 2019	689,829
August 2019	32,002
September 2019	137,031

m^3 = cubic metre

Operational Phase

The operational phase was assessed by modifying the baseline model as follows:

- The Whale Tail Lake outlet was disconnected from Lake A16 (Mammoth Lake), to simulate the Mammoth Dike.
- The local lake area of the Lake A16 (Mammoth Lake) watershed was decreased by 0.012 km^2, to simulate the encroachment of the Mammoth Dike on the Lake A16 (Mammoth Lake) watershed.
- The local land area of the Lake A16 (Mammoth Lake) watershed was decreased by 0.067 km^2, to simulate the cumulative effects of the encroachment of the Mammoth Dike on the Lake A16 (Mammoth Lake) watershed (i.e., a loss of 0.344 km^2 in land area), and of the runoff diversion from the North Channel to Lake A16 (Mammoth Lake) (i.e., an increase of 0.277 km^2).
- Inflows were added to Lake A16 (Mammoth Lake), following the pumping schedule presented in Table A-2, to simulate discharge of the Water Treatment Plant to Lake A16 (Mammoth Lake). Inflow volumes were derived from the water management plan (Volume 8, Appendix 8-B.2) and diversion studies (Volume 6, Appendix 6-F) on a monthly basis, and were distributed using a daily average rate for each month.
- The local watershed area of Lake A20 was modified to include the local watershed area of Whale Tail Lake (South Basin) (i.e., 14.1 km^2 of local watershed area, inclusive of 4.10 km^2 of local lake area, 0.053 km^2 of local tributary area, and 9.95 km^2 of local land area), with inflows from the Lake A23, Lake A60, Lake A56, and Lake A53 (i.e., from the East Channel diversion) watersheds, and outflow to the Lake A16 (Mammoth Lake) watershed (Figure A-1). The rating curve of Lake A20 was not modified, assuming that the diversion channel connecting Lake A20 to Lake A45 will result in similar discharge regimes, in the absence of detailed design plans. The latter is not anticipated to affect conclusions herein.
- 118,625 m^3 of water per year was pumped from Lake C38 (Nemo Lake), distributed using a daily average rate, to simulate freshwater intake from Lake C38 (Nemo Lake).
- The local watershed area of Lake A47 was modified to include the local watershed area of the Northeast Sector (i.e., 1.85 km^2 of local watershed area, inclusive of 0.263 km^2 of local lake area, 0.041 km^2 of local tributary area, and 1.55 km^2 of local land area), with inflows from the Lake A49 watershed, and outflow to the Lake C38 (Nemo Lake) watershed (Figure A-2). The rating curve of Lake A47 was used to represent the resulting stage-discharge relationship for the Northeast Sector.

Table A-2: Dewatering Volumes to Lake A16 (Mammoth Lake) during the Operational Phase

Date	Volume (m^3)
June 2020 / 2021	194,806
July 2020 / 2021	15,602
August 2020 / 2021	28,465
September 2020 / 2021	101,263

m^3 = cubic metres

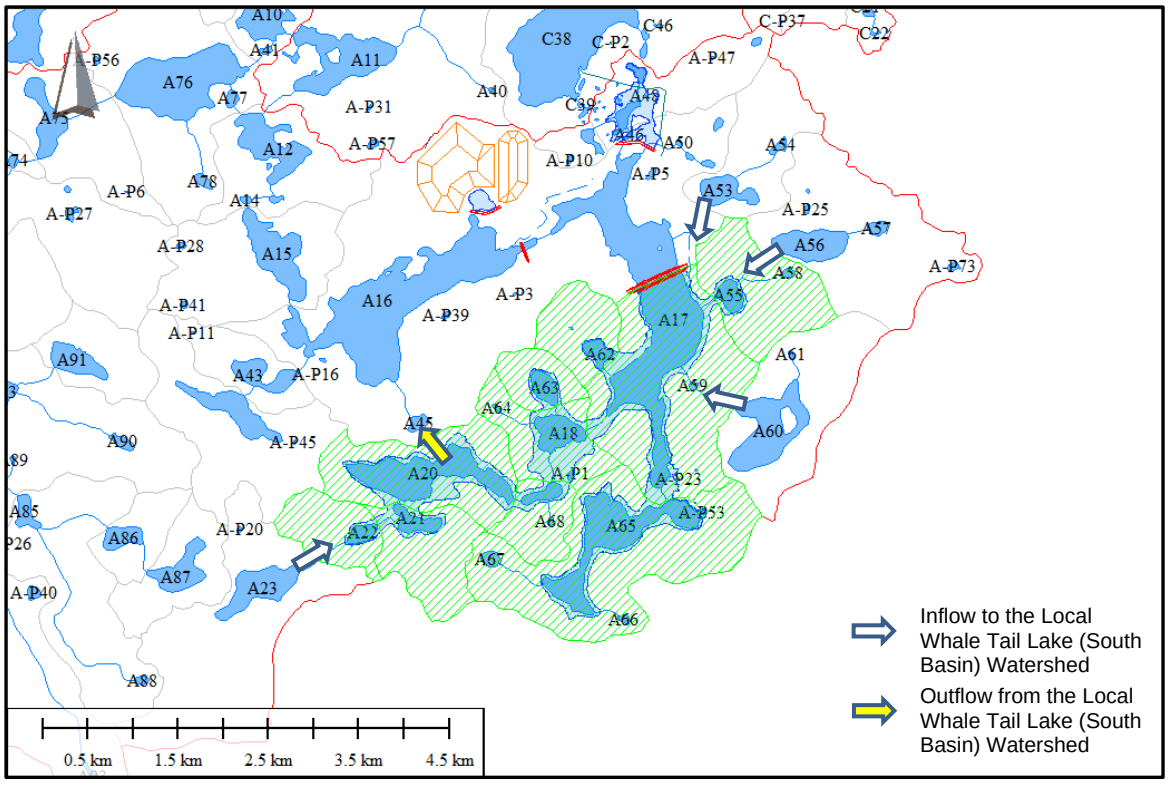


Figure A-2: Whale Tail Lake (South Basin) Local Watershed

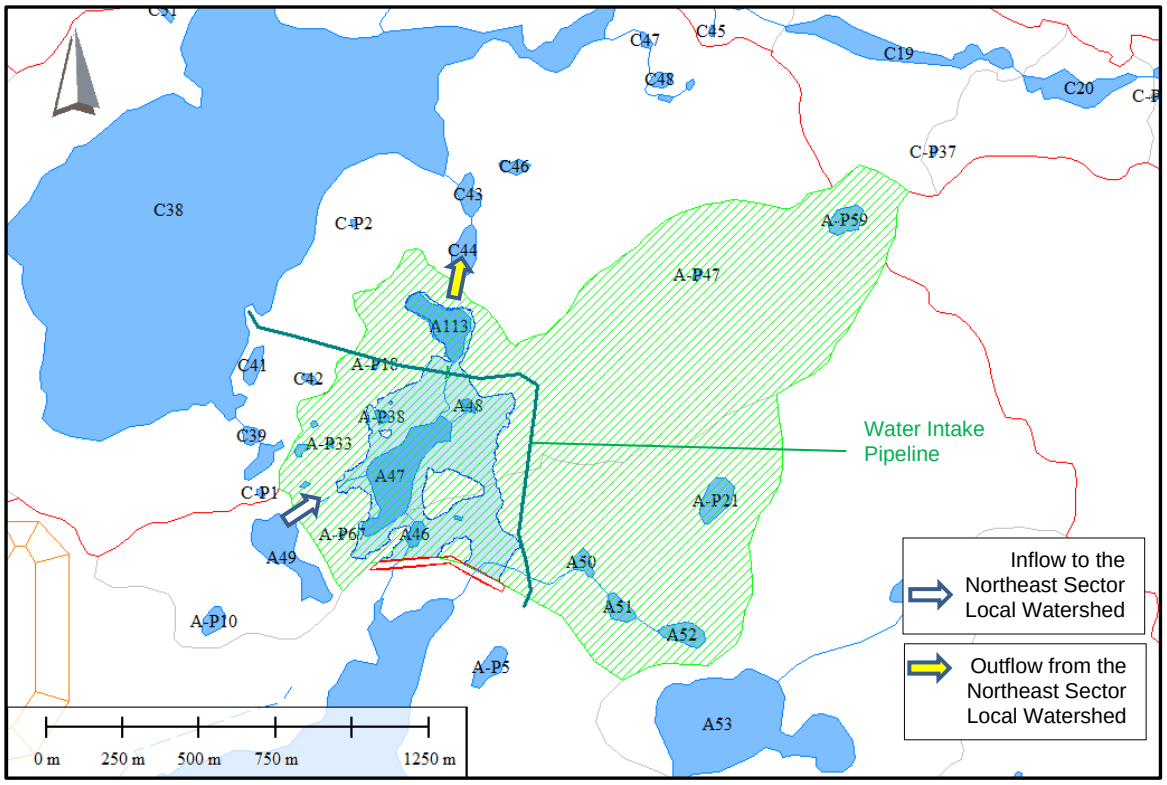


Figure A-3: Northeast Sector Local Watershed

Closure Phase

The closure phase was assessed by modifying the dewatering model (Section 6.E-3.2) as follows:

- The dewatering volumes from Whale Tail Lake were removed from input to Lake A16 (Mammoth Lake), to simulate refilling of the Whale Tail Lake (North Basin).
- The local lake area of the Lake A16 (Mammoth Lake) watershed was not changed from the dewatering model (i.e. decreased by 0.012 km^2 from the baseline model), to simulate the encroachment of the Mammoth Dike on the Lake A16 (Mammoth Lake) watershed.
- The local land area of the Lake A16 (Mammoth Lake) watershed remained the same as in the dewatering model, that is decreased by 0.952 km^2, to simulate the cumulative effects of the Whale Tail WRSF Dike (i.e., a loss of 1.162 km^2 in land area), and the encroachment of the Mammoth Dike on the Lake A16 (Mammoth Lake) watershed (i.e., a loss of 0.344 km^2 in land area).

Post-Closure Phase

The post-closure phase was assessed by modifying the baseline model (Volume 6, Appendix 6-C) as follows:

- The surface area of Lake A17 (Whale Tail Lake) was increased from 1.66 km^2 to 1.87 km^2.

APPENDIX 6-F

Flooding During Phases

6.F-1 BACKGROUND

Two water diversions, the Whale Tail Lake (South Basin) diversion, and the Northeast diversion, are planned as part of water management activities.

The Whale Tail Lake (South Basin) diversion consists of construction of the Whale Tail Dike, from June 2018 to February 2019, to divert Whale Tail Lake (South Basin) and tributary lakes through Lake A45, just south of Lake A16 (Mammoth Lake), once a water surface elevation of 156.00 metres above sea level (masl) is reached. Flooded tributary lakes include Lake A18, Lake A19, Lake A20, Lake A21, Lake A22, Lake A55, Lake A62, Lake A63, Lake A65, Pond A-P1, and Pond A-P53. The Whale Tail Lake (South Basin) diversion is shown on Figure 6-F-1.

The Northeast diversion consists of construction of the Northeast dike, from February to March 2019, to divert Lake A46 and tributary lakes through Lake C44 in the Nemo Lake watershed, once a water surface elevation of 156.66 masl is reached. Flooded tributary lakes include Lake A47, Lake A48, Lake A113, Pond A-P38, and Pond A-P68. The Northeast diversion is shown on Figure 6-F-2.

The purpose of this appendix is to present the anticipated flooding area and schedule during the Whale Tail Lake (South Basin) and Northeast diversions. Results are also presented for the migratory bird nesting season (May 17 to August 15) to assist the wildlife environmental impact assessment.

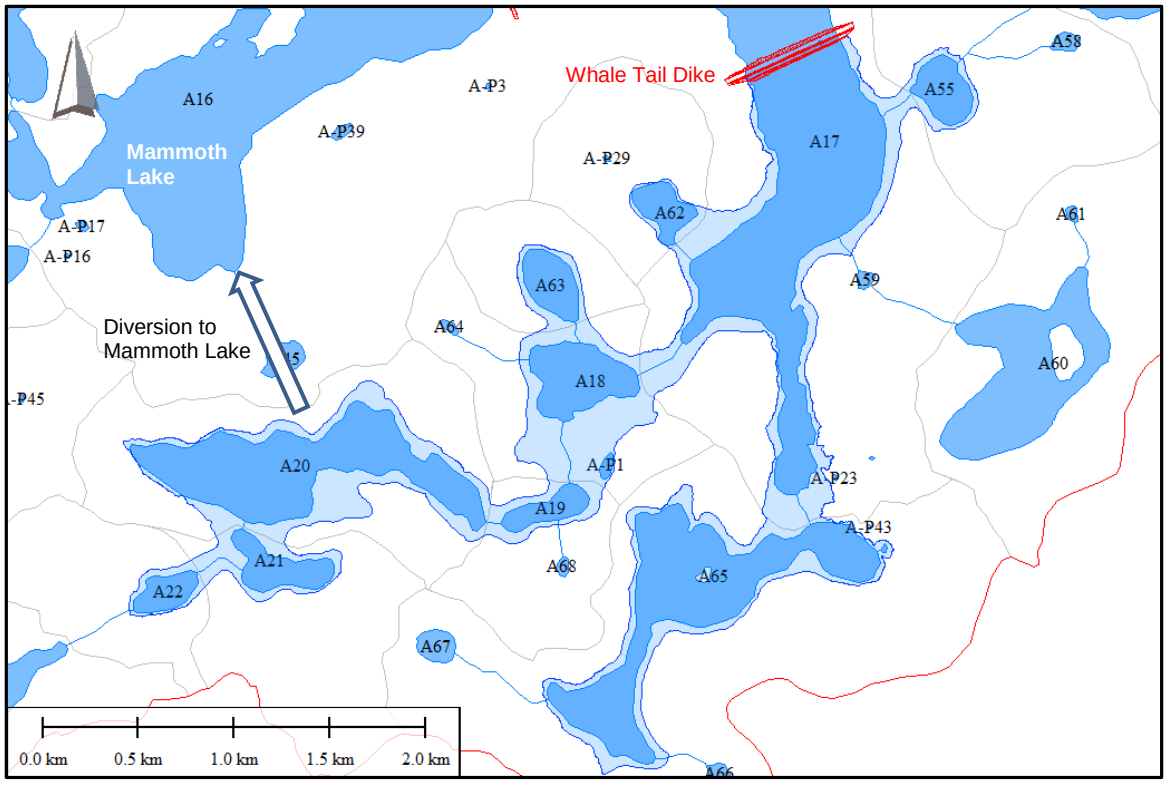


Figure 6-F-1: Whale Tail Lake (South Basin) Diversion

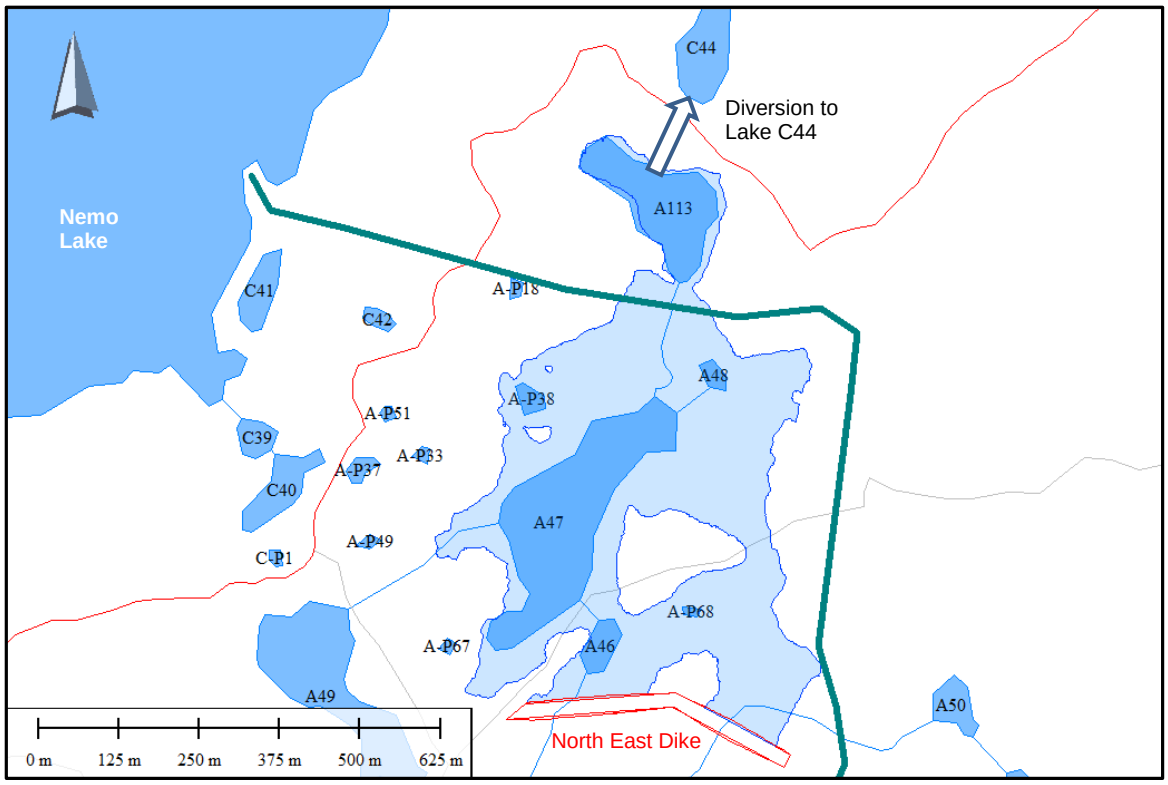


Figure 6-F-2: Northeast Diversion

6.F-2 WATER MANAGEMENT ACTIVITIES

6.F-2.1 Whale Tail Lake (South Basin) Diversion

Water management activities relevant to the Whale Tail Lake (South Basin) diversion are listed below:

- Construction of the Whale Tail dike from June 2018 to February 2019: construction of the dike will result in backwatering upstream of the dike during runoff. The water surface elevation of Whale Tail Lake (South Basin) will increase until the spilling elevation of 156.00 masl is reached, and the flooded Whale Tail Lake (South Basin) can discharge through Lake A45, just upstream of Mammoth Lake.
- Dewatering of Whale Tail Lake, downstream of the Whale Tail dike (i.e., North Whale Tail Lake) from February to September 2019: dewatering is planned from February to May 2019 through Whale Tail Lake (South Basin) to expedite the filling period. Dewatering is also planned from June to September 2019 through Mammoth Lake, and discussed further in Volume 6, Appendix 6-E.
- Active refilling of the Whale Tail Pit from May to November 2022: active refilling of the Whale Tail Pit will include pumping of the elevated Whale Tail Lake (South Basin) sector, starting in May 2022, until the baseline water surface elevation of Whale Tail Lake (South Basin) (i.e., 152.50 masl) is restored. Active refilling will also include pumping of the Northeast sector, discussed in Section 6.F-2.2. Once the baseline water surface elevation of Whale Tail Lake (South Basin) is restored, the Whale Tail Pit will continue to fill passively.

6.F-2.2 Northeast Diversion

- Construction of the Northeast dike from February to March 2019: construction of the dike will result in backwatering upstream of the dike during runoff. The water surface elevation of Lake A46 will increase until the spilling elevation of 156.66 masl is reached, and the flooded Lake A46 can discharge through Lake C44.
- Active refilling of the Whale Tail Pit from May to November 2022: active refilling of the Whale Tail Pit will include pumping of the elevated Northeast sector, starting in May 2022, until the baseline water surface elevation of Lake A46 (i.e., 154.43 masl) is restored. Active refilling will also include pumping of the Whale Tail Lake (South Basin) sector, discussed in Section 6.F-2.1. Once the baseline water surface elevation of Lake A46 is restored, the Whale Tail Pit will continue to fill passively.

6.F-3 METHODS

Methods are presented in Attachment A.

6.F-4 RESULTS

6.F-4.1 Whale Tail Lake (South Basin) Diversion

Based on a mean annual water balance, the Whale Tail Lake (South Basin) diversion is expected to reach the spilling water surface water elevation of 156.00 masl by the end of June 2020, remain at 156.00 masl until the end of April 2022, and return to the baseline water surface elevation of 152.50 masl by the end of November 2022.

Total flooded and flooded terrestrial areas are presented in Table 6-F-1 for bird nesting months of May, June, July, and August, during the diversion, at the start of each month.

The derived water surface elevation of the Whale Tail Lake (South Basin) diversion is shown in Figure 6-F-3, and the maximum water surface elevation of the Whale Tail Lake (South Basin) diversion is shown in Figure 6-F-4.

This analysis was based on mean annual climate conditions and actual filling duration may differ under wet or dry conditions.

Table 6-F-1: Total Flooded and Flooded Terrestrial Area during the Whale Tail Lake (South Basin) Diversion

Date	Water Surface Elevation (masl)	Total Flooded Area (m^2)	Flooded Terrestrial Area (m^2)	Change in Flooded Terrestrial Area (m^2)
May 2018	152.50	893,448	0	0
June 2018	152.50	893,448	0	0
July 2018	152.50	893,448	0	0
August 2018	152.61	903,582	2,060	2,060
May 2019	154.85	1,437,026	628,385	626,325
June 2019	155.11	1,755,701	849,873	221,488
July 2019	155.50	2,672,890	1,161,693	311,820
August 2019	155.50	2,672,890	1,161,693	0
May 2020	155.70	3,139,815	1,322,012	160,319
June 2020	155.70	3,139,815	1,322,012	0
July 2020	156.00	3,851,450	1,575,487	253,475
August 2020	156.00	3,851,450	1,575,487	0
May 2021	156.00	3,851,450	1,575,487	0
June 2021	156.00	3,851,450	1,575,487	0
July 2021	156.00	3,851,450	1,575,487	0
August 2021	156.00	3,851,450	1,575,487	0
May 2022	156.00	3,851,450	1,575,487	0
June 2022	155.60	2,912,668	1,242,689	-332,798
July 2022	155.60	2,916,686	1,244,047	1,358
August 2022	155.20	1,977,904	926,073	-317,974

masl = metres above sea level; m^2 = square metres

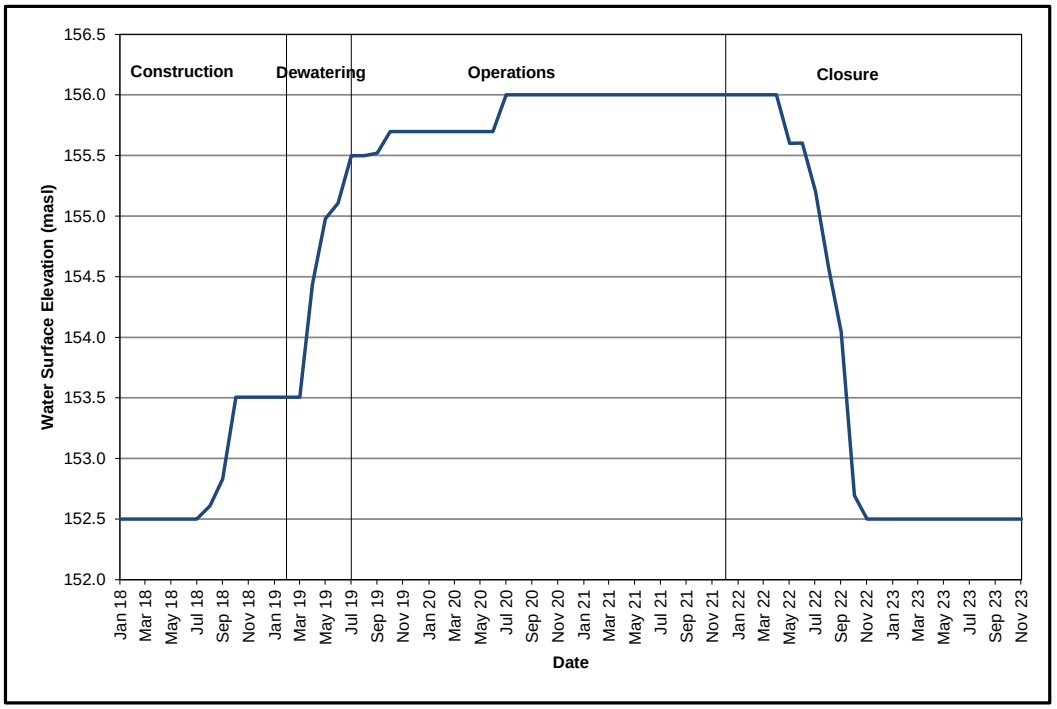


Figure 6-F-3: Derived Water Surface Elevation of the Whale Tail Lake (South Basin) Diversion

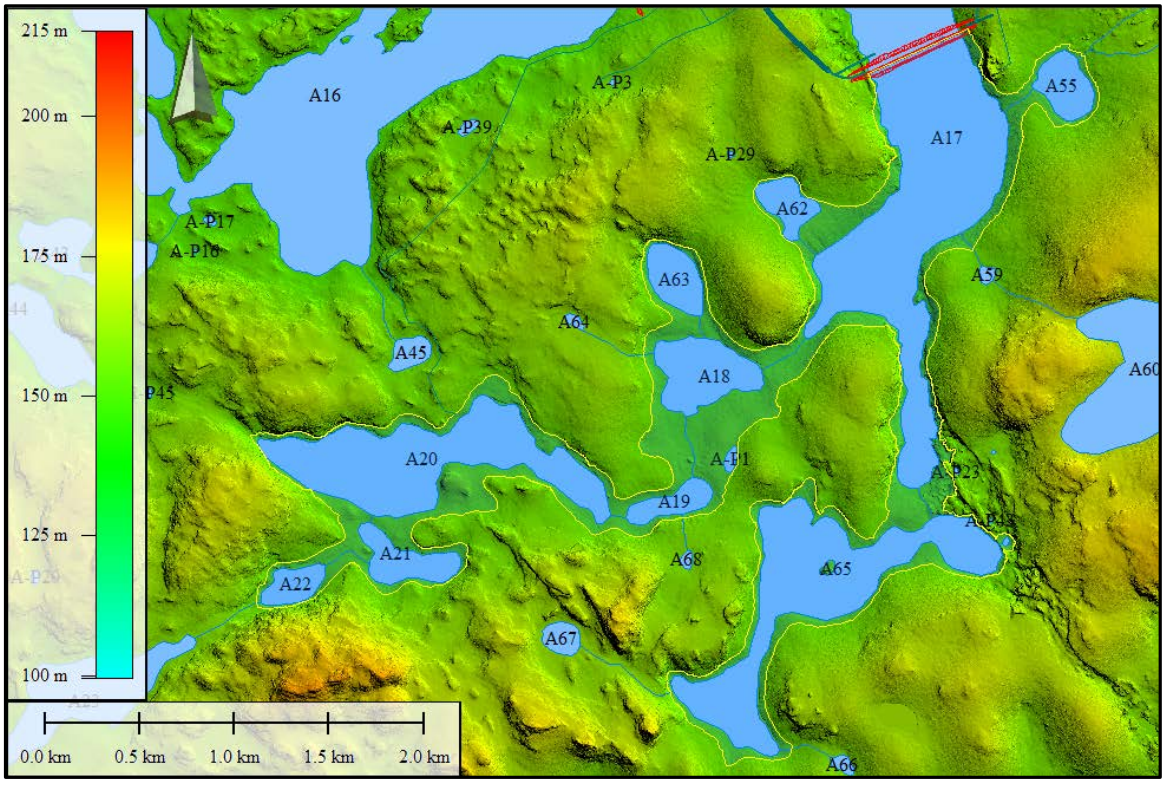


Figure 6-F-4: Maximum Water Surface Elevation of the Whale Tail Lake (South Basin) Diversion

6.F-4.2 Northeast Diversion

Based on a mean annual water balance, the Northeast diversion is expected to reach the spilling water surface water elevation of 156.66 masl by the end of June 2020, remain at 156.66 masl until the end of April 2022, and return to the baseline water surface elevation of 152.50 masl by the end of May 2022.

Total flooded and flooded terrestrial areas are presented in Table 6-F-2 for bird nesting months of May, June, July, and August, during the diversion, at the start of each month.

The derived water surface elevation of the Northeast diversion is shown in Figure 6-F-5 and the maximum water surface elevation of the Northeast diversion is shown in Figure 6-F-4.

This analysis was based on mean annual climate conditions and actual filling duration may differ under wet or dry conditions.

Table 6-F-2: Total Flooded and Flooded Terrestrial Area during the Northeast Diversion

Date	Water Surface Elevation (masl)	Total Flooded Area (m^2)	Flooded Terrestrial Area (m^2)	Change in Flooded Terrestrial Area (m^2)
June 2019	154.43	0	0	0
July 2019	155.82	115,778	65,844	65,844
August 2019	155.82	115,778	65,844	0
May 2020	156.24	181,231	130,187	64,343
June 2020	156.24	181,231	130,187	0
July 2020	156.66	262,600	184,457	54,270
August 2020	156.66	262,600	184,457	0
May 2021	156.66	262,600	184,457	0
June 2021	156.66	262,600	184,457	0
July 2021	156.66	262,600	184,457	0
August 2021	156.66	262,600	184,457	0
May 2022	156.66	262,600	184,457	0
June 2022	154.43	0	0	-184,457

masl = metres above sea level; m^2 = square metres

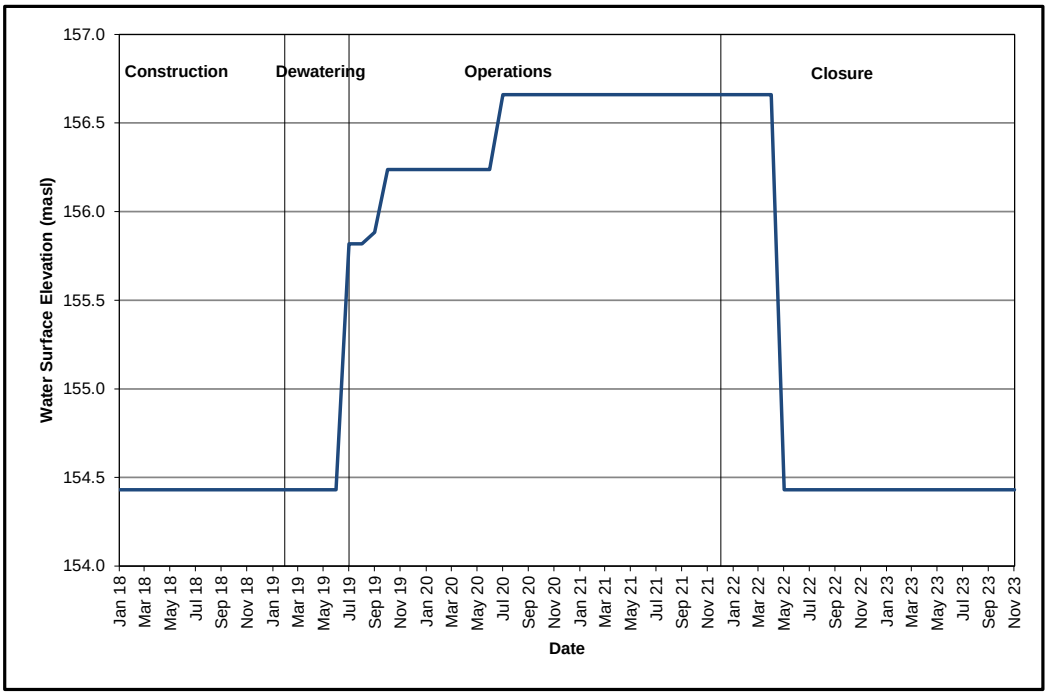


Figure 6-F-5: Derived Water Surface Elevation of the Northeast Diversion

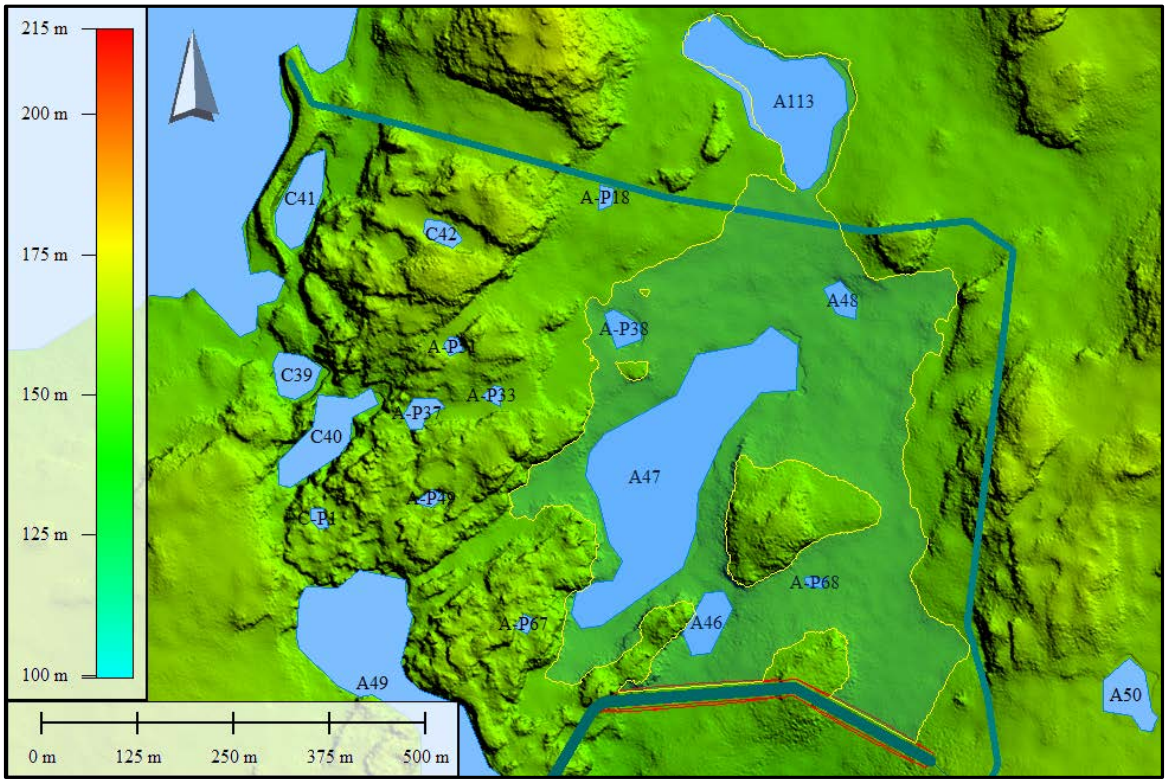


Figure 6-F-6: Maximum Water Surface Elevation of the Northeast Diversion

6.F-5 REFERENCES

PhotoSat Information Ltd. (PhotoSat). 2015. PhotoSat Stereo Satellite Elevation Mapping Project Report. Reference No. 3631.

ATTACHMENT A

This attachment presents methods to derive results presented herein.

Whale Tail Lake (South Basin) Diversion

- A mean annual water balance was developed on a monthly timestep for the Whale Tail Lake (South Basin) diversion, based on mean annual water balances, dewatering, and refilling rates presented in the water management plan (Volume 8, Appendix 8-B.2).
- Flooded area and storage were derived based on available elevation-area-storage relationships for Whale Tail Lake (South Basin) diversion (Volume 8, Appendix 8-B.2), and are presented in Figure A-1 (elevation-storage) and Figure A-2 (elevation-area).
- Flooded terrestrial areas were derived based on the updated water balance and the elevation-terrestrial area relationship (Figure A-2), derived based on Project topographic data (PhotoSat 2015).

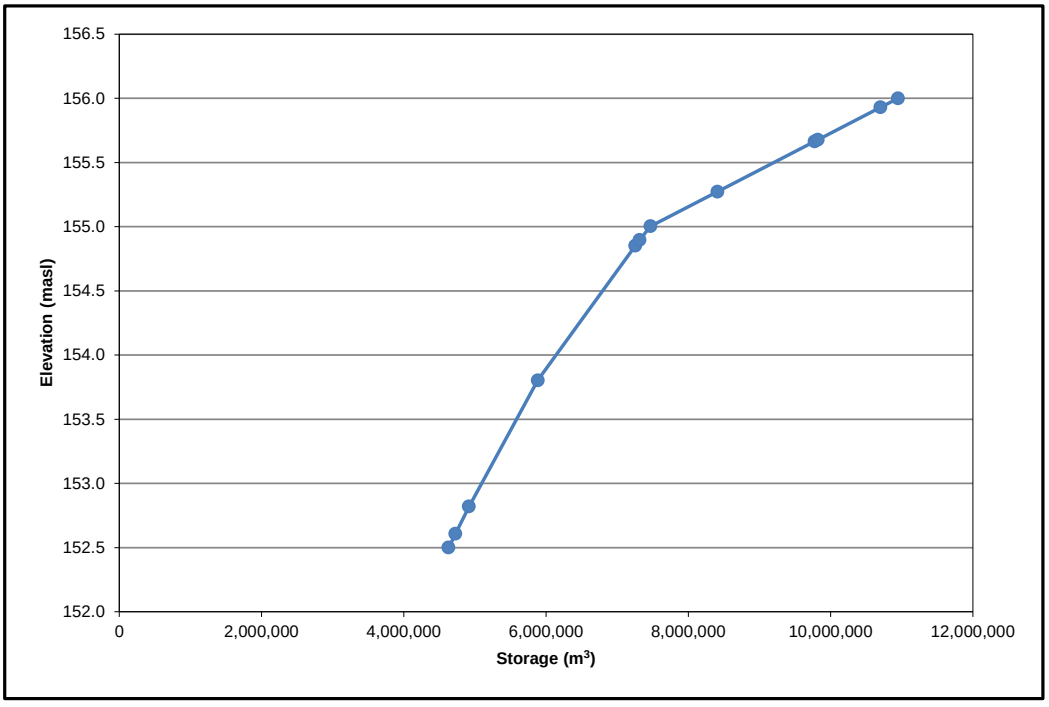


Figure A-1: Elevation-Storage Relationship for the Whale Tail Lake (South Basin) Diversion

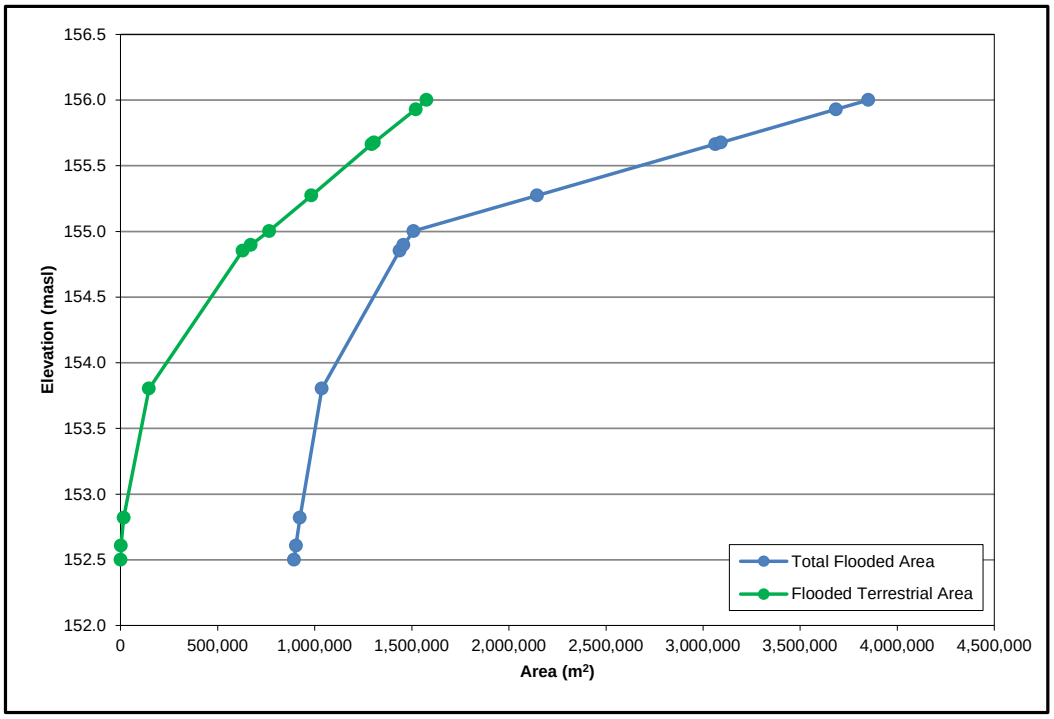


Figure A-2: Elevation-Area Relationship for the Whale Tail Lake (South Basin) Diversion

Northeast Diversion

A mean annual water balance was developed on a monthly timestep for the Northeast diversion, based on mean annual water balances and refilling rates presented in the water management plan (Volume 8, Appendix 8-B.2).

Elevation-storage-area relationships were derived based on Project topographic data (PhotoSat 2015), and are presented in Figure A-3 (elevation-storage) and Figure A-4 (elevation-area).

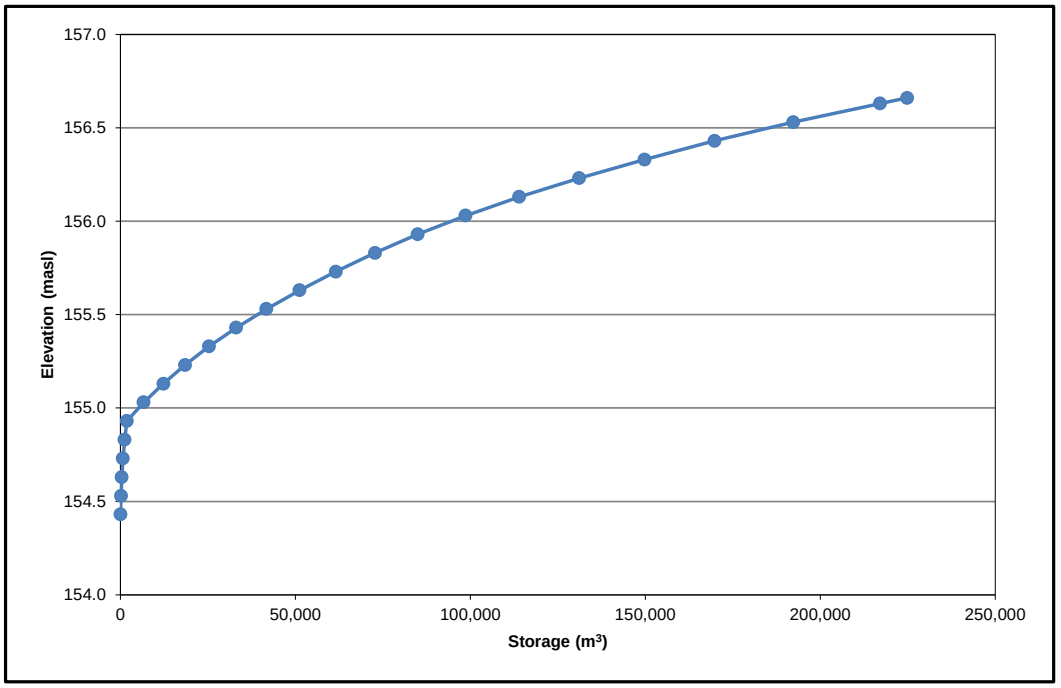


Figure A-3: Derived Elevation-Storage Relationship for the North East Diversion

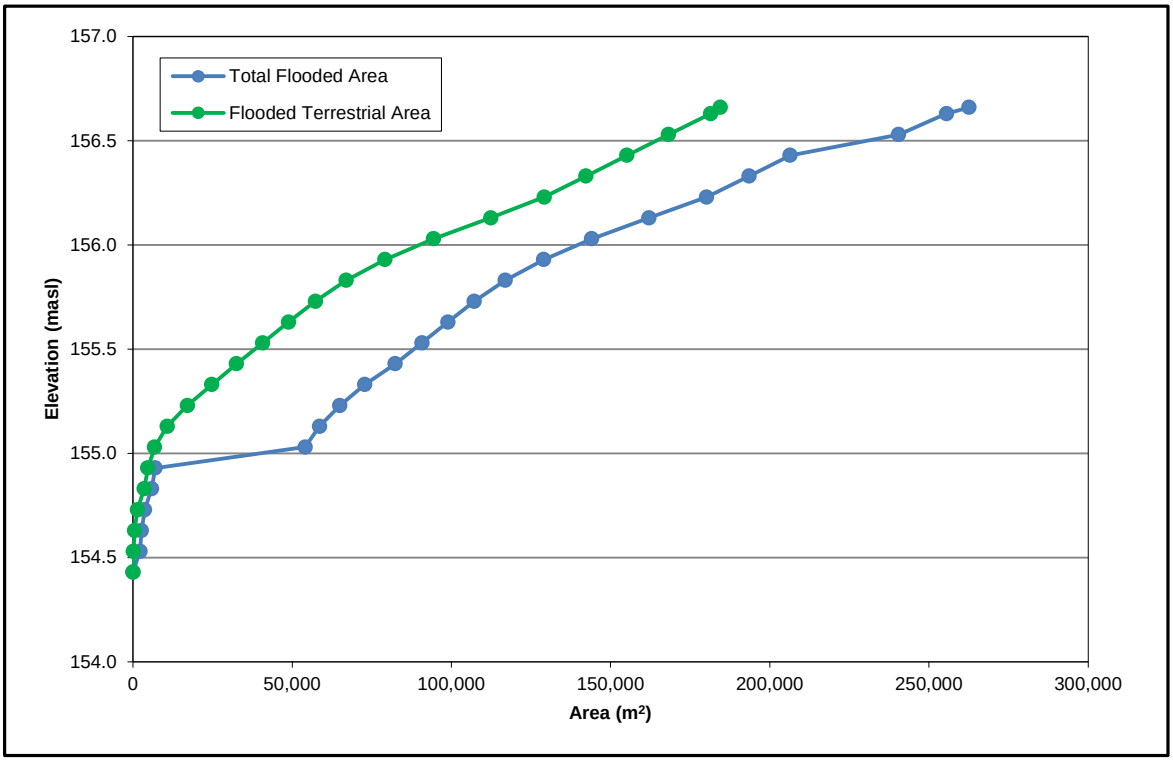


Figure A-4: Derived Elevation-Area Relationship for the Northeast Diversion

APPENDIX 6-G

Whale Tail Pit Core Receiving Environment Monitoring Program 2014-2015 Baseline Studies

June 2016
Report No. 1541520

AGNICO EAGLE

Golder Associates

FINAL

Whale Tail Pit Core Receiving Environment Monitoring Program (CREMP): 2014-2015 Baseline Studies

Prepared for:

Agnico Eagle Mines Ltd.

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January 2016



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Project No. AEM-15-03

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- Gary Mann (Azimuth) – Gary was responsible for overall management of this project. He also provided oversight and logistical support for the field crew, collaborated on the study design, and reviewed the report.
- Eric Franz (Azimuth) – Eric was responsible for overall coordination of the 2015 baseline program. He coordinated field sampling logistics, completed the August sampling event, and was the primary author of the report.
- Morgan Finley (Azimuth) – Morgan completed the July and September sampling events and helped coordinate the field program.

PROFESSIONAL LIABILITY STATEMENT

This report has been prepared by Azimuth Consulting Group Partnership (Azimuth; managing partner Azimuth Consulting Group Inc.), for the use of Agnico Eagle Mines Ltd. (AEM), who has been party to the development of the scope of work for this project and understands its limitations. The extent to which previous investigations were relied on is detailed in the report.

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ACRONYMS

AEM	Agnico Eagle Mines Ltd.
BAER	Baseline Aquatic Ecosystem Report
CCME	Canadian Council of Ministers of the Environment
CREMP	Core Receiving Environment Monitoring Program
CRM	Certified Reference Material
DQO	Data Quality Objective
dw	dry weight
EIA	Environmental Impact Assessment
GCDWQ	Guidelines for Canadian Drinking Water Quality
GPS	Global Positioning System
INUG	Inuggugayualik Lake
ISQG	Interim sediment quality guidelines (CCME sediment quality guidelines)
KIA	Kivalliq Inuit Association
LPL	Lowest practical level (taxonomic identification)
MAM	Mammoth Lake
MB	Method blank
MDL	Method detection limit
MS	Matrix spike
MTG	Major taxa group
NEM	Nemo Lake
NF	Near-field
NTI	Nunavut Tunngavik Incorporated
NWB	Nunavut Water Board
PAHs	Polycyclic aromatic hydrocarbons
PEL	Probable effect level (CCME sediment quality guidelines)
PDL	Pipedream Lake
QA/QC	Quality Assurance / Quality Control
REF	Reference
RPD	Relative percent difference
SOP	Standard Operating Procedure
SQG	Sediment quality guidelines
UTM	Universal Transverse Mercator

WQG	Water quality guidelines
WTN	Whale Tail Lake North Basin
WTN-Ex	Whale Tail Lake North Basin (shallow)
WTS	Whale Tail Lake South Basin
ww	wet weight

1. INTRODUCTION

1.1. Background

The Amaruq Exploration Property is a 408-square kilometer area located on Inuit Owned Land, approximately 150 kilometers north of Baker Lake and approximately 50 kilometers northwest of the Meadowbank mine (**Figure 1ï1**). Agnico Eagle Mines Limited (AEM) leased exploration rights to the Amaruq Exploration Property from Nunavut Tunngavik Incorporated (NTI) in April 2013. AEM's exploration activities have been conducted under a land use permit issued by the Kivalliq Inuit Association (KIA) and a water licence issued by the Nunavut Water Board (NWB).

AEM intends to pursue development of the Whale Tail satellite open pit located on the Amaruq site as an extension to the operational Meadowbank Mine. This report presents results of the aquatic baseline sampling studies carried out in support of the environmental impact assessment (EIA) process for the proposed development of the Whale Tail Pit.

1.2. Environmental Setting

The Whale Tail Pit and Meadowbank projects are situated in the barren-ground central Arctic region of Nunavut within an area of continuous permafrost known as the Wager Bay Plateau (Campbell et al. 2012). The landscape around the Amaruq property consists of rolling hills and relief with low-growing vegetative cover and poor soil development. Numerous lakes are interspersed among boulder fields, eskers and bedrock outcrops, with indistinct and complex drainages (**Figure 1ï2**). The near-field (NF) lakes within the Amaruq Exploration Property are Whale Tail Lake (WTL), Nemo Lake (NEM), and Mammoth Lake (MAM). These are headwater ultra-oligotrophic/oligotrophic (nutrient poor with low biological productivity) lakes, situated on the watershed boundary that separates the Arctic and Hudson Bay drainages. Only a few hundred meters to the north of Third Portage Lake is the divide between water that flows north to the Arctic Ocean or to Chesterfield Inlet and Hudson Bay. Lakes near the Meadowbank project (i.e., Third Portage, Second Portage, and Tehek) flow into the Quoich River system while the CREMP reference lakes (Pipedream [PDL] and Inuggugayualik [INUG]) and lakes within the Amaruq Exploration Property flow north via the Meadowbank and Back River system.

As is common of headwater lakes, all of the project lakes have small drainage areas relative to the surface area of the lakes themselves. A drainage divide separates Nemo Lake to the north from Mammoth and Whale Tail Lake to the south (Golder 2015a). Local inflow from surrounding terrain is the predominant influence on water movement within the system. Small stream channels connect the project area lakes, although there is little flow between lakes except during freshet and possibly none during winter months. Movement by fish between lakes is also rare, as populations remain quite isolated from one another (Portt and Associates 2015b). The ice-free season on these lakes is short, with ice break-up in late-June to mid-July and ice-up beginning in late September or early October.

1.3. Baseline Sampling Overview

This document presents results of the baseline monitoring program completed by Azimuth Consulting Group Partnership (Azimuth) in 2015, as well as baseline data collected by C. Portt and Associates (Portt and Associates) in 2014 and water quality data collected by Golder Associates Ltd (Golder) in 2015. An overview of the sampling programs is provided below.

In addition to characterizing water quality, sediment quality and lower trophic aquatic communities in support of the EIA process, these baseline studies were intended to support the development and

implementation of a long-term receiving environment monitoring program consistent with that being implemented at the Meadowbank Mine (i.e., the core receiving environment monitoring program [CREMP]).

1.3.1. 2014 Baseline Program

Preliminary baseline sampling was completed by Portt and Associates during the first week of September in 2014. The field program involved sampling for water chemistry, sediment chemistry, phytoplankton taxonomy, benthic invertebrate taxonomy, and fish community in Whale Tail Lake, Nemo Lake, and Mammoth Lake (**Table 1ï1**). The full report was submitted to AEM in January 2015 (Portt and Associates 2015a).

Water, sediment, phytoplankton, and benthic invertebrate results were provided to Azimuth by Portt and Associates and are included in this report for comparison with results from the 2015 baseline program. Sampling was conducted broadly throughout each lake, in general accordance with the standard operating procedures (SOPs) for the Meadowbank CREMP. Five replicate stations were chosen throughout each lake at a target depth of 8 m ± 1.5 m. The locations were broadly distributed throughout each of the lakes **Figure 1ï3** (Whale Tail), **Figure 1ï4** (Nemo), **Figure 1ï5** (Mammoth).

1.3.2. 2015 Baseline Program

The following sections provide an overview of the 2015 baseline monitoring studies, broken down into three components:

- Whale Tail Pit Study Area lakes (herein referred to as the "Lakes"),
- Stream locations along the proposed the proposed access road (herein referred to as the "Sentinel stations"),
- Streams within the Whale Tail Pit Study Area (herein referred to as the "Tributaries").

1.3.2.1. Whale Tail Pit Study Area Lakes

Whale Tail Lake, Nemo Lake, and Mammoth Lake were sampled by Azimuth in 2015. Whale Tail Lake was divided into two basins, the North Basin (WTN) and South Basin (WTS) to characterize the aquatic resources. WTN is located in the vicinity of the proposed mining operations (**Figure 1ï1**), and it is anticipated that this area of Whale Tail Lake will be dewatered to allow development of the Whale Tail Pit. Five additional shallow sampling stations were established in the North Basin (referred to as WTN-Ex) to document aquatic resources in support of the EIA. The following media were sampled in 2015 at the Lake stations:

- *In-situ* limnology (July, August, and September)
- Water chemistry (July, August, and September)
- Sediment chemistry (August)
- Benthic invertebrate community (August)
- Zooplankton community (July, August, and September)
- Periphyton (qualitative survey, July August, and September)

Sampling locations for the 2015 baseline program in Whale Tail, Nemo, and Mammoth Lakes are presented in **Table 1ï2** and shown in **Figure 1ï3**, **Figure 1ï4**, and **Figure 1ï5**, respectively.

The Meadowbank CREMP reference lakes Inuggugayualik Lake (INUG) and Pipedream Lake (PDL) are considered suitable reference lakes for the Whale Tail Pit Study Area Lakes, and the 2015 data are used

herein to provide a broader context where appropriate. INUG is located about 41 km southeast of the Whale Tail Pit Study Area, while PDL is located 40 km to the southeast (**Figure 1ï1**). Pipedream Lake is located northeast of INUG, and the proposed access road runs along the northeast shore of this lake. INUG and PDL satisfied the requirements of an external reference lake for the Meadowbank CREMP from a physical/chemical perspective because they are at similar latitude, have similar geology, relief and climate, do not have any significant inflows and has generally similar limnology, water chemistry and aquatic biological community structure to the project lakes (BAER, 2005). It should be noted that their proximity to the proposed access road may lead to dust deposition into each of the lakes under certain conditions. However, both lakes are quite large and the sampling locations for each are away from the road (i.e., approximately 2 km for PDL and 10 km for INUG), so while road-related trends will be tracked they are not anticipated.

It is anticipated that the baseline data collected from Whale Tail Lake, Nemo Lake, and Mammoth Lake will also be used to define pre-mining conditions for the Core Receiving Environment Monitoring Program (CREMP) designed to detect whether future development of the Whale Tail deposit is adversely affecting aquatic resources.

1.3.2.2. Sentinel Stations

Sentinel stations are defined as the monitoring locations along the route of a proposed access road between the Whale Tail Pit Study Area and the Vault Pit area at Meadowbank (**Figure 1ï1**). The baseline characterization of the Sentinel stations will support making future inferences about road-related changes to water quality once the road is built. The locations were chosen based on the fisheries and habitat surveys completed by Portt and Associates in 2014 (2015b). In general, the monitoring locations were chosen because of the presence of seasonal habitat, suitable spawning habitat, and/or potential migration route for large-bodied fish. The report identified several water bodies and watercourses that intersected the approximate route of the proposed access road, and of the locations surveyed, five were selected as long-term monitoring locations (**Table 1ï2**). Water samples (*in-situ* field parameters and water chemistry) were collected by Azimuth in July, August, and September 2015. Qualitative observations on the periphyton community were also collected during each sampling event.

1.3.2.3. Whale Tail Pit Study Area Tributaries

Several streams in the vicinity of the Whale Tail Pit Study Area were sampled by Golder in August and September 2015 to support water quality model development for the EIA. Water quality data collected from the "tributary" streams are included herein for completeness.

The Tributary locations were named according to a hydrology naming convention established prior to the August sampling event. Lakes within the local watershed boundaries were given alphanumeric names based on the watershed they were located in, termed A, B, or C. Tributaries were defined based on their upstream and downstream lakes. For example, Tributary station A17-A16 is located downstream of Lake A17 and upstream of lake A16. The naming convention was revised after sampling was completed in September, which required updating and cross-referencing the old tributary names with the new naming convention. Table 1 in **Appendix D** provides the new and old tributary names to assist interpreting the original laboratory data reports submitted using the original naming convention. Labels shown in the figures reflect the current, updated naming convention.

Table 1-1. Sampling location coordinates (GPS, UTM, NAD83), Whale Tail Pit Baseline, 2014.

							Sampling Program				
Lake	Date	Location	Zone	Easting	Northing	Station Depth (m)	*In-situ* Water Quality	Water Chemistry	Sediment Chemistry	Phytoplankton Taxonomy	Benthic Invertebrate Taxonomy
Mammoth Lake	04-Sep-14	1	14W	605074	7254893	8.1	✓	✓	✓	✓	✓
		2	14W	604486	7254566	7.3	✓				✓
		3	14W	604398	7254336	8.3	✓	✓	✓	✓	✓
		4	14W	603925	7254200	7.4	✓				✓
		5	14W	604191	7253847	7.3	✓	✓	✓	✓	✓
Whale Tail Lake	05-Sep-14	1	14W	607005	7255983	8.5	✓	✓	✓	✓	✓
		2	14W	607431	7255251	7.8	✓				✓
		3	14W	607538	7254596	8.0	✓	✓	✓	✓	✓
		4	14W	607230	7253781	7.8	✓				✓
		5	14W	607120	7253603	8.0	✓	✓	✓	✓	✓
Nemo Lake	06-Sep-14	1	14W	606358	7257042	7.6	✓	✓	✓	✓	✓
		2	14W	606040	7257418	7.4	✓				✓
		3	14W	606048	7257571	8.3	✓	✓	✓	✓	✓
		4	14W	606963	7257756	8.5	✓				✓
		5	14W	606740	7257566	8.7	✓	✓	✓	✓	✓

Notes:
Baseline 2014 sampling was completed by Portt and Associates (2015b).

Table 1-2. Sampling location coordinates (GPS, UTM, NAD83), Whale Tail Pit Baseline, 2015.

		Water & Phytoplankton (monthly)[1]				**Zooplankton** (monthly)				**Benthos & Sediment Grabs** (August)				
		Area-	**Depth**	**Coordinates (zone 14W)**		**Area-**	**Depth**	**Coordinates (zone 14W)**		**Area-**	**Sample**	**Depth**	**Coordinates (zone 14W)**	
Lake	**Month**	**Replicate**	**(m)**	**Easting**	**Northing**	**Replicate**	**(m)**	**Easting**	**Northing**	**Replicate**[2]	**Type**[3]	**(m)**	**Easting**	**Northing**
Whale Tail (North Basin)	July	WTN-1	7.4	607207	7254975	WTN-1	7.4	607207	7254975	WTN-1	B & C	8.0	606929	7255745
	July	WTN-2	6.7	607252	7254613	WTN-2	6.4	607252	7254613	WTN-2	B & C	8.4	606930	7255703
	August	WTN-3	6.8	607387	7254563	WTN-3	8.6	607393	7254558	WTN-3	B & C	7.9	606922	7255641
	August	WTN-4	7.9	607221	7254980	WTN-4	6.4	607221	7254988	WTN-4	B & C	9.1	606883	7255744
	September	WTN-5	6.7	607244	7255025	WTN-5	6.7	607244	7255025	WTN-5	B & C	7.5	606944	7255763
	September	WTN-6	10.9	607329	7254542	WTN-6	10.9	607329	7254542	WTN-COMP	C			
										WTN-Ex-1	B & C	5.0	607063	7255973
										WTN-Ex-2	B & C	5.4	607048	7256005
										WTN-Ex-3	B & C	5.7	607042	7255883
										WTN-Ex-4	B & C	6.1	607062	7255952
										WTN-Ex-5	B & C	5.4	607071	7255991
Whale Tail (South Basin)	July	WTS-1	9.5	607450	7253884	WTS-1	9.5	607450	7253884	WTS-1	B & C	7.2	607152	7253537
	July	WTS-2	5.1	607621	7254253	WTS-2	5.1	607621	7254253	WTS-2	B & C	7.1	607179	7253534
	August	WTS-3	8.5	607173	7253550	WTS-3	7.8	607155	7253550	WTS-3	B & C	7.8	607110	7253570
	August	WTS-4	7.5	607571	7254138	WTS-4	7.5	607571	7254138	WTS-4	B & C	7.4	607099	7253641
	September	WTS-5	6.5	607612	7253907	WTS-5	6.5	607612	7253907	WTS-5	B & C	7.8	607160	7253639
	September	WTS-6	7.8	607568	7254259	WTS-6	7.8	607568	7254259	WTS-COMP	C			
Nemo	July	NEM-1	10.5	606604	7257508	NEM-1	10.5	606604	7254415	NEM-1	B & C	8.0	606553	7257356
	July	NEM-2	11.1	606454	7257135	NEM-2	11.9	606454	7257135	NEM-2	B & C	9.0	606528	7257358
	August	NEM-3	8.0	606553	7257360	NEM-3	8.0	606553	7257360	NEM-3	B & C	8.9	606534	7257302
	August	NEM-4	11.8	606378	7257257	NEM-4	10.2	606370	7257235	NEM-4	B & C	8.0	606572	7257370
	September	NEM-5	10.5	606288	7257418	NEM-5	10.5	606289	7257418	NEM-5	B & C	8.5	606544	7257328
	September	NEM-6	15.2	606611	7257938	NEM-6	15.2	606611	7257938	NEM-COMP	C			
Mammoth	July	MAM-1	5.1	604278	7254163	MAM-1	7.8	604145	7254415	MAM-1	B & C	8.0	605073	7254864
	July	MAM-2	7.8	604145	7254415	MAM-2	5.1	604278	7254163	MAM-2	B & C	8.1	605056	7254887
	August	MAM-3	7.2	604273	7254244	MAM-3	7.4	604273	7254244	MAM-3	B & C	7.5	605033	7254895
	August	MAM-4	7.8	604239	7253860	MAM-4	7.8	604239	7253860	MAM-4	B & C	8.1	605001	7254886
	September	MAM-5	8.9	604357	7254348	MAM-5	8.9	604357	7254348	MAM-5	B & C	8.8	605010	7254862
	September	MAM-6	6.4	604228	7253834	MAM-6	6.4	604228	7253834	MAM-COMP	C			
Sentinel Stations	July, August, September[5]	C2	-	638199	7221598									
		C14	-	632916	7232202									
		C17	-	630583	7234684									
		C20	-	627265	7236464									
		C41	-	620607	7244690									

Notes:

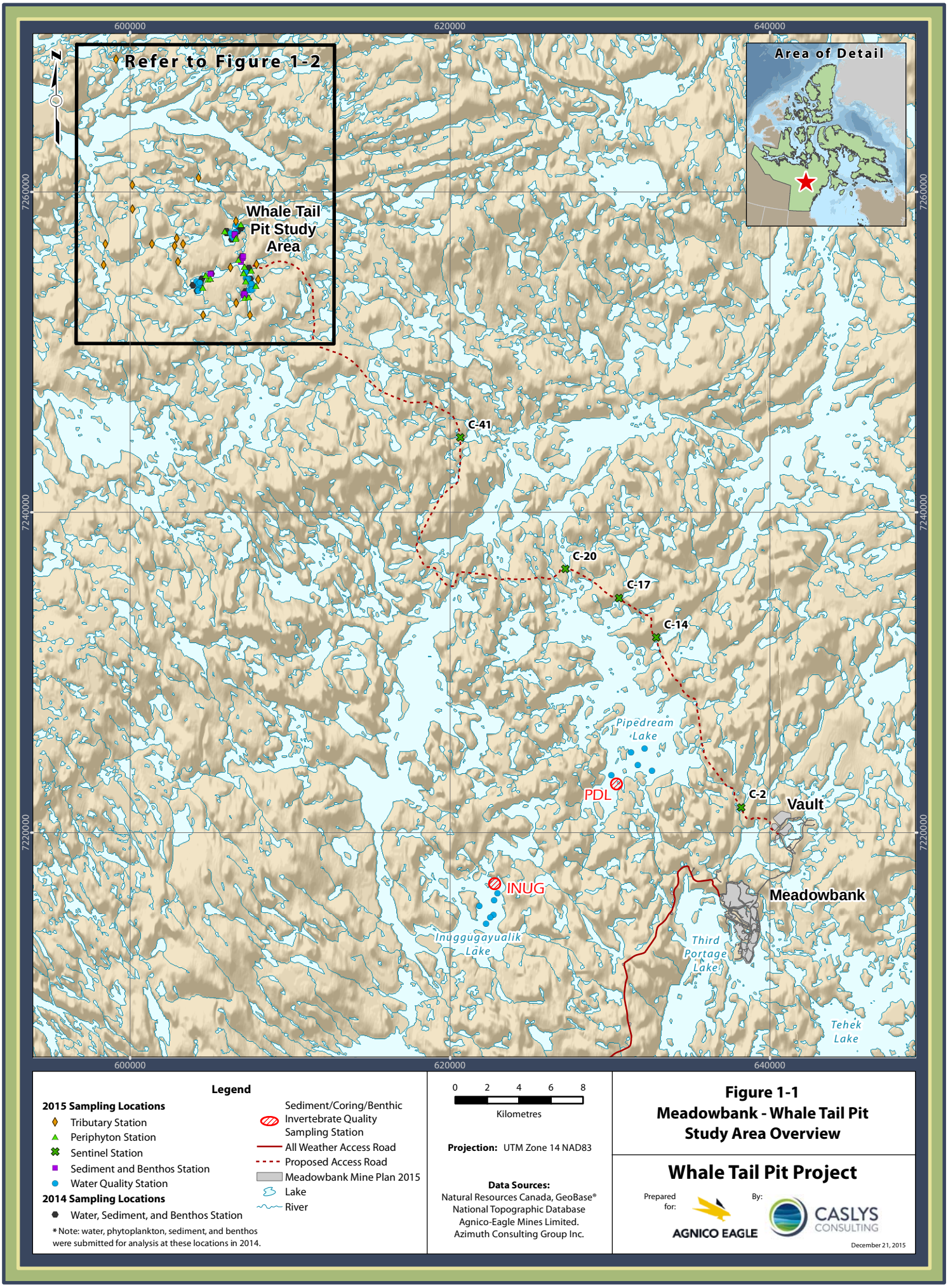
[1] Water and phytoplankton from the Lake stations were collected 3 m below the surface. Phytoplankton was not collected at the Sentinel stations.

[2] Area IDs are as follows: WTN = Whale Tail Lake North Basin; WTN-Ex = Whale Tail Lake North Basin (shallow); WTS = Whale Tail Lake South Basin.

[3] Sample types: B = Benthos; C = chemistry.

[4] COMP = composite sample of all 5 replicate samples from each area. COMP samples are analzyed for Mineral oil and grease, PAHs,

[5] Water sampling at the Sentinel stations was conducted in the same general location during each event (month).



Legend

2015 Sampling Locations
- Tributary Station
- Periphyton Station
- Sentinel Station
- Sediment and Benthos Station
- Water Quality Station

2014 Sampling Locations
- Water, Sediment, and Benthos Station

* Note: water, phytoplankton, sediment, and benthos were submitted for analysis at these locations in 2014.

- Sediment/Coring/Benthic Invertebrate Quality Sampling Station
- All Weather Access Road
- Proposed Access Road
- Meadowbank Mine Plan 2015
- Lake
- River

0 2 4 6 8
Kilometres

Projection: UTM Zone 14 NAD83

Data Sources:
Natural Resources Canada, GeoBase®
National Topographic Database
Agnico-Eagle Mines Limited.
Azimuth Consulting Group Inc.

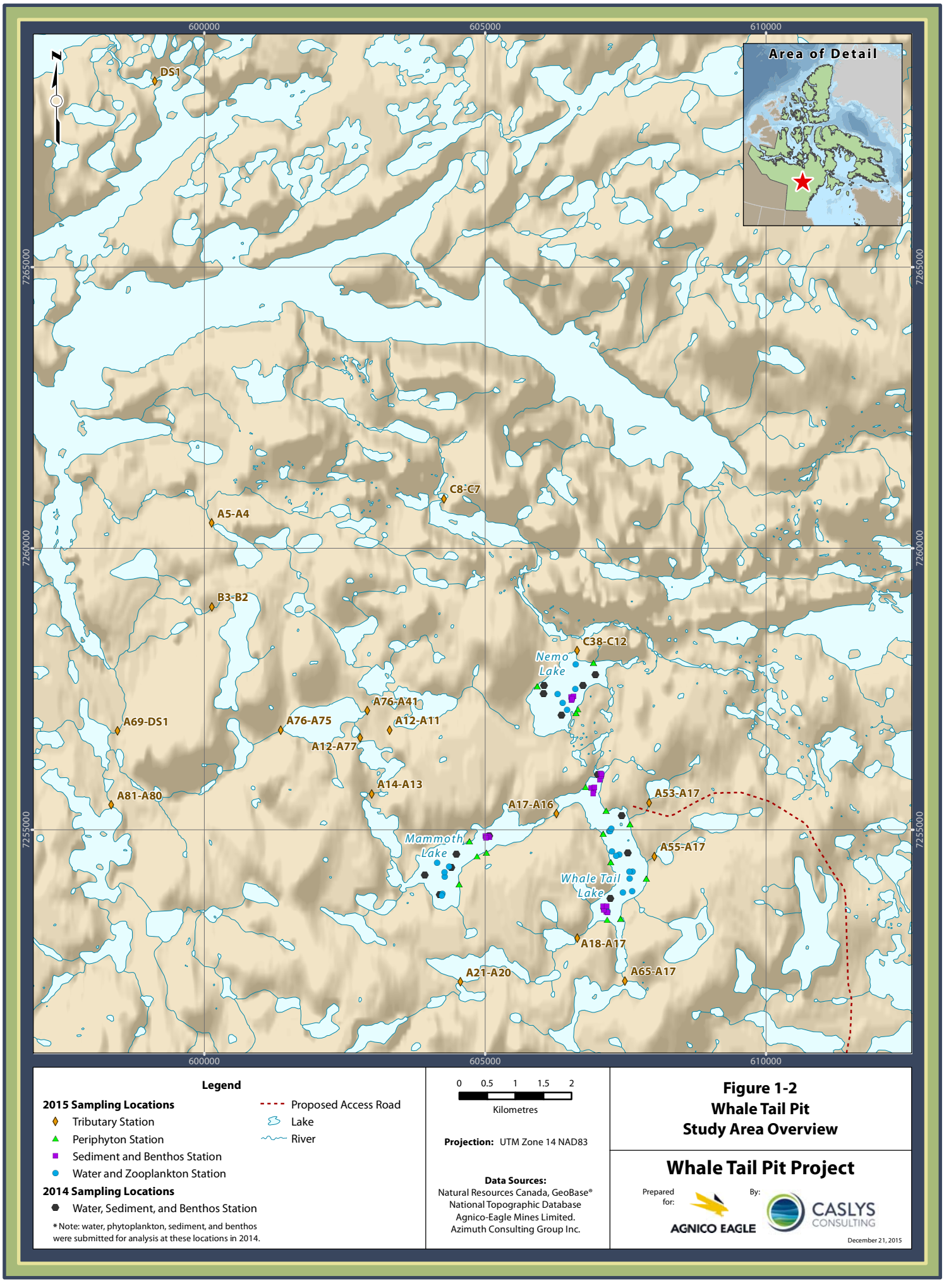
Figure 1-1
Meadowbank - Whale Tail Pit Study Area Overview

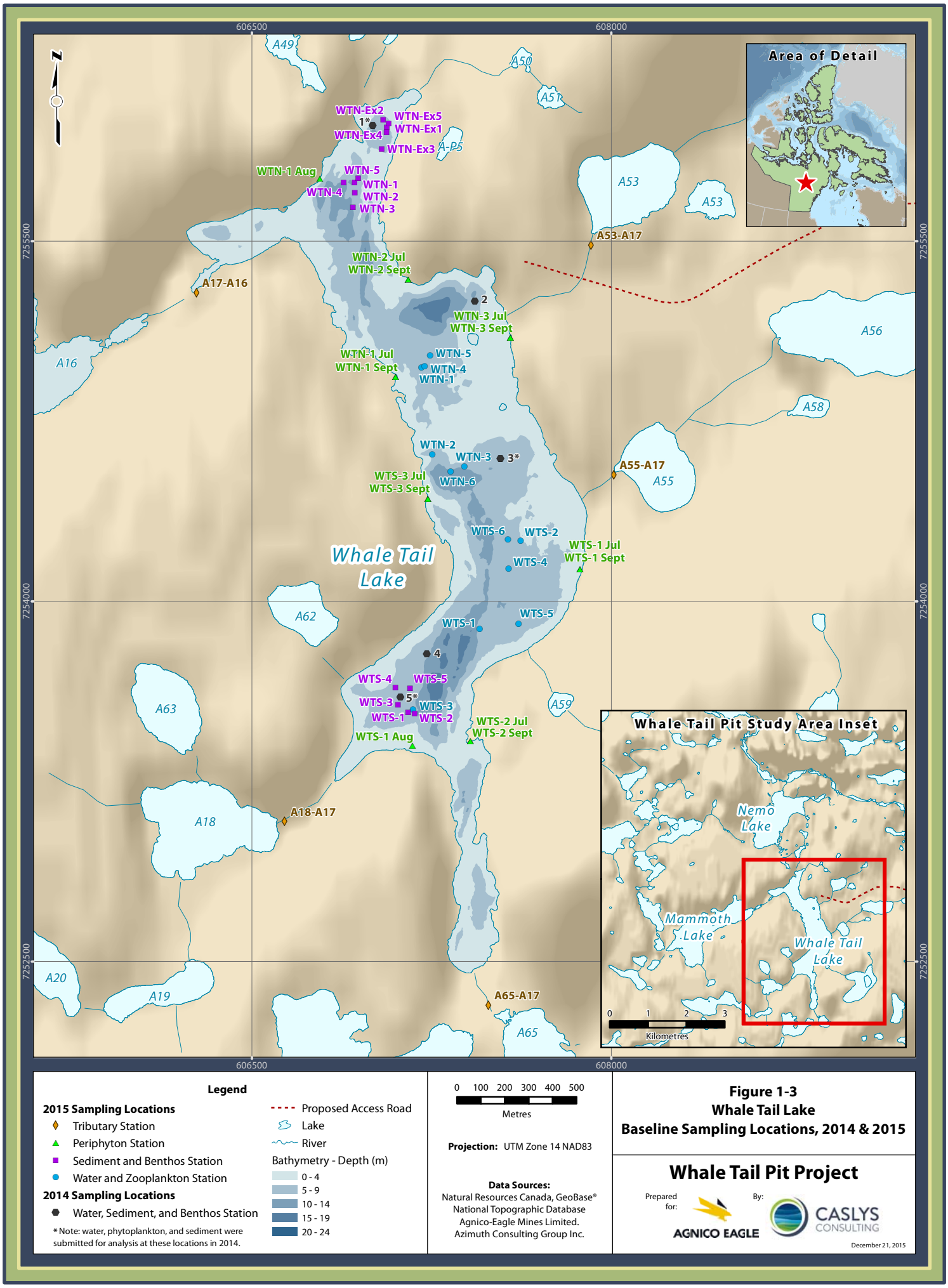
Whale Tail Pit Project

Prepared for: AGNICO EAGLE

By: CASLYS CONSULTING

December 21, 2015


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7255000
N
DS1
Area of Detail
C8-C7
A5-A4
B3-B2
C38-C12
Nemo Lake
A76-A41
A69-DS1
A76-A75
A12-A11
A12-A77
A14-A13
A81-A80
A17-A16
A53-A17
Mammoth Lake
A55-A17
Whale Tail Lake
A18-A17
A21-A20
A65-A17
Legend
2015 Sampling Locations
Tributary Station
Periphyton Station
Sediment and Benthos Station
Water and Zooplankton Station
2014 Sampling Locations
Water, Sediment, and Benthos Station
* Note: water, phytoplankton, sediment, and benthos were submitted for analysis at these locations in 2014.
Proposed Access Road
Lake
River
0 0.5 1 1.5 2
Kilometres
Projection: UTM Zone 14 NAD83
Data Sources:
Natural Resources Canada, GeoBase®
National Topographic Database
Agnico-Eagle Mines Limited.
Azimuth Consulting Group Inc.
Figure 1-2
Whale Tail Pit
Study Area Overview
Whale Tail Pit Project
Prepared for:
AGNICO EAGLE
By:
CASLYS CONSULTING
December 21, 2015



Legend

2015 Sampling Locations
- Tributary Station
- Periphyton Station
- Sediment and Benthos Station
- Water and Zooplankton Station

2014 Sampling Locations
- Water, Sediment, and Benthos Station

* Note: water, phytoplankton, and sediment were submitted for analysis at these locations in 2014.

- Proposed Access Road
- Lake
- River

Bathymetry - Depth (m)
- 0 - 4
- 5 - 9
- 10 - 14
- 15 - 19
- 20 - 24

0 100 200 300 400 500
Metres

Projection: UTM Zone 14 NAD83

Data Sources:
Natural Resources Canada, GeoBase®
National Topographic Database
Agnico-Eagle Mines Limited.
Azimuth Consulting Group Inc.

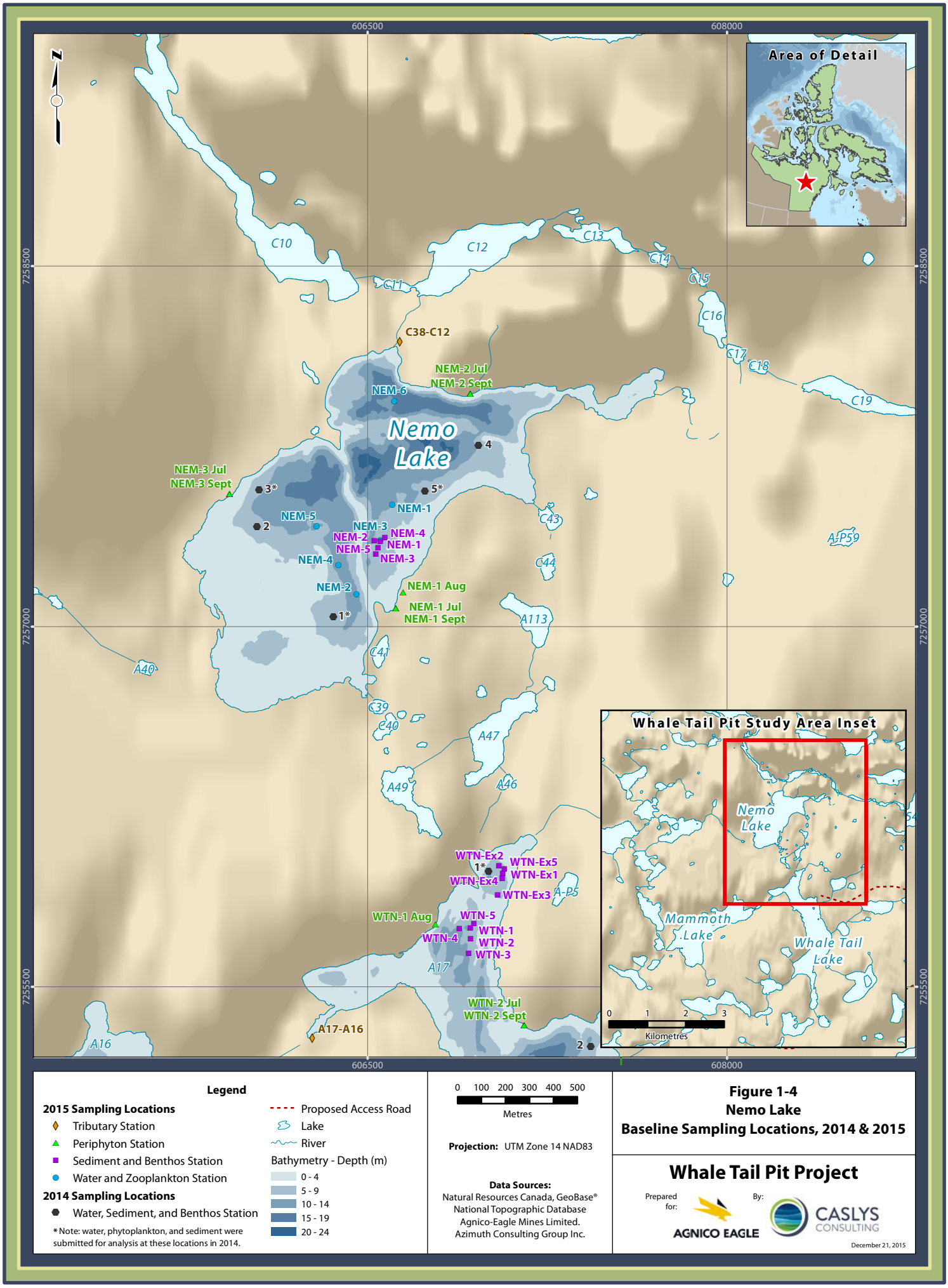
Figure 1-3
Whale Tail Lake
Baseline Sampling Locations, 2014 & 2015

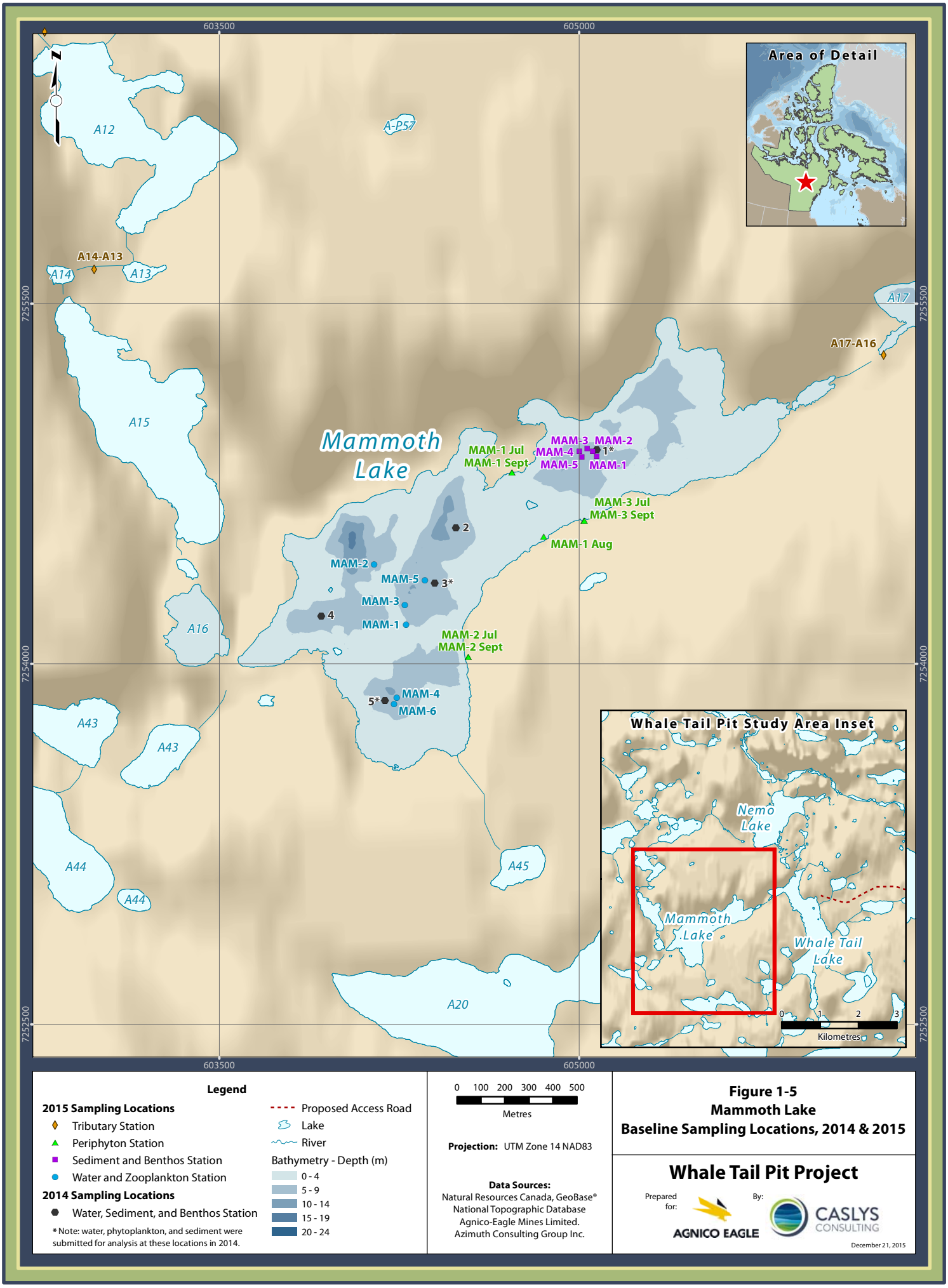
Whale Tail Pit Project

Prepared for: AGNICO EAGLE

By: CASLYS CONSULTING

December 21, 2015


606500
608000
7258500
7257000
7255500
Area of Detail
C10
C12
C13
C14
C15
C16
C17
C18
C19
C11
C38-C12
NEM-2 Jul
NEM-2 Sept
NEM-6
Nemo
Lake
4
NEM-3 Jul
NEM-3 Sept
3*
5*
NEM-1
NEM-5
2
NEM-3
NEM-2
NEM-4
NEM-1
NEM-5
NEM-3
NEM-4
C43
A-P59
C44
NEM-2
NEM-1 Aug
NEM-1 Jul
NEM-1 Sept
1*
A113
C41
A40
C39
C40
A47
A49
A46
WTN-Ex2
1*
WTN-Ex5
WTN-Ex1
WTN-Ex4
WTN-Ex3
A-P5
WTN-1 Aug
WTN-5
WTN-1
WTN-4
WTN-2
WTN-3
A17
WTN-2 Jul
WTN-2 Sept
A17-A16
A16
2
Whale Tail Pit Study Area Inset
Nemo
Lake
Mammoth
Lake
Whale Tail
Lake
0
1
2
3
Kilometres
Legend
2015 Sampling Locations
Tributary Station
Periphyton Station
Sediment and Benthos Station
Water and Zooplankton Station
2014 Sampling Locations
Water, Sediment, and Benthos Station
* Note: water, phytoplankton, and sediment were submitted for analysis at these locations in 2014.
Proposed Access Road
Lake
River
Bathymetry - Depth (m)
0 - 4
5 - 9
10 - 14
15 - 19
20 - 24
0 100 200 300 400 500
Metres
Projection: UTM Zone 14 NAD83
Data Sources:
Natural Resources Canada, GeoBase®
National Topographic Database
Agnico-Eagle Mines Limited.
Azimuth Consulting Group Inc.
Figure 1-4
Nemo Lake
Baseline Sampling Locations, 2014 & 2015
Whale Tail Pit Project
Prepared for:
AGNICO EAGLE
By:
CASLYS CONSULTING
December 21, 2015



Legend

2015 Sampling Locations
- Tributary Station
- Periphyton Station
- Sediment and Benthos Station
- Water and Zooplankton Station

2014 Sampling Locations
- Water, Sediment, and Benthos Station

* Note: water, phytoplankton, and sediment were submitted for analysis at these locations in 2014.

- Proposed Access Road
- Lake
- River

Bathymetry - Depth (m)
- 0 - 4
- 5 - 9
- 10 - 14
- 15 - 19
- 20 - 24

0 100 200 300 400 500
Metres

Projection: UTM Zone 14 NAD83

Data Sources:
Natural Resources Canada, GeoBase®
National Topographic Database
Agnico-Eagle Mines Limited.
Azimuth Consulting Group Inc.

Figure 1-5
Mammoth Lake
Baseline Sampling Locations, 2014 & 2015

Whale Tail Pit Project

Prepared for: AGNICO EAGLE

By: CASLYS CONSULTING

December 21, 2015

2. WATER QUALITY

2.1. Methods Overview

Baseline water quality sampling at Whale Tail Lake, Nemo Lake, and Mammoth Lake was completed by Portt and Associates in 2014 and Azimuth in 2015. Water samples were collected by Azimuth at the Sentinel stations along the proposed access road in 2015. Tributaries within the Whale Tail Pit Study Area were sampled by Golder in 2015. Water sampling at the Lake and Sentinel stations was conducted according to the SOP used for the Meadowbank CREMP program[1]. The collection method/SOP used by Golder for water sampling at the Tributary stations is included as **Appendix D** of this report.

2.1.1. Sample Collection

Lake Stations (2014)

Details on the sample collection and analysis plan for the 2014 baseline study can be found in the original report prepared by Portt and Associates (2015a). The water samples were collected according to methods outlined in the Azimuth SOP described below. *In-situ* water quality measurements (temperature, pH, DO, specific conductance, and turbidity) were recorded at 1 m depth intervals at 5 locations where benthic invertebrate sampling was conducted. Water samples were collected for chemistry at stations 1, 3, and 5 in each lake at a depth of 3 m, consistent with the Azimuth SOP.

Lake and Sentinel Stations (2015)

2015 baseline water quality sampling for the Lake stations and the Sentinel stations was carried out by Azimuth in July, August, and September. Reference areas INUG and PDL are routinely sampled as part of Meadowbank CREMP monitoring and are included in this baseline report for additional context where appropriate; samples were collected in July (by AEM), August (by Azimuth) and September (by AEM). The 2015 Lake sampling locations were pre-determined by bounding the sample areas and using a random number generator to select coordinates within those bounds. Coordinates were then recorded in MapSource (Garmin Ltd.) and in the hand-held GPS units (NAD 83) before going out into the field. Lake stations (two per basin per event) were sampled in areas with a minimum water depth of 5 m. In the event that the location associated with the random sampling coordinates was situated in less than 5 m of water, the station was relocated to the nearest appropriate location

As described in **Section 1.3.2.2**, the initial locations of the Sentinel stations were established based on existing information about the proposed access road route provided by Portt and Associates (2015b). Upon arriving in the general area of each Sentinel station, the sampling locations were chosen in areas downstream of the proposed road crossing, and if possible, downwind.

In situ water quality measurements (pH, temperature, dissolved oxygen, and specific conductance) were collected using a multi-parameter probe (YSI Pro Plus). At the Lake stations, profiles were collected at 1 m intervals to a depth of approximately 1 m above the sediment. Water samples for chemistry were collected at a depth of 3 m using a battery-operated pump and tubing system according to methods outlined in the SOP (Azimuth 2015b). The pump and tubing was flushed with water from the location for approximately 2 minutes prior to collecting a sample. Dissolved water samples were collected by attaching an in-line high capacity filter (0.45 µm; Pine Environmental) to the outlet tubing. Samples were

[1] Refer to the 2014 Meadowbank CREMP report (Azimuth 2015b) for details of the SOP.

kept cool while in the field and were preserved back at the camp. Chlorophyll-*a*[2] samples were processed at camp by filtering 500 mL of water using a hand-pump vacuum filter system and 0.45 µm filter. The filters were placed in 15 mL black tubes and stored frozen prior to shipping.

Tributary Stations (2015)

Tributaries in the Whale Tail Pit Study Area were sampled by Golder in August and September 2015. Details regarding the tributary sampling program were provided as a memorandum by Golder (**Appendix D** of this report). *In situ* water quality measurements were taken with an YSI Pro Plus from 16 stations in August and 11 stations in September. Water samples for chemistry were collected from 11 stations in August and 6 stations in September. The samples were collected by hand (i.e., grab samples) at a depth of 30 cm, if possible, or 10 cm at locations with lower water levels. Samples for dissolved parameters were filtered back at the camp using a hand-pump vacuum system (0.45 µm filter).

2.1.2. Laboratory Methods

All water samples were submitted to ALS (Burnaby, BC) for analysis. The samples were transported in coolers with ice packs and shipped to ALS at the earliest convenience to minimize the possibility of exceeding the recommended hold-times between collection and analysis. A complete list of parameters, detection limits, data quality objectives, and method references is present in Table 1 of the Water Sampling SOP (Azimuth 2015b).

2.1.3. Data Handling and Analysis

Water chemistry results from the 2014 baseline study were provided to Azimuth by Portt and Associates. Water chemistry data collected from the Lake, Sentinel, and Tributary stations were tabulated in Microsoft Excel and screened against the following criteria:

1. Freshwater aquatic life water quality guidelines (CCME 2015a).
2. Guidelines for Canadian Drinking Water Quality (Health Canada 2014). Health-based standards were given priority over aesthetic and operational guidelines. Standards for the following parameters are aesthetic and meant to protect against taste and odour: chloride, sulphate, copper, iron, manganese, sodium, zinc.

Lake water quality data were also compared against trigger and threshold values developed for the Meadowbank CREMP (Azimuth 2015a). These values were included in the screening to help put the baseline water quality data in context with screening values applied to the Meadowbank project lakes[3]. A brief description of the trigger and threshold values is provided below. For more information, refer to Azimuth (2015a, Appendix D).

- Thresholds are legal requirements, regulatory guidelines (e.g., CCME), or other discrete benchmarks, below which unacceptable adverse effects are not expected and above which adverse effects may occur. If effects-based thresholds do not exist for a particular variable, then early warning triggers (based on statistical criteria) were developed without thresholds.
- Triggers are considered "early warning" criteria and are typically more conservative (lower) than threshold values. They are intended to alert management to changes so that the situation can be assessed in advance of thresholds being exceeded.

[2] Chlorophyll-*a* results are discussed in the Phytoplankton section.

[3] Meadowbank project lakes are Third Portage Lake (North, South, and East basins), Second Portage Lake, and Tehek Lake.

2.2. Quality Assurance / Quality Control

2.2.1. QA/QC Methods

The objective of quality assurance / quality control (QA/QC) is to assure that the chemical data collected are representative of the material or populations being sampled, are of known quality, have sufficient laboratory precision to be highly repeatable, are properly documented, and are scientifically defensible. Data quality was assured throughout the collection and analysis of samples using specified standardized procedures, by the employment of laboratories that have been certified for all applicable methods, and by staffing the program with experienced technicians.

Laboratory QC

Data Quality Objectives (DQOs) are numerically definable measures of analytical precision, bias and completeness. Analytical precision is a measurement of the variability associated with duplicate analyses of the same sample in the laboratory. The laboratory duplicate is a new aliquot from the sample bottle/jar and is analyzed from the start in the same manner as the original aliquot taken from the bottle/jar. Bias refers to a systematic deviation from a known result. Certified Reference Materials (CRM), method blanks (MB), and matrix spikes (MS) are always included as part of routine laboratory QC to ensure that any bias is within the specified acceptable range. Results of the CRM, MB, and MS analyses are included in the laboratory data reports in **Appendix C**.

Field QA/QC

The standard QA/QC procedures include thoroughly flushing the flexible tubing and pump to prevent cross-contamination between areas and thoroughly rinsing the sample containers with site water prior to sample collection. Field QA procedures include collection and/or analysis of the following:

- Field Duplicates – An independent collection of water samples at the same time and location as the original, as a measure of consistency in sampling methodology and heterogeneity of chemical parameters at discrete locations. The number of field duplicates taken is approximately 10% of original samples.
- Travel Blanks – Laboratory supplied bottles of distilled water that are transported to site, carried back and forth into the field and returned to the laboratory, unopened, to test for inadvertent contamination during the transport and field sampling process.
- Equipment Blanks – Equipment blanks are included in the QA/QC program for samples collected according to the Azimuth SOP (Lake and Sentinel stations). At the beginning or end of a field sampling episode, after routine rinsing of the pump and tubing, distilled water is run through the equipment and placed in sampling bottles for analysis of a wide suite of parameters (e.g., metals, nutrients, and conventional parameters). This sample tests for possible cross-contamination of samples from the water sampling equipment (i.e., the pump and tubing).

Data Quality Objectives (DQOs)

Quality control results of the laboratory and field duplicates are assessed by measuring the relative percent difference (RPD) between original and duplicate measurements as measure of precision by the laboratory and the magnitude of variability between original and field duplicate samples, respectively. The equation used to calculate a RPD is:

$$RPD = \frac{(A - B)}{(\frac{A + B}{2})} x\ 100$$

where: A = analytical result; B = duplicate result[4].

Laboratory duplicate DQOs are parameter-specific and depend on the concentration in the sample. For most parameters including metals, anions, and nutrients, the DQO is an RPD of less than 20% when the concentration is greater than 10-times the MDL. For parameters with concentrations less than 10-times the MDL, the DQO is a difference in concentration between the original and duplicate samples of less than 2-times the MDL. The DQOs for field duplicates is RPDs less than 50% when concentrations exceed 10-times the MDL. RPD values may be either positive or negative, and ideally should provide a mix of the two, clustered around zero. RPDs are not calculated for cases where one of the samples (i.e., either A or B above) is below detection and the other is not.

Results from both the equipment and travel blanks are examined for detectable concentrations of any of the parameters measured; no parameter in either blank should exceed laboratory method detection limits (MDLs). If an analyte is detected in a blank, the results for the batch of samples submitted with the blank are compared with the measured concentration in the blank; results that are less than 5-times the detected analyte concentration in the equipment blank are flagged to examine the potential for cross-contamination to affect the results[5]. Results carried forward in the QA/QC assessment are given either a cautionary flag or an unreliable flag. Cautionary flags are applied to sample results if the analyte was detected in the blank, but the effect of potential cross-contamination is considered minor (e.g., the concentration in the equipment blank is a small percentage of the concentration in the samples). Unreliable data flags are applied to water quality results that are anomalous or unrepresentative of the water quality (e.g., elevated metals concentrations in a sample that are not observed in other replicate sample(s) collected during the same event). The "cautionary" and "unreliable" data flags are provided for clarity on which results should be excluded from decision making.

2.2.2. QA/QC Results

Detailed results of the water quality QA/QC assessment are provided in **Appendix A1**. A summary of the laboratory QC and field QA/QC results are provided below.

Laboratory QC

The QC results provided by ALS were within the DQOs for the MB, CRM, MS, and laboratory duplicates for the majority of the water quality analyses in 2015. There were a few isolated instances of elevated MDLs due to sample matrix effects and method blanks that were slightly above detection. Despite the DQOs not being met, ALS's concluded the data were reliable.

Field QA/QC

No data quality issues were reported in the QA/QC assessment of the field duplicate samples and travel blanks for the 2014 and 2015 baseline studies. The equipment blanks submitted for Lake samples in 2014 and Lake and Sentinel stations in 2015 had a few parameters that were occasionally detected above the MDL, namely aluminum, barium, lead, and manganese. Lake and Sentinel station samples that were submitted with equipment blanks that had metals concentrations above the MDL were flagged to assess the reliability of the results. The barium and manganese results were considered reliable in spite of detectable concentrations in some of the equipment blanks because the concentrations represent a small percentage of the concentrations in the Lake and Sentinel station samples (**Appendix A1**, **Section A1-1**). Cautionary flags were applied to some of the aluminum data from samples that were submitted with

[4] RPD values are not calculated when one of the analytical results is below the MDL.

[5] This approach is consistent with how ALS flags unreliable results for the laboratory method blanks.

equipment blanks in September 2014 (dissolved), July 2015 (dissolved), and August 2015 (total), specifically, samples where the dissolved and total aluminum concentrations were less than 5-times the detected concentration in the equipment blank. Total lead was detected in the September 2014 equipment blank, and all three equipment blanks submitted in 2015; however, the majority of the Lake and Sentinel station samples were below the MDL (**Table 2ï1** [2014 Lake stations], **Table 2ï2** [2015 Lake stations], **Table 2ï3** [2015 Sentinel stations]). The few detected concentrations of lead in the Lake and Sentinel station samples from 2014 and 2015 were considered unreliable based on the QA/QC assessment. A few other anomalous results were flagged as unreliable in **Section A1-1**, and were not included in the discussion of the water quality results below.

2.3. Results

2.3.1. Lake Stations

Locations of the 2014 and 2015 baseline water quality stations and bathymetry are shown in **Figure 1ï3** (Whale Tail Lake), **Figure 1ï4** (Nemo Lake), and **Figure 1ï5** (Mammoth Lake). An overview of the water quality monitoring stations sampled at INUG and PDL in are shown in **Figure 1ï1**.

Field Measurements

Field-collected data from the water quality stations are presented in **Appendix B**. *In-situ* water quality depth profiles from the 2014 and 2015 Lake stations are provided in **Table B1ï1** and **Table B2ï1**, respectively.

Water temperatures were between 9°C and 12°C during the summer months in 2014 and 2015 (July to early September). Some minor thermal stratification was noted at a few of the deeper locations (> 9 m) in the July 2015 sampling event (i.e., shortly after ice-off), but the difference in temperature was less than 4°C. For the majority of the open-water season, wind maintains uniform temperature and high oxygen profiles in the water column in all lakes due to vertical mixing. Whale Tail, Nemo, and Mammoth Lakes are shallow oligotrophic lakes with low concentrations of dissolved solids and major ions as evidenced by specific conductance measuring at or below 25 µS/cm. Conductivity was uniform throughout the water column at all stations sampled during the open water season and consistent with results collected during the 2014 survey (Portt and Associates 2015a).

Chemistry

Water chemistry data from the 2014 and 2015 baseline studies are presented in **Table 2ï1** and **Table 2ï2**, respectively. The 2014 data presented in **Table 2ï1** were adapted from Portt and Associates (2015a). ALS laboratory reports for the 2015 baseline study are included in **Appendix C** of this document. Chlorophyll-*a* results are discussed in **Section 4.3** along with the phytoplankton taxonomy and biomass results.

Surface water collected during the open water season was soft, measuring less than 10 mg/L (as $CaCO_3$) at all of the sampling stations. The buffering capacity of the surface water is also quite low as evidenced by alkalinity concentrations (as bicarbonate) of approximately 5 mg/L, characteristic of low productivity headwater lakes in the Arctic. Consistent with the low turbidity and high Secchi depth results, TSS levels were at or below detection for all Lake samples (**Table 2ï1**, and **Table 2ï2**).

The majority of the chemistry parameters were below their respective MDLs for the samples collected in 2014 and 2015, including cyanides (free and total), most metals (total and dissolved fractions), nitrates and nitrites, and ammonia (as N) to name a few. Importantly, there were no exceedances of the

GCDWQs or the CCME freshwater aquatic life criteria in the Lake samples collected in 2014 and 2015[6]. There were a few instances of parameters exceeding the Meadowbank trigger values, particularly at Nemo Lake in 2014 and 2015 and Mammoth Lake in 2015, namely conductivity, hardness, calcium, magnesium, and potassium. However, triggers for all those parameters were based on baseline/reference data from the Meadowbank project lakes and are shown for context only. Overall, the water quality results from the Lakes were similar to results from the reference areas in 2015.

2.3.2. Sentinel Stations

Field Measurements

Field measured water quality parameters are presented in **Table B3ï1**. *In-situ* water quality measurements from the Sentinel stations were overall quite similar to the field measurements reported for the Lake stations. Conductivity was below 25 µS/cm, the dissolved oxygen concentrations were high, and pH was circumneutral (6.78 to 7.36) at all of the Sentinel stations in 2015.

Chemistry

Results of the water chemistry analyses for the Sentinel stations are presented in **Table 2ï3**. The ALS laboratory reports are included in **Appendix C**.

Water chemistry results were generally quite similar between the Lake and Sentinel station samples. There were three instances in September where total phosphorus was measured above the CCME aquatic life guideline of 0.004 mg/L (C14, C20, and C41). The elevated phosphorus at C14 and C41 may be related to detectable TSS in the sample (all other Sentinel station samples had TSS below the DL). A few results were also flagged because of detectable concentrations in the equipment blank, dissolved analyses that were detected when the total concentration was less than the MDL, or TSS-related issues. Refer to **Section A1-1.2** for more information on the data that were flagged when interpreting the water chemistry at the Sentinel stations.

2.3.3. Tributary Stations

Field Measurements

In-situ water quality results were provided to Azimuth by Golder and are attached as **Appendix D** of this report. August water temperatures in the Tributaries were between 12.6°C and 17.2°C. September temperatures were below 6°C, and depth was recorded as less than 30 cm at the 11 stations. Dissolved oxygen saturation levels were high (>95%) at all locations sampled in August and September, corresponding to DO concentrations above 9.5 mg/L at most locations. pH in August ranged between slight acidic (6.23) to neutral (7.02), while the September samples were neutral (7.08) to slightly alkaline (8.04). It's unclear whether the difference in pH is an artifact of the variability in the instrument or actual seasonal difference in pH. By comparison, pH measurements taken at the Sentinel stations in August and September were circumneutral, with little temporal variability (August = 7.19 ± 0.24; September = 6.96 ± 0.05).

[6] Rep-1 from Whale Tail exceeds the CCME aquatic life guideline for lead, but the result was flagged as unreliable in the QA/QC assessment (see **Section A1-1.1**).

Chemistry

Water chemistry results for the Tributary stations are presented in **Table 2ï4**. Concentrations of metals, major ions, and nutrients were largely below the aquatic life and human health screening criteria, with the exception of the following:

- Total aluminum concentrations exceeded the CCME aquatic life criteria at A55-A17 (stream to the east of Whale Tail Lake) and A5-A4 (6 km NW of the camp) in August and A55-A17 in September. The August samples had pH values below 6.5, triggering the application of the more sensitive WQG for aluminum of 0.005 mg/L. As noted above, it is unclear if the lower pH values seen in August are real or the result of measurement error. The September exceedance coincided with elevated TSS in the sample and is not considered a reliable measurement (see below).
- Elevated TSS (11 mg/L) was noted in sample A55-A17 that also had exceedances of the WQG for aluminum (CCME), chromium (CCME), and iron (CCME and GCWQG). The elevated TSS concentration is likely an artifact of sample collection and the WQG exceedance are not considered reflective of September water quality at these locations. A few other metals, including lead, molybdenum, vanadium, and zinc were detected in the total fraction that were below the MDL for all other locations. The metals concentrations from this sample should be interpreted cautiously in light of the effect of high TSS.

Table 2-1. Water chemistry data for the Lake stations, Whale Tail Pit Baseline, 2014.

Lake					Whale Tail Lake			Nemo Lake			Mammoth Lake		
Station	**Aquatic Life Guidelines**	**Human Health Guidelines**	**Trigger[3]**	**Threshold[3]**	IVR-WHALE-REP-1	IVR-WHALE-REP-3	IVR-WHALE-REP-5	IVR-NEMO-REP-1	IVR-NEMO-REP-3	IVR-NEMO-REP-5	IVR-LAKE3-REP-1	IVR-LAKE3-REP-3	IVR-LAKE3-REP-5
Area-Replicate ID					3	3	3	3	3	3	3	3	3
Depth (m)													
Date	**CCME[1]**	**GCDWQ[2]**	**Meadowbank**		5-Sep-14	5-Sep-14	4-Sep-14	6-Sep-14	6-Sep-14	6-Sep-14	4-Sep-14	4-Sep-14	4-Sep-14
Field Measurements (Surface)													
Temperature (°C)					9.3	9.4	9.2	9.2	9.3	9.4	9.3	9.4	9.2
Specific Conductivity (µS/cm)					21.8	17.3	17.4	25.1	25.1	25.0	21.6	20.9	20.8
Dissolved Oxygen (mg/L)					11.6	11.5	11.4	11.5	11.4	11.4	11.5	11.7	11.2
pH	6.5 - 9.0		6.5 - 7.94	6.5 - 9.0	7.30	7.02	7.12	7.32	7.09	7.29	7.59	7.00	7.04
Physical Tests (mg/L)													
Conductivity (µS/cm)			23.5		21	17	17	**25**	**25**	**25**	23	20	20
Hardness			8.5		8.2	6.7	6.6	**9.3**	**10.0**	**10.0**	8.1	8.0	8.0
pH (Laboratory)	6.5 - 9.0		6.50 - 7.94	6.5 - 9.0	6.99	6.91	6.92	7.11	7.11	7.11	7.17	6.83	7.14
Total Suspended Solids			3.0	5.0	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	1	*<1.0*
Total Dissolved Solids			18.0		**20**	14	**21**	**22**	**20**	**21**	**21**	**22**	17
Turbidity (NTU)					0.38	0.40	0.39	0.28	0.28	0.25	0.49	0.40	0.42
Anions and Nutrients (mg/L)													
Alkalinity - Bicarbonate			8.6		5.5	4.7	4.7	7.1	7.0	6.9	5.8	4.4	5.7
Alkalinity - Carbonate			4		*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Alkalinity - Hydroxide					*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Alkalinity - Total			8.5		5.5	4.7	4.7	7.1	7.0	6.9	5.8	4.4	5.7
Ammonia (as N)[4]	***equation***		0.065	0.126	*<0.0050*	**0.10**	0.02	*<0.0050*	0.01	*<0.0050*	0.03	0.03	0.03
Bromide					*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*
Chloride	120	250	60.28	120	0.93	0.72	0.73	0.55	0.55	0.55	0.86	0.69	0.69
Fluoride	0.120	1.5			0.034	0.031	0.033	0.026	0.026	0.027	0.033	0.032	0.032
Nitrate (as N)	3.0	10	1.50	3	*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*
Nitrite (as N)	0.060	1	0.031	0.060	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*
Total Kjeldahl Nitrogen			0.170										
Ortho Phosphate (as P)			0.002		0.0018	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	0.0013	0.0013	*<0.0010*
Phosphorus (P)-Total Diss.					*<0.0020*	*<0.0020*	*<0.0020*	*<0.0020*	*<0.0020*	*<0.0020*	*<0.0020*	*<0.0020*	0.0021
Phosphorus (P)-Total	0.0040		0.0060	0.004	*<0.0020*	***0.0833***	*<0.0020*	0.0030	*<0.0020*	*<0.0020*	*<0.0020*	*<0.0020*	*<0.0020*
Silicate (as SiO_2)			1.0		*<0.50*	*<0.50*	*<0.50*	*<0.50*	*<0.50*	*<0.50*	0.64	*<0.50*	0.51
Sulphate (SO_4)		500	64.71	128	2.59	1.61	1.64	3.30	3.30	3.29	2.88	2.84	2.83
Cyanides													
Total Cyanide					*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*
Free Cyanide					*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*
Organic / Inorganic Carbon (mg/L)													
Dissolved Organic Carbon			2.6		***2.8***	***2.4***	***2.8***	***2.2***	***2.1***	***2.1***	***2.6***	***2.3***	***2.2***
Total Organic Carbon			2.8		2.6	2.7	2.6	1.9	1.9	2.0	2.3	2.1	1.9
Plant Pigments (µg/L)													
Chlorophyll-*a*					0.29	0.38	0.55	0.25	0.27	0.25	0.34	0.36	0.34
Total Metals (mg/L)													
Aluminum[4]	***equation***		0.054	0.100	0.0120	0.0165	0.0155	0.0046	0.0055	0.0072	0.0157	0.0106	0.0095
Antimony		0.006	0.0101	0.020	0.00	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Arsenic	0.0050	0.01	0.00255	0.005	0.0003	0.0002	0.0002	0.0003	0.0003	0.0003	0.0005	0.0005	0.0004
Barium		1	0.50	1	0.0034	0.0030	0.0027	0.0037	0.0038	0.0038	0.0035	0.0035	0.0035
Beryllium			0.0027	0.0053	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Bismuth					*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*
Boron	1.5	5	0.76	1.5	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*
Cadmium[4]	***equation***	0.005	0.000025	0.000040	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*
Calcium			2.15		2.05	1.56	1.47	**2.29**	**2.28**	**2.35**	1.92	1.89	1.91
Chromium[5]	0.001	0.05	0.00056	0.001	0.0001	0.0001	0.0001	*<0.00010*	0.0002	0.0001	0.0002	0.0001	0.0001
Cobalt					*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Copper[3]	***equation***	1	0.00124	0.002	0.0006	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	0.0005	0.0006	*<0.00050*
Iron	0.3	0.3	0.155	0.3	0.033	0.037	0.032	*<0.010*	0.012	0.014	0.031	0.022	0.021
Lead[3]	***equation***	0.01	0.000525	0.001	***0.00686***	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	~~0.00007~~	*<0.000050*
Lithium			0.048	0.096	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*
Magnesium			0.83		0.79	0.72	0.68	**1.07**	**1.06**	**1.07**	0.78	0.73	0.74
Manganese[4]		0.05	0.3157	***equation***	0.0034	0.0016	0.0015	0.0020	0.0022	0.0023	0.0015	0.0014	0.0014
Mercury	0.000026	0.001	0.000018	0.000026	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*
Molybdenum	0.073		0.0365	0.073	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*
Nickel[4]	***equation***		0.0127	0.025	0.0007	*<0.00050*	*<0.00050*	*<0.00050*	0.0005	0.0005	0.0007	0.0005	0.0005
Phosphorus					*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*
Potassium			0.50		0.44	0.40	0.36	**0.58**	**0.57**	**0.58**	0.48	0.48	**0.53**
Selenium	0.001	0.01	0.00055	0.001	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Silicon					0.31	0.31	0.31	0.21	0.21	0.23	0.38	0.32	0.32

Table 2-1. Water chemistry data for the Lake stations, Whale Tail Pit Baseline, 2014.

Lake					Whale Tail Lake			Nemo Lake			Mammoth Lake		
Station	**Aquatic Life Guidelines**	**Human Health Guidelines**	**Trigger[3]**	**Threshold[3]**	IVR-WHALE-REP-1	IVR-WHALE-REP-3	IVR-WHALE-REP-5	IVR-NEMO-REP-1	IVR-NEMO-REP-3	IVR-NEMO-REP-5	IVR-LAKE3-REP-1	IVR-LAKE3-REP-3	IVR-LAKE3-REP-5
Area-Replicate ID					3	3	3	3	3	3	3	3	3
Depth (m)					5-Sep-14	5-Sep-14	4-Sep-14	6-Sep-14	6-Sep-14	6-Sep-14	4-Sep-14	4-Sep-14	4-Sep-14
Date	**CCME[1]**	**GCDWQ[2]**	**Meadowbank**										
Silver	0.0001				*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*
Sodium		200	0.975		0.53	0.55	0.52	0.47	0.49	0.48	0.51	0.50	0.50
Strontium			0.0279	0.049	0.0090	0.0076	0.0071	0.0098	0.0098	0.0099	0.0081	0.0077	0.0078
Sulfur					0.91	0.61	0.56	1.15	1.14	1.12	0.95	0.94	0.96
Thallium	0.0008		0.00041	0.0008	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*
Tin			0.0002		*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Titanium			1.00	2	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*
Uranium	0.015	0.02	0.0075	0.015	0.000034	0.000039	0.000039	*<0.000010*	*<0.000010*	0.000010	0.000032	0.000026	0.000024
Vanadium			0.0035	0.006	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*
Zinc[4]	0.030	0.5	0.0063	***equation***	*<0.0030*	*<0.0030*	*<0.0030*	*<0.0030*	*<0.0030*	*<0.0030*	*<0.0030*	*<0.0030*	*<0.0030*
Dissolved Metals (mg/L)													
Aluminum[4]			0.0263	0.05	~~0.0079~~	~~0.0087~~	0.0106	~~0.0050~~	~~0.0033~~	~~0.0047~~	0.0101	~~0.0057~~	~~0.0060~~
Antimony			0.0101	0.020	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Arsenic			0.0026	0.005	0.0003	0.0002	0.0002	0.0003	0.0003	0.0003	0.0005	0.0004	0.0004
Barium			0.5010	1	0.0033	0.0027	0.0027	0.0037	0.0037	0.0037	0.0035	0.0035	0.0035
Beryllium			0.0027	0.0053	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Bismuth					*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*
Boron			0.76	1.5	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*
Cadmium			0.000025	0.00004	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*
Calcium					1.99	1.52	1.50	2.14	2.26	2.27	1.96	1.96	1.94
Chromium			0.00055	0.001	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Cobalt					*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Copper			0.00119	0.002	0.00040	0.00037	0.00039	0.00024	0.00024	0.00023	0.00050	0.00042	0.00039
Iron			0.155	0.3	0.02	0.02	0.02	*<0.010*	*<0.010*	*<0.010*	0.02	0.01	0.01
Lead			0.000525	0.001	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*
Lithium			0.048	0.096	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*
Magnesium					0.78	0.69	0.68	0.97	1.05	1.06	0.79	0.76	0.76
Manganese[4]			0.315	***equation***	0.0027	0.0011	0.0011	0.0012	0.0011	0.0016	0.0011	0.0010	0.0010
Mercury			0.000018	0.000026	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*
Molybdenum			0.037	0.073	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*
Nickel			0.013	0.025	0.0006	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	0.0006	*<0.00050*	*<0.00050*
Phosphorus					*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*
Potassium					0.44	0.36	0.36	0.50	0.55	0.60	0.49	0.51	0.53
Selenium			0.00055	0.001	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Silicon					0.30	0.31	0.31	0.19	0.22	0.21	0.37	0.33	0.33
Silver					*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*
Sodium					0.52	0.53	0.53	0.48	0.47	0.47	0.52	0.50	0.50
Strontium			0.028	0.049	0.0086	0.0070	0.0070	0.0095	0.0095	0.0095	0.0079	0.0076	0.0075
Sulfur					0.91	0.58	0.57	1.18	1.12	1.09	0.97	1.02	0.93
Thallium			0.00041	0.0008	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*
Tin			0.0002		*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Titanium			1.01	2	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*
Uranium			0.0075	0.015	0.00003	0.00004	0.00003	0.00001	*<0.000010*	*<0.000010*	0.00003	0.00002	0.00002
Vanadium			0.0035	0.006	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*
Zinc[4]			0.0053	***equation***	*<0.0010*	*<0.0010*	*<0.0010*	0.001	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*

Notes:

Data presented here were adapted from Portt and Associates (2015a).

[1] CCME (Canadian Council of Ministers of the Environment) Canadian Water Quality Guidelines for the Protection of Aquatic Life, 1999, updated up to 2015.

[2] Guidelines for Canadian Drinking Water Quality (Federal-Provincial-Territorial Committee on Health and the Environment). Standards for the following parameters are aesthetic and meant to protect against taste and odour: chloride, sulphate, copper, iron, manganese, sodium, zinc.

[3] Trigger and threshold values are presented in "CREMP 2015 Plan Update" (Azimuth 2015a).

A number of thresholds were derived from methods (or sources) other than CCME guidelines - see Azimuth (2015a) for details.

[4] "***equation*** " means that CCME guidelines (or thresholds) are calculated based on an equation which is either pH or hardness dependent. The ammonia and aluminum (t & d) guidelines vary with pH; the cadmium, copper, lead, manganese, nickel and zinc guidelines vary with hardness.

[5] Chromium CCME guideline is for Cr VI.

123	Shaded concentrations exceed the CCME aquatic life guidelines.
123	Bordered concentrations exceed the GCDWQ.
123	Bolded concentrations exceed the trigger value.
123	Bold, italicized concentrations exceed the threshold value.

Italicized numbers are below detection limits.

"-" not collected.

~~strikethrough~~ = results flagged as unreliable in the QC assessement (see Section 2.2.1. for more details).

Table 2-2. Water chemistry data for the Lake stations, Whale Tail Pit Baseline, 2015.

Lake					Whale Tail Lake											
Station	Aquatic Life Guidelines	Human Health Guidelines	Trigger[3]	Threshold[3]	North Basin (WTN)						South Basin (WTS)					
Area-Replicate ID					WTN-01-S	WTN-02-S	WTN-03-S	WTN-04-S	WTN-05-S	WTN-06-S	WTS-01-S	WTS-02-S	WTS-03-S	WTS-04-S	WTS-05-S	WTS-06-S
Depth (m)					3	3	3	3	3	3	3	3	3	3	3	3
Date	CCME[1]	GCDWQ[2]	Meadowbank		17-Jul-15	17-Jul-15	20-Aug-15	20-Aug-15	18-Sep-15	18-Sep-15	17-Jul-15	17-Jul-15	21-Aug-15	21-Aug-15	18-Sep-15	18-Sep-15
Field Measurements (Surface)																
Temperature (°C)					10.1	9.2	11.4	11.3	4.8	4.9	9.1	7.7	10.8	10.8	4.9	4.9
Specific Conductivity (µS/cm)					19.2	15.8	17.1	18.2	23.5	20.4	15.3	15.2	17	17.1	19.8	19.8
Dissolved Oxygen (mg/L)					11.3	11.4	10.5	10.1	12.2	11.2	11.4	11.7	10.3	10.3	13.1	12.1
pH	6.5 - 9.0		6.5 - 7.94	6.5 - 9.0	6.81	6.85	7.03	6.99	6.81	6.82	6.85	6.79	6.77	6.84	6.59	6.76
Physical Tests (mg/L)																
Conductivity (µS/cm)			23.5		20	17	19	20	**25**	22	16	16	19	19	20	21
Hardness			8.5		7.3	6.2	6.7	7.2	**8.6**	7.8	5.9	5.8	6.7	6.7	7.3	7.3
pH (Laboratory)	6.5 - 9.0		6.50 - 7.94	6.5 - 9.0	6.83	6.81	6.83	6.82	6.81	6.75	6.78	6.78	6.66	6.74	6.75	6.76
Total Suspended Solids			3.0	5.0	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Total Dissolved Solids			18.0		16	13	14	13	18	18	13	14	12	15	16	16
Turbidity (NTU)					0.42	0.39	0.23	0.28	0.32	0.35	0.43	0.35	0.26	0.23	0.34	0.35
Anions and Nutrients (mg/L)																
Alkalinity - Bicarbonate			8.6		4.5	4.2	4.9	3.9	5.3	4.6	4.2	4.2	4.5	3.8	4.4	4.3
Alkalinity - Carbonate			4		*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Alkalinity - Hydroxide					*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Alkalinity - Total			8.5		4.5	4.2	4.9	3.9	5.3	4.6	4.2	4.2	4.5	3.8	4.4	4.3
Ammonia (as N)[4]	***equation***		0.065	0.126	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*
Bromide					*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Chloride	120	250	60.28	120	1.94	1.22	1.57	1.84	2.99	2.38	1.06	1.06	1.57	1.58	2.11	2.10
Fluoride	0.120	1.5			0.022	0.025	0.025	0.025	0.026	0.026	0.023	0.025	0.024	0.024	0.026	0.026
Nitrate (as N)	3.0	10	1.50	3	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*
Nitrite (as N)	0.060	1	0.031	0.060	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Total Kjeldahl Nitrogen			0.170		**0.173**	0.137	0.109	0.107	0.116	0.118	0.140	0.143	0.128	0.111	0.120	0.129
Ortho Phosphate (as P)			0.002		*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Phosphorus (P)-Total Diss.					*<0.002*	*<0.002*	0.0025	0.0028	*<0.002*	*<0.002*	*<0.002*	0.0020	0.0024	0.0022	*<0.002*	*<0.002*
Phosphorus (P)-Total	0.0040		0.0060	0.004	0.0020	0.0028	*<0.002*	0.0023	*<0.002*	0.0031	0.0025	0.0024	*<0.002*	0.0028	0.0023	*<0.002*
Silicate (as SiO_2)			1.0		0.56	0.57	0.56	0.57	0.69	0.67	0.54	0.54	0.59	0.60	0.68	0.65
Sulphate (SO_4)		500	64.71	128	1.39	1.24	1.31	1.37	1.49	1.37	1.20	1.22	1.30	1.31	1.32	1.32
Cyanides																
Total Cyanide					*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Free Cyanide					*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Organic / Inorganic Carbon (mg/L)																
Dissolved Organic Carbon			2.6		2.2	2.1	1.7	2.1	1.8	1.7	2.0	2.0	1.9	1.9	1.7	1.8
Total Organic Carbon			2.8		2.3	2.1	1.7	1.8	1.7	1.8	2.2	2.0	1.7	1.7	1.8	1.7
Plant Pigments (µg/L)																
Chlorophyll-*a*					0.32	0.25	0.65	0.70	0.77	0.93	0.28	0.28	0.67	0.64	0.82	0.88
Total Metals (mg/L)																
Aluminum[4]	***equation***		0.054	0.100	0.0215	0.0176	~~0.0083~~	~~0.0099~~	0.0116	0.0120	0.0172	0.0170	~~0.0094~~	~~0.0077~~	0.0107	0.0111
Antimony		0.006	0.0101	0.020	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Arsenic	0.0050	0.01	0.00255	0.005	0.0002	0.0001	0.0002	0.0002	0.0002	0.0002	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002
Barium		1	0.50	1	0.0044	0.0034	0.0033	0.0035	0.0041	0.0037	0.0034	0.0033	0.0032	0.0033	0.0035	0.0035
Beryllium			0.0027	0.0053	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*
Bismuth					*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Boron	1.5	5	0.76	1.5	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*

Table 2-2. Water chemistry data for the Lake stations, Whale Tail Pit Baseline, 2015.

Lake					Whale Tail Lake											
Station					North Basin (WTN)						South Basin (WTS)					
Area-Replicate ID	Aquatic Life Guidelines	Human Health Guidelines	Trigger[3]	Threshold[3]	WTN-01-S	WTN-02-S	WTN-03-S	WTN-04-S	WTN-05-S	WTN-06-S	WTS-01-S	WTS-02-S	WTS-03-S	WTS-04-S	WTS-05-S	WTS-06-S
Depth (m)	CCME[1]	GCDWQ[2]	Meadowbank		3	3	3	3	3	3	3	3	3	3	3	3
Date					17-Jul-15	17-Jul-15	20-Aug-15	20-Aug-15	18-Sep-15	18-Sep-15	17-Jul-15	17-Jul-15	21-Aug-15	21-Aug-15	18-Sep-15	18-Sep-15
Cadmium[4]	***equation***	0.005	0.000025	0.000040	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Calcium			2.15		1.87	1.44	1.64	1.77	**2.15**	1.95	1.39	1.37	1.62	1.63	1.77	1.78
Chromium[5]	0.001	0.05	0.00056	0.001	0.0001	0.0001	*<0.0001*	0.0001	0.0001	0.0001	0.0001	*<0.0001*	*<0.0001*	0.0001	0.0001	0.0001
Cobalt					*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Copper[3]	***equation***	1	0.00124	0.002	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*
Iron	0.3	0.3	0.155	0.3	0.036	0.037	0.016	0.019	0.021	0.024	0.037	0.037	0.020	0.017	0.024	0.022
Lead[3]	***equation***	0.01	0.000525	0.001	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Lithium			0.048	0.096	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Magnesium			0.83		0.63	0.59	0.64	0.65	0.71	0.70	0.57	0.56	0.62	0.62	0.66	0.66
Manganese[4]		0.05	0.3157	***equation***	0.0064	0.0049	0.0020	0.0026	0.0037	0.0029	0.0049	0.0052	0.0021	0.0020	0.0026	0.0025
Mercury	0.000026	0.001	0.000018	0.000026	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Molybdenum	0.073		0.0365	0.073	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	0.0001	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Nickel[4]	***equation***		0.0127	0.025	0.0009	0.0007	0.0006	0.0006	0.0006	0.0006	0.0007	0.0007	0.0005	0.0005	0.0005	0.0005
Phosphorus					*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Potassium			0.50		0.38	0.32	0.39	0.37	0.39	0.38	0.33	0.33	0.37	0.36	0.37	0.36
Selenium	0.001	0.01	0.00055	0.001	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Silicon					0.31	0.31	0.25	0.27	0.25	0.26	0.30	0.31	0.26	0.26	0.26	0.26
Silver	0.0001				*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Sodium		200	0.975		0.51	0.47	0.50	0.49	0.53	0.55	0.49	0.47	0.52	0.51	0.53	0.54
Strontium			0.0279	0.049	0.0131	0.0087	0.0099	0.0111	0.0145	0.0128	0.0080	0.0078	0.0099	0.0102	0.0113	0.0115
Sulfur					0.50	*<0.5*	0.50	*<0.5*	0.54	0.53	*<0.5*	*<0.5*	0.52	0.50	*<0.5*	0.50
Thallium	0.0008		0.00041	0.0008	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Tin			0.0002		*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Titanium			1.00	2	0.00038	0.00030	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*
Uranium	0.015	0.02	0.0075	0.015	0.000045	0.000045	0.000037	0.000035	0.000032	0.000035	0.000047	0.000043	0.000037	0.000036	0.000035	0.000035
Vanadium			0.0035	0.006	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*
Zinc[4]	0.030	0.5	0.0063	***equation***	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*
Zirconium					*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*
Dissolved Metals (mg/L)																
Aluminum[4]			0.0263	0.05	0.0081	0.0085	0.0045	0.0048	0.0035	0.0038	0.0110	0.0120	0.0061	0.0053	0.0033	0.0033
Antimony			0.0101	0.020	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Arsenic			0.0026	0.005	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002	0.0001	0.0001	0.0002	0.0002	0.0001	0.0001
Barium			0.5010	1	0.0042	0.0034	0.0032	0.0035	0.0042	0.0037	0.0033	0.0033	0.0032	0.0033	0.0034	0.0034
Beryllium			0.0027	0.0053	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	0.00	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*
Bismuth					*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Boron			0.76	1.5	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Cadmium			0.000025	0.00004	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Calcium					1.89	1.48	1.65	1.80	2.24	1.96	1.42	1.39	1.62	1.63	1.82	1.82
Chromium			0.00055	0.001	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Cobalt					*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Copper			0.00119	0.002	**0.00170**	0.00035	0.00037	0.00037	0.00034	0.0003	0.00031	0.00034	0.00036	0.00034	0.00033	0.00031
Iron			0.155	0.3	*<0.01*	0.10	*<0.01*	*<0.01*	*<0.01*	*<0.01*	0.02	0.02	0.01	0.01	*<0.01*	*<0.01*
Lead			0.000525	0.001	~~0.00010~~	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	~~0.00008~~	*<0.00005*	*<0.00005*	~~0.00005~~	*<0.00005*
Lithium			0.048	0.096	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Magnesium					0.64	0.60	0.63	0.66	0.74	0.70	0.57	0.56	0.63	0.63	0.67	0.67
Manganese[4]			0.315	***equation***	0.0045	0.0043	0.0006	0.0013	0.0014	0.0008	0.0038	0.0042	0.0012	0.0014	0.0006	0.0007
Mercury			0.000018	0.000026	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Molybdenum			0.037	0.073	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*

Table 2-2. Water chemistry data for the Lake stations, Whale Tail Pit Baseline, 2015.

Lake					Whale Tail Lake											
Station					North Basin (WTN)						South Basin (WTS)					
Area-Replicate ID	Aquatic Life Guidelines	Human Health Guidelines	Trigger[3]	Threshold[3]	WTN-01-S	WTN-02-S	WTN-03-S	WTN-04-S	WTN-05-S	WTN-06-S	WTS-01-S	WTS-02-S	WTS-03-S	WTS-04-S	WTS-05-S	WTS-06-S
Depth (m)					3	3	3	3	3	3	3	3	3	3	3	3
Date	CCME[1]	GCDWQ[2]	Meadowbank		17-Jul-15	17-Jul-15	20-Aug-15	20-Aug-15	18-Sep-15	18-Sep-15	17-Jul-15	17-Jul-15	21-Aug-15	21-Aug-15	18-Sep-15	18-Sep-15
Nickel			0.013	0.025	0.0008	0.0007	*<0.0005*	0.0005	0.0006	0.0005	0.0007	0.0007	*<0.0005*	0.0005	*<0.0005*	*<0.0005*
Phosphorus					*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Potassium					0.38	0.34	0.38	0.37	0.41	0.39	0.35	0.31	0.37	0.36	0.36	0.37
Selenium			0.00055	0.001	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Silicon					0.29	0.29	0.25	0.26	0.25	0.25	0.30	0.30	0.25	0.25	0.24	0.24
Silver					*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Sodium					0.49	0.48	0.50	0.50	0.53	0.53	0.47	0.46	0.51	0.50	0.52	0.52
Strontium			0.028	0.049	0.0128	0.0086	0.0097	0.0110	0.0150	0.0128	0.0078	0.0077	0.0096	0.0098	0.0116	0.0115
Sulfur					*<0.5*	*<0.5*	*<0.5*	*<0.5*	0.53	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*
Thallium			0.00041	0.0008	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Tin			0.0002		*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Titanium			1.01	2	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*
Uranium			0.0075	0.015	0.00004	0.00004	0.00003	0.00003	0.00003	0.00003	0.00004	0.00004	0.00003	0.00003	0.00003	0.00003
Vanadium			0.0035	0.006	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*
Zinc[4]			0.0053	***equation***	0.002	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Zirconium					*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*

Notes:

[1] CCME (Canadian Council of Ministers of the Environment) Canadian Water Quality Guidelines for the Protection of Aquatic Life, 1999, updated up to 2015.

[2] Guidelines for Canadian Drinking Water Quality (Federal-Provincial-Territorial Committee on Health and the Environment). Standards for the following parameters are aesthetic and meant to protect against taste and odour: chloride, sulphate, copper, iron, manganese, sodium, zinc.

[3] Trigger and threshold values are presented in "CREMP 2015 Plan Update" (Azimuth 2015a).
A number of thresholds were derived from methods (or sources) other than CCME guidelines - see Azimuth (2015a) for details.

[4] "***equation*** " means that CCME guidelines (or thresholds) are calculated based on an equation which is either pH or hardness dependent. The ammonia and aluminum (t & d) guidelines vary with pH; the cadmium, copper, lead, manganese, nickel and zinc guidelines vary with hardness.

[5] Chromium CCME guideline is for Cr VI.

123	Shaded concentrations exceed the CCME aquatic life guidelines.
123	Bordered concentrations exceed the GCDWQ.
123	Bolded concentrations exceed the trigger value.
123	Bold, italicized concentrations exceed the threshold value.

Italicized numbers are below detection limits.

"-" not collected.

~~strikethrough~~ = results flagged as unreliable in the QC assessment (see **Section 2.2.1.** for more details).

Table 2-2. Water chemistry data for the Lake stations, Whale Tail Pit Baseline, 2015.

Lake					Nemo Lake (NEM)						Mammoth Lake (MAM)					
Station	**Aquatic Life**	**Human Health**	**Trigger**[3]	**Threshold**[3]	NEM-01-S	NEM-02-S	NEM-03-S	NEM-04-S	NEM-05-S	NEM-06-S	MAM-01-S	MAM-02-S	MAM-03-S	MAM-04-S	MAM-05-S	MAM-06-S
Area-Replicate ID	**Guidelines**	**Guidelines**														
Depth (m)	**CCME**[1]	**GCDWQ**[2]	**Meadowbank**		3	3	3	3	3	3	3	3	3	3	3	3
Date					18-Jul-15	18-Jul-15	23-Aug-15	23-Aug-15	19-Sep-15	19-Sep-15	18-Jul-15	18-Jul-15	24-Aug-05	24-Aug-05	19-Sep-15	19-Sep-15
Field Measurements (Surface)																
Temperature (°C)					6.2	6.4	11.3	11.1	5.5	5.8	10.6	10.2	11.0	11.0	4.5	4.5
Specific Conductivity (µS/cm)					24.1	24.1	21.7	21.7	23.4	23.4	22.1	22.1	21.3	21.3	24	23.8
Dissolved Oxygen (mg/L)					14.8	15.3	11.7	12.9	14.1	14.3	12.5	12.5	11.1	12.6	14.5	15.2
pH	6.5 - 9.0		6.5 - 7.94	6.5 - 9.0	7.06	7.01	7.25	7.08	7.17	7.20	7.09	7.09	6.96	7.11	7.04	6.97
Physical Tests (mg/L)																
Conductivity (µS/cm)			23.5		**25**	**25**	**26**	**25**	**25**	**25**	23	23	**25**	**24**	**26**	**26**
Hardness			8.5		**9.8**	**9.8**	**9.8**	**10.0**	**9.6**	**9.6**	**8.5**	8.4	**9.1**	**9.1**	**9.2**	**9.2**
pH (Laboratory)	6.5 - 9.0		6.50 - 7.94	6.5 - 9.0	7.03	7.04	7.06	7.05	7.05	7.04	6.86	6.86	6.85	6.83	6.86	6.83
Total Suspended Solids			3.0	5.0	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Total Dissolved Solids			18.0		17	18	16	16	17	17	17	16	15	15	18	**18**
Turbidity (NTU)					0.24	0.23	0.19	0.21	0.21	0.20	0.36	0.37	0.24	0.27	0.26	0.30
Anions and Nutrients (mg/L)																
Alkalinity - Bicarbonate			8.6		7.1	7.0	6.8	6.7	7.5	7.2	4.8	5.0	4.8	4.5	5.2	5.1
Alkalinity - Carbonate			4		*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Alkalinity - Hydroxide					*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Alkalinity - Total			8.5		7.1	7.0	6.8	6.7	7.5	7.2	4.8	5.0	4.8	4.5	5.2	5.1
Ammonia (as N)[4]	***equation***		0.065	0.126	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*
Bromide					*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Chloride	120	250	60.28	120	0.53	0.53	0.54	0.54	0.53	0.54	1.98	1.98	2.33	2.32	2.59	2.58
Fluoride	0.120	1.5			0.023	0.021	0.022	0.022	0.023	0.023	0.023	0.024	0.026	0.025	0.025	0.025
Nitrate (as N)	3.0	10	1.50	3	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*
Nitrite (as N)	0.060	1	0.031	0.060	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Total Kjeldahl Nitrogen			0.170		**0.171**	**0.171**	0.084	0.107	0.123	0.115	0.139	0.137	0.095	0.129	0.135	0.131
Ortho Phosphate (as P)			0.002		*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Phosphorus (P)-Total Diss.					*<0.002*	*<0.002*	0.0022	0.0023	*<0.002*	*<0.002*	*<0.002*	*<0.002*	0.0038	0.0023	*<0.002*	*<0.002*
Phosphorus (P)-Total	0.0040		0.0060	0.004	*<0.002*	0.0035	*<0.002*	*<0.002*	*<0.002*	*<0.002*	0.0031	0.0033	*<0.002*	*<0.002*	*<0.002*	0.0031
Silicate (as SiO_2)			1.0		*<0.5*	*<0.5*	*<0.5*	*<0.5*	0.62	0.60	0.55	0.58	0.63	0.67	0.79	0.76
Sulphate (SO_4)		500	64.71	128	3.19	3.19	3.24	3.24	3.22	3.19	2.10	2.11	2.23	2.23	2.24	2.24
Cyanides																
Total Cyanide					*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Free Cyanide					*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Organic / Inorganic Carbon (mg/L)																
Dissolved Organic Carbon			2.6		1.5	1.4	1.4	1.6	1.4	1.2	1.8	1.9	1.6	1.6	1.5	1.5
Total Organic Carbon			2.8		1.5	2.0	1.3	1.4	1.3	1.6	1.9	1.9	1.9	1.6	1.6	1.6
Plant Pigments (µg/L)																
Chlorophyll-*a*					0.15	0.13	0.32	0.39	0.53	0.50	0.24	0.23	0.39	0.47	0.80	0.70
Total Metals (mg/L)																
Aluminum[4]	***equation***		0.054	0.100	0.0043	**0.0981**	~~0.0043~~	~~0.0050~~	0.0032	0.0043	0.0152	0.0142	~~0.0050~~	~~0.0058~~	0.0062	0.0080
Antimony		0.006	0.0101	0.020	*<0.0001*	*<0.0001*	0.00	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Arsenic	0.0050	0.01	0.00255	0.005	0.0003	0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0004	0.0004	0.0004	0.0004
Barium		1	0.50	1	0.0043	0.0042	0.0041	0.0041	0.0038	0.0039	0.0049	0.0048	0.0044	0.0044	0.0046	0.0046
Beryllium			0.0027	0.0053	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*
Bismuth					*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Boron	1.5	5	0.76	1.5	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*

Table 2-2. Water chemistry data for the Lake stations, Whale Tail Pit Baseline, 2015.

Lake					Nemo Lake (NEM)						Mammoth Lake (MAM)					
Station	Aquatic Life Guidelines	Human Health Guidelines	Trigger[3]	Threshold[3]	NEM-01-S	NEM-02-S	NEM-03-S	NEM-04-S	NEM-05-S	NEM-06-S	MAM-01-S	MAM-02-S	MAM-03-S	MAM-04-S	MAM-05-S	MAM-06-S
Area-Replicate ID																
Depth (m)	CCME[1]	GCDWQ[2]	Meadowbank		3	3	3	3	3	3	3	3	3	3	3	3
Date					18-Jul-15	18-Jul-15	23-Aug-15	23-Aug-15	19-Sep-15	19-Sep-15	18-Jul-15	18-Jul-15	24-Aug-05	24-Aug-05	19-Sep-15	19-Sep-15
Cadmium[4]	***equation***	0.005	0.000025	0.000040	*<0.000005*	*<0.000005*	~~0.000012~~	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	0.000006
Calcium			2.15		**2.20**	**2.24**	**2.23**	**2.22**	2.14	2.14	**2.16**	2.14	**2.32**	**2.29**	**2.33**	**2.41**
Chromium[5]	0.001	0.05	0.00056	0.001	*<0.0001*	0.0001	*<0.0001*	0.0001	0.0001	0.0001	0.0002	0.0002	*<0.0001*	*<0.0001*	0.0001	0.0001
Cobalt					*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Copper[3]	***equation***	1	0.00124	0.002	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*
Iron	0.3	0.3	0.155	0.3	0.018	0.021	0.013	0.011	0.011	0.010	0.024	0.024	0.014	0.014	0.016	0.019
Lead[3]	***equation***	0.01	0.000525	0.001	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	~~0.00009~~
Lithium			0.048	0.096	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Magnesium			0.83		**1.00**	**1.02**	**1.01**	**1.01**	**0.98**	**0.97**	0.74	0.73	0.77	0.77	0.77	0.79
Manganese[4]		0.05	0.3157	***equation***	0.0104	0.0097	0.0036	0.0034	0.0025	0.0027	0.0043	0.0040	0.0017	0.0017	0.0022	0.0025
Mercury	0.000026	0.001	0.000018	0.000026	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Molybdenum	0.073		0.0365	0.073	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Nickel[4]	***equation***		0.0127	0.025	0.0008	0.0007	0.0006	0.0006	0.0005	0.0005	0.0009	0.0009	0.0006	0.0006	0.0006	0.0006
Phosphorus					*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Potassium			0.50		**0.59**	**0.59**	**0.58**	**0.56**	**0.56**	**0.53**	0.49	0.49	**0.53**	**0.52**	0.48	0.49
Selenium	0.001	0.01	0.00055	0.001	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Silicon					0.21	0.21	0.22	0.21	0.21	0.21	0.31	0.31	0.29	0.30	0.29	0.30
Silver	0.0001				*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Sodium		200	0.975		0.48	0.48	0.49	0.48	0.49	0.49	0.51	0.50	0.53	0.52	0.54	0.55
Strontium			0.0279	0.049	0.0091	0.0092	0.0095	0.0096	0.0095	0.0095	0.0119	0.0119	0.0126	0.0126	0.0133	0.0134
Sulfur					1.07	1.07	1.15	1.16	1.12	1.11	0.73	0.73	0.83	0.81	0.79	0.86
Thallium	0.0008		0.00041	0.0008	*<0.00001*	*<0.00001*	0.00	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Tin			0.0002		*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Titanium			1.00	2	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	0.00032	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*
Uranium	0.015	0.02	0.0075	0.015	*<0.00001*	*<0.00001*	0.000014	*<0.00001*	*<0.00001*	*<0.00001*	0.000031	0.000034	0.000025	0.000024	0.000022	0.000024
Vanadium			0.0035	0.006	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*
Zinc[4]	0.030	0.5	0.0063	***equation***	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*
Zirconium					*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*
Dissolved Metals (mg/L)																
Aluminum[4]			0.0263	0.05	~~0.0023~~	~~0.0017~~	0.0016	0.0012	0.0024	0.0017	0.0064	0.0066	0.0022	0.0024	0.0025	0.0033
Antimony			0.0101	0.020	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Arsenic			0.0026	0.005	0.0002	0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0004	0.0004	0.0003	0.0004
Barium			0.5010	1	0.0041	0.0042	0.0039	0.0039	0.0040	0.0039	0.0047	0.0046	0.0043	0.0043	0.0043	0.0044
Beryllium			0.0027	0.0053	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*
Bismuth					*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Boron			0.76	1.5	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Cadmium			0.000025	0.00004	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Calcium					2.28	2.26	2.25	2.29	2.19	2.19	2.20	2.19	2.34	2.35	2.38	2.40
Chromium			0.00055	0.001	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Cobalt					*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Copper			0.00119	0.002	*<0.0002*	0.00021	0.00023	0.00024	0.00026	0.00021	0.00036	0.00037	0.00036	0.00042	0.00037	0.00054
Iron			0.155	0.3	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Lead			0.000525	0.001	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	~~**0.00056**~~	~~0.00010~~	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	~~0.00027~~	*<0.00005*
Lithium			0.048	0.096	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Magnesium					1.01	1.00	1.02	1.04	1.01	1.01	0.72	0.72	0.79	0.79	0.78	0.78
Manganese[4]			0.315	***equation***	0.0077	0.0075	0.0006	0.0005	0.0006	0.0005	0.0032	0.0031	0.0003	0.0003	0.0007	0.0007
Mercury			0.000018	0.000026	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	0.00	0.00
Molybdenum			0.037	0.073	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*

Table 2-2. Water chemistry data for the Lake stations, Whale Tail Pit Baseline, 2015.

Lake					Nemo Lake (NEM)						Mammoth Lake (MAM)					
Station	Aquatic Life Guidelines	Human Health Guidelines	Trigger[3]	Threshold[3]	NEM-01-S	NEM-02-S	NEM-03-S	NEM-04-S	NEM-05-S	NEM-06-S	MAM-01-S	MAM-02-S	MAM-03-S	MAM-04-S	MAM-05-S	MAM-06-S
Area-Replicate ID					3	3	3	3	3	3	3	3	3	3	3	3
Depth (m)	CCME[1]	GCDWQ[2]	Meadowbank													
Date					18-Jul-15	18-Jul-15	23-Aug-15	23-Aug-15	19-Sep-15	19-Sep-15	18-Jul-15	18-Jul-15	24-Aug-05	24-Aug-05	19-Sep-15	19-Sep-15
Nickel			0.013	0.025	0.0007	0.0007	0.0005	0.0005	*<0.0005*	*<0.0005*	0.0009	0.0009	0.0005	0.0005	0.0005	0.0006
Phosphorus					*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Potassium					0.57	0.55	0.59	0.60	0.56	0.56	0.46	0.46	0.53	0.52	0.49	0.49
Selenium			0.00055	0.001	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Silicon					0.21	0.21	0.20	0.21	0.21	0.21	0.30	0.30	0.29	0.29	0.28	0.28
Silver					*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Sodium					0.47	0.47	0.48	0.47	0.48	0.48	0.50	0.50	0.52	0.52	0.53	0.52
Strontium			0.028	0.049	0.0089	0.0090	0.0094	0.0094	0.0094	0.0094	0.0116	0.0116	0.0125	0.0123	0.0130	0.0130
Sulfur					1.05	1.07	1.14	1.12	1.08	1.08	0.71	0.71	0.81	0.79	0.78	0.79
Thallium			0.00041	0.0008	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Tin			0.0002		*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Titanium			1.01	2	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*
Uranium			0.0075	0.015	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	0.00003	0.00003	0.00002	0.00002	0.00002	0.00002
Vanadium			0.0035	0.006	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*
Zinc[4]			0.0053	***equation***	*<0.001*	*<0.001*	*<0.001*	*<0.001*	0.001	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Zirconium					*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*

Notes:

[1] CCME (Canadian Council of Ministers of the Environment) Canadian Water Quality Guidelines for the Protection of Aquatic Life, 1999, updated up to 2015.

[2] Guidelines for Canadian Drinking Water Quality (Federal-Provincial-Territorial Committee on Health and the Environment). Standards for the following parameters are aesthetic and meant to protect against taste and odour: chloride, sulphate, copper, iron, manganese, sodium, zinc.

[3] Trigger and threshold values are presented in "CREMP 2015 Plan Update" (Azimuth 2015a).
A number of thresholds were derived from methods (or sources) other than CCME guidelines - see Azimuth (2015a) for details.

[4] "***equation*** " means that CCME guidelines (or thresholds) are calculated based on an equation which is either pH or hardness dependent. The ammonia and aluminum (t & d) guidelines vary with pH; the cadmium, copper, lead, manganese, nickel and zinc guidelines vary with hardness.

[5] Chromium CCME guideline is for Cr VI.

123	Shaded concentrations exceed the CCME aquatic life guidelines.
123	Bordered concentrations exceed the GCDWQ.
123	Bolded concentrations exceed the trigger value.
123	Bold, italicized concentrations exceed the threshold value.

Italicized numbers are below detection limits.

"-" not collected.

~~strikethrough~~ = results flagged as unreliable in the QC assessment (see **Section 2.2.1.** for more details).

Table 2-2. Water chemistry data for the Lake stations, Whale Tail Pit Baseline, 2015.

Lake					Inuggugayualik Lake (INUG)						Pipedream Lake (PDL)				
Station	Aquatic Life Guidelines	Human Health Guidelines	Trigger[3]	Threshold[3]	INUG-70-S	INUG-71-S	INUG-72-S	INUG-73-S	INUG-74-S	INUG-75-S	PDL-37-S	PDL-38-S	PDL-39-S	PDL-40-S	PDL-41-S
Area-Replicate ID															
Depth (m)					3	3	3	3	3	3	3	3	3	3	3
Date	CCME[1]	GCDWQ[2]	Meadowbank		27-Jul-15	27-Jul-15	27-Aug-15	27-Aug-15	1-Oct-15	1-Oct-15	28-Jul-15	28-Jul-15	26-Aug-15	26-Aug-15	4-Oct-15
Field Measurements (Surface)															
Temperature (°C)					10.7	10.7	11.5	11.5	2.5	2.4	7.9	6.3	10.6	10.6	3.0
Specific Conductivity (µS/cm)					12	12	13.3	13.2	157	43	15	18	18.7	18.7	37
Dissolved Oxygen (mg/L)					10.0	10.0	10.0	10.1	10.4	10.3	11.6	10.7	12.2	13.0	10.6
pH	6.5 - 9.0		6.5 - 7.94	6.5 - 9.0	7.04	7.12	7.31	6.94	6.74	7	6.55	6.5	7.16	7.27	6.43
Physical Tests (mg/L)															
Conductivity (µS/cm)			23.5		15.2	15.3	16.1	15.7	15.9	16.7	22.3	21.9	21.9	22	23
Hardness			8.5		5.76	5.87	5.7	5.69	5.75	5.88	**8.83**	**8.68**	**8.92**	**8.78**	**8.91**
pH (Laboratory)	6.5 - 9.0		6.50 - 7.94	6.5 - 9.0	6.89	6.9	6.84	6.82	6.73	6.75	7	6.97	7.05	7.04	7.07
Total Suspended Solids			3.0	5.0	*<1.0*	*<1.0*	*<1.0*	*<1.0*	1	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Total Dissolved Solids			18.0		16.4	16.7	16.1	15.2	13	11.9	12.4	12.5	17.3	17.4	17.8
Turbidity (NTU)					0.31	0.29	0.29	0.28	0.38	0.37	0.2	0.22	0.22	0.19	0.23
Anions and Nutrients (mg/L)															
Alkalinity - Bicarbonate			8.6		4.8	5	4.9	4.9	5.7	5.3	8.1	7.5	7.6	6.9	8.2
Alkalinity - Carbonate			4		*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Alkalinity - Hydroxide					*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Alkalinity - Total			8.5		4.8	5	4.9	4.9	5.7	5.3	8.1	7.5	7.6	6.9	8.2
Ammonia (as N)[4]	***equation***		0.065	0.126	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*
Bromide					*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Chloride	120	250	60.28	120	0.73	0.73	0.77	0.76	0.75	0.75	0.59	0.59	0.62	0.62	0.6
Fluoride	0.120	1.5			0.056	0.056	0.059	0.058	0.058	0.059	0.035	0.036	0.036	0.035	0.035
Nitrate (as N)	3.0	10	1.50	3	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*
Nitrite (as N)	0.060	1	0.031	0.060	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Total Kjeldahl Nitrogen			0.170		0.09	0.093	0.12	0.115	0.145	0.135	0.077	0.081	0.112	0.106	**0.172**
Ortho Phosphate (as P)			0.002		*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Phosphorus (P)-Total Diss.					*<0.002*	*<0.002*	0.0021	*<0.002*	0.002	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*
Phosphorus (P)-Total	0.0040		0.0060	0.004	*<0.002*	***0.0058***	0.0028	*<0.002*	*<0.002*	0.0025	0.0023	*<0.002*	*<0.002*	*<0.002*	*<0.002*
Silicate (as SiO_2)			1.0		*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*
Sulphate (SO_4)		500	64.71	128	0.88	0.88	0.9	0.9	0.87	0.87	1.59	1.6	1.67	1.68	1.63
Cyanides															
Total Cyanide					*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Free Cyanide					*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Organic / Inorganic Carbon (mg/L)															
Dissolved Organic Carbon			2.6		1.9	1.9	1.8	1.5	1.6	1.6	1.8	1.9	1.3	1.3	1.5
Total Organic Carbon			2.8		1.9	2.0	1.6	1.6	1.9	1.8	1.8	1.8	1.3	1.5	1.6
Plant Pigments (µg/L)															
Chlorophyll-*a*					0.30	0.27	0.39	0.44	0.32	0.37	0.30	0.33	0.38	0.39	0.35
Total Metals (mg/L)															
Aluminum[4]	***equation***		0.054	0.100	0.0104	0.0099	~~0.0079~~	~~0.0085~~	0.0124	0.0109	0.005	0.0046	~~0.0048~~	~~0.0047~~	0.0059
Antimony		0.006	0.0101	0.020	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Arsenic	0.0050	0.01	0.00255	0.005	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	0.00016	0.00014	0.00013	0.00013	0.00016
Barium		1	0.50	1	0.0021	0.00192	0.00186	0.0019	0.00169	0.00179	0.00206	0.002	0.00199	0.00204	0.00202
Beryllium			0.0027	0.0053	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*
Bismuth					*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Boron	1.5	5	0.76	1.5	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*

Table 2-2. Water chemistry data for the Lake stations, Whale Tail Pit Baseline, 2015.

Lake					Inuggugayualik Lake (INUG)						Pipedream Lake (PDL)				
Station	Aquatic Life	Human Health	Trigger[3]	Threshold[3]	INUG-70-S	INUG-71-S	INUG-72-S	INUG-73-S	INUG-74-S	INUG-75-S	PDL-37-S	PDL-38-S	PDL-39-S	PDL-40-S	PDL-41-S
Area-Replicate ID															
Depth (m)					3	3	3	3	3	3	3	3	3	3	3
Date	CCME[1]	GCDWQ[2]	Meadowbank		27-Jul-15	27-Jul-15	27-Aug-15	27-Aug-15	1-Oct-15	1-Oct-15	28-Jul-15	28-Jul-15	26-Aug-15	26-Aug-15	4-Oct-15
Cadmium[4]	***equation***	0.005	0.000025	0.000040	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Calcium			2.15		1.18	1.13	1.16	1.14	1.12	1.17	**2.33**	**2.28**	**2.18**	**2.2**	**2.24**
Chromium[5]	0.001	0.05	0.00056	0.001	0.0002	*<0.0001*	*<0.0001*	0.0001	*<0.0001*	*<0.0001*	0.0001	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Cobalt					*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Copper[3]	***equation***	1	0.00124	0.002	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	0.00052	0.0005	*<0.0005*	*<0.0005*	*<0.0005*
Iron	0.3	0.3	0.155	0.3	0.02	0.019	0.02	0.015	0.022	0.023	*<0.01*	*<0.01*	0.017	*<0.01*	0.012
Lead[3]	***equation***	0.01	0.000525	0.001	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	~~0.000489~~	*<0.00005*	*<0.00005*
Lithium			0.048	0.096	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Magnesium			0.83		0.71	0.69	0.69	0.69	0.68	0.72	0.79	0.78	0.76	0.77	0.8
Manganese[4]		0.05	0.3157	***equation***	0.00496	0.00495	0.00232	0.00243	0.00225	0.00224	0.00175	0.00164	0.00125	0.00125	0.00147
Mercury	0.000026	0.001	0.000018	0.000026	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Molybdenum	0.073		0.0365	0.073	0.000075	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	0.000051	*<0.00005*	0.000055	*<0.00005*	*<0.00005*
Nickel[4]	***equation***		0.0127	0.025	0.00051	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	0.00074	0.00062	0.00059	0.0006	0.00055
Phosphorus					*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Potassium			0.50		0.38	0.4	0.4	0.4	0.36	0.39	0.36	0.34	0.37	0.35	0.35
Selenium	0.001	0.01	0.00055	0.001	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Silicon					0.153	0.149	0.122	0.123	0.122	0.129	0.143	0.14	0.121	0.123	0.118
Silver	0.0001				*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Sodium		200	0.975		0.563	0.54	0.565	0.563	0.577	0.56	0.502	0.497	0.478	0.502	0.508
Strontium			0.0279	0.049	0.00637	0.0061	0.00683	0.00663	0.00641	0.00659	0.00914	0.00908	0.00932	0.00937	0.00947
Sulfur					*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	0.59	0.56	0.58	0.58	0.64
Thallium	0.0008		0.00041	0.0008	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Tin			0.0002		*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Titanium			1.00	2	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*
Uranium	0.015	0.02	0.0075	0.015	0.000054	0.000048	0.000048	0.000048	0.000043	0.000044	0.000021	0.000021	0.000023	0.000024	0.000021
Vanadium			0.0035	0.006	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*
Zinc[4]	0.030	0.5	0.0063	***equation***	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*
Zirconium					*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*
Dissolved Metals (mg/L)															
Aluminum[4]			0.0263	0.05	0.004	0.0052	0.003	0.0036	0.0018	0.0024	0.0025	0.0018	0.0024	0.0019	0.0036
Antimony			0.0101	0.020	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Arsenic			0.0026	0.005	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	0.00014	0.00013	0.00014	0.00014	0.00014
Barium			0.5010	1	0.00187	0.00195	0.00183	0.00188	0.00166	0.00164	0.00198	0.002	0.00196	0.00199	0.00194
Beryllium			0.0027	0.0053	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*
Bismuth					*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Boron			0.76	1.5	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Cadmium			0.000025	0.00004	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Calcium					1.15	1.17	1.15	1.14	1.15	1.18	2.27	2.23	2.27	2.23	2.26
Chromium			0.00055	0.001	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Cobalt					*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Copper			0.00119	0.002	0.00032	0.0003	0.00032	0.00033	0.00029	0.0003	0.00046	0.0004	0.0004	0.00038	0.00048
Iron			0.155	0.3	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Lead			0.000525	0.001	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Lithium			0.048	0.096	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Magnesium					0.7	0.71	0.69	0.69	0.7	0.72	0.77	0.76	0.79	0.78	0.79
Manganese[4]			0.315	***equation***	0.0031	0.00331	0.00032	0.00034	0.00051	0.0005	0.00106	0.001	0.00056	0.00051	0.00043
Mercury			0.000018	0.000026	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Molybdenum			0.037	0.073	*<0.00005*	*<0.00005*	*<0.00005*	0.000202	*<0.00005*	*<0.00005*	0.000051	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*

Table 2-2. Water chemistry data for the Lake stations, Whale Tail Pit Baseline, 2015.

Lake					Inuggugayualik Lake (INUG)						Pipedream Lake (PDL)				
Station	Aquatic Life Guidelines	Human Health Guidelines	Trigger[3]	Threshold[3]	INUG-70-S	INUG-71-S	INUG-72-S	INUG-73-S	INUG-74-S	INUG-75-S	PDL-37-S	PDL-38-S	PDL-39-S	PDL-40-S	PDL-41-S
Area-Replicate ID					3	3	3	3	3	3	3	3	3	3	3
Depth (m)	CCME[1]	GCDWQ[2]	Meadowbank												
Date					27-Jul-15	27-Jul-15	27-Aug-15	27-Aug-15	1-Oct-15	1-Oct-15	28-Jul-15	28-Jul-15	26-Aug-15	26-Aug-15	4-Oct-15
Nickel			0.013	0.025	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	0.00071	0.00062	0.00057	0.00054	*<0.0005*
Phosphorus					*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Potassium					0.4	0.41	0.35	0.37	0.38	0.39	0.35	0.31	0.34	0.33	0.32
Selenium			0.00055	0.001	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Silicon					0.141	0.137	0.111	0.108	0.1	0.108	0.135	0.128	0.119	0.117	0.107
Silver					*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Sodium					0.527	0.538	0.534	0.559	0.552	0.565	0.483	0.474	0.489	0.479	0.503
Strontium			0.028	0.049	0.00603	0.00606	0.00658	0.00649	0.00644	0.00641	0.00873	0.0086	0.0095	0.00939	0.00904
Sulfur					*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	0.55	0.55	0.57	0.58	0.59
Thallium			0.00041	0.0008	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Tin			0.0002		*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Titanium			1.01	2	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*
Uranium			0.0075	0.015	0.000041	0.000043	0.000042	0.000041	0.000033	0.000034	0.000016	0.00002	0.000021	0.000021	0.000018
Vanadium			0.0035	0.006	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*
Zinc[4]			0.0053	***equation***	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	0.0012	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Zirconium					*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*

Notes:

[1] CCME (Canadian Council of Ministers of the Environment) Canadian Water Quality Guidelines for the Protection of Aquatic Life, 1999, updated up to 2015.

[2] Guidelines for Canadian Drinking Water Quality (Federal-Provincial-Territorial Committee on Health and the Environment). Standards for the following parameters are aesthetic and meant to protect against taste and odour: chloride, sulphate, copper, iron, manganese, sodium, zinc.

[3] Trigger and threshold values are presented in "CREMP 2015 Plan Update" (Azimuth 2015a).
A number of thresholds were derived from methods (or sources) other than CCME guidelines - see Azimuth (2015a) for details.

[4] "***equation*** " means that CCME guidelines (or thresholds) are calculated based on an equation which is either pH or hardness dependent. The ammonia and aluminum (t & d) guidelines vary with pH; the cadmium, copper, lead, manganese, nickel and zinc guidelines vary with hardness.

[5] Chromium CCME guideline is for Cr VI.

123	Shaded concentrations exceed the CCME aquatic life guidelines.
123	Bordered concentrations exceed the GCDWQ.
123	Bolded concentrations exceed the trigger value.
123	Bold, italicized concentrations exceed the threshold value.

Italicized numbers are below detection limits.

"-" not collected.

~~strikethrough~~ = results flagged as unreliable in the QC assessment (see **Section 2.2.1.** for more details).

Table 2-3. Water chemistry data for the Sentinel stations, Whale Tail Pit Baseline, 2015.

Lake			Sentinel Stations													
Station	**Aquatic Life**	**Human Health**	**C2**			**C14**			**C17**			**C20**			**C41**		
Area-Replicate ID	**Guidelines**	**Guidelines**	C2-JUL	C2-AUG	C2-SEP	C14-JUL	C14-AUG	C14-SEPT	C17-JUL	C17-AUG	C17-SEPT	C20-JUL	C20-AUG	C20-SEPT	C41-JUL	C41-AUG	C41-SEPT
Depth (m)			Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
Date	**CCME**[1]	**GCDWQ**[2]	19-Jul-15	25-Aug-15	20-Sep-15	19-Jul-15	25-Aug-15	20-Sep-15	19-Jul-15	25-Aug-15	20-Sep-15	19-Jul-15	25-Aug-15	20-Sep-15	19-Jul-15	25-Aug-15	20-Sep-15
Field Measurements (Surface)																	
Temperature (°C)			10.3	9.6	2.7	9.4	10.9	4.0	10.0	10.1	3.2	8.2	10.6	3.6	10.7	9.6	2.5
Specific Conductivity (µS/cm)			22.7	16.9	22.6	24.8	20.4	22.7	23.4	14.1	21.3	23.4	18.6	20.3	17.2	16.9	23.3
Dissolved Oxygen (mg/L)			11.98	11.34	13.71	13.03	10.97	13.26	12.5	11.19	13.54	13.75	10.68	13.62	11.72	11.34	15
pH	6.5 - 9.0		-	7.22	7.02	7.03	7.36	6.98	7.03	6.78	6.98	7.05	7.36	6.92	7.10	7.22	6.90
Physical Tests (mg/L)																	
Conductivity (µS/cm)			22	23	24	25	24	24	23	23	23	23	22	22	17	20	25
Hardness			8.7	8.8	9.2	10.4	10.0	10.3	9.6	9.4	9.4	9.6	8.7	8.8	6.8	7.9	9.9
pH (Laboratory)	6.5 - 9.0		6.92	6.83	6.87	7.13	7.08	7.08	7.07	7.01	7.00	7.12	7.08	7.04	6.91	6.96	6.93
Total Suspended Solids			*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	2	*<1.0*	1	*<1.0*	*<1.0*	*<1.0*	*<1.0*	1	*<1.0*	9
Total Dissolved Solids			15	16	17	18	17	19	18	18	19	15	16	14	13	15	20
Turbidity (NTU)			0.33	0.24	0.31	0.32	0.35	0.72	0.38	0.82	0.50	0.21	0.24	0.45	0.83	0.33	1.53
Anions and Nutrients (mg/L)																	
Alkalinity - Bicarbonate			5.7	5.2	5.7	8.7	7.7	8.9	7.7	7.9	7.7	7.8	7.1	7.5	5.1	5.8	6.7
Alkalinity - Carbonate			*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Alkalinity - Hydroxide			*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Alkalinity - Total			5.7	5.2	5.7	8.7	7.7	8.9	7.7	7.9	7.7	7.8	7.1	7.5	5.1	5.8	6.7
Ammonia (as N)[3]	***equation***		*<0.005*	0.0052	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	0.0053	*<0.005*	*<0.005*	*<0.005*	0.0051	*<0.005*	*<0.005*	*<0.005*
Bromide			*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Chloride	120	250	0.47	0.51	0.51	0.55	0.56	0.55	0.57	0.59	0.58	0.67	0.64	0.63	0.50	0.58	0.62
Fluoride	0.120	1.5	0.063	0.072	0.073	0.034	0.034	0.034	0.046	0.049	0.048	0.039	0.037	0.037	0.043	0.055	0.054
Nitrate (as N)	3.0	10	*<0.005*	0.0243	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*	0.0055	0.0097	0.0148
Nitrite (as N)	0.060	1	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Total Kjeldahl Nitrogen			0.154	0.085	0.125	0.265	0.162	0.188	0.184	0.144	0.160	0.124	0.090	0.234	0.129	0.100	0.203
Ortho Phosphate (as P)			*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Phosphorus (P)-Total Diss.			0.0020	0.0021	*<0.002*	0.0028	0.0027	*<0.002*	0.0022	0.0031	0.0022	*<0.002*	0.0021	*<0.002*	0.0022	0.0028	0.0022
Phosphorus (P)-Total	0.0040		*<0.002*	*<0.002*	*<0.002*	0.0022	*<0.002*	0.0042	0.0022	0.0032	0.0026	*<0.002*	*<0.002*	0.0072	0.0030	*<0.002*	0.007
Silicate (as SiO_2)			0.64	0.88	1.14	0.59	0.58	0.74	0.76	0.63	0.97	*<0.5*	*<0.5*	*<0.5*	0.52	0.86	1.39
Sulphate (SO_4)		500	3.45	3.67	3.97	1.52	1.54	1.55	1.48	1.43	1.52	1.71	1.63	1.63	1.73	2.05	3.26
Cyanides																	
Total Cyanide			*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Free Cyanide			*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Organic / Inorganic Carbon (mg/L)																	
Dissolved Organic Carbon			1.6	1.3	1.5	2.5	2.3	2.3	2.8	2.7	2.7	1.5	1.4	1.4	1.6	1.9	1.9
Total Organic Carbon			1.6	1.4	1.5	2.5	2.4	2.4	2.7	2.7	2.7	1.5	1.4	2.1	2.0	1.4	1.9
Plant Pigments (µg/L)																	
Chlorophyll-*a*			0.34	0.58	0.61	0.37	0.63	1.50	0.36	0.84	0.79	0.21	0.39	0.56	0.36	0.46	2.30
Total Metals (mg/L)																	
Aluminum[3]	***equation***		0.0126	~~0.0044~~	0.0091	0.0086	~~0.0064~~	0.0338	0.0148	0.0211	0.0156	0.0050	~~0.0042~~	0.0099	0.0210	~~0.0081~~	0.0647
Antimony		0.006	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Arsenic	0.0050	0.01	0.0002	0.0002	0.0002	0.0002	0.0003	0.0004	0.0002	0.0004	0.0003	0.0001	0.0002	0.0002	0.0001	0.0002	0.0003
Barium		1	0.0035	0.0032	0.0034	0.0036	0.0030	0.0037	0.0027	0.0027	0.0024	0.0021	0.0018	0.0019	0.0043	0.0039	0.0059
Beryllium			*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*
Bismuth			*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Boron	1.5	5	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Cadmium[3]	***equation***	0.005	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	0.000006	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	0.000009	*<0.000005*	*<0.000005*	0.000008
Calcium			2.15	2.10	2.26	2.82	2.71	2.84	2.49	2.44	2.43	2.27	2.26	2.17	1.42	1.64	2.18
Chromium[4]	0.001	0.05	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	0.0002	0.0001	0.0003	0.0002	*<0.0001*	*<0.0001*	0.0001	0.0004	0.0002	0.0008
Cobalt			*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	0.00	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	0.00
Copper[3]	***equation***	1	0.0010	0.0008	0.0008	0.0006	0.0007	0.0007	0.0007	0.0008	0.0007	*<0.0005*	*<0.0005*	*<0.0005*	0.0007	0.0007	0.0011
Iron	0.3	0.3	0.032	0.028	0.039	0.028	0.023	0.108	0.044	0.164	0.078	0.012	0.014	0.021	0.070	0.059	~~0.34~~
Lead[3]	***equation***	0.01	~~0.00006~~	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	~~0.00011~~	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	~~0.00037~~	*<0.00005*	~~0.00008~~	~~0.00032~~
Lithium			*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Magnesium			0.80	0.78	0.84	0.74	0.70	0.75	0.82	0.79	0.79	0.81	0.77	0.75	0.76	0.87	1.20
Manganese[3]		0.05	0.0016	0.0003	0.0011	0.0024	0.0029	0.0091	0.0039	0.0169	0.0076	0.0013	0.0010	0.0013	0.0016	0.0017	0.0059
Mercury	0.000026	0.001	*<0.000005*	*<0.000005*	0.00	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Molybdenum	0.073		*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	0.0001	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	0.0001	0.0001	0.0001
Nickel[3]	***equation***		0.0006	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	0.0005	0.0007	0.0005	0.0006	*<0.0005*	*<0.0005*	0.0032	0.0023	0.0046
Phosphorus			*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Potassium			0.32	0.32	0.30	0.37	0.35	0.35	0.40	0.38	0.35	0.36	0.34	0.30	0.29	0.29	0.33
Selenium	0.001	0.01	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Silicon			0.36	0.38	0.46	0.31	0.27	0.35	0.43	0.30	0.40	0.15	0.14	0.16	0.31	0.37	0.72
Silver	0.0001		*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Sodium		200	0.49	0.52	0.54	0.51	0.51	0.53	0.56	0.56	0.56	0.51	0.49	0.49	0.42	0.48	0.56

Table 2-3. Water chemistry data for the Sentinel stations, Whale Tail Pit Baseline, 2015.

Lake			Sentinel Stations													
Station	**Aquatic Life**	**Human Health**	**C2**			**C14**			**C17**			**C20**			**C41**		
Area-Replicate ID	**Guidelines**	**Guidelines**	C2-JUL	C2-AUG	C2-SEP	C14-JUL	C14-AUG	C14-SEPT	C17-JUL	C17-AUG	C17-SEPT	C20-JUL	C20-AUG	C20-SEPT	C41-JUL	C41-AUG	C41-SEPT
Depth (m)			Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
Date	**CCME**[1]	**GCDWQ**[2]	19-Jul-15	25-Aug-15	20-Sep-15	19-Jul-15	25-Aug-15	20-Sep-15	19-Jul-15	25-Aug-15	20-Sep-15	19-Jul-15	25-Aug-15	20-Sep-15	19-Jul-15	25-Aug-15	20-Sep-15
Strontium			0.0115	0.0113	0.0119	0.0143	0.0142	0.0150	0.0129	0.0127	0.0128	0.0091	0.0088	0.0091	0.0072	0.0082	0.0107
Sulfur			1.17	1.28	1.39	0.55	0.60	0.61	0.54	0.57	0.58	0.60	0.61	0.58	0.60	0.75	1.18
Thallium	0.0008		*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Tin			*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	0.0003	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Titanium			*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	0.00096	*<0.0003*	0.00036	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	0.00034	*<0.0003*	0.00134
Uranium	0.015	0.02	0.000060	0.000029	0.000036	0.000033	0.000028	0.000040	0.000043	0.000041	0.000041	0.000022	0.000020	0.000022	0.000038	0.000022	0.000060
Vanadium			*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*
Zinc	0.030	0.5	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*
Zirconium			*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*
Dissolved Metals (mg/L)																	
Aluminum			~~0.0038~~	0.0013	0.0033	0.0053	0.0027	0.0053	0.0065	0.0038	0.0049	~~0.0021~~	0.0018	0.0086	0.0062	0.0026	0.0053
Antimony			*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Arsenic			0.0001	0.0001	0.0001	0.0002	0.0003	0.0003	0.0002	0.0003	0.0003	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001
Barium			0.0033	0.0032	0.0031	0.0035	0.0029	0.0034	0.0026	0.0024	0.0023	0.0020	0.0017	0.0020	0.0040	0.0038	0.0048
Beryllium			*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*
Bismuth			*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Boron			*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Cadmium			*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	0.00001	*<0.000005*	*<0.000005*	*<0.000005*
Calcium			2.18	2.18	2.29	2.90	2.79	2.89	2.52	2.47	2.45	2.44	2.24	2.25	1.47	1.69	2.10
Chromium			*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	0.00	*<0.0001*	0.00
Cobalt			*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	0.00	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Copper			0.00080	0.00069	0.00070	0.00061	0.00061	0.00060	0.00062	0.00067	0.00064	0.00037	0.00041	0.00041	0.00053	0.00054	0.00068
Iron			0.01	*<0.01*	0.01	0.01	*<0.01*	0.02	0.02	0.07	0.04	0.01	*<0.01*	0.01	0.03	0.03	0.03
Lead			*<0.00005*	*<0.00005*	*<0.00005*	~~0.00005~~	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	~~0.00010~~	*<0.00005*	*<0.00005*	*<0.00005*
Lithium			*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Magnesium			0.80	0.81	0.85	0.76	0.74	0.76	0.80	0.78	0.80	0.85	0.76	0.78	0.75	0.89	1.13
Manganese			0.0012	*<0.0001*	0.0008	0.0014	0.0012	0.0036	0.0030	0.0146	0.0063	0.0010	0.0005	0.0008	0.0010	0.0011	0.0017
Mercury			*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	0.00	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Molybdenum			*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	0.0001	0.0001
Nickel			0.0006	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	0.0005	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	0.0029	0.0023	0.0033
Phosphorus			*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Potassium			0.32	0.33	0.31	0.37	0.37	0.34	0.38	0.37	0.36	0.36	0.33	0.35	0.26	0.30	0.33
Selenium			*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Silicon			0.34	0.39	0.46	0.31	0.26	0.29	0.40	0.27	0.38	0.16	0.14	0.16	0.29	0.37	0.61
Silver			*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Sodium			0.48	0.52	0.53	0.51	0.50	0.52	0.54	0.54	0.55	0.51	0.48	0.48	0.40	0.48	0.57
Strontium			0.0112	0.0114	0.0121	0.0143	0.0139	0.0147	0.0124	0.0123	0.0124	0.0092	0.0087	0.0092	0.0070	0.0080	0.0102
Sulfur			1.13	1.27	1.36	0.54	0.57	0.57	0.52	0.52	0.56	0.61	0.57	0.58	0.60	0.72	1.11
Thallium			*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Tin			*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Titanium			*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	0.00	*<0.0003*	*<0.0003*	*<0.0003*
Uranium			0.00005	0.00002	0.00003	0.00003	0.00002	0.00003	0.00004	0.00003	0.00004	0.00002	0.00002	0.00002	0.00004	0.00002	0.00003
Vanadium			*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*
Zinc			*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Zirconium			*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*

Notes:

[1] CCME (Canadian Council of Ministers of the Environment) Canadian Water Quality Guidelines for the Protection of Aquatic Life, 1999, updated up to 2015.

[2] Guidelines for Canadian Drinking Water Quality (Federal-Provincial-Territorial Committee on Health and the Environment). Standards for the following parameters are aesthetic and meant to protect against taste and odour: chloride, sulphate, copper, iron, manganese, sodium, zinc.

[3] "***equation*** " means that CCME guidelines are calculated based on an equation which is either pH or hardness dependent. The ammonia and aluminum guidelines vary with pH; the cadmium, copper, lead, and nickel guidelines vary with hardness.

[4] Chromium CCME guideline is for Cr VI.

123	Shaded concentrations exceed the CCME aquatic life guidelines.
123	Bordered concentrations exceed the GCDWQ.
123	Bolded concentrations exceed the trigger value.
123	Bold, italicized concentrations exceed the threshold value.

Italicized numbers are below detection limits.

"-" not collected.

~~strikethrough~~ = results flagged as unreliable in the QC assessment (see **Section 2.2.1.** for more details).

Table 2-4. Water chemistry data for the Tributary stations, Whale Tail Pit Baseline, 2015.

Sampling Event			August										September					
Station ID (maps)	**Aquatic Life Guidelines**	**Human Health Guidelines**	A21-A20	A76-A75	DS1	A81-A80	C8-C7	A55-A17	A69-DS1	A14-A13	A18-A17	C38-C12	A5-A4	A55-A17	A17-A16	C38-C12	A69-DS1	A18-A17	A15-A14
Lab Report ID			A20-A19	A8-A7	D1	A101-A100	C8-C7	A34-A16	A1-DS1	A12-A11	A17-A16	C58 OUTLET	B5-B4	A34-A16	A16-A14	C58 OUTLET	A1-DS1	A17-A16	A13-A12
Depth (m)			Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
Date	**CCME**[1]	**GCDWQ**[2]	6-Aug-15	5-Aug-15	5-Aug-15	8-Aug-15	8-Aug-15	7-Aug-15	4-Aug-15	4-Aug-15	4-Aug-15	4-Aug-15	6-Aug-15	17-Sep-15	17-Sep-15	19-Sep-15	19-Sep-15	19-Sep-15	21-Sep-15
Field Measurements (Surface)																			
Temperature (°C)			17	13	14	15	13	17	15	14	17	16	16	-	-	5.5	4.2	4.7	1.8
Specific Conductivity (µS/cm)			13	22	21	12	25	15	17	24	15	24	21	-	18	16	13	11	18
Dissolved Oxygen (mg/L)			9.6	9.6	11	9.5	11	10	10	10	10	10	10	13	13	12	13	13	13
pH	6.5 - 9.0		6.8	6.9	7.0	6.5	6.9	6.5	6.6	6.5	6.7	6.7	6.2	7.3	7.2	7.1	7.3	7.1	7.1
Physical Tests (mg/L)																			
Conductivity (µS/cm)			14	23	22	13	26	15	16	24	15	24	22	19	34	28	21	17	28
Hardness			4.5	8.2	8.4	4.2	11	5.2	5.8	9.0	5.3	9.7	7.8	6.2	13	9.6	7.3	5.9	10
pH (Laboratory)	6.5 - 9.0		6.8	7.0	7.0	6.7	7.2	6.8	6.8	6.8	6.8	7.0	6.9	6.7	6.7	7.0	6.9	6.8	6.8
Total Suspended Solids			*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	1.7	*<1.0*	*<1.0*	*<1.0*	*<1.0*	1.8	11	3.2	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Total Dissolved Solids			16	19	20	14	22	16	13	18	14	19	18	15	24	16	14	10	15
Turbidity (NTU)			0.35	0.24	0.37	0.31	0.22	0.57	0.29	0.24	0.26	0.23	0.30	15	0.31	0.25	0.81	0.22	0.36
Anions and Nutrients (mg/L)																			
Alkalinity - Bicarbonate			4.8	6.4	7.1	3.9	9.4	6.3	5.0	5.8	5.0	7.2	5.8	5.4	4.3	6.6	6.3	5.7	5.9
Alkalinity - Carbonate			*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Alkalinity - Hydroxide			*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Alkalinity - Total			4.8	6.4	7.1	3.9	9.4	6.3	5.0	5.8	5.0	7.2	5.8	5.4	4.3	6.6	6.3	5.7	5.9
Ammonia (as N)[3]	***equation***		*<0.005*	*<0.005*	0.0057	*<0.005*	*<0.005*	*<0.005*	0.0050	0.0073	*<0.005*	*<0.005*	*<0.005*	0.0064	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*
Bromide			*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	0.063	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Chloride	120	250	0.59	0.94	0.95	0.65	0.49	0.94	0.74	1.7	0.68	0.51	1.1	0.64	5.7	0.53	0.95	0.73	2.1
Fluoride	0.120	1.5	0.029	0.025	0.038	0.027	0.033	0.025	0.028	0.025	0.031	0.023	0.028	0.032	0.026	0.024	0.028	0.032	0.025
Nitrate (as N)	3.0	10	0.012	*<0.005*	*<0.005*	0.0055	*<0.005*	*<0.005*	*<0.005*	0.0065	*<0.005*	*<0.005*	*<0.005*	0.014	*<0.005*	*<0.005*	0.011	0.0068	0.014
Nitrite (as N)	0.060	1	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Total Kjeldahl Nitrogen			0.14	0.15	0.16	0.12	0.095	0.19	0.14	0.14	0.15	0.12	0.14	0.17	0.15	0.13	0.18	0.29	0.13
Ortho Phosphate (as P)			*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	0.0014	0.0012	0.0011	0.0014	0.0012
Phosphorus (P)-Total Diss.			0.0043	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	0.0026	*<0.002*	*<0.002*	0.0026	*<0.002*	*<0.002*
Phosphorus (P)-Total	0.0040		0.0026	*<0.002*	0.0028	0.0026	*<0.02*	0.0038	0.0026	*<0.002*	0.0023	*<0.002*	*<0.002*	-	-	-	-	-	-
Silicate (as SiO_2)			1.3	0.87	*<0.5*	0.92	1.4	0.88	*<0.5*	0.58	0.81	*<0.5*	0.76	1.4	0.65	*<0.5*	1.0	1.2	0.99
Sulphate (SO_4)		500	0.73	2.6	1.2	0.71	2.3	2.6	1.3	2.6	0.85	3.0	2.4	1.4	1.7	3.2	2.0	1.1	3.3
Cyanides																			
Total Cyanide			*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Free Cyanide			*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	0.0010	*<0.001*	*<0.001*	*<0.001*	0.0010	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Organic / Inorganic Carbon (mg/L)																			
Dissolved Organic Carbon			2.0	1.7	2.2	1.8	1.4	2.3	1.9	1.8	1.9	1.6	1.6	2.8	13	1.8	1.9	1.8	3.5
Total Organic Carbon			2.1	1.6	2.3	1.9	1.4	2.4	1.9	1.7	1.6	1.5	1.6	2.8	2.5	1.7	1.8	3.0	1.6
Plant Pigments (µg/L)																			
Chlorophyll-*a*			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Metals (mg/L)																			
Aluminum[3]	***equation***		0.017	0.0064	0.014	0.010	0.0051	0.021	0.0090	0.0084	0.0085	0.0049	0.0088	~~0.49~~	0.0087	0.0039	0.030	0.0053	0.0086
Antimony		0.006	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Arsenic	0.0050	0.01	*<0.0001*	0.00023	0.00014	*<0.0001*	0.00036	0.00018	0.00010	0.00035	0.00011	0.00030	0.00020	0.00035	0.00027	0.00026	0.00011	*<0.0001*	0.00030
Barium		1	0.0036	0.0047	0.0028	0.0017	0.0099	0.0022	0.0030	0.0047	0.0037	0.0039	0.0046	0.0061	0.0051	0.0036	0.0038	0.0034	0.0049
Beryllium			*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	0.00004	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*
Bismuth			*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	0.00005	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Boron	1.5	5	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Cadmium[3]	***equation***	0.005	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	0.00001
Calcium			1.2	2.1	2.0	1.2	2.5	0.91	1.5	2.3	1.3	2.3	1.9	1.0	3.1	2.2	1.9	1.4	2.5
Chromium[4]	0.001	0.05	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	0.00015	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	0.00010	~~0.0020~~	0.00014	*<0.0001*	0.00014	*<0.0001*	0.00015
Cobalt			*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	0.00028	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Copper[3]	***equation***	1	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	0.00072	*<0.0005*	0.00050	*<0.0005*	*<0.0005*	*<0.0005*	0.0016	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	0.00063
Iron	0.3	0.3	0.038	0.017	0.028	0.031	*<0.01*	0.16	0.051	0.017	0.057	0.015	0.035	~~0.79~~	0.020	*<0.01*	0.070	0.030	0.022
Lead[3]	***equation***	0.01	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	0.00054	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	0.00026
Lithium			*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Magnesium			0.41	0.72	0.85	0.29	1.1	0.69	0.46	0.79	0.50	1.0	0.71	0.97	0.92	0.99	0.59	0.52	0.86
Manganese[3]		0.05	0.00077	0.0023	0.0024	0.0024	0.0027	0.0026	0.0016	0.00075	0.00080	0.0039	0.00097	0.0094	0.0031	0.0026	0.0015	0.00039	0.00081
Mercury	0.000026	0.001	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Molybdenum	0.073		*<0.00005*	*<0.00005*	*<0.00005*	0.00006	0.00097	0.00008	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	0.00007	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Nickel[3]	***equation***		*<0.0005*	0.00054	*<0.0005*	*<0.0005*	0.00056	0.00076	*<0.0005*	0.00066	*<0.0005*	0.00052	*<0.0005*	0.0020	0.0010	0.0048	*<0.0005*	*<0.0005*	0.00072
Phosphorus			*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Potassium			0.38	0.53	0.34	0.27	0.50	0.37	0.37	0.57	0.41	0.63	0.59	0.49	0.40	0.56	0.45	0.34	0.57
Selenium	0.001	0.01	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Silicon			0.57	0.37	0.20	0.41	0.63	0.34	0.27	0.35	0.46	0.22	0.34	1.4	0.27	0.21	0.49	0.52	0.43

Table 2-4. Water chemistry data for the Tributary stations, Whale Tail Pit Baseline, 2015.

Sampling Event			August										September					
Station ID (maps)	**Aquatic Life Guidelines**	**Human Health Guidelines**	A21-A20	A76-A75	DS1	A81-A80	C8-C7	A55-A17	A69-DS1	A14-A13	A18-A17	C38-C12	A5-A4	A55-A17	A17-A16	C38-C12	A69-DS1	A18-A17	A15-A14
Lab Report ID			A20-A19	A8-A7	D1	A101-A100	C8-C7	A34-A16	A1-DS1	A12-A11	A17-A16	C58 OUTLET	B5-B4	A34-A16	A16-A14	C58 OUTLET	A1-DS1	A17-A16	A13-A12
Depth (m)			Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
Date	**CCME[1]**	**GCDWQ[2]**	6-Aug-15	5-Aug-15	5-Aug-15	8-Aug-15	8-Aug-15	7-Aug-15	4-Aug-15	4-Aug-15	4-Aug-15	4-Aug-15	6-Aug-15	17-Sep-15	17-Sep-15	19-Sep-15	19-Sep-15	19-Sep-15	21-Sep-15
Silver	0.0001		*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Sodium		200	0.63	0.54	0.73	0.58	0.63	0.61	0.62	0.58	0.66	0.51	0.54	0.61	0.57	0.49	0.61	0.64	0.58
Strontium			0.0070	0.0090	0.0061	0.0056	0.012	0.0052	0.0073	0.012	0.0071	0.0096	0.0083	0.0063	0.022	0.0093	0.0081	0.0070	0.011
Sulfur			*<0.5*	0.91	*<0.5*	*<0.5*	0.83	*<0.5*	0.56	0.94	*<0.5*	1.1	0.82	*<0.5*	0.61	1.1	0.67	*<0.5*	1.2
Thallium	0.0008		*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Tin			*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Titanium			0.00033	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	0.00048	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	0.016	*<0.0003*	*<0.0003*	0.00081	*<0.0003*	0.00030
Uranium	0.015	0.02	0.00005	0.00002	0.00005	0.00005	0.00002	0.00007	0.00004	0.00003	0.00003	*<0.00001*	0.00003	0.00032	0.00003	*<0.00001*	0.00003	0.00002	0.00002
Vanadium			*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	0.00081	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*
Zinc	0.030	0.5	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	0.0033	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*
Zirconium			*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	0.00039	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*
Dissolved Metals (mg/L)																			
Aluminum			0.0060	0.0027	0.0054	0.0034	0.0026	0.0073	0.0040	0.0022	0.0040	0.0018	0.0033	0.045	0.0039	0.0021	0.0072	0.0023	0.0032
Antimony			*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Arsenic			*<0.0001*	0.00020	0.00015	*<0.0001*	0.00034	0.00015	*<0.0001*	0.00032	*<0.0001*	0.00029	0.00016	0.00019	0.00023	0.00026	0.00010	*<0.0001*	0.00024
Barium			0.0066	0.0075	0.0031	0.0026	0.012	0.0038	0.0035	0.0061	0.0048	0.0041	0.0074	0.0034	0.0073	0.0039	0.0058	0.0042	0.0055
Beryllium			*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*
Bismuth			*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Boron			*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Cadmium			*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	0.00001	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Calcium			1.2	2.1	2.0	1.2	2.5	0.92	1.5	2.3	1.3	2.2	2.0	1.1	3.4	2.2	1.9	1.5	2.5
Chromium			*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	0.00010	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	0.00040	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Cobalt			*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Copper			0.00069	0.00063	0.00064	0.00053	0.00047	0.00074	0.00032	0.00080	0.00032	0.00026	0.00082	0.00090	0.00043	0.00025	0.00056	0.00034	0.00055
Iron			0.014	*<0.01*	0.011	*<0.01*	*<0.01*	0.080	0.014	*<0.01*	0.025	*<0.01*	0.012	0.085	*<0.01*	*<0.01*	0.021	0.012	*<0.01*
Lead			*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	0.00014	0.00014	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Lithium			*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	0.0010	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Magnesium			0.38	0.72	0.85	0.28	1.1	0.70	0.47	0.79	0.49	1.0	0.71	0.84	1.0	0.99	0.62	0.54	0.89
Manganese			0.00046	0.00096	0.00068	0.00062	0.0011	0.0018	0.00065	0.00059	0.00041	0.00042	0.00055	0.0028	0.0018	0.00059	0.00083	0.00040	0.00043
Mercury			*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Molybdenum			*<0.00005*	*<0.00005*	*<0.00005*	0.00005	0.00013	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	0.00005	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Nickel			*<0.0005*	0.00052	*<0.0005*	*<0.0005*	*<0.0005*	0.00069	*<0.0005*	0.00061	*<0.0005*	*<0.0005*	*<0.0005*	0.0011	0.0010	*<0.0005*	*<0.0005*	*<0.0005*	0.00065
Phosphorus			*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Potassium			0.34	0.54	0.32	0.27	0.53	0.44	0.37	0.57	0.40	0.59	0.60	0.38	0.45	0.59	0.45	0.38	0.58
Selenium			*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Silicon			0.54	0.37	0.19	0.39	0.64	0.32	0.25	0.36	0.45	0.21	0.34	0.68	0.29	0.21	0.46	0.54	0.44
Silver			*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Sodium			0.77	0.63	0.82	0.65	0.70	0.70	0.56	0.68	0.67	0.51	0.65	0.69	0.63	0.49	0.74	0.80	0.62
Strontium			0.0067	0.0087	0.0062	0.0053	0.012	0.0048	0.0066	0.011	0.0070	0.0093	0.0082	0.0059	0.023	0.0091	0.0080	0.0069	0.011
Sulfur			*<0.5*	0.89		*<0.5*	0.80	*<0.5*	*<0.5*	0.93	*<0.5*	1.1	0.83	*<0.5*	0.60	1.3	0.71	*<0.5*	1.1
Thallium			*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Tin			0.00016	0.00012	0.00013	0.00013	0.00011	*<0.0001*	*<0.0001*	0.00012	*<0.0001*	*<0.0001*	0.00027	*<0.0001*	0.00011	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Titanium			*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	0.0011	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*
Uranium			0.00004	0.00002	0.00004	0.00005	0.00002	0.00005	0.00003	0.00002	0.00002	*<0.00001*	0.00003	0.00014	0.00002	*<0.00001*	0.00002	0.00001	0.00001
Vanadium			*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*
Zinc			*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	0.0015	*<0.001*	*<0.001*	0.0012	*<0.001*	0.0012
Zirconium			*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*

Notes:

[1] CCME (Canadian Council of Ministers of the Environment) Canadian Water Quality Guidelines for the Protection of Aquatic Life, 1999, updated up to 2014.

[2] Guidelines for Canadian Drinking Water Quality (Federal-Provincial-Territorial Committee on Health and the Environment). Standards for the following parameters are aesthetic and meant to protect against taste and odour: chloride, sulphate, copper, iron, manganese, sodium, zinc.

[3] "equation" means that CCME guidelines are calculated based on an equation which is either pH or hardness dependent. The ammonia and aluminum guidelines vary with pH; the cadmium, copper, lead, and nickel guidelines vary with hardness.

[4] Chromium CCME guideline is for Cr VI.

123 Shaded concentrations exceed the CCME aquatic life guidelines.

123 Bordered concentrations exceed the GCDWQ.

Italicized numbers are below detection limits.

"-" analysis/measurement not collected.

~~strikethrough~~ = results flagged as unreliable in the QC assessment (see Section 2.2.2 for more details).

3. SEDIMENT CHEMISTRY

3.1. Methods Overview

3.1.1. Sample Collection

Baseline sediment sampling was completed by Portt and Associates in 2014 and Azimuth in 2015 according to methods outlined in the Meadowbank CREMP SOP (Azimuth 2015b). The sampling locations for the 2014 baseline study were synoptic with the benthic invertebrate stations established broadly throughout each of the Lakes. Of the 5 benthic invertebrate locations in each lake, Locations 1, 3 and 5 were sampled for sediment (**Figure 1ï3** [Whale Tail], **Figure 1ï4** [Nemo], **Figure 1ï5** [Mammoth]). The 2015 baseline study established replicate sediment/benthic invertebrate sampling locations over a smaller spatial scale (~100 m diameter) in areas (basins) of each lake with the targeted sampling depth of 8 m ± 1.5 m. This approach to defining the sampling basins is consistent with the Meadowbank CREMP; allowing for long-term monitoring of sediment quality in the Whale Tail Pit Study Area Lakes.

Sediment and benthic invertebrate samples were collected from 5 basins during the August 2015 sampling event.

- North basin of Whale Tail Lake (WTN and WTN-Ex [shallow])
- South basin of Whale Tail Lake (WTS)
- Nemo Lake (NEM)
- Mammoth Lake (MAM)

The 5 stations (replicates) in each 2015 area were spaced a minimum of 20 m apart. WTN and WTN-Ex are located in the area of Whale Tail Lake where the open pit is planned (**Figure 1ï2**). These areas were sampled to characterize the habitat prior to anticipated development activities. The sampling locations were established in areas where the water depth was 8 m ± 1.5 m; the exception was WTN-Ex, which was located in a shallower area of the North Basin of Whale Tail Lake.

Sediment samples were collected after sampling the benthic invertebrates at each station according to the SOP (Azimuth 2015b). A Petite Ponar grab sampler was used to collect the sediment samples, and each sample was a composite of two grabs. Sediment was collected by lowering the grab to the within 1 m of the sediment, at which point the rate of decent was slowed to minimize disruption of the surficial layer of sediment. Upon retrieval, the grab was placed in a large stainless steel bowl and inspected according to the acceptability criteria outlined in the SOP, namely: the absence of large foreign objects, adequate penetration depth, the grab is not overfilled, the jaws closed completely (i.e., well-sealed), and the sediment surface in the grab is undisturbed. Grabs that failed the acceptability criteria were discarded into a 20-L bucket and retained until sampling was completed at the station. Grabs that met the acceptability criteria were sampled by scooping the top 3 to 5 cm of sediment from the grab into a stainless steel bowl using a stainless steel spoon. Sediment from the first grab was discarded into a 20-L bucket and the grab was rinsed with lake water before collecting the second grab sample. After collecting the second grab, the sediment was thoroughly homogenized and transferred into two 125 mL glass jars, one for metals, moisture and pH, and the other for particle size analysis and total organic carbon (TOC) content. A single scoop of sediment was placed in a separate stainless steel bowl used to composite sediment from each of the 5 replicate stations. This composite sample was submitted for analysis of mineral oil and grease, hydrocarbons, and polycyclic aromatic hydrocarbons (PAHs).

3.1.2. Laboratory Methods

Sediment samples were shipped to ALS and analyzed for the following parameters:

- Moisture and pH
- Particle size and TOC
- Metals
- Mineral oil and grease
- Hydrocarbons (LEPHs and HEPHs)
- PAHs

A complete list of the sediment parameters, detection limits, data quality objectives, and method references is present in Table 1 of the SOP (Azimuth 2015b).

3.1.3. Data Handling and Analysis

Sediment chemistry results from the 2014 baseline study were provided to Azimuth by Portt and Associates. The data from 2014 and 2015 were tabulated in Microsoft Excel and screened against the interim sediment quality guidelines (ISQGs) and probable effect level (PEL) concentrations in CCME (2015b). The results were also qualitatively compared to the chemistry data from the reference lakes (INUG and PDL) for additional context and the triggers/thresholds developed for the Meadowbank CREMP lakes (Azimuth 2012b).

3.2. Quality Assurance / Quality Control

The QA/QC assessment is limited to the 2015 data collected by Azimuth. Refer to Portt and Associates (2015a) for information on laboratory and field duplicate QA/QC results from the 2014 baseline study.

3.2.1. QA/QC Methods

Laboratory QC

Laboratory duplicates were analyzed for sediment chemistry parameters similar to water chemistry parameters. The full list of laboratory DQOs for each parameter are presented in SOP (Azimuth 2015b). Analysis of method blanks and CRM are also included as part of ALS's QC program.

Field QA/QC

Field QA consisted of taking care between sampling areas, by rinsing and cleaning the sampling gear for sediment grabs (Petite Ponar grab, stainless steel compositing bowls and spoons) and sediment cores (corer and spatula) using site water and phosphate-free cleaning detergent, avoids the possibility of cross-contamination. Field QC measures included collection and analysis of the following:

- Field Duplicates – Field duplicate samples are collected in the immediate vicinity of original samples from randomly selected locations as a test of consistency in field methodology and to characterize heterogeneity of sediment chemistry within discrete areas. The number of field duplicates taken is approximately 10% of original samples. The DQO for field duplicate samples is based on an RPD of 50% for concentrations that are >10 x MDL. Failure of this DQO indicates high variability, which may be due to natural causes (e.g., heterogeneous mineralization) or to incomplete homogenization during mixing.

- Filter Swipes – Metals analysis is conducted on an ashless filter that is swiped over the pre-cleaned bowl and grab to assess the cleaning procedures; this is done on 10% of the samples. The significance of any metal detected on the filter is evaluated by factoring in the potential influence of those trace amounts to the entire sample. Where comparisons were required, the concentration of metals originating from any equipment was estimated by dividing the amount detected on the filter (weight) by the volume of two Petite Ponar grabs (assuming a thickness of 3 cm was collected from each), that was multiplied by the density of sediment (assumed to be 2 g/cm^3).

3.2.2. QA/QC Results

Detailed results of the sediment chemistry QA/QC assessment are provided in **Appendix A1** (**Section A1-2**) and summarized in the following sections.

Laboratory QC

Results of the laboratory duplicate samples analysis are presented in **Table A1ï8**. The DQOs were met for all of the laboratory duplicate samples that were analyzed as part of the 2015 baseline sediment sampling program. Method blank and CRM results were also within the laboratory DQOs in 2015. The original ALS data report for the sediment analysis is presented in **Appendix C**.

Field QA/QC

The DQOs were met for all metals analyses in the field duplicates submitted in 2015 with the exception of particle size in one set of duplicate samples (sand and clay in the duplicate from Mammoth Lake [**Table A1ï8**]). The observed difference in this field duplicate is like a result of small-scale spatial heterogeneity in the particle size distribution at this location.

There were a few parameters that were detected on at least one of the swipe samples: aluminum, barium, chromium, iron, magnesium, manganese, nickel, tin, titanium, and zinc (**Table A1ï8**). Mass balance estimates from the swipes corresponded to less than 0.1% of the total metals concentration in the sediment samples, indicating that any residual metals present on the equipment would not influence the overall sediment chemistry.

3.3. Results

Lake sediment chemistry results from the 2014 and 2015 baseline programs are presented in **Table 3ï1** (particle size, TOC, and metals) and **Table 3ï2** (mineral oil and grease, hydrocarbons, and PAHs). The original ALS data report for samples collected in 2015 is included in **Appendix C**.

The particle size distribution in the top 3-5 cm of sediment was predominantly silt/clay, characteristic of depositional areas in all the lakes sampled in this region (Azimuth 2015b). Average silt/clay content in Whale Tail Lake (WTN and WTS) and Mammoth Lake was greater than 95% in the samples collected in 2014 and 2015 with the exception of Location 1 in the North Basin of Whale Tail Lake in 2014 that had 12% sand (**Table 3ï1**). Nemo Lake had a slightly coarser particle size distribution despite similar station depths. Sediment collected from Locations 3 and 5 in 2014 were predominantly sand (68% and 50%, respectively; **Table 3ï1**). In 2015, samples collected from the NEM basin (**Figure 1ï4**) had approximately 30% sand (0.063 mm to 2 mm particle size range) compared to WTN, WTS and MAM, which all had average percent sand content of less than 5%. Sediment collected from the shallow zone of the North Basin of Whale Tail Lake (WTN-Ex [~ 5 m deep]) was also coarser (range) relative to deeper locations (range).

Arsenic, chromium, and to a lesser extent copper, exceeded the ISQG and PEL SQGs at most of the stations sampled in Whale Tail Pit Study Area Lakes in 2014 and 2015, as well as at the reference areas INUG and PDL. Meadowbank trigger values were also consistently exceeded for arsenic at WTN and chromium at WTN-Ex, MAM, and PDL (**Table 3ï1**), suggesting that development of triggers specific to the Whale Tail Pit Study Area Lakes for these metals would be appropriate. Within Whale Tail Lake, the 2014 and 2015 results are similar, with higher metals concentrations (particularly arsenic and chromium) in sediment from the North Basin (Location 1 in 2014 and WTN/ WTN-Ex in 2015) compared to the South Basin (Location 5 in 2014 and WTS in 2015). Nemo Lake (NEM) had the lowest overall metals concentrations in the samples collected in 2014 and 2015, consistent with courser overall particle size compared to the other areas that were sampled. With the exception of arsenic, the metals concentrations from the Whale Tail Pit Study Area Lakes were generally similar to the concentrations measured at INUG and PDL (**Table 3ï1**). Average arsenic concentrations in sediment from INUG and PDL were 69 mg/kg and 35 mg/kg, respectively. The highest arsenic concentrations, averaging over 1,000 mg/kg (dw) were measured in sediment from WTN in 2015. At WTN-Ex (and Location 1 in 2014), less than 100 m to the west of WTN, concentrations were an order of magnitude less, averaging approximately 100 mg/kg. High natural spatial heterogeneity in sediment metals concentrations is common in areas of natural mineralization and has previously been documented under baseline conditions for lakes monitored as part of the Meadowbank CREMP (Azimuth 2015b).

Table 3-1. Conventional sediment grab chemistry, particle size, and total metals concentrations, Whale Tail Pit Baseline, 2014 and 2015.

Baseline Year					Whale Tail Lake															
Baseline Program	**CCME (2002)**		**Meadowbank Triggers**		**2014 Baseline[1]**			**2015 Baseline**												
Basin Name & Code	**Guideline[2]**		**and Thresholds**					**North Basin - Shallow (WTN-Ex)**					**North Basin (WTN)**					**South Basin (WTS)**				
Area-Replicate ID					REP-1	REP-3	REP-5	WTN-EX-1	WTN-EX-2	WTN-EX-3	WTN-EX-4	WTN-EX-5	WTN-1	WTN-2	WTN-3	WTN-4	WTN-5	WTS-1	WTS-2	WTS-3	WTS-4	WTS-5
Date	**ISQG**	**PEL**	**Trigger[3]**	**Threshold[3]**	5-Sep-14	5-Sep-14	5-Sep-14	22-Aug-15	22-Aug-15	22-Aug-15	22-Aug-15	22-Aug-15	22-Aug-15	22-Aug-15	22-Aug-15	22-Aug-15	22-Aug-15	21-Aug-15	21-Aug-15	21-Aug-15	21-Aug-15	21-Aug-15
Physical & Organic Parameters																						
Moisture (%)					88	86	87	86	87	88	87	89	85	87	81	87	87	86	85	87	87	84
pH					6.2	5.1	6.0	6.0	5.8	6.4	6.0	6.2	6.3	6.2	5.7	5.7	5.8	5.5	5.5	5.5	5.8	5.9
Total Organic Carbon (% dw)					7.0	4.7	5.8	6.7	7.1	7.8	7.4	8.7	4.9	5.2	4.7	5.7	5.2	5.3	5.5	6.2	6.4	4.6
Particle Size																						
% Gravel (>2mm)					*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*	0.15	*<0.10*	*<0.10*	0.41	*<0.10*	*<0.10*	0.12	*<0.10*	*<0.10*	*<0.10*	*<0.10*	0.82
% Sand (2.00mm - 0.063mm)					12	1.5	0.85	24	9.2	22	22	9.4	4.1	4.1	4.7	3.2	4.8	5.4	3.1	2.8	2.8	4.5
% Silt (0.063mm - 4µm)					75	80	80	66	79	71	70	83	87	86	83	85	84	82	82	82	85	82
% Clay (<4µm)					13	19	20	9.9	12	7.2	8.0	8.1	9.0	9.5	13	12	12	13	15	15	13	13
Total Metals (mg/kg dw)																						
Aluminum					18800	19200	19900	14700	18400	13500	15200	16000	13900	12700	14800	14200	13400	14700	16800	17100	16200	16400
Antimony					0.31	0.23	0.22	0.27	0.29	0.29	0.29	0.35	0.25	0.27	0.25	0.34	0.27	0.23	0.26	0.22	0.23	0.22
Arsenic*	5.9	17	120.0		***51***	***151***	***8.6***	***69***	***147***	***80***	***82***	***139***	***897***	***1000***	***568***	***1760***	***809***	***102***	***152***	***80***	***112***	***118***
Barium					116	134	134	98	129	102	107	106	212	586	97	180	179	113	120	122	133	104
Beryllium					1.3	1.5	1.5	1.1	1.5	1.1	1.1	1.3	1.2	1.2	1.3	1.3	1.2	1.4	1.7	1.5	1.4	1.3
Bismuth					0.39	0.59	0.54	0.33	0.47	0.33	0.34	0.40	0.45	0.42	0.47	0.49	0.46	0.52	0.58	0.55	0.56	0.53
Cadmium*	0.6	3.5	1.10		0.41	0.35	0.47	0.30	0.48	0.30	0.33	0.38	0.32	0.48	0.15	0.36	0.41	0.41	0.18	0.18	0.30	0.22
Calcium					3040	1850	2780	3310	2950	3220	3340	3710	1950	2150	2050	2260	1660	2300	2340	2630	2530	2030
Chromium*	37.3	90	114.3		***210***	***80***	***79***	***162***	***197***	***169***	***176***	***176***	***84***	***81***	***95***	***95***	***88***	***63***	***70***	***71***	***69***	***66***
Cobalt					15	13	8.7	14	17	15	16	15	24	20	21	25	24	16	16	10	13	24
Copper*	35.7	197	126.0		***49***	***49***	***53***	33	***51***	34	35	***41***	***37***	***38***	36	***42***	***39***	***38***	***45***	***41***	***42***	***39***
Iron					33600	90000	22700	35200	51700	38600	39000	50900	151000	146000	127000	179000	139000	69000	94100	54800	77400	89500
Lead	35	91.3	32.5	35	11	13	14	10	13	9.9	10	11	11	11	12	13	12	14	14	13	14	13
Lithium					18	16	19	16	18	15	17	15	13	12	14	13	13	13	14	15	14	13
Magnesium					10400	6850	7440	8770	9750	8870	9440	9030	5800	5410	6300	6110	5880	5690	5720	6250	5900	5750
Manganese					436	622	267	916	816	1170	1230	744	6660	23500	2200	5430	3900	2010	1890	1040	2180	2760
Mercury	0.17	0.486	0.104	0.17	0.053	0.050	0.038	0.060	0.076	0.068	0.067	0.079	0.074	0.083	0.061	0.094	0.080	0.076	0.079	0.075	0.095	0.066
Molybdenum					2.6	3.3	2.0	2.3	4.6	2.4	2.3	3.8	6.3	6.9	5.3	8.6	5.8	3.3	5.6	3.9	4.0	4.1
Nickel					109	81	76	91	117	92	99	96	92	126	60	93	108	74	64	54	67	60
Phosphorus					675	2270	756	662	794	716	795	864	1830	2250	1770	2750	2020	1680	1380	1050	1330	1070
Potassium					2040	2410	2420	1940	2340	1760	2030	2150	2040	2060	2150	2110	1840	2170	2420	2580	2450	2340
Selenium					0.72	1.0	0.71	0.40	0.70	0.47	0.48	0.59	0.78	0.78	0.75	0.96	0.76	0.67	0.78	0.68	0.82	0.75
Silver					0.29	0.32	0.37	0.21	0.31	0.21	0.23	0.27	0.26	0.28	0.23	0.32	0.25	0.26	0.29	0.33	0.34	0.24
Sodium					160	180	160	293	339	327	390	506	292	302	257	355	328	282	276	344	409	330
Strontium					23	22	25	24	23	22	26	25	22	30	22	25	19	22	23	25	25	21
Thallium					0.19	0.21	0.15	0.13	0.19	0.13	0.14	0.16	0.22	0.24	0.15	0.21	0.24	0.20	0.18	0.17	0.19	0.20
Tin					*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*
Titanium					529	497	458	485	537	393	507	500	379	370	413	393	308	407	437	456	425	447
Uranium					9.9	12	13	8.1	12	7.7	8.3	10	8.8	8.5	9.2	9.6	9.2	9.5	12	11	11	10
Vanadium					37	29	27	31	38	29	32	34	24	22	26	25	24	24	27	27	26	26
Zinc*	123	315	121.3		105	112	99	85	112	86	90	107	88	99	79	96	93	87	99	88	90	84

Notes:

[1] 2014 data presented here was adapted from Portt and Associates (2015a).

[2] CCME (Canadian Council of Ministers of the Environment) Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, 1999, updated in 2002. ISQG = Interim freshwater Sediment Quality Guideline. ISQG = Interim sediment quality guideline; PEL = probable effect level.

[3] Trigger and threshold values are described in (Azimuth, 2015b). Thresholds are set equal to CCME ISQG guidelines, where available.

* CCME guideline not used as threshold value because threshold value is lower than trigger value.

123 Bold italicized concentrations exceed the ISQG guideline.

123 Bordered concentrations exceed the PEL guideline.

123 Bolded and shaded concentrations also exceed the trigger value.

Italicized numbers are below detection limits.

Table 3-1. Conventional sediment grab chemistry, particle size, and total metals concentrations, Whale Tail Pit Baseline, 2014 and 2015.

Baseline Year					Mammoth Lake (MAM)								Nemo Lake (NEM)							
Baseline Program					2014 Baseline[1]			2015 Baseline					2014 Baseline[1]			2015 Baseline				
Basin Name & Code	**CCME (2002)**		**Meadowbank Triggers**																	
Area-Replicate ID	**Guideline**[2]		**and Thresholds**		REP-1	REP-3	REP-5	MAM-1	MAM-2	MAM-3	MAM-4	MAM-5	REP-1	REP-3	REP-5	NEM-1	NEM-2	NEM-3	NEM-4	NEM-5
Date	**ISQG**	**PEL**	**Trigger**[3]	**Threshold**[3]	4-Sep-14	4-Sep-14	4-Sep-14	24-Aug-15	24-Aug-15	24-Aug-15	24-Aug-15	24-Aug-15	6-Sep-14	6-Sep-14	6-Sep-14	23-Aug-15	23-Aug-15	23-Aug-15	23-Aug-15	23-Aug-15
Physical & Organic Parameters																				
Moisture (%)					91	89	91	90	91	91	90	90	89	31	80	92	86	91	91	87
pH					5.7	5.9	6.0	5.9	6.0	5.7	5.5	5.4	5.5	6.3	5.9	6.2	6.5	6.3	6.5	6.5
Total Organic Carbon (% dw)					9.6	7.0	9.3	11	12	11	12	11	6.6	0.26	3.3	8.2	6.0	11	11	5.5
Particle Size																				
% Gravel (>2mm)					*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*	6.3	0.94	*<0.10*	0.26	*<0.10*	*<0.10*	*<0.10*
% Sand (2.00mm - 0.063mm)					0.11	0.20	0.15	0.92	2.5	0.72	0.85	1.1	19	68	50	13	50	19	19	44
% Silt (0.063mm - 4µm)					84	84	84	94	92	94	93	92	76	25	46	78	47	76	77	53
% Clay (<4µm)					16	16	15	5.2	5.1	5.3	6.1	6.6	5.7	0.58	3.2	9.6	2.4	4.4	3.6	2.6
Total Metals (mg/kg dw)																				
Aluminum					21500	28500	20000	19100	18600	19500	17000	18400	11600	6390	9850	10800	9250	10800	9990	9610
Antimony					0.37	0.38	0.41	0.29	0.32	0.37	0.25	0.26	0.37	*<0.10*	0.44	0.40	0.22	0.35	0.36	0.20
Arsenic*	5.9	17	120.0		***71***	***158***	***55***	***76***	***143***	***277***	***69***	***70***	***25***	***11***	***17***	***52***	***13***	***46***	***80***	***26***
Barium					142	213	155	142	142	153	125	136	64	23	64	99	63	91	99	64
Beryllium					1.4	1.9	1.5	1.3	1.3	1.6	1.1	1.2	0.68	0.27	0.58	0.64	0.46	0.59	0.55	0.47
Bismuth					0.52	0.76	0.59	0.47	0.45	0.53	0.39	0.43	0.22	*<0.20*	0.21	0.23	*<0.20*	0.21	0.22	*<0.20*
Cadmium*	0.6	3.5	1.10		0.42	***0.61***	0.54	0.27	0.26	0.30	0.27	0.30	0.22	*<0.050*	0.38	0.25	0.18	0.22	0.20	0.14
Calcium					2530	2610	2980	3620	3370	3310	2770	2780	2690	1430	1940	3490	3030	3690	3160	2280
Chromium*	37.3	90	114.3		***174***	***211***	***163***	***161***	***162***	***168***	***141***	***158***	***112***	***66***	***87***	***113***	***97***	***110***	***104***	***106***
Cobalt					12	16	12	11	12	14	12	13	7.6	7.2	6.0	8.6	6.9	8.0	10	6.8
Copper*	35.7	197	126.0		***76***	***117***	***88***	***63***	***64***	***76***	***57***	***61***	***39***	7.1	***38***	***40***	22	***36***	33	28
Iron					35100	53100	32200	34100	43400	61200	30200	33000	19400	15800	16000	25800	14600	23800	32500	18000
Lead	35	91.3	32.5	35	17	24	19	17	17	19	16	17	7.4	3.3	6.8	9.3	6.4	8.4	8.6	7.2
Lithium					17	22	19	18	17	16	15	15	13	7.9	11	9.8	9.9	10	8.5	8.5
Magnesium					9980	12000	9310	9260	9010	8660	8380	8900	7170	5250	5640	6450	6640	6590	6130	6480
Manganese					307	583	309	349	414	468	357	408	210	408	194	407	236	302	861	301
Mercury	0.17	0.486	0.104	0.17	0.059	0.052	0.049	0.099	0.099	0.097	0.096	0.096	0.011	*<0.0050*	0.009	0.030	0.018	0.029	0.032	0.021
Molybdenum					4.3	5.1	4.1	3.2	3.7	6.0	2.8	2.9	2.6	*<0.50*	2.1	3.8	1.4	2.5	3.2	3.0
Nickel					123	194	127	105	102	109	99	107	79	37	84	88	64	78	86	66
Phosphorus					632	1220	871	868	911	951	764	796	504	345	375	697	518	664	736	498
Potassium					2860	3840	2900	3090	2950	2990	2710	2990	1310	650	1090	1470	1210	1460	1380	1230
Selenium					0.90	1.4	0.95	0.63	0.63	0.84	0.61	0.67	0.54	*<0.20*	0.50	0.56	0.34	0.51	0.56	0.36
Silver					0.46	0.55	0.54	0.42	0.42	0.48	0.43	0.44	0.13	*<0.10*	0.15	0.18	*<0.10*	0.16	0.13	0.11
Sodium					160	210	150	424	442	520	304	338	*<100*	*<100*	*<100*	430	390	555	522	297
Strontium					18	21	21	25	24	24	20	21	26	17	20	26	26	27	24	20
Thallium					0.30	0.38	0.33	0.25	0.22	0.25	0.22	0.25	0.091	*<0.050*	0.088	0.093	0.060	0.079	0.081	0.064
Tin					*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*
Titanium					509	744	556	528	510	565	451	481	325	245	237	269	333	258	241	261
Uranium					13	18	15	12	12	14	11	11	4.4	1.6	4.2	4.1	2.5	3.6	3.5	3.0
Vanadium					42	56	42	40	40	43	36	38	24	14	19	24	19	23	22	21
Zinc*	123	315	121.3		***141***	***154***	***147***	110	109	***129***	99	110	63	25	54	60	44	54	55	45

Notes:

[1] 2014 data presented here was adapted from Portt and Associates (2015a).

[2] CCME (Canadian Council of Ministers of the Environment) Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, 1999, updated in 2002. ISQG = Interim freshwater Sediment Quality Guideline. ISQG = Interim sediment quality guideline; PEL = probable effect level.

[3] Trigger and threshold values are described in (Azimuth, 2015b). Thresholds are set equal to CCME ISQG guidelines, where available.

* CCME guideline not used as threshold value because threshold value is lower than trigger v

123 Bold italicized concentrations exceed the ISQG guideline.

123 Bordered concentrations exceed the PEL guideline.

123 Bolded and shaded concentrations also exceed the trigger value.

Italicized numbers are below detection limits.

Table 3-1. Conventional sediment grab chemistry, particle size, and total metals concentrations, Whale Tail Pit Baseline, 2014 and 2015.

Baseline Year					Inuggugayualik Lake (INUG)					Pipedream Lake (PDL)				
Baseline Program					2015 Baseline					2015 Baseline				
Basin Name & Code	**CCME (2002)**		**Meadowbank Triggers**											
Area-Replicate ID	**Guideline**[2]		**and Thresholds**		INUG-1	INUG-2	INUG-3	INUG-4	INUG-5	PDL-1	PDL-2	PDL-3	PDL-4	PDL-5
Date	**ISQG**	**PEL**	**Trigger**[3]	**Threshold**[3]	27-Aug-15	27-Aug-15	27-Aug-15	27-Aug-15	27-Aug-15	26-Aug-15	26-Aug-15	26-Aug-15	26-Aug-15	26-Aug-15
Physical & Organic Parameters														
Moisture (%)					82	85	85	86	84	86	79	79	81	78
pH					6.0	6.1	5.8	5.7	5.7	5.9	6.3	6.2	6.2	5.9
Total Organic Carbon (% dw)					3.8	4.4	4.9	4.9	3.8	5.1	2.5	2.4	2.7	2.5
Particle Size														
% Gravel (>2mm)					*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*
% Sand (2.00mm - 0.063mm)					5.6	6.3	3.5	2.7	3.1	10.0	15	5.7	5.8	14
% Silt (0.063mm - 4µm)					85	80	82	83	80	78	75	75	77	79
% Clay (<4µm)					9.8	14	15	14	17	12	9.9	19	17	7.6
Total Metals (mg/kg dw)														
Aluminum					19300	20900	20400	20100	18300	17400	19200	23600	22000	16700
Antimony					0.19	0.18	0.20	0.23	0.18	0.26	0.23	0.29	0.30	0.26
Arsenic*	5.9	17	120.0		***121***	***11***	***17***	***62***	***135***	***12***	***13***	***53***	***39***	***60***
Barium					109	126	128	132	109	99	96	109	99	82
Beryllium					1.3	1.4	1.4	1.4	1.2	0.94	1.0	1.2	1.2	0.83
Bismuth					1.1	1.2	1.3	1.2	1.1	0.77	0.89	1.2	1.1	0.73
Cadmium*	0.6	3.5	1.10		0.15	0.23	0.29	0.30	0.16	0.28	0.13	0.22	0.13	0.19
Calcium					1900	2280	2150	2110	1730	2660	2470	2320	2390	2390
Chromium*	37.3	90	114.3		***99***	***110***	***107***	***105***	***95***	***121***	***131***	***160***	***149***	***117***
Cobalt					12	11	11	13	14	10	12	21	18	15
Copper*	35.7	197	126.0		***43***	***46***	***48***	***48***	***42***	***45***	***43***	***63***	***54***	***37***
Iron					91900	37500	44900	70900	129000	26200	29900	50700	44300	50300
Lead	35	91.3	32.5	35	13	14	16	16	12	14	14	17	17	13
Lithium					26	29	28	28	25	27	29	35	33	25
Magnesium					8660	9450	9070	9120	8190	9700	10500	12200	11600	9590
Manganese					1060	712	660	1060	1440	265	338	2100	1160	675
Mercury	0.17	0.486	0.104	0.17	0.028	0.032	0.040	0.043	0.027	0.021	0.014	0.013	0.016	0.018
Molybdenum					6.8	3.3	3.9	4.9	13	1.8	2.2	4.3	3.3	5.0
Nickel					68	78	79	85	72	80	78	114	90	78
Phosphorus					2650	810	1080	1820	2010	517	508	582	519	598
Potassium					3340	3600	3450	3360	3050	2670	2970	3560	3350	2550
Selenium					0.59	0.54	0.64	0.74	0.63	0.42	0.38	0.24	0.35	0.40
Silver					0.15	0.18	0.22	0.23	0.15	0.25	0.18	*<0.10*	*<0.10*	0.15
Sodium					231	314	343	320	225	282	192	216	223	197
Strontium					24	26	25	24	21	23	25	26	26	23
Thallium					0.19	0.21	0.21	0.21	0.19	0.17	0.18	0.23	0.21	0.17
Tin					*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*
Titanium					544	601	550	517	474	530	617	617	597	584
Uranium					14	16	17	17	14	7.5	7.8	12	11	6.4
Vanadium					34	37	37	35	32	33	38	45	42	34
Zinc*	123	315	121.3		82	86	91	91	82	77	77	96	87	71

Notes:

[1] 2014 data presented here was adapted from Portt and Associates (2015a).

[2] CCME (Canadian Council of Ministers of the Environment) Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, 1999, updated in 2002. ISQG = Interim freshwater Sediment Quality Guideline. ISQG = Interim sediment quality guideline; PEL = probable effect level.

[3] Trigger and threshold values are described in (Azimuth, 2015b). Thresholds are set equal to CCME ISQG guidelines, where available.

* CCME guideline not used as threshold value because threshold value is lower than trigger v

123 Bold italicized concentrations exceed the ISQG guideline.

123 Bordered concentrations exceed the PEL guideline.

123 Bolded and shaded concentrations also exceed the trigger value.

Italicized numbers are below detection limits.

Table 3-2. Hydrocarbon and PAH concentrations in composite sediment grab samples, Whale Tail Pit Baseline, 2014 and 2015.

Baseline Year			2014 Baseline[1]			2015 Baseline			
Lake	CCME (2002) Guidelines[2]		Whale Tail Lake	Mammoth Lake	Nemo Lake	Whale tail Lake		Mammoth Lake	Nemo Lake
Area ID						WTN	WTS	MAM	NEM
Date	ISQG	PEL	5-Sep-14	4-Sep-14	6-Sep-14	22-Aug-15	21-Aug-15	24-Aug-15	23-Aug-15
Physical Parameters									
Moisture (%)			84.8	89.3	77.2	88.1	85.9	90.9	90.0
Aggregate Organics (mg/kg)									
Mineral Oil and Grease			1150	1690	720	*<525*	1690	1960	2990
Hydrocarbons (mg/kg)									
EPH10-19			*<540*	*<800*	*<380*	*<820*	*<680*	*<1100*	*<880*
EPH19-32			*<540*	*<800*	*<380*	*<820*	*<680*	*<1100*	*<880*
LEPH			*<540*	*<800*	*<380*	*<820*	*<680*	*<1100*	*<880*
HEPH			*<540*	*<800*	*<380*	*<820*	*<680*	*<1100*	*<880*
Polycyclic Aromatic Hydrocarbons (mg/kg)									
Acenaphthene	0.00671	0.0889	*<0.0050*	*<0.0050*	*<0.0050*	*<0.010*	*<0.0050*	*<0.015*	*<0.010*
Acenaphthylene	0.00587	0.128	*<0.0050*	*<0.0050*	*<0.0050*	*<0.010*	*<0.0050*	*<0.015*	*<0.010*
Anthracene	0.0469	0.245	*<0.0040*	*<0.0040*	*<0.0040*	*<0.0080*	*<0.0040*	*<0.012*	*<0.0080*
Benzo(a)anthracene	0.0317	0.385	*<0.010*	*<0.010*	*<0.010*	*<0.020*	*<0.010*	*<0.030*	*<0.020*
Benzo(a)pyrene	0.0319	0.782	*<0.010*	*<0.010*	*<0.010*	*<0.020*	*<0.010*	*<0.030*	*<0.020*
Benzo(b)fluoranthene			*<0.010*	*<0.010*	*<0.010*	*<0.020*	*<0.010*	*<0.030*	*<0.020*
Benzo(b+j+k)fluoranthene			*<0.015*	*<0.015*	*<0.015*	*<0.028*	*<0.015*	*<0.042*	*<0.028*
Benzo(g,h,i)perylene			*<0.010*	*<0.010*	*<0.010*	*<0.020*	*<0.010*	*<0.030*	*<0.020*
Benzo(k)fluoranthene			*<0.010*	*<0.010*	*<0.010*	*<0.020*	*<0.010*	*<0.030*	*<0.020*
Chrysene	0.0571	0.862	*<0.010*	*<0.010*	*<0.010*	*<0.020*	*<0.010*	*<0.030*	*<0.020*
Dibenz(a,h)anthracene	0.00622	0.135	*<0.0050*	*<0.0050*	*<0.0050*	*<0.010*	*<0.0050*	*<0.015*	*<0.010*
Fluoranthene	0.111	2.355	*<0.010*	*<0.010*	*<0.010*	*<0.020*	*<0.010*	*<0.030*	*<0.020*
Fluorene	0.0212	0.144	*<0.010*	*<0.010*	*<0.010*	*<0.020*	*<0.010*	*<0.030*	*<0.020*
Indeno(1,2,3-c,d)pyrene			*<0.010*	*<0.010*	*<0.010*	*<0.020*	*<0.010*	*<0.030*	*<0.020*
2-Methylnaphthalene	0.0202	0.201	*<0.010*	*<0.010*	*<0.010*	*<0.020*	*<0.010*	*<0.030*	*<0.020*
Naphthalene	0.0346	0.391	*<0.010*	*<0.010*	*<0.010*	*<0.020*	*<0.010*	*<0.030*	*<0.020*
Phenanthrene	0.0419	0.515	*<0.010*	*<0.010*	*<0.010*	*<0.020*	*<0.010*	*<0.030*	*<0.020*
Pyrene	0.053	0.875	*<0.010*	*<0.010*	*<0.010*	*<0.020*	*<0.010*	*<0.030*	*<0.020*
d10-Acenaphthene (%)			88.8	95.0	87.6	95.2	97.0	87.7	94.4
d12-Chrysene (%)			083.8	099.3	106.9	113.5	121.5	115.7	122.1
d8-Naphthalene (%)			84.6	91.6	86.5	90.2	92.2	78.1	85.3
d10-Phenanthrene (%)			83.8	94.4	97.6	108.6	114.2	108.1	115.2
B(a)P Total Potency Equivalent			*<0.020*	*<0.020*	*<0.020*	*<0.020*	*<0.020*	*<0.029*	*<0.020*
IACR (CCME)			*<0.15*	*<0.15*	*<0.15*	*<0.21*	*<0.15*	*<0.32*	*<0.21*

Notes:

[1] 2014 data presented here was adapted from Portt and Associates (2015a).

[2] CCME (Canadian Council of Ministers of the Environment) Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, 1999, updated in 2002.

ISQG = Interim freshwater Sediment Quality Guideline

PEL = Probable effect level

123 Bold italicized concentrations exceed the ISQG guideline.

123 Bordered concentrations exceed the PEL guideline.

Italicized numbers are below detection limits.

4. PHYTOPLANKTON

4.1. Methods Overview

4.1.1. Sample Collection

Baseline Lake phytoplankton sampling was completed by Portt and Associates in 2014 and Azimuth in 2015 according to the Meadowbank CREMP SOP (Azimuth 2015b). Unfiltered water samples were collected for phytoplankton taxonomy from the Lake stations[7] concurrent with water samples collected for analysis of chlorophyll-*a* and other parameters discussed in **Section 2**. Baseline sampling for 2014 study was completed in early September. Sampling for the 2015 baseline program was completed monthly during the open water season (July, August, and September). Water samples were collected from 3 m using the pump and tubing system described above (**Section 2.1.1**) and preserved using Lugol's iodine solution.

4.1.2. Laboratory Methods

Phytoplankton samples were submitted to Plankton-R-Us Inc. (Winnipeg, MB) for taxonomy and biomass measurements for the 2014 and 2015 baseline studies. For the analysis, 10-mL aliquots of preserved sample were gravity settled for 24 hours. Counts were performed on an inverted microscope at magnifications of 125X, 400X, and 1200X with phase contrast illumination. Cell counts were performed using the Ütermohl technique as modified by Nauwerck (1963). Cell counts were converted to wet weight biomass (mg/m^3) by estimating cell volume. Estimates of cell volume for each species were obtained by measurements of up to 50 cells of an individual species and applying the geometric formula best fitted to the shape of the cell (Vollenweider, 1968; Rott, 1981). A specific gravity of 1 was assumed for cellular mass. All biomass (mg/m^3) and density (cells/L) estimates are summed by major taxa, per area.

4.1.3. Data Handling and Analysis

Phytoplankton taxonomy data from the 2014 baseline study were provided to Azimuth by Portt and Associates. Density and biomass results from 2014 and 2015 were tabulated in Microsoft Excel and plotted using R software. Chlorophyll-*a* data were tabulated and presented with other water quality data in **Section 2.3.1**. Density (mg/L) and biomass (mg/m^3) were discussed at the major taxa group level of identification, specifically, cyanophytes (blue green algae), chlorophytes (green algae), chrysophytes (golden-brown algae), diatoms, cryptophytes and dinoflagellates. Taxonomy, biomass, and chlorophyll-*a* results from the Whale Tail Pit Study Area Lakes were qualitatively compared against the results from the reference areas PDL and INUG.

4.2. Quality Assurance / Quality Control

4.2.1. QA/QC Methods

Field duplicates were collected for phytoplankton during each sampling event in coordination with water sample duplicates. The duplicates were taken to assess sampling variability and sample homogeneity. A RPD of 50% for total density and total biomass concentrations is considered acceptable.

As a measure of laboratory QA/QC on the enumeration method, replicate counts are performed on 10% of the samples. Replicate samples are chosen at random and processed at different times from the

[7] Phytoplankton samples were not collected at the Sentinel or Tributary stations.

original analysis to reduce biases. The laboratory replicate is a new aliquot (10 mL) from the sample jar and is counted from the start in the same manner as the original aliquot (10 mL) taken from the jar. A RPD of 25% for total density and total biomass concentrations is considered acceptable for laboratory duplicates.

4.2.2. QA/QC Results

Results of the QA/QC assessment for the 2014 and 2015 phytoplankton data are presented in **Appendix A2**. The laboratory duplicate results and field duplicate results are presented in **Table A2ï1** and **Table A2ï2**, respectively. Field and laboratory duplicates RPDs for total density and total biomass mostly met the DQOs (i.e., < 25% for laboratory and < 50% for field) with the exception of total density in the August 2015 field duplicate that slightly exceeded the DQO by approximately 2% (i.e., RPD value of 51.9%).

4.3. Results

Phytoplankton data from September 2014 samples collected by Portt and Associates (2015a) are presented in **Table 4ï1** (biomass) and **Table 4ï2** (density and richness). Results from the 2015 baseline program completed by Azimuth in July, August, and September 2015 are shown in **Table 4ï3** (biomass) and **Table 4ï4** (density and richness).

Six major taxonomic groups of phytoplankton are present in the study lakes, namely blue green algae (*Cyanophyta*), green algae (*Chlorophyta*), golden-brown algae (*Chrysophyta*), diatoms, *Cryptophyta* and *Dinoflagellata*. Richness (at the lowest practical level [LPL] of taxonomy) was somewhat variable between sampling events, but the number of taxa present was generally between 30 and 40 in the 2014 (**Table 4ï2**) and 2015 (**Table 4ï4**) baseline surveys, similar to the number of taxa reported at the reference stations in 2015. Furthermore, species richness at the Whale Tail Pit Study Area Lakes is similar to the long-term observation of between 35 and 40 taxa at PDL and INUG during the open water sampling events dating back to 2006 (Azimuth 2015b).

Phytoplankton density exceeded 1.5 million individuals per litre with total biomass ranging between approximately 100 mg/m^3 and 440 mg/m^3 during the open water season (July to September). These results are consistent with results from other lakes in the area sampled as part of the Meadowbank CREMP (Azimuth 2015b). Phytoplankton density in the summer is typically greater than 1 million individuals per liter, with average total biomass of approximately 200 mg/m^3 (Azimuth 2015b). Within the Whale Tail Pit Study Area, density and biomass were lowest in Nemo Lake and highest in Whale Tail Lake and Mammoth Lake in the 2014 (**Figure 4ï1**) and 2015 (**Figure 4ï3**) baseline studies. Lower primary productivity in Nemo Lake relative to Whale Tail Lake and Mammoth Lake is also evidenced by ultra-oligotrophic concentrations of chlorophyll-*a* (<0.5 µg/L; Villeneuve et al. 2001) during the open water period (**Table 2ï1** [2014],**Table 2ï2** [2015]). The ultra-oligotrophic status of Nemo Lake is similar to the long-term dataset for INUG and PDL where chlorophyll-*a* concentrations during the summer months range between 1 µg/L and 5 µg/L and have been relatively consistent dating back to 2006 (Azimuth 2015b).

Temporally, the highest phytoplankton density and biomass was observed during the July (2015) sampling event (**Figure 4ï3**). Chrysophytes (golden-brown algae) were the dominant major taxa group in terms of density and biomass in the 2014 and 2015 baseline studies (**Figure 4ï1** [2014] and **Figure 4ï3** [2015]). These results are consistent with observations of the phytoplankton community composition in lakes sampled as part of the Meadowbank CREMP (Azimuth 2015b). Chrysophyte density and biomass were greatest in July for all of the sampling areas, mirroring the pattern of higher total density and total biomass reported in this sampling event. Lower relative chrysophyte density and

biomass in August and September coincided with a greater proportion of the phytoplankton community comprised of other major taxa groups, particularly chlorophytes (**Figure 4ï4** [2015]). It's important to note that seasonal production of phytoplankton can vary widely depending upon water temperature, nutrient concentration, time of year, water clarity and amount of sunlight, and predation by zooplankton.

Table 4-1. Phytoplankton biomass (mg/m^3) by major taxa group, Whale Tail Pit Baseline, 2014.

			Biomass in mg/m^3 (percent of total in parentheses)						
Lake	**Sample**	**date**	Cyanophyte	Chlorophyte	Chrysophyte	Diatoms	Cryptophytes	Dinoflagellates	Total Biomass
Whale Tail Lake	WHAL - 1	5/Sep/14	1 (0.6)	9.7 (5.3)	152 (83)	6.8 (3.7)	2.2 (1.2)	11 (5.9)	183
	WHAL - 3	5/Sep/14	19 (9)	5.1 (2.4)	156 (72)	9.9 (4.6)	10 (4.8)	15 (6.9)	215
	WHAL - 5	5/Sep/14	15 (5.5)	9.1 (3.4)	213 (80)	11 (4.3)	14 (5.3)	5.1 (1.9)	267
Mammoth Lake	LAK3 - 1	4/Sep/14	0 (0)	5.7 (2.1)	176 (66)	21 (7.9)	11.6 (4.3)	53 (20)	268
	LAK3 - 3	4/Sep/14	0.1 (0.1)	4.2 (1.6)	211 (81)	12 (4.5)	7.1 (2.7)	25 (10)	259
	LAK3 - 5	4/Sep/14	0.1 (0.05)	6 (2.1)	204 (71)	13 (4.5)	5 (1.8)	57 (20)	286
Nemo Lake	NEMO - 1	6/Sep/14	0.3 (0.2)	4.6 (3)	107 (70)	29 (19)	5.9 (4)	6.4 (4.2)	154
	NEMO - 3	6/Sep/14	0 (0)	3.3 (2)	121 (72)	26 (16)	7.8 (4.7)	10 (6)	168
	NEMO - 5	6/Sep/14	15 (11)	10 (7.9)	70 (54)	22.4 (17)	1.7 (1.3)	11 (8.7)	130

Notes:

Data presented here was adapted from Portt and Associates (2015a).

Biomass (wet weight) shown by major taxa group.

Table 4-2. Phytoplankton density (cells/L) and richness by major taxa group, Whale Tail Pit Baseline, 2014.

			Richness	Density in cells/L (percent of total in parentheses)						
Lake	**Sample**	**date**	(# of species)	Cyanophyte	Chlorophyte	Chrysophyte	Diatoms	Cryptophytes	Dinoflagellates	Total Density
Whale Tail Lake	WHAL - 1	5/Sep/14	35	14768 (1)	417272 (17)	1840104 (73)	215920 (8.6)	15768 (0.6)	15168 (0.6)	2,519,000
	WHAL - 3	5/Sep/14	38	57472 (2)	352016 (13)	1883208 (69)	356016 (13)	68856 (3)	16568 (0.6)	2,734,136
	WHAL - 5	5/Sep/14	38	50488 (2)	337848 (11)	2357352 (74)	324680 (10)	98792 (3)	800 (0.03)	3,169,960
Mammoth Lake	LAK3 - 1	4/Sep/14	35	0 (0)	302128 (8)	2474296 (67)	820176 (22)	74440 (2)	3600 (0.1)	3,674,640
	LAK3 - 3	4/Sep/14	34	400 (0.01)	466960 (14)	2245608 (66)	654344 (19)	38320 (1)	8984 (0.3)	3,414,616
	LAK3 - 5	4/Sep/14	35	600 (0.02)	524632 (14)	2554920 (69)	619624 (17)	23752 (1)	4800 (0.1)	3,728,328
Nemo Lake	NEMO - 1	6/Sep/14	35	1200 (0.05)	182000 (7)	1710792 (67)	605056 (24)	36920 (1)	600 (0.02)	2,536,568
	NEMO - 3	6/Sep/14	35	200 (0.01)	216920 (9)	1596248 (68)	476744 (20)	44904 (2)	7984 (0.3)	2,343,000
	NEMO - 5	6/Sep/14	34	50488 (3)	396320 (22)	898600 (50)	453992 (25)	14568 (1)	800 (0.04)	1,814,768

Notes:

Data presented here was adapted from Portt and Associates (2015a).

Species richness calculated at the lowest practical level (LPL) of identification.

Density shown by major taxa group.

Table 4-3. Phytoplankton biomass (mg/m^3) by major taxa group, Whale Tail Pit Baseline, 2015.

			Biomass in mg/m^3 (percent of total in parentheses)						
Station	**Sample**	**date**	Cyanophyte	Chlorophyte	Chrysophyte	Diatoms	Cryptophytes	Dinoflagellates	Total Biomass
WTN	WTN1-S	17/Jul/15	0 (0)	1.2 (0.3)	344 (95)	2.2 (0.6)	6.7 (1.8)	9.8 (2.7)	364
	WTN2-S	17/Jul/15	0 (0)	1 (0.4)	234 (86)	3.6 (1.3)	6.8 (2.5)	25 (9)	270
	WTN3-S	20/Aug/15	0.1 (0.1)	4.5 (2.5)	140 (76)	7.3 (4)	7.8 (4.2)	24 (13)	184
	WTN4-S	20/Aug/15	0 (0)	3.7 (2.4)	104 (68)	11 (7.2)	4.7 (3)	30 (20)	154
	WTN5-S	18/Sep/15	0.2 (0.1)	6 (2.5)	191 (79)	25 (10.4)	4.3 (1.8)	15.3 (6.3)	242
	WTN6-S	18/Sep/15	0.3 (0.1)	1.9 (0.8)	189 (83)	15 (6.6)	4.4 (1.9)	16.3 (7.2)	226
WTS	WTS1-S	17/Jul/15	0 (0)	1 (0.3)	284 (83)	6 (1.7)	20 (5.8)	30 (8.8)	340
	WTS2-S	17/Jul/15	0 (0)	1.3 (0.5)	211 (80)	5.4 (2)	12.8 (4.8)	35 (13)	265
	WTS3-S	21/Aug/15	3.5 (2)	11.1 (6.4)	122 (71)	8.4 (4.9)	2.9 (1.7)	24 (14)	173
	WTS4-S	21/Aug/15	2.7 (2)	5.9 (4.4)	112 (84)	5 (3.7)	2.1 (1.5)	6.3 (4.7)	134
	WTS5-S	18/Sep/15	0.9 (0.5)	1.6 (0.8)	158 (81)	20 (10)	4.5 (2.3)	10.1 (5.2)	195
	WTS6-S	18/Sep/15	0.1 (0)	13.6 (4.6)	248 (85)	17 (6)	8.8 (3)	4.5 (1.5)	293
MAM	MAM1-S	18/Jul/15	0 (0)	1.2 (0.4)	236 (85)	17.4 (6.3)	11 (4)	11.6 (4.2)	277
	MAM2-S	18/Jul/15	0 (0)	0.9 (0.5)	179 (92)	5.8 (3)	3.7 (1.9)	4.5 (2.3)	194
	MAM3-S	24/Aug/15	0.2 (0.1)	10.3 (6.5)	113 (71)	11.4 (7.2)	4.8 (3.1)	18.6 (11.8)	158
	MAM4-S	24/Aug/15	0 (0)	6.5 (4.8)	108 (79)	7.1 (5.2)	4.8 (3.5)	10.1 (7.4)	137
	MAM5-S	19/Sep/15	0.1 (0)	2.7 (1.2)	198 (87)	11.4 (5)	5.2 (2.3)	11.2 (4.9)	228
	MAM6-S	19/Sep/15	3.1 (1.5)	5.3 (2.5)	173 (81)	13.3 (6.2)	5.6 (2.6)	13.4 (6.2)	214
NEM	NEM1-S	18/Jul/15	0 (0)	1.8 (1.1)	121 (73)	13.4 (8.1)	12.3 (7.4)	17.1 (10.4)	165
	NEM2-S	18/Jul/15	0 (0)	3.3 (1.3)	205 (80)	13.9 (5.4)	12.9 (5)	21.6 (8.4)	257
	NEM3-S	23/Aug/15	0 (0)	20.9 (18.8)	59 (53)	23 (21)	2.1 (1.9)	6.3 (5.7)	111
	NEM4-S	23/Aug/15	0 (0)	15.7 (14.7)	70 (65)	19.1 (18)	0.3 (0.3)	1.8 (1.7)	107
	NEM5-S	19/Sep/15	0.7 (0.5)	6.7 (4.5)	115 (78)	17.9 (12)	0.6 (0.4)	6.5 (4.4)	147
	NEM6-S	19/Sep/15	0.6 (0.4)	5.2 (3.4)	133 (87)	7.9 (5.2)	1.9 (1.2)	4.1 (2.7)	152
INUG	INUG-70S	27/Jul/15	0 (0)	2.4 (0.6)	369 (89)	13.1 (3.2)	15 (3.6)	13.6 (3.3)	413
	INUG-71S	27/Jul/15	0 (0)	2.1 (0.5)	399 (91)	6.3 (1.4)	12.2 (2.8)	20.8 (4.7)	440
	INUG72S	27/Aug/15	0.1 (0.1)	5.8 (3.2)	157 (87)	13.3 (7.4)	1 (0.6)	2.3 (1.3)	179
	INUG73S	27/Aug/15	0.6 (0.3)	6.4 (3.2)	167 (83)	11.6 (5.8)	5.8 (2.9)	10 (5)	202
	INUG74S	1/Oct/15	3.4 (1.7)	6 (3)	156 (77)	21 (10)	9.7 (4.7)	8.1 (4)	204
	INUG75S	1/Oct/15	2 (1)	8.3 (4.3)	148 (77)	18 (9.4)	7 (3.7)	7.9 (4.2)	191
PDL	PDL37S	28/Jul/15	0 (0)	0.6 (0.3)	199 (87)	13.7 (6)	7.8 (3.4)	6.6 (2.9)	227
	PDL38S	28/Jul/15	0 (0)	0.1 (0)	230 (88)	10.2 (3.9)	6.3 (2.4)	15.1 (5.8)	262
	PDL39S	26/Aug/15	0.8 (0.5)	7.8 (5)	127 (81)	16.6 (10.6)	2.5 (1.6)	2.3 (1.5)	158
	PDL40S	26/Aug/15	0.9 (0.6)	5.3 (3.3)	135 (83)	16.3 (10.1)	2.2 (1.4)	2.1 (1.3)	162
	PDL41S	4/Oct/15	2.5 (1.8)	9 (6.5)	97 (71)	11.4 (8.3)	4 (2.9)	13.3 (9.7)	137

Notes:

Biomass (wet weight) shown by major taxa group.

Table 4-4. Phytoplankton density (cells/L) and richness by major taxa group, Whale Tail Pit Baseline, 2015.

Station	Sample	date	Richness (# of species)	Density in cells/L (percent of total in parentheses)						
				Cyanophyte	Chlorophyte	Chrysophyte	Diatoms	Cryptophytes	Dinoflagellates	Total Density
WTN	WTN1-S	17/Jul/15	30	0 (0)	35920 (0.7)	4638096 (96)	65056 (1.3)	95592 (2)	1600 (0.03)	4,836,264
	WTN2-S	17/Jul/15	30	0 (0)	36120 (0.9)	3971584 (96)	67856 (1.6)	68656 (2)	10384 (0.2)	4,154,600
	WTN3-S	20/Aug/15	33	800 (0.04)	165432 (8)	1567312 (76)	131512 (6)	165232 (8)	23552 (1.1)	2,053,840
	WTN4-S	20/Aug/15	35	400 (0.02)	158248 (10)	1201128 (73)	146480 (9)	100576 (6)	44704 (2.7)	1,651,536
	WTN5-S	18/Sep/15	37	600 (0.02)	237472 (9)	2011736 (75)	362216 (13)	52088 (2)	22752 (0.8)	2,686,864
	WTN6-S	18/Sep/15	38	1800 (0.07)	143680 (6)	2094344 (83)	228520 (9)	65456 (3)	2200 (0.09)	2,536,000
WTS	WTS1-S	17/Jul/15	29	0 (0)	50288 (1.1)	3985568 (89)	97592 (2)	299144 (7)	23952 (0.5)	4,456,544
	WTS2-S	17/Jul/15	35	0 (0)	72040 (2.3)	2880616 (92)	54488 (2)	113360 (4)	4000 (0.1)	3,124,504
	WTS3-S	21/Aug/15	40	72840 (3)	366984 (15)	1703008 (72)	177016 (7)	50288 (2)	3600 (0.2)	2,373,736
	WTS4-S	21/Aug/15	35	57472 (3)	323880 (17)	1315472 (70)	133312 (7)	35920 (2)	8184 (0.4)	1,874,240
	WTS5-S	18/Sep/15	33	29936 (1)	122128 (5)	1851888 (77)	298960 (13)	72640 (3)	15768 (0.7)	2,391,320
	WTS6-S	18/Sep/15	37	600 (0.02)	173616 (5)	2737520 (81)	323512 (10)	144880 (4)	7584 (0.2)	3,387,712
MAM	MAM1-S	18/Jul/15	32	0 (0)	71840 (2)	3346560 (91)	157864 (4)	99392 (3)	13384 (0.4)	3,689,040
	MAM2-S	18/Jul/15	26	0 (0)	57472 (2)	2900952 (94)	87608 (3)	37720 (1)	1200 (0.04)	3,084,952
	MAM3-S	24/Aug/15	38	1000 (0.05)	424056 (21)	1323256 (65)	187200 (9)	72840 (4)	23752 (1.2)	2,032,104
	MAM4-S	24/Aug/15	37	400 (0.02)	359600 (16)	1604632 (73)	151080 (7)	73040 (3)	9184 (0.4)	2,197,936
	MAM5-S	19/Sep/15	36	600 (0.02)	316696 (11)	2149432 (78)	223368 (8)	79624 (3)	1200 (0.04)	2,770,920
	MAM6-S	19/Sep/15	37	57472 (2.1)	359400 (13)	2023120 (72)	265688 (10)	87008 (3)	1600 (0.1)	2,794,288
NEM	NEM1-S	18/Jul/15	28	0 (0)	36120 (2)	1975816 (85)	245488 (11)	69256 (3)	2000 (0.09)	2,328,680
	NEM2-S	18/Jul/15	31	0 (0)	65056 (2)	2694616 (86)	259272 (8)	104576 (3)	9384 (0.3)	3,132,904
	NEM3-S	23/Aug/15	30	0 (0)	424456 (27)	900400 (57)	218120 (14)	43104 (3)	7384 (0.5)	1,593,464
	NEM4-S	23/Aug/15	29	400 (0.03)	395720 (30)	636792 (49)	266408 (20)	7184 (1)	200 (0.02)	1,306,704
	NEM5-S	19/Sep/15	30	15368 (0.99)	266408 (17)	974256 (62)	288760 (19)	7384 (0)	7584 (0.5)	1,559,760
	NEM6-S	19/Sep/15	35	14968 (0.84)	208936 (12)	1320688 (74)	209136 (12)	29336 (2)	400 (0.02)	1,783,464
INUG	INUG-70S	27/Jul/15	30	0 (0)	172616 (6)	2061504 (77)	296744 (11)	140096 (5)	800 (0.03)	2,671,760
	INUG-71S	27/Jul/15	33	0 (0)	129712 (5)	2190616 (87)	117144 (5)	57688 (2)	8784 (0.35)	2,503,944
	INUG72S	27/Aug/15	35	400 (0.02)	196768 (11)	1419448 (77)	210336 (11)	14768 (1)	7184 (0.39)	1,848,904
	INUG73S	27/Aug/15	37	7584 (0.33)	211536 (9)	1671288 (73)	260424 (11)	114944 (5)	8384 (0.4)	2,274,160
	INUG74S	1/Oct/15	40	66056 (2.67)	274992 (11)	1734744 (70)	305544 (12)	72640 (3)	21752 (0.88)	2,475,728
	INUG75S	1/Oct/15	39	14968 (0.62)	209736 (9)	1734144 (72)	356232 (15)	79424 (3)	21552 (0.9)	2,416,056
PDL	PDL37S	28/Jul/15	28	0 (0)	36320 (2)	1790048 (85)	225112 (11)	59872 (3)	1400 (0.07)	2,112,752
	PDL38S	28/Jul/15	23	0 (0)	14368 (1)	1986416 (88)	207552 (9)	38920 (2)	10584 (0.5)	2,257,840
	PDL39S	26/Aug/15	32	9184 (0.49)	244456 (13)	1361176 (72)	219520 (12)	43504 (2)	600 (0.03)	1,878,440
	PDL40S	26/Aug/15	32	3800 (0.22)	123328 (7)	1370160 (79)	213536 (12)	22952 (1)	400 (0.02)	1,734,176
	PDL41S	4/Oct/15	30	7400 (0.47)	359200 (23)	939920 (60)	219520 (14)	22152 (1)	14968 (1)	1,563,160

Notes:

Species richness calculated at the lowest practical level (LPL) of identification.

Density shown by major taxa group.

Figure 4ï1. Phytoplankton density (cells/L) and biomass (mg/m^3) by major taxa group, Whale Tail Pit Baseline, 2014.

Notes: See text for information on the major taxa groups (MTG). Samples were collected in early September 2014.

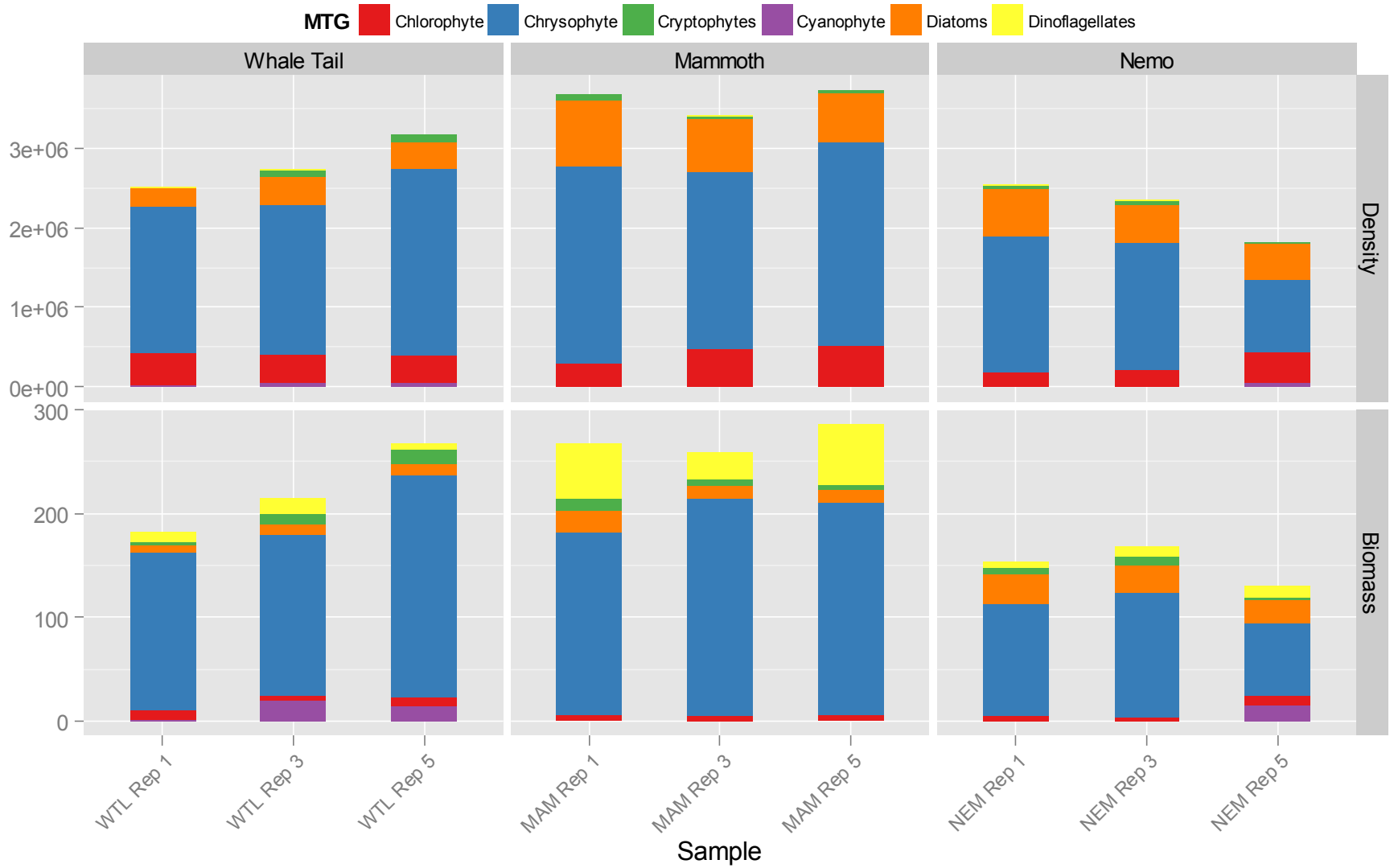


Figure 4ï2. Percent phytoplankton density and biomass by major taxa group, Whale Tail Pit Baseline, 2014.

Notes: See text for information on the major taxa groups (MTG). Samples were collected in early September 2014.

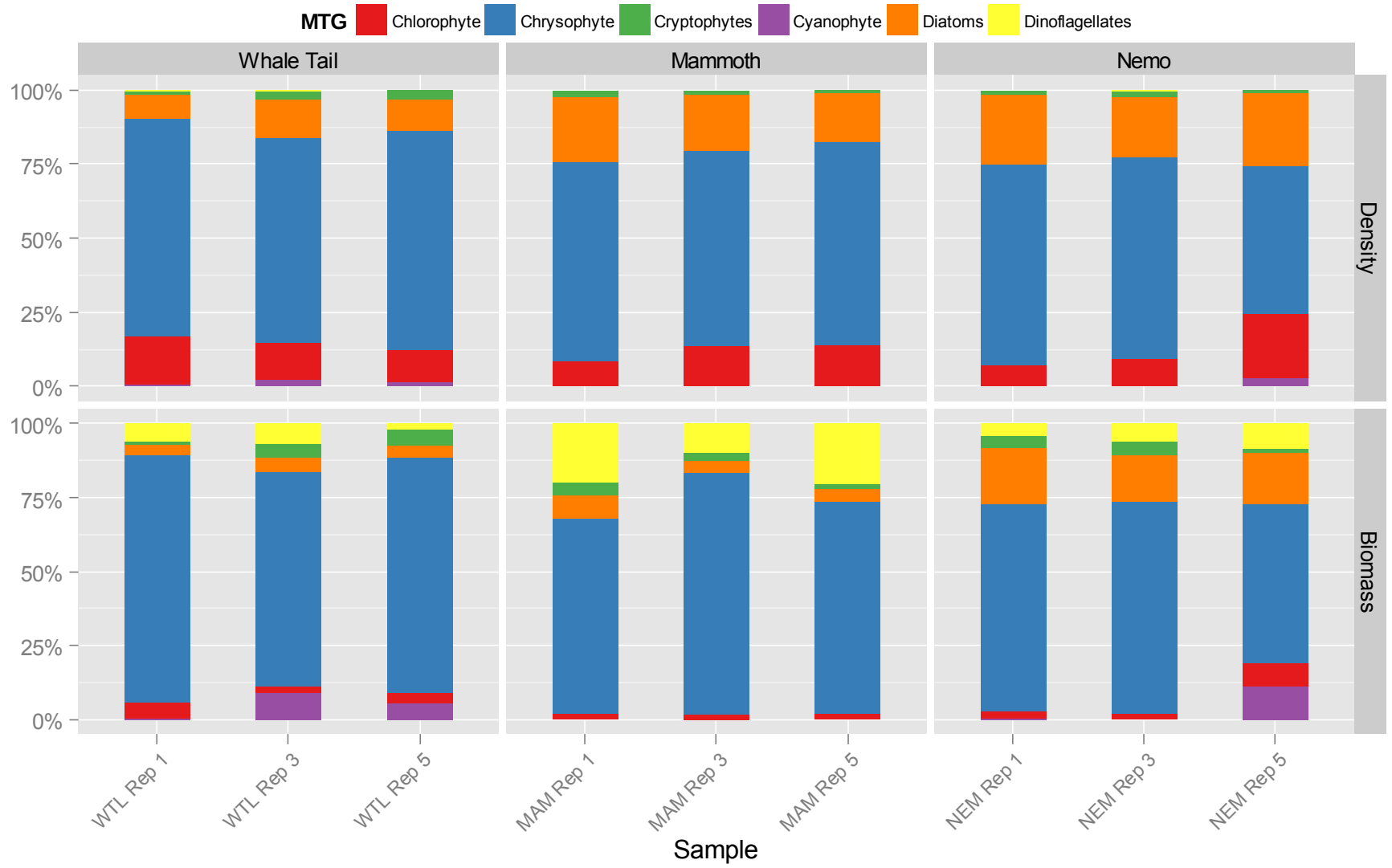


Figure 4ï3. Phytoplankton density (cells/L) and biomass (mg/m^3) by major taxa group, Whale Tail Pit Baseline, 2015.

Notes: See text for information on the major taxa groups (MTG). Vertical dashed lines separate the samples by sampling event (i.e., July, August, and September).

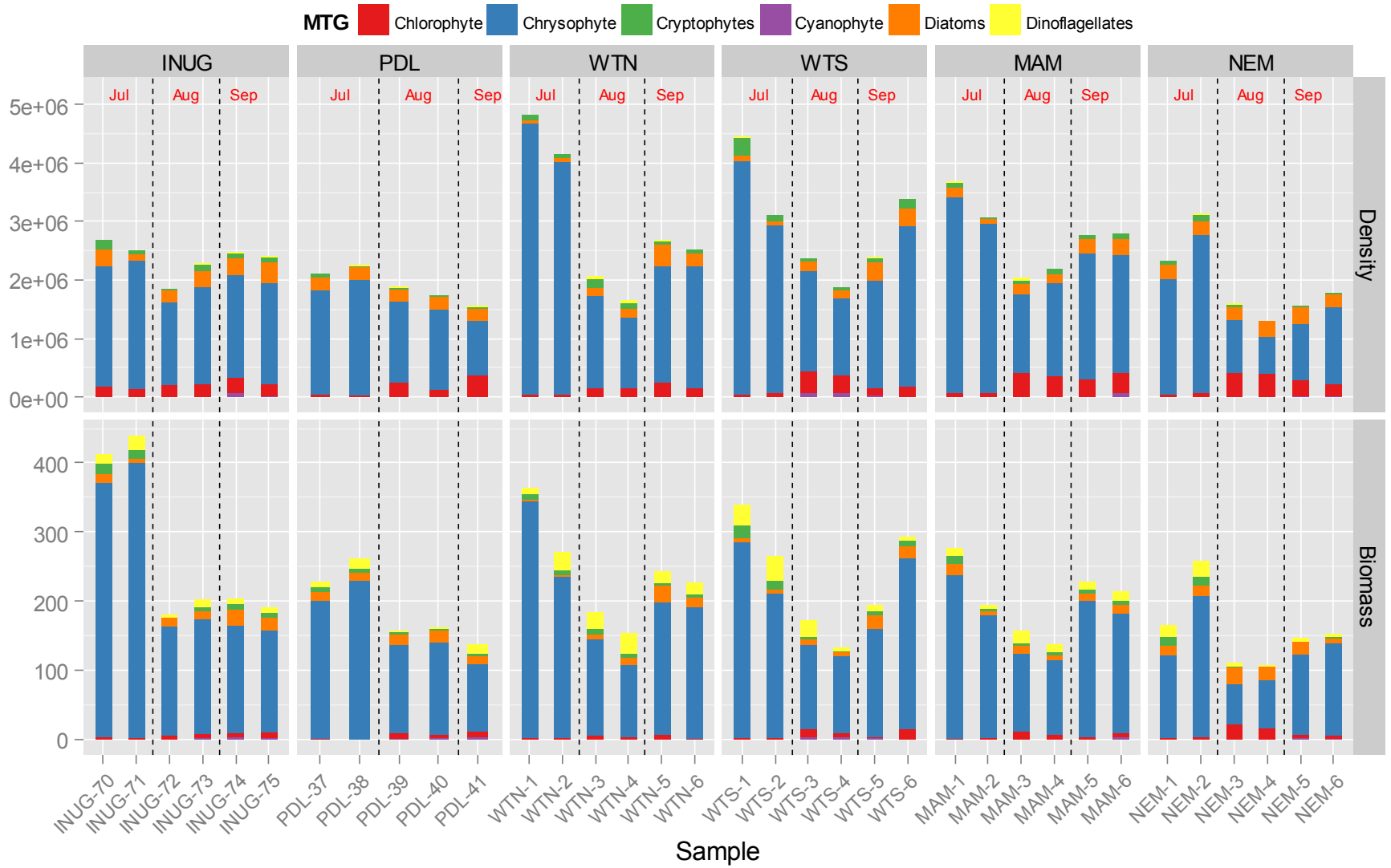
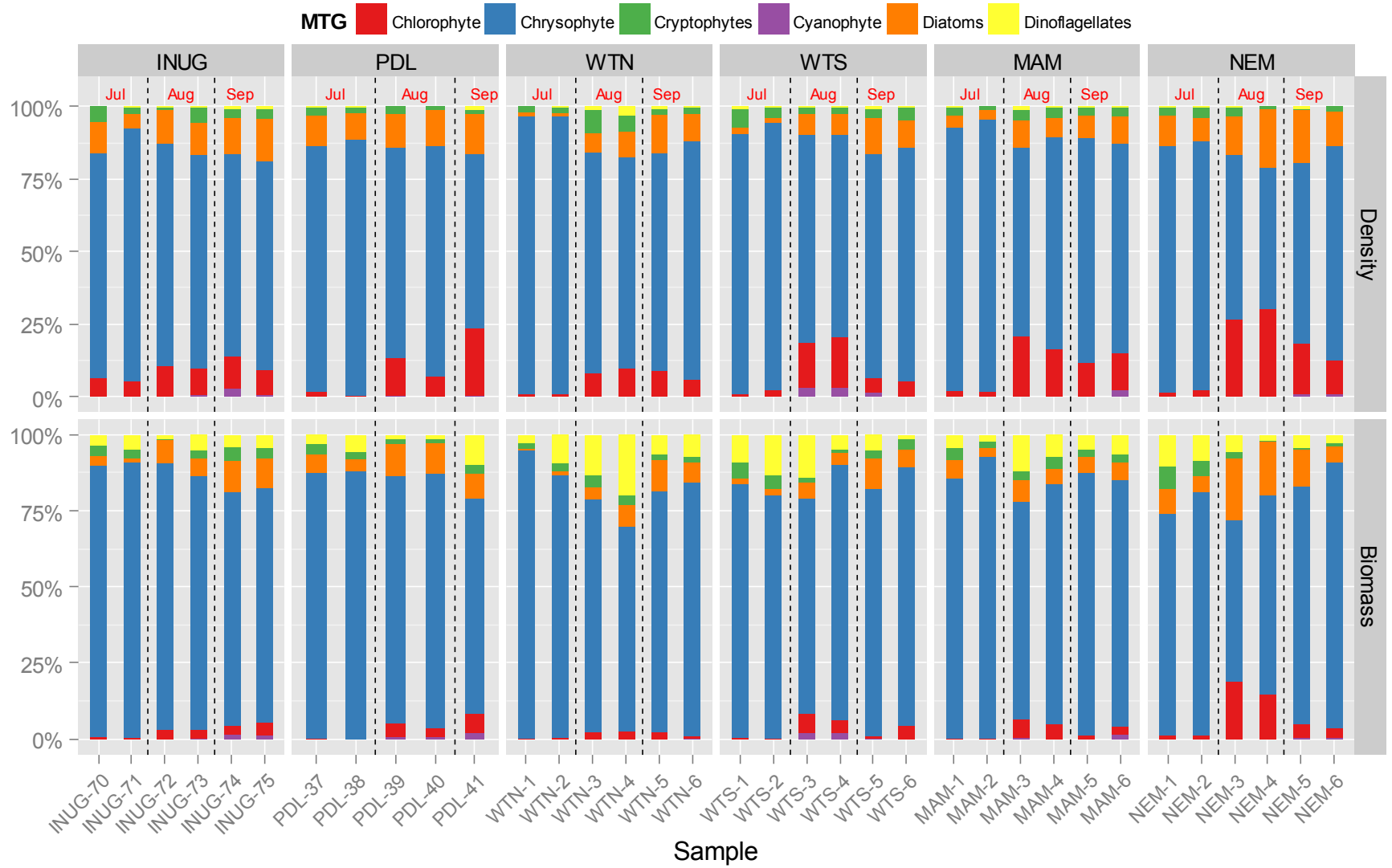


Figure 4ï4. Percent phytoplankton density and biomass by major taxa group, Whale Tail Pit Baseline, 2015.

Notes: See text for information on the major taxa groups (MTG). Vertical dashed lines separate the samples by sampling event (i.e., July, August, and September).



5. BENTHIC INVERTEBRATES

5.1. Methods Overview

5.1.1. Sample Collection

Benthic invertebrate samples were collected according to methods outlined in the Meadowbank CREMP SOP (Azimuth 2015b) for the 2014 and 2015 baseline programs. Samples were collected using a Petite Ponar grab (0.023 m^2) and a 500-µm sieve at the same time and locations as sediment chemistry samples. For the 2014 baseline program, five locations were established throughout each lake at the target depth to assess variability in the benthic invertebrate community at the spatial scale of the entire lake. The 2015 baseline program was designed according to the Meadowbank CREMP with five replicates established over a smaller spatial area (~ 100 m radius) to assess the spatial variability in the benthic invertebrate community at the level of the basin, consistent with the approach used in the Meadowbank CREMP. At each replicate station, two independent grabs were composited to form a single sample. Benthic invertebrate samples were preserved in the field using neutral buffered formalin to final concentration of approximately 10% formalin. Each sample had enough water and formalin to completely cover any debris in the sample. Lastly, an internal water-proof label was added to each replicate sample, and the lids were sealed with electrical tape.

5.1.2. Laboratory Methods

Different taxonomists were used for sample identification in 2014 and 2015, but the taxonomic identification methods were similar between years. Taxonomic analysis of the 2014 samples was completed William Morton and Dr. G.L. Mackie at the LPL of taxonomic resolution. A detailed description of the laboratory methods used in 2014 is presented in Portt and Associates (2015a).

Samples collected in 2015 were sent to Zaranko Environmental Assessment Services (ZEAS; Nobleton, ON), the same lab used for the Meadowbank CREMP, for taxonomic identification and analysis. Upon arrival at ZEAS, samples were logged and inspected upon arrival to ensure adequate preservation to a minimum concentration of 10% buffered formalin. Samples were sorted at a magnification of between 7 and 10-times with the use of a stereomicroscope. To expedite sorting prior to processing, all samples were stained with a protein dye that is absorbed by aquatic organisms but not by organic material, such as detritus and algae. Prior to sorting, samples were washed free of formalin in a 500-µm sieve. Benthic invertebrates were enumerated and sorted into major taxonomic groups, (i.e., order and family), placed in glass bottles and re-preserved in 80% ethanol for more detailed taxonomic analysis by senior staff. Each bottle was labeled internally with the survey name, date, area and replicate number.

Abundance of organisms/m^2 was determined from the total number of organisms enumerated. Nematods (phylum *Nemata*) and ostracods were not reported, nor were they included in abundance and richness calculations consistent with taxonomic methods outlined by Environment Canada (2012). Organisms at pupal stage of development were excluded from the species richness totals in each sample unless they were the only stage identified in the sample.

5.1.3. Data Handling and Analysis

The benthic invertebrate results (abundance and richness) were grouped by major taxa, specifically oligochaetes (phyla *Annelida*), insects (class *Insecta*), molluscs (phylum *Mollusca*), and other taxa (phylum *Arthropoda* and phylum *Platyhelminthes*). Data were tabulated in Microsoft Excel and plotted using R software.

5.2. Quality Assurance / Quality Control

5.2.1. QA/QC Methods

No information was provided on the QA/QC method used by William Morton and Dr. G.L. Mackie in their taxonomic identifications. ZEAS incorporates the following set of QA/QC procedures in all benthic projects undertaken by the company to ensure the generation of high quality and reliable data:

- Samples are logged upon arrival, inspected, and enumerated;
- Samples are checked for proper preservation;
- Samples are stained to facilitate sorting;
- Taxonomic identifications are based on the most updated and widely used keys;
- 10% of the samples are re-sorted, and re-counted, targeting >90% recovery;
- Precision and accuracy estimates are calculated;
- A voucher collection is compiled;
- Sorted sediments and debris are re-preserved in 10% formalin and are retained for up to three months. For samples subject to subsampling, sorted and unsorted fractions are re-preserved separately.

5.2.2. QA/QC Results

Results of the QA/QC assessment for the 2015 benthic invertebrate data are presented in **Appendix A2**. Samples were sorted in their entirety due to low overall abundance. Three samples were resorted, and the lowest percent recovery was 93%, with an average percent recovery of 95% (**Table A2ï3**).

5.3. Results

Abundance and richness of benthic invertebrates from the 2014 baseline program are presented in **Table 5ï1** and shown in **Figure 5ï1** (abundance and richness [per m^2]) and **Figure 5ï2** (percent abundance and richness). The tabulated data presented here were adapted from the original laboratory data presented in the 2014 baseline report (Portt and Associates 2015a).

Results of the 2015 baseline benthic invertebrate community assessment are presented in **Table 5ï2** and shown in **Figure 5ï3** (abundance and richness [per m^2]) and **Figure 5ï4** (percent abundance and richness). Raw benthic invertebrate data from ZEAS are included as **Appendix F**.

Overall abundance and richness was low at most locations sampled in 2014 and 2015, characteristic of depositional areas in northern lakes with low productivity and nutrient cycling. Insects, primarily chironomids in the subfamilies *Chironominae* and *Tanypodinae*, and fingernail clams (*Sphaeriidae*) were the dominant benthic invertebrate taxa in the Whale Tail Pit Study Area Lakes (2014 and 2015) and CREMP reference areas (2015). Abundance and richness in the reference areas was approximately 1,700 organisms/m^2 and 13 taxa at INUG and 1,200 organisms/m^2 and 9 taxa at PDL. Average taxa richness in the 2014 baseline study was 11 at Whale Tail Lake, 9 at Nemo Lake, and 12 at Mammoth Lake (**Table 5ï1**). The 2014 baseline study shows there is considerable within-lake variability in the benthic invertebrate community abundance despite similar water depths (**Figure 5ï1**). In 2015, taxa richness ranged between 11 (WTN) and 16 (WTN-Ex) (**Table 5ï2**). Overall, the abundance and richness at the reference areas in 2015 were within the historical range reported for these areas (Azimuth 2015b). With the exception of WTN, abundance was generally higher at the Lake stations in 2015 compared to the reference areas. The highest abundance (over 8,000 mg/m^2) was reported in a sample from Mammoth

Lake, which was also the area with the highest spatial variability in abundance of the lakes/basins sampled in 2015. On average, however, the highest abundance was observed at WTN-Ex (5,300 organisms/m^2). The higher abundance was due primarily to increased abundance of chironomids in the genus *Corynocera* and fingernail clams *Cyclocalyx / Neopisidium*. At WTN, the lower overall abundance was due primarily to a reduction in the number of chironomid larvae.

The abundance and species composition of benthic invertebrates are strongly affected by water depth, substrate size and organic carbon. Other physical factors, such as water temperature, influence larval development rates and ultimately timing of hatching for insect larvae.

Table 5-1. Benthic invertebrate abundance (#/m^2) and richness (# taxa) by major taxa group, Whale Tail Pit Baseline, 2014.

Lake & Replicate	Depth (m)	Abundance (#/m^2)				Total Abundance	Richness (# taxa)				Total Richness
		Oligochaetes	Insects	Molluscs	Other Taxa		Oligochaetes	Insects	Molluscs	Other Taxa	
Whale Tail Lake											
Rep 1	8.5	0	9217	870	0	10087	0	8	2	0	10
Rep 2	7.8	22	2130	261	65	2478	1	9	1	2	13
Rep 3	8.0	22	1435	217	0	1674	1	6	1	0	8
Rep 4	7.8	65	1261	174	0	1500	1	8	2	0	11
Rep 5	8.0	22	1783	326	0	2130	1	8	2	0	11
Lake Mean		***26***	***3165***	***370***	***13***	***3574***	***1***	***8***	***2***	***0***	***11***
Nemo Lake											
Rep 1	7.6	0	3043	261	0	3304	0	7	1	0	8
Rep 2	7.4	65	1435	348	0	1848	1	8	1	0	10
Rep 3	8.3	22	478	370	0	870	1	7	2	0	10
Rep 4	8.5	22	435	65	22	543	1	5	2	1	9
Rep 5	8.7	43	500	65	22	630	1	7	1	1	10
Area Mean		***30***	***1178***	***222***	***9***	***1439***	***1***	***7***	***1***	***0***	***9***
Mammoth Lake											
Rep 1	8.1	196	1391	283	22	1891	2	9	2	1	14
Rep 2	7.3	22	891	478	22	1413	1	9	1	1	12
Rep 3	8.3	22	1739	326	0	2087	1	9	1	0	11
Rep 4	7.4	43	5478	239	0	5761	1	8	2	0	11
Rep 5	7.3	22	4696	326	22	5065	1	7	2	1	11
Area Mean		***61***	***2839***	***330***	***13***	***3243***	***1***	***8***	***2***	***1***	***12***

Notes:

Data presented here were adapted from Portt and Associates (2015a).

[1] Other taxa: (Hygrobatidae, Lebertiidae, and Platyhelminthes).

Table 5-2. Benthic invertebrate abundance (#/m^2) and richness (# taxa) by major taxa group, Whale Tail Pit Baseline, 2015.

Area-Replicate	Depth (m)	Abundance (#/m^2)				Total	Richness (# taxa)				Total
		Oligochaetes	Insects	Molluscs	Other Taxa	Abundance	Oligochaetes	Insects	Molluscs	Other Taxa	Richness
Inuggugayualik Lake											
INUG-1	7.0	22	565	348	0	935	1	7	2	0	10
INUG-2	6.5	43	1696	630	0	2370	1	13	3	0	17
INUG-3	7.4	130	1609	457	65	2261	1	10	3	2	16
INUG-4	8.5	22	1304	391	0	1717	1	9	2	0	12
INUG-5	8.5	43	935	435	0	1413	1	6	2	0	9
Area Mean		***52***	***1222***	***452***	***13***	***1739***	***1***	***9***	***2***	***0***	***13***
Pipedream Lake											
PDL-1	6.5	0	1239	196	0	1435	0	9	2	0	11
PDL-2	6.7	87	957	304	22	1370	2	7	1	1	11
PDL-3	8.5	0	891	435	43	1370	0	6	1	2	9
PDL-4	8.5	43	370	196	0	609	1	4	1	0	6
PDL-5	6.8	0	783	283	43	1109	0	6	1	1	8
Area Mean		***26***	***848***	***283***	***22***	***1178***	***1***	***6***	***1***	***1***	***9***
Whale Tail North Basin											
WTN-1	8.0	0	717	174	109	1000	0	6	2	2	10
WTN-2	8.4	0	565	22	22	609	0	4	1	1	6
WTN-3	7.9	0	413	457	87	957	0	8	3	3	14
WTN-4	9.1	87	435	348	65	935	2	5	2	2	11
WTN-5	7.5	43	1326	261	65	1696	1	8	2	2	13
Area Mean		***26***	***691***	***252***	***70***	***1039***	***1***	***6***	***2***	***2***	***11***
Whale Tail North Basin (shallow)											
WTN-Ex-1	5.0	22	4217	1543	130	5913	1	9	3	3	16
WTN-Ex-2	5.4	0	1152	913	152	2217	0	11	3	3	17
WTN-Ex-3	5.7	174	4891	1087	239	6391	2	9	3	3	17
WTN-Ex-4	6.1	109	4043	1326	217	5696	2	8	3	4	17
WTN-Ex-5	5.4	43	4891	1435	174	6543	2	9	2	2	15
Area Mean		***70***	***3839***	***1261***	***183***	***5352***	***1***	***9***	***3***	***3***	***16***
Whale Tail South Basin											
WTS-1	7.2	0	696	457	22	1174	0	9	3	1	13
WTS-2	7.1	0	717	457	65	1239	0	8	3	1	12
WTS-3	7.8	22	2304	674	152	3152	1	10	3	4	18
WTS-4	7.4	0	1957	522	109	2587	0	10	3	2	15
WTS-5	7.8	0	652	413	43	1109	0	9	3	2	14
Area Mean		***4***	***1265***	***504***	***78***	***1852***	***0***	***9***	***3***	***2***	***14***

Table 5-2. Benthic invertebrate abundance (#/m^2) and richness (# taxa) by major taxa group, Whale Tail Pit Baseline, 2015.

Area-Replicate	Depth (m)	Abundance (#/m^2)				Total	Richness (# taxa)				Total
		Oligochaetes	Insects	Molluscs	Other Taxa	Abundance	Oligochaetes	Insects	Molluscs	Other Taxa	Richness
Nemo Lake											
NEM-1	8.0	43	1870	761	65	2739	1	5	2	2	10
NEM-2	9.0	43	2413	696	174	3326	1	6	3	4	14
NEM-3	8.9	0	2370	500	87	2957	0	6	2	3	11
NEM-4	8.0	43	1978	652	109	2783	1	7	2	2	12
NEM-5	8.5	65	2217	348	87	2717	1	7	2	1	11
Area Mean		***39***	***2170***	***591***	***104***	***2904***	***1***	***6***	***2***	***2***	***12***
Mammoth Lake											
MAM-1	8.0	109	2978	717	87	3891	2	8	2	2	14
MAM-2	8.1	174	1804	674	109	2761	2	8	3	2	15
MAM-3	7.5	43	1283	565	87	1978	1	8	2	2	13
MAM-4	8.1	22	7109	1065	109	8304	1	7	3	3	14
MAM-5	8.8	65	5130	370	43	5609	1	6	3	2	12
Area Mean		***83***	***3661***	***678***	***87***	***4509***	***1***	***7***	***3***	***2***	***14***

Notes:

[1] Other taxa: (Turbellaria, Acalyptonotidae, Hygrobatidae, Lebertiidae, Oxidae, and Notostraca).

Figure 5ï1. Benthic invertebrate abundance (organisms/m^2) and richness by major taxa group, Whale Tail Pit Baseline, 2014.

Notes: See text for information on the major taxa groups (MTG) and locations of the replicates in each lake.

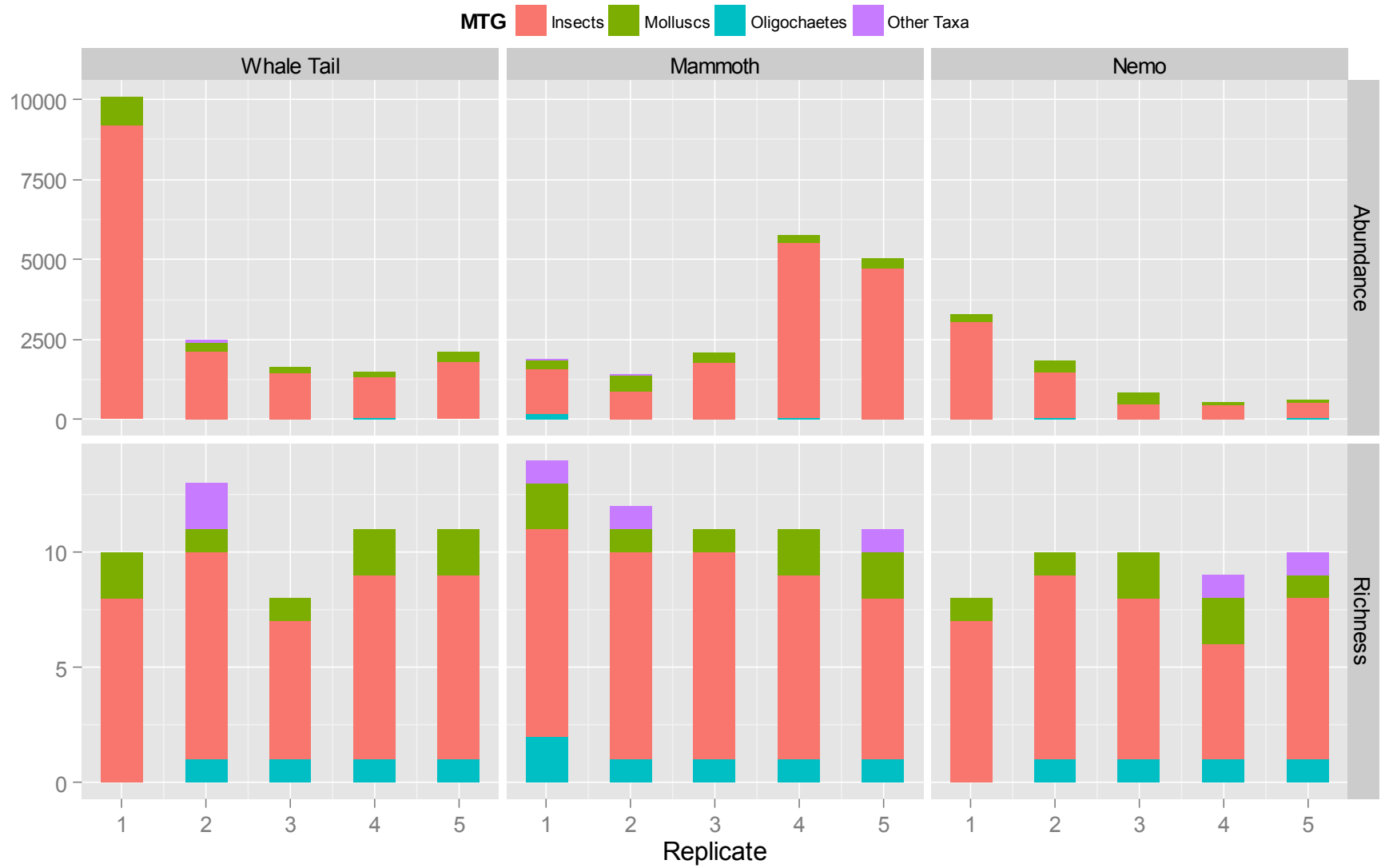


Figure 5ï2. Percent benthic invertebrate abundance and richness by major taxa group, Whale Tail Pit Baseline, 2014.

Notes: See text for information on the major taxa groups (MTG) and locations of the replicates in each lake.

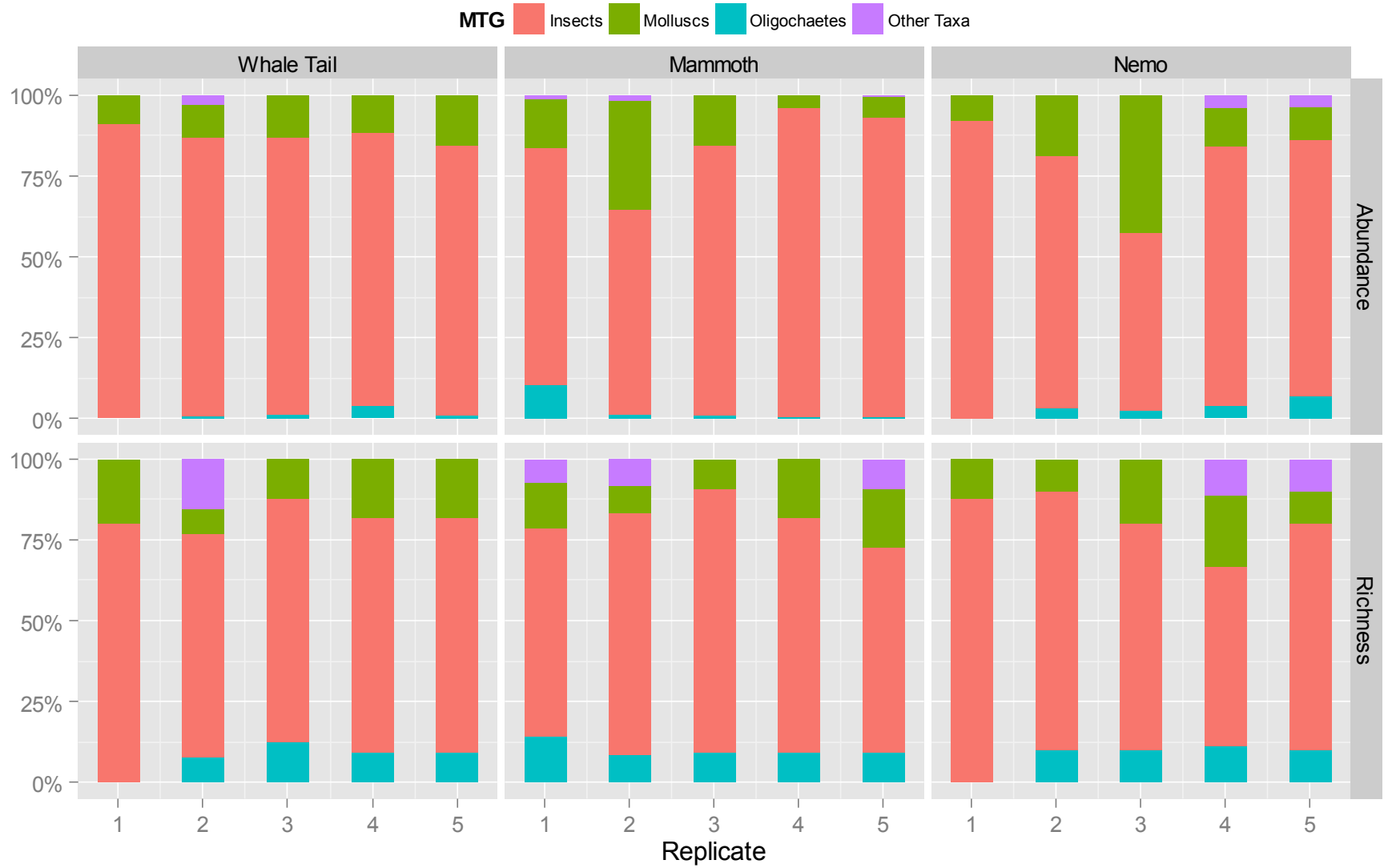


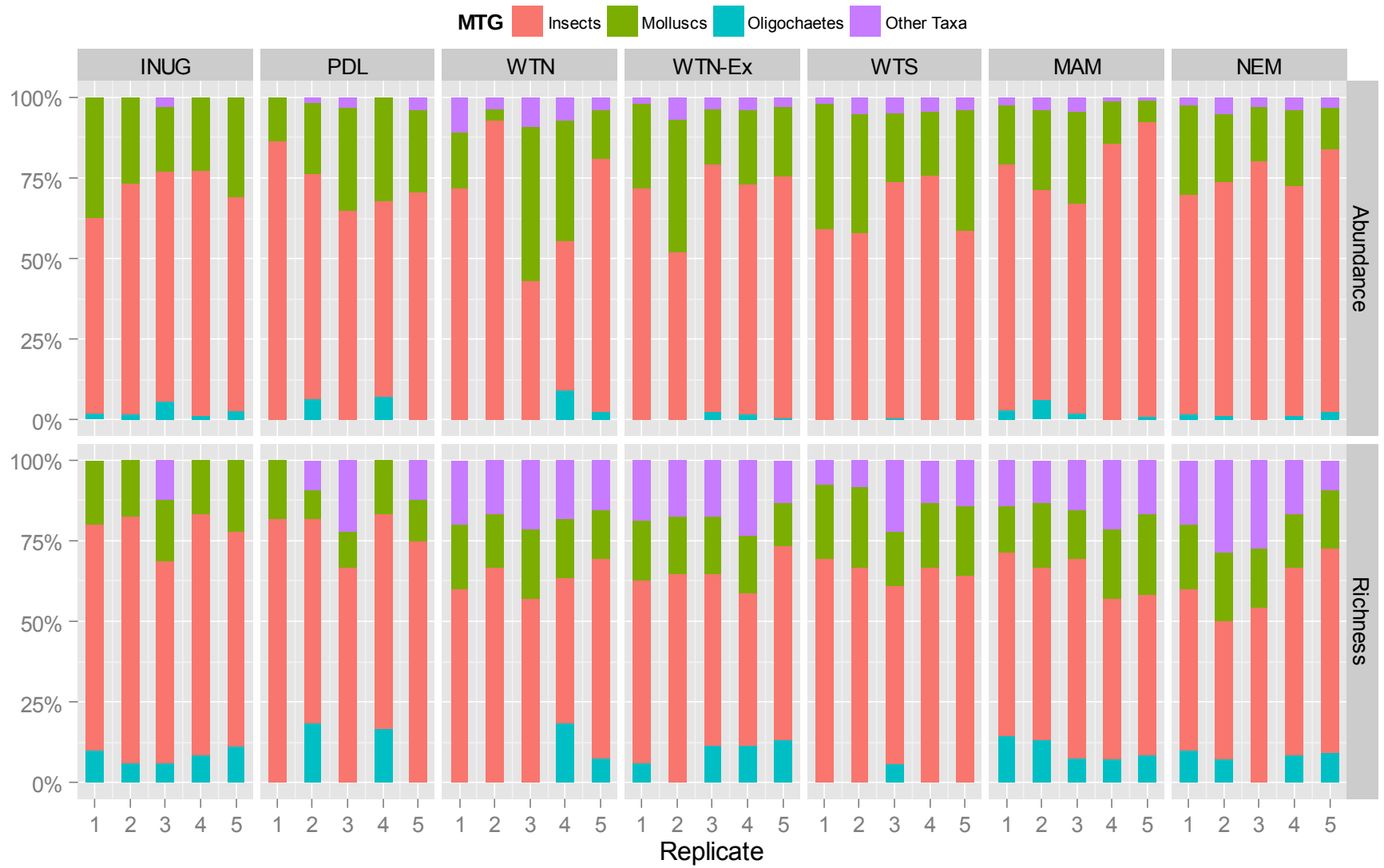
Figure 5ï3. Benthic invertebrate abundance (organisms/m^2) and richness by major taxa group, Whale Tail Pit Baseline, 2015.

Notes: See text for information on the major taxa groups (MTG).



Figure 5ï4. Percent benthic invertebrate abundance and richness by major taxa group, Whale Tail Pit Baseline, 2015.

Notes: See text for information on the major taxa groups (MTG).



6. ZOOPLANKTON

6.1. Methods

6.1.1. Sample Collection

Zooplankton samples were collected synoptically from limnology/water chemistry sampling stations from the Whale Tail Pit Study Area Lakes during each 2015 event in support of the EIA. The samples were collected according to an SOP provided to Azimuth by Golder (pers. comm.). Zooplankton was not collected as part of the 2014 baseline program. Location information (UTM coordinates), station depth, haul depth (vertical length of water towed), and number or tows per sample were recorded for each station. The information is presented in **Table 6ï1**.

Samples were collected after taking the limnology measurement and collecting water samples for chemistry at each station. The boat was not anchored unless wind conditions necessitated. The zooplankton net measured 2.4 m in length, 30 cm in diameter (at the opening), and had a mesh size of 80 µm (74 µm mesh size on the cod end). To collect the sample, the net was lowered to depth where the cod end (bottom of the net) was within 1 m of the sediment surface. Station depth was determined using a portable depth sounder. A weight was also tied to the bottom of the net at 1 m below the cod end to confirm when the cod end was 1 m above the sediment. The net was deployed slowly and held at the appropriate depth for approximately 30 seconds. The net was retrieved at a rate of approximately 0.5 m/second. Once at the surface, the net was pulled into the boat while simultaneously rinsing the net with a squirt bottle by spraying the outside of the net. After checking the net for any adhered zooplankton, the contents of the cod end was rinsed into a 500 mL wide-mouth plastic jar. Samples were preserved by first adding half a tablet of Alka-Seltzer® to immobilize the zooplankton, followed by fixation with buffered formalin to a final concentration of approximately 5% (v/v). One field duplicate zooplankton sample was collected during each sampling event.

6.1.2. Laboratory Methods

Zooplankton samples were submitted to Biologica Environmental Services Ltd. (Victoria, BC) for abundance, biomass, and biovolume measurements. Zooplankton was subsampled using a Hensen-Stempel® pipette. Care was taken to mix the sample in a random fashion before pipetting to avoid bias due to sinking of heavier organisms. The contents of the smallest subsample were identified to the lowest taxon and life-stage possible (typically genus or species) and enumerated. The larger subsamples were then re-examined for species that occur in numbers less than 10 individuals. The largest and rarest organisms were counted in their entirety, whereas the numbers of the smallest and most common organisms were extrapolated from the subsample. Micro-zooplankton (i.e., rotifers) were identified at magnification between 20-times and 100-times, suitable to observe characteristic morphological features required for identification. Once identified, organisms were enumerated in a counting tray. Subsamples were processed until the targeted range of 200 to 400 organisms per sample (except for rotifers and copepod nauplii) was counted. A Sedgwick-Rafter® counting cell or Utermöl® counting chamber was used to enumerate rotifers and copepod nauplii using 100-times magnification. Copepod nauplii of calanoid and cyclopoid copepod species were enumerated separately from adults; juveniles of these species are enumerated together due to the lack of distinguishing characteristics.

Biovolume (based on length measurements) are taken for the first 20 individuals of each zooplankton species identified from each taxonomic group using a calibrated eyepiece reticule. An initial comparison of the lengths of dominant taxa between sampling regions will determine if there is any among-site variability in per-taxon size estimates that should be accounted for. Individual lengths are then used to

calculate body mass for each zooplankton species measured using length-weight relationships developed for each species by McCauley (1984). Taxa-specific biomeasurements and conversions are presented in **Appendix G1**. Biomass (in mg [ww and dw]) was calculated by multiplying the number of individuals of a given species in a given sample by the average individual weight for that species.

6.1.3. Data Handling and Analysis

Taxa abundance and biomass results were tabulated in Microsoft Excel. Zooplankton abundance and biomass were converted to density measures by dividing the abundance and biomass by the volume of water filtered through the zooplankton net ($V = \pi r^2 h$). Three major groups of zooplankton typically dominate the plankton community in freshwater lakes. These are rotifers, and two subclasses of the *Crustacea*, *Cladocera* and *Copepoda* (within which there are two major orders, calanoid and cyclopoid copepods) (Wetzel, 1983). Rotifers are a large and diverse group that are predominantly sessile and associated with littoral substrates, although planktonic species can form a significant component of the zooplankton community. Copepod nauplii were grouped together as a major taxa group in the data analysis because of difficult distinguishing between the juvenile stages.

6.2. Quality Assurance / Quality Control

6.2.1. QA/QC Methods

Laboratory Duplicates

The laboratory QA/QC program for zooplankton is made up of two components:

- Subsampling accuracy – determined on approximately 10% of the samples (one per sampling event). Samples are chosen are randomly for evaluation of the precision of the subsampling procedure (i.e., consistency of duplicate processing). The difference between two sample fractions is used as an indicator of subsampling consistency and quantified using RPD. Guidance on precision between subsamples is lacking for zooplankton, so guidance from Environment Canada (2002) on subsampling precision for benthic invertebrates is applied. Estimates of organism abundance in each group of samples should be within 20% of each other. If the error between subsamples abundance exceeds 20%, the laboratory will be consulted to determine the potential cause of the error.
- Accuracy of taxonomic identification – comparing the number of disagreements in unique taxa (at the lowest practical level of identification) between two taxonomists.

Field Duplicates

A field duplicate was collected during each sampling event to assess sampling variability and sample homogeneity. Total biomass and abundance between the duplicate and original sample were compared, but no formal DQO was applied because zooplankton communities can be highly variable within the water column within a small spatial area.

6.2.2. QA/QC Results

Subsampling precision and taxonomic accuracy results are presented in **Table A2ï4**. The mean subsampling precision was 10.6% with a maximum subsampling error of 15.3%, well within the DQO of 20%. There were no disagreements between taxonomists in the identification of unique taxa in the three QA samples (**Table A2ï4**).

The RPD results of the field duplicate samples are presented in **Table A2ï5**. There was considerable variability in both biomass and abundance for individual major taxa groups as well as for total estimates of abundance and biomass. The differences are considered representative of the high degree of variability in the zooplankton community within the stations.

6.3. Results

Zooplankton density (organisms/m^3) and richness (number of taxa) are presented in **Table 6ï2**. Biomass results are presented in **Table 6ï3**. Density and biomass are shown in **Figure 6ï1** (per m^3) and **Figure 6ï2** (percent). The raw zooplankton data from Biolgoica are presented in **Appendix G1**. Historical zooplankton biomass and taxonomy results from Inuggugayualik Lake and Pipedream Lake are included in **Appendix G2** and **Appendix G3** for 2010 and 2011, respectively. The data are included for context purposes, but caution should be applied when comparing the historical data from Inuggugayualik Lake and Pipedream Lake to the 2015 baseline results from the Whale Tail Pit Study Area Lakes because of differences in field collection methods[8], different taxonomic methods[9], and the absence of paired reference data for 2015 to compare with the historical reference data. For more information on the historical zooplankton data, refer to Azimuth 2011 and 2012b Meadowbank CREMP reports.

Twenty different taxa (6 cladoceran, 3 calanoid copepods, 3 cyclopoid copepods, and 8 rotifers) were identified at the LPL from the samples submitted in 2015. Taxa richness ranged from a high of ten at WTN-1 in July to a low of three at NEM-3 in August (**Table 6ï2**). Overall, rotifers were the most abundant major taxa group, with more than 50% of the total zooplankton density comprised of rotifers (**Figure 6ï2**). Nemo Lake was the exception, where copepods (nauplii and adult cyclopods) were the most abundant zooplankton taxa during all three sampling events. The other major taxa group, the cladocerans, were a relatively small portion of the zooplankton community during the summer months (<1% to 7%). Cladocerans, primarily *Holopedium gibberum*, *Daphnia* sp., and *Bosmina* sp. occurred in their highest abundance in July, with fewer individuals observed during the August and September sampling events (**Figure 6ï2**). Zooplankton sampling for the Meadowbank CREMP noted similarly low overall abundance of cladocerans in 2010 and 2011 from all of the Meadowbank project lakes (Azimuth 2012a).

Some spatial variability in zooplankton density was observed at most locations during each month, but most notably seen in samples collected at Mammoth Lake during the July and August sampling events. The sample collected from MAM-2 in July had nearly 150,000 organisms/m^2 compared with MAM-1 where zooplankton density was less than 20,000 organisms/m^2 (**Figure 6ï1**, **Table 6ï2**). Sample abundance was comprised mainly of rotifers at 83%, the highest reported abundance of this major taxonomic group of all the samples collected in 2015. MAM-2 was located in a relatively shallow location in Mammoth Lake compared to MAM-1 (**Figure 1ï5**), which is important because rotifers are predominantly sessile and associated with littoral substrates.

Zooplankton biomass was generally between 50 mg/m^3 and 100 mg/m^3 with the exception of Mammoth Lake where highly variable biomass was reported for the replicate samples in the July and August sampling events (**Figure 6ï1**). The two July replicate samples collected from Mammoth Lake had total biomass measurements of 11 mg/m^3 and 183 mg/m^3. Similarly variable results were reported in the two August replicate samples: 304 mg/m^3 and 59 mg/m^3 (**Table 6ï3**). Despite the variability in total

[8] Zooplankton samples were collected in 2010 and 2011 from a depth of 8 m depth to surface. Each sample was a composite of 2 tows.

[9] Rotifers, which were prevalent in the 2015 samples, were not identified in the 2010 and 2011 samples.

biomass, the percent composition of taxa contributing to the total biomass was similar between replicates for each event (**Figure 6ï2**). Temporally, the July and September samples had higher proportions of the biomass comprised of Cyclopoid copepods, whereas the August samples had more of the total zooplankton biomass comprised of Calanoid copepods. Whale Tail Lake (WTN and WTS) had increased biomass from rotifers in August, coinciding with reduced biomass from the Cyclopoid copepods. This pattern was not observed in Mammoth Lake and Nemo Lake.

In summary, zooplankton abundance and biomass can vary considerably within lakes and between lakes depending on a range of environmental factors (nutrients, phytoplankton community and abundance, turbidity, wind speed, direction, water depth, etc.).

Table 6-1. Zooplankton station information, Whale Tail Pit Baseline, 2015.

Sampling Event	Sampling Area	Date	UTM Coordinates			Depth (m)	Haul Depth[1] (m)	DUP	Number of Tows	Number of Jars
			Zone	Easting	Northing					
July	WTN-1	17-Jul-15	14W	607207	7254975	7.4	6.0	No	1	1
	WTN-2	17-Jul-15	14W	607252	7254613	6.4	5.0	No	1	1
	WTS-1	17-Jul-15	14W	607450	7253884	9.5	8.0	No	1	1
	WTS-2	17-Jul-15	14W	607621	7254253	5.1	4.0	Yes	1	1
	NEM-1	18-Jul-15	14W	606604	7254415	10.5	9.0	No	1	1
	NEM-2	18-Jul-15	14W	606454	7257135	11.9	11.0	No	1	1
	MAM-1	18-Jul-15	14W	604145	7254415	7.8	7.5	No	1	1
	MAM-2	18-Jul-15	14W	604278	7254163	5.1	4.0	No	1	1
August	WTN-3	22-Aug-15	14W	607393	7254558	8.6	7.6	No	1	1
	WTN-4	22-Aug-15	14W	607221	7254988	6.4	5.4	No	1	1
	WTS-3	22-Aug-15	14W	607155	7253550	7.8	6.8	Yes	1	1
	WTS-4	21-Aug-15	14W	607571	7254138	7.5	6.5	No	1	1
	NEM-3	23-Aug-15	14W	606553	7257360	8	7.0	No	1	1
	NEM-4	23-Aug-15	14W	606370	7257235	10.2	9.2	No	1	1
	MAM-3	24-Aug-15	14W	604273	7254244	7.4	6.4	No	1	1
	MAM-4	24-Aug-15	14W	604239	7253860	7.8	6.8	No	1	1
September	WTN-5	18-Sep-15	14W	607244	7255025	6.7	5.7	No	1	1
	WTN-6	18-Sep-15	14W	607329	7254542	10.9	9.9	No	1	1
	WTS-5	18-Sep-15	14W	607612	7253907	6.5	5.5	Yes	1	1
	WTS-6	18-Sep-15	14W	607568	7254259	7.8	6.8	No	1	1
	NEM-5	19-Sep-15	14W	606289	7257418	10.5	10.0	No	1	1
	NEM-6	19-Sep-15	14W	606611	7257938	15.2	10.0	No	1	1
	MAM-5	19-Sep-15	14W	604357	7254348	8.9	8.0	No	1	1
	MAM-6	19-Sep-15	14W	604228	7253834	6.4	6.0	No	1	1

Notes:

Haul depth start is the depth measured from the surface to the bottom of the cod end on the zooplankton net.

Table 6-2. Zooplankton richness and density (organisms/m^3) by major taxa group, Whale Tail Pit Baseline, 2015.

Area-Replicate	Haul Length[1] (m)	Total Richness[2]	Density[3] (organisms/m^3)					Total Density
			Cladocera	Calanoida	Cyclopoida	Copepod Nauplii	Rotifera	
Whale Tail Lake North Basin								
WTN-1	3.6	10	1140 (2.2)	825 (1.6)	10296 (20)	9169 (18)	30914 (59)	52344
WTN-2	2.6	5	3374 (7.6)	653 (1.5)	8651 (19)	13422 (30)	18500 (41)	44600
WTN-3	5.1	7	166 (0.4)	860 (2)	2136 (5)	9616 (23)	29174 (70)	41951
WTN-4	3.0	8	47 (0.07)	723 (1.1)	2326 (3.7)	20278 (32)	39769 (63)	63143
WTN-5	3.3	5	17 (0.05)	111 (0.3)	2255 (7)	5859 (18)	24079 (74)	32321
WTN-6	7.5	7	19 (0.04)	1103 (2.1)	5187 (10)	10249 (20)	35085 (68)	51643
Whale Tail Lake South Basin								
WTS-1	5.6	9	1011 (3.2)	126 (0.4)	6871 (22)	7831 (25)	16084 (50)	31924
WTS-2	1.6	6	725 (1.3)	265 (0.5)	18391 (32)	9431 (17)	28294 (50)	57107
WTS-3	4.4	5	0 (0)	1109 (2)	2508 (4.6)	10289 (19)	40727 (75)	54632
WTS-4	4.1	6	17 (0.04)	1070 (2.4)	2519 (5.6)	8971 (20)	32780 (72)	45357
WTS-5	3.1	7	68 (0.2)	479 (1.5)	4723 (15)	9736 (30)	17189 (53)	32196
WTS-6	4.4	5	32 (0.1)	322 (1.4)	3237 (14.1)	4609 (20)	14790 (64)	22989
Nemo Lake								
NEM-1	6.6	8	227 (0.8)	4116 (15)	4223 (16)	9146 (34)	9360 (35)	27071
NEM-2	8.6	8	191 (0.7)	2884 (11)	4228 (16)	12009 (45)	7457 (28)	26768
NEM-3	4.6	4	123 (0.3)	6858 (17)	5382 (13.4)	14762 (37)	12917 (32)	40042
NEM-4	6.8	3	0 (0)	3537 (13)	3495 (12.9)	12067 (45)	7906 (29)	27004
NEM-5	7.6	8	9 (0.04)	3109 (13)	2383 (10.3)	10859 (47)	6794 (29)	23153
NEM-6	7.6	5	19 (0.09)	1861 (9.3)	1173 (5.9)	8811 (44)	8066 (40)	19930
Mammoth Lake								
MAM-1	5.1	6	89 (0.5)	202 (1.1)	255 (1.3)	5733 (30)	12760 (67)	19039
MAM-2	1.6	8	3625 (2.5)	1238 (0.9)	12556 (9)	6985 (5)	120545 (83)	144949
MAM-3	4.0	9	354 (0.51)	13322 (19)	16151 (23)	10257 (15)	29591 (42)	69674
MAM-4	4.4	8	3 (0.01)	498 (1.8)	569 (2)	9324 (33)	18005 (63)	28400
MAM-5	5.6	6	17 (0.09)	472 (2.5)	1684 (9.1)	6231 (34)	10105 (55)	18509
MAM-6	3.6	7	24 (0.11)	495 (2.3)	1619 (7)	7336 (33)	12444 (57)	21918

Notes:

[1] Haul length = the vertical length of the water towed (i.e., length of the water column from the surface to the opening of the zooplankton net).

[2] Taxonomic richness measured at the lowest practical level (LPL) of taxonomic identification.

[3] Density reported as number of organisms/m^3 calculated based on the length of the haul (percent of total shown in parentheses). Volume of water (cubic meters) towed was calculated using the following equation: $V = \pi r^2 h$; where r = the radius of the net (0.15 m) and h = the haul length.

Table 6-3. Zooplankton biomass (mg/m^3) by major taxa group, Whale Tail Pit Baseline, 2015.

Area-Replicate	Haul Length[1] (m)	Zooplankton Biomass[2] (mg/m^3)					Total Biomass
		Cladocera	Calanoida	Cyclopoida	Copepod Nauplii	Rotifera	
Whale Tail Lake North Basin							
WTN-1	3.6	7 (9.4)	4 (6)	41 (58)	2 (2.1)	18 (25)	72
WTN-2	2.6	14 (21)	3 (5)	36 (54)	2 (3.4)	11 (16)	66
WTN-3	5.1	1 (3)	18 (38)	7 (13.6)	0 (0.5)	22 (45)	48
WTN-4	3.0	0 (0.7)	17 (29)	6 (11.1)	1 (0.9)	34 (58)	58
WTN-5	3.3	0 (0.2)	2 (6)	8 (26)	0 (0.9)	20 (67)	30
WTN-6	7.5	0 (0.1)	29 (34)	21 (25)	0 (0.5)	34 (40)	85
Whale Tail Lake South Basin							
WTS-1	5.6	3 (6.7)	1 (1)	26 (59)	1 (2.9)	13 (30)	43
WTS-2	1.6	2 (2)	1 (1)	63 (58)	1 (1.1)	41 (38)	109
WTS-3	4.4	0 (0)	24 (34)	7 (9.9)	0 (0.4)	40 (56)	71
WTS-4	4.1	0 (0.6)	22 (37)	6 (10.2)	1 (1.1)	31 (51)	61
WTS-5	3.1	1 (2)	12 (24)	20 (37)	1 (1.5)	19 (36)	53
WTS-6	4.4	1 (1.9)	6 (15)	14 (38)	0 (1.1)	16 (44)	37
Nemo Lake							
NEM-1	6.6	2 (4.2)	20 (41)	17 (35)	0.88 (1.8)	8.5 (18)	48
NEM-2	8.6	1 (2)	14 (41)	11 (33)	0.65 (1.9)	7.4 (22)	34
NEM-3	4.6	2 (2.1)	78 (75)	10 (9.4)	0.36 (0.3)	13.3 (13)	104
NEM-4	6.8	0 (0)	42 (74)	6 (10.8)	0.27 (0.5)	8.4 (15)	56
NEM-5	7.6	0.14 (0.2)	47 (79)	4 (7)	0.34 (0.6)	7.8 (13)	60
NEM-6	7.6	0.17 (0.4)	29 (70)	3 (6)	0.37 (0.9)	9.6 (23)	42
Mammoth Lake							
MAM-1	5.1	0 (4)	1.2 (10)	1 (12)	0.84 (7.4)	8 (66)	11
MAM-2	1.6	22 (11.8)	7.5 (4)	70 (38)	1.17 (0.6)	83 (45)	183
MAM-3	4.0	6 (2)	235 (78)	37 (12.2)	0.69 (0.2)	24 (8)	304
MAM-4	4.4	0.07 (0.1)	42 (70)	1 (2.1)	0.41 (0.7)	16 (27)	59
MAM-5	5.6	0.11 (0.4)	10 (38)	6 (19.8)	0.27 (1)	11 (41)	28
MAM-6	3.6	0.23 (0.8)	9 (33)	5 (18.5)	0.61 (2.1)	13 (46)	28

Notes:

[1] Haul length = the vertical length of the water towed (i.e., length of the water column from the surface to the opening of the zooplankton net).

[2] Biomass reported as grams dry weight/m^3 calculated based on the length of the haul (percent of total shown in parentheses). Volume of water (cubic meters) towed was calculated using the following equation: $V = \pi r^2 h$; where r = the radius of the net (0.15 m) and h = the haul length.

Figure 6ï1. Zooplankton density (organisms/m^3) and biomass (mg/m^3 dry weight) by major taxa group, Whale Tail Pit Baseline, 2015.

Notes: See text for information on the major taxa groups (MTG). Vertical dashed lines separate the samples by sampling event (i.e., July, August, and September).

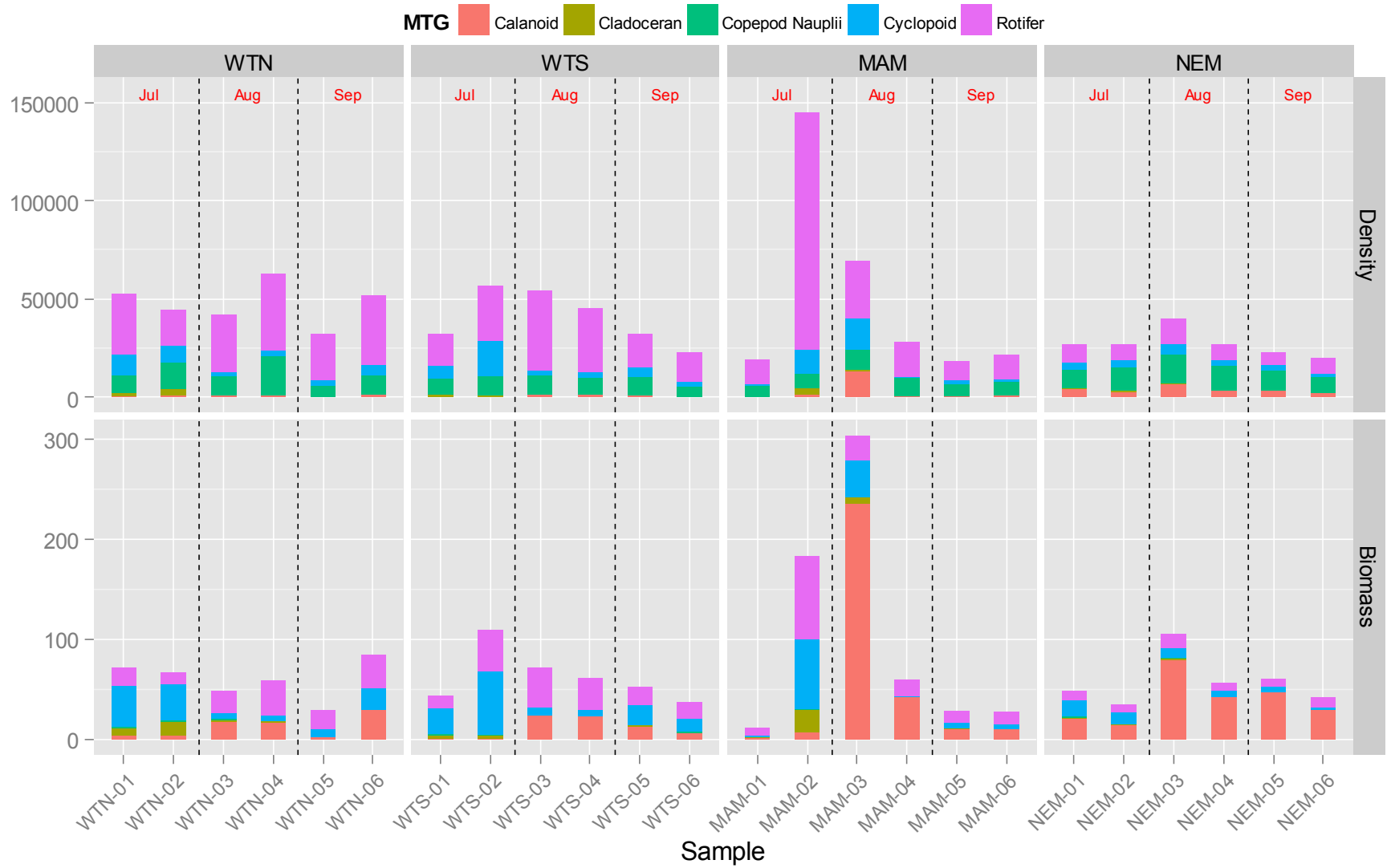
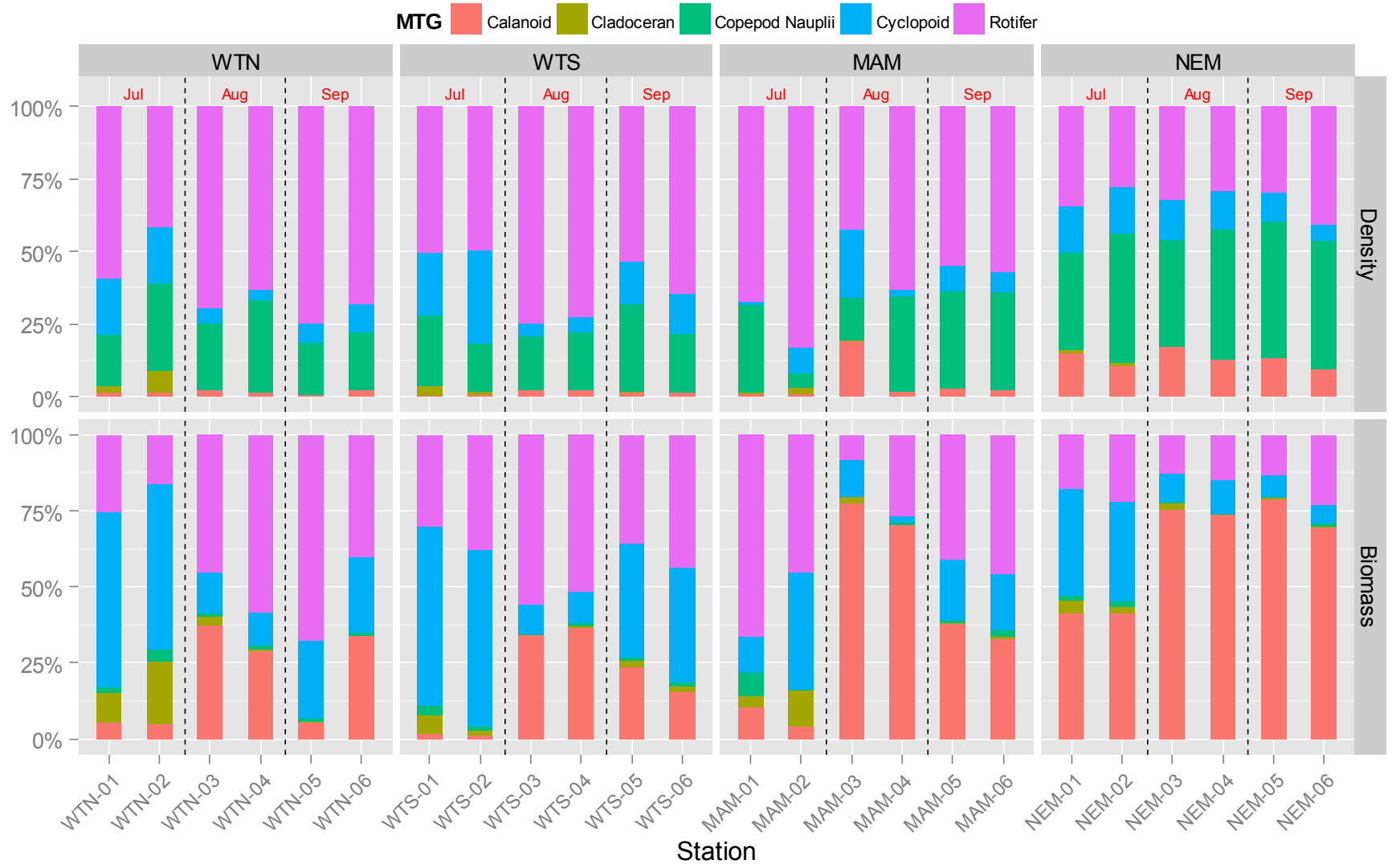


Figure 6ï2. Percent zooplankton density and biomass by major taxa group, Whale Tail Pit Baseline, 2015.

Notes: See text for information on the major taxa groups (MTG). Vertical dashed lines separate the samples by sampling event (i.e., July, August, and September).



7. PERIPHYTON

7.1. Qualitative Survey Methods

Periphyton surveys were completed during each 2015 sampling event to provide a qualitative assessment of the abundance and distribution of periphyton in the study area; no periphyton assessment was conducted in 2014. Data collection was carried out according to methods provided by Golder (Golder 2015b) and included the following:

- GPS coordinates,
- Photographs of the microhabitat of the sampling area as well as the macrohabitat surrounding the area,
- Visual estimate of the percent periphyton cover at the micro and macrohabitat scales,
- Substrate types present and their proportions, and
- A description of the periphyton community, including colour, thickness, and texture.

Results were recorded on waterproof paper using the field datasheet template provided by Golder. Field observations, coordinates, and photographs were submitted to Golder at the end of each sampling event for use in the EIA. Tabulated results are presented in **Appendix H**.

7.2. Results

Location of the periphyton surveys in Whale Tail, Nemo, and Mammoth Lakes are shown on **Figure 1ï3** to **Figure 1ï5**. The July and September surveys were completed in the same general location in each lake. Periphyton growth in the July survey was considered sparse to moderate at most locations. Sparse growth was evident in areas where ice scour was noticeable on the rock substrate. Periphyton cover was more noticeable at deeper depths (as an example, see notes for WTN-2 in **Appendix H**). Below 20 cm, periphyton cover was generally rated as moderate (25-75% cover). Periphyton growth was considered low to moderate at most stations in the August survey. Green filamentous algae was observed at most locations and the periphyton was firmly attached to the substrate with a thickness between 1 mm and 5 mm. Lake levels in the September survey were noticeably lower at several locations. Exposed rocks had dried periphyton visible along the shoreline, but below 10 cm growth was rated as moderate to high (>75%).

Periphyton surveys were completed at the Sentinel stations during each event (**Figure 1ï1**). Periphyton cover was spatially heterogeneous at the Sentinel stations during each of the sampling events. Areas of low flow and adequate depth had dense mats of periphyton growth (>75% cover). Lower water levels were noted in September relative to July, but in areas where the rocks were submerged, dense periphyton growth was noted (see the survey for C2 on September 20th as an example).

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APPENDICES

APPENDIX A

Quality Assurance / Quality Control Results

APPENDIX A1

Water and Sediment Chemistry QA/QC Results

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A1-1. WATER CHEMISTRY QA/QC RESULTS

A1-1.1. Lake Stations (2014)

A full review of the QA/QC results for the 2014 surface water samples collected by Portt and Associates was not done in this report. The QA/QC assessment presented here is limited to results from the equipment blank and duplicate samples submitted with the 2014 Lake samples. **Table A1ï1** presents the DLs, equipment blank concentrations, and field duplicate RPDs.

- Equipment Blanks – A few metals were detected above the MDL in the equipment blank collected by Portt and Associates in September 2014, specifically total and dissolved barium, total and dissolved lead, total and dissolved manganese, dissolved aluminum, and dissolved organic carbon (DOC). Each of these parameters was reviewed in detail to evaluate the implications of the possible cross-contamination identified in the equipment blanks.
    - Barium – Barium was detected in the total and dissolved fractions of each sample submitted in 2014. The barium concentration in the total and dissolved blanks represented less than 5% of the concentrations reported in the Lake samples. The effects of cross-contamination (i.e., <5%) are well within laboratory variability, so the barium results for the 2014 Lake samples were considered reliable for this project.
    - Lead – Total lead was measured at the DL (0.00005 mg/L) in the equipment blank and dissolved lead was measured at nearly 10-times the DL (0.00047 mg/L). Dissolved lead was lower than the DL in all of the 2014 Lake samples, and only two samples had measured concentrations of total lead. One seemingly anomalous total lead concentration of 0.0069 mg/L in sample Rep-1 from Whale Tail Lake in 2014 exceeded the CCME aquatic life criteria as well as the trigger and threshold values developed for the Meadowbank project lakes (**Table 2ï1**). Rep-1 was collected from the North Basin in 2014 (Location 1, **Figure 1ï3**). The other two replicates were below the DL for total lead of (0.00005 mg/L), and based on these data, the total lead concentration from replicate 1 is considered unreliable. The other sample with detected total lead was at Location 3 in Mammoth Lake, and was considered unreliable because the reported concentration was less than 5-times the concentration in the equipment blank.
    - Manganese – Manganese, like barium, was detected in the total and dissolved fractions of each sample submitted in 2014, but in each case, the reported concentration was greater than 5-times the concentration in the equipment blank. The effect of cross-contamination from the equipment blank was minor, representing less than 6% for total manganese and 11% for dissolved manganese in the Lake samples. A cautionary flag is applied to the dissolved manganese results.
    - Dissolved aluminum – The DL for dissolved aluminum is 0.001 mg/L and the concentration measured in the equipment blank was 0.0018 mg/L (**Table A1ï1**). Seven of the nine Lake samples collected in 2014 had dissolved aluminum concentrations within 5-times the concentration in the equipment blank; consequently, a cautionary flag is applied to these results.
    - DOC – The equipment blank result for DOC was 0.83 mg/L, marginally above the DL of 0.5 mg/L. A cautionary flag is applied to all of the DOC results because the measured concentration in the Lake samples is less than 5-times the concentration in the equipment blank.

- Field Duplicates – All field duplicate parameters were less than the DQO of 50% RPD between the duplicate samples.
- Other Considerations – Replicate 3 from Whale Tail Lake had concentrations of ammonia and total phosphorus that were over an order of magnitude higher than the other two replicate samples collected from Whale Tail Lake during the same sampling event in September 2014 (**Table 2ï1**). In the case of phosphorus, replicate 1 and 5 were below the DL, while replicate 3 was 40-fold higher at 0.083 mg/L. The magnitude of the difference in ammonia between replicate 3 and replicates 1 and 5 is low (~5 to 20-fold). Surface water tends to be well mixed and homogenous throughout the Lakes, as evidenced by the similarity in *in-situ* field-measured water quality parameters (**Table B1ï1**); as such, order of magnitude differences in ammonia and total phosphorus observed at Whale Tail Lake would not be expected. For this reason, the results for ammonia and total phosphorus at Whale Tail Lake are flagged as unreliable.

A1-1.2. Lake and Sentinel Stations (2015)

One duplicate water sample and one equipment blank were collected during each of the three lake and sentinel station sampling events in July, August, and September. Travel blanks were submitted for the July and August events, but the September water samples were submitted without a travel blank, as one was not available on site. QA/QC results are presented in **Table A1ï2** (MDLs, equipment blanks, and travel blanks), **Table A1ï3** (laboratory duplicates), and **Table A1ï4** (field duplicates). Results of the QA/QC analyses are discussed below.

- Laboratory QC
    - There were no instances of laboratory duplicate samples failing the DQOs.
    - Matrix spike samples and CRM analyses were within the laboratory DQOs.
    - There were occasional exceedances of the MB DQO for total alkalinity (< 1.0 mg/L), calcium (<0.05 mg/L). In all cases the results were considered reliable (i.e., concentrations were at least 5-times greater than the blank levels).
    - Dissolved vs Total Concentrations – While lower MDLs are reported for dissolved aluminum, copper, and zinc compared to the total analyses, there were no unexpected patterns of higher dissolved concentrations relative to total.
- Travel Blanks – All analyses were below the MDLs in the travel blanks submitted in July and August.
- Equipment Blanks – The majority of the total and dissolved parameters were below the MDLs for the equipment blanks submitted in July, August, and September. A few metals were detected above the MDL in each event:
    - July – total lead and dissolved aluminum
    - August – total aluminum, barium, cadmium, and lead
    - September – total and dissolved lead

  Each metal parameter was reviewed in detail to evaluate the implications of the possible cross-contamination identified in the equipment blanks:
    - Total aluminum – The concentration in the August equipment blank was 0.0035 mg/L (MDL = 0.003 mg/L). Aluminum was detected in all of the August Lake and Sentinel station samples, but the concentrations were less than 10-times the MDL. For this

reason, even low levels of cross-contamination in the equipment blank have the potential to affect the results. In total, 12 Lake samples and 4 Sentinel station samples were less 5-times the concentration reported in the August equipment blank. Despite the potential influence of cross-contamination, the total aluminum data are only given a cautionary flagging for the following reasons: 1) the August total aluminum concentrations were generally less than the July and September results, and 2) dissolved aluminum was detected in all August samples.

- Total barium – The concentration in the August equipment blank was 0.00009 mg/L. Barium was detected in every water sample (see **Table 2ï2**). The minimum concentration reported for the August event (Lake and Sentinel stations) was 0.0018 mg/L, or 20-fold higher than the equipment blank. Consequently, the effects of cross-contamination (i.e., <5%) are well within laboratory variability, so the barium results for August meet the overall DQOs for this project.
- Total cadmium – The cadmium concentration in the August equipment blank was 0.0000089 mg/L. The single August field sample (collected from NEM-3) with measured concentrations was less than 5-times the equipment blank concentration, so is considered unreliable.
- Total lead – Detected in each event's equipment blank, ranging in concentration from 0.00006 to 0.00071 mg/L. While most of the actual Lake and Sentinel station samples were less than MDL (0.00005 mg/L), total lead concentrations for MAM-06 (September) and PDL-39 (August) were flagged as unreliable, as well as 5 detected values from the Sentinel stations.
- Dissolved aluminum – Dissolved aluminum was detected in the July equipment blank near the MDL (0.001 mg/L). A cautionary flag was applied to the dissolved aluminum results at NEM-01, NEM-02, C2-JUL, and C20-July because the concentration was below 5-times the concentration in the equipment blank (0.005 mg/L).
- Dissolved lead – Detected in the September equipment blank (0.000069 mg/L). Results from four Lake samples (WTS-05, NEM-05, NEM-06, MAM-05) and one Sentinel station sample (C20-SEPT) were flagged as unreliable for two reasons: 1) the total lead concentrations were less than the MDL in each sample, and 2) the dissolved concentrations in these samples were less than 5-times the concentration detected in the equipment blank.

- Field Duplicates – All field duplicate parameters were less than the DQO of 50% RPD between the duplicate samples.
- Field Measurements – Anomalous water quality measurements were noted in several field-parameters collected by AEM technicians from the reference areas in 2015. At INUG-74, specific conductivity was greater than 121 µS/cm at all depth profiles down to 10 m. By comparison, the specific conductivity at INUG-75 was between 43 and 26 µS/cm, which is consistent with long-term conditions at INUG. The anomalous results are likely due to issues with the conductivity probe. Similarly, there were two instances of low pH (at or below pH 6.5) at PDL that are also likely reflective of water quality meter issues.
- Other Considerations – TSS was detected in the September sample from C41, which also had elevated concentrations of iron and total phosphorus relative to previous sampling events. The elevated TSS is likely a sampling artifact due to low flow at the time of sample collection; the total iron result for this station is flagged as unreliable.

A1-1.3. Tributary Stations (2015)

A duplicate water sample was collected during each of the August and September sampling events. A travel blank was submitted for the August event but not for September as one was not available at the time of sampling. Equipment blanks were not prepared as the samples were collected directly into the bottles. QA/QC results for the tributary samples are presented in **Table A1ï5** (MDLs, equipment blanks, and travel blanks), **Table A1ï6** (laboratory duplicates), and **Table A1ï7** (field duplicates). Results of the QA/QC analyses are discussed below.

- Travel Blanks – No parameters were above the MDL in the August travel blank.
- Laboratory Duplicates – There were no instances of laboratory duplicate samples failing the DQO.
- Field Duplicates – All field duplicate parameters were less than the DQO of 50% RPD between the duplicate samples.
- Dissolved vs Total Concentrations – There were two instances of dissolved organic carbon (DOC) concentration being reported higher than the total organic carbon (TOC) concentration in tributary samples collected in September (A16-A14 and A13-A12). The results were verified by repeat analysis, suggesting the DOC and TOC samples were labelled incorrectly in the field. No other issues were identified.
- Other Considerations – TSS was detected in a few of the samples. The highest concentration was observed in A55-A17 in September, and resulted in exceedances of the screening criteria of a few parameters. The elevated TSS is likely a sampling artifact due to low flow at the time of sample collection; the total iron result for this station is flagged as unreliable. Further discussion of the exceedance is presented in **Section 2.3.3** of the Main Report.

A1-2. SEDIMENT CHEMISTRY QA/QC RESULTS

Table A1ï8 presents the QA/QC assessment of the metal analyses and includes results of the laboratory duplicate RPDs, the field duplicate RPDs, and results from the equipment swipes. **Table A1ï9** shows the field duplicate RPD results for the hydrocarbon and PAH analyses. No laboratory duplicate or equipment swipe analyses were completed for hydrocarbons or PAHs.

A1-2.1. Laboratory Duplicates

There were no exceedance of the laboratory DQOs for the laboratory duplicates (**Table A1ï8**), indicating acceptable precision in the analytical method.

A1-2.2. Equipment Swipes

Four equipment swipes were submitted with the sediment samples, corresponding to approximately 10% of the samples that were collected. There were a few parameters that were detected on at least one of the swipe samples: aluminum, barium, chromium, iron, magnesium, manganese, nickel, tin, titanium, and zinc (**Table A1ï8**). Of these parameters, only iron was greater than 10-times the MDL (reported in mg metal per swipe). Because of the number of parameters that were detected, two "blank" swipes were submitted in October. Fewer analytes were detected in the blank swipes, but iron, magnesium, and zinc were detected at less than 10-times the MDL. Despite detectable metals on the swipes, the concentrations contributed less than 0.1% of the total metals concentration in the sediment samples in all cases, indicating that any residual metals present on the equipment would not influence the overall sediment chemistry.

A1-2.3. Field Duplicates

Four duplicate sediment samples were collected for metals analysis, one from each of the areas sampled in August. There were no exceedances of the DQO (50% RPD) for metals in the field duplicate samples (**Table A1ï8**). The range of reported RPDs was between -22% and 29%. One duplicate sample had RPDs that exceeded 50% for sand and clay content, likely an artifact of small-scale spatial heterogeneity in particle size at the location (MAM-2).

PAHs and hydrocarbons were below the MDL for the composite sample and duplicate collected from Mammoth Lake in August (**Table A1ï9**). Mineral oil and grease had an RPD of 64% in the field duplicates, but the concentrations were less than 10-times the MDL.

Table A1-1. Equipment blanks and field duplicate results for water parameters, Whale Tail Pit Baseline, 2014.

Analyte	Detection Limits	Equipment Blank[1]	Field Duplicate (Mammoth Lake Rep 5)		
			Rep 5	Duplicate	RPD[2]
Physical Tests					
Conductivity (µS/cm)	2	*<2.0*	20.40	20.8	-1.9
Hardness (mg/L)	0.5	*<0.50*	08.0	07.8	2.3
pH (Laboratory)	0.1	5.58	7.14	6.76	5.5
Total Suspended Solids (mg/L)	1	*<1.0*	*<1.0*	*<1.0*	
Total Dissolved Solids (mg/L)	3	*<10*	17.0	20.0	-16.2
Turbidity (NTU)	0.1	*<0.10*	0.42	0.39	7
Anions and Nutrients (mg/L)					
Alkalinity, Bicarbonate (as $CaCO_3$)	1	*<1.0*	5.70	4.00	35
Alkalinity, Carbonate (as $CaCO_3$)	1	*<1.0*	*<1.0*	*<1.0*	
Alkalinity, Hydroxide (as CaCO3)	1	*<1.0*	*<1.0*	*<1.0*	
Alkalinity, Total (as $CaCO_3$)	1	*<1.0*	5.70	4.00	35
Ammonia, Total (as N)	0.005	*<0.0050*	0.03	0.02	45
Bromide (Br)	0.05	*<0.050*	*<0.050*	*<0.050*	
Chloride (Cl)	0.1	*<0.10*	0.69	0.69	0
Fluoride (F)	0.02	*<0.020*	0.03	0.03	6.5
Nitrate (as N)	0.005	*<0.0050*	*<0.0050*	*<0.0050*	
Nitrite (as N)	0.001	*<0.0010*	*<0.0010*	*<0.0010*	
Total Kjeldahl Nitrogen	0.05				
Orthophosphate-Dissolved (as P)	0.001	*<0.0010*	*<0.0010*	*<0.0010*	
Phosphorus (P)-Total Dissolved	0.002	*<0.0020*	0.0021	*<0.0020*	
Phosphorus (P)-Total	0.002	*<0.0020*	*<0.0020*	*<0.0020*	
Silicate (as SiO_2)	0.5	*<0.50*	0.51	0.57	-11.1
Sulfate (SO_4)	0.3	*<0.50*	2.83	2.80	1
Cyanides (mg/L)					
Total Cyanide	0.001	*<0.0050*	*<0.0050*	*<0.0050*	
Free Cyanide	0.001	*<0.0050*	*<0.0050*	*<0.0050*	
Organic / Inorganic Carbon (mg/L)					
Dissolved Organic Carbon	0.5	**0.83**	2.19	2.25	-3
Total Organic Carbon	0.5	*<0.50*	1.93	1.87	3.2
Plant Pigments (µg/L)					
Chlorophyll-a	0.01	-	0.34	0.37	-10
Total Metals (mg/L)					
Aluminum	0.003	*<0.0030*	0.01	0.01	-10
Antimony	0.0001	*<0.00010*	*<0.00010*	*<0.00010*	
Arsenic	0.0001	*<0.00010*	0.00043	0.00043	0
Barium	0.00005	**0.00006**	0.0035	0.0035	1.2
Beryllium	0.0001	*<0.00010*	*<0.00010*	*<0.00010*	
Bismuth	0.0005	*<0.00050*	*<0.00050*	*<0.00050*	
Boron	0.01	*<0.010*	*<0.010*	*<0.010*	
Cadmium	0.00001	*<0.000010*	*<0.000010*	*<0.000010*	
Calcium	0.05	*<0.050*	1.91	1.89	1.1
Chromium	0.0001	*<0.00010*	0.00013	0.00	17
Cobalt	0.0001	*<0.00010*	*<0.00010*	*<0.00010*	
Copper	0.0005	*<0.00050*	*<0.00050*	*<0.00050*	
Iron	0.01	*<0.010*	0.021	0.021	0.0
Lead	0.00005	**0.00005**	*<0.000050*	*<0.000050*	
Lithium	0.0005	*<0.00050*	*<0.00050*	*<0.00050*	
Magnesium	0.1	*<0.10*	0.74	0.74	0.0
Manganese	0.00005	**0.00008**	0.0014	0.0014	1.4
Mercury	0.00001	*<0.000010*	*<0.000010*	*<0.000010*	
Molybdenum	0.00005	*<0.000050*	*<0.000050*	*<0.000050*	
Nickel	0.0005	*<0.00050*	0.00052	0.00050	3.9
Phosphorus	0.05	*<0.050*	*<0.050*	*<0.050*	
Potassium	0.1	*<0.10*	0.53	0.55	-4
Selenium	0.0001	*<0.00010*	*<0.00010*	*<0.00010*	
Silicon	0.05	*<0.050*	0.32	0.33	-1.5
Silver	0.00001	*<0.000010*	*<0.000010*	*<0.000010*	
Sodium	0.05	*<0.050*	0.50	0.50	-1.0
Strontium	0.0002	*<0.00020*	0.008	0.008	0
Sulfur	0.5	*<0.50*	0.96	0.93	3
Thallium	0.00001	*<0.000010*	*<0.000010*	*<0.000010*	
Tin	0.0001	*<0.00010*	*<0.00010*	*<0.00010*	
Titanium	0.01	*<0.010*	*<0.010*	*<0.010*	
Uranium	0.00001	*<0.000010*	0.000024	0.000021	13.3
Vanadium	0.001	*<0.0010*	*<0.0010*	*<0.0010*	
Zinc	0.003	*<0.0030*	*<0.0030*	*<0.0030*	

Table A1-1. Equipment blanks and field duplicate results for water parameters, Whale Tail Pit Baseline, 2014.

Analyte	Detection Limits	Equipment Blank[1]	Field Duplicate (Mammoth Lake Rep 5)		
			Rep 5	Duplicate	RPD[2]
Dissolved Metals (mg/L)					
Aluminum	0.001	**0.0018**	0.0060	0.0066	-10
Antimony	0.0001	*<0.00010*	*<0.00010*	*<0.00010*	
Arsenic	0.0001	*<0.00010*	0.0004	0.00040	-2.5
Barium	0.00005	**0.000099**	0.0035	0.0035	1.4
Beryllium	0.0001	*<0.00010*	*<0.00010*	*<0.00010*	
Bismuth	0.0005	*<0.00050*	*<0.00050*	*<0.00050*	
Boron	0.01	*<0.010*	*<0.010*	*<0.010*	
Cadmium	0.00001	*<0.000010*	*<0.000010*	*<0.000010*	
Calcium	0.05	*<0.050*	1.94	1.91	1.6
Chromium	0.0001	*<0.00010*	*<0.00010*	*<0.00010*	
Cobalt	0.0001	*<0.00010*	*<0.00010*	*<0.00010*	
Copper	0.0002	*<0.00020*	0.00039	0.00038	2.6
Iron	0.01	*<0.010*	0.01	0.01	10
Lead	0.00005	**0.00047**	*<0.000050*	*<0.000050*	
Lithium	0.0005	*<0.00050*	*<0.00050*	*<0.00050*	
Magnesium	0.1	*<0.10*	0.76	0.73	4.0
Manganese	0.00005	**0.000114**	0.0010	0.0009	7
Mercury	0.00001	*<0.000010*	*<0.000010*	*<0.000010*	
Molybdenum	0.00005	*<0.000050*	*<0.000050*	*<0.000050*	
Nickel	0.0005	*<0.00050*	*<0.00050*	*<0.00050*	
Phosphorus	0.05	*<0.050*	*<0.050*	*<0.050*	
Potassium	0.1	*<0.10*	0.53	0.53	0.0
Selenium	0.0001	*<0.00010*	*<0.00010*	*<0.00010*	
Silicon	0.05	*<0.050*	0.33	0.32	4.3
Silver	0.00001	*<0.000010*	*<0.000010*	*<0.000010*	
Sodium	0.05	*<0.050*	0.50	0.50	-0.8
Strontium	0.0002	*<0.00020*	0.008	0.008	0.0
Sulfur	0.5	*<0.50*	0.93	0.98	-5
Thallium	0.00001	*<0.000010*	*<0.000010*	*<0.000010*	
Tin	0.0001	*<0.00010*	*<0.00010*	*<0.00010*	
Titanium	0.01	*<0.010*	*<0.010*	*<0.010*	
Uranium	0.00001	*<0.000010*	0.000020	0.000022	-9.5
Vanadium	0.001	*<0.0010*	*<0.0010*	*<0.0010*	
Zinc	0.001	*<0.0010*	*<0.0010*	*<0.0010*	

Notes:

Data presented here were adapted from Portt and Associates (2015a).

[1] **Bolded Equipment Blank values** concentrations exceeds laboratory MDLs but < 10 x MDL.

Shaded Equipment Blank values concentrations is > 10 x MDL.

[2] RPD = Relative Percent Difference (%) = ((original - duplicate) / (original + duplicate)/2) x 100.

RPDs have not been calculated for cases where one of the samples is below detection and the other is not and in cases where both are below detection. RPD has been left blank.

The data quality objective (DQO) for field duplicates is an RPD < 50%.

Bolded RPDs RPD values exceed 50% but < 10 x MDL.

Shaded RPD RPD values exceed 50% and > 10 x MDL.

Italicized numbers are below detection limits.

Table A1-2. Detection limits, equipment blanks, and travel blanks for water parameters in Lake and Sentinel station samples, Whale Tail Pit Baseline, 2015.

Analyte	Month	Detection Limits			Equipment Blanks			Travel Blanks[1]	
		July	August	September	JUL EB-1	AUG EB-1	SEPT EB-1	JUL TRAV-1	AUG TRAV-2
		Min	Min	Min					
Physical Tests									
Conductivity (µS/cm)		2	2	2	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*
Hardness (mg/L)		0.5	0.5	0.5	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*
pH (Laboratory)		0.1	0.1	0.1	5.45	5.4	5.54	5.8	5.34
Total Suspended Solids (mg/L)		1	1	1	*<1.0*	*<1.0*	*<1.0*	-	*<1.0*
Total Dissolved Solids (mg/L)		3	3	3	*<3.0*	*<3.0*	*<3.0*	-	*<3.0*
Turbidity (NTU)		0.1	0.1	0.1	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*
Anions and Nutrients (mg/L)									
Alkalinity, Bicarbonate (as $CaCO_3$)		1	1	1	*<1.0*	*<1.0*	*<1.0*	*<2.0*	*<1.0*
Alkalinity, Carbonate (as $CaCO_3$)		1	1	1	*<1.0*	*<1.0*	*<1.0*	*<2.0*	*<1.0*
Alkalinity, Hydroxide (as CaCO3)		1	1	1	*<1.0*	*<1.0*	*<1.0*	*<2.0*	*<1.0*
Alkalinity, Total (as $CaCO_3$)		1	1	1	*<1.0*	*<1.0*	*<1.0*	*<2.0*	*<1.0*
Ammonia, Total (as N)		0.005	0.005	0.005	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*
Bromide (Br)		0.05	0.05	0.05	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Chloride (Cl)		0.1	0.1	0.1	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*
Fluoride (F)		0.02	0.02	0.02	*<0.02*	*<0.02*	*<0.02*	*<0.02*	*<0.02*
Nitrate (as N)		0.005	0.005	0.005	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*
Nitrite (as N)		0.001	0.001	0.001	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Total Kjeldahl Nitrogen		0.05	0.05	0.05	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Orthophosphate-Dissolved (as P)		0.001	0.001	0.001	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Phosphorus (P)-Total Dissolved		0.002	0.002	0.002	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*
Phosphorus (P)-Total		0.002	0.002	0.002	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*
Silicate (as SiO_2)		0.5	0.5	0.5	*<0.5*	*<0.5*	*<0.5*	*<0.002*	*<0.5*
Sulfate (SO_4)		0.3	0.3	0.3	*<0.30*	*<0.30*	*<0.30*	*<0.5*	*<0.30*
Cyanides (mg/L)									
Total Cyanide		0.001	0.001	0.001	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Free Cyanide		0.001	0.001	0.001	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Organic / Inorganic Carbon (mg/L)									
Dissolved Organic Carbon		0.5	0.5	0.5	*<0.5*	*<0.5*	*<0.5*	-	-
Total Organic Carbon		0.5	0.5	0.5	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*
Plant Pigments (µg/L)									
Chlorophyll-a		0.01	0.01	0.01					
Total Metals (mg/L)									
Aluminum		0.003	0.003	0.003	*<0.003*	**0.0035**	*<0.003*	*<0.003*	*<0.003*
Antimony		0.0001	0.0001	0.0001	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Arsenic		0.0001	0.0001	0.0001	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Barium		0.00005	0.00005	0.00005	*<0.00005*	**0.00009**	*<0.00005*	*<0.00005*	*<0.00005*
Beryllium		0.00002	0.00002	0.00002	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*
Bismuth		0.00005	0.00005	0.00005	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Boron		0.01	0.01	0.01	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Cadmium		0.000005	0.000005	0.000005	*<0.000005*	**0.0000087**	*<0.000005*	*<0.000005*	*<0.000005*
Calcium		0.05	0.05	0.05	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Chromium		0.0001	0.0001	0.0001	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Cobalt		0.0001	0.0001	0.0001	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Copper		0.0005	0.0005	0.0005	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*
Iron		0.01	0.01	0.01	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Lead		0.00005	0.00005	0.00005	**0.00006**	0.00071	**0.00019**	*<0.00005*	*<0.00005*
Lithium		0.001	0.001	0.001	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Magnesium		0.1	0.1	0.1	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*
Manganese		0.0001	0.0001	0.0001	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Mercury		0.000005	0.000005	0.000005	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Molybdenum		0.00005	0.00005	0.00005	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Nickel		0.0005	0.0005	0.0005	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*
Phosphorus		0.05	0.05	0.05	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Potassium		0.1	0.1	0.1	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*
Selenium		0.00005	0.00005	0.00005	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Silicon		0.05	0.05	0.05	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Silver		0.00001	0.00001	0.00001	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Sodium		0.05	0.05	0.05	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Strontium		0.0002	0.0002	0.0002	*<0.0002*	*<0.0002*	*<0.0002*	*<0.0002*	*<0.0002*
Sulfur		0.5	0.5	0.5	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*
Thallium		0.00001	0.00001	0.00001	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Tin		0.0001	0.0001	0.0001	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Titanium		0.0003	0.0003	0.0003	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*
Uranium		0.00001	0.00001	0.00001	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Vanadium		0.0005	0.0005	0.0005	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*
Zinc		0.003	0.003	0.003	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*
Zirconium		0.0003	0.0003	0.0003	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*
Dissolved Metals (mg/L)		0							
Aluminum		0.001	0.001	0.001	**0.001**	*<0.001*	*<0.001*		
Antimony		0.0001	0.0001	0.0001	*<0.0001*	*<0.0001*	*<0.0001*		
Arsenic		0.0001	0.0001	0.0001	*<0.0001*	*<0.0001*	*<0.0001*		
Barium		0.00005	0.00005	0.00005	*<0.00005*	*<0.00005*	*<0.00005*		
Beryllium		0.00002	0.00002	0.00002	*<0.00002*	*<0.00002*	*<0.00002*		
Bismuth		0.00005	0.00005	0.00005	*<0.00005*	*<0.00005*	*<0.00005*		
Boron		0.01	0.01	0.01	*<0.01*	*<0.01*	*<0.01*		
Cadmium		0.000005	0.000005	0.000005	*<0.000005*	*<0.000005*	*<0.000005*		
Calcium		0.05	0.05	0.05	*<0.05*	*<0.05*	*<0.05*		
Chromium		0.0001	0.0001	0.0001	*<0.0001*	*<0.0001*	*<0.0001*		
Cobalt		0.0001	0.0001	0.0001	*<0.0001*	*<0.0001*	*<0.0001*		

Table A1-2. Detection limits, equipment blanks, and travel blanks for water parameters in Lake and Sentinel station samples, Whale Tail Pit Baseline, 2015.

		Detection Limits			Equipment Blanks			Travel Blanks[1]	
	Month	July	August	September	JUL EB-1	AUG EB-1	SEPT EB-1	JUL TRAV-1	AUG TRAV-2
Analyte		Min	Min	Min					
Copper		0.0002	0.0002	0.0002	*<0.0002*	*<0.0002*	*<0.0002*		
Iron		0.01	0.01	0.01	*<0.01*	*<0.01*	*<0.01*		
Lead		0.00005	0.00005	0.00005	*<0.00005*	*<0.00005*	**0.00007**		
Lithium		0.001	0.001	0.001	*<0.001*	*<0.001*	*<0.001*		
Magnesium		0.1	0.1	0.1	*<0.1*	*<0.1*	*<0.1*		
Manganese		0.0001	0.0001	0.0001	*<0.0001*	*<0.0001*	*<0.0001*		
Mercury		0.000005	0.000005	0.000005	*<0.000005*	*<0.000005*	*<0.000005*		
Molybdenum		0.00005	0.00005	0.00005	*<0.00005*	*<0.00005*	*<0.00005*		
Nickel		0.0005	0.0005	0.0005	*<0.0005*	*<0.0005*	*<0.0005*		
Phosphorus		0.05	0.05	0.05	*<0.05*	*<0.05*	*<0.05*		
Potassium		0.1	0.1	0.1	*<0.1*	*<0.1*	*<0.1*		
Selenium		0.00005	0.00005	0.00005	*<0.00005*	*<0.00005*	*<0.00005*		
Silicon		0.05	0.05	0.05	*<0.05*	*<0.05*	*<0.05*		
Silver		0.00001	0.00001	0.00001	*<0.00001*	*<0.00001*	*<0.00001*		
Sodium		0.05	0.05	0.05	*<0.05*	*<0.05*	*<0.05*		
Strontium		0.0002	0.0002	0.0002	*<0.0002*	*<0.0002*	*<0.0002*		
Sulfur		0.5	0.5	0.5	*<0.5*	*<0.5*	*<0.5*		
Thallium		0.00001	0.00001	0.00001	*<0.00001*	*<0.00001*	*<0.00001*		
Tin		0.0001	0.0001	0.0001	*<0.0001*	*<0.0001*	*<0.0001*		
Titanium		0.0003	0.0003	0.0003	*<0.0003*	*<0.0003*	*<0.0003*		
Uranium		0.00001	0.00001	0.00001	*<0.00001*	*<0.00001*	*<0.00001*		
Vanadium		0.0005	0.0005	0.0005	*<0.0005*	*<0.0005*	*<0.0005*		
Zinc		0.001	0.001	0.0010	*<0.001*	*<0.001*	*<0.001*		
Zirconium		0.0003	0.0003	0.0003	*<0.0003*	*<0.0003*	*<0.0003*		

Notes:

[1] A travel blank was not available for submission with the September samples.

Bolded Equipment or Travel Blank values concentrations exceeds laboratory MDLs but < 10 x MDL.

Shaded Equipment or Travel Blank values concentrations is > 10 x MDL.

Italicized numbers are below detection limits.

Table A1-3. Laboratory QA/QC results for water parameters in Lake and Sentinel station samples, Whale Tail Pit Baseline, 2015.

Analyte	Month / ALS Report Number	Laboratory DQOs[1]	July MDLs	July L1648210 & L1649931 Original	July L1648210 & L1649931 Lab Dup	July L1648210 & L1649931 RPD[2]/Diff[3]	August MDLs	August L1665542 & L1667195 Original	August L1665542 & L1667195 Lab Dup	August L1665542 & L1667195 RPD[2]/Diff[3]	September MDLs	September L1679751 & L1681194 Original	September L1679751 & L1681194 Lab Dup	September L1679751 & L1681194 RPD[2]/Diff[3]
Physical Tests														
Conductivity (µS/cm)		10	2				2				2			
Hardness (mg/L)		25	0.5				0.5				0.5			
pH (Laboratory)		0.3	0.1				0.1				0.1			
Total Suspended Solids (mg/L)		20	1				1				1			
Total Dissolved Solids (mg/L)		20	3	16	14.9	7.1	3				3			
Turbidity (NTU)		15	0.1	0.39	0.39	0	0.1	0.23	0.26	-12	0.1			
Anions and Nutrients (mg/L)														
Alkalinity, Bicarbonate (as $CaCO_3$)		20	1				1				1			
Alkalinity, Carbonate (as $CaCO_3$)		20	1				1				1			
Alkalinity, Hydroxide (as CaCO3)		20	1				1				1			
Alkalinity, Total (as $CaCO_3$)		20	1				1				1			
Ammonia, Total (as N)		20	0.005				0.005	*<0.005*	*<0.005*		0.005	*<0.005*	*<0.005*	
Bromide (Br)		20	0.05				0.05	*<0.05*	*<0.05*		0.05			
Chloride (Cl)		20	0.1				0.1	1.57	1.57	0	0.1			
Fluoride (F)		20	0.02				0.02	0.025	0.025	0	0.02			
Nitrate (as N)		20	0.005				0.005	*<0.005*	*<0.005*		0.005			
Nitrite (as N)		20	0.001				0.001	*<0.001*	*<0.001*		0.001			
Total Kjeldahl Nitrogen		20	0.05	0.171	0.164	4.2	0.05	0.107	0.108	-0.9	0.05	0.129	0.127	1.6
Orthophosphate (as P)		20	0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*		0.001			
Phosphorus (P)-Total Diss.		20	0.002				0.002	0.0023	0.003	0.0007	0.002			
Phosphorus (P)-Total		20	0.002				0.002	*<0.002*	*<0.002*		0.002	*<0.002*	*<0.002*	
Silicate (as SiO_2)		20	0.5				0.5				0.5			
Sulfate (SO_4)		20	0.3				0.3	1.31	1.31	0	0.3			
Cyanides (mg/L)														
Total Cyanide		20	0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*	
Free Cyanide		20	0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*	
Organic / Inorganic Carbon (mg/L)														
Dissolved Organic Carbon		20	0.5	2.15	2.07	3.8	0.5	1.85	1.77	4.4	0.5	1.22	1.31	-7.1
Total Organic Carbon		20	0.5	2.29	2.46	-7.2	0.5	1.72	1.8	-4.5	0.5	1.55	1.45	6.7
Plant Pigments (µg/L)														
Chlorophyll-a		35	0.01				0.01				0.01			
Total Metals (mg/L)														
Aluminum		20	0.003				0.003				0.003	0.0116	0.0127	-9.1
Antimony		20	0.0001				0.0001				0.0001	*<0.0001*	*<0.0001*	
Arsenic		20	0.0001				0.0001				0.0001	0.00019	0.00019	0
Barium		20	0.00005				0.00005				0.00005	0.0041	0.00411	-0.2
Beryllium		20	0.00002				0.00002				0.00002	*<0.00002*	*<0.00002*	
Bismuth		20	0.00005				0.00005				0.00005	*<0.00005*	*<0.00005*	
Boron		20	0.01				0.01				0.01	*<0.01*	*<0.01*	
Cadmium		20	0.000005				0.000005				0.000005	*<0.000005*	*<0.000005*	
Calcium		20	0.05				0.05				0.05	2.15	2.11	1.9
Chromium		20	0.0001				0.0001				0.0001	0.00014	0.00016	-13
Cobalt		20	0.0001				0.0001				0.0001	*<0.0001*	*<0.0001*	
Copper		20	0.0005				0.0005				0.0005	*<0.0005*	*<0.0005*	
Iron		20	0.01				0.01				0.01	0.021	0.028	0.007
Lead		20	0.00005				0.00005				0.00005	*<0.00005*	*<0.00005*	
Lithium		20	0.001				0.001				0.001	*<0.001*	*<0.001*	
Magnesium		20	0.1				0.1				0.1	0.71	0.7	1.4
Manganese		20	0.0001				0.0001				0.0001	0.00365	0.00359	1.7
Mercury		20	0.000005	*<0.000005*	*<0.000005*		0.000005				0.000005			
Molybdenum		20	0.00005				0.00005				0.00005	*<0.00005*	*<0.00005*	
Nickel		20	0.0005				0.0005				0.0005	0.0006	0.00063	-4.9
Phosphorus		20	0.05				0.05				0.05	*<0.05*	*<0.05*	
Potassium		20	0.1				0.1				0.1	0.39	0.38	2.6
Selenium		20	0.00005				0.00005				0.00005	*<0.00005*	*<0.00005*	
Silicon		20	0.05				0.05				0.05	0.247	0.246	0.4
Silver		20	0.00001				0.00001				0.00001	*<0.00001*	*<0.00001*	
Sodium		20	0.05				0.05				0.05	0.526	0.52	1.1
Strontium		20	0.0002				0.0002				0.0002	0.0145	0.0143	1.4
Sulfur		20	0.5				0.5				0.5	0.54	0.52	3.8
Thallium		20	0.00001				0.00001				0.00001	*<0.00001*	*<0.00001*	
Tin		20	0.0001				0.0001				0.0001	*<0.0001*	*<0.0001*	
Titanium		20	0.0003				0.0003				0.0003	*<0.0003*	*<0.0003*	
Uranium		20	0.00001				0.00001				0.00001	0.000032	0.000032	0
Vanadium		20	0.0005				0.0005				0.0005	*<0.0005*	*<0.0005*	
Zinc		20	0.003				0.003				0.003	*<0.003*	*<0.003*	
Zirconium		20	0.0003				0.0003				0.0003	*<0.0003*	*<0.0003*	
Dissolved Metals (mg/L)														
Aluminum		20	0.001				0.001	0.0053	0.0055	-3.7	0.001			
Antimony		20	0.0001				0.0001	*<0.0001*	*<0.0001*		0.0001			
Arsenic		20	0.0001				0.0001	0.00016	0.00017	-6.1	0.0001			
Barium		20	0.00005				0.00005	0.00329	0.00326	0.9	0.00005			
Beryllium		20	0.00002				0.00002	*<0.00002*	*<0.00002*		0.00002			
Bismuth		20	0.00005				0.00005	*<0.00005*	*<0.00005*		0.00005			
Boron		20	0.01				0.01	*<0.01*	*<0.01*		0.01			
Cadmium		20	0.000005				0.000005	*<0.000005*	*<0.000005*		0.000005			
Calcium		20	0.05				0.05	1.63	1.65	-1.2	0.05			
Chromium		20	0.0001				0.0001	*<0.0001*	*<0.0001*		0.0001			
Cobalt		20	0.0001				0.0001	*<0.0001*	*<0.0001*		0.0001			
Copper		20	0.0002				0.0002	0.00034	0.00036	-5.7	0.0002			
Iron		20	0.01				0.01	0.011	0.011	0	0.01			
Lead		20	0.00005				0.00005	*<0.00005*	*<0.00005*		0.00005			
Lithium		20	0.001				0.001	*<0.001*	*<0.001*		0.001			
Magnesium		20	0.1				0.1	0.63	0.64	-1.6	0.1			
Manganese		20	0.0001				0.0001	0.00136	0.00134	1.5	0.0001			
Mercury		20	0.000005	*<0.000005*	*<0.000005*		0.000005				0.000005			
Molybdenum		20	0.00005				0.00005	*<0.00005*	*<0.00005*		0.00005			
Nickel		20	0.0005				0.0005	0.0005	0.0005	0	0.0005			
Phosphorus		20	0.05				0.05	*<0.05*	*<0.05*		0.05			
Potassium		20	0.1				0.1	0.36	0.35	2.8	0.1			
Selenium		20	0.00005				0.00005	*<0.00005*	*<0.00005*		0.00005			
Silicon		20	0.05				0.05	0.25	0.253	-1.2	0.05			
Silver		20	0.00001				0.00001	*<0.00001*	*<0.00001*		0.00001			
Sodium		20	0.05				0.05	0.502	0.506	-0.8	0.05			
Strontium		20	0.0002				0.0002	0.00984	0.00986	-0.2	0.0002			
Sulfur		20	0.5				0.5	*<0.5*	*<0.5*		0.5			
Thallium		20	0.00001				0.00001	*<0.00001*	*<0.00001*		0.00001			
Tin		20	0.0001				0.0001	*<0.0001*	*<0.0001*		0.0001			
Titanium		20	0.0003				0.0003	*<0.0003*	*<0.0003*		0.0003			
Uranium		20	0.00001				0.00001	0.000031	0.000032	-3.2	0.00001			
Vanadium		20	0.0005				0.0005	*<0.0005*	*<0.0005*		0.0005			
Zinc		20	0.001				0.001	*<0.001*	*<0.001*		0.001			
Zirconium		20	0.0003				0.0003	*<0.0003*	*<0.0003*		0.0003			

Notes:

[1] DQO = Data quality objectives (i.e., RPD limits) for laboratory duplicate samples. DQOs shown as percentages except for pH (units).

[2] RPD = Relative Percent Difference (%) = ((original - duplicate) / (original + duplicate)/2) x 100.
RPDs have not been calculated for cases where one of the samples is below detection and the other is not and in cases where both are below detection. RPD has been left blank.

[3] Diff = The difference between the replicate values in concentration units. Used in cases where the concentration is <10x the MDL.
For low level results, the DQO is a concentration difference between the two measurements of < 2x the MDL (unless the RPD is met).

Bolded RPDs RPD values exceed laboratory DQO but < 10 x MDL.

Shaded RPD RPD values exceed laboratory DQO and > 10 x MDL.

Blank cells indicate no laboratory duplicate analysis was conducted.

Italicized numbers are below detection limits.

Table A1-4. Field duplicate QA/QC results from the Lake and Sentinel station water sampling program, Whale Tail Pit Baseline, 2015.

Month	July				August				September			
Station		Whale Tail Lake (South Basin)				Whale Tail Lake (North Basin)				Whale Tail Lake (North Basin)		
Analyte	July MDLs	WTS-02-S	JUL DUP-1	RPD	August MDLs	WTN-04-S	AUG DUP-1	RPD	September MDLs	WTN-06-S	SEP DUP-1	RPD
Physical Tests												
Conductivity (µS/cm)	2	15.9	15.4	3.2	2	19.80	19.5	1.5	2	21.80	21.4	1.9
Hardness (mg/L)	0.5	5.8	5.9	-1.7	0.5	07.2	07.1	0.6	0.5	07.8	8.09	-4.2
pH (Laboratory)	0.1	6.78	6.76	0.3	0.1	6.82	6.70	1.8	0.1	6.75	6.76	-0.1
Total Suspended Solids (mg/L)	1	*<1.0*	*<1.0*		1	*<1.0*	*<1.0*		1	*<1.0*	*<1.0*	
Total Dissolved Solids (mg/L)	3	13.8	13.3	3.7	3	13.2	14.2	-7.3	3	17.7	17.0	4.0
Turbidity (NTU)	0.1	0.35	0.37	-5.6	0.1	0.28	0.24	15	0.1	0.35	0.32	9.0
Anions and Nutrients (mg/L)												
Alkalinity, Bicarbonate (as $CaCO_3$)	1	4.20	3.90	7.4	1	3.90	4.30	-10	1	5	4	6.7
Alkalinity, Carbonate (as $CaCO_3$)	1	*<1.0*	*<1.0*		1	*<1.0*	*<1.0*		1	*<1.0*	*<1.0*	
Alkalinity, Hydroxide (as CaCO3)	1	*<1.0*	*<1.0*		1	*<1.0*	*<1.0*		1	*<1.0*	*<1.0*	
Alkalinity, Total (as $CaCO_3$)	1	4.20	3.90	7.4	1	3.90	4.30	-10	1	5	4	6.7
Ammonia, Total (as N)	0.005	*<0.005*	*<0.005*		0.005	*<0.005*	0.01		0.005	*<0.005*	*<0.005*	
Bromide (Br)	0.05	*<0.05*	*<0.05*		0.05	*<0.05*	*<0.05*		0.05	*<0.05*	*<0.05*	
Chloride (Cl)	0.1	1.06	1.05	0.9	0.1	1.84	1.84	0	0.1	2.38	2.36	0.8
Fluoride (F)	0.02	0.03	0.02	4.1	0.02	0.03	0.03	-3.9	0.02	0.026	0.026	0
Nitrate (as N)	0.005	*<0.005*	*<0.005*		0.005	*<0.005*	*<0.005*		0.005	*<0.005*	*<0.005*	
Nitrite (as N)	0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*	
Total Kjeldahl Nitrogen	0.05	0.14	0.16	-13	0.05	0.11	0.15	-35	0.05	0.12	0.12	-2.5
Orthophosphate-Dissolved (as P)	0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*	
Phosphorus (P)-Total Dissolved	0.002	0.002	*<0.002*		0.002	0.0028	0.0025	11	0.002	*<0.002*	*<0.002*	
Phosphorus (P)-Total	0.002	0.002	0.005	**-67**	0.002	0.002	0.004	-44	0.002	0.0031	*<0.002*	
Silicate (as SiO_2)	0.5	0.54	0.54	0	0.5	0.57	0.56	1.8	0.5	0.67	0.67	0
Sulfate (SO_4)	0.3	1.22	1.21	0.8	0.3	1.37	1.37	0	0.3	1.37	1.37	0
Cyanides (mg/L)												
Total Cyanide	0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*	
Free Cyanide	0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*	
Organic / Inorganic Carbon (mg/L)												
Dissolved Organic Carbon	0.5	1.98	2.04	-3.0	0.5	2.09	1.79	15	0.5	1.74	1.79	-2.8
Total Organic Carbon	0.5	2.02	1.96	3.0	0.5	1.78	1.80	-1.1	0.5	1.77	1.87	-5.5
Plant Pigments (µg/L)												
Chlorophyll-a	0.01	0.28	0.21	29	0.01	0.70	0.80	-14	0.01	0.934	0.85	10
Total Metals (mg/L)												
Aluminum	0.003	0.02	0.02	-2.9	0.003	0.01	0.01	18	0.003	0.012	0.0112	6.9
Antimony	0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*	
Arsenic	0.0001	0.00013	0.00013	0	0.0001	0.00018	0.00021	-15	0.0001	0.00018	0.00018	0
Barium	0.00005	0.0033	0.0034	-3.3	0.00005	0.0035	0.0036	-2.9	0.00005	0.00372	0.00374	-0.5
Beryllium	0.00002	*<0.00002*	*<0.00002*		0.00002	*<0.00002*	*<0.00002*		0.00002	*<0.00002*	*<0.00002*	
Bismuth	0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*	
Boron	0.01	*<0.01*	*<0.01*		0.01	*<0.01*	*<0.01*		0.01	*<0.01*	*<0.01*	
Cadmium	0.000005	*<0.000005*	*<0.000005*		0.000005	*<0.000005*	*<0.000005*		0.000005	*<0.000005*	*<0.000005*	
Calcium	0.05	1.37	1.36	0.7	0.05	1.77	1.74	1.7	0.05	1.95	1.93	1.0
Chromium	0.0001	*<0.0001*	0.00012		0.0001	0.00010	*<0.0001*		0.0001	0.00011	0.00017	-43
Cobalt	0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*	
Copper	0.0005	*<0.0005*	*<0.0005*		0.0005	*<0.0005*	*<0.0005*		0.0005	*<0.0005*	*<0.0005*	
Iron	0.01	0.037	0.037	0	0.01	0.019	0.018	5.4	0.01	0.024	0.021	13
Lead	0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*	
Lithium	0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*	
Magnesium	0.1	0.56	0.55	1.8	0.1	0.65	0.64	1.6	0.1	0.70	0.70	0
Manganese	0.0001	0.0052	0.0051	0.8	0.0001	0.0026	0.0027	-4.6	0.0001	0.00294	0.00262	12
Mercury	0.000005	*<0.000005*	*<0.000005*		0.000005	*<0.000005*	*<0.000005*		0.000005	*<0.000005*	*<0.000005*	
Molybdenum	0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*		0.00005	0.000059	*<0.00005*	
Nickel	0.0005	0.00067	0.00067	0	0.0005	0.00059	0.00061	-3.3	0.0005	0.00061	0.00057	6.8
Phosphorus	0.05	*<0.05*	*<0.05*		0.05	*<0.05*	*<0.05*		0.05	*<0.05*	*<0.05*	
Potassium	0.1	0.33	0.33	0	0.1	0.37	0.37	0	0.1	0.38	0.36	5.4
Selenium	0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*	
Silicon	0.05	0.31	0.30	3.0	0.05	0.27	0.25	5.0	0.05	0.263	0.259	1.5
Silver	0.00001	*<0.00001*	*<0.00001*		0.00001	*<0.00001*	*<0.00001*		0.00001	*<0.00001*	*<0.00001*	
Sodium	0.05	0.47	0.48	-0.4	0.05	0.49	0.52	-4.6	0.05	0.55	0.52	4.5
Strontium	0.0002	0.008	0.008	0	0.0002	0.011	0.011	0	0.0002	0.0128	0.0126	1.6
Sulfur	0.5	*<0.5*	*<0.5*		0.5	*<0.5*	0.52		0.5	0.53	*<0.5*	
Thallium	0.00001	*<0.00001*	*<0.00001*		0.00001	*<0.00001*	*<0.00001*		0.00001	*<0.00001*	*<0.00001*	
Tin	0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*	
Titanium	0.0003	*<0.0003*	*<0.0003*		0.0003	*<0.0003*	*<0.0003*		0.0003	*<0.0003*	*<0.0003*	
Uranium	0.00001	0.000043	0.000042	2.4	0.00001	0.000035	0.000034	2.9	0.00001	0.000035	0.000035	0
Vanadium	0.0005	*<0.0005*	*<0.0005*		0.0005	*<0.0005*	*<0.0005*		0.0005	*<0.0005*	*<0.0005*	
Zinc	0.003	*<0.003*	*<0.003*		0.003	*<0.003*	*<0.003*		0.003	*<0.003*	*<0.003*	
Zirconium	0.0003	*<0.0003*	*<0.0003*		0.0003	*<0.0003*	*<0.0003*		0.0003	*<0.0003*	*<0.0003*	
Dissolved Metals (mg/L)												
Aluminum	0.001	0.012	0.013	-10	0.001	0.0048	0.0048	0	0.001	0.0038	0.0037	2.7
Antimony	0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*	
Arsenic	0.0001	0.00012	0.00011	8.7	0.0001	0.00	0.00020	-5.1	0.0001	0.00017	0.00017	0
Barium	0.00005	0.0033	0.0032	3.1	0.00005	0.00	0.0036	-2.9	0.00005	0.00373	0.00380	-1.9
Beryllium	0.00002	0.00	*<0.00002*		0.00002	*<0.00002*	*<0.00002*		0.00002	*<0.00002*	*<0.00002*	
Bismuth	0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*	
Boron	0.01	*<0.01*	*<0.01*		0.01	*<0.01*	*<0.01*		0.01	*<0.01*	*<0.01*	
Cadmium	0.000005	*<0.000005*	*<0.000005*		0.000005	*<0.000005*	*<0.000005*		0.000005	*<0.000005*	*<0.000005*	
Calcium	0.05	1.39	1.42	-2.1	0.05	1.80	1.78	1.1	0.05	1.96	2.06	-5.0
Chromium	0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*	
Cobalt	0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*	
Copper	0.0002	0.00034	0.00034	0	0.0002	0.00037	0.00036	2.7	0.0002	0.00031	0.00033	-6.3
Iron	0.01	0.023	0.021	9.1	0.01	*<0.01*	*<0.01*		0.01	*<0.01*	*<0.01*	
Lead	0.00005	0.00008	0.00006	37	0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*	
Lithium	0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*	
Magnesium	0.1	0.56	0.57	-1.8	0.1	0.66	0.65	1.5	0.1	0.70	0.71	-1.4
Manganese	0.0001	0.0042	0.0041	3.1	0.0001	0.0013	0.0012	12	0.0001	0.00084	0.00085	-1.2
Mercury	0.000005	*<0.000005*	*<0.000005*		0.000005	*<0.000005*	*<0.000005*		0.000005	*<0.000005*	*<0.000005*	
Molybdenum	0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*	
Nickel	0.0005	0.00068	0.00063	7.6	0.0005	0.00053	0.00054	-1.9	0.0005	0.00053	0.00051	3.8
Phosphorus	0.05	*<0.05*	*<0.05*		0.05	*<0.05*	*<0.05*		0.05	*<0.05*	*<0.05*	
Potassium	0.1	0.31	0.32	-3.2	0.1	0.37	0.38	-2.7	0.1	0.39	0.37	5.3
Selenium	0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*	
Silicon	0.05	0.30	0.30	0	0.05	0.26	0.25	2.4	0.05	0.246	0.243	1.2
Silver	0.00001	*<0.00001*	*<0.00001*		0.00001	*<0.00001*	*<0.00001*		0.00001	*<0.00001*	*<0.00001*	
Sodium	0.05	0.46	0.47	-1.3	0.05	0.50	0.51	-1.8	0.05	0.53	0.52	1.7
Strontium	0.0002	0.01	0.01	-1.7	0.0002	0.011	0.011	-0.9	0.0002	0.0128	0.01320	-3.1
Sulfur	0.5	*<0.5*	*<0.5*		0.5	*<0.5*	*<0.5*		0.5	*<0.5*	*<0.5*	
Thallium	0.00001	*<0.00001*	*<0.00001*		0.00001	*<0.00001*	*<0.00001*		0.00001	*<0.00001*	*<0.00001*	
Tin	0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*	
Titanium	0.0003	*<0.0003*	*<0.0003*		0.0003	*<0.0003*	*<0.0003*		0.0003	*<0.0003*	*<0.0003*	
Uranium	0.00001	0.000042	0.000040	4.9	0.00001	0.000031	0.000030	3.3	0.00001	0.000028	0.000027	3.6
Vanadium	0.0005	*<0.0005*	*<0.0005*		0.0005	*<0.0005*	*<0.0005*		0.0005	*<0.0005*	*<0.0005*	
Zinc	0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*		0.001	*<0.001*	0.006	
Zirconium	0.0003	*<0.0003*	*<0.0003*		0.0003	*<0.0003*	*<0.0003*		0.0003	*<0.0003*	*<0.0003*	

Notes:

RPD = Relative Percent Difference (%) = ((original - duplicate) / (original + duplicate)/2) x 100.

RPDs have not been calculated for cases where one of the samples is below detection and the other is not and in cases where both are below detection. RPD has been left blank.

The data quality objective (DQO) for field duplicates is an RPD < 50%.

Bolded RPDs	RPD values exceed 50% but < 10 x MDL.
Shaded RPD	RPD values exceed 50% and > 10 x MDL.

Italicized numbers are below detection limits.

Table A1-5. Detection limits and travel blanks for water parameters from the Tributary sampling program, Whale Tail Pit Baseline, 2015.

Analyte	Month	Detection Limits August Min	Detection Limits September Min	Travel Blanks[1] AUG TRAV-2
Physical Tests				
Conductivity (µS/cm)		2	2	
Hardness (mg/L)		0.5	0.5	*<0.5*
pH (Laboratory)		0.1	0.1	
Total Suspended Solids (mg/L)		1	1	
Total Dissolved Solids (mg/L)		3	3	
Turbidity (NTU)		0.1	0.1	
Anions and Nutrients (mg/L)				
Alkalinity, Bicarbonate (as $CaCO_3$)		1	1	
Alkalinity, Carbonate (as $CaCO_3$)		1	1	
Alkalinity, Hydroxide (as CaCO3)		1	1	
Alkalinity, Total (as $CaCO_3$)		1	1	
Ammonia, Total (as N)		0.005	0.005	*<0.005*
Bromide (Br)		0.05	0.05	
Chloride (Cl)		0.1	0.1	
Fluoride (F)		0.02	0.02	
Nitrate (as N)		0.005	0.005	
Nitrite (as N)		0.001	0.001	
Total Kjeldahl Nitrogen		0.05	0.05	*<0.05*
Orthophosphate-Dissolved (as P)		0.001	0.001	
Phosphorus (P)-Total Dissolved		0.002	0.002	
Phosphorus (P)-Total		0.002	-	*<0.002*
Silicate (as SiO_2)		0.5	0.5	
Sulfate (SO_4)		0.3	0.3	
Cyanides (mg/L)				
Total Cyanide		0.001	0.001	*<0.001*
Free Cyanide		0.001	0.001	*<0.001*
Organic / Inorganic Carbon (mg/L)				
Dissolved Organic Carbon		0.5	0.5	
Total Organic Carbon		0.5	0.5	*<0.5*
Plant Pigments (µg/L)				
Chlorophyll-a				
Total Metals (mg/L)				
Aluminum		0.003	0.003	*<0.003*
Antimony		0.0001	0.0001	*<0.0001*
Arsenic		0.0001	0.0001	*<0.0001*
Barium		0.00005	0.00005	*<0.00005*
Beryllium		0.00002	0.00002	*<0.00002*
Bismuth		0.00005	0.00005	*<0.00005*
Boron		0.01	0.01	*<0.01*
Cadmium		0.000005	0.000005	*<0.000005*
Calcium		0.05	0.05	*<0.05*
Chromium		0.0001	0.0001	*<0.0001*
Cobalt		0.0001	0.0001	*<0.0001*
Copper		0.0005	0.0005	*<0.0005*
Iron		0.01	0.01	*<0.01*
Lead		0.00005	0.00005	*<0.00005*
Lithium		0.001	0.001	*<0.001*
Magnesium		0.1	0.1	*<0.1*
Manganese		0.0001	0.0001	*<0.0001*
Mercury		0.000005	0.000005	*<0.000005*
Molybdenum		0.00005	0.00005	*<0.00005*
Nickel		0.0005	0.0005	*<0.0005*
Phosphorus		0.05	0.05	*<0.05*
Potassium		0.1	0.1	*<0.1*
Selenium		0.00005	0.00005	*<0.00005*
Silicon		0.05	0.05	*<0.05*
Silver		0.00001	0.00001	*<0.00001*
Sodium		0.05	0.05	*<0.05*
Strontium		0.0002	0.0002	*<0.0002*
Sulfur		0.5	0.5	*<0.5*
Thallium		0.00001	0.00001	*<0.00001*
Tin		0.0001	0.0001	*<0.0001*
Titanium		0.0003	0.0003	*<0.0003*
Uranium		0.00001	0.00001	*<0.00001*
Vanadium		0.0005	0.0005	*<0.0005*
Zinc		0.003	0.003	*<0.003*
Zirconium		0.0003	0.0003	*<0.0003*

Table A1-5. Detection limits and travel blanks for water parameters from the Tributary sampling program, Whale Tail Pit Baseline, 2015.

Analyte	Month	Detection Limits		Travel Blanks[1]
		August	September	AUG TRAV-2
		Min	Min	
Dissolved Metals (mg/L)				
Aluminum		0.001	0.001	
Antimony		0.0001	0.0001	
Arsenic		0.0001	0.0001	
Barium		0.00005	0.00005	
Beryllium		0.00002	0.00002	
Bismuth		0.00005	0.00005	
Boron		0.01	0.01	
Cadmium		0.000005	0.000005	
Calcium		0.05	0.05	
Chromium		0.0001	0.0001	
Cobalt		0.0001	0.0001	
Copper		0.0002	0.0002	
Iron		0.01	0.01	
Lead		0.00005	0.00005	
Lithium		0.001	0.001	
Magnesium		0.1	0.1	
Manganese		0.0001	0.0001	
Mercury		0.000005	0.000005	
Molybdenum		0.00005	0.00005	
Nickel		0.0005	0.0005	
Phosphorus		0.05	0.05	
Potassium		0.1	0.1	
Selenium		0.00005	0.00005	
Silicon		0.05	0.05	
Silver		0.00001	0.00001	
Sodium		0.05	0.05	
Strontium		0.0002	0.0002	
Sulfur		0.5	0.5	
Thallium		0.00001	0.00001	
Tin		0.0001	0.0001	
Titanium		0.0003	0.0003	
Uranium		0.00001	0.00001	
Vanadium		0.0005	0.0005	
Zinc		0.001	0.0010	
Zirconium		0.0003	0.0003	

Notes:

[1] A travel blank was not submitted with the September samples.

Bolded Equipment or Travel Blank values concentrations exceeds laboratory MDLs but < 10 x MDL.

Shaded Equipment or Travel Blank values concentrations is > 10 x MDL.

Italicized numbers are below detection limits.

Table A1-6. Laboratory QA/QC results for water parameters from the Tributary sampling program, Whale Tail Pit Baseline, 2015.

Month			August				September			
ALS Report Numbers	Laboratory	August MDLs	L1655097, L1658117, L1659270 & L1659279			September MDLs	L1679754 & L1681194			
Analyte	DQOs[1]		Original	Lab Dup	RPD[2]/Diff[3]		Original	Lab Dup	RPD[2]/Diff[3]	
Physical Tests										
Conductivity (µS/cm)	10	2	12.6	12.6	0.0	2				
Hardness (mg/L)	25	0.5				0.5				
pH (Laboratory)	0.3	0.1	6.74	6.75	-0.01	0.1				
Total Suspended Solids (mg/L)	20	1				1				
Total Dissolved Solids (mg/L)	20	3				3				
Turbidity (NTU)	15	0.1	0.22	0.2	9.5	0.1				
Anions and Nutrients (mg/L)										
Alkalinity, Bicarbonate (as $CaCO_3$)	20	1				1				
Alkalinity, Carbonate (as $CaCO_3$)	20	1				1				
Alkalinity, Hydroxide (as CaCO3)	20	1				1				
Alkalinity, Total (as $CaCO_3$)	20	1				1	5.8	5.3	9.0	
Ammonia, Total (as N)	20	0.005				0.005				
Bromide (Br)	20	0.05	*<0.05*	*<0.05*		0.05	*<0.05*	*<0.05*		
Chloride (Cl)	20	0.1	1.73	1.73	0.0	0.1	0.73	0.73	0.0	
Fluoride (F)	20	0.02	0.025	0.025	0.0	0.02	0.032	0.032	0.0	
Nitrate (as N)	20	0.005	0.0065	0.0061	6.3	0.005	0.0068	0.0067	1.5	
Nitrite (as N)	20	0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*		
Total Kjeldahl Nitrogen	20	0.05				0.05				
Orthophosphate (as P)	20	0.001				0.001				
Phosphorus (P)-Total Diss.	20	0.002	*<0.002*	*<0.002*		0.002				
Phosphorus (P)-Total	20	0.002	0.0026	0.0021	0.0005	-				
Silicate (as SiO_2)	20	0.5	0.88	0.87	1.14	0.5	0.89	0.93	-4.4	
Sulfate (SO_4)	20	0.3	2.57	2.57	0.0	0.3	1.06	1.05	0.9	
Cyanides (mg/L)										
Total Cyanide	20	0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*		
Free Cyanide	20	0.001	*<0.001*	*<0.001*		0.001	0.001	0.001	0.0	
Organic / Inorganic Carbon (mg/L)										
Dissolved Organic Carbon	20	0.5	1.92	1.77	8.1	0.5	2.76	2.62	5.2	
Total Organic Carbon	20	0.5	1.9	1.66	13.5	0.5	2.76	2.46	11.5	
Plant Pigments (µg/L)										
Chlorophyll-a	35									
Total Metals (mg/L)										
Aluminum	20	0.003				0.003	0.0087	0.0088	-1.1	
Antimony	20	0.0001				0.0001	*<0.0001*	*<0.0001*		
Arsenic	20	0.0001				0.0001	0.00027	0.00027	0.0	
Barium	20	0.00005				0.00005	0.00508	0.00518	-1.9	
Beryllium	20	0.00002				0.00002	*<0.00002*	*<0.00002*		
Bismuth	20	0.00005				0.00005	*<0.00005*	*<0.00005*		
Boron	20	0.01				0.01	*<0.01*	*<0.01*		
Cadmium	20	0.000005				0.000005	*<0.000005*	*<0.000005*		
Calcium	20	0.05				0.05	3.07	3.08	-0.3	
Chromium	20	0.0001				0.0001	0.00014	0.00012	15.4	
Cobalt	20	0.0001				0.0001	*<0.0001*	*<0.0001*		
Copper	20	0.0005				0.0005	*<0.0005*	*<0.0005*		
Iron	20	0.01				0.01	0.02	0.021	-4.9	
Lead	20	0.00005				0.00005	*<0.00005*	*<0.00005*		
Lithium	20	0.001				0.001	*<0.001*	*<0.001*		
Magnesium	20	0.1				0.1	0.92	0.93	-1.1	
Manganese	20	0.0001				0.0001	0.00313	0.00323	-3.1	
Mercury	20	0.000005	*<0.000005*	*<0.000005*		0.000005				
Molybdenum	20	0.00005				0.00005	*<0.00005*	*<0.00005*		
Nickel	20	0.0005				0.0005	0.00103	0.00101	2.0	
Phosphorus	20	0.05				0.05	*<0.05*	*<0.05*		
Potassium	20	0.1				0.1	0.4	0.4	0.0	
Selenium	20	0.00005				0.00005	*<0.00005*	*<0.00005*		
Silicon	20	0.05				0.05	0.266	0.273	-2.6	
Silver	20	0.00001				0.00001	*<0.00001*	*<0.00001*		
Sodium	20	0.05				0.05	0.574	0.571	0.5	
Strontium	20	0.0002				0.0002	0.0223	0.0221	0.9	
Sulfur	20	0.5				0.5	0.61	0.59	3.3	
Thallium	20	0.00001				0.00001	*<0.00001*	*<0.00001*		
Tin	20	0.0001				0.0001	*<0.0001*	*<0.0001*		
Titanium	20	0.0003				0.0003	*<0.0003*	*<0.0003*		
Uranium	20	0.00001				0.00001	0.000027	0.000026	3.8	
Vanadium	20	0.0005				0.0005	*<0.0005*	*<0.0005*		
Zinc	20	0.003				0.003	*<0.003*	*<0.003*		
Zirconium	20	0.0003				0.0003	*<0.0003*	*<0.0003*		
Dissolved Metals (mg/L)										
Aluminum	20	0.001	0.0033	0.0025	0.0008	0.001				
Antimony	20	0.0001	*<0.0001*	*<0.0001*		0.0001				
Arsenic	20	0.0001	0.0002	0.00019	5.1	0.0001				
Barium	20	0.00005	0.00802	0.00809	-0.9	0.00005				
Beryllium	20	0.00002	*<0.00002*	*<0.00002*		0.00002				
Bismuth	20	0.00005	*<0.00005*	*<0.00005*		0.00005				
Boron	20	0.01	*<0.01*	*<0.01*		0.01				
Cadmium	20	0.000005	*<0.000005*	*<0.000005*		0.000005				
Calcium	20	0.05	2.15	2.14	0.5	0.05				
Chromium	20	0.0001	*<0.0001*	*<0.0001*		0.0001				
Cobalt	20	0.0001	*<0.0001*	*<0.0001*		0.0001				
Copper	20	0.0002	0.00059	0.00059	0.0	0.0002				
Iron	20	0.01	*<0.01*	*<0.01*		0.01				
Lead	20	0.00005	*<0.00005*	*<0.00005*		0.00005				
Lithium	20	0.001	*<0.001*	*<0.001*		0.001				
Magnesium	20	0.1	0.74	0.72	2.7	0.1				
Manganese	20	0.0001	0.00094	0.00094	0.0	0.0001				
Mercury	20	0.000005	*<0.000005*	*<0.000005*		0.000005	*<0.000005*	*<0.000005*		
Molybdenum	20	0.00005	*<0.00005*	*<0.00005*		0.00005				
Nickel	20	0.0005	0.00052	*<0.0005*		0.0005				
Phosphorus	20	0.05	*<0.05*	*<0.05*		0.05				
Potassium	20	0.1	0.55	0.54	1.8	0.1				
Selenium	20	0.00005	*<0.00005*	*<0.00005*		0.00005				
Silicon	20	0.05	0.39	0.387	0.8	0.05				
Silver	20	0.00001	*<0.00001*	*<0.00001*		0.00001				
Sodium	20	0.05	0.658	0.662	-0.6	0.05				
Strontium	20	0.0002	0.00868	0.00864	0.5	0.0002				
Sulfur	20	0.5	0.89	0.9	-1.1	0.5				
Thallium	20	0.00001	*<0.00001*	*<0.00001*		0.00001				
Tin	20	0.0001	0.00013	0.00012	8.0	0.0001				
Titanium	20	0.0003	*<0.0003*	*<0.0003*		0.0003				
Uranium	20	0.00001	0.000018	0.000017	5.7	0.00001				
Vanadium	20	0.0005	*<0.0005*	*<0.0005*		0.0005				
Zinc	20	0.001	*<0.001*	*<0.001*		0.001				
Zirconium	20	0.0003	*<0.0003*	*<0.0003*		0.0003				

Notes:

[1] DQO = Data quality objectives (i.e., RPD limits) for laboratory duplicate samples. DQOs shown as percentages except for pH (units).

[2] RPD = Relative Percent Difference (%) = ((original - duplicate) / (original + duplicate)/2) x 100.
RPDs have not been calculated for cases where one of the samples is below detection and the other is not and in cases where both are below detection. RPD has been left blank.

[3] Diff = The difference between the replicate values in concentration units. Used in cases where the concentration is <10x the MDL.
For low level results, the DQO is a concentration difference between the two measurements of < 2x the MDL (unless the RPD is met).

Bolded RPDs	RPD values exceed laboratory DQO but < 10 x MDL.
Shaded RPD	RPD values exceed laboratory DQO and > 10 x MDL.

Blank cells indicate no laboratory duplicate analysis was conducted.
Italicized numbers are below detection limits.

Table A1-7. Field duplicate QA/QC results from the Tributary water sampling program, Whale Tail Pit Baseline, 2015.

Analyte	Month	August	August			September	September		
	Station	August	A8-A7			September	A1-DS1		
		MDLs	Original	E3-E2 (Dup)	RPD	MDLs	Original	E5-E4 (Dup)	RPD
Physical Tests									
Conductivity (µS/cm)		2	23	23	0.9	2	21	21	1.9
Hardness (mg/L)		0.5	8.2	8.4	-2.2	0.5	7.3	7.4	-0.4
pH (Laboratory)		0.1	7.0	7.0	-0.3	0.1	6.9	6.9	-0.3
Total Suspended Solids (mg/L)		1	*<1.0*	*<1.0*		1	*<1.0*	1.1	
Total Dissolved Solids (mg/L)		3	19	20	-2.1	3	14	16	-10.2
Turbidity (NTU)		0.1	0.24	0.27	-11.8	0.1	0.81	0.77	5
Anions and Nutrients (mg/L)									
Alkalinity, Bicarbonate (as $CaCO_3$)		1	6.4	6.3	1.6	1	6.3	5.8	8.3
Alkalinity, Carbonate (as $CaCO_3$)		1	*<1.0*	*<1.0*		1	*<1.0*	*<1.0*	
Alkalinity, Hydroxide (as CaCO3)		1	*<1.0*	*<1.0*		1	*<1.0*	*<1.0*	
Alkalinity, Total (as $CaCO_3$)		1	6.4	6.3	1.6	1	6.3	5.8	8.3
Ammonia, Total (as N)		0.005	*<0.005*	0.0061		0.005	*<0.005*	*<0.005*	
Bromide (Br)		0.05	*<0.05*	*<0.05*		0.05	*<0.05*	*<0.05*	
Chloride (Cl)		0.1	0.94	0.94	0.0	0.1	0.95	0.96	-1.0
Fluoride (F)		0.02	0.025	0.025	0.0	0.02	0.028	0.027	3.6
Nitrate (as N)		0.005	*<0.005*	*<0.005*		0.005	0.011	0.011	-4.6
Nitrite (as N)		0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*	
Total Kjeldahl Nitrogen		0.05	0.15	0.13	12.8	0.05	0.18	0.12	43.5
Orthophosphate-Dissolved (as P)		0.001	*<0.001*	*<0.001*		0.001	0.0011	*<0.001*	
Phosphorus (P)-Total Dissolved		0.002	*<0.002*	*<0.002*		0.002	0.0026	*<0.002*	
Phosphorus (P)-Total		0.002	*<0.002*	0.0048		-			
Silicate (as SiO_2)		0.5	0.87	0.88	-1.1	0.5	1.0	0.89	12.6
Sulfate (SO_4)		0.3	2.6	2.6	0.0	0.3	2.0	2.1	-2.0
Cyanides (mg/L)									
Total Cyanide		0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*	
Free Cyanide		0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*	
Organic / Inorganic Carbon (mg/L)									
Dissolved Organic Carbon		0.5	1.7	1.9	-6.7	0.5	1.9	2.2	-13.9
Total Organic Carbon		0.5	1.6	1.5	11.0	0.5	1.8	1.9	-4.4
Plant Pigments (µg/L)									
Chlorophyll-a		0				0			
Total Metals (mg/L)									
Aluminum		0.003	0.0064	0.0060	6.5	0.003	0.030	0.024	24.4
Antimony		0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*	
Arsenic		0.0001	0.00023	0.00023	0.0	0.0001	0.00011	0.00011	0.0
Barium		0.00005	0.0047	0.0048	-0.4	0.00005	0.0038	0.0036	3.5
Beryllium		0.00002	*<0.00002*	*<0.00002*		0.00002	*<0.00002*	*<0.00002*	
Bismuth		0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*	
Boron		0.01	*<0.01*	*<0.01*		0.01	*<0.01*	*<0.01*	
Cadmium		0.000005	*<0.000005*	*<0.000005*		0.000005	*<0.000005*	*<0.000005*	
Calcium		0.05	2.1	2.2	-5.6	0.05	1.9	1.9	-0.5
Chromium		0.0001	*<0.0001*	*<0.0001*		0.0001	0.00014	0.00011	24.0
Cobalt		0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*	
Copper		0.0005	*<0.0005*	*<0.0005*		0.0005	*<0.0005*	*<0.0005*	
Iron		0.01	0.017	0.016	6.1	0.01	0.070	0.062	12.1
Lead		0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	0.00006	
Lithium		0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*	
Magnesium		0.1	0.72	0.80	-10.5	0.1	0.59	0.61	-3.3
Manganese		0.0001	0.0023	0.0018	22.8	0.0001	0.0015	0.0013	20.8
Mercury		0.000005	*<0.000005*	*<0.000005*		0.000005	*<0.000005*	*<0.000005*	
Molybdenum		0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*	
Nickel		0.0005	0.00054	0.00052	3.8	0.0005	*<0.0005*	*<0.0005*	
Phosphorus		0.05	*<0.05*	*<0.05*		0.05	*<0.05*	*<0.05*	
Potassium		0.1	0.53	0.61	-14.0	0.1	0.45	0.47	-4.3
Selenium		0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*	
Silicon		0.05	0.37	0.40	-7.5	0.05	0.49	0.47	2.7
Silver		0.00001	*<0.00001*	*<0.00001*		0.00001	*<0.00001*	*<0.00001*	
Sodium		0.05	0.54	0.54	0.7	0.05	0.61	0.66	-8.7
Strontium		0.0002	0.0090	0.0090	-0.4	0.0002	0.0081	0.0081	0.5
Sulfur		0.5	0.91	1.0	-9.4	0.5	0.67	0.68	-1.5
Thallium		0.00001	*<0.00001*	*<0.00001*		0.00001	*<0.00001*	*<0.00001*	
Tin		0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*	
Titanium		0.0003	*<0.0003*	*<0.0003*		0.0003	0.00081	0.00068	17.4
Uranium		0.00001	0.00002	0.00002	0.0	0.00001	0.00003	0.00003	12.9
Vanadium		0.0005	*<0.0005*	*<0.0005*		0.0005	*<0.0005*	*<0.0005*	
Zinc		0.003	*<0.003*	*<0.003*		0.003	*<0.003*	*<0.003*	
Zirconium		0.0003	*<0.0003*	*<0.0003*		0.0003	*<0.0003*	*<0.0003*	
Dissolved Metals (mg/L)									
Aluminum		0.001	0.0027	0.0033	-20.0	0.001	0.0072	0.0076	-5
Antimony		0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*	
Arsenic		0.0001	0.00020	0.00020	0.0	0.0001	0.00010	*<0.0001*	
Barium		0.00005	0.0075	0.0080	-7.0	0.00005	0.0058	0.0044	27.8
Beryllium		0.00002	*<0.00002*	*<0.00002*		0.00002	*<0.00002*	*<0.00002*	
Bismuth		0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*	
Boron		0.01	*<0.01*	*<0.01*		0.01	*<0.01*	*<0.01*	
Cadmium		0.000005	*<0.000005*	*<0.000005*		0.000005	*<0.000005*	*<0.000005*	
Calcium		0.05	2.1	2.2	-1.9	0.05	1.9	1.9	0.0
Chromium		0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*	
Cobalt		0.0001	*<0.0001*	*<0.0001*		0.0001	*<0.0001*	*<0.0001*	
Copper		0.0002	0.00063	0.00059	6.6	0.0002	0.00056	0.00048	15.4
Iron		0.01	*<0.01*	*<0.01*		0.01	0.021	0.021	0.0
Lead		0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*	
Lithium		0.001	*<0.001*	*<0.001*		0.001	*<0.001*	*<0.001*	
Magnesium		0.1	0.72	0.74	-2.7	0.1	0.62	0.62	0.0
Manganese		0.0001	0.00096	0.00094	2.1	0.0001	0.00083	0.00088	-5.8
Mercury		0.000005	*<0.000005*	*<0.000005*		0.000005	*<0.000005*	*<0.000005*	
Molybdenum		0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*	
Nickel		0.0005	0.00052	0.00052	0.0	0.0005	*<0.0005*	*<0.0005*	
Phosphorus		0.05	*<0.05*	*<0.05*		0.05	*<0.05*	*<0.05*	
Potassium		0.1	0.54	0.55	-1.8	0.1	0.45	0.48	-6
Selenium		0.00005	*<0.00005*	*<0.00005*		0.00005	*<0.00005*	*<0.00005*	
Silicon		0.05	0.37	0.39	-5.5	0.05	0.46	0.46	0.2

Table A1-7. Field duplicate QA/QC results from the Tributary water sampling program, Whale Tail Pit Baseline, 2015.

	Month	August				September			
	Station	August	A8-A7			September	A1-DS1		
Analyte		MDLs	Original	E3-E2 (Dup)	RPD	MDLs	Original	E5-E4 (Dup)	RPD
Silver		0.00001	*<0.00001*	*<0.00001*		0.00001	*<0.00001*	*<0.00001*	
Sodium		0.05	0.63	0.66	-4.5	0.05	0.74	0.75	-1.6
Strontium		0.0002	0.0087	0.0087	0.2	0.0002	0.0080	0.0081	0
Sulfur		0.5	0.89	0.89	0.0	0.5	0.71	0.69	3
Thallium		0.00001	*<0.00001*	*<0.00001*		0.00001	*<0.00001*	*<0.00001*	
Tin		0.0001	0.00012	0.00013	-8.0	0.0001	*<0.0001*	*<0.0001*	
Titanium		0.0003	*<0.0003*	*<0.0003*		0.0003	*<0.0003*	*<0.0003*	
Uranium		0.00001	0.00002	0.00002	-5.7	0.00001	0.00002	0.00002	4
Vanadium		0.0005	*<0.0005*	*<0.0005*		0.0005	*<0.0005*	*<0.0005*	
Zinc		0.001	*<0.001*	*<0.001*		0.001	0.0012	*<0.001*	
Zirconium		0.0003	*<0.0003*	*<0.0003*		0.0003	*<0.0003*	*<0.0003*	

Notes:

RPD = Relative Percent Difference (%) = ((original - duplicate) / (original + duplicate)/2) x 100.

RPDs have not been calculated for cases where one of the samples is below detection and the other is not and in cases where both are below detection. RPD has been left blank.

The data quality objective (DQO) for field duplicates is an RPD < 50%.

Bolded RPDs	RPD values exceed 50% but < 10 x MDL.
Shaded RPD	RPD values exceed 50% and > 10 x MDL.

Italicized numbers are below detection limits.

Table A1-8. QA/QC data for sediment metals analyses, Whale Tail Baseline, 2015.

			Field Duplicates												Laboratory Duplicates								
			Whale Tail Lake			Whale Tail Lake			Nemo Lake			Mammoth Lake			WTN-1 (L1669874-6)			WTN-4 (L1669874-9)			MAM-5 (L1669874-22)		
Analyte	Laboratory DQOs[1,2]	MDLs	WTN-3	Field DUP-1	RPD[3]	WTS-1	Field DUP-2	RPD[3]	NEM-3	Field DUP-3	RPD[3]	MAM-2	Field DUP-4	RPD[3]	Original	Laboratory Duplicate	RPD	Original	Laboratory Duplicate	RPD	Original	Laboratory Duplicate	RPD
			22-Aug-15	21-Aug-15	(%)	21-Aug-05	21-Aug-05	(%)	23-Aug-15	23-Aug-15	(%)	24-Aug-15	24-Aug-15	(%)									
Physical & Organic Parameters																							
Moisture (%)	20	*0.25*	80.9	84.3	-4.1	85.5	85.6	-0.1	90.9	91.3	-0.4	90.7	90.4	0.3									
pH	0.30	*0.10*	5.71	5.47	4.3	5.48	5.83	-6.2	6.32	6.37	-0.8	5.98	6.27	-4.7	6.29	6.36	0.07				5.4	5.55	0.15
Total Organic Carbon (% dw)	30	*0.10*	4.65	4.61	0.9	5.29	5.33	-0.8	11.10	9.18	19	11.70	11.70	0.0				5.72	5.73	-0.2			
Particle Size																							
% Gravel (>2mm)	5	*0.10*	*<0.10*	0.34		*<0.10*	*<0.10*		*<0.10*	*<0.10*		*<0.10*	*<0.10*					*<0.10*	*<0.10*				
% Sand (2.00mm - 0.063mm)	5	*0.10*	4.68	4.54	3.0	5.4	5.1	5.5	19.2	17.2	11.0	2.5	0.5	132.2				3.18	2.89	0.3			
% Silt (0.063mm - 4µm)	5	*0.10*	82.6	82.8	-0.2	82.0	82.8	-1.0	76.4	78.7	-3.0	92.4	86.1	7.1				84.6	89	4.4			
% Clay (<4µm)	5	*0.10*	12.6	12.3	2.4	12.6	12.0	4.9	4.4	4.2	5.6	5.1	13.4	-89.3				12.2	8.08	4.1			
Total Metals (mg/kg dw)																							
Aluminum	40	*50*	14800	14300	3.4	14700	14500	1.4	10800	10300	4.7	18600	17200	7.8	13900	13500	2.9				18400	19500	-5.8
Antimony	30	*0.10*	0.25	0.22	12.8	0.23	0.21	9.1	0.35	0.38	-8.2	0.32	0.33	-3.1	0.25	0.33	-27.6				0.26	0.27	-3.8
Arsenic	30	*0.100*	568.0	557.0	2.0	102.0	96.7	5.3	46.4	47.2	-1.7	143.0	138.0	3.6	897	859	4.3				70	71.2	-1.7
Barium	40	*0.50*	97	92	5.5	113	112	0.9	91	92	-1.0	142	138	2.9	212	214	-0.9				136	140	-2.9
Beryllium	30	*0.10*	1.27	1.09	15.3	1.35	1.26	6.9	0.59	0.68	-14	1.29	1.34	-3.8	1.22	1.17	4.2				1.2	1.25	-4.1
Bismuth	30	*0.20*	0.47	0.40	16.1	0.52	0.49	5.9	0.21	0.25	-17	0.45	0.45	0.0	0.45	0.44	2.2				0.43	0.42	2.4
Cadmium	30	*5.0*	0.151	0.137	9.7	0.410	0.383	6.8	0.221	0.273	-21	0.255	0.258	-1.2	0.315	0.319	-1.3				0.296	0.278	6.3
Calcium	30	*50*	2050	1720	17.5	2300	2270	1.3	3690	3620	1.9	3370	3370	0.0	1950	2010	-3.0				2780	2920	-4.9
Chromium	30	*0.50*	94.5	92.4	2.2	63	63	1.3	110.0	113.0	-2.7	162.0	158.0	2.5	84.4	82.6	2.2				158	162	-2.5
Cobalt	30	*0.10*	20.5	19.7	4.0	16.1	15.8	1.9	8.0	8.1	-1.2	11.5	11.4	0.9	24	23.9	0.4				13.3	13.4	-0.7
Copper	30	*0.50*	35.5	33.6	5.5	37.9	36.5	3.8	36.4	39.7	-8.7	63.9	63.1	1.3	37.3	36.4	2.4				60.5	60.5	0.0
Iron	30	*50*	127000	122000	4.0	69000	64300	7.1	23800	24500	-2.9	43400	43800	-1	151000	143000	5.4				33000	34700	-5.0
Lead	40	*0.5*	11.7	10.4	11.8	13.7	13.3	3.0	8.4	9.4	-12	16.5	16.2	1.8	10.9	10.8	0.9				16.8	16.6	1.2
Lithium	30	*2.0*	14.0	10.5	28.6	13.1	11.2	16	10.0	12.4	-21	17.1	18.0	-5	13.4	12.9	3.8				15.1	15.8	-4.5
Magnesium	30	*20*	6300	6000	4.9	5690	5620	1.2	6590	6610	-0.3	9010	8570	5.0	5800	5640	2.8				8900	9190	-3.2
Manganese	30	*1.0*	2200	1960	11.5	2010	1850	8.3	302	304	-0.7	414	389	6	6660	6950	-4.3				408	417	-2.2
Mercury	40	*0.005*	0.0612	0.0542	12.1	0.0764	0.0746	2.4	0.0289	0.0304	-5	0.0991	0.0874	13	0.0742	0.0704	5.3				0.0955	0.0965	-1.0
Molybdenum	40	*0.10*	5.33	4.88	8.8	3.26	3.21	1.5	2.50	2.70	-7.7	3.73	3.64	2.4	6.27	6.21	1.0				2.89	3	-3.7
Nickel	30	*0.5*	59.9	57.8	3.6	73.9	71.5	3.3	78.4	83.7	-6.5	102.0	99.80	2.2	92	93.6	-1.7				107	108	-0.9
Phosphorus	30	*50*	1770	1680	5.2	1680	1560	7.4	664	656	1.2	911	876	3.9	1830	1690	8.0				796	810	-1.7
Potassium	40	*100*	2150	1950	9.8	2170	2100	3.3	1460	1440	1.4	2950	2780	6	2040	2010	1.5				2990	3200	-6.8
Selenium	30	*0.20*	0.75	0.71	5.5	0.67	0.67	0.0	0.51	0.57	-11	0.63	0.66	-4.7	0.78	0.76	2.6				0.67	0.65	3.0
Silver	40	*0.1*	0.23	0.20	14.0	0.26	0.24	8.0	0.16	0.20	-22	0.42	0.42	0.0	0.26	0.25	3.9				0.44	0.47	-6.6
Sodium	40	*50*	257	222	14.6	282	284	-0.7	555	503	9.8	442	342	26	292	269	8.2				338	351	-3.8
Strontium	40	*0.5*	21.6	18.1	17.6	22.1	22.1	0.0	26.7	27.1	-1.5	24.3	23.7	2.5	22	22.5	-2.2				20.6	22.3	-7.9
Thallium	30	*0.05*	0.154	0.130	16.9	0.195	0.190	2.6	0.079	0.090	-13	0.223	0.215	4	0.219	0.226	-3.1				0.249	0.252	-1.2
Tin	40	*2.0*	*<2.0*	*<2.0*		*<2.0*	*<2.0*		*<2.0*	*<2.0*		*<2.0*	*<2.0*		*<2.0*	*<2.0*					*<2.0*	*<2.0*	
Titanium	40	*1.0*	413	363	12.9	407	403	1.0	258	247	4.4	510	457	11	379	366	3.5				481	586	-19.7
Uranium	30	*0.05*	9.2	8.1	13.4	9.5	9.3	2.3	3.6	4.2	-15	11.8	11.9	-0.8	8.78	8.67	1.3				11.1	10.8	2.7
Vanadium	30	*0.2*	25.9	24.7	4.7	24.3	23.6	2.9	23.1	23.4	-1.3	39.6	38.6	2.6	23.7	23	3.0				38.4	39.9	-3.8
Zinc	30	*2.0*	79.1	75.2	5.1	86.7	82.7	4.7	54.2	57.7	-6.3	109.0	106.0	2.8	88.1	85.9	2.5				110	111	-0.9

Notes:

[1] Laboratory data quality objectives (DQOs) for moisture, TOC, and metals are expressed as the relative percent difference (RPD).

[2] The laboratory DQOs for pH and particle size are the absolute difference between the original sample and laboratory duplicate.

[3] The DQO for field duplicates is an RPD of < 50%.
RPD (%) = ((original - duplicate) / (original + duplicate)/2) x 100.
RPDs have not been calculated for cases where one of the samples is below detection and the other is not and in cases where both are below detection. RPD has been left blank.

Bold RPDs values exceed the DQOs, but concentrations are < 10 x MDL.
Shaded RPDs values exceed the DQOs, and concentrations are > 10 x MDL.
Bold Filter Swipe value is > MDL, but < 10 x MDL.
Shaded Filter Swipe value > 10x MDL.

Field Dup' samples are homogenization duplicates - the original and duplicate samples were split from the same homogenized bowl of sediment.

Italicized numbers are below detection limits.

Table A1-8. QA/QC data for sediment metals analyses, Whale Tail Baseline, 2015.

Analyte	Laboratory DQOs[1,2]	MDLs	Laboratory Duplicates: Field DUP-1 (L1669874-30) Original	Field DUP-1 Laboratory Duplicate	Field DUP-1 RPD (%)	Field DUP-3 (L1669874-32) Original	Field DUP-3 Laboratory Duplicate	Field DUP-3 RPD (%)	Field DUP-4 (L1669874-33) Original	Field DUP-4 Laboratory Duplicate	Field DUP-4 RPD (%)	Swipe MDLs (mg)	Equipment Swipes: SWIPE-1 FILTER 22-Aug-15	SWIPE-2 FILTER 21-Aug-15	SWIPE-3 FILTER 24-Aug-15	SWIPE-4 FILTER 24-Aug-15	SWIPE-QA-1 FILTER 8-Oct-15	SWIPE-QA-2 FILTER 8-Oct-15
Physical & Organic Parameters																		
Moisture (%)	20	*0.25*				91.3	91.2	0.1										
pH	0.30	*0.10*																
Total Organic Carbon (% dw)	30	*0.10*				9.18	9.28	-1.1										
Particle Size																		
% Gravel (>2mm)	5	*0.10*	0.34	0.34	0.0													
% Sand (2.00mm - 0.063mm)	5	*0.10*	4.54	4.14	0.4													
% Silt (0.063mm - 4µm)	5	*0.10*	82.8	83.4	0.6													
% Clay (<4µm)	5	*0.10*	12.3	12.2	0.1													
Total Metals (mg/kg dw)													**TOTAL METALS (mg)**					
Aluminum	40	*50*							17200	17400	-1.2	0.010	**0.011**	**0.018**	**0.015**	*<0.010*	*<0.010*	*<0.010*
Antimony	30	*0.10*							0.33	0.33	0.0	0.010	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*
Arsenic	30	*0.100*							138	138	0.0	0.010	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*
Barium	40	*0.50*							138	140	-1.4	0.00050	**0.00135**	**0.00147**	**0.00084**	*<0.00050*	*<0.00050*	*<0.00050*
Beryllium	30	*0.10*							1.34	1.35	-0.7	0.00030	*<0.00030*	*<0.00030*	*<0.00030*	*<0.00030*	*<0.00030*	*<0.00030*
Bismuth	30	*0.20*							0.45	0.47	-4.3	0.010	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*
Cadmium	30	*5.0*							0.258	0.258	0.0	0.00050	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*
Calcium	30	*50*							3370	4140	-20.5	0.050	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*
Chromium	30	*0.50*							158	158	0.0	0.0010	**0.0021**	**0.0083**	**0.0042**	**0.0054**	*<0.0010*	*<0.0010*
Cobalt	30	*0.10*							11.4	11.7	-2.6	0.00050	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*
Copper	30	*0.50*							63.1	64.8	-2.7	0.00050	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*
Iron	30	*50*							43800	44300	-1.1	0.0020	0.0312	0.0696	0.0452	0.0395	**0.0074**	**0.0124**
Lead	40	*0.5*							16.2	16.2	0.0	0.0030	*<0.0030*	**0.0038**	*<0.0030*	*<0.0030*	*<0.0030*	*<0.0030*
Lithium	30	*2.0*							18	18.1	-0.6	0.00050	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*
Magnesium	30	*20*							8570	8740	-2.0	0.0050	**0.0084**	**0.0170**	**0.0154**	**0.0094**	**0.0090**	**0.0098**
Manganese	30	*1.0*							389	395	-1.5	0.00030	**0.00147**	**0.00107**	**0.00077**	**0.00060**	*<0.00030*	*<0.00030*
Mercury	40	*0.005*							0.0874	0.0855	2.2							
Molybdenum	40	*0.10*							3.64	3.66	-0.5	0.0020	*<0.0020*	*<0.0020*	*<0.0020*	*<0.0020*	*<0.0020*	*<0.0020*
Nickel	30	*0.5*							99.8	102	-2.2	0.0030	*<0.0030*	**0.0038**	*<0.0030*	*<0.0030*	*<0.0030*	*<0.0030*
Phosphorus	30	*50*							876	899	-2.6	0.020	*<0.020*	*<0.020*	*<0.020*	*<0.020*	*<0.020*	*<0.020*
Potassium	40	*100*							2780	2790	-0.4	0.10	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*
Selenium	30	*0.20*							0.66	0.71	-7.3	0.010	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*
Silver	40	*0.1*							0.42	0.43	-2.4	0.00050	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*
Sodium	40	*50*							342	355	-3.7	0.10	**0.10**	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*
Strontium	40	*0.5*							23.7	24.4	-2.9	0.00030	*<0.00030*	*<0.00030*	*<0.00030*	*<0.00030*	*<0.00030*	*<0.00030*
Thallium	30	*0.05*							0.215	0.218	-1.4	0.010	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*
Tin	40	*2.0*							*<2.0*	*<2.0*		0.0020	*<0.0020*	**0.0023**	*<0.0020*	*<0.0020*	*<0.0020*	*<0.0020*
Titanium	40	*1.0*							457	453	0.9	0.00050	**0.00059**	**0.00089**	**0.00055**	*<0.00050*	*<0.00050*	*<0.00050*
Uranium	30	*0.05*							11.9	11.9	0.0							
Vanadium	30	*0.2*							38.6	39.3	-1.8	0.0020	*<0.0020*	*<0.0020*	*<0.0020*	*<0.0020*	*<0.0020*	*<0.0020*
Zinc	30	*2.0*							106	107	-0.9	0.00030	**0.00031**	**0.00113**	**0.00095**	**0.00047**	**0.00033**	**0.00042**

Notes:

[1] Laboratory data quality objectives (DQOs) for moisture, TOC, and metals are expressed as the relative percent difference (RPD).

[2] The laboratory DQOs for pH and particle size are the absolute difference between the original sample and laboratory duplicate.

[3] The DQO for field duplicates is an RPD of < 50%.
RPD (%) = ((original - duplicate) / (original + duplicate)/2) x 100.
RPDs have not been calculated for cases where one of the samples is below detection and the other is not and in cases where both are below detection. RPD has been left blank.

Bold RPDs values exceed the DQOs, but concentrations are < 10 x MDL.
Shaded RPDs values exceed the DQOs, and concentrations are > 10 x MDL.
Bold Filter Swipe value is > MDL, but < 10 x MDL.
Shaded Filter Swipe value > 10x MDL.
Field Dup' samples are homogenization duplicates - the original and duplicate samples were split from the same homogenized bowl of sediment.
Italicized numbers are below detection limits.

Table A1-9. QA/QC data for sediment hydrocarbon and PAH analyses, Whale Tail Baseline, 2015.

Analyte	MDLs	Mammoth Lake		
		MAM-COMP	COMP DUP-1	RPD (%)
Physical Parameters				
Moisture (%)	*0.25*	90.9	91.2	-0.3
Aggregate Organics (mg/kg)				
Mineral Oil and Grease	*500*	1960	1010	**64.0**
Hydrocarbons (mg/kg)				
EPH10-19	*680*	*<1100*	*<1000*	
EPH19-32	*680*	*<1100*	*<1000*	
LEPH	*680*	*<1100*	*<1000*	
HEPH	*680*	*<1100*	*<1000*	
Polycyclic Aromatic Hydrocarbons (mg/kg)				
Acenaphthene	*0.0050*	*<0.015*	*<0.015*	
Acenaphthylene	*0.0050*	*<0.015*	*<0.015*	
Anthracene	*0.0040*	*<0.012*	*<0.012*	
Benzo(a)anthracene	*0.010*	*<0.030*	*<0.030*	
Benzo(a)pyrene	*0.010*	*<0.030*	*<0.030*	
Benzo(b)fluoranthene	*0.010*	*<0.030*	*<0.030*	
Benzo(b+j+k)fluoranthene	*0.015*	*<0.042*	*<0.042*	
Benzo(g,h,i)perylene	*0.010*	*<0.030*	*<0.030*	
Benzo(k)fluoranthene	*0.010*	*<0.030*	*<0.030*	
Chrysene	*0.010*	*<0.030*	*<0.030*	
Dibenz(a,h)anthracene	*0.0050*	*<0.015*	*<0.015*	
Fluoranthene	*0.010*	*<0.030*	*<0.030*	
Fluorene	*0.010*	*<0.030*	*<0.030*	
Indeno(1,2,3-c,d)pyrene	*0.010*	*<0.030*	*<0.030*	
2-Methylnaphthalene	*0.010*	*<0.030*	*<0.030*	
Naphthalene	*0.010*	*<0.030*	*<0.030*	
Phenanthrene	*0.010*	*<0.030*	*<0.030*	
Pyrene	*0.010*	*<0.030*	*<0.030*	
d10-Acenaphthene (%)		87.7	90.8	-3.5
d12-Chrysene (%)		115.7	115.6	0.1
d8-Naphthalene (%)		78.1	85.0	-8.5
d10-Phenanthrene (%)		108.1	108.4	-0.3
B(a)P Total Potency Equivalent	*0.020*	*<0.029*	*<0.029*	
IACR (CCME)	*0.15*	*<0.32*	*<0.32*	

Notes:

RPD = Relative Percent Difference (%) = ((original - duplicate) / (original + duplicate)/2) x 100.

RPDs have not been calculated for cases where one of the samples is below detection and the other is not and in cases where both are below detection. RPD has been left blank.

Bold RPDs values exceed the DQOs, but concentrations are < 10 x MDL.

Shaded RPDs values exceed the DQOs, and concentrations are > 10 x MDL.

COMP DUP samples are homogenization duplicates - the original and duplicate samples were split from the same homogenized bowl of sediment.

"-" = no measurement

Italicized numbers are below detection limits.

APPENDIX A2

Phytoplankton, Benthic Invertebrate, and Zooplankton QA/QC Results

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Table A2-1. QA/QC results for the laboratory duplicate phytoplankton samples, Whale Tail Pit Baseline, 2014 and 2015.

2014 Baseline Program			
	September Lab Duplicate		
Sample	LAK3 - 1	LAK3 - 1R	
date	04/09/14	04/09/14	**RPD**[1]
Total biomass (mg/m^3)	268	253	5.7
Total Density (cells/L)	3,674,640	3,573,464	2.8

Notes:

2014 baseline data was adapted from Portt and Associates (2015a).

[1] The DQO for laboratory duplicates is an RPD of < 25% for total biomass and total density.

RPD (%) = ((original - duplicate) / (original + duplicate)/2) x 100.

2015 Baseline Program									
	July Field Duplicate			August Laboratory Duplicate			September Field Duplicate		
Sample	NEM2-S	NEM2-SR		WTN3-S	WTN3-SR		NEM6-S	NEM6-SR	
date	18/07/15	18/07/15	**RPD**[1]	20/08/15	20/08/15	**RPD**[1]	19/09/15	19/09/15	**RPD**[1]
Total biomass (mg/m^3)	257	245	4.8	184	198	-7.4	152	153	-0.8
Total Density (cells/L)	3,132,904	3,103,968	0.9	2,053,840	2,062,424	-0.4	1,783,464	1,692,472	5.2

Notes:

[1] The DQO for laboratory duplicates is an RPD of < 25% for total biomass and total density.

RPD (%) = ((original - duplicate) / (original + duplicate)/2) x 100.

Table A2-2. QA/QC results for the field duplicate phytoplankton samples, Whale Tail Pit Baseline, 2014 and 2015.

2014 Baseline Program			
	September Lab Duplicate		
Sample	LAK3 - 5	DUP - 1	
date	04/09/14	04/09/14	**RPD**[1]
Total biomass (mg/m^3)	286	246	14.9
Total Density (cells/L)	3,728,328	3,824,704	-2.6

Notes:

2014 baseline data was adapted from Portt and Associates (2015a).

[1] The DQO for field duplicates is an RPD of < 50% for total biomass and total density.

RPD (%) = ((original - duplicate) / (original + duplicate)/2) x 100.

2015 Baseline Program									
	July Field Duplicate			August Field Duplicate			September Field Duplicate		
Sample	WTS2-S	DUP1		WTN4-S	DUP1		WTN6-S	DUP1	
date	17/07/15	01/07/15	**RPD**[1]	20/08/15	01/08/15	**RPD**[1]	18/09/15	01/09/15	**RPD**[1]
Total Biomass (mg/m^3)	265	321	-19.1	154	211	-31.4	226	205	10.1
Total Density (cells/L)	4,154,600	4,115,096	1.0	1,651,536	2,808,760	-51.9	2,536,000	2,629,192	-3.6

Notes:

[1] The DQO for field duplicates is an RPD of < 50% for total biomass and total density.

RPD (%) = ((original - duplicate) / (original + duplicate)/2) x 100.

Table A2-3. QA/QC summary of the benthic invertebrate taxonomy, 2015 baseline program.

Area-Replicate	Number of Organisms		
	Initial Count	Resort	Percent Recovery
MAM-2	135	142	95.1%
NEM-1	143	147	97.3%
WTN-3	53	57	93.0%
		Average % Recovery	95.1%

Notes:
All samples were sorted in their entirety.

Table A2-4. Laboratory QA/QC results from the zooplankton taxonomic identification, Whale Tail Pit Baseline, 2015.

Subsampling Accuracy			
QA Sample	Abundance (Original Replicate) (A)	Abundance (QA Replicate) (B)	Accuracy 1-(A/B)*100
MAM-02-S	16393	18903	15.3
WTS-05-S	7055	7852	10.2
MAM-05-S	7327	7833	6.5
		Mean Subsampling Error (%)	**10.6**

Taxonomic Accuracy - Internal			
QA Sample	Number of Unique Taxa (B)	Number of disagreements (A)	% Accuracy 1-(A/B)*100
MAM-02-S	7	0	100.0
WTS-05-S	7	0	100.0
MAM-05-S	6	0	100.0
		Mean Internal Taxonomic Accuracy (%)	**100.0**

Table A2-5. QA/QC results for the field duplicate zooplankton samples, Whale Tail Pit Baseline, 2015.

	July Field Duplicate (WTS-2)					
	Biomass (ww/sample)			Abundance (organisms/sample)		
Major Taxa Group	**Original**	**Duplicate**	**RPDs[1]**	**Original**	**Duplicate**	**RPDs[1]**
Cladocera	1.1	2.7	-82	82	186	-78
Calanoida	3.7	49	-172	30	400	-172
Cyclopoida	36	81	-78	2080	5440	-89
Copepod Nauplii	0.69	1.0	-40	1067	1433	-29
Rotifera	47	61	-27	3200	4833	-41
Total Zooplankton	88	195	-76	6459	12293	-62

	August Field Duplicate (WTS-3)					
	Biomass (ww/sample)			Abundance (organisms/sample)		
Major Taxa Group	**Original**	**Duplicate**	**RPDs[1]**	**Original**	**Duplicate**	**RPDs[1]**
Cladocera	0.00	0.62	-200	0	23	-200
Calanoida	155	113	31	345	243	35
Cyclopoida	11	7.1	42	780	650	18
Copepod Nauplii	0.40	0.31	25	3200	2300	33
Rotifera	123	39	104	12667	5300	82
Total Zooplankton	289	160	57	16992	8516	66

	September Field Duplicate (WTS-5)					
	Biomass (ww/sample)			Abundance (organisms/sample)		
Major Taxa Group	**Original**	**Duplicate**	**RPDs[1]**	**Original**	**Duplicate**	**RPDs[1]**
Cladocera	1.16	0.48	84	15	10	40
Calanoida	49	57	-15	105	123	-15
Cyclopoida	21	15	33	1035	688	40
Copepod Nauplii	0.84	0.30	94	2133	667	105
Rotifera	41	40	2.3	3767	3900	-3.5
Total Zooplankton	113	113	0.1	7055	5387	27

Notes:

[1] RPD = Relative Percent Difference (%) = ((original - duplicate) / (original + duplicate)/2) x 100.

APPENDIX B

In-situ Water Quality Results, Whale Tail Pit Baseline, 2014 and 2015

APPENDIX B1

2014 *In-situ* Water Quality Results: Lake Stations

Table B1-1. *In-situ* water quality results from the Lake stations, Whale Tail Pit Baseline, 2014.

Lake	Date	Location	UTM Coordinates			Water Depth (m)	Secchi Depth (m)	Profile Depth (m)	pH	Temp. (°C)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)
			Zone	Easting	Northing								
Whale Tail Lake	05-Sep-14	1*	14W	607005	7255983	8.5	8.5	0	7.30	9.3	21.8	11.6	0.06
								1	7.30	9.3	21.8	11.5	0.05
								2	7.24	9.3	21.7	11.4	0.06
								3	7.21	9.3	21.8	11.2	0.09
								4	7.06	9.3	21.7	11.1	0.09
								5	7.05	9.3	21.7	10.8	0.09
								6	7.14	9.3	21.8	11.0	0.10
								7	7.03	9.3	21.7	11.2	0.10
								8	7.05	9.3	21.7	11.2	0.11
		2	14W	607431	7255251	7.8	6.4	0	6.77	9.4	18.5	11.6	0.10
								1	6.97	9.4	18.5	11.5	0.09
								2	6.83	9.4	18.5	11.6	0.10
								3	6.79	9.4	18.5	11.6	0.09
								4	6.76	9.4	18.5	11.7	0.10
								5	6.80	9.4	18.5	11.8	0.10
								6	6.80	9.4	18.5	11.7	0.11
								7	6.85	9.4	18.5	11.8	0.10
		3*	14W	607538	7254596	8	7	0	7.02	9.4	17.3	11.5	0.10
								1	6.93	9.5	17.4	11.5	0.11
								2	6.87	9.5	17.4	11.5	0.13
								3	6.83	9.4	17.4	11.6	0.13
								4	6.92	9.4	17.4	11.6	0.13
								5	6.99	9.4	17.3	11.6	0.13
								6	6.95	9.4	17.4	11.7	0.14
								7	6.95	9.4	17.3	11.7	0.14
		4	14W	607230	7253781	7.8	6.5	0	7.07	9.3	17.3	11.4	0.09
								1	7.01	9.3	17.3	11.5	0.12
								2	6.97	9.3	17.3	11.4	0.14
								3	7.01	9.3	17.3	11.5	0.13
								4	6.90	9.3	17.3	11.5	0.14
								5	6.90	9.3	17.3	11.6	0.15
								6	6.91	9.3	17.3	11.6	0.12
								7	6.88	9.3	17.3	11.6	0.13
		5*	14W	607120	7253603	8	7	0	7.12	9.2	17.4	11.4	0.15
								1	7.14	9.2	17.3	11.4	0.15
								2	6.95	9.3	17.4	11.3	0.15
								3	6.89	9.2	17.4	11.5	0.15
								4	6.99	9.2	17.3	11.5	0.15
								5	7.03	9.3	17.3	11.5	0.15
								6	6.87	9.3	17.3	11.5	0.15
								7	6.95	9.3	17.3	11.6	0.15
Nemo Lake	06-Sep-14	1*	14W	606358	7257042	7.6	>7.6	0	7.32	9.2	25.1	11.51	0.00
								1	7.23	9.2	25.1	11.50	0.00
								2	7.28	9.2	25.1	11.52	0.00
								3	7.23	9.1	25.1	11.58	0.00
								4	7.28	9.1	25.1	11.62	0.00
								5	7.28	9.1	25.1	11.59	0.00
								6	7.28	9.1	25.1	11.58	0.00
								7	7.29	9.1	25.1	11.62	0.00
		2	14W	606040	7257418	7.4	>7.4	0	7.34	9.5	25.1	11.47	0.00
								1	7.19	9.3	25.1	11.45	0.00
								2	7.28	9.3	25.1	11.45	0.00
								3	7.14	9.3	25.1	11.49	0.00
								4	7.26	9.3	25.1	11.51	0.00
								5	7.20	9.3	25.1	11.54	0.00
								6	7.22	9.3	25.1	11.57	0.00
								7	7.11	9.3	25.1	11.56	0.00
		3*	14W	606048	7257571	8.3	>8.3	0	7.09	9.3	25.1	11.39	0.00
								1	7.17	9.3	25.1	11.34	0.00
								2	7.20	9.3	25.1	11.26	0.00
								3	7.15	9.3	25.0	11.00	0.00
								4	7.19	9.3	25.0	10.76	0.00
								5	7.23	9.2	25.1	10.67	0.00
								6	7.07	9.2	25.0	10.66	0.00
								7	7.11	9.2	25.0	10.62	0.00

Table B1-1. *In-situ* water quality results from the Lake stations, Whale Tail Pit Baseline, 2014.

Lake	Date	Location	UTM Coordinates			Water Depth (m)	Secchi Depth (m)	Profile Depth (m)	pH	Temp. (°C)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)
			Zone	Easting	Northing								
Nemo Lake	6-Sep-14	4	14W	606963	7257756	8.5	>8.5	0	7.31	9.4	25.0	11.30	0.00
								1	7.20	9.4	25.0	11.27	0.00
								2	7.28	9.4	25.0	11.18	0.00
								3	7.29	9.4	25.0	11.14	0.00
								4	7.22	9.4	25.0	11.05	0.00
								5	7.28	9.4	25.0	10.97	0.00
								6	7.28	9.4	25.0	11.04	0.00
								7	7.27	9.4	25.0	11.00	0.00
								8	7.21	9.4	25.0	11.14	0.00
		5*	14W	606740	7257566	8.7	8.3	0	7.29	9.4	25.0	11.35	0.00
								1	7.31	9.4	25.0	11.29	0.00
								2	7.29	9.4	25.0	11.17	0.00
								3	7.25	9.4	25.0	10.98	0.00
								4	7.18	9.4	25.0	10.84	0.00
								5	7.25	9.4	25.0	10.81	0.00
								6	7.27	9.4	25.0	10.79	0.00
								7	7.15	9.4	25.0	10.79	0.00
								8	7.24	9.4	25.0	10.85	0.00
Mammoth Lake	04-Sep-14	1*	14W	605074	7254893	8.1	6.5	0	7.59	9.8	21.6	11.5	0.29
								1	7.53	9.8	21.6	11.5	0.29
								2	7.59	9.8	21.6	11.3	0.32
								3	7.54	9.8	21.6	11.6	0.31
								4	7.46	9.3	22.1	11.9	0.31
								5	7.30	9.8	21.7	12.4	0.31
								6	7.30	9.7	21.9	11.9	0.28
								7	7.37	9.6	21.9	11.8	0.33
								8	7.24	9.5	22.1	11.6	
		2	14W	604486	7254566	7.3	7.2	0	7.23	10.0	21.0	11.5	0.14
								1	7.30	10.0	20.9	11.5	0.16
								2	7.24	10.0	20.9	11.2	0.16
								3	7.24	10.0	21.0	11.1	0.17
								4	7.28	10.0	21.0	11.1	0.17
								5	7.20	10.0	21.0	11.2	0.16
								6	7.19	10.0	21.0	11.2	0.16
								7	7.24	9.7	20.9	11.2	0.17
		3*	14W	604398	7254336	8.3	7.5	0	7.00	10.0	20.9	11.7	0.14
								1	7.07	9.9	20.9	11.7	0.14
								2	6.99	9.9	20.9	11.5	0.15
								3	7.04	9.9	20.9	11.2	0.16
								4	6.96	9.9	20.9	11.1	0.16
								5	7.00	9.9	20.9	11.0	0.16
								6	7.11	9.9	21.0	10.9	0.16
								7	7.15	9.5	21.0	11.0	0.17
								8	7.02	9.4	21.0	11.0	0.16
		4	14W	603925	7254200	7.4	7.0	0	7.00	9.9	20.9	11.8	0.17
								1	7.00	9.8	20.9	11.7	0.16
								2	6.94	9.8	20.9	11.5	0.17
								3	7.02	9.8	20.9	11.3	0.17
								4	6.98	9.8	20.9	11.2	0.17
								5	7.00	9.8	20.9	11.1	0.17
								6	7.03	9.7	20.9	10.9	0.17
								7	7.06	9.7	20.8	11.0	0.18
		5*	14W	604191	7253847	7.3	7.3	0	7.04	10.1	20.8	11.2	0.11
								1	7.10	10.1	20.8	11.3	0.13
								2	7.07	10.1	20.9	11.0	0.14
								3	7.08	10.0	20.9	11.0	0.13
								4	7.14	9.9	20.8	11.4	0.15
								5	6.94	9.9	20.8	11.5	0.17
								6	7.05	9.6	20.8	11.6	0.17
								7	7.11	9.6	20.9	11.4	0.17

Notes:

Data presented here were adapted from Portt and Associates (2015a).

* = water, phytoplankton, and sediment were submitted for analysis from these locations.

APPENDIX B2

2015 *In-situ* Water Quality Results: Lakes Stations

Table B2-1. *In-situ* water quality results from the Lake stations, Whale Tail Pit Baseline, 2015.

Area-Replicate	Date	UTM Coordinates			Water Depth	Secchi Depth	Profile Depth	pH	Temp.	Specific Conductivity	Dissolved Oxygen
		Zone	Easting	Northing	(m)	(m)	(m)		(°C)	(µS/cm)	(mg/L)
WTN-1	17-Jul-15	14W	607207	7254975	7.4	4.3	0	6.81	10.1	19.2	11.3
							1	6.77	10.1	19.2	11.4
							2	6.76	10.1	19.2	11.2
							3	6.77	8.1	19.2	11.8
							4	6.71	7.8	19.7	11.7
							5	6.71	7.1	20.3	12.1
							6	6.68	6.8	20.4	12.2
							7	6.70	6.6	20.7	12.5
WTN-2	17-Jul-15	14W	607252	7254613	6.7	4.7	0	6.85	9.2	15.8	11.4
							1	6.84	9.1	15.8	11.5
							2	6.85	9.1	15.8	11.3
							3	6.77	9.1	15.9	11.2
							4	6.79	7.9	15.7	11.6
							5	6.79	6.4	15.2	12.0
WTN-3	20-Aug-15	14W	607387	7254563	6.8	6.1	0	7.03	11.4	17.1	10.5
							1	7.00	11.4	17.1	10.3
							2	6.99	11.4	17.1	10.2
							3	6.99	11.4	17.1	10.2
							4	6.99	11.4	17.1	10.1
							5	6.99	11.4	17.1	10.1
							6	6.99	11.4	17.1	10.1
WTN-4	20-Aug-15	14W	607221	7254980	7.9	5.4	0	6.99	11.3	18.2	10.1
							1	6.97	11.3	18.3	10.0
							2	6.97	11.3	18.2	10.0
							3	6.98	11.3	18.2	10.0
							4	6.96	11.4	18.3	9.9
							5	6.97	11.4	18.1	9.9
							6	6.96	11.4	18.2	9.9
							7	6.95	11.4	18.6	9.8
WTN-5	18-Sep-15	14W	607244	7255025	6.7	4.0	0	6.81	4.8	23.5	12.2
							1	6.82	4.8	23.4	11.8
							2	6.80	4.8	23.5	11.8
							3	6.79	4.8	23.4	11.8
							4	6.79	4.8	23.4	11.7
							5	6.76	4.8	23.4	11.8
							6	6.78	4.8	23.3	11.9
WTN-6	18-Sep-15	14W	607329	7254542	10.9	5.6	0	6.82	4.9	20.4	11.2
							1	6.81	4.9	20.4	11.1
							2	6.82	4.9	20.4	11.2
							3	6.79	5.0	20.6	11.2
							4	6.78	5.0	20.8	11.1
							5	6.78	4.9	21.0	11.1
							6	6.78	5.0	21.1	11.1
							7	6.74	5.0	21.2	11.1
							8	6.71	5.0	21.2	11.1
							9	6.72	5.0	21.1	11.2
							10	6.72	4.9	21.1	11.3
WTS-1	17-Jul-15	14W	607450	7253884	9.5	3.7	0	6.85	9.1	15.3	11.4
							1	6.80	9.1	15.3	11.1
							2	6.79	9.0	15.2	11.3
							3	6.80	9.0	15.1	11.1
							4	6.78	8.7	15.0	11.2
							5	6.80	7.9	15.0	11.2
							6	6.75	5.7	14.9	12.0
							7	6.70	5.6	15.0	12.0
							8	6.73	5.4	14.9	12.0
WTS-2	17-Jul-15	14W	607621	7254253	5.1	3.5	0	6.79	7.7	15.2	11.7
							1	6.78	7.7	15.2	11.8
							2	6.79	7.7	15.1	11.6
							3	6.77	7.6	15.1	11.6
							4	6.78	7.6	15.5	11.9
WTS-3	21-Aug-15	14W	607173	7253550	8.5	5.5	0	6.77	10.8	17.0	10.3
							1	6.81	10.8	17.0	10.1

Table B2-1. *In-situ* water quality results from the Lake stations, Whale Tail Pit Baseline, 2015.

Area-Replicate	Date	UTM Coordinates			Water Depth (m)	Secchi Depth (m)	Profile Depth (m)	pH	Temp. (°C)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)
		Zone	Easting	Northing							
WTS-3 (con't)							2	6.84	10.8	17.0	10.0
							3	6.90	10.8	17.0	10.1
							4	6.90	10.8	17.0	10.0
							5	6.90	10.8	17.0	10.1
							6	6.91	10.8	17.0	10.0
							7	6.91	10.8	17.0	9.9
							8	6.90	10.8	17.0	10.0
WTS-4	21-Aug-15	14W	607571	7254138	7.5	6.5	0	6.84	10.8	17.1	10.3
							1	6.86	10.8	17.1	10.3
							2	6.86	10.8	17.1	10.2
							3	6.85	10.8	17.1	10.2
							4	6.86	10.8	17.1	10.2
							5	6.87	10.8	17.1	10.0
							6	6.87	10.8	17.1	10.1
							7	6.85	10.8	17.1	10.1
WTS-5	18-Sep-15	14W	607612	7253907	6.5	5.1	0	6.59	4.9	19.8	13.1
							1	6.60	4.9	19.8	13.1
							2	6.57	4.9	19.8	13.1
							3	6.49	4.9	19.8	13.1
							4	6.47	4.9	19.8	13.1
							5	6.38	4.9	19.8	13.4
WTS-6	18-Sep-15	14W	607568	725459	7.8	5.0	0	6.76	4.9	19.8	12.1
							1	6.75	4.9	19.8	12.0
							2	6.73	4.9	19.8	12.0
							3	6.76	4.9	19.7	12.0
							4	6.74	4.9	19.8	12.0
							5	6.68	4.9	19.8	12.1
							6	6.69	4.9	19.8	12.1
							7	6.66	4.9	19.8	12.3
NEM-1	18-Jul-15	14W	606604	7257508	10.5	8.0	0	7.06	6.2	24.1	14.8
							1	7.08	6.2	24.2	14.8
							2	7.07	6.3	24.1	14.5
							3	7.08	6.2	24.2	14.6
							4	7.10	6.2	24.1	14.5
							5	7.09	6.2	24.2	14.3
							6	7.10	6.1	24.1	14.4
							7	7.11	6.1	24.1	14.4
							8	7.12	6.1	24.1	14.3
							9	7.15	6.1	24.1	14.2
NEM-2	18-Jul-15	14W	606454	7257135	11.1	7.0	0	7.01	6.4	24.1	15.3
							1	7.01	6.4	24.2	15.2
							2	7.01	6.4	24.1	15.2
							3	7.03	6.1	24.1	15.0
							4	7.03	6.1	24.2	15.1
							5	7.04	6.0	24.2	15.3
							6	7.05	6.0	24.2	15.1
							7	7.07	5.9	24.3	15.4
							8	7.09	5.9	24.2	15.2
							9	7.13	5.9	24.2	15.2
							10	7.22	6.1	24.1	15.2
NEM-3	23-Aug-15	14W	606553	7257360	8	7.6	0	7.25	11.3	21.7	11.7
							1	7.25	11.2	21.7	11.6
							2	7.27	11.2	21.7	11.1
							3	7.26	11.2	21.7	11.2
							4	7.26	11.1	21.7	11.3
							5	7.26	11.1	21.7	11.0
							6	7.26	11.1	21.7	10.7
							7	7.26	11.1	21.7	11.0
NEM-4	23-Aug-15	14W	606378	7257257	11.8	8.4	0	7.08	11.1	21.7	12.9
							1	7.12	11.1	21.7	12.6
							2	7.14	11.1	21.7	12.6
							3	7.14	11.1	21.7	12.7
							4	7.16	11.1	21.7	12.7

Table B2-1. *In-situ* water quality results from the Lake stations, Whale Tail Pit Baseline, 2015.

Area-Replicate	Date	UTM Coordinates			Water Depth (m)	Secchi Depth (m)	Profile Depth (m)	pH	Temp. (°C)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)
		Zone	Easting	Northing							
NEM-4 (con't)							5	7.16	11.1	21.7	12.2
							6	7.17	11.1	21.7	12.4
							7	7.17	11.0	21.7	12.5
							8	7.18	11.0	21.7	12.0
							9	7.18	11.0	21.7	12.2
							10	7.18	11.0	21.7	12.0
							11	7.19	11.0	21.7	12.1
NEM-5	19-Sep-15	14W	606288	7257418	10.5	7.5	0	7.17	5.5	23.4	14.1
							1	7.15	5.5	23.4	13.9
							2	7.12	5.5	23.4	14.0
							3	7.18	5.5	23.4	14.0
							4	7.19	5.5	23.4	14.0
							5	7.14	5.5	23.4	14.0
							6	7.16	5.5	23.4	14.2
							7	7.14	5.5	23.4	14.2
							8	7.20	5.5	23.4	14.3
							9	7.24	5.5	23.4	14.7
NEM-6	19-Sep-15	14W	606611	7257938	15.2	8.5	0	7.20	5.8	23.4	14.3
							1	7.17	5.8	23.4	14.1
							2	7.18	5.8	23.4	14.0
							3	7.19	5.8	23.4	13.9
							4	7.18	5.8	23.4	13.9
							5	7.17	5.8	23.4	14.0
							6	7.15	5.8	23.4	13.9
							7	7.19	5.8	23.4	13.8
							8	7.21	5.8	23.4	13.8
							9	7.19	5.8	23.4	13.9
							10	7.19	5.8	23.4	14.0
							11	7.17	5.8	23.4	14.1
							12	7.18	5.8	23.4	13.9
							13	7.17	5.8	23.4	14.2
							14	7.12	5.8	23.4	14.3
MAM-1	18-Jul-15	14W	604278	7254163	5.1	5.1	0	7.09	10.6	22.1	12.5
							1	7.08	10.5	22.1	12.4
							2	7.09	10.5	22.1	12.2
							3	7.08	10.4	22.1	12.2
							4	7.08	10.4	22.1	12.2
MAM-2	18-Jul-15	14W	604145	7254415	7.8	6.5	0	7.09	10.2	22.1	12.5
							1	7.10	10.1	22.1	12.5
							2	7.08	10.0	22.1	12.4
							3	7.07	10.0	22.1	12.1
							4	7.05	9.9	22.1	12.1
							5	7.04	8.8	21.8	12.2
							6	7.07	7.7	21.4	13.3
							7	7.09	6.9	21.3	13.8
MAM-3	24-Aug-15	14W	604273	7254244	7.2	6.6	0	6.96	11.0	21.3	11.1
							1	6.96	11.0	21.3	11.0
							2	6.95	11.0	21.3	10.9
							3	6.95	10.9	21.3	11.0
							4	6.96	10.9	21.3	10.8
							5	6.95	10.9	21.3	10.8
							6	6.96	10.9	21.3	10.6
							7	6.95	10.9	21.3	10.5
MAM-4	24-Aug-15	14W	604239	7253860	7.8	6.5	0	7.11	11.0	21.3	12.6
							1	7.10	11.0	21.3	12.2
							2	7.08	11.0	21.3	12.4
							3	7.08	11.0	21.3	12.3
							4	7.08	11.0	21.3	12.0
							5	7.08	11.0	21.3	11.8
							6	7.07	11.0	21.3	12.0
							7	7.07	11.0	21.3	12.0
MAM-5	19-Sep-15	14W	604357	7254348	8.9	6.0	0	7.04	4.5	24.0	14.5
							1	7.06	4.5	24.0	14.4

Table B2-1. *In-situ* water quality results from the Lake stations, Whale Tail Pit Baseline, 2015.

Area-Replicate	Date	UTM Coordinates			Water Depth (m)	Secchi Depth (m)	Profile Depth (m)	pH	Temp. (°C)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)
		Zone	Easting	Northing							
MAM-5 (con't)							2	7.06	4.5	24.0	14.4
							3	7.07	4.5	24.0	14.3
							4	7.11	4.5	24.0	14.3
							5	7.08	4.5	24.0	14.4
							6	7.09	4.5	24.0	14.4
							7	7.08	4.5	24.0	14.5
							8	7.15	4.5	24.0	14.5
MAM-6	19-Sep-15	14W	604228	7253834	6.4	5.9	0	6.97	4.5	23.8	15.2
							1	7.00	4.5	23.8	15.1
							2	7.00	4.5	23.8	15.0
							3	7.00	4.5	23.8	15.1
							4	6.97	4.5	23.8	14.9
PDL-37	28-Jul-15	14W	631323	7224998	28		0	6.55			
							1		7.9	15.0	11.6
							2		7.0	18.0	11.6
							3		6.8	19.0	11.2
							4		6.7	19.0	10.9
							5		6.1	20.0	10.7
							6		5.5	21.0	11.1
							7		5.3	21.0	11.2
							8		5.2	24.0	11.1
							9		5.1	18.0	11.0
							10		5.1	18.0	10.9
							11		5.0	18.0	10.7
							12		5.0	18.0	10.4
							13		4.9	17.0	10.7
							14		4.9	17.0	10.7
							15		4.8	17.0	10.8
PDL-38†	28-Jul-15	14W	632161	7225256	27	10.0	0	6.20			
							1		6.3	18.0	10.7
							2		5.9	20.0	10.3
							3		5.7	21.0	10.3
							4		5.3	21.0	9.4
							5		5.2	21.0	9.6
							6		4.9	21.0	10.1
							7		4.8	20.0	9.8
							8		4.8	18.0	9.9
							9		4.8	17.0	10.0
							10		4.7	17.0	10.1
							11		4.7	16.0	10.0
							12		4.6	15.0	10.0
							13		4.6	14.0	9.2
							14		4.5	16.0	9.6
							15		4.5	16.0	9.4
PDL-39	26-Aug-15	14W	631743	7224224	23.4	9.9	0	7.16	10.6	18.7	12.2
							1	7.15	10.4	18.7	12.3
							2	7.15	10.4	18.7	12.4
							3	7.16	10.3	18.7	12.3
							4	7.15	10.3	18.7	12.3
							5	7.15	10.2	18.7	12.2
							6	7.15	10.2	18.7	12.2
							7	7.14	10.2	18.7	12.0
							8	7.15	10.2	18.7	12.2
							9	7.15	10.2	18.7	12.1
							10	7.15	10.2	18.7	12.2
							11	7.15	10.2	18.7	12.1
							12	7.15	10.2	18.7	12.1
							13	7.16	10.2	18.7	12.2
							14	7.14	10.1	18.7	12.0
							15	7.16	10.1	18.7	12.0
							16	7.14	10.1	18.7	12.1
							17	7.15	10.1	18.7	11.9
							18	7.15	10.1	18.7	11.9

Table B2-1. *In-situ* water quality results from the Lake stations, Whale Tail Pit Baseline, 2015.

Area-Replicate	Date	UTM Coordinates			Water Depth (m)	Secchi Depth (m)	Profile Depth (m)	pH	Temp. (°C)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)
		Zone	Easting	Northing							
PDL-39 (con't)							19	7.15	10.1	18.7	12.0
							20	7.15	10.1	18.7	12.0
PDL-40	26-Aug-15	14W	632623	7223870	26.9	11.6	0	7.27	10.6	18.7	13.0
							1	7.27	10.3	18.7	13.0
							2	7.27	10.3	18.6	13.0
							3	7.26	10.1	18.7	12.1
							4	7.26	10.1	18.7	12.2
							5	7.25	10.1	18.7	12.1
							6	7.25	10.1	18.7	12.0
							7	7.25	10.1	18.7	12.0
							8	7.25	10.1	18.7	12.1
							9	7.24	10.1	18.7	12.0
							10	7.25	10.1	18.7	12.1
							11	7.24	10.1	18.7	12.1
							12	7.24	10.1	18.7	11.9
							13	7.24	10.1	18.7	12.0
							14	7.24	10.1	18.7	12.1
							15	7.24	10.0	18.7	12.1
							16	7.24	10.0	18.7	12.0
							17	7.23	10.0	18.7	12.0
							18	7.23	9.9	18.7	11.9
							19	7.21	9.8	18.7	12.0
							20	7.20	9.8	18.7	11.9
PDL-41†	4-Oct-15	14W	630089	7223596	13.5		0	6.43			
							1		3.0	37.0	10.6
							2		3.0	26.0	10.5
							3		3.1	26.0	10.4
							4		3.1	26.0	10.2
							5		3.1	25.0	10.2
							6		3.1	25.0	10.2
							7		3.1	25.0	10.2
							8		3.1	25.0	10.1
							9		3.1	25.0	10.1
							10		3.1	25.0	10.1
							11		3.1	26.0	10.1
							12		3.1	26.0	10.1
							13		3.1	26.0	10.1
INUG-70	27-Jul-15	14W	622965	7216215	4.5		0	7.04			
							1		10.7	12.0	10.0
							2		10.5	12.0	9.8
							3		10.2	12.0	9.9
							4		10.1	12.0	9.8
INUG-71	27-Jul-15	14W	622256	7214295	8.5	8.5	0	7.12			
							1		10.7	12.0	10.0
							2		10.4	12.0	10.3
							3		10.1	12.0	9.8
							4		10.1	12.0	10.0
							5		9.9	13.0	10.1
							6		9.5	13.0	10.1
							7		9.2	13.0	10.1
INUG-72	27-Aug-15	14W	621832	7215439	9.8	9.4	0	7.31	11.5	13.3	10.0
							1	7.27	11.6	13.3	9.9
							2	7.26	11.5	13.3	10.1
							3	7.24	11.5	13.3	9.9
							4	7.22	11.5	13.3	9.9
							5	7.18	11.5	13.3	9.8
							6	7.18	11.5	13.3	9.8
							7	7.16	11.5	13.3	9.6
							8	7.16	11.5	13.3	9.7
							9	7.12	11.4	13.3	9.9
INUG-73	27-Aug-15	14W	622718	7214853	9.3	8.6	0	6.94	11.5	13.2	10.1
							1	6.95	11.5	13.2	9.8
							2	6.94	11.5	13.2	9.9

Table B2-1. *In-situ* water quality results from the Lake stations, Whale Tail Pit Baseline, 2015.

Area-Replicate	Date	UTM Coordinates			Water Depth (m)	Secchi Depth (m)	Profile Depth (m)	pH	Temp. (°C)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)
		Zone	Easting	Northing							
INUG-73 (con't)							3	6.94	11.5	13.2	10.0
							4	6.94	11.5	13.3	10.0
							5	6.94	11.5	13.2	9.9
							6	6.94	11.4	13.2	9.8
							7	6.94	11.4	13.3	9.9
							8	6.94	11.4	13.3	9.8
							9	6.94	11.4	13.3	9.7
INUG-74*	1-Oct-15	14W	622518	7214715	11		0	6.74	2.5	157	10.4
							1		2.5	154	10.3
							2		2.4	153	10.3
							3		2.4	140	10.2
							4		2.4	140	10.1
							5		2.4	138	10.1
							6		2.4	132	10.1
							7		2.4	129	10.2
							8		2.4	126	10.1
							9		2.4	122	10.1
							10		2.4	121	10.1
INUG-75	1-Oct-15	14W	622756	7215766	13		0	7.00	2.4	43.0	10.3
							1		2.4	27.0	10.4
							2		2.4	27.0	10.3
							3		2.4	26.0	10.3
							4		2.4	26.0	10.2
							5		2.4	27.0	10.2
							6		2.4	27.0	10.3
							7		2.4	27.0	10.3
							8		2.4	27.0	10.2
							9		2.4	28.0	10.2
							10		2.4	29.0	10.2
							11		2.4	29.0	10.2
							12		2.4	29.0	10.2

Notes:

pH profiles were not recorded by AEM staff at PDL and INUG during the July and September/October sampling events.

* Specific conductivity measurements for INUG-74 are considered anomalous relative to the measurements recorded at INUG-75 and long-term specific conductivity at INUG.

† pH measurements at PDL-38 and PDL-41 were considered anomalous relative to the other pH measurement taken during the sampling event.

APPENDIX B3

2015 *In-situ* Water Quality Results: Sentinel Stations

Table B3-1. *In-situ* water quality results from the Sentinel stations, Whale Tail Pit Baseline, 2015.

Area-Replicate	Date	UTM Coordinates			pH	Temp.	Specific Conductivity	Dissolved Oxygen
		Zone	Easting	Northing		(°C)	(µS/cm)	(mg/L)
C2	19-Jul-15	14W	638199	7221598	-	10.3	22.7	11.98
	25-Aug-15	14W	638217	7221627	7.22	9.6	16.9	11.34
	20-Sep-15	14W	638328	7221902	7.02	2.7	22.6	13.71
C14	19-Jul-15	14W	632916	7232202	7.03	9.4	24.8	13.03
	25-Aug-15	14W	632890	7232182	7.36	10.9	20.4	10.97
	20-Sep-15	14W	632916	7232202	6.98	4.0	22.7	13.3
C17	19-Jul-15	14W	630583	7234684	7.03	10.0	23.4	12.5
	25-Aug-15	14W	630557	7234667	6.78	10.1	14.1	11.2
	20-Sep-15	14W	630583	7234684	6.98	3.2	21.3	13.5
C20	19-Jul-15	14W	627265	7236464	7.05	8.2	23.4	13.8
	25-Aug-15	14W	627186	7236475	7.36	10.6	18.6	10.7
	20-Sep-15	14W	627265	7236464	6.92	3.6	20.3	13.6
C41	19-Jul-15	14W	620607	7244690	7.10	10.7	17.2	11.7
	25-Aug-15	14W	620637	7244668	7.22	9.6	16.9	11.3
	20-Sep-15	14W	620607	7244690	6.90	2.5	23.3	15.0

Notes:
No pH for C2 in July.

APPENDIX C

ALS Certificates of Analysis, Whale Tail Pit Baseline, 2015

AZIMUTH CONSULTING GROUP INC.
ATTN: Eric Franz
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 27-JUL-15
Report Date: 30-JUL-15 14:31 (MT)
Version: FINAL

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1648210

Project P.O. #: NOT SUBMITTED
Job Reference: AMARUQ SURFACEWATER
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1648210-1	L1648210-2	L1648210-3	L1648210-4	L1648210-5
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	17-JUL-15	17-JUL-15	17-JUL-15	17-JUL-15	18-JUL-15
Sampled Time					
Client ID	WTN-1-S	WTN-2-S	WTS-1-S	WTS-2-S	NEM-1-S
Grouping / **Analyte**					
WATER					
Physical Tests					
Conductivity (uS/cm)	20.4	17.4	16.0	15.9	24.5
pH (pH)	6.83	6.81	6.78	6.78	7.03
Total Suspended Solids (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Total Dissolved Solids (mg/L)	16.0	12.8	13.0	13.8	16.6
Turbidity (NTU)	0.42	0.39	0.43	0.35	0.24
Anions and Nutrients					
Alkalinity, Bicarbonate (as CaCO3) (mg/L)	4.5	4.2	4.2	4.2	7.1
Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3) (mg/L)	4.5	4.2	4.2	4.2	7.1
Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl) (mg/L)	1.94	1.22	1.06	1.06	0.53
Fluoride (F) (mg/L)	0.022	0.025	0.023	0.025	0.023
Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	0.0020	<0.0020
Silicate (as SiO2) (mg/L)	0.56	0.57	0.54	0.54	<0.50
Sulfate (SO4) (mg/L)	1.39	1.24	1.20	1.22	3.19

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1648210-6 Surface Water 18-JUL-15 NEM-2-S	L1648210-7 Surface Water 18-JUL-15 MAM-1-S	L1648210-8 Surface Water 18-JUL-15 MAM-2-S	L1648210-9 Surface Water DUP-JULY-AMARUQ	L1648210-10 Surface Water 18-JUL-15 EB-JULY-AMARUQ
Sample ID						
Description						
Sampled Date						
Sampled Time						
Client ID						
WATER						
Physical Tests	Conductivity (uS/cm)	24.5	22.5	22.6	15.4	<2.0
	pH (pH)	7.04	6.86	6.86	6.76	5.45
	Total Suspended Solids (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Total Dissolved Solids (mg/L)	17.6	16.9	16.2	13.3	<3.0
	Turbidity (NTU)	0.23	0.36	0.37	0.37	<0.10
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	7.0	4.8	5.0	3.9	<1.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	7.0	4.8	5.0	3.9	<1.0
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	0.53	1.98	1.98	1.05	<0.10
	Fluoride (F) (mg/L)	0.021	0.023	0.024	0.024	<0.020
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Silicate (as SiO2) (mg/L)	<0.50	0.55	0.58	0.54	<0.50
	Sulfate (SO4) (mg/L)	3.19	2.10	2.11	1.21	<0.30

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Fluoride (F)	DLM	L1648210-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Bromide (Br)	DLM	L1648210-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Fluoride (F)	DLM	L1648210-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Nitrite (as N)	DLM	L1648210-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Nitrate (as N)	MS-B	L1648210-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Fluoride (F)	MS-B	L1648210-1, -10, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CL-L-IC-N-VA	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-TD-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SILICATE-COL-VA	Water	Silicate by Colourimetric analysis	APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Reference Information

TDS-LOW-VA	Water	Low Level TDS (3.0mg/L) by Gravimetric	APHA 2540C

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total dissolved solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-LOW-VA	Water	Total Suspended Solids by Grav. (1 mg/L)	APHA 2540D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Short Holding Time

ALS Environmental

● *Rush Processing*

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # _____

Page 1 of

Report To		**Report Format / Distribution**	**Service Requested** (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☐ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☐ PDF ☐ Excel ☑ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	**Analysis Request**
Invoice To	Same as Report ? ☑ Yes ☐ No	**Client / Project Information**	Please indicate below Filtered, Preserved or both (F, P, F/P)
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:		Quote #: Q39503	
Lab Work Order (lab use only)	L1648210-COFC	ALS Contact:	Sampler:

Sample #	(This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Conventionals** see notes	TSS-Low, TDS-Low										
	WTN-1-S	17-Jul-15		Surface Water	X	X										
	WTN-2-S	17-Jul-15		Surface Water	X	X										
	WTS-1-S	17-Jul-15		Surface Water	X	X										
	WTS-2-S	17-Jul-15		Surface Water	X	X										
	NEM-1-S	18-Jul-15		Surface Water	X	X										
	NEM-2-S	18-Jul-15		Surface Water	X	X										
	MAM-1-S	18-Jul-15		Surface Water	X	X										
	MAM-2-S	18-Jul-15		Surface Water	X	X										
	DUP-JULY-AMARUQ			Surface Water	X	X										
	EB-JULY-AMARUQ	18-Jul-15		Surface Water	X	X										

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

**Conventionals includes: Alk Species, pH, EC, Turbidity, Conductivity, Anions (F, NO2, NO3, Br, SO4), low-level Chloride, Silicate, TD-P, and Ortho-PO4.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observation Yes / No ? If Yes add
Morgan Finley	20-Jul-15	9:00	Jeav	27 Jul	8:38	18.1 18.1 °C				

GENF 20.00 Front



L1648210-COFC

Number of Containers
2
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AZIMUTH CONSULTING GROUP INC.
ATTN: Eric Franz
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 27-JUL-15
Report Date: 29-JUL-15 16:19 (MT)
Version: FINAL

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1648239

Project P.O. #: NOT SUBMITTED
Job Reference: AMARUQ SURFACEWATER
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1648239-1	L1648239-2	L1648239-3	L1648239-4	L1648239-5
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	19-JUL-15	19-JUL-15	19-JUL-15	19-JUL-15	19-JUL-15
Sampled Time					
Client ID	C2	C14	C17	C20	C41
Grouping / **Analyte**					
WATER					
Physical Tests					
Conductivity (uS/cm)	22.1	24.5	22.8	23.1	17.0
pH (pH)	6.92	7.13	7.07	7.12	6.91
Total Suspended Solids (mg/L)	<1.0	<1.0	<1.0	<1.0	1.3
Total Dissolved Solids (mg/L)	15.0	17.7	18.4	15.4	13.3
Turbidity (NTU)	0.33	0.32	0.38	0.21	0.83
Anions and Nutrients					
Alkalinity, Bicarbonate (as CaCO3) (mg/L)	5.7	8.7	7.7	7.8	5.1
Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3) (mg/L)	5.7	8.7	7.7	7.8	5.1
Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl) (mg/L)	0.47	0.55	0.57	0.67	0.50
Fluoride (F) (mg/L)	0.063	0.034	0.046	0.039	0.043
Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	0.0055
Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total Dissolved (mg/L)	0.0020	0.0028	0.0022	<0.0020	0.0022
Silicate (as SiO2) (mg/L)	0.64	0.59	0.76	<0.50	0.52
Sulfate (SO4) (mg/L)	3.45	1.52	1.48	1.71	1.73

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Fluoride (F)	DLM	L1648239-1, -2, -3, -4, -5
Duplicate	Bromide (Br)	DLM	L1648239-1, -2, -3, -4, -5
Duplicate	Fluoride (F)	DLM	L1648239-1, -2, -3, -4, -5
Duplicate	Nitrite (as N)	DLM	L1648239-1, -2, -3, -4, -5
Matrix Spike	Nitrate (as N)	MS-B	L1648239-1, -2, -3, -4, -5
Matrix Spike	Fluoride (F)	MS-B	L1648239-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CL-L-IC-N-VA	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-TD-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SILICATE-COL-VA	Water	Silicate by Colourimetric analysis	APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Reference Information

TDS-LOW-VA	Water	Low Level TDS (3.0mg/L) by Gravimetric	APHA 2540C

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total dissolved solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-LOW-VA	Water	Total Suspended Solids by Grav. (1 mg/L)	APHA 2540D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # _____

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☐ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☐ PDF ☐ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	Analysis Request
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:		Quote #: Q39503	
Lab Work Order (lab use only)	L1648239-COFC	ALS Contact:	Sampler:

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Conventionals** see notes	TSS-Low, TDS-Low										
	C2	19-Jul-15		Surface Water	X	X										
	C14	19-Jul-15		Surface Water	X	X										
	C17	19-Jul-15		Surface Water	X	X										
	C20	19-Jul-15		Surface Water	X	X										
	C41	19-Jul-15		Surface Water	X	X										

Short Holding Time

● *Rush Processing*

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

**Conventionals includes: Alk Species, pH, EC, Turbidity, Conductivity, Anions (F, NO2, NO3, Br, SO4), low-level Chloride, Silicate, TD-P, and Ortho-PO4.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observatic Yes / No ? If Yes add
Morgan Finley	20-Jul-15	9:00	Jean	27 Jul	8:38	18.1 °C				

2

Number of Containers
2
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ons:

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AZIMUTH CONSULTING GROUP INC.
ATTN: Eric Franz
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 29-JUL-15
Report Date: 07-AUG-15 12:24 (MT)
Version: FINAL

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1649855

Project P.O. #: NOT SUBMITTED
Job Reference: AMARUQ SURFACEWATER
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1649855-1 OTHER 17-JUL-15 WTN-1-S	L1649855-2 OTHER 17-JUL-15 WTN-2-S	L1649855-3 OTHER 17-JUL-15 WTS-1-S	L1649855-4 OTHER 17-JUL-15 WTS-2-S	L1649855-5 OTHER 18-JUL-15 NEM-1-S
Sample ID / **Description** / **Sampled Date** / **Sampled Time** / **Client ID**						
FILTER						
Plant Pigments	Chlorophyll a (ug/L)	0.320	0.251	0.282	0.284	0.148

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID Description Sampled Date Sampled Time Client ID	L1649855-6 OTHER 18-JUL-15 NEM-2-S	L1649855-7 OTHER 18-JUL-15 MAM-1-S	L1649855-8 OTHER 18-JUL-15 MAM-2-S	L1649855-9 OTHER DUP-JULY-AMARUQ	L1649855-10 OTHER 19-JUL-15 C2
FILTER							
Plant Pigments	Chlorophyll a (ug/L)		0.134	0.237	0.231	0.211	0.340

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1649855-11	L1649855-12	L1649855-13	L1649855-14	
Description	OTHER	OTHER	OTHER	OTHER	
Sampled Date	19-JUL-15	19-JUL-15	19-JUL-15	19-JUL-15	
Sampled Time					
Client ID	C14	C17	C20	C41	
Grouping **Analyte**					
FILTER					
Plant Pigments Chlorophyll a (ug/L)	0.370	0.359	0.209	0.360	

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CHLOROA-F-VA	Filter	Chlorophyll a by Fluorometer (Filter)	EPA 445.0

This analysis is done using procedures modified from EPA Method 445.0. Chlorophyll-a is determined by a routine acetone extraction followed with analysis by fluorometry using the non-acidification procedure. This method is not subject to interferences from chlorophyll b.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
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Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
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COC # _____

Page 1 of 2

Report To		**Report Format / Distribution**	**Service Requested** (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☐ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☐ PDF ☐ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	**Analysis Request**
Invoice To	Same as Report ? ☑ Yes ☐ No	**Client / Project Information**	Please indicate below Filtered, Preserved or both (F, P, F/P)
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q39503	
Lab Work Order # (lab use only)		ALS Contact:	Sampler:

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Chlorophyl 'a'
	WTN-1-S	17-Jul-15		Other	X
	WTN-2-S	17-Jul-15		Other	X
	WTS-1-S	17-Jul-15		Other	X
	WTS-2-S	17-Jul-15		Other	X
	NEM-1-S	18-Jul-15		Other	X
	NEM-2-S	18-Jul-15		Other	X
	MAM-1-S	18-Jul-15		Other	X
	MAM-2-S	18-Jul-15		Other	X
	DUP-JULY-AMARUQ			Other	X

L1649855-COFC

Short Holding Time
Rush Processing

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observatic Yes / No ? If Yes add
Morgan Finley						22 °C	EC	29/7	11:59	

GENF 20.00 Front

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # _____

Report To		**Report Format / Distribution**	**Service Requested** (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☐ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☐ PDF ☐ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	**Analysis Request**
Invoice To	Same as Report ? ☑ Yes ☐ No	**Client / Project Information**	Please indicate below Filtered, Preserved or both (F, P, F/P)
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q39503	
Lab Work Order # (lab use only)		ALS Contact:	Sampler:

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Chlorophyl 'a'
	C2	19-Jul-15		Other	X
	C14	19-Jul-15		Other	X
	C17	19-Jul-15		Other	X
	C20	19-Jul-15		Other	X
	C41	19-Jul-15		Other	X

L1649855-COFC

Short Holding Time
Rush Processing

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

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SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observatic Yes / No ? If Yes add
Morgan Finley						22 °C	EK	July 29/15	11:59	

AZIMUTH CONSULTING GROUP INC.
ATTN: Eric Franz
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 29-JUL-15
Report Date: 07-AUG-15 13:40 (MT)
Version: FINAL

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1649931

Project P.O. #: NOT SUBMITTED
Job Reference: AMARUQ SURFACEWATER
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1649931-1 Surface Water 17-JUL-15 WTN-1-S	L1649931-2 Surface Water 17-JUL-15 WTN-2-S	L1649931-3 Surface Water 17-JUL-15 WTS-1-S	L1649931-4 Surface Water 17-JUL-15 WTS-2-S	L1649931-5 Surface Water 18-JUL-15 NEM-1-S
WATER						
Physical Tests	Conductivity (uS/cm)					
	Hardness (as CaCO3) (mg/L)	7.33	6.17	5.91	5.80	9.83
	pH (pH)					
	Turbidity (NTU)					
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)					
	Alkalinity, Carbonate (as CaCO3) (mg/L)					
	Alkalinity, Hydroxide (as CaCO3) (mg/L)					
	Alkalinity, Total (as CaCO3) (mg/L)					
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Bromide (Br) (mg/L)					
	Chloride (Cl) (mg/L)					
	Fluoride (F) (mg/L)					
	Nitrate (as N) (mg/L)					
	Nitrite (as N) (mg/L)					
	Total Kjeldahl Nitrogen (mg/L)	0.173	0.137	0.140	0.143	0.171
	Orthophosphate-Dissolved (as P) (mg/L)					
	Phosphorus (P)-Total Dissolved (mg/L)					
	Phosphorus (P)-Total (mg/L)	0.0020	0.0028	0.0025	0.0024	<0.0020
	Silicate (as SiO2) (mg/L)					
	Sulfate (SO4) (mg/L)					
Cyanides	Cyanide, Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cyanide, Free (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	2.15	2.07	2.04	1.98	1.45
	Total Organic Carbon (mg/L)	2.29	2.12	2.24	2.02	1.54
Total Metals	Aluminum (Al)-Total (mg/L)	0.0215	0.0176	0.0172	0.0170	0.0043
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00018	0.00014	0.00012	0.00013	0.00025
	Barium (Ba)-Total (mg/L)	0.00440	0.00343	0.00335	0.00325	0.00429
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	1.87	1.44	1.39	1.37	2.20
	Chromium (Cr)-Total (mg/L)	0.00013	0.00013	0.00012	<0.00010	<0.00010
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1649931-6 Surface Water 18-JUL-15 NEM-2-S	L1649931-7 Surface Water 18-JUL-15 MAM-1-S	L1649931-8 Surface Water 18-JUL-15 MAM-2-S	L1649931-9 Surface Water 18-JUL-15 DUP-JULY-AMARUQ	L1649931-10 Surface Water 18-JUL-15 EB-JULY-AMARUQ
WATER						
Physical Tests	Conductivity (uS/cm)					
	Hardness (as CaCO3) (mg/L)	9.78	8.48	8.44	5.90	<0.50
	pH (pH)					
	Turbidity (NTU)					
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)					
	Alkalinity, Carbonate (as CaCO3) (mg/L)					
	Alkalinity, Hydroxide (as CaCO3) (mg/L)					
	Alkalinity, Total (as CaCO3) (mg/L)					
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Bromide (Br) (mg/L)					
	Chloride (Cl) (mg/L)					
	Fluoride (F) (mg/L)					
	Nitrate (as N) (mg/L)					
	Nitrite (as N) (mg/L)					
	Total Kjeldahl Nitrogen (mg/L)	0.171	0.139	0.137	0.163	<0.050
	Orthophosphate-Dissolved (as P) (mg/L)					
	Phosphorus (P)-Total Dissolved (mg/L)					
	Phosphorus (P)-Total (mg/L)	0.0035	0.0031	0.0033	0.0048	<0.0020
	Silicate (as SiO2) (mg/L)					
	Sulfate (SO4) (mg/L)					
Cyanides	Cyanide, Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cyanide, Free (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.43	1.81	1.85	2.04	<0.50
	Total Organic Carbon (mg/L)	1.97	1.91	1.86	1.96	<0.50
Total Metals	Aluminum (Al)-Total (mg/L)	0.0981	0.0152	0.0142	0.0175	<0.0030
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00024	0.00030	0.00031	0.00013	<0.00010
	Barium (Ba)-Total (mg/L)	0.00423	0.00485	0.00479	0.00336	<0.000050
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	2.24	2.16	2.14	1.36	<0.050
	Chromium (Cr)-Total (mg/L)	0.00013	0.00016	0.00015	0.00012	<0.00010
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1649931-11 Surface Water 18-JUL-15 TRAVEL BLANK-JULY-AMARUQ	L1649931-12 Surface Water 19-JUL-15 C2	L1649931-13 Surface Water 19-JUL-15 C14	L1649931-14 Surface Water 19-JUL-15 C17	L1649931-15 Surface Water 19-JUL-15 C20
WATER						
Physical Tests	Conductivity (uS/cm)	<2.0				
	Hardness (as CaCO3) (mg/L)	<0.50	8.72	10.4	9.60	9.60
	pH (pH)	5.80				
	Turbidity (NTU)	<0.10				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	<2.0				
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	<0.10				
	Fluoride (F) (mg/L)	<0.020				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	<0.050	0.154	0.265	0.184	0.124
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010				
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020				
	Phosphorus (P)-Total (mg/L)	<0.0020	<0.0020	0.0022	0.0022	<0.0020
	Silicate (as SiO2) (mg/L)	<0.50				
	Sulfate (SO4) (mg/L)	<0.30				
Cyanides	Cyanide, Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cyanide, Free (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)		1.62	2.51	2.80	1.51
	Total Organic Carbon (mg/L)	<0.50	1.61	2.52	2.74	1.47
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030	0.0126	0.0086	0.0148	0.0050
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	<0.00010	0.00015	0.00024	0.00023	0.00014
	Barium (Ba)-Total (mg/L)	<0.000050	0.00352	0.00361	0.00274	0.00205
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	<0.050	2.15	2.82	2.49	2.27
	Chromium (Cr)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00012	<0.00010
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	<0.00050	0.00099	0.00064	0.00069	<0.00050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1649931-16				
	Description	Surface Water				
	Sampled Date	19-JUL-15				
	Sampled Time					
	Client ID	C41				
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)					
	Hardness (as CaCO3) (mg/L)	6.77				
	pH (pH)					
	Turbidity (NTU)					
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)					
	Alkalinity, Carbonate (as CaCO3) (mg/L)					
	Alkalinity, Hydroxide (as CaCO3) (mg/L)					
	Alkalinity, Total (as CaCO3) (mg/L)					
	Ammonia, Total (as N) (mg/L)	<0.0050				
	Bromide (Br) (mg/L)					
	Chloride (Cl) (mg/L)					
	Fluoride (F) (mg/L)					
	Nitrate (as N) (mg/L)					
	Nitrite (as N) (mg/L)					
	Total Kjeldahl Nitrogen (mg/L)	0.129				
	Orthophosphate-Dissolved (as P) (mg/L)					
	Phosphorus (P)-Total Dissolved (mg/L)					
	Phosphorus (P)-Total (mg/L)	0.0030				
	Silicate (as SiO2) (mg/L)					
	Sulfate (SO4) (mg/L)					
Cyanides	Cyanide, Total (mg/L)	<0.0010				
	Cyanide, Free (mg/L)	<0.0010				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.61				
	Total Organic Carbon (mg/L)	1.98				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0210				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	0.00013				
	Barium (Ba)-Total (mg/L)	0.00426				
	Beryllium (Be)-Total (mg/L)	<0.000020				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	<0.010				
	Cadmium (Cd)-Total (mg/L)	<0.0000050				
	Calcium (Ca)-Total (mg/L)	1.42				
	Chromium (Cr)-Total (mg/L)	0.00040				
	Cobalt (Co)-Total (mg/L)	<0.00010				
	Copper (Cu)-Total (mg/L)	0.00066				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1649931-1	L1649931-2	L1649931-3	L1649931-4	L1649931-5
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	17-JUL-15	17-JUL-15	17-JUL-15	17-JUL-15	18-JUL-15
Sampled Time					
Client ID	WTN-1-S	WTN-2-S	WTS-1-S	WTS-2-S	NEM-1-S
Grouping / **Analyte**					
WATER					
Total Metals Iron (Fe)-Total (mg/L)	0.036	0.037	0.037	0.037	0.018
Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Total (mg/L)	0.63	0.59	0.57	0.56	1.00
Manganese (Mn)-Total (mg/L)	0.00635	0.00490	0.00494	0.00516	0.0104
Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)-Total (mg/L)	0.00086	0.00069	0.00069	0.00067	0.00075
Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total (mg/L)	0.38	0.32	0.33	0.33	0.59
Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Silicon (Si)-Total (mg/L)	0.312	0.307	0.301	0.307	0.209
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total (mg/L)	0.513	0.473	0.492	0.473	0.479
Strontium (Sr)-Total (mg/L)	0.0131	0.00866	0.00800	0.00780	0.00908
Sulfur (S)-Total (mg/L)	0.50	<0.50	<0.50	<0.50	1.07
Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total (mg/L)	0.00038	0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Total (mg/L)	0.000045	0.000045	0.000047	0.000043	<0.000010
Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0081	0.0085	0.0110	0.0120	0.0023
Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)	0.00013	0.00013	0.00011	0.00012	0.00023
Barium (Ba)-Dissolved (mg/L)	0.00416	0.00340	0.00329	0.00330	0.00410
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Dissolved (mg/L)	1.89	1.48	1.42	1.39	2.28
Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved (mg/L)	0.00170 DTC	0.00035	0.00031	0.00034	<0.00020

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1649931-6	L1649931-7	L1649931-8	L1649931-9	L1649931-10
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	18-JUL-15	18-JUL-15	18-JUL-15	18-JUL-15	18-JUL-15
Sampled Time					
Client ID	NEM-2-S	MAM-1-S	MAM-2-S	DUP-JULY-AMARUQ	EB-JULY-AMARUQ
Grouping / **Analyte**					
WATER					
Total Metals Iron (Fe)-Total (mg/L)	0.021	0.024	0.024	0.037	<0.010
Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	0.000062
Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Total (mg/L)	1.02	0.74	0.73	0.55	<0.10
Manganese (Mn)-Total (mg/L)	0.00974	0.00428	0.00399	0.00512	<0.00010
Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)-Total (mg/L)	0.00074	0.00091	0.00089	0.00067	<0.00050
Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total (mg/L)	0.59	0.49	0.49	0.33	<0.10
Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Silicon (Si)-Total (mg/L)	0.214	0.313	0.314	0.298	<0.050
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total (mg/L)	0.481	0.510	0.498	0.475	<0.050
Strontium (Sr)-Total (mg/L)	0.00917	0.0119	0.0119	0.00778	<0.00020
Sulfur (S)-Total (mg/L)	1.07	0.73	0.73	<0.50	<0.50
Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	0.00032	<0.00030	<0.00030
Uranium (U)-Total (mg/L)	<0.000010	0.000031	0.000034	0.000042	<0.000010
Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0017	0.0064	0.0066	0.0132	0.0010
Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)	0.00022	0.00027	0.00026	0.00011	<0.00010
Barium (Ba)-Dissolved (mg/L)	0.00417	0.00471	0.00462	0.00320	<0.000050
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Dissolved (mg/L)	2.26	2.20	2.19	1.42	<0.050
Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved (mg/L)	0.00021	0.00036	0.00037	0.00034	<0.00020

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1649931-11	L1649931-12	L1649931-13	L1649931-14	L1649931-15
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	18-JUL-15	19-JUL-15	19-JUL-15	19-JUL-15	19-JUL-15
Sampled Time					
Client ID	TRAVEL BLANK-JULY-AMARUQ	C2	C14	C17	C20
Grouping / **Analyte**					
WATER					
Total Metals Iron (Fe)-Total (mg/L)	<0.010	0.032	0.028	0.044	0.012
Lead (Pb)-Total (mg/L)	<0.000050	0.000061	<0.000050	<0.000050	<0.000050
Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Total (mg/L)	<0.10	0.80	0.74	0.82	0.81
Manganese (Mn)-Total (mg/L)	<0.00010	0.00161	0.00244	0.00390	0.00133
Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)-Total (mg/L)	<0.00050	0.00057	<0.00050	0.00051	0.00055
Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total (mg/L)	<0.10	0.32	0.37	0.40	0.36
Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Silicon (Si)-Total (mg/L)	<0.050	0.357	0.309	0.425	0.153
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total (mg/L)	<0.050	0.494	0.512	0.559	0.506
Strontium (Sr)-Total (mg/L)	<0.00020	0.0115	0.0143	0.0129	0.00913
Sulfur (S)-Total (mg/L)	<0.50	1.17	0.55	0.54	0.60
Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00027	<0.00010
Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Total (mg/L)	<0.000010	0.000060	0.000033	0.000043	0.000022
Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals Dissolved Mercury Filtration Location		FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location		FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)		0.0038	0.0053	0.0065	0.0021
Antimony (Sb)-Dissolved (mg/L)		<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)		0.00014	0.00023	0.00023	0.00013
Barium (Ba)-Dissolved (mg/L)		0.00332	0.00351	0.00260	0.00203
Beryllium (Be)-Dissolved (mg/L)		<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)		<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved (mg/L)		<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Dissolved (mg/L)		2.18	2.90	2.52	2.44
Chromium (Cr)-Dissolved (mg/L)		<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Dissolved (mg/L)		<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved (mg/L)		0.00080	0.00061	0.00062	0.00037

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1649931-16				
	Description	Surface Water				
	Sampled Date	19-JUL-15				
	Sampled Time					
	Client ID	C41				
Grouping	**Analyte**					
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	0.070				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	<0.0010				
	Magnesium (Mg)-Total (mg/L)	0.76				
	Manganese (Mn)-Total (mg/L)	0.00164				
	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	0.000062				
	Nickel (Ni)-Total (mg/L)	0.00318				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	0.29				
	Selenium (Se)-Total (mg/L)	<0.000050				
	Silicon (Si)-Total (mg/L)	0.306				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	0.417				
	Strontium (Sr)-Total (mg/L)	0.00720				
	Sulfur (S)-Total (mg/L)	0.60				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	0.00034				
	Uranium (U)-Total (mg/L)	0.000038				
	Vanadium (V)-Total (mg/L)	<0.00050				
	Zinc (Zn)-Total (mg/L)	<0.0030				
	Zirconium (Zr)-Total (mg/L)	<0.00030				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0062				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00011				
	Barium (Ba)-Dissolved (mg/L)	0.00400				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	<0.010				
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050				
	Calcium (Ca)-Dissolved (mg/L)	1.47				
	Chromium (Cr)-Dissolved (mg/L)	0.00013				
	Cobalt (Co)-Dissolved (mg/L)	<0.00010				
	Copper (Cu)-Dissolved (mg/L)	0.00053				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1649931-1	L1649931-2	L1649931-3	L1649931-4	L1649931-5
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	17-JUL-15	17-JUL-15	17-JUL-15	17-JUL-15	18-JUL-15
Sampled Time					
Client ID	WTN-1-S	WTN-2-S	WTS-1-S	WTS-2-S	NEM-1-S
Grouping / **Analyte**					
WATER					
Dissolved Metals Iron (Fe)-Dissolved (mg/L)	<0.010	0.096 DTC	0.018	0.023	<0.010
Lead (Pb)-Dissolved (mg/L)	0.000104	<0.000050	<0.000050	0.000080	<0.000050
Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Dissolved (mg/L)	0.64	0.60	0.57	0.56	1.01
Manganese (Mn)-Dissolved (mg/L)	0.00445	0.00431	0.00377	0.00424	0.00766
Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)-Dissolved (mg/L)	0.00082	0.00071	0.00066	0.00068	0.00073
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	0.38	0.34	0.35	0.31	0.57
Selenium (Se)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Silicon (Si)-Dissolved (mg/L)	0.288	0.288	0.296	0.301	0.207
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	0.492	0.479	0.474	0.463	0.474
Strontium (Sr)-Dissolved (mg/L)	0.0128	0.00857	0.00782	0.00774	0.00891
Sulfur (S)-Dissolved (mg/L)	<0.50	<0.50	<0.50	<0.50	1.05
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.000037	0.000041	0.000040	0.000042	<0.000010
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)	0.0016	<0.0010	<0.0010	<0.0010	<0.0010
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1649931-6	L1649931-7	L1649931-8	L1649931-9	L1649931-10
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	18-JUL-15	18-JUL-15	18-JUL-15	18-JUL-15	18-JUL-15
Sampled Time					
Client ID	NEM-2-S	MAM-1-S	MAM-2-S	DUP-JULY-AMARUQ	EB-JULY-AMARUQ
Grouping / **Analyte**					
WATER					
Dissolved Metals Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.021	<0.010
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	0.000055	<0.000050
Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Dissolved (mg/L)	1.00	0.72	0.72	0.57	<0.10
Manganese (Mn)-Dissolved (mg/L)	0.00750	0.00323	0.00314	0.00411	<0.00010
Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)-Dissolved (mg/L)	0.00071	0.00085	0.00089	0.00063	<0.00050
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	0.55	0.46	0.46	0.32	<0.10
Selenium (Se)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Silicon (Si)-Dissolved (mg/L)	0.208	0.296	0.298	0.300	<0.050
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	0.471	0.500	0.504	0.469	<0.050
Strontium (Sr)-Dissolved (mg/L)	0.00903	0.0116	0.0116	0.00787	<0.00020
Sulfur (S)-Dissolved (mg/L)	1.07	0.71	0.71	<0.50	<0.50
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	<0.000010	0.000027	0.000030	0.000040	<0.000010
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1649931-11	L1649931-12	L1649931-13	L1649931-14	L1649931-15
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	18-JUL-15	19-JUL-15	19-JUL-15	19-JUL-15	19-JUL-15
Sampled Time					
Client ID	TRAVEL BLANK-JULY-AMARUQ	C2	C14	C17	C20
Grouping / **Analyte**					
WATER					
Dissolved Metals Iron (Fe)-Dissolved (mg/L)		0.012	0.011	0.020	0.014
Lead (Pb)-Dissolved (mg/L)		<0.000050	0.000053	<0.000050	<0.000050
Lithium (Li)-Dissolved (mg/L)		<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Dissolved (mg/L)		0.80	0.76	0.80	0.85
Manganese (Mn)-Dissolved (mg/L)		0.00123	0.00144	0.00300	0.00095
Mercury (Hg)-Dissolved (mg/L)		<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)-Dissolved (mg/L)		0.00055	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Dissolved (mg/L)		<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)		0.32	0.37	0.38	0.36
Selenium (Se)-Dissolved (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050
Silicon (Si)-Dissolved (mg/L)		0.342	0.307	0.401	0.155
Silver (Ag)-Dissolved (mg/L)		<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)		0.484	0.507	0.542	0.511
Strontium (Sr)-Dissolved (mg/L)		0.0112	0.0143	0.0124	0.00921
Sulfur (S)-Dissolved (mg/L)		1.13	0.54	0.52	0.61
Thallium (Tl)-Dissolved (mg/L)		<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)		<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)		<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)		0.000051	0.000028	0.000039	0.000020
Vanadium (V)-Dissolved (mg/L)		<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)		<0.0010	<0.0010	<0.0010	<0.0010
Zirconium (Zr)-Dissolved (mg/L)		<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1649931-16				
	Description	Surface Water				
	Sampled Date	19-JUL-15				
	Sampled Time					
	Client ID	C41				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Iron (Fe)-Dissolved (mg/L)	0.026				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	<0.0010				
	Magnesium (Mg)-Dissolved (mg/L)	0.75				
	Manganese (Mn)-Dissolved (mg/L)	0.00097				
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	<0.000050				
	Nickel (Ni)-Dissolved (mg/L)	0.00286				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	0.26				
	Selenium (Se)-Dissolved (mg/L)	<0.000050				
	Silicon (Si)-Dissolved (mg/L)	0.286				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	0.396				
	Strontium (Sr)-Dissolved (mg/L)	0.00704				
	Sulfur (S)-Dissolved (mg/L)	0.60				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Uranium (U)-Dissolved (mg/L)	0.000035				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Nitrite (as N)	DLM	L1649931-11
Duplicate	Titanium (Ti)-Total	DLM	L1649931-15, -16
Duplicate	Bromide (Br)	DLM	L1649931-11
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1649931-1, -10, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Iron (Fe)-Dissolved	MS-B	L1649931-1, -10, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1649931-1, -10, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1649931-1, -10, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L1649931-1, -10, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1649931-1, -10, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1649931-1, -10, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1649931-1, -10, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1649931-1, -10, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Phosphorus (P)-Total	MS-B	L1649931-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1649931-1, -10, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1649931-1, -10, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1649931-1, -10, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1649931-1, -10, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Uranium (U)-Dissolved	MS-B	L1649931-1, -10, -12, -13, -14, -15, -16, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects.
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

BE-D-L-CCMS-VA Water Diss. Be (low) in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

BE-T-L-CCMS-VA Water Total Be (Low) in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

BR-L-IC-N-VA Water Bromide in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Reference Information

CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CL-L-IC-N-VA	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CN-FREE-L-CFA-VA	Water	Low Level Free Cyanide in water by CFA	ASTM 7237

This analysis is carried out using procedures adapted from ASTM Method 7237 "Free Cyanide with Flow Injection Analysis (FIA) Utilizing Gas Diffusion Separation and Amperometric Detection". Free cyanide is determined by in-line gas diffusion at pH 6 with final determination by colourimetric analysis.

CN-T-L-CFA-VA	Water	Low Level Total Cyanide in water by CFA	ISO 14403:2002

This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-DIS-LOW-ICP-VA	Water	Dissolved Metals in Water by ICPOES	EPA 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-TOT-LOW-ICP-VA	Water	Total Metals in Water by ICPOES	EPA 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

Reference Information

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

S-DIS-ICP-VA Water Dissolved Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

S-TOT-ICP-VA Water Total Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

SILICATE-COL-VA Water Silicate by Colourimetric analysis APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

Reference Information

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

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Canada Toll Free: 1
www.alsglob

L1649931-COFC

COC # _____

Page 1 of

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☐ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☐ PDF ☐ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TA
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	Analysis Request
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q39503	
Lab Work Order # (lab use only)		ALS Contact:	Sampler:

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	P TOC, Ammonia, TKN, Total P	F/P DOC	P T-CN (Low), Free CN (Low)	P Total mercury	F/P Dissolved mercury	P Total Metals	F/P Dissolved Metals	Conventionals ** See Notes
	WTN-1-S	17-Jul-15		Surface Water	X	X	X	X	X	X	X	
	WTN-2-S	17-Jul-15		Surface Water	X	X	X	X	X	X	X	
	WTS-1-S	17-Jul-15		Surface Water	X	X	X	X	X	X	X	
	WTS-2-S	17-Jul-15		Surface Water	X	X	X	X	X	X	X	
	NEM-1-S	18-Jul-15		Surface Water	X	X	X	X	X	X	X	
	NEM-2-S	18-Jul-15		Surface Water	X	X	X	X	X	X	X	
	MAM-1-S	18-Jul-15		Surface Water	X	X	X	X	X	X	X	
	MAM-2-S	18-Jul-15		Surface Water	X	X	X	X	X	X	X	
	DUP-JULY-AMARUQ			Surface Water	X	X	X	X	X	X	X	
	EB-JULY-AMARUQ	18-Jul-15		Surface Water	X	X	X	X	X	X	X	
	TRAVEL BLANK - JULY - AMARUQ			Surface Water	X		X	X		X		X

Short Holding Time
Rush Processing

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Included in this shipment is one complete travel blank set. "Converntionals" may not accurately describe the use of the 1 L bottle and is only to provide a place holder on this COC.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observatic Yes / No ? If Yes add
Morgan Finley	20-Jul-15	9:00				20 °C	EK	July 29/15	12:05	

GENF 20.00 Front

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

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COC # _____

Page 2 of

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☐ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☐ PDF ☐ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	Analysis Request
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q39503	
Lab Work Order # (lab use only)		ALS Contact:	Sampler:

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	TOC, Ammonia, TKN, Total P	DOC	T-CN (Low), Free CN (Low)	Total mercury	Dissolved mercury	Total Metals	Dissolved Metals
					P	F/P	P	P	F/P	P	F/P
	C2	19-Jul-15		Surface Water	X	X	X	X	X	X	X
	C14	19-Jul-15		Surface Water	X	X	X	X	X	X	X
	C17	19-Jul-15		Surface Water	X	X	X	X	X	X	X
	C20	19-Jul-15		Surface Water	X	X	X	X	X	X	X
	C41	19-Jul-15		Surface Water	X	X	X	X	X	X	X

L1649931-COFC

Short Holding Time

Rush Processing

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observatic Yes / No ? If Yes add
Morgan Finley	20-Jul-15	9:00				20 °C	EX	July 20/15	12:05	

AZIMUTH CONSULTING GROUP INC.
ATTN: Eric Franz
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 31-AUG-15
Report Date: 21-SEP-15 09:59 (MT)
Version: FINAL REV. 2

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1665542

Project P.O. #: NOT SUBMITTED
Job Reference: AMARUQ SURFACEWATER
C of C Numbers:
Legal Site Desc:

Comments:

21-SEP-2015 This report replaces the previous version and contains updated Sampling Dates for 2 samples.

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1665542-1 SURFACE WATE 21-AUG-15 11:30 WTS-03-S	L1665542-2 SURFACE WATE 21-AUG-15 12:30 WTS-04-S	L1665542-3 SURFACE WATE 23-AUG-15 13:10 NEM-03-S	L1665542-4 SURFACE WATE 23-AUG-15 11:20 NEM-04-S	L1665542-5 SURFACE WATE 24-AUG-15 13:05 MAM-03-S
WATER						
Physical Tests	Conductivity (uS/cm)	18.6	18.5	25.5	25.4	24.6
	pH (pH)	6.66	6.74	7.06	7.05	6.85
	Total Suspended Solids (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Total Dissolved Solids (mg/L)	12.2	14.5	15.7	15.7	14.8
	Turbidity (NTU)	0.26	0.23	0.19	0.21	0.24
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	4.5	3.8	6.8	6.7	4.8
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	4.5	3.8	6.8	6.7	4.8
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	1.57	1.58	0.54	0.54	2.33
	Fluoride (F) (mg/L)	0.024	0.024	0.022	0.022	0.026
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	0.0024	0.0022	0.0022	0.0023	0.0038
	Silicate (as SiO2) (mg/L)	0.59	0.60	<0.50	<0.50	0.63
	Sulfate (SO4) (mg/L)	1.30	1.31	3.24	3.24	2.23

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1665542-6	L1665542-7	L1665542-8	L1665542-9	L1665542-10
Description	SURFACE WATE	SURFACE WATE	SURFACE WATE	SURFACE WATE	SURFACE WATE
Sampled Date	24-AUG-15		25-AUG-15	25-AUG-15	25-AUG-15
Sampled Time	12:30		12:20	11:55	11:25
Client ID	MAM-04-S	AMARUQ AUG DUP-1	C2-AUG	C14-AUG	C17-AUG
Grouping / **Analyte**					
WATER					
Physical Tests					
Conductivity (uS/cm)	24.4	19.5	22.7	23.5	23.0
pH (pH)	6.83	6.70	6.83	7.08	7.01
Total Suspended Solids (mg/L)	<1.0	<1.0	<1.0	<1.0	1.1
Total Dissolved Solids (mg/L)	15.3	14.2	15.9	17.0	17.8
Turbidity (NTU)	0.27	0.24	0.24	0.35	0.82
Anions and Nutrients					
Alkalinity, Bicarbonate (as CaCO3) (mg/L)	4.5	4.3	5.2	7.7	7.9
Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3) (mg/L)	4.5	4.3	5.2	7.7	7.9
Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl) (mg/L)	2.32	1.84	0.51	0.56	0.59
Fluoride (F) (mg/L)	0.025	0.026	0.072	0.034	0.049
Nitrate (as N) (mg/L)	<0.0050	<0.0050	0.0243	<0.0050	<0.0050
Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total Dissolved (mg/L)	0.0023	0.0025	0.0021	0.0027	0.0031
Silicate (as SiO2) (mg/L)	0.67	0.56	0.88	0.58	0.63
Sulfate (SO4) (mg/L)	2.23	1.37	3.67	1.54	1.43

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1665542-11 SURFACE WATE 25-AUG-15 10:50 C20-AUG	L1665542-12 SURFACE WATE 25-AUG-15 10:15 C41-AUG	L1665542-13 SURFACE WATE 25-AUG-15 AMARUQ AUG EB-1	L1665542-14 SURFACE WATE 20-AUG-15 16:30 WTN-03-S	L1665542-15 SURFACE WATE 20-AUG-15 17:30 WTN-04-S
WATER						
Physical Tests	Conductivity (uS/cm)	22.2	20.0	<2.0	18.8	19.8
	pH (pH)	7.08	6.96	5.40	6.83	6.82
	Total Suspended Solids (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Total Dissolved Solids (mg/L)	15.9	15.4	<3.0	14.2	13.2
	Turbidity (NTU)	0.24	0.33	<0.10	0.23	0.28
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	7.1	5.8	<1.0	4.9	3.9
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	7.1	5.8	<1.0	4.9	3.9
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	0.64	0.58	<0.10	1.57	1.84
	Fluoride (F) (mg/L)	0.037	0.055	<0.020	0.025	0.025
	Nitrate (as N) (mg/L)	<0.0050	0.0097	<0.0050	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	0.0021	0.0028	<0.0020	0.0025	0.0028
	Silicate (as SiO2) (mg/L)	<0.50	0.86	<0.50	0.56	0.57
	Sulfate (SO4) (mg/L)	1.63	2.05	<0.30	1.31	1.37

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1665542-16				
	Description	SURFACE WATE				
	Sampled Date					
	Sampled Time					
	Client ID	AMARUQ AUG TRAV-1				
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	<2.0				
	pH (pH)	5.34				
	Total Suspended Solids (mg/L)	<1.0				
	Total Dissolved Solids (mg/L)	<3.0				
	Turbidity (NTU)	<0.10				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	<1.0				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	<0.10				
	Fluoride (F) (mg/L)	<0.020				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010				
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020				
	Silicate (as SiO2) (mg/L)	<0.50				
	Sulfate (SO4) (mg/L)	<0.30				

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CL-L-IC-N-VA	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
P-TD-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode It is recommended that this analysis be conducted in the field.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode It is recommended that this analysis be conducted in the field.			
PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorus
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.			
SILICATE-COL-VA	Water	Silicate by Colourimetric analysis	APHA 4500-SiO2 E.
This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-LOW-VA	Water	Low Level TDS (3.0mg/L) by Gravimetric	APHA 2540C
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total dissolved solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.			
TSS-LOW-VA	Water	Total Suspended Solids by Grav. (1 mg/L)	APHA 2540D
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"
This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.			
TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity
This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Reference Information

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Short Holding Time

Rush Processing

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # _____

Page 1 of 2

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☑ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☑ PDF ☑ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	Analysis Request
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q39503	
Lab Work Order # (lab use only)		ALS Contact: Brent Mack	Sampler: Eric Fra nz

Sample	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Conventionals** see notes	TSS-Low, TDS-Low										Number of Containers
	WTS-03-S	21-Aug-15	11:30	Surface Water	X	X										2
	WTS-04-S	21-Aug-15	12:30	Surface Water	X	X										2
	NEM-03-S	23-Aug-15	13:10	Surface Water	X	X										2
	NEM-04-S	23-Aug-15	11:20	Surface Water	X	X										2
	MAM-03-S	24-Aug-15	13:05	Surface Water	X	X										2
	MAM-04-S	24-Aug-15	12:30	Surface Water	X	X										2
	AMARUQ AUG DUP-1	-	-	Surface Water	X	X										2
	C2-AUG	25-Aug-15	12:20	Surface Water	X	X										2
	C14-AUG	25-Aug-15	11:55	Surface Water	X	X										2
	C17-AUG	25-Aug-15	11:25	Surface Water	X	X										2
	C20-AUG	25-Aug-15	10:50	Surface Water	X	X										2
	C41-AUG	25-Aug-15	10:15	Surface Water	X	X										2

L1665542-COFC

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

**Conventionals includes: Alk Species, pH, EC, Turbidity, Conductivity, Anions (F, NO2, NO3, Br, SO4), low-level Chloride, Silicate, TD-P, and Ortho-PO4.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Eric Franz	26-Aug-15	8:00	Jeew	31/Aug	11:50	17.4 16.5 °C				

GENF 20.00 Front

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # _____

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☑ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☑ PDF ☑ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	**Analysis Request**
Invoice To	Same as Report ? ☑ Yes ☐ No	**Client / Project Information**	Please indicate below Filtered, Preserved or both (F, P, F/P)
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q39503	
Lab Work Order # (lab use only)		**ALS Contact:** Brent Mack	**Sampler:** Eric Fra nz

Sample	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Conventionals** see notes	TSS-Low, TDS-Low	Number of Containers
	AMARUQ AUG EB-1	25-Aug-15		Surface Water	X	X	2
	WTN-03-S	20-Aug-15	16:30	Surface Water	X	X	2
	WTN-04-S	20-Aug-15	17:30	Surface Water	X	X	2
	AMARUQ AUG TRAV-1	-	-	Surface Water	X	X	1

L1665542-COFC

Short Holding Time

- *Rush Processing*

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

**Conventionals includes: Alk Species, pH, EC, Turbidity, Conductivity, Anions (F, NO2, NO3, Br, SO4), low-level Chloride, Silicate, TD-P, and Ortho-PO4.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Eric Franz	26-Aug-15					°C				

AZIMUTH CONSULTING GROUP INC.
ATTN: Eric Franz
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 02-SEP-15
Report Date: 17-SEP-15 09:39 (MT)
Version: FINAL REV. 2

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1667195

Project P.O. #: NOT SUBMITTED
Job Reference: AMARUQ SURFACEWATER
C of C Numbers:
Legal Site Desc:

Comments: 17-SEP-2015 This report replaces the previous version and contains a change to a Sampling Date for one sample.

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1667195-1	L1667195-2	L1667195-3	L1667195-4	L1667195-5
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	21-AUG-15	21-AUG-15	23-AUG-15	23-AUG-15	24-AUG-15
Sampled Time	11:30	12:30	13:10	11:20	13:05
Client ID	WTS-03-S	WTS-04-S	NEM-03-S	NEM-04-S	MAM-03-S
Grouping / **Analyte**					
WATER					
Physical Tests Hardness (as CaCO3) (mg/L)	6.66	6.65	9.80	10.0	9.11
Anions and Nutrients Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Total Kjeldahl Nitrogen (mg/L)	0.128	0.111	0.084	0.107	0.095
Phosphorus (P)-Total (mg/L)	<0.0020	0.0028	<0.0020	<0.0020	<0.0020
Cyanides Cyanide, Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon Dissolved Organic Carbon (mg/L)	1.92	1.85	1.38	1.55	1.57
Total Organic Carbon (mg/L)	1.73	1.72	1.30	1.41	1.88
Total Metals Aluminum (Al)-Total (mg/L)	0.0094	0.0077	0.0043	0.0050	0.0050
Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	0.00011	<0.00010	<0.00010
Arsenic (As)-Total (mg/L)	0.00017	0.00018	0.00033	0.00031	0.00043
Barium (Ba)-Total (mg/L)	0.00323	0.00325	0.00408	0.00409	0.00440
Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	0.0000122	<0.0000050	<0.0000050
Calcium (Ca)-Total (mg/L)	1.62	1.63	2.23	2.22	2.32
Chromium (Cr)-Total (mg/L)	<0.00010	0.00010	<0.00010	0.00011	<0.00010
Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)-Total (mg/L)	0.020	0.017	0.013	0.011	0.014
Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Total (mg/L)	0.62	0.62	1.01	1.01	0.77
Manganese (Mn)-Total (mg/L)	0.00207	0.00202	0.00355	0.00340	0.00169
Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)-Total (mg/L)	0.00052	0.00054	0.00061	0.00060	0.00061
Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total (mg/L)	0.37	0.36	0.58	0.56	0.53
Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Silicon (Si)-Total (mg/L)	0.261	0.262	0.216	0.214	0.293
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total (mg/L)	0.524	0.505	0.491	0.479	0.525
Strontium (Sr)-Total (mg/L)	0.00988	0.0102	0.00953	0.00958	0.0126
Sulfur (S)-Total (mg/L)	0.52	0.50	1.15	1.16	0.83

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1667195-6	L1667195-7	L1667195-8	L1667195-9	L1667195-10
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	24-AUG-15		25-AUG-15	25-AUG-15	25-AUG-15
Sampled Time	12:30		12:20	11:55	11:25
Client ID	MAM-04-S	AMARUQ AUG DUP-1	C2-AUG	C14-AUG	C17-AUG
Grouping / **Analyte**					
WATER					
Physical Tests Hardness (as CaCO3) (mg/L)	9.13	7.14	8.78	10.0	9.39
Anions and Nutrients Ammonia, Total (as N) (mg/L)	<0.0050	0.0073	0.0052	<0.0050	0.0053
Total Kjeldahl Nitrogen (mg/L)	0.129	0.153	0.085	0.162	0.144
Phosphorus (P)-Total (mg/L)	<0.0020	0.0036	<0.0020	<0.0020	0.0032
Cyanides Cyanide, Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon Dissolved Organic Carbon (mg/L)	1.61	1.79	1.29	2.34	2.73
Total Organic Carbon (mg/L)	1.58	1.80	1.41	2.39	2.68
Total Metals Aluminum (Al)-Total (mg/L)	0.0058	0.0083	0.0044	0.0064	0.0211
Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Total (mg/L)	0.00043	0.00021	0.00015	0.00031	0.00039
Barium (Ba)-Total (mg/L)	0.00441	0.00355	0.00324	0.00304	0.00267
Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Total (mg/L)	2.29	1.74	2.10	2.71	2.44
Chromium (Cr)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00028
Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00013
Copper (Cu)-Total (mg/L)	<0.00050	<0.00050	0.00082	0.00070	0.00080
Iron (Fe)-Total (mg/L)	0.014	0.018	0.028	0.023	0.164
Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Total (mg/L)	0.77	0.64	0.78	0.70	0.79
Manganese (Mn)-Total (mg/L)	0.00173	0.00268	0.00031	0.00293	0.0169
Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	0.000055
Nickel (Ni)-Total (mg/L)	0.00057	0.00061	<0.00050	<0.00050	0.00065
Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total (mg/L)	0.52	0.37	0.32	0.35	0.38
Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Silicon (Si)-Total (mg/L)	0.297	0.252	0.379	0.268	0.304
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total (mg/L)	0.520	0.515	0.518	0.510	0.555
Strontium (Sr)-Total (mg/L)	0.0126	0.0111	0.0113	0.0142	0.0127
Sulfur (S)-Total (mg/L)	0.81	0.52	1.28	0.60	0.57

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1667195-11	L1667195-12	L1667195-13	L1667195-14	L1667195-15
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	25-AUG-15	25-AUG-15	25-AUG-15	20-AUG-15	20-AUG-15
Sampled Time	10:50	10:15	11:30	16:30	17:30
Client ID	C20-AUG	C41-AUG	AMARUQ AUG EB-1	WTN-03-S	WTN-04-S
Grouping / **Analyte**					
WATER					
Physical Tests Hardness (as CaCO3) (mg/L)	8.74	7.87	<0.50	6.70	7.18
Anions and Nutrients Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Total Kjeldahl Nitrogen (mg/L)	0.090	0.100	<0.050	0.109	0.107
Phosphorus (P)-Total (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	0.0023
Cyanides Cyanide, Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon Dissolved Organic Carbon (mg/L)	1.39	1.91	<0.50	1.73	2.09
Total Organic Carbon (mg/L)	1.35	1.44	<0.50	1.71	1.78
Total Metals Aluminum (Al)-Total (mg/L)	0.0042	0.0081	0.0035 RRV	0.0083	0.0099
Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Total (mg/L)	0.00017	0.00015	<0.00010	0.00016	0.00018
Barium (Ba)-Total (mg/L)	0.00183	0.00392	0.000088 RRV	0.00327	0.00345
Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	0.0000087	<0.0000050	<0.0000050
Calcium (Ca)-Total (mg/L)	2.26	1.64	<0.050	1.64	1.77
Chromium (Cr)-Total (mg/L)	<0.00010	0.00019	<0.00010	<0.00010	0.00010
Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Total (mg/L)	<0.00050	0.00066	<0.00050	<0.00050	<0.00050
Iron (Fe)-Total (mg/L)	0.014	0.059	<0.010	0.016	0.019
Lead (Pb)-Total (mg/L)	<0.000050	0.000081	0.000708 RRV	<0.000050	<0.000050
Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Total (mg/L)	0.77	0.87	<0.10	0.64	0.65
Manganese (Mn)-Total (mg/L)	0.00104	0.00173	<0.00010	0.00198	0.00256
Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total (mg/L)	<0.000050	0.000073	<0.000050	<0.000050	<0.000050
Nickel (Ni)-Total (mg/L)	<0.00050	0.00230	<0.00050	0.00058	0.00059
Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total (mg/L)	0.34	0.29	<0.10	0.39	0.37
Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Silicon (Si)-Total (mg/L)	0.140	0.369	<0.050	0.249	0.265
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total (mg/L)	0.487	0.476	<0.050	0.500	0.492
Strontium (Sr)-Total (mg/L)	0.00879	0.00817	<0.00020	0.00987	0.0111
Sulfur (S)-Total (mg/L)	0.61	0.75	<0.50	0.50	<0.50

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1667195-16				
	Description	Surface Water				
	Sampled Date	20-AUG-15				
	Sampled Time	11:30				
	Client ID	AMARUQ AUG TRAV-1				
Grouping	**Analyte**					
WATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	<0.50				
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	<0.0050				
	Total Kjeldahl Nitrogen (mg/L)	<0.050				
	Phosphorus (P)-Total (mg/L)	<0.0020				
Cyanides	Cyanide, Total (mg/L)	<0.0010				
	Cyanide, Free (mg/L)	<0.0010				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					
	Total Organic Carbon (mg/L)	<0.50				
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	<0.00010				
	Barium (Ba)-Total (mg/L)	<0.000050				
	Beryllium (Be)-Total (mg/L)	<0.000020				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	<0.010				
	Cadmium (Cd)-Total (mg/L)	<0.0000050				
	Calcium (Ca)-Total (mg/L)	<0.050				
	Chromium (Cr)-Total (mg/L)	<0.00010				
	Cobalt (Co)-Total (mg/L)	<0.00010				
	Copper (Cu)-Total (mg/L)	<0.00050				
	Iron (Fe)-Total (mg/L)	<0.010				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	<0.0010				
	Magnesium (Mg)-Total (mg/L)	<0.10				
	Manganese (Mn)-Total (mg/L)	<0.00010				
	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	<0.000050				
	Nickel (Ni)-Total (mg/L)	<0.00050				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	<0.10				
	Selenium (Se)-Total (mg/L)	<0.000050				
	Silicon (Si)-Total (mg/L)	<0.050				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	<0.050				
	Strontium (Sr)-Total (mg/L)	<0.00020				
	Sulfur (S)-Total (mg/L)	<0.50				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1667195-1	L1667195-2	L1667195-3	L1667195-4	L1667195-5
	Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
	Sampled Date	21-AUG-15	21-AUG-15	23-AUG-15	23-AUG-15	24-AUG-15
	Sampled Time	11:30	12:30	13:10	11:20	13:05
	Client ID	WTS-03-S	WTS-04-S	NEM-03-S	NEM-04-S	MAM-03-S
Grouping	**Analyte**					
WATER						
Total Metals	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Total (mg/L)	0.000037	0.000036	0.000014	<0.000010	0.000025
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0061	0.0053	0.0016	0.0012	0.0022
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00016	0.00016	0.00027	0.00029	0.00039
	Barium (Ba)-Dissolved (mg/L)	0.00315	0.00329	0.00387	0.00390	0.00433
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	1.62	1.63	2.25	2.29	2.34
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00036	0.00034	0.00023	0.00024	0.00036
	Iron (Fe)-Dissolved (mg/L)	0.011	0.011	<0.010	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	0.63	0.63	1.02	1.04	0.79
	Manganese (Mn)-Dissolved (mg/L)	0.00123	0.00136	0.00061	0.00046	0.00034
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00050	0.00054	0.00052	0.00054
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	0.37	0.36	0.59	0.60	0.53
	Selenium (Se)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)-Dissolved (mg/L)	0.254	0.250	0.202	0.209	0.289
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	0.509	0.502	0.480	0.470	0.520
	Strontium (Sr)-Dissolved (mg/L)	0.00964	0.00984	0.00942	0.00937	0.0125
	Sulfur (S)-Dissolved (mg/L)	<0.50	<0.50	1.14	1.12	0.81

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1667195-6	L1667195-7	L1667195-8	L1667195-9	L1667195-10
	Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
	Sampled Date	24-AUG-15		25-AUG-15	25-AUG-15	25-AUG-15
	Sampled Time	12:30		12:20	11:55	11:25
	Client ID	MAM-04-S	AMARUQ AUG DUP-1	C2-AUG	C14-AUG	C17-AUG
Grouping	**Analyte**					
WATER						
Total Metals	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00036
	Uranium (U)-Total (mg/L)	0.000024	0.000034	0.000029	0.000028	0.000041
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0024	0.0048	0.0013	0.0027	0.0038
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00036	0.00020	0.00012	0.00026	0.00034
	Barium (Ba)-Dissolved (mg/L)	0.00429	0.00355	0.00318	0.00287	0.00241
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	2.35	1.78	2.18	2.79	2.47
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00042	0.00036	0.00069	0.00061	0.00067
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	0.072
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	0.79	0.65	0.81	0.74	0.78
	Manganese (Mn)-Dissolved (mg/L)	0.00032	0.00117	<0.00010	0.00120	0.0146
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel (Ni)-Dissolved (mg/L)	0.00052	0.00054	<0.00050	<0.00050	0.00053
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	0.52	0.38	0.33	0.37	0.37
	Selenium (Se)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)-Dissolved (mg/L)	0.289	0.250	0.385	0.263	0.273
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	0.523	0.511	0.517	0.504	0.538
	Strontium (Sr)-Dissolved (mg/L)	0.0123	0.0111	0.0114	0.0139	0.0123
	Sulfur (S)-Dissolved (mg/L)	0.79	<0.50	1.27	0.57	0.52

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1667195-11 Surface Water 25-AUG-15 10:50 C20-AUG	L1667195-12 Surface Water 25-AUG-15 10:15 C41-AUG	L1667195-13 Surface Water 25-AUG-15 11:30 AMARUQ AUG EB-1	L1667195-14 Surface Water 20-AUG-15 16:30 WTN-03-S	L1667195-15 Surface Water 20-AUG-15 17:30 WTN-04-S
Sample ID						
Description						
Sampled Date						
Sampled Time						
Client ID						
WATER						
Total Metals	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Total (mg/L)	0.000020	0.000022	<0.000010	0.000037	0.000035
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0018	0.0026	<0.0010	0.0045	0.0048
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00013	0.00013	<0.00010	0.00014	0.00019
	Barium (Ba)-Dissolved (mg/L)	0.00174	0.00376	<0.000050	0.00316	0.00345
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	2.24	1.69	<0.050	1.65	1.80
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00041	0.00054	<0.00020	0.00037	0.00037
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.029	<0.010	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	0.76	0.89	<0.10	0.63	0.66
	Manganese (Mn)-Dissolved (mg/L)	0.00045	0.00113	<0.00010	0.00057	0.00132
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	<0.000050	0.000067	<0.000050	<0.000050	<0.000050
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00230	<0.00050	<0.00050	0.00053
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	0.33	0.30	<0.10	0.38	0.37
	Selenium (Se)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)-Dissolved (mg/L)	0.137	0.365	<0.050	0.249	0.256
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	0.476	0.483	<0.050	0.502	0.502
	Strontium (Sr)-Dissolved (mg/L)	0.00873	0.00795	<0.00020	0.00966	0.0110
	Sulfur (S)-Dissolved (mg/L)	0.57	0.72	<0.50	<0.50	<0.50

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1667195-16				
	Description	Surface Water				
	Sampled Date	20-AUG-15				
	Sampled Time	11:30				
	Client ID	AMARUQ AUG TRAV-1				
Grouping	**Analyte**					
WATER						
Total Metals	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	<0.00030				
	Uranium (U)-Total (mg/L)	<0.000010				
	Vanadium (V)-Total (mg/L)	<0.00050				
	Zinc (Zn)-Total (mg/L)	<0.0030				
	Zirconium (Zr)-Total (mg/L)	<0.00030				
Dissolved Metals	Dissolved Mercury Filtration Location					
	Dissolved Metals Filtration Location					
	Aluminum (Al)-Dissolved (mg/L)					
	Antimony (Sb)-Dissolved (mg/L)					
	Arsenic (As)-Dissolved (mg/L)					
	Barium (Ba)-Dissolved (mg/L)					
	Beryllium (Be)-Dissolved (mg/L)					
	Bismuth (Bi)-Dissolved (mg/L)					
	Boron (B)-Dissolved (mg/L)					
	Cadmium (Cd)-Dissolved (mg/L)					
	Calcium (Ca)-Dissolved (mg/L)					
	Chromium (Cr)-Dissolved (mg/L)					
	Cobalt (Co)-Dissolved (mg/L)					
	Copper (Cu)-Dissolved (mg/L)					
	Iron (Fe)-Dissolved (mg/L)					
	Lead (Pb)-Dissolved (mg/L)					
	Lithium (Li)-Dissolved (mg/L)					
	Magnesium (Mg)-Dissolved (mg/L)					
	Manganese (Mn)-Dissolved (mg/L)					
	Mercury (Hg)-Dissolved (mg/L)					
	Molybdenum (Mo)-Dissolved (mg/L)					
	Nickel (Ni)-Dissolved (mg/L)					
	Phosphorus (P)-Dissolved (mg/L)					
	Potassium (K)-Dissolved (mg/L)					
	Selenium (Se)-Dissolved (mg/L)					
	Silicon (Si)-Dissolved (mg/L)					
	Silver (Ag)-Dissolved (mg/L)					
	Sodium (Na)-Dissolved (mg/L)					
	Strontium (Sr)-Dissolved (mg/L)					
	Sulfur (S)-Dissolved (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1667195-1 Surface Water 21-AUG-15 11:30 WTS-03-S	L1667195-2 Surface Water 21-AUG-15 12:30 WTS-04-S	L1667195-3 Surface Water 23-AUG-15 13:10 NEM-03-S	L1667195-4 Surface Water 23-AUG-15 11:20 NEM-04-S	L1667195-5 Surface Water 24-AUG-15 13:05 MAM-03-S
Sample ID / Description / Sampled Date / Sampled Time / Client ID						
WATER						
Dissolved Metals	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000031	0.000031	<0.000010	<0.000010	0.000018
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1667195-6	L1667195-7	L1667195-8	L1667195-9	L1667195-10
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	24-AUG-15		25-AUG-15	25-AUG-15	25-AUG-15
Sampled Time	12:30		12:20	11:55	11:25
Client ID	MAM-04-S	AMARUQ AUG DUP-1	C2-AUG	C14-AUG	C17-AUG
Grouping **Analyte**					
WATER					
Dissolved Metals Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.000018	0.000030	0.000022	0.000022	0.000033
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1667195-11 Surface Water 25-AUG-15 10:50 C20-AUG	L1667195-12 Surface Water 25-AUG-15 10:15 C41-AUG	L1667195-13 Surface Water 25-AUG-15 11:30 AMARUQ AUG EB-1	L1667195-14 Surface Water 20-AUG-15 16:30 WTN-03-S	L1667195-15 Surface Water 20-AUG-15 17:30 WTN-04-S
WATER						
Dissolved Metals	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000017	0.000017	<0.000010	0.000030	0.000031
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1667195-16				
	Description	Surface Water				
	Sampled Date	20-AUG-15				
	Sampled Time	11:30				
	Client ID	AMARUQ AUG TRAV-1				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Thallium (Tl)-Dissolved (mg/L)					
	Tin (Sn)-Dissolved (mg/L)					
	Titanium (Ti)-Dissolved (mg/L)					
	Uranium (U)-Dissolved (mg/L)					
	Vanadium (V)-Dissolved (mg/L)					
	Zinc (Zn)-Dissolved (mg/L)					
	Zirconium (Zr)-Dissolved (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Aluminum (Al)-Total	MS-B	L1667195-14, -15, -16
Matrix Spike	Barium (Ba)-Total	MS-B	L1667195-14, -15, -16
Matrix Spike	Manganese (Mn)-Total	MS-B	L1667195-14, -15, -16
Matrix Spike	Strontium (Sr)-Total	MS-B	L1667195-14, -15, -16
Matrix Spike	Titanium (Ti)-Total	MS-B	L1667195-14, -15, -16
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Aluminum (Al)-Dissolved	RRV	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Barium (Ba)-Dissolved	RRV	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Lead (Pb)-Dissolved	RRV	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Manganese (Mn)-Dissolved	RRV	L1667195-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Reference Information

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

CARBONS-DOC-VA Water Dissolved organic carbon by combustion APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CARBONS-TOC-VA Water Total organic carbon by combustion APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CN-FREE-L-CFA-VA Water Low Level Free Cyanide in water by CFA ASTM 7237

This analysis is carried out using procedures adapted from ASTM Method 7237 "Free Cyanide with Flow Injection Analysis (FIA) Utilizing Gas Diffusion Separation and Amperometric Detection". Free cyanide is determined by in-line gas diffusion at pH 6 with final determination by colourimetric analysis.

CN-T-L-CFA-VA Water Low Level Total Cyanide in water by CFA ISO 14403:2002

This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-DIS-LOW-ICP-VA Water Dissolved Metals in Water by ICPOES EPA 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-TOT-LOW-ICP-VA Water Total Metals in Water by ICPOES EPA 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

Reference Information

S-DIS-ICP-VA	Water	Dissolved Sulfur in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

S-TOT-ICP-VA	Water	Total Sulfur in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # _____

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☑ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☑ PDF ☑ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	Analysis Request
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q39503	
Lab Work Order # (lab use only)		ALS Contact: Brent Mack	Sampler: Eric Franz

Sample #	Sample Identification (This description will appear on the rep	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	TOC, Ammonia, TKN, Total P	DOC	T-CN (Low), Free CN (Low)	Total mercury	Dissolved mercury	Total Metals	Dissolved Metals		Number of Containers
					P	F/P	P	P	F/P	P	F/P		
1	WTS-03-S	21-Aug-15	11:30	Surface Water	X	X	X	X	X	X	X		7
2	WTS-04-S	21-Aug-15	12:30	Surface Water	X	X	X	X	X	X	X		7
3	NEM-03-S	23-Aug-15	13:10	Surface Water	X	X	X	X	X	X	X		7
4	NEM-04-S	23-Aug-15	11:20	Surface Water	X	X	X	X	X	X	X		7
5	MAM-03-S	24-Aug-15	13:05	Surface Water	X	X	X	X	X	X	X		7
6	MAM-04-S	24-Aug-15	12:30	Surface Water	X	X	X	X	X	X	X		7
7	AMARUQ AUG DUP-1	-	-	Surface Water	X	X	X	X	X	X	X		7
8	C2-AUG	25-Aug-15	12:20	Surface Water	X	X	X	X	X	X	X		7
9	C14-AUG	25-Aug-15	11:55	Surface Water	X	X	X	X	X	X	X		7
10	C17-AUG	25-Aug-15	11:25	Surface Water	X	X	X	X	X	X	X		7
11	C20-AUG	25-Aug-15	10:50	Surface Water	X	X	X	X	X	X	X		7
12	C41-AUG	25-Aug-15	10:15	Surface Water	X	X	X	X	X	X	X		7

L1667195-COFC

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Sport Fishing Time

Rush Processing

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Eric Franz	26-Aug-15	09:00	lady	Sept. 2	11AM	15.2 °C 17.3 16.2/15.0				

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # _____

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☑ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☑ PDF ☑ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	Analysis Request
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q39503	
Lab Work Order # (lab use only)		ALS Contact: Brent Mack	Sampler: Eric Franz

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	TOC, Ammonia, TKN, Total P	DOC	T-CN (Low), Free CN (Low)	Total mercury	Dissolved mercury	Total Metals	Dissolved Metals						Number of Containers
					P	F/P	P	P	F/P	P	F/P						
13	AMARUQ AUG EB-1	25-Aug-15		Surface Water	X	X	X	X	X	X	X						7
14	WTN-03-S	20-Aug-15	16:30	Surface Water	X	X	X	X	X	X	X						7
15	WTN-04-S	20-Aug-15	17:30	Surface Water	X	X	X	X	X	X	X						7
16	AMARUQ AUG TRAV-1	-	-	Surface Water	X	X	X	X		X							4

L1667195-COFC

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Eric Franz	26-Aug-15	08:00	lady	Sept. 2	11AM	15.2 17.3 °C 16.2/15.0				

AZIMUTH CONSULTING GROUP INC.
ATTN: Eric Franz
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 03-SEP-15
Report Date: 16-SEP-15 16:25 (MT)
Version: FINAL

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1667870

Project P.O. #: NOT SUBMITTED
Job Reference: AMARUQ SURFACEWATER
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1667870-1	L1667870-2	L1667870-3	L1667870-4	L1667870-5
Description	Other	Other	Other	Other	Other
Sampled Date	21-AUG-15	21-AUG-15	23-AUG-15	23-AUG-15	24-AUG-15
Sampled Time	11:30	12:30	13:10	11:20	13:05
Client ID	WTS-03-S	WTS-04-S	NEM-03-S	NEM-04-S	MAM-03-S
Grouping **Analyte**					
FILTER					
Plant Pigments Chlorophyll a (ug/L)	0.665	0.640	0.324	0.390	0.392

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1667870-6	L1667870-7	L1667870-8	L1667870-9	L1667870-10
Description	Other	Other	Other	Other	Other
Sampled Date	24-AUG-15		25-AUG-15	25-AUG-15	25-AUG-15
Sampled Time	12:30		12:20	11:55	11:25
Client ID	MAM-04-S	AMARUQ AUG DUP-1	C2-AUG	C14-AUG	C17-AUG
Grouping **Analyte**					
FILTER					
Plant Pigments Chlorophyll a (ug/L)	0.471	0.798	0.580	0.627	0.844

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1667870-11	L1667870-12	L1667870-13	L1667870-14	
	Description	Other	Other	Other	Other	
	Sampled Date	25-AUG-15	25-AUG-15	20-AUG-15	20-AUG-15	
	Sampled Time	10:50	10:15	16:30	17:30	
	Client ID	C20-AUG	C41-AUG	WTN-03-S	WTN-04-S	
Grouping	**Analyte**					
FILTER						
Plant Pigments	Chlorophyll a (ug/L)	0.394	0.463	0.652	0.696	

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CHLOROA-F-VA	Filter	Chlorophyll a by Fluorometer (Filter)	EPA 445.0

This analysis is done using procedures modified from EPA Method 445.0. Chlorophyll-a is determined by a routine acetone extraction followed with analysis by fluorometry using the non-acidification procedure. This method is not subject to interferences from chlorophyll b.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # _____

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☑ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☑ PDF ☑ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	Analysis Request
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	Please indicate below Filtered, Preserved or both (F, P, F/P)
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q39503	
Lab Work Order # (lab use only)		ALS Contact: Brent Mack	Sampler: Eric Franz

Sample #	Sample Identification (This description will appear on the r	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Chlorophyl 'a'												Number of Containers
	WTS-03-S	21-Aug-15	11:30	Other	X												1
	WTS-04-S	21-Aug-15	12:30	Other	X												1
	NEM-03-S	23-Aug-15	13:10	Other	X												1
	NEM-04-S	23-Aug-15	11:20	Other	X												1
	MAM-03-S	24-Aug-15	13:05	Other	X												1
	MAM-04-S	24-Aug-15	12:30	Other	X												1
	AMARUQ AUG DUP-1	-	-	Other	X												1
	C2-AUG	25-Aug-15	12:20	Other	X												1
	C14-AUG	25-Aug-15	11:55	Other	X												1
	C17-AUG	25-Aug-15	11:25	Other	X												1
	C20-AUG	25-Aug-15	10:50	Other	X												1
	C41-AUG	25-Aug-15	10:15	Other	X												1

L1667870-COFC

Short Holding Time

Rush Processing

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Eric Franz	31 Aug 015	9:00				16 °C	EC	Sep 3/15	1111	

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # _____

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☑ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☑ PDF ☑ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: qmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	Analysis Request
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	Please indicate below Filtered, Preserved or both (F, P, F/P)
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q39503	
Lab Work Order # (lab use only)		ALS Contact: Brent Mack	Sampler: Eric Franz

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Chlorophyll 'a'	Number of Containers
	WTN-03-S	20-Aug-15	16:30	Other	X	1
	WTN-04-S	20-Aug-15	17:30	Other	X	1

L1667870-COFC

Short Holding Time

Rush Processing

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Eric Franz	31-Aug-15	9:00				16 °C	EZ	Sep 3/15	11:00	

AZIMUTH CONSULTING GROUP INC.
ATTN: Eric Franz
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 10-AUG-15
Report Date: 17-AUG-15 13:47 (MT)
Version: FINAL

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1655097

Project P.O. #: NOT SUBMITTED
Job Reference: AMARUQ SURFACEWATER
C of C Numbers: E-1
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1655097-1 SURFACE WATE 04-AUG-15 11:05 A12-A11	L1655097-2 SURFACE WATE 04-AUG-15 13:40 A17-A16	L1655097-3 SURFACE WATE 04-AUG-15 08:30 A1-DS1	L1655097-4 SURFACE WATE 04-AUG-15 16:40 C58 OUTLET	
	Sample ID / **Description** / **Sampled Date** / **Sampled Time** / **Client ID**					
WATER						
Physical Tests	Conductivity (uS/cm)	23.9	15.0	16.1	24.4	
	pH (pH)	6.81	6.80	6.77	6.98	
	Total Suspended Solids (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Total Dissolved Solids (mg/L)	17.7	13.7	13.2	18.9	
	Turbidity (NTU)	0.24	0.26	0.29	0.23	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	5.8	5.0	5.0	7.2	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	5.8	5.0	5.0	7.2	
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Chloride (Cl) (mg/L)	1.73	0.68	0.74	0.51	
	Fluoride (F) (mg/L)	0.025	0.031	0.028	0.023	
	Nitrate (as N) (mg/L)	0.0065	<0.0050	<0.0050	<0.0050	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	
	Silicate (as SiO2) (mg/L)	0.58	0.81	<0.50	<0.50	
	Sulfate (SO4) (mg/L)	2.57	0.85	1.32	3.03	

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CL-L-IC-N-VA	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
P-TD-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode It is recommended that this analysis be conducted in the field.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode It is recommended that this analysis be conducted in the field.			
PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorus
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.			
SILICATE-COL-VA	Water	Silicate by Colourimetric analysis	APHA 4500-SiO2 E.
This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-LOW-VA	Water	Low Level TDS (3.0mg/L) by Gravimetric	APHA 2540C
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total dissolved solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.			
TSS-LOW-VA	Water	Total Suspended Solids by Grav. (1 mg/L)	APHA 2540D
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"
This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.			
TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity
This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Reference Information

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

E-1

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Express Shipping

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Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # E-1
Page 1 of 1

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☒ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☒ PDF ☒ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	Analysis Request
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q39503	
Lab Work Order # (lab use only)		ALS Contact:	Sampler: J. Neuil

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Conventionals** see notes	TSS-Low, TDS-Low	Number of Containers
	A12-A11	4-Aug-15	11:05	Surface Water	X	X	2
	A17-A16	4-Aug-15	13 40	Surface Water	X	X	
	A1-DS1	4-Aug-15	08 30	Surface Water	X	X	
	CS8 Outlet	4-Aug-15	16 40	Surface Water	X	X	

Short Holding Time

● *Rush Processing*

L1655097-COFC

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

**Conventionals includes: Alk Species, pH, EC, Turbidity, Conductivity, Anions (F, NO2, NO3, Br, SO4), low-level Chloride, Silicate, TD-P, and Ortho-PO4.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
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Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
J Neuil	5-Aug-15	0800	Slater	August 10	1130	20 °C				

GENF 20.00 Front

AZIMUTH CONSULTING GROUP INC.
ATTN: Eric Franz
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 14-AUG-15
Report Date: 20-AUG-15 16:25 (MT)
Version: FINAL

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1658117

Project P.O. #: NOT SUBMITTED
Job Reference: AMARUQ SURFACEWATER
C of C Numbers: 2
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1658117-1 Surface Water 05-AUG-15 08:30 A8-A7	L1658117-2 Surface Water 05-AUG-15 12:30 D1	L1658117-3 Surface Water 06-AUG-15 08:40 B5-B4	L1658117-4 Surface Water 06-AUG-15 16:15 A20-A19	L1658117-5 Surface Water 07-AUG-15 10:45 A34-A16
WATER						
Physical Tests	Conductivity (uS/cm)	23.2	22.0	21.6	13.8	14.7
	pH (pH)	6.95	7.02	6.92	6.84	6.79
	Total Suspended Solids (mg/L)	<1.0	<1.0	1.8	<1.0	1.7
	Total Dissolved Solids (mg/L)	19.1	20.0	17.9	15.8	16.4
	Turbidity (NTU)	0.24	0.37	0.30	0.35	0.57
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	6.4	7.1	5.8	4.8	5.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	6.4	7.1	5.8	4.8	5.0
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	0.94	0.95	1.11	0.59	0.56
	Fluoride (F) (mg/L)	0.025	0.038	0.028	0.029	0.039
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050	0.0123	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	0.0043	<0.0020
	Silicate (as SiO2) (mg/L)	0.87	<0.50	0.76	1.25	0.72
	Sulfate (SO4) (mg/L)	2.64	1.23	2.39	0.73	1.12

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1658117-6	L1658117-7	L1658117-8		
	Description	Surface Water	Surface Water	Surface Water		
	Sampled Date	08-AUG-15	08-AUG-15	05-AUG-15		
	Sampled Time	09:00	11:50	08:40		
	Client ID	C8-C7	A101-A100	E3-E2		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	26.4	12.6	23.0		
	pH (pH)	7.15	6.74	6.97		
	Total Suspended Solids (mg/L)	<1.0	<1.0	<1.0		
	Total Dissolved Solids (mg/L)	21.5	13.8	19.5		
	Turbidity (NTU)	0.22	0.31	0.27		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	9.4	3.9	6.3		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	9.4	3.9	6.3		
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050		
	Chloride (Cl) (mg/L)	0.49	0.65	0.94		
	Fluoride (F) (mg/L)	0.033	0.027	0.025		
	Nitrate (as N) (mg/L)	<0.0050	0.0055	<0.0050		
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010		
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010		
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	<0.0020		
	Silicate (as SiO2) (mg/L)	1.43	0.92	0.88		
	Sulfate (SO4) (mg/L)	2.26	0.71	2.64		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Alkalinity, Total (as CaCO3)	B	L1658117-1, -2, -3, -4, -5, -6, -8
Method Blank	Alkalinity, Total (as CaCO3)	B	L1658117-7
Method Blank	Alkalinity, Total (as CaCO3)	B	L1658117-7
Matrix Spike	Phosphorus (P)-Total Dissolved	MS-B	L1658117-1, -2, -3, -4, -5, -6, -7, -8

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. All associated sample results are at least 5 times greater than blank levels and are considered reliable.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CL-L-IC-N-VA	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
P-TD-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode It is recommended that this analysis be conducted in the field.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode It is recommended that this analysis be conducted in the field.			
PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorus
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.			
SILICATE-COL-VA	Water	Silicate by Colourimetric analysis	APHA 4500-SiO2 E.
This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.			
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-LOW-VA	Water	Low Level TDS (3.0mg/L) by Gravimetric	APHA 2540C

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total dissolved solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-LOW-VA Water Total Suspended Solids by Grav. (1 mg/L) APHA 2540D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Express Shipping

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # 2

Page 1 of 1

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☒ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☒ PDF ☒ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	Analysis Request
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:		Quote #: Q39503	
Lab Work (lab use)	L1658117-COFC	ALS Contact:	Sampler: J Nev; 11

Sample #	(This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Conventionals** see notes	TSS-Low, TDS-Low	Number of Containers
	A8-A7	5-Aug-15	0830	Surface Water	X	X	2
	D1	5-Aug-15	12:30	↓	X	X	2
	B5-B4	6-Aug-15	0840		X	X	2
	A20-A19	6-Aug-15	16:15		X	X	2
	A34-A16	7-Aug-15	10:45		X	X	2
	C8-C7	8-Aug-15	9:00		X	X	2
	A101-A100	8-Aug-15	11:50		X	X	2
	E3-E2	5-Aug-15	0840	↓	X	X	2

Short Holding Time
Rush Processing

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

**Conventionals includes: Alk Species, pH, EC, Turbidity, Conductivity, Anions (F, NO2, NO3, Br, SO4), low-level Chloride, Silicate, TD-P, and Ortho-PO4.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
J Nev; 11	10-Aug-15	0900	Jeav	14Aug	10:15	6.5 °C				

GENF 20.00 Front

AZIMUTH CONSULTING GROUP INC.
ATTN: Eric Franz
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 18-AUG-15
Report Date: 27-AUG-15 17:42 (MT)
Version: FINAL

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1659270

Project P.O. #: NOT SUBMITTED
Job Reference: AMARUQ SURFACEWATER
C of C Numbers: 3
Legal Site Desc:

Comments: ADDITIONAL 27-AUG-15 17:31

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1659270-1 Surface Water 04-AUG-15 08:00 A1-D51	L1659270-2 Surface Water 04-AUG-15 10:30 A12-A11	L1659270-3 Surface Water 04-AUG-15 13:10 A17-A16	L1659270-4 Surface Water 04-AUG-15 16:28 C58 OUTLET	L1659270-5 Surface Water 06-AUG-15 08:40 B5-B4
WATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	5.77	8.98	5.31	9.68	7.84
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0050	0.0073	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (mg/L)	0.144	0.144	0.152	0.124	0.143
	Phosphorus (P)-Total (mg/L)	0.0026	<0.0020	0.0023	<0.0020	<0.0020
Cyanides	Cyanide, Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cyanide, Free (mg/L)	<0.0010	0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.92	1.84	1.88	1.60	1.57
	Total Organic Carbon (mg/L)	1.90	1.70	1.63	1.47	1.56
Total Metals	Aluminum (Al)-Total (mg/L)	0.0090	0.0084	0.0085	0.0049	0.0088
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00010	0.00035	0.00011	0.00030	0.00020
	Barium (Ba)-Total (mg/L)	0.00301	0.00473	0.00371	0.00389	0.00457
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	0.000051	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	1.51	2.30	1.33	2.26	1.94
	Chromium (Cr)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00010
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	<0.00050	0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Total (mg/L)	0.051	0.017	0.057	0.015	0.035
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Total (mg/L)	0.46	0.79	0.50	1.02	0.71
	Manganese (Mn)-Total (mg/L)	0.00162	0.00075	0.00080	0.00386	0.00097
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel (Ni)-Total (mg/L)	<0.00050	0.00066	<0.00050	0.00052	<0.00050
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	0.37	0.57	0.41	0.63	0.59
	Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)-Total (mg/L)	0.265	0.354	0.464	0.219	0.344
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	0.620	0.577	0.656	0.506	0.542
	Strontium (Sr)-Total (mg/L)	0.00727	0.0115	0.00714	0.00961	0.00825
	Sulfur (S)-Total (mg/L)	0.56	0.94	<0.50	1.10	0.82

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1659270-6				
	Description	QA				
	Sampled Date	04-AUG-15				
	Sampled Time	08:00				
	Client ID	TRAVEL BLANK				
Grouping	**Analyte**					
WATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	<0.50				
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	<0.0050				
	Total Kjeldahl Nitrogen (mg/L)	<0.050				
	Phosphorus (P)-Total (mg/L)	<0.0020				
Cyanides	Cyanide, Total (mg/L)	<0.0010				
	Cyanide, Free (mg/L)	<0.0010				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					
	Total Organic Carbon (mg/L)	<0.50				
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	<0.00010				
	Barium (Ba)-Total (mg/L)	<0.000050				
	Beryllium (Be)-Total (mg/L)	<0.000020				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	<0.010				
	Cadmium (Cd)-Total (mg/L)	<0.0000050				
	Calcium (Ca)-Total (mg/L)	<0.050				
	Chromium (Cr)-Total (mg/L)	<0.00010				
	Cobalt (Co)-Total (mg/L)	<0.00010				
	Copper (Cu)-Total (mg/L)	<0.00050				
	Iron (Fe)-Total (mg/L)	<0.010				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	<0.0010				
	Magnesium (Mg)-Total (mg/L)	<0.10				
	Manganese (Mn)-Total (mg/L)	<0.00010				
	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	<0.000050				
	Nickel (Ni)-Total (mg/L)	<0.00050				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	<0.10				
	Selenium (Se)-Total (mg/L)	<0.000050				
	Silicon (Si)-Total (mg/L)	<0.050				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	<0.050				
	Strontium (Sr)-Total (mg/L)	<0.00020				
	Sulfur (S)-Total (mg/L)	<0.50				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1659270-1	L1659270-2	L1659270-3	L1659270-4	L1659270-5
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	04-AUG-15	04-AUG-15	04-AUG-15	04-AUG-15	06-AUG-15
Sampled Time	08:00	10:30	13:10	16:28	08:40
Client ID	A1-D51	A12-A11	A17-A16	C58 OUTLET	B5-B4
Grouping / **Analyte**					
WATER					
Total Metals Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Total (mg/L)	0.000035	0.000028	0.000027	<0.000010	0.000025
Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0040	0.0022	0.0040	0.0018	0.0033
Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)	<0.00010	0.00032	<0.00010	0.00029	0.00016
Barium (Ba)-Dissolved (mg/L)	0.00353	0.00614 DTC	0.00483 DTC	0.00410	0.00742 DTC
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000063
Calcium (Ca)-Dissolved (mg/L)	1.54	2.29	1.33	2.23	1.97
Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved (mg/L)	0.00032	0.00080	0.00032	0.00026	0.00082
Iron (Fe)-Dissolved (mg/L)	0.014	<0.010	0.025	<0.010	0.012
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	0.000137
Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Dissolved (mg/L)	0.47	0.79	0.49	1.00	0.71
Manganese (Mn)-Dissolved (mg/L)	0.00065	0.00059	0.00041	0.00042	0.00055
Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00061	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	0.37	0.57	0.40	0.59	0.60
Selenium (Se)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Silicon (Si)-Dissolved (mg/L)	0.253	0.358	0.447	0.209	0.340
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	0.555	0.676	0.672	0.511	0.649
Strontium (Sr)-Dissolved (mg/L)	0.00663	0.0110	0.00701	0.00930	0.00824
Sulfur (S)-Dissolved (mg/L)	<0.50	0.93	<0.50	1.07	0.83

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1659270-6				
	Description	QA				
	Sampled Date	04-AUG-15				
	Sampled Time	08:00				
	Client ID	TRAVEL BLANK				
Grouping	**Analyte**					
WATER						
Total Metals	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	<0.00030				
	Uranium (U)-Total (mg/L)	<0.000010				
	Vanadium (V)-Total (mg/L)	<0.00050				
	Zinc (Zn)-Total (mg/L)	<0.0030				
	Zirconium (Zr)-Total (mg/L)	<0.00030				
Dissolved Metals	Dissolved Mercury Filtration Location					
	Dissolved Metals Filtration Location					
	Aluminum (Al)-Dissolved (mg/L)					
	Antimony (Sb)-Dissolved (mg/L)					
	Arsenic (As)-Dissolved (mg/L)					
	Barium (Ba)-Dissolved (mg/L)					
	Beryllium (Be)-Dissolved (mg/L)					
	Bismuth (Bi)-Dissolved (mg/L)					
	Boron (B)-Dissolved (mg/L)					
	Cadmium (Cd)-Dissolved (mg/L)					
	Calcium (Ca)-Dissolved (mg/L)					
	Chromium (Cr)-Dissolved (mg/L)					
	Cobalt (Co)-Dissolved (mg/L)					
	Copper (Cu)-Dissolved (mg/L)					
	Iron (Fe)-Dissolved (mg/L)					
	Lead (Pb)-Dissolved (mg/L)					
	Lithium (Li)-Dissolved (mg/L)					
	Magnesium (Mg)-Dissolved (mg/L)					
	Manganese (Mn)-Dissolved (mg/L)					
	Mercury (Hg)-Dissolved (mg/L)					
	Molybdenum (Mo)-Dissolved (mg/L)					
	Nickel (Ni)-Dissolved (mg/L)					
	Phosphorus (P)-Dissolved (mg/L)					
	Potassium (K)-Dissolved (mg/L)					
	Selenium (Se)-Dissolved (mg/L)					
	Silicon (Si)-Dissolved (mg/L)					
	Silver (Ag)-Dissolved (mg/L)					
	Sodium (Na)-Dissolved (mg/L)					
	Strontium (Sr)-Dissolved (mg/L)					
	Sulfur (S)-Dissolved (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1659270-1	L1659270-2	L1659270-3	L1659270-4	L1659270-5
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	04-AUG-15	04-AUG-15	04-AUG-15	04-AUG-15	06-AUG-15
Sampled Time	08:00	10:30	13:10	16:28	08:40
Client ID	A1-D51	A12-A11	A17-A16	C58 OUTLET	B5-B4
Grouping / **Analyte**					
WATER					
Dissolved Metals Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	0.00012	<0.00010	<0.00010	0.00027
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.000028	0.000023	0.000021	<0.000010	0.000025
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1659270-6				
	Description	QA				
	Sampled Date	04-AUG-15				
	Sampled Time	08:00				
	Client ID	TRAVEL BLANK				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Thallium (Tl)-Dissolved (mg/L)					
	Tin (Sn)-Dissolved (mg/L)					
	Titanium (Ti)-Dissolved (mg/L)					
	Uranium (U)-Dissolved (mg/L)					
	Vanadium (V)-Dissolved (mg/L)					
	Zinc (Zn)-Dissolved (mg/L)					
	Zirconium (Zr)-Dissolved (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Bismuth (Bi)-Total	DLA	L1659270-6
Duplicate	Cadmium (Cd)-Total	DLA	L1659270-6
Duplicate	Lead (Pb)-Total	DLA	L1659270-6
Duplicate	Silver (Ag)-Total	DLA	L1659270-6
Duplicate	Thallium (Tl)-Total	DLA	L1659270-6
Duplicate	Tin (Sn)-Total	DLA	L1659270-6
Duplicate	Titanium (Ti)-Total	DLA	L1659270-6
Duplicate	Vanadium (V)-Total	DLA	L1659270-6
Duplicate	Zinc (Zn)-Total	DLA	L1659270-6
Duplicate	Zirconium (Zr)-Total	DLA	L1659270-6
Duplicate	Bismuth (Bi)-Dissolved	DLA	L1659270-1, -2, -3, -4, -5
Duplicate	Cadmium (Cd)-Dissolved	DLA	L1659270-1, -2, -3, -4, -5
Duplicate	Chromium (Cr)-Dissolved	DLA	L1659270-1, -2, -3, -4, -5
Duplicate	Cobalt (Co)-Dissolved	DLA	L1659270-1, -2, -3, -4, -5
Duplicate	Lead (Pb)-Dissolved	DLA	L1659270-1, -2, -3, -4, -5
Duplicate	Silver (Ag)-Dissolved	DLA	L1659270-1, -2, -3, -4, -5
Duplicate	Thallium (Tl)-Dissolved	DLA	L1659270-1, -2, -3, -4, -5
Duplicate	Titanium (Ti)-Dissolved	DLA	L1659270-1, -2, -3, -4, -5
Duplicate	Vanadium (V)-Dissolved	DLA	L1659270-1, -2, -3, -4, -5
Duplicate	Zirconium (Zr)-Dissolved	DLA	L1659270-1, -2, -3, -4, -5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1659270-1, -2, -3, -4, -5
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1659270-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1659270-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1659270-1, -2, -3, -4, -5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1659270-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1659270-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1659270-1, -2, -3, -4, -5
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1659270-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1659270-1, -2, -3, -4, -5
Matrix Spike	Aluminum (Al)-Dissolved	MS-B	L1659270-1, -2, -3, -4, -5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1659270-1, -2, -3, -4, -5
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L1659270-1, -2, -3, -4, -5
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1659270-1, -2, -3, -4, -5
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1659270-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1659270-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1659270-1, -2, -3, -4, -5
Matrix Spike	Zinc (Zn)-Dissolved	MS-B	L1659270-1, -2, -3, -4, -5
Matrix Spike	Total Organic Carbon	MS-B	L1659270-3
Matrix Spike	Total Organic Carbon	MS-B	L1659270-3
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1659270-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1659270-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Reference Information

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

BE-T-L-CCMS-VA Water Total Be (Low) in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

CARBONS-DOC-VA Water Dissolved organic carbon by combustion APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CARBONS-TOC-VA Water Total organic carbon by combustion APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CN-FREE-L-CFA-VA Water Low Level Free Cyanide in water by CFA ASTM 7237

This analysis is carried out using procedures adapted from ASTM Method 7237 "Free Cyanide with Flow Injection Analysis (FIA) Utilizing Gas Diffusion Separation and Amperometric Detection". Free cyanide is determined by in-line gas diffusion at pH 6 with final determination by colourimetric analysis.

CN-T-L-CFA-VA Water Low Level Total Cyanide in water by CFA ISO 14403:2002

This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-DIS-LOW-ICP-VA Water Dissolved Metals in Water by ICPOES EPA 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-TOT-LOW-ICP-VA Water Total Metals in Water by ICPOES EPA 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society

Reference Information

of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

S-DIS-ICP-VA Water Dissolved Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

S-TOT-ICP-VA Water Total Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location

Chain of Custody Numbers:

3

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Ground Shipping

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # 3
Page 1 of 1

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☒ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☒ PDF ☒ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	Analysis Request
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q39503	
Lab Work Order # (lab use only)		ALS Contact:	Sampler: J Neuil

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	TOC, Ammonia, TKN, Total P	DOC	T-CN (Low), Free CN (Low)	Total mercury	Dissolved mercury	Total Metals	Dissolved Metals	Number of Containers
	A1-D51	4-Aug-15	0800	Surface Water	X	X	X	X	X	X	X	7
	A12-A11	4-Aug-15	10:30	Surface water	X	X	X	X	X	X	X	7
	A17-A16	4-Aug-15	13:10	↓	X	X	X	X	X	X	X	7
	C58 Outlet	4-Aug-15	16:28	↓	X	X	X	X	X	X	X	7
	B5-B4	6-Aug-15	0840	↓	X	X	X	X	X	X	X	7
	Travel blank	—	—	QA	X	X	X	X	X	X	X	5

Short Holding Time
Rush Processing

L1659270-COFC

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
J Neuil	10-Aug-15	0900	Shafel	Aug 18	1215	20/20 °C				

GENF 20.00 Front

AZIMUTH CONSULTING GROUP INC.
ATTN: Eric Franz
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 18-AUG-15
Report Date: 26-AUG-15 17:33 (MT)
Version: FINAL REV. 2

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1659279

Project P.O. #: NOT SUBMITTED
Job Reference: AMARUQ SURFACEWATER
C of C Numbers: 4
Legal Site Desc:

Comments: Please note Dissolved S data has been removed from this report, as requested, for sample D1 only, due to the possibility of improper preservation and, therefore, field contamination.

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1659279-1	L1659279-2	L1659279-3	L1659279-4	L1659279-5
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	06-AUG-15	05-AUG-15	05-AUG-15	05-AUG-15	08-AUG-15
Sampled Time	16:15	08:40	13:00	08:40	11:50
Client ID	A20-A19	A8-A7	D1	E3-E2	A101-A100
Grouping / **Analyte**					
WATER					
Physical Tests Hardness (as CaCO3) (mg/L)	4.45	8.22	8.43	8.40	4.17
Anions and Nutrients Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	0.0057	0.0061	<0.0050
Total Kjeldahl Nitrogen (mg/L)	0.142	0.150	0.157	0.132	0.123
Phosphorus (P)-Total (mg/L)	0.0026	<0.0020	0.0028	0.0048	0.0026
Cyanides Cyanide, Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon Dissolved Organic Carbon (mg/L)	1.96	1.74	2.24	1.86	1.75
Total Organic Carbon (mg/L)	2.08	1.63	2.30	1.46	1.86
Total Metals Aluminum (Al)-Total (mg/L)	0.0170	0.0064	0.0144	0.0060	0.0102
Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Total (mg/L)	<0.00010	0.00023	0.00014	0.00023	<0.00010
Barium (Ba)-Total (mg/L)	0.00355	0.00473	0.00275	0.00475	0.00173
Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Total (mg/L)	1.21	2.09	1.95	2.21	1.24
Chromium (Cr)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)-Total (mg/L)	0.038	0.017	0.028	0.016	0.031
Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Total (mg/L)	0.41	0.72	0.85	0.80	0.29
Manganese (Mn)-Total (mg/L)	0.00077	0.00225	0.00238	0.00179	0.00240
Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	0.000060
Nickel (Ni)-Total (mg/L)	<0.00050	0.00054	<0.00050	0.00052	<0.00050
Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total (mg/L)	0.38	0.53	0.34	0.61	0.27
Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Silicon (Si)-Total (mg/L)	0.571	0.372	0.195	0.401	0.412
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total (mg/L)	0.632	0.541	0.727	0.537	0.580
Strontium (Sr)-Total (mg/L)	0.00699	0.00899	0.00610	0.00903	0.00556
Sulfur (S)-Total (mg/L)	<0.50	0.91	<0.50	1.00	<0.50

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1659279-6	L1659279-7			
	Description	Surface Water	Surface Water			
	Sampled Date	08-AUG-15	07-AUG-15			
	Sampled Time	09:00	10:45			
	Client ID	C8-C7	A34-A16			
Grouping	**Analyte**					
WATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	10.6	5.19			
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050			
	Total Kjeldahl Nitrogen (mg/L)	0.095	0.193			
	Phosphorus (P)-Total (mg/L)	<0.020 DLM	0.0038			
Cyanides	Cyanide, Total (mg/L)	<0.0010	<0.0010			
	Cyanide, Free (mg/L)	<0.0010	<0.0010			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.35	2.33			
	Total Organic Carbon (mg/L)	1.41	2.43			
Total Metals	Aluminum (Al)-Total (mg/L)	0.0051	0.0211			
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010			
	Arsenic (As)-Total (mg/L)	0.00036	0.00018			
	Barium (Ba)-Total (mg/L)	0.00991	0.00218			
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020			
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050			
	Boron (B)-Total (mg/L)	<0.010	<0.010			
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050			
	Calcium (Ca)-Total (mg/L)	2.47	0.906			
	Chromium (Cr)-Total (mg/L)	<0.00010	0.00015			
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010			
	Copper (Cu)-Total (mg/L)	<0.00050	0.00072			
	Iron (Fe)-Total (mg/L)	<0.010	0.161			
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050			
	Lithium (Li)-Total (mg/L)	<0.0010	<0.0010			
	Magnesium (Mg)-Total (mg/L)	1.09	0.69			
	Manganese (Mn)-Total (mg/L)	0.00269	0.00257			
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Total (mg/L)	0.000966	0.000083			
	Nickel (Ni)-Total (mg/L)	0.00056	0.00076			
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050			
	Potassium (K)-Total (mg/L)	0.50	0.37			
	Selenium (Se)-Total (mg/L)	<0.000050	<0.000050			
	Silicon (Si)-Total (mg/L)	0.634	0.335			
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Total (mg/L)	0.625	0.614			
	Strontium (Sr)-Total (mg/L)	0.0119	0.00523			
	Sulfur (S)-Total (mg/L)	0.83	<0.50			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1659279-1	L1659279-2	L1659279-3	L1659279-4	L1659279-5
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	06-AUG-15	05-AUG-15	05-AUG-15	05-AUG-15	08-AUG-15
Sampled Time	16:15	08:40	13:00	08:40	11:50
Client ID	A20-A19	A8-A7	D1	E3-E2	A101-A100
Grouping / **Analyte**					
WATER					
Total Metals					
Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total (mg/L)	0.00033	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Total (mg/L)	0.000048	0.000021	0.000045	0.000021	0.000052
Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals					
Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0060	0.0027	0.0054	0.0033	0.0034
Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)	<0.00010	0.00020	0.00015	0.00020	<0.00010
Barium (Ba)-Dissolved (mg/L)	0.00655 DTC	0.00748 DTC	0.00313	0.00802 DTC	0.00256 DTC
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Dissolved (mg/L)	1.16	2.11	1.98	2.15	1.20
Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved (mg/L)	0.00069	0.00063	0.00064	0.00059	0.00053
Iron (Fe)-Dissolved (mg/L)	0.014	<0.010	0.011	<0.010	<0.010
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Dissolved (mg/L)	0.38	0.72	0.85	0.74	0.28
Manganese (Mn)-Dissolved (mg/L)	0.00046	0.00096	0.00068	0.00094	0.00062
Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	0.000054
Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00052	<0.00050	0.00052	<0.00050
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	0.34	0.54	0.32	0.55	0.27
Selenium (Se)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Silicon (Si)-Dissolved (mg/L)	0.536	0.369	0.191	0.390	0.386
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	0.767	0.629	0.820	0.658 DTC	0.649
Strontium (Sr)-Dissolved (mg/L)	0.00669	0.00870	0.00618	0.00868	0.00533
Sulfur (S)-Dissolved (mg/L)	<0.50	0.89		0.89	<0.50

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1659279-6	L1659279-7			
	Description	Surface Water	Surface Water			
	Sampled Date	08-AUG-15	07-AUG-15			
	Sampled Time	09:00	10:45			
	Client ID	C8-C7	A34-A16			
Grouping	**Analyte**					
WATER						
Total Metals	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Total (mg/L)	<0.00030	0.00048			
	Uranium (U)-Total (mg/L)	0.000020	0.000069			
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050			
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030			
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0026	0.0073			
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010			
	Arsenic (As)-Dissolved (mg/L)	0.00034	0.00015			
	Barium (Ba)-Dissolved (mg/L)	0.0115	0.00376 DTC			
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050			
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010			
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Calcium (Ca)-Dissolved (mg/L)	2.47	0.922			
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00010			
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010			
	Copper (Cu)-Dissolved (mg/L)	0.00047	0.00074			
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.080			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010			
	Magnesium (Mg)-Dissolved (mg/L)	1.08	0.70			
	Manganese (Mn)-Dissolved (mg/L)	0.00108	0.00179			
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)	0.000126	<0.000050			
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00069			
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050			
	Potassium (K)-Dissolved (mg/L)	0.53	0.44			
	Selenium (Se)-Dissolved (mg/L)	<0.000050	<0.000050			
	Silicon (Si)-Dissolved (mg/L)	0.636	0.324			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	0.698	0.701			
	Strontium (Sr)-Dissolved (mg/L)	0.0124	0.00483			
	Sulfur (S)-Dissolved (mg/L)	0.80	<0.50			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1659279-1	L1659279-2	L1659279-3	L1659279-4	L1659279-5
	Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
	Sampled Date	06-AUG-15	05-AUG-15	05-AUG-15	05-AUG-15	08-AUG-15
	Sampled Time	16:15	08:40	13:00	08:40	11:50
	Client ID	A20-A19	A8-A7	D1	E3-E2	A101-A100
Grouping	**Analyte**					
WATER						
Dissolved Metals	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	0.00016	0.00012	0.00013	0.00013	0.00013
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000044	0.000017	0.000043	0.000018	0.000045
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1659279-6	L1659279-7			
	Description	Surface Water	Surface Water			
	Sampled Date	08-AUG-15	07-AUG-15			
	Sampled Time	09:00	10:45			
	Client ID	C8-C7	A34-A16			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Dissolved (mg/L)	0.00011	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030			
	Uranium (U)-Dissolved (mg/L)	0.000018	0.000054			
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050			
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010			
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Bismuth (Bi)-Dissolved	DLA	L1659279-1, -2, -3, -4, -5, -6, -7
Duplicate	Cadmium (Cd)-Dissolved	DLA	L1659279-1, -2, -3, -4, -5, -6, -7
Duplicate	Chromium (Cr)-Dissolved	DLA	L1659279-1, -2, -3, -4, -5, -6, -7
Duplicate	Cobalt (Co)-Dissolved	DLA	L1659279-1, -2, -3, -4, -5, -6, -7
Duplicate	Lead (Pb)-Dissolved	DLA	L1659279-1, -2, -3, -4, -5, -6, -7
Duplicate	Silver (Ag)-Dissolved	DLA	L1659279-1, -2, -3, -4, -5, -6, -7
Duplicate	Thallium (Tl)-Dissolved	DLA	L1659279-1, -2, -3, -4, -5, -6, -7
Duplicate	Titanium (Ti)-Dissolved	DLA	L1659279-1, -2, -3, -4, -5, -6, -7
Duplicate	Vanadium (V)-Dissolved	DLA	L1659279-1, -2, -3, -4, -5, -6, -7
Duplicate	Zirconium (Zr)-Dissolved	DLA	L1659279-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1659279-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1659279-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1659279-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1659279-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1659279-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1659279-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Phosphorus (P)-Total	MS-B	L1659279-1, -2, -3, -4, -5, -7
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1659279-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1659279-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1659279-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Aluminum (Al)-Dissolved	MS-B	L1659279-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1659279-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L1659279-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1659279-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1659279-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1659279-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1659279-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Zinc (Zn)-Dissolved	MS-B	L1659279-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Total Organic Carbon	MS-B	L1659279-4
Matrix Spike	Total Organic Carbon	MS-B	L1659279-4
Matrix Spike	Phosphorus (P)-Total	MS-B	L1659279-6
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1659279-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1659279-1, -2, -3, -4, -5, -6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects.
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

		Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

Reference Information

CARBONS-DOC-VA Water

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CARBONS-TOC-VA Water Total organic carbon by combustion APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CN-FREE-L-CFA-VA Water Low Level Free Cyanide in water by CFA ASTM 7237

This analysis is carried out using procedures adapted from ASTM Method 7237 "Free Cyanide with Flow Injection Analysis (FIA) Utilizing Gas Diffusion Separation and Amperometric Detection". Free cyanide is determined by in-line gas diffusion at pH 6 with final determination by colourimetric analysis.

CN-T-L-CFA-VA Water Low Level Total Cyanide in water by CFA ISO 14403:2002

This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-DIS-LOW-ICP-VA Water Dissolved Metals in Water by ICPOES EPA 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-TOT-LOW-ICP-VA Water Total Metals in Water by ICPOES EPA 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

S-DIS-ICP-VA Water Dissolved Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or

Reference Information

microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

S-TOT-ICP-VA Water Total Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location

Chain of Custody Numbers:

4

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Ground Shipping

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # 4
Page 1 of 1

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☒ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☒ PDF ☒ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	**Analysis Request**
Invoice To	Same as Report ? ☑ Yes ☐ No	**Client / Project Information**	Please indicate below Filtered, Preserved or both (F, P, F/P)
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q39503	
Lab Work Order # (lab use only)		ALS Contact:	Sampler: J Neuil

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	P TOC, Ammonia, TKN, Total P	F/P DOC	P T-CN (Low), Free CN (Low)	P Total mercury	F/P Dissolved mercury	P Total Metals	F/P Dissolved Metals	Number of Containers
	A20-A19	6-Aug-15	16:15	Surface Water	X	X	X	X	X	X	X	7
	AB-A7	5-Aug-15	08 40		X	X	X	X	X	X	X	7
	D1	5-Aug-15	13:00		X	X	X	X	X	X	X	7
	E3-E2	5-Aug-15	08 40		X	X	X	X	X	X	X	7
	A101-A100	8-Aug-15	11:50		X	X	X	X	X	X	X	7
	C8-C7	8-Aug-15	0900		X	X	X	X	X	X	X	7
	A34-A16	7-Aug-15	10:45		X	X	X	X	X	X	X	7

Short Holding Time
• Rush Processing

L1659279-COFC

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
J. Neuil	10 Aug 15	0900	Shafer	Aug 18	1215	20/20 °C				

GENF 20.00 Front

AZIMUTH CONSULTING GROUP INC.
ATTN: Maggie McConnell
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 09-SEP-15
Report Date: 22-SEP-15 14:32 (MT)
Version: FINAL

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1669874

Project P.O. #:	NOT SUBMITTED
Job Reference:	AMARUQ SEDIMENT
C of C Numbers:	2, 3, OL-1767
Legal Site Desc:	

Comments: Please note that Silver (Ag) results for Filter samples are denoted with 'RRR' qualifiers due to a failing Laboratory Control Standard associated with those results. Due to the destructive nature of Filter analysis the testing could not be repeated and the results for Silver (Ag) should be considered approximate values.

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1669874-34 Filter 22-AUG-15 AMARUQ SWIPE-1	L1669874-35 Filter 21-AUG-15 AMARUQ SWIPE-2	L1669874-36 Filter 24-AUG-15 AMARUQ SWIPE-3	L1669874-37 Filter 24-AUG-15 AMARUQ SWIPE-4
Sample ID		L1669874-34	L1669874-35	L1669874-36	L1669874-37
Description		Filter	Filter	Filter	Filter
Sampled Date		22-AUG-15	21-AUG-15	24-AUG-15	24-AUG-15
Sampled Time					
Client ID		AMARUQ SWIPE-1	AMARUQ SWIPE-2	AMARUQ SWIPE-3	AMARUQ SWIPE-4
FILTER					
Metals	Aluminum (Al)-Total (mg)	0.011	0.018	0.015	<0.010
	Antimony (Sb)-Total (mg)	<0.010	<0.010	<0.010	<0.010
	Arsenic (As)-Total (mg)	<0.010	<0.010	<0.010	<0.010
	Barium (Ba)-Total (mg)	0.00135	0.00147	0.00084	<0.00050
	Beryllium (Be)-Total (mg)	<0.00030	<0.00030	<0.00030	<0.00030
	Bismuth (Bi)-Total (mg)	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg)	<0.00050	<0.00050	<0.00050	<0.00050
	Calcium (Ca)-Total (mg)	<0.050	<0.050	<0.050	<0.050
	Chromium (Cr)-Total (mg)	0.0021	0.0083	0.0042	0.0054
	Cobalt (Co)-Total (mg)	<0.00050	<0.00050	<0.00050	<0.00050
	Copper (Cu)-Total (mg)	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Total (mg)	0.0312	0.0696	0.0452	0.0395
	Lead (Pb)-Total (mg)	<0.0030	0.0038	<0.0030	<0.0030
	Lithium (Li)-Total (mg)	<0.00050	<0.00050	<0.00050	<0.00050
	Magnesium (Mg)-Total (mg)	0.0084	0.0170	0.0154	0.0094
	Manganese (Mn)-Total (mg)	0.00147	0.00107	0.00077	0.00060
	Molybdenum (Mo)-Total (mg)	<0.0020	<0.0020	<0.0020	<0.0020
	Nickel (Ni)-Total (mg)	<0.0030	0.0038	<0.0030	<0.0030
	Phosphorus (P)-Total (mg)	<0.020	<0.020	<0.020	<0.020
	Potassium (K)-Total (mg)	<0.10	<0.10	<0.10	<0.10
	Selenium (Se)-Total (mg)	<0.010	<0.010	<0.010	<0.010
	Silver (Ag)-Total (mg)	<0.00050 RRR	<0.00050 RRR	<0.00050 RRR	<0.00050 RRR
	Sodium (Na)-Total (mg)	0.10	<0.10	<0.10	<0.10
	Strontium (Sr)-Total (mg)	<0.00030	<0.00030	<0.00030	<0.00030
	Thallium (Tl)-Total (mg)	<0.010	<0.010	<0.010	<0.010
	Tin (Sn)-Total (mg)	<0.0020	0.0023	<0.0020	<0.0020
	Titanium (Ti)-Total (mg)	0.00059	0.00089	0.00055	<0.00050
	Vanadium (V)-Total (mg)	<0.0020	<0.0020	<0.0020	<0.0020
	Zinc (Zn)-Total (mg)	0.00031	0.00113	0.00095	0.00047

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1669874-1	L1669874-2	L1669874-3	L1669874-4	L1669874-5
Description	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste
Sampled Date	22-AUG-15	22-AUG-15	22-AUG-15	22-AUG-15	22-AUG-15
Sampled Time					
Client ID	WTN-EX-1	WTN-EX-2	WTN-EX-3	WTN-EX-4	WTN-EX-5
Grouping / **Analyte**					
SOIL					
Physical Tests Moisture (%)	86.3	86.9	87.9	86.6	89.0
pH (1:2 soil:water) (pH)	6.03	5.80	6.40	6.02	6.16
Particle Size % Gravel (>2mm) (%)	<0.10	<0.10	<0.10	0.15	<0.10
% Sand (2.0mm - 0.063mm) (%)	24.0	9.19	21.7	21.9	9.37
% Silt (0.063mm - 4um) (%)	66.1	79.3	71.1	69.9	82.5
% Clay (<4um) (%)	9.92	11.5	7.16	8.00	8.11
Texture	Silt loam	Silt	Silt loam	Silt loam	Silt
Organic / Inorganic Carbon Total Organic Carbon (%)	6.65	7.08	7.80	7.36	8.66
Metals Aluminum (Al) (mg/kg)	14700	18400	13500	15200	16000
Antimony (Sb) (mg/kg)	0.27	0.29	0.29	0.29	0.35
Arsenic (As) (mg/kg)	69.4	147	79.5	81.7	139
Barium (Ba) (mg/kg)	98.0	129	102	107	106
Beryllium (Be) (mg/kg)	1.12	1.53	1.06	1.14	1.32
Bismuth (Bi) (mg/kg)	0.33	0.47	0.33	0.34	0.40
Boron (B) (mg/kg)	10.0	10.3	10.0	10.1	12.5
Cadmium (Cd) (mg/kg)	0.297	0.481	0.304	0.334	0.375
Calcium (Ca) (mg/kg)	3310	2950	3220	3340	3710
Chromium (Cr) (mg/kg)	162	197	169	176	176
Cobalt (Co) (mg/kg)	13.6	17.0	15.0	15.8	14.9
Copper (Cu) (mg/kg)	32.6	50.8	33.5	34.7	40.9
Iron (Fe) (mg/kg)	35200	51700	38600	39000	50900
Lead (Pb) (mg/kg)	10.0	13.3	9.90	10.1	11.4
Lithium (Li) (mg/kg)	16.2	17.6	14.7	16.7	15.4
Magnesium (Mg) (mg/kg)	8770	9750	8870	9440	9030
Manganese (Mn) (mg/kg)	916	816	1170	1230	744
Mercury (Hg) (mg/kg)	0.0597	0.0764	0.0675	0.0667	0.0788
Molybdenum (Mo) (mg/kg)	2.29	4.57	2.39	2.32	3.79
Nickel (Ni) (mg/kg)	90.7	117	91.8	98.9	95.6
Phosphorus (P) (mg/kg)	662	794	716	795	864
Potassium (K) (mg/kg)	1940	2340	1760	2030	2150
Selenium (Se) (mg/kg)	0.40	0.70	0.47	0.48	0.59
Silver (Ag) (mg/kg)	0.21	0.31	0.21	0.23	0.27
Sodium (Na) (mg/kg)	293	339	327	390	506
Strontium (Sr) (mg/kg)	24.4	22.7	21.6	25.6	24.8
Thallium (Tl) (mg/kg)	0.129	0.189	0.130	0.142	0.158
Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti) (mg/kg)	485	537	393	507	500

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1669874-6	L1669874-7	L1669874-8	L1669874-9	L1669874-10
Description	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste
Sampled Date	22-AUG-15	22-AUG-15	22-AUG-15	22-AUG-15	22-AUG-15
Sampled Time					
Client ID	WTN-1	WTN-2	WTN-3	WTN-4	WTN-5
Grouping / **Analyte**					
SOIL					
Physical Tests Moisture (%)	85.0	86.8	80.9	87.2	87.2
pH (1:2 soil:water) (pH)	6.29	6.17	5.71	5.67	5.76
Particle Size % Gravel (>2mm) (%)	<0.10	0.41	<0.10	<0.10	0.12
% Sand (2.0mm - 0.063mm) (%)	4.08	4.09	4.68	3.18	4.75
% Silt (0.063mm - 4um) (%)	87.0	86.0	82.6	84.6	83.6
% Clay (<4um) (%)	8.95	9.53	12.6	12.2	11.6
Texture	Silt	Silt	Silt	Silt	Silt
Organic / Inorganic Carbon Total Organic Carbon (%)	4.91	5.20	4.65	5.72	5.20
Metals Aluminum (Al) (mg/kg)	13900	12700	14800	14200	13400
Antimony (Sb) (mg/kg)	0.25	0.27	0.25	0.34	0.27
Arsenic (As) (mg/kg)	897	1000	568	1760	809
Barium (Ba) (mg/kg)	212	586	97.4	180	179
Beryllium (Be) (mg/kg)	1.22	1.18	1.27	1.28	1.18
Bismuth (Bi) (mg/kg)	0.45	0.42	0.47	0.49	0.46
Boron (B) (mg/kg)	7.3	7.2	6.9	7.7	6.4
Cadmium (Cd) (mg/kg)	0.315	0.483	0.151	0.363	0.407
Calcium (Ca) (mg/kg)	1950	2150	2050	2260	1660
Chromium (Cr) (mg/kg)	84.4	80.5	94.5	95.4	87.5
Cobalt (Co) (mg/kg)	24.0	20.0	20.5	25.3	24.0
Copper (Cu) (mg/kg)	37.3	38.4	35.5	41.7	38.6
Iron (Fe) (mg/kg)	151000	146000	127000	179000	139000
Lead (Pb) (mg/kg)	10.9	11.0	11.7	12.8	11.5
Lithium (Li) (mg/kg)	13.4	11.8	14.0	13.1	12.5
Magnesium (Mg) (mg/kg)	5800	5410	6300	6110	5880
Manganese (Mn) (mg/kg)	6660	23500	2200	5430	3900
Mercury (Hg) (mg/kg)	0.0742	0.0827	0.0612	0.0939	0.0795
Molybdenum (Mo) (mg/kg)	6.27	6.91	5.33	8.63	5.81
Nickel (Ni) (mg/kg)	92.0	126	59.9	92.7	108
Phosphorus (P) (mg/kg)	1830	2250	1770	2750	2020
Potassium (K) (mg/kg)	2040	2060	2150	2110	1840
Selenium (Se) (mg/kg)	0.78	0.78	0.75	0.96	0.76
Silver (Ag) (mg/kg)	0.26	0.28	0.23	0.32	0.25
Sodium (Na) (mg/kg)	292	302	257	355	328
Strontium (Sr) (mg/kg)	22.0	29.5	21.6	25.0	19.0
Thallium (Tl) (mg/kg)	0.219	0.240	0.154	0.210	0.236
Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti) (mg/kg)	379	370	413	393	308

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1669874-11	L1669874-12	L1669874-13	L1669874-14	L1669874-15
Description	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste
Sampled Date	22-AUG-15	21-AUG-15	21-AUG-15	21-AUG-15	21-AUG-15
Sampled Time					
Client ID	WTN-COMP	WTS-1	WTS-2	WTS-3	WTS-4
Grouping / **Analyte**					
SOIL					
Physical Tests Moisture (%)	88.1	85.5	85.2	87.0	87.0
pH (1:2 soil:water) (pH)		5.48	5.46	5.53	5.76
Particle Size % Gravel (>2mm) (%)		<0.10	<0.10	<0.10	<0.10
% Sand (2.0mm - 0.063mm) (%)		5.41	3.07	2.77	2.75
% Silt (0.063mm - 4um) (%)		82.0	82.4	82.2	84.7
% Clay (<4um) (%)		12.6	14.5	15.0	12.6
Texture		Silt	Silt	Silt	Silt
Organic / Inorganic Carbon Total Organic Carbon (%)		5.29	5.50	6.24	6.41
Metals Aluminum (Al) (mg/kg)		14700	16800	17100	16200
Antimony (Sb) (mg/kg)		0.23	0.26	0.22	0.23
Arsenic (As) (mg/kg)		102	152	80.3	112
Barium (Ba) (mg/kg)		113	120	122	133
Beryllium (Be) (mg/kg)		1.35	1.67	1.47	1.42
Bismuth (Bi) (mg/kg)		0.52	0.58	0.55	0.56
Boron (B) (mg/kg)		6.9	7.9	9.4	8.9
Cadmium (Cd) (mg/kg)		0.410	0.181	0.177	0.299
Calcium (Ca) (mg/kg)		2300	2340	2630	2530
Chromium (Cr) (mg/kg)		63.3	70.0	70.6	68.6
Cobalt (Co) (mg/kg)		16.1	15.9	10.4	13.4
Copper (Cu) (mg/kg)		37.9	45.0	41.4	42.0
Iron (Fe) (mg/kg)		69000	94100	54800	77400
Lead (Pb) (mg/kg)		13.7	13.7	13.0	13.8
Lithium (Li) (mg/kg)		13.1	14.1	15.0	13.7
Magnesium (Mg) (mg/kg)		5690	5720	6250	5900
Manganese (Mn) (mg/kg)		2010	1890	1040	2180
Mercury (Hg) (mg/kg)		0.0764	0.0789	0.0752	0.0952
Molybdenum (Mo) (mg/kg)		3.26	5.57	3.87	3.97
Nickel (Ni) (mg/kg)		73.9	63.6	54.4	67.0
Phosphorus (P) (mg/kg)		1680	1380	1050	1330
Potassium (K) (mg/kg)		2170	2420	2580	2450
Selenium (Se) (mg/kg)		0.67	0.78	0.68	0.82
Silver (Ag) (mg/kg)		0.26	0.29	0.33	0.34
Sodium (Na) (mg/kg)		282	276	344	409
Strontium (Sr) (mg/kg)		22.1	23.2	25.4	24.5
Thallium (Tl) (mg/kg)		0.195	0.181	0.171	0.188
Tin (Sn) (mg/kg)		<2.0	<2.0	<2.0	<2.0
Titanium (Ti) (mg/kg)		407	437	456	425

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID / Description / Sampled Date / Sampled Time / Client ID	L1669874-16 Soil/Sed/Waste 21-AUG-15 WTS-5	L1669874-17 Soil/Sed/Waste 21-AUG-15 WTS-COMP	L1669874-18 Soil/Sed/Waste 24-AUG-15 MAM-1	L1669874-19 Soil/Sed/Waste 24-AUG-15 MAM-2	L1669874-20 Soil/Sed/Waste 24-AUG-15 MAM-3
SOIL							
Physical Tests	Moisture (%)		84.4	85.9	89.7	90.7	91.0
	pH (1:2 soil:water) (pH)		5.94		5.85	5.98	5.72
Particle Size	% Gravel (>2mm) (%)		0.82		<0.10	<0.10	<0.10
	% Sand (2.0mm - 0.063mm) (%)		4.49		0.92	2.45	0.72
	% Silt (0.063mm - 4um) (%)		82.2		93.9	92.4	94.0
	% Clay (<4um) (%)		12.5		5.20	5.13	5.33
	Texture		Silt		Silt	Silt	Silt
Organic / Inorganic Carbon	Total Organic Carbon (%)		4.58		11.4	11.7	10.7
Metals	Aluminum (Al) (mg/kg)		16400		19100	18600	19500
	Antimony (Sb) (mg/kg)		0.22		0.29	0.32	0.37
	Arsenic (As) (mg/kg)		118		75.7	143	277
	Barium (Ba) (mg/kg)		104		142	142	153
	Beryllium (Be) (mg/kg)		1.28		1.34	1.29	1.55
	Bismuth (Bi) (mg/kg)		0.53		0.47	0.45	0.53
	Boron (B) (mg/kg)		6.7		19.5	20.8	20.6
	Cadmium (Cd) (mg/kg)		0.224		0.267	0.255	0.300
	Calcium (Ca) (mg/kg)		2030		3620	3370	3310
	Chromium (Cr) (mg/kg)		66.1		161	162	168
	Cobalt (Co) (mg/kg)		23.7		11.4	11.5	13.6
	Copper (Cu) (mg/kg)		39.1		62.5	63.9	75.7
	Iron (Fe) (mg/kg)		89500		34100	43400	61200
	Lead (Pb) (mg/kg)		12.5		17.4	16.5	19.1
	Lithium (Li) (mg/kg)		13.2		18.4	17.1	15.7
	Magnesium (Mg) (mg/kg)		5750		9260	9010	8660
	Manganese (Mn) (mg/kg)		2760		349	414	468
	Mercury (Hg) (mg/kg)		0.0657		0.0987	0.0991	0.0972
	Molybdenum (Mo) (mg/kg)		4.09		3.24	3.73	5.96
	Nickel (Ni) (mg/kg)		60.0		105	102	109
	Phosphorus (P) (mg/kg)		1070		868	911	951
	Potassium (K) (mg/kg)		2340		3090	2950	2990
	Selenium (Se) (mg/kg)		0.75		0.63	0.63	0.84
	Silver (Ag) (mg/kg)		0.24		0.42	0.42	0.48
	Sodium (Na) (mg/kg)		330		424	442	520
	Strontium (Sr) (mg/kg)		21.3		24.8	24.3	24.4
	Thallium (Tl) (mg/kg)		0.199		0.246	0.223	0.245
	Tin (Sn) (mg/kg)		<2.0		<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)		447		528	510	565

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1669874-21	L1669874-22	L1669874-23	L1669874-24	L1669874-25
Description	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste
Sampled Date	24-AUG-15	24-AUG-15	24-AUG-15	23-AUG-15	23-AUG-15
Sampled Time					
Client ID	MAM-4	MAM-5	MAM-COMP	NEM-1	NEM-2
Grouping / **Analyte**					
SOIL					
Physical Tests Moisture (%)	89.9	89.8	90.9	91.7	85.6
pH (1:2 soil:water) (pH)	5.54	5.40		6.20	6.53
Particle Size % Gravel (>2mm) (%)	<0.10	<0.10		<0.10	0.26
% Sand (2.0mm - 0.063mm) (%)	0.85	1.08		12.5	50.3
% Silt (0.063mm - 4um) (%)	93.1	92.3		77.9	47.1
% Clay (<4um) (%)	6.09	6.60		9.56	2.35
Texture	Silt	Silt		Silt	Sandy loam
Organic / Inorganic Carbon Total Organic Carbon (%)	11.5	10.6		8.19	6.02
Metals Aluminum (Al) (mg/kg)	17000	18400		10800	9250
Antimony (Sb) (mg/kg)	0.25	0.26		0.40	0.22
Arsenic (As) (mg/kg)	68.6	70.0		52.0	13.4
Barium (Ba) (mg/kg)	125	136		98.5	63.1
Beryllium (Be) (mg/kg)	1.14	1.20		0.64	0.46
Bismuth (Bi) (mg/kg)	0.39	0.43		0.23	<0.20
Boron (B) (mg/kg)	17.0	15.3		14.1	9.1
Cadmium (Cd) (mg/kg)	0.269	0.296		0.248	0.180
Calcium (Ca) (mg/kg)	2770	2780		3490	3030
Chromium (Cr) (mg/kg)	141	158		113	96.5
Cobalt (Co) (mg/kg)	11.7	13.3		8.59	6.86
Copper (Cu) (mg/kg)	57.4	60.5		40.0	21.9
Iron (Fe) (mg/kg)	30200	33000		25800	14600
Lead (Pb) (mg/kg)	15.9	16.8		9.33	6.40
Lithium (Li) (mg/kg)	14.7	15.1		9.8	9.9
Magnesium (Mg) (mg/kg)	8380	8900		6450	6640
Manganese (Mn) (mg/kg)	357	408		407	236
Mercury (Hg) (mg/kg)	0.0960	0.0955		0.0299	0.0180
Molybdenum (Mo) (mg/kg)	2.83	2.89		3.84	1.42
Nickel (Ni) (mg/kg)	98.7	107		88.0	64.1
Phosphorus (P) (mg/kg)	764	796		697	518
Potassium (K) (mg/kg)	2710	2990		1470	1210
Selenium (Se) (mg/kg)	0.61	0.67		0.56	0.34
Silver (Ag) (mg/kg)	0.43	0.44		0.18	<0.10
Sodium (Na) (mg/kg)	304	338		430	390
Strontium (Sr) (mg/kg)	20.2	20.6		25.9	25.9
Thallium (Tl) (mg/kg)	0.224	0.249		0.093	0.060
Tin (Sn) (mg/kg)	<2.0	<2.0		<2.0	<2.0
Titanium (Ti) (mg/kg)	451	481		269	333

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1669874-26	L1669874-27	L1669874-28	L1669874-29	L1669874-30
Description	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste
Sampled Date	23-AUG-15	23-AUG-15	23-AUG-15	23-AUG-15	
Sampled Time					
Client ID	NEM-3	NEM-4	NEM-5	NEM-COMP	AMARUQ DUP-1
Grouping / **Analyte**					
SOIL					
Physical Tests Moisture (%)	90.9	91.3	86.8	90.0	84.3
pH (1:2 soil:water) (pH)	6.32	6.45	6.49		5.47
Particle Size % Gravel (>2mm) (%)	<0.10	<0.10	<0.10		0.34
% Sand (2.0mm - 0.063mm) (%)	19.2	19.0	44.0		4.54
% Silt (0.063mm - 4um) (%)	76.4	77.4	53.3		82.8
% Clay (<4um) (%)	4.42	3.60	2.63		12.3
Texture	Silt loam	Silt loam	Silt loam		Silt
Organic / Inorganic Carbon Total Organic Carbon (%)	11.1	10.9	5.49		4.61
Metals Aluminum (Al) (mg/kg)	10800	9990	9610		14300
Antimony (Sb) (mg/kg)	0.35	0.36	0.20		0.22
Arsenic (As) (mg/kg)	46.4	79.9	26.1		557
Barium (Ba) (mg/kg)	91.3	99.3	64.3		92.2
Beryllium (Be) (mg/kg)	0.59	0.55	0.47		1.09
Bismuth (Bi) (mg/kg)	0.21	0.22	<0.20		0.40
Boron (B) (mg/kg)	12.5	13.5	7.7		5.3
Cadmium (Cd) (mg/kg)	0.221	0.201	0.144		0.137
Calcium (Ca) (mg/kg)	3690	3160	2280		1720
Chromium (Cr) (mg/kg)	110	104	106		92.4
Cobalt (Co) (mg/kg)	7.96	10.2	6.77		19.7
Copper (Cu) (mg/kg)	36.4	33.1	27.5		33.6
Iron (Fe) (mg/kg)	23800	32500	18000		122000
Lead (Pb) (mg/kg)	8.35	8.60	7.16		10.4
Lithium (Li) (mg/kg)	10.0	8.5	8.5		10.5
Magnesium (Mg) (mg/kg)	6590	6130	6480		6000
Manganese (Mn) (mg/kg)	302	861	301		1960
Mercury (Hg) (mg/kg)	0.0289	0.0320	0.0213		0.0542
Molybdenum (Mo) (mg/kg)	2.50	3.17	2.99		4.88
Nickel (Ni) (mg/kg)	78.4	85.5	66.1		57.8
Phosphorus (P) (mg/kg)	664	736	498		1680
Potassium (K) (mg/kg)	1460	1380	1230		1950
Selenium (Se) (mg/kg)	0.51	0.56	0.36		0.71
Silver (Ag) (mg/kg)	0.16	0.13	0.11		0.20
Sodium (Na) (mg/kg)	555	522	297		222
Strontium (Sr) (mg/kg)	26.7	24.1	20.4		18.1
Thallium (Tl) (mg/kg)	0.079	0.081	0.064		0.130
Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0		<2.0
Titanium (Ti) (mg/kg)	258	241	261		363

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1669874-31	L1669874-32	L1669874-33	L1669874-38	
Description	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste	
Sampled Date					
Sampled Time					
Client ID	AMARUQ DUP-2	AMARUQ DUP-3	AMARUQ DUP-4	AMARUQ-COMP-DUP	
Grouping / **Analyte**					
SOIL					
Physical Tests Moisture (%)	85.6	91.3	90.4	91.2	
pH (1:2 soil:water) (pH)	5.83	6.37	6.27		
Particle Size % Gravel (>2mm) (%)	<0.10	<0.10	<0.10		
% Sand (2.0mm - 0.063mm) (%)	5.12	17.2	0.50		
% Silt (0.063mm - 4um) (%)	82.8	78.7	86.1		
% Clay (<4um) (%)	12.0	4.18	13.4		
Texture	Silt	Silt loam	Silt		
Organic / Inorganic Carbon Total Organic Carbon (%)	5.33	9.18	11.7		
Metals Aluminum (Al) (mg/kg)	14500	10300	17200		
Antimony (Sb) (mg/kg)	0.21	0.38	0.33		
Arsenic (As) (mg/kg)	96.7	47.2	138		
Barium (Ba) (mg/kg)	112	92.2	138		
Beryllium (Be) (mg/kg)	1.26	0.68	1.34		
Bismuth (Bi) (mg/kg)	0.49	0.25	0.45		
Boron (B) (mg/kg)	7.0	13.0	19.8		
Cadmium (Cd) (mg/kg)	0.383	0.273	0.258		
Calcium (Ca) (mg/kg)	2270	3620	3370		
Chromium (Cr) (mg/kg)	62.5	113	158		
Cobalt (Co) (mg/kg)	15.8	8.06	11.4		
Copper (Cu) (mg/kg)	36.5	39.7	63.1		
Iron (Fe) (mg/kg)	64300	24500	43800		
Lead (Pb) (mg/kg)	13.3	9.41	16.2		
Lithium (Li) (mg/kg)	11.2	12.4	18.0		
Magnesium (Mg) (mg/kg)	5620	6610	8570		
Manganese (Mn) (mg/kg)	1850	304	389		
Mercury (Hg) (mg/kg)	0.0746	0.0304	0.0874		
Molybdenum (Mo) (mg/kg)	3.21	2.70	3.64		
Nickel (Ni) (mg/kg)	71.5	83.7	99.8		
Phosphorus (P) (mg/kg)	1560	656	876		
Potassium (K) (mg/kg)	2100	1440	2780		
Selenium (Se) (mg/kg)	0.67	0.57	0.66		
Silver (Ag) (mg/kg)	0.24	0.20	0.42		
Sodium (Na) (mg/kg)	284	503	342		
Strontium (Sr) (mg/kg)	22.1	27.1	23.7		
Thallium (Tl) (mg/kg)	0.190	0.090	0.215		
Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0		
Titanium (Ti) (mg/kg)	403	247	457		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1669874-1 Soil/Sed/Waste 22-AUG-15 WTN-EX-1	L1669874-2 Soil/Sed/Waste 22-AUG-15 WTN-EX-2	L1669874-3 Soil/Sed/Waste 22-AUG-15 WTN-EX-3	L1669874-4 Soil/Sed/Waste 22-AUG-15 WTN-EX-4	L1669874-5 Soil/Sed/Waste 22-AUG-15 WTN-EX-5
SOIL						
Metals	Uranium (U) (mg/kg)	8.05	12.3	7.72	8.27	10.2
	Vanadium (V) (mg/kg)	30.5	38.4	29.3	32.3	34.3
	Zinc (Zn) (mg/kg)	85.4	112	86.1	90.1	107
	Zirconium (Zr) (mg/kg)	1.3	1.7	1.6	1.4	1.6
Aggregate Organics	Mineral Oil and Grease (mg/kg)					
Hydrocarbons	EPH10-19 (mg/kg)					
	EPH19-32 (mg/kg)					
	LEPH (mg/kg)					
	HEPH (mg/kg)					
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)					
	Acenaphthylene (mg/kg)					
	Anthracene (mg/kg)					
	Benz(a)anthracene (mg/kg)					
	Benzo(a)pyrene (mg/kg)					
	Benzo(b)fluoranthene (mg/kg)					
	Benzo(b+j+k)fluoranthene (mg/kg)					
	Benzo(g,h,i)perylene (mg/kg)					
	Benzo(k)fluoranthene (mg/kg)					
	Chrysene (mg/kg)					
	Dibenz(a,h)anthracene (mg/kg)					
	Fluoranthene (mg/kg)					
	Fluorene (mg/kg)					
	Indeno(1,2,3-c,d)pyrene (mg/kg)					
	2-Methylnaphthalene (mg/kg)					
	Naphthalene (mg/kg)					
	Phenanthrene (mg/kg)					
	Pyrene (mg/kg)					
	Surrogate: Acenaphthene d10 (%)					
	Surrogate: Chrysene d12 (%)					
	Surrogate: Naphthalene d8 (%)					
	Surrogate: Phenanthrene d10 (%)					
	B(a)P Total Potency Equivalent (mg/kg)					
	IACR (CCME) (mg/kg)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1669874-6 Soil/Sed/Waste 22-AUG-15 WTN-1	L1669874-7 Soil/Sed/Waste 22-AUG-15 WTN-2	L1669874-8 Soil/Sed/Waste 22-AUG-15 WTN-3	L1669874-9 Soil/Sed/Waste 22-AUG-15 WTN-4	L1669874-10 Soil/Sed/Waste 22-AUG-15 WTN-5
Sample ID						
Description						
Sampled Date						
Sampled Time						
Client ID						
SOIL						
Metals	Uranium (U) (mg/kg)	8.78	8.47	9.22	9.64	9.21
	Vanadium (V) (mg/kg)	23.7	22.4	25.9	25.3	23.5
	Zinc (Zn) (mg/kg)	88.1	99.3	79.1	96.2	92.8
	Zirconium (Zr) (mg/kg)	<1.0	1.3	1.2	1.3	1.2
Aggregate Organics	Mineral Oil and Grease (mg/kg)					
Hydrocarbons	EPH10-19 (mg/kg)					
	EPH19-32 (mg/kg)					
	LEPH (mg/kg)					
	HEPH (mg/kg)					
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)					
	Acenaphthylene (mg/kg)					
	Anthracene (mg/kg)					
	Benz(a)anthracene (mg/kg)					
	Benzo(a)pyrene (mg/kg)					
	Benzo(b)fluoranthene (mg/kg)					
	Benzo(b+j+k)fluoranthene (mg/kg)					
	Benzo(g,h,i)perylene (mg/kg)					
	Benzo(k)fluoranthene (mg/kg)					
	Chrysene (mg/kg)					
	Dibenz(a,h)anthracene (mg/kg)					
	Fluoranthene (mg/kg)					
	Fluorene (mg/kg)					
	Indeno(1,2,3-c,d)pyrene (mg/kg)					
	2-Methylnaphthalene (mg/kg)					
	Naphthalene (mg/kg)					
	Phenanthrene (mg/kg)					
	Pyrene (mg/kg)					
	Surrogate: Acenaphthene d10 (%)					
	Surrogate: Chrysene d12 (%)					
	Surrogate: Naphthalene d8 (%)					
	Surrogate: Phenanthrene d10 (%)					
	B(a)P Total Potency Equivalent (mg/kg)					
	IACR (CCME) (mg/kg)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1669874-11 Soil/Sed/Waste 22-AUG-15 WTN-COMP	L1669874-12 Soil/Sed/Waste 21-AUG-15 WTS-1	L1669874-13 Soil/Sed/Waste 21-AUG-15 WTS-2	L1669874-14 Soil/Sed/Waste 21-AUG-15 WTS-3	L1669874-15 Soil/Sed/Waste 21-AUG-15 WTS-4
SOIL						
Metals	Uranium (U) (mg/kg)		9.53	12.3	11.2	11.1
	Vanadium (V) (mg/kg)		24.3	26.9	26.5	25.6
	Zinc (Zn) (mg/kg)		86.7	99.2	87.9	89.8
	Zirconium (Zr) (mg/kg)		1.2	1.4	1.9	1.3
Aggregate Organics	Mineral Oil and Grease (mg/kg)	<525 DLHM				
Hydrocarbons	EPH10-19 (mg/kg)	<820 DLHM				
	EPH19-32 (mg/kg)	<820 DLHM				
	LEPH (mg/kg)	<820				
	HEPH (mg/kg)	<820				
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.010 DLHM				
	Acenaphthylene (mg/kg)	<0.010 DLHM				
	Anthracene (mg/kg)	<0.0080 DLHM				
	Benz(a)anthracene (mg/kg)	<0.020 DLHM				
	Benzo(a)pyrene (mg/kg)	<0.020 DLHM				
	Benzo(b)fluoranthene (mg/kg)	<0.020 DLHM				
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.028				
	Benzo(g,h,i)perylene (mg/kg)	<0.020 DLHM				
	Benzo(k)fluoranthene (mg/kg)	<0.020 DLHM				
	Chrysene (mg/kg)	<0.020 DLHM				
	Dibenz(a,h)anthracene (mg/kg)	<0.010 DLHM				
	Fluoranthene (mg/kg)	<0.020 DLHM				
	Fluorene (mg/kg)	<0.020 DLHM				
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.020 DLHM				
	2-Methylnaphthalene (mg/kg)	<0.020 DLHM				
	Naphthalene (mg/kg)	<0.020 DLHM				
	Phenanthrene (mg/kg)	<0.020 DLHM				
	Pyrene (mg/kg)	<0.020 DLHM				
	Surrogate: Acenaphthene d10 (%)	95.2				
	Surrogate: Chrysene d12 (%)	113.5				
	Surrogate: Naphthalene d8 (%)	90.2				
	Surrogate: Phenanthrene d10 (%)	108.6				
	B(a)P Total Potency Equivalent (mg/kg)	<0.020				
	IACR (CCME) (mg/kg)	<0.21				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1669874-16 Soil/Sed/Waste 21-AUG-15 WTS-5	L1669874-17 Soil/Sed/Waste 21-AUG-15 WTS-COMP	L1669874-18 Soil/Sed/Waste 24-AUG-15 MAM-1	L1669874-19 Soil/Sed/Waste 24-AUG-15 MAM-2	L1669874-20 Soil/Sed/Waste 24-AUG-15 MAM-3
Grouping	**Analyte**					
SOIL						
Metals	Uranium (U) (mg/kg)	10.3		11.5	11.8	13.8
	Vanadium (V) (mg/kg)	25.6		39.5	39.6	43.3
	Zinc (Zn) (mg/kg)	84.4		110	109	129
	Zirconium (Zr) (mg/kg)	1.1		4.2	3.7	3.5
Aggregate Organics	Mineral Oil and Grease (mg/kg)		1690			
Hydrocarbons	EPH10-19 (mg/kg)		<680 DLHM			
	EPH19-32 (mg/kg)		<680 DLHM			
	LEPH (mg/kg)		<680			
	HEPH (mg/kg)		<680			
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)		<0.0050			
	Acenaphthylene (mg/kg)		<0.0050			
	Anthracene (mg/kg)		<0.0040			
	Benz(a)anthracene (mg/kg)		<0.010			
	Benzo(a)pyrene (mg/kg)		<0.010			
	Benzo(b)fluoranthene (mg/kg)		<0.010			
	Benzo(b+j+k)fluoranthene (mg/kg)		<0.015			
	Benzo(g,h,i)perylene (mg/kg)		<0.010			
	Benzo(k)fluoranthene (mg/kg)		<0.010			
	Chrysene (mg/kg)		<0.010			
	Dibenz(a,h)anthracene (mg/kg)		<0.0050			
	Fluoranthene (mg/kg)		<0.010			
	Fluorene (mg/kg)		<0.010			
	Indeno(1,2,3-c,d)pyrene (mg/kg)		<0.010			
	2-Methylnaphthalene (mg/kg)		<0.010			
	Naphthalene (mg/kg)		<0.010			
	Phenanthrene (mg/kg)		<0.010			
	Pyrene (mg/kg)		<0.010			
	Surrogate: Acenaphthene d10 (%)		97.0			
	Surrogate: Chrysene d12 (%)		121.5			
	Surrogate: Naphthalene d8 (%)		92.2			
	Surrogate: Phenanthrene d10 (%)		114.2			
	B(a)P Total Potency Equivalent (mg/kg)		<0.020			
	IACR (CCME) (mg/kg)		<0.15			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1669874-21 Soil/Sed/Waste 24-AUG-15 MAM-4	L1669874-22 Soil/Sed/Waste 24-AUG-15 MAM-5	L1669874-23 Soil/Sed/Waste 24-AUG-15 MAM-COMP	L1669874-24 Soil/Sed/Waste 23-AUG-15 NEM-1	L1669874-25 Soil/Sed/Waste 23-AUG-15 NEM-2
SOIL						
Metals	Uranium (U) (mg/kg)	10.6	11.1		4.08	2.46
	Vanadium (V) (mg/kg)	35.5	38.4		24.1	19.4
	Zinc (Zn) (mg/kg)	99.0	110		59.7	44.3
	Zirconium (Zr) (mg/kg)	4.2	4.4		<1.0	<1.0
Aggregate Organics	Mineral Oil and Grease (mg/kg)			1960		
Hydrocarbons	EPH10-19 (mg/kg)			DLHM <1100		
	EPH19-32 (mg/kg)			DLHM <1100		
	LEPH (mg/kg)			<1100		
	HEPH (mg/kg)			<1100		
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)			DLHM <0.015		
	Acenaphthylene (mg/kg)			DLHM <0.015		
	Anthracene (mg/kg)			DLHM <0.012		
	Benz(a)anthracene (mg/kg)			DLHM <0.030		
	Benzo(a)pyrene (mg/kg)			DLHM <0.030		
	Benzo(b)fluoranthene (mg/kg)			DLHM <0.030		
	Benzo(b+j+k)fluoranthene (mg/kg)			<0.042		
	Benzo(g,h,i)perylene (mg/kg)			DLHM <0.030		
	Benzo(k)fluoranthene (mg/kg)			DLHM <0.030		
	Chrysene (mg/kg)			DLHM <0.030		
	Dibenz(a,h)anthracene (mg/kg)			DLHM <0.015		
	Fluoranthene (mg/kg)			DLHM <0.030		
	Fluorene (mg/kg)			DLHM <0.030		
	Indeno(1,2,3-c,d)pyrene (mg/kg)			DLHM <0.030		
	2-Methylnaphthalene (mg/kg)			DLHM <0.030		
	Naphthalene (mg/kg)			DLHM <0.030		
	Phenanthrene (mg/kg)			DLHM <0.030		
	Pyrene (mg/kg)			DLHM <0.030		
	Surrogate: Acenaphthene d10 (%)			87.7		
	Surrogate: Chrysene d12 (%)			115.7		
	Surrogate: Naphthalene d8 (%)			78.1		
	Surrogate: Phenanthrene d10 (%)			108.1		
	B(a)P Total Potency Equivalent (mg/kg)			<0.029		
	IACR (CCME) (mg/kg)			<0.32		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1669874-26	L1669874-27	L1669874-28	L1669874-29	L1669874-30
Description	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste	Soil/Sed/Waste
Sampled Date	23-AUG-15	23-AUG-15	23-AUG-15	23-AUG-15	
Sampled Time					
Client ID	NEM-3	NEM-4	NEM-5	NEM-COMP	AMARUQ DUP-1
Grouping / **Analyte**					
SOIL					
Metals Uranium (U) (mg/kg)	3.61	3.52	3.00		8.06
Vanadium (V) (mg/kg)	23.1	21.9	21.2		24.7
Zinc (Zn) (mg/kg)	54.2	54.7	44.6		75.2
Zirconium (Zr) (mg/kg)	<1.0	<1.0	<1.0		<1.0
Aggregate Organics Mineral Oil and Grease (mg/kg)				2990	
Hydrocarbons EPH10-19 (mg/kg)				<880 DLHM	
EPH19-32 (mg/kg)				<880 DLHM	
LEPH (mg/kg)				<880	
HEPH (mg/kg)				<880	
Polycyclic Aromatic Hydrocarbons Acenaphthene (mg/kg)				<0.010 DLHM	
Acenaphthylene (mg/kg)				<0.010 DLHM	
Anthracene (mg/kg)				<0.0080 DLHM	
Benz(a)anthracene (mg/kg)				<0.020 DLHM	
Benzo(a)pyrene (mg/kg)				<0.020 DLHM	
Benzo(b)fluoranthene (mg/kg)				<0.020 DLHM	
Benzo(b+j+k)fluoranthene (mg/kg)				<0.028	
Benzo(g,h,i)perylene (mg/kg)				<0.020 DLHM	
Benzo(k)fluoranthene (mg/kg)				<0.020 DLHM	
Chrysene (mg/kg)				<0.020 DLHM	
Dibenz(a,h)anthracene (mg/kg)				<0.010 DLHM	
Fluoranthene (mg/kg)				<0.020 DLHM	
Fluorene (mg/kg)				<0.020 DLHM	
Indeno(1,2,3-c,d)pyrene (mg/kg)				<0.020 DLHM	
2-Methylnaphthalene (mg/kg)				<0.020 DLHM	
Naphthalene (mg/kg)				<0.020 DLHM	
Phenanthrene (mg/kg)				<0.020 DLHM	
Pyrene (mg/kg)				<0.020 DLHM	
Surrogate: Acenaphthene d10 (%)				94.4	
Surrogate: Chrysene d12 (%)				122.1	
Surrogate: Naphthalene d8 (%)				85.3	
Surrogate: Phenanthrene d10 (%)				115.2	
B(a)P Total Potency Equivalent (mg/kg)				<0.020	
IACR (CCME) (mg/kg)				<0.21	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1669874-31 Soil/Sed/Waste AMARUQ DUP-2	L1669874-32 Soil/Sed/Waste AMARUQ DUP-3	L1669874-33 Soil/Sed/Waste AMARUQ DUP-4	L1669874-38 Soil/Sed/Waste AMARUQ-COMP-DUP	
SOIL						
Metals	Uranium (U) (mg/kg)	9.31	4.18	11.9		
	Vanadium (V) (mg/kg)	23.6	23.4	38.6		
	Zinc (Zn) (mg/kg)	82.7	57.7	106		
	Zirconium (Zr) (mg/kg)	<1.0	1.6	4.0		
Aggregate Organics	Mineral Oil and Grease (mg/kg)				1010	
Hydrocarbons	EPH10-19 (mg/kg)				DLHM <1000	
	EPH19-32 (mg/kg)				DLHM <1000	
	LEPH (mg/kg)				<1000	
	HEPH (mg/kg)				<1000	
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)				DLHM <0.015	
	Acenaphthylene (mg/kg)				DLHM <0.015	
	Anthracene (mg/kg)				DLHM <0.012	
	Benz(a)anthracene (mg/kg)				DLHM <0.030	
	Benzo(a)pyrene (mg/kg)				DLHM <0.030	
	Benzo(b)fluoranthene (mg/kg)				DLHM <0.030	
	Benzo(b+j+k)fluoranthene (mg/kg)				<0.042	
	Benzo(g,h,i)perylene (mg/kg)				DLHM <0.030	
	Benzo(k)fluoranthene (mg/kg)				DLHM <0.030	
	Chrysene (mg/kg)				DLHM <0.030	
	Dibenz(a,h)anthracene (mg/kg)				DLHM <0.015	
	Fluoranthene (mg/kg)				DLHM <0.030	
	Fluorene (mg/kg)				DLHM <0.030	
	Indeno(1,2,3-c,d)pyrene (mg/kg)				DLHM <0.030	
	2-Methylnaphthalene (mg/kg)				DLHM <0.030	
	Naphthalene (mg/kg)				DLHM <0.030	
	Phenanthrene (mg/kg)				DLHM <0.030	
	Pyrene (mg/kg)				DLHM <0.030	
	Surrogate: Acenaphthene d10 (%)				90.8	
	Surrogate: Chrysene d12 (%)				115.6	
	Surrogate: Naphthalene d8 (%)				85.0	
	Surrogate: Phenanthrene d10 (%)				108.4	
	B(a)P Total Potency Equivalent (mg/kg)				<0.029	
	IACR (CCME) (mg/kg)				<0.32	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	EPH10-19	DLHM	L1669874-11, -17, -23, -29, -38
Duplicate	EPH19-32	DLHM	L1669874-11, -17, -23, -29, -38
Laboratory Control Sample	Silver (Ag)-Total	LCS-L	L1669874-34, -35, -36, -37

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLHM	Detection Limit Adjusted: Sample has High Moisture Content
LCS-L	Lab Control Sample recovery was below ALS DQO. Reference Material and/or Matrix Spike results were acceptable. Non-detected sample results are considered reliable. Other results, if reported, have been qualified.
RRR	Refer to Report Remarks for issues regarding this analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
AIR VOLUME-VA	Misc.	Air volume (L)	HYGIENE METHOD
C-TOT-ORG-LECO-SK	Soil	Organic Carbon by combustion method	SSSA (1996) p. 973

Total Organic Carbon (C-TOT-ORG-LECO-SK, C-TOT-ORG-SK)

Total C and inorganic C are determined on separate samples. The total C is determined by combustion and thermal conductivity detection, while inorganic C is determined by weight lass after addition of hydrochloric acid. Organic C is calculated by the difference between these two determinations.

Reference for Total C:
Nelson, D.W. and Sommers, L.E. 1996. Total Carbon, organic carbon and organic matter. P. 961-1010 In: J.M. Bartels et al. (ed.) Methods of soil analysis: Part 3 Chemical methods. (3rd ed.) ASA and SSSA, Madison, WI. Book series no. 5

Reference for Inorganic C:
Loeppert, R.H. and Suarez, D.L. 1996. Gravimetric Method for Loss of Carbon Dioxide. P. 455-456 In: J.M. Bartels et al. (ed.) Methods of soil analysis: Part 3 Chemical methods. (3rd ed.) ASA and SSSA, Madison, WI. Book series no. 5

EPH-TUMB-FID-VA	Soil	EPH in Solids by Tumbler and GCFID	BC MOE EPH GCFID

Analysis is in accordance with BC MOE Lab Manual method "Extractable Petroleum Hydrocarbons in Solids by GC/FID", v2.1, July 1999. Soil samples are extracted with a 1:1 mixture of hexane and acetone using a rotary extraction technique modified from EPA 3570 prior to gas chromatography with flame ionization detection (GC-FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).

HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAFS	EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAFS.

LEPH/HEPH-CALC-VA	Soil	LEPHs and HEPHs	BC MOE LABORATORY MANUAL (2005)

Light and Heavy Extractable Petroleum Hydrocarbons in Solids. These results are determined according to the British Columbia Ministry of Environment, Lands, and Parks Analytical Method for Contaminated Sites "Calculation of Light and Heavy Extractable Petroleum Hydrocarbons in Solids or Water". According to this method, LEPH and HEPH are calculated
by subtracting selected Polycyclic Aromatic Hydrocarbon results from Extractable Petroleum Hydrocarbon results. To calculate LEPH, the individual results for Naphthalene and Phenanthrene are subtracted from EPH(C10-19). To calculate HEPH, the individual results for Benz(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenz(a,h)anthracene, Indeno(1,2,3-c,d)pyrene, and Pyrene
are subtracted from EPH(C19-32). Analysis of Extractable Petroleum Hydrocarbons adheres to all prescribed elements of the BCMELP method "Extractable Petroleum Hydrocarbons in Solids by GC/FID" (Version 2.1, July 20, 1999).

MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CRC ICPMS.

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. This method does not dissolve all silicate materials and may result in a partial extraction. depending on the sample matrix, for some metals, including, but not limited to Al, Ba, Be, Cr, Sr, Ti, Tl, and V.

MET-AR-MG-ICP-VA	Filter	Metals in Filter by ICPOES	NIOSH 7303/EPA 6010B

This analysis is carried out using procedures adapted from Method 7303 in the NIOSH Manual of Analytcial Methods (NMAM). The procedure involves a hot block digestion of the filter media, using a combination of nitric acid and hydrochloric acid. Instrumental analysis of the filter extract is by inductively coupled plasma - optical emission spectrophotometry (EPA 6010B).

MOISTURE-VA	Soil	Moisture content	ASTM D2974-00 Method A

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

OGG-TUMB-SG-VA	Soil	CWS MOG with Silica Gel	CCME PETROLEUM HYDROCARBONS-

Reference Information

GRAVIMETRIC

This analysis is carried out in accordance with the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." A subsample of the sediment/soil is extracted with 1:1 hexane:acetone using a rotary extraction apparatus. The extract undergoes a silica-gel clean-up to remove polar compounds, and is analyzed gravimetrically. Mineral Oil and Grease is equivalent to fraction F4G of the Canada-wide Standard for Petroleum Hydrocarbons.

Accuracy target values for Reference Materials used in this method are derived from averages of long-term method performance, as certified values do not exist for the reported parameters.

PAH-TMB-H/A-MS-VA Soil PAH - Rotary Extraction (Hexane/Acetone) EPA 3570/8270

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3570 & 8270, published by the United States Environmental Protection Agency (EPA). The procedure uses a mechanical shaking technique to extract a subsample of the sediment/soil with a 1:1 mixture of hexane and acetone. The extract is then solvent exchanged to toluene. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Surrogate recoveries may not be reported in cases where interferences from the sample matrix prevent accurate quantitation. Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PH-1:2-VA Soil pH in Soil (1:2 Soil:Water Extraction) BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

PSA-PIPET+GRAVEL-SK Soil Particle size - Sieve and Pipette SSIR-51 METHOD 3.2.1

Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.

Reference:

Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2 3 OL-1767

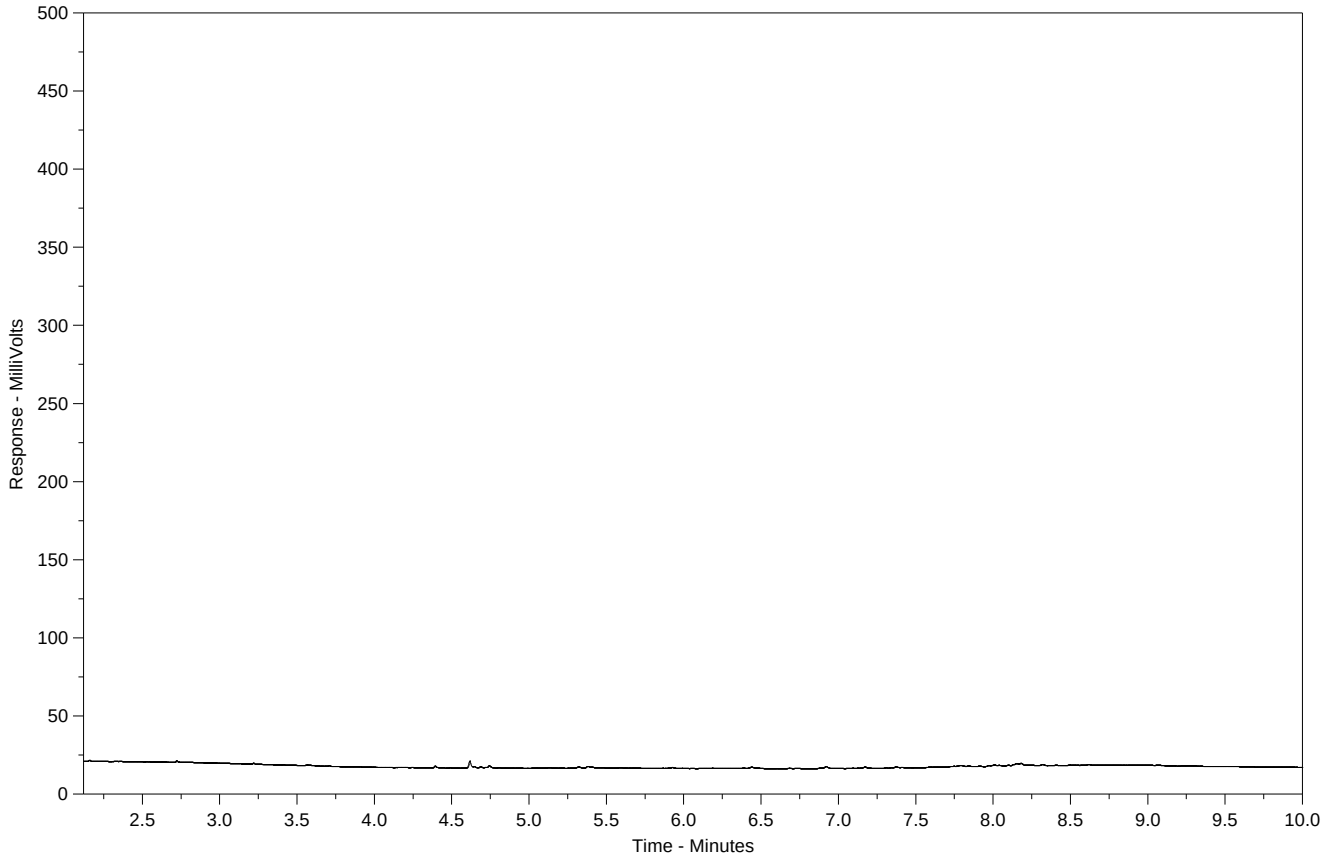
GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Hydrocarbon Distribution Report

ALS Sample ID: L1669874-11
Client Sample ID: WTN-COMP



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

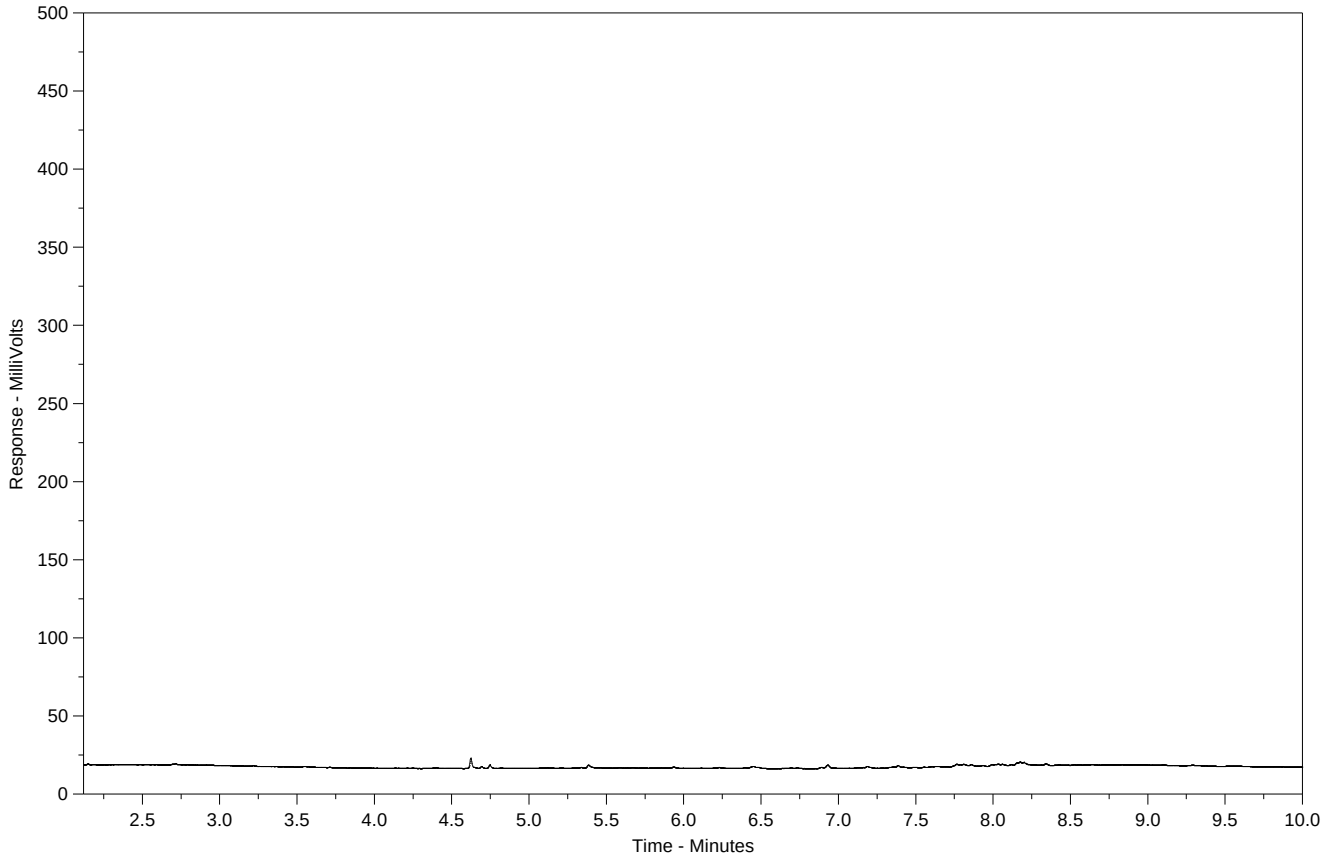
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1669874-17
Client Sample ID: WTS-COMP



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

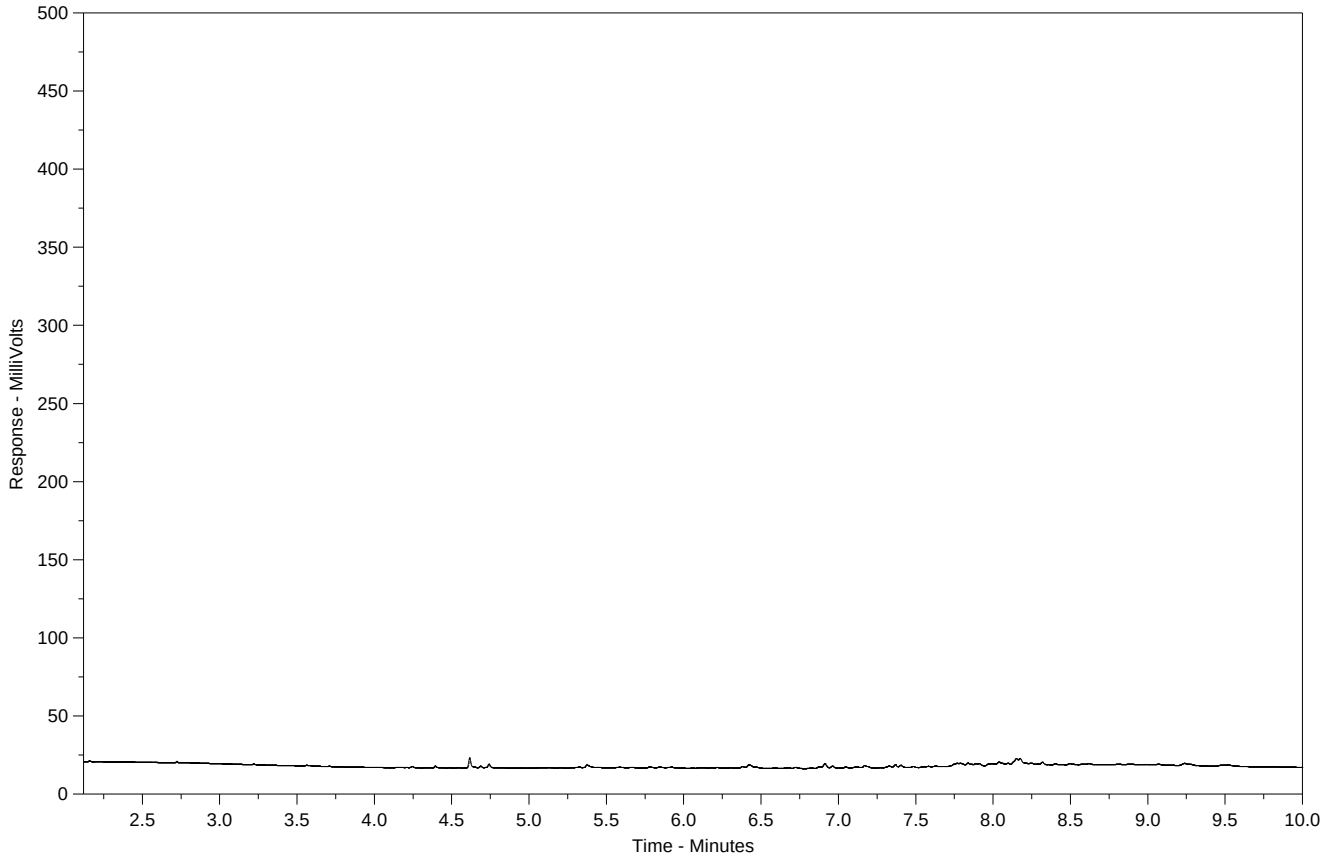
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1669874-23
Client Sample ID: MAM-COMP



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

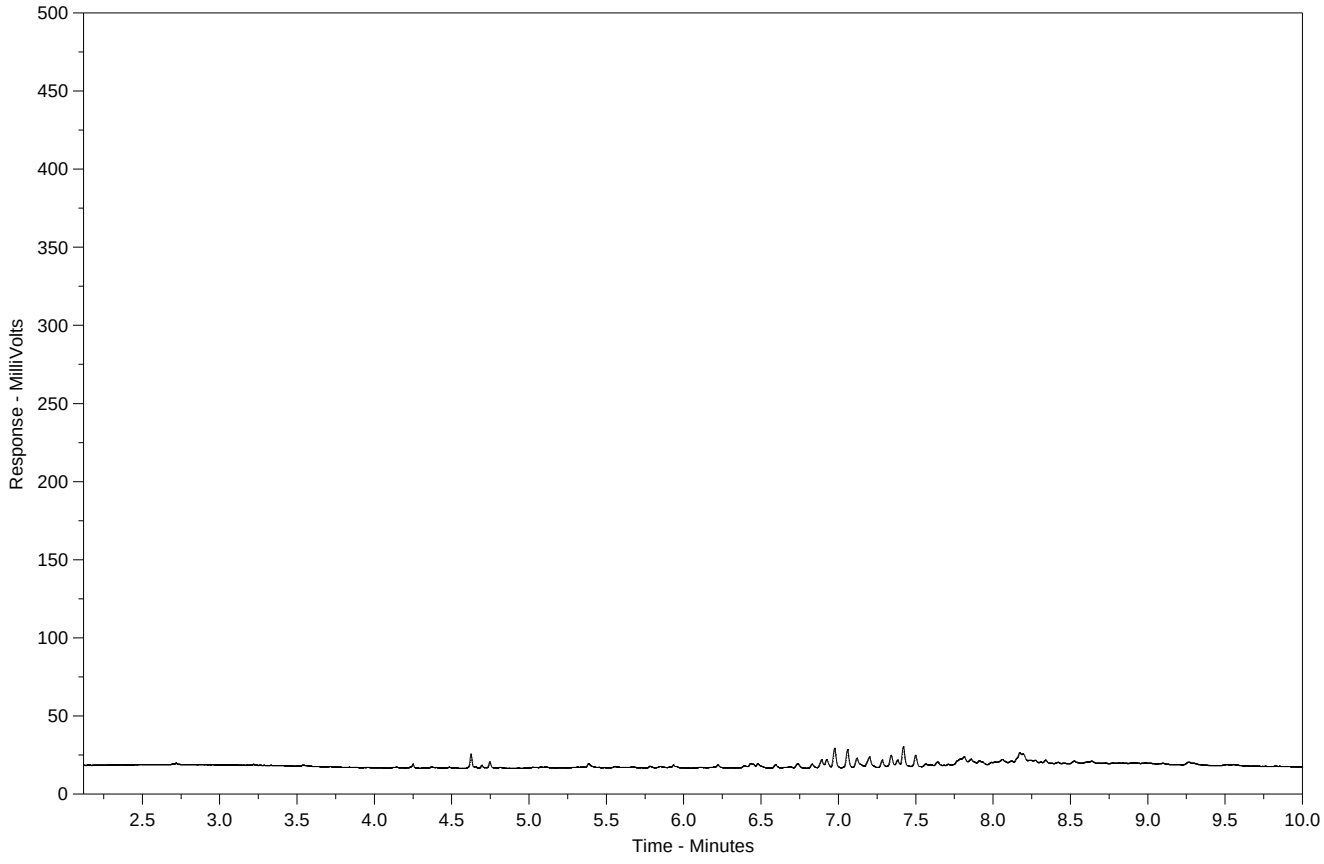
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1669874-29
Client Sample ID: NEM-COMP



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

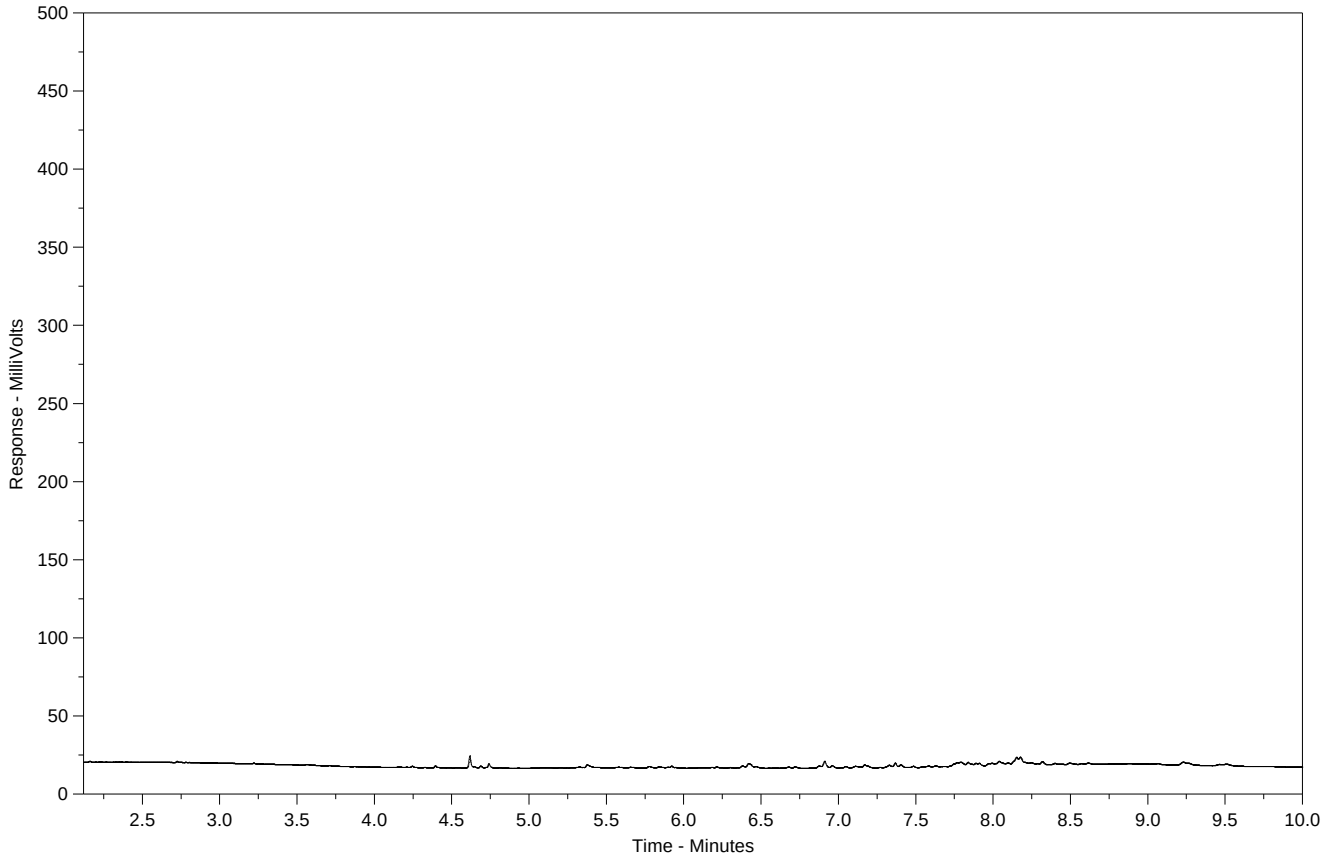
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1669874-38
Client Sample ID: AMARUQ-COMP-DUP



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free : 1 800 668 9878
www.alsglobal.com

COC #: OL-1767

Report To			Reporting	Service Requested
Company:	Azimuth Consulting Group		Distribution: ☐Fax ☐Mail ☑Email	◉Regular (Standard Turnaround Times - Business Days) - R
Contact:	Maggie McConnell		☐Ciriteria on Report (select from Guidelines below)	○Priority (3 Days) - surcharge will apply - P
Address:	#218 - 2902 West Broadway Vancouver, BC Canada, V6K 2G8		Report Type: ☑Excel ☐Digital	○Priority (2 Days) - surcharge will apply - P2
			Report Format:	○Emergency (1-2 day) – surcharge will apply - E
			Report Email(s): gmann@azimuthgroup.ca efranz@azimuthgroup.ca mmcconnell@azimuthgroup.ca	○Same Day or Weekend Emergency - surcharge will apply - E2
				○Specify date required - X
Phone:	604-730-1220	Fax: 604-739-8511		
Invoice To	☑Email ☐Mail		EDD Format:	Analysis Requests
Company:	Azimuth Consulting Group		EDD Email(s):	
Contact:	Maggie McConnell			
Address:	#218 - 2902 West Broadway Vancouver, BC Canada, V6K 2G8		Project Info	
			Job #: Amaruq Sediment	
			PO/AFE:	
Email:	mmcconnell@azimuthgroup.ca		LSD:	
Phone:	604-730-1220		Quote #: Q38011	
Lab Work Order # (lab use only)	L1669874		ALS Contact: Brent Mack	Sampler:

Sample #	Sample Identification (This will appear on the report)	Coordinates Longitude	Coordinates Latitude	Date	Time	Sample Type	Number of Containers	Total metals, pH, Moisture	TOC, Grain size	PAHs, LEPHs, HEPHs, MOG	Total Metals	Please indicate below Filtered (F), Preserved (P), or Filtered and Preserved (F/P)
11	WTN-Ex-1			22 Aug 15		Soil/Sed/Waste	2	R	R			
12	WTN-Ex-2			"		Soil/Sed/Waste	2	R	R			
13	WTN-Ex-3			"		Soil/Sed/Waste	2	R	R			
14	WTN-Ex-4			"		Soil/Sed/Waste	2	R	R			
15	WTN-Ex-5			"		Soil/Sed/Waste	2	R	R			
16	WTN-1			"		Soil/Sed/Waste	2	R	R			
17	WTN-2			"		Soil/Sed/Waste	2	R	R			
18	WTN-3			"		Soil/Sed/Waste	2	R	R			

(See page 2 for further samples)

L1669874-COFC

Special Instructions/Comments	The questions below must be answered for water samples (check Yes or No)	Guidelines
	Are any sample taken from a regulated DW system? ☐Yes ☐No If yes, please use an authorized drinking water COC Is the water sampled intended to be potable for human consumption? ☐Yes ☐No	

SAMPLE CONDITION (lab use only)
☐Frozen ☐Cold ☐Ambient ☐Cooling Initiated

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: ☐Yes If Yes add SIF
Eric Franz	31-Aug-15	10:26am	lady	Sept. 9	9AM	17.9 °C 16.1 16.8 17.8				

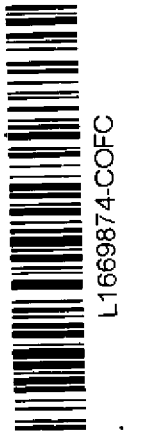
ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free : 1 800 668 9878
www.alsglobal.com

COC #: OL-1767

Sample #	Sample Identification (This will appear on the report)	Coordinates		Date	Time	Sample Type	Analysis Requests																		
		Longitude	Latitude				Number of Containers	Total metals, pH, Moisture	TOC, Grain size	PAHs, LEPHs, HEPHs, MOG	Total Metals														
							Please indicate below Filtered, Preserved or both(F, P, F/P)																		
9	WTN-4			22-Aug-15		Soil/Sed/Waste	2	R	R																
10	WTN-5			"		Soil/Sed/Waste	2	R	R																
11	WTN-COMP			"		Soil/Sed/Waste	1			R															
12	WTS-1			21-Aug-15		Soil/Sed/Waste	2	R	R																
13	WTS-2			"		Soil/Sed/Waste	2	R	R																
14	WTS-3			"		Soil/Sed/Waste	2	R	R																
15	WTS-4			"		Soil/Sed/Waste	2	R	R																
16	WTS-5			"		Soil/Sed/Waste	2	R	R																
17	WTS-COMP			"		Soil/Sed/Waste	1			R															
18	MAM-1			24-Aug-15		Soil/Sed/Waste	2	R	R																
19	MAM-2			"		Soil/Sed/Waste	2	R	R																
20	MAM-3			"		Soil/Sed/Waste	2	R	R																
21	MAM-4			"		Soil/Sed/Waste	2	R	R																
22	MAM-5			"		Soil/Sed/Waste	2	R	R																
23	MAM-COMP			"		Soil/Sed/Waste	1			R															
24	NEM-1			23-Aug-15		Soil/Sed/Waste	2	R	R																
25	NEM-2			"		Soil/Sed/Waste	2	R	R																
26	NEM-3			"		Soil/Sed/Waste	2	R	R																
27	NEM-4			"		Soil/Sed/Waste	2	R	R																
28	NEM-5			"		Soil/Sed/Waste	2	R	R																
29	NEM-COMP			"		Soil/Sed/Waste	1			R															
30	AMARUQ DUP-1			N/A		Soil/Sed/Waste	2	R	R																
31	AMARUQ DUP-2			N/A		Soil/Sed/Waste	2	R	R																
32	AMARUQ DUP-3			N/A		Soil/Sed/Waste	2	R	R																
33	AMARUQ DUP-4			N/A		Soil/Sed/Waste	2	R	R																
34	AMARUQ SWIPE-1			22-Aug-15		Filter	1				R														
35	AMARUQ SWIPE-2			21-Aug-15		Filter	1				R														

(See page 3 for further samples)



ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free : 1 800 668 9878
www.alsglobal.com

COC #: OL-1787

Sample #	Sample Identification (This will appear on the report)	Coordinates		Date	Time	Sample Type	Analysis Requests					
		Longitude	Latitude				Number of Containers	Total metals, pH, Moisture	TOC, Grain size	PAHs, LEPHs, HEPHs, MOG	Total Metals	
							Please indicate below Filtered, Preserved or both(F, P, F/P)					
36	AMARUQ SWPE-3			24-Aug-15		Filter	1				R	
37	AMARUQ SWPE-4			24-Aug-15		Filter	1				R	
38	AMARUQ-COMP-DUP			N/A		Soil/Sed/Waste	1			R		



AZIMUTH CONSULTING GROUP INC.
ATTN: Eric Franz
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 28-SEP-15
Report Date: 05-OCT-15 12:21 (MT)
Version: FINAL

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1679754

Project P.O. #: NOT SUBMITTED
Job Reference: AMARUQ SURFACE WATER
C of C Numbers: 14-490824
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1679754-1	L1679754-2	L1679754-3	L1679754-4	L1679754-5
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	17-SEP-15	17-SEP-15	19-SEP-15	19-SEP-15	19-SEP-15
Sampled Time	14:47	15:45	12:20	14:55	16:10
Client ID	A34-A16	A16-A14	C58 OUTLET	A1-DS1	A17-A16
Grouping / **Analyte**					
WATER					
Physical Tests					
Conductivity (uS/cm)	18.6	34.1	28.3	21.2	17.1
pH (pH)	6.74	6.70	7.04	6.85	6.84
Total Suspended Solids (mg/L)	10.5	3.2	<1.0	<1.0	<1.0
Total Dissolved Solids (mg/L)	14.8	23.5	15.9	14.0	10.2
Turbidity (NTU)	14.9	0.31	0.25	0.81	0.22
Anions and Nutrients					
Alkalinity, Bicarbonate (as CaCO3) (mg/L)	5.4	4.3	6.6	6.3	5.7
Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3) (mg/L)	5.4	4.3	6.6	6.3	5.7
Bromide (Br) (mg/L)	<0.050	0.063	<0.050	<0.050	<0.050
Chloride (Cl) (mg/L)	0.64	5.66	0.53	0.95	0.73
Fluoride (F) (mg/L)	0.032	0.026	0.024	0.028	0.032
Nitrate (as N) (mg/L)	0.0138	<0.0050	<0.0050	0.0107	0.0068
Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	0.0014	0.0012	0.0011	0.0014
Phosphorus (P)-Total Dissolved (mg/L)	0.0026	<0.0020	<0.0020	0.0026	<0.0020
Silicate (as SiO2) (mg/L)	1.38	0.65	<0.50	1.01	1.15
Sulfate (SO4) (mg/L)	1.36	1.73	3.20	2.02	1.06

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1679754-6	L1679754-8			
	Description	Surface Water	Surface Water			
	Sampled Date	21-SEP-15	19-SEP-15			
	Sampled Time	12:38	14:56			
	Client ID	A13-A12	E5-E4			
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	27.6	20.8			
	pH (pH)	6.78	6.87			
	Total Suspended Solids (mg/L)	<1.0	1.1			
	Total Dissolved Solids (mg/L)	14.7	15.5			
	Turbidity (NTU)	0.36	0.77			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	5.9	5.8			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)	5.9	5.8			
	Bromide (Br) (mg/L)	<0.050	<0.050			
	Chloride (Cl) (mg/L)	2.08	0.96			
	Fluoride (F) (mg/L)	0.025	0.027			
	Nitrate (as N) (mg/L)	0.0139	0.0112			
	Nitrite (as N) (mg/L)	<0.0010	<0.0010			
	Orthophosphate-Dissolved (as P) (mg/L)	0.0012	<0.0010			
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020			
	Silicate (as SiO2) (mg/L)	0.99	0.89			
	Sulfate (SO4) (mg/L)	3.33	2.06			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Nitrite (as N)	DLM	L1679754-1, -2, -3, -4, -5, -6
Duplicate	Nitrite (as N)	DLM	L1679754-1, -2, -3, -4, -5, -6
Duplicate	Fluoride (F)	DLM	L1679754-8
Duplicate	Nitrite (as N)	DLM	L1679754-8
Duplicate	Nitrite (as N)	DLM	L1679754-8
Matrix Spike	Orthophosphate-Dissolved (as P)	MS-B	L1679754-8

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CL-L-IC-N-VA	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-TD-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SILICATE-COL-VA	Water	Silicate by Colourimetric analysis	APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Reference Information

TDS-LOW-VA	Water	Low Level TDS (3.0mg/L) by Gravimetric	APHA 2540C

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total dissolved solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-LOW-VA	Water	Total Suspended Solids by Grav. (1 mg/L)	APHA 2540D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

14-490824

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1679754-COFC

COC Number: 14 - 490824

Page 1 of 1

Report To		Report Format /		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	AZIMUTH CONSULTING GROUP	Select Report Format:	☐ PDF ☐ EXCEL ☐ EDD (DIGITAL)	R ☒ Regular (Standard TAT if received by 3pm)
Contact:	ERIC FRANZ	Quality Control (QC) Report with Report	☐ Yes ☐ No	P ☐ Priority (2-4 business days if received by 3pm)
Address:	218 - 2902 WEST BROADWAY, VANCOUVER, BC V6K 2G8	☐ Criteria on Report - provide details below if box checked		E ☐ Emergency (1-2 business days if received by 3pm)
		Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency if received by 10am – contact ALS for surcharge.
Phone:	~~(604) 730-1220~~ (604) 730-1220	Email 1 or Fax	eFranz@azimuthgroup.ca	Specify Date Required for E2,E or P:
		Email 2	ryan.vanenger@agnicocagle.com	Analysis Request

Invoice To		Invoice Distribution	
	Same as Report To ☑ Yes ☐ No	Select Invoice Distribution:	☒ EMAIL ☐ MAIL ☐ FAX
	Copy of Invoice with Report ☐ Yes ☑ No		
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:		Approver ID:	Cost Center:
Job #:	[redacted] AMARUQ SURFACE WATER	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only): L1679754

ALS Contact: | Sampler:

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identifi (This descriptic	tes rt)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Conventionals ** (see note)	TSS-Low, TDS-Low	Number of Containers
	A34 - A16		17-Sep-15	14:47	SURFACE WATER	X	X	2
	A16 - A14		17-Sep-15	15:45		X	X	
	C58 OUTLET		19-Sep-15	12:20		X	X	
	A1 - DS1		19-Sep-15	14:55		X	X	
	A17 - A16		19-Sep-15	16:10		X	X	
	A13 - A12		21-Sep-15	12:38		X	X	
	E5 - E4		21-Sep-15	13:00		X	X	

Short Holding Time
● Rush Processing

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No	** CONVENTIONALS INCLUDE: ALK SPECIES, pH, EC, TURBIDITY, CONDUCTIVITY, ANIONS (F, NO_2, NO_3, Br, SO_4), LOW-LEVEL CHLORIDE TP-P; SILICATE; AND ORTHO-PO_4
Are samples for human drinking water use? ☐ Yes ☐ No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐		SIF Observations	Yes ☐	No ☐		
Ice packs	Yes ☐	No ☐	Custody seal intact	Yes ☐	No ☐		
Cooling Initiated	☐						

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			14	14/15	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by: Shafee	Date: Sept.28	Time: 1110

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

ALS FM-032fle v09 Front/04 January 2014

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

AZIMUTH CONSULTING GROUP INC.
ATTN: Eric Franz
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 30-SEP-15
Report Date: 09-OCT-15 13:10 (MT)
Version: FINAL

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1681194

Project P.O. #: NOT SUBMITTED
Job Reference: AMARUA SURFACE WATER
C of C Numbers: 14-490825
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1681194-1 Surface Water 17-SEP-15 14:47 A34-A16	L1681194-2 Surface Water 17-SEP-15 15:45 A16-A14	L1681194-3 Surface Water 19-SEP-15 12:20 C58 OUTLET	L1681194-4 Surface Water 19-SEP-15 14:55 A1-DS1	L1681194-5 Surface Water 19-SEP-15 16:10 A17-A16
WATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	6.18	12.6	9.61	7.34	5.85
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0064	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (mg/L)	0.173	0.150	0.129	0.179	0.293
Cyanides	Cyanide, Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cyanide, Free (mg/L)	0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	2.76	13.2 RRV	1.83	1.94	1.84
	Total Organic Carbon (mg/L)	2.76	2.45 RRV	1.65	1.79	3.03
Total Metals	Aluminum (Al)-Total (mg/L)	0.491	0.0087	0.0039	0.0304	0.0053
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00035	0.00027	0.00026	0.00011	<0.00010
	Barium (Ba)-Total (mg/L)	0.00613	0.00508	0.00362	0.00377	0.00342
	Beryllium (Be)-Total (mg/L)	0.000038	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	1.04	3.07	2.18	1.85	1.37
	Chromium (Cr)-Total (mg/L)	0.00199	0.00014	<0.00010	0.00014	<0.00010
	Cobalt (Co)-Total (mg/L)	0.00028	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.00164	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Total (mg/L)	0.793	0.020	<0.010	0.070	0.030
	Lead (Pb)-Total (mg/L)	0.000536	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Total (mg/L)	0.97	0.92	0.99	0.59	0.52
	Manganese (Mn)-Total (mg/L)	0.00943	0.00313	0.00258	0.00154	0.00039
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.000065	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel (Ni)-Total (mg/L)	0.00201	0.00103	0.00480	<0.00050	<0.00050
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	0.49	0.40	0.56	0.45	0.34
	Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)-Total (mg/L)	1.41	0.266	0.211	0.486	0.522
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	0.605	0.574	0.489	0.607	0.644
	Strontium (Sr)-Total (mg/L)	0.00626	0.0223	0.00932	0.00811	0.00695
	Sulfur (S)-Total (mg/L)	<0.50	0.61	1.12	0.67	<0.50
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1681194-6	L1681194-7			
	Description	Surface Water	Surface Water			
	Sampled Date	21-SEP-15	21-SEP-15			
	Sampled Time	12:38	13:00			
	Client ID	A13-A12	E5-E4			
Grouping	**Analyte**					
WATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	10.0	7.37			
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050			
	Total Kjeldahl Nitrogen (mg/L)	0.126	0.115			
Cyanides	Cyanide, Total (mg/L)	<0.0010	<0.0010			
	Cyanide, Free (mg/L)	<0.0010	<0.0010			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	3.45 RRV	2.23			
	Total Organic Carbon (mg/L)	1.57 RRV	1.87			
Total Metals	Aluminum (Al)-Total (mg/L)	0.0086	0.0238			
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010			
	Arsenic (As)-Total (mg/L)	0.00030	0.00011			
	Barium (Ba)-Total (mg/L)	0.00487	0.00364			
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020			
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050			
	Boron (B)-Total (mg/L)	<0.010	<0.010			
	Cadmium (Cd)-Total (mg/L)	0.0000107	<0.0000050			
	Calcium (Ca)-Total (mg/L)	2.53	1.86			
	Chromium (Cr)-Total (mg/L)	0.00015	0.00011			
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010			
	Copper (Cu)-Total (mg/L)	0.00063	<0.00050			
	Iron (Fe)-Total (mg/L)	0.022	0.062			
	Lead (Pb)-Total (mg/L)	0.000263	0.000059			
	Lithium (Li)-Total (mg/L)	<0.0010	<0.0010			
	Magnesium (Mg)-Total (mg/L)	0.86	0.61			
	Manganese (Mn)-Total (mg/L)	0.00081	0.00125			
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Total (mg/L)	<0.000050	<0.000050			
	Nickel (Ni)-Total (mg/L)	0.00072	<0.00050			
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050			
	Potassium (K)-Total (mg/L)	0.57	0.47			
	Selenium (Se)-Total (mg/L)	<0.000050	<0.000050			
	Silicon (Si)-Total (mg/L)	0.434	0.473			
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Total (mg/L)	0.583	0.662			
	Strontium (Sr)-Total (mg/L)	0.0112	0.00807			
	Sulfur (S)-Total (mg/L)	1.15	0.68			
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1681194-1 Surface Water 17-SEP-15 14:47 A34-A16	L1681194-2 Surface Water 17-SEP-15 15:45 A16-A14	L1681194-3 Surface Water 19-SEP-15 12:20 C58 OUTLET	L1681194-4 Surface Water 19-SEP-15 14:55 A1-DS1	L1681194-5 Surface Water 19-SEP-15 16:10 A17-A16
WATER						
Total Metals	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.0156	<0.00030	<0.00030	0.00081	<0.00030
	Uranium (U)-Total (mg/L)	0.000318	0.000027	<0.000010	0.000033	0.000017
	Vanadium (V)-Total (mg/L)	0.00081	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	0.0033	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	0.00039	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0452	0.0039	0.0021	0.0072	0.0023
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00019	0.00023	0.00026	0.00010	<0.00010
	Barium (Ba)-Dissolved (mg/L)	0.00339	0.00728 DTC	0.00387	0.00577 DTC	0.00418 DTC
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	1.08	3.40	2.22	1.93	1.46
	Chromium (Cr)-Dissolved (mg/L)	0.00040	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00090	0.00043	0.00025	0.00056	0.00034
	Iron (Fe)-Dissolved (mg/L)	0.085	<0.010	<0.010	0.021	0.012
	Lead (Pb)-Dissolved (mg/L)	0.000142	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	0.84	1.00	0.99	0.62	0.54
	Manganese (Mn)-Dissolved (mg/L)	0.00279	0.00180	0.00059	0.00083	0.00040
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.000051	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel (Ni)-Dissolved (mg/L)	0.00114	0.00104	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	0.38	0.45	0.59	0.45	0.38
	Selenium (Se)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)-Dissolved (mg/L)	0.675	0.285	0.208	0.458	0.543
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	0.687	0.625	0.491	0.735	0.801 DTC
	Strontium (Sr)-Dissolved (mg/L)	0.00591	0.0225	0.00909	0.00804	0.00690
	Sulfur (S)-Dissolved (mg/L)	<0.50	0.60	1.25	0.71	<0.50
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1681194-6	L1681194-7			
	Description	Surface Water	Surface Water			
	Sampled Date	21-SEP-15	21-SEP-15			
	Sampled Time	12:38	13:00			
	Client ID	A13-A12	E5-E4			
Grouping	**Analyte**					
WATER						
Total Metals	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Total (mg/L)	0.00030	0.00068			
	Uranium (U)-Total (mg/L)	0.000017	0.000029			
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050			
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030			
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0032	0.0076			
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010			
	Arsenic (As)-Dissolved (mg/L)	0.00024	<0.00010			
	Barium (Ba)-Dissolved (mg/L)	0.00548	0.00436			
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050			
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010			
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Calcium (Ca)-Dissolved (mg/L)	2.54	1.93			
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010			
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010			
	Copper (Cu)-Dissolved (mg/L)	0.00055	0.00048			
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.021			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010			
	Magnesium (Mg)-Dissolved (mg/L)	0.89	0.62			
	Manganese (Mn)-Dissolved (mg/L)	0.00043	0.00088			
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)	<0.000050	<0.000050			
	Nickel (Ni)-Dissolved (mg/L)	0.00065	<0.00050			
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050			
	Potassium (K)-Dissolved (mg/L)	0.58	0.48			
	Selenium (Se)-Dissolved (mg/L)	<0.000050	<0.000050			
	Silicon (Si)-Dissolved (mg/L)	0.439	0.457			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	0.623	0.747			
	Strontium (Sr)-Dissolved (mg/L)	0.0112	0.00805			
	Sulfur (S)-Dissolved (mg/L)	1.11	0.69			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1681194-1	L1681194-2	L1681194-3	L1681194-4	L1681194-5
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	17-SEP-15	17-SEP-15	19-SEP-15	19-SEP-15	19-SEP-15
Sampled Time	14:47	15:45	12:20	14:55	16:10
Client ID	A34-A16	A16-A14	C58 OUTLET	A1-DS1	A17-A16
Grouping / **Analyte**					
WATER					
Dissolved Metals Tin (Sn)-Dissolved (mg/L)	<0.00010	0.00011	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	0.00109	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.000143	0.000024	<0.000010	0.000024	0.000014
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)	0.0015	<0.0010	<0.0010	0.0012	<0.0010
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1681194-6	L1681194-7			
	Description	Surface Water	Surface Water			
	Sampled Date	21-SEP-15	21-SEP-15			
	Sampled Time	12:38	13:00			
	Client ID	A13-A12	E5-E4			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030			
	Uranium (U)-Dissolved (mg/L)	0.000014	0.000023			
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050			
	Zinc (Zn)-Dissolved (mg/L)	0.0012	<0.0010			
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1681194-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1681194-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1681194-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1681194-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1681194-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1681194-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1681194-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1681194-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Barium (Ba)-Total	MS-B	L1681194-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sodium (Na)-Total	MS-B	L1681194-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Total	MS-B	L1681194-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1681194-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1681194-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1681194-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1681194-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1681194-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1681194-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Total Organic Carbon	MS-B	L1681194-1, -3, -4, -5, -7
Matrix Spike	Total Organic Carbon	MS-B	L1681194-2, -6
Matrix Spike	Dissolved Organic Carbon	MS-B	L1681194-2, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CN-FREE-L-CFA-VA	Water	Low Level Free Cyanide in water by CFA	ASTM 7237

This analysis is carried out using procedures adapted from ASTM Method 7237 "Free Cyanide with Flow Injection Analysis (FIA) Utilizing Gas Diffusion Separation and Amperometric Detection". Free cyanide is determined by in-line gas diffusion at pH 6 with final determination by colourimetric analysis.

CN-T-L-CFA-VA	Water	Low Level Total Cyanide in water by CFA	ISO 14403:2002

This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents.

Reference Information

Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-DIS-LOW-ICP-VA Water Dissolved Metals in Water by ICPOES EPA 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-TOT-LOW-ICP-VA Water Total Metals in Water by ICPOES EPA 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

S-DIS-ICP-VA Water Dissolved Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

S-TOT-ICP-VA Water Total Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Reference Information

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location

Chain of Custody Numbers:

14-490825

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Canadian Locations (Toll Free 1-800-668-9878)

EMERGENCY SPILL RESPONSE: +1 855 633 LABS (5227)

Vancouver, BC		**Fort St. John, BC**	
8081 Lougheed Hwy		10345A Dogwood Street	
Burnaby, BC	Ph: 604-253-4188	Fort St. John, BC	Ph: 250-261-5517
V5A 1W9	Fax: 604-253-6700	V1J 6W7	Fax: 250-261-5587
		After Hours / Emergency	Ph: 250-261-4247
Kamloops, BC		**Fort Nelson, BC**	
3645 McGill Rd. Unit 2B		Airport Terminal Building	
Kamloops, BC	Ph: 250-372-2638	No.1 Ossake Way, Rm 105	Ph: 250-775-0923
V2C 6K7	Ph: 250-372-3670	Fort Nelson, BC	
After Hours / Emergency	Ph: 250-572-1458	V0C 1R0	
Edmonton, AB		**Calgary, AB**	
9936-67 Avenue NW		2559-29th Street NE	
Edmonton, AB	Ph: 780-413-5227	Calgary, AB	
T6E 0P5	Fax: 780-437-2311	T1Y 7B5	Fax: 403-291-0298
After Hours / Emergency	Ph: 780-913-2398	After Hours / Emergency	Ph: 403-651-1471
Fort McMurray, AB		**Grande Prairie, AB**	
Bay 1, 245 MacDonald Crescent		9505-111th Street	
Fort McMurray, AB	Ph: 780-791-1524	T8V 5W1	Fax: 780-513-3191
T9H 4B5	Fax: 780-791-1555	After Hours / Emergency	Ph: 780-512-4343
After Hours / Emergency	Ph: 780-714-8462		
Winnipeg, MB		**Regina, SK**	
1020 Nairobi Road East, Unit 12		1119 Osler Street	
Winnipeg, MB	Ph: 204-255-9720	Regina, SK	
R2J 3T4	Fax: 204-255-9721	S4N 6R4	
After Hours / Emergency	Ph: 204-794-6877	After Hours / Emergency	Ph: 306-321-7147
Saskatoon, SK		**Thunder Bay, ON**	
819 - 58 Street East		1081 Burton Street	
Saskatoon, SK	Ph: 306-668-8370	Thunder Bay, ON	Ph: 807-623-6463
S7K 6X5	Fax: 306-668-8383	P7B 5N3	Fax: 807-623-7556
After Hours / Emergency	Ph: 306-221-7147	After Hours / Emergency	Ph: 807-624-4462
Waterloo, ON		**Burlington, ON**	
60 Northland Drive, Unit 1		5420 Mainway Drive, Unit 5	
Waterloo, ON	Ph: 519-886-6910	Burlington, ON	Ph: 905-331-3111
N2V 2L8	Fax: 519-886-9047	L7L 6A4	Fax: 905-331-4567
After Hours / Emergency	Ph: 519-569-4044		
Mississauga, ON		**London, ON**	
6790 Century Avenue, Unit 320		300 Exeter Road, Unit 629	
Mississauga, ON	Ph: 905-507-9510	London, ON	Ph: 519-652-9044
L4T 2G9	Fax: 905-507-9577	N6L 1C1	Fax: 519-652-9671
Richmond Hill, ON		**Ottawa, ON**	
25 West Beaver Creek Road, Unit 1		190 Colonnade Road, Unit 7	
Richmond Hill, ON	Ph: 905-881-0887	Nepean, ON	Ph: 613-225-8279
L4B 1H2	Fax: 905-881-5062	K2E 7J5	Fax: 613-225-2901
Yellowknife, NT		**Whitehorse, YT**	
116 - 314 Old Airport Road		12 - 151 Industrial Road	
Yellowknife, NT	Ph: 867-873-5593	Whitehorse, YT	Ph: 867-668-5626
X1A 3T3	Fax: 867-920-4238	Y1A 2V3	Fax: 867-668-5684
After Hours / Emergency	Ph: 867-445-0393	After Hours / Emergency	Ph: 867-335-5416

Sample Container, Preservation and Holding Time Table

Keep samples cool (4°C) and ship to an ALS location as soon as possible.

Note: Specific container, preservation and holding times may vary based on regulatory requirements - consult your local ALS laboratory for assistance prior to sampling.

	Analysis [1]	Water Container	Water Preservation	Additional Notes	Soil Container	Water / Soil Hold Time
Inorganics	Acidity and Alkalinity	0.5-1 L Plastic			125-250 mL Jar or Bag	14 Days / NA
	Anions (Br, Cl, SO4, F) and Electrical Conductivity	0.5-1 L Plastic			125-250 mL Jar or Bag	28 Days / 56 Months
	Bromide, Chloride and Chlorine	125 mL Plastic	EDA (Ethylenediamine)		NA	28 Days (Chlorine 14 Days)
	BOD, Colour and Turbidity	0.5-1 L Plastic			NA	2-4 Days [2] / NA
	COD and Phenols (4AAP)	125-250 mL Glass	1:1 Sulfuric Acid (H_2SO_4)		NA	28 Days / NA
	Cyanide, Total, Weak Acid Dissociable, Free	140 mL Plastic	5N NaOH		125-250 mL Jar or Bag	14 Days / 14 Days
	Dissolved Oxygen	300 mL BOD bottle	1 each: MnSO4, & alkaline iodide azide pillows		NA	8 Hours / NA
	Dissolved or Total Inorganic Carbon (DIC or TIC)	125-250 mL Glass	Field Filter for Dissolved		125-250 mL Jar or Bag	14 Days / 28 Days
	Dissolved or Total Organic Carbon (DOC or TOC)	125-250 mL Glass	1:1 Sulfuric Acid (H_2SO_4)	Field Filter for Dissolved	125-250 mL Jar or Bag	28 Days / 28 Days
	Fluoride	2 x 100mL Amber Glass		Zero Headspace	125-250 mL Jar	7 Days / 7 Days
	pH	0.5-1 L Plastic			125-250 mL Jar or Bag	0.25 Hours / 30 Days [3]
	Solids (TS, TSS, TDS)	0.5-1 L Plastic			NA	7 Days / NA
	Sulfide	125 mL Plastic	Zinc Acetate & 5N NaOH		125-250 mL Jar or Bag	7 Days / 7 Days
	Sulfite	125 mL Plastic			NA	0.25 Hours / NA
Nutrients	Ammonia-Nitrogen	250 mL Glass or Plastic	1:1 Sulfuric Acid (H_2SO_4)		125-250 mL Jar or Bag	28 Days / 7 Days [4]
	Nitrate or Nitrite-Nitrogen (and Ammonia unpreserved)	0.5-1 L Plastic			NA	2-7 Days [4] / NA
	Nitrogen, Kjeldahl, Organic, Total or Dissolved	250 mL Glass or Plastic	1:1 Sulfuric Acid (H_2SO_4)	Field Filter for Dissolved	NA	28 Days / NA
	Nutrients, Available (N,P,K,S)	NA			125-250 mL Jar or Bag	NA / 3 Days [4]
	Phosphorus, Reactive (orthophosphate)	0.5-1 L Plastic			NA	2-7 Days [4] / NA
	Phosphorus, Total Dissolved	250 mL Glass or Plastic	1:1 Sulfuric Acid (H_2SO_4)	Field Filter for Dissolved	NA	28 Days / NA
	Phosphorus, Total	250 mL Glass or Plastic	1:1 Sulfuric Acid (H_2SO_4)		NA	28 Days / NA
Metals	Chromium VI (Hexavalent)	125 mL Plastic	50 % NaOH (BC MoE) or 6N NaOH + Ammonium Buffer (OMoE)		125-250 mL Jar or Bag	28 Days / 30 Days
	Mercury, Methyl	250 mL pre-cleaned Glass or HPE	Contact Lab	Contact Lab	125-250 mL Jar or Bag	8 Months / 28 Days
	Mercury, Total or Dissolved	40 mL Glass Vial or 120 mL Glass	1:1 Hydrochloric Acid (HCl)	Field Filter for Dissolved	125-250 mL Jar or Bag	28 Days / 28 Days
	Metals, Total or Dissolved	125-250 mL Plastic	1:3 Nitric Acid (HNO_3) to pH<2	Field Filter for Dissolved	125-250 mL Jar or Bag	6 Months / 6 Months
Organics						
Hydrocarbons	BTEX / F1 or VPH	2 or 3 x 40 mL Glass Vials [7]	Sodium Bisulfate	Zero Headspace	125 mL Jar, Enviro or Terra Core sampling kit [8]	14 Days / 7 Days [7]
	Volatile Organics (VHW, Petroleum/Hydrocarbons)	2 or 3 x 40 mL Glass Vials [7]	Sodium Bisulfate [9]	Zero Headspace		14 Days / 7 Days [7]
	CWS F2-F4	2 x 60 mL Amber Glass Vials or 500 mL Amber Glass [5]	Sodium Bisulfate		125 - 500 mL Jar	14 Days / 7-14 Days
	EPH or LEPH/HEPH	2 x 500 mL Amber Glass	Sodium Bisulfate		125 - 500 mL Jar	14 Days / 14 Days
	Polycyclic Aromatic Hydrocarbons (PAHs)	2 x 0.5 - 1 L Amber Glass	Sodium Bisulfate [9]		125 - 500 mL Jar	14 Days / 28 Days
	Oil & Grease or Mineral Oil & Grease	2 x 0.5 - 1 L Glass	1:1 HCl or H_2SO_4		125 - 500 mL Jar	28 Days / 28 Days
Trace Organics	Acrolein	2 x 40 mL Glass Vials		Zero Headspace	125 - 500 mL Jar	7 Days / 14 Days
	Alkanolamines (MEA, DEA, TIPA)	125 mL Amber Glass			125 - 500 mL Jar	7 Days / 14 Days
	Dioxins and Furans	2 x 1 L Amber Glass			125 - 500 mL Jar	Unlimited / Unlimited
	AOX	40 - 250 mL Amber Glass	1:2 Nitric Acid (HNO_3) to pH<2		125 - 500 mL Jar	6 months [10] / 28 Days
	Formaldehyde	2 x 40 mL Amber Glass Vials [6]	Ammonium Chloride-Copper Sulfate	Zero Headspace	125 - 500 mL Jar	7 Days / 5 Days
	Glycols	2 x 40 mL Amber Glass Vials			125 - 500 mL Jar	7 Days / 14 Days
	Naphthenic Acids	2 x 250 mL Amber Glass			125 - 500 mL Jar	14 Days / 14 Days
	PCN	2 x 0.5 - 1 L Amber Glass			125 - 500 mL Jar	Unlimited / Unlimited
	Phenolics, Chlorinated and Non-Chlorinated	2 x 0.5 - 1 L Amber Glass	Ascorbic Acid & Sodium Bisulfate [5]		125 - 500 mL Jar	14 Days / 14 Days
	Priority Pollutants (TRA 625 list) or SVOCs	2 x 1 L Amber Glass			125 - 500 mL Jar	7 Days / 14 Days [11]
	Resin Acids & Fatty Acids	2 x 0.5 - 1 L Amber Glass	Ascorbic Acid & NaOH		125 mL Jar	14 Days / 14 Days
	Sulfonic Acids	2 x 0.5 - 1 L Amber Glass			125 mL Jar	7 Days / 14 Days
Pesticide Residues	Carbamate Pesticides	2 x 1 L Amber Glass	Potassium Dihydrogen Citrate or Citric/KOH buffer		125 - 500 mL Jar	28 Days / 14 Days
	Glyphosate / AMPA	2 x 1 L Amber Glass	Use Sodium Thiosulfate if chlorinated		125 - 500 mL Jar	14 Days / 14 Days
	Herbicides, Acidic	2 x 1 L Amber Glass	Sodium Bisulfate		125 - 500 mL Jar	14 Days / 14 Days
	Nonylphenol & Ethoxylates	2 x 0.5 - 1 L Amber Glass	Sodium Bisulfate		125 - 500 mL Jar	28 Days / 14 Days
	Organochlorine or Organophosphate Pesticides	2 x 1 L Amber Glass			125 - 500 mL Jar	7 Days / 14 Days
	Soil Standard Scan	2 x 1 L Amber Glass			250 g Poly Bag	7 Days / 14 Days
Microbiological	Coliforms-Fecal, Total, Ecoli & HPC	100 - 200 mL Sterilized Bottle	Sodium Thiosulfate		500 mL Sterilized Jar	24-48 Hours [12] / [12]
	Microtox	1 L Amber Glass			125-250 mL Jar or Bag	3 Days / 3 Days

NA = Not Available

1. Additional analyses with this same container and preservation may be possible - consult the lab for details.
2. The number of 40 mL glass vials required (2 or 3) for BTEX & VOC varies by lab based on instrumentation. Consult the lab for details.
3. If CWS F2-F4 is required in addition to EPH or LEPH/HEPH, only 2 x 500 mL Amber Glass containers are required. For Ontario Ministry of Environment (OMoE) CWS PHC F2-F4, All 5 requires 2 x 500 mL Amber Glass.
4. Use Sodium Thiosulfate instead of Sodium Bisulfate if sample is chlorinated.
5. No preservative is required for these analyses in OMoE.
6. Soil sampling options depend on soil location and condition of soil. Terra Core® sampling kit consists of Terra Core® sampler, two pre-weighed 40mL glass vials with methanol preservative and a 125 mL soil jar for moisture. Known samples and 125 mL soil jars with zero headspace are other options - consult the lab for details.
7. 4 Days hold time for Brooks Columbia as per BC Ministry of Environment (BC MoE), 4 Days hold time as per OMoE.
8. 3 Days hold time for British Columbia as per BC Ministry of Environment (BC MoE), 4 Days hold time as per OMoE.
9. pH in water should be taken in the field as per BC MoE, 4 Days hold time for Ontario MSA and 28 Days hold time for OMoE. 30 Days hold time as received for pH in soil as per OMoE. Unlimited hold time once soil is dried.
10. 3 Days hold time as per BC MoE, 5 Days hold time as per Ontario MSA and 7 Days hold time as per OMoE.
11. 3 Days hold time until resolved. Unlimited hold time once soil is dried.
12. 3 Days hold time as per BC MoE and 7 Days hold time as per OMoE.
13. 40 Days hold time for field matrixed preserved samples, 7 Days hold time for COME CWS PHC F1 and 2 Days hold time for Enc
14. 40 Days hold time as per OMoE
15. 14 Days hold time as per Ontario MSA.
16. 14 Days hold time as per OMoE
17. 14 Days hold time for water and 56 Days hold time for soil as per OMoE.
18. 30 Hours hold time as per BC Drinking Water Regulation and 48 Hours as per OMoE

White Paper Co. 604-951-3000

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L1681194-COFC

COC Number: 14 - 490825

Page 1 of 1

Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	AZIMUTH CONSULTING GROUP	Select Report Format:	PDF EXCEL EDD (DIGITAL)	R Regular (Standard TAT if received by 3pm)
Contact:	ERIC FRANZ	Quality Control (QC) Report with Report	Yes No	P Priority (2-4 business days if received by 3pm)
Address:	218-2902 WEST BROADWAY VANCOUVER BC V6K 2G8	Criteria on Report - provide details below if box checked		E Emergency (1-2 business days if received by 3pm)
		Select Distribution:	EMAIL MAIL FAX	E2 Same day or weekend emergency if received by 10am - contact ALS for surcharge.
Phone:	(604) 730-1220	Email 1 or Fax	e.franz@azimuthgroup.ca	Specify Date Required for E2,E or P:
		Email 2	ryan.vanenger@agnicleagle.com	

Invoice To		Invoice Distribution	
Same as Report To	Yes No	Select Invoice Distribution:	EMAIL MAIL FAX
Copy of Invoice with Report	Yes No	Email 1 or Fax	
Company:		Email 2	
Contact:		Oil and Gas Required Fields (client use)	

Project Information		
ALS Quote #:	Approver ID:	Cost Center:
Job #: [redacted] - AMARUQ SURFACE WATER	GL Account:	Routing Code:
PO / AFE:	Activity Code:	
LSD:	Location:	
ALS Lab Work Order # (lab use only)	ALS Contact:	Sampler:

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Analysis Request: Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below								Number of Containers
					P	F/P	P	P	F/P	P	F/P		
					TKN; Ammonia, TKN	DOC	T-N (Low), Free CN (Low)	Total Mercury	Dissolved Mercury	Total Metals	Dissolved Metals		
	A34 - A16	17-Sep-15	14:47	Surface water	X	X	X	X	X	X	X		7
	A16 - A14	17-Sep-15	15:45		X	X	X	X	X	X	X		7
	C58 OUTLET	19-Sep-15	12:20		X	X	X	X	X	X	X		7
	A1 - DS1	19-Sep-15	14:55		X	X	X	X	X	X	X		7
	A17 - A16	19-Sep-15	16:10		X	X	X	X	X	X	X		7
	A13 - A12	21-Sep-15	12:38		X	X	X	X	X	X	X		7
	E5 - E4	21-Sep-15	13:00		X	X	X	X	X	X	X		7

Drinking Water (DW) Samples [1] (client use)	Special Instructions / Specify Criteria to add on report (client use)
Are samples taken from a Regulated DW System? Yes No	
Are samples for human drinking water use? Yes No	

SAMPLE CONDITION AS RECEIVED (lab use only)			
Frozen		SIF Observations	Yes No
Ice packs	Yes No	Custody seal intact	Yes No
Cooling Initiated			
INITIAL COOLER TEMPERATURES °C		FINAL COOLER TEMPERATURES °C	
		12	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
						Shafel	Sep 30	1130

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

ALS Canada Ltd. Version 4.0 - Effective: January 2014

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

AZIMUTH CONSULTING GROUP INC.
ATTN: Eric Franz
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 24-SEP-15
Report Date: 30-SEP-15 14:08 (MT)
Version: FINAL

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1678136

Project P.O. #: NOT SUBMITTED
Job Reference: AMARUQ SURFACEWATER
C of C Numbers: 1, 2
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1678136-1	L1678136-2	L1678136-3	L1678136-4	L1678136-5
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	18-SEP-15	18-SEP-15	18-SEP-15	18-SEP-15	19-SEP-15
Sampled Time					
Client ID	WTN-05-S	WTN-06-S	WTS-05-S	WTS-06-S	NEM-05-S
Grouping / **Analyte**					
WATER					
Physical Tests					
Conductivity (uS/cm)	25.2	21.8	20.3	20.5	25.3
pH (pH)	6.81	6.75	6.75	6.76	7.05
Total Suspended Solids (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Total Dissolved Solids (mg/L)	18.0	17.7	16.0	15.5	17.4
Turbidity (NTU)	0.32	0.35	0.34	0.35	0.21
Anions and Nutrients					
Alkalinity, Bicarbonate (as CaCO3) (mg/L)	5.3	4.6	4.4	4.3	7.5
Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3) (mg/L)	5.3	4.6	4.4	4.3	7.5
Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl) (mg/L)	2.99	2.38	2.11	2.10	0.53
Fluoride (F) (mg/L)	0.026	0.026	0.026	0.026	0.023
Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Silicate (as SiO2) (mg/L)	0.69	0.67	0.68	0.65	0.62
Sulfate (SO4) (mg/L)	1.49	1.37	1.32	1.32	3.22

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1678136-6	L1678136-7	L1678136-8	L1678136-9	L1678136-10
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	19-SEP-15	19-SEP-15	19-SEP-15	20-SEP-15	20-SEP-15
Sampled Time					
Client ID	NEM-06-S	MAM-05-S	MAM-06-S	C2-SEP	C14-SEP
Grouping / **Analyte**					
WATER					
Physical Tests					
Conductivity (uS/cm)	25.4	25.7	25.5	23.8	24.4
pH (pH)	7.04	6.86	6.83	6.87	7.08
Total Suspended Solids (mg/L)	<1.0	<1.0	<1.0	<1.0	1.5
Total Dissolved Solids (mg/L)	16.5	17.8	18.1	17.4	19.4
Turbidity (NTU)	0.20	0.26	0.30	0.31	0.72
Anions and Nutrients					
Alkalinity, Bicarbonate (as CaCO3) (mg/L)	7.2	5.2	5.1	5.7	8.9
Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3) (mg/L)	7.2	5.2	5.1	5.7	8.9
Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl) (mg/L)	0.54	2.59	2.58	0.51	0.55
Fluoride (F) (mg/L)	0.023	0.025	0.025	0.073	0.034
Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Silicate (as SiO2) (mg/L)	0.60	0.79	0.76	1.14	0.74
Sulfate (SO4) (mg/L)	3.19	2.24	2.24	3.97	1.55

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1678136-11	L1678136-12	L1678136-13	L1678136-14	L1678136-15
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	20-SEP-15	20-SEP-15	20-SEP-15	20-SEP-15	19-SEP-15
Sampled Time					
Client ID	C17-SEP	C20-SEP	C41-SEP	AMARUQ SEP DUP-1	AMARUQ SEP EB-1
Grouping / **Analyte**					
WATER					
Physical Tests					
Conductivity (uS/cm)	22.9	21.7	25.2	21.4	<2.0
pH (pH)	7.00	7.04	6.93	6.76	5.54
Total Suspended Solids (mg/L)	<1.0	<1.0	9.0	<1.0	<1.0
Total Dissolved Solids (mg/L)	18.6	14.4	20.4	17.0	<3.0
Turbidity (NTU)	0.50	0.45	1.53	0.32	<0.10
Anions and Nutrients					
Alkalinity, Bicarbonate (as CaCO3) (mg/L)	7.7	7.5	6.7	4.3	<1.0
Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3) (mg/L)	7.7	7.5	6.7	4.3	<1.0
Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl) (mg/L)	0.58	0.63	0.62	2.36	<0.10
Fluoride (F) (mg/L)	0.048	0.037	0.054	0.026	<0.020
Nitrate (as N) (mg/L)	<0.0050	<0.0050	0.0148	<0.0050	<0.0050
Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total Dissolved (mg/L)	0.0022	<0.0020	0.0022	<0.0020	<0.0020
Silicate (as SiO2) (mg/L)	0.97	<0.50	1.39	0.67	<0.50
Sulfate (SO4) (mg/L)	1.52	1.63	3.26	1.37	<0.30

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Alkalinity, Total (as CaCO3)	B	L1678136-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Fluoride (F)	DLM	L1678136-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Nitrite (as N)	DLM	L1678136-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Nitrate (as N)	DLM	L1678136-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Orthophosphate-Dissolved (as P)	MS-B	L1678136-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. All associated sample results are at least 5 times greater than blank levels and are considered reliable.
DLM	Detection Limit Adjusted due to sample matrix effects.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CL-L-IC-N-VA	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-TD-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SILICATE-COL-VA	Water	Silicate by Colourimetric analysis	APHA 4500-SiO2 E.

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-LOW-VA	Water	Low Level TDS (3.0mg/L) by Gravimetric	APHA 2540C

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total dissolved solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-LOW-VA	Water	Total Suspended Solids by Grav. (1 mg/L)	APHA 2540D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

1 2

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # _____

Page 1 of 2

Report To		Report Format / Distribution		Service Requested (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☑ Standard ☐ Other		◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☑ PDF ☑ Excel ☐ Digital ☐ Fax		○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1:	efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2:	gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3:	ryan.vanengen@agnicoeagle.com	**Analysis Request**
Invoice To	Same as Report ? ☑ Yes ☐ No	**Client / Project Information**		Please indicate below Filtered, Preserved or both (F, P, F/P)
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #:	Amaruq Surfacewater	
Company:		PO / AFE:		
Contact:		LSD:		
Address:				
Phone:	Fax:	Quote #:	Q39503	
Lab Work Order # (lab use only)	L1678136	**ALS Contact:**	Brent Mack	**Sampler:** Morgan Finley

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Conventionals** see notes	TSS-Low, TDS-Low							Number of Containers
	WTN-05-S	18-Sept-15		Surface Water	X	X							2
	WTN-06-S			Surface Water	X	X							2
	WTS-05-S			Surface Water	X	X							2
	WTS-06-S			Surface Water	X	X							2
	NEM-05-S	19-Sept-15		Surface Water	X	X							2
	NEM-06-S			Surface Water	X	X							2
	MAM-05-S			Surface Water	X	X							2
	MAM-06-S			Surface Water	X	X							2
	C2-SEP	20-Sept-15		Surface Water	X	X							2
	C14-SEP			Surface Water	X	X							2
	C17-SEP			Surface Water	X	X							2
	C20-SEP			Surface Water	X	X							2

Short Holding Time
Rush Processing

L1678136-COFC

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

**Conventionals includes: Alk Species, pH, EC, Turbidity, Conductivity, Anions (F, NO2, NO3, Br, SO4), low-level Chloride, Silicate, TD-P, and Ortho-PO4.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Morgan Finley	21-Sept-15		lady	Sept.24	9AM	14.3 14.8 °C				

GENF 20.00 Front

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

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COC # _____

Page ___ of ___

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☑ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☑ PDF ☑ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	**Analysis Request**
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	Please indicate below Filtered, Preserved or both (F, P, F/P)
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q39503	
Lab Work Order # (lab use only)		ALS Contact: Brent Mack	Sampler: Morgan Finley

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Conventionals** see notes	TSS-Low, TDS-Low	Number of Containers
	C41-SEP	20-Sept-15		Surface Water	X	X	2
	AMARUQ SEP DUP-1			Surface Water	X	X	2
	AMARUQ SEP EB-1	19-Sept-15		Surface Water	X	X	2

L1678136-COFC

Short Holding Time

Rush Processing

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

**Conventionals includes: Alk Species, pH, EC, Turbidity, Conductivity, Anions (F, NO2, NO3, Br, SO4), low-level Chloride, Silicate, TD-P, and Ortho-PO4.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Morgan Finley	21-Sept-15		Lady	Sept-24	9Am	14.3 14.8 °C				

GENF 20.00 Front

AZIMUTH CONSULTING GROUP INC.
ATTN: Eric Franz
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 24-SEP-15
Report Date: 05-OCT-15 15:12 (MT)
Version: FINAL

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1678156

Project P.O. #: NOT SUBMITTED
Job Reference: AMARUQ SURFACEWATER
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1678156-1	L1678156-2	L1678156-3	L1678156-4	L1678156-5
	Description	Other	Other	Other	Other	Other
	Sampled Date	18-SEP-15	18-SEP-15	18-SEP-15	18-SEP-15	18-SEP-15
	Sampled Time					
	Client ID	WTN-05-S	WTN-06-S	WTS-05-S	WTS-06-S	NEM-05-S
Grouping	**Analyte**					
FILTER						
Plant Pigments	Chlorophyll a (ug/L)	0.769	0.934	0.822	0.884	0.526

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1678156-6	L1678156-7	L1678156-8	L1678156-9	L1678156-10
	Description	Other	Other	Other	Other	Other
	Sampled Date	18-SEP-15	18-SEP-15	18-SEP-15	18-SEP-15	18-SEP-15
	Sampled Time					
	Client ID	NEM-06-S	MAM-05-S	MAM-06-S	C2-SEP	C14-SEP
Grouping	**Analyte**					
FILTER						
Plant Pigments	Chlorophyll a (ug/L)	0.500	0.801	0.704	0.608	1.50

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1678156-11 Other 18-SEP-15 C17-SEP	L1678156-12 Other 18-SEP-15 C20-SEP	L1678156-13 Other 18-SEP-15 C41-SEP	L1678156-14 Other 18-SEP-15 AMARUQ SEP DUP-1	
Sample ID **Description** **Sampled Date** **Sampled Time** **Client ID**						
FILTER						
Plant Pigments	Chlorophyll a (ug/L)	0.791	0.556	2.30	0.847	

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CHLOROA-F-VA	Filter	Chlorophyll a by Fluorometer (Filter)	EPA 445.0

This analysis is done using procedures modified from EPA Method 445.0. Chlorophyll-a is determined by a routine acetone extraction followed with analysis by fluorometry using the non-acidification procedure. This method is not subject to interferences from chlorophyll b.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Short Holding Time

Rush Processing

Chain of Custody / Analytic
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L1678156-COFC

COC # _____

Page 1 of 2

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☑ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☑ PDF ☑ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	Analysis Request
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q39503	
Lab Work Order # (lab use only)		ALS Contact: Brent Mack	Sampler: Morgan Finley

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Chlorophyll 'a'	Number of Containers
	WTN-05-S	18-Sep-15		Other	X	1
	WTN-06-S			Other	X	1
	WTS-05-S			Other	X	1
	WTS-06-S			Other	X	1
	NEM-05-S	19-Sep-15		Other	X	1
	NEM-06-S			Other	X	1
	MAM-05-S			Other	X	1
	MAM-06-S			Other	X	1
	C2-SEP	20-Sep-15		Other	X	1
	C14-SEP			Other	X	1
	C17-SEP			Other	X	1
	C20-SEP			Other	X	1

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

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Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Morgan Finley			Jean	24/9	8:50	13 °C				

GENF 20.00 Front

ALS Environmental

Chain of Custody / Analytic
Canada Toll Free: 1 8
www.alsglobal.

L1678156-COFC

COC # _____

Page 2 of 2

Report To		Report Format / Distribution		Service Requested (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☑ Standard ☐ Other		◉ Regular (Standard Turnaround Times - Business Days)
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Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca		○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca		○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com		Analysis Request
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information		Please indicate below Filtered, Preserved or both (F, P, F/P)
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater		
Company:		PO / AFE:		
Contact:		LSD:		
Address:				
Phone:	Fax:	Quote #: Q39503		
Lab Work Order # (lab use only)		ALS Contact: Brent Mack	Sampler: Morgan Finley	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Chlorophyll 'a'	Number of Containers
	C41-SEP	20-Sep-15		Other	X	1
	AMARUQ SEP DUP-1	-	-	Other	X	1

Short Holding Time

Rush Processing

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

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SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Morgan Finley.			Jean	24/9	8:50	13 °C				

GENF 20.00 Front

AZIMUTH CONSULTING GROUP INC.
ATTN: Eric Franz
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 28-SEP-15
Report Date: 07-OCT-15 13:41 (MT)
Version: FINAL

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L1679751

Project P.O. #: NOT SUBMITTED
Job Reference: AMARUQ SURFACEWATER
C of C Numbers: 1, 2
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1679751-1	L1679751-2	L1679751-3	L1679751-4	L1679751-5
	Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
	Sampled Date	18-SEP-15	18-SEP-15	18-SEP-15	18-SEP-15	19-SEP-15
	Sampled Time					
	Client ID	WTN-05-S	WTN-06-S	WTS-05-S	WTS-06-S	NEM-05-S
Grouping	**Analyte**					
WATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	8.63	7.76	7.30	7.30	9.63
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (mg/L)	0.116	0.118	0.120	0.129	0.123
	Phosphorus (P)-Total (mg/L)	<0.0020	0.0031	0.0023	<0.0020	<0.0020
Cyanides	Cyanide, Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cyanide, Free (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.81	1.74	1.74	1.76	1.44
	Total Organic Carbon (mg/L)	1.70	1.77	1.77	1.74	1.34
Total Metals	Aluminum (Al)-Total (mg/L)	0.0116	0.0120	0.0107	0.0111	0.0032
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00019	0.00018	0.00017	0.00017	0.00031
	Barium (Ba)-Total (mg/L)	0.00410	0.00372	0.00354	0.00347	0.00384
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	2.15	1.95	1.77	1.78	2.14
	Chromium (Cr)-Total (mg/L)	0.00014	0.00011	0.00012	0.00011	0.00011
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Total (mg/L)	0.021	0.024	0.024	0.022	0.011
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Total (mg/L)	0.71	0.70	0.66	0.66	0.98
	Manganese (Mn)-Total (mg/L)	0.00365	0.00294	0.00256	0.00249	0.00248
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	<0.000050	0.000059	<0.000050	<0.000050	<0.000050
	Nickel (Ni)-Total (mg/L)	0.00060	0.00061	0.00052	0.00050	0.00053
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	0.39	0.38	0.37	0.36	0.56
	Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)-Total (mg/L)	0.247	0.263	0.256	0.255	0.210
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	0.526	0.546	0.531	0.536	0.485
	Strontium (Sr)-Total (mg/L)	0.0145	0.0128	0.0113	0.0115	0.00945
	Sulfur (S)-Total (mg/L)	0.54	0.53	<0.50	0.50	1.12

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1679751-6 Surface Water 19-SEP-15 NEM-06-S	L1679751-7 Surface Water 19-SEP-15 MAM-05-S	L1679751-8 Surface Water 19-SEP-15 MAM-06-S	L1679751-9 Surface Water 20-SEP-15 C2-SEP	L1679751-10 Surface Water 20-SEP-15 C14-SEP
Sample ID / Description / Sampled Date / Sampled Time / Client ID						
WATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	9.61	9.18	9.21	9.21	10.3
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (mg/L)	0.115	0.135	0.131	0.125	0.188
	Phosphorus (P)-Total (mg/L)	<0.0020	<0.0020	0.0031	<0.0020	0.0042
Cyanides	Cyanide, Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cyanide, Free (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.22	1.46	1.54	1.47	2.34
	Total Organic Carbon (mg/L)	1.55	1.60	1.62	1.50	2.36
Total Metals	Aluminum (Al)-Total (mg/L)	0.0043	0.0062	0.0080	0.0091	0.0338
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00032	0.00040	0.00041	0.00018	0.00042
	Barium (Ba)-Total (mg/L)	0.00391	0.00457	0.00464	0.00343	0.00372
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	0.0000056	<0.0000050	0.0000064
	Calcium (Ca)-Total (mg/L)	2.14	2.33	2.41	2.26	2.84
	Chromium (Cr)-Total (mg/L)	0.00011	0.00012	0.00013	<0.00010	0.00023
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	<0.00050	<0.00050	<0.00050	0.00077	0.00073
	Iron (Fe)-Total (mg/L)	0.010	0.016	0.019	0.039	0.108
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	0.000086	<0.000050	0.000109
	Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Total (mg/L)	0.97	0.77	0.79	0.84	0.75
	Manganese (Mn)-Total (mg/L)	0.00266	0.00220	0.00245	0.00106	0.00912
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000080	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel (Ni)-Total (mg/L)	0.00053	0.00057	0.00061	<0.00050	<0.00050
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	0.53	0.48	0.49	0.30	0.35
	Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)-Total (mg/L)	0.209	0.288	0.300	0.464	0.345
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	0.490	0.537	0.552	0.536	0.533
	Strontium (Sr)-Total (mg/L)	0.00945	0.0133	0.0134	0.0119	0.0150
	Sulfur (S)-Total (mg/L)	1.11	0.79	0.86	1.39	0.61

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1679751-11 Surface Water 20-SEP-15 C17-SEP	L1679751-12 Surface Water 20-SEP-15 C20-SEP	L1679751-13 Surface Water 20-SEP-15 C41-SEP	L1679751-14 Surface Water 20-SEP-15 AMARUQ SEP DUP-1	L1679751-15 Surface Water 19-SEP-15 AMARUQ SEP EB-1
WATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	9.40	8.83	9.88	8.09	<0.50
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	<0.0050	0.0051	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (mg/L)	0.160	0.234	0.203	0.121	<0.050
	Phosphorus (P)-Total (mg/L)	0.0026	0.0072	0.0071	<0.0020	<0.0020
Cyanides	Cyanide, Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cyanide, Free (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	2.69	1.41	1.88	1.79	<0.50
	Total Organic Carbon (mg/L)	2.65	2.12	1.91	1.87	<0.50
Total Metals	Aluminum (Al)-Total (mg/L)	0.0156	0.0099	0.0647	0.0112	<0.0030
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00029	0.00017	0.00027	0.00018	<0.00010
	Barium (Ba)-Total (mg/L)	0.00243	0.00190	0.00592	0.00374	<0.000050
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	<0.0000050	0.0000093	0.0000082	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	2.43	2.17	2.18	1.93	<0.050
	Chromium (Cr)-Total (mg/L)	0.00018	0.00010	0.00079	0.00017	<0.00010
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	0.00013	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.00070	<0.00050	0.00107	<0.00050	<0.00050
	Iron (Fe)-Total (mg/L)	0.078	0.021	0.336	0.021	<0.010
	Lead (Pb)-Total (mg/L)	<0.000050	0.000372	0.000317	<0.000050	0.000190 RRV
	Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Total (mg/L)	0.79	0.75	1.20	0.70	<0.10
	Manganese (Mn)-Total (mg/L)	0.00762	0.00131	0.00591	0.00262	<0.00010
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	<0.000050	<0.000050	0.000078	<0.000050	<0.000050
	Nickel (Ni)-Total (mg/L)	0.00052	<0.00050	0.00462	0.00057	<0.00050
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	0.35	0.30	0.33	0.36	<0.10
	Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)-Total (mg/L)	0.404	0.164	0.722	0.259	<0.050
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	0.560	0.487	0.555	0.522	<0.050
	Strontium (Sr)-Total (mg/L)	0.0128	0.00905	0.0107	0.0126	<0.00020
	Sulfur (S)-Total (mg/L)	0.58	0.58	1.18	<0.50	<0.50

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1679751-1 Surface Water 18-SEP-15 WTN-05-S	L1679751-2 Surface Water 18-SEP-15 WTN-06-S	L1679751-3 Surface Water 18-SEP-15 WTS-05-S	L1679751-4 Surface Water 18-SEP-15 WTS-06-S	L1679751-5 Surface Water 19-SEP-15 NEM-05-S
Sample ID / Description / Sampled Date / Sampled Time / Client ID						
WATER						
Total Metals	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Total (mg/L)	0.000032	0.000035	0.000035	0.000035	<0.000010
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0035	0.0038	0.0033	0.0033	0.0024
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00017	0.00017	0.00014	0.00013	0.00026
	Barium (Ba)-Dissolved (mg/L)	0.00423	0.00373	0.00339	0.00340	0.00395
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	2.24	1.96	1.82	1.82	2.19
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00034	0.00031	0.00033	0.00031	0.00026
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	0.000053	<0.000050	0.000556 DTC
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	0.74	0.70	0.67	0.67	1.01
	Manganese (Mn)-Dissolved (mg/L)	0.00135	0.00084	0.00057	0.00065	0.00057
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel (Ni)-Dissolved (mg/L)	0.00061	0.00053	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	0.41	0.39	0.36	0.37	0.56
	Selenium (Se)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)-Dissolved (mg/L)	0.245	0.246	0.241	0.239	0.205
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	0.534	0.532	0.515	0.518	0.478
	Strontium (Sr)-Dissolved (mg/L)	0.0150	0.0128	0.0116	0.0115	0.00939
	Sulfur (S)-Dissolved (mg/L)	0.53	<0.50	<0.50	<0.50	1.08

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1679751-6 Surface Water 19-SEP-15 NEM-06-S	L1679751-7 Surface Water 19-SEP-15 MAM-05-S	L1679751-8 Surface Water 19-SEP-15 MAM-06-S	L1679751-9 Surface Water 20-SEP-15 C2-SEP	L1679751-10 Surface Water 20-SEP-15 C14-SEP
WATER						
Total Metals	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00096
	Uranium (U)-Total (mg/L)	<0.000010	0.000022	0.000024	0.000036	0.000040
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0017	0.0025	0.0033	0.0033	0.0053
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00028	0.00034	0.00036	0.00014	0.00029
	Barium (Ba)-Dissolved (mg/L)	0.00391	0.00432	0.00436	0.00309	0.00338
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	2.19	2.38	2.40	2.29	2.89
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00021	0.00037	0.00054	0.00070	0.00060
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.013	0.019
	Lead (Pb)-Dissolved (mg/L)	0.000104	0.000270 DTC	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	1.01	0.78	0.78	0.85	0.76
	Manganese (Mn)-Dissolved (mg/L)	0.00052	0.00068	0.00074	0.00081	0.00358
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	0.0000063	0.0000055	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00051	0.00056	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	0.56	0.49	0.49	0.31	0.34
	Selenium (Se)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)-Dissolved (mg/L)	0.210	0.278	0.276	0.457	0.290
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	0.477	0.527	0.523	0.527	0.517
	Strontium (Sr)-Dissolved (mg/L)	0.00941	0.0130	0.0130	0.0121	0.0147
	Sulfur (S)-Dissolved (mg/L)	1.08	0.78	0.79	1.36	0.57

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1679751-11 Surface Water 20-SEP-15 C17-SEP	L1679751-12 Surface Water 20-SEP-15 C20-SEP	L1679751-13 Surface Water 20-SEP-15 C41-SEP	L1679751-14 Surface Water 20-SEP-15 AMARUQ SEP DUP-1	L1679751-15 Surface Water 19-SEP-15 AMARUQ SEP EB-1
WATER						
Total Metals	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	0.00134	<0.00030	<0.00030
	Uranium (U)-Total (mg/L)	0.000041	0.000022	0.000060	0.000035	<0.000010
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0049	0.0086	0.0053	0.0037	<0.0010
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00027	0.00015	0.00011	0.00017	<0.00010
	Barium (Ba)-Dissolved (mg/L)	0.00228	0.00196	0.00477	0.00380	<0.000050
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.0000067	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	2.45	2.25	2.10	2.06	<0.050
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00014	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00064	0.00041	0.00068	0.00033	<0.00020
	Iron (Fe)-Dissolved (mg/L)	0.036	0.014	0.030	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000098	<0.000050	<0.000050	0.000069 RRV
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	0.80	0.78	1.13	0.71	<0.10
	Manganese (Mn)-Dissolved (mg/L)	0.00630	0.00077	0.00169	0.00085	<0.00010
	Mercury (Hg)-Dissolved (mg/L)	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	<0.000050	<0.000050	0.000104	<0.000050	<0.000050
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	0.00329	0.00051	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	0.36	0.35	0.33	0.37	<0.10
	Selenium (Se)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)-Dissolved (mg/L)	0.383	0.163	0.606	0.243	<0.050
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	0.554	0.481	0.565	0.523	<0.050
	Strontium (Sr)-Dissolved (mg/L)	0.0124	0.00917	0.0102	0.0132	<0.00020
	Sulfur (S)-Dissolved (mg/L)	0.56	0.58	1.11	<0.50	<0.50

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1679751-1	L1679751-2	L1679751-3	L1679751-4	L1679751-5
Description	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Sampled Date	18-SEP-15	18-SEP-15	18-SEP-15	18-SEP-15	19-SEP-15
Sampled Time					
Client ID	WTN-05-S	WTN-06-S	WTS-05-S	WTS-06-S	NEM-05-S
Grouping / **Analyte**					
WATER					
Dissolved Metals Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.000028	0.000028	0.000028	0.000029	<0.000010
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	0.0011
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1679751-6 Surface Water 19-SEP-15 NEM-06-S	L1679751-7 Surface Water 19-SEP-15 MAM-05-S	L1679751-8 Surface Water 19-SEP-15 MAM-06-S	L1679751-9 Surface Water 20-SEP-15 C2-SEP	L1679751-10 Surface Water 20-SEP-15 C14-SEP
Sample ID / Description / Sampled Date / Sampled Time / Client ID						
WATER						
Dissolved Metals	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	<0.000010	0.000017	0.000017	0.000030	0.000026
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1679751-11 Surface Water 20-SEP-15 C17-SEP	L1679751-12 Surface Water 20-SEP-15 C20-SEP	L1679751-13 Surface Water 20-SEP-15 C41-SEP	L1679751-14 Surface Water 20-SEP-15 AMARUQ SEP DUP-1	L1679751-15 Surface Water 19-SEP-15 AMARUQ SEP EB-1
Sample ID **Description** **Sampled Date** **Sampled Time** **Client ID**						
WATER						
Dissolved Metals	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00034	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000035	0.000021	0.000025	0.000027	<0.000010
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	0.0060	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Calcium (Ca)-Total	B	L1679751-1, -2
Matrix Spike	Total Kjeldahl Nitrogen	MS-B	L1679751-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Phosphorus (P)-Total	MS-B	L1679751-1, -2, -3, -4
Matrix Spike	Phosphorus (P)-Total	MS-B	L1679751-10, -11, -12, -13, -14, -15, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1679751-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1679751-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1679751-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1679751-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1679751-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1679751-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1679751-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L1679751-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1679751-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1679751-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1679751-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1679751-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Boron (B)-Dissolved	MS-B	L1679751-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1679751-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1679751-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Total Organic Carbon	MS-B	L1679751-14, -15
Matrix Spike	Barium (Ba)-Total	MS-B	L1679751-10, -11, -12, -13, -14, -15, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Molybdenum (Mo)-Total	MS-B	L1679751-10, -11, -12, -13, -14, -15, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L1679751-10, -11, -12, -13, -14, -15, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. All associated sample results are at least 5 times greater than blank levels and are considered reliable.
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Reference Information

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

CARBONS-DOC-VA Water Dissolved organic carbon by combustion APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CARBONS-TOC-VA Water Total organic carbon by combustion APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CN-FREE-L-CFA-VA Water Low Level Free Cyanide in water by CFA ASTM 7237

This analysis is carried out using procedures adapted from ASTM Method 7237 "Free Cyanide with Flow Injection Analysis (FIA) Utilizing Gas Diffusion Separation and Amperometric Detection". Free cyanide is determined by in-line gas diffusion at pH 6 with final determination by colourimetric analysis.

CN-T-L-CFA-VA Water Low Level Total Cyanide in water by CFA ISO 14403:2002

This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-DIS-LOW-ICP-VA Water Dissolved Metals in Water by ICPOES EPA 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-TOT-LOW-ICP-VA Water Total Metals in Water by ICPOES EPA 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

S-DIS-ICP-VA Water Dissolved Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

Reference Information

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

S-TOT-ICP-VA Water Total Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location

Chain of Custody Numbers:

1 2

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # _____

Page 2 of 2

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☑ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☑ PDF ☑ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	**Analysis Request**
Invoice To	Same as Report ? ☑ Yes ☐ No	**Client / Project Information**	Please indicate below Filtered, Preserved or both (F, P, F/P)
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q39503	
Lab Work Order # (lab use only)		**ALS Contact:** Brent Mack	**Sampler:** Morgan Finley

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	P TOC, Ammonia, TKN, Total P	F/P DOC	P T-CN (Low), Free CN (Low)	P Total mercury	F/P Dissolved mercury	P Total Metals	F/P Dissolved Metals	Number of Containers
	C41-SEP	20-Sept-15		Surface Water	X	X	X	X	X	X	X	7
	AMARUQ SEP DUP-1			Surface Water	X	X	X	X	X	X	X	7
	AMARUQ SEP EB-1	19-Sept-15		Surface Water	X	X	X	X	X	X	X	7



Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Morgan Finley	21-Sept-15					°C				

GENF 20.00 Front

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # _____

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☑ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☑ PDF ☑ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: gmann@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3: ryan.vanengen@agnicoeagle.com	**Analysis Request**
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	Please indicate below Filtered, Preserved or both (F, P, F/P)
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq Surfacewater	
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q39503	
Lab Work Order # (lab use only)	L1679751	ALS Contact: Brent Mack	Sampler: Morgan Finley

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	TOC, Ammonia, TKN, Total P (P)	DOC (F/P)	T-CN (Low), Free CN (Low) (P)	Total mercury (P)	Dissolved mercury (F/P)	Total Metals (P)	Dissolved Metals (F/P)	Number of Containers
	WTN-05-S	18-Sept-15		Surface Water	X	X	X	X	X	X	X	7
	WTN-06-S			Surface Water	X	X	X	X	X	X	X	7
	WTS-05-S			Surface Water	X	X	X	X	X	X	X	7
	WTS-06-S			Surface Water	X	X	X	X	X	X	X	7
	NEM-05-S	19-Sept-15		Surface Water	X	X	X	X	X	X	X	7
	NEM-06-S			Surface Water	X	X	X	X	X	X	X	7
	MAM-05-S			Surface Water	X	X	X	X	X	X	X	7
	MAM-06-S			Surface Water	X	X	X	X	X	X	X	7
	C2-SEP	20-Sept-15		Surface Water	X	X	X	X	X	X	X	7
	C14-SEP			Surface Water	X	X	X	X	X	X	X	7
	C17-SEP			Surface Water	X	X	X	X	X	X	X	7
	C20-SEP			Surface Water	X	X	X	X	X	X	X	7

Short Holding Time

Rush Processing

L1679751-COFC

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Morgan Finley	21-Sept-15		Shafee	Sept.28	1230	14/14/13°C				

APPENDIX D

Golder Memorandum – Stream Water Quality Program

MEMORANDUM

TO Azimuth Consulting: Gary Mann and Maggie McConnell **DATE** 10 December 2015

CC Dionne Filiatrault, Jen Range

FROM Colleen Prather **PROJECT No.** Doc 030-1524321.1010.1011 Ver 1

AMARUQ STREAM WATER QUALITY PROGRAM

Methods:

- Sample summary
  - Field measurements were recorded at 16 tributaries during the August sampling program (Table 1).
  - One set of water quality grab samples were collected at 11 tributaries during the August sampling program (Table 1); two quality control samples (travel blank and a duplicate from A8-A7) were also collected.
  - One set of water quality grab samples were collected at 6 tributaries during the September sampling program; one quality control sample (duplicate from A1-DS1) was also collected.
- Field measurements
  - In situ physico-chemical measurements of specific conductivity, dissolved oxygen (concentration and percent saturation), pH, and water temperature were collected using a submersible YSI Pro Plus multi-sensor probe system (Table 2).
  - Measurements were taken below the water surface in an area of flow.
  - Additional field notes are provided in Table 3.
- Laboratory water quality samples
  - Water samples were collected at a depth of 0.3 m (30 cm), unless water depth was less than 0.3 m.
  - If water depth was less than 0.3 m, water samples were collected at 0.1 m.
  - The actual sampling depth was recorded on the field data sheet.
  - Sample bottles were filled directly in the field.
  - Samples were processed (i.e., filtered and/or preserved) according to the instructions provided by ALS Environmental (ALS).
  - Samples requiring filtration were filtered through a 0.45 micron (µm) Millipore filter in a Nalgene filter tower.
  - Samples were submitted to ALS as soon as possible after sample collection for analysis of a suite of parameters including:

- conventional parameters (i.e., alkalinity [total, bicarbonate, carbonate, and hydroxide], conductivity, hardness, pH, total dissolved solids [TDS], total suspended solids [TSS], and turbidity);
- major ions (i.e., bromide, calcium, chloride, fluoride, magnesium, potassium, sodium, and sulphate);
- nutrients (i.e., total organic carbon [TOC], dissolved organic carbon [DOC], total Kjeldahl nitrogen [TKN], total ammonia, nitrate, nitrite, total phosphorus [TP], total dissolved phosphorus [TDP], dissolved orthophosphate, and silicate); and
- total and dissolved metals, metalloids, and non-metals (i.e., aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, cesium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, rubidium, selenium, silicon, silver, strontium, sulfur, tellurium, thallium, thorium, tin, titanium, tungsten, uranium, vanadium, zinc, and zirconium).

Table 1: Sample Collection Summary

Current Station ID	Original Station ID	UTM Zone 14W		August Program			September Program		
		Easting	Northing	Date	Field Data Measured	WQ Sample Collected	Date	Field Data Measured	WQ Sample Collected
A18-A17	A17-A16	606637	7253084	4-Aug-15	yes	yes	19-Sep-15	yes	Yes
A17-A16	A16-A14	606269	7255286	7-Aug-15	yes	no	17-Sep-15	yes	Yes
C38-C12	C58 Outlet	606635	7258187	4-Aug-15	yes	yes	19-Sep-15	yes	Yes
A14-A13	A12-A11	602978	7255643	4-Aug-15	yes	yes	-	-	-
A12-A77	A10-A9	602772	7256632	5-Aug-15	yes	no	18-Sep-15	yes	No
A12-A11	A10-B11	603297	7256774	5-Aug-15	yes	no	19-Sep-15	yes	No
A69-DS1	A1-DS1	598452	7256756	4-Aug-15	yes	yes	19-Sep-15	yes	Yes
DS1	D1	599116	7268305	5-Aug-15	yes	yes	19-Sep-15	yes	No
A65-A17	A23-A16	607487	7252319	5-Aug-15	no water in channel		-	-	-
A55-A17	A34-A16	608010	7254529	7-Aug-15	yes	yes	17-Sep-15	yes	Yes
A21-A20	A20-A19	604557	7252299	6-Aug-15	yes	yes	-	-	-
A76-A75	A8-A7	601358	7256775	5-Aug-15	yes	yes	-	-	-
B3-B2	A92-A91	600133	7258962	7-Aug-15	yes	no	-	-	-
A81-A80	A101-A100	598340	7255446	8-Aug-15	yes	yes	17-Sep-15	yes	No
A5-A4	B5-B4	600130	7260456	6-Aug-15	yes	yes	-	-	-
A53-A17	A40-A16	607914	7255485	7-Aug-15	yes	no	-	-	-
C8-C7	C8-C7	604266	7260887	8-Aug-15	yes	yes	-	-	-
A76-A41	A8-B10	602904	7257119	-	-	-	19-Sep-15	yes	No
A15-A14	A13-A12	603003	7255649	-	-	-	21-Sep-15	yes	Yes
E2-E1 (travel blank)	E2-E1 (travel blank)	-	-	8-Aug-15	-	yes	-	-	-
E3-E2 (duplicate from A76-A75)	E3-E2 (duplicate from A8-A7)	-	-	5-Aug-15	-	yes	-	-	-
E5-E4 (duplicate from A69-DS1)	E5-E4 (duplicate from A1-DS1)	-	-	-	-	-	19-Sep-15	-	yes

Table 2: August and September Field Data

Current Station ID	Original Station ID	UTM (easting), Zone 14W	UTM (northing), Zone 14W	Date (D/M/Y)	WQ Sample collected (yes/no)	Total Depth (m)	Sample Depth (m)	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Conductivity (µS/cm)	pH
A18-A17	A17-A16	606637	7253084	4-Aug-15	yes	0.17	0.1	17.2	10.1	103	15.1	6.71
A17-A16	A16-A14	606269	7255286	7-Aug-15	no	0.25	0.1	13.8	8.9	86	20.8	6.8
C38-C12	C58 Outlet	606635	7258187	4-Aug-15	yes	0.12	0.08	16.1	10.4	105	24.1	6.65
A14-A13	A12-A11	602978	7255643	4-Aug-15	yes	0.65	0.3	14.4	10	101	23.5	6.53
A12-A77	A10-A9	602772	7256632	5-Aug-15	no	0.25	0.15	14.6	9.7	96	23.2	6.73
A12-A11	A10-B11	603297	7256774	5-Aug-15	no	-	-	14.3	9.7	95	23.4	6.72
A69-DS1	A1-DS1	598452	7256756	4-Aug-15	yes	0.3	0.15	14.6	10.2	100	17.1	6.6
DS1	D1	599116	7268305	5-Aug-15	yes	0.35	0.2	13.6	11.1	107	20.8	7.02
A65-A17	A23-A16	607487	7252319	5-Aug-15	no	-	-	-	-	-	-	-
A55-A17	A34-A16	608010	7254529	7-Aug-15	yes	0.15	0.1	16.6	10.1	102	14.9	6.48
A21-A20	A20-A19	604557	7252299	6-Aug-15	yes	0.2	0.1	17.2	9.6	98.7	13.4	6.75
A76-A75	A8-A7	601358	7256775	5-Aug-15	Yes & duplicate	0.35	0.2	13.1	9.6	93	22	6.93
B3-B2	A92-A91	600133	7258962	7-Aug-15	no	0.15	0.1	14.5	8.9	90	15.5	6.25
A81-A80	A101-A100	598340	7255446	8-Aug-15	yes	0.25	0.1	15.4	9.5	95	12	6.52
A5-A4	B5-B4	600130	7260456	6-Aug-15	yes	0.2	0.1	15.5	10	100	20.6	6.23
A53-A17	A40-A16	607914	7255485	7-Aug-15	no	0.1	0.05	16.2	9.6	100	15.2	6.62
C8-C7	C8-C7	604266	7260887	8-Aug-15	yes	0.3	0.1	12.6	10.7	101	25.1	6.85
A81-A80	A101-A100	598347	7255434	17-Sep-15	No	-	<0.3	3.2	12.5	94	11.4	7.2
A55-A17	A34-A16	608010	7254529	17-Sep-15	Yes	-	<0.3		13.1	98	-	7.25
A17-A16	A16-A14	606189	7255256	17-Sep-15	Yes	-	<0.3		12.7	96	18	7.16
A12-A77	A10-A9	602772	7256620	18-Sep-15	No	-	<0.3	3.3	12.7	96	18.2	8.04
A69-DS1	A1-DS1	598443	7256729	18-Sep-15	No	-	<0.3	3.9	13	100	12.2	7.77
A12-A11	A10-B11	603030	7256592	19-Sep-15	No	-	<0.3	2.9	13.2	100	17.4	8.02
A76-A41	A8-B10	602904	7257119	19-Sep-15	No	-	<0.3	4.1	11.6	90	15.6	7.71
C38-C12	C58	606634	7258188	19-Sep-15	Yes	-	<0.3	5.5	11.8	95	16.3	7.14
DS1	DS1	599158	7268338	19-Sep-15	No	-	<0.3	6	12.1	98	15.5	7.14
A69-DS1	A1-DS1	598443	7256729	19-Sep-15	Yes & duplicate	-	<0.3	4.2	12.7	99	12.9	7.33
A18-A17	A17-A16	606635	7253081	19-Sep-15	Yes	-	<0.3	4.7	12.5	98	10.5	7.14
A15-A14	A13-A12	603003	7255649	21-Sep-15	Yes	-	<0.3	1.8	12.9	98	17.7	7.08

Table 3: August and September Field Notes

Revised Station ID	Original Station ID	Air Temperature (°C)	Cloud Cover (%)	Wind (dir/rate)	Weather	Other Notes:
A18-A17	A17-A16	21.3	2	from south @ 10 km/h	clear, sunny	water level low; boulder/cobble substrate
A17-A16	A16-A14	15.2	10	from south, gusting to 20 km/h	clear, windy, cool	moderate periphyton cover; very slow flowing water; clear, colourless; 100% boulder
C38-C12	C58 Outlet	20.4	30	from south @ 10-15 km/h	clear, sunny	-
A14-A13	A12-A11	22	19	from south @ 5 km/h	clear, sunny	substrate is large boulder throughout
A12-A77	A10-A9	14.2	45	south, gusting to 30 km/h	breezy, cool	watercourse not on original list; field data only
A12-A11	A10-B11	14.2	45	south, gusting to 30 km/h	breezy, cool	no sample collected
A69-DS1	A1-DS1	15.5	5	from south @ 5 km/h	clear, sunny	meters calibrated morning of August 4; fish observed; cobble substrate
DS1	D1	14	80	south at 35 km/h	windy, cool	fast moving water, large channel
A65-A17	A23-A16	-	-	-	-	fly over only; no water in channel
A55-A17	A34-A16	18.4	5	from south at 15 km/h	clear, breezy, sunny	high periphyton cover along shoreline, but sparse mid-channel; 90% boulder, 10% cobble
A21-A20	A20-A19	20.4	15	SW at 15 km/h	clear, sunny	periphyton present; no observable flow or distinct channel; clear, colourless water
A76-A75	A8-A7	12.5	25	30 km/h from south	clear, cool and breezy	drainage through large boulder garden; duplicate sample (E3-E2) collected
B3-B2	A92-A91	24.3	2	south at 15 km/h	sunny, clear, breezy	small, shallow channel; boulder 40%, cobble 30%, small gravel 30%; moderate periphyton cover spread across channel
A81-A80	A101-A100	16	85	N @ 10 km/h	overcast, cool, windy	fish observed; periphyton with moderate coverage; 100% boulder
A5-A4	B5-B4	20	35	south @ 10 km/h	clear, sunny	periphyton present (see field book); good flow, but dispersed throughout boulder garden; clear, colourless water
A53-A17	A40-A16	15.8	5	south @ 15 km/h	clear, windy, sunny	organic substrate, few boulders; small drainage creek east of camp; total periphyton coverage on bed; som flow observable

Revised Station ID	Original Station ID	Air Temperature (°C)	Cloud Cover (%)	Wind (dir/rate)	Weather	Other Notes:
C8-C7	C8-C7	14.7	100	NE @ 10-20 km/h	overcast, cool and windy	short outflow channel (~40 m); fast moving water, obvious change in elevation between lakes; periphyton present with moderate cover
A81-A80	A101-A100	~2 C	low cloud cover	very windy	-	
A55-A17	A34-A16	~2 C	low cloud cover	very windy	-	
A17-A16	A16-A14	~2 C	low cloud cover	very windy	-	
A12-A77	A10-A9	~5 C	mostly cloudy	light wind	some rain	
A69-DS1	A1-DS1	~5 C	mostly cloudy	light wind	some rain	
A12-A11	A10-B11	~5 C	clear skies	gentle breeze	sunny	
A76-A41	A8-B10	~5 C	clear skies	gentle breeze	sunny	
C38-C12	C58	~5 C	clear skies	gentle breeze	sunny	
DS1	DS1	~5 C	clear skies	gentle breeze	sunny	
A69-DS1	A1-DS1	~5 C	clear skies	gentle breeze	sunny	duplicate
A18-A17	A17-A16	~5 C	clear skies	gentle breeze	sunny	
A15-A14	A13-A12	~3 C	cloudy	very windy	low cloud cover	

APPENDIX E

Phytoplankton Taxonomy, Whale Tail Pit Baseline, 2015

Seasonal Phytoplankton biomass for AMARUQ 2015 and CREMP INUG and PDL stations

******** *R=QA\QC sample*

*****All data are in (mg m^{-3})*

Station	date	Cyanophyte mg m^{-3}	Chlorophyte mg m^{-3}	Euglenophyte mg m^{-3}	Chrysophyte mg m^{-3}	Diatoms mg m^{-3}	Cryptophytes mg m^{-3}	Dinoflagellates mg m^{-3}	Total biomass mg m^{-3}	# species	Simpsons Diversity
DUP1	1/Jul/15	0.00	1.50	0.00	259.24	8.21	12.15	39.44	320.54	33	0.68
DUP1	1/Aug/15	1.20	9.09	0.00	147.20	12.30	5.12	36.41	211.33	36	0.87
DUP1	1/Sep/15	0.18	2.22	0.00	174.61	15.68	5.79	6.22	204.69	37	0.87
MAM1-S	18/Jul/15	0.00	1.22	0.00	236.00	17.45	10.98	11.65	277.29	32	0.67
MAM2-S	18/Jul/15	0.00	0.91	0.00	179.18	5.82	3.67	4.47	194.05	26	0.68
MAM3-S	24/Aug/15	0.22	10.34	0.00	112.65	11.42	4.83	18.63	158.10	38	0.91
MAM4-S	24/Aug/15	0.05	6.50	0.00	108.09	7.08	4.82	10.08	136.61	37	0.87
MAM5-S	19/Sep/15	0.06	2.65	0.00	197.57	11.42	5.24	11.17	228.12	36	0.90
MAM6-S	19/Sep/15	3.10	5.27	0.00	173.26	13.28	5.55	13.35	213.82	37	0.89
NEM1-S	18/Jul/15	0.00	1.82	0.00	120.53	13.42	12.30	17.12	165.18	28	0.79
NEM2-S	18/Jul/15	0.00	3.28	0.00	205.25	13.89	12.88	21.60	256.90	31	0.83
NEM2-SR	18/Jul/15	0.00	2.92	0.00	199.97	15.28	15.18	11.41	244.76	31	0.83
NEM3-S	23/Aug/15	0.00	20.94	0.00	59.06	22.86	2.13	6.32	111.30	30	0.90
NEM4-S	23/Aug/15	0.05	15.70	0.00	69.75	19.11	0.34	1.82	106.77	29	0.91
NEM5-S	19/Sep/15	0.71	6.67	0.00	114.56	17.91	0.57	6.48	146.91	30	0.89
NEM6-S	19/Sep/15	0.64	5.18	0.00	132.57	7.91	1.89	4.08	152.27	35	0.87
NEM6-SR	19/Sep/15	0.48	4.78	0.00	139.60	5.41	1.16	2.04	153.46	36	0.88
WTN1-S	17/Jul/15	0.00	1.15	0.00	343.85	2.17	6.72	9.82	363.71	30	0.61
WTN2-S	17/Jul/15	0.00	1.02	0.00	233.57	3.64	6.76	25.48	270.48	30	0.72
WTN3-S	20/Aug/15	0.10	4.54	0.00	140.23	7.28	7.79	23.85	183.78	33	0.91
WTN3-SR	20/Aug/15	0.18	5.15	0.00	152.68	5.89	8.43	25.53	197.87	32	0.91
WTN4-S	20/Aug/15	0.05	3.71	0.00	104.11	11.02	4.69	30.43	154.01	35	0.90
WTN5-S	18/Sep/15	0.24	6.05	0.00	191.32	25.18	4.33	15.26	242.39	37	0.90
WTN6-S	18/Sep/15	0.28	1.89	0.00	188.62	14.95	4.36	16.29	226.39	38	0.90
WTS1-S	17/Jul/15	0.00	1.19	0.00	283.77	5.68	19.73	29.98	340.35	29	0.71
WTS2-S	17/Jul/15	0.00	1.28	0.00	210.55	5.39	12.79	34.64	264.65	35	0.74
WTS3-S	21/Aug/15	3.50	11.06	0.00	122.42	8.40	2.85	24.37	172.61	40	0.87
WTS4-S	21/Aug/15	2.70	5.89	0.00	112.13	5.00	2.05	6.25	134.03	35	0.91
WTS5-S	18/Sep/15	0.89	1.57	0.00	157.69	20.05	4.54	10.07	194.82	33	0.86
WTS6-S	18/Sep/15	0.08	13.58	0.00	248.35	17.33	8.80	4.47	292.62	37	0.84
INUG68S	16/May/15	0.00	0.30	0.00	41.69	7.16	9.25	9.05	67.45	25	0.67
INUG69S	16/May/15	0.00	0.60	0.00	23.25	5.06	10.15	1.56	40.62	17	0.68
INUG70S	27/Jul/15	0.00	2.38	0.00	368.81	13.06	14.99	13.60	412.84	30	0.85
INUG71S	27/Jul/15	0.00	2.13	0.00	398.85	6.34	12.17	20.84	440.33	33	0.85
INUG72S	27/Aug/15	0.10	5.76	0.00	156.60	13.32	1.02	2.29	179.10	35	0.89
INUG73S	27/Aug/15	0.59	6.39	0.00	167.17	11.64	5.78	9.99	201.56	37	0.90
INUG74S	1/Oct/15	3.39	6.04	0.00	156.27	20.71	9.65	8.13	204.19	40	0.90
INUG75S	1/Oct/15	1.97	8.31	0.00	147.89	18.04	7.03	7.94	191.19	39	0.86
PDL37S	28/Jul/15	0.00	0.59	0.00	198.76	13.66	7.78	6.64	227.43	28	0.72
PDL38S	28/Jul/15	0.00	0.07	0.00	230.32	10.16	6.26	15.07	261.88	23	0.71
PDL39S	26/Aug/15	0.84	7.83	0.00	127.44	16.64	2.49	2.32	157.57	32	0.84
PDL40S	26/Aug/15	0.90	5.35	0.00	134.66	16.33	2.24	2.11	161.59	32	0.85
PDL41S	4/Oct/15	2.51	8.95	0.00	97.02	11.44	3.96	13.33	137.20	30	0.91

Seasonal Phytoplankton cell density for AMARUQ 2015 and CREMP INUG and PDL stations

******** *R=QA\QC sample*

*****All data are in cells L^{-1}*

Station	date	Cyanophyte cells L^{-1}	Chlorophyte cells L^{-1}	Euglenophyte cells L^{-1}	Chrysophyte cells L^{-1}	Diatoms cells L^{-1}	Cryptophytes cells L^{-1}	Dinoflagellates cells L^{-1}	Total density cells L^{-1}
DUP1	1/Jul/15	0	43704	0	3828704	69456	161448	11784	4115096
DUP1	1/Aug/15	35920	288160	0	2012120	297144	107760	67656	2808760
DUP1	1/Sep/15	1200	115544	0	2153016	257856	93792	7784	2629192
MAM1-S	18/Jul/15	0	71840	0	3346560	157864	99392	13384	3689040
MAM2-S	18/Jul/15	0	57472	0	2900952	87608	37720	1200	3084952
MAM3-S	24/Aug/15	1000	424056	0	1323256	187200	72840	23752	2032104
MAM4-S	24/Aug/15	400	359600	0	1604632	151080	73040	9184	2197936
MAM5-S	19/Sep/15	600	316696	0	2149432	223368	79624	1200	2770920
MAM6-S	19/Sep/15	57472	359400	0	2023120	265688	87008	1600	2794288
NEM1-S	18/Jul/15	0	36120	0	1975816	245488	69256	2000	2328680
NEM2-S	18/Jul/15	0	65056	0	2694616	259272	104576	9384	3132904
NEM2-SR	18/Jul/15	0	65256	0	2680448	229736	120144	8384	3103968
NEM3-S	23/Aug/15	0	424456	0	900400	218120	43104	7384	1593464
NEM4-S	23/Aug/15	400	395720	0	636792	266408	7184	200	1306704
NEM5-S	19/Sep/15	15368	266408	0	974256	288760	7384	7584	1559760
NEM6-S	19/Sep/15	14968	208936	0	1320688	209136	29336	400	1783464
NEM6-SR	19/Sep/15	8984	187184	0	1286368	194768	14968	200	1692472
WTN1-S	17/Jul/15	0	35920	0	4638096	65056	95592	1600	4836264
WTN2-S	17/Jul/15	0	36120	0	3971584	67856	68656	10384	4154600
WTN3-S	20/Aug/15	800	165432	0	1567312	131512	165232	23552	2053840
WTN3-SR	20/Aug/15	1400	208536	0	1546160	88808	179600	37920	2062424
WTN4-S	20/Aug/15	400	158248	0	1201128	146480	100576	44704	1651536
WTN5-S	18/Sep/15	600	237472	0	2011736	362216	52088	22752	2686864
WTN6-S	18/Sep/15	1800	143680	0	2094344	228520	65456	2200	2536000
WTS1-S	17/Jul/15	0	50288	0	3985568	97592	299144	23952	4456544
WTS2-S	17/Jul/15	0	72040	0	2880616	54488	113360	4000	3124504
WTS3-S	21/Aug/15	72840	366984	0	1703008	177016	50288	3600	2373736
WTS4-S	21/Aug/15	57472	323880	0	1315472	133312	35920	8184	1874240
WTS5-S	18/Sep/15	29936	122128	0	1851888	298960	72640	15768	2391320
WTS6-S	18/Sep/15	600	173616	0	2737520	323512	144880	7584	3387712
INUG68S	16/May/15	0	3746	0	969985	39107	65230	700	1078768
INUG69S	16/May/15	0	3946	0	518531	28469	75468	200	626614
INUG70S	27/Jul/15	0	172616	0	2061504	296744	140096	800	2671760
INUG71S	27/Jul/15	0	129712	0	2190616	117144	57688	8784	2503944
INUG72S	27/Aug/15	400	196768	0	1419448	210336	14768	7184	1848904
INUG73S	27/Aug/15	7584	211536	0	1671288	260424	114944	8384	2274160
INUG74S	1/Oct/15	66056	274992	0	1734744	305544	72640	21752	2475728
INUG75S	1/Oct/15	14968	209736	0	1734144	356232	79424	21552	2416056
PDL37S	28/Jul/15	0	36320	0	1790048	225112	59872	1400	2112752
PDL38S	28/Jul/15	0	14368	0	1986416	207552	38920	10584	2257840
PDL39S	26/Aug/15	9184	244456	0	1361176	219520	43504	600	1878440
PDL40S	26/Aug/15	3800	123328	0	1370160	213536	22952	400	1734176
PDL41S	4/Oct/15	7400	359200	0	939920	219520	22152	14968	1563160

Phytoplankton species data for AMARUQ 2015 and CREMP INUG and PDL stations

** 1st number in **species code** = group 1=cyanophyte 2=chlorophyte
3= Euglenophyte 4=chrysophyte 5=diatoms 6=Cryptophyte 7=Dinoflagellates
***R=QA\QC sample
** total daily biomass is sum of all species on a date.

Station	Date	Species code	Speceis name	density cells/L	biomass mg/m^3	length µ	width µ	cell volume μ^3
DUP 1	1-Jul-15	2105	Chlamydomonas spp.	28736	0.68	5.00	3.00	23.60
DUP 1	1-Jul-15	2187	Staurodesmus extensus (Andersson) Teiling	600	0.21	13.00	12.00	354.00
DUP 1	1-Jul-15	2235	Ankistrodesmus spiralis Lemmermann	7184	0.45	33.00	2.20	62.70
DUP 1	1-Jul-15	2260	Monomastix minuta Skuja	7184	0.16	6.10	3.20	21.80
DUP 1	1-Jul-15	4351	Small chrysophyceae	617824	7.91	2.90	2.90	12.80
DUP 1	1-Jul-15	4352	Large chrysophyceae	35920	4.70	6.30	6.30	130.90
DUP 1	1-Jul-15	4357	Chrysococcus sp.	2191120	111.75	4.60	4.60	51.00
DUP 1	1-Jul-15	4361	Kephyrion boreale Skuja	7184	0.90	6.20	6.20	124.80
DUP 1	1-Jul-15	4362	Kephyrion sp.	423856	5.98	3.00	3.00	14.10
DUP 1	1-Jul-15	4363	Spinifiromonas sirratus**********	7184	0.66	5.60	5.60	92.00
DUP 1	1-Jul-15	4368	Mallomonas crassisquama (Asmund) Fott	200	0.21	19.60	10.00	1026.30
DUP 1	1-Jul-15	4378	Dinobryon borgei Lemmermann	14368	0.74	9.00	3.30	51.30
DUP 1	1-Jul-15	4388	Dinobryon sertularia Ehrenberg	86208	22.75	14.00	6.00	263.90
DUP 1	1-Jul-15	4388	Dinobryon sertularia Ehrenberg	11400	26.51	0.00	0.00	2325.00
DUP 1	1-Jul-15	4390	Dinobryon sociale Ehrenberg	43104	9.75	12.00	6.00	226.20
DUP 1	1-Jul-15	4390	Dinobryon sociale Ehrenberg	2400	4.78	0.00	0.00	1991.00
DUP 1	1-Jul-15	4396	Chrysolkos skuja (Nauwerck) Willen	100576	2.84	5.60	3.10	28.20
DUP 1	1-Jul-15	4401	Uroglena volvox Ehrenberg	129312	14.63	6.00	6.00	113.10
DUP 1	1-Jul-15	4413	Chrysochromulina laurentiana Kling	107760	42.52	9.10	9.10	394.60
DUP 1	1-Jul-15	4414	Stichogloea spp.	7184	0.36	6.00	4.00	50.30
DUP 1	1-Jul-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	35920	0.88	5.20	3.00	24.50
DUP 1	1-Jul-15	4436	Dinobryon attenatum Hill	7184	1.40	10.30	6.00	194.20
DUP 1	1-Jul-15	5507	Cyclotella stelligera Cleve and Grunow	200	0.24	9.10	18.20	1183.70
DUP 1	1-Jul-15	5509	Cyclotella ocellata Pant.	28736	3.23	4.15	8.30	112.30
DUP 1	1-Jul-15	5514	Tabellaria flocculsa (Roth) Kutzing	3000	3.93	25.50	14.00	1308.50
DUP 1	1-Jul-15	5518	Synedra acus Kutzing	1600	0.13	80.00	2.00	83.80
DUP 1	1-Jul-15	5551	Cyclotella michiganiana Skvortzow	35920	0.69	2.30	4.60	19.10
DUP 1	1-Jul-15	6554	Rhodomonas minuta Skuja	50288	4.39	10.00	5.00	87.30
DUP 1	1-Jul-15	6558	Cryptomonas erosa Ehrenberg	2600	1.91	21.00	10.00	733.00
DUP 1	1-Jul-15	6562	Cryptomonas reflexa (Marsson) Skuja	400	0.27	19.60	10.00	684.20
DUP 1	1-Jul-15	6565	Cryptomonas rostratiformis Skuja	400	0.77	28.00	14.00	1915.70
DUP 1	1-Jul-15	6568	Katablepharis ovalis Skuja	107760	4.82	8.00	4.00	44.70
DUP 1	1-Jul-15	7632	Gymnodinium sp.	7184	2.24	9.30	8.00	311.60
DUP 1	1-Jul-15	7632	Gymnodinium sp.	1800	16.57	26.00	26.00	9202.80
DUP 1	1-Jul-15	7639	Peridinium pusillum (Penard) Lemmermann	600	0.60	13.30	12.00	1002.80
DUP 1	1-Jul-15	7641	Peridinium aciculiferum Lemmermann	2200	20.04	30.20	24.00	9108.10
DUP 1	1-Aug-15	1008	Aphanocapsa sp.	7184	0.72	0.00	0.00	100.00
DUP 1	1-Aug-15	1033	Rhabdogloea lineare Schmidle and Lauterborn	28736	0.48	8.00	2.00	16.80
DUP 1	1-Aug-15	2100	Pyramidomonas tetrarhynchus Schmarda	600	0.32	14.20	12.00	535.30
DUP 1	1-Aug-15	2105	Chlamydomonas spp.	35920	0.46	5.00	2.20	12.70
DUP 1	1-Aug-15	2112	Sphaerocystis schroeteri Chodat	7184	0.21	3.80	3.80	28.70
DUP 1	1-Aug-15	2121	Oocystis lacustris Chodat	114944	5.78	6.00	4.00	50.30
DUP 1	1-Aug-15	2137	Dictyosphaerium simplex Sukja	57472	0.24	2.00	2.00	4.20
DUP 1	1-Aug-15	2167	Elakatothrix gelatinosa Willen	57472	1.17	13.00	2.00	20.40
DUP 1	1-Aug-15	2206	Botryococcus braunii Kutzing	200	0.14	11.00	11.00	696.90
DUP 1	1-Aug-15	2235	Ankistrodesmus spiralis Lemmermann	14368	0.77	31.00	2.10	53.70
DUP 1	1-Aug-15	4351	Small chrysophyceae	510064	8.77	3.20	3.20	17.20
DUP 1	1-Aug-15	4352	Large chrysophyceae	7184	1.29	7.00	7.00	179.60
DUP 1	1-Aug-15	4357	Chrysococcus sp.	783056	51.21	5.00	5.00	65.40
DUP 1	1-Aug-15	4362	Kephyrion sp.	107760	2.03	3.30	3.30	18.80
DUP 1	1-Aug-15	4367	Mallomonas duerrschmidtiae Siver, Hamer and Kling	200	0.12	17.60	8.00	589.80
DUP 1	1-Aug-15	4378	Dinobryon borgei Lemmermann	79024	4.88	9.10	3.60	61.80
DUP 1	1-Aug-15	4381	Dinobryon mucronutom Nygaard	21552	2.82	10.00	5.00	130.90
DUP 1	1-Aug-15	4383	Dinobryon bavaricum Imhof	50288	11.38	12.00	6.00	226.20
DUP 1	1-Aug-15	4383	Dinobryon bavaricum Imhof	400	0.80	0.00	0.00	1990.00
DUP 1	1-Aug-15	4388	Dinobryon sertularia Ehrenberg	35920	8.33	12.30	6.00	231.80
DUP 1	1-Aug-15	4390	Dinobryon sociale Ehrenberg	50288	11.38	12.00	6.00	226.20
DUP 1	1-Aug-15	4396	Chrysolkos skuja (Nauwerck) Willen	35920	0.88	5.20	3.00	24.50
DUP 1	1-Aug-15	4401	Uroglena volvox Ehrenberg	215520	24.38	6.00	6.00	113.10
DUP 1	1-Aug-15	4411	Bitrichia chodatii (Reverdin) Chodat	14368	0.70	5.80	4.00	48.60
DUP 1	1-Aug-15	4413	Chrysochromulina laurentiana Kling	28736	11.72	9.20	9.20	407.70
DUP 1	1-Aug-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	43104	1.20	5.20	3.20	27.90
DUP 1	1-Aug-15	4437	Pteridomonas sp.	28736	5.33	8.10	8.10	185.50
DUP 1	1-Aug-15	5507	Cyclotella stelligera Cleve and Grunow	400	0.63	10.00	20.00	1570.80
DUP 1	1-Aug-15	5509	Cyclotella ocellata Pant.	35920	3.89	4.10	8.20	108.30
DUP 1	1-Aug-15	5511	Rhizosolenia eriense H.L. Smith	21552	1.68	11.00	3.00	77.80
DUP 1	1-Aug-15	5513	Tabellaria fenestrata (Lyngbye) Kutzing	1200	0.88	78.00	6.00	735.10
DUP 1	1-Aug-15	5518	Synedra acus Kutzing	1000	0.08	76.00	2.00	79.60
DUP 1	1-Aug-15	5551	Cyclotella michiganiana Skvortzow	237072	5.14	2.40	4.80	21.70

Station	Date	Species code	Speceis name	density cells/L	biomass mg/m^3	length µ	width µ	cell volume µ^3
DUP 1	1-Aug-15	6554	Rhodomonas minuta Skuja	35920	1.67	8.30	4.00	46.40
DUP 1	1-Aug-15	6568	Katablepharis ovalis Skuja	71840	3.46	8.30	4.00	48.10
DUP 1	1-Aug-15	7632	Gymnodinium sp.	64656	21.67	10.00	8.00	335.10
DUP 1	1-Aug-15	7632	Gymnodinium sp.	1400	12.74	25.90	25.90	9097.00
DUP 1	1-Aug-15	7639	Peridinium pusillum (Penard) Lemmermann	1600	2.01	14.20	13.00	1256.50
DUP 1	1-Sep-15	1054	Planktolyngbya limnetica	1200	0.18	132.00	1.20	149.30
DUP 1	1-Sep-15	2100	Pyramidomonas tetrarhynchus Schmarda	200	0.12	13.90	13.00	615.00
DUP 1	1-Sep-15	2105	Chlamydomonas spp.	7184	0.16	6.00	2.70	22.90
DUP 1	1-Sep-15	2137	Dictyosphaerium simplex Sukja	43104	0.18	2.00	2.00	4.20
DUP 1	1-Sep-15	2167	Elakatothrix gelatinosa Willen	7184	0.13	11.60	2.00	18.20
DUP 1	1-Sep-15	2182	Euastrum spp.	200	0.10	15.00	13.00	510.50
DUP 1	1-Sep-15	2199	Spondylosium planum (Wolle) W. and G.S. West	21552	0.81	6.00	6.00	37.70
DUP 1	1-Sep-15	2206	Botryococcus braunii Kutzing	200	0.10	10.00	10.00	523.60
DUP 1	1-Sep-15	2215	Tetraedron caudatum (Corda) Hansgrig	28736	0.14	3.00	3.00	4.70
DUP 1	1-Sep-15	2235	Ankistrodesmus spiralis Lemmermann	7184	0.46	34.00	2.20	64.60
DUP 1	1-Sep-15	4351	Small chrysophyceae	445408	6.95	3.10	3.10	15.60
DUP 1	1-Sep-15	4357	Chrysococcus sp.	711216	46.51	5.00	5.00	65.40
DUP 1	1-Sep-15	4361	Kephyrion boreale Skuja	57472	6.83	6.10	6.10	118.80
DUP 1	1-Sep-15	4362	Kephyrion sp.	229888	4.32	3.30	3.30	18.80
DUP 1	1-Sep-15	4363	Spinifiromonas sirratus**********	7184	0.90	6.20	6.20	124.80
DUP 1	1-Sep-15	4370	Mallomonas akrokomos Asmund and Kristiansen	7184	2.31	16.00	6.20	322.00
DUP 1	1-Sep-15	4378	Dinobryon borgei Lemmermann	35920	1.63	9.00	3.10	45.30
DUP 1	1-Sep-15	4381	Dinobryon mucronutom Nygaard	21552	2.82	10.00	5.00	130.90
DUP 1	1-Sep-15	4390	Dinobryon sociale Ehrenberg	294544	66.63	12.00	6.00	226.20
DUP 1	1-Sep-15	4390	Dinobryon sociale Ehrenberg	5000	6.33	0.00	0.00	1265.00
DUP 1	1-Sep-15	4396	Chrysolkos skuja (Nauwerck) Willen	64656	1.94	5.60	3.20	30.00
DUP 1	1-Sep-15	4401	Uroglena volvox Ehrenberg	93392	10.56	6.00	6.00	113.10
DUP 1	1-Sep-15	4411	Bitrichia chodatii (Reverdin) Chodat	7184	0.36	6.00	4.00	50.30
DUP 1	1-Sep-15	4413	Chrysochromulina laurentiana Kling	21552	8.50	9.10	9.10	394.60
DUP 1	1-Sep-15	4414	Stichogloea spp.	93392	4.70	6.00	4.00	50.30
DUP 1	1-Sep-15	4415	Bicoeca lacustris Clark	7184	0.63	5.50	5.50	87.10
DUP 1	1-Sep-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	43104	1.36	5.90	3.20	31.60
DUP 1	1-Sep-15	4437	Pteridomonas sp.	7184	1.33	8.10	8.10	185.50
DUP 1	1-Sep-15	5509	Cyclotella ocellata Pant.	35920	4.03	4.15	8.30	112.30
DUP 1	1-Sep-15	5511	Rhizosolenia eriense H.L. Smith	100576	7.82	11.00	3.00	77.80
DUP 1	1-Sep-15	5518	Synedra acus Kutzing	13600	1.18	83.00	2.00	86.90
DUP 1	1-Sep-15	5551	Cyclotella michiganiana Skvortzow	107760	2.64	2.50	5.00	24.50
DUP 1	1-Sep-15	6554	Rhodomonas minuta Skuja	35920	1.90	9.00	4.10	52.80
DUP 1	1-Sep-15	6558	Cryptomonas erosa Ehrenberg	200	0.15	21.30	10.00	743.50
DUP 1	1-Sep-15	6565	Cryptomonas rostratiformis Skuja	200	0.41	30.00	14.00	2052.50
DUP 1	1-Sep-15	6568	Katablepharis ovalis Skuja	57472	3.33	9.00	4.10	58.00
DUP 1	1-Sep-15	7632	Gymnodinium sp.	7184	2.24	9.30	8.00	311.60
DUP 1	1-Sep-15	7632	Gymnodinium sp.	400	3.68	26.00	26.00	9202.80
DUP 1	1-Sep-15	7639	Peridinium pusillum (Penard) Lemmermann	200	0.30	14.70	14.00	1508.60
MAM - 1-S	18-Jul-15	2105	Chlamydomonas spp.	14368	0.31	4.60	3.00	21.70
MAM - 1-S	18-Jul-15	2121	Oocystis lacustris Chodat	14368	0.35	5.20	3.00	24.50
MAM - 1-S	18-Jul-15	2167	Elakatothrix gelatinosa Willen	35920	0.51	9.00	2.00	14.10
MAM - 1-S	18-Jul-15	2215	Tetraedron caudatum (Corda) Hansgrig	7184	0.05	3.30	3.30	6.30
MAM - 1-S	18-Jul-15	4351	Small chrysophyceae	481328	6.79	3.00	3.00	14.10
MAM - 1-S	18-Jul-15	4352	Large chrysophyceae	7184	1.29	7.00	7.00	179.60
MAM - 1-S	18-Jul-15	4357	Chrysococcus sp.	2025888	132.49	5.00	5.00	65.40
MAM - 1-S	18-Jul-15	4358	Chrysostephanospaera globulifera Scherffel	7184	4.48	10.60	10.60	623.60
MAM - 1-S	18-Jul-15	4362	Kephyrion sp.	387936	7.29	3.30	3.30	18.80
MAM - 1-S	18-Jul-15	4363	Spinifiromonas sirratus**********	7184	0.73	5.80	5.80	102.20
MAM - 1-S	18-Jul-15	4368	Mallomonas crassisquama (Asmund) Fott	1000	1.10	21.10	10.00	1104.80
MAM - 1-S	18-Jul-15	4378	Dinobryon borgei Lemmermann	64656	3.32	9.00	3.30	51.30
MAM - 1-S	18-Jul-15	4381	Dinobryon mucronutom Nygaard	21552	2.82	10.00	5.00	130.90
MAM - 1-S	18-Jul-15	4388	Dinobryon sertularia Ehrenberg	71840	16.25	12.00	6.00	226.20
MAM - 1-S	18-Jul-15	4388	Dinobryon sertularia Ehrenberg	4400	8.76	0.00	0.00	1991.00
MAM - 1-S	18-Jul-15	4390	Dinobryon sociale Ehrenberg	86208	19.50	12.00	6.00	226.20
MAM - 1-S	18-Jul-15	4390	Dinobryon sociale Ehrenberg	600	0.73	0.00	0.00	1221.00
MAM - 1-S	18-Jul-15	4396	Chrysolkos skuja (Nauwerck) Willen	100576	2.84	5.60	3.10	28.20
MAM - 1-S	18-Jul-15	4413	Chrysochromulina laurentiana Kling	64656	26.36	9.20	9.20	407.70
MAM - 1-S	18-Jul-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	7184	0.16	4.60	3.00	21.70
MAM - 1-S	18-Jul-15	4439	Chrysosphaerella brevispina	7184	1.08	6.60	6.60	150.50
MAM - 1-S	18-Jul-15	5507	Cyclotella stelligera Cleve and Grunow	400	0.51	9.30	18.60	1263.50
MAM - 1-S	18-Jul-15	5508	Cyclotella pseudostelligera	35920	7.93	5.20	10.40	220.90
MAM - 1-S	18-Jul-15	5509	Cyclotella ocellata Pant.	35920	4.49	4.30	8.60	124.90
MAM - 1-S	18-Jul-15	5514	Tabellaria flocculsa (Roth) Kutzing	1600	2.16	26.30	14.00	1349.50
MAM - 1-S	18-Jul-15	5518	Synedra acus Kutzing	5000	0.42	81.00	2.00	84.80
MAM - 1-S	18-Jul-15	5551	Cyclotella michiganiana Skvortzow	79024	1.94	2.50	5.00	24.50
MAM - 1-S	18-Jul-15	6554	Rhodomonas minuta Skuja	21552	1.92	10.20	5.00	89.00
MAM - 1-S	18-Jul-15	6558	Cryptomonas erosa Ehrenberg	4400	3.23	21.00	10.00	733.00
MAM - 1-S	18-Jul-15	6562	Cryptomonas reflexa (Marsson) Skuja	600	0.42	20.00	10.00	698.10
MAM - 1-S	18-Jul-15	6565	Cryptomonas rostratiformis Skuja	1000	2.05	30.00	14.00	2052.50
MAM - 1-S	18-Jul-15	6568	Katablepharis ovalis Skuja	71840	3.37	8.10	4.10	46.90
MAM - 1-S	18-Jul-15	7632	Gymnodinium sp.	7184	3.08	10.10	9.00	428.40
MAM - 1-S	18-Jul-15	7632	Gymnodinium sp.	2000	4.45	16.20	16.20	2226.10
MAM - 1-S	18-Jul-15	7639	Peridinium pusillum (Penard) Lemmermann	4200	4.12	13.00	12.00	980.20
MAM - 2-S	18-Jul-15	2105	Chlamydomonas spp.	7184	0.16	4.60	3.00	21.70

Station	Date	Species code	Speceis name	density cells/L	biomass mg/m^3	length µ	width µ	cell volume µ^3
MAM - 2-S	18-Jul-15	2121	Oocystis lacustris Chodat	14368	0.35	5.20	3.00	24.50
MAM - 2-S	18-Jul-15	2199	Spondylosium planum (Wolle) W. and G.S. West	7184	0.27	6.00	6.00	37.70
MAM - 2-S	18-Jul-15	2215	Tetraedron caudatum (Corda) Hansgrig	28736	0.14	3.00	3.00	4.70
MAM - 2-S	18-Jul-15	4351	Small chrysophyceae	646560	9.12	3.00	3.00	14.10
MAM - 2-S	18-Jul-15	4352	Large chrysophyceae	7184	2.74	9.00	9.00	381.70
MAM - 2-S	18-Jul-15	4357	Chrysococcus sp.	1573296	102.89	5.00	5.00	65.40
MAM - 2-S	18-Jul-15	4362	Kephyrion sp.	337648	6.35	3.30	3.30	18.80
MAM - 2-S	18-Jul-15	4363	Spinifiromonas sirratus**********	7184	0.66	5.60	5.60	92.00
MAM - 2-S	18-Jul-15	4378	Dinobryon borgei Lemmermann	35920	1.84	9.00	3.30	51.30
MAM - 2-S	18-Jul-15	4381	Dinobryon mucronutom Nygaard	7184	0.90	9.60	5.00	125.70
MAM - 2-S	18-Jul-15	4388	Dinobryon sertularia Ehrenberg	93392	22.88	13.00	6.00	245.00
MAM - 2-S	18-Jul-15	4388	Dinobryon sertularia Ehrenberg	4800	9.56	0.00	0.00	1991.00
MAM - 2-S	18-Jul-15	4390	Dinobryon sociale Ehrenberg	43104	9.75	12.00	6.00	226.20
MAM - 2-S	18-Jul-15	4390	Dinobryon sociale Ehrenberg	1000	1.22	0.00	0.00	1221.00
MAM - 2-S	18-Jul-15	4396	Chrysolkos skuja (Nauwerck) Willen	114944	3.24	5.60	3.10	28.20
MAM - 2-S	18-Jul-15	4413	Chrysochromulina laurentiana Kling	14368	5.86	9.20	9.20	407.70
MAM - 2-S	18-Jul-15	4439	Chrysosphaerella brevispina	14368	2.16	6.60	6.60	150.50
MAM - 2-S	18-Jul-15	5508	Cyclotella pseudostelligera	7184	1.88	5.50	11.00	261.30
MAM - 2-S	18-Jul-15	5509	Cyclotella ocellata Pant.	21552	2.42	4.15	8.30	112.30
MAM - 2-S	18-Jul-15	5518	Synedra acus Kutzing	1400	0.12	81.00	2.00	84.80
MAM - 2-S	18-Jul-15	5551	Cyclotella michiganiana Skvortzow	57472	1.41	2.50	5.00	24.50
MAM - 2-S	18-Jul-15	6558	Cryptomonas erosa Ehrenberg	1000	0.70	20.00	10.00	698.10
MAM - 2-S	18-Jul-15	6562	Cryptomonas reflexa (Marsson) Skuja	200	0.14	19.60	10.00	684.20
MAM - 2-S	18-Jul-15	6565	Cryptomonas rostratiformis Skuja	600	1.15	28.00	14.00	1915.70
MAM - 2-S	18-Jul-15	6568	Katablepharis ovalis Skuja	35920	1.68	8.20	4.00	46.90
MAM - 2-S	18-Jul-15	7632	Gymnodinium sp.	400	3.68	26.00	26.00	9202.80
MAM - 2-S	18-Jul-15	7639	Peridinium pusillum (Penard) Lemmermann	800	0.78	13.00	12.00	980.20
MAM - 3-S	24-Aug-15	1054	Planktolyngbya limnetica	800	0.12	131.00	1.20	148.20
MAM - 3-S	24-Aug-15	1073	Snowella sp	200	0.11	0.00	0.00	525.00
MAM - 3-S	24-Aug-15	2105	Chlamydomonas spp.	14368	0.33	5.30	2.90	23.30
MAM - 3-S	24-Aug-15	2121	Oocystis lacustris Chodat	114944	5.78	6.00	4.00	50.30
MAM - 3-S	24-Aug-15	2137	Dictyosphaerium simplex Sukja	64656	0.27	2.00	2.00	4.20
MAM - 3-S	24-Aug-15	2164	Quadrigula closterioides (Bohl.) Printz	86208	2.07	15.30	2.00	24.00
MAM - 3-S	24-Aug-15	2167	Elakatothrix gelatinosa Willen	28736	0.50	11.00	2.00	17.30
MAM - 3-S	24-Aug-15	2199	Spondylosium planum (Wolle) W. and G.S. West	21552	0.81	6.00	6.00	37.70
MAM - 3-S	24-Aug-15	2206	Botryococcus braunii Kutzing	200	0.14	11.00	11.00	696.90
MAM - 3-S	24-Aug-15	2215	Tetraedron caudatum (Corda) Hansgrig	93392	0.44	3.00	3.00	4.70
MAM - 3-S	24-Aug-15	4351	Small chrysophyceae	287360	4.48	3.10	3.10	15.60
MAM - 3-S	24-Aug-15	4352	Large chrysophyceae	43104	7.74	7.00	7.00	179.60
MAM - 3-S	24-Aug-15	4357	Chrysococcus sp.	445408	22.72	4.60	4.60	51.00
MAM - 3-S	24-Aug-15	4358	Chrysostephanospaera globulifera Scherffel	28736	10.25	8.80	8.80	356.80
MAM - 3-S	24-Aug-15	4361	Kephyrion boreale Skuja	43104	5.38	6.20	6.20	124.80
MAM - 3-S	24-Aug-15	4362	Kephyrion sp.	100576	2.25	3.50	3.50	22.40
MAM - 3-S	24-Aug-15	4367	Mallomonas duerrschmidtiae Siver, Hamer and Kling	400	0.26	19.60	8.00	656.80
MAM - 3-S	24-Aug-15	4368	Mallomonas crassisquama (Asmund) Fott	200	0.23	22.20	10.00	1162.40
MAM - 3-S	24-Aug-15	4378	Dinobryon borgei Lemmermann	21552	1.11	9.60	3.20	51.50
MAM - 3-S	24-Aug-15	4383	Dinobryon bavaricum Imhof	28736	6.99	12.90	6.00	243.20
MAM - 3-S	24-Aug-15	4383	Dinobryon bavaricum Imhof	600	0.76	0.00	0.00	1265.00
MAM - 3-S	24-Aug-15	4388	Dinobryon sertularia Ehrenberg	7184	1.63	12.00	6.00	226.20
MAM - 3-S	24-Aug-15	4390	Dinobryon sociale Ehrenberg	79024	17.88	12.00	6.00	226.20
MAM - 3-S	24-Aug-15	4390	Dinobryon sociale Ehrenberg	200	0.20	0.00	0.00	991.00
MAM - 3-S	24-Aug-15	4396	Chrysolkos skuja (Nauwerck) Willen	7184	0.19	5.50	3.00	25.90
MAM - 3-S	24-Aug-15	4400	Ochromonas sp.	7184	0.61	8.80	4.30	85.20
MAM - 3-S	24-Aug-15	4401	Uroglena volvox Ehrenberg	122128	13.81	6.00	6.00	113.10
MAM - 3-S	24-Aug-15	4411	Bitrichia chodatii (Reverdin) Chodat	21552	1.01	5.60	4.00	46.90
MAM - 3-S	24-Aug-15	4413	Chrysochromulina laurentiana Kling	35920	13.71	9.00	9.00	381.70
MAM - 3-S	24-Aug-15	4414	Stichogloea spp.	7184	0.36	6.00	4.00	50.30
MAM - 3-S	24-Aug-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	35920	1.08	5.60	3.20	30.00
MAM - 3-S	24-Aug-15	5507	Cyclotella stelligera Cleve and Grunow	800	0.93	9.05	18.10	1164.30
MAM - 3-S	24-Aug-15	5509	Cyclotella ocellata Pant.	64656	7.26	4.15	8.30	112.30
MAM - 3-S	24-Aug-15	5518	Synedra acus Kutzing	6800	0.58	81.00	2.00	84.80
MAM - 3-S	24-Aug-15	5551	Cyclotella michiganiana Skvortzow	114944	2.66	2.45	4.90	23.10
MAM - 3-S	24-Aug-15	6554	Rhodomonas minuta Skuja	43104	2.39	9.00	4.20	55.40
MAM - 3-S	24-Aug-15	6558	Cryptomonas erosa Ehrenberg	1000	0.77	22.10	10.00	771.40
MAM - 3-S	24-Aug-15	6568	Katablepharis ovalis Skuja	28736	1.67	9.00	4.10	58.00
MAM - 3-S	24-Aug-15	7632	Gymnodinium sp.	21552	6.93	9.60	8.00	321.70
MAM - 3-S	24-Aug-15	7632	Gymnodinium sp.	1000	10.19	26.90	26.90	10191.90
MAM - 3-S	24-Aug-15	7639	Peridinium pusillum (Penard) Lemmermann	1200	1.51	14.20	13.00	1256.50
MAM - 4-S	24-Aug-15	1054	Planktolyngbya limnetica	400	0.05	110.00	1.20	124.40
MAM - 4-S	24-Aug-15	2100	Pyramidomonas tetrarhynchus Schmarda	400	0.20	13.30	12.00	501.40
MAM - 4-S	24-Aug-15	2105	Chlamydomonas spp.	21552	0.50	5.30	2.90	23.30
MAM - 4-S	24-Aug-15	2121	Oocystis lacustris Chodat	64656	3.25	6.00	4.00	50.30
MAM - 4-S	24-Aug-15	2137	Dictyosphaerium simplex Sukja	86208	0.36	2.00	2.00	4.20
MAM - 4-S	24-Aug-15	2145	Crucigenia quadrata Morr.	28736	0.14	3.00	3.00	4.70
MAM - 4-S	24-Aug-15	2164	Quadrigula closterioides (Bohl.) Printz	28736	0.69	15.30	2.00	24.00
MAM - 4-S	24-Aug-15	2167	Elakatothrix gelatinosa Willen	21552	0.37	11.00	2.00	17.30
MAM - 4-S	24-Aug-15	2199	Spondylosium planum (Wolle) W. and G.S. West	14368	0.54	6.00	6.00	37.70
MAM - 4-S	24-Aug-15	2215	Tetraedron caudatum (Corda) Hansgrig	93392	0.44	3.00	3.00	4.70
MAM - 4-S	24-Aug-15	4351	Small chrysophyceae	402304	6.28	3.10	3.10	15.60
MAM - 4-S	24-Aug-15	4352	Large chrysophyceae	79024	14.19	7.00	7.00	179.60

Station	Date	Species code	Speceis name	density cells/L	biomass mg/m^3	length µ	width µ	cell volume µ^3
MAM - 4-S	24-Aug-15	4357	Chrysococcus sp.	617824	31.51	4.60	4.60	51.00
MAM - 4-S	24-Aug-15	4361	Kephyrion boreale Skuja	21552	2.56	6.10	6.10	118.80
MAM - 4-S	24-Aug-15	4362	Kephyrion sp.	165232	3.70	3.50	3.50	22.40
MAM - 4-S	24-Aug-15	4368	Mallomonas crassisquama (Asmund) Fott	400	0.46	22.20	10.00	1162.40
MAM - 4-S	24-Aug-15	4378	Dinobryon borgei Lemmermann	35920	1.66	8.60	3.20	46.10
MAM - 4-S	24-Aug-15	4381	Dinobryon mucronutom Nygaard	14368	1.77	9.40	5.00	123.00
MAM - 4-S	24-Aug-15	4383	Dinobryon bavaricum Imhof	7184	1.63	12.00	6.00	226.20
MAM - 4-S	24-Aug-15	4383	Dinobryon bavaricum Imhof	400	0.40	0.00	0.00	991.00
MAM - 4-S	24-Aug-15	4388	Dinobryon sertularia Ehrenberg	14368	3.25	12.00	6.00	226.20
MAM - 4-S	24-Aug-15	4390	Dinobryon sociale Ehrenberg	64656	14.63	12.00	6.00	226.20
MAM - 4-S	24-Aug-15	4390	Dinobryon sociale Ehrenberg	1800	2.28	0.00	0.00	1265.00
MAM - 4-S	24-Aug-15	4396	Chrysolkos skuja (Nauwerck) Willen	43104	1.12	5.50	3.00	25.90
MAM - 4-S	24-Aug-15	4400	Ochromonas sp.	7184	0.50	8.30	4.00	69.50
MAM - 4-S	24-Aug-15	4401	Uroglena volvox Ehrenberg	35920	4.06	6.00	6.00	113.10
MAM - 4-S	24-Aug-15	4411	Bitrichia chodatii (Reverdin) Chodat	7184	0.36	6.00	4.00	50.30
MAM - 4-S	24-Aug-15	4413	Chrysochromulina laurentiana Kling	43104	16.45	9.00	9.00	381.70
MAM - 4-S	24-Aug-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	43104	1.29	5.60	3.20	30.00
MAM - 4-S	24-Aug-15	5507	Cyclotella stelligera Cleve and Grunow	400	0.46	9.00	18.00	1145.10
MAM - 4-S	24-Aug-15	5509	Cyclotella ocellata Pant.	21552	2.42	4.15	8.30	112.30
MAM - 4-S	24-Aug-15	5511	Rhizosolenia eriense H.L. Smith	14368	1.12	11.00	3.00	77.80
MAM - 4-S	24-Aug-15	5518	Synedra acus Kutzing	7000	0.59	81.00	2.00	84.80
MAM - 4-S	24-Aug-15	5551	Cyclotella michiganiana Skvortzow	107760	2.49	2.45	4.90	23.10
MAM - 4-S	24-Aug-15	6554	Rhodomonas minuta Skuja	57472	3.18	9.00	4.20	55.40
MAM - 4-S	24-Aug-15	6558	Cryptomonas erosa Ehrenberg	1200	0.93	22.20	10.00	774.90
MAM - 4-S	24-Aug-15	6568	Katablepharis ovalis Skuja	14368	0.71	8.30	4.10	49.30
MAM - 4-S	24-Aug-15	7632	Gymnodinium sp.	7184	2.17	9.00	8.00	301.60
MAM - 4-S	24-Aug-15	7632	Gymnodinium sp.	600	6.12	26.90	26.90	10191.90
MAM - 4-S	24-Aug-15	7639	Peridinium pusillum (Penard) Lemmermann	1400	1.80	14.50	13.00	1283.10
MAM - 5-S	19-Sep-15	1054	Planktolyngbya limnetica	600	0.06	93.00	1.20	105.20
MAM - 5-S	19-Sep-15	2100	Pyramidomonas tetrarhynchus Schmarda	200	0.12	14.10	13.00	623.80
MAM - 5-S	19-Sep-15	2105	Chlamydomonas spp.	21552	0.66	7.00	2.90	30.80
MAM - 5-S	19-Sep-15	2121	Oocystis lacustris Chodat	21552	0.38	5.00	2.60	17.70
MAM - 5-S	19-Sep-15	2137	Dictyosphaerium simplex Sukja	129312	0.54	2.00	2.00	4.20
MAM - 5-S	19-Sep-15	2187	Staurodesmus extensus (Andersson) Teiling	200	0.11	15.10	14.00	557.10
MAM - 5-S	19-Sep-15	2193	Staurodesmus paradoxum Meyen	200	0.15	17.20	15.00	774.50
MAM - 5-S	19-Sep-15	2215	Tetraedron caudatum (Corda) Hansgrig	143680	0.68	3.00	3.00	4.70
MAM - 5-S	19-Sep-15	4351	Small chrysophyceae	380752	5.94	3.10	3.10	15.60
MAM - 5-S	19-Sep-15	4352	Large chrysophyceae	35920	14.64	9.20	9.20	407.70
MAM - 5-S	19-Sep-15	4357	Chrysococcus sp.	617824	31.51	4.60	4.60	51.00
MAM - 5-S	19-Sep-15	4358	Chrysostephanospaera globulifera Scherffel	7184	2.83	9.10	9.10	394.60
MAM - 5-S	19-Sep-15	4361	Kephyrion boreale Skuja	21552	3.24	6.60	6.60	150.50
MAM - 5-S	19-Sep-15	4362	Kephyrion sp.	215520	3.36	3.10	3.10	15.60
MAM - 5-S	19-Sep-15	4363	Spinifiromonas sirratus**********	14368	1.71	6.10	6.10	118.80
MAM - 5-S	19-Sep-15	4368	Mallomonas crassisquama (Asmund) Fott	400	0.44	21.00	10.00	1099.60
MAM - 5-S	19-Sep-15	4378	Dinobryon borgei Lemmermann	14368	0.69	9.00	3.20	48.30
MAM - 5-S	19-Sep-15	4381	Dinobryon mucronutom Nygaard	7184	0.94	10.00	5.00	130.90
MAM - 5-S	19-Sep-15	4390	Dinobryon sociale Ehrenberg	287360	65.00	12.00	6.00	226.20
MAM - 5-S	19-Sep-15	4390	Dinobryon sociale Ehrenberg	8200	10.37	0.00	0.00	1265.00
MAM - 5-S	19-Sep-15	4394	Epiphyxis sp.	21552	1.68	9.30	4.00	77.90
MAM - 5-S	19-Sep-15	4396	Chrysolkos skuja (Nauwerck) Willen	107760	3.25	6.00	3.10	30.20
MAM - 5-S	19-Sep-15	4401	Uroglena volvox Ehrenberg	244256	27.63	6.00	6.00	113.10
MAM - 5-S	19-Sep-15	4411	Bitrichia chodatii (Reverdin) Chodat	7184	0.36	6.00	4.00	50.30
MAM - 5-S	19-Sep-15	4413	Chrysochromulina laurentiana Kling	43104	17.01	9.10	9.10	394.60
MAM - 5-S	19-Sep-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	93392	2.80	5.60	3.20	30.00
MAM - 5-S	19-Sep-15	4437	Pteridomonas sp.	21552	4.15	8.20	8.20	192.50
MAM - 5-S	19-Sep-15	5507	Cyclotella stelligera Cleve and Grunow	200	0.25	9.30	18.60	1263.50
MAM - 5-S	19-Sep-15	5509	Cyclotella ocellata Pant.	14368	1.79	4.30	8.60	124.90
MAM - 5-S	19-Sep-15	5511	Rhizosolenia eriense H.L. Smith	50288	3.91	11.00	3.00	77.80
MAM - 5-S	19-Sep-15	5518	Synedra acus Kutzing	29200	2.48	81.00	2.00	84.80
MAM - 5-S	19-Sep-15	5551	Cyclotella michiganiana Skvortzow	129312	2.99	2.45	4.90	23.10
MAM - 5-S	19-Sep-15	6554	Rhodomonas minuta Skuja	21552	1.14	9.00	4.10	52.80
MAM - 5-S	19-Sep-15	6558	Cryptomonas erosa Ehrenberg	400	0.30	21.30	10.00	743.50
MAM - 5-S	19-Sep-15	6565	Cryptomonas rostratiformis Skuja	200	0.41	30.00	14.00	2052.50
MAM - 5-S	19-Sep-15	6568	Katablepharis ovalis Skuja	57472	3.40	9.20	4.00	59.10
MAM - 5-S	19-Sep-15	7632	Gymnodinium sp.	1200	11.17	26.10	26.10	9309.40
MAM - 6-S	19-Sep-15	1014	Chroococcus limneticus Lemmermann	28736	2.24	5.30	5.30	78.00
MAM - 6-S	19-Sep-15	1037	Myxobaktron smithii **********	28736	0.86	5.60	3.20	30.00
MAM - 6-S	19-Sep-15	2100	Pyramidomonas tetrarhynchus Schmarda	200	0.16	15.30	14.00	785.10
MAM - 6-S	19-Sep-15	2105	Chlamydomonas spp.	50288	1.55	7.00	2.90	30.80
MAM - 6-S	19-Sep-15	2121	Oocystis lacustris Chodat	21552	0.38	5.00	2.60	17.70
MAM - 6-S	19-Sep-15	2137	Dictyosphaerium simplex Sukja	35920	0.15	2.00	2.00	4.20
MAM - 6-S	19-Sep-15	2167	Elakatothrix gelatinosa Willen	28736	0.59	13.10	2.00	20.60
MAM - 6-S	19-Sep-15	2199	Spondylosium planum (Wolle) W. and G.S. West	14368	0.54	6.00	6.00	37.70
MAM - 6-S	19-Sep-15	2215	Tetraedron caudatum (Corda) Hansgrig	193968	0.91	3.00	3.00	4.70
MAM - 6-S	19-Sep-15	2235	Ankistrodesmus spiralis Lemmermann	14368	0.98	36.00	2.20	68.40
MAM - 6-S	19-Sep-15	4351	Small chrysophyceae	323280	5.04	3.10	3.10	15.60
MAM - 6-S	19-Sep-15	4352	Large chrysophyceae	7184	2.83	9.10	9.10	394.60
MAM - 6-S	19-Sep-15	4357	Chrysococcus sp.	754320	38.47	4.60	4.60	51.00
MAM - 6-S	19-Sep-15	4361	Kephyrion boreale Skuja	93392	14.06	6.60	6.60	150.50
MAM - 6-S	19-Sep-15	4362	Kephyrion sp.	158048	2.47	3.10	3.10	15.60

Station	Date	Species code	Speceis name	density cells/L	biomass mg/m^3	length µ	width µ	cell volume $µ^3$
MAM - 6-S	19-Sep-15	4368	Mallomonas crassisquama (Asmund) Fott	200	0.22	21.00	10.00	1099.60
MAM - 6-S	19-Sep-15	4378	Dinobryon borgei Lemmermann	43104	2.08	9.00	3.20	48.30
MAM - 6-S	19-Sep-15	4381	Dinobryon mucronutom Nygaard	7184	0.94	10.00	5.00	130.90
MAM - 6-S	19-Sep-15	4388	Dinobryon sertularia Ehrenberg	35920	8.13	12.00	6.00	226.20
MAM - 6-S	19-Sep-15	4390	Dinobryon sociale Ehrenberg	165232	37.38	12.00	6.00	226.20
MAM - 6-S	19-Sep-15	4390	Dinobryon sociale Ehrenberg	11400	14.42	0.00	0.00	1265.00
MAM - 6-S	19-Sep-15	4394	Epiphyxis sp.	7184	0.54	9.00	4.00	75.40
MAM - 6-S	19-Sep-15	4396	Chrysolkos skuja (Nauwerck) Willen	136496	4.12	6.00	3.10	30.20
MAM - 6-S	19-Sep-15	4401	Uroglena volvox Ehrenberg	122128	13.81	6.00	6.00	113.10
MAM - 6-S	19-Sep-15	4413	Chrysochromulina laurentiana Kling	64656	25.51	9.10	9.10	394.60
MAM - 6-S	19-Sep-15	4414	Stichogloea spp.	21552	1.08	6.00	4.00	50.30
MAM - 6-S	19-Sep-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	71840	2.16	5.60	3.20	30.00
MAM - 6-S	19-Sep-15	5507	Cyclotella stelligera Cleve and Grunow	400	0.51	9.30	18.60	1263.50
MAM - 6-S	19-Sep-15	5509	Cyclotella ocellata Pant.	14368	1.79	4.30	8.60	124.90
MAM - 6-S	19-Sep-15	5511	Rhizosolenia eriense H.L. Smith	50288	3.91	11.00	3.00	77.80
MAM - 6-S	19-Sep-15	5514	Tabellaria flocculsa (Roth) Kutzing	200	0.27	26.00	14.00	1334.10
MAM - 6-S	19-Sep-15	5518	Synedra acus Kutzing	35200	2.98	81.00	2.00	84.80
MAM - 6-S	19-Sep-15	5551	Cyclotella michiganiana Skvortzow	165232	3.82	2.45	4.90	23.10
MAM - 6-S	19-Sep-15	6554	Rhodomonas minuta Skuja	21552	1.14	9.00	4.10	52.80
MAM - 6-S	19-Sep-15	6558	Cryptomonas erosa Ehrenberg	800	0.59	21.30	10.00	743.50
MAM - 6-S	19-Sep-15	6568	Katablepharis ovalis Skuja	64656	3.82	9.20	4.00	59.10
MAM - 6-S	19-Sep-15	7632	Gymnodinium sp.	1400	13.03	26.10	26.10	9309.40
MAM - 6-S	19-Sep-15	7639	Peridinium pusillum (Penard) Lemmermann	200	0.32	15.50	14.00	1590.70
NEM - 1-S	18-Jul-15	2105	Chlamydomonas spp.	21552	0.71	7.00	3.00	33.00
NEM - 1-S	18-Jul-15	2138	Monoraphidium komarkovae (Nyg.) Komarkova-Legnerova	14368	1.00	41.00	1.80	69.60
NEM - 1-S	18-Jul-15	2206	Botryococcus braunii Kutzing	200	0.10	10.00	10.00	523.60
NEM - 1-S	18-Jul-15	4351	Small chrysophyceae	833344	11.75	3.00	3.00	14.10
NEM - 1-S	18-Jul-15	4352	Large chrysophyceae	35920	6.45	7.00	7.00	179.60
NEM - 1-S	18-Jul-15	4357	Chrysococcus sp.	581904	35.85	4.90	4.90	61.60
NEM - 1-S	18-Jul-15	4358	Chrysostephanospaera globulifera Scherffel	7184	4.48	10.60	10.60	623.60
NEM - 1-S	18-Jul-15	4362	Kephyrion sp.	237072	4.46	3.30	3.30	18.80
NEM - 1-S	18-Jul-15	4368	Mallomonas crassisquama (Asmund) Fott	600	0.63	20.10	10.00	1052.40
NEM - 1-S	18-Jul-15	4378	Dinobryon borgei Lemmermann	100576	5.22	9.10	3.30	51.90
NEM - 1-S	18-Jul-15	4388	Dinobryon sertularia Ehrenberg	7184	1.63	12.00	6.00	226.20
NEM - 1-S	18-Jul-15	4388	Dinobryon sertularia Ehrenberg	3400	11.53	0.00	0.00	3390.00
NEM - 1-S	18-Jul-15	4390	Dinobryon sociale Ehrenberg	64656	14.63	12.00	6.00	226.20
NEM - 1-S	18-Jul-15	4390	Dinobryon sociale Ehrenberg	3400	6.77	0.00	0.00	1991.00
NEM - 1-S	18-Jul-15	4396	Chrysolkos skuja (Nauwerck) Willen	43104	1.22	5.60	3.10	28.20
NEM - 1-S	18-Jul-15	4413	Chrysochromulina laurentiana Kling	28736	11.34	9.10	9.10	394.60
NEM - 1-S	18-Jul-15	4436	Dinobryon attenatum Hill	7184	1.35	10.00	6.00	188.50
NEM - 1-S	18-Jul-15	4439	Chrysosphaerella brevispina	21552	3.24	6.60	6.60	150.50
NEM - 1-S	18-Jul-15	5507	Cyclotella stelligera Cleve and Grunow	600	0.76	9.30	18.60	1263.50
NEM - 1-S	18-Jul-15	5509	Cyclotella ocellata Pant.	57472	7.18	4.30	8.60	124.90
NEM - 1-S	18-Jul-15	5518	Synedra acus Kutzing	15000	1.26	80.00	2.00	83.80
NEM - 1-S	18-Jul-15	5551	Cyclotella michiganiana Skvortzow	172416	4.22	2.50	5.00	24.50
NEM - 1-S	18-Jul-15	6554	Rhodomonas minuta Skuja	57472	5.67	11.30	5.00	98.60
NEM - 1-S	18-Jul-15	6558	Cryptomonas erosa Ehrenberg	3400	4.03	23.60	12.00	1186.30
NEM - 1-S	18-Jul-15	6562	Cryptomonas reflexa (Marsson) Skuja	200	0.14	20.00	10.00	698.10
NEM - 1-S	18-Jul-15	6565	Cryptomonas rostratiformis Skuja	1000	2.12	31.00	14.00	2120.90
NEM - 1-S	18-Jul-15	6568	Katablepharis ovalis Skuja	7184	0.34	8.00	4.20	46.90
NEM - 1-S	18-Jul-15	7632	Gymnodinium sp.	1400	13.18	26.20	26.20	9416.80
NEM - 1-S	18-Jul-15	7639	Peridinium pusillum (Penard) Lemmermann	200	0.20	13.10	12.00	987.70
NEM - 1-S	18-Jul-15	7641	Peridinium aciculiferum Lemmermann	400	3.74	31.00	24.00	9349.40
NEM - 2-S	18-Jul-15	2105	Chlamydomonas spp.	14368	0.47	7.00	3.00	33.00
NEM - 2-S	18-Jul-15	2121	Oocystis lacustris Chodat	28736	1.47	6.10	4.00	51.10
NEM - 2-S	18-Jul-15	2132	Scenedesmus denticulatus Lagerhiem	14368	0.67	8.30	4.00	46.40
NEM - 2-S	18-Jul-15	2167	Elakatothrix gelatinosa Willen	7184	0.11	10.00	2.00	15.70
NEM - 2-S	18-Jul-15	2178	Cosmarium sp.	400	0.56	20.00	20.00	1396.30
NEM - 2-S	18-Jul-15	4351	Small chrysophyceae	567536	8.85	3.10	3.10	15.60
NEM - 2-S	18-Jul-15	4352	Large chrysophyceae	43104	7.74	7.00	7.00	179.60
NEM - 2-S	18-Jul-15	4357	Chrysococcus sp.	1041680	72.40	5.10	5.10	69.50
NEM - 2-S	18-Jul-15	4362	Kephyrion sp.	366384	4.69	2.90	2.90	12.80
NEM - 2-S	18-Jul-15	4363	Spinifiromonas sirratus**********	7184	0.90	6.20	6.20	124.80
NEM - 2-S	18-Jul-15	4368	Mallomonas crassisquama (Asmund) Fott	800	0.77	18.30	10.00	958.20
NEM - 2-S	18-Jul-15	4378	Dinobryon borgei Lemmermann	107760	5.66	9.80	3.20	52.50
NEM - 2-S	18-Jul-15	4388	Dinobryon sertularia Ehrenberg	50288	11.94	12.60	6.00	237.50
NEM - 2-S	18-Jul-15	4388	Dinobryon sertularia Ehrenberg	2400	4.78	0.00	0.00	1991.00
NEM - 2-S	18-Jul-15	4390	Dinobryon sociale Ehrenberg	43104	9.75	12.00	6.00	226.20
NEM - 2-S	18-Jul-15	4390	Dinobryon sociale Ehrenberg	4600	5.62	0.00	0.00	1221.00
NEM - 2-S	18-Jul-15	4396	Chrysolkos skuja (Nauwerck) Willen	201152	5.37	5.30	3.10	26.70
NEM - 2-S	18-Jul-15	4413	Chrysochromulina laurentiana Kling	150864	61.51	9.20	9.20	407.70
NEM - 2-S	18-Jul-15	4414	Stichogloea spp.	100576	5.06	6.00	4.00	50.30
NEM - 2-S	18-Jul-15	4415	Bicoeca lacustris Clark	7184	0.22	5.40	3.30	30.80
NEM - 2-S	18-Jul-15	5507	Cyclotella stelligera Cleve and Grunow	400	0.51	9.30	18.60	1263.50
NEM - 2-S	18-Jul-15	5509	Cyclotella ocellata Pant.	28736	4.54	4.65	9.30	157.90
NEM - 2-S	18-Jul-15	5514	Tabellaria flocculsa (Roth) Kutzing	1600	2.05	25.00	14.00	1282.80
NEM - 2-S	18-Jul-15	5518	Synedra acus Kutzing	20200	1.69	80.00	2.00	83.80
NEM - 2-S	18-Jul-15	5551	Cyclotella michiganiana Skvortzow	208336	5.10	2.50	5.00	24.50
NEM - 2-S	18-Jul-15	6554	Rhodomonas minuta Skuja	100576	9.92	11.30	5.00	98.60
NEM - 2-S	18-Jul-15	6558	Cryptomonas erosa Ehrenberg	3400	2.56	21.60	10.00	754.00

Station	Date	Species code	Speceis name	density cells/L	biomass mg/m^3	length µ	width µ	cell volume µ^3
NEM - 2-S	18-Jul-15	6562	Cryptomonas reflexa (Marsson) Skuja	600	0.40	19.00	10.00	663.20
NEM - 2-S	18-Jul-15	7631	Gymnodinium helveticum Penard	200	5.00	53.00	30.00	24975.70
NEM - 2-S	18-Jul-15	7632	Gymnodinium sp.	7184	2.52	10.20	8.10	350.40
NEM - 2-S	18-Jul-15	7632	Gymnodinium sp.	200	1.26	22.90	22.90	6287.90
NEM - 2-S	18-Jul-15	7635	Peridinium willei Huitfeldt-Kaas	200	6.21	39.00	39.00	31059.40
NEM - 2-S	18-Jul-15	7639	Peridinium pusillum (Penard) Lemmermann	1000	1.01	13.00	12.20	1013.10
NEM - 2-S	18-Jul-15	7641	Peridinium aciculiferum Lemmermann	600	5.61	31.00	24.00	9349.40
NEM - 2-SR	18-Jul-15	2105	Chlamydomonas spp.	14368	0.47	7.00	3.00	33.00
NEM - 2-SR	18-Jul-15	2121	Oocystis lacustris Chodat	14368	0.73	6.10	4.00	51.10
NEM - 2-SR	18-Jul-15	2167	Elakatothrix gelatinosa Willen	28736	0.45	10.00	2.00	15.70
NEM - 2-SR	18-Jul-15	2178	Cosmarium sp.	600	0.84	20.00	20.00	1396.30
NEM - 2-SR	18-Jul-15	2235	Ankistrodesmus spiralis Lemmermann	7184	0.42	31.00	2.20	58.90
NEM - 2-SR	18-Jul-15	4351	Small chrysophyceae	452592	7.06	3.10	3.10	15.60
NEM - 2-SR	18-Jul-15	4352	Large chrysophyceae	64656	11.61	7.00	7.00	179.60
NEM - 2-SR	18-Jul-15	4357	Chrysococcus sp.	1034496	71.90	5.10	5.10	69.50
NEM - 2-SR	18-Jul-15	4362	Kephyrion sp.	452592	5.79	2.90	2.90	12.80
NEM - 2-SR	18-Jul-15	4363	Spinifiromonas sirratus**********	21552	2.69	6.20	6.20	124.80
NEM - 2-SR	18-Jul-15	4368	Mallomonas crassisquama (Asmund) Fott	1800	1.72	18.30	10.00	958.20
NEM - 2-SR	18-Jul-15	4378	Dinobryon borgei Lemmermann	150864	7.20	8.90	3.20	47.70
NEM - 2-SR	18-Jul-15	4388	Dinobryon sertularia Ehrenberg	64656	14.63	12.00	6.00	226.20
NEM - 2-SR	18-Jul-15	4388	Dinobryon sertularia Ehrenberg	2400	4.78	0.00	0.00	1991.00
NEM - 2-SR	18-Jul-15	4390	Dinobryon sociale Ehrenberg	50288	11.94	12.60	6.00	237.50
NEM - 2-SR	18-Jul-15	4390	Dinobryon sociale Ehrenberg	3800	4.64	0.00	0.00	1221.00
NEM - 2-SR	18-Jul-15	4396	Chrysolkos skuja (Nauwerck) Willen	179600	4.80	5.30	3.10	26.70
NEM - 2-SR	18-Jul-15	4400	Ochromonas sp.	7184	0.52	8.60	4.00	72.00
NEM - 2-SR	18-Jul-15	4413	Chrysochromulina laurentiana Kling	114944	46.86	9.20	9.20	407.70
NEM - 2-SR	18-Jul-15	4414	Stichogloea spp.	71840	3.61	6.00	4.00	50.30
NEM - 2-SR	18-Jul-15	4415	Bicoeca lacustris Clark	7184	0.22	5.40	3.30	30.80
NEM - 2-SR	18-Jul-15	5507	Cyclotella stelligera Cleve and Grunow	200	0.25	9.30	18.60	1263.50
NEM - 2-SR	18-Jul-15	5509	Cyclotella ocellata Pant.	43104	6.81	4.65	9.30	157.90
NEM - 2-SR	18-Jul-15	5514	Tabellaria flocculsa (Roth) Kutzing	2000	2.57	25.00	14.00	1282.80
NEM - 2-SR	18-Jul-15	5518	Synedra acus Kutzing	19200	1.61	80.00	2.00	83.80
NEM - 2-SR	18-Jul-15	5551	Cyclotella michiganiana Skvortzow	165232	4.05	2.50	5.00	24.50
NEM - 2-SR	18-Jul-15	6554	Rhodomonas minuta Skuja	114944	11.33	11.30	5.00	98.60
NEM - 2-SR	18-Jul-15	6558	Cryptomonas erosa Ehrenberg	4400	3.32	21.60	10.00	754.00
NEM - 2-SR	18-Jul-15	6562	Cryptomonas reflexa (Marsson) Skuja	800	0.53	19.00	10.00	663.20
NEM - 2-SR	18-Jul-15	7632	Gymnodinium sp.	7184	2.52	10.20	8.10	350.40
NEM - 2-SR	18-Jul-15	7635	Peridinium willei Huitfeldt-Kaas	200	6.21	39.00	39.00	31059.40
NEM - 2-SR	18-Jul-15	7639	Peridinium pusillum (Penard) Lemmermann	800	0.81	13.00	12.20	1013.10
NEM - 2-SR	18-Jul-15	7641	Peridinium aciculiferum Lemmermann	200	1.87	31.00	24.00	9349.40
NEM - 3-S	23-Aug-15	2105	Chlamydomonas spp.	21552	0.47	6.10	2.60	21.60
NEM - 3-S	23-Aug-15	2112	Sphaerocystis schroeteri Chodat	43104	1.44	4.00	4.00	33.50
NEM - 3-S	23-Aug-15	2121	Oocystis lacustris Chodat	251440	16.85	8.00	4.00	67.00
NEM - 3-S	23-Aug-15	2137	Dictyosphaerium simplex Sukja	71840	0.26	1.90	1.90	3.60
NEM - 3-S	23-Aug-15	2167	Elakatothrix gelatinosa Willen	28736	0.59	13.10	2.00	20.60
NEM - 3-S	23-Aug-15	2178	Cosmarium sp.	600	0.84	20.00	20.00	1396.30
NEM - 3-S	23-Aug-15	2235	Ankistrodesmus spiralis Lemmermann	7184	0.49	36.00	2.20	68.40
NEM - 3-S	23-Aug-15	4351	Small chrysophyceae	280176	4.82	3.20	3.20	17.20
NEM - 3-S	23-Aug-15	4352	Large chrysophyceae	7184	1.29	7.00	7.00	179.60
NEM - 3-S	23-Aug-15	4357	Chrysococcus sp.	129312	8.46	5.00	5.00	65.40
NEM - 3-S	23-Aug-15	4362	Kephyrion sp.	201152	3.78	3.30	3.30	18.80
NEM - 3-S	23-Aug-15	4368	Mallomonas crassisquama (Asmund) Fott	400	0.65	21.60	12.00	1628.60
NEM - 3-S	23-Aug-15	4378	Dinobryon borgei Lemmermann	43104	2.57	8.80	3.60	59.70
NEM - 3-S	23-Aug-15	4381	Dinobryon mucronutom Nygaard	14368	1.88	10.00	5.00	130.90
NEM - 3-S	23-Aug-15	4383	Dinobryon bavaricum Imhof	43104	10.07	12.40	6.00	233.70
NEM - 3-S	23-Aug-15	4383	Dinobryon bavaricum Imhof	2000	2.57	0.00	0.00	1285.00
NEM - 3-S	23-Aug-15	4390	Dinobryon sociale Ehrenberg	35920	8.13	12.00	6.00	226.20
NEM - 3-S	23-Aug-15	4394	Epiphyxis sp.	7184	0.74	9.30	4.60	103.00
NEM - 3-S	23-Aug-15	4396	Chrysolkos skuja (Nauwerck) Willen	14368	0.42	5.50	3.20	29.50
NEM - 3-S	23-Aug-15	4401	Uroglena volvox Ehrenberg	79024	8.94	6.00	6.00	113.10
NEM - 3-S	23-Aug-15	4413	Chrysochromulina laurentiana Kling	7184	2.93	9.20	9.20	407.70
NEM - 3-S	23-Aug-15	4414	Stichogloea spp.	35920	1.81	6.00	4.00	50.30
NEM - 3-S	23-Aug-15	5507	Cyclotella stelligera Cleve and Grunow	400	0.53	9.45	18.90	1325.60
NEM - 3-S	23-Aug-15	5509	Cyclotella ocellata Pant.	179600	20.17	4.15	8.30	112.30
NEM - 3-S	23-Aug-15	5511	Rhizosolenia eriense H.L. Smith	7184	0.46	9.00	3.00	63.60
NEM - 3-S	23-Aug-15	5518	Synedra acus Kutzing	1400	0.11	75.00	2.00	78.50
NEM - 3-S	23-Aug-15	5540	Aulacoseira italica v subarctica (O. Muller) Simonsen	800	1.05	26.00	8.00	1306.90
NEM - 3-S	23-Aug-15	5551	Cyclotella michiganiana Skvortzow	28736	0.55	2.30	4.60	19.10
NEM - 3-S	23-Aug-15	6554	Rhodomonas minuta Skuja	35920	1.79	8.10	4.20	49.90
NEM - 3-S	23-Aug-15	6568	Katablepharis ovalis Skuja	7184	0.34	8.20	4.00	46.90
NEM - 3-S	23-Aug-15	7632	Gymnodinium sp.	7184	4.14	11.00	10.00	576.00
NEM - 3-S	23-Aug-15	7632	Gymnodinium sp.	200	2.18	27.50	27.50	10889.20
NEM - 4-S	23-Aug-15	1054	Planktolyngbya limnetica	400	0.05	106.00	1.20	119.90
NEM - 4-S	23-Aug-15	2105	Chlamydomonas spp.	7184	0.10	5.60	2.20	14.20
NEM - 4-S	23-Aug-15	2112	Sphaerocystis schroeteri Chodat	208336	6.98	4.00	4.00	33.50
NEM - 4-S	23-Aug-15	2121	Oocystis lacustris Chodat	107760	7.22	8.00	4.00	67.00
NEM - 4-S	23-Aug-15	2137	Dictyosphaerium simplex Sukja	57472	0.24	2.00	2.00	4.20
NEM - 4-S	23-Aug-15	2167	Elakatothrix gelatinosa Willen	14368	0.29	13.00	2.00	20.40
NEM - 4-S	23-Aug-15	2206	Botryococcus braunii Kutzing	400	0.28	11.00	11.00	696.90
NEM - 4-S	23-Aug-15	2247	Oocystis gigas Archer	200	0.59	22.00	16.00	2948.90

Station	Date	Species code	Speceis name	density cells/L	biomass mg/m^3	length µ	width µ	cell volume µ^3
NEM - 4-S	23-Aug-15	4351	Small chrysophyceae	136496	2.35	3.20	3.20	17.20
NEM - 4-S	23-Aug-15	4352	Large chrysophyceae	14368	2.58	7.00	7.00	179.60
NEM - 4-S	23-Aug-15	4357	Chrysococcus sp.	64656	4.23	5.00	5.00	65.40
NEM - 4-S	23-Aug-15	4361	Kephyrion boreale Skuja	7184	0.77	5.90	5.90	107.50
NEM - 4-S	23-Aug-15	4362	Kephyrion sp.	143680	2.96	3.40	3.40	20.60
NEM - 4-S	23-Aug-15	4378	Dinobryon borgei Lemmermann	21552	1.32	9.00	3.60	61.10
NEM - 4-S	23-Aug-15	4381	Dinobryon mucronutom Nygaard	43104	5.64	10.00	5.00	130.90
NEM - 4-S	23-Aug-15	4383	Dinobryon bavaricum Imhof	43104	9.99	12.30	6.00	231.80
NEM - 4-S	23-Aug-15	4383	Dinobryon bavaricum Imhof	4600	9.15	0.00	0.00	1990.00
NEM - 4-S	23-Aug-15	4388	Dinobryon sertularia Ehrenberg	28736	6.50	12.00	6.00	226.20
NEM - 4-S	23-Aug-15	4390	Dinobryon sociale Ehrenberg	21552	4.88	12.00	6.00	226.20
NEM - 4-S	23-Aug-15	4396	Chrysolkos skuja (Nauwerck) Willen	7184	0.20	5.50	3.10	27.70
NEM - 4-S	23-Aug-15	4401	Uroglena volvox Ehrenberg	43104	4.88	6.00	6.00	113.10
NEM - 4-S	23-Aug-15	4413	Chrysochromulina laurentiana Kling	28736	11.72	9.20	9.20	407.70
NEM - 4-S	23-Aug-15	4414	Stichogloea spp.	21552	1.08	6.00	4.00	50.30
NEM - 4-S	23-Aug-15	4436	Dinobryon attenatum Hill	7184	1.50	11.10	6.00	209.20
NEM - 4-S	23-Aug-15	5507	Cyclotella stelligera Cleve and Grunow	400	0.63	10.00	20.00	1570.80
NEM - 4-S	23-Aug-15	5509	Cyclotella ocellata Pant.	143680	16.14	4.15	8.30	112.30
NEM - 4-S	23-Aug-15	5518	Synedra acus Kutzing	200	0.02	77.00	2.00	80.60
NEM - 4-S	23-Aug-15	5551	Cyclotella michiganiana Skvortzow	122128	2.33	2.30	4.60	19.10
NEM - 4-S	23-Aug-15	6568	Katablepharis ovalis Skuja	7184	0.34	8.20	4.00	46.90
NEM - 4-S	23-Aug-15	7632	Gymnodinium sp.	200	1.82	25.90	25.90	9097.00
NEM - 5-S	19-Sep-15	1014	Chroococcus limneticus Lemmermann	14368	0.60	4.30	4.30	41.60
NEM - 5-S	19-Sep-15	1054	Planktolyngbya limnetica	1000	0.12	103.00	1.20	116.50
NEM - 5-S	19-Sep-15	2105	Chlamydomonas spp.	14368	0.25	5.00	2.60	17.70
NEM - 5-S	19-Sep-15	2112	Sphaerocystis schroeteri Chodat	114944	1.98	3.20	3.20	17.20
NEM - 5-S	19-Sep-15	2121	Oocystis lacustris Chodat	57472	1.72	5.60	3.20	30.00
NEM - 5-S	19-Sep-15	2167	Elakatothrix gelatinosa Willen	64656	1.12	11.00	2.00	17.30
NEM - 5-S	19-Sep-15	2178	Cosmarium sp.	600	0.84	20.00	20.00	1396.30
NEM - 5-S	19-Sep-15	2199	Spondylosium planum (Wolle) W. and G.S. West	7184	0.27	6.00	6.00	37.70
NEM - 5-S	19-Sep-15	2235	Ankistrodesmus spiralis Lemmermann	7184	0.49	36.00	2.20	68.40
NEM - 5-S	19-Sep-15	4351	Small chrysophyceae	301728	4.71	3.10	3.10	15.60
NEM - 5-S	19-Sep-15	4352	Large chrysophyceae	28736	5.16	7.00	7.00	179.60
NEM - 5-S	19-Sep-15	4357	Chrysococcus sp.	258624	16.91	5.00	5.00	65.40
NEM - 5-S	19-Sep-15	4362	Kephyrion sp.	122128	2.10	3.20	3.20	17.20
NEM - 5-S	19-Sep-15	4368	Mallomonas crassisquama (Asmund) Fott	400	0.46	22.10	10.00	1157.20
NEM - 5-S	19-Sep-15	4378	Dinobryon borgei Lemmermann	28736	1.39	9.00	3.20	48.30
NEM - 5-S	19-Sep-15	4381	Dinobryon mucronutom Nygaard	35920	4.70	10.00	5.00	130.90
NEM - 5-S	19-Sep-15	4383	Dinobryon bavaricum Imhof	71840	16.25	12.00	6.00	226.20
NEM - 5-S	19-Sep-15	4383	Dinobryon bavaricum Imhof	11200	37.97	0.00	0.00	3390.00
NEM - 5-S	19-Sep-15	4388	Dinobryon sertularia Ehrenberg	21552	4.88	12.00	6.00	226.20
NEM - 5-S	19-Sep-15	4396	Chrysolkos skuja (Nauwerck) Willen	14368	0.48	5.50	3.40	33.30
NEM - 5-S	19-Sep-15	4401	Uroglena volvox Ehrenberg	35920	4.06	6.00	6.00	113.10
NEM - 5-S	19-Sep-15	4413	Chrysochromulina laurentiana Kling	35920	15.13	9.30	9.30	421.20
NEM - 5-S	19-Sep-15	4414	Stichogloea spp.	7184	0.36	6.00	4.00	50.30
NEM - 5-S	19-Sep-15	5507	Cyclotella stelligera Cleve and Grunow	1000	1.33	9.45	18.90	1325.60
NEM - 5-S	19-Sep-15	5509	Cyclotella ocellata Pant.	71840	8.97	4.30	8.60	124.90
NEM - 5-S	19-Sep-15	5523	Synedra ulna (Nitzsch) Ehrenberg	200	1.39	265.00	10.00	6937.70
NEM - 5-S	19-Sep-15	5551	Cyclotella michiganiana Skvortzow	215520	4.68	2.40	4.80	21.70
NEM - 5-S	19-Sep-15	5720	Cyclotella bodanica Eulenst.	200	1.54	17.00	34.00	7717.30
NEM - 5-S	19-Sep-15	6554	Rhodomonas minuta Skuja	7184	0.41	9.30	4.20	57.30
NEM - 5-S	19-Sep-15	6558	Cryptomonas erosa Ehrenberg	200	0.16	22.60	10.00	788.90
NEM - 5-S	19-Sep-15	7632	Gymnodinium sp.	7184	2.41	10.00	8.00	335.10
NEM - 5-S	19-Sep-15	7632	Gymnodinium sp.	400	4.08	26.90	26.90	10191.90
NEM - 6-S	19-Sep-15	1012	Aphanothece sp.	14368	0.57	0.00	0.00	40.00
NEM - 6-S	19-Sep-15	1054	Planktolyngbya limnetica	600	0.07	96.00	1.20	108.60
NEM - 6-S	19-Sep-15	2105	Chlamydomonas spp.	14368	0.25	5.00	2.60	17.70
NEM - 6-S	19-Sep-15	2112	Sphaerocystis schroeteri Chodat	93392	1.76	3.30	3.30	18.80
NEM - 6-S	19-Sep-15	2121	Oocystis lacustris Chodat	50288	1.51	5.60	3.20	30.00
NEM - 6-S	19-Sep-15	2167	Elakatothrix gelatinosa Willen	43104	0.75	11.00	2.00	17.30
NEM - 6-S	19-Sep-15	2178	Cosmarium sp.	400	0.70	21.60	21.60	1758.90
NEM - 6-S	19-Sep-15	2206	Botryococcus braunii Kutzing	200	0.18	12.00	12.00	904.80
NEM - 6-S	19-Sep-15	2215	Tetraedron caudatum (Corda) Hansgrig	7184	0.03	3.00	3.00	4.70
NEM - 6-S	19-Sep-15	4351	Small chrysophyceae	395120	6.16	3.10	3.10	15.60
NEM - 6-S	19-Sep-15	4352	Large chrysophyceae	7184	1.29	7.00	7.00	179.60
NEM - 6-S	19-Sep-15	4357	Chrysococcus sp.	366384	23.96	5.00	5.00	65.40
NEM - 6-S	19-Sep-15	4361	Kephyrion boreale Skuja	7184	0.81	6.00	6.00	113.10
NEM - 6-S	19-Sep-15	4362	Kephyrion sp.	265808	4.57	3.20	3.20	17.20
NEM - 6-S	19-Sep-15	4368	Mallomonas crassisquama (Asmund) Fott	200	0.22	21.00	10.00	1099.60
NEM - 6-S	19-Sep-15	4378	Dinobryon borgei Lemmermann	7184	0.35	9.00	3.20	48.30
NEM - 6-S	19-Sep-15	4381	Dinobryon mucronutom Nygaard	28736	3.76	10.00	5.00	130.90
NEM - 6-S	19-Sep-15	4383	Dinobryon bavaricum Imhof	71840	16.25	12.00	6.00	226.20
NEM - 6-S	19-Sep-15	4383	Dinobryon bavaricum Imhof	13000	44.07	0.00	0.00	3390.00
NEM - 6-S	19-Sep-15	4388	Dinobryon sertularia Ehrenberg	7184	1.76	13.00	6.00	245.00
NEM - 6-S	19-Sep-15	4390	Dinobryon sociale Ehrenberg	64656	14.63	12.00	6.00	226.20
NEM - 6-S	19-Sep-15	4394	Epiphyxis sp.	14368	0.99	8.20	4.00	68.70
NEM - 6-S	19-Sep-15	4401	Uroglena volvox Ehrenberg	14368	1.63	6.00	6.00	113.10
NEM - 6-S	19-Sep-15	4411	Bitrichia chodatii (Reverdin) Chodat	7184	0.36	6.00	4.00	50.30
NEM - 6-S	19-Sep-15	4413	Chrysochromulina laurentiana Kling	28736	10.97	9.00	9.00	381.70
NEM - 6-S	19-Sep-15	4414	Stichogloea spp.	7184	0.36	6.00	4.00	50.30

Station	Date	Species code	Speceis name	density cells/L	biomass mg/m^3	length µ	width µ	cell volume µ^3
NEM - 6-S	19-Sep-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	14368	0.43	5.60	3.20	30.00
NEM - 6-S	19-Sep-15	5507	Cyclotella stelligera Cleve and Grunow	600	0.76	9.30	18.60	1263.50
NEM - 6-S	19-Sep-15	5509	Cyclotella ocellata Pant.	28736	3.00	4.05	8.10	104.30
NEM - 6-S	19-Sep-15	5514	Tabellaria flocculsa (Roth) Kutzing	200	0.26	25.00	14.00	1282.80
NEM - 6-S	19-Sep-15	5551	Cyclotella michiganiana Skvortzow	179600	3.90	2.40	4.80	21.70
NEM - 6-S	19-Sep-15	6554	Rhodomonas minuta Skuja	14368	0.82	9.30	4.20	57.30
NEM - 6-S	19-Sep-15	6558	Cryptomonas erosa Ehrenberg	400	0.29	21.10	10.00	736.50
NEM - 6-S	19-Sep-15	6562	Cryptomonas reflexa (Marsson) Skuja	200	0.13	19.00	10.00	663.20
NEM - 6-S	19-Sep-15	6568	Katablepharis ovalis Skuja	14368	0.64	8.00	4.00	44.70
NEM - 6-S	19-Sep-15	7632	Gymnodinium sp.	400	4.08	26.90	26.90	10191.90
NEM - 6-SR	19-Sep-15	1012	Aphanothece sp.	7184	0.29	0.00	0.00	40.00
NEM - 6-SR	19-Sep-15	1054	Planktolyngbya limnetica	1800	0.20	96.00	1.20	108.60
NEM - 6-SR	19-Sep-15	2105	Chlamydomonas spp.	7184	0.13	5.00	2.60	17.70
NEM - 6-SR	19-Sep-15	2112	Sphaerocystis schroeteri Chodat	64656	1.22	3.30	3.30	18.80
NEM - 6-SR	19-Sep-15	2121	Oocystis lacustris Chodat	79024	2.37	5.60	3.20	30.00
NEM - 6-SR	19-Sep-15	2167	Elakatothrix gelatinosa Willen	28736	0.50	11.00	2.00	17.30
NEM - 6-SR	19-Sep-15	2178	Cosmarium sp.	200	0.35	21.60	21.60	1758.90
NEM - 6-SR	19-Sep-15	2206	Botryococcus braunii Kutzing	200	0.18	12.00	12.00	904.80
NEM - 6-SR	19-Sep-15	2215	Tetraedron caudatum (Corda) Hansgrig	7184	0.03	3.00	3.00	4.70
NEM - 6-SR	19-Sep-15	4351	Small chrysophyceae	308912	4.82	3.10	3.10	15.60
NEM - 6-SR	19-Sep-15	4352	Large chrysophyceae	7184	1.29	7.00	7.00	179.60
NEM - 6-SR	19-Sep-15	4357	Chrysococcus sp.	373568	24.43	5.00	5.00	65.40
NEM - 6-SR	19-Sep-15	4358	Chrysostephanospaera globulifera Scherffel	14368	5.67	9.10	9.10	394.60
NEM - 6-SR	19-Sep-15	4361	Kephyrion boreale Skuja	28736	3.25	6.00	6.00	113.10
NEM - 6-SR	19-Sep-15	4362	Kephyrion sp.	229888	3.95	3.20	3.20	17.20
NEM - 6-SR	19-Sep-15	4368	Mallomonas crassisquama (Asmund) Fott	200	0.22	21.00	10.00	1099.60
NEM - 6-SR	19-Sep-15	4378	Dinobryon borgei Lemmermann	28736	1.39	9.00	3.20	48.30
NEM - 6-SR	19-Sep-15	4381	Dinobryon mucronutom Nygaard	14368	1.88	10.00	5.00	130.90
NEM - 6-SR	19-Sep-15	4383	Dinobryon bavaricum Imhof	57472	13.00	12.00	6.00	226.20
NEM - 6-SR	19-Sep-15	4383	Dinobryon bavaricum Imhof	14600	49.49	0.00	0.00	3390.00
NEM - 6-SR	19-Sep-15	4390	Dinobryon sociale Ehrenberg	57472	13.00	12.00	6.00	226.20
NEM - 6-SR	19-Sep-15	4394	Epiphyxis sp.	14368	0.99	8.20	4.00	68.70
NEM - 6-SR	19-Sep-15	4400	Ochromonas sp.	7184	0.44	4.90	4.90	61.60
NEM - 6-SR	19-Sep-15	4401	Uroglena volvox Ehrenberg	43104	4.88	6.00	6.00	113.10
NEM - 6-SR	19-Sep-15	4411	Bitrichia chodatii (Reverdin) Chodat	7184	0.36	6.00	4.00	50.30
NEM - 6-SR	19-Sep-15	4413	Chrysochromulina laurentiana Kling	21552	8.23	9.00	9.00	381.70
NEM - 6-SR	19-Sep-15	4414	Stichogloea spp.	28736	1.45	6.00	4.00	50.30
NEM - 6-SR	19-Sep-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	28736	0.86	5.60	3.20	30.00
NEM - 6-SR	19-Sep-15	5507	Cyclotella stelligera Cleve and Grunow	200	0.25	9.30	18.60	1263.50
NEM - 6-SR	19-Sep-15	5509	Cyclotella ocellata Pant.	7184	0.75	4.05	8.10	104.30
NEM - 6-SR	19-Sep-15	5511	Rhizosolenia eriense H.L. Smith	7184	0.46	9.00	3.00	63.60
NEM - 6-SR	19-Sep-15	5518	Synedra acus Kutzing	600	0.05	81.00	2.00	84.80
NEM - 6-SR	19-Sep-15	5551	Cyclotella michiganiana Skvortzow	179600	3.90	2.40	4.80	21.70
NEM - 6-SR	19-Sep-15	6554	Rhodomonas minuta Skuja	7184	0.39	9.30	4.10	54.60
NEM - 6-SR	19-Sep-15	6558	Cryptomonas erosa Ehrenberg	600	0.44	21.10	10.00	736.50
NEM - 6-SR	19-Sep-15	6568	Katablepharis ovalis Skuja	7184	0.32	8.00	4.00	44.70
NEM - 6-SR	19-Sep-15	7632	Gymnodinium sp.	200	2.04	26.90	26.90	10191.90
WTN - 1-S	17-Jul-15	2105	Chlamydomonas spp.	14368	0.34	5.00	3.00	23.60
WTN - 1-S	17-Jul-15	2235	Ankistrodesmus spiralis Lemmermann	7184	0.49	36.00	2.20	68.40
WTN - 1-S	17-Jul-15	2260	Monomastix minuta Skuja	14368	0.32	6.30	3.20	22.50
WTN - 1-S	17-Jul-15	4351	Small chrysophyceae	395120	5.06	2.90	2.90	12.80
WTN - 1-S	17-Jul-15	4352	Large chrysophyceae	7184	0.94	6.30	6.30	130.90
WTN - 1-S	17-Jul-15	4357	Chrysococcus sp.	2923888	149.12	4.60	4.60	51.00
WTN - 1-S	17-Jul-15	4358	Chrysostephanospaera globulifera Scherffel	7184	2.65	8.90	8.90	369.10
WTN - 1-S	17-Jul-15	4362	Kephyrion sp.	344832	5.93	3.20	3.20	17.20
WTN - 1-S	17-Jul-15	4363	Spinifiromonas sirratus**********	14368	1.32	5.60	5.60	92.00
WTN - 1-S	17-Jul-15	4368	Mallomonas crassisquama (Asmund) Fott	200	0.21	20.00	10.00	1047.20
WTN - 1-S	17-Jul-15	4378	Dinobryon borgei Lemmermann	7184	0.37	9.00	3.30	51.30
WTN - 1-S	17-Jul-15	4381	Dinobryon mucronutom Nygaard	14368	1.88	10.00	5.00	130.90
WTN - 1-S	17-Jul-15	4388	Dinobryon sertularia Ehrenberg	79024	20.85	14.00	6.00	263.90
WTN - 1-S	17-Jul-15	4388	Dinobryon sertularia Ehrenberg	10600	24.65	0.00	0.00	2325.00
WTN - 1-S	17-Jul-15	4390	Dinobryon sociale Ehrenberg	35920	8.13	12.00	6.00	226.20
WTN - 1-S	17-Jul-15	4390	Dinobryon sociale Ehrenberg	800	1.59	0.00	0.00	1991.00
WTN - 1-S	17-Jul-15	4396	Chrysolkos skuja (Nauwerck) Willen	136496	3.85	5.60	3.10	28.20
WTN - 1-S	17-Jul-15	4401	Uroglena volvox Ehrenberg	495696	56.06	6.00	6.00	113.10
WTN - 1-S	17-Jul-15	4413	Chrysochromulina laurentiana Kling	150864	59.53	9.10	9.10	394.60
WTN - 1-S	17-Jul-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	7184	0.18	5.20	3.00	24.50
WTN - 1-S	17-Jul-15	4436	Dinobryon attenatum Hill	7184	1.53	11.30	6.00	213.00
WTN - 1-S	17-Jul-15	5509	Cyclotella ocellata Pant.	7184	0.81	4.15	8.30	112.30
WTN - 1-S	17-Jul-15	5518	Synedra acus Kutzing	400	0.03	81.00	2.00	84.80
WTN - 1-S	17-Jul-15	5551	Cyclotella michiganiana Skvortzow	57472	1.33	2.45	4.90	23.10
WTN - 1-S	17-Jul-15	6554	Rhodomonas minuta Skuja	14368	1.30	10.00	5.10	90.80
WTN - 1-S	17-Jul-15	6558	Cryptomonas erosa Ehrenberg	1600	1.15	20.60	10.00	719.10
WTN - 1-S	17-Jul-15	6562	Cryptomonas reflexa (Marsson) Skuja	400	0.27	19.10	10.00	666.70
WTN - 1-S	17-Jul-15	6565	Cryptomonas rostratiformis Skuja	200	0.38	28.00	14.00	1915.70
WTN - 1-S	17-Jul-15	6568	Katablepharis ovalis Skuja	79024	3.62	8.10	4.00	45.80
WTN - 1-S	17-Jul-15	7632	Gymnodinium sp.	400	3.64	25.90	25.90	9097.00
WTN - 1-S	17-Jul-15	7639	Peridinium pusillum (Penard) Lemmermann	600	0.57	12.60	12.00	950.00
WTN - 1-S	17-Jul-15	7641	Peridinium aciculiferum Lemmermann	600	5.61	31.00	24.00	9349.40
WTN - 2-S	17-Jul-15	2105	Chlamydomonas spp.	7184	0.17	5.00	3.00	23.60

Station	Date	Species code	Speceis name	density cells/L	biomass mg/m^3	length µ	width µ	cell volume µ^3
WTN - 2-S	17-Jul-15	2137	Dictyosphaerium simplex Sukja	14368	0.09	2.30	2.30	6.40
WTN - 2-S	17-Jul-15	2178	Cosmarium sp.	200	0.28	20.00	20.00	1396.30
WTN - 2-S	17-Jul-15	2215	Tetraedron caudatum (Corda) Hansgrig	7184	0.03	3.00	3.00	4.70
WTN - 2-S	17-Jul-15	2235	Ankistrodesmus spiralis Lemmermann	7184	0.45	33.00	2.20	62.70
WTN - 2-S	17-Jul-15	4351	Small chrysophyceae	948288	12.14	2.90	2.90	12.80
WTN - 2-S	17-Jul-15	4352	Large chrysophyceae	21552	2.82	6.30	6.30	130.90
WTN - 2-S	17-Jul-15	4357	Chrysococcus sp.	1910944	97.46	4.60	4.60	51.00
WTN - 2-S	17-Jul-15	4362	Kephyrion sp.	438224	6.18	3.00	3.00	14.10
WTN - 2-S	17-Jul-15	4363	Spinifiromonas sirratus**********	21552	2.56	6.10	6.10	118.80
WTN - 2-S	17-Jul-15	4378	Dinobryon borgei Lemmermann	14368	0.74	9.00	3.30	51.30
WTN - 2-S	17-Jul-15	4388	Dinobryon sertularia Ehrenberg	79024	20.85	14.00	6.00	263.90
WTN - 2-S	17-Jul-15	4388	Dinobryon sertularia Ehrenberg	11800	27.44	0.00	0.00	2325.00
WTN - 2-S	17-Jul-15	4390	Dinobryon sociale Ehrenberg	7184	1.63	12.00	6.00	226.20
WTN - 2-S	17-Jul-15	4390	Dinobryon sociale Ehrenberg	1400	2.79	0.00	0.00	1991.00
WTN - 2-S	17-Jul-15	4396	Chrysolkos skuja (Nauwerck) Willen	215520	6.08	5.60	3.10	28.20
WTN - 2-S	17-Jul-15	4401	Uroglena volvox Ehrenberg	193968	21.94	6.00	6.00	113.10
WTN - 2-S	17-Jul-15	4413	Chrysochromulina laurentiana Kling	71840	28.35	9.10	9.10	394.60
WTN - 2-S	17-Jul-15	4414	Stichogloea spp.	21552	1.08	6.00	4.00	50.30
WTN - 2-S	17-Jul-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	7184	0.18	5.20	3.00	24.50
WTN - 2-S	17-Jul-15	4436	Dinobryon attenatum Hill	7184	1.35	10.00	6.00	188.50
WTN - 2-S	17-Jul-15	5509	Cyclotella ocellata Pant.	7184	0.81	4.15	8.30	112.30
WTN - 2-S	17-Jul-15	5514	Tabellaria flocculsa (Roth) Kutzing	1200	1.57	25.50	14.00	1308.50
WTN - 2-S	17-Jul-15	5518	Synedra acus Kutzing	2000	0.17	81.00	2.00	84.80
WTN - 2-S	17-Jul-15	5551	Cyclotella michiganiana Skvortzow	57472	1.10	2.30	4.60	19.10
WTN - 2-S	17-Jul-15	6558	Cryptomonas erosa Ehrenberg	14368	1.30	10.00	5.10	90.80
WTN - 2-S	17-Jul-15	6558	Cryptomonas erosa Ehrenberg	3400	2.49	21.00	10.00	733.00
WTN - 2-S	17-Jul-15	6562	Cryptomonas reflexa (Marsson) Skuja	400	0.27	19.60	10.00	684.20
WTN - 2-S	17-Jul-15	6565	Cryptomonas rostratiformis Skuja	200	0.38	28.00	14.00	1915.70
WTN - 2-S	17-Jul-15	6568	Katablepharis ovalis Skuja	50288	2.30	8.10	4.00	45.80
WTN - 2-S	17-Jul-15	7632	Gymnodinium sp.	7184	2.65	11.00	8.00	368.60
WTN - 2-S	17-Jul-15	7632	Gymnodinium sp.	1800	16.57	26.00	26.00	9202.80
WTN - 2-S	17-Jul-15	7639	Peridinium pusillum (Penard) Lemmermann	800	0.80	13.30	12.00	1002.80
WTN - 2-S	17-Jul-15	7641	Peridinium aciculiferum Lemmermann	600	5.46	30.20	24.00	9108.10
WTN - 3-S	20-Aug-15	1054	Planktolyngbya limnetica	800	0.10	116.00	1.20	131.20
WTN - 3-S	20-Aug-15	2121	Oocystis lacustris Chodat	43104	2.17	6.00	4.00	50.30
WTN - 3-S	20-Aug-15	2137	Dictyosphaerium simplex Sukja	64656	0.27	2.00	2.00	4.20
WTN - 3-S	20-Aug-15	2167	Elakatothrix gelatinosa Willen	43104	0.88	13.00	2.00	20.40
WTN - 3-S	20-Aug-15	2182	Euastrum spp.	200	0.37	22.00	22.00	1858.40
WTN - 3-S	20-Aug-15	2235	Ankistrodesmus spiralis Lemmermann	14368	0.85	34.00	2.10	58.90
WTN - 3-S	20-Aug-15	4351	Small chrysophyceae	323280	5.56	3.20	3.20	17.20
WTN - 3-S	20-Aug-15	4352	Large chrysophyceae	35920	6.45	7.00	7.00	179.60
WTN - 3-S	20-Aug-15	4357	Chrysococcus sp.	387936	25.37	5.00	5.00	65.40
WTN - 3-S	20-Aug-15	4361	Kephyrion boreale Skuja	21552	2.56	6.10	6.10	118.80
WTN - 3-S	20-Aug-15	4362	Kephyrion sp.	158048	2.97	3.30	3.30	18.80
WTN - 3-S	20-Aug-15	4363	Spinifiromonas sirratus**********	7184	1.08	6.60	6.60	150.50
WTN - 3-S	20-Aug-15	4378	Dinobryon borgei Lemmermann	100576	6.22	9.10	3.60	61.80
WTN - 3-S	20-Aug-15	4381	Dinobryon mucronutom Nygaard	35920	4.70	10.00	5.00	130.90
WTN - 3-S	20-Aug-15	4383	Dinobryon bavaricum Imhof	50288	11.38	12.00	6.00	226.20
WTN - 3-S	20-Aug-15	4383	Dinobryon bavaricum Imhof	1000	1.99	0.00	0.00	1990.00
WTN - 3-S	20-Aug-15	4388	Dinobryon sertularia Ehrenberg	14368	3.41	12.60	6.00	237.50
WTN - 3-S	20-Aug-15	4388	Dinobryon sertularia Ehrenberg	200	0.53	0.00	0.00	2650.00
WTN - 3-S	20-Aug-15	4390	Dinobryon sociale Ehrenberg	28736	6.50	12.00	6.00	226.20
WTN - 3-S	20-Aug-15	4396	Chrysolkos skuja (Nauwerck) Willen	43104	1.06	5.20	3.00	24.50
WTN - 3-S	20-Aug-15	4401	Uroglena volvox Ehrenberg	186784	21.13	6.00	6.00	113.10
WTN - 3-S	20-Aug-15	4411	Bitrichia chodatii (Reverdin) Chodat	7184	0.36	6.00	4.00	50.30
WTN - 3-S	20-Aug-15	4413	Chrysochromulina laurentiana Kling	86208	35.15	9.20	9.20	407.70
WTN - 3-S	20-Aug-15	4414	Stichogloea spp.	21552	1.08	6.00	4.00	50.30
WTN - 3-S	20-Aug-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	50288	1.40	5.20	3.20	27.90
WTN - 3-S	20-Aug-15	4437	Pteridomonas sp.	7184	1.33	8.10	8.10	185.50
WTN - 3-S	20-Aug-15	5507	Cyclotella stelligera Cleve and Grunow	400	0.63	10.00	20.00	1570.80
WTN - 3-S	20-Aug-15	5509	Cyclotella ocellata Pant.	28736	3.11	4.10	8.20	108.30
WTN - 3-S	20-Aug-15	5511	Rhizosolenia eriense H.L. Smith	21552	1.68	11.00	3.00	77.80
WTN - 3-S	20-Aug-15	5518	Synedra acus Kutzing	1800	0.14	76.00	2.00	79.60
WTN - 3-S	20-Aug-15	5551	Cyclotella michiganiana Skvortzow	79024	1.71	2.40	4.80	21.70
WTN - 3-S	20-Aug-15	6554	Rhodomonas minuta Skuja	93392	4.33	8.30	4.00	46.40
WTN - 3-S	20-Aug-15	6568	Katablepharis ovalis Skuja	71840	3.46	8.30	4.00	48.10
WTN - 3-S	20-Aug-15	7632	Gymnodinium sp.	21552	7.22	10.00	8.00	335.10
WTN - 3-S	20-Aug-15	7632	Gymnodinium sp.	1800	16.37	25.90	25.90	9097.00
WTN - 3-S	20-Aug-15	7639	Peridinium pusillum (Penard) Lemmermann	200	0.25	14.20	13.00	1256.50
WTN - 3-SR	20-Aug-15	1054	Planktolyngbya limnetica	1400	0.18	116.00	1.20	131.20
WTN - 3-SR	20-Aug-15	2105	Chlamydomonas spp.	14368	0.35	5.60	2.90	24.70
WTN - 3-SR	20-Aug-15	2121	Oocystis lacustris Chodat	71840	3.61	6.00	4.00	50.30
WTN - 3-SR	20-Aug-15	2137	Dictyosphaerium simplex Sukja	114944	0.48	2.00	2.00	4.20
WTN - 3-SR	20-Aug-15	2178	Cosmarium sp.	200	0.28	20.00	20.00	1396.30
WTN - 3-SR	20-Aug-15	2235	Ankistrodesmus spiralis Lemmermann	7184	0.42	34.00	2.10	58.90
WTN - 3-SR	20-Aug-15	4351	Small chrysophyceae	258624	4.45	3.20	3.20	17.20
WTN - 3-SR	20-Aug-15	4352	Large chrysophyceae	14368	2.58	7.00	7.00	179.60
WTN - 3-SR	20-Aug-15	4357	Chrysococcus sp.	423856	27.72	5.00	5.00	65.40
WTN - 3-SR	20-Aug-15	4361	Kephyrion boreale Skuja	14368	1.71	6.10	6.10	118.80
WTN - 3-SR	20-Aug-15	4362	Kephyrion sp.	122128	2.30	3.30	3.30	18.80

Station	Date	Species code	Speceis name	density cells/L	biomass mg/m^3	length µ	width µ	cell volume $µ^3$
WTN - 3-SR	20-Aug-15	4378	Dinobryon borgei Lemmermann	71840	4.44	9.10	3.60	61.80
WTN - 3-SR	20-Aug-15	4381	Dinobryon mucronutom Nygaard	35920	4.70	10.00	5.00	130.90
WTN - 3-SR	20-Aug-15	4383	Dinobryon bavaricum Imhof	71840	16.25	12.00	6.00	226.20
WTN - 3-SR	20-Aug-15	4383	Dinobryon bavaricum Imhof	1400	2.79	0.00	0.00	1990.00
WTN - 3-SR	20-Aug-15	4388	Dinobryon sertularia Ehrenberg	14368	3.41	12.60	6.00	237.50
WTN - 3-SR	20-Aug-15	4388	Dinobryon sertularia Ehrenberg	200	0.53	0.00	0.00	2650.00
WTN - 3-SR	20-Aug-15	4390	Dinobryon sociale Ehrenberg	14368	3.25	12.00	6.00	226.20
WTN - 3-SR	20-Aug-15	4396	Chrysolkos skuja (Nauwerck) Willen	28736	0.70	5.20	3.00	24.50
WTN - 3-SR	20-Aug-15	4401	Uroglena volvox Ehrenberg	251440	28.44	6.00	6.00	113.10
WTN - 3-SR	20-Aug-15	4411	Bitrichia chodatii (Reverdin) Chodat	21552	1.08	6.00	4.00	50.30
WTN - 3-SR	20-Aug-15	4413	Chrysochromulina laurentiana Kling	107760	43.93	9.20	9.20	407.70
WTN - 3-SR	20-Aug-15	4414	Stichogloea spp.	28736	1.45	6.00	4.00	50.30
WTN - 3-SR	20-Aug-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	57472	1.62	5.60	3.10	28.20
WTN - 3-SR	20-Aug-15	4437	Pteridomonas sp.	7184	1.33	8.10	8.10	185.50
WTN - 3-SR	20-Aug-15	5507	Cyclotella stelligera Cleve and Grunow	200	0.31	10.00	20.00	1570.80
WTN - 3-SR	20-Aug-15	5509	Cyclotella ocellata Pant.	35920	3.89	4.10	8.20	108.30
WTN - 3-SR	20-Aug-15	5511	Rhizosolenia eriense H.L. Smith	7184	0.56	11.00	3.00	77.80
WTN - 3-SR	20-Aug-15	5518	Synedra acus Kutzing	2400	0.19	76.00	2.00	79.60
WTN - 3-SR	20-Aug-15	5551	Cyclotella michiganiana Skvortzow	43104	0.94	2.40	4.80	21.70
WTN - 3-SR	20-Aug-15	6554	Rhodomonas minuta Skuja	122128	5.67	8.30	4.00	46.40
WTN - 3-SR	20-Aug-15	6568	Katablepharis ovalis Skuja	57472	2.76	8.30	4.00	48.10
WTN - 3-SR	20-Aug-15	7632	Gymnodinium sp.	35920	12.04	10.00	8.00	335.10
WTN - 3-SR	20-Aug-15	7632	Gymnodinium sp.	1400	12.74	25.90	25.90	9097.00
WTN - 3-SR	20-Aug-15	7639	Peridinium pusillum (Penard) Lemmermann	600	0.75	14.20	13.00	1256.50
WTN - 4-S	20-Aug-15	1054	Planktolyngbya limnetica	400	0.05	100.00	1.20	113.10
WTN - 4-S	20-Aug-15	2112	Sphaerocystis schroeteri Chodat	64656	1.86	3.80	3.80	28.70
WTN - 4-S	20-Aug-15	2121	Oocystis lacustris Chodat	14368	0.72	6.00	4.00	50.30
WTN - 4-S	20-Aug-15	2137	Dictyosphaerium simplex Sukja	14368	0.06	2.00	2.00	4.20
WTN - 4-S	20-Aug-15	2167	Elakatothrix gelatinosa Willen	43104	0.83	12.30	2.00	19.30
WTN - 4-S	20-Aug-15	2206	Botryococcus braunii Kutzing	200	0.14	11.00	11.00	696.90
WTN - 4-S	20-Aug-15	2215	Tetraedron caudatum (Corda) Hansgrig	21552	0.10	3.00	3.00	4.70
WTN - 4-S	20-Aug-15	4351	Small chrysophyceae	251440	4.32	3.20	3.20	17.20
WTN - 4-S	20-Aug-15	4352	Large chrysophyceae	50288	9.03	7.00	7.00	179.60
WTN - 4-S	20-Aug-15	4357	Chrysococcus sp.	359200	23.49	5.00	5.00	65.40
WTN - 4-S	20-Aug-15	4358	Chrysostephanospaera globulifera Scherffel	7184	1.65	7.60	7.60	229.80
WTN - 4-S	20-Aug-15	4361	Kephyrion boreale Skuja	14368	1.71	6.10	6.10	118.80
WTN - 4-S	20-Aug-15	4362	Kephyrion sp.	143680	2.96	3.40	3.40	20.60
WTN - 4-S	20-Aug-15	4367	Mallomonas duerrschmidtiae Siver, Hamer and Kling	200	0.13	19.00	8.00	636.70
WTN - 4-S	20-Aug-15	4378	Dinobryon borgei Lemmermann	21552	1.33	9.10	3.60	61.80
WTN - 4-S	20-Aug-15	4381	Dinobryon mucronutom Nygaard	7184	0.94	10.00	5.00	130.90
WTN - 4-S	20-Aug-15	4383	Dinobryon bavaricum Imhof	28736	6.50	12.00	6.00	226.20
WTN - 4-S	20-Aug-15	4383	Dinobryon bavaricum Imhof	1000	1.99	0.00	0.00	1990.00
WTN - 4-S	20-Aug-15	4388	Dinobryon sertularia Ehrenberg	7184	1.76	13.00	6.00	245.00
WTN - 4-S	20-Aug-15	4390	Dinobryon sociale Ehrenberg	28736	6.50	12.00	6.00	226.20
WTN - 4-S	20-Aug-15	4396	Chrysolkos skuja (Nauwerck) Willen	7184	0.18	5.20	3.00	24.50
WTN - 4-S	20-Aug-15	4401	Uroglena volvox Ehrenberg	165232	18.69	6.00	6.00	113.10
WTN - 4-S	20-Aug-15	4401	Uroglena volvox Ehrenberg	200	2.26	0.00	0.00	11300.00
WTN - 4-S	20-Aug-15	4411	Bitrichia chodatii (Reverdin) Chodat	21552	1.08	6.00	4.00	50.30
WTN - 4-S	20-Aug-15	4413	Chrysochromulina laurentiana Kling	43104	17.57	9.20	9.20	407.70
WTN - 4-S	20-Aug-15	4414	Stichogloea spp.	35920	1.81	6.00	4.00	50.30
WTN - 4-S	20-Aug-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	7184	0.20	5.60	3.10	28.20
WTN - 4-S	20-Aug-15	5507	Cyclotella stelligera Cleve and Grunow	200	0.31	10.00	20.00	1570.80
WTN - 4-S	20-Aug-15	5509	Cyclotella ocellata Pant.	57472	6.69	4.20	8.40	116.40
WTN - 4-S	20-Aug-15	5511	Rhizosolenia eriense H.L. Smith	7184	0.46	9.00	3.00	63.60
WTN - 4-S	20-Aug-15	5514	Tabellaria flocculsa (Roth) Kutzing	1400	1.75	24.30	14.00	1246.90
WTN - 4-S	20-Aug-15	5518	Synedra acus Kutzing	1200	0.10	80.00	2.00	83.80
WTN - 4-S	20-Aug-15	5551	Cyclotella michiganiana Skvortzow	79024	1.71	2.40	4.80	21.70
WTN - 4-S	20-Aug-15	6554	Rhodomonas minuta Skuja	86208	4.00	8.30	4.00	46.40
WTN - 4-S	20-Aug-15	6568	Katablepharis ovalis Skuja	14368	0.69	8.30	4.00	48.10
WTN - 4-S	20-Aug-15	7632	Gymnodinium sp.	43104	14.44	10.00	8.00	335.10
WTN - 4-S	20-Aug-15	7632	Gymnodinium sp.	1200	15.48	29.10	29.10	12902.60
WTN - 4-S	20-Aug-15	7639	Peridinium pusillum (Penard) Lemmermann	400	0.50	14.20	13.00	1256.50
WTN - 5-S	18-Sep-15	1054	Planktolyngbya limnetica	200	0.02	109.00	1.20	123.30
WTN - 5-S	18-Sep-15	1073	Snowella sp	400	0.22	0.00	0.00	550.00
WTN - 5-S	18-Sep-15	2105	Chlamydomonas spp.	21552	0.48	4.70	3.00	22.10
WTN - 5-S	18-Sep-15	2112	Sphaerocystis schroeteri Chodat	43104	0.55	2.90	2.90	12.80
WTN - 5-S	18-Sep-15	2121	Oocystis lacustris Chodat	43104	2.17	6.00	4.00	50.30
WTN - 5-S	18-Sep-15	2157	Kichnerella lunaris (Kirchn.) Moeb.	28736	0.32	5.90	2.20	11.20
WTN - 5-S	18-Sep-15	2167	Elakatothrix gelatinosa Willen	50288	0.87	11.00	2.00	17.30
WTN - 5-S	18-Sep-15	2186	Xanthidium sp.	7184	1.25	10.00	10.00	174.50
WTN - 5-S	18-Sep-15	2206	Botryococcus braunii Kutzing	400	0.21	10.00	10.00	523.60
WTN - 5-S	18-Sep-15	2215	Tetraedron caudatum (Corda) Hansgrig	43104	0.20	3.00	3.00	4.70
WTN - 5-S	18-Sep-15	4351	Small chrysophyceae	538800	10.13	3.30	3.30	18.80
WTN - 5-S	18-Sep-15	4352	Large chrysophyceae	35920	13.71	9.00	9.00	381.70
WTN - 5-S	18-Sep-15	4357	Chrysococcus sp.	517248	33.83	5.00	5.00	65.40
WTN - 5-S	18-Sep-15	4358	Chrysostephanospaera globulifera Scherffel	7184	2.15	8.30	8.30	299.40
WTN - 5-S	18-Sep-15	4361	Kephyrion boreale Skuja	43104	5.12	6.10	6.10	118.80
WTN - 5-S	18-Sep-15	4362	Kephyrion sp.	201152	4.51	3.50	3.50	22.40
WTN - 5-S	18-Sep-15	4378	Dinobryon borgei Lemmermann	28736	1.39	9.00	3.20	48.30
WTN - 5-S	18-Sep-15	4381	Dinobryon mucronutom Nygaard	21552	2.82	10.00	5.00	130.90

Station	Date	Species code	Speceis name	density cells/L	biomass mg/m^3	length µ	width µ	cell volume $µ^3$
WTN - 5-S	18-Sep-15	4383	Dinobryon bavaricum Imhof	7184	1.63	12.00	6.00	226.20
WTN - 5-S	18-Sep-15	4383	Dinobryon bavaricum Imhof	200	0.40	0.00	0.00	1990.00
WTN - 5-S	18-Sep-15	4390	Dinobryon sociale Ehrenberg	165232	35.51	11.40	6.00	214.90
WTN - 5-S	18-Sep-15	4390	Dinobryon sociale Ehrenberg	7200	9.11	0.00	0.00	1265.00
WTN - 5-S	18-Sep-15	4396	Chrysolkos skuja (Nauwerck) Willen	57472	1.62	5.60	3.10	28.20
WTN - 5-S	18-Sep-15	4401	Uroglena volvox Ehrenberg	201152	22.75	6.00	6.00	113.10
WTN - 5-S	18-Sep-15	4413	Chrysochromulina laurentiana Kling	79024	34.37	9.40	9.40	434.90
WTN - 5-S	18-Sep-15	4414	Stichogloea spp.	21552	1.08	6.00	4.00	50.30
WTN - 5-S	18-Sep-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	35920	0.95	5.60	3.00	26.40
WTN - 5-S	18-Sep-15	4437	Pteridomonas sp.	43104	10.25	8.80	8.80	237.90
WTN - 5-S	18-Sep-15	5507	Cyclotella stelligera Cleve and Grunow	400	0.46	9.00	18.00	1145.10
WTN - 5-S	18-Sep-15	5509	Cyclotella ocellata Pant.	28736	3.59	4.30	8.60	124.90
WTN - 5-S	18-Sep-15	5511	Rhizosolenia eriense H.L. Smith	208336	16.21	11.00	3.00	77.80
WTN - 5-S	18-Sep-15	5518	Synedra acus Kutzing	9600	0.76	76.00	2.00	79.60
WTN - 5-S	18-Sep-15	5523	Synedra ulna (Nitzsch) Ehrenberg	200	1.35	257.00	10.00	6728.20
WTN - 5-S	18-Sep-15	5551	Cyclotella michiganiana Skvortzow	114944	2.82	2.50	5.00	24.50
WTN - 5-S	18-Sep-15	6554	Rhodomonas minuta Skuja	21552	1.21	9.10	4.20	56.00
WTN - 5-S	18-Sep-15	6558	Cryptomonas erosa Ehrenberg	1800	1.39	22.10	10.00	771.40
WTN - 5-S	18-Sep-15	6568	Katablepharis ovalis Skuja	28736	1.74	9.30	4.00	60.40
WTN - 5-S	18-Sep-15	7632	Gymnodinium sp.	21552	7.40	10.00	8.10	343.50
WTN - 5-S	18-Sep-15	7632	Gymnodinium sp.	800	7.36	26.00	26.00	9202.80
WTN - 5-S	18-Sep-15	7639	Peridinium pusillum (Penard) Lemmermann	400	0.49	13.90	13.00	1230.00
WTN - 6-S	18-Sep-15	1054	Planktolyngbya limnetica	1800	0.28	136.00	1.20	153.80
WTN - 6-S	18-Sep-15	2112	Sphaerocystis schroeteri Chodat	21552	0.28	2.90	2.90	12.80
WTN - 6-S	18-Sep-15	2121	Oocystis lacustris Chodat	14368	0.72	6.00	4.00	50.30
WTN - 6-S	18-Sep-15	2137	Dictyosphaerium simplex Sukja	28736	0.12	2.00	2.00	4.20
WTN - 6-S	18-Sep-15	2145	Crucigenia quadrata Morr.	28736	0.04	2.00	2.00	1.40
WTN - 6-S	18-Sep-15	2167	Elakatothrix gelatinosa Willen	14368	0.25	11.00	2.00	17.30
WTN - 6-S	18-Sep-15	2215	Tetraedron caudatum (Corda) Hansgrig	21552	0.10	3.00	3.00	4.70
WTN - 6-S	18-Sep-15	2235	Ankistrodesmus spiralis Lemmermann	14368	0.38	30.00	1.50	26.50
WTN - 6-S	18-Sep-15	4351	Small chrysophyceae	452592	8.51	3.30	3.30	18.80
WTN - 6-S	18-Sep-15	4352	Large chrysophyceae	43104	16.45	9.00	9.00	381.70
WTN - 6-S	18-Sep-15	4357	Chrysococcus sp.	553168	36.18	5.00	5.00	65.40
WTN - 6-S	18-Sep-15	4358	Chrysostephanospaera globulifera Scherffel	14368	4.62	8.50	8.50	321.60
WTN - 6-S	18-Sep-15	4361	Kephyrion boreale Skuja	100576	11.95	6.10	6.10	118.80
WTN - 6-S	18-Sep-15	4362	Kephyrion sp.	208336	4.67	3.50	3.50	22.40
WTN - 6-S	18-Sep-15	4363	Spinifiromonas sirratus**********	28736	3.41	6.10	6.10	118.80
WTN - 6-S	18-Sep-15	4378	Dinobryon borgei Lemmermann	43104	2.08	9.00	3.20	48.30
WTN - 6-S	18-Sep-15	4381	Dinobryon mucronutom Nygaard	21552	2.82	10.00	5.00	130.90
WTN - 6-S	18-Sep-15	4383	Dinobryon bavaricum Imhof	600	1.19	0.00	0.00	1990.00
WTN - 6-S	18-Sep-15	4390	Dinobryon sociale Ehrenberg	193968	41.68	11.40	6.00	214.90
WTN - 6-S	18-Sep-15	4390	Dinobryon sociale Ehrenberg	3200	4.05	0.00	0.00	1265.00
WTN - 6-S	18-Sep-15	4396	Chrysolkos skuja (Nauwerck) Willen	79024	2.23	5.60	3.10	28.20
WTN - 6-S	18-Sep-15	4401	Uroglena volvox Ehrenberg	150864	17.06	6.00	6.00	113.10
WTN - 6-S	18-Sep-15	4411	Bitrichia chodatii (Reverdin) Chodat	21552	1.08	6.00	4.00	50.30
WTN - 6-S	18-Sep-15	4413	Chrysochromulina laurentiana Kling	57472	24.99	9.40	9.40	434.90
WTN - 6-S	18-Sep-15	4414	Stichogloea spp.	100576	5.06	6.00	4.00	50.30
WTN - 6-S	18-Sep-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	21552	0.57	5.60	3.00	26.40
WTN - 6-S	18-Sep-15	5507	Cyclotella stelligera Cleve and Grunow	200	0.23	9.00	18.00	1145.10
WTN - 6-S	18-Sep-15	5509	Cyclotella ocellata Pant.	35920	4.49	4.30	8.60	124.90
WTN - 6-S	18-Sep-15	5511	Rhizosolenia eriense H.L. Smith	86208	6.71	11.00	3.00	77.80
WTN - 6-S	18-Sep-15	5514	Tabellaria flocculsa (Roth) Kutzing	200	0.27	26.00	14.00	1334.10
WTN - 6-S	18-Sep-15	5518	Synedra acus Kutzing	12600	0.98	74.00	2.00	77.50
WTN - 6-S	18-Sep-15	5551	Cyclotella michiganiana Skvortzow	93392	2.29	2.50	5.00	24.50
WTN - 6-S	18-Sep-15	6554	Rhodomonas minuta Skuja	35920	2.01	9.10	4.20	56.00
WTN - 6-S	18-Sep-15	6558	Cryptomonas erosa Ehrenberg	800	0.62	22.10	10.00	771.40
WTN - 6-S	18-Sep-15	6568	Katablepharis ovalis Skuja	28736	1.74	9.30	4.00	60.40
WTN - 6-S	18-Sep-15	7631	Gymnodinium helveticum Penard	200	4.71	50.00	30.00	23561.90
WTN - 6-S	18-Sep-15	7632	Gymnodinium sp.	1000	8.78	25.60	25.60	8784.50
WTN - 6-S	18-Sep-15	7639	Peridinium pusillum (Penard) Lemmermann	800	0.98	13.90	13.00	1230.00
WTN - 6-S	18-Sep-15	7641	Peridinium aciculiferum Lemmermann	200	1.81	30.00	24.00	9047.80
WTS - 1-S	17-Jul-15	2105	Chlamydomonas spp.	50288	1.19	5.00	3.00	23.60
WTS - 1-S	17-Jul-15	4351	Small chrysophyceae	725584	9.29	2.90	2.90	12.80
WTS - 1-S	17-Jul-15	4352	Large chrysophyceae	14368	2.36	6.80	6.80	164.60
WTS - 1-S	17-Jul-15	4355	Chrysochromulina parva Lackey	21552	1.41	5.00	5.00	65.40
WTS - 1-S	17-Jul-15	4357	Chrysococcus sp.	2248592	114.68	4.60	4.60	51.00
WTS - 1-S	17-Jul-15	4361	Kephyrion boreale Skuja	7184	0.85	6.10	6.10	118.80
WTS - 1-S	17-Jul-15	4362	Kephyrion sp.	330464	4.66	3.00	3.00	14.10
WTS - 1-S	17-Jul-15	4363	Spinifiromonas sirratus**********	21552	1.98	5.60	5.60	92.00
WTS - 1-S	17-Jul-15	4370	Mallomonas akrokomos Asmund and Kristiansen	7184	1.90	14.00	6.00	263.90
WTS - 1-S	17-Jul-15	4378	Dinobryon borgei Lemmermann	21552	1.11	9.00	3.30	51.30
WTS - 1-S	17-Jul-15	4388	Dinobryon sertularia Ehrenberg	107760	28.44	14.00	6.00	263.90
WTS - 1-S	17-Jul-15	4388	Dinobryon sertularia Ehrenberg	18800	43.71	0.00	0.00	2325.00
WTS - 1-S	17-Jul-15	4390	Dinobryon sociale Ehrenberg	93392	21.13	12.00	6.00	226.20
WTS - 1-S	17-Jul-15	4390	Dinobryon sociale Ehrenberg	1200	2.39	0.00	0.00	1991.00
WTS - 1-S	17-Jul-15	4396	Chrysolkos skuja (Nauwerck) Willen	165232	4.28	5.50	3.00	25.90
WTS - 1-S	17-Jul-15	4401	Uroglena volvox Ehrenberg	64656	7.31	6.00	6.00	113.10
WTS - 1-S	17-Jul-15	4413	Chrysochromulina laurentiana Kling	93392	36.85	9.10	9.10	394.60
WTS - 1-S	17-Jul-15	4414	Stichogloea spp.	14368	0.72	6.00	4.00	50.30
WTS - 1-S	17-Jul-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	28736	0.70	5.20	3.00	24.50

Station	Date	Species code	Speceis name	density cells/L	biomass mg/m^3	length µ	width µ	cell volume $µ^3$
WTS - 1-S	17-Jul-15	5509	Cyclotella ocellata Pant.	14368	1.61	4.15	8.30	112.30
WTS - 1-S	17-Jul-15	5514	Tabellaria flocculsa (Roth) Kutzing	1800	2.36	25.50	14.00	1308.50
WTS - 1-S	17-Jul-15	5518	Synedra acus Kutzing	2400	0.20	80.00	2.00	83.80
WTS - 1-S	17-Jul-15	5551	Cyclotella michiganiana Skvortzow	79024	1.51	2.30	4.60	19.10
WTS - 1-S	17-Jul-15	6554	Rhodomonas minuta Skuja	100576	8.78	10.00	5.00	87.30
WTS - 1-S	17-Jul-15	6558	Cryptomonas erosa Ehrenberg	3800	2.79	21.00	10.00	733.00
WTS - 1-S	17-Jul-15	6565	Cryptomonas rostratiformis Skuja	800	1.53	28.00	14.00	1915.70
WTS - 1-S	17-Jul-15	6568	Katablepharis ovalis Skuja	193968	6.63	7.00	4.00	34.20
WTS - 1-S	17-Jul-15	7632	Gymnodinium sp.	21552	6.93	9.60	8.00	321.70
WTS - 1-S	17-Jul-15	7632	Gymnodinium sp.	800	7.36	26.00	26.00	9202.80
WTS - 1-S	17-Jul-15	7635	Peridinium willei Huitfeldt-Kaas	200	6.21	39.00	39.00	31059.40
WTS - 1-S	17-Jul-15	7639	Peridinium pusillum (Penard) Lemmermann	400	0.39	13.00	12.00	980.20
WTS - 1-S	17-Jul-15	7641	Peridinium aciculiferum Lemmermann	1000	9.08	30.10	24.00	9077.90
WTS - 2-S	17-Jul-15	2105	Chlamydomonas spp.	35920	0.85	5.00	3.00	23.60
WTS - 2-S	17-Jul-15	2137	Dictyosphaerium simplex Sukja	28736	0.12	2.00	2.00	4.20
WTS - 2-S	17-Jul-15	2178	Cosmarium sp.	200	0.28	20.00	20.00	1396.30
WTS - 2-S	17-Jul-15	2215	Tetraedron caudatum (Corda) Hansgrig	7184	0.03	3.00	3.00	4.70
WTS - 2-S	17-Jul-15	4351	Small chrysophyceae	466960	5.98	2.90	2.90	12.80
WTS - 2-S	17-Jul-15	4352	Large chrysophyceae	57472	7.52	6.30	6.30	130.90
WTS - 2-S	17-Jul-15	4355	Chrysochromulina parva Lackey	14368	0.94	5.00	5.00	65.40
WTS - 2-S	17-Jul-15	4357	Chrysococcus sp.	1472720	75.11	4.60	4.60	51.00
WTS - 2-S	17-Jul-15	4361	Kephyrion boreale Skuja	7184	0.85	6.10	6.10	118.80
WTS - 2-S	17-Jul-15	4362	Kephyrion sp.	330464	4.66	3.00	3.00	14.10
WTS - 2-S	17-Jul-15	4363	Spinifiromonas sirratus**********	21552	1.98	5.60	5.60	92.00
WTS - 2-S	17-Jul-15	4370	Mallomonas akrokomos Asmund and Kristiansen	7184	1.90	14.00	6.00	263.90
WTS - 2-S	17-Jul-15	4378	Dinobryon borgei Lemmermann	43104	2.21	9.00	3.30	51.30
WTS - 2-S	17-Jul-15	4388	Dinobryon sertularia Ehrenberg	93392	24.65	14.00	6.00	263.90
WTS - 2-S	17-Jul-15	4388	Dinobryon sertularia Ehrenberg	12600	29.30	0.00	0.00	2325.00
WTS - 2-S	17-Jul-15	4390	Dinobryon sociale Ehrenberg	35920	8.13	12.00	6.00	226.20
WTS - 2-S	17-Jul-15	4390	Dinobryon sociale Ehrenberg	1600	3.19	0.00	0.00	1991.00
WTS - 2-S	17-Jul-15	4396	Chrysolkos skuja (Nauwerck) Willen	143680	3.72	5.50	3.00	25.90
WTS - 2-S	17-Jul-15	4400	Ochromonas sp.	7184	0.58	9.60	4.00	80.40
WTS - 2-S	17-Jul-15	4401	Uroglena volvox Ehrenberg	71840	8.13	6.00	6.00	113.10
WTS - 2-S	17-Jul-15	4413	Chrysochromulina laurentiana Kling	79024	31.18	9.10	9.10	394.60
WTS - 2-S	17-Jul-15	4414	Stichogloea spp.	7184	0.36	6.00	4.00	50.30
WTS - 2-S	17-Jul-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	7184	0.18	5.20	3.00	24.50
WTS - 2-S	17-Jul-15	5507	Cyclotella stelligera Cleve and Grunow	200	0.24	9.10	18.20	1183.70
WTS - 2-S	17-Jul-15	5509	Cyclotella ocellata Pant.	7184	0.81	4.15	8.30	112.30
WTS - 2-S	17-Jul-15	5514	Tabellaria flocculsa (Roth) Kutzing	2600	3.40	25.50	14.00	1308.50
WTS - 2-S	17-Jul-15	5518	Synedra acus Kutzing	1400	0.12	80.00	2.00	83.80
WTS - 2-S	17-Jul-15	5551	Cyclotella michiganiana Skvortzow	43104	0.82	2.30	4.60	19.10
WTS - 2-S	17-Jul-15	6554	Rhodomonas minuta Skuja	64656	5.64	10.00	5.00	87.30
WTS - 2-S	17-Jul-15	6558	Cryptomonas erosa Ehrenberg	3200	2.35	21.00	10.00	733.00
WTS - 2-S	17-Jul-15	6562	Cryptomonas reflexa (Marsson) Skuja	1400	0.96	19.60	10.00	684.20
WTS - 2-S	17-Jul-15	6565	Cryptomonas rostratiformis Skuja	1000	1.92	28.00	14.00	1915.70
WTS - 2-S	17-Jul-15	6568	Katablepharis ovalis Skuja	43104	1.93	8.00	4.00	44.70
WTS - 2-S	17-Jul-15	7632	Gymnodinium sp.	1200	11.04	26.00	26.00	9202.80
WTS - 2-S	17-Jul-15	7635	Peridinium willei Huitfeldt-Kaas	400	11.49	38.00	38.00	28730.90
WTS - 2-S	17-Jul-15	7639	Peridinium pusillum (Penard) Lemmermann	1200	1.18	13.00	12.00	980.20
WTS - 2-S	17-Jul-15	7641	Peridinium aciculiferum Lemmermann	1200	10.93	30.20	24.00	9108.10
WTS - 3-S	21-Aug-15	1014	Chroococcus limneticus Lemmermann	71840	3.37	5.60	4.00	46.90
WTS - 3-S	21-Aug-15	1054	Planktolyngbya limnetica	1000	0.13	116.00	1.20	131.20
WTS - 3-S	21-Aug-15	2100	Pyramidomonas tetrarhynchus Schmarda	200	0.10	13.40	12.20	522.10
WTS - 3-S	21-Aug-15	2105	Chlamydomonas spp.	14368	0.18	5.00	2.20	12.70
WTS - 3-S	21-Aug-15	2112	Sphaerocystis schroeteri Chodat	229888	8.30	4.10	4.10	36.10
WTS - 3-S	21-Aug-15	2121	Oocystis lacustris Chodat	43104	1.06	5.60	2.90	24.70
WTS - 3-S	21-Aug-15	2137	Dictyosphaerium simplex Sukja	28736	0.14	2.10	2.10	4.80
WTS - 3-S	21-Aug-15	2167	Elakatothrix gelatinosa Willen	21552	0.48	14.10	2.00	22.10
WTS - 3-S	21-Aug-15	2182	Euastrum spp.	200	0.37	22.00	22.00	1858.40
WTS - 3-S	21-Aug-15	2187	Staurodesmus extensus (Andersson) Teiling	200	0.09	14.00	12.90	441.30
WTS - 3-S	21-Aug-15	2215	Tetraedron caudatum (Corda) Hansgrig	14368	0.07	3.00	3.00	4.70
WTS - 3-S	21-Aug-15	2235	Ankistrodesmus spiralis Lemmermann	14368	0.27	21.00	1.50	18.60
WTS - 3-S	21-Aug-15	4351	Small chrysophyceae	488512	9.18	3.30	3.30	18.80
WTS - 3-S	21-Aug-15	4352	Large chrysophyceae	21552	3.87	7.00	7.00	179.60
WTS - 3-S	21-Aug-15	4357	Chrysococcus sp.	596272	36.73	4.90	4.90	61.60
WTS - 3-S	21-Aug-15	4358	Chrysostephanospaera globulifera Scherffel	7184	2.15	8.30	8.30	299.40
WTS - 3-S	21-Aug-15	4361	Kephyrion boreale Skuja	14368	1.71	6.10	6.10	118.80
WTS - 3-S	21-Aug-15	4362	Kephyrion sp.	122128	2.30	3.30	3.30	18.80
WTS - 3-S	21-Aug-15	4378	Dinobryon borgei Lemmermann	43104	2.24	9.10	3.30	51.90
WTS - 3-S	21-Aug-15	4381	Dinobryon mucronutom Nygaard	50288	6.58	10.00	5.00	130.90
WTS - 3-S	21-Aug-15	4383	Dinobryon bavaricum Imhof	200	0.15	0.00	0.00	765.00
WTS - 3-S	21-Aug-15	4388	Dinobryon sertularia Ehrenberg	50288	12.42	13.10	6.00	246.90
WTS - 3-S	21-Aug-15	4390	Dinobryon sociale Ehrenberg	35920	8.13	12.00	6.00	226.20
WTS - 3-S	21-Aug-15	4390	Dinobryon sociale Ehrenberg	200	0.25	0.00	0.00	1225.00
WTS - 3-S	21-Aug-15	4394	Epiphyxis sp.	21552	1.81	9.10	4.20	84.10
WTS - 3-S	21-Aug-15	4396	Chrysolkos skuja (Nauwerck) Willen	21552	0.69	6.00	3.20	32.20
WTS - 3-S	21-Aug-15	4401	Uroglena volvox Ehrenberg	86208	9.75	6.00	6.00	113.10
WTS - 3-S	21-Aug-15	4413	Chrysochromulina laurentiana Kling	50288	19.19	9.00	9.00	381.70
WTS - 3-S	21-Aug-15	4414	Stichogloea spp.	64656	3.25	6.00	4.00	50.30
WTS - 3-S	21-Aug-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	21552	0.61	5.30	3.20	28.40

Station	Date	Species code	Speceis name	density cells/L	biomass mg/m^3	length µ	width µ	cell volume $µ^3$
WTS - 3-S	21-Aug-15	4436	Dinobryon attenatum Hill	7184	1.41	10.40	6.00	196.00
WTS - 3-S	21-Aug-15	5507	Cyclotella stelligera Cleve and Grunow	400	0.64	10.05	20.10	1594.50
WTS - 3-S	21-Aug-15	5509	Cyclotella ocellata Pant.	7184	1.59	5.20	10.40	220.90
WTS - 3-S	21-Aug-15	5511	Rhizosolenia eriense H.L. Smith	28736	2.24	11.00	3.00	77.80
WTS - 3-S	21-Aug-15	5514	Tabellaria flocculsa (Roth) Kutzing	800	1.07	26.00	14.00	1334.10
WTS - 3-S	21-Aug-15	5518	Synedra acus Kutzing	3400	0.27	75.00	2.00	78.50
WTS - 3-S	21-Aug-15	5551	Cyclotella michiganiana Skvortzow	136496	2.61	2.30	4.60	19.10
WTS - 3-S	21-Aug-15	6554	Rhodomonas minuta Skuja	21552	1.19	9.00	4.20	55.40
WTS - 3-S	21-Aug-15	6568	Katablepharis ovalis Skuja	28736	1.66	9.10	4.00	57.80
WTS - 3-S	21-Aug-15	7632	Gymnodinium sp.	1800	22.05	28.60	28.60	12248.90
WTS - 3-S	21-Aug-15	7639	Peridinium pusillum (Penard) Lemmermann	1800	2.33	14.60	13.00	1291.90
WTS - 4-S	21-Aug-15	1014	Chroococcus limneticus Lemmermann	57472	2.70	5.60	4.00	46.90
WTS - 4-S	21-Aug-15	2100	Pyramidomonas tetrarhynchus Schmarda	600	0.40	15.20	13.00	672.50
WTS - 4-S	21-Aug-15	2112	Sphaerocystis schroeteri Chodat	143680	2.24	3.10	3.10	15.60
WTS - 4-S	21-Aug-15	2121	Oocystis lacustris Chodat	35920	1.81	6.00	4.00	50.30
WTS - 4-S	21-Aug-15	2137	Dictyosphaerium simplex Sukja	79024	0.33	2.00	2.00	4.20
WTS - 4-S	21-Aug-15	2167	Elakatothrix gelatinosa Willen	43104	0.88	13.00	2.00	20.40
WTS - 4-S	21-Aug-15	2215	Tetraedron caudatum (Corda) Hansgrig	14368	0.07	3.00	3.00	4.70
WTS - 4-S	21-Aug-15	2260	Monomastix minuta Skuja	7184	0.16	6.40	3.20	22.90
WTS - 4-S	21-Aug-15	4351	Small chrysophyceae	280176	4.82	3.20	3.20	17.20
WTS - 4-S	21-Aug-15	4352	Large chrysophyceae	64656	11.61	7.00	7.00	179.60
WTS - 4-S	21-Aug-15	4357	Chrysococcus sp.	409488	26.78	5.00	5.00	65.40
WTS - 4-S	21-Aug-15	4361	Kephyrion boreale Skuja	14368	1.54	5.90	5.90	107.50
WTS - 4-S	21-Aug-15	4362	Kephyrion sp.	93392	1.61	3.20	3.20	17.20
WTS - 4-S	21-Aug-15	4378	Dinobryon borgei Lemmermann	28736	1.30	9.00	3.10	45.30
WTS - 4-S	21-Aug-15	4381	Dinobryon mucronutom Nygaard	7184	0.94	10.00	5.00	130.90
WTS - 4-S	21-Aug-15	4383	Dinobryon bavaricum Imhof	35920	8.13	12.00	6.00	226.20
WTS - 4-S	21-Aug-15	4383	Dinobryon bavaricum Imhof	400	0.80	0.00	0.00	1990.00
WTS - 4-S	21-Aug-15	4390	Dinobryon sociale Ehrenberg	93392	21.13	12.00	6.00	226.20
WTS - 4-S	21-Aug-15	4390	Dinobryon sociale Ehrenberg	400	0.51	0.00	0.00	1265.00
WTS - 4-S	21-Aug-15	4394	Epiphyxis sp.	21552	1.64	9.10	4.00	76.20
WTS - 4-S	21-Aug-15	4396	Chrysolkos skuja (Nauwerck) Willen	14368	0.43	5.60	3.20	30.00
WTS - 4-S	21-Aug-15	4401	Uroglena volvox Ehrenberg	79024	8.94	6.00	6.00	113.10
WTS - 4-S	21-Aug-15	4411	Bitrichia chodatii (Reverdin) Chodat	21552	1.08	6.00	4.00	50.30
WTS - 4-S	21-Aug-15	4413	Chrysochromulina laurentiana Kling	21552	8.23	9.00	9.00	381.70
WTS - 4-S	21-Aug-15	4414	Stichogloea spp.	79024	3.97	6.00	4.00	50.30
WTS - 4-S	21-Aug-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	14368	0.43	5.60	3.20	30.00
WTS - 4-S	21-Aug-15	4436	Dinobryon attenatum Hill	7184	1.41	10.40	6.00	196.00
WTS - 4-S	21-Aug-15	4437	Pteridomonas sp.	28736	6.84	8.80	8.80	237.90
WTS - 4-S	21-Aug-15	5507	Cyclotella stelligera Cleve and Grunow	400	0.53	9.45	18.90	1325.60
WTS - 4-S	21-Aug-15	5509	Cyclotella ocellata Pant.	7184	0.81	4.15	8.30	112.30
WTS - 4-S	21-Aug-15	5511	Rhizosolenia eriense H.L. Smith	7184	0.56	11.00	3.00	77.80
WTS - 4-S	21-Aug-15	5518	Synedra acus Kutzing	3600	0.29	76.00	2.00	79.60
WTS - 4-S	21-Aug-15	5551	Cyclotella michiganiana Skvortzow	114944	2.82	2.50	5.00	24.50
WTS - 4-S	21-Aug-15	6554	Rhodomonas minuta Skuja	14368	0.80	9.10	4.20	56.00
WTS - 4-S	21-Aug-15	6568	Katablepharis ovalis Skuja	21552	1.25	9.00	4.10	58.00
WTS - 4-S	21-Aug-15	7632	Gymnodinium sp.	7184	3.25	10.00	9.30	452.90
WTS - 4-S	21-Aug-15	7632	Gymnodinium sp.	200	1.82	25.90	25.90	9097.00
WTS - 4-S	21-Aug-15	7639	Peridinium pusillum (Penard) Lemmermann	800	1.18	14.60	13.90	1477.00
WTS - 5-S	18-Sep-15	1014	Chroococcus limneticus Lemmermann	28736	0.70	3.60	3.60	24.40
WTS - 5-S	18-Sep-15	1054	Planktolyngbya limnetica	1200	0.19	140.00	1.20	158.30
WTS - 5-S	18-Sep-15	2112	Sphaerocystis schroeteri Chodat	57472	0.90	3.10	3.10	15.60
WTS - 5-S	18-Sep-15	2137	Dictyosphaerium simplex Sukja	14368	0.06	2.00	2.00	4.20
WTS - 5-S	18-Sep-15	2167	Elakatothrix gelatinosa Willen	28736	0.51	11.40	2.00	17.90
WTS - 5-S	18-Sep-15	2215	Tetraedron caudatum (Corda) Hansgrig	21552	0.10	3.00	3.00	4.70
WTS - 5-S	18-Sep-15	4351	Small chrysophyceae	387936	6.05	3.10	3.10	15.60
WTS - 5-S	18-Sep-15	4352	Large chrysophyceae	28736	5.16	7.00	7.00	179.60
WTS - 5-S	18-Sep-15	4357	Chrysococcus sp.	732768	47.92	5.00	5.00	65.40
WTS - 5-S	18-Sep-15	4361	Kephyrion boreale Skuja	143680	2.70	3.30	3.30	18.80
WTS - 5-S	18-Sep-15	4361	Kephyrion boreale Skuja	79024	9.39	6.10	6.10	118.80
WTS - 5-S	18-Sep-15	4363	Spinifiromonas sirratus**********	7184	0.94	6.30	6.30	130.90
WTS - 5-S	18-Sep-15	4378	Dinobryon borgei Lemmermann	14368	0.65	9.00	3.10	45.30
WTS - 5-S	18-Sep-15	4381	Dinobryon mucronutom Nygaard	14368	1.88	10.00	5.00	130.90
WTS - 5-S	18-Sep-15	4388	Dinobryon sertularia Ehrenberg	5600	7.08	0.00	0.00	1265.00
WTS - 5-S	18-Sep-15	4390	Dinobryon sociale Ehrenberg	158048	35.75	12.00	6.00	226.20
WTS - 5-S	18-Sep-15	4396	Chrysolkos skuja (Nauwerck) Willen	86208	2.59	5.60	3.20	30.00
WTS - 5-S	18-Sep-15	4401	Uroglena volvox Ehrenberg	50288	5.69	6.00	6.00	113.10
WTS - 5-S	18-Sep-15	4411	Bitrichia chodatii (Reverdin) Chodat	7184	0.36	6.00	4.00	50.30
WTS - 5-S	18-Sep-15	4413	Chrysochromulina laurentiana Kling	71840	28.35	9.10	9.10	394.60
WTS - 5-S	18-Sep-15	4414	Stichogloea spp.	14368	0.72	6.00	4.00	50.30
WTS - 5-S	18-Sep-15	4415	Bicoeca lacustris Clark	14368	1.32	5.60	5.60	92.00
WTS - 5-S	18-Sep-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	35920	1.14	5.90	3.20	31.60
WTS - 5-S	18-Sep-15	5507	Cyclotella stelligera Cleve and Grunow	400	0.59	9.80	19.60	1478.40
WTS - 5-S	18-Sep-15	5509	Cyclotella ocellata Pant.	14368	1.61	4.15	8.30	112.30
WTS - 5-S	18-Sep-15	5511	Rhizosolenia eriense H.L. Smith	172416	13.41	11.00	3.00	77.80
WTS - 5-S	18-Sep-15	5514	Tabellaria flocculsa (Roth) Kutzing	1000	1.21	23.60	14.00	1211.00
WTS - 5-S	18-Sep-15	5518	Synedra acus Kutzing	10200	0.76	71.00	2.00	74.40
WTS - 5-S	18-Sep-15	5551	Cyclotella michiganiana Skvortzow	100576	2.46	2.50	5.00	24.50
WTS - 5-S	18-Sep-15	6554	Rhodomonas minuta Skuja	35920	1.90	9.00	4.10	52.80
WTS - 5-S	18-Sep-15	6558	Cryptomonas erosa Ehrenberg	800	0.56	20.00	10.00	698.10

Station	Date	Species code	Speceis name	density cells/L	biomass mg/m^3	length µ	width µ	cell volume $µ^3$
WTS - 5-S	18-Sep-15	6568	Katablepharis ovalis Skuja	35920	2.08	9.00	4.10	58.00
WTS - 5-S	18-Sep-15	7632	Gymnodinium sp.	14368	4.81	10.00	8.00	335.10
WTS - 5-S	18-Sep-15	7632	Gymnodinium sp.	400	3.68	26.00	26.00	9202.80
WTS - 5-S	18-Sep-15	7639	Peridinium pusillum (Penard) Lemmermann	1000	1.57	15.30	14.00	1570.20
WTS - 6-S	18-Sep-15	1054	Planktolyngbya limnetica	600	0.08	115.00	1.20	130.10
WTS - 6-S	18-Sep-15	2100	Pyramidomonas tetrarhynchus Schmarda	7184	6.89	14.30	16.00	958.40
WTS - 6-S	18-Sep-15	2112	Sphaerocystis schroeteri Chodat	7184	0.11	3.10	3.10	15.60
WTS - 6-S	18-Sep-15	2121	Oocystis lacustris Chodat	43104	1.22	6.00	3.00	28.30
WTS - 6-S	18-Sep-15	2167	Elakatothrix gelatinosa Willen	43104	0.77	11.40	2.00	17.90
WTS - 6-S	18-Sep-15	2167	Elakatothrix gelatinosa Willen	7184	0.43	9.00	4.10	59.40
WTS - 6-S	18-Sep-15	2182	Euastrum spp.	600	1.12	22.00	22.00	1858.40
WTS - 6-S	18-Sep-15	2199	Spondylosium planum (Wolle) W. and G.S. West	14368	0.54	6.00	6.00	37.70
WTS - 6-S	18-Sep-15	2206	Botryococcus braunii Kutzing	600	0.31	10.00	10.00	523.60
WTS - 6-S	18-Sep-15	2215	Tetraedron caudatum (Corda) Hansgrig	28736	0.14	3.00	3.00	4.70
WTS - 6-S	18-Sep-15	2235	Ankistrodesmus spiralis Lemmermann	21552	2.06	36.00	2.60	95.60
WTS - 6-S	18-Sep-15	4351	Small chrysophyceae	646560	10.09	3.10	3.10	15.60
WTS - 6-S	18-Sep-15	4352	Large chrysophyceae	43104	7.74	7.00	7.00	179.60
WTS - 6-S	18-Sep-15	4357	Chrysococcus sp.	1084784	70.94	5.00	5.00	65.40
WTS - 6-S	18-Sep-15	4358	Chrysostephanospaera globulifera Scherffel	7184	2.39	8.60	8.60	333.00
WTS - 6-S	18-Sep-15	4361	Kephyrion boreale Skuja	50288	5.97	6.10	6.10	118.80
WTS - 6-S	18-Sep-15	4362	Kephyrion sp.	158048	2.97	3.30	3.30	18.80
WTS - 6-S	18-Sep-15	4378	Dinobryon borgei Lemmermann	50288	2.28	9.00	3.10	45.30
WTS - 6-S	18-Sep-15	4381	Dinobryon mucronutom Nygaard	35920	4.70	10.00	5.00	130.90
WTS - 6-S	18-Sep-15	4383	Dinobryon bavaricum Imhof	200	0.40	0.00	0.00	1990.00
WTS - 6-S	18-Sep-15	4388	Dinobryon sertularia Ehrenberg	14368	3.25	12.00	6.00	226.20
WTS - 6-S	18-Sep-15	4390	Dinobryon sociale Ehrenberg	294544	66.63	12.00	6.00	226.20
WTS - 6-S	18-Sep-15	4390	Dinobryon sociale Ehrenberg	7400	9.36	0.00	0.00	1265.00
WTS - 6-S	18-Sep-15	4396	Chrysolkos skuja (Nauwerck) Willen	50288	1.51	5.60	3.20	30.00
WTS - 6-S	18-Sep-15	4401	Uroglena volvox Ehrenberg	64656	7.31	6.00	6.00	113.10
WTS - 6-S	18-Sep-15	4411	Bitrichia chodatii (Reverdin) Chodat	14368	0.72	6.00	4.00	50.30
WTS - 6-S	18-Sep-15	4413	Chrysochromulina laurentiana Kling	122128	48.19	9.10	9.10	394.60
WTS - 6-S	18-Sep-15	4414	Stichogloea spp.	50288	2.53	6.00	4.00	50.30
WTS - 6-S	18-Sep-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	43104	1.36	5.90	3.20	31.60
WTS - 6-S	18-Sep-15	5507	Cyclotella stelligera Cleve and Grunow	200	0.31	10.00	20.00	1570.80
WTS - 6-S	18-Sep-15	5509	Cyclotella ocellata Pant.	43104	0.94	2.40	4.80	21.70
WTS - 6-S	18-Sep-15	5511	Rhizosolenia eriense H.L. Smith	158048	12.30	11.00	3.00	77.80
WTS - 6-S	18-Sep-15	5518	Synedra acus Kutzing	14400	1.15	76.00	2.00	79.60
WTS - 6-S	18-Sep-15	5551	Cyclotella michiganiana Skvortzow	107760	2.64	2.50	5.00	24.50
WTS - 6-S	18-Sep-15	6554	Rhodomonas minuta Skuja	79024	4.17	9.00	4.10	52.80
WTS - 6-S	18-Sep-15	6558	Cryptomonas erosa Ehrenberg	1200	0.88	21.00	10.00	733.00
WTS - 6-S	18-Sep-15	6568	Katablepharis ovalis Skuja	64656	3.75	9.00	4.10	58.00
WTS - 6-S	18-Sep-15	7632	Gymnodinium sp.	7184	2.41	10.00	8.00	335.10
WTS - 6-S	18-Sep-15	7632	Gymnodinium sp.	200	1.76	25.60	25.60	8784.50
WTS - 6-S	18-Sep-15	7639	Peridinium pusillum (Penard) Lemmermann	200	0.31	14.90	14.00	1529.10
INUG68S	16-May-15	2105	Chlamydomonas spp.	3546.1	0.11	5.60	3.20	30.00
INUG68S	16-May-15	2187	Staurodesmus extensus (Andersson) Teiling	100	0.05	14.50	13.00	477.00
INUG68S	16-May-15	2206	Botryococcus braunii Kutzing	100	0.14	14.00	14.00	1436.80
INUG68S	16-May-15	4351	Small chrysophyceae	517730.6	7.30	3.00	3.00	14.10
INUG68S	16-May-15	4352	Large chrysophyceae	14184.4	2.55	7.00	7.00	179.60
INUG68S	16-May-15	4355	Chrysochromulina parva Lackey	21276.6	1.23	4.80	4.80	57.90
INUG68S	16-May-15	4357	Chrysococcus sp.	319149	22.18	5.10	5.10	69.50
INUG68S	16-May-15	4362	Kephyrion sp.	17730.5	0.25	3.00	3.00	14.10
INUG68S	16-May-15	4363	Spinifiromonas sirratus**********	3546.1	0.42	6.10	6.10	118.80
INUG68S	16-May-15	4368	Mallomonas crassisquama (Asmund) Fott	100	0.11	21.00	10.00	1099.60
INUG68S	16-May-15	4388	Dinobryon sertularia Ehrenberg	600	1.28	0.00	0.00	2125.00
INUG68S	16-May-15	4390	Dinobryon sociale Ehrenberg	1200	0.27	12.00	6.00	226.20
INUG68S	16-May-15	4396	Chrysolkos skuja (Nauwerck) Willen	60283.7	1.68	5.90	3.00	27.80
INUG68S	16-May-15	4413	Chrysochromulina laurentiana Kling	10638.3	4.34	9.20	9.20	407.70
INUG68S	16-May-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	3546.1	0.09	5.60	3.00	26.40
INUG68S	16-May-15	5507	Cyclotella stelligera Cleve and Grunow	100	0.11	9.00	18.00	1145.10
INUG68S	16-May-15	5509	Cyclotella ocellata Pant.	35461	6.96	5.00	10.00	196.30
INUG68S	16-May-15	5551	Cyclotella michiganiana Skvortzow	3546.1	0.08	2.45	4.90	23.10
INUG68S	16-May-15	6554	Rhodomonas minuta Skuja	63829.8	7.69	11.00	5.60	120.40
INUG68S	16-May-15	6558	Cryptomonas erosa Ehrenberg	1400	1.57	22.30	12.00	1120.90
INUG68S	16-May-15	7631	Gymnodinium helveticum Penard	100	2.36	50.00	30.00	23561.90
INUG68S	16-May-15	7632	Gymnodinium sp.	300	2.34	24.60	24.60	7794.80
INUG68S	16-May-15	7635	Peridinium willei Huitfeldt-Kaas	100	3.35	40.00	40.00	33510.30
INUG68S	16-May-15	7639	Peridinium pusillum (Penard) Lemmermann	100	0.10	13.20	12.00	995.30
INUG68S	16-May-15	7641	Peridinium aciculiferum Lemmermann	100	0.90	30.00	24.00	9047.80
INUG69S	16-May-15	2105	Chlamydomonas spp.	3546.1	0.12	6.00	3.30	34.20
INUG69S	16-May-15	2187	Staurodesmus extensus (Andersson) Teiling	100	0.05	14.50	13.00	477.00
INUG69S	16-May-15	2206	Botryococcus braunii Kutzing	300	0.43	14.00	14.00	1436.80
INUG69S	16-May-15	4351	Small chrysophyceae	283688	4.00	3.00	3.00	14.10
INUG69S	16-May-15	4352	Large chrysophyceae	14184.4	2.55	7.00	7.00	179.60
INUG69S	16-May-15	4357	Chrysococcus sp.	198581.6	13.80	5.10	5.10	69.50
INUG69S	16-May-15	4363	Spinifiromonas sirratus**********	3546.1	0.46	6.30	6.30	130.90
INUG69S	16-May-15	4368	Mallomonas crassisquama (Asmund) Fott	400	0.44	21.00	10.00	1099.60
INUG69S	16-May-15	4390	Dinobryon sociale Ehrenberg	400	0.09	12.00	6.00	226.20
INUG69S	16-May-15	4396	Chrysolkos skuja (Nauwerck) Willen	14184.4	0.46	5.70	3.30	32.50

Station	Date	Species code	Speceis name	density cells/L	biomass mg/m^3	length µ	width µ	cell volume µ^3
INUG69S	16-May-15	4413	Chrysochromulina laurentiana Kling	3546.1	1.45	9.20	9.20	407.70
INUG69S	16-May-15	5507	Cyclotella stelligera Cleve and Grunow	100	0.11	9.00	18.00	1145.10
INUG69S	16-May-15	5509	Cyclotella ocellata Pant.	24822.7	4.87	5.00	10.00	196.30
INUG69S	16-May-15	5551	Cyclotella michiganiana Skvortzow	3546.1	0.07	2.35	4.70	20.40
INUG69S	16-May-15	6554	Rhodomonas minuta Skuja	74468.1	8.97	11.00	5.60	120.40
INUG69S	16-May-15	6558	Cryptomonas erosa Ehrenberg	1000	1.18	23.50	12.00	1181.20
INUG69S	16-May-15	7632	Gymnodinium sp.	200	1.56	24.60	24.60	7794.80
INUG70S	27-Jul-15	2105	Chlamydomonas spp.	28736	0.36	5.00	2.20	12.70
INUG70S	27-Jul-15	2112	Sphaerocystis schroeteri Chodat	136496	1.75	2.90	2.90	12.80
INUG70S	27-Jul-15	2121	Oocystis lacustris Chodat	7184	0.16	4.60	3.00	21.70
INUG70S	27-Jul-15	2187	Staurodesmus extensus (Andersson) Teiling	200	0.11	15.30	14.00	572.00
INUG70S	27-Jul-15	4351	Small chrysophyceae	409488	7.04	3.20	3.20	17.20
INUG70S	27-Jul-15	4352	Large chrysophyceae	14368	2.58	7.00	7.00	179.60
INUG70S	27-Jul-15	4357	Chrysococcus sp.	818976	53.56	5.00	5.00	65.40
INUG70S	27-Jul-15	4362	Kephyrion sp.	150864	2.84	3.30	3.30	18.80
INUG70S	27-Jul-15	4368	Mallomonas crassisquama (Asmund) Fott	400	0.44	21.10	10.00	1104.80
INUG70S	27-Jul-15	4370	Mallomonas akrokomos Asmund and Kristiansen	7184	1.19	15.00	4.60	166.20
INUG70S	27-Jul-15	4378	Dinobryon borgei Lemmermann	28736	2.28	9.00	4.10	79.20
INUG70S	27-Jul-15	4381	Dinobryon mucronutom Nygaard	21552	2.71	9.60	5.00	125.70
INUG70S	27-Jul-15	4384	Dinobryon bavaricum v vanhoeffenii (Bachmann) Krieger	1600	7.52	0.00	0.00	4700.00
INUG70S	27-Jul-15	4388	Dinobryon sertularia Ehrenberg	114944	28.60	13.20	6.00	248.80
INUG70S	27-Jul-15	4388	Dinobryon sertularia Ehrenberg	11000	55.94	0.00	0.00	5085.00
INUG70S	27-Jul-15	4390	Dinobryon sociale Ehrenberg	323280	73.13	12.00	6.00	226.20
INUG70S	27-Jul-15	4390	Dinobryon sociale Ehrenberg	29800	101.02	0.00	0.00	3390.00
INUG70S	27-Jul-15	4396	Chrysolkos skuja (Nauwerck) Willen	50288	1.42	5.60	3.10	28.20
INUG70S	27-Jul-15	4411	Bitrichia chodatii (Reverdin) Chodat	14368	0.72	6.00	4.00	50.30
INUG70S	27-Jul-15	4413	Chrysochromulina laurentiana Kling	57472	27.47	9.70	9.70	477.90
INUG70S	27-Jul-15	4414	Stichogloea spp.	7184	0.36	6.00	4.00	50.30
INUG70S	27-Jul-15	5507	Cyclotella stelligera Cleve and Grunow	200	0.31	10.00	20.00	1570.80
INUG70S	27-Jul-15	5509	Cyclotella ocellata Pant.	50288	5.45	4.10	8.20	108.30
INUG70S	27-Jul-15	5511	Rhizosolenia eriense H.L. Smith	43104	2.74	9.00	3.00	63.60
INUG70S	27-Jul-15	5518	Synedra acus Kutzing	2000	0.20	93.60	2.00	98.00
INUG70S	27-Jul-15	5551	Cyclotella michiganiana Skvortzow	201152	4.37	2.40	4.80	21.70
INUG70S	27-Jul-15	6554	Rhodomonas minuta Skuja	86208	8.28	11.00	5.00	96.00
INUG70S	27-Jul-15	6558	Cryptomonas erosa Ehrenberg	3000	4.00	22.60	13.00	1333.20
INUG70S	27-Jul-15	6562	Cryptomonas reflexa (Marsson) Skuja	600	0.41	19.40	10.00	677.20
INUG70S	27-Jul-15	6568	Katablepharis ovalis Skuja	50288	2.30	8.00	4.10	45.80
INUG70S	27-Jul-15	7632	Gymnodinium sp.	600	6.90	28.00	28.00	11494.00
INUG70S	27-Jul-15	7635	Peridinium willei Huitfeldt-Kaas	200	6.70	40.00	40.00	33510.30
INUG71S	27-Jul-15	2105	Chlamydomonas spp.	21552	0.27	5.00	2.20	12.70
INUG71S	27-Jul-15	2112	Sphaerocystis schroeteri Chodat	86208	1.10	2.90	2.90	12.80
INUG71S	27-Jul-15	2167	Elakatothrix gelatinosa Willen	14368	0.25	11.00	2.00	17.30
INUG71S	27-Jul-15	2187	Staurodesmus extensus (Andersson) Teiling	400	0.23	15.30	14.00	572.00
INUG71S	27-Jul-15	2199	Spondylosium planum (Wolle) W. and G.S. West	7184	0.27	6.00	6.00	37.70
INUG71S	27-Jul-15	4351	Small chrysophyceae	438224	7.54	3.20	3.20	17.20
INUG71S	27-Jul-15	4352	Large chrysophyceae	43104	7.74	7.00	7.00	179.60
INUG71S	27-Jul-15	4357	Chrysococcus sp.	711216	46.51	5.00	5.00	65.40
INUG71S	27-Jul-15	4358	Chrysostephanospaera globulifera Scherffel	7184	2.15	8.30	8.30	299.40
INUG71S	27-Jul-15	4362	Kephyrion sp.	114944	2.16	3.30	3.30	18.80
INUG71S	27-Jul-15	4363	Spinifiromonas sirratus**********	14368	2.16	6.60	6.60	150.50
INUG71S	27-Jul-15	4378	Dinobryon borgei Lemmermann	28736	2.28	9.00	4.10	79.20
INUG71S	27-Jul-15	4381	Dinobryon mucronutom Nygaard	57472	7.52	10.00	5.00	130.90
INUG71S	27-Jul-15	4384	Dinobryon bavaricum v vanhoeffenii (Bachmann) Krieger	1800	8.46	0.00	0.00	4700.00
INUG71S	27-Jul-15	4388	Dinobryon sertularia Ehrenberg	201152	49.28	13.00	6.00	245.00
INUG71S	27-Jul-15	4388	Dinobryon sertularia Ehrenberg	9000	45.77	0.00	0.00	5085.00
INUG71S	27-Jul-15	4390	Dinobryon sociale Ehrenberg	359200	81.25	12.00	6.00	226.20
INUG71S	27-Jul-15	4390	Dinobryon sociale Ehrenberg	31800	107.80	0.00	0.00	3390.00
INUG71S	27-Jul-15	4396	Chrysolkos skuja (Nauwerck) Willen	50288	1.42	5.60	3.10	28.20
INUG71S	27-Jul-15	4400	Ochromonas sp.	7184	0.49	8.10	4.00	67.90
INUG71S	27-Jul-15	4413	Chrysochromulina laurentiana Kling	57472	23.43	9.20	9.20	407.70
INUG71S	27-Jul-15	4414	Stichogloea spp.	57472	2.89	6.00	4.00	50.30
INUG71S	27-Jul-15	5507	Cyclotella stelligera Cleve and Grunow	600	0.94	10.00	20.00	1570.80
INUG71S	27-Jul-15	5509	Cyclotella ocellata Pant.	14368	1.56	4.10	8.20	108.30
INUG71S	27-Jul-15	5511	Rhizosolenia eriense H.L. Smith	35920	2.28	9.00	3.00	63.60
INUG71S	27-Jul-15	5518	Synedra acus Kutzing	1600	0.16	94.00	2.00	98.40
INUG71S	27-Jul-15	5551	Cyclotella michiganiana Skvortzow	64656	1.40	2.40	4.80	21.70
INUG71S	27-Jul-15	6554	Rhodomonas minuta Skuja	7184	0.69	11.00	5.00	96.00
INUG71S	27-Jul-15	6558	Cryptomonas erosa Ehrenberg	6200	8.41	23.00	13.00	1356.80
INUG71S	27-Jul-15	6562	Cryptomonas reflexa (Marsson) Skuja	1000	0.68	19.60	10.00	684.20
INUG71S	27-Jul-15	6565	Cryptomonas rostratiformis Skuja	200	0.41	30.00	14.00	2052.50
INUG71S	27-Jul-15	6568	Katablepharis ovalis Skuja	43104	1.97	8.00	4.10	45.80
INUG71S	27-Jul-15	7632	Gymnodinium sp.	7184	2.24	9.30	8.00	311.60
INUG71S	27-Jul-15	7632	Gymnodinium sp.	1000	11.49	28.00	28.00	11494.00
INUG71S	27-Jul-15	7635	Peridinium willei Huitfeldt-Kaas	200	6.70	40.00	40.00	33510.30
INUG71S	27-Jul-15	7639	Peridinium pusillum (Penard) Lemmermann	400	0.40	13.30	12.00	1002.80
INUG72S	27-Aug-15	1054	Planktolyngbya limnetica	400	0.10	229.00	1.20	259.00
INUG72S	27-Aug-15	2100	Pyramidomonas tetrarhynchus Schmarda	400	0.31	15.00	14.00	769.70
INUG72S	27-Aug-15	2105	Chlamydomonas spp.	14368	0.25	5.00	2.60	17.70
INUG72S	27-Aug-15	2112	Sphaerocystis schroeteri Chodat	57472	0.90	3.10	3.10	15.60
INUG72S	27-Aug-15	2121	Oocystis lacustris Chodat	43104	1.02	5.00	3.00	23.60

Station	Date	Species code	Speceis name	density cells/L	biomass mg/m^3	length µ	width µ	cell volume µ^3
INUG72S	27-Aug-15	2137	Dictyosphaerium simplex Sukja	28736	0.14	2.10	2.10	4.80
INUG72S	27-Aug-15	2167	Elakatothrix gelatinosa Willen	28736	0.41	9.00	2.00	14.10
INUG72S	27-Aug-15	2187	Staurodesmus extensus (Andersson) Teiling	1800	1.07	15.60	14.00	594.60
INUG72S	27-Aug-15	2199	Spondylosium planum (Wolle) W. and G.S. West	21552	0.81	6.00	6.00	37.70
INUG72S	27-Aug-15	2206	Botryococcus braunii Kutzing	600	0.86	14.00	14.00	1436.80
INUG72S	27-Aug-15	4351	Small chrysophyceae	359200	3.70	2.70	2.70	10.30
INUG72S	27-Aug-15	4352	Large chrysophyceae	14368	2.58	7.00	7.00	179.60
INUG72S	27-Aug-15	4357	Chrysococcus sp.	323280	21.14	5.00	5.00	65.40
INUG72S	27-Aug-15	4361	Kephyrion boreale Skuja	7184	0.85	6.10	6.10	118.80
INUG72S	27-Aug-15	4362	Kephyrion sp.	129312	1.66	2.90	2.90	12.80
INUG72S	27-Aug-15	4368	Mallomonas crassisquama (Asmund) Fott	200	0.21	20.50	10.00	1073.40
INUG72S	27-Aug-15	4378	Dinobryon borgei Lemmermann	7184	0.31	8.60	3.10	43.30
INUG72S	27-Aug-15	4381	Dinobryon mucronutom Nygaard	21552	2.82	10.00	5.00	130.90
INUG72S	27-Aug-15	4383	Dinobryon bavaricum Imhof	79024	17.88	12.00	6.00	226.20
INUG72S	27-Aug-15	4383	Dinobryon bavaricum Imhof	3600	12.20	0.00	0.00	3390.00
INUG72S	27-Aug-15	4384	Dinobryon bavaricum v vanhoeffenii (Bachmann) Krieger	7184	2.88	15.60	7.00	400.20
INUG72S	27-Aug-15	4384	Dinobryon bavaricum v vanhoeffenii (Bachmann) Krieger	400	1.09	0.00	0.00	2725.00
INUG72S	27-Aug-15	4388	Dinobryon sertularia Ehrenberg	21552	4.88	12.00	6.00	226.20
INUG72S	27-Aug-15	4390	Dinobryon sociale Ehrenberg	258624	58.50	12.00	6.00	226.20
INUG72S	27-Aug-15	4411	Bitrichia chodatii (Reverdin) Chodat	14368	0.72	6.00	4.00	50.30
INUG72S	27-Aug-15	4413	Chrysochromulina laurentiana Kling	50288	19.19	9.00	9.00	381.70
INUG72S	27-Aug-15	4414	Stichogloea spp.	114944	5.78	6.00	4.00	50.30
INUG72S	27-Aug-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	7184	0.21	5.70	3.10	28.70
INUG72S	27-Aug-15	5507	Cyclotella stelligera Cleve and Grunow	1200	1.42	9.10	18.20	1183.70
INUG72S	27-Aug-15	5509	Cyclotella ocellata Pant.	64656	6.50	4.00	8.00	100.50
INUG72S	27-Aug-15	5511	Rhizosolenia eriense H.L. Smith	28736	2.24	11.00	3.00	77.80
INUG72S	27-Aug-15	5514	Tabellaria flocculsa (Roth) Kutzing	400	0.47	23.00	14.00	1180.20
INUG72S	27-Aug-15	5518	Synedra acus Kutzing	400	0.04	90.00	2.00	94.20
INUG72S	27-Aug-15	5551	Cyclotella michiganiana Skvortzow	114944	2.66	2.45	4.90	23.10
INUG72S	27-Aug-15	6554	Rhodomonas minuta Skuja	14368	0.72	9.00	4.00	50.30
INUG72S	27-Aug-15	6558	Cryptomonas erosa Ehrenberg	400	0.30	21.20	10.00	740.00
INUG72S	27-Aug-15	7632	Gymnodinium sp.	7184	2.29	9.50	8.00	318.30
INUG73S	27-Aug-15	1008	Aphanocapsa sp.	7184	0.47	0.00	0.00	65.00
INUG73S	27-Aug-15	1054	Planktolyngbya limnetica	400	0.12	261.00	1.20	295.20
INUG73S	27-Aug-15	2100	Pyramidomonas tetrarhynchus Schmarda	600	0.46	15.00	14.00	769.70
INUG73S	27-Aug-15	2105	Chlamydomonas spp.	14368	0.25	5.00	2.60	17.70
INUG73S	27-Aug-15	2112	Sphaerocystis schroeteri Chodat	28736	0.45	3.10	3.10	15.60
INUG73S	27-Aug-15	2121	Oocystis lacustris Chodat	93392	2.20	5.00	3.00	23.60
INUG73S	27-Aug-15	2137	Dictyosphaerium simplex Sukja	21552	0.09	2.00	2.00	4.20
INUG73S	27-Aug-15	2167	Elakatothrix gelatinosa Willen	35920	0.51	9.00	2.00	14.10
INUG73S	27-Aug-15	2187	Staurodesmus extensus (Andersson) Teiling	2200	1.31	15.60	14.00	594.60
INUG73S	27-Aug-15	2199	Spondylosium planum (Wolle) W. and G.S. West	14368	0.54	6.00	6.00	37.70
INUG73S	27-Aug-15	2206	Botryococcus braunii Kutzing	400	0.57	14.00	14.00	1436.80
INUG73S	27-Aug-15	4351	Small chrysophyceae	330464	3.40	2.70	2.70	10.30
INUG73S	27-Aug-15	4352	Large chrysophyceae	7184	1.29	7.00	7.00	179.60
INUG73S	27-Aug-15	4357	Chrysococcus sp.	380752	24.90	5.00	5.00	65.40
INUG73S	27-Aug-15	4361	Kephyrion boreale Skuja	21552	3.24	6.60	6.60	150.50
INUG73S	27-Aug-15	4362	Kephyrion sp.	208336	2.67	2.90	2.90	12.80
INUG73S	27-Aug-15	4378	Dinobryon borgei Lemmermann	21552	0.93	8.60	3.10	43.30
INUG73S	27-Aug-15	4381	Dinobryon mucronutom Nygaard	7184	0.94	10.00	5.00	130.90
INUG73S	27-Aug-15	4383	Dinobryon bavaricum Imhof	4200	0.27	0.00	0.00	65.00
INUG73S	27-Aug-15	4383	Dinobryon bavaricum Imhof	57472	13.00	12.00	6.00	226.20
INUG73S	27-Aug-15	4384	Dinobryon bavaricum v vanhoeffenii (Bachmann) Krieger	14368	5.60	15.20	7.00	390.00
INUG73S	27-Aug-15	4384	Dinobryon bavaricum v vanhoeffenii (Bachmann) Krieger	200	0.55	0.00	0.00	2725.00
INUG73S	27-Aug-15	4388	Dinobryon sertularia Ehrenberg	43104	9.75	12.00	6.00	226.20
INUG73S	27-Aug-15	4390	Dinobryon sociale Ehrenberg	330464	74.75	12.00	6.00	226.20
INUG73S	27-Aug-15	4390	Dinobryon sociale Ehrenberg	200	0.68	0.00	0.00	3390.00
INUG73S	27-Aug-15	4396	Chrysolkos skuja (Nauwerck) Willen	14368	0.37	5.50	3.00	25.90
INUG73S	27-Aug-15	4411	Bitrichia chodatii (Reverdin) Chodat	43104	1.29	5.60	3.20	30.00
INUG73S	27-Aug-15	4413	Chrysochromulina laurentiana Kling	43104	16.45	9.00	9.00	381.70
INUG73S	27-Aug-15	4414	Stichogloea spp.	136496	6.87	6.00	4.00	50.30
INUG73S	27-Aug-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	7184	0.21	5.70	3.10	28.70
INUG73S	27-Aug-15	5507	Cyclotella stelligera Cleve and Grunow	200	0.24	9.10	18.20	1183.70
INUG73S	27-Aug-15	5509	Cyclotella ocellata Pant.	57472	5.78	4.00	8.00	100.50
INUG73S	27-Aug-15	5511	Rhizosolenia eriense H.L. Smith	7184	0.56	11.00	3.00	77.80
INUG73S	27-Aug-15	5514	Tabellaria flocculsa (Roth) Kutzing	400	0.47	23.00	14.00	1180.20
INUG73S	27-Aug-15	5518	Synedra acus Kutzing	600	0.06	90.00	2.00	94.20
INUG73S	27-Aug-15	5524	Asterionella formosa Hassall	600	0.06	96.00	2.00	100.50
INUG73S	27-Aug-15	5551	Cyclotella michiganiana Skvortzow	193968	4.48	2.45	4.90	23.10
INUG73S	27-Aug-15	6554	Rhodomonas minuta Skuja	114944	5.78	9.00	4.00	50.30
INUG73S	27-Aug-15	7632	Gymnodinium sp.	7184	2.19	9.10	8.00	304.90
INUG73S	27-Aug-15	7632	Gymnodinium sp.	800	7.36	26.00	26.00	9202.80
INUG73S	27-Aug-15	7639	Peridinium pusillum (Penard) Lemmermann	400	0.44	14.60	12.00	1100.80
INUG74S	1-Oct-15	1012	Aphanothece sp.	7184	0.37	0.00	0.00	52.00
INUG74S	1-Oct-15	1014	Chroococcus limneticus Lemmermann	57472	2.74	4.50	4.50	47.70
INUG74S	1-Oct-15	1054	Planktolyngbya limnetica	1400	0.27	171.00	1.20	193.40
INUG74S	1-Oct-15	2100	Pyramidomonas tetrarhynchus Schmarda	200	0.11	14.00	12.00	527.80
INUG74S	1-Oct-15	2105	Chlamydomonas spp.	14368	0.34	5.00	3.00	23.60
INUG74S	1-Oct-15	2121	Oocystis lacustris Chodat	64656	3.03	5.60	4.00	46.90
INUG74S	1-Oct-15	2145	Crucigenia quadrata Morr.	114944	0.16	2.00	2.00	1.40

Station	Date	Species code	Speceis name	density cells/L	biomass mg/m^3	length µ	width µ	cell volume µ^3
INUG74S	1-Oct-15	2167	Elakatothrix gelatinosa Willen	71840	1.13	10.00	2.00	15.70
INUG74S	1-Oct-15	2178	Cosmarium sp.	200	0.20	18.00	18.00	1017.90
INUG74S	1-Oct-15	2187	Staurodesmus extensus (Andersson) Teiling	1600	1.04	16.30	14.00	649.20
INUG74S	1-Oct-15	2215	Tetraedron caudatum (Corda) Hansgrig	7184	0.03	3.00	3.00	4.70
INUG74S	1-Oct-15	4351	Small chrysophyceae	352016	4.96	3.00	3.00	14.10
INUG74S	1-Oct-15	4352	Large chrysophyceae	21552	4.39	7.30	7.30	203.70
INUG74S	1-Oct-15	4357	Chrysococcus sp.	524432	32.31	4.90	4.90	61.60
INUG74S	1-Oct-15	4361	Kephyrion boreale Skuja	28736	2.79	5.70	5.70	97.00
INUG74S	1-Oct-15	4362	Kephyrion sp.	150864	3.68	3.60	3.60	24.40
INUG74S	1-Oct-15	4363	Spinifiromonas sirratus**********	43104	3.75	5.50	5.50	87.10
INUG74S	1-Oct-15	4370	Mallomonas akrokomos Asmund and Kristiansen	7184	1.74	21.00	4.70	242.90
INUG74S	1-Oct-15	4378	Dinobryon borgei Lemmermann	21552	1.11	9.60	3.20	51.50
INUG74S	1-Oct-15	4381	Dinobryon mucronutom Nygaard	7184	0.94	10.00	5.00	130.90
INUG74S	1-Oct-15	4383	Dinobryon bavaricum Imhof	200	0.25	0.00	0.00	1250.00
INUG74S	1-Oct-15	4384	Dinobryon bavaricum v vanhoeffenii (Bachmann) Krieger	200	1.02	0.00	0.00	5085.00
INUG74S	1-Oct-15	4388	Dinobryon sertularia Ehrenberg	43104	9.75	12.00	6.00	226.20
INUG74S	1-Oct-15	4390	Dinobryon sociale Ehrenberg	251440	56.88	12.00	6.00	226.20
INUG74S	1-Oct-15	4390	Dinobryon sociale Ehrenberg	3000	5.97	0.00	0.00	1991.00
INUG74S	1-Oct-15	4396	Chrysolkos skuja (Nauwerck) Willen	50288	1.42	5.60	3.10	28.20
INUG74S	1-Oct-15	4411	Bitrichia chodatii (Reverdin) Chodat	14368	0.71	5.90	4.00	49.40
INUG74S	1-Oct-15	4413	Chrysochromulina laurentiana Kling	43104	16.45	9.00	9.00	381.70
INUG74S	1-Oct-15	4414	Stichogloea spp.	150864	7.59	6.00	4.00	50.30
INUG74S	1-Oct-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	21552	0.56	5.50	3.00	25.90
INUG74S	1-Oct-15	5507	Cyclotella stelligera Cleve and Grunow	1400	2.55	10.50	21.00	1818.40
INUG74S	1-Oct-15	5509	Cyclotella ocellata Pant.	50288	6.73	4.40	8.80	133.80
INUG74S	1-Oct-15	5511	Rhizosolenia eriense H.L. Smith	28736	1.83	9.00	3.00	63.60
INUG74S	1-Oct-15	5514	Tabellaria flocculsa (Roth) Kutzing	3000	3.69	24.00	14.00	1231.50
INUG74S	1-Oct-15	5518	Synedra acus Kutzing	6600	0.63	91.00	2.00	95.30
INUG74S	1-Oct-15	5551	Cyclotella michiganiana Skvortzow	215520	5.28	2.50	5.00	24.50
INUG74S	1-Oct-15	6554	Rhodomonas minuta Skuja	57472	7.94	11.00	6.00	138.20
INUG74S	1-Oct-15	6558	Cryptomonas erosa Ehrenberg	800	0.97	24.10	12.00	1211.40
INUG74S	1-Oct-15	6568	Katablepharis ovalis Skuja	14368	0.74	8.60	4.00	51.60
INUG74S	1-Oct-15	7632	Gymnodinium sp.	21552	7.94	11.00	8.00	368.60
INUG74S	1-Oct-15	7639	Peridinium pusillum (Penard) Lemmermann	200	0.19	12.60	12.00	950.00
INUG75S	1-Oct-15	1054	Planktolyngbya limnetica	600	0.10	146.00	1.20	165.10
INUG75S	1-Oct-15	1077	Pseudoanabaena sp.	14368	1.87	46.00	1.90	130.40
INUG75S	1-Oct-15	2105	Chlamydomonas spp.	7184	0.17	5.00	3.00	23.60
INUG75S	1-Oct-15	2121	Oocystis lacustris Chodat	35920	1.68	5.60	4.00	46.90
INUG75S	1-Oct-15	2145	Crucigenia quadrata Morr.	57472	0.08	2.00	2.00	1.40
INUG75S	1-Oct-15	2167	Elakatothrix gelatinosa Willen	43104	0.68	10.00	2.00	15.70
INUG75S	1-Oct-15	2178	Cosmarium sp.	200	0.28	20.00	20.00	1396.30
INUG75S	1-Oct-15	2187	Staurodesmus extensus (Andersson) Teiling	1000	0.65	16.30	14.00	649.20
INUG75S	1-Oct-15	2193	Staurodesmus paradoxum Meyen	200	0.75	30.00	24.00	3769.90
INUG75S	1-Oct-15	2215	Tetraedron caudatum (Corda) Hansgrig	7184	0.03	3.00	3.00	4.70
INUG75S	1-Oct-15	2235	Ankistrodesmus spiralis Lemmermann	57472	3.98	40.00	2.10	69.30
INUG75S	1-Oct-15	4351	Small chrysophyceae	287360	4.05	3.00	3.00	14.10
INUG75S	1-Oct-15	4352	Large chrysophyceae	21552	4.39	7.30	7.30	203.70
INUG75S	1-Oct-15	4357	Chrysococcus sp.	761504	46.91	4.90	4.90	61.60
INUG75S	1-Oct-15	4361	Kephyrion boreale Skuja	28736	2.79	5.70	5.70	97.00
INUG75S	1-Oct-15	4362	Kephyrion sp.	129312	3.16	3.60	3.60	24.40
INUG75S	1-Oct-15	4363	Spinifiromonas sirratus**********	14368	1.25	5.50	5.50	87.10
INUG75S	1-Oct-15	4370	Mallomonas akrokomos Asmund and Kristiansen	14368	3.49	21.00	4.70	242.90
INUG75S	1-Oct-15	4378	Dinobryon borgei Lemmermann	21552	1.05	9.10	3.20	48.80
INUG75S	1-Oct-15	4381	Dinobryon mucronutom Nygaard	14368	1.88	10.00	5.00	130.90
INUG75S	1-Oct-15	4383	Dinobryon bavaricum Imhof	200	0.25	0.00	0.00	1250.00
INUG75S	1-Oct-15	4388	Dinobryon sertularia Ehrenberg	28736	6.50	12.00	6.00	226.20
INUG75S	1-Oct-15	4390	Dinobryon sociale Ehrenberg	215520	48.75	12.00	6.00	226.20
INUG75S	1-Oct-15	4390	Dinobryon sociale Ehrenberg	2600	5.18	0.00	0.00	1991.00
INUG75S	1-Oct-15	4396	Chrysolkos skuja (Nauwerck) Willen	14368	0.41	5.60	3.10	28.20
INUG75S	1-Oct-15	4411	Bitrichia chodatii (Reverdin) Chodat	14368	0.71	5.90	4.00	49.40
INUG75S	1-Oct-15	4413	Chrysochromulina laurentiana Kling	28736	10.97	9.00	9.00	381.70
INUG75S	1-Oct-15	4414	Stichogloea spp.	107760	5.42	6.00	4.00	50.30
INUG75S	1-Oct-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	28736	0.74	5.50	3.00	25.90
INUG75S	1-Oct-15	5507	Cyclotella stelligera Cleve and Grunow	1000	1.82	10.50	21.00	1818.40
INUG75S	1-Oct-15	5509	Cyclotella ocellata Pant.	14368	1.92	4.40	8.80	133.80
INUG75S	1-Oct-15	5511	Rhizosolenia eriense H.L. Smith	57472	3.66	9.00	3.00	63.60
INUG75S	1-Oct-15	5513	Tabellaria fenestrata (Lyngbye) Kutzing	600	0.45	80.00	6.00	754.00
INUG75S	1-Oct-15	5514	Tabellaria flocculsa (Roth) Kutzing	2200	2.78	24.60	14.00	1262.30
INUG75S	1-Oct-15	5518	Synedra acus Kutzing	7600	0.72	91.00	2.00	95.30
INUG75S	1-Oct-15	5551	Cyclotella michiganiana Skvortzow	272992	6.69	2.50	5.00	24.50
INUG75S	1-Oct-15	6554	Rhodomonas minuta Skuja	28736	3.97	11.00	6.00	138.20
INUG75S	1-Oct-15	6558	Cryptomonas erosa Ehrenberg	400	0.46	23.10	12.00	1161.10
INUG75S	1-Oct-15	6568	Katablepharis ovalis Skuja	50288	2.59	8.60	4.00	51.60
INUG75S	1-Oct-15	7632	Gymnodinium sp.	21552	7.94	11.00	8.00	368.60
PDL37S	28-Jul-15	2105	Chlamydomonas spp.	21552	0.35	5.00	2.50	16.40
PDL37S	28-Jul-15	2187	Staurodesmus extensus (Andersson) Teiling	400	0.16	14.00	12.00	410.50
PDL37S	28-Jul-15	2215	Tetraedron caudatum (Corda) Hansgrig	14368	0.07	3.00	3.00	4.70
PDL37S	28-Jul-15	4351	Small chrysophyceae	316096	3.26	2.70	2.70	10.30
PDL37S	28-Jul-15	4352	Large chrysophyceae	43104	7.74	7.00	7.00	179.60
PDL37S	28-Jul-15	4357	Chrysococcus sp.	1041680	64.17	4.90	4.90	61.60

Station	Date	Species code	Speceis name	density cells/L	biomass mg/m^3	length µ	width µ	cell volume µ^3
PDL37S	28-Jul-15	4362	Kephyrion sp.	158048	3.86	3.60	3.60	24.40
PDL37S	28-Jul-15	4363	Spinifiromonas sirratus**********	7184	0.90	6.20	6.20	124.80
PDL37S	28-Jul-15	4378	Dinobryon borgei Lemmermann	7184	0.33	8.60	3.20	46.10
PDL37S	28-Jul-15	4381	Dinobryon mucronutom Nygaard	14368	1.62	8.60	5.00	112.60
PDL37S	28-Jul-15	4388	Dinobryon sertularia Ehrenberg	43104	9.75	12.00	6.00	226.20
PDL37S	28-Jul-15	4388	Dinobryon sertularia Ehrenberg	7600	38.65	0.00	0.00	5085.00
PDL37S	28-Jul-15	4390	Dinobryon sociale Ehrenberg	50288	11.38	12.00	6.00	226.20
PDL37S	28-Jul-15	4390	Dinobryon sociale Ehrenberg	8000	27.12	0.00	0.00	3390.00
PDL37S	28-Jul-15	4413	Chrysochromulina laurentiana Kling	71840	29.29	9.20	9.20	407.70
PDL37S	28-Jul-15	4414	Stichogloea spp.	7184	0.36	6.00	4.00	50.30
PDL37S	28-Jul-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	14368	0.35	5.20	3.00	24.50
PDL37S	28-Jul-15	5507	Cyclotella stelligera Cleve and Grunow	600	0.85	9.65	19.30	1411.60
PDL37S	28-Jul-15	5509	Cyclotella ocellata Pant.	57472	5.99	4.05	8.10	104.30
PDL37S	28-Jul-15	5511	Rhizosolenia eriense H.L. Smith	17960	1.40	11.00	3.00	77.80
PDL37S	28-Jul-15	5518	Synedra acus Kutzing	4800	0.48	96.00	2.00	100.50
PDL37S	28-Jul-15	5540	Aulacoseira italica v subarctica (O. Muller) Simonsen	600	1.42	69.00	6.60	2360.60
PDL37S	28-Jul-15	5551	Cyclotella michiganiana Skvortzow	143680	3.52	2.50	5.00	24.50
PDL37S	28-Jul-15	6554	Rhodomonas minuta Skuja	28736	3.64	12.00	5.50	126.70
PDL37S	28-Jul-15	6558	Cryptomonas erosa Ehrenberg	2200	2.65	24.00	12.00	1206.40
PDL37S	28-Jul-15	6562	Cryptomonas reflexa (Marsson) Skuja	200	0.14	20.00	10.00	698.10
PDL37S	28-Jul-15	6568	Katablepharis ovalis Skuja	28736	1.35	8.20	4.00	46.90
PDL37S	28-Jul-15	7632	Gymnodinium sp.	400	2.42	22.60	22.60	6044.00
PDL37S	28-Jul-15	7639	Peridinium pusillum (Penard) Lemmermann	600	0.61	13.40	12.00	1010.30
PDL37S	28-Jul-15	7641	Peridinium aciculiferum Lemmermann	400	3.62	30.00	24.00	9047.80
PDL38S	28-Jul-15	2215	Tetraedron caudatum (Corda) Hansgrig	14368	0.07	3.00	3.00	4.70
PDL38S	28-Jul-15	4351	Small chrysophyceae	280176	2.89	2.70	2.70	10.30
PDL38S	28-Jul-15	4352	Large chrysophyceae	43104	7.74	7.00	7.00	179.60
PDL38S	28-Jul-15	4357	Chrysococcus sp.	1142256	70.36	4.90	4.90	61.60
PDL38S	28-Jul-15	4362	Kephyrion sp.	201152	3.46	3.20	3.20	17.20
PDL38S	28-Jul-15	4363	Spinifiromonas sirratus**********	35920	2.80	5.30	5.30	78.00
PDL38S	28-Jul-15	4378	Dinobryon borgei Lemmermann	14368	0.66	8.60	3.20	46.10
PDL38S	28-Jul-15	4384	Dinobryon bavaricum v vanhoeffenii (Bachmann) Krieger	200	0.93	0.00	0.00	4625.00
PDL38S	28-Jul-15	4388	Dinobryon sertularia Ehrenberg	28736	6.50	12.00	6.00	226.20
PDL38S	28-Jul-15	4388	Dinobryon sertularia Ehrenberg	6600	33.56	0.00	0.00	5085.00
PDL38S	28-Jul-15	4390	Dinobryon sociale Ehrenberg	79024	17.88	12.00	6.00	226.20
PDL38S	28-Jul-15	4390	Dinobryon sociale Ehrenberg	11200	37.97	0.00	0.00	3390.00
PDL38S	28-Jul-15	4396	Chrysolkos skuja (Nauwerck) Willen	7184	0.20	5.40	3.10	27.20
PDL38S	28-Jul-15	4413	Chrysochromulina laurentiana Kling	107760	43.93	9.20	9.20	407.70
PDL38S	28-Jul-15	4414	Stichogloea spp.	28736	1.45	6.00	4.00	50.30
PDL38S	28-Jul-15	5509	Cyclotella ocellata Pant.	14368	1.50	4.05	8.10	104.30
PDL38S	28-Jul-15	5511	Rhizosolenia eriense H.L. Smith	64656	5.03	11.00	3.00	77.80
PDL38S	28-Jul-15	5518	Synedra acus Kutzing	6400	0.64	96.00	2.00	100.50
PDL38S	28-Jul-15	5551	Cyclotella michiganiana Skvortzow	122128	2.99	2.50	5.00	24.50
PDL38S	28-Jul-15	6554	Rhodomonas minuta Skuja	14368	1.69	12.00	5.30	117.70
PDL38S	28-Jul-15	6558	Cryptomonas erosa Ehrenberg	3000	3.56	23.60	12.00	1186.30
PDL38S	28-Jul-15	6568	Katablepharis ovalis Skuja	21552	1.01	8.20	4.00	46.90
PDL38S	28-Jul-15	7632	Gymnodinium sp.	7184	2.31	9.60	8.00	321.70
PDL38S	28-Jul-15	7632	Gymnodinium sp.	1800	9.50	21.60	21.60	5276.70
PDL38S	28-Jul-15	7639	Peridinium pusillum (Penard) Lemmermann	1400	1.39	13.20	12.00	995.30
PDL38S	28-Jul-15	7641	Peridinium aciculiferum Lemmermann	200	1.87	31.00	24.00	9349.40
PDL39S	26-Aug-15	1012	Aphanothece sp.	7184	0.47	0.00	0.00	66.00
PDL39S	26-Aug-15	1054	Planktolyngbya limnetica	2000	0.37	163.00	1.20	184.30
PDL39S	26-Aug-15	2105	Chlamydomonas spp.	14368	0.24	5.00	2.50	16.40
PDL39S	26-Aug-15	2112	Sphaerocystis schroeteri Chodat	86208	3.11	4.10	4.10	36.10
PDL39S	26-Aug-15	2121	Oocystis lacustris Chodat	35920	1.81	6.00	4.00	50.30
PDL39S	26-Aug-15	2167	Elakatothrix gelatinosa Willen	100576	1.58	10.00	2.00	15.70
PDL39S	26-Aug-15	2193	Staurodesmus paradoxum Meyen	200	0.67	28.30	24.00	3354.80
PDL39S	26-Aug-15	2235	Ankistrodesmus spiralis Lemmermann	7184	0.42	31.00	2.20	58.90
PDL39S	26-Aug-15	4351	Small chrysophyceae	222704	2.85	2.90	2.90	12.80
PDL39S	26-Aug-15	4352	Large chrysophyceae	7184	1.29	7.00	7.00	179.60
PDL39S	26-Aug-15	4357	Chrysococcus sp.	646560	42.29	5.00	5.00	65.40
PDL39S	26-Aug-15	4361	Kephyrion boreale Skuja	7184	0.85	6.10	6.10	118.80
PDL39S	26-Aug-15	4362	Kephyrion sp.	107760	2.22	3.40	3.40	20.60
PDL39S	26-Aug-15	4363	Spinifiromonas sirratus**********	14368	1.47	5.80	5.80	102.20
PDL39S	26-Aug-15	4378	Dinobryon borgei Lemmermann	14368	0.74	9.00	3.30	51.30
PDL39S	26-Aug-15	4381	Dinobryon mucronutom Nygaard	21552	2.82	10.00	5.00	130.90
PDL39S	26-Aug-15	4388	Dinobryon sertularia Ehrenberg	50288	11.38	12.00	6.00	226.20
PDL39S	26-Aug-15	4388	Dinobryon sertularia Ehrenberg	1600	3.18	0.00	0.00	1990.00
PDL39S	26-Aug-15	4388	Dinobryon sertularia Ehrenberg	1800	3.87	0.00	0.00	2150.00
PDL39S	26-Aug-15	4390	Dinobryon sociale Ehrenberg	179600	40.63	12.00	6.00	226.20
PDL39S	26-Aug-15	4396	Chrysolkos skuja (Nauwerck) Willen	14368	0.40	5.50	3.10	27.70
PDL39S	26-Aug-15	4401	Uroglena volvox Ehrenberg	43104	4.88	6.00	6.00	113.10
PDL39S	26-Aug-15	4413	Chrysochromulina laurentiana Kling	21552	8.23	9.00	9.00	381.70
PDL39S	26-Aug-15	4414	Stichogloea spp.	7184	0.36	6.00	4.00	50.30
PDL39S	26-Aug-15	5507	Cyclotella stelligera Cleve and Grunow	600	1.09	10.50	21.00	1818.40
PDL39S	26-Aug-15	5509	Cyclotella ocellata Pant.	64656	9.57	4.55	9.10	148.00
PDL39S	26-Aug-15	5511	Rhizosolenia eriense H.L. Smith	50288	3.20	9.00	3.00	63.60
PDL39S	26-Aug-15	5518	Synedra acus Kutzing	3400	0.32	90.00	2.00	94.20
PDL39S	26-Aug-15	5551	Cyclotella michiganiana Skvortzow	100576	2.46	2.50	5.00	24.50
PDL39S	26-Aug-15	6554	Rhodomonas minuta Skuja	21552	1.14	9.00	4.10	52.80

Station	Date	Species code	Speceis name	density cells/L	biomass mg/m^3	length µ	width µ	cell volume µ^3
PDL39S	26-Aug-15	6558	Cryptomonas erosa Ehrenberg	400	0.32	22.60	10.00	788.90
PDL39S	26-Aug-15	6568	Katablepharis ovalis Skuja	21552	1.04	8.30	4.00	48.10
PDL39S	26-Aug-15	7632	Gymnodinium sp.	400	2.11	21.60	21.60	5276.70
PDL39S	26-Aug-15	7639	Peridinium pusillum (Penard) Lemmermann	200	0.21	14.00	12.00	1055.60
PDL40S	26-Aug-15	1054	Planktolyngbya limnetica	3800	0.90	210.00	1.20	237.50
PDL40S	26-Aug-15	2112	Sphaerocystis schroeteri Chodat	35920	1.30	4.10	4.10	36.10
PDL40S	26-Aug-15	2137	Dictyosphaerium simplex Sukja	21552	0.14	2.30	2.30	6.40
PDL40S	26-Aug-15	2167	Elakatothrix gelatinosa Willen	14368	0.23	10.00	2.00	15.70
PDL40S	26-Aug-15	2187	Staurodesmus extensus (Andersson) Teiling	200	0.08	13.50	12.00	381.70
PDL40S	26-Aug-15	2193	Staurodesmus paradoxum Meyen	200	0.67	28.30	24.00	3354.80
PDL40S	26-Aug-15	2199	Spondylosium planum (Wolle) W. and G.S. West	14368	0.54	6.00	6.00	37.70
PDL40S	26-Aug-15	2206	Botryococcus braunii Kutzing	400	0.21	10.00	10.00	523.60
PDL40S	26-Aug-15	2215	Tetraedron caudatum (Corda) Hansgrig	14368	0.07	3.00	3.00	4.70
PDL40S	26-Aug-15	2235	Ankistrodesmus spiralis Lemmermann	21552	1.16	31.00	2.10	53.70
PDL40S	26-Aug-15	2247	Oocystis gigas Archer	400	0.97	18.00	16.00	2412.70
PDL40S	26-Aug-15	4351	Small chrysophyceae	337648	4.32	2.90	2.90	12.80
PDL40S	26-Aug-15	4352	Large chrysophyceae	21552	3.87	7.00	7.00	179.60
PDL40S	26-Aug-15	4357	Chrysococcus sp.	531616	34.77	5.00	5.00	65.40
PDL40S	26-Aug-15	4362	Kephyrion sp.	93392	1.92	3.40	3.40	20.60
PDL40S	26-Aug-15	4378	Dinobryon borgei Lemmermann	21552	1.11	9.00	3.30	51.30
PDL40S	26-Aug-15	4381	Dinobryon mucronutom Nygaard	14368	1.88	10.00	5.00	130.90
PDL40S	26-Aug-15	4388	Dinobryon sertularia Ehrenberg	93392	21.13	12.00	6.00	226.20
PDL40S	26-Aug-15	4388	Dinobryon sertularia Ehrenberg	2600	5.59	0.00	0.00	2150.00
PDL40S	26-Aug-15	4390	Dinobryon sociale Ehrenberg	158048	35.75	12.00	6.00	226.20
PDL40S	26-Aug-15	4390	Dinobryon sociale Ehrenberg	2600	5.17	0.00	0.00	1990.00
PDL40S	26-Aug-15	4396	Chrysolkos skuja (Nauwerck) Willen	7184	0.20	5.50	3.10	27.70
PDL40S	26-Aug-15	4401	Uroglena volvox Ehrenberg	43104	4.88	6.00	6.00	113.10
PDL40S	26-Aug-15	4413	Chrysochromulina laurentiana Kling	35920	13.71	9.00	9.00	381.70
PDL40S	26-Aug-15	4414	Stichogloea spp.	7184	0.36	6.00	4.00	50.30
PDL40S	26-Aug-15	5507	Cyclotella stelligera Cleve and Grunow	400	0.73	10.50	21.00	1818.40
PDL40S	26-Aug-15	5509	Cyclotella ocellata Pant.	43104	6.38	4.55	9.10	148.00
PDL40S	26-Aug-15	5511	Rhizosolenia eriense H.L. Smith	50288	3.20	9.00	3.00	63.60
PDL40S	26-Aug-15	5518	Synedra acus Kutzing	4400	0.41	90.00	2.00	94.20
PDL40S	26-Aug-15	5551	Cyclotella michiganiana Skvortzow	114944	2.82	2.50	5.00	24.50
PDL40S	26-Aug-15	5720	Cyclotella bodanica Eulenst.	400	2.80	16.45	32.90	6992.30
PDL40S	26-Aug-15	6554	Rhodomonas minuta Skuja	21552	1.14	9.00	4.10	52.80
PDL40S	26-Aug-15	6558	Cryptomonas erosa Ehrenberg	1400	1.10	22.60	10.00	788.90
PDL40S	26-Aug-15	7632	Gymnodinium sp.	400	2.11	21.60	21.60	5276.70
PDL41S	4-Oct-15	1054	Planktolyngbya limnetica	7400	2.51	300.00	1.20	339.30
PDL41S	4-Oct-15	2105	Chlamydomonas spp.	14368	0.72	6.00	4.00	50.30
PDL41S	4-Oct-15	2112	Sphaerocystis schroeteri Chodat	64656	0.67	2.70	2.70	10.30
PDL41S	4-Oct-15	2121	Oocystis lacustris Chodat	136496	3.92	6.10	3.00	28.70
PDL41S	4-Oct-15	2130	Scenedesmus quadricauda (Turp.) Brebisson	14368	1.50	12.00	5.00	104.70
PDL41S	4-Oct-15	2137	Dictyosphaerium simplex Sukja	86208	0.36	2.00	2.00	4.20
PDL41S	4-Oct-15	2167	Elakatothrix gelatinosa Willen	21552	0.44	13.00	2.00	20.40
PDL41S	4-Oct-15	2235	Ankistrodesmus spiralis Lemmermann	21552	1.34	36.00	2.10	62.30
PDL41S	4-Oct-15	4351	Small chrysophyceae	272992	3.85	3.00	3.00	14.10
PDL41S	4-Oct-15	4352	Large chrysophyceae	14368	2.58	7.00	7.00	179.60
PDL41S	4-Oct-15	4355	Chrysochromulina parva Lackey	14368	0.94	5.00	5.00	65.40
PDL41S	4-Oct-15	4357	Chrysococcus sp.	215520	10.99	4.60	4.60	51.00
PDL41S	4-Oct-15	4362	Kephyrion sp.	122128	2.98	3.60	3.60	24.40
PDL41S	4-Oct-15	4378	Dinobryon borgei Lemmermann	28736	1.78	9.10	3.60	61.80
PDL41S	4-Oct-15	4384	Dinobryon bavaricum v vanhoeffenii (Bachmann) Krieger	200	0.51	0.00	0.00	2525.00
PDL41S	4-Oct-15	4388	Dinobryon sertularia Ehrenberg	50288	11.38	12.00	6.00	226.20
PDL41S	4-Oct-15	4388	Dinobryon sertularia Ehrenberg	1000	3.39	0.00	0.00	3390.00
PDL41S	4-Oct-15	4390	Dinobryon sociale Ehrenberg	114944	26.00	12.00	6.00	226.20
PDL41S	4-Oct-15	4390	Dinobryon sociale Ehrenberg	4800	16.27	0.00	0.00	3390.00
PDL41S	4-Oct-15	4396	Chrysolkos skuja (Nauwerck) Willen	21552	0.61	5.60	3.10	28.20
PDL41S	4-Oct-15	4413	Chrysochromulina laurentiana Kling	35920	13.71	9.00	9.00	381.70
PDL41S	4-Oct-15	4414	Stichogloea spp.	35920	1.81	6.00	4.00	50.30
PDL41S	4-Oct-15	4418	Salpingoeca frequentissima (Zach.) Lemmermann	7184	0.23	6.00	3.20	32.20
PDL41S	4-Oct-15	5507	Cyclotella stelligera Cleve and Grunow	1400	2.55	10.50	21.00	1818.40
PDL41S	4-Oct-15	5509	Cyclotella ocellata Pant.	21552	2.69	4.30	8.60	124.90
PDL41S	4-Oct-15	5518	Synedra acus Kutzing	2400	0.23	91.00	2.00	95.30
PDL41S	4-Oct-15	5551	Cyclotella michiganiana Skvortzow	193968	4.48	2.45	4.90	23.10
PDL41S	4-Oct-15	5720	Cyclotella bodanica Eulenst.	200	1.49	16.80	33.60	7448.10
PDL41S	4-Oct-15	6554	Rhodomonas minuta Skuja	21552	3.25	12.00	6.00	150.80
PDL41S	4-Oct-15	6558	Cryptomonas erosa Ehrenberg	600	0.71	23.40	12.00	1176.20
PDL41S	4-Oct-15	7631	Gymnodinium helveticum Penard	200	4.81	51.00	30.00	24033.20
PDL41S	4-Oct-15	7632	Gymnodinium sp.	14368	5.01	10.40	8.00	348.50
PDL41S	4-Oct-15	7632	Gymnodinium sp.	400	3.51	25.60	25.60	8784.50

APPENDIX F

Benthic Invertebrate Taxonomy, Whale Tail Pit Baseline, 2015

Raw benthic invertebrate data, Whale Tail Pit Baseline, 2015.

Program	Meadowbank Reference Lakes										Amaruq Study Lakes									
Lake Name	Inuggugayualik Lake					Pipedream Lake					Mammoth Lake					Nemo Lake				
Station	INUG					PDL					MAM					NEM				
Replicate	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
ROUNDWORMS																				
P. Nemata	8	2	5	5	5	3	6	1	2	2	-	1	1	4	1	-	1	4	2	3
FLATWORMS																				
P. Platyhelminthes																				
Cl. Turbellaria																				
indeterminate	-	-	-	-	-	-	-	-	-	-	1	2	-	-	1	-	1	-	1	-
ANNELIDS																				
P. Annelida																				
WORMS																				
Cl. Oligochaeta																				
F. Naididae																				
S.F. Tubificinae																				
immatures with hair chaetae	-	-	-	1	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
S.F. Rhyacodrilinae																				
Rhyacodrilus coccineus	-	-	-	-	-	-	-	-	-	-	3	3	-	-	2	-	-	-	1	-
Rhyacodrilus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. Lumbriculidae																				
Lumbriculus	1	2	6	-	2	-	1	-	2	-	1	3	2	1	-	2	1	-	-	3
ARTHROPODS																				
P. Arthropoda																				
MITES																				
Cl. Arachnida																				
O. Acarina																				
indeterminate	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-	1
F. Acalyptonotidae																				
Acalyptonotus	-	-	1	-	-	-	1	-	-	-	-	-	-	1	1	1	-	2	4	4
F. Hygrobatidae																				
Hygrobates	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-
F. Lebertiidae																				
Lebertia	-	-	-	-	-	-	-	1	-	2	-	-	2	-	-	2	3	1	-	-
F. Oxidae																				
Frontipoda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oxus	-	-	-	-	-	-	-	-	-	-	3	3	2	3	-	-	3	-	-	-
SEED SHRIMPS																				
Cl. Ostracoda	1	6	6	2	1	21	5	4	2	3	17	15	12	15	6	20	12	7	12	20
FAIRY SHRIMP																				
O. Notostraca																				
Lepidurus arcticus	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-
INSECTS																				
Cl. Insecta																				
CADDISFLIES																				
O. Trichoptera																				
F. Limnephilidae																				
Grensia praeterita	-	-	1	-	-	4	-	-	1	1	-	-	1	-	-	-	-	-	-	-
TRUE FLIES																				
O. Diptera																				
MIDGES																				
F. Chironomidae																				
chironomid pupae	-	-	-	-	-	-	-	-	-	-	-	**1**	**1**	-	-	**1**	**2**	**2**	-	-
S.F. Chironominae																				
Cladotanytarsus	-	2	-	1	-	-	-	-	-	-	1	5	-	1	-	-	-	-	-	-
Corynocera	-	4	3	5	-	-	-	-	-	-	12	3	2	15	9	-	-	-	-	-
Dicrotendipes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Micropsectra	-	18	-	-	2	-	-	-	-	-	-	-	9	-	-	3	-	-	4	2
Microtendipes	3	22	19	31	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Parachironomus	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paratanytarsus	2	3	6	1	2	6	-	-	-	-	6	14	5	33	23	-	-	7	2	-
Sergentia	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Stempellinella	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Stictochironomus	5	9	26	5	7	20	13	20	6	21	5	6	7	-	-	28	45	7	38	51
Tanytarsus	-	7	11	8	8	9	-	-	-	-	95	38	17	261	184	32	43	69	18	17
S.F. Diamesinae																				
Protanypus	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S.F. Orthocladiinae																				
Abiskomyia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heterotrissocladius	-	-	-	1	-	1	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Paracladius	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Parakiefferiella	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Psectrocladius	2	4	1	-	-	7	9	3	1	2	2	1	-	1	5	5	1	3	7	10
Zalutschia	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S.F. Prodiamesinae																				
Monodiamesa	3	2	1	4	-	-	2	2	-	2	2	2	3	1	-	-	-	-	-	-
S.F. Tanypodinae																				
Ablabesmyia	-	1	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	1
Procladius	10	4	5	4	11	6	15	14	9	8	14	13	14	15	14	17	15	19	19	17
Thienemannimyia complex	-	-	-	-	-	3	2	-	-	-	-	-	-	-	-	-	4	2	3	4
F. Empididae																				
Chelifera/Neoplasta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOLLUSCS																				
P. Mollusca																				
CLAMS																				
Cl. Bivalvia																				
F. Sphaeriidae																				
Cyclocalyx/Neopisidium	14	23	15	16	17	2	14	20	9	13	27	19	18	31	7	29	20	16	21	12
Cyclocalyx	-	2	4	-	-	7	-	-	-	-	6	11	8	12	8	6	11	7	9	4
Sphaerium nitidum	2	4	2	2	3	-	-	-	-	-	-	1	-	6	2	-	1	-	-	-
R (Richness) - totals																				
Total	10	17	16	12	9	11	11	9	6	8	14	15	13	14	12	10	14	11	12	11
Oligochaete	1	1	1	1	1	0	2	0	1	0	2	2	1	1	1	1	1	0	1	1
Insect	7	13	10	9	6	9	7	6	4	6	8	8	8	7	6	5	6	6	7	7
Mollusc	2	3	3	2	2	2	1	1	1	1	2	3	2	3	3	2	3	2	2	2
Other[3]	0	0	2	0	0	0	1	2	0	1	2	2	2	3	2	2	4	3	2	1
N (Abundance) - raw																				
Total	43	109	104	79	65	66	63	63	28	51	178	125	91	382	257	126	152	136	127	125
Oligochaete	1	2	6	1	2	0	4	0	2	0	4	6	2	1	2	2	1	0	1	3
Insect	26	78	74	60	43	57	44	41	17	36	137	83	59	327	236	86	111	109	91	102
Mollusc	16	29	21	18	20	9	14	20	9	13	33	31	26	49	17	35	32	23	30	16
Other	0	0	3	0	0	0	1	2	0	2	4	5	4	5	2	3	8	4	5	4
N (Abundance) - #/m^2																				
Total	935	2370	2261	1717	1413	1435	1370	1370	609	1109	3870	2717	1978	8304	5587	2739	3304	2957	2761	2717
Oligochaete	22	43	130	22	43	0	87	0	43	0	87	130	43	22	43	43	22	0	22	65
Insect	565	1696	1609	1304	935	1239	957	891	370	783	2978	1804	1283	7109	5130	1870	2413	2370	1978	2217
Mollusc	348	630	457	391	435	196	304	435	196	283	717	674	565	1065	370	761	696	500	652	348
Other	0	0	65	0	0	0	22	43	0	43	87	109	87	109	43	65	174	87	109	87
TOTAL NUMBER OF TAXA [1]	**10**	**17**	**16**	**12**	**9**	**11**	**11**	**9**	**6**	**8**	**14**	**15**	**13**	**14**	**12**	**10**	**14**	**11**	**12**	**11**
TOTAL NUMBER OF ORGANISMS [2]	**43**	**109**	**104**	**79**	**65**	**66**	**63**	**63**	**28**	**51**	**178**	**125**	**91**	**382**	**257**	**126**	**152**	**136**	**127**	**125**

Notes:

[1] Number of taxa totals exclude P. Nemata and Cl. Ostracoda, pupae (Chironomidae) and indeterminates (Acarina).

[2] Number of organisms totals exclude P. Nemata and Cl. Ostracoda.

[3] Other taxa: (Cl. Turbellaria, F. Acalyptonotidae, F. Hygrobatidae, F. Lebertiidae, F. Oxidae, and O. Notostraca).

Raw benthic invertebrate data, Whale Tail Pit Baseline, 2015.

Program	Amaruq Study Lakes														
Lake Name	Whale Tail Lake - North Basin (deep)					Whale Tail Lake - North Basin (shallow)					Whale Tail Lake - South Basin				
Station	WTN					WTN-EX					WTS				
Replicate	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
ROUNDWORMS															
P. Nemata	2	-	1	-	2	1	2	1	1	1	1	-	3	2	-
FLATWORMS															
P. Platyhelminthes															
Cl. Turbellaria															
indeterminate	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
ANNELIDS															
P. Annelida															
WORMS															
Cl. Oligochaeta															
F. Naididae															
S.F. Tubificinae															
immatures with hair chaetae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S.F. Rhyacodrilinae															
Rhyacodrilus coccineus	-	-	-	2	-	1	-	6	1	-	-	-	1	-	-
Rhyacodrilus	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
F. Lumbriculidae															
Lumbriculus	-	-	-	2	2	-	-	2	2	1	-	-	-	-	-
ARTHROPODS															
P. Arthropoda															
MITES															
Cl. Arachnida															
O. Acarina															
indeterminate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F. Acalyptonotidae															
Acalyptonotus	4	1	2	1	1	4	2	2	1	3	-	-	2	2	1
F. Hygrobatidae															
Hygrobates	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-
F. Lebertiidae															
Lebertia	-	-	1	-	-	1	-	4	3	-	-	-	2	-	-
F. Oxidae															
Frontipoda	-	-	-	-	-	-	-	-	-	5	1	3	2	3	1
Oxus	1	-	1	2	2	1	4	5	4	-	-	-	-	-	-
SEED SHRIMPS															
Cl. Ostracoda	25	7	12	11	19	45	43	48	77	57	25	10	21	11	19
FAIRY SHRIMP															
O. Notostraca															
Lepidurus arcticus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
INSECTS															
Cl. Insecta															
CADDISFLIES															
O. Trichoptera															
F. Limnephilidae															
Grensia praeterita	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
TRUE FLIES															
O. Diptera															
MIDGES															
F. Chironomidae															
chironomid pupae	-	-	-	-	**1**	-	-	-	-	**1**	-	-	-	**1**	-
S.F. Chironominae															
Cladotanytarsus	-	-	-	-	-	-	3	6	5	-	1	-	-	-	-
Corynocera	-	-	1	-	-	108	7	137	118	124	3	-	45	12	1
Dicrotendipes	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Micropsectra	1	-	1	-	4	4	9	-	7	-	2	12	14	38	1
Microtendipes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Parachironomus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paratanytarsus	2	-	-	-	3	-	-	-	-	-	2	4	8	1	3
Sergentia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stempellinella	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Stictochironomus	13	14	6	6	41	41	8	47	30	44	3	1	3	12	2
Tanytarsus	1	-	1	2	3	9	2	6	-	22	8	1	14	6	5
S.F. Diamesinae															
Protanypus	1	-	-	2	-	-	2	-	-	-	-	-	1	2	2
S.F. Orthocladiinae															
Abiskomyia	-	-	1	-	1	-	-	-	-	-	-	-	-	1	1
Heterotrissocladius	-	1	-	-	1	1	-	-	-	-	-	1	1	-	-
Paracladius	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Parakiefferiella	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psectrocladius	-	-	1	-	-	2	1	-	-	4	1	3	9	1	-
Zalutschia	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
S.F. Prodiamesinae															
Monodiamesa	-	1	1	1	-	2	3	3	3	1	3	1	-	5	1
S.F. Tanypodinae															
Ablabesmyia	-	-	-	-	-	-	2	1	1	3	-	-	-	-	-
Procladius	15	10	7	9	6	26	15	20	21	24	9	10	10	11	14
Thienemannimyia complex	-	-	-	-	-	1	-	3	1	1	-	-	-	-	-
F. Empididae															
Chelifera/Neoplasta	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
MOLLUSCS															
P. Mollusca															
CLAMS															
Cl. Bivalvia															
F. Sphaeriidae															
Cyclocalyx/Neopisidium	7	1	18	15	10	54	39	38	48	39	14	18	23	15	16
Cyclocalyx	-	-	1	-	-	15	1	9	9	27	5	1	5	8	2
Sphaerium nitidum	1	-	2	1	2	2	2	3	4	-	2	2	3	1	1
R (Richness) - totals															
Total	10	6	14	11	13	16	17	17	17	15	13	12	18	15	14
Oligochaete	0	0	0	2	1	1	0	2	2	2	0	0	1	0	0
Insect	6	4	8	5	8	9	11	9	8	9	9	8	10	10	9
Mollusc	2	1	3	2	2	3	3	3	3	2	3	3	3	3	3
Other[3]	2	1	3	2	2	3	3	3	4	2	1	1	4	2	2
N (Abundance) - raw															
Total	46	28	44	43	78	272	102	294	260	301	54	57	145	119	51
Oligochaete	0	0	0	4	2	1	0	8	3	2	0	0	1	0	0
Insect	33	26	19	20	61	194	53	225	186	225	32	33	106	90	30
Mollusc	8	1	21	16	12	71	42	50	61	66	21	21	31	24	19
Other	5	1	4	3	3	6	7	11	10	8	1	3	7	5	2
N (Abundance) - #/m^2															
Total	1000	609	957	935	1696	5913	2217	6391	5652	6543	1174	1239	3152	2587	1109
Oligochaete	0	0	0	87	43	22	0	174	65	43	0	0	22	0	0
Insect	717	565	413	435	1326	4217	1152	4891	4043	4891	696	717	2304	1957	652
Mollusc	174	22	457	348	261	1543	913	1087	1326	1435	457	457	674	522	413
Other	109	22	87	65	65	130	152	239	217	174	22	65	152	109	43
TOTAL NUMBER OF TAXA [1]	**10**	**6**	**14**	**11**	**13**	**16**	**17**	**17**	**17**	**15**	**13**	**12**	**18**	**15**	**14**
TOTAL NUMBER OF ORGANISMS [2]	**46**	**28**	**44**	**43**	**78**	**272**	**102**	**294**	**260**	**301**	**54**	**57**	**145**	**119**	**51**

Notes:

[1] Number of taxa totals exclude P. Nemata and Cl. Ostracoda, pupae (Chironomidae) and indeterminates (Acarina).

[2] Number of organisms totals exclude P. Nemata and Cl. Ostracoda.

[3] Other taxa: (Cl. Turbellaria, F. Acalyptonotidae, F. Hygrobatidae, F. Lebertiidae, F. Oxidae, and O. Notostraca).

APPENDIX G

Zooplankton Taxonomy

APPENDIX G1

Zooplankton Taxonomy, Whale Tail Pit Baseline, 2015

Abbreviations Definitions

Abundance Data:

Total Taxa	Number of unique taxa present identified to lowest possible level. Does not include higher-order taxa of which there are identified lower-level taxa present.
Nauplius	Crustacean early larval stage
Presence	Taxa enumerated in sample
#/sample	Count data converted to "per sample" total value
Copepods:	
III	Calanoid copepod stage 3; with 3 abdominal segments
IV	Calanoid copepod stage 4: with 4 abdominal segments
V	Calanoid copepod stage 5: with 5 abdominant segments
F	Reproductive, adult stage with 6 abdominal segments. Female.
M	Reproductive, adult stage with 6 abdominal segments. Male.
Rotifers:	
Individual	Non-colonial rotifer
Colony	Colonial rotifer
Cladocerans:	
J	Juvenile
F	Adult Female

Biomass Measurements:

WW	Wet weight
DW	Dry weight
mg/sample	milligrams per sample
Crustaceans:	Ln(W) (mg DW) = Ln α + β Ln (L) (Length in mm)
α	Species-specific constant in biomass estimation formula for copepods (intercept) (sources in reference column)
β	Species-specfic constant in biomass estimation formula for copepods (slope) (sources in reference column)
Rotifers:	Rotifer biomass (µg DW) = (length3 x FF) + (%BV x length3 x FF) x 10-6 x WW : DW
FF	Species-specific constant for calculation of biomass in rotifers, source of values in Reference column
%BV	Species-specific volume of portrusions that is >0 in some rotifers, term in equation for biomass estimate, source of values in reference column

Worksheets:

1. Definitions & Abbreviations	Glossary of terms and outline of report
2. Matrix - Abundance	Abundance Data in matrix format, including Total Abundance per sample
3. Matrix - Biomass	Biomass Data in matrix format, including Total Biomass per sample (wet weight and dry weight data)
4. Matrix - Presence Absence	Presence/Absence Data in matrix format, including total unique taxa count per sample
5. Data Summaries	Data summaries in matrix format, including Total Taxa count per sample, Total Abundance per sample, and total biomass(WW and DW) per sample
6. Data - Long	Abundance and Biomass data in long format with average taxon biomass inserted in order to calculate total biomass and abundance per sample
7. Measurements & Biomass	Raw length measurements and biomass conversions, including references
8. QAQC	Report on subsampling error and internal taxonomic consistency

Zooplankton abundance data matrix, Azimuth Nunavut 2015

		Biologica #	Grand Total	15-25-01	15-25-02	15-25-03	15-25-04	15-25-05	15-25-06	15-25-07	15-25-08	15-25-08 - QA	15-25-09
		Project	Nunavut	Nunavut	Nunavut	Nunavut	Nunavut	Nunavut	Nunavut	Nunavut	Nunavut	Nunavut	Nunavut
		Client ID		WTN-01-S	WTN-02-S	WTS-01-S	WTS-02-S	NEM-01-S	NEM-02-S	MAM-01-S	MAM-02-S	MAM-02-S-QA	DUP-July-Amaruq
		Date		7/17/2015	7/17/2015	7/17/2015	7/17/2015	7/18/2015	7/18/2015	7/18/2015	7/18/2015	7/18/2015	
			Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)
Major Group	**Taxon**	**Stage**											
Cladoceran	Bosmina sp.	F	425	30	10	2		8	2	7	190	110	2
Cladoceran	Daphnia ambigua	F	2										2
Cladoceran	Daphnia middendorffiana	F	309	20	50	7	1	30	8		10	10	1
Cladoceran	Daphnia sp.	F	113	30		1	1	7	6		10	10	
Cladoceran	Holopedium gibberum	F	2168	200	560	390	80	60	100	24	200	310	180
Cladoceran	Leptodora kindtii	F	13	10				1		1			1
	Total Cladocera		**3029**	**290**	**620**	**400**	**82**	**106**	**116**	**32**	**410**	**440**	**186**
Calanoid	Calanoida indet.	I-IV	5988	210	120	50	30	1920	1750	64	120	110	400
Calanoid	Calanoida indet.	V	757							9	20	70	
Calanoid	Heterocope septentrionalis	F	392										
Calanoid	Heterocope septentrionalis	M	281										
Calanoid	Leptodiaptomus pribilofensis	F	5181										
Calanoid	Leptodiaptomus pribilofensis	I-IV	13										
Calanoid	Leptodiaptomus pribilofensis	M	5585										
Calanoid	Leptodiaptomus pribilofensis	V	154										
Calanoid	Tropocyclops prasinus mexicanus	F	3						3				
	Total Calanoida		**18354**	**210**	**120**	**50**	**30**	**1920**	**1753**	**73**	**140**	**180**	**400**
Cyclopoid	Cyclopoida indet.	F	265										
Cyclopoid	Cyclopoida indet.	I-IV	25273	1200	600	1300	1160	1020	1970	16	310	320	3420
Cyclopoid	Cyclopoida indet.	M	338						10	2			100
Cyclopoid	Cyclopoida indet.	V	4712	160	200	450	200	70	120	20	80	60	720
Cyclopoid	Cyclops scutifer	F	7583	740	320	500	400	700	410	39	830	860	560
Cyclopoid	Cyclops scutifer	I-IV	203										
Cyclopoid	Cyclops scutifer	M	4816	520	470	470	320	180	60	15	200	310	640
Cyclopoid	Cyclops scutifer	V	100										
Cyclopoid	Diacyclops thomasi	F	206										
Cyclopoid	Diacyclops thomasi	I-IV	430										
Cyclopoid	Diacyclops thomasi	M	150										
Cyclopoid	Diacyclops thomasi	V	85										
Cyclopoid	Microcyclops sp.	F	68										
	Total Cyclopoida		**44226**	**2620**	**1590**	**2720**	**2080**	**1970**	**2570**	**92**	**1420**	**1550**	**5440**
Copepod	Calanoid indet.	nauplius	64983	133	100	267	267	2200	5700	367	50	233	300
Copepod	Cyclopoid indet.	nauplius	26573	2167	2100	2700	533	2033	1567	1533	740	2333	1133
Copepod	Copepoda indet.	nauplius	1033	33	267	133	267	33	33	167			
	Total Copepod Nauplii		**92590**	**2333**	**2467**	**3100**	**1067**	**4267**	**7300**	**2067**	**790**	**2567**	**1433**
	Total Crustacean Zooplankton		**158199**	**5453**	**4797**	**6270**	**3259**	**8263**	**11739**	**2264**	**2760**	**4737**	**7459**
Rotifer	Asplanchna sp.		533	67		67							
Rotifer	Collotheca sp.		33	33									
Rotifer	Conochilus sp.		60783	4333	2067	2867	533	1200	967	2567	7000	8367	867
Rotifer	Kellicottia sp.		131933	3167	1333	3300	2400	3033	3467	1867	6400	5233	3533
Rotifer	Keratella sp.		1683										33
Rotifer	Polyarthra sp.		2917									467	
Rotifer	Polyarthra sp.		767				100	100		133	200		233
Rotifer	Rotifer indet.		500	267		67	0	33	100	33			
Rotifer	Synchaeta sp.		533			67	167				33	100	167
	Total Rotifers		**199683**	**7867**	**3400**	**6367**	**3200**	**4367**	**4533**	**4600**	**13633**	**14167**	**4833**
	Total Zooplankton		**357882**	**13320**	**8197**	**12637**	**6459**	**12629**	**16272**	**6864**	**16393**	**18903**	**12293**

Zooplankton abundance data matrix, Azimuth Nunavut 2015

		Biologica #	15-25-10	15-25-11	15-25-12	15-25-13	15-25-14	15-25-26	15-25-15	15-25-16	15-25-16-QA	15-25-17	15-25-18
		Project	Nunavut	Nunavut	Nunavut	Nunavut	Nunavut	Nunavut	Nunavut	Nunavut	Nunavut	Nunavut	Nunavut
		Client ID	WTN-03-S	WTN-04-S	WTN-05-S	WTN-06-S	WTS-03-S	DUP-1	WTS-04-S	WTS-05-S	WTS-05-S-QA	WTS-06-S	NEM-03-S
		Date	8/22/2015	8/22/2015	9/18/2015	9/18/2015	8/22/2015	8/22/2015	8/21/2015	9/18/2015	9/18/2015	9/18/2015	8/23/2015
			Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)
Major Group	**Taxon**	**Stage**											
Cladoceran	Bosmina sp.	F											10
Cladoceran	Daphnia ambigua	F											
Cladoceran	Daphnia middendorffiana	F	20	3				3	5	10	5	10	30
Cladoceran	Daphnia sp.	F			4	10		3		5	5		
Cladoceran	Holopedium gibberum	F	40	7				16					
Cladoceran	Leptodora kindtii	F											
	Total Cladocera		**60**	**10**	**4**	**10**	**0**	**23**	**5**	**15**	**10**	**10**	**40**
Calanoid	Calanoida indet.	I-IV		3		15	15						640
Calanoid	Calanoida indet.	V				30	30		5	15	5	13	300
Calanoid	Heterocope septentrionalis	F	10	13		35	15	23	25	10	5	3	
Calanoid	Heterocope septentrionalis	M	15	3		55	20	17		5	15		
Calanoid	Leptodiaptomus pribilofensis	F	150	93	16	250	115	103	135	50	35	70	530
Calanoid	Leptodiaptomus pribilofensis	I-IV						13					
Calanoid	Leptodiaptomus pribilofensis	M	120	33	10	195	150	77	145	25	40	13	760
Calanoid	Leptodiaptomus pribilofensis	V	15	7		5		10					
Calanoid	Tropocyclops prasinus mexicanus	F											
	Total Calanoida		**310**	**153**	**26**	**585**	**345**	**243**	**310**	**105**	**100**	**100**	**2230**
Cyclopoid	Cyclopoida indet.	F									230	30	
Cyclopoid	Cyclopoida indet.	I-IV	490	330	284	1040	525	543	540	420		333	1600
Cyclopoid	Cyclopoida indet.	M		3							190	17	
Cyclopoid	Cyclopoida indet.	V	155	117	62	480	180	47	130	110		140	60
Cyclopoid	Cyclops scutifer	F	115	40	76	500	75	57	50	250		183	90
Cyclopoid	Cyclops scutifer	I-IV											
Cyclopoid	Cyclops scutifer	M	10	3	82	625		3	5	220		230	
Cyclopoid	Cyclops scutifer	V											
Cyclopoid	Diacyclops thomasi	F			8	45				30	25	50	
Cyclopoid	Diacyclops thomasi	I-IV									430		
Cyclopoid	Diacyclops thomasi	M			14	60			5	5	15	23	
Cyclopoid	Diacyclops thomasi	V									85		
Cyclopoid	Microcyclops sp.	F											
	Total Cyclopoida		**770**	**493**	**526**	**2750**	**780**	**650**	**730**	**1035**	**975**	**1007**	**1750**
Copepod	Calanoid indet.	nauplius	3367	4133	1133	4833	3100	2200	1700	1333	1433	833	4667
Copepod	Cyclopoid indet.	nauplius	100	167	233	600	100	100	900	800	800	600	133
Copepod	Copepoda indet.	nauplius											
	Total Copepod Nauplii		**3467**	**4300**	**1367**	**5433**	**3200**	**2300**	**2600**	**2133**	**2233**	**1433**	**4800**
	Total Crustacean Zooplankton		**4607**	**4957**	**1923**	**8778**	**4325**	**3216**	**3645**	**3288**	**3318**	**2550**	**8820**
Rotifer	Asplanchna sp.				100				100				
Rotifer	Collotheca sp.												
Rotifer	Conochilus sp.		4617	2600	1867	4267	2800	2167	2300	300	200	467	833
Rotifer	Kellicottia sp.		5667	5433	3500	13933	9467	2833	7000	3233	4167	3900	3367
Rotifer	Keratella sp.			100		200	200	100		100	67		
Rotifer	Polyarthra sp.		233	300	150	200	200	200	100	133	100	233	
Rotifer	Polyarthra sp.												
Rotifer	Rotifer indet.												
Rotifer	Synchaeta sp.												
	Total Rotifers		**10517**	**8433**	**5617**	**18600**	**12667**	**5300**	**9500**	**3767**	**4534**	**4600**	**4200**
	Total Zooplankton		**15123**	**13390**	**7539**	**27378**	**16992**	**8516**	**13145**	**7055**	**7852**	**7150**	**13020**

Zooplankton abundance data matrix, Azimuth Nunavut 2015

		Biologica #	15-25-19	15-25-20	15-25-21	15-25-22	15-25-23	15-25-24	15-25-24-QA	15-25-25	15-25-27
		Project	Nunavut	Nunavut	Nunavut	Nunavut	Nunavut	Nunavut	Nunavut	Nunavut	Nunavut
		Client ID	NEM-04-S	NEM-05-S	NEM-06-S	MAM-03-S	MAM-04-S	MAM-05-S	MAM-05-S-QA	MAM-06-S	DUP-1-September
		Date	8/23/2015	9/19/2015	9/19/2015	8/24/2015	8/24/2015	9/19/2015	9/19/2015	9/19/2015	9/19/2015
			Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)	Total Abundance (#/sample)
Major Group	**Taxon**	**Stage**									
Cladoceran	Bosmina sp.	F		1	10	33		3	3		3
Cladoceran	Daphnia ambigua	F									
Cladoceran	Daphnia middendorffiana	F		3		67	1			2	3
Cladoceran	Daphnia sp.	F						3	3	4	5
Cladoceran	Holopedium gibberum	F		1							
Cladoceran	Leptodora kindtii	F									
	Total Cladocera		**0**	**5**	**10**	**100**	**1**	**7**	**7**	**6**	**10**
Calanoid	Calanoida indet.	I-IV	530				4		7		
Calanoid	Calanoida indet.	V	240				1		3		
Calanoid	Heterocope septentrionalis	F	10	10	15	100	91	7		2	8
Calanoid	Heterocope septentrionalis	M				67	46	10	17	4	3
Calanoid	Leptodiaptomus pribilofensis	F	450	950	450	1300	5	150	157	94	63
Calanoid	Leptodiaptomus pribilofensis	I-IV									
Calanoid	Leptodiaptomus pribilofensis	M	470	710	535	2200	4	20	30	20	43
Calanoid	Leptodiaptomus pribilofensis	V				100	4			6	8
Calanoid	Tropocyclops prasinus mexicanus	F									
	Total Calanoida		**1700**	**1670**	**1000**	**3767**	**155**	**187**	**213**	**126**	**123**
Cyclopoid	Cyclopoida indet.	F								2	3
Cyclopoid	Cyclopoida indet.	I-IV	1550	1150	510	3500	145	397	343	256	
Cyclopoid	Cyclopoida indet.	M								8	8
Cyclopoid	Cyclopoida indet.	V	60	110	105	767	18	37	43	12	
Cyclopoid	Cyclops scutifer	F	60	20	15	233	12	113	107	80	148
Cyclopoid	Cyclops scutifer	I-IV									203
Cyclopoid	Cyclops scutifer	M	10				1	107	90	42	203
Cyclopoid	Cyclops scutifer	V									100
Cyclopoid	Diacyclops thomasi	F						7	13	8	15
Cyclopoid	Diacyclops thomasi	I-IV									
Cyclopoid	Diacyclops thomasi	M						7	17	4	10
Cyclopoid	Diacyclops thomasi	V									
Cyclopoid	Microcyclops sp.	F				67	1				
	Total Cyclopoida		**1680**	**1280**	**630**	**4567**	**177**	**667**	**613**	**412**	**688**
Copepod	Calanoid indet.	nauplius	5700	5400	4067	2033	2467	2100	2067	1100	367
Copepod	Cyclopoid indet.	nauplius	100	433	667	867	433	367	567	667	300
Copepod	Copepoda indet.	nauplius								100	
	Total Copepod Nauplii		**5800**	**5833**	**4733**	**2900**	**2900**	**2467**	**2633**	**1867**	**667**
	Total Crustacean Zooplankton		**9180**	**8788**	**6373**	**11333**	**3233**	**3327**	**3467**	**2411**	**1487**
Rotifer	Asplanchna sp.					100	100				
Rotifer	Collotheca sp.										
Rotifer	Conochilus sp.		633	100	100	3033	1667	333	433	500	500
Rotifer	Kellicottia sp.		3167	3300	4100	5133	3733	3567	3733	2567	3133
Rotifer	Keratella sp.			150	133	100	100	100	100		100
Rotifer	Polyarthra sp.			100					100	100	167
Rotifer	Polyarthra sp.										
Rotifer	Rotifer indet.										
Rotifer	Synchaeta sp.										
	Total Rotifers		**3800**	**3650**	**4333**	**8367**	**5600**	**4000**	**4367**	**3167**	**3900**
	Total Zooplankton		**12980**	**12438**	**10707**	**19700**	**8833**	**7327**	**7833**	**5577**	**5387**

Zooplankton DW and WW biomass data matrix, Azimuth Nunavut 2015

		Biologica #	Grand Total		15-25-01		15-25-02		15-25-03	
		Project	Nunavut		Nunavut		Nunavut		Nunavut	
		Client ID			WTN-01-S		WTN-02-S		WTS-01-S	
		Date			7/17/2015		7/17/2015		7/17/2015	
			Total Biomass		Total Biomass		Total Biomass		Total Biomass	
			WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)
Major Group	**Taxon**	**Stage**								
Cladoceran	Bosmina sp.	F	18.85	3.77	1.33	0.27	0.44	0.09	0.09	0.02
Cladoceran	Daphnia ambigua	F	0.03	0.00						
Cladoceran	Daphnia middendorffiana	F	32.77	6.55	2.12	0.42	5.30	1.06	0.74	0.15
Cladoceran	Daphnia sp.	F	2.26	0.45	0.60	0.12			0.02	0.00
Cladoceran	Holopedium gibberum	F	27.06	5.41	2.50	0.50	6.99	1.40	4.87	0.97
Cladoceran	Leptodora kindtii	F	2.71	0.54	2.08	0.42				
	Total Cladocera		**83.67**	**16.73**	**8.63**	**1.73**	**12.74**	**2.55**	**5.72**	**1.14**
Calanoid	Calanoida indet.	I-IV	728.69	28.76	25.56	1.01	14.60	0.58	6.08	0.24
Calanoid	Calanoida indet.	V	345.94	10.11						
Calanoid	Heterocope septentrionalis	F	184.88	36.98						
Calanoid	Heterocope septentrionalis	M	128.39	25.68						
Calanoid	Leptodiaptomus pribilofensis	F	2442.44	80.94						
Calanoid	Leptodiaptomus pribilofensis	I-IV	6.10	0.06						
Calanoid	Leptodiaptomus pribilofensis	M	2553.33	74.64						
Calanoid	Leptodiaptomus pribilofensis	V	70.48	2.06						
Calanoid	Tropocyclops prasinus mexicanus	F	1.37	0.04						
	Total Calanoida		**6461.63**	**259.27**	**25.56**	**1.01**	**14.60**	**0.58**	**6.08**	**0.24**
Cyclopoid	Cyclopoida indet.	F	6.67	1.33						
Cyclopoid	Cyclopoida indet.	I-IV	175.56	35.11	8.34	1.67	4.17	0.83	9.03	1.81
Cyclopoid	Cyclopoida indet.	M	8.51	1.70						
Cyclopoid	Cyclopoida indet.	V	118.80	23.76	4.03	0.81	5.04	1.01	11.35	2.27
Cyclopoid	Cyclops scutifer	F	274.33	54.87	26.77	5.35	11.58	2.32	18.09	3.62
Cyclopoid	Cyclops scutifer	I-IV	1.41	0.28						
Cyclopoid	Cyclops scutifer	M	124.87	24.97	13.48	2.70	12.19	2.44	12.19	2.44
Cyclopoid	Cyclops scutifer	V	2.52	0.21						
Cyclopoid	Diacyclops thomasi	F	6.48	1.30						
Cyclopoid	Diacyclops thomasi	I-IV	2.99	0.60						
Cyclopoid	Diacyclops thomasi	M	3.12	0.62						
Cyclopoid	Diacyclops thomasi	V	2.14	0.43						
Cyclopoid	Microcyclops sp.	F	0.33	0.07						
	Total Cyclopoida		**727.73**	**145.26**	**52.63**	**10.53**	**32.97**	**6.59**	**50.65**	**10.13**
Copepod	Calanoid	nauplius	23.63	1.30	1.93	0.00	1.87	0.00	2.40	0.01
Copepod	Cyclopoid	nauplius	6.50	4.73	0.01	0.39	0.01	0.37	0.03	0.48
Copepod	Copepoda indet.	nauplius	0.73	0.15	0.02	0.00	0.19	0.04	0.09	0.02
	Total Copepod Nauplii		**30.87**	**6.17**	**1.96**	**0.39**	**2.07**	**0.41**	**2.52**	**0.50**
	Total Crustacean Zooplankton		**7303.90**	**427.44**	**88.78**	**13.65**	**62.39**	**10.13**	**64.98**	**12.02**
Rotifer	Asplanchna sp.		1.07	0.04	0.13	0.01			0.13	0.01
Rotifer	Collotheca sp.		0.36	0.04	0.36	0.04				
Rotifer	Conochilus sp.		88.83	8.88	6.33	0.63	3.02	0.30	4.19	0.42
Rotifer	Kellicottia sp.		1652.06	165.21	39.65	3.97	16.70	1.67	41.32	4.13
Rotifer	Keratella sp.		1.78	0.18						
Rotifer	Polyarthra sp.		2.64	0.26						
Rotifer	Rotifer indet.		0.00	0.00	0.00	0.00			0.00	0.00
Rotifer	Synchaeta sp.		50.07	5.01					6.26	0.63
	Total Rotifera		**1796.80**	**179.61**	**46.48**	**4.64**	**19.72**	**1.97**	**51.90**	**5.18**
	Total Zooplankton		**9100.70**	**607.05**	**135.26**	**18.29**	**82.10**	**12.10**	**116.88**	**17.20**

Zooplankton DW and WW biomass data matrix, Azimuth Nunavut 2015

		Biologica #	15-25-04		15-25-05		15-25-06		15-25-07		15-25-08	
		Project	Nunavut		Nunavut		Nunavut		Nunavut		Nunavut	
		Client ID	WTS-02-S		NEM-01-S		NEM-02-S		MAM-01-S		MAM-02-S	
		Date	7/17/2015		7/18/2015		7/18/2015		7/18/2015		7/18/2015	
			Total Biomass		Total Biomass		Total Biomass		Total Biomass		Total Biomass	
			WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)
Major Group	**Taxon**	**Stage**										
Cladoceran	Bosmina sp.	F			0.36	0.07	0.09	0.02	0.31	0.06	8.44	1.69
Cladoceran	Daphnia ambigua	F										
Cladoceran	Daphnia middendorffiana	F	0.11	0.02	3.18	0.64	0.85	0.17			1.06	0.21
Cladoceran	Daphnia sp.	F	0.02	0.00	0.14	0.03	0.12	0.02			0.20	0.04
Cladoceran	Holopedium gibberum	F	1.00	0.20	0.75	0.15	1.25	0.25	0.30	0.06	2.50	0.50
Cladoceran	Leptodora kindtii	F			0.21	0.04			0.21	0.04		
	Total Cladocera		**1.12**	**0.22**	**4.64**	**0.93**	**2.31**	**0.46**	**0.82**	**0.16**	**12.19**	**2.44**
Calanoid	Calanoida indet.	I-IV	3.65	0.14	233.65	9.22	212.96	8.40	7.79	0.31	14.60	0.58
Calanoid	Calanoida indet.	V							4.11	0.12	9.14	0.27
Calanoid	Heterocope septentrionalis	F										
Calanoid	Heterocope septentrionalis	M										
Calanoid	Leptodiaptomus pribilofensis	F										
Calanoid	Leptodiaptomus pribilofensis	I-IV										
Calanoid	Leptodiaptomus pribilofensis	M										
Calanoid	Leptodiaptomus pribilofensis	V										
Calanoid	Tropocyclops prasinus mexicanus	F					1.37	0.04				
	Total Calanoida		**3.65**	**0.14**	**233.65**	**9.22**	**214.33**	**8.45**	**11.90**	**0.43**	**23.75**	**0.84**
Cyclopoid	Cyclopoida indet.	F										
Cyclopoid	Cyclopoida indet.	I-IV	8.06	1.61	7.09	1.42	13.68	2.74	0.11	0.02	2.15	0.43
Cyclopoid	Cyclopoida indet.	M					0.25	0.05	0.05	0.01		
Cyclopoid	Cyclopoida indet.	V	5.04	1.01	1.76	0.35	3.03	0.61	0.50	0.10	2.02	0.40
Cyclopoid	Cyclops scutifer	F	14.47	2.89	25.32	5.06	14.83	2.97	1.41	0.28	30.03	6.01
Cyclopoid	Cyclops scutifer	I-IV										
Cyclopoid	Cyclops scutifer	M	8.30	1.66	4.67	0.93	1.56	0.31	0.39	0.08	5.19	1.04
Cyclopoid	Cyclops scutifer	V										
Cyclopoid	Diacyclops thomasi	F										
Cyclopoid	Diacyclops thomasi	I-IV										
Cyclopoid	Diacyclops thomasi	M										
Cyclopoid	Diacyclops thomasi	V										
Cyclopoid	Microcyclops sp.	F										
	Total Cyclopoida		**35.87**	**7.17**	**38.84**	**7.77**	**33.35**	**6.67**	**2.47**	**0.49**	**39.38**	**7.88**
Copepod	Calanoid	nauplius	0.47	0.01	1.81	0.04	1.39	0.11	1.36	0.01	0.66	0.00
Copepod	Cyclopoid	nauplius	0.03	0.09	0.22	0.36	0.57	0.28	0.04	0.27	0.01	0.13
Copepod	Copepoda indet.	nauplius	0.19	0.04	0.02	0.00	0.02	0.00	0.12	0.02		
	Total Copepod Nauplii		**0.69**	**0.14**	**2.05**	**0.41**	**1.99**	**0.40**	**1.52**	**0.30**	**0.66**	**0.13**
	Total Crustacean Zooplankton		**41.34**	**7.68**	**279.18**	**18.33**	**251.98**	**15.97**	**16.71**	**1.39**	**75.99**	**11.29**
Rotifer	Asplanchna sp.											
Rotifer	Collotheca sp.											
Rotifer	Conochilus sp.		0.78	0.08	1.75	0.18	1.41	0.14	3.75	0.38	10.23	1.02
Rotifer	Kellicottia sp.		30.05	3.01	37.98	3.80	43.41	4.34	23.37	2.34	80.14	8.01
Rotifer	Keratella sp.											
Rotifer	Polyarthra sp.		0.07	0.01	0.07	0.01			0.10	0.01	0.14	0.01
Rotifer	Rotifer indet.		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Rotifer	Synchaeta sp.		15.65	1.56							3.13	0.31
	Total Rotifera		**46.55**	**4.66**	**39.81**	**3.98**	**44.82**	**4.48**	**27.22**	**2.72**	**93.64**	**9.36**
	Total Zooplankton		**87.89**	**12.34**	**318.99**	**22.31**	**296.80**	**20.46**	**43.93**	**4.11**	**169.63**	**20.66**

Zooplankton DW and WW biomass data matrix, Azimuth Nunavut 2015

		Biologica #	15-25-08 - QA		15-25-09		15-25-10		15-25-11		15-25-12	
		Project	Nunavut		Nunavut		Nunavut		Nunavut		Nunavut	
		Client ID	MAM-02-S		DUP-July-Amaruq		WTN-03-S		WTN-04-S		WTN-05-S	
		Date	7/18/2015		(blank)		8/22/2015		8/22/2015		9/18/2015	
			Total Biomass		Total Biomass		Total Biomass		Total Biomass		Total Biomass	
			WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)
Major Group	**Taxon**	**Stage**										
Cladoceran	Bosmina sp.	F	4.88	0.98	0.09	0.02						
Cladoceran	Daphnia ambigua	F			0.03	0.00						
Cladoceran	Daphnia middendorffiana	F	1.06	0.21	0.11	0.02	2.12	0.42	0.35	0.07		
Cladoceran	Daphnia sp.	F	0.20	0.04							0.08	0.02
Cladoceran	Holopedium gibberum	F	3.87	0.77	2.25	0.45	0.50	0.10	0.08	0.02		
Cladoceran	Leptodora kindtii	F			0.21	0.04						
	Total Cladocera		**10.02**	**2.00**	**2.68**	**0.53**	**2.62**	**0.52**	**0.44**	**0.09**	**0.08**	**0.02**
Calanoid	Calanoida indet.	I-IV	13.39	0.53	48.68	1.92			0.41	0.02		
Calanoid	Calanoida indet.	V	32.00	0.94								
Calanoid	Heterocope septentrionalis	F					4.71	0.94	6.29	1.26		
Calanoid	Heterocope septentrionalis	M					6.86	1.37	1.52	0.30		
Calanoid	Leptodiaptomus pribilofensis	F					70.72	2.34	44.00	1.46	7.54	0.25
Calanoid	Leptodiaptomus pribilofensis	I-IV										
Calanoid	Leptodiaptomus pribilofensis	M					54.86	1.60	15.24	0.45	4.57	0.13
Calanoid	Leptodiaptomus pribilofensis	V					6.86	0.20	3.05	0.09		
Calanoid	Tropocyclops prasinus mexicanus	F										
	Total Calanoida		**45.39**	**1.46**	**48.68**	**1.92**	**144.01**	**6.46**	**70.50**	**3.57**	**12.11**	**0.38**
Cyclopoid	Cyclopoida indet.	F										
Cyclopoid	Cyclopoida indet.	I-IV	2.22	0.44	23.76	4.75	3.40	0.68	2.29	0.46	1.97	0.39
Cyclopoid	Cyclopoida indet.	M			2.52	0.50			0.08	0.02		
Cyclopoid	Cyclopoida indet.	V	1.51	0.30	18.15	3.63	3.91	0.78	2.94	0.59	1.56	0.31
Cyclopoid	Cyclops scutifer	F	31.11	6.22	20.26	4.05	4.16	0.83	1.45	0.29	2.75	0.55
Cyclopoid	Cyclops scutifer	I-IV										
Cyclopoid	Cyclops scutifer	M	8.04	1.61	16.60	3.32	0.26	0.05	0.09	0.02	2.13	0.43
Cyclopoid	Cyclops scutifer	V										
Cyclopoid	Diacyclops thomasi	F									0.25	0.05
Cyclopoid	Diacyclops thomasi	I-IV										
Cyclopoid	Diacyclops thomasi	M									0.29	0.06
Cyclopoid	Diacyclops thomasi	V										
Cyclopoid	Microcyclops sp.	F										
	Total Cyclopoida		**42.89**	**8.58**	**81.29**	**16.26**	**11.73**	**2.35**	**6.85**	**1.37**	**8.96**	**1.79**
Copepod	Calanoid	nauplius	2.07	0.00	1.01	0.01	0.09	0.07	0.15	0.08	0.21	0.02
Copepod	Cyclopoid	nauplius	0.02	0.41	0.03	0.20	0.34	0.02	0.41	0.03	0.11	0.04
Copepod	Copepoda indet.	nauplius										
	Total Copepod Nauplii		**2.10**	**0.42**	**1.04**	**0.21**	**0.43**	**0.09**	**0.56**	**0.11**	**0.32**	**0.06**
	Total Crustacean Zooplankton		**100.39**	**12.46**	**133.68**	**18.92**	**158.79**	**9.42**	**78.35**	**5.14**	**21.47**	**2.25**
Rotifer	Asplanchna sp.										0.20	0.01
Rotifer	Collotheca sp.											
Rotifer	Conochilus sp.		12.23	1.22	1.27	0.13	6.75	0.67	3.80	0.38	2.73	0.27
Rotifer	Kellicottia sp.		65.53	6.55	44.24	4.42	70.96	7.10	68.04	6.80	43.83	4.38
Rotifer	Keratella sp.				0.04	0.00			0.11	0.01		
Rotifer	Polyarthra sp.		0.33	0.03	0.17	0.02	0.17	0.02	0.21	0.02	0.11	0.01
Rotifer	Rotifer indet.											
Rotifer	Synchaeta sp.		9.39	0.94	15.65	1.56						
	Total Rotifera		**87.48**	**8.75**	**61.36**	**6.14**	**77.87**	**7.79**	**72.16**	**7.22**	**46.86**	**4.67**
	Total Zooplankton		**187.87**	**21.21**	**195.04**	**25.06**	**236.66**	**17.21**	**150.51**	**12.36**	**68.33**	**6.93**

Zooplankton DW and WW biomass data matrix, Azimuth Nunavut 2015

		Biologica #	15-25-13		15-25-14		15-25-15		15-25-16		15-25-16-QA	
		Project	Nunavut		Nunavut		Nunavut		Nunavut		Nunavut	
		Client ID	WTN-06-S		**WTS-03-S		WTS-04-S		WTS-05-S		WTS-05-S	
		Date	9/18/2015		8/22/2015		8/21/2015		9/18/2015		9/18/2015	
			Total Biomass		Total Biomass		Total Biomass		Total Biomass		Total Biomass	
			WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)
Major Group	**Taxon**	**Stage**										
Cladoceran	Bosmina sp.	F										
Cladoceran	Daphnia ambigua	F										
Cladoceran	Daphnia middendorffiana	F					0.53	0.11	1.06	0.21	0.53	0.11
Cladoceran	Daphnia sp.	F	0.20	0.04					0.10	0.02	0.20	0.10
Cladoceran	Holopedium gibberum	F										
Cladoceran	Leptodora kindtii	F										
	Total Cladocera		**0.20**	**0.04**	**0.00**	**0.00**	**0.53**	**0.11**	**1.16**	**0.23**	**0.73**	**0.21**
Calanoid	Calanoida indet.	I-IV	1.83	0.07	1.83	0.07						
Calanoid	Calanoida indet.	V	13.72	0.40	13.72	0.40	2.29	0.07	6.86	0.20	2.29	0.07
Calanoid	Heterocope septentrionalis	F	16.50	3.30	7.07	1.41	11.79	2.36	4.71	0.94	2.36	0.42
Calanoid	Heterocope septentrionalis	M	25.15	5.03	9.14	1.83			2.29	0.46	6.86	1.37
Calanoid	Leptodiaptomus pribilofensis	F	117.86	3.91	54.22	1.80	63.64	2.11	23.57	0.78	16.50	0.55
Calanoid	Leptodiaptomus pribilofensis	I-IV										
Calanoid	Leptodiaptomus pribilofensis	M	89.15	2.61	68.58	2.00	66.29	1.94	11.43	0.33	18.29	0.53
Calanoid	Leptodiaptomus pribilofensis	V	2.29	0.07								
Calanoid	Tropocyclops prasinus mexicanus	F										
	Total Calanoida		**266.48**	**15.38**	**154.55**	**7.52**	**144.01**	**6.47**	**48.86**	**2.72**	**46.29**	**2.94**
Cyclopoid	Cyclopoida indet.	F									5.80	1.16
Cyclopoid	Cyclopoida indet.	I-IV	7.22	1.44	3.65	0.73	3.75	0.75	2.92	0.58		
Cyclopoid	Cyclopoida indet.	M									4.79	0.96
Cyclopoid	Cyclopoida indet.	V	12.10	2.42	4.54	0.91	3.28	0.66	2.77	0.55		
Cyclopoid	Cyclops scutifer	F	18.09	3.62	2.71	0.54	1.81	0.36	9.04	1.81		
Cyclopoid	Cyclops scutifer	I-IV										
Cyclopoid	Cyclops scutifer	M	16.21	3.24			0.13	0.03	5.70	1.14		
Cyclopoid	Cyclops scutifer	V										
Cyclopoid	Diacyclops thomasi	F	1.42	0.28					0.94	0.19	0.79	0.16
Cyclopoid	Diacyclops thomasi	I-IV									2.99	0.60
Cyclopoid	Diacyclops thomasi	M	1.25	0.25			0.10	0.02	0.10	0.02	0.31	0.06
Cyclopoid	Diacyclops thomasi	V									2.14	0.43
Cyclopoid	Microcyclops sp.	F										
	Total Cyclopoida		**56.29**	**11.26**	**10.90**	**2.18**	**9.07**	**1.81**	**21.49**	**4.30**	**16.82**	**3.36**
Copepod	Calanoid	nauplius	0.53	0.10	0.09	0.06	0.80	0.03	0.71	0.03	0.71	0.14
Copepod	Cyclopoid	nauplius	0.48	0.11	0.31	0.02	0.17	0.16	0.13	0.14	0.14	0.03
Copepod	Copepoda indet.	nauplius										
	Total Copepod Nauplii		**1.02**	**0.20**	**0.40**	**0.08**	**0.97**	**0.19**	**0.84**	**0.17**	**0.85**	**0.17**
	Total Crustacean Zooplankton		**323.99**	**26.88**	**165.85**	**9.78**	**154.58**	**8.59**	**72.35**	**7.41**	**64.69**	**6.68**
Rotifer	Asplanchna sp.						0.20	0.01				
Rotifer	Collotheca sp.											
Rotifer	Conochilus sp.		6.24	0.62	4.09	0.41	3.36	0.34	0.44	0.04	0.29	0.03
Rotifer	Kellicottia sp.		174.47	17.45	118.54	11.85	87.65	8.77	40.49	4.05	52.17	5.22
Rotifer	Keratella sp.		0.21	0.02	0.21	0.02			0.11	0.01	0.07	0.01
Rotifer	Polyarthra sp.		0.14	0.01	0.14	0.01	0.07	0.01	0.10	0.01	0.07	0.01
Rotifer	Rotifer indet.											
Rotifer	Synchaeta sp.											
	Total Rotifera		**181.06**	**18.11**	**122.99**	**12.30**	**91.29**	**9.12**	**41.13**	**4.11**	**52.61**	**5.26**
	Total Zooplankton		**505.05**	**44.99**	**288.84**	**22.08**	**245.87**	**17.70**	**113.48**	**11.53**	**117.30**	**11.94**

Zooplankton DW and WW biomass data matrix, Azimuth Nunavut 2015

		Biologica #	15-25-17		15-25-18		15-25-19		15-25-20		15-25-21	
		Project	Nunavut		Nunavut		Nunavut		Nunavut		Nunavut	
		Client ID	WTS-06-S		NEM-03-S		NEM-04-S		NEM-05-S		NEM-06-S	
		Date	9/18/2015		8/23/2015		8/23/2015		9/19/2015		9/19/2015	
			Total Biomass		Total Biomass		Total Biomass		Total Biomass		Total Biomass	
			WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)
Major Group	**Taxon**	**Stage**										
Cladoceran	Bosmina sp.	F			0.44	0.09			0.04	0.01	0.44	0.09
Cladoceran	Daphnia ambigua	F										
Cladoceran	Daphnia middendorffiana	F	1.06	0.21	3.18	0.64			0.32	0.06		
Cladoceran	Daphnia sp.	F										
Cladoceran	Holopedium gibberum	F							0.01	0.00		
Cladoceran	Leptodora kindtii	F										
	Total Cladocera		**1.06**	**0.21**	**3.63**	**0.73**	**0.00**	**0.00**	**0.38**	**0.08**	**0.44**	**0.09**
Calanoid	Calanoida indet.	I-IV			77.88	3.07	64.50	2.55				
Calanoid	Calanoida indet.	V	6.10	0.18	137.16	4.01	109.73	3.21				
Calanoid	Heterocope septentrionalis	F	1.57	0.31			4.71	0.94	4.71	0.94	7.07	1.41
Calanoid	Heterocope septentrionalis	M										
Calanoid	Leptodiaptomus pribilofensis	F	33.00	1.09	249.86	8.28	212.15	7.03	447.87	14.84	212.15	7.03
Calanoid	Leptodiaptomus pribilofensis	I-IV										
Calanoid	Leptodiaptomus pribilofensis	M	6.10	0.18	347.46	10.16	214.88	6.28	324.61	9.49	244.60	7.15
Calanoid	Leptodiaptomus pribilofensis	V										
Calanoid	Tropocyclops prasinus mexicanus	F										
	Total Calanoida		**46.76**	**1.76**	**812.37**	**25.52**	**605.96**	**20.01**	**777.19**	**25.27**	**463.82**	**15.59**
Cyclopoid	Cyclopoida indet.	F	0.76	0.15								
Cyclopoid	Cyclopoida indet.	I-IV	2.32	0.46	11.11	2.22	10.77	2.15	7.99	1.60	3.54	0.71
Cyclopoid	Cyclopoida indet.	M	0.42	0.08								
Cyclopoid	Cyclopoida indet.	V	3.53	0.71	1.51	0.30	1.51	0.30	2.77	0.55	2.65	0.53
Cyclopoid	Cyclops scutifer	F	6.63	1.33	3.26	0.65	2.17	0.43	0.72	0.14	0.54	0.11
Cyclopoid	Cyclops scutifer	I-IV										
Cyclopoid	Cyclops scutifer	M	5.96	1.19			0.26	0.05				
Cyclopoid	Cyclops scutifer	V										
Cyclopoid	Diacyclops thomasi	F	1.57	0.31								
Cyclopoid	Diacyclops thomasi	I-IV										
Cyclopoid	Diacyclops thomasi	M	0.49	0.10								
Cyclopoid	Diacyclops thomasi	V										
Cyclopoid	Microcyclops sp.	F										
	Total Cyclopoida		**21.68**	**4.34**	**15.88**	**3.18**	**14.71**	**2.94**	**11.49**	**2.30**	**6.73**	**1.35**
Copepod	Calanoid	nauplius	0.53	0.02	0.12	0.09	0.09	0.11	0.39	0.11	0.59	0.08
Copepod	Cyclopoid	nauplius	0.08	0.11	0.47	0.02	0.57	0.02	0.54	0.08	0.41	0.12
Copepod	Copepoda indet.	nauplius										
	Total Copepod Nauplii		**0.62**	**0.12**	**0.59**	**0.12**	**0.66**	**0.13**	**0.93**	**0.19**	**1.00**	**0.20**
	Total Crustacean Zooplankton		**70.12**	**6.44**	**832.46**	**29.54**	**621.33**	**23.08**	**789.97**	**27.83**	**471.99**	**17.23**
Rotifer	Asplanchna sp.											
Rotifer	Collotheca sp.											
Rotifer	Conochilus sp.		0.68	0.07	1.22	0.12	0.93	0.09	0.15	0.01	0.15	0.01
Rotifer	Kellicottia sp.		48.84	4.88	42.16	4.22	39.65	3.97	41.32	4.13	51.34	5.13
Rotifer	Keratella sp.								0.16	0.02	0.14	0.01
Rotifer	Polyarthra sp.		0.17	0.02					0.07	0.01		
Rotifer	Rotifer indet.											
Rotifer	Synchaeta sp.											
	Total Rotifera		**49.68**	**4.97**	**43.37**	**4.34**	**40.58**	**4.06**	**41.70**	**4.17**	**51.63**	**5.16**
	Total Zooplankton		**119.80**	**11.40**	**875.84**	**33.88**	**661.91**	**27.14**	**831.67**	**32.00**	**523.62**	**22.39**

Zooplankton DW and WW biomass data matrix, Azimuth Nunavut 2015

		Biologica #	15-25-22		15-25-23		15-25-24		15-25-24-QA		15-25-25	
		Project	Nunavut		Nunavut		Nunavut		Nunavut		Nunavut	
		Client ID	MAM-03-S		MAM-04-S		MAM-05-S		MAM-05-S		MAM-06-S	
		Date	8/24/2015		8/24/2015		9/19/2015		9/19/2015		9/19/2015	
			Total Biomass		Total Biomass		Total Biomass		Total Biomass		Total Biomass	
			WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)
Major Group	**Taxon**	**Stage**										
Cladoceran	Bosmina sp.	F	1.48	0.30			0.15	0.03	0.15	0.03		
Cladoceran	Daphnia ambigua	F										
Cladoceran	Daphnia middendorffiana	F	7.07	1.41	0.11	0.02					0.21	0.04
Cladoceran	Daphnia sp.	F					0.07	0.01	0.07	0.01	0.08	0.02
Cladoceran	Holopedium gibberum	F										
Cladoceran	Leptodora kindtii	F										
	Total Cladocera		**8.55**	**1.71**	**0.11**	**0.02**	**0.21**	**0.04**	**0.21**	**0.04**	**0.29**	**0.06**
Calanoid	Calanoida indet.	I-IV			0.49	0.02			0.81	0.03		
Calanoid	Calanoida indet.	V			0.46	0.01			1.52	0.04		
Calanoid	Heterocope septentrionalis	F	47.14	9.43	42.90	8.58	3.14	0.63			0.94	0.19
Calanoid	Heterocope septentrionalis	M	30.48	6.10	21.03	4.21	4.57	0.91	7.62	1.52	1.83	0.37
Calanoid	Leptodiaptomus pribilofensis	F	612.87	20.31	2.36	0.08	70.72	2.34	73.86	2.45	44.32	1.47
Calanoid	Leptodiaptomus pribilofensis	I-IV										
Calanoid	Leptodiaptomus pribilofensis	M	1005.82	29.40	1.83	0.05	9.14	0.27	13.72	0.40	9.14	0.27
Calanoid	Leptodiaptomus pribilofensis	V	45.72	1.34	1.83	0.05					2.74	0.08
Calanoid	Tropocyclops prasinus mexicanus	F										
	Total Calanoida		**1742.03**	**66.57**	**70.89**	**13.00**	**87.57**	**4.15**	**97.53**	**4.45**	**58.97**	**2.37**
Cyclopoid	Cyclopoida indet.	F									0.05	0.01
Cyclopoid	Cyclopoida indet.	I-IV	24.31	4.86	1.01	0.20	2.76	0.55	2.39	0.48	1.78	0.36
Cyclopoid	Cyclopoida indet.	M									0.20	0.04
Cyclopoid	Cyclopoida indet.	V	19.33	3.87	0.45	0.09	0.92	0.18	1.09	0.22	0.30	0.06
Cyclopoid	Cyclops scutifer	F	8.44	1.69	0.43	0.09	4.10	0.82	3.86	0.77	2.89	0.58
Cyclopoid	Cyclops scutifer	I-IV										
Cyclopoid	Cyclops scutifer	M			0.03	0.01	2.77	0.55	2.33	0.47	1.09	0.22
Cyclopoid	Cyclops scutifer	V										
Cyclopoid	Diacyclops thomasi	F					0.21	0.04	0.42	0.08	0.25	0.05
Cyclopoid	Diacyclops thomasi	I-IV										
Cyclopoid	Diacyclops thomasi	M					0.14	0.03	0.35	0.07	0.08	0.02
Cyclopoid	Diacyclops thomasi	V										
Cyclopoid	Microcyclops sp.	F	0.32	0.06	0.00	0.00						
	Total Cyclopoida		**52.41**	**10.48**	**1.93**	**0.39**	**10.89**	**2.18**	**10.44**	**2.09**	**6.65**	**1.33**
Copepod	Calanoid	nauplius	0.77	0.04	0.39	0.05	0.33	0.04	0.50	0.04	0.59	0.02
Copepod	Cyclopoid	nauplius	0.20	0.15	0.25	0.08	0.21	0.07	0.21	0.10	0.11	0.12
Copepod	Copepoda indet.	nauplius									0.07	0.01
	Total Copepod Nauplii		**0.97**	**0.19**	**0.63**	**0.13**	**0.54**	**0.11**	**0.71**	**0.14**	**0.77**	**0.15**
	Total Crustacean Zooplankton		**1803.96**	**78.96**	**73.55**	**13.54**	**99.22**	**6.48**	**108.89**	**6.72**	**66.69**	**3.91**
Rotifer	Asplanchna sp.		0.20	0.01	0.20	0.01						
Rotifer	Collotheca sp.											
Rotifer	Conochilus sp.		4.43	0.44	2.44	0.24	0.49	0.05	0.63	0.06	0.73	0.07
Rotifer	Kellicottia sp.		64.28	6.43	46.75	4.67	44.66	4.47	46.75	4.67	32.14	3.21
Rotifer	Keratella sp.		0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.01		
Rotifer	Polyarthra sp.								0.07	0.01	0.07	0.01
Rotifer	Rotifer indet.											
Rotifer	Synchaeta sp.											
	Total Rotifera		**69.02**	**6.89**	**49.49**	**4.94**	**45.25**	**4.53**	**47.56**	**4.76**	**32.94**	**3.29**
	Total Zooplankton		**1872.98**	**85.85**	**123.04**	**18.47**	**144.47**	**11.01**	**156.45**	**11.48**	**99.63**	**7.21**

Zooplankton DW and WW biomass data matrix, Azimuth Nunavut 2015

		Biologica #	15-25-26		15-25-27	
		Project	Nunavut		Nunavut	
		Client ID	**DUP-1		DUP-1-September	
		Date	9/24/2015		9/19/2015	
			Total Biomass		Total Biomass	
			WW (mg/sample)	DW (mg/sample)	WW (mg/sample)	DW (mg/sample)
Major Group	**Taxon**	**Stage**				
Cladoceran	Bosmina sp.	F			0.11	0.02
Cladoceran	Daphnia ambigua	F				
Cladoceran	Daphnia middendorffiana	F	0.35	0.07	0.27	0.05
Cladoceran	Daphnia sp.	F	0.07	0.01	0.10	0.02
Cladoceran	Holopedium gibberum	F	0.20	0.04		
Cladoceran	Leptodora kindtii	F				
	Total Cladocera		**0.62**	**0.12**	**0.48**	**0.10**
Calanoid	Calanoida indet.	I-IV				
Calanoid	Calanoida indet.	V				
Calanoid	Heterocope septentrionalis	F	11.00	2.20	3.54	0.71
Calanoid	Heterocope septentrionalis	M	7.62	1.52	1.14	0.23
Calanoid	Leptodiaptomus pribilofensis	F	48.72	1.61	29.46	0.98
Calanoid	Leptodiaptomus pribilofensis	I-IV	6.10	0.06		
Calanoid	Leptodiaptomus pribilofensis	M	35.05	1.02	19.43	0.57
Calanoid	Leptodiaptomus pribilofensis	V	4.57	0.13	3.43	0.10
Calanoid	Tropocyclops prasinus mexicanus	F				
	Total Calanoida		**113.05**	**6.56**	**57.00**	**2.58**
Cyclopoid	Cyclopoida indet.	F			0.06	0.01
Cyclopoid	Cyclopoida indet.	I-IV	3.77	0.75		
Cyclopoid	Cyclopoida indet.	M			0.19	0.04
Cyclopoid	Cyclopoida indet.	V	1.18	0.24		
Cyclopoid	Cyclops scutifer	F	2.05	0.41	5.34	1.07
Cyclopoid	Cyclops scutifer	I-IV			1.41	0.28
Cyclopoid	Cyclops scutifer	M	0.09	0.02	5.25	1.05
Cyclopoid	Cyclops scutifer	V			2.52	0.21
Cyclopoid	Diacyclops thomasi	F			0.47	0.09
Cyclopoid	Diacyclops thomasi	I-IV				
Cyclopoid	Diacyclops thomasi	M			0.21	0.04
Cyclopoid	Diacyclops thomasi	V				
Cyclopoid	Microcyclops sp.	F				
	Total Cyclopoida		**7.09**	**1.42**	**15.45**	**2.80**
Copepod	Calanoid	nauplius	0.09	0.04	0.27	0.01
Copepod	Cyclopoid	nauplius	0.22	0.02	0.04	0.05
Copepod	Copepoda indet.	nauplius				
	Total Copepod Nauplii		**0.31**	**0.06**	**0.30**	**0.06**
	Total Crustacean Zooplankton		**121.07**	**8.16**	**73.23**	**5.54**
Rotifer	Asplanchna sp.					
Rotifer	Collotheca sp.					
Rotifer	Conochilus sp.		3.17	0.32	0.73	0.07
Rotifer	Kellicottia sp.		35.48	3.55	39.24	3.92
Rotifer	Keratella sp.		0.11	0.01	0.11	0.01
Rotifer	Polyarthra sp.		0.14	0.01	0.12	0.01
Rotifer	Rotifer indet.					
Rotifer	Synchaeta sp.					
	Total Rotifera		**38.89**	**3.89**	**40.19**	**4.02**
	Total Zooplankton		**159.96**	**12.05**	**113.42**	**9.56**

Zooplankton per-sample taxonomic presence/absence, zooplankton taxonomic richness, Azimuth Nunavut 2015

	Biologica #	**Grand Total**	**15-25-01**	**15-25-02**	**15-25-03**	**15-25-04**	**15-25-05**	**15-25-06**
	Project	**Nunavut**	**Nunavut**	**Nunavut**	**Nunavut**	**Nunavut**	**Nunavut**	**Nunavut**
	Client ID		**WTN-01-S**	**WTN-02-S**	**WTS-01-S**	**WTS-02-S**	**NEM-01-S**	**NEM-02-S**
	Date		**7/17/2015**	**7/17/2015**	**7/17/2015**	**7/17/2015**	**7/18/2015**	**7/18/2015**
		Presence	**Presence**	**Presence**	**Presence**	**Presence**	**Presence**	**Presence**
		Present - Shaded	**Present - Shaded**	**Present - Shaded**	**Present - Shaded**	**Present - Shaded**	**Present - Shaded**	**Present - Shaded**
Major Group	Taxon							
Cladoceran	Bosmina sp.	■	■	■	■		■	■
Cladoceran	Daphnia ambigua	■						
Cladoceran	Daphnia middendorffiana	■	■	■	■	■	■	■
Cladoceran	Daphnia sp.	■	■		■	■	■	■
Cladoceran	Holopedium gibberum	■	■	■	■	■	■	■
Cladoceran	Leptodora kindtii	■	■				■	
Calanoid	Heterocope septentrionalis	■						
Calanoid	Leptodiaptomus pribilofensis	■						
Calanoid	Tropocyclops prasinus mexicanus	■						■
Cyclopoid	Cyclops scutifer	■						
Cyclopoid	Diacyclops thomasi	■						
Cyclopoid	Microcyclops sp.	■						
Rotifer	Asplanchna sp.	■	■		■			
Rotifer	Collotheca sp.	■	■					
Rotifer	Conochilus sp.	■	■	■	■	■	■	■
Rotifer	Kellicottia sp.	■	■	■	■	■	■	■
Rotifer	Keratella sp.	■						
Rotifer	Polyarthra sp.	■						
Rotifer	Rotifer indet.	■	■		■		■	■
Rotifer	Synchaeta sp.	■			■	■		
	Total Zooplankton	20	10	5	9	6	8	8

Zooplankton per-sample taxonomic presence/absence, zooplankton taxonomic richness, Azimuth Nunavut 2015

	Biologica #	**15-25-07**	**15-25-08**	**15-25-08 - QA**	**15-25-09**	**15-25-10**	**15-25-11**	**15-25-12**
	Project	**Nunavut**	**Nunavut**	**Nunavut**	**Nunavut**	**Nunavut**	**Nunavut**	**Nunavut**
	Client ID	**MAM-01-S**	**MAM-02-S**	**MAM-02-S**	**DUP-July-Amaruq**	**WTN-03-S**	**WTN-04-S**	**WTN-05-S**
	Date	**7/18/2015**	**7/18/2015**	**7/18/2015**		**8/22/2015**	**8/22/2015**	**9/18/2015**
		Presence	**Presence**	**Presence**	**Presence**	**Presence**	**Presence**	**Presence**
		Present - Shaded	**Present - Shaded**	**Present - Shaded**	**Present - Shaded**	**Present - Shaded**	**Present - Shaded**	**Present - Shaded**
Major Group	Taxon							
Cladoceran	Bosmina sp.	■	■	■	■			
Cladoceran	Daphnia ambigua				■			
Cladoceran	Daphnia middendorffiana		■	■	■	■	■	
Cladoceran	Daphnia sp.		■	■				■
Cladoceran	Holopedium gibberum	■	■	■	■	■	■	
Cladoceran	Leptodora kindtii	■			■			
Calanoid	Heterocope septentrionalis					■	■	
Calanoid	Leptodiaptomus pribilofensis					■	■	
Calanoid	Tropocyclops prasinus mexicanus							
Cyclopoid	Cyclops scutifer							
Cyclopoid	Diacyclops thomasi							
Cyclopoid	Microcyclops sp.							
Rotifer	Asplanchna sp.							■
Rotifer	Collotheca sp.							
Rotifer	Conochilus sp.	■	■	■	■	■	■	■
Rotifer	Kellicottia sp.	■	■	■	■	■	■	■
Rotifer	Keratella sp.				■		■	
Rotifer	Polyarthra sp.			■		■	■	■
Rotifer	Rotifer indet.	■						
Rotifer	Synchaeta sp.		■	■	■			
	Total Zooplankton	6	7	8	9	7	8	5

Zooplankton per-sample taxonomic presence/absence, zooplankton taxonomic richness, Azimuth Nunavut 2015

Biologica #	**15-25-13**	**15-25-14**	**15-25-26**	**15-25-15**	**15-25-16**	**15-25-16-QA**	**15-25-17**
Project	**Nunavut**	**Nunavut**	**Nunavut**	**Nunavut**	**Nunavut**	**Nunavut**	**Nunavut**
Client ID	**WTN-06-S**	**WTS-03-S**	**DUP-1**	**WTS-04-S**	**WTS-05-S**	**WTS-05-S**	**WTS-06-S**
Date	**9/18/2015**	**8/22/2015**	**8/22/2015**	**8/21/2015**	**9/18/2015**	**9/18/2015**	**9/18/2015**
	Presence	**Presence**	**Presence**	**Presence**	**Presence**	**Presence**	**Presence**
	Present - Shaded	**Present - Shaded**	**Present - Shaded**	**Present - Shaded**	**Present - Shaded**	**Present - Shaded**	**Present - Shaded**
Major Group	Taxon						
Cladoceran	Bosmina sp.						
Cladoceran	Daphnia ambigua						
Cladoceran	Daphnia middendorffiana		■	■	■	■	■
Cladoceran	Daphnia sp.	■		■		■	■	
Cladoceran	Holopedium gibberum			■				
Cladoceran	Leptodora kindtii							
Calanoid	Heterocope septentrionalis	■	■	■	■	■	■	■
Calanoid	Leptodiaptomus pribilofensis	■		■				
Calanoid	Tropocyclops prasinus mexicanus							
Cyclopoid	Cyclops scutifer							
Cyclopoid	Diacyclops thomasi						■	
Cyclopoid	Microcyclops sp.							
Rotifer	Asplanchna sp.				■			
Rotifer	Collotheca sp.							
Rotifer	Conochilus sp.	■	■	■	■	■	■	■
Rotifer	Kellicottia sp.	■	■	■	■	■	■	■
Rotifer	Keratella sp.	■	■	■		■	■	
Rotifer	Polyarthra sp.	■	■	■	■	■	■	■
Rotifer	Rotifer indet.							
Rotifer	Synchaeta sp.							
	Total Zooplankton	7	5	9	6	7	8	5

Zooplankton per-sample taxonomic presence/absence, zooplankton taxonomic richness, Azimuth Nunavut 2015

Biologica #		**15-25-18**	**15-25-19**	**15-25-20**	**15-25-21**	**15-25-22**	**15-25-23**	**15-25-24**
Project		**Nunavut**	**Nunavut**	**Nunavut**	**Nunavut**	**Nunavut**	**Nunavut**	**Nunavut**
Client ID		**NEM-03-S**	**NEM-04-S**	**NEM-05-S**	**NEM-06-S**	**MAM-03-S**	**MAM-04-S**	**MAM-05-S**
Date		**8/23/2015**	**8/23/2015**	**9/19/2015**	**9/19/2015**	**8/24/2015**	**8/24/2015**	**9/19/2015**
		Presence	**Presence**	**Presence**	**Presence**	**Presence**	**Presence**	**Presence**
		Present - Shaded	**Present - Shaded**	**Present - Shaded**	**Present - Shaded**	**Present - Shaded**	**Present - Shaded**	**Present - Shaded**
Major Group	Taxon							
Cladoceran	Bosmina sp.	■		■	■	■		■
Cladoceran	Daphnia ambigua							
Cladoceran	Daphnia middendorffiana	■		■		■	■	
Cladoceran	Daphnia sp.							■
Cladoceran	Holopedium gibberum			■				
Cladoceran	Leptodora kindtii							
Calanoid	Heterocope septentrionalis		■	■	■	■	■	■
Calanoid	Leptodiaptomus pribilofensis					■	■	
Calanoid	Tropocyclops prasinus mexicanus							
Cyclopoid	Cyclops scutifer							
Cyclopoid	Diacyclops thomasi							
Cyclopoid	Microcyclops sp.					■	■	
Rotifer	Asplanchna sp.					■	■	
Rotifer	Collotheca sp.							
Rotifer	Conochilus sp.	■	■	■	■	■	■	■
Rotifer	Kellicottia sp.	■	■	■	■	■	■	■
Rotifer	Keratella sp.			■	■	■	■	■
Rotifer	Polyarthra sp.			■				
Rotifer	Rotifer indet.							
Rotifer	Synchaeta sp.							
	Total Zooplankton	4	3	8	5	9	8	6

Zooplankton per-sample taxonomic presence/absence, zooplankton taxonomic richness, Azimuth Nunavut 2015

	Biologica #	**15-25-24-QA**	**15-25-25**	**15-25-27**
	Project	**Nunavut**	**Nunavut**	**Nunavut**
	Client ID	**MAM-05-S**	**MAM-06-S**	**DUP-1-September**
	Date	**9/19/2015**	**9/19/2015**	**9/19/2015**
		Presence	**Presence**	**Presence**
		Present - Shaded	**Present - Shaded**	**Present - Shaded**
Major Group	Taxon			
Cladoceran	Bosmina sp.	■		■
Cladoceran	Daphnia ambigua			
Cladoceran	Daphnia middendorffiana		■	■
Cladoceran	Daphnia sp.	■	■	■
Cladoceran	Holopedium gibberum			
Cladoceran	Leptodora kindtii			
Calanoid	Heterocope septentrionalis		■	■
Calanoid	Leptodiaptomus pribilofensis		■	■
Calanoid	Tropocyclops prasinus mexicanus			
Cyclopoid	Cyclops scutifer			■
Cyclopoid	Diacyclops thomasi			
Cyclopoid	Microcyclops sp.			
Rotifer	Asplanchna sp.			
Rotifer	Collotheca sp.			
Rotifer	Conochilus sp.	■	■	■
Rotifer	Kellicottia sp.	■	■	■
Rotifer	Keratella sp.	■		■
Rotifer	Polyarthra sp.	■	■	■
Rotifer	Rotifer indet.			
Rotifer	Synchaeta sp.			
	Total Zooplankton	6	7	10

Total Zooplankton WW/DW Biomass (mg/sample), Abundance (#/sample), and taxonomic richness (total taxa/sample), Azimuth Nunavut 2015

Biologica #	Grand Total			15-25-01			15-25-02		
Project	Nunavut			Nunavut			Nunavut		
Client ID				WTN-01-S			WTN-02-S		
Date				7/17/2015			7/17/2015		
	Total Biomass		Total Abundance	Total Biomass		Total Abundance	Total Biomass		Total Abundance
	WW (mg/sample)	DW (mg/sample)	(#/sample)	WW (mg/sample)	DW (mg/sample)	(#/sample)	WW (mg/sample)	DW (mg/sample)	(#/sample)
Total Cladocera	83.67	16.73	3029	8.63	1.73	290	12.74	2.55	620
Total Calanoida	6461.63	259.27	18353.83333	25.56	1.01	210	14.60	0.58	120
Total Cyclopoida	727.74	145.26	44226.16667	52.63	10.53	2620	32.97	6.59	1590
Total Copepod Nauplii	30.87	6.17	92590	1.96	0.39	2333.333333	2.07	0.41	2466.666667
Total Rotifera	1796.80	179.61	199683.3333	46.48	4.64	7866.666667	19.72	1.97	3400
Total Zooplankton	9100.71	607.05	357882.3333	135.26	18.29	13320	82.10	12.10	8196.666667

Total Zooplankton WW/DW Biomass (mg/sample), Abundance (#/sample), and taxonomic richness (total taxa/sample), Azimuth Nunavut 2015

Biologica #	15-25-03			15-25-04			15-25-05		
Project	Nunavut			Nunavut			Nunavut		
Client ID	WTS-01-S			WTS-02-S			NEM-01-S		
Date	7/17/2015			7/17/2015			7/18/2015		
	Total Biomass		Total Abundance	Total Biomass		Total Abundance	Total Biomass		Total Abundance
	WW (mg/sample)	DW (mg/sample)	(#/sample)	WW (mg/sample)	DW (mg/sample)	(#/sample)	WW (mg/sample)	DW (mg/sample)	(#/sample)
Total Cladocera	5.72	1.14	400	1.12	0.22	82	4.64	0.93	106
Total Calanoida	6.08	0.24	50	3.65	0.14	30	233.65	9.22	1920
Total Cyclopoida	50.65	10.13	2720	35.87	7.17	2080	38.84	7.77	1970
Total Copepod Nauplii	2.52	0.50	3100	0.69	0.14	1066.666667	2.05	0.41	4266.666667
Total Rotifera	51.90	5.18	6366.666667	46.55	4.66	3200	39.81	3.98	4366.666667
Total Zooplankton	116.88	17.20	12636.66667	87.89	12.34	6458.666667	318.99	22.31	12629.33333

Total Zooplankton WW/DW Biomass (mg/sample), Abundance (#/sample), and taxonomic richness (total taxa/sample), Azimuth Nunavut 2015

Biologica #	15-25-06			15-25-07			15-25-08		
Project	Nunavut			Nunavut			Nunavut		
Client ID	NEM-02-S			MAM-01-S			MAM-02-S		
Date	7/18/2015			7/18/2015			7/18/2015		
	Total Biomass		Total Abundance	Total Biomass		Total Abundance	Total Biomass		Total Abundance
	WW (mg/sample)	DW (mg/sample)	(#/sample)	WW (mg/sample)	DW (mg/sample)	(#/sample)	WW (mg/sample)	DW (mg/sample)	(#/sample)
Total Cladocera	2.31	0.46	116	0.82	0.16	32	12.19	2.44	410
Total Calanoida	214.33	8.45	1753	11.90	0.43	73	23.75	0.84	140
Total Cyclopoida	33.35	6.67	2570	2.47	0.49	92	39.38	7.88	1420
Total Copepod Nauplii	1.99	0.40	7300	1.52	0.30	2066.666667	0.66	0.13	790
Total Rotifera	44.82	4.48	4533.333333	27.22	2.72	4600	93.64	9.36	13633.33333
Total Zooplankton	296.80	20.46	16272.33333	43.93	4.11	6863.666667	169.63	20.66	16393.33333

Total Zooplankton WW/DW Biomass (mg/sample), Abundance (#/sample), and taxonomic richness (total taxa/sample), Azimuth Nunavut 2015

Biologica #	15-25-08 - QA			15-25-09			15-25-10		
Project	Nunavut			Nunavut			Nunavut		
Client ID	MAM-02-S-QA			DUP-July-Amaruq			WTN-03-S		
Date	7/18/2015			(blank)			8/22/2015		
	Total Biomass			Total Biomass			Total Biomass		
	WW (mg/sample)	DW (mg/sample)	Total Abundance (#/sample)	WW (mg/sample)	DW (mg/sample)	Total Abundance (#/sample)	WW (mg/sample)	DW (mg/sample)	Total Abundance (#/sample)
Total Cladocera	10.02	2.00	440	2.68	0.53	186	2.62	0.52	60
Total Calanoida	45.39	1.46	180	48.68	1.92	400	144.01	6.46	310
Total Cyclopoida	42.89	8.58	1550	81.29	16.26	5440	11.73	2.35	770
Total Copepod Nauplii	2.10	0.42	2566.67	1.04	0.21	1433.33	0.43	0.09	3466.67
Total Rotifera	87.48	8.75	14166.67	61.36	6.14	4833.33	77.87	7.79	10517.00
Total Zooplankton	187.87	21.21	18903.33	195.04	25.06	12292.67	236.66	17.21	15123.33

Total Zooplankton WW/DW Biomass (mg/sample), Abundance (#/sample), and taxonomic richness (total taxa/sample), Azimuth Nunavut 2015

Biologica #	15-25-11			15-25-12			15-25-13		
Project	Nunavut			Nunavut			Nunavut		
Client ID	WTN-04-S			WTN-05-S			WTN-06-S		
Date	8/22/2015			9/18/2015			9/18/2015		
	Total Biomass		Total Abundance	Total Biomass		Total Abundance	Total Biomass		Total Abundance
	WW (mg/sample)	DW (mg/sample)	(#/sample)	WW (mg/sample)	DW (mg/sample)	(#/sample)	WW (mg/sample)	DW (mg/sample)	(#/sample)
Total Cladocera	0.44	0.09	10	0.08	0.02	4	0.20	0.04	10
Total Calanoida	70.50	3.57	153.3333333	12.11	0.38	26	266.48	15.38	585
Total Cyclopoida	6.85	1.37	493.3333333	8.96	1.79	526	56.29	11.26	2750
Total Copepod Nauplii	0.56	0.11	4300	0.32	0.06	1366.666667	1.02	0.20	5433.333333
Total Rotifera	72.16	7.22	8433.333333	46.86	4.67	5616.666667	181.06	18.11	18600
Total Zooplankton	150.51	12.36	13390	68.33	6.93	7539.333333	505.05	44.99	27378.33333

Total Zooplankton WW/DW Biomass (mg/sample), Abundance (#/sample), and taxonomic richness (total taxa/sample), Azimuth Nunavut 2015

Biologica #	15-25-14			15-25-26			15-25-15		
Project	Nunavut			Nunavut			Nunavut		
Client ID	WTS-03-S			DUP-1			WTS-04-S		
Date	8/22/2015			8/22/2015			8/21/2015		
	Total Biomass		Total Abundance	Total Biomass		Total Abundance	Total Biomass		Total Abundance
	WW (mg/sample)	DW (mg/sample)	(#/sample)	WW (mg/sample)	DW (mg/sample)	(#/sample)	WW (mg/sample)	DW (mg/sample)	(#/sample)
Total Cladocera	0.00	0.00	0	0.62	0.12	22.66666667	0.53	0.11	5
Total Calanoida	154.55	7.52	345	113.05	6.56	243.3333333	144.01	6.47	310
Total Cyclopoida	10.90	2.18	780	7.09	1.42	650	9.07	1.81	730
Total Copepod Nauplii	0.40	0.08	3200	0.31	0.06	2300	0.97	0.19	2600
Total Rotifera	122.99	12.30	12666.66667	38.89	3.89	5300	91.29	9.12	9500
Total Zooplankton	288.84	22.08	16991.66667	159.96	12.05	8516	245.87	17.70	13145

Total Zooplankton WW/DW Biomass (mg/sample), Abundance (#/sample), and taxonomic richness (total taxa/sample), Azimuth Nunavut 2015

Biologica #	15-25-16			15-25-16-QA			15-25-17		
Project	Nunavut			Nunavut			Nunavut		
Client ID	WTS-05-S			WTS-05-S-QA			WTS-06-S		
Date	9/18/2015			9/18/2015			9/18/2015		
	Total Biomass		Total Abundance	Total Biomass		Total Abundance	Total Biomass		Total Abundance
	WW (mg/sample)	DW (mg/sample)	(#/sample)	WW (mg/sample)	DW (mg/sample)	(#/sample)	WW (mg/sample)	DW (mg/sample)	(#/sample)
Total Cladocera	1.16	0.23	15	0.73	0.21	10	1.06	0.21	10
Total Calanoida	48.86	2.72	105	46.29	2.94	100	46.76	1.76	100
Total Cyclopoida	21.49	4.30	1035	16.82	3.36	975	21.68	4.34	1006.666667
Total Copepod Nauplii	0.84	0.17	2133.333333	0.85	0.17	2233	0.62	0.12	1433.333333
Total Rotifera	41.13	4.11	3766.666667	52.61	5.26	4534	49.68	4.97	4600
Total Zooplankton	113.48	11.53	7055	117.30	11.94	7852	119.80	11.40	7150

Total Zooplankton WW/DW Biomass (mg/sample), Abundance (#/sample), and taxonomic richness (total taxa/sample), Azimuth Nunavut 2015

Biologica #	15-25-18			15-25-19			15-25-20		
Project	Nunavut			Nunavut			Nunavut		
Client ID	NEM-03-S			NEM-04-S			NEM-05-S		
Date	8/23/2015			8/23/2015			9/19/2015		
	Total Biomass		Total Abundance	Total Biomass		Total Abundance	Total Biomass		Total Abundance
	WW (mg/sample)	DW (mg/sample)	(#/sample)	WW (mg/sample)	DW (mg/sample)	(#/sample)	WW (mg/sample)	DW (mg/sample)	(#/sample)
Total Cladocera	3.63	0.73	40	0.00	0.00	0	0.38	0.08	5
Total Calanoida	812.37	25.52	2230	605.96	20.01	1700	777.19	25.27	1670
Total Cyclopoida	15.88	3.18	1750	14.71	2.94	1680	11.49	2.30	1280
Total Copepod Nauplii	0.59	0.12	4800	0.66	0.13	5800	0.93	0.19	5833.333333
Total Rotifera	43.37	4.34	4200	40.58	4.06	3800	41.70	4.17	3650
Total Zooplankton	875.84	33.88	13020	661.91	27.14	12980	831.67	32.00	12438.33333

Total Zooplankton WW/DW Biomass (mg/sample), Abundance (#/sample), and taxonomic richness (total taxa/sample), Azimuth Nunavut 2015

Biologica #	15-25-21			15-25-22			15-25-23		
Project	Nunavut			Nunavut			Nunavut		
Client ID	NEM-06-S			MAM-03-S			MAM-04-S		
Date	9/19/2015			8/24/2015			8/24/2015		
	Total Biomass		Total Abundance	Total Biomass		Total Abundance	Total Biomass		Total Abundance
	WW (mg/sample)	DW (mg/sample)	(#/sample)	WW (mg/sample)	DW (mg/sample)	(#/sample)	WW (mg/sample)	DW (mg/sample)	(#/sample)
Total Cladocera	0.44	0.09	10	8.55	1.71	100	0.11	0.02	1
Total Calanoida	463.82	15.59	1000	1742.03	66.57	3766.666667	70.89	13.00	155
Total Cyclopoida	6.73	1.35	630	52.41	10.48	4566.666667	1.93	0.39	177
Total Copepod Nauplii	1.00	0.20	4733.333333	0.97	0.19	2900	0.63	0.13	2900
Total Rotifera	51.63	5.16	4333.333333	69.02	6.89	8366.666667	49.49	4.94	5600
Total Zooplankton	523.62	22.39	10706.66667	1872.98	85.85	19700	123.04	18.47	8833

Total Zooplankton WW/DW Biomass (mg/sample), Abundance (#/sample), and taxonomic richness (total taxa/sample), Azimuth Nunavut 2015

Biologica #	15-25-24			15-25-24-QA			15-25-25		
Project	Nunavut			Nunavut			Nunavut		
Client ID	MAM-05-S			MAM-05-S-QA			MAM-06-S		
Date	9/19/2015			9/19/2015			9/19/2015		
	Total Biomass		Total Abundance	Total Biomass		Total Abundance	Total Biomass		Total Abundance
	WW (mg/sample)	DW (mg/sample)	(#/sample)	WW (mg/sample)	DW (mg/sample)	(#/sample)	WW (mg/sample)	DW (mg/sample)	(#/sample)
Total Cladocera	0.21	0.04	6.666666667	0.21	0.04	6.666666667	0.29	0.06	6
Total Calanoida	87.57	4.15	186.6666667	97.53	4.45	213.3333333	58.97	2.37	126
Total Cyclopoida	10.89	2.18	666.6666667	10.44	2.09	613.3333333	6.65	1.33	412
Total Copepod Nauplii	0.54	0.11	2466.666667	0.71	0.14	2633.333333	0.77	0.15	1866.666667
Total Rotifera	45.25	4.53	4000	47.56	4.76	4366.666667	32.94	3.29	3166.666667
Total Zooplankton	144.47	11.01	7326.666667	156.45	11.48	7833.333333	99.63	7.21	5577.333333

Total Zooplankton WW/DW Biomass (mg/sample), Abundance (#/sample), and taxonomic richness (total taxa/sample), Azimuth Nunavut 2015

Biologica #		**15-25-27**	
Project		**Nunavut**	
Client ID		**DUP-1-September**	
Date		**9/19/2015**	
	Total Biomass		**Total Abundance**
	WW (mg/sample)	**DW (mg/sample)**	**(#/sample)**
Total Cladocera	0.48	0.10	10
Total Calanoida	57.00	2.58	122.5
Total Cyclopoida	15.45	2.80	687.5
Total Copepod Nauplii	0.30	0.06	666.6666667
Total Rotifera	40.19	4.02	3900
Total Zooplankton	113.42	9.56	5386.666667

Zooplankton raw count data for abundance calculations and biomass calculations, Azimuth Nunavut 2015

Client	Project	Year	Biologica #	Split	Date	Client ID	Fraction	Major Group	Groupcode	Family	Taxon	Stage	Raw Abundance	Split Multiplier	Total Abundance	Mean DW Biomass_mg	Mean WW Biomass_mg	Biomass assumptions	Total DW Biomass_mg	Total WW Biomass _mg
Azimuth	Nunavut	2015	15-25-01	3/100	7/17/2015	WTN-01-S		Rotifer	ROTI		Asplanchna sp.	n/a	2	33.33333333	66.66666667	7.80401E-05	0.002001028		0.005202672	0.13340184
Azimuth	Nunavut	2015	15-25-01	1/10	7/17/2015	WTN-01-S		Cladoceran	CRCL		Bosmina sp.	F	3	10	30	0.008880563	0.044402816		0.266416894	1.33208447
Azimuth	Nunavut	2015	15-25-01	1/10	7/17/2015	WTN-01-S		Calanoid	CRCO		Calanoida indet.	I-IV	21	10	210	0.004802846	0.121691779		1.008597743	25.55527369
Azimuth	Nunavut	2015	15-25-01	3/100	7/17/2015	WTN-01-S		Calanoid	CRCO		Calanoida indet.	nauplius	65	33.33333333	2166.666667	0.000177853	0.000889266		0.385348494	1.926742472
Azimuth	Nunavut	2015	15-25-01	3/100	7/17/2015	WTN-01-S		Rotifer	ROTI		Collotheca sp.	n/a	1	33.33333333	33.33333333	0.001085142	0.010851422		0.036171408	0.36171408
Azimuth	Nunavut	2015	15-25-01	3/100	7/17/2015	WTN-01-S		Rotifer	ROTI		Conochilus sp.	n/a	130	33.33333333	4333.333333	0.000146136	0.001461355		0.633254044	6.33254044
Azimuth	Nunavut	2015	15-25-01	3/100	7/17/2015	WTN-01-S		Copepod	CRCO		Copepoda indet.	nauplius	1	33.33333333	33.33333333	0.000142032	0.000710161		0.004734405	0.023672026
Azimuth	Nunavut	2015	15-25-01	1/10	7/17/2015	WTN-01-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	120	10	1200	0.001389335	0.006946677		1.66720246	8.336012298
Azimuth	Nunavut	2015	15-25-01	3/100	7/17/2015	WTN-01-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	4	33.33333333	133.3333333	2.00168E-05	0.000100084		0.002668912	0.013344558
Azimuth	Nunavut	2015	15-25-01	1/10	7/17/2015	WTN-01-S		Cyclopoid	CRCO		Cyclopoida indet.	V	16	10	160	0.005042793	0.025213967		0.806846937	4.034234683
Azimuth	Nunavut	2015	15-25-01	1/10	7/17/2015	WTN-01-S		Cyclopoid	CRCO		Cyclops scutifer	F	74	10	740	0.007235588	0.036177938		5.354334856	26.77167428
Azimuth	Nunavut	2015	15-25-01	1/10	7/17/2015	WTN-01-S		Cyclopoid	CRCO		Cyclops scutifer	M	52	10	520	0.005185998	0.025929991		2.69671903	13.48359515
Azimuth	Nunavut	2015	15-25-01	1/10	7/17/2015	WTN-01-S		Cladoceran	CRCL		Daphnia middendorffiana	F	1	10	10	0.021219637	0.106098184		0.212196369	1.060981843
Azimuth	Nunavut	2015	15-25-01	1/10	7/17/2015	WTN-01-S		Cladoceran	CRCL		Daphnia middendorffiana	F	1	10	10	0.021219637	0.106098184		0.212196369	1.060981843
Azimuth	Nunavut	2015	15-25-01	1/10	7/17/2015	WTN-01-S		Cladoceran	CRCL		Daphnia sp.	F	2	10	20	0.003999883	0.019999416		0.079997665	0.399988323
Azimuth	Nunavut	2015	15-25-01	1/10	7/17/2015	WTN-01-S		Cladoceran	CRCL		Daphnia sp.	F	1	10	10	0.003999883	0.019999416		0.039998832	0.199994162
Azimuth	Nunavut	2015	15-25-01	1/10	7/17/2015	WTN-01-S		Cladoceran	CRCL		Holopedium gibberum	F	7	10	70	0.002497062	0.012485309		0.174794323	0.873971617
Azimuth	Nunavut	2015	15-25-01	1/10	7/17/2015	WTN-01-S		Cladoceran	CRCL		Holopedium gibberum	F	13	10	130	0.002497062	0.012485309		0.324618029	1.623090147
Azimuth	Nunavut	2015	15-25-01	3/100	7/17/2015	WTN-01-S		Rotifer	ROTI		Kellicottia sp.	n/a	95	33.33333333	3166.666667	0.001252192	0.012521918		3.965274142	39.65274142
Azimuth	Nunavut	2015	15-25-01	1/10	7/17/2015	WTN-01-S		Cladoceran	CRCL		Leptodora kindtii	F	1	10	10	0.041665665	0.208328325		0.416656649	2.083283246
Azimuth	Nunavut	2015	15-25-01	3/100	7/17/2015	WTN-01-S		Rotifer	ROTI		Rotifer indet.	n/a	8	33.33333333	266.6666667	0	0		0	0
Azimuth	Nunavut	2015	15-25-02	1/10	7/17/2015	WTN-02-S		Cladoceran	CRCL		Bosmina sp.	F	1	10	10	0.008880563	0.044402816		0.088805631	0.444028157
Azimuth	Nunavut	2015	15-25-02	1/10	7/17/2015	WTN-02-S		Calanoid	CRCO		Calanoida indet.	I-IV	12	10	120	0.004802846	0.121691779		0.576341568	14.60301354
Azimuth	Nunavut	2015	15-25-02	3/100	7/17/2015	WTN-02-S		Calanoid	CRCO		Calanoida indet.	nauplius	63	33.33333333	2100	0.000177853	0.000889266		0.373491618	1.867458089
Azimuth	Nunavut	2015	15-25-02	3/100	7/17/2015	WTN-02-S		Rotifer	ROTI		Conochilus sp.	n/a	62	33.33333333	2066.666667	0.000146136	0.001461355		0.302013467	3.020134671
Azimuth	Nunavut	2015	15-25-02	3/100	7/17/2015	WTN-02-S		Copepod	CRCO		Copepoda indet.	nauplius	8	33.33333333	266.6666667	0.000142032	0.000710161		0.037875241	0.189376207
Azimuth	Nunavut	2015	15-25-02	1/10	7/17/2015	WTN-02-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	60	10	600	0.001389335	0.006946677		0.83360123	4.168006149
Azimuth	Nunavut	2015	15-25-02	3/100	7/17/2015	WTN-02-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	3	33.33333333	100	2.00168E-05	0.000100084		0.002001684	0.010008419
Azimuth	Nunavut	2015	15-25-02	1/10	7/17/2015	WTN-02-S		Cyclopoid	CRCO		Cyclopoida indet.	V	20	10	200	0.005042793	0.025213967		1.008558671	5.042793353
Azimuth	Nunavut	2015	15-25-02	1/10	7/17/2015	WTN-02-S		Cyclopoid	CRCO		Cyclops scutifer	F	32	10	320	0.007235588	0.036177938		2.315388046	11.57694023
Azimuth	Nunavut	2015	15-25-02	1/10	7/17/2015	WTN-02-S		Cyclopoid	CRCO		Cyclops scutifer	M	47	10	470	0.005185998	0.025929991		2.437419123	12.18709561
Azimuth	Nunavut	2015	15-25-02	1/10	7/17/2015	WTN-02-S		Cladoceran	CRCL		Daphnia middendorffiana	F	1	10	10	0.021219637	0.106098184		0.212196369	1.060981843
Azimuth	Nunavut	2015	15-25-02	1/10	7/17/2015	WTN-02-S		Cladoceran	CRCL		Daphnia middendorffiana	F	4	10	40	0.021219637	0.106098184		0.848785474	4.243927371
Azimuth	Nunavut	2015	15-25-02	1/10	7/17/2015	WTN-02-S		Cladoceran	CRCL		Holopedium gibberum	F	21	10	210	0.002497062	0.012485309		0.52438297	2.621914852
Azimuth	Nunavut	2015	15-25-02	1/10	7/17/2015	WTN-02-S		Cladoceran	CRCL		Holopedium gibberum	F	35	10	350	0.002497062	0.012485309		0.873971617	4.369858087
Azimuth	Nunavut	2015	15-25-02	3/100	7/17/2015	WTN-02-S		Rotifer	ROTI		Kellicottia sp.	n/a	40	33.33333333	1333.333333	0.001252192	0.012521918		1.669589113	16.69589113
Azimuth	Nunavut	2015	15-25-03	3/100	7/17/2015	WTS-01-S		Rotifer	ROTI		Asplanchna sp.	n/a	2	33.33333333	66.66666667	7.80401E-05	0.002001028		0.005202672	0.13340184
Azimuth	Nunavut	2015	15-25-03	1	7/17/2015	WTS-01-S		Cladoceran	CRCL		Bosmina sp.	F	2	1	2	0.008880563	0.044402816		0.017761126	0.088805631
Azimuth	Nunavut	2015	15-25-03	1/10	7/17/2015	WTS-01-S		Calanoid	CRCO		Calanoida indet.	I-IV	5	10	50	0.004802846	0.121691779		0.24014232	6.084588975
Azimuth	Nunavut	2015	15-25-03	3/100	7/17/2015	WTS-01-S		Calanoid	CRCO		Calanoida indet.	nauplius	81	33.33333333	2700	0.000177853	0.000889266		0.480203508	2.401017542
Azimuth	Nunavut	2015	15-25-03	3/100	7/17/2015	WTS-01-S		Rotifer	ROTI		Conochilus sp.	n/a	86	33.33333333	2866.666667	0.000146136	0.001461355		0.418921906	4.18921906
Azimuth	Nunavut	2015	15-25-03	3/100	7/17/2015	WTS-01-S		Copepod	CRCO		Copepoda indet.	nauplius	4	33.33333333	133.3333333	0.000142032	0.000710161		0.018937621	0.094688103
Azimuth	Nunavut	2015	15-25-03	1/10	7/17/2015	WTS-01-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	130	10	1300	0.001389335	0.006946677		1.806135998	9.03067999
Azimuth	Nunavut	2015	15-25-03	3/100	7/17/2015	WTS-01-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	8	33.33333333	266.6666667	2.00168E-05	0.000100084		0.005337823	0.026689116
Azimuth	Nunavut	2015	15-25-03	1/10	7/17/2015	WTS-01-S		Cyclopoid	CRCO		Cyclopoida indet.	V	45	10	450	0.005042793	0.025213967		2.269257009	11.34628504
Azimuth	Nunavut	2015	15-25-03	1/10	7/17/2015	WTS-01-S		Cyclopoid	CRCO		Cyclops scutifer	F	50	10	500	0.007235588	0.036177938		3.617793822	18.08896911
Azimuth	Nunavut	2015	15-25-03	1/10	7/17/2015	WTS-01-S		Cyclopoid	CRCO		Cyclops scutifer	M	47	10	470	0.005185998	0.025929991		2.437419123	12.18709561
Azimuth	Nunavut	2015	15-25-03	1	7/17/2015	WTS-01-S		Cladoceran	CRCL		Daphnia middendorffiana	F	1	1	1	0.021219637	0.106098184		0.021219637	0.106098184
Azimuth	Nunavut	2015	15-25-03	1	7/17/2015	WTS-01-S		Cladoceran	CRCL		Daphnia middendorffiana	F	6	1	6	0.021219637	0.106098184		0.127317821	0.636589106
Azimuth	Nunavut	2015	15-25-03	1	7/17/2015	WTS-01-S		Cladoceran	CRCL		Daphnia sp.	F	1	1	1	0.003999883	0.019999416		0.003999883	0.019999416
Azimuth	Nunavut	2015	15-25-03	1/10	7/17/2015	WTS-01-S		Cladoceran	CRCL		Holopedium gibberum	F	15	10	150	0.002497062	0.012485309		0.374559265	1.872796323
Azimuth	Nunavut	2015	15-25-03	1/10	7/17/2015	WTS-01-S		Cladoceran	CRCL		Holopedium gibberum	F	24	10	240	0.002497062	0.012485309		0.599294823	2.996474117
Azimuth	Nunavut	2015	15-25-03	3/100	7/17/2015	WTS-01-S		Rotifer	ROTI		Kellicottia sp.	n/a	99	33.33333333	3300	0.001252192	0.012521918		4.132233053	41.32233053
Azimuth	Nunavut	2015	15-25-03	3/100	7/17/2015	WTS-01-S		Rotifer	ROTI		Rotifer indet.	n/a	2	33.33333333	66.66666667	0	0		0	0
Azimuth	Nunavut	2015	15-25-03	3/100	7/17/2015	WTS-01-S		Rotifer	ROTI		Synchaeta sp.	n/a	2	33.33333333	66.66666667	0.009388446	0.093884464		0.625896425	6.258964251
Azimuth	Nunavut	2015	15-25-04	1/10	7/17/2015	WTS-02-S		Calanoid	CRCO		Calanoida indet.	I-IV	3	10	30	0.004802846	0.121691779		0.144085392	3.650753385
Azimuth	Nunavut	2015	15-25-04	3/100	7/17/2015	WTS-02-S		Calanoid	CRCO		Calanoida indet.	nauplius	16	33.33333333	533.3333333	0.000177853	0.000889266		0.094855014	0.47427507
Azimuth	Nunavut	2015	15-25-04	3/100	7/17/2015	WTS-02-S		Rotifer	ROTI		Conochilus sp.	n/a	16	33.33333333	533.3333333	0.000146136	0.001461355		0.077938959	0.779389593
Azimuth	Nunavut	2015	15-25-04	3/100	7/17/2015	WTS-02-S		Copepod	CRCO		Copepoda indet.	nauplius	8	33.33333333	266.6666667	0.000142032	0.000710161		0.037875241	0.189376207
Azimuth	Nunavut	2015	15-25-04	1/10	7/17/2015	WTS-02-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	116	10	1160	0.001389335	0.006946677		1.611629044	8.058145222
Azimuth	Nunavut	2015	15-25-04	3/100	7/17/2015	WTS-02-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	8	33.33333333	266.6666667	2.00168E-05	0.000100084		0.005337823	0.026689116
Azimuth	Nunavut	2015	15-25-04	1/10	7/17/2015	WTS-02-S		Cyclopoid	CRCO		Cyclopoida indet.	V	20	10	200	0.005042793	0.025213967		1.008558671	5.042793353
Azimuth	Nunavut	2015	15-25-04	1/10	7/17/2015	WTS-02-S		Cyclopoid	CRCO		Cyclops scutifer	F	40	10	400	0.007235588	0.036177938		2.894235057	14.47117529
Azimuth	Nunavut	2015	15-25-04	1/10	7/17/2015	WTS-02-S		Cyclopoid	CRCO		Cyclops scutifer	M	32	10	320	0.005185998	0.025929991		1.659519403	8.297597014
Azimuth	Nunavut	2015	15-25-04	1	7/17/2015	WTS-02-S		Cladoceran	CRCL		Daphnia middendorffiana	F	1	1	1	0.021219637	0.106098184		0.021219637	0.106098184
Azimuth	Nunavut	2015	15-25-04	1	7/17/2015	WTS-02-S		Cladoceran	CRCL		Daphnia sp.	F	1	1	1	0.003999883	0.019999416		0.003999883	0.019999416
Azimuth	Nunavut	2015	15-25-04	1/10	7/17/2015	WTS-02-S		Cladoceran	CRCL		Holopedium gibberum	F	2	10	20	0.002497062	0.012485309		0.049941235	0.249706176
Azimuth	Nunavut	2015	15-25-04	1/10	7/17/2015	WTS-02-S		Cladoceran	CRCL		Holopedium gibberum	F	6	10	60	0.002497062	0.012485309		0.149823706	0.749118529
Azimuth	Nunavut	2015	15-25-04	3/100	7/17/2015	WTS-02-S		Rotifer	ROTI		Kellicottia sp.	n/a	72	33.33333333	2400	0.001252192	0.012521918		3.005260403	30.05260403
Azimuth	Nunavut	2015	15-25-04	3/100	7/17/2015	WTS-02-S		Rotifer	ROTI		Polyarthra sp.	n/a	3	33.33333333	100	7.16125E-05	0.000716125		0.007161253	0.071612533
Azimuth	Nunavut	2015	15-25-04	3/100	7/17/2015	WTS-02-S		Rotifer	ROTI		Rotifer indet.	n/a		33.33333333	0	0	0		0	0
Azimuth	Nunavut	2015	15-25-04	3/100	7/17/2015	WTS-02-S		Rotifer	ROTI		Synchaeta sp.	n/a	5	33.33333333	166.6666667	0.009388446	0.093884464		1.564741063	15.64741063
Azimuth	Nunavut	2015	15-25-05	1	7/18/2015	NEM-01-S		Cladoceran	CRCL		Bosmina sp.	F	6	1	6	0.008880563	0.044402816		0.053283379	0.266416894

Zooplankton raw count data for abundance calculations and biomass calculations, Azimuth Nunavut 2015

Client	Project	Year	Biologica #	Split	Date	Client ID	Fraction	Major Group	Groupcode	Family	Taxon	Stage	Raw Abundance	Split Multiplier	Total Abundance	Mean DW Biomass_mg	Mean WW Biomass_mg	Biomass assumptions	Total DW Biomass_mg	Total WW Biomass _mg
Azimuth	Nunavut	2015	15-25-05	1	7/18/2015	NEM-01-S		Cladoceran	CRCL		Bosmina sp.	F	2	1	2	0.008880563	0.044402816		0.017761126	0.088805631
Azimuth	Nunavut	2015	15-25-05	1/10	7/18/2015	NEM-01-S		Calanoid	CRCO		Calanoida indet.	I-IV	192	10	1920	0.004802846	0.121691779		9.221465081	233.6482166
Azimuth	Nunavut	2015	15-25-05	3/100	7/18/2015	NEM-01-S		Calanoid	CRCO		Calanoida indet.	nauplius	61	33.33333333	2033.333333	0.000177853	0.000889266		0.361634741	1.808173705
Azimuth	Nunavut	2015	15-25-05	3/100	7/18/2015	NEM-01-S		Rotifer	ROTI		Conochilus sp.	n/a	36	33.33333333	1200	0.000146136	0.001461355		0.175362658	1.753626583
Azimuth	Nunavut	2015	15-25-05	3/100	7/18/2015	NEM-01-S		Copepod	CRCO		Copepoda indet.	nauplius	1	33.33333333	33.33333333	0.000142032	0.000710161		0.004734405	0.023672026
Azimuth	Nunavut	2015	15-25-05	1/10	7/18/2015	NEM-01-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	102	10	1020	0.001389335	0.006946677		1.417122091	7.085610453
Azimuth	Nunavut	2015	15-25-05	3/100	7/18/2015	NEM-01-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	66	33.33333333	2200	2.00168E-05	0.000100084		0.044037042	0.22018521
Azimuth	Nunavut	2015	15-25-05	1/10	7/18/2015	NEM-01-S		Cyclopoid	CRCO		Cyclopoida indet.	V	7	10	70	0.005042793	0.025213967		0.352995535	1.764977674
Azimuth	Nunavut	2015	15-25-05	1/10	7/18/2015	NEM-01-S		Cyclopoid	CRCO		Cyclops scutifer	F	70	10	700	0.007235588	0.036177938		5.06491135	25.32455675
Azimuth	Nunavut	2015	15-25-05	1/10	7/18/2015	NEM-01-S		Cyclopoid	CRCO		Cyclops scutifer	M	18	10	180	0.005185998	0.025929991		0.933479664	4.66739832
Azimuth	Nunavut	2015	15-25-05	1	7/18/2015	NEM-01-S		Cladoceran	CRCL		Daphnia middendorffiana	F	16	1	16	0.021219637	0.106098184		0.33951419	1.697570948
Azimuth	Nunavut	2015	15-25-05	1	7/18/2015	NEM-01-S		Cladoceran	CRCL		Daphnia middendorffiana	F	14	1	14	0.021219637	0.106098184		0.297074916	1.48537458
Azimuth	Nunavut	2015	15-25-05	1	7/18/2015	NEM-01-S		Cladoceran	CRCL		Daphnia sp.	F	7	1	7	0.003999883	0.019999416		0.027999183	0.139995913
Azimuth	Nunavut	2015	15-25-05	1/10	7/18/2015	NEM-01-S		Cladoceran	CRCL		Holopedium gibberum	F	2	10	20	0.002497062	0.012485309		0.049941235	0.249706176
Azimuth	Nunavut	2015	15-25-05	1/10	7/18/2015	NEM-01-S		Cladoceran	CRCL		Holopedium gibberum	F	4	10	40	0.002497062	0.012485309		0.099882471	0.499412353
Azimuth	Nunavut	2015	15-25-05	3/100	7/18/2015	NEM-01-S		Rotifer	ROTI		Kellicottia sp.	n/a	91	33.33333333	3033.333333	0.001252192	0.012521918		3.798315231	37.98315231
Azimuth	Nunavut	2015	15-25-05	1	7/18/2015	NEM-01-S		Cladoceran	CRCL		Leptodora kindtii	F	1	1	1	0.041665665	0.208328325		0.041665665	0.208328325
Azimuth	Nunavut	2015	15-25-05	3/100	7/18/2015	NEM-01-S		Rotifer	ROTI		Polyarthra sp.	n/a	3	33.33333333	100	7.16125E-05	0.000716125		0.007161253	0.071612533
Azimuth	Nunavut	2015	15-25-05	3/100	7/18/2015	NEM-01-S		Rotifer	ROTI		Rotifer indet.	n/a	1	33.33333333	33.33333333	0	0		0	0
Azimuth	Nunavut	2015	15-25-06	1	7/18/2015	NEM-02-S		Cladoceran	CRCL		Bosmina sp.	F	2	1	2	0.008880563	0.044402816		0.017761126	0.088805631
Azimuth	Nunavut	2015	15-25-06	1/10	7/18/2015	NEM-02-S		Calanoid	CRCO		Calanoida indet.	I-IV	175	10	1750	0.004802846	0.121691779		8.404981194	212.9606141
Azimuth	Nunavut	2015	15-25-06	3/100	7/18/2015	NEM-02-S		Calanoid	CRCO		Calanoida indet.	nauplius	47	33.33333333	1566.666667	0.000177853	0.000889266		0.278636604	1.393183018
Azimuth	Nunavut	2015	15-25-06	3/100	7/18/2015	NEM-02-S		Rotifer	ROTI		Conochilus sp.	n/a	29	33.33333333	966.6666667	0.000146136	0.001461355		0.141264364	1.412643637
Azimuth	Nunavut	2015	15-25-06	3/100	7/18/2015	NEM-02-S		Copepod	CRCO		Copepoda indet.	nauplius	1	33.33333333	33.33333333	0.000142032	0.000710161		0.004734405	0.023672026
Azimuth	Nunavut	2015	15-25-06	1/10	7/18/2015	NEM-02-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	197	10	1970	0.001389335	0.006946677		2.736990705	13.68495352
Azimuth	Nunavut	2015	15-25-06	1/10	7/18/2015	NEM-02-S		Cyclopoid	CRCO		Cyclopoida indet.	M	1	10	10	0.005042793	0.025213967		0.050427934	0.252139668
Azimuth	Nunavut	2015	15-25-06	3/100	7/18/2015	NEM-02-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	171	33.33333333	5700	2.00168E-05	0.000100084		0.114095973	0.570479864
Azimuth	Nunavut	2015	15-25-06	1/10	7/18/2015	NEM-02-S		Cyclopoid	CRCO		Cyclopoida indet.	V	1	10	10	0.005042793	0.025213967		0.050427934	0.252139668
Azimuth	Nunavut	2015	15-25-06	1/10	7/18/2015	NEM-02-S		Cyclopoid	CRCO		Cyclopoida indet.	V	11	10	110	0.005042793	0.025213967		0.554707269	2.773536344
Azimuth	Nunavut	2015	15-25-06	1/10	7/18/2015	NEM-02-S		Cyclopoid	CRCO		Cyclops scutifer	F	41	10	410	0.007235588	0.036177938		2.966590934	14.83295467
Azimuth	Nunavut	2015	15-25-06	1/10	7/18/2015	NEM-02-S		Cyclopoid	CRCO		Cyclops scutifer	M	6	10	60	0.005185998	0.025929991		0.311159888	1.55579944
Azimuth	Nunavut	2015	15-25-06	1	7/18/2015	NEM-02-S		Cladoceran	CRCL		Daphnia middendorffiana	F	2	1	2	0.021219637	0.106098184		0.042439274	0.212196369
Azimuth	Nunavut	2015	15-25-06	1	7/18/2015	NEM-02-S		Cladoceran	CRCL		Daphnia middendorffiana	F	6	1	6	0.021219637	0.106098184		0.127317821	0.636589106
Azimuth	Nunavut	2015	15-25-06	1	7/18/2015	NEM-02-S		Cladoceran	CRCL		Daphnia sp.	F	6	1	6	0.003999883	0.019999416		0.023999299	0.119996497
Azimuth	Nunavut	2015	15-25-06	1/10	7/18/2015	NEM-02-S		Cladoceran	CRCL		Holopedium gibberum	F	5	10	50	0.002497062	0.012485309		0.124853088	0.624265441
Azimuth	Nunavut	2015	15-25-06	1/10	7/18/2015	NEM-02-S		Cladoceran	CRCL		Holopedium gibberum	F	5	10	50	0.002497062	0.012485309		0.124853088	0.624265441
Azimuth	Nunavut	2015	15-25-06	3/100	7/18/2015	NEM-02-S		Rotifer	ROTI		Rotifer indet.	n/a	104	33.33333333	3466.666667	0.001252192	0.012521918		4.340931693	43.40931693
Azimuth	Nunavut	2015	15-25-06	3/100	7/18/2015	NEM-02-S		Rotifer	ROTI		Rotifer indet.	n/a	3	33.33333333	100	0	0		0	0
Azimuth	Nunavut	2015	15-25-06	1	7/18/2015	NEM-02-S		Calanoid	CRCO		Tropocyclops prasinus mexicanus	F	3	1	3	0.013365482	0.457190372		0.040096445	1.371571116
Azimuth	Nunavut	2015	15-25-07	1	7/18/2015	MAM-01-S		Cladoceran	CRCL		Bosmina sp.	F	7	1	7	0.008880563	0.044402816		0.062163942	0.31081971
Azimuth	Nunavut	2015	15-25-07	1	7/18/2015	MAM-01-S		Calanoid	CRCO		Calanoida indet.	I-IV	2	1	2	0.004802846	0.121691779		0.009605693	0.243383559
Azimuth	Nunavut	2015	15-25-07	1	7/18/2015	MAM-01-S		Calanoid	CRCO		Calanoida indet.	I-IV	62	1	62	0.004802846	0.121691779		0.297776477	7.544890328
Azimuth	Nunavut	2015	15-25-07	3/100	7/18/2015	MAM-01-S		Calanoid	CRCO		Calanoida indet.	nauplius	46	33.33333333	1533.333333	0.000177853	0.000889266		0.272708165	1.363540827
Azimuth	Nunavut	2015	15-25-07	1	7/18/2015	MAM-01-S		Calanoid	CRCO		Calanoida indet.	V	9	1	9	0.013365482	0.457190372		0.120289334	4.114713347
Azimuth	Nunavut	2015	15-25-07	3/100	7/18/2015	MAM-01-S		Rotifer	ROTI		Conochilus sp.	n/a	77	33.33333333	2566.666667	0.000146136	0.001461355		0.375081241	3.750812414
Azimuth	Nunavut	2015	15-25-07	3/100	7/18/2015	MAM-01-S		Copepod	CRCO		Copepoda indet.	nauplius	5	33.33333333	166.6666667	0.000142032	0.000710161		0.023672026	0.118360129
Azimuth	Nunavut	2015	15-25-07	1	7/18/2015	MAM-01-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	16	1	16	0.001389335	0.006946677		0.022229366	0.111146831
Azimuth	Nunavut	2015	15-25-07	1	7/18/2015	MAM-01-S		Cyclopoid	CRCO		Cyclopoida indet.	M	2	1	2	0.005042793	0.025213967		0.010085587	0.050427934
Azimuth	Nunavut	2015	15-25-07	3/100	7/18/2015	MAM-01-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	11	33.33333333	366.6666667	2.00168E-05	0.000100084		0.007339507	0.036697535
Azimuth	Nunavut	2015	15-25-07	1	7/18/2015	MAM-01-S		Cyclopoid	CRCO		Cyclopoida indet.	V	7	1	7	0.005042793	0.025213967		0.035299553	0.176497767
Azimuth	Nunavut	2015	15-25-07	1	7/18/2015	MAM-01-S		Cyclopoid	CRCO		Cyclopoida indet.	V	13	1	13	0.005042793	0.025213967		0.065556314	0.327781568
Azimuth	Nunavut	2015	15-25-07	1	7/18/2015	MAM-01-S		Cyclopoid	CRCO		Cyclops scutifer	F	39	1	39	0.007235588	0.036177938		0.282187918	1.41093959
Azimuth	Nunavut	2015	15-25-07	1	7/18/2015	MAM-01-S		Cyclopoid	CRCO		Cyclops scutifer	M	15	1	15	0.005185998	0.025929991		0.077789972	0.38894986
Azimuth	Nunavut	2015	15-25-07	1	7/18/2015	MAM-01-S		Cladoceran	CRCL		Holopedium gibberum	F	7	1	7	0.002497062	0.012485309		0.017479432	0.087397162
Azimuth	Nunavut	2015	15-25-07	1	7/18/2015	MAM-01-S		Cladoceran	CRCL		Holopedium gibberum	F	17	1	17	0.002497062	0.012485309		0.04245005	0.21225025
Azimuth	Nunavut	2015	15-25-07	3/100	7/18/2015	MAM-01-S		Rotifer	ROTI		Kellicottia sp.	n/a	56	33.33333333	1866.666667	0.001252192	0.012521918		2.337424758	23.37424758
Azimuth	Nunavut	2015	15-25-07	1	7/18/2015	MAM-01-S		Cladoceran	CRCL		Leptodora kindtii	F	1	1	1	0.041665665	0.208328325		0.041665665	0.208328325
Azimuth	Nunavut	2015	15-25-07	3/100	7/18/2015	MAM-01-S		Rotifer	ROTI		Polyarthra sp.	n/a	4	33.33333333	133.3333333	7.16125E-05	0.000716125		0.009548338	0.095483378
Azimuth	Nunavut	2015	15-25-07	3/100	7/18/2015	MAM-01-S		Rotifer	ROTI		Rotifer indet.	n/a	1	33.33333333	33.33333333	0	0		0	0
Azimuth	Nunavut	2015	15-25-08	1/10	7/18/2015	MAM-02-S		Cladoceran	CRCL		Bosmina sp.	F	18	10	180	0.008880563	0.044402816		1.598501364	7.992506822
Azimuth	Nunavut	2015	15-25-08	1/10	7/18/2015	MAM-02-S		Cladoceran	CRCL		Bosmina sp.	F	1	10	10	0.008880563	0.044402816		0.088805631	0.444028157
Azimuth	Nunavut	2015	15-25-08	1/10	7/18/2015	MAM-02-S		Calanoid	CRCO		Calanoida indet.	I-IV	4	10	40	0.004802846	0.121691779		0.192113856	4.86767118
Azimuth	Nunavut	2015	15-25-08	1/10	7/18/2015	MAM-02-S		Calanoid	CRCO		Calanoida indet.	I-IV	8	10	80	0.004802846	0.121691779		0.384227712	9.735342359
Azimuth	Nunavut	2015	15-25-08	3/100	7/18/2015	MAM-02-S		Calanoid	CRCO		Calanoida indet.	nauplius	74	10	740	0.000177853	0.000889266		0.131611332	0.65805666
Azimuth	Nunavut	2015	15-25-08	1/10	7/18/2015	MAM-02-S		Calanoid	CRCO		Calanoida indet.	V	2	10	20	0.013365482	0.457190372		0.267309631	9.143807437
Azimuth	Nunavut	2015	15-25-08	3/100	7/18/2015	MAM-02-S		Rotifer	ROTI		Conochilus sp.	n/a	210	33.33333333	7000	0.000146136	0.001461355		1.02294884	10.2294884
Azimuth	Nunavut	2015	15-25-08	1/10	7/18/2015	MAM-02-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	31	10	310	0.001389335	0.006946677		0.430693969	2.153469844
Azimuth	Nunavut	2015	15-25-08	3/100	7/18/2015	MAM-02-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	5	10	50	2.00168E-05	0.000100084		0.001000842	0.005004209
Azimuth	Nunavut	2015	15-25-08	1/10	7/18/2015	MAM-02-S		Cyclopoid	CRCO		Cyclopoida indet.	V	8	10	80	0.005042793	0.025213967		0.403423468	2.017117341
Azimuth	Nunavut	2015	15-25-08	1/10	7/18/2015	MAM-02-S		Cyclopoid	CRCO		Cyclops scutifer	F	83	10	830	0.007235588	0.036177938		6.005537744	30.02768872
Azimuth	Nunavut	2015	15-25-08	1/10	7/18/2015	MAM-02-S		Cyclopoid	CRCO		Cyclops scutifer	M	20	10	200	0.005185998	0.025929991		1.037199627	5.185998134
Azimuth	Nunavut	2015	15-25-08	1/10	7/18/2015	MAM-02-S		Cladoceran	CRCL		Daphnia middendorffiana	F	1	10	10	0.021219637	0.106098184		0.212196369	1.060981843
Azimuth	Nunavut	2015	15-25-08	1/10	7/18/2015	MAM-02-S		Cladoceran	CRCL		Daphnia sp.	F	1	10	10	0.003999883	0.019999416		0.039998832	0.199994162

Zooplankton raw count data for abundance calculations and biomass calculations, Azimuth Nunavut 2015

Client	Project	Year	Biologica #	Split	Date	Client ID	Fraction	Major Group	Groupcode	Family	Taxon	Stage	Raw Abundance	Split Multiplier	Total Abundance	Mean DW Biomass_mg	Mean WW Biomass_mg	Biomass assumptions	Total DW Biomass_mg	Total WW Biomass _mg
Azimuth	Nunavut	2015	15-25-08	1/10	7/18/2015	MAM-02-S		Cladoceran	CRCL		Holopedium gibberum	F	15	10	150	0.002497062	0.012485309		0.374559265	1.872796323
Azimuth	Nunavut	2015	15-25-08	1/10	7/18/2015	MAM-02-S		Cladoceran	CRCL		Holopedium gibberum	F	5	10	50	0.002497062	0.012485309		0.124853088	0.624265441
Azimuth	Nunavut	2015	15-25-08	3/100	7/18/2015	MAM-02-S		Rotifer	ROTI		Kellicottia sp.	n/a	192	33.33333333	6400	0.001252192	0.012521918		8.01402774	80.1402774
Azimuth	Nunavut	2015	15-25-08	3/100	7/18/2015	MAM-02-S		Rotifer	ROTI		Polyarthra sp.	n/a	6	33.33333333	200	7.16125E-05	0.000716125		0.014322507	0.143225066
Azimuth	Nunavut	2015	15-25-08	3/100	7/18/2015	MAM-02-S		Rotifer	ROTI		Synchaeta sp.	n/a	1	33.33333333	33.33333333	0.009388446	0.093884464		0.312948213	3.129482126
Azimuth	Nunavut	2015	15-25-08 - QA	1/10	7/18/2015	MAM-02-S-QA		Cladoceran	CRCL		Bosmina sp.	F	11	10	110	0.008880563	0.044402816		0.976861945	4.884309725
Azimuth	Nunavut	2015	15-25-08 - QA	1/10	7/18/2015	MAM-02-S-QA		Calanoid	CRCO		Calanoida indet.	I-IV	11	10	110	0.004802846	0.121691779		0.528313104	13.38609574
Azimuth	Nunavut	2015	15-25-08 - QA	3/100	7/18/2015	MAM-02-S-QA		Calanoid	CRCO		Calanoida indet.	nauplius	70	33.33333333	2333.333333	0.000177853	0.000889266		0.414990686	2.074953432
Azimuth	Nunavut	2015	15-25-08 - QA	1/10	7/18/2015	MAM-02-S-QA		Calanoid	CRCO		Calanoida indet.	V	7	10	70	0.013365482	0.457190372		0.935583709	32.00332603
Azimuth	Nunavut	2015	15-25-08 - QA	3/100	7/18/2015	MAM-02-S-QA		Rotifer	ROTI		Conochilus sp.	n/a	248	33.33333333	8266.666667	0.000146136	0.001461355		1.208053869	12.08053869
Azimuth	Nunavut	2015	15-25-08 - QA	1/100	7/18/2015	MAM-02-S-QA		Rotifer	ROTI		Conochilus sp.	n/a	1	100	100	0.000146136	0.001461355		0.014613555	0.146135549
Azimuth	Nunavut	2015	15-25-08 - QA	1/10	7/18/2015	MAM-02-S-QA		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	32	10	320	0.001389335	0.006946677		0.444587323	2.222936613
Azimuth	Nunavut	2015	15-25-08 - QA	3/100	7/18/2015	MAM-02-S-QA		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	7	33.33333333	233.3333333	2.00168E-05	0.000100084		0.004670595	0.023352977
Azimuth	Nunavut	2015	15-25-08 - QA	1/10	7/18/2015	MAM-02-S-QA		Cyclopoid	CRCO		Cyclopoida indet.	V	6	10	60	0.005042793	0.025213967		0.302567601	1.512838006
Azimuth	Nunavut	2015	15-25-08 - QA	1/10	7/18/2015	MAM-02-S-QA		Cyclopoid	CRCO		Cyclops scutifer	F	86	10	860	0.007235588	0.036177938		6.222605373	31.11302687
Azimuth	Nunavut	2015	15-25-08 - QA	1/10	7/18/2015	MAM-02-S-QA		Cyclopoid	CRCO		Cyclops scutifer	M	31	10	310	0.005185998	0.025929991		1.607659421	8.038297107
Azimuth	Nunavut	2015	15-25-08 - QA	1/10	7/18/2015	MAM-02-S-QA		Cladoceran	CRCL		Daphnia middendorffiana	F	1	10	10	0.021219637	0.106098184		0.212196369	1.060981843
Azimuth	Nunavut	2015	15-25-08 - QA	1/10	7/18/2015	MAM-02-S-QA		Cladoceran	CRCL		Daphnia sp.	F	1	10	10	0.003999883	0.019999416		0.039998832	0.199994162
Azimuth	Nunavut	2015	15-25-08 - QA	1/10	7/18/2015	MAM-02-S-QA		Cladoceran	CRCL		Holopedium gibberum	F	20	10	200	0.002497062	0.012485309		0.499412353	2.497061764
Azimuth	Nunavut	2015	15-25-08 - QA	1/10	7/18/2015	MAM-02-S-QA		Cladoceran	CRCL		Holopedium gibberum	F	11	10	110	0.002497062	0.012485309		0.274676794	1.37338397
Azimuth	Nunavut	2015	15-25-08 - QA	3/100	7/18/2015	MAM-02-S-QA		Rotifer	ROTI		Kellicottia sp.	n/a	157	33.33333333	5233.333333	0.001252192	0.012521918		6.553137267	65.53137267
Azimuth	Nunavut	2015	15-25-08 - QA	3/100	7/18/2015	MAM-02-S-QA		Rotifer	ROTI		Polyarthra sp.	n/a	14	33.33333333	466.6666667	7.16125E-05	0.000716125		0.033419182	0.334191822
Azimuth	Nunavut	2015	15-25-08 - QA	1/100	7/18/2015	MAM-02-S-QA		Rotifer	ROTI		Synchaeta sp.	n/a	1	100	100	0.009388446	0.093884464		0.938844638	9.388446377
Azimuth	Nunavut	2015	15-25-09	1		DUP-July-Amaruq		Cladoceran	CRCL		Bosmina sp.	F	2	1	2	0.008880563	0.044402816		0.017761126	0.088805631
Azimuth	Nunavut	2015	15-25-09	2/10		DUP-July-Amaruq		Calanoid	CRCO		Calanoida indet.	I-IV	20	20	400	0.004802846	0.121691779		1.921138559	48.6767118
Azimuth	Nunavut	2015	15-25-09	3/100		DUP-July-Amaruq		Calanoid	CRCO		Calanoida indet.	nauplius	34	33.33333333	1133.333333	0.000177853	0.000889266		0.201566905	1.007834524
Azimuth	Nunavut	2015	15-25-09	3/100		DUP-July-Amaruq		Rotifer	ROTI		Conochilus sp.	n/a	26	33.33333333	866.6666667	0.000146136	0.001461355		0.126650809	1.266508088
Azimuth	Nunavut	2015	15-25-09	2/10		DUP-July-Amaruq		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	171	20	3420	0.001389335	0.006946677		4.75152701	23.75763505
Azimuth	Nunavut	2015	15-25-09	2/10		DUP-July-Amaruq		Cyclopoid	CRCO		Cyclopoida indet.	M	5	20	100	0.005042793	0.025213967		0.504279335	2.521396677
Azimuth	Nunavut	2015	15-25-09	3/100		DUP-July-Amaruq		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	9	33.33333333	300	2.00168E-05	0.000100084		0.006005051	0.030025256
Azimuth	Nunavut	2015	15-25-09	2/10		DUP-July-Amaruq		Cyclopoid	CRCO		Cyclopoida indet.	V	3	20	60	0.005042793	0.025213967		0.302567601	1.512838006
Azimuth	Nunavut	2015	15-25-09	2/10		DUP-July-Amaruq		Cyclopoid	CRCO		Cyclopoida indet.	V	33	20	660	0.005042793	0.025213967		3.328243613	16.64121807
Azimuth	Nunavut	2015	15-25-09	2/10		DUP-July-Amaruq		Cyclopoid	CRCO		Cyclops scutifer	F	28	20	560	0.007235588	0.036177938		4.05192908	20.2596454
Azimuth	Nunavut	2015	15-25-09	2/10		DUP-July-Amaruq		Cyclopoid	CRCO		Cyclops scutifer	M	32	20	640	0.005185998	0.025929991		3.319038806	16.59519403
Azimuth	Nunavut	2015	15-25-09	1		DUP-July-Amaruq		Cladoceran	CRCL		Daphnia ambigua	F	2	1	2	0.002148681	0.012892088		0.004297363	0.025784177
Azimuth	Nunavut	2015	15-25-09	1		DUP-July-Amaruq		Cladoceran	CRCL		Daphnia middendorffiana	F	1	1	1	0.021219637	0.106098184		0.021219637	0.106098184
Azimuth	Nunavut	2015	15-25-09	2/10		DUP-July-Amaruq		Cladoceran	CRCL		Holopedium gibberum	F	3	20	60	0.002497062	0.012485309		0.149823706	0.749118529
Azimuth	Nunavut	2015	15-25-09	2/10		DUP-July-Amaruq		Cladoceran	CRCL		Holopedium gibberum	F	6	20	120	0.002497062	0.012485309		0.299647412	1.498237059
Azimuth	Nunavut	2015	15-25-09	3/100		DUP-July-Amaruq		Rotifer	ROTI		Kellicottia sp.	n/a	106	33.33333333	3533.333333	0.001252192	0.012521918		4.424411148	44.24411148
Azimuth	Nunavut	2015	15-25-09	3/100		DUP-July-Amaruq		Rotifer	ROTI		Keratella sp.	n/a	1	33.33333333	33.33333333	0.000105538	0.001055381		0.003517938	0.035179375
Azimuth	Nunavut	2015	15-25-09	1		DUP-July-Amaruq		Cladoceran	CRCL		Leptodora kindtii	F	1	1	1	0.041665665	0.208328325		0.041665665	0.208328325
Azimuth	Nunavut	2015	15-25-09	3/100		DUP-July-Amaruq		Rotifer	ROTI		Polyarthra sp.	n/a	7	33.33333333	233.3333333	7.16125E-05	0.000716125		0.016709591	0.167095911
Azimuth	Nunavut	2015	15-25-09	3/100		DUP-July-Amaruq		Rotifer	ROTI		Synchaeta sp.	n/a	5	33.33333333	166.6666667	0.009388446	0.093884464		1.564741063	15.64741063
Azimuth	Nunavut	2015	15-25-10	3/100	8/22/2015	WTN-03-S		Calanoid	CRCO		Calanoida indet.	nauplius	3	33.33333333	100	0.000177853	0.000889266		0.017785315	0.088926576
Azimuth	Nunavut	2015	15-25-10	3/100	8/22/2015	WTN-03-S		Rotifer	ROTI		Conochilus sp.	n/a	134	33.33333333	4466.666667	0.000146136	0.001461355		0.652738784	6.527387838
Azimuth	Nunavut	2015	15-25-10	2/100	8/22/2015	WTN-03-S		Rotifer	ROTI		Conochilus sp.	n/a	3	50	150	0.000146136	0.001461355		0.021920332	0.219203323
Azimuth	Nunavut	2015	15-25-10	2/10	8/22/2015	WTN-03-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	98	5	490	0.001389335	0.006946677		0.680774338	3.403871688
Azimuth	Nunavut	2015	15-25-10	3/100	8/22/2015	WTN-03-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	101	33.33333333	3366.666667	2.00168E-05	0.000100084		0.067390019	0.336950095
Azimuth	Nunavut	2015	15-25-10	2/10	8/22/2015	WTN-03-S		Cyclopoid	CRCO		Cyclopoida indet.	V	31	5	155	0.005042793	0.025213967		0.78163297	3.908164849
Azimuth	Nunavut	2015	15-25-10	2/10	8/22/2015	WTN-03-S		Cyclopoid	CRCO		Cyclops scutifer	F	23	5	115	0.007235588	0.036177938		0.832092579	4.160462895
Azimuth	Nunavut	2015	15-25-10	2/10	8/22/2015	WTN-03-S		Cyclopoid	CRCO		Cyclops scutifer	M	2	5	10	0.005185998	0.025929991		0.051859981	0.259299907
Azimuth	Nunavut	2015	15-25-10	2/10	8/22/2015	WTN-03-S		Cladoceran	CRCL		Daphnia middendorffiana	F	4	5	20	0.021219637	0.106098184		0.424392737	2.121963685
Azimuth	Nunavut	2015	15-25-10	2/10	8/22/2015	WTN-03-S		Calanoid	CRCO		Heterocope septentrionalis	F	2	5	10	0.094287498	0.471437491		0.942874982	4.714374911
Azimuth	Nunavut	2015	15-25-10	2/10	8/22/2015	WTN-03-S		Calanoid	CRCO		Heterocope septentrionalis	M	3	5	15	0.091438074	0.457190372		1.371571116	6.857855578
Azimuth	Nunavut	2015	15-25-10	2/10	8/22/2015	WTN-03-S		Cladoceran	CRCL		Holopedium gibberum	F	8	5	40	0.002497062	0.012485309		0.099882471	0.499412353
Azimuth	Nunavut	2015	15-25-10	3/100	8/22/2015	WTN-03-S		Rotifer	ROTI		Kellicottia sp.	n/a	170	33.33333333	5666.666667	0.001252192	0.012521918		7.095753728	70.95753728
Azimuth	Nunavut	2015	15-25-10	2/10	8/22/2015	WTN-03-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	30	5	150	0.015622034	0.471437491		2.343305172	70.71562366
Azimuth	Nunavut	2015	15-25-10	2/10	8/22/2015	WTN-03-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	24	5	120	0.013365482	0.457190372		1.603857788	54.86284462
Azimuth	Nunavut	2015	15-25-10	2/10	8/22/2015	WTN-03-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	V	3	5	15	0.013365482	0.457190372		0.200482223	6.857855578
Azimuth	Nunavut	2015	15-25-10	3/100	8/22/2015	WTN-03-S		Rotifer	ROTI		Polyarthra sp.	n/a	7	33.33333333	233.3333333	7.16125E-05	0.000716125		0.016709591	0.167095911
Azimuth	Nunavut	2015	15-25-11	3/10	8/22/2015	WTN-04-S		Calanoid	CRCO		Calanoida indet.	I-IV	1	3.333333333	3.333333333	0.004802846	0.121691779		0.016009488	0.405639265
Azimuth	Nunavut	2015	15-25-11	3/100	8/22/2015	WTN-04-S		Calanoid	CRCO		Calanoida indet.	nauplius	5	33.33333333	166.6666667	0.000177853	0.000889266		0.029642192	0.148210959
Azimuth	Nunavut	2015	15-25-11	3/100	8/22/2015	WTN-04-S		Rotifer	ROTI		Conochilus sp.	n/a	78	33.33333333	2600	0.000146136	0.001461355		0.379952426	3.799524264
Azimuth	Nunavut	2015	15-25-11	3/10	8/22/2015	WTN-04-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	99	3.333333333	330	0.001389335	0.006946677		0.458480676	2.292403382
Azimuth	Nunavut	2015	15-25-11	3/10	8/22/2015	WTN-04-S		Cyclopoid	CRCO		Cyclopoida indet.	M	1	3.333333333	3.333333333	0.005042793	0.025213967		0.016809311	0.084046556
Azimuth	Nunavut	2015	15-25-11	3/100	8/22/2015	WTN-04-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	124	33.33333333	4133.333333	2.00168E-05	0.000100084		0.082736261	0.413681305
Azimuth	Nunavut	2015	15-25-11	3/10	8/22/2015	WTN-04-S		Cyclopoid	CRCO		Cyclopoida indet.	V	35	3.333333333	116.6666667	0.005042793	0.025213967		0.588325891	2.941629456
Azimuth	Nunavut	2015	15-25-11	3/10	8/22/2015	WTN-04-S		Cyclopoid	CRCO		Cyclops scutifer	F	12	3.333333333	40	0.007235588	0.036177938		0.289423506	1.447117529
Azimuth	Nunavut	2015	15-25-11	3/10	8/22/2015	WTN-04-S		Cyclopoid	CRCO		Cyclops scutifer	M	1	3.333333333	3.333333333	0.005185998	0.025929991		0.01728666	0.086433302
Azimuth	Nunavut	2015	15-25-11	3/10	8/22/2015	WTN-04-S		Cladoceran	CRCL		Daphnia middendorffiana	F	1	3.333333333	3.333333333	0.021219637	0.106098184		0.070732123	0.353660614
Azimuth	Nunavut	2015	15-25-11	3/10	8/22/2015	WTN-04-S		Calanoid	CRCO		Heterocope septentrionalis	F	4	3.333333333	13.33333333	0.094287498	0.471437491		1.257166643	6.285833215
Azimuth	Nunavut	2015	15-25-11	3/10	8/22/2015	WTN-04-S		Calanoid	CRCO		Heterocope septentrionalis	M	1	3.333333333	3.333333333	0.091438074	0.457190372		0.304793581	1.523967906
Azimuth	Nunavut	2015	15-25-11	3/10	8/22/2015	WTN-04-S		Cladoceran	CRCL		Holopedium gibberum	F	2	3.333333333	6.666666667	0.002497062	0.012485309		0.016647078	0.083235392

Zooplankton raw count data for abundance calculations and biomass calculations, Azimuth Nunavut 2015

Client	Project	Year	Biologica #	Split	Date	Client ID	Fraction	Major Group	Groupcode	Family	Taxon	Stage	Raw Abundance	Split Multiplier	Total Abundance	Mean DW Biomass_mg	Mean WW Biomass_mg	Biomass assumptions	Total DW Biomass_mg	Total WW Biomass _mg
Azimuth	Nunavut	2015	15-25-11	3/100	8/22/2015	WTN-04-S		Rotifer	ROTI		Kellicottia sp.	n/a	163	33.33333333	5433.333333	0.001252192	0.012521918		6.803575633	68.03575633
Azimuth	Nunavut	2015	15-25-11	1/100	8/22/2015	WTN-04-S		Rotifer	ROTI		Keratella sp.	n/a	1	100	100	0.000105538	0.001055381		0.010553813	0.105538125
Azimuth	Nunavut	2015	15-25-11	3/10	8/22/2015	WTN-04-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	28	3.333333333	93.33333333	0.015622034	0.471437491		1.458056552	44.0008325
Azimuth	Nunavut	2015	15-25-11	3/10	8/22/2015	WTN-04-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	10	3.333333333	33.33333333	0.013365482	0.457190372		0.445516052	15.23967906
Azimuth	Nunavut	2015	15-25-11	3/10	8/22/2015	WTN-04-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	V	2	3.333333333	6.666666667	0.013365482	0.457190372		0.08910321	3.047935812
Azimuth	Nunavut	2015	15-25-11	3/100	8/22/2015	WTN-04-S		Rotifer	ROTI		Polyarthra sp.	n/a	9	33.33333333	300	7.16125E-05	0.000716125		0.02148376	0.2148376
Azimuth	Nunavut	2015	15-25-12	1/100	9/18/2015	WTN-05-S		Rotifer	ROTI		Asplanchna sp.	n/a	1	100	100	7.80401E-05	0.002001028		0.007804008	0.20010276
Azimuth	Nunavut	2015	15-25-12	3/100	9/18/2015	WTN-05-S		Calanoid	CRCO		Calanoida indet.	nauplius	7	33.33333333	233.3333333	0.000177853	0.000889266		0.041499069	0.207495343
Azimuth	Nunavut	2015	15-25-12	3/100	9/18/2015	WTN-05-S		Rotifer	ROTI		Conochilus sp.	n/a	56	33.33333333	1866.666667	0.000146136	0.001461355		0.272786357	2.727863574
Azimuth	Nunavut	2015	15-25-12	1/2	9/18/2015	WTN-05-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	142	2	284	0.001389335	0.006946677		0.394571249	1.972856244
Azimuth	Nunavut	2015	15-25-12	3/100	9/18/2015	WTN-05-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	34	33.33333333	1133.333333	2.00168E-05	0.000100084		0.022685749	0.113428745
Azimuth	Nunavut	2015	15-25-12	1/2	9/18/2015	WTN-05-S		Cyclopoid	CRCO		Cyclopoida indet.	V	31	2	62	0.005042793	0.025213967		0.312653188	1.563265939
Azimuth	Nunavut	2015	15-25-12	1/2	9/18/2015	WTN-05-S		Cyclopoid	CRCO		Cyclops scutifer	F	38	2	76	0.007235588	0.036177938		0.549904661	2.749523304
Azimuth	Nunavut	2015	15-25-12	1/2	9/18/2015	WTN-05-S		Cyclopoid	CRCO		Cyclops scutifer	M	41	2	82	0.005185998	0.025929991		0.425251847	2.126259235
Azimuth	Nunavut	2015	15-25-12	1/2	9/18/2015	WTN-05-S		Cladoceran	CRCL		Daphnia sp.	F	2	2	4	0.003999883	0.019999416		0.015999533	0.079997665
Azimuth	Nunavut	2015	15-25-12	1/2	9/18/2015	WTN-05-S		Cyclopoid	CRCO		Diacyclops thomasi	F	4	2	8	0.006289189	0.031445943		0.050313509	0.251567547
Azimuth	Nunavut	2015	15-25-12	1/2	9/18/2015	WTN-05-S		Cyclopoid	CRCO		Diacyclops thomasi	M	7	2	14	0.004170636	0.020853182		0.05838891	0.291944551
Azimuth	Nunavut	2015	15-25-12	3/100	9/18/2015	WTN-05-S		Rotifer	ROTI		Kellicottia sp.	n/a	105	33.33333333	3500	0.001252192	0.012521918		4.38267142	43.8267142
Azimuth	Nunavut	2015	15-25-12	1/2	9/18/2015	WTN-05-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	8	2	16	0.015622034	0.471437491		0.249952552	7.542999858
Azimuth	Nunavut	2015	15-25-12	1/2	9/18/2015	WTN-05-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	5	2	10	0.013365482	0.457190372		0.133654816	4.571903718
Azimuth	Nunavut	2015	15-25-12	2/100	9/18/2015	WTN-05-S		Rotifer	ROTI		Polyarthra sp.	n/a	3	50	150	7.16125E-05	0.000716125		0.01074188	0.1074188
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Calanoid	CRCO		Calanoida indet.	I-IV	3	5	15	0.004802846	0.121691779		0.072042696	1.825376692
Azimuth	Nunavut	2015	15-25-13	3/100	9/18/2015	WTN-06-S		Calanoid	CRCO		Calanoida indet.	nauplius	15	33.33333333	500	0.000177853	0.000889266		0.088926576	0.444632878
Azimuth	Nunavut	2015	15-25-13	3/100	9/18/2015	WTN-06-S		Calanoid	CRCO		Calanoida indet.	nauplius	3	33.33333333	100	0.000177853	0.000889266		0.017785315	0.088926576
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Calanoid	CRCO		Calanoida indet.	V	6	5	30	0.013365482	0.457190372		0.400964447	13.71571116
Azimuth	Nunavut	2015	15-25-13	3/100	9/18/2015	WTN-06-S		Rotifer	ROTI		Conochilus sp.	n/a	44	33.33333333	1466.666667	0.000146136	0.001461355		0.214332138	2.14332138
Azimuth	Nunavut	2015	15-25-13	3/100	9/18/2015	WTN-06-S		Rotifer	ROTI		Conochilus sp.	n/a	84	33.33333333	2800	0.000146136	0.001461355		0.409179536	4.091795361
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	103	5	515	0.001389335	0.006946677		0.715507722	3.577538611
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	105	5	525	0.001389335	0.006946677		0.729401076	3.64700538
Azimuth	Nunavut	2015	15-25-13	3/100	9/18/2015	WTN-06-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	52	33.33333333	1733.333333	2.00168E-05	0.000100084		0.034695851	0.173479257
Azimuth	Nunavut	2015	15-25-13	3/100	9/18/2015	WTN-06-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	93	33.33333333	3100	2.00168E-05	0.000100084		0.062052196	0.310260978
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Cyclopoid	CRCO		Cyclopoida indet.	V	60	5	300	0.005042793	0.025213967		1.512838006	7.56419003
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Cyclopoid	CRCO		Cyclopoida indet.	V	36	5	180	0.005042793	0.025213967		0.907702804	4.538514018
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Cyclopoid	CRCO		Cyclops scutifer	F	85	5	425	0.007235588	0.036177938		3.075124748	15.37562374
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Cyclopoid	CRCO		Cyclops scutifer	F	15	5	75	0.007235588	0.036177938		0.542669073	2.713345366
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Cyclopoid	CRCO		Cyclops scutifer	M	125	5	625	0.005185998	0.025929991		3.241248834	16.20624417
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Cladoceran	CRCL		Daphnia sp.	F	2	5	10	0.003999883	0.019999416		0.039998832	0.199994162
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Cyclopoid	CRCO		Diacyclops thomasi	F	9	5	45	0.006289189	0.031445943		0.283013491	1.415067454
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Cyclopoid	CRCO		Diacyclops thomasi	M	12	5	60	0.004170636	0.020853182		0.250238186	1.251190931
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Calanoid	CRCO		Heterocope septentrionalis	F	4	5	20	0.094287498	0.471437491		1.885749964	9.428749822
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Calanoid	CRCO		Heterocope septentrionalis	F	3	5	15	0.094287498	0.471437491		1.414312473	7.071562366
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Calanoid	CRCO		Heterocope septentrionalis	M	7	5	35	0.091438074	0.457190372		3.200332603	16.00166301
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Calanoid	CRCO		Heterocope septentrionalis	M	4	5	20	0.091438074	0.457190372		1.828761487	9.143807437
Azimuth	Nunavut	2015	15-25-13	3/100	9/18/2015	WTN-06-S		Rotifer	ROTI		Kellicottia sp.	n/a	134	33.33333333	4466.666667	0.001252192	0.012521918		5.593123527	55.93123527
Azimuth	Nunavut	2015	15-25-13	3/100	9/18/2015	WTN-06-S		Rotifer	ROTI		Kellicottia sp.	n/a	284	33.33333333	9466.666667	0.001252192	0.012521918		11.8540827	118.540827
Azimuth	Nunavut	2015	15-25-13	1/100	9/18/2015	WTN-06-S		Rotifer	ROTI		Keratella sp.	n/a	2	100	200	0.000105538	0.001055381		0.021107625	0.21107625
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	27	5	135	0.015622034	0.471437491		2.108974655	63.6440613
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	23	5	115	0.015622034	0.471437491		1.796533965	54.21531148
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	9	5	45	0.013365482	0.457190372		0.60144667	20.57356673
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	30	5	150	0.013365482	0.457190372		2.004822235	68.57855578
Azimuth	Nunavut	2015	15-25-13	2/10	9/18/2015	WTN-06-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	V	1	5	5	0.013365482	0.457190372		0.066827408	2.285951859
Azimuth	Nunavut	2015	15-25-13	3/100	9/18/2015	WTN-06-S		Rotifer	ROTI		Polyarthra sp.	n/a	6	33.33333333	200	7.16125E-05	0.000716125		0.014322507	0.143225066
Azimuth	Nunavut	2015	15-25-14	2/10	8/22/2015	WTS-03-S		Calanoid	CRCO		Calanoida indet.	I-IV	3	5	15	0.004802846	0.121691779		0.072042696	1.825376692
Azimuth	Nunavut	2015	15-25-14	3/100	8/22/2015	WTS-03-S		Calanoid	CRCO		Calanoida indet.	nauplius	3	33.33333333	100	0.000177853	0.000889266		0.017785315	0.088926576
Azimuth	Nunavut	2015	15-25-14	2/10	8/22/2015	WTS-03-S		Calanoid	CRCO		Calanoida indet.	V	6	5	30	0.013365482	0.457190372		0.400964447	13.71571116
Azimuth	Nunavut	2015	15-25-14	3/100	8/22/2015	WTS-03-S		Rotifer	ROTI		Conochilus sp.	n/a	84	33.33333333	2800	0.000146136	0.001461355		0.409179536	4.091795361
Azimuth	Nunavut	2015	15-25-14	2/10	8/22/2015	WTS-03-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	105	5	525	0.001389335	0.006946677		0.729401076	3.64700538
Azimuth	Nunavut	2015	15-25-14	3/100	8/22/2015	WTS-03-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	93	33.33333333	3100	2.00168E-05	0.000100084		0.062052196	0.310260978
Azimuth	Nunavut	2015	15-25-14	2/10	8/22/2015	WTS-03-S		Cyclopoid	CRCO		Cyclopoida indet.	V	36	5	180	0.005042793	0.025213967		0.907702804	4.538514018
Azimuth	Nunavut	2015	15-25-14	2/10	8/22/2015	WTS-03-S		Cyclopoid	CRCO		Cyclops scutifer	F	15	5	75	0.007235588	0.036177938		0.542669073	2.713345366
Azimuth	Nunavut	2015	15-25-14	2/10	8/22/2015	WTS-03-S		Calanoid	CRCO		Heterocope septentrionalis	F	3	5	15	0.094287498	0.471437491		1.414312473	7.071562366
Azimuth	Nunavut	2015	15-25-14	2/10	8/22/2015	WTS-03-S		Calanoid	CRCO		Heterocope septentrionalis	M	4	5	20	0.091438074	0.457190372		1.828761487	9.143807437
Azimuth	Nunavut	2015	15-25-14	3/100	8/22/2015	WTS-03-S		Rotifer	ROTI		Kellicottia sp.	n/a	284	33.33333333	9466.666667	0.001252192	0.012521918		11.8540827	118.540827
Azimuth	Nunavut	2015	15-25-14	1/100	8/22/2015	WTS-03-S		Rotifer	ROTI		Keratella sp.	n/a	2	100	200	0.000105538	0.001055381		0.021107625	0.21107625
Azimuth	Nunavut	2015	15-25-14	2/10	8/22/2015	WTS-03-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	23	5	115	0.015622034	0.471437491		1.796533965	54.21531148
Azimuth	Nunavut	2015	15-25-14	2/10	8/22/2015	WTS-03-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	30	5	150	0.013365482	0.457190372		2.004822235	68.57855578
Azimuth	Nunavut	2015	15-25-14	3/100	8/22/2015	WTS-03-S		Rotifer	ROTI		Polyarthra sp.	n/a	6	33.33333333	200	7.16125E-05	0.000716125		0.014322507	0.143225066
Azimuth	Nunavut	2015	15-25-15	2/100	8/21/2015	WTS-04-S		Rotifer	ROTI		Asplanchna sp.	n/a	2	50	100	7.80401E-05	0.002001028		0.007804008	0.20010276
Azimuth	Nunavut	2015	15-25-15	3/100	8/21/2015	WTS-04-S		Calanoid	CRCO		Calanoida indet.	nauplius	27	33.33333333	900	0.000177853	0.000889266		0.160067836	0.800339181
Azimuth	Nunavut	2015	15-25-15	2/10	8/21/2015	WTS-04-S		Calanoid	CRCO		Calanoida indet.	V	1	5	5	0.013365482	0.457190372		0.066827408	2.285951859
Azimuth	Nunavut	2015	15-25-15	3/100	8/21/2015	WTS-04-S		Rotifer	ROTI		Conochilus sp.	n/a	66	33.33333333	2200	0.000146136	0.001461355		0.321498207	3.214982069
Azimuth	Nunavut	2015	15-25-15	2/100	8/21/2015	WTS-04-S		Rotifer	ROTI		Conochilus sp.	n/a	2	50	100	0.000146136	0.001461355		0.014613555	0.146135549
Azimuth	Nunavut	2015	15-25-15	2/10	8/21/2015	WTS-04-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	108	5	540	0.001389335	0.006946677		0.750241107	3.751205534

Zooplankton raw count data for abundance calculations and biomass calculations, Azimuth Nunavut 2015

Client	Project	Year	Biologica #	Split	Date	Client ID	Fraction	Major Group	Groupcode	Family	Taxon	Stage	Raw Abundance	Split Multiplier	Total Abundance	Mean DW Biomass_mg	Mean WW Biomass_mg	Biomass assumptions	Total DW Biomass_mg	Total WW Biomass _mg
Azimuth	Nunavut	2015	15-25-15	3/100	8/21/2015	WTS-04-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	51	33.33333333	1700	2.00168E-05	0.000100084		0.034028623	0.170143117
Azimuth	Nunavut	2015	15-25-15	2/10	8/21/2015	WTS-04-S		Cyclopoid	CRCO		Cyclopoida indet.	V	26	5	130	0.005042793	0.025213967		0.655563136	3.27781568
Azimuth	Nunavut	2015	15-25-15	2/10	8/21/2015	WTS-04-S		Cyclopoid	CRCO		Cyclops scutifer	F	10	5	50	0.007235588	0.036177938		0.361779382	1.808896911
Azimuth	Nunavut	2015	15-25-15	2/10	8/21/2015	WTS-04-S		Cyclopoid	CRCO		Cyclops scutifer	M	1	5	5	0.005185998	0.025929991		0.025929991	0.129649953
Azimuth	Nunavut	2015	15-25-15	2/10	8/21/2015	WTS-04-S		Cladoceran	CRCL		Daphnia middendorffiana	F	1	5	5	0.021219637	0.106098184		0.106098184	0.530490921
Azimuth	Nunavut	2015	15-25-15	2/10	8/21/2015	WTS-04-S		Cyclopoid	CRCO		Diacyclops thomasi	M	1	5	5	0.004170636	0.020853182		0.020853182	0.104265911
Azimuth	Nunavut	2015	15-25-15	2/10	8/21/2015	WTS-04-S		Calanoid	CRCO		Heterocope septentrionalis	F	5	5	25	0.094287498	0.471437491		2.357187455	11.78593728
Azimuth	Nunavut	2015	15-25-15	3/100	8/21/2015	WTS-04-S		Rotifer	ROTI		Kellicottia sp.	n/a	210	33.33333333	7000	0.001252192	0.012521918		8.765342841	87.65342841
Azimuth	Nunavut	2015	15-25-15	2/10	8/21/2015	WTS-04-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	27	5	135	0.015622034	0.471437491		2.108974655	63.6440613
Azimuth	Nunavut	2015	15-25-15	2/10	8/21/2015	WTS-04-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	29	5	145	0.013365482	0.457190372		1.937994827	66.29260392
Azimuth	Nunavut	2015	15-25-15	2/100	8/21/2015	WTS-04-S		Rotifer	ROTI		Polyarthra sp.	n/a	2	50	100	7.16125E-05	0.000716125		0.007161253	0.071612533
Azimuth	Nunavut	2015	15-25-16	3/100	9/18/2015	WTS-05-S		Calanoid	CRCO		Calanoida indet.	nauplius	24	33.33333333	800	0.000177853	0.000889266		0.142282521	0.711412605
Azimuth	Nunavut	2015	15-25-16	2/10	9/18/2015	WTS-05-S		Calanoid	CRCO		Calanoida indet.	V	3	5	15	0.013365482	0.457190372		0.200482223	6.857855578
Azimuth	Nunavut	2015	15-25-16	3/100	9/18/2015	WTS-05-S		Rotifer	ROTI		Conochilus sp.	n/a	9	33.33333333	300	0.000146136	0.001461355		0.043840665	0.438406646
Azimuth	Nunavut	2015	15-25-16	2/10	9/18/2015	WTS-05-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	84	5	420	0.001389335	0.006946677		0.583520861	2.917604304
Azimuth	Nunavut	2015	15-25-16	3/100	9/18/2015	WTS-05-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	40	33.33333333	1333.333333	2.00168E-05	0.000100084		0.026689116	0.133445582
Azimuth	Nunavut	2015	15-25-16	2/10	9/18/2015	WTS-05-S		Cyclopoid	CRCO		Cyclopoida indet.	V	22	5	110	0.005042793	0.025213967		0.554707269	2.773536344
Azimuth	Nunavut	2015	15-25-16	2/10	9/18/2015	WTS-05-S		Cyclopoid	CRCO		Cyclops scutifer	F	50	5	250	0.007235588	0.036177938		1.808896911	9.044484554
Azimuth	Nunavut	2015	15-25-16	2/10	9/18/2015	WTS-05-S		Cyclopoid	CRCO		Cyclops scutifer	M	44	5	220	0.005185998	0.025929991		1.140919589	5.704597947
Azimuth	Nunavut	2015	15-25-16	2/10	9/18/2015	WTS-05-S		Cladoceran	CRCL		Daphnia middendorffiana	F	2	5	10	0.021219637	0.106098184		0.212196369	1.060981843
Azimuth	Nunavut	2015	15-25-16	2/10	9/18/2015	WTS-05-S		Cladoceran	CRCL		Daphnia sp.	F	1	5	5	0.003999883	0.019999416		0.019999416	0.099997081
Azimuth	Nunavut	2015	15-25-16	2/10	9/18/2015	WTS-05-S		Cyclopoid	CRCO		Diacyclops thomasi	F	6	5	30	0.006289189	0.031445943		0.18867566	0.943378302
Azimuth	Nunavut	2015	15-25-16	2/10	9/18/2015	WTS-05-S		Cyclopoid	CRCO		Diacyclops thomasi	M	1	5	5	0.004170636	0.020853182		0.020853182	0.104265911
Azimuth	Nunavut	2015	15-25-16	2/10	9/18/2015	WTS-05-S		Calanoid	CRCO		Heterocope septentrionalis	F	2	5	10	0.094287498	0.471437491		0.942874982	4.714374911
Azimuth	Nunavut	2015	15-25-16	2/10	9/18/2015	WTS-05-S		Calanoid	CRCO		Heterocope septentrionalis	M	1	5	5	0.091438074	0.457190372		0.457190372	2.285951859
Azimuth	Nunavut	2015	15-25-16	3/100	9/18/2015	WTS-05-S		Rotifer	ROTI		Kellicottia sp.	n/a	97	33.33333333	3233.333333	0.001252192	0.012521918		4.048753598	40.48753598
Azimuth	Nunavut	2015	15-25-16	3/100	9/18/2015	WTS-05-S		Rotifer	ROTI		Keratella sp.	n/a	3	33.33333333	100	0.000105538	0.001055381		0.010553813	0.105538125
Azimuth	Nunavut	2015	15-25-16	2/10	9/18/2015	WTS-05-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	10	5	50	0.015622034	0.471437491		0.781101724	23.57187455
Azimuth	Nunavut	2015	15-25-16	2/10	9/18/2015	WTS-05-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	5	5	25	0.013365482	0.457190372		0.334137039	11.4297593
Azimuth	Nunavut	2015	15-25-16	3/100	9/18/2015	WTS-05-S		Rotifer	ROTI		Polyarthra sp.	n/a	4	33.33333333	133.3333333	7.16125E-05	0.000716125		0.009548338	0.095483378
Azimuth	Nunavut	2015	15-25-16-QA	3/100	9/18/2015	WTS-05-S-QA		Calanoid	CRCO		Calanoida indet.	nauplius	24	33.33333333	800	0.000177853	0.000889266		0.142282521	0.711412605
Azimuth	Nunavut	2015	15-25-16-QA	2/10	9/18/2015	WTS-05-S-QA		Calanoid	CRCO		Calanoida indet.	V	1	5	5	0.013365482	0.457190372		0.066827408	2.285951859
Azimuth	Nunavut	2015	15-25-16-QA	3/100	9/18/2015	WTS-05-S-QA		Rotifer	ROTI		Conochilus sp.	n/a	6	33.33333333	200	0.000146136	0.001461355		0.02922711	0.292271097
Azimuth	Nunavut	2015	15-25-16-QA	2/10	9/18/2015	WTS-05-S-QA		Cyclopoid	CRCO		Cyclopoida indet.	F	46	5	230	0.005042793	0.025213967		1.159842471	5.799212356
Azimuth	Nunavut	2015	15-25-16-QA	2/10	9/18/2015	WTS-05-S-QA		Cyclopoid	CRCO		Cyclopoida indet.	M	38	5	190	0.005042793	0.025213967		0.958130737	4.790653685
Azimuth	Nunavut	2015	15-25-16-QA	3/100	9/18/2015	WTS-05-S-QA		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	43	33.33333333	1433.333333	2.00168E-05	0.000100084		0.0286908	0.143454001
Azimuth	Nunavut	2015	15-25-16-QA	2/10	9/18/2015	WTS-05-S-QA		Cladoceran	CRCL		Daphnia middendorffiana	F	1	5	5	0.021219637	0.106098184		0.106098184	0.530490921
Azimuth	Nunavut	2015	15-25-16-QA	2/10	9/18/2015	WTS-05-S-QA		Cladoceran	CRCL		Daphnia sp.	F	1	5	5	0.003999883	0.019999416		0.019999416	0.099997081
Azimuth	Nunavut	2015	15-25-16-QA	2/10	9/18/2015	WTS-05-S-QA		Cyclopoid	CRCO		Diacyclops thomasi	F	5	5	25	0.006289189	0.031445943		0.157229717	0.786148585
Azimuth	Nunavut	2015	15-25-16-QA	2/10	9/18/2015	WTS-05-S-QA		Cyclopoid	CRCO		Diacyclops thomasi	I-IV	86	5	430	0.001389335	0.006946677		0.597414215	2.987071074
Azimuth	Nunavut	2015	15-25-16-QA	2/10	9/18/2015	WTS-05-S-QA		Cyclopoid	CRCO		Diacyclops thomasi	M	3	5	15	0.004170636	0.020853182		0.062559547	0.312797733
Azimuth	Nunavut	2015	15-25-16-QA	2/10	9/18/2015	WTS-05-S-QA		Cyclopoid	CRCO		Diacyclops thomasi	V	17	5	85	0.005042793	0.025213967		0.428637435	2.143187175
Azimuth	Nunavut	2015	15-25-16-QA	2/10	9/18/2015	WTS-05-S-QA		Calanoid	CRCO		Heterocope septentrionalis	F	1	5	5	0.094287498	0.471437491		0.471437491	2.357187455
Azimuth	Nunavut	2015	15-25-16-QA	2/10	9/18/2015	WTS-05-S-QA		Calanoid	CRCO		Heterocope septentrionalis	M	3	5	15	0.091438074	0.457190372		1.371571116	6.857855578
Azimuth	Nunavut	2015	15-25-16-QA	3/100	9/18/2015	WTS-05-S-QA		Rotifer	ROTI		Kellicottia sp.	n/a	125	33.33333333	4166.666667	0.001252192	0.012521918		5.217465977	52.17465977
Azimuth	Nunavut	2015	15-25-16-QA	3/100	9/18/2015	WTS-05-S-QA		Rotifer	ROTI		Keratella sp.	n/a	2	33.33333333	66.66666667	0.000105538	0.001055381		0.007035875	0.07035875
Azimuth	Nunavut	2015	15-25-16-QA	2/10	9/18/2015	WTS-05-S-QA		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	7	5	35	0.015622034	0.471437491		0.546771207	16.50031219
Azimuth	Nunavut	2015	15-25-16-QA	2/10	9/18/2015	WTS-05-S-QA		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	8	5	40	0.013365482	0.457190372		0.534619263	18.28761487
Azimuth	Nunavut	2015	15-25-16-QA	3/100	9/18/2015	WTS-05-S-QA		Rotifer	ROTI		Polyarthra sp.	n/a	3	33.33333333	100	7.16125E-05	0.000716125		0.007161253	0.071612533
Azimuth	Nunavut	2015	15-25-17	3/100	9/18/2015	WTS-06-S		Calanoid	CRCO		Calanoida indet.	nauplius	18	33.33333333	600	0.000177853	0.000889266		0.106711891	0.533559454
Azimuth	Nunavut	2015	15-25-17	3/10	9/18/2015	WTS-06-S		Calanoid	CRCO		Calanoida indet.	V	4	3.333333333	13.33333333	0.013365482	0.457190372		0.178206421	6.095871625
Azimuth	Nunavut	2015	15-25-17	3/100	9/18/2015	WTS-06-S		Rotifer	ROTI		Conochilus sp.	n/a	14	33.33333333	466.6666667	0.000146136	0.001461355		0.068196589	0.681965894
Azimuth	Nunavut	2015	15-25-17	3/10	9/18/2015	WTS-06-S		Cyclopoid	CRCO		Cyclopoida indet.	F	9	3.333333333	30	0.005042793	0.025213967		0.151283801	0.756419003
Azimuth	Nunavut	2015	15-25-17	3/10	9/18/2015	WTS-06-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	100	3.333333333	333.3333333	0.001389335	0.006946677		0.463111794	2.315558972
Azimuth	Nunavut	2015	15-25-17	3/10	9/18/2015	WTS-06-S		Cyclopoid	CRCO		Cyclopoida indet.	M	5	3.333333333	16.66666667	0.005042793	0.025213967		0.084046556	0.420232779
Azimuth	Nunavut	2015	15-25-17	3/100	9/18/2015	WTS-06-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	25	33.33333333	833.3333333	2.00168E-05	0.000100084		0.016680698	0.083403489
Azimuth	Nunavut	2015	15-25-17	3/10	9/18/2015	WTS-06-S		Cyclopoid	CRCO		Cyclopoida indet.	V	42	3.333333333	140	0.005042793	0.025213967		0.705991069	3.529955347
Azimuth	Nunavut	2015	15-25-17	3/10	9/18/2015	WTS-06-S		Cyclopoid	CRCO		Cyclops scutifer	F	55	3.333333333	183.3333333	0.007235588	0.036177938		1.326524401	6.632622006
Azimuth	Nunavut	2015	15-25-17	3/10	9/18/2015	WTS-06-S		Cyclopoid	CRCO		Cyclops scutifer	M	69	3.333333333	230	0.005185998	0.025929991		1.192779571	5.963897854
Azimuth	Nunavut	2015	15-25-17	3/10	9/18/2015	WTS-06-S		Cladoceran	CRCL		Daphnia middendorffiana	F	2	3.333333333	6.666666667	0.021219637	0.106098184		0.141464246	0.707321228
Azimuth	Nunavut	2015	15-25-17	3/10	9/18/2015	WTS-06-S		Cladoceran	CRCL		Daphnia middendorffiana	F	1	3.333333333	3.333333333	0.021219637	0.106098184		0.070732123	0.353660614
Azimuth	Nunavut	2015	15-25-17	3/10	9/18/2015	WTS-06-S		Cyclopoid	CRCO		Diacyclops thomasi	F	15	3.333333333	50	0.006289189	0.031445943		0.314459434	1.572297171
Azimuth	Nunavut	2015	15-25-17	3/10	9/18/2015	WTS-06-S		Cyclopoid	CRCO		Diacyclops thomasi	M	7	3.333333333	23.33333333	0.004170636	0.020853182		0.09731485	0.486574251
Azimuth	Nunavut	2015	15-25-17	3/10	9/18/2015	WTS-06-S		Calanoid	CRCO		Heterocope septentrionalis	F	1	3.333333333	3.333333333	0.094287498	0.471437491		0.314291661	1.571458304
Azimuth	Nunavut	2015	15-25-17	3/100	9/18/2015	WTS-06-S		Rotifer	ROTI		Kellicottia sp.	n/a	117	33.33333333	3900	0.001252192	0.012521918		4.883548154	48.83548154
Azimuth	Nunavut	2015	15-25-17	3/10	9/18/2015	WTS-06-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	21	3.333333333	70	0.015622034	0.471437491		1.093542414	33.00062438
Azimuth	Nunavut	2015	15-25-17	3/10	9/18/2015	WTS-06-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	4	3.333333333	13.33333333	0.013365482	0.457190372		0.178206421	6.095871625
Azimuth	Nunavut	2015	15-25-17	3/100	9/18/2015	WTS-06-S		Rotifer	ROTI		Polyarthra sp.	n/a	7	33.33333333	233.3333333	7.16125E-05	0.000716125		0.016709591	0.167095911
Azimuth	Nunavut	2015	15-25-18	1/10	8/23/2015	NEM-03-S		Cladoceran	CRCL		Bosmina sp.	F	1	10	10	0.008880563	0.044402816		0.088805631	0.444028157
Azimuth	Nunavut	2015	15-25-18	1/10	8/23/2015	NEM-03-S		Calanoid	CRCO		Calanoida indet.	I-IV	64	10	640	0.004802846	0.121691779		3.073821694	77.88273887
Azimuth	Nunavut	2015	15-25-18	3/100	8/23/2015	NEM-03-S		Calanoid	CRCO		Calanoida indet.	nauplius	4	33.33333333	133.3333333	0.000177853	0.000889266		0.023713754	0.118568768
Azimuth	Nunavut	2015	15-25-18	1/10	8/23/2015	NEM-03-S		Calanoid	CRCO		Calanoida indet.	V	30	10	300	0.013365482	0.457190372		4.009644469	137.1571116
Azimuth	Nunavut	2015	15-25-18	3/100	8/23/2015	NEM-03-S		Rotifer	ROTI		Conochilus sp.	n/a	22	33.33333333	733.3333333	0.000146136	0.001461355		0.107166069	1.07166069

Zooplankton raw count data for abundance calculations and biomass calculations, Azimuth Nunavut 2015

Client	Project	Year	Biologica #	Split	Date	Client ID	Fraction	Major Group	Groupcode	Family	Taxon	Stage	Raw Abundance	Split Multiplier	Total Abundance	Mean DW Biomass_mg	Mean WW Biomass_mg	Biomass assumptions	Total DW Biomass_mg	Total WW Biomass _mg
Azimuth	Nunavut	2015	15-25-18	2/100	8/23/2015	NEM-03-S		Rotifer	ROTI		Conochilus sp.	n/a	2	50	100	0.000146136	0.001461355		0.014613555	0.146135549
Azimuth	Nunavut	2015	15-25-18	1/10	8/23/2015	NEM-03-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	160	10	1600	0.001389335	0.006946677		2.222936613	11.11468306
Azimuth	Nunavut	2015	15-25-18	3/100	8/23/2015	NEM-03-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	140	33.33333333	4666.666667	2.00168E-05	0.000100084		0.093411907	0.467059537
Azimuth	Nunavut	2015	15-25-18	1/100	8/23/2015	NEM-03-S		Cyclopoid	CRCO		Cyclopoida indet.	V	6	10	60	0.005042793	0.025213967		0.302567601	1.512838006
Azimuth	Nunavut	2015	15-25-18	1/10	8/23/2015	NEM-03-S		Cyclopoid	CRCO		Cyclops scutifer	F	9	10	90	0.007235588	0.036177938		0.651202888	3.25601444
Azimuth	Nunavut	2015	15-25-18	1/10	8/23/2015	NEM-03-S		Cladoceran	CRCL		Daphnia middendorffiana	F	3	10	30	0.021219637	0.106098184		0.636589106	3.182945528
Azimuth	Nunavut	2015	15-25-18	3/100	8/23/2015	NEM-03-S		Rotifer	ROTI		Kellicottia sp.	n/a	101	33.33333333	3366.666667	0.001252192	0.012521918		4.215712509	42.15712509
Azimuth	Nunavut	2015	15-25-18	1/10	8/23/2015	NEM-03-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	53	10	530	0.015622034	0.471437491		8.279678275	249.8618703
Azimuth	Nunavut	2015	15-25-18	1/10	8/23/2015	NEM-03-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	76	10	760	0.013365482	0.457190372		10.15776599	347.4646826
Azimuth	Nunavut	2015	15-25-19	1/10	8/23/2015	NEM-04-S		Calanoid	CRCO		Calanoida indet.	I-IV	53	10	530	0.004802846	0.121691779		2.54550859	64.49664313
Azimuth	Nunavut	2015	15-25-19	1/100	8/23/2015	NEM-04-S		Calanoid	CRCO		Calanoida indet.	nauplius	1	100	100	0.000177853	0.000889266		0.017785315	0.088926576
Azimuth	Nunavut	2015	15-25-19	1/10	8/23/2015	NEM-04-S		Calanoid	CRCO		Calanoida indet.	V	24	10	240	0.013365482	0.457190372		3.207715575	109.7256892
Azimuth	Nunavut	2015	15-25-19	3/100	8/23/2015	NEM-04-S		Rotifer	ROTI		Conochilus sp.	n/a	19	33.33333333	633.3333333	0.000146136	0.001461355		0.092552514	0.925525141
Azimuth	Nunavut	2015	15-25-19	1/10	8/23/2015	NEM-04-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	155	10	1550	0.001389335	0.006946677		2.153469844	10.76734922
Azimuth	Nunavut	2015	15-25-19	3/100	8/23/2015	NEM-04-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	171	33.33333333	5700	2.00168E-05	0.000100084		0.114095973	0.570479864
Azimuth	Nunavut	2015	15-25-19	1/10	8/23/2015	NEM-04-S		Cyclopoid	CRCO		Cyclopoida indet.	V	6	10	60	0.005042793	0.025213967		0.302567601	1.512838006
Azimuth	Nunavut	2015	15-25-19	1/10	8/23/2015	NEM-04-S		Cyclopoid	CRCO		Cyclops scutifer	F	6	10	60	0.007235588	0.036177938		0.434135259	2.170676293
Azimuth	Nunavut	2015	15-25-19	1/10	8/23/2015	NEM-04-S		Cyclopoid	CRCO		Cyclops scutifer	M	1	10	10	0.005185998	0.025929991		0.051859981	0.259299907
Azimuth	Nunavut	2015	15-25-19	1/10	8/23/2015	NEM-04-S		Calanoid	CRCO		Heterocope septentrionalis	F	1	10	10	0.094287498	0.471437491		0.942874982	4.714374911
Azimuth	Nunavut	2015	15-25-19	3/100	8/23/2015	NEM-04-S		Rotifer	ROTI		Kellicottia sp.	n/a	95	33.33333333	3166.666667	0.001252192	0.012521918		3.965274142	39.65274142
Azimuth	Nunavut	2015	15-25-19	1/10	8/23/2015	NEM-04-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	45	10	450	0.015622034	0.471437491		7.029915516	212.146871
Azimuth	Nunavut	2015	15-25-19	1/10	8/23/2015	NEM-04-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	47	10	470	0.013365482	0.457190372		6.281776335	214.8794748
Azimuth	Nunavut	2015	15-25-20	Whole	9/19/2015	NEM-05-S		Cladoceran	CRCL		Bosmina sp.	F	1	1	1	0.008880563	0.044402816		0.008880563	0.044402816
Azimuth	Nunavut	2015	15-25-20	3/100	9/19/2015	NEM-05-S		Calanoid	CRCO		Calanoida indet.	nauplius	13	33.33333333	433.3333333	0.000177853	0.000889266		0.077069699	0.385348494
Azimuth	Nunavut	2015	15-25-20	3/100	9/19/2015	NEM-05-S		Rotifer	ROTI		Conochilus sp.	n/a	3	33.33333333	100	0.000146136	0.001461355		0.014613555	0.146135549
Azimuth	Nunavut	2015	15-25-20	1/10	9/19/2015	NEM-05-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	115	10	1150	0.001389335	0.006946677		1.59773569	7.988678452
Azimuth	Nunavut	2015	15-25-20	3/100	9/19/2015	NEM-05-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	162	33.33333333	5400	2.00168E-05	0.000100084		0.108090922	0.540454608
Azimuth	Nunavut	2015	15-25-20	1/10	9/19/2015	NEM-05-S		Cyclopoid	CRCO		Cyclopoida indet.	V	11	10	110	0.005042793	0.025213967		0.554707269	2.773536344
Azimuth	Nunavut	2015	15-25-20	1/10	9/19/2015	NEM-05-S		Cyclopoid	CRCO		Cyclops scutifer	F	2	10	20	0.007235588	0.036177938		0.144711753	0.723558764
Azimuth	Nunavut	2015	15-25-20	Whole	9/19/2015	NEM-05-S		Cladoceran	CRCL		Daphnia middendorffiana	F	2	1	2	0.021219637	0.106098184		0.042439274	0.212196369
Azimuth	Nunavut	2015	15-25-20	Whole	9/19/2015	NEM-05-S		Cladoceran	CRCL		Daphnia middendorffiana	F	1	1	1	0.021219637	0.106098184		0.021219637	0.106098184
Azimuth	Nunavut	2015	15-25-20	1/10	9/19/2015	NEM-05-S		Calanoid	CRCO		Heterocope septentrionalis	F	1	10	10	0.094287498	0.471437491		0.942874982	4.714374911
Azimuth	Nunavut	2015	15-25-20	Whole	9/19/2015	NEM-05-S		Cladoceran	CRCL		Holopedium gibberum	F	1	1	1	0.002497062	0.012485309		0.002497062	0.012485309
Azimuth	Nunavut	2015	15-25-20	3/100	9/19/2015	NEM-05-S		Rotifer	ROTI		Kellicottia sp.	n/a	99	33.33333333	3300	0.001252192	0.012521918		4.132233053	41.32233053
Azimuth	Nunavut	2015	15-25-20	2/100	9/19/2015	NEM-05-S		Rotifer	ROTI		Keratella sp.	n/a	3	50	150	0.000105538	0.001055381		0.015830719	0.158307188
Azimuth	Nunavut	2015	15-25-20	1/10	9/19/2015	NEM-05-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	95	10	950	0.015622034	0.471437491		14.84093276	447.8656165
Azimuth	Nunavut	2015	15-25-20	2/100	9/19/2015	NEM-05-S		Rotifer	ROTI		Polyarthra sp.	n/a	2	50	100	7.16125E-05	0.000716125		0.007161253	0.071612533
Azimuth	Nunavut	2015	15-25-21	2/10	9/19/2015	NEM-06-S		Cladoceran	CRCL		Bosmina sp.	F	2	5	10	0.008880563	0.044402816		0.088805631	0.444028157
Azimuth	Nunavut	2015	15-25-21	3/100	9/19/2015	NEM-06-S		Calanoid	CRCO		Calanoida indet.	nauplius	20	33.33333333	666.6666667	0.000177853	0.000889266		0.118568768	0.592843838
Azimuth	Nunavut	2015	15-25-21	3/100	9/19/2015	NEM-06-S		Rotifer	ROTI		Conochilus sp.	n/a	3	33.33333333	100	0.000146136	0.001461355		0.014613555	0.146135549
Azimuth	Nunavut	2015	15-25-21	2/10	9/19/2015	NEM-06-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	102	5	510	0.001389335	0.006946677		0.708561045	3.542805227
Azimuth	Nunavut	2015	15-25-21	3/100	9/19/2015	NEM-06-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	122	33.33333333	4066.666667	2.00168E-05	0.000100084		0.081401805	0.407009025
Azimuth	Nunavut	2015	15-25-21	2/10	9/19/2015	NEM-06-S		Cyclopoid	CRCO		Cyclopoida indet.	V	21	5	105	0.005042793	0.025213967		0.529493302	2.64746651
Azimuth	Nunavut	2015	15-25-21	2/10	9/19/2015	NEM-06-S		Cyclopoid	CRCO		Cyclops scutifer	F	3	5	15	0.007235588	0.036177938		0.108533815	0.542669073
Azimuth	Nunavut	2015	15-25-21	2/10	9/19/2015	NEM-06-S		Calanoid	CRCO		Heterocope septentrionalis	F	3	5	15	0.094287498	0.471437491		1.414312473	7.071562366
Azimuth	Nunavut	2015	15-25-21	3/100	9/19/2015	NEM-06-S		Rotifer	ROTI		Kellicottia sp.	n/a	123	33.33333333	4100	0.001252192	0.012521918		5.133986521	51.33986521
Azimuth	Nunavut	2015	15-25-21	3/100	9/19/2015	NEM-06-S		Rotifer	ROTI		Keratella sp.	n/a	4	33.33333333	133.3333333	0.000105538	0.001055381		0.01407175	0.1407175
Azimuth	Nunavut	2015	15-25-21	2/10	9/19/2015	NEM-06-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	90	5	450	0.015622034	0.471437491		7.029915516	212.146871
Azimuth	Nunavut	2015	15-25-21	2/10	9/19/2015	NEM-06-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	107	5	535	0.013365482	0.457190372		7.150532636	244.5968489
Azimuth	Nunavut	2015	15-25-22	1/100	8/24/2015	MAM-03-S		Rotifer	ROTI		Asplanchna sp.	n/a	1	100	100	7.80401E-05	0.002001028		0.007804008	0.20010276
Azimuth	Nunavut	2015	15-25-22	3/100	8/24/2015	MAM-03-S		Cladoceran	CRCL		Bosmina sp.	F	1	33.33333333	33.33333333	0.008880563	0.044402816		0.296018771	1.480093856
Azimuth	Nunavut	2015	15-25-22	3/100	8/24/2015	MAM-03-S		Calanoid	CRCO		Calanoida indet.	nauplius	26	33.33333333	866.6666667	0.000177853	0.000889266		0.154139398	0.770696989
Azimuth	Nunavut	2015	15-25-22	3/100	8/24/2015	MAM-03-S		Rotifer	ROTI		Conochilus sp.	n/a	87	33.33333333	2900	0.000146136	0.001461355		0.423793091	4.23793091
Azimuth	Nunavut	2015	15-25-22	3/100	8/24/2015	MAM-03-S		Rotifer	ROTI		Conochilus sp.	n/a	4	33.33333333	133.3333333	0.000146136	0.001461355		0.01948474	0.194847398
Azimuth	Nunavut	2015	15-25-22	3/100	8/24/2015	MAM-03-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	105	33.33333333	3500	0.001389335	0.006946677		4.862673841	24.3133692
Azimuth	Nunavut	2015	15-25-22	3/100	8/24/2015	MAM-03-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	61	33.33333333	2033.333333	2.00168E-05	0.000100084		0.040700903	0.203504513
Azimuth	Nunavut	2015	15-25-22	3/100	8/24/2015	MAM-03-S		Cyclopoid	CRCO		Cyclopoida indet.	V	23	33.33333333	766.6666667	0.005042793	0.025213967		3.866141571	19.33070785
Azimuth	Nunavut	2015	15-25-22	3/100	8/24/2015	MAM-03-S		Cyclopoid	CRCO		Cyclops scutifer	F	7	33.33333333	233.3333333	0.007235588	0.036177938		1.688303783	8.441518917
Azimuth	Nunavut	2015	15-25-22	3/100	8/24/2015	MAM-03-S		Cladoceran	CRCL		Daphnia middendorffiana	F	1	33.33333333	33.33333333	0.021219637	0.106098184		0.707321228	3.536606142
Azimuth	Nunavut	2015	15-25-22	3/100	8/24/2015	MAM-03-S		Cladoceran	CRCL		Daphnia middendorffiana	F	1	33.33333333	33.33333333	0.021219637	0.106098184		0.707321228	3.536606142
Azimuth	Nunavut	2015	15-25-22	3/100	8/24/2015	MAM-03-S		Calanoid	CRCO		Heterocope septentrionalis	F	3	33.33333333	100	0.094287498	0.471437491		9.428749822	47.14374911
Azimuth	Nunavut	2015	15-25-22	3/100	8/24/2015	MAM-03-S		Calanoid	CRCO		Heterocope septentrionalis	M	2	33.33333333	66.66666667	0.091438074	0.457190372		6.095871625	30.47935812
Azimuth	Nunavut	2015	15-25-22	3/100	8/24/2015	MAM-03-S		Rotifer	ROTI		Kellicottia sp.	n/a	154	33.33333333	5133.333333	0.001252192	0.012521918		6.427918083	64.27918083
Azimuth	Nunavut	2015	15-25-22	2/100	8/24/2015	MAM-03-S		Rotifer	ROTI		Keratella sp.	n/a	2	50	100	0.000105538	0.001055381		0.010553813	0.105538125
Azimuth	Nunavut	2015	15-25-22	3/100	8/24/2015	MAM-03-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	39	33.33333333	1300	0.015622034	0.471437491		20.30864482	612.8687384
Azimuth	Nunavut	2015	15-25-22	3/100	8/24/2015	MAM-03-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	66	33.33333333	2200	0.013365482	0.457190372		29.40405944	1005.818818
Azimuth	Nunavut	2015	15-25-22	3/100	8/24/2015	MAM-03-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	V	3	33.33333333	100	0.013365482	0.457190372		1.336548156	45.71903718
Azimuth	Nunavut	2015	15-25-22	3/100	8/24/2015	MAM-03-S		Cyclopoid	CRCO		Microcyclops sp.	F	2	33.33333333	66.66666667	0.000961953	0.004809763		0.064130168	0.320650838
Azimuth	Nunavut	2015	15-25-23	2/100	8/24/2015	MAM-04-S		Rotifer	ROTI		Asplanchna sp.	n/a	2	50	100	7.80401E-05	0.002001028		0.007804008	0.20010276
Azimuth	Nunavut	2015	15-25-23	Whole	8/24/2015	MAM-04-S		Calanoid	CRCO		Calanoida indet.	I-IV	4	1	4	0.004802846	0.121691779		0.019211386	0.486767118
Azimuth	Nunavut	2015	15-25-23	3/100	8/24/2015	MAM-04-S		Calanoid	CRCO		Calanoida indet.	nauplius	13	33.33333333	433.3333333	0.000177853	0.000889266		0.077069699	0.385348494
Azimuth	Nunavut	2015	15-25-23	Whole	8/24/2015	MAM-04-S		Calanoid	CRCO		Calanoida indet.	V	1	1	1	0.013365482	0.457190372		0.013365482	0.457190372

Zooplankton raw count data for abundance calculations and biomass calculations, Azimuth Nunavut 2015

Client	Project	Year	Biologica #	Split	Date	Client ID	Fraction	Major Group	Groupcode	Family	Taxon	Stage	Raw Abundance	Split Multiplier	Total Abundance	Mean DW Biomass_mg	Mean WW Biomass_mg	Biomass assumptions	Total DW Biomass_mg	Total WW Biomass _mg
Azimuth	Nunavut	2015	15-25-23	3/100	8/24/2015	MAM-04-S		Rotifer	ROTI		Conochilus sp.	n/a	47	33.33333333	1566.666667	0.000146136	0.001461355		0.228945693	2.289456928
Azimuth	Nunavut	2015	15-25-23	1/100	8/24/2015	MAM-04-S		Rotifer	ROTI		Conochilus sp.	n/a	1	100	100	0.000146136	0.001461355		0.014613555	0.146135549
Azimuth	Nunavut	2015	15-25-23	Whole	8/24/2015	MAM-04-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	145	1	145	0.001389335	0.006946677		0.201453631	1.007268153
Azimuth	Nunavut	2015	15-25-23	3/100	8/24/2015	MAM-04-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	74	33.33333333	2466.666667	2.00168E-05	0.000100084		0.049374865	0.246874327
Azimuth	Nunavut	2015	15-25-23	Whole	8/24/2015	MAM-04-S		Cyclopoid	CRCO		Cyclopoida indet.	V	18	1	18	0.005042793	0.025213967		0.09077028	0.453851402
Azimuth	Nunavut	2015	15-25-23	Whole	8/24/2015	MAM-04-S		Cyclopoid	CRCO		Cyclops scutifer	F	12	1	12	0.007235588	0.036177938		0.086827052	0.434135259
Azimuth	Nunavut	2015	15-25-23	Whole	8/24/2015	MAM-04-S		Cyclopoid	CRCO		Cyclops scutifer	M	1	1	1	0.005185998	0.025929991		0.005185998	0.025929991
Azimuth	Nunavut	2015	15-25-23	Whole	8/24/2015	MAM-04-S		Cladoceran	CRCL		Daphnia middendorffiana	F	1	1	1	0.021219637	0.106098184		0.021219637	0.106098184
Azimuth	Nunavut	2015	15-25-23	Whole	8/24/2015	MAM-04-S		Calanoid	CRCO		Heterocope septentrionalis	F	91	1	91	0.094287498	0.471437491		8.580162338	42.90081169
Azimuth	Nunavut	2015	15-25-23	Whole	8/24/2015	MAM-04-S		Calanoid	CRCO		Heterocope septentrionalis	M	46	1	46	0.091438074	0.457190372		4.206151421	21.0307571
Azimuth	Nunavut	2015	15-25-23	3/100	8/24/2015	MAM-04-S		Rotifer	ROTI		Kellicottia sp.	n/a	112	33.33333333	3733.333333	0.001252192	0.012521918		4.674849515	46.74849515
Azimuth	Nunavut	2015	15-25-23	2/100	8/24/2015	MAM-04-S		Rotifer	ROTI		Keratella sp.	n/a	2	50	100	0.000105538	0.001055381		0.010553813	0.105538125
Azimuth	Nunavut	2015	15-25-23	Whole	8/24/2015	MAM-04-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	5	1	5	0.015622034	0.471437491		0.078110172	2.357187455
Azimuth	Nunavut	2015	15-25-23	Whole	8/24/2015	MAM-04-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	4	1	4	0.013365482	0.457190372		0.053461926	1.828761487
Azimuth	Nunavut	2015	15-25-23	Whole	8/24/2015	MAM-04-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	V	4	1	4	0.013365482	0.457190372		0.053461926	1.828761487
Azimuth	Nunavut	2015	15-25-23	Whole	8/24/2015	MAM-04-S		Cyclopoid	CRCO		Microcyclops sp.	F	1	1	1	0.000961953	0.004809763		0.000961953	0.004809763
Azimuth	Nunavut	2015	15-25-24	3/10	9/19/2015	MAM-05-S		Cladoceran	CRCL		Bosmina sp.	F	1	3.333333333	3.333333333	0.008880563	0.044402816		0.029601877	0.148009386
Azimuth	Nunavut	2015	15-25-24	3/100	9/19/2015	MAM-05-S		Calanoid	CRCO		Calanoida indet.	nauplius	11	33.33333333	366.6666667	0.000177853	0.000889266		0.065212822	0.326064111
Azimuth	Nunavut	2015	15-25-24	3/100	9/19/2015	MAM-05-S		Rotifer	ROTI		Conochilus sp.	n/a	7	33.33333333	233.3333333	0.000146136	0.001461355		0.034098295	0.340982947
Azimuth	Nunavut	2015	15-25-24	1/100	9/19/2015	MAM-05-S		Rotifer	ROTI		Conochilus sp.	n/a	1	100	100	0.000146136	0.001461355		0.014613555	0.146135549
Azimuth	Nunavut	2015	15-25-24	3/10	9/19/2015	MAM-05-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	119	3.333333333	396.6666667	0.001389335	0.006946677		0.551103035	2.755515176
Azimuth	Nunavut	2015	15-25-24	3/100	9/19/2015	MAM-05-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	63	33.33333333	2100	2.00168E-05	0.000100084		0.042035358	0.210176792
Azimuth	Nunavut	2015	15-25-24	3/10	9/19/2015	MAM-05-S		Cyclopoid	CRCO		Cyclopoida indet.	V	11	3.333333333	36.66666667	0.005042793	0.025213967		0.184902423	0.924512115
Azimuth	Nunavut	2015	15-25-24	3/10	9/19/2015	MAM-05-S		Cyclopoid	CRCO		Cyclops scutifer	F	34	3.333333333	113.3333333	0.007235588	0.036177938		0.820033266	4.100166331
Azimuth	Nunavut	2015	15-25-24	3/10	9/19/2015	MAM-05-S		Cyclopoid	CRCO		Cyclops scutifer	M	32	3.333333333	106.6666667	0.005185998	0.025929991		0.553173134	2.765865671
Azimuth	Nunavut	2015	15-25-24	3/10	9/19/2015	MAM-05-S		Cladoceran	CRCL		Daphnia sp.	F	1	3.333333333	3.333333333	0.003999883	0.019999416		0.013332944	0.066664721
Azimuth	Nunavut	2015	15-25-24	3/10	9/19/2015	MAM-05-S		Cyclopoid	CRCO		Diacyclops thomasi	F	2	3.333333333	6.666666667	0.006289189	0.031445943		0.041927925	0.209639623
Azimuth	Nunavut	2015	15-25-24	3/10	9/19/2015	MAM-05-S		Cyclopoid	CRCO		Diacyclops thomasi	M	2	3.333333333	6.666666667	0.004170636	0.020853182		0.027804243	0.139021215
Azimuth	Nunavut	2015	15-25-24	3/10	9/19/2015	MAM-05-S		Calanoid	CRCO		Heterocope septentrionalis	F	2	3.333333333	6.666666667	0.094287498	0.471437491		0.628583321	3.142916607
Azimuth	Nunavut	2015	15-25-24	3/10	9/19/2015	MAM-05-S		Calanoid	CRCO		Heterocope septentrionalis	M	3	3.333333333	10	0.091438074	0.457190372		0.914380744	4.571903718
Azimuth	Nunavut	2015	15-25-24	3/100	9/19/2015	MAM-05-S		Rotifer	ROTI		Kellicottia sp.	n/a	107	33.33333333	3566.666667	0.001252192	0.012521918		4.466150876	44.66150876
Azimuth	Nunavut	2015	15-25-24	1/100	9/19/2015	MAM-05-S		Rotifer	ROTI		Keratella sp.	n/a	1	100	100	0.000105538	0.001055381		0.010553813	0.105538125
Azimuth	Nunavut	2015	15-25-24	3/10	9/19/2015	MAM-05-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	45	3.333333333	150	0.015622034	0.471437491		2.343305172	70.71562366
Azimuth	Nunavut	2015	15-25-24	3/10	9/19/2015	MAM-05-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	6	3.333333333	20	0.013365482	0.457190372		0.267309631	9.143807437
Azimuth	Nunavut	2015	15-25-24-QA	3/10	9/19/2015	MAM-05-S-QA		Cladoceran	CRCL		Bosmina sp.	F	1	3.333333333	3.333333333	0.008880563	0.044402816		0.029601877	0.148009386
Azimuth	Nunavut	2015	15-25-24-QA	3/10	9/19/2015	MAM-05-S-QA		Calanoid	CRCO		Calanoida indet.	I-IV	2	3.333333333	6.666666667	0.004802846	0.121691779		0.032018976	0.81127853
Azimuth	Nunavut	2015	15-25-24-QA	3/10	9/19/2015	MAM-05-S-QA		Calanoid	CRCO		Calanoida indet.	nauplius	17	33.33333333	566.6666667	0.000177853	0.000889266		0.100783452	0.503917262
Azimuth	Nunavut	2015	15-25-24-QA	3/10	9/19/2015	MAM-05-S-QA		Calanoid	CRCO		Calanoida indet.	V	1	3.333333333	3.333333333	0.013365482	0.457190372		0.044551605	1.523967906
Azimuth	Nunavut	2015	15-25-24-QA	3/100	9/19/2015	MAM-05-S-QA		Rotifer	ROTI		Conochilus sp.	n/a	13	33.33333333	433.3333333	0.000146136	0.001461355		0.063325404	0.633254044
Azimuth	Nunavut	2015	15-25-24-QA	3/10	9/19/2015	MAM-05-S-QA		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	103	3.333333333	343.3333333	0.001389335	0.006946677		0.477005148	2.385025741
Azimuth	Nunavut	2015	15-25-24-QA	3/100	9/19/2015	MAM-05-S-QA		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	62	33.33333333	2066.666667	2.00168E-05	0.000100084		0.04136813	0.206840652
Azimuth	Nunavut	2015	15-25-24-QA	3/10	9/19/2015	MAM-05-S-QA		Cyclopoid	CRCO		Cyclopoida indet.	V	13	3.333333333	43.33333333	0.005042793	0.025213967		0.218521045	1.092605227
Azimuth	Nunavut	2015	15-25-24-QA	3/10	9/19/2015	MAM-05-S-QA		Cyclopoid	CRCO		Cyclops scutifer	F	32	3.333333333	106.6666667	0.007235588	0.036177938		0.771796015	3.858980076
Azimuth	Nunavut	2015	15-25-24-QA	3/10	9/19/2015	MAM-05-S-QA		Cyclopoid	CRCO		Cyclops scutifer	M	27	3.333333333	90	0.005185998	0.025929991		0.466739832	2.33369916
Azimuth	Nunavut	2015	15-25-24-QA	3/10	9/19/2015	MAM-05-S-QA		Cladoceran	CRCL		Daphnia sp.	F	1	3.333333333	3.333333333	0.003999883	0.019999416		0.013332944	0.066664721
Azimuth	Nunavut	2015	15-25-24-QA	3/10	9/19/2015	MAM-05-S-QA		Cyclopoid	CRCO		Diacyclops thomasi	F	4	3.333333333	13.33333333	0.006289189	0.031445943		0.083855849	0.419279246
Azimuth	Nunavut	2015	15-25-24-QA	3/10	9/19/2015	MAM-05-S-QA		Cyclopoid	CRCO		Diacyclops thomasi	M	5	3.333333333	16.66666667	0.004170636	0.020853182		0.069510607	0.347553036
Azimuth	Nunavut	2015	15-25-24-QA	3/10	9/19/2015	MAM-05-S-QA		Calanoid	CRCO		Heterocope septentrionalis	M	5	3.333333333	16.66666667	0.091438074	0.457190372		1.523967906	7.619839531
Azimuth	Nunavut	2015	15-25-24-QA	3/100	9/19/2015	MAM-05-S-QA		Rotifer	ROTI		Kellicottia sp.	n/a	112	33.33333333	3733.333333	0.001252192	0.012521918		4.674849515	46.74849515
Azimuth	Nunavut	2015	15-25-24-QA	1/100	9/19/2015	MAM-05-S-QA		Rotifer	ROTI		Keratella sp.	n/a	1	100	100	0.000105538	0.001055381		0.010553813	0.105538125
Azimuth	Nunavut	2015	15-25-24-QA	3/10	9/19/2015	MAM-05-S-QA		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	47	3.333333333	156.6666667	0.015622034	0.471437491		2.447452069	73.85854027
Azimuth	Nunavut	2015	15-25-24-QA	3/10	9/19/2015	MAM-05-S-QA		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	9	3.333333333	30	0.013365482	0.457190372		0.400964447	13.71571116
Azimuth	Nunavut	2015	15-25-24-QA	2/100	9/19/2015	MAM-05-S-QA		Rotifer	ROTI		Polyarthra sp.	n/a	2	50	100	7.16125E-05	0.000716125		0.007161253	0.071612533
Azimuth	Nunavut	2015	15-25-25	3/100	9/19/2015	MAM-06-S		Calanoid	CRCO		Calanoida indet.	nauplius	20	33.33333333	666.6666667	0.000177853	0.000889266		0.118568768	0.592843838
Azimuth	Nunavut	2015	15-25-25	3/100	9/19/2015	MAM-06-S		Rotifer	ROTI		Conochilus sp.	n/a	15	33.33333333	500	0.000146136	0.001461355		0.073067774	0.730677743
Azimuth	Nunavut	2015	15-25-25	1/100	9/19/2015	MAM-06-S		Copepod	CRCO		Copepoda indet.	nauplius	1	100	100	0.000142032	0.000710161		0.014203216	0.071016078
Azimuth	Nunavut	2015	15-25-25	5/10	9/19/2015	MAM-06-S		Cyclopoid	CRCO		Cyclopoida indet.	F	1	2	2	0.005042793	0.025213967		0.010085587	0.050427934
Azimuth	Nunavut	2015	15-25-25	5/10	9/19/2015	MAM-06-S		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	128	2	256	0.001389335	0.006946677		0.355669858	1.77834929
Azimuth	Nunavut	2015	15-25-25	5/10	9/19/2015	MAM-06-S		Cyclopoid	CRCO		Cyclopoida indet.	M	4	2	8	0.005042793	0.025213967		0.040342347	0.201711734
Azimuth	Nunavut	2015	15-25-25	3/100	9/19/2015	MAM-06-S		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	33	33.33333333	1100	2.00168E-05	0.000100084		0.022018521	0.110092605
Azimuth	Nunavut	2015	15-25-25	5/10	9/19/2015	MAM-06-S		Cyclopoid	CRCO		Cyclopoida indet.	V	6	2	12	0.005042793	0.025213967		0.06051352	0.302567601
Azimuth	Nunavut	2015	15-25-25	5/10	9/19/2015	MAM-06-S		Cyclopoid	CRCO		Cyclops scutifer	F	40	2	80	0.007235588	0.036177938		0.578847011	2.894235057
Azimuth	Nunavut	2015	15-25-25	5/10	9/19/2015	MAM-06-S		Cyclopoid	CRCO		Cyclops scutifer	M	21	2	42	0.005185998	0.025929991		0.217811922	1.089059608
Azimuth	Nunavut	2015	15-25-25	5/10	9/19/2015	MAM-06-S		Cladoceran	CRCL		Daphnia middendorffiana	F	1	2	2	0.021219637	0.106098184		0.042439274	0.212196369
Azimuth	Nunavut	2015	15-25-25	5/10	9/19/2015	MAM-06-S		Cladoceran	CRCL		Daphnia sp.	F	2	2	4	0.003999883	0.019999416		0.015999533	0.079997665
Azimuth	Nunavut	2015	15-25-25	5/10	9/19/2015	MAM-06-S		Cyclopoid	CRCO		Diacyclops thomasi	F	4	2	8	0.006289189	0.031445943		0.050313509	0.251567547
Azimuth	Nunavut	2015	15-25-25	5/10	9/19/2015	MAM-06-S		Cyclopoid	CRCO		Diacyclops thomasi	M	2	2	4	0.004170636	0.020853182		0.016682546	0.083412729
Azimuth	Nunavut	2015	15-25-25	5/10	9/19/2015	MAM-06-S		Calanoid	CRCO		Heterocope septentrionalis	F	1	2	2	0.094287498	0.471437491		0.188574996	0.942874982
Azimuth	Nunavut	2015	15-25-25	5/10	9/19/2015	MAM-06-S		Calanoid	CRCO		Heterocope septentrionalis	M	2	2	4	0.091438074	0.457190372		0.365752297	1.828761487
Azimuth	Nunavut	2015	15-25-25	3/100	9/19/2015	MAM-06-S		Rotifer	ROTI		Kellicottia sp.	n/a	77	33.33333333	2566.666667	0.001252192	0.012521918		3.213959042	32.13959042
Azimuth	Nunavut	2015	15-25-25	5/10	9/19/2015	MAM-06-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	47	2	94	0.015622034	0.471437491		1.468471241	44.31512416
Azimuth	Nunavut	2015	15-25-25	5/10	9/19/2015	MAM-06-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	10	2	20	0.013365482	0.457190372		0.267309631	9.143807437
Azimuth	Nunavut	2015	15-25-25	5/10	9/19/2015	MAM-06-S		Calanoid	CRCO		Leptodiaptomus pribilofensis	V	3	2	6	0.013365482	0.457190372		0.080192889	2.743142231

Zooplankton raw count data for abundance calculations and biomass calculations, Azimuth Nunavut 2015

Client	Project	Year	Biologica #	Split	Date	Client ID	Fraction	Major Group	Groupcode	Family	Taxon	Stage	Raw Abundance	Split Multiplier	Total Abundance	Mean DW Biomass_mg	Mean WW Biomass_mg	Biomass assumptions	Total DW Biomass_mg	Total WW Biomass _mg
Azimuth	Nunavut	2015	15-25-25	1/100	9/19/2015	MAM-06-S		Rotifer	ROTI		Polyarthra sp.	n/a	1	100	100	7.16125E-05	0.000716125		0.007161253	0.071612533
Azimuth	Nunavut	2015	15-25-26	1/100	8/22/2015	DUP-1		Calanoid	CRCO		Calanoida indet.	nauplius	1	100	100	0.000177853	0.000889266		0.017785315	0.088926576
Azimuth	Nunavut	2015	15-25-26	3/100	8/22/2015	DUP-1		Rotifer	ROTI		Conochilus sp.	n/a	65	33.33333333	2166.666667	0.000146136	0.001461355		0.316627022	3.16627022
Azimuth	Nunavut	2015	15-25-26	3/10	8/22/2015	DUP-1		Cyclopoid	CRCO		Cyclopoida indet.	I-IV	163	3.333333333	543.3333333	0.001389335	0.006946677		0.754872225	3.774361124
Azimuth	Nunavut	2015	15-25-26	3/100	8/22/2015	DUP-1		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	66	33.33333333	2200	2.00168E-05	0.000100084		0.044037042	0.22018521
Azimuth	Nunavut	2015	15-25-26	3/10	8/22/2015	DUP-1		Cyclopoid	CRCO		Cyclopoida indet.	V	14	3.333333333	46.66666667	0.005042793	0.025213967		0.235330356	1.176651782
Azimuth	Nunavut	2015	15-25-26	3/10	8/22/2015	DUP-1		Cyclopoid	CRCO		Cyclops scutifer	F	17	3.333333333	56.66666667	0.007235588	0.036177938		0.410016633	2.050083166
Azimuth	Nunavut	2015	15-25-26	3/10	8/22/2015	DUP-1		Cyclopoid	CRCO		Cyclops scutifer	M	1	3.333333333	3.333333333	0.005185998	0.025929991		0.01728666	0.086433302
Azimuth	Nunavut	2015	15-25-26	3/10	8/22/2015	DUP-1		Cladoceran	CRCL		Daphnia middendorffiana	F	1	3.333333333	3.333333333	0.021219637	0.106098184		0.070732123	0.353660614
Azimuth	Nunavut	2015	15-25-26	3/10	8/22/2015	DUP-1		Cladoceran	CRCL		Daphnia sp.	F	1	3.333333333	3.333333333	0.003999883	0.019999416		0.013332944	0.066664721
Azimuth	Nunavut	2015	15-25-26	3/10	8/22/2015	DUP-1		Calanoid	CRCO		Heterocope septentrionalis	F	7	3.333333333	23.33333333	0.094287498	0.471437491		2.200041625	11.00020813
Azimuth	Nunavut	2015	15-25-26	3/10	8/22/2015	DUP-1		Calanoid	CRCO		Heterocope septentrionalis	M	5	3.333333333	16.66666667	0.091438074	0.457190372		1.523967906	7.619839531
Azimuth	Nunavut	2015	15-25-26	Whole	8/22/2015	DUP-1		Cladoceran	CRCL		Holopedium gibberum	F	16	1	16	0.002497062	0.012485309		0.039952988	0.199764941
Azimuth	Nunavut	2015	15-25-26	3/100	8/22/2015	DUP-1		Rotifer	ROTI		Kellicottia sp.	n/a	85	33.33333333	2833.333333	0.001252192	0.012521918		3.547876864	35.47876864
Azimuth	Nunavut	2015	15-25-26	1/100	8/22/2015	DUP-1		Rotifer	ROTI		Keratella sp.	n/a	1	100	100	0.000105538	0.001055381		0.010553813	0.105538125
Azimuth	Nunavut	2015	15-25-26	3/10	8/22/2015	DUP-1		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	31	3.333333333	103.3333333	0.015622034	0.471437491		1.614276896	48.71520741
Azimuth	Nunavut	2015	15-25-26	3/10	8/22/2015	DUP-1		Calanoid	CRCO		Leptodiaptomus pribilofensis	I-IV	4	3.333333333	13.33333333	0.004802846	0.457190372		0.064037952	6.095871625
Azimuth	Nunavut	2015	15-25-26	3/10	8/22/2015	DUP-1		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	23	3.333333333	76.66666667	0.013365482	0.457190372		1.02468692	35.05126184
Azimuth	Nunavut	2015	15-25-26	3/10	8/22/2015	DUP-1		Calanoid	CRCO		Leptodiaptomus pribilofensis	V	3	3.333333333	10	0.013365482	0.457190372		0.133654816	4.571903718
Azimuth	Nunavut	2015	15-25-26	3/100	8/22/2015	DUP-1		Rotifer	ROTI		Polyarthra sp.	n/a	6	33.33333333	200	7.16125E-05	0.000716125		0.014322507	0.143225066
Azimuth	Nunavut	2015	15-25-27	4/10	9/19/2015	DUP-1-September		Cladoceran	CRCL		Bosmina sp.	F	1	2.5	2.5	0.008880563	0.044402816		0.022201408	0.111007039
Azimuth	Nunavut	2015	15-25-27	3/100	9/19/2015	DUP-1-September		Calanoid	CRCO		Calanoida indet.	nauplius	9	33.33333333	300	0.000177853	0.000889266		0.053355945	0.266779727
Azimuth	Nunavut	2015	15-25-27	3/100	9/19/2015	DUP-1-September		Rotifer	ROTI		Conochilus sp.	n/a	15	33.33333333	500	0.000146136	0.001461355		0.073067774	0.730677743
Azimuth	Nunavut	2015	15-25-27	4/10	9/19/2015	DUP-1-September		Cyclopoid	CRCO		Cyclopoida indet.	F	1	2.5	2.5	0.005042793	0.025213967		0.012606983	0.063034917
Azimuth	Nunavut	2015	15-25-27	4/10	9/19/2015	DUP-1-September		Cyclopoid	CRCO		Cyclopoida indet.	M	3	2.5	7.5	0.005042793	0.025213967		0.03782095	0.189104751
Azimuth	Nunavut	2015	15-25-27	3/100	9/19/2015	DUP-1-September		Cyclopoid	CRCO		Cyclopoida indet.	nauplius	11	33.33333333	366.6666667	2.00168E-05	0.000100084		0.007339507	0.036697535
Azimuth	Nunavut	2015	15-25-27	4/10	9/19/2015	DUP-1-September		Cyclopoid	CRCO		Cyclops scutifer	F	59	2.5	147.5	0.007235588	0.036177938		1.067249177	5.336245887
Azimuth	Nunavut	2015	15-25-27	4/10	9/19/2015	DUP-1-September		Cyclopoid	CRCO		Cyclops scutifer	I-IV	81	2.5	202.5	0.001389335	0.006946677		0.281340415	1.406702075
Azimuth	Nunavut	2015	15-25-27	4/10	9/19/2015	DUP-1-September		Cyclopoid	CRCO		Cyclops scutifer	M	81	2.5	202.5	0.005185998	0.025929991		1.050164622	5.25082311
Azimuth	Nunavut	2015	15-25-27	4/10	9/19/2015	DUP-1-September		Cyclopoid	CRCO		Cyclops scutifer	V	40	2.5	100	0.002148681	0.025213967		0.21486814	2.521396677
Azimuth	Nunavut	2015	15-25-27	4/10	9/19/2015	DUP-1-September		Cladoceran	CRCL		Daphnia middendorffiana	F	1	2.5	2.5	0.021219637	0.106098184		0.053049092	0.265245461
Azimuth	Nunavut	2015	15-25-27	4/10	9/19/2015	DUP-1-September		Cladoceran	CRCL		Daphnia sp.	F	2	2.5	5	0.003999883	0.019999416		0.019999416	0.099997081
Azimuth	Nunavut	2015	15-25-27	4/10	9/19/2015	DUP-1-September		Cyclopoid	CRCO		Diacyclops thomasi	F	6	2.5	15	0.006289189	0.031445943		0.09433783	0.471689151
Azimuth	Nunavut	2015	15-25-27	4/10	9/19/2015	DUP-1-September		Cyclopoid	CRCO		Diacyclops thomasi	M	4	2.5	10	0.004170636	0.020853182		0.041706364	0.208531822
Azimuth	Nunavut	2015	15-25-27	4/10	9/19/2015	DUP-1-September		Calanoid	CRCO		Heterocope septentrionalis	F	3	2.5	7.5	0.094287498	0.471437491		0.707156237	3.535781183
Azimuth	Nunavut	2015	15-25-27	4/10	9/19/2015	DUP-1-September		Calanoid	CRCO		Heterocope septentrionalis	M	1	2.5	2.5	0.091438074	0.457190372		0.228595186	1.14297593
Azimuth	Nunavut	2015	15-25-27	3/100	9/19/2015	DUP-1-September		Rotifer	ROTI		Kellicottia sp.	n/a	94	33.33333333	3133.333333	0.001252192	0.012521918		3.923534414	39.23534414
Azimuth	Nunavut	2015	15-25-27	1/100	9/19/2015	DUP-1-September		Rotifer	ROTI		Keratella sp.	n/a	1	100	100	0.000105538	0.001055381		0.010553813	0.105538125
Azimuth	Nunavut	2015	15-25-27	4/10	9/19/2015	DUP-1-September		Calanoid	CRCO		Leptodiaptomus pribilofensis	F	25	2.5	62.5	0.015622034	0.471437491		0.976377155	29.46484319
Azimuth	Nunavut	2015	15-25-27	4/10	9/19/2015	DUP-1-September		Calanoid	CRCO		Leptodiaptomus pribilofensis	M	17	2.5	42.5	0.013365482	0.457190372		0.568032966	19.4305908
Azimuth	Nunavut	2015	15-25-27	4/10	9/19/2015	DUP-1-September		Calanoid	CRCO		Leptodiaptomus pribilofensis	V	3	2.5	7.5	0.013365482	0.457190372		0.100241112	3.428927789
Azimuth	Nunavut	2015	15-25-27	3/100	9/19/2015	DUP-1-September		Rotifer	ROTI		Polyarthra sp.	n/a	5	33.33333333	166.6666667	7.16125E-05	0.000716125		0.011935422	0.119354222

Zooplankton biomeasurements and conversions for calculation of biomass data, Azimuth Nunavut 2015

Groupcode	Taxon	Stage	Biologica Sample	Client Sample	Unit	Conversion (mm)	Objective	Length (units)	Width (units)	Calibration	Length (mm)	CRUSTACEA - Ln(Length)	CRUSTACEA - Ln(α)	CRUSTACEA - β	CRUSTACEA - mg DW	CRUSTACEA - WW:DW	CRUSTACEA - mg WW	CRUSTACEA α/β Reference	Rotifera - FF	Rotifera - %BV	Rotifera - WW:DW	Rotifera - mg DW	Rotifera - mg WW	Rotifera - FF/%BV Reference	Final Biomass - DW	Final Biomass - WW
CRCO	Calanoida indet.	Nauplius	15-25-13		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; Calanoid copepodites							0.000131422	0.000657112
CRCO	Calanoida indet.	Nauplius	15-25-13		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; Calanoid copepodites							0.000131422	0.000657112
CRCO	Calanoida indet.	Nauplius	15-25-13		4	1	4x	0.8		0.26	0.2080	-1.570217199	1.050	2.460	0.000060	5	0.000300	EPA SOP; Calanoid copepodites							6.00406E-05	0.000300203
CRCO	Calanoida indet.	Nauplius	15-25-13		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; Calanoid copepodites							0.000131422	0.000657112
CRCO	Calanoida indet.	Nauplius	15-25-13		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.050	2.460	0.000163	5	0.000814	EPA SOP; Calanoid copepodites							0.000162791	0.000813953
CRCO	Calanoida indet.	Nauplius	15-25-13		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; Calanoid copepodites							0.000131422	0.000657112
CRCO	Calanoida indet.	Nauplius	15-25-13		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; Calanoid copepodites							0.000131422	0.000657112
CRCO	Calanoida indet.	Nauplius	15-25-13		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; Calanoid copepodites							0.000131422	0.000657112
CRCO	Calanoida indet.	Nauplius	15-25-13		4	1	4x	1		0.26	0.2600	-1.347073648	1.050	2.460	0.000104	5	0.000520	EPA SOP; Calanoid copepodites							0.000103955	0.000519773
CRCO	Calanoida indet.	Nauplius	15-25-13		4	1	4x	1		0.26	0.2600	-1.347073648	1.050	2.460	0.000104	5	0.000520	EPA SOP; Calanoid copepodites							0.000103955	0.000519773
CRCO	Calanoida indet.	Nauplius	15-25-13		4	1	4x	0.9		0.26	0.2340	-1.452434164	1.050	2.460	0.000080	5	0.000401	EPA SOP; Calanoid copepodites							8.02195E-05	0.000401098
CRCO	Calanoida indet.	Nauplius	15-25-13		4	1	4x	1		0.26	0.2600	-1.347073648	1.050	2.460	0.000104	5	0.000520	EPA SOP; Calanoid copepodites							0.000103955	0.000519773
CRCO	Calanoida indet.	Nauplius	15-25-13		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; Calanoid copepodites							0.000131422	0.000657112
CRCO	Calanoida indet.	Nauplius	15-25-15		4	1	4x	1		0.26	0.2600	-1.347073648	1.050	2.460	0.000104	5	0.000520	EPA SOP; Calanoid copepodites							0.000103955	0.000519773
CRCO	Calanoida indet.	Nauplius	15-25-15		4	1	4x	0.9		0.26	0.2340	-1.452434164	1.050	2.460	0.000080	5	0.000401	EPA SOP; Calanoid copepodites							8.02195E-05	0.000401098
CRCO	Calanoida indet.	Nauplius	15-25-15		4	1	4x	1		0.26	0.2600	-1.347073648	1.050	2.460	0.000104	5	0.000520	EPA SOP; Calanoid copepodites							0.000103955	0.000519773
CRCO	Calanoida indet.	Nauplius	15-25-17		4	1	4x	1		0.26	0.2600	-1.347073648	1.050	2.460	0.000104	5	0.000520	EPA SOP; Calanoid copepodites							0.000103955	0.000519773
CRCO	Calanoida indet.	Nauplius	15-25-17		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.050	2.460	0.000163	5	0.000814	EPA SOP; Calanoid copepodites							0.000162791	0.000813953
CRCO	Calanoida indet.	Nauplius	15-25-17		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.050	2.460	0.000163	5	0.000814	EPA SOP; Calanoid copepodites							0.000162791	0.000813953
CRCO	Calanoida indet.	Nauplius	15-25-17		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; Calanoid copepodites							0.000131422	0.000657112
CRCO	Calanoida indet.	Nauplius	15-25-17		4	1	4x	1		0.26	0.2600	-1.347073648	1.050	2.460	0.000104	5	0.000520	EPA SOP; Calanoid copepodites							0.000103955	0.000519773
CRCL	Daphnia middendorffiana	F	15-25-15		4	1	4x	8.5		0.26	2.2100	0.792992516	1.393	3.011	0.043847	5	0.219234	EPA SOP							0.043846744	0.21923372
CRCL	Daphnia middendorffiana	F	15-25-15		4	1	4x	3.5		0.26	0.9100	-0.094310679	1.393	3.011	0.003031	5	0.015157	EPA SOP							0.003031418	0.015157091
CRCL	Daphnia sp.	F	15-25-16		4	1	4x	3.9		0.26	1.0140	0.013902905	1.510	2.560	0.004691	5	0.023454	EPA SOP							0.004690745	0.023453725
CRCO	Cyclops scutifer	F	15-25-16		4	1	4x	5.2		0.26	1.3520	0.301584978	1.492	1.990	0.008102	5	0.040512	EPA SOP							0.00810235	0.040511748
CRCO	Cyclops scutifer	F	15-25-13		4	1	4x	4.8		0.26	1.2480	0.22154227	1.492	1.990	0.006909	5	0.034547	EPA SOP							0.006909305	0.034546527
CRCO	Cyclops scutifer	F	15-25-13		4	1	4x	4.4		0.26	1.1440	0.134530893	1.492	1.990	0.005811	5	0.029054	EPA SOP							0.00581079	0.029053948
CRCO	Cyclops scutifer	F	15-25-13		4	1	4x	4.4		0.26	1.1440	0.134530893	1.492	1.990	0.005811	5	0.029054	EPA SOP							0.00581079	0.029053948
CRCO	Cyclops scutifer	F	15-25-13		4	1	4x	4.5		0.26	1.1700	0.157003749	1.492	1.990	0.006077	5	0.030383	EPA SOP							0.006076552	0.030382761
CRCO	Cyclops scutifer	F	15-25-13		4	1	4x	4.6		0.26	1.1960	0.178982656	1.492	1.990	0.006348	5	0.031741	EPA SOP							0.006348227	0.031741133
CRCO	Cyclops scutifer	F	15-25-13		4	1	4x	4.6		0.26	1.1960	0.178982656	1.492	1.990	0.006348	5	0.031741	EPA SOP							0.006348227	0.031741133
CRCO	Cyclops scutifer	F	15-25-13		4	1	4x	4.4		0.26	1.1440	0.134530893	1.492	1.990	0.005811	5	0.029054	EPA SOP							0.00581079	0.029053948
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	4.6		0.26	1.1960	0.178982656	1.492	1.990	0.006348	5	0.031741	EPA SOP							0.006348227	0.031741133
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	4.9		0.26	1.2740	0.242161557	1.492	1.990	0.007199	5	0.035994	EPA SOP							0.007198708	0.035993538
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	5.4		0.26	1.4040	0.339325306	1.492	1.990	0.008734	5	0.043671	EPA SOP							0.008734296	0.043671481
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	4.9		0.26	1.2740	0.242161557	1.492	1.990	0.007199	5	0.035994	EPA SOP							0.007198708	0.035993538
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	4.7		0.26	1.2220	0.200488861	1.492	1.990	0.006626	5	0.033129	EPA SOP							0.006625811	0.033129057
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	4.3		0.26	1.1180	0.111541375	1.492	1.990	0.005551	5	0.027755	EPA SOP							0.00555094	0.027754701
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	5		0.26	1.3000	0.262364264	1.492	1.990	0.007494	5	0.037470	EPA SOP							0.007494016	0.037470082
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	5.1		0.26	1.3260	0.282166892	1.492	1.990	0.007795	5	0.038976	EPA SOP							0.007795231	0.038976154
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	5		0.26	1.3000	0.262364264	1.492	1.990	0.007494	5	0.037470	EPA SOP							0.007494016	0.037470082
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	5.1		0.26	1.3260	0.282166892	1.492	1.990	0.007795	5	0.038976	EPA SOP							0.007795231	0.038976154
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	4.9		0.26	1.2740	0.242161557	1.492	1.990	0.007199	5	0.035994	EPA SOP							0.007198708	0.035993538
CRCO	Cyclops scutifer	F	15-25-16		4	1	4x	3.8		0.26	0.9880	-0.012072581	1.492	1.990	0.004340	5	0.021702	EPA SOP							0.004340439	0.021702196
CRCO	Cyclops scutifer	F	15-25-16		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP							0.004806885	0.024034424
CRCO	Cyclops scutifer	F	15-25-16		4	1	4x	4.7		0.26	1.2220	0.200488861	1.492	1.990	0.006626	5	0.033129	EPA SOP							0.006625811	0.033129057
CRCO	Cyclops scutifer	F	15-25-16		4	1	4x	4.2		0.26	1.0920	0.088010877	1.492	1.990	0.005297	5	0.026485	EPA SOP							0.005297005	0.026485027
CRCO	Cyclops scutifer	F	15-25-17		4	1	4x	4.4		0.26	1.1440	0.134530893	1.492	1.990	0.005811	5	0.029054	EPA SOP							0.00581079	0.029053948
CRCO	Cyclops scutifer	F	15-25-17		4	1	4x	4.3		0.26	1.1180	0.111541375	1.492	1.990	0.005551	5	0.027755	EPA SOP							0.00555094	0.027754701
CRCO	Cyclops scutifer	F	15-25-25		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP							0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	3.9		0.26	1.0140	0.013902905	1.492	1.990	0.004571	5	0.022854	EPA SOP							0.004570702	0.022853509
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	3.8		0.26	0.9880	-0.012072581	1.492	1.990	0.004340	5	0.021702	EPA SOP							0.004340439	0.021702196
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP							0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	4.2		0.26	1.0920	0.088010877	1.492	1.990	0.005297	5	0.026485	EPA SOP							0.005297005	0.026485027
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	4.2		0.26	1.0920	0.088010877	1.492	1.990	0.005297	5	0.026485	EPA SOP							0.005297005	0.026485027
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP							0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	3.1		0.26	0.8060	-0.215671536	1.492	1.990	0.002895	5	0.014473	EPA SOP							0.002894504	0.014472518
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP							0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	4.6		0.26	1.1960	0.178982656	1.492	1.990	0.006348	5	0.031741	EPA SOP							0.006348227	0.031741133
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	4.4		0.26	1.1440	0.134530893	1.492	1.990	0.005811	5	0.029054	EPA SOP							0.00581079	0.029053948
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	5.1		0.26	1.3260	0.282166892	1.492	1.990	0.007795	5	0.038976	EPA SOP							0.007795231	0.038976154
CRCO	Cyclops scutifer	M	15-25-15		4	1	4x	4.3		0.26	1.1180	0.111541375	1.492	1.990	0.005551	5	0.027755	EPA SOP							0.00555094	0.027754701
CRCO	Cyclops scutifer	M	15-25-16		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP							0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-24		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP							0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-24		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP							0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-24		4	1	4x	4.2		0.26	1.0920	0.088010877	1.492	1.990	0.005297	5	0.026485	EPA SOP							0.005297005	0.026485027
CRCO	Cyclops scutifer	M	15-25-24		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP							0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-24		4	1	4x	4.2		0.26	1.0920	0.088010877	1.492	1.990	0.005297	5	0.026485	EPA SOP							0.005297005	0.026485027
CRCO	Leptodiaptomus pribilofensis	M	15-25-14		4	1	4x	5.2		0.26	1.3520	0.301584978	1.953	2.400	0.014539	5	0.072693	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.014538553	0.072692765
CRCO	Leptodiaptomus pribilofensis	M	15-25-18		4	1	4x	4.8		0.26	1.2480	0.22154227	1.953	2.400	0.011998	5	0.059988	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.011997538	0.059987689
CRCO	Leptodiaptomus pribilofensis	M	15-25-18		4	1	4x	4.8		0.26	1.2480	0.22154227	1.953	2.400	0.011998	5	0.059988	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.011997538	0.059987689
CRCO	Leptodiaptomus pribilofensis	M	15-25-18		4	1	4x	5.2		0.26	1.3520	0.301584978	1.953	2.400	0.014539	5	0.072693	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.014538553	0.072692765
CRCO	Leptodiaptomus pribilofensis	M	15-25-21		4	1	4x	4.4		0.26	1.1440	0.134530893	1.953	2.400	0.009736	5	0.048682	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.009736426	0.048682132
CRCO	Leptodiaptomus pribilofensis	M	15-25-21		4	1	4x	4.6		0.26	1.1960	0.178982656	1.953	2.400	0.010833	5	0.054163	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.010832581	0.054162906
CRCO	Leptodiaptomus pribilofensis	M	15-25-25		4	1	4x	5.1		0.26	1.3260	0.282166892	1.953	2.400	0.013877	5	0.069383	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.013876552	0.069382762
CRCO	Leptodiaptomus pribilofensis	M	15-25-25		4	1	4x	5		0.26	1.3000	0.262364264	1.953	2.400	0.013232	5	0.066162	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.013232478	0.066162388
CRCO	Leptodiaptomus pribilofensis	M	15-25-26		4	1	4x	5		0.26	1.3000	0.262364264	1.953	2.400	0.013232	5	0.066162	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.013232478	0.066162388
CRCO	Leptodiaptomus pribilofensis	M	15-25-26		4	1	4x	5.2		0.26	1.3520	0.301584978	1.953	2.400	0.014539	5	0.072693	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.014538553	0.072692765
CRCO	Leptodiaptomus pribilofensis	M	15-25-26		4	1	4x	5.3		0.26	1.3780	0.320633173	1.953	2.400	0.015219	5	0.076093	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.015218619	0.076093095
CRCO	Leptodiaptomus pribilofensis	M	15-25-26		4	1	4x	4.3		0.26	1.1180	0.111541375	1.953	2.400	0.009214	5	0.046069	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.009213772	0.046068859
CRCO	Leptodiaptomus pribilofensis	M	15-25-26		4	1	4x	5.1		0.26	1.3260	0.282166892	1.953	2.400	0.013877	5	0.069383	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.013876552	0.069382762
CRCO	Leptodiaptomus pribilofensis	M	15-25-26		4	1	4x	5.2		0.26	1.3520	0.301584978	1.953	2.400	0.014539	5	0.072693	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.014538553	0.072692765
CRCO	Leptodiaptomus pribilofensis	M	15-25-26		4	1	4x	5.2		0.26	1.3520	0.301584978	1.953	2.400	0.014539	5	0.072693	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.014538553	0.072692765
CRCO	Leptodiaptomus pribilofensis	M	15-25-26		4	1	4x	4.8		0.26	1.2480	0.22154227	1.953	2.400	0.011998	5	0.059988	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.011997538	0.059987689
CRCO	Leptodiaptomus pribilofensis	M	15-25-26		4	1	4x	5.3		0.26	1.3780	0.320633173	1.953	2.400	0.015219	5	0.076093	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.015218619	0.076093095
CRCO	Leptodiaptomus pribilofensis	M	15-25-26		4	1	4x	5.2		0.26	1.3520	0.301584978	1.953	2.400	0.014539	5	0.072693	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.014538553	0.072692765
CRCO	Leptodiaptomus pribilofensis	M	15-25-26		4	1	4x	5.1		0.26	1.3260	0.282166892	1.953	2.400	0.013877	5	0.069383	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.013876552	0.069382762
CRCO	Leptodiaptomus pribilofensis	M	15-25-26		4	1	4x	4.9		0.26	1.2740	0.242161557	1.953	2.400	0.012606	5	0.063031	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.012606187	0.063030936
CRCO	Leptodiaptomus pribilofensis	M	15-25-26		4	1	4x	4.8		0.26	1.2480	0.22154227	1.953	2.400	0.011998	5	0.059988	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.011997538	0.059987689
CRCO	Leptodiaptomus pribilofensis	M	15-25-26		4	1	4x	5.1		0.26	1.3260	0.282166892	1.953	2.400	0.013877	5	0.069383	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.013876552	0.069382762
CRCO	Leptodiaptomus pribilofensis	M	15-25-20		4	1	4x	4.8		0.26	1.2480	0.22154227	1.953	2.400	0.011998	5	0.059988	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.011997538	0.059987689
CRCO	Leptodiaptomus pribilofensis	M	15-25-20		4	1	4x	4.7		0.26	1.2220	0.200488861	1.953	2.400	0.011406	5	0.057032	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.011406385	0.057031924
CRCO	Leptodiaptomus pribilofensis	M	15-25-20		4	1	4x	5		0.26	1.3000	0.262364264	1.953	2.400	0.013232	5	0.066162	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.013232478	0.066162388
CRCO	Leptodiaptomus pribilofensis	M	15-25-20		4	1	4x	5.3		0.26	1.3780	0.320633173	1.953	2.400	0.015219	5	0.076093	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.015218619	0.076093095
CRCO	Leptodiaptomus pribilofensis	M	15-25-20		4	1	4x	5		0.26	1.3000	0.262364264	1.953	2.400	0.013232	5	0.066162	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.013232478	0.066162388
CRCO	Leptodiaptomus pribilofensis	M	15-25-20		4	1	4x	5.1		0.26	1.3260	0.282166892	1.953	2.400	0.013877	5	0.069383	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.013876552	0.069382762
CRCO	Leptodiaptomus pribilofensis	M	15-25-20		4	1	4x	5.2		0.26	1.3520	0.301584978	1.953	2.400	0.014539	5	0.072693	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.014538553	0.072692765
CRCO	Leptodiaptomus pribilofensis	M	15-25-20		4	1	4x	5.5		0.26	1.4300	0.357674444	1.953	2.400	0.016633	5	0.083167	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.016633499	0.083167494
CRCO	Leptodiaptomus pribilofensis	M	15-25-20		4	1	4x	5.1		0.26	1.3260	0.282166892	1.953	2.400	0.013877	5	0.069383	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.013876552	0.069382762
CRCO	Leptodiaptomus pribilofensis	M	15-25-20		4	1	4x	4.8		0.26	1.2480	0.22154227	1.953	2.400	0.011998	5	0.059988	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.011997538	0.059987689
CRCO	Leptodiaptomus pribilofensis	M	15-25-20		4	1	4x	5.3		0.26	1.3780	0.320633173	1.953	2.400	0.015219	5	0.076093	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.015218619	0.076093095
CRCO	Leptodiaptomus pribilofensis	M	15-25-24		4	1	4x	5.2		0.26	1.3520	0.301584978	1.953	2.400	0.014539	5	0.072693	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.014538553	0.072692765
CRCO	Leptodiaptomus pribilofensis	M	15-25-24		4	1	4x	5.2		0.26	1.3520	0.301584978	1.953	2.400	0.014539	5	0.072693	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.014538553	0.072692765
CRCO	Leptodiaptomus pribilofensis	M	15-25-24		4	1	4x	4.6		0.26	1.1960	0.178982656	1.953	2.400	0.010833	5	0.054163	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.010832581	0.054162906
CRCO	Leptodiaptomus pribilofensis	F	15-25-14		4	1	4x	5		0.26	1.3000	0.262364264	1.953	2.400	0.013232	5	0.066162	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.013232478	0.066162388
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.5		0.26	1.4300	0.357674444	1.953	2.400	0.016633	5	0.083167	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.016633499	0.083167494
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.6		0.26	1.4560	0.37569295	1.953	2.400	0.017369	5	0.086843	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.017368584	0.086842922
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.3		0.26	1.3780	0.320633173	1.953	2.400	0.015219	5	0.076093	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.015218619	0.076093095
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.8		0.26	1.5080	0.41078427	1.953	2.400	0.018895	5	0.094474	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.018894715	0.094473574

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Groupcode	Taxon	Stage	Biologica Sample	Client Sample	Unit	Conversion (mm)	Objective	Length (units)	Width (units)	Calibration	Length (mm)	CRUSTACEA - Ln(Length)	CRUSTACEA - Ln(α)	CRUSTACEA - β	CRUSTACEA - mg DW	CRUSTACEA - WW:DW	CRUSTACEA - mg WW	CRUSTACEA α/β Reference	Rotifera - FF	Rotifera - %BV	Rotifera - WW:DW	Rotifera - mg DW	Rotifera - mg WW	Rotifera - FF/%BV Reference	Final Biomass - DW	Final Biomass - WW
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.8		0.26	1.5080	0.41078427	1.953	2.400	0.018895	5	0.094474	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.018894715	0.094473574
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.7		0.26	1.4820	0.393392527	1.953	2.400	0.018122	5	0.090611	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.018122279	0.090611395
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5		0.26	1.3000	0.262364264	1.953	2.400	0.013232	5	0.066162	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.013232478	0.066162388
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.3		0.26	1.3780	0.320633173	1.953	2.400	0.015219	5	0.076093	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.015218619	0.076093095
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.8		0.26	1.5080	0.41078427	1.953	2.400	0.018895	5	0.094474	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.018894715	0.094473574
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.6		0.26	1.4560	0.37569295	1.953	2.400	0.017369	5	0.086843	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.017368584	0.086842922
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.2		0.26	1.3520	0.301584978	1.953	2.400	0.014539	5	0.072693	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.014538553	0.072692765
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.6		0.26	1.4560	0.37569295	1.953	2.400	0.017369	5	0.086843	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.017368584	0.086842922
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5		0.26	1.3000	0.262364264	1.953	2.400	0.013232	5	0.066162	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.013232478	0.066162388
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.2		0.26	1.3520	0.301584978	1.953	2.400	0.014539	5	0.072693	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.014538553	0.072692765
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.8		0.26	1.5080	0.41078427	1.953	2.400	0.018895	5	0.094474	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.018894715	0.094473574
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5		0.26	1.3000	0.262364264	1.953	2.400	0.013232	5	0.066162	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.013232478	0.066162388
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.2		0.26	1.3520	0.301584978	1.953	2.400	0.014539	5	0.072693	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.014538553	0.072692765
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.5		0.26	1.4300	0.357674444	1.953	2.400	0.016633	5	0.083167	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.016633499	0.083167494
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.3		0.26	1.3780	0.320633173	1.953	2.400	0.015219	5	0.076093	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.015218619	0.076093095
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.3		0.26	1.3780	0.320633173	1.953	2.400	0.015219	5	0.076093	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.015218619	0.076093095
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.5		0.26	1.4300	0.357674444	1.953	2.400	0.016633	5	0.083167	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.016633499	0.083167494
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.2		0.26	1.3520	0.301584978	1.953	2.400	0.014539	5	0.072693	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.014538553	0.072692765
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5		0.26	1.3000	0.262364264	1.953	2.400	0.013232	5	0.066162	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.013232478	0.066162388
CRCO	Leptodiaptomus pribilofensis	F	15-25-25		4	1	4x	5.7		0.26	1.4820	0.393392527	1.953	2.400	0.018122	5	0.090611	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.018122279	0.090611395
CRCO	Leptodiaptomus pribilofensis	F	15-25-26		4	1	4x	5		0.26	1.3000	0.262364264	1.953	2.400	0.013232	5	0.066162	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.013232478	0.066162388
CRCO	Leptodiaptomus pribilofensis	F	15-25-26		4	1	4x	5.4		0.26	1.4040	0.339325306	1.953	2.400	0.015917	5	0.079584	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.015916889	0.079584444
CRCO	Leptodiaptomus pribilofensis	F	15-25-26		4	1	4x	5.3		0.26	1.3780	0.320633173	1.953	2.400	0.015219	5	0.076093	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.015218619	0.076093095
CRCO	Leptodiaptomus pribilofensis	F	15-25-26		4	1	4x	5.2		0.26	1.3520	0.301584978	1.953	2.400	0.014539	5	0.072693	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.014538553	0.072692765
CRCO	Leptodiaptomus pribilofensis	F	15-25-26		4	1	4x	5.6		0.26	1.4560	0.37569295	1.953	2.400	0.017369	5	0.086843	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.017368584	0.086842922
CRCO	Leptodiaptomus pribilofensis	F	15-25-26		4	1	4x	5.1		0.26	1.3260	0.282166892	1.953	2.400	0.013877	5	0.069383	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.013876552	0.069382762
CRCO	Leptodiaptomus pribilofensis	F	15-25-26		4	1	4x	5.3		0.26	1.3780	0.320633173	1.953	2.400	0.015219	5	0.076093	Bottrell et al. 1976 as in Watkins et al. ; pooled Calanoid copepodites							0.015218619	0.076093095

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Groupcode	Taxon	Stage	Biologica Sample	Client Sample	Unit	Conversion (mm)	Objective	Length (units)	Width (units)	Calibration	Length (mm)	CRUSTACEA - Ln(Length)	CRUSTACEA - Ln(α)	CRUSTACEA - β	CRUSTACEA - mg DW	CRUSTACEA - WW:DW	CRUSTACEA - mg WW	CRUSTACEA α/β Reference	Rotifera - FF	Rotifera - %BV	Rotifera - WW:DW	Rotifera - mg DW	Rotifera - mg WW	Rotifera - FF/%BV Reference	Final Biomass - DW	Final Biomass - WW
CRCO	Diacyclops thomasi	M	15-25-16		4	1	4x	3.8		0.26	0.9880	-0.012072581	1.492	1.990	0.004340	5	0.021702	EPA SOP							0.004340439	0.021702196
CRCO	Diacyclops thomasi	M	15-25-17		4	1	4x	3.6		0.26	0.9360	-0.066139803	1.492	1.990	0.003898	5	0.019488	EPA SOP							0.003897681	0.019488406
CRCO	Diacyclops thomasi	M	15-25-17		4	1	4x	3.5		0.26	0.9100	-0.094310679	1.492	1.990	0.003685	5	0.018426	EPA SOP							0.003685189	0.018425944
CRCO	Diacyclops thomasi	M	15-25-17		4	1	4x	3.8		0.26	0.9880	-0.012072581	1.492	1.990	0.004340	5	0.021702	EPA SOP							0.004340439	0.021702196
CRCO	Diacyclops thomasi	M	15-25-17		4	1	4x	3.8		0.26	0.9880	-0.012072581	1.492	1.990	0.004340	5	0.021702	EPA SOP							0.004340439	0.021702196
CRCO	Diacyclops thomasi	M	15-25-17		4	1	4x	3.9		0.26	1.0140	0.013902905	1.492	1.990	0.004571	5	0.022854	EPA SOP							0.004570702	0.022853509
CRCO	Diacyclops thomasi	M	15-25-17		4	1	4x	3.7		0.26	0.9620	-0.038740828	1.492	1.990	0.004116	5	0.020580	EPA SOP							0.004116099	0.020580493
CRCO	Diacyclops thomasi	M	15-25-17		4	1	4x	3.7		0.26	0.9620	-0.038740828	1.492	1.990	0.004116	5	0.020580	EPA SOP							0.004116099	0.020580493
CRCO	Diacyclops thomasi	M	15-25-17		4	1	4x	3.8		0.26	0.9880	-0.012072581	1.492	1.990	0.004340	5	0.021702	EPA SOP							0.004340439	0.021702196
CRCO	Diacyclops thomasi	M	15-25-17		4	1	4x	3.8		0.26	0.9880	-0.012072581	1.492	1.990	0.004340	5	0.021702	EPA SOP							0.004340439	0.021702196
CRCO	Diacyclops thomasi	M	15-25-24		4	1	4x	3.8		0.26	0.9880	-0.012072581	1.492	1.990	0.004340	5	0.021702	EPA SOP							0.004340439	0.021702196
CRCO	Diacyclops thomasi	M	15-25-24		4	1	4x	3.1		0.26	0.8060	-0.215671536	1.492	1.990	0.002895	5	0.014473	EPA SOP							0.002894504	0.014472518
CRCO	Diacyclops thomasi	M	15-25-25		4	1	4x	3.8		0.26	0.9880	-0.012072581	1.492	1.990	0.004340	5	0.021702	EPA SOP							0.004340439	0.021702196
CRCO	Diacyclops thomasi	M	15-25-25		4	1	4x	3.8		0.26	0.9880	-0.012072581	1.492	1.990	0.004340	5	0.021702	EPA SOP							0.004340439	0.021702196
CRCO	Diacyclops thomasi	F	15-25-13		4	1	4x	4.8		0.26	1.2480	0.22154227	1.492	1.990	0.006909	5	0.034547	EPA SOP							0.006909305	0.034546527
CRCO	Diacyclops thomasi	F	15-25-13		4	1	4x	4.4		0.26	1.1440	0.134530893	1.492	1.990	0.005811	5	0.029054	EPA SOP							0.00581079	0.029053948
CRCO	Diacyclops thomasi	F	15-25-13		4	1	4x	4.4		0.26	1.1440	0.134530893	1.492	1.990	0.005811	5	0.029054	EPA SOP							0.00581079	0.029053948
CRCO	Diacyclops thomasi	F	15-25-13		4	1	4x	4.5		0.26	1.1700	0.157003749	1.492	1.990	0.006077	5	0.030383	EPA SOP							0.006076552	0.030382761
CRCO	Diacyclops thomasi	F	15-25-13		4	1	4x	4.6		0.26	1.1960	0.178982656	1.492	1.990	0.006348	5	0.031741	EPA SOP							0.006348227	0.031741133
CRCO	Diacyclops thomasi	F	15-25-13		4	1	4x	4.6		0.26	1.1960	0.178982656	1.492	1.990	0.006348	5	0.031741	EPA SOP							0.006348227	0.031741133
CRCO	Diacyclops thomasi	F	15-25-13		4	1	4x	4.4		0.26	1.1440	0.134530893	1.492	1.990	0.005811	5	0.029054	EPA SOP							0.00581079	0.029053948
CRCO	Diacyclops thomasi	F	15-25-16		4	1	4x	3.7		0.26	0.9620	-0.038740828	1.492	1.990	0.004116	5	0.020580	EPA SOP							0.004116099	0.020580493
CRCO	Diacyclops thomasi	F	15-25-16		4	1	4x	4.6		0.26	1.1960	0.178982656	1.492	1.990	0.006348	5	0.031741	EPA SOP							0.006348227	0.031741133
CRCO	Diacyclops thomasi	F	15-25-16		4	1	4x	4.3		0.26	1.1180	0.111541375	1.492	1.990	0.005551	5	0.027755	EPA SOP							0.00555094	0.027754701
CRCO	Diacyclops thomasi	F	15-25-16		4	1	4x	4.6		0.26	1.1960	0.178982656	1.492	1.990	0.006348	5	0.031741	EPA SOP							0.006348227	0.031741133
CRCO	Diacyclops thomasi	F	15-25-16		4	1	4x	4.7		0.26	1.2220	0.200488861	1.492	1.990	0.006626	5	0.033129	EPA SOP							0.006625811	0.033129057
CRCO	Diacyclops thomasi	F	15-25-16		4	1	4x	4.8		0.26	1.2480	0.22154227	1.492	1.990	0.006909	5	0.034547	EPA SOP							0.006909305	0.034546527
CRCO	Diacyclops thomasi	F	15-25-17		4	1	4x	4.9		0.26	1.2740	0.242161557	1.492	1.990	0.007199	5	0.035994	EPA SOP							0.007198708	0.035993538
CRCO	Diacyclops thomasi	F	15-25-17		4	1	4x	4.7		0.26	1.2220	0.200488861	1.492	1.990	0.006626	5	0.033129	EPA SOP							0.006625811	0.033129057
CRCO	Diacyclops thomasi	F	15-25-17		4	1	4x	4.5		0.26	1.1700	0.157003749	1.492	1.990	0.006077	5	0.030383	EPA SOP							0.006076552	0.030382761
CRCO	Diacyclops thomasi	F	15-25-17		4	1	4x	4.7		0.26	1.2220	0.200488861	1.492	1.990	0.006626	5	0.033129	EPA SOP							0.006625811	0.033129057
CRCO	Diacyclops thomasi	F	15-25-17		4	1	4x	4.6		0.26	1.1960	0.178982656	1.492	1.990	0.006348	5	0.031741	EPA SOP							0.006348227	0.031741133
CRCO	Diacyclops thomasi	F	15-25-17		4	1	4x	4.9		0.26	1.2740	0.242161557	1.492	1.990	0.007199	5	0.035994	EPA SOP							0.007198708	0.035993538
CRCO	Diacyclops thomasi	F	15-25-24		4	1	4x	4.5		0.26	1.1700	0.157003749	1.492	1.990	0.006077	5	0.030383	EPA SOP							0.006076552	0.030382761
CRCO	Diacyclops thomasi	F	15-25-24		4	1	4x	4.8		0.26	1.2480	0.22154227	1.492	1.990	0.006909	5	0.034547	EPA SOP							0.006909305	0.034546527
ROTI	Kellicottia sp.	n/a	15-25-01		4	1	4x	2.1		0.26	0.5460								0.030	0.015	0.100	0.00050	0.00496	EPA SOP	0.000495639	0.004956387
ROTI	Kellicottia sp.	n/a	15-25-01		4	1	4x	2.4		0.26	0.6240								0.030	0.015	0.100	0.00074	0.00740	EPA SOP	0.000739846	0.007398456
ROTI	Kellicottia sp.	n/a	15-25-01		4	1	4x	2.2		0.26	0.5720								0.030	0.015	0.100	0.00057	0.00570	EPA SOP	0.000569869	0.005698695
ROTI	Kellicottia sp.	n/a	15-25-01		4	1	4x	2.8		0.26	0.7280								0.030	0.015	0.100	0.00117	0.01175	EPA SOP	0.001174847	0.011748473
ROTI	Kellicottia sp.	n/a	15-25-01		4	1	4x	2.2		0.26	0.5720								0.030	0.015	0.100	0.00057	0.00570	EPA SOP	0.000569869	0.005698695
ROTI	Kellicottia sp.	n/a	15-25-01		4	1	4x	2.3		0.26	0.5980								0.030	0.015	0.100	0.00065	0.00651	EPA SOP	0.000651165	0.006511647
ROTI	Kellicottia sp.	n/a	15-25-01		4	1	4x	2.9		0.26	0.7540								0.030	0.015	0.100	0.00131	0.01305	EPA SOP	0.001305273	0.013052729
ROTI	Kellicottia sp.	n/a	15-25-01		4	1	4x	2.7		0.26	0.7020								0.030	0.015	0.100	0.00105	0.01053	EPA SOP	0.001053413	0.010534129
ROTI	Kellicottia sp.	n/a	15-25-01		4	1	4x	2.8		0.26	0.7280								0.030	0.015	0.100	0.00117	0.01175	EPA SOP	0.001174847	0.011748473
ROTI	Kellicottia sp.	n/a	15-25-01		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-02		4	1	4x	2.7		0.26	0.7020								0.030	0.015	0.100	0.00105	0.01053	EPA SOP	0.001053413	0.010534129
ROTI	Kellicottia sp.	n/a	15-25-02		4	1	4x	2		0.26	0.5200								0.030	0.015	0.100	0.00043	0.00428	EPA SOP	0.000428151	0.004281514
ROTI	Kellicottia sp.	n/a	15-25-02		4	1	4x	2.8		0.26	0.7280								0.030	0.015	0.100	0.00117	0.01175	EPA SOP	0.001174847	0.011748473
ROTI	Kellicottia sp.	n/a	15-25-02		4	1	4x	2.6		0.26	0.6760								0.030	0.015	0.100	0.00094	0.00941	EPA SOP	0.000940649	0.009406485
ROTI	Kellicottia sp.	n/a	15-25-02		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-02		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-02		4	1	4x	3.2		0.26	0.8320								0.030	0.015	0.100	0.00175	0.01754	EPA SOP	0.001753708	0.01753708
ROTI	Kellicottia sp.	n/a	15-25-02		4	1	4x	2.9		0.26	0.7540								0.030	0.015	0.100	0.00131	0.01305	EPA SOP	0.001305273	0.013052729
ROTI	Kellicottia sp.	n/a	15-25-02		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-02		4	1	4x	2.7		0.26	0.7020								0.030	0.015	0.100	0.00105	0.01053	EPA SOP	0.001053413	0.010534129
ROTI	Kellicottia sp.	n/a	15-25-02		4	1	4x	2.8		0.26	0.7280								0.030	0.015	0.100	0.00117	0.01175	EPA SOP	0.001174847	0.011748473
ROTI	Kellicottia sp.	n/a	15-25-03		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-03		4	1	4x	2.8		0.26	0.7280								0.030	0.015	0.100	0.00117	0.01175	EPA SOP	0.001174847	0.011748473
ROTI	Kellicottia sp.	n/a	15-25-03		4	1	4x	2.8		0.26	0.7280								0.030	0.015	0.100	0.00117	0.01175	EPA SOP	0.001174847	0.011748473
ROTI	Kellicottia sp.	n/a	15-25-03		4	1	4x	2.7		0.26	0.7020								0.030	0.015	0.100	0.00105	0.01053	EPA SOP	0.001053413	0.010534129
ROTI	Kellicottia sp.	n/a	15-25-03		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-03		4	1	4x	3.1		0.26	0.8060								0.030	0.015	0.100	0.00159	0.01594	EPA SOP	0.001594382	0.015943821
ROTI	Kellicottia sp.	n/a	15-25-03		4	1	4x	3.1		0.26	0.8060								0.030	0.015	0.100	0.00159	0.01594	EPA SOP	0.001594382	0.015943821
ROTI	Kellicottia sp.	n/a	15-25-03		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-03		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-03		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-03		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-04		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-04		4	1	4x	2.8		0.26	0.7280								0.030	0.015	0.100	0.00117	0.01175	EPA SOP	0.001174847	0.011748473
ROTI	Kellicottia sp.	n/a	15-25-04		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-04		4	1	4x	2.8		0.26	0.7280								0.030	0.015	0.100	0.00117	0.01175	EPA SOP	0.001174847	0.011748473
ROTI	Kellicottia sp.	n/a	15-25-04		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-04		4	1	4x	3.2		0.26	0.8320								0.030	0.015	0.100	0.00175	0.01754	EPA SOP	0.001753708	0.01753708
ROTI	Kellicottia sp.	n/a	15-25-04		4	1	4x	2.7		0.26	0.7020								0.030	0.015	0.100	0.00105	0.01053	EPA SOP	0.001053413	0.010534129
ROTI	Kellicottia sp.	n/a	15-25-04		4	1	4x	3.1		0.26	0.8060								0.030	0.015	0.100	0.00159	0.01594	EPA SOP	0.001594382	0.015943821
ROTI	Kellicottia sp.	n/a	15-25-04		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-04		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-05		4	1	4x	2		0.26	0.5200								0.030	0.015	0.100	0.00043	0.00428	EPA SOP	0.000428151	0.004281514
ROTI	Kellicottia sp.	n/a	15-25-05		4	1	4x	2.5		0.26	0.6500								0.030	0.015	0.100	0.00084	0.00836	EPA SOP	0.000836233	0.008362331
ROTI	Kellicottia sp.	n/a	15-25-05		4	1	4x	2.6		0.26	0.6760								0.030	0.015	0.100	0.00094	0.00941	EPA SOP	0.000940649	0.009406485
ROTI	Kellicottia sp.	n/a	15-25-05		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-05		4	1	4x	2.5		0.26	0.6500								0.030	0.015	0.100	0.00084	0.00836	EPA SOP	0.000836233	0.008362331
ROTI	Kellicottia sp.	n/a	15-25-06		4	1	4x	2.9		0.26	0.7540								0.030	0.015	0.100	0.00131	0.01305	EPA SOP	0.001305273	0.013052729
ROTI	Kellicottia sp.	n/a	15-25-06		4	1	4x	2.5		0.26	0.6500								0.030	0.015	0.100	0.00084	0.00836	EPA SOP	0.000836233	0.008362331
ROTI	Kellicottia sp.	n/a	15-25-06		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-06		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-06		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-06		4	1	4x	2.9		0.26	0.7540								0.030	0.015	0.100	0.00131	0.01305	EPA SOP	0.001305273	0.013052729
ROTI	Kellicottia sp.	n/a	15-25-06		4	1	4x	2.8		0.26	0.7280								0.030	0.015	0.100	0.00117	0.01175	EPA SOP	0.001174847	0.011748473
ROTI	Kellicottia sp.	n/a	15-25-07		4	1	4x	2.9		0.26	0.7540								0.030	0.015	0.100	0.00131	0.01305	EPA SOP	0.001305273	0.013052729
ROTI	Kellicottia sp.	n/a	15-25-07		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-07		4	1	4x	2.6		0.26	0.6760								0.030	0.015	0.100	0.00094	0.00941	EPA SOP	0.000940649	0.009406485
ROTI	Kellicottia sp.	n/a	15-25-07		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-07		4	1	4x	2.6		0.26	0.6760								0.030	0.015	0.100	0.00094	0.00941	EPA SOP	0.000940649	0.009406485
ROTI	Kellicottia sp.	n/a	15-25-08		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-08		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-08		4	1	4x	2.7		0.26	0.7020								0.030	0.015	0.100	0.00105	0.01053	EPA SOP	0.001053413	0.010534129
ROTI	Kellicottia sp.	n/a	15-25-08		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-08		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-09		4	1	4x	3.2		0.26	0.8320								0.030	0.015	0.100	0.00175	0.01754	EPA SOP	0.001753708	0.01753708
ROTI	Kellicottia sp.	n/a	15-25-09		4	1	4x	3.1		0.26	0.8060								0.030	0.015	0.100	0.00159	0.01594	EPA SOP	0.001594382	0.015943821
ROTI	Kellicottia sp.	n/a	15-25-09		4	1	4x	3.1		0.26	0.8060								0.030	0.015	0.100	0.00159	0.01594	EPA SOP	0.001594382	0.015943821
ROTI	Kellicottia sp.	n/a	15-25-09		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-09		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Kellicottia sp.	n/a	15-25-09		4	1	4x	3		0.26	0.7800								0.030	0.015	0.100	0.00145	0.01445	EPA SOP	0.001445011	0.014450108
ROTI	Conochilus sp.	n/a	15-25-01		4	1	4x	0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-01		4	1		0.5		0.26	0.1300								0.260	0.000	0.100	0.00006	0.00057	EPA SOP	0.000057122	0.00057122

Zooplankton biomeasurements and conversions for calculation of biomass data, Azimuth Nunavut 2015

Groupcode	Taxon	Stage	Biologica Sample	Client Sample	Unit	Conversion (mm)	Objective	Length (units)	Width (units)	Calibration	Length (mm)	CRUSTACEA - Ln(Length)	CRUSTACEA - Ln(α)	CRUSTACEA - β	CRUSTACEA - mg DW	CRUSTACEA - WW:DW	CRUSTACEA - mg WW	CRUSTACEA α/β Reference	Rotifera - FF	Rotifera - %BV	Rotifera - WW:DW	Rotifera - mg DW	Rotifera - mg WW	Rotifera - FF/%BV Reference	Final Biomass - DW	Final Biomass - WW
ROTI	Conochilus sp.	n/a	15-25-01		4	1		0.5		0.26	0.1300								0.260	0.000	0.100	0.00006	0.00057	EPA SOP	0.000057122	0.00057122
ROTI	Conochilus sp.	n/a	15-25-01		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-01		4	1		0.8		0.26	0.2080								0.260	0.000	0.100	0.00023	0.00234	EPA SOP	0.000233972	0.002339717
ROTI	Conochilus sp.	n/a	15-25-01		4	1		0.8		0.26	0.2080								0.260	0.000	0.100	0.00023	0.00234	EPA SOP	0.000233972	0.002339717
ROTI	Conochilus sp.	n/a	15-25-01		4	1		0.5		0.26	0.1300								0.260	0.000	0.100	0.00006	0.00057	EPA SOP	0.000057122	0.00057122
ROTI	Conochilus sp.	n/a	15-25-01		4	1		0.6		0.26	0.1560								0.260	0.000	0.100	0.00010	0.00099	EPA SOP	9.87068E-05	0.000987068
ROTI	Conochilus sp.	n/a	15-25-01		4	1		0.5		0.26	0.1300								0.260	0.000	0.100	0.00006	0.00057	EPA SOP	0.000057122	0.00057122
ROTI	Conochilus sp.	n/a	15-25-01		4	1		0.6		0.26	0.1560								0.260	0.000	0.100	0.00010	0.00099	EPA SOP	9.87068E-05	0.000987068
ROTI	Conochilus sp.	n/a	15-25-01		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-01		4	1		0.8		0.26	0.2080								0.260	0.000	0.100	0.00023	0.00234	EPA SOP	0.000233972	0.002339717
ROTI	Conochilus sp.	n/a	15-25-01		4	1		0.9		0.26	0.2340								0.260	0.000	0.100	0.00033	0.00333	EPA SOP	0.000333136	0.003331355
ROTI	Conochilus sp.	n/a	15-25-01		4	1		0.5		0.26	0.1300								0.260	0.000	0.100	0.00006	0.00057	EPA SOP	0.000057122	0.00057122
ROTI	Conochilus sp.	n/a	15-25-01		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-01		4	1		0.8		0.26	0.2080								0.260	0.000	0.100	0.00023	0.00234	EPA SOP	0.000233972	0.002339717
ROTI	Conochilus sp.	n/a	15-25-02		4	1		0.5		0.26	0.1300								0.260	0.000	0.100	0.00006	0.00057	EPA SOP	0.000057122	0.00057122
ROTI	Conochilus sp.	n/a	15-25-02		4	1		0.4		0.26	0.1040								0.260	0.000	0.100	0.00003	0.00029	EPA SOP	2.92465E-05	0.000292465
ROTI	Conochilus sp.	n/a	15-25-02		4	1		0.4		0.26	0.1040								0.260	0.000	0.100	0.00003	0.00029	EPA SOP	2.92465E-05	0.000292465
ROTI	Conochilus sp.	n/a	15-25-02		4	1		0.9		0.26	0.2340								0.260	0.000	0.100	0.00033	0.00333	EPA SOP	0.000333136	0.003331355
ROTI	Conochilus sp.	n/a	15-25-02		4	1		0.8		0.26	0.2080								0.260	0.000	0.100	0.00023	0.00234	EPA SOP	0.000233972	0.002339717
ROTI	Conochilus sp.	n/a	15-25-02		4	1		0.4		0.26	0.1040								0.260	0.000	0.100	0.00003	0.00029	EPA SOP	2.92465E-05	0.000292465
ROTI	Conochilus sp.	n/a	15-25-02		4	1		0.3		0.26	0.0780								0.260	0.000	0.100	0.00001	0.00012	EPA SOP	1.23384E-05	0.000123384
ROTI	Conochilus sp.	n/a	15-25-02		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-02		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-02		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-02		4	1		0.6		0.26	0.1560								0.260	0.000	0.100	0.00010	0.00099	EPA SOP	9.87068E-05	0.000987068
ROTI	Conochilus sp.	n/a	15-25-02		4	1		0.6		0.26	0.1560								0.260	0.000	0.100	0.00010	0.00099	EPA SOP	9.87068E-05	0.000987068
ROTI	Conochilus sp.	n/a	15-25-02		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-02		4	1		0.6		0.26	0.1560								0.260	0.000	0.100	0.00010	0.00099	EPA SOP	9.87068E-05	0.000987068
ROTI	Conochilus sp.	n/a	15-25-02		4	1		0.4		0.26	0.1040								0.260	0.000	0.100	0.00003	0.00029	EPA SOP	2.92465E-05	0.000292465
ROTI	Conochilus sp.	n/a	15-25-02		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-03		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-03		4	1		0.6		0.26	0.1560								0.260	0.000	0.100	0.00010	0.00099	EPA SOP	9.87068E-05	0.000987068
ROTI	Conochilus sp.	n/a	15-25-03		4	1		0.6		0.26	0.1560								0.260	0.000	0.100	0.00010	0.00099	EPA SOP	9.87068E-05	0.000987068
ROTI	Conochilus sp.	n/a	15-25-03		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-03		4	1		0.5		0.26	0.1300								0.260	0.000	0.100	0.00006	0.00057	EPA SOP	0.000057122	0.00057122
ROTI	Conochilus sp.	n/a	15-25-03		4	1		0.5		0.26	0.1300								0.260	0.000	0.100	0.00006	0.00057	EPA SOP	0.000057122	0.00057122
ROTI	Conochilus sp.	n/a	15-25-03		4	1		0.5		0.26	0.1300								0.260	0.000	0.100	0.00006	0.00057	EPA SOP	0.000057122	0.00057122
ROTI	Conochilus sp.	n/a	15-25-03		4	1		0.4		0.26	0.1040								0.260	0.000	0.100	0.00003	0.00029	EPA SOP	2.92465E-05	0.000292465
ROTI	Conochilus sp.	n/a	15-25-03		4	1		0.6		0.26	0.1560								0.260	0.000	0.100	0.00010	0.00099	EPA SOP	9.87068E-05	0.000987068
ROTI	Conochilus sp.	n/a	15-25-03		4	1		0.5		0.26	0.1300								0.260	0.000	0.100	0.00006	0.00057	EPA SOP	0.000057122	0.00057122
ROTI	Conochilus sp.	n/a	15-25-03		4	1		0.4		0.26	0.1040								0.260	0.000	0.100	0.00003	0.00029	EPA SOP	2.92465E-05	0.000292465
ROTI	Conochilus sp.	n/a	15-25-03		4	1		0.6		0.26	0.1560								0.260	0.000	0.100	0.00010	0.00099	EPA SOP	9.87068E-05	0.000987068
ROTI	Conochilus sp.	n/a	15-25-03		4	1		0.8		0.26	0.2080								0.260	0.000	0.100	0.00023	0.00234	EPA SOP	0.000233972	0.002339717
ROTI	Conochilus sp.	n/a	15-25-04		4	1		0.9		0.26	0.2340								0.260	0.000	0.100	0.00033	0.00333	EPA SOP	0.000333136	0.003331355
ROTI	Conochilus sp.	n/a	15-25-04		4	1		0.6		0.26	0.1560								0.260	0.000	0.100	0.00010	0.00099	EPA SOP	9.87068E-05	0.000987068
ROTI	Conochilus sp.	n/a	15-25-04		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-04		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-04		4	1		0.6		0.26	0.1560								0.260	0.000	0.100	0.00010	0.00099	EPA SOP	9.87068E-05	0.000987068
ROTI	Conochilus sp.	n/a	15-25-05		4	1		0.8		0.26	0.2080								0.260	0.000	0.100	0.00023	0.00234	EPA SOP	0.000233972	0.002339717
ROTI	Conochilus sp.	n/a	15-25-05		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-05		4	1		0.8		0.26	0.2080								0.260	0.000	0.100	0.00023	0.00234	EPA SOP	0.000233972	0.002339717
ROTI	Conochilus sp.	n/a	15-25-05		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-05		4	1		0.8		0.26	0.2080								0.260	0.000	0.100	0.00023	0.00234	EPA SOP	0.000233972	0.002339717
ROTI	Conochilus sp.	n/a	15-25-05		4	1		0.6		0.26	0.1560								0.260	0.000	0.100	0.00010	0.00099	EPA SOP	9.87068E-05	0.000987068
ROTI	Conochilus sp.	n/a	15-25-05		4	1		0.4		0.26	0.1040								0.260	0.000	0.100	0.00003	0.00029	EPA SOP	2.92465E-05	0.000292465
ROTI	Conochilus sp.	n/a	15-25-06		4	1		0.5		0.26	0.1300								0.260	0.000	0.100	0.00006	0.00057	EPA SOP	0.000057122	0.00057122
ROTI	Conochilus sp.	n/a	15-25-06		4	1		0.5		0.26	0.1300								0.260	0.000	0.100	0.00006	0.00057	EPA SOP	0.000057122	0.00057122
ROTI	Conochilus sp.	n/a	15-25-06		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-06		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-06		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-06		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-06		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-07		4	1		1		0.26	0.2600								0.260	0.000	0.100	0.00046	0.00457	EPA SOP	0.000456976	0.00456976
ROTI	Conochilus sp.	n/a	15-25-07		4	1		0.9		0.26	0.2340								0.260	0.000	0.100	0.00033	0.00333	EPA SOP	0.000333136	0.003331355
ROTI	Conochilus sp.	n/a	15-25-07		4	1		0.9		0.26	0.2340								0.260	0.000	0.100	0.00033	0.00333	EPA SOP	0.000333136	0.003331355
ROTI	Conochilus sp.	n/a	15-25-07		4	1		0.9		0.26	0.2340								0.260	0.000	0.100	0.00033	0.00333	EPA SOP	0.000333136	0.003331355
ROTI	Conochilus sp.	n/a	15-25-07		4	1		0.8		0.26	0.2080								0.260	0.000	0.100	0.00023	0.00234	EPA SOP	0.000233972	0.002339717
ROTI	Conochilus sp.	n/a	15-25-07		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Conochilus sp.	n/a	15-25-07		4	1		0.9		0.26	0.2340								0.260	0.000	0.100	0.00033	0.00333	EPA SOP	0.000333136	0.003331355
ROTI	Conochilus sp.	n/a	15-25-07		4	1		0.8		0.26	0.2080								0.260	0.000	0.100	0.00023	0.00234	EPA SOP	0.000233972	0.002339717
ROTI	Conochilus sp.	n/a	15-25-07		4	1		0.8		0.26	0.2080								0.260	0.000	0.100	0.00023	0.00234	EPA SOP	0.000233972	0.002339717
ROTI	Conochilus sp.	n/a	15-25-08		4	1		0.8		0.26	0.2080								0.260	0.000	0.100	0.00023	0.00234	EPA SOP	0.000233972	0.002339717
ROTI	Conochilus sp.	n/a	15-25-08		4	1		0.5		0.26	0.1300								0.260	0.000	0.100	0.00006	0.00057	EPA SOP	0.000057122	0.00057122
ROTI	Conochilus sp.	n/a	15-25-08		4	1		0.6		0.26	0.1560								0.260	0.000	0.100	0.00010	0.00099	EPA SOP	9.87068E-05	0.000987068
ROTI	Conochilus sp.	n/a	15-25-08		4	1		0.6		0.26	0.1560								0.260	0.000	0.100	0.00010	0.00099	EPA SOP	9.87068E-05	0.000987068
ROTI	Conochilus sp.	n/a	15-25-08		4	1		0.6		0.26	0.1560								0.260	0.000	0.100	0.00010	0.00099	EPA SOP	9.87068E-05	0.000987068
ROTI	Conochilus sp.	n/a	15-25-09		4	1		0.6		0.26	0.1560								0.260	0.000	0.100	0.00010	0.00099	EPA SOP	9.87068E-05	0.000987068
ROTI	Conochilus sp.	n/a	15-25-09		4	1		0.5		0.26	0.1300								0.260	0.000	0.100	0.00006	0.00057	EPA SOP	0.000057122	0.00057122
ROTI	Conochilus sp.	n/a	15-25-09		4	1		0.6		0.26	0.1560								0.260	0.000	0.100	0.00010	0.00099	EPA SOP	9.87068E-05	0.000987068
ROTI	Conochilus sp.	n/a	15-25-09		4	1		0.8		0.26	0.2080								0.260	0.000	0.100	0.00023	0.00234	EPA SOP	0.000233972	0.002339717
ROTI	Conochilus sp.	n/a	15-25-09		4	1		0.7		0.26	0.1820								0.260	0.000	0.100	0.00016	0.00157	EPA SOP	0.000156743	0.001567428
ROTI	Polyarthra sp.	n/a	15-25-05		4	1	4x	0.5		0.26	0.1300								0.230	0.100	0.100	0.00006	0.00056	EPA SOP	5.55841E-05	0.000555841
ROTI	Polyarthra sp.	n/a	15-25-05		4	1		0.5		0.26	0.1300								0.230	0.100	0.100	0.00006	0.00056	EPA SOP	5.55841E-05	0.000555841
ROTI	Polyarthra sp.	n/a	15-25-05		4	1		0.5		0.26	0.1300								0.230	0.100	0.100	0.00006	0.00056	EPA SOP	5.55841E-05	0.000555841
ROTI	Polyarthra sp.	n/a	15-25-07		4	1		0.6		0.26	0.1560								0.230	0.100	0.100	0.00010	0.00096	EPA SOP	9.60493E-05	0.000960493
ROTI	Polyarthra sp.	n/a	15-25-07		4	1		0.4		0.26	0.1040								0.230	0.100	0.100	0.00003	0.00028	EPA SOP	2.84591E-05	0.000284591
ROTI	Polyarthra sp.	n/a	15-25-07		4	1		0.6		0.26	0.1560								0.230	0.100	0.100	0.00010	0.00096	EPA SOP	9.60493E-05	0.000960493
ROTI	Polyarthra sp.	n/a	15-25-08		4	1		0.6		0.26	0.1560								0.230	0.100	0.100	0.00010	0.00096	EPA SOP	9.60493E-05	0.000960493
ROTI	Polyarthra sp.	n/a	15-25-08		4	1		0.4		0.26	0.1040								0.230	0.100	0.100	0.00003	0.00028	EPA SOP	2.84591E-05	0.000284591
ROTI	Polyarthra sp.	n/a	15-25-08		4	1		0.5		0.26	0.1300								0.230	0.100	0.100	0.00006	0.00056	EPA SOP	5.55841E-05	0.000555841
ROTI	Polyarthra sp.	n/a	15-25-08		4	1		0.6		0.26	0.1560								0.230	0.100	0.100	0.00010	0.00096	EPA SOP	9.60493E-05	0.000960493
ROTI	Polyarthra sp.	n/a	15-25-09		4	1		0.5		0.26	0.1300								0.230	0.100	0.100	0.00006	0.00056	EPA SOP	5.55841E-05	0.000555841
ROTI	Polyarthra sp.	n/a	15-25-09		4	1		0.6		0.26	0.1560								0.230	0.100	0.100	0.00010	0.00096	EPA SOP	9.60493E-05	0.000960493
ROTI	Polyarthra sp.	n/a	15-25-09		4	1		0.4		0.26	0.1040								0.230	0.100	0.100	0.00003	0.00028	EPA SOP	2.84591E-05	0.000284591
ROTI	Polyarthra sp.	n/a	15-25-09		4	1		0.7		0.26	0.1820								0.230	0.100	0.100	0.00015	0.00153	EPA SOP	0.000152523	0.001525228
ROTI	Polyarthra sp.	n/a	15-25-09		4	1		0.6		0.26	0.1560								0.230	0.100	0.100	0.00010	0.00096	EPA SOP	9.60493E-05	0.000960493
ROTI	Polyarthra sp.	n/a	15-25-09		4	1		0.4		0.26	0.1040								0.230	0.100	0.100	0.00003	0.00028	EPA SOP	2.84591E-05	0.000284591
ROTI	Polyarthra sp.	n/a	15-25-09		4	1		0.5		0.26	0.1300								0.230	0.100	0.100	0.00006	0.00056	EPA SOP	5.55841E-05	0.000555841
ROTI	Polyarthra sp.	n/a	15-25-03		4	1		0.6		0.26	0.1560								0.230	0.100	0.100	0.00010	0.00096	EPA SOP	9.60493E-05	0.000960493
ROTI	Polyarthra sp.	n/a	15-25-03		4	1		0.5		0.26	0.1300								0.230	0.100	0.100	0.00006	0.00056	EPA SOP	5.55841E-05	0.000555841
ROTI	Polyarthra sp.	n/a	15-25-03		4	1		0.6		0.26	0.1560								0.230	0.100	0.100	0.00010	0.00096	EPA SOP	9.60493E-05	0.000960493
ROTI	Polyarthra sp.	n/a	15-25-03		4	1		0.5		0.26	0.1300								0.230	0.100	0.100	0.00006	0.00056	EPA SOP	5.55841E-05	0.000555841
ROTI	Polyarthra sp.	n/a	15-25-03		4	1		0.6		0.26	0.1560								0.230	0.100	0.100	0.00010	0.00096	EPA SOP	9.60493E-05	0.000960493
ROTI	Asplanchna sp.	n/a	15-25-01		4	1	4x	0.5		0.26	0.1300								0.230	0.000	0.039	0.00002	0.00051	EPA SOP	1.97071E-05	0.00050531
ROTI	Asplanchna sp.	n/a	15-25-01		4	1	4x	0.8		0.26	0.2080								0.230	0.000	0.039	0.00008	0.00207	EPA SOP	8.07202E-05	0.00206975
ROTI	Asplanchna sp.	n/a	15-25-03		4	1	4x	0.7		0.26	0.1820								0.230	0.000	0.039	0.00005	0.00139	EPA SOP	5.40763E-05	0.001386571
ROTI	Asplanchna sp.	n/a	15-25-03		4	1	4x	1.0		0.26	0.2600								0.230	0.000	0.039	0.00016	0.00404	EPA SOP	0.000157657	0.00404248

Zooplankton biomeasurements and conversions for calculation of biomass data, Azimuth Nunavut 2015

Groupcode	Taxon	Stage	Biologica Sample	Client Sample	Unit	Conversion (mm)	Objective	Length (units)	Width (units)	Calibration	Length (mm)	CRUSTACEA - Ln(Length)	CRUSTACEA - Ln(α)	CRUSTACEA - β	CRUSTACEA - mg DW	CRUSTACEA - WW:DW	CRUSTACEA - mg WW	CRUSTACEA α/β Reference	Rotifera - FF	Rotifera - %BV	Rotifera - WW:DW	Rotifera - mg DW	Rotifera - mg WW	Rotifera - FF/%BV Reference	Final Biomass - DW	Final Biomass - WW
ROTI	Collotheca sp.	n/a	15-25-01		4	1	4x	0.7		0.26	0.1820								1.800	0.000	0.100	0.00109	0.01085	EPA SOP	0.001085142	0.010851422
ROTI	Synchaeta sp.	n/a	15-25-03		4	1	4x	1.1		0.26	0.2860								0.100	0.000	0.100	0.00023	0.00234	EPA SOP	0.000233937	0.002339366
ROTI	Synchaeta sp.	n/a	15-25-03		4	1	4x	9		0.26	2.3400								0.100	0.000	0.100	0.12813	1.28129	EPA SOP	0.12812904	1.2812904
ROTI	Synchaeta sp.	n/a	15-25-03		4	1	4x	1.3		0.26	0.3380								0.100	0.000	0.100	0.00039	0.00386	EPA SOP	0.000386145	0.003861447
ROTI	Synchaeta sp.	n/a	15-25-03		4	1	4x	1		0.26	0.2600								0.100	0.000	0.100	0.00018	0.00176	EPA SOP	0.00017576	0.0017576
ROTI	Synchaeta sp.	n/a	15-25-04		4	1	4x	1.1		0.26	0.2860								0.100	0.000	0.100	0.00023	0.00234	EPA SOP	0.000233937	0.002339366
ROTI	Synchaeta sp.	n/a	15-25-04		4	1	4x	0.8		0.26	0.2080								0.100	0.000	0.100	0.00009	0.00090	EPA SOP	8.99891E-05	0.000899891
ROTI	Synchaeta sp.	n/a	15-25-04		4	1	4x	1		0.26	0.2600								0.100	0.000	0.100	0.00018	0.00176	EPA SOP	0.00017576	0.0017576
ROTI	Synchaeta sp.	n/a	15-25-04		4	1	4x	1		0.26	0.2600								0.100	0.000	0.100	0.00018	0.00176	EPA SOP	0.00017576	0.0017576
ROTI	Synchaeta sp.	n/a	15-25-04		4	1	4x	1.1		0.26	0.2860								0.100	0.000	0.100	0.00023	0.00234	EPA SOP	0.000233937	0.002339366
ROTI	Synchaeta sp.	n/a	15-25-09		4	1	4x	1.3		0.26	0.3380								0.100	0.000	0.100	0.00039	0.00386	EPA SOP	0.000386145	0.003861447
ROTI	Synchaeta sp.	n/a	15-25-09		4	1	4x	0.9		0.26	0.2340								0.100	0.000	0.100	0.00013	0.00128	EPA SOP	0.00128129	0.00128129
ROTI	Synchaeta sp.	n/a	15-25-09		4	1	4x	1.2		0.26	0.3120								0.100	0.000	0.100	0.00030	0.00304	EPA SOP	0.000303713	0.003037133
ROTI	Synchaeta sp.	n/a	15-25-09		4	1	4x	1.4		0.26	0.3640								0.100	0.000	0.100	0.00048	0.00482	EPA SOP	0.000482285	0.004822854
ROTI	Synchaeta sp.	n/a	15-25-09		4	1	4x	1.2		0.26	0.3120								0.100	0.000	0.100	0.00030	0.00304	EPA SOP	0.000303713	0.003037133
CRCO	Calanoida indet.	Nauplius	15-25-01		4	1	4x	1.5		0.26	0.3900	-0.94160854	1.050	2.460	0.000282	5	0.001409	EPA SOP; Calanoid copepodites							0.000281857	0.001409283
CRCO	Calanoida indet.	Nauplius	15-25-01		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.050	2.460	0.000163	5	0.000814	EPA SOP; Calanoid copepodites							0.000162791	0.000813953
CRCO	Calanoida indet.	Nauplius	15-25-01		4	1	4x	1.7		0.26	0.4420	-0.816445397	1.050	2.460	0.000383	5	0.001917	EPA SOP; Calanoid copepodites							0.000383485	0.001917423
CRCO	Calanoida indet.	Nauplius	15-25-01		4	1	4x	2.1		0.26	0.5460	-0.605136303	1.050	2.460	0.000645	5	0.003225	EPA SOP; Calanoid copepodites							0.000644916	0.00322458
CRCO	Calanoida indet.	Nauplius	15-25-01		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; Calanoid copepodites							0.000131422	0.000657112
CRCO	Calanoida indet.	Nauplius	15-25-01		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.050	2.460	0.000163	5	0.000814	EPA SOP; Calanoid copepodites							0.000162791	0.000813953
CRCO	Calanoida indet.	Nauplius	15-25-01		4	1	4x	1.4		0.26	0.3640	-1.010601411	1.050	2.460	0.000238	5	0.001189	EPA SOP; Calanoid copepodites							0.000237858	0.001189292
CRCO	Calanoida indet.	Nauplius	15-25-01		4	1	4x	1.3		0.26	0.3380	-1.084709383	1.050	2.460	0.000198	5	0.000991	EPA SOP; Calanoid copepodites							0.000198219	0.000991093

Zooplankton biomeasurements and conversions for calculation of biomass data, Azimuth Nunavut 2015

Groupcode	Taxon	Stage	Biologica Sample	Client Sample	Unit	Conversion (mm)	Objective	Length (units)	Width (units)	Calibration	Length (mm)	CRUSTACEA - Ln(Length)	CRUSTACEA - Ln(α)	CRUSTACEA - β	CRUSTACEA - mg DW	CRUSTACEA - WW:DW	CRUSTACEA - mg WW	CRUSTACEA α/β Reference	Rotifera - FF	Rotifera - %BV	Rotifera - WW:DW	Rotifera - mg DW	Rotifera - mg WW	Rotifera - FF/%BV Reference	Final Biomass - DW	Final Biomass - WW
CRCO	Calanoida indet.	Nauplius	15-25-07		4	1	4x	1		0.26	0.2600	-1.347073648	1.050	2.460	0.000104	5	0.000520	EPA SOP; Calanoid copepodites							0.000103955	0.000519773
CRCO	Calanoida indet.	Nauplius	15-25-07		4	1	4x	1		0.26	0.2600	-1.347073648	1.050	2.460	0.000104	5	0.000520	EPA SOP; Calanoid copepodites							0.000103955	0.000519773
CRCO	Calanoida indet.	Nauplius	15-25-07		4	1	4x	1.3		0.26	0.3380	-1.084709383	1.050	2.460	0.000198	5	0.000991	EPA SOP; Calanoid copepodites							0.000198219	0.000991093
CRCO	Calanoida indet.	Nauplius	15-25-07		4	1	4x	1.3		0.26	0.3380	-1.084709383	1.050	2.460	0.000198	5	0.000991	EPA SOP; Calanoid copepodites							0.000198219	0.000991093
CRCO	Calanoida indet.	Nauplius	15-25-07		4	1	4x	1.4		0.26	0.3640	-1.010601411	1.050	2.460	0.000238	5	0.001189	EPA SOP; Calanoid copepodites							0.000237858	0.001189292
CRCO	Calanoida indet.	Nauplius	15-25-08		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; Calanoid copepodites							0.000131422	0.000657112
CRCO	Calanoida indet.	Nauplius	15-25-08		4	1	4x	1.4		0.26	0.3640	-1.010601411	1.050	2.460	0.000238	5	0.001189	EPA SOP; Calanoid copepodites							0.000237858	0.001189292
CRCO	Calanoida indet.	Nauplius	15-25-08		4	1	4x	1		0.26	0.2600	-1.347073648	1.050	2.460	0.000104	5	0.000520	EPA SOP; Calanoid copepodites							0.000103955	0.000519773
CRCO	Calanoida indet.	Nauplius	15-25-08		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.050	2.460	0.000163	5	0.000814	EPA SOP; Calanoid copepodites							0.000162791	0.000813953
CRCO	Calanoida indet.	Nauplius	15-25-08		4	1	4x	1.3		0.26	0.3380	-1.084709383	1.050	2.460	0.000198	5	0.000991	EPA SOP; Calanoid copepodites							0.000198219	0.000991093
CRCO	Calanoida indet.	Nauplius	15-25-08		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.050	2.460	0.000163	5	0.000814	EPA SOP; Calanoid copepodites							0.000162791	0.000813953
CRCO	Calanoida indet.	Nauplius	15-25-08		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; Calanoid copepodites							0.000131422	0.000657112
CRCO	Calanoida indet.	Nauplius	15-25-08		4	1	4x	1.5		0.26	0.3900	-0.94160854	1.050	2.460	0.000282	5	0.001409	EPA SOP; Calanoid copepodites							0.000281857	0.001409283
CRCO	Calanoida indet.	Nauplius	15-25-09		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.050	2.460	0.000163	5	0.000814	EPA SOP; Calanoid copepodites							0.000162791	0.000813953
CRCO	Calanoida indet.	Nauplius	15-25-09		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.050	2.460	0.000163	5	0.000814	EPA SOP; Calanoid copepodites							0.000162791	0.000813953
CRCO	Calanoida indet.	Nauplius	15-25-09		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; Calanoid copepodites							0.000131422	0.000657112
CRCO	Calanoida indet.	Nauplius	15-25-09		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.050	2.460	0.000163	5	0.000814	EPA SOP; Calanoid copepodites							0.000162791	0.000813953
CRCO	Calanoida indet.	Nauplius	15-25-09		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.050	2.460	0.000163	5	0.000814	EPA SOP; Calanoid copepodites							0.000162791	0.000813953
CRCO	Calanoida indet.	Nauplius	15-25-09		4	1	4x	0.9		0.26	0.2340	-1.452434164	1.050	2.460	0.000080	5	0.000401	EPA SOP; Calanoid copepodites							8.02195E-05	0.000401098
CRCO	Calanoida indet.	Nauplius	15-25-09		4	1	4x	1		0.26	0.2600	-1.347073648	1.050	2.460	0.000104	5	0.000520	EPA SOP; Calanoid copepodites							0.000103955	0.000519773
CRCO	Calanoida indet.	Nauplius	15-25-09		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; Calanoid copepodites							0.000131422	0.000657112
CRCO	Calanoida indet.	Nauplius	15-25-09		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; Calanoid copepodites							0.000131422	0.000657112
CRCO	Calanoida indet.	Nauplius	15-25-09		4	1	4x	1.4		0.26	0.3640	-1.010601411	1.050	2.460	0.000238	5	0.001189	EPA SOP; Calanoid copepodites							0.000237858	0.001189292
CRCO	Calanoida indet.	Nauplius	15-25-09		4	1	4x	1.3		0.26	0.3380	-1.084709383	1.050	2.460	0.000198	5	0.000991	EPA SOP; Calanoid copepodites							0.000198219	0.000991093
CRCO	Calanoida indet.	Nauplius	15-25-09		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; Calanoid copepodites							0.000131422	0.000657112
CRCO	Cyclopoida indet.	Nauplius	15-25-01		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.660	3.970	0.000037	5	0.000183	EPA SOP; Cyclopoid copepodites							3.65344E-05	0.000182672
CRCO	Cyclopoida indet.	Nauplius	15-25-01		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.660	3.970	0.000037	5	0.000183	EPA SOP; Cyclopoid copepodites							3.65344E-05	0.000182672
CRCO	Cyclopoida indet.	Nauplius	15-25-01		4	1	4x	0.9		0.26	0.2340	-1.452434164	1.660	3.970	0.000016	5	0.000082	EPA SOP; Cyclopoid copepodites							1.64708E-05	8.23542E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-01		4	1	4x	1.4		0.26	0.3640	-1.010601411	1.660	3.970	0.000095	5	0.000476	EPA SOP; Cyclopoid copepodites							9.51703E-05	0.000475851
CRCO	Cyclopoida indet.	Nauplius	15-25-01		4	1	4x	1		0.26	0.2600	-1.347073648	1.660	3.970	0.000025	5	0.000125	EPA SOP; Cyclopoid copepodites							2.50249E-05	0.000125125
CRCO	Cyclopoida indet.	Nauplius	15-25-01		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.660	3.970	0.000037	5	0.000183	EPA SOP; Cyclopoid copepodites							3.65344E-05	0.000182672
CRCO	Cyclopoida indet.	Nauplius	15-25-01		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.660	3.970	0.000052	5	0.000258	EPA SOP; Cyclopoid copepodites							5.16087E-05	0.000258043
CRCO	Cyclopoida indet.	Nauplius	15-25-01		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.660	3.970	0.000052	5	0.000258	EPA SOP; Cyclopoid copepodites							5.16087E-05	0.000258043
CRCO	Cyclopoida indet.	Nauplius	15-25-01		4	1	4x	0.7		0.26	0.1820	-1.703748592	1.660	3.970	0.000006	5	0.000030	EPA SOP; Cyclopoid copepodites							6.07313E-06	3.03656E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-01		4	1	4x	0.6		0.26	0.1560	-1.857899272	1.660	3.970	0.000003	5	0.000016	EPA SOP; Cyclopoid copepodites							3.29332E-06	1.64666E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-01		4	1	4x	1		0.26	0.2600	-1.347073648	1.660	3.970	0.000025	5	0.000125	EPA SOP; Cyclopoid copepodites							2.50249E-05	0.000125125
CRCO	Cyclopoida indet.	Nauplius	15-25-02		4	1	4x	1		0.26	0.2600	-1.347073648	1.660	3.970	0.000025	5	0.000125	EPA SOP; Cyclopoid copepodites							2.50249E-05	0.000125125
CRCO	Cyclopoida indet.	Nauplius	15-25-02		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.660	3.970	0.000052	5	0.000258	EPA SOP; Cyclopoid copepodites							5.16087E-05	0.000258043
CRCO	Cyclopoida indet.	Nauplius	15-25-02		4	1	4x	1		0.26	0.2600	-1.347073648	1.660	3.970	0.000025	5	0.000125	EPA SOP; Cyclopoid copepodites							2.50249E-05	0.000125125
CRCO	Cyclopoida indet.	Nauplius	15-25-02		4	1	4x	1.4		0.26	0.3640	-1.010601411	1.660	3.970	0.000095	5	0.000476	EPA SOP; Cyclopoid copepodites							9.51703E-05	0.000475851
CRCO	Cyclopoida indet.	Nauplius	15-25-02		4	1	4x	1		0.26	0.2600	-1.347073648	1.660	3.970	0.000025	5	0.000125	EPA SOP; Cyclopoid copepodites							2.50249E-05	0.000125125
CRCO	Cyclopoida indet.	Nauplius	15-25-02		4	1	4x	1		0.26	0.2600	-1.347073648	1.660	3.970	0.000025	5	0.000125	EPA SOP; Cyclopoid copepodites							2.50249E-05	0.000125125
CRCO	Cyclopoida indet.	Nauplius	15-25-02		4	1	4x	0.7		0.26	0.1820	-1.703748592	1.660	3.970	0.000006	5	0.000030	EPA SOP; Cyclopoid copepodites							6.07313E-06	3.03656E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-02		4	1	4x	1		0.26	0.2600	-1.347073648	1.660	3.970	0.000025	5	0.000125	EPA SOP; Cyclopoid copepodites							2.50249E-05	0.000125125
CRCO	Cyclopoida indet.	Nauplius	15-25-02		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.660	3.970	0.000037	5	0.000183	EPA SOP; Cyclopoid copepodites							3.65344E-05	0.000182672
CRCO	Cyclopoida indet.	Nauplius	15-25-02		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.660	3.970	0.000052	5	0.000258	EPA SOP; Cyclopoid copepodites							5.16087E-05	0.000258043
CRCO	Cyclopoida indet.	Nauplius	15-25-02		4	1	4x	1		0.26	0.2600	-1.347073648	1.660	3.970	0.000025	5	0.000125	EPA SOP; Cyclopoid copepodites							2.50249E-05	0.000125125
CRCO	Cyclopoida indet.	Nauplius	15-25-02		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.660	3.970	0.000037	5	0.000183	EPA SOP; Cyclopoid copepodites							3.65344E-05	0.000182672
CRCO	Cyclopoida indet.	Nauplius	15-25-02		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.660	3.970	0.000037	5	0.000183	EPA SOP; Cyclopoid copepodites							3.65344E-05	0.000182672
CRCO	Cyclopoida indet.	Nauplius	15-25-03		4	1	4x	1		0.26	0.2600	-1.347073648	1.660	3.970	0.000025	5	0.000125	EPA SOP; Cyclopoid copepodites							2.50249E-05	0.000125125
CRCO	Cyclopoida indet.	Nauplius	15-25-03		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.660	3.970	0.000037	5	0.000183	EPA SOP; Cyclopoid copepodites							3.65344E-05	0.000182672
CRCO	Cyclopoida indet.	Nauplius	15-25-03		4	1	4x	0.9		0.26	0.2340	-1.452434164	1.660	3.970	0.000016	5	0.000082	EPA SOP; Cyclopoid copepodites							1.64708E-05	8.23542E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-03		4	1	4x	0.8		0.26	0.2080	-1.570217199	1.660	3.970	0.000010	5	0.000052	EPA SOP; Cyclopoid copepodites							1.03191E-05	5.15953E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-03		4	1	4x	1		0.26	0.2600	-1.347073648	1.660	3.970	0.000025	5	0.000125	EPA SOP; Cyclopoid copepodites							2.50249E-05	0.000125125
CRCO	Cyclopoida indet.	Nauplius	15-25-03		4	1	4x	1		0.26	0.2600	-1.347073648	1.660	3.970	0.000025	5	0.000125	EPA SOP; Cyclopoid copepodites							2.50249E-05	0.000125125
CRCO	Cyclopoida indet.	Nauplius	15-25-04		4	1	4x	1		0.26	0.2600	-1.347073648	1.660	3.970	0.000025	5	0.000125	EPA SOP; Cyclopoid copepodites							2.50249E-05	0.000125125
CRCO	Cyclopoida indet.	Nauplius	15-25-04		4	1	4x	1		0.26	0.2600	-1.347073648	1.660	3.970	0.000025	5	0.000125	EPA SOP; Cyclopoid copepodites							2.50249E-05	0.000125125
CRCO	Cyclopoida indet.	Nauplius	15-25-04		4	1	4x	0.7		0.26	0.1820	-1.703748592	1.660	3.970	0.000006	5	0.000030	EPA SOP; Cyclopoid copepodites							6.07313E-06	3.03656E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-04		4	1	4x	0.8		0.26	0.2080	-1.570217199	1.660	3.970	0.000010	5	0.000052	EPA SOP; Cyclopoid copepodites							1.03191E-05	5.15953E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-04		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.660	3.970	0.000037	5	0.000183	EPA SOP; Cyclopoid copepodites							3.65344E-05	0.000182672
CRCO	Cyclopoida indet.	Nauplius	15-25-04		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.660	3.970	0.000052	5	0.000258	EPA SOP; Cyclopoid copepodites							5.16087E-05	0.000258043
CRCO	Cyclopoida indet.	Nauplius	15-25-04		4	1	4x	1		0.26	0.2600	-1.347073648	1.660	3.970	0.000025	5	0.000125	EPA SOP; Cyclopoid copepodites							2.50249E-05	0.000125125
CRCO	Cyclopoida indet.	Nauplius	15-25-05		4	1	4x	0.6		0.26	0.1560	-1.857899272	1.660	3.970	0.000003	5	0.000016	EPA SOP; Cyclopoid copepodites							3.29332E-06	1.64666E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-05		4	1	4x	0.5		0.26	0.1300	-2.040220829	1.660	3.970	0.000002	5	0.000008	EPA SOP; Cyclopoid copepodites							1.59692E-06	7.98461E-06
CRCO	Cyclopoida indet.	Nauplius	15-25-05		4	1	4x	0.4		0.26	0.1040	-2.26336438	1.660	3.970	0.000001	5	0.000003	EPA SOP; Cyclopoid copepodites							6.58493E-07	3.29247E-06
CRCO	Cyclopoida indet.	Nauplius	15-25-05		4	1	4x	0.5		0.26	0.1300	-2.040220829	1.660	3.970	0.000002	5	0.000008	EPA SOP; Cyclopoid copepodites							1.59692E-06	7.98461E-06
CRCO	Cyclopoida indet.	Nauplius	15-25-05		4	1	4x	0.5		0.26	0.1300	-2.040220829	1.660	3.970	0.000002	5	0.000008	EPA SOP; Cyclopoid copepodites							1.59692E-06	7.98461E-06
CRCO	Cyclopoida indet.	Nauplius	15-25-05		4	1	4x	0.6		0.26	0.1560	-1.857899272	1.660	3.970	0.000003	5	0.000016	EPA SOP; Cyclopoid copepodites							3.29332E-06	1.64666E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-05		4	1	4x	0.5		0.26	0.1300	-2.040220829	1.660	3.970	0.000002	5	0.000008	EPA SOP; Cyclopoid copepodites							1.59692E-06	7.98461E-06
CRCO	Cyclopoida indet.	Nauplius	15-25-06		4	1	4x	0.6		0.26	0.1560	-1.857899272	1.660	3.970	0.000003	5	0.000016	EPA SOP; Cyclopoid copepodites							3.29332E-06	1.64666E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-06		4	1	4x	0.6		0.26	0.1560	-1.857899272	1.660	3.970	0.000003	5	0.000016	EPA SOP; Cyclopoid copepodites							3.29332E-06	1.64666E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-06		4	1	4x	0.6		0.26	0.1560	-1.857899272	1.660	3.970	0.000003	5	0.000016	EPA SOP; Cyclopoid copepodites							3.29332E-06	1.64666E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-06		4	1	4x	0.5		0.26	0.1300	-2.040220829	1.660	3.970	0.000002	5	0.000008	EPA SOP; Cyclopoid copepodites							1.59692E-06	7.98461E-06
CRCO	Cyclopoida indet.	Nauplius	15-25-06		4	1	4x	0.5		0.26	0.1300	-2.040220829	1.660	3.970	0.000002	5	0.000008	EPA SOP; Cyclopoid copepodites							1.59692E-06	7.98461E-06
CRCO	Cyclopoida indet.	Nauplius	15-25-06		4	1	4x	0.5		0.26	0.1300	-2.040220829	1.660	3.970	0.000002	5	0.000008	EPA SOP; Cyclopoid copepodites							1.59692E-06	7.98461E-06
CRCO	Cyclopoida indet.	Nauplius	15-25-06		4	1	4x	0.6		0.26	0.1560	-1.857899272	1.660	3.970	0.000003	5	0.000016	EPA SOP; Cyclopoid copepodites							3.29332E-06	1.64666E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-06		4	1	4x	0.6		0.26	0.1560	-1.857899272	1.660	3.970	0.000003	5	0.000016	EPA SOP; Cyclopoid copepodites							3.29332E-06	1.64666E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-06		4	1	4x	0.6		0.26	0.1560	-1.857899272	1.660	3.970	0.000003	5	0.000016	EPA SOP; Cyclopoid copepodites							3.29332E-06	1.64666E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-06		4	1	4x	0.5		0.26	0.1300	-2.040220829	1.660	3.970	0.000002	5	0.000008	EPA SOP; Cyclopoid copepodites							1.59692E-06	7.98461E-06
CRCO	Cyclopoida indet.	Nauplius	15-25-07		4	1	4x	0.7		0.26	0.1820	-1.703748592	1.660	3.970	0.000006	5	0.000030	EPA SOP; Cyclopoid copepodites							6.07313E-06	3.03656E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-07		4	1	4x	0.9		0.26	0.2340	-1.452434164	1.660	3.970	0.000016	5	0.000082	EPA SOP; Cyclopoid copepodites							1.64708E-05	8.23542E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-07		4	1	4x	0.7		0.26	0.1820	-1.703748592	1.660	3.970	0.000006	5	0.000030	EPA SOP; Cyclopoid copepodites							6.07313E-06	3.03656E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-07		4	1	4x	0.7		0.26	0.1820	-1.703748592	1.660	3.970	0.000006	5	0.000030	EPA SOP; Cyclopoid copepodites							6.07313E-06	3.03656E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-07		4	1	4x	0.6		0.26	0.1560	-1.857899272	1.660	3.970	0.000003	5	0.000016	EPA SOP; Cyclopoid copepodites							3.29332E-06	1.64666E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-07		4	1	4x	0.7		0.26	0.1820	-1.703748592	1.660	3.970	0.000006	5	0.000030	EPA SOP; Cyclopoid copepodites							6.07313E-06	3.03656E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-07		4	1	4x	0.7		0.26	0.1820	-1.703748592	1.660	3.970	0.000006	5	0.000030	EPA SOP; Cyclopoid copepodites							6.07313E-06	3.03656E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-08		4	1	4x	0.6		0.26	0.1560	-1.857899272	1.660	3.970	0.000003	5	0.000016	EPA SOP; Cyclopoid copepodites							3.29332E-06	1.64666E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-09		4	1	4x	0.8		0.26	0.2080	-1.570217199	1.660	3.970	0.000010	5	0.000052	EPA SOP; Cyclopoid copepodites							1.03191E-05	5.15953E-05
CRCO	Cyclopoida indet.	Nauplius	15-25-09		4	1	4x	0.6		0.26	0.1560	-1.857899272	1.660	3.970	0.000003	5	0.000016	EPA SOP; Cyclopoid copepodites							3.29332E-06	1.64666E-05
CRCO	Copepoda indet.	Nauplius	15-25-01		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.050	2.460	0.000163	5	0.000814	EPA SOP; *Diaptomus copepodites*							0.000162791	0.000813953
CRCO	Copepoda indet.	Nauplius	15-25-01		4	1	4x	1		0.26	0.2600	-1.347073648	1.050	2.460	0.000104	5	0.000520	EPA SOP; *Diaptomus copepodites*							0.000103955	0.000519773
CRCO	Copepoda indet.	Nauplius	15-25-01		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.050	2.460	0.000163	5	0.000814	EPA SOP; *Diaptomus copepodites*							0.000162791	0.000813953
CRCO	Copepoda indet.	Nauplius	15-25-01		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.050	2.460	0.000163	5	0.000814	EPA SOP; *Diaptomus copepodites*							0.000162791	0.000813953
CRCO	Copepoda indet.	Nauplius	15-25-02		4	1	4x	1.4		0.26	0.3640	-1.010601411	1.050	2.460	0.000238	5	0.001189	EPA SOP; *Diaptomus copepodites*							0.000237858	0.001189292
CRCO	Copepoda indet.	Nauplius	15-25-02		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; *Diaptomus copepodites*							0.000131422	0.000657112
CRCO	Copepoda indet.	Nauplius	15-25-02		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; *Diaptomus copepodites*							0.000131422	0.000657112
CRCO	Copepoda indet.	Nauplius	15-25-02		4	1	4x	1.3		0.26	0.3380	-1.084709383	1.050	2.460	0.000198	5	0.000991	EPA SOP; *Diaptomus copepodites*							0.000198219	0.000991093
CRCO	Copepoda indet.	Nauplius	15-25-02		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; *Diaptomus copepodites*							0.000131422	0.000657112
CRCO	Copepoda indet.	Nauplius	15-25-02		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; *Diaptomus copepodites*							0.000131422	0.000657112
CRCO	Copepoda indet.	Nauplius	15-25-02		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.050	2.460	0.000163	5	0.000814	EPA SOP; *Diaptomus copepodites*							0.000162791	0.000813953
CRCO	Copepoda indet.	Nauplius	15-25-02		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.050	2.460	0.000163	5	0.000814	EPA SOP; *Diaptomus copepodites*							0.000162791	0.000813953
CRCO	Copepoda indet.	Nauplius	15-25-04		4	1	4x	0.9		0.26	0.2340	-1.452434164	1.050	2.460	0.000080	5	0.000401	EPA SOP; *Diaptomus copepodites*							8.02195E-05	0.000401098
CRCO	Copepoda indet.	Nauplius	15-25-04		4	1	4x	1.2		0.26	0.3120	-1.164752091	1.050	2.460	0.000163	5	0.000814	EPA SOP; *Diaptomus copepodites*							0.000162791	0.000813953
CRCO	Copepoda indet.	Nauplius	15-25-04		4	1	4x	1.1		0.26	0.2860	-1.251763468	1.050	2.460	0.000131	5	0.000657	EPA SOP; *Diaptomus copepodites*							0.000131422	0.000657112

Zooplankton biomeasurements and conversions for calculation of biomass data, Azimuth Nunavut 2015

Groupcode	Taxon	Stage	Biologica Sample	Client Sample	Unit	Conversion (mm)	Objective	Length (units)	Width (units)	Calibration	Length (mm)	CRUSTACEA - Ln(Length)	CRUSTACEA - Ln(α)	CRUSTACEA - β	CRUSTACEA - mg DW	CRUSTACEA - WW:DW	CRUSTACEA - mg WW	CRUSTACEA α/β Reference	Rotifera - FF	Rotifera - %BV	Rotifera - WW:DW	Rotifera - mg DW	Rotifera - mg WW	Rotifera - FF/%BV Reference	Final Biomass - DW	Final Biomass - WW
CRCO	Copepoda indet.	Nauplius	15-25-06		4	1	4x	0.9		0.26	0.2340	-1.452434164	1.050	2.460	0.000080	5	0.000401	EPA SOP; *Diaptomus copepodites*							8.02195E-05	0.000401098
CRCO	Copepoda indet.	Nauplius	15-25-07		4	1	4x	0.9		0.26	0.2340	-1.452434164	1.050	2.460	0.000080	5	0.000401	EPA SOP; *Diaptomus copepodites*							8.02195E-05	0.000401098
CRCL	Holopedium gibberum	F	15-25-01		4	1	4x	3.0		0.26	0.7800	-0.248461359	2.073	3.190	0.003598	5	0.017991	EPA SOP; Alpha modified via Watkins et al.							0.003598108	0.017990542
CRCL	Holopedium gibberum	F	15-25-01		4	1	4x	3		0.26	0.7800	-0.248461359	2.073	3.190	0.003598	5	0.017991	EPA SOP; Alpha modified via Watkins et al.							0.003598108	0.017990542
CRCL	Holopedium gibberum	F	15-25-01		4	1	4x	2.3		0.26	0.5980	-0.514164525	2.073	3.190	0.001542	5	0.007708	EPA SOP; Alpha modified via Watkins et al.							0.001541591	0.007707956
CRCL	Holopedium gibberum	F	15-25-01		4	1	4x	2.7		0.26	0.7020	-0.353821875	2.073	3.190	0.002571	5	0.012855	EPA SOP; Alpha modified via Watkins et al.							0.002571034	0.012855171
CRCL	Holopedium gibberum	F	15-25-02		4	1	4x	2		0.26	0.5200	-0.653926467	2.073	3.190	0.000987	5	0.004935	EPA SOP; Alpha modified via Watkins et al.							0.000987059	0.004935295
CRCL	Holopedium gibberum	F	15-25-02		4	1	4x	3		0.26	0.7800	-0.248461359	2.073	3.190	0.003598	5	0.017991	EPA SOP; Alpha modified via Watkins et al.							0.003598108	0.017990542
CRCL	Holopedium gibberum	F	15-25-02		4	1	4x	2.3		0.26	0.5980	-0.514164525	2.073	3.190	0.001542	5	0.007708	EPA SOP; Alpha modified via Watkins et al.							0.001541591	0.007707956
CRCL	Holopedium gibberum	F	15-25-02		4	1	4x	2		0.26	0.5200	-0.653926467	2.073	3.190	0.000987	5	0.004935	EPA SOP; Alpha modified via Watkins et al.							0.000987059	0.004935295
CRCL	Holopedium gibberum	F	15-25-02		4	1	4x	2.2		0.26	0.5720	-0.558616288	2.073	3.190	0.001338	5	0.006689	EPA SOP; Alpha modified via Watkins et al.							0.001337783	0.006688917
CRCL	Holopedium gibberum	F	15-25-02		4	1	4x	2.5		0.26	0.6500	-0.430782916	2.073	3.190	0.002011	5	0.010057	EPA SOP; Alpha modified via Watkins et al.							0.002011343	0.010056713
CRCL	Holopedium gibberum	F	15-25-02		4	1	4x	2.2		0.26	0.5720	-0.558616288	2.073	3.190	0.001338	5	0.006689	EPA SOP; Alpha modified via Watkins et al.							0.001337783	0.006688917
CRCL	Holopedium gibberum	F	15-25-02		4	1	4x	2		0.26	0.5200	-0.653926467	2.073	3.190	0.000987	5	0.004935	EPA SOP; Alpha modified via Watkins et al.							0.000987059	0.004935295
CRCL	Holopedium gibberum	F	15-25-03		4	1	4x	3		0.26	0.7800	-0.248461359	2.073	3.190	0.003598	5	0.017991	EPA SOP; Alpha modified via Watkins et al.							0.003598108	0.017990542
CRCL	Holopedium gibberum	F	15-25-03		4	1	4x	3.2		0.26	0.8320	-0.183922838	2.073	3.190	0.004421	5	0.022103	EPA SOP; Alpha modified via Watkins et al.							0.004420647	0.022103237
CRCL	Holopedium gibberum	F	15-25-03		4	1	4x	2.3		0.26	0.5980	-0.514164525	2.073	3.190	0.001542	5	0.007708	EPA SOP; Alpha modified via Watkins et al.							0.001541591	0.007707956
CRCL	Holopedium gibberum	F	15-25-03		4	1	4x	2		0.26	0.5200	-0.653926467	2.073	3.190	0.000987	5	0.004935	EPA SOP; Alpha modified via Watkins et al.							0.000987059	0.004935295
CRCL	Holopedium gibberum	F	15-25-03		4	1	4x	2.2		0.26	0.5720	-0.558616288	2.073	3.190	0.001338	5	0.006689	EPA SOP; Alpha modified via Watkins et al.							0.001337783	0.006688917
CRCL	Holopedium gibberum	F	15-25-03		4	1	4x	2.5		0.26	0.6500	-0.430782916	2.073	3.190	0.002011	5	0.010057	EPA SOP; Alpha modified via Watkins et al.							0.002011343	0.010056713
CRCL	Holopedium gibberum	F	15-25-03		4	1	4x	2.2		0.26	0.5720	-0.558616288	2.073	3.190	0.001338	5	0.006689	EPA SOP; Alpha modified via Watkins et al.							0.001337783	0.006688917
CRCL	Holopedium gibberum	F	15-25-03		4	1	4x	2		0.26	0.5200	-0.653926467	2.073	3.190	0.000987	5	0.004935	EPA SOP; Alpha modified via Watkins et al.							0.000987059	0.004935295
CRCL	Holopedium gibberum	F	15-25-03		4	1	4x	3		0.26	0.7800	-0.248461359	2.073	3.190	0.003598	5	0.017991	EPA SOP; Alpha modified via Watkins et al.							0.003598108	0.017990542
CRCL	Holopedium gibberum	F	15-25-03		4	1	4x	3.2		0.26	0.8320	-0.183922838	2.073	3.190	0.004421	5	0.022103	EPA SOP; Alpha modified via Watkins et al.							0.004420647	0.022103237
CRCL	Holopedium gibberum	F	15-25-03		4	1	4x	3.4		0.26	0.8840	-0.123298216	2.073	3.190	0.005364	5	0.026819	EPA SOP; Alpha modified via Watkins et al.							0.005363832	0.026819161
CRCL	Holopedium gibberum	F	15-25-03		4	1	4x	2.9		0.26	0.7540	-0.282362911	2.073	3.190	0.003229	5	0.016146	EPA SOP; Alpha modified via Watkins et al.							0.00322929	0.01614645
CRCL	Holopedium gibberum	F	15-25-03		4	1	4x	2.4		0.26	0.6240	-0.471604911	2.073	3.190	0.001766	5	0.008829	EPA SOP; Alpha modified via Watkins et al.							0.001765758	0.008828792
CRCL	Holopedium gibberum	F	15-25-03		4	1	4x	2.2		0.26	0.5720	-0.558616288	2.073	3.190	0.001338	5	0.006689	EPA SOP; Alpha modified via Watkins et al.							0.001337783	0.006688917
CRCL	Holopedium gibberum	F	15-25-04		4	1	4x	2.9		0.26	0.7540	-0.282362911	2.073	3.190	0.003229	5	0.016146	EPA SOP; Alpha modified via Watkins et al.							0.00322929	0.01614645
CRCL	Holopedium gibberum	F	15-25-04		4	1	4x	2.5		0.26	0.6500	-0.430782916	2.073	3.190	0.002011	5	0.010057	EPA SOP; Alpha modified via Watkins et al.							0.002011343	0.010056713
CRCL	Holopedium gibberum	F	15-25-04		4	1	4x	2.6		0.26	0.6760	-0.391562203	2.073	3.190	0.002279	5	0.011397	EPA SOP; Alpha modified via Watkins et al.							0.00227941	0.011397049
CRCL	Holopedium gibberum	F	15-25-04		4	1	4x	2.2		0.26	0.5720	-0.558616288	2.073	3.190	0.001338	5	0.006689	EPA SOP; Alpha modified via Watkins et al.							0.001337783	0.006688917
CRCL	Holopedium gibberum	F	15-25-04		4	1	4x	2.5		0.26	0.6500	-0.430782916	2.073	3.190	0.002011	5	0.010057	EPA SOP; Alpha modified via Watkins et al.							0.002011343	0.010056713
CRCL	Holopedium gibberum	F	15-25-04		4	1	4x	3.3		0.26	0.8580	-0.153151179	2.073	3.190	0.004877	5	0.024383	EPA SOP; Alpha modified via Watkins et al.							0.004876597	0.024382987
CRCL	Holopedium gibberum	F	15-25-05		4	1	4x	2.5		0.26	0.6500	-0.430782916	2.073	3.190	0.002011	5	0.010057	EPA SOP; Alpha modified via Watkins et al.							0.002011343	0.010056713
CRCL	Holopedium gibberum	F	15-25-05		4	1	4x	2.4		0.26	0.6240	-0.471604911	2.073	3.190	0.001766	5	0.008829	EPA SOP; Alpha modified via Watkins et al.							0.001765758	0.008828792
CRCL	Holopedium gibberum	F	15-25-05		4	1	4x	3.3		0.26	0.8580	-0.153151179	2.073	3.190	0.004877	5	0.024383	EPA SOP; Alpha modified via Watkins et al.							0.004876597	0.024382987
CRCL	Holopedium gibberum	F	15-25-05		4	1	4x	3.3		0.26	0.8580	-0.153151179	2.073	3.190	0.004877	5	0.024383	EPA SOP; Alpha modified via Watkins et al.							0.004876597	0.024382987
CRCL	Holopedium gibberum	F	15-25-05		4	1	4x	3.2		0.26	0.8320	-0.183922838	2.073	3.190	0.004421	5	0.022103	EPA SOP; Alpha modified via Watkins et al.							0.004420647	0.022103237
CRCL	Holopedium gibberum	F	15-25-05		4	1	4x	2.9		0.26	0.7540	-0.282362911	2.073	3.190	0.003229	5	0.016146	EPA SOP; Alpha modified via Watkins et al.							0.00322929	0.01614645
CRCL	Holopedium gibberum	F	15-25-05		4	1	4x	2.4		0.26	0.6240	-0.471604911	2.073	3.190	0.001766	5	0.008829	EPA SOP; Alpha modified via Watkins et al.							0.001765758	0.008828792
CRCL	Holopedium gibberum	F	15-25-07		4	1	4x	2.7		0.26	0.7020	-0.353821875	2.073	3.190	0.002571	5	0.012855	EPA SOP; Alpha modified via Watkins et al.							0.002571034	0.012855171
CRCL	Holopedium gibberum	F	15-25-07		4	1	4x	2.9		0.26	0.7540	-0.282362911	2.073	3.190	0.003229	5	0.016146	EPA SOP; Alpha modified via Watkins et al.							0.00322929	0.01614645
CRCL	Holopedium gibberum	F	15-25-07		4	1	4x	2.8		0.26	0.7280	-0.317454231	2.073	3.190	0.002887	5	0.014436	EPA SOP; Alpha modified via Watkins et al.							0.002887298	0.014436488
CRCL	Holopedium gibberum	F	15-25-07		4	1	4x	2.6		0.26	0.6760	-0.391562203	2.073	3.190	0.002279	5	0.011397	EPA SOP; Alpha modified via Watkins et al.							0.00227941	0.011397049
CRCL	Holopedium gibberum	F	15-25-07		4	1	4x	2.2		0.26	0.5720	-0.558616288	2.073	3.190	0.001338	5	0.006689	EPA SOP; Alpha modified via Watkins et al.							0.001337783	0.006688917
CRCL	Holopedium gibberum	F	15-25-07		4	1	4x	2.2		0.26	0.5720	-0.558616288	2.073	3.190	0.001338	5	0.006689	EPA SOP; Alpha modified via Watkins et al.							0.001337783	0.006688917
CRCL	Leptodora kindtii	F	15-25-07		4	1	4x	5.5		1	5.5000	1.704748092	-0.822	2.670	0.041666	5	0.208328	Malley et al. 1989							0.041665665	0.208328325
CRCL	Daphnia middendorffiana	F	15-25-01		4	1	4x	7.3		0.26	1.8980	0.6408007	1.393	3.011	0.027728	5	0.138641	Malley et al. 1989							0.027728227	0.138641133
CRCL	Daphnia middendorffiana	F	15-25-01		4	1	4x	6.9		0.26	1.7940	0.584447764	1.393	3.011	0.023401	5	0.117004	Malley et al. 1989							0.023400847	0.117004235
CRCL	Daphnia middendorffiana	F	15-25-01		4	1	4x	7		0.26	1.8200	0.598836501	1.393	3.011	0.024437	5	0.122185	Malley et al. 1989							0.024436959	0.122184796
CRCL	Daphnia middendorffiana	F	15-25-01		4	1	4x	6		0.26	1.5600	0.444685821	1.393	3.011	0.015363	5	0.076814	Malley et al. 1989							0.0153628	0.076814
CRCL	Daphnia middendorffiana	F	15-25-01		4	1	4x	6.2		0.26	1.6120	0.477475644	1.393	3.011	0.016957	5	0.084785	Malley et al. 1989							0.016956973	0.084784867
CRCL	Daphnia middendorffiana	F	15-25-01		4	1	4x	6.7		0.26	1.7420	0.555033878	1.393	3.011	0.021417	5	0.107087	Malley et al. 1989							0.021417471	0.107087357
CRCL	Daphnia middendorffiana	F	15-25-01		4	1	4x	6.7		0.26	1.7420	0.555033878	1.393	3.011	0.021417	5	0.107087	Malley et al. 1989							0.021417471	0.107087357
CRCL	Daphnia middendorffiana	F	15-25-01		4	1	4x	6.6		0.26	1.7160	0.539996001	1.393	3.011	0.020469	5	0.102347	Malley et al. 1989							0.020469336	0.10234668
CRCL	Daphnia middendorffiana	F	15-25-01		4	1	4x	6.6		0.26	1.7160	0.539996001	1.393	3.011	0.020469	5	0.102347	Malley et al. 1989							0.020469336	0.10234668
CRCL	Daphnia middendorffiana	F	15-25-01		4	1	4x	6.8		0.26	1.7680	0.569848964	1.393	3.011	0.022394	5	0.111972	Malley et al. 1989							0.022394496	0.111972482
CRCL	Daphnia middendorffiana	F	15-25-01		4	1	4x	7.2		0.26	1.8720	0.627007378	1.393	3.011	0.026600	5	0.133001	Malley et al. 1989							0.026600213	0.133001064
CRCL	Daphnia middendorffiana	F	15-25-02		4	1	4x	6.1		0.26	1.5860	0.461215123	1.393	3.011	0.016147	5	0.080734	Malley et al. 1989							0.016146749	0.080733746
CRCL	Daphnia middendorffiana	F	15-25-02		4	1	4x	9.3		0.26	2.4180	0.882940752	1.393	3.011	0.057486	5	0.287428	Malley et al. 1989							0.057485607	0.287428035
CRCL	Daphnia middendorffiana	F	15-25-02		4	1	4x	6		0.26	1.5600	0.444685821	1.393	3.011	0.015363	5	0.076814	Malley et al. 1989							0.0153628	0.076814
CRCL	Daphnia middendorffiana	F	15-25-02		4	1	4x	5.9		0.26	1.5340	0.427878703	1.393	3.011	0.014605	5	0.073023	Malley et al. 1989							0.014604691	0.073023455
CRCL	Daphnia middendorffiana	F	15-25-02		4	1	4x	6.2		0.26	1.6120	0.477475644	1.393	3.011	0.016957	5	0.084785	Malley et al. 1989							0.016956973	0.084784867
CRCL	Daphnia middendorffiana	F	15-25-02		4	1	4x	7.5		0.26	1.9500	0.667829373	1.393	3.011	0.030079	5	0.150396	Malley et al. 1989							0.03007921	0.150396051
CRCL	Daphnia middendorffiana	F	15-25-02		4	1	4x	6.5		0.26	1.6900	0.524728529	1.393	3.011	0.019550	5	0.097748	Malley et al. 1989							0.019549654	0.097748271
CRCL	Daphnia middendorffiana	F	15-25-02		4	1	4x	7.4		0.26	1.9240	0.654406352	1.393	3.011	0.028888	5	0.144439	Malley et al. 1989							0.028887747	0.144438735
CRCL	Daphnia middendorffiana	F	15-25-02		4	1	4x	6.3		0.26	1.6380	0.493475985	1.393	3.011	0.017794	5	0.088970	Malley et al. 1989							0.017793909	0.088969544
CRCL	Daphnia middendorffiana	F	15-25-03		4	1	4x	8.2		0.26	2.1320	0.757060506	1.393	3.011	0.039351	5	0.196753	Malley et al. 1989							0.03935052	0.196752599
CRCL	Daphnia middendorffiana	F	15-25-03		4	1	4x	6.5		0.26	1.6900	0.524728529	1.393	3.011	0.019550	5	0.097748	Malley et al. 1989							0.019549654	0.097748271
CRCL	Daphnia middendorffiana	F	15-25-03		4	1	4x	7		0.26	1.8200	0.598836501	1.393	3.011	0.024437	5	0.122185	Malley et al. 1989							0.024436959	0.122184796
CRCL	Daphnia middendorffiana	F	15-25-03		4	1	4x	7.4		0.26	1.9240	0.654406352	1.393	3.011	0.028888	5	0.144439	Malley et al. 1989							0.028887747	0.144438735
CRCL	Daphnia middendorffiana	F	15-25-03		4	1	4x	7		0.26	1.8200	0.598836501	1.393	3.011	0.024437	5	0.122185	Malley et al. 1989							0.024436959	0.122184796
CRCL	Daphnia middendorffiana	F	15-25-03		4	1	4x	7.5		0.26	1.9500	0.667829373	1.393	3.011	0.030079	5	0.150396	Malley et al. 1989							0.03007921	0.150396051
CRCL	Daphnia middendorffiana	F	15-25-03		4	1	4x	7.5		0.26	1.9500	0.667829373	1.393	3.011	0.030079	5	0.150396	Malley et al. 1989							0.03007921	0.150396051
CRCL	Daphnia middendorffiana	F	15-25-03		4	1	4x	5		0.26	1.3000	0.262364264	1.393	3.011	0.008873	5	0.044363	Malley et al. 1989							0.008872697	0.044363485
CRCL	Daphnia middendorffiana	F	15-25-03		4	1	4x	5.1		0.26	1.3260	0.282166892	1.393	3.011	0.009418	5	0.047089	Malley et al. 1989							0.009417828	0.047089141
CRCL	Daphnia middendorffiana	F	15-25-03		4	1	4x	5.5		0.26	1.4300	0.357674444	1.393	3.011	0.011822	5	0.059110	Malley et al. 1989							0.011821947	0.059109737
CRCL	Daphnia middendorffiana	F	15-25-03		4	1	4x	8.1		0.26	2.1060	0.744790414	1.393	3.011	0.037923	5	0.189616	Malley et al. 1989							0.037923233	0.189616166
CRCL	Daphnia middendorffiana	F	15-25-03		4	1	4x	7.5		0.26	1.9500	0.667829373	1.393	3.011	0.030079	5	0.150396	Malley et al. 1989							0.03007921	0.150396051
CRCL	Daphnia middendorffiana	F	15-25-03		4	1	4x	7.2		0.26	1.8720	0.627007378	1.393	3.011	0.026600	5	0.133001	Malley et al. 1989							0.026600213	0.133001064
CRCL	Daphnia middendorffiana	F	15-25-03		4	1	4x	7.3		0.26	1.8980	0.6408007	1.393	3.011	0.027728	5	0.138641	Malley et al. 1989							0.027728227	0.138641133
CRCL	Daphnia middendorffiana	F	15-25-03		4	1	4x	7.7		0.26	2.0020	0.694146681	1.393	3.011	0.032560	5	0.162799	Malley et al. 1989							0.032559711	0.162798554
CRCL	Daphnia middendorffiana	F	15-25-05		4	1	4x	7.7		0.26	2.0020	0.694146681	1.393	3.011	0.032560	5	0.162799	Malley et al. 1989							0.032559711	0.162798554
CRCL	Daphnia middendorffiana	F	15-25-06		4	1	4x	8.5		0.26	2.2100	0.792992516	1.393	3.011	0.043847	5	0.219234	Malley et al. 1989							0.043846744	0.21923372
CRCL	Daphnia middendorffiana	F	15-25-06		4	1	4x	7		0.26	1.8200	0.598836501	1.393	3.011	0.024437	5	0.122185	Malley et al. 1989							0.024436959	0.122184796
CRCL	Daphnia middendorffiana	F	15-25-06		4	1	4x	6.6		0.26	1.7160	0.539996001	1.393	3.011	0.020469	5	0.102347	Malley et al. 1989							0.020469336	0.10234668
CRCL	Daphnia middendorffiana	F	15-25-06		4	1	4x	6.6		0.26	1.7160	0.539996001	1.393	3.011	0.020469	5	0.102347	Malley et al. 1989							0.020469336	0.10234668
CRCL	Daphnia middendorffiana	F	15-25-08		4	1	4x	8.5		0.26	2.2100	0.792992516	1.393	3.011	0.043847	5	0.219234	Malley et al. 1989							0.043846744	0.21923372
CRCL	Daphnia middendorffiana	F	15-25-08		4	1	4x	5.5		0.26	1.4300	0.357674444	1.393	3.011	0.011822	5	0.059110	Malley et al. 1989							0.011821947	0.059109737
CRCL	Daphnia middendorffiana	F	15-25-02		4	1	4x	3.8		0.26	0.9880	-0.012072581	1.393	3.011	0.003883	5	0.019416	Malley et al. 1989							0.003883161	0.019415804
CRCL	Daphnia middendorffiana	F	15-25-03		4	1	4x	3		0.26	0.7800	-0.248461359	1.393	3.011	0.001906	5	0.009529	Malley et al. 1989							0.001905764	0.009528819
CRCL	Daphnia middendorffiana	F	15-25-03		4	1	4x	4		0.26	1.0400	0.039220713	1.393	3.011	0.004532	5	0.022658	Malley et al. 1989							0.004531684	0.022658419
CRCL	Daphnia middendorffiana	F	15-25-03		4	1	4x	4.1		0.26	1.0660	0.063913326	1.393	3.011	0.004881	5	0.024407	Malley et al. 1989							0.004881453	0.024407267
CRCL	Daphnia middendorffiana	F	15-25-03		4	1	4x	3.2		0.26	0.8320	-0.183922838	1.393	3.011	0.002315	5	0.011573	Malley et al. 1989							0.002314534	0.01157267
CRCL	Daphnia middendorffiana	F	15-25-05		4	1	4x	4.4		0.26	1.1440	0.134530893	1.393	3.011	0.006038	5	0.030190	Malley et al. 1989							0.006037998	0.030189991
CRCL	Daphnia middendorffiana	F	15-25-05		4	1	4x	4.9		0.26	1.2740	0.242161557	1.393	3.011	0.008349	5	0.041745	Malley et al. 1989							0.008349056	0.041745279
CRCL	Daphnia middendorffiana	F	15-25-06		4	1	4x	4		0.26	1.0400	0.039220713	1.393	3.011	0.004532	5	0.022658	Malley et al. 1989							0.004531684	0.022658419
CRCL	Daphnia middendorffiana	F	15-25-09		4	1	4x	4		0.26	1.0400	0.039220713	1.393	3.011	0.004532	5	0.022658	Malley et al. 1989							0.004531684	0.022658419
CRCL	Daphnia sp.	F	15-25-01		4	1	4x	3.0		0.26	0.7800	-0.248461359	1.510	2.560	0.002396	5	0.011982	EPA SOP							0.002396331	0.011981656
CRCL	Daphnia sp.	F	15-25-01		4	1	4x	5		0.26	1.3000	0.262364264	1.510	2.560	0.008861	5	0.044305	EPA SOP							0.008860937	0.044304685
CRCL	Daphnia sp.	F	15-25-01		4	1	4x	4.7		0.26	1.2220	0.200488861	1.510	2.560	0.007563	5	0.037814	EPA SOP							0.007562876	0.037814378
CRCL	Daphnia sp.	F	15-25-01		4	1	4x	3.7		0.26	0.9620	-0.038740828	1.510	2.560	0.004099	5	0.020497	EPA SOP							0.00409933	0.020496649
CRCL	Daphnia sp.	F	15-25-01		4	1	4x	3.8		0.26	0.9880	-0.012072581	1.510	2.560	0.004389	5	0.021945	EPA SOP							0.004388968	0.021944842
CRCL	Daphnia sp.	F	15-25-02		4	1	4x	3.9		0.26	1.0140	0.013902905	1.510	2.560	0.004691	5	0.023454	EPA SOP							0.004690745	0.023453725
CRCL	Daphnia sp.	F	15-25-02		4	1	4x	2.8		0.26	0.7280	-0.317454231	1.510	2.560	0.002008	5	0.010042	EPA SOP							0.002008357	0.010041787
CRCL	Daphnia sp.	F	15-25-02		4	1	4x	2.8		0.26	0.7280	-0.317454231	1.510	2.560	0.002008	5	0.010042	EPA SOP							0.002008357	0.010041787
CRCL	Daphnia sp.	F	15-25-02		4	1	4x	3.2		0.26	0.8320	-0.183922838	1.510	2.560	0.002827	5	0.014134	EPA SOP							0.002826834	0.014134172
CRCL	Daphnia sp.	F	15-25-02		4	1	4x	3.1		0.26	0.8060	-0.215671536	1.510	2.560	0.002606	5	0.013031	EPA SOP							0.002606168	0.013030839

Zooplankton biomeasurements and conversions for calculation of biomass data, Azimuth Nunavut 2015

Groupcode	Taxon	Stage	Biologica Sample	Client Sample	Unit	Conversion (mm)	Objective	Length (units)	Width (units)	Calibration	Length (mm)	CRUSTACEA - Ln(Length)	CRUSTACEA - Ln(α)	CRUSTACEA - β	CRUSTACEA - mg DW	CRUSTACEA - WW:DW	CRUSTACEA - mg WW	CRUSTACEA α/β Reference	Rotifera - FF	Rotifera - %BV	Rotifera - WW:DW	Rotifera - mg DW	Rotifera - mg WW	Rotifera - FF/%BV Reference	Final Biomass - DW	Final Biomass - WW
CRCL	Daphnia sp.	F	15-25-03		4	1	4x	2.6		0.26	0.6760	-0.391562203	1.510	2.560	0.001661	5	0.008307	EPA SOP								0.001661301	0.008306503
CRCL	Daphnia sp.	F	15-25-05		4	1	4x	3.8		0.26	0.9880	-0.012072581	1.510	2.560	0.004389	5	0.021945	EPA SOP								0.004388968	0.021944842
CRCL	Daphnia sp.	F	15-25-05		4	1	4x	3.7		0.26	0.9620	-0.038740828	1.510	2.560	0.004099	5	0.020497	EPA SOP								0.00409933	0.020496649
CRCL	Daphnia sp.	F	15-25-05		4	1	4x	3.7		0.26	0.9620	-0.038740828	1.510	2.560	0.004099	5	0.020497	EPA SOP								0.00409933	0.020496649
CRCL	Daphnia sp.	F	15-25-05		4	1	4x	3.9		0.26	1.0140	0.013902905	1.510	2.560	0.004691	5	0.023454	EPA SOP								0.004690745	0.023453725
CRCL	Daphnia sp.	F	15-25-05		4	1	4x	3.9		0.26	1.0140	0.013902905	1.510	2.560	0.004691	5	0.023454	EPA SOP								0.004690745	0.023453725
CRCL	Daphnia sp.	F	15-25-06		4	1	4x	3.2		0.26	0.8320	-0.183922838	1.510	2.560	0.002827	5	0.014134	EPA SOP								0.002826834	0.014134172
CRCL	Daphnia sp.	F	15-25-06		4	1	4x	3.7		0.26	0.9620	-0.038740828	1.510	2.560	0.004099	5	0.020497	EPA SOP								0.00409933	0.020496649
CRCL	Daphnia sp.	F	15-25-06		4	1	4x	3.4		0.26	0.8840	-0.123298216	1.510	2.560	0.003301	5	0.016507	EPA SOP								0.003301433	0.016507164
CRCL	Daphnia ambigua	F	15-25-09		4	1	4x	3		0.26	0.7800	-0.248461359	1.468	2.830	0.002149	6	0.012892	Watkins et al., 2011								0.002148681	0.012892088
CRCL	Bosmina sp.	F	15-25-01		4	1	4x	1.7		0.26	0.4420	-0.816445397	2.712	2.529	0.001910	5	0.009548	EPA SOP								0.001909579	0.009547897
CRCL	Bosmina sp.	F	15-25-01		4	1	4x	2.2		0.26	0.5720	-0.558616288	2.712	2.529	0.003666	5	0.018329	EPA SOP								0.003665761	0.018328805
CRCL	Bosmina sp.	F	15-25-01		4	1	4x	2.2		0.26	0.5720	-0.558616288	2.712	2.529	0.003666	5	0.018329	EPA SOP								0.003665761	0.018328805
CRCL	Bosmina sp.	F	15-25-03		4	1	4x	3.2		0.26	0.8320	-0.183922838	2.712	2.529	0.009457	5	0.047286	EPA SOP								0.009457287	0.047286436
CRCL	Bosmina sp.	F	15-25-03		4	1	4x	3.5		0.26	0.9100	-0.094310679	2.712	2.529	0.011863	5	0.059317	EPA SOP								0.011863311	0.059316557
CRCL	Bosmina sp.	F	15-25-05		4	1	4x	1.9		0.26	0.4940	-0.705219762	2.712	2.529	0.002530	5	0.012650	EPA SOP								0.002529995	0.012649973
CRCL	Bosmina sp.	F	15-25-05		4	1	4x	3.7		0.26	0.9620	-0.038740828	2.712	2.529	0.013654	5	0.068268	EPA SOP								0.013653678	0.068268391
CRCL	Bosmina sp.	F	15-25-05		4	1	4x	3.6		0.26	0.9360	-0.066139803	2.712	2.529	0.012739	5	0.063697	EPA SOP								0.012739482	0.06369741
CRCL	Bosmina sp.	F	15-25-07		4	1	4x	2.8		0.26	0.7280	-0.317454231	2.712	2.529	0.006747	5	0.033733	EPA SOP								0.00674655	0.03373275
CRCL	Bosmina sp.	F	15-25-07		4	1	4x	3.4		0.26	0.8840	-0.123298216	2.712	2.529	0.011025	5	0.055123	EPA SOP								0.011024604	0.055123019
CRCL	Bosmina sp.	F	15-25-07		4	1	4x	3.5		0.26	0.9100	-0.094310679	2.712	2.529	0.011863	5	0.059317	EPA SOP								0.011863311	0.059316557
CRCL	Bosmina sp.	F	15-25-07		4	1	4x	2.7		0.26	0.7020	-0.353821875	2.712	2.529	0.006154	5	0.030768	EPA SOP								0.006153635	0.030768175
CRCL	Bosmina sp.	F	15-25-07		4	1	4x	2.5		0.26	0.6500	-0.430782916	2.712	2.529	0.005065	5	0.025326	EPA SOP								0.005065119	0.025325597
CRCL	Bosmina sp.	F	15-25-08		4	1	4x	3.5		0.26	0.9100	-0.094310679	2.712	2.529	0.011863	5	0.059317	EPA SOP								0.011863311	0.059316557
CRCL	Bosmina sp.	F	15-25-08		4	1	4x	3.5		0.26	0.9100	-0.094310679	2.712	2.529	0.011863	5	0.059317	EPA SOP								0.011863311	0.059316557
CRCL	Bosmina sp.	F	15-25-08		4	1	4x	3.2		0.26	0.8320	-0.183922838	2.712	2.529	0.009457	5	0.047286	EPA SOP								0.009457287	0.047286436
CRCL	Bosmina sp.	F	15-25-08		4	1	4x	3.2		0.26	0.8320	-0.183922838	2.712	2.529	0.009457	5	0.047286	EPA SOP								0.009457287	0.047286436
CRCL	Bosmina sp.	F	15-25-08		4	1	4x	3.5		0.26	0.9100	-0.094310679	2.712	2.529	0.011863	5	0.059317	EPA SOP								0.011863311	0.059316557
CRCL	Bosmina sp.	F	15-25-08		4	1	4x	3.4		0.26	0.8840	-0.123298216	2.712	2.529	0.011025	5	0.055123	EPA SOP								0.011024604	0.055123019
CRCL	Bosmina sp.	F	15-25-08		4	1	4x	3		0.26	0.7800	-0.248461359	2.712	2.529	0.008033	5	0.040164	EPA SOP								0.00803287	0.040164349
CRCL	Bosmina sp.	F	15-25-08		4	1	4x	3.5		0.26	0.9100	-0.094310679	2.712	2.529	0.011863	5	0.059317	EPA SOP								0.011863311	0.059316557
CRCL	Bosmina sp.	F	15-25-08		4	1	4x	2.7		0.26	0.7020	-0.353821875	2.712	2.529	0.006154	5	0.030768	EPA SOP								0.006153635	0.030768175
CRCL	Bosmina sp.	F	15-25-08		4	1	4x	3.5		0.26	0.9100	-0.094310679	2.712	2.529	0.011863	5	0.059317	EPA SOP								0.011863311	0.059316557
CRCL	Bosmina sp.	F	15-25-08		4	1	4x	2.5		0.26	0.6500	-0.430782916	2.712	2.529	0.005065	5	0.025326	EPA SOP								0.005065119	0.025325597
CRCL	Bosmina sp.	F	15-25-09		4	1	4x	3.4		0.26	0.8840	-0.123298216	2.712	2.529	0.011025	5	0.055123	EPA SOP								0.011024604	0.055123019
CRCL	Bosmina sp.	F	15-25-09		4	1	4x	3.4		0.26	0.8840	-0.123298216	2.712	2.529	0.011025	5	0.055123	EPA SOP								0.011024604	0.055123019
CRCO	Cyclops scutifer	F	15-25-01		4	1	4x	4.8		0.26	1.2480	0.22154227	1.492	1.990	0.006909	5	0.034547	EPA SOP								0.006909305	0.034546527
CRCO	Cyclops scutifer	F	15-25-01		4	1	4x	4.5		0.26	1.1700	0.157003749	1.492	1.990	0.006077	5	0.030383	EPA SOP								0.006076552	0.030382761
CRCO	Cyclops scutifer	F	15-25-02		4	1	4x	5.3		0.26	1.3780	0.320633173	1.492	1.990	0.008415	5	0.042077	EPA SOP								0.008415372	0.042076859
CRCO	Cyclops scutifer	F	15-25-02		4	1	4x	5.4		0.26	1.4040	0.339325306	1.492	1.990	0.008734	5	0.043671	EPA SOP								0.008734296	0.043671481
CRCO	Cyclops scutifer	F	15-25-02		4	1	4x	6.1		0.26	1.5860	0.461215123	1.492	1.990	0.011132	5	0.055660	EPA SOP								0.011131936	0.05565968
CRCO	Cyclops scutifer	F	15-25-02		4	1	4x	5		0.26	1.3000	0.262364264	1.492	1.990	0.007494	5	0.037470	EPA SOP								0.007494016	0.037470082
CRCO	Cyclops scutifer	F	15-25-02		4	1	4x	5.2		0.26	1.3520	0.301584978	1.492	1.990	0.008102	5	0.040512	EPA SOP								0.00810235	0.040511748
CRCO	Cyclops scutifer	F	15-25-02		4	1	4x	5.7		0.26	1.4820	0.393392527	1.492	1.990	0.009726	5	0.048632	EPA SOP								0.009726471	0.048632355
CRCO	Cyclops scutifer	F	15-25-02		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclops scutifer	F	15-25-02		4	1	4x	5.4		0.26	1.4040	0.339325306	1.492	1.990	0.008734	5	0.043671	EPA SOP								0.008734296	0.043671481
CRCO	Cyclops scutifer	F	15-25-02		4	1	4x	4.8		0.26	1.2480	0.22154227	1.492	1.990	0.006909	5	0.034547	EPA SOP								0.006909305	0.034546527
CRCO	Cyclops scutifer	F	15-25-02		4	1	4x	5.3		0.26	1.3780	0.320633173	1.492	1.990	0.008415	5	0.042077	EPA SOP								0.008415372	0.042076859
CRCO	Cyclops scutifer	F	15-25-03		4	1	4x	7		0.26	1.8200	0.598836501	1.492	1.990	0.014639	5	0.073195	EPA SOP								0.014638933	0.073194666
CRCO	Cyclops scutifer	F	15-25-03		4	1	4x	6.7		0.26	1.7420	0.555033878	1.492	1.990	0.013417	5	0.067085	EPA SOP								0.013416931	0.067084655
CRCO	Cyclops scutifer	F	15-25-03		4	1	4x	6.5		0.26	1.6900	0.524728529	1.492	1.990	0.012632	5	0.063159	EPA SOP								0.012631703	0.063158515
CRCO	Cyclops scutifer	F	15-25-04		4	1	4x	5		0.26	1.3000	0.262364264	1.492	1.990	0.007494	5	0.037470	EPA SOP								0.007494016	0.037470082
CRCO	Cyclops scutifer	F	15-25-04		4	1	4x	5.6		0.26	1.4560	0.37569295	1.492	1.990	0.009390	5	0.046949	EPA SOP								0.009389847	0.046949234
CRCO	Cyclops scutifer	F	15-25-04		4	1	4x	5.1		0.26	1.3260	0.282166892	1.492	1.990	0.007795	5	0.038976	EPA SOP								0.007795231	0.038976154
CRCO	Cyclops scutifer	F	15-25-04		4	1	4x	4.8		0.26	1.2480	0.22154227	1.492	1.990	0.006909	5	0.034547	EPA SOP								0.006909305	0.034546527
CRCO	Cyclops scutifer	F	15-25-04		4	1	4x	5.5		0.26	1.4300	0.357674444	1.492	1.990	0.009059	5	0.045296	EPA SOP								0.009059121	0.045295607
CRCO	Cyclops scutifer	F	15-25-04		4	1	4x	5.1		0.26	1.3260	0.282166892	1.492	1.990	0.007795	5	0.038976	EPA SOP								0.007795231	0.038976154
CRCO	Cyclops scutifer	F	15-25-05		4	1	4x	5.1		0.26	1.3260	0.282166892	1.492	1.990	0.007795	5	0.038976	EPA SOP								0.007795231	0.038976154
CRCO	Cyclops scutifer	F	15-25-05		4	1	4x	4.7		0.26	1.2220	0.200488861	1.492	1.990	0.006626	5	0.033129	EPA SOP								0.006625811	0.033129057
CRCO	Cyclops scutifer	F	15-25-05		4	1	4x	4.7		0.26	1.2220	0.200488861	1.492	1.990	0.006626	5	0.033129	EPA SOP								0.006625811	0.033129057
CRCO	Cyclops scutifer	F	15-25-05		4	1	4x	4.8		0.26	1.2480	0.22154227	1.492	1.990	0.006909	5	0.034547	EPA SOP								0.006909305	0.034546527
CRCO	Cyclops scutifer	F	15-25-05		4	1	4x	5		0.26	1.3000	0.262364264	1.492	1.990	0.007494	5	0.037470	EPA SOP								0.007494016	0.037470082
CRCO	Cyclops scutifer	F	15-25-05		4	1	4x	5.7		0.26	1.4820	0.393392527	1.492	1.990	0.009726	5	0.048632	EPA SOP								0.009726471	0.048632355
CRCO	Cyclops scutifer	F	15-25-06		4	1	4x	5.8		0.26	1.5080	0.41078427	1.492	1.990	0.010069	5	0.050345	EPA SOP								0.010068993	0.050344965
CRCO	Cyclops scutifer	F	15-25-06		4	1	4x	5.1		0.26	1.3260	0.282166892	1.492	1.990	0.007795	5	0.038976	EPA SOP								0.007795231	0.038976154
CRCO	Cyclops scutifer	F	15-25-06		4	1	4x	4.8		0.26	1.2480	0.22154227	1.492	1.990	0.006909	5	0.034547	EPA SOP								0.006909305	0.034546527
CRCO	Cyclops scutifer	F	15-25-08		4	1	4x	4.7		0.26	1.2220	0.200488861	1.492	1.990	0.006626	5	0.033129	EPA SOP								0.006625811	0.033129057
CRCO	Cyclops scutifer	F	15-25-08		4	1	4x	5		0.26	1.3000	0.262364264	1.492	1.990	0.007494	5	0.037470	EPA SOP								0.007494016	0.037470082
CRCO	Cyclops scutifer	F	15-25-08		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclops scutifer	F	15-25-08		4	1	4x	5.2		0.26	1.3520	0.301584978	1.492	1.990	0.008102	5	0.040512	EPA SOP								0.00810235	0.040511748
CRCO	Cyclops scutifer	F	15-25-08		4	1	4x	4.8		0.26	1.2480	0.22154227	1.492	1.990	0.006909	5	0.034547	EPA SOP								0.006909305	0.034546527
CRCO	Cyclops scutifer	F	15-25-08		4	1	4x	4.5		0.26	1.1700	0.157003749	1.492	1.990	0.006077	5	0.030383	EPA SOP								0.006076552	0.030382761
CRCO	Cyclops scutifer	F	15-25-09		4	1	4x	5		0.26	1.3000	0.262364264	1.492	1.990	0.007494	5	0.037470	EPA SOP								0.007494016	0.037470082
CRCO	Cyclops scutifer	F	15-25-09		4	1	4x	5.7		0.26	1.4820	0.393392527	1.492	1.990	0.009726	5	0.048632	EPA SOP								0.009726471	0.048632355
CRCO	Cyclops scutifer	F	15-25-09		4	1	4x	5.8		0.26	1.5080	0.41078427	1.492	1.990	0.010069	5	0.050345	EPA SOP								0.010068993	0.050344965
CRCO	Cyclops scutifer	F	15-25-09		4	1	4x	5		0.26	1.3000	0.262364264	1.492	1.990	0.007494	5	0.037470	EPA SOP								0.007494016	0.037470082
CRCO	Cyclops scutifer	F	15-25-09		4	1	4x	5.1		0.26	1.3260	0.282166892	1.492	1.990	0.007795	5	0.038976	EPA SOP								0.007795231	0.038976154
CRCO	Cyclops scutifer	F	15-25-13		4	1	4x	4.8		0.26	1.2480	0.22154227	1.492	1.990	0.006909	5	0.034547	EPA SOP								0.006909305	0.034546527
CRCO	Cyclops scutifer	F	15-25-13		4	1	4x	4.4		0.26	1.1440	0.134530893	1.492	1.990	0.005811	5	0.029054	EPA SOP								0.00581079	0.029053948
CRCO	Cyclops scutifer	F	15-25-13		4	1	4x	4.4		0.26	1.1440	0.134530893	1.492	1.990	0.005811	5	0.029054	EPA SOP								0.00581079	0.029053948
CRCO	Cyclops scutifer	F	15-25-13		4	1	4x	4.5		0.26	1.1700	0.157003749	1.492	1.990	0.006077	5	0.030383	EPA SOP								0.006076552	0.030382761
CRCO	Cyclops scutifer	F	15-25-13		4	1	4x	4.6		0.26	1.1960	0.178982656	1.492	1.990	0.006348	5	0.031741	EPA SOP								0.006348227	0.031741133
CRCO	Cyclops scutifer	F	15-25-13		4	1	4x	4.6		0.26	1.1960	0.178982656	1.492	1.990	0.006348	5	0.031741	EPA SOP								0.006348227	0.031741133
CRCO	Cyclops scutifer	F	15-25-13		4	1	4x	4.4		0.26	1.1440	0.134530893	1.492	1.990	0.005811	5	0.029054	EPA SOP								0.00581079	0.029053948
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	4.6		0.26	1.1960	0.178982656	1.492	1.990	0.006348	5	0.031741	EPA SOP								0.006348227	0.031741133
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	4.9		0.26	1.2740	0.242161557	1.492	1.990	0.007199	5	0.035994	EPA SOP								0.007198708	0.035993538
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	5.4		0.26	1.4040	0.339325306	1.492	1.990	0.008734	5	0.043671	EPA SOP								0.008734296	0.043671481
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	4.9		0.26	1.2740	0.242161557	1.492	1.990	0.007199	5	0.035994	EPA SOP								0.007198708	0.035993538
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	4.7		0.26	1.2220	0.200488861	1.492	1.990	0.006626	5	0.033129	EPA SOP								0.006625811	0.033129057
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	4.3		0.26	1.1180	0.111541375	1.492	1.990	0.005551	5	0.027755	EPA SOP								0.00555094	0.027754701
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	5		0.26	1.3000	0.262364264	1.492	1.990	0.007494	5	0.037470	EPA SOP								0.007494016	0.037470082
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	5.1		0.26	1.3260	0.282166892	1.492	1.990	0.007795	5	0.038976	EPA SOP								0.007795231	0.038976154
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	5		0.26	1.3000	0.262364264	1.492	1.990	0.007494	5	0.037470	EPA SOP								0.007494016	0.037470082
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	5.1		0.26	1.3260	0.282166892	1.492	1.990	0.007795	5	0.038976	EPA SOP								0.007795231	0.038976154
CRCO	Cyclops scutifer	F	15-25-15		4	1	4x	4.9		0.26	1.2740	0.242161557	1.492	1.990	0.007199	5	0.035994	EPA SOP								0.007198708	0.035993538
CRCO	Cyclops scutifer	F	15-25-16		4	1	4x	3.8		0.26	0.9880	-0.012072581	1.492	1.990	0.004340	5	0.021702	EPA SOP								0.004340439	0.021702196
CRCO	Cyclops scutifer	F	15-25-16		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclops scutifer	F	15-25-16		4	1	4x	4.7		0.26	1.2220	0.200488861	1.492	1.990	0.006626	5	0.033129	EPA SOP								0.006625811	0.033129057
CRCO	Cyclops scutifer	F	15-25-16		4	1	4x	4.2		0.26	1.0920	0.088010877	1.492	1.990	0.005297	5	0.026485	EPA SOP								0.005297005	0.026485027
CRCO	Cyclops scutifer	F	15-25-17		4	1	4x	4.4		0.26	1.1440	0.134530893	1.492	1.990	0.005811	5	0.029054	EPA SOP								0.00581079	0.029053948
CRCO	Cyclops scutifer	F	15-25-17		4	1	4x	4.3		0.26	1.1180	0.111541375	1.492	1.990	0.005551	5	0.027755	EPA SOP								0.00555094	0.027754701
CRCO	Cyclops scutifer	F	15-25-17		4	1	4x	5.2		0.26	1.3520	0.301584978	1.492	1.990	0.008102	5	0.040512	EPA SOP								0.00810235	0.040511748
CRCO	Cyclops scutifer	F	15-25-18		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-01		4	1	4x	4.6		0.26	1.1960	0.178982656	1.492	1.990	0.006348	5	0.031741	EPA SOP								0.006348227	0.031741133
CRCO	Cyclops scutifer	M	15-25-01		4	1	4x	4.4		0.26	1.1440	0.134530893	1.492	1.990	0.005811	5	0.029054	EPA SOP								0.00581079	0.029053948
CRCO	Cyclops scutifer	M	15-25-01		4	1	4x	3.8		0.26	0.9880	-0.012072581	1.492	1.990	0.004340	5	0.021702	EPA SOP								0.004340439	0.021702196
CRCO	Cyclops scutifer	M	15-25-01		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	4.1		0.26	1.0660	0.063913326	1.492	1.990	0.005049	5	0.025245	EPA SOP								0.005048986	0.025244932

Zooplankton biomeasurements and conversions for calculation of biomass data, Azimuth Nunavut 2015

Groupcode	Taxon	Stage	Biologica Sample	Client Sample	Unit	Conversion (mm)	Objective	Length (units)	Width (units)	Calibration	Length (mm)	CRUSTACEA - Ln(Length)	CRUSTACEA - Ln(α)	CRUSTACEA - β	CRUSTACEA - mg DW	CRUSTACEA - WW:DW	CRUSTACEA - mg WW	CRUSTACEA α/β Reference	Rotifera - FF	Rotifera - %BV	Rotifera - WW:DW	Rotifera - mg DW	Rotifera - mg WW	Rotifera - FF/%BV Reference	Final Biomass - DW	Final Biomass - WW
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	4.1		0.26	1.0660	0.063913326	1.492	1.990	0.005049	5	0.025245	EPA SOP								0.005048986	0.025244932
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	3.9		0.26	1.0140	0.013902905	1.492	1.990	0.004571	5	0.022854	EPA SOP								0.004570702	0.022853509
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	4.3		0.26	1.1180	0.111541375	1.492	1.990	0.005551	5	0.027755	EPA SOP								0.00555094	0.027754701
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	4.9		0.26	1.2740	0.242161557	1.492	1.990	0.007199	5	0.035994	EPA SOP								0.007198708	0.035993538
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	4.6		0.26	1.1960	0.178982656	1.492	1.990	0.006348	5	0.031741	EPA SOP								0.006348227	0.031741133
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	4.5		0.26	1.1700	0.157003749	1.492	1.990	0.006077	5	0.030383	EPA SOP								0.006076552	0.030382761
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	4.4		0.26	1.1440	0.134530893	1.492	1.990	0.005811	5	0.029054	EPA SOP								0.00581079	0.029053948
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	4.2		0.26	1.0920	0.088010877	1.492	1.990	0.005297	5	0.026485	EPA SOP								0.005297005	0.026485027
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	3.8		0.26	0.9880	-0.012072581	1.492	1.990	0.004340	5	0.021702	EPA SOP								0.004340439	0.021702196
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	4.1		0.26	1.0660	0.063913326	1.492	1.990	0.005049	5	0.025245	EPA SOP								0.005048986	0.025244932
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	4.2		0.26	1.0920	0.088010877	1.492	1.990	0.005297	5	0.026485	EPA SOP								0.005297005	0.026485027
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	3.9		0.26	1.0140	0.013902905	1.492	1.990	0.004571	5	0.022854	EPA SOP								0.004570702	0.022853509
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	3.9		0.26	1.0140	0.013902905	1.492	1.990	0.004571	5	0.022854	EPA SOP								0.004570702	0.022853509
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	4.2		0.26	1.0920	0.088010877	1.492	1.990	0.005297	5	0.026485	EPA SOP								0.005297005	0.026485027
CRCO	Cyclops scutifer	M	15-25-02		4	1	4x	4.1		0.26	1.0660	0.063913326	1.492	1.990	0.005049	5	0.025245	EPA SOP								0.005048986	0.025244932
CRCO	Cyclops scutifer	M	15-25-03		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-03		4	1	4x	3.8		0.26	0.9880	-0.012072581	1.492	1.990	0.004340	5	0.021702	EPA SOP								0.004340439	0.021702196
CRCO	Cyclops scutifer	M	15-25-03		4	1	4x	4.2		0.26	1.0920	0.088010877	1.492	1.990	0.005297	5	0.026485	EPA SOP								0.005297005	0.026485027
CRCO	Cyclops scutifer	M	15-25-03		4	1	4x	4.2		0.26	1.0920	0.088010877	1.492	1.990	0.005297	5	0.026485	EPA SOP								0.005297005	0.026485027
CRCO	Cyclops scutifer	M	15-25-03		4	1	4x	4.2		0.26	1.0920	0.088010877	1.492	1.990	0.005297	5	0.026485	EPA SOP								0.005297005	0.026485027
CRCO	Cyclops scutifer	M	15-25-03		4	1	4x	4.3		0.26	1.1180	0.111541375	1.492	1.990	0.005551	5	0.027755	EPA SOP								0.00555094	0.027754701
CRCO	Cyclops scutifer	M	15-25-04		4	1	4x	4.1		0.26	1.0660	0.063913326	1.492	1.990	0.005049	5	0.025245	EPA SOP								0.005048986	0.025244932
CRCO	Cyclops scutifer	M	15-25-04		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-04		4	1	4x	4.5		0.26	1.1700	0.157003749	1.492	1.990	0.006077	5	0.030383	EPA SOP								0.006076552	0.030382761
CRCO	Cyclops scutifer	M	15-25-04		4	1	4x	4.3		0.26	1.1180	0.111541375	1.492	1.990	0.005551	5	0.027755	EPA SOP								0.00555094	0.027754701
CRCO	Cyclops scutifer	M	15-25-04		4	1	4x	4.1		0.26	1.0660	0.063913326	1.492	1.990	0.005049	5	0.025245	EPA SOP								0.005048986	0.025244932
CRCO	Cyclops scutifer	M	15-25-04		4	1	4x	4.2		0.26	1.0920	0.088010877	1.492	1.990	0.005297	5	0.026485	EPA SOP								0.005297005	0.026485027
CRCO	Cyclops scutifer	M	15-25-05		4	1	4x	4.5		0.26	1.1700	0.157003749	1.492	1.990	0.006077	5	0.030383	EPA SOP								0.006076552	0.030382761
CRCO	Cyclops scutifer	M	15-25-05		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-05		4	1	4x	4.1		0.26	1.0660	0.063913326	1.492	1.990	0.005049	5	0.025245	EPA SOP								0.005048986	0.025244932
CRCO	Cyclops scutifer	M	15-25-05		4	1	4x	4.1		0.26	1.0660	0.063913326	1.492	1.990	0.005049	5	0.025245	EPA SOP								0.005048986	0.025244932
CRCO	Cyclops scutifer	M	15-25-05		4	1	4x	4.6		0.26	1.1960	0.178982656	1.492	1.990	0.006348	5	0.031741	EPA SOP								0.006348227	0.031741133
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	3.9		0.26	1.0140	0.013902905	1.492	1.990	0.004571	5	0.022854	EPA SOP								0.004570702	0.022853509
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	3.8		0.26	0.9880	-0.012072581	1.492	1.990	0.004340	5	0.021702	EPA SOP								0.004340439	0.021702196
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	4.2		0.26	1.0920	0.088010877	1.492	1.990	0.005297	5	0.026485	EPA SOP								0.005297005	0.026485027
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	4.2		0.26	1.0920	0.088010877	1.492	1.990	0.005297	5	0.026485	EPA SOP								0.005297005	0.026485027
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	3.1		0.26	0.8060	-0.215671536	1.492	1.990	0.002895	5	0.014473	EPA SOP								0.002894504	0.014472518
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	4.6		0.26	1.1960	0.178982656	1.492	1.990	0.006348	5	0.031741	EPA SOP								0.006348227	0.031741133
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	4.4		0.26	1.1440	0.134530893	1.492	1.990	0.005811	5	0.029054	EPA SOP								0.00581079	0.029053948
CRCO	Cyclops scutifer	M	15-25-13		4	1	4x	5.1		0.26	1.3260	0.282166892	1.492	1.990	0.007795	5	0.038976	EPA SOP								0.007795231	0.038976154
CRCO	Cyclops scutifer	M	15-25-15		4	1	4x	4.3		0.26	1.1180	0.111541375	1.492	1.990	0.005551	5	0.027755	EPA SOP								0.00555094	0.027754701
CRCO	Cyclops scutifer	M	15-25-16		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-14		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-14		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclops scutifer	M	15-25-14		4	1	4x	4.2		0.26	1.0920	0.088010877	1.492	1.990	0.005297	5	0.026485	EPA SOP								0.005297005	0.026485027
CRCO	Cyclops scutifer	M	15-25-14		4	1	4x	4		0.26	1.0400	0.039220713	1.492	1.990	0.004807	5	0.024034	EPA SOP								0.004806885	0.024034424
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	3.0		0.26	0.7800	-0.248461359	1.660	3.970	0.001961	5	0.009807	EPA SOP; Cyclopoid copepodites								0.001961302	0.009806509
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	2.8		0.26	0.7280	-0.317454231	1.660	3.970	0.001491	5	0.007457	EPA SOP; Cyclopoid copepodites								0.001491387	0.007456936
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	2.7		0.26	0.7020	-0.353821875	1.660	3.970	0.001291	5	0.006454	EPA SOP; Cyclopoid copepodites								0.001290884	0.006454419
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	2.9		0.26	0.7540	-0.282362911	1.660	3.970	0.001714	5	0.008572	EPA SOP; Cyclopoid copepodites								0.001714325	0.008571624
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	2.4		0.26	0.6240	-0.471604911	1.660	3.970	0.000809	5	0.004044	EPA SOP; Cyclopoid copepodites								0.000808745	0.004043725
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	2.4		0.26	0.6240	-0.471604911	1.660	3.970	0.000809	5	0.004044	EPA SOP; Cyclopoid copepodites								0.000808745	0.004043725
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	2.8		0.26	0.7280	-0.317454231	1.660	3.970	0.001491	5	0.007457	EPA SOP; Cyclopoid copepodites								0.001491387	0.007456936
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	2.3		0.26	0.5980	-0.514164525	1.660	3.970	0.000683	5	0.003415	EPA SOP; Cyclopoid copepodites								0.000683019	0.003415093
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	2.5		0.26	0.6500	-0.430782916	1.660	3.970	0.000951	5	0.004755	EPA SOP; Cyclopoid copepodites								0.000951031	0.004755157
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	3.5		0.26	0.9100	-0.094310679	1.660	3.970	0.003617	5	0.018084	EPA SOP; Cyclopoid copepodites								0.003616789	0.018083945
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	2.4		0.26	0.6240	-0.471604911	1.660	3.970	0.000809	5	0.004044	EPA SOP; Cyclopoid copepodites								0.000808745	0.004043725
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	3.4		0.26	0.8840	-0.123229216	1.660	3.970	0.003224	5	0.016118	EPA SOP; Cyclopoid copepodites								0.003223624	0.016118118
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	3		0.26	0.7800	-0.248461359	1.660	3.970	0.001961	5	0.009807	EPA SOP; Cyclopoid copepodites								0.001961302	0.009806509
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	2.8		0.26	0.7280	-0.317454231	1.660	3.970	0.001491	5	0.007457	EPA SOP; Cyclopoid copepodites								0.001491387	0.007456936
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	3.5		0.26	0.9100	-0.094310679	1.660	3.970	0.003617	5	0.018084	EPA SOP; Cyclopoid copepodites								0.003616789	0.018083945
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	3.2		0.26	0.8320	-0.183922838	1.660	3.970	0.002534	5	0.012670	EPA SOP; Cyclopoid copepodites								0.002534069	0.012670345
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	3.1		0.26	0.8060	-0.215671536	1.660	3.970	0.002234	5	0.011170	EPA SOP; Cyclopoid copepodites								0.002233978	0.011169892
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	2.5		0.26	0.6500	-0.430782916	1.660	3.970	0.000951	5	0.004755	EPA SOP; Cyclopoid copepodites								0.000951031	0.004755157
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	1.9		0.26	0.4940	-0.70521762	1.660	3.970	0.001600	5	0.008000	EPA SOP; Cyclopoid copepodites								0.001599539	0.007995908
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	2.6		0.26	0.6760	-0.391562203	1.660	3.970	0.001111	5	0.005556	EPA SOP; Cyclopoid copepodites								0.001111264	0.00555632
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	2.4		0.26	0.6240	-0.471604911	1.660	3.970	0.000809	5	0.004044	EPA SOP; Cyclopoid copepodites								0.000808745	0.004043725
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	2.5		0.26	0.6500	-0.430782916	1.660	3.970	0.000951	5	0.004755	EPA SOP; Cyclopoid copepodites								0.000951031	0.004755157
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	3.2		0.26	0.8320	-0.183922838	1.660	3.970	0.002534	5	0.012670	EPA SOP; Cyclopoid copepodites								0.002534069	0.012670345
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	3.1		0.26	0.8060	-0.215671536	1.660	3.970	0.002234	5	0.011170	EPA SOP; Cyclopoid copepodites								0.002233978	0.011169892
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	2.4		0.26	0.6240	-0.471604911	1.660	3.970	0.000809	5	0.004044	EPA SOP; Cyclopoid copepodites								0.000808745	0.004043725
CRCO	Cyclopoida indet.	I-IV	15-25-05		4	1	4x	3.1		0.26	0.8060	-0.215671536	1.660	3.970	0.002234	5	0.011170	EPA SOP; Cyclopoid copepodites								0.002233978	0.011169892
CRCO	Cyclopoida indet.	I-IV	15-25-07		4	1	4x	2.9		0.26	0.7540	-0.282362911	1.660	3.970	0.001714	5	0.008572	EPA SOP; Cyclopoid copepodites								0.001714325	0.008571624
CRCO	Cyclopoida indet.	I-IV	15-25-07		4	1	4x	2.5		0.26	0.6500	-0.430782916	1.660	3.970	0.000951	5	0.004755	EPA SOP; Cyclopoid copepodites								0.000951031	0.004755157
CRCO	Cyclopoida indet.	I-IV	15-25-07		4	1	4x	2.4		0.26	0.6240	-0.471604911	1.660	3.970	0.000809	5	0.004044	EPA SOP; Cyclopoid copepodites								0.000808745	0.004043725
CRCO	Cyclopoida indet.	I-IV	15-25-07		4	1	4x	2.8		0.26	0.7280	-0.317454231	1.660	3.970	0.001491	5	0.007457	EPA SOP; Cyclopoid copepodites								0.001491387	0.007456936
CRCO	Cyclopoida indet.	I-IV	15-25-07		4	1	4x	2.3		0.26	0.5980	-0.514164525	1.660	3.970	0.000683	5	0.003415	EPA SOP; Cyclopoid copepodites								0.000683019	0.003415093
CRCO	Cyclopoida indet.	I-IV	15-25-07		4	1	4x	2.4		0.26	0.6240	-0.471604911	1.660	3.970	0.000809	5	0.004044	EPA SOP; Cyclopoid copepodites								0.000808745	0.004043725
CRCO	Cyclopoida indet.	I-IV	15-25-07		4	1	4x	2.5		0.26	0.6500	-0.430782916	1.660	3.970	0.000951	5	0.004755	EPA SOP; Cyclopoid copepodites								0.000951031	0.004755157
CRCO	Cyclopoida indet.	I-IV	15-25-07		4	1	4x	2		0.26	0.5200	-0.653929667	1.660	3.970	0.000392	5	0.001961	EPA SOP; Cyclopoid copepodites								0.000392159	0.001960795
CRCO	Cyclopoida indet.	I-IV	15-25-07		4	1	4x	2.5		0.26	0.6500	-0.430782916	1.660	3.970	0.000951	5	0.004755	EPA SOP; Cyclopoid copepodites								0.000951031	0.004755157
CRCO	Cyclopoida indet.	I-IV	15-25-07		4	1	4x	2.4		0.26	0.6240	-0.471604911	1.660	3.970	0.000809	5	0.004044	EPA SOP; Cyclopoid copepodites								0.000808745	0.004043725
CRCO	Cyclopoida indet.	I-IV	15-25-07		4	1	4x	2.5		0.26	0.6500	-0.430782916	1.660	3.970	0.000951	5	0.004755	EPA SOP; Cyclopoid copepodites								0.000951031	0.004755157
CRCO	Cyclopoida indet.	I-IV	15-25-07		4	1	4x	2.5		0.26	0.6500	-0.430782916	1.660	3.970	0.000951	5	0.004755	EPA SOP; Cyclopoid copepodites								0.000951031	0.004755157
CRCO	Cyclopoida indet.	I-IV	15-25-07		4	1	4x	3.3		0.26	0.8580	-0.153151179	1.660	3.970	0.002863	5	0.014317	EPA SOP; Cyclopoid copepodites								0.002863343	0.014316715
CRCO	Cyclopoida indet.	I-IV	15-25-07		4	1	4x	2.6		0.26	0.6760	-0.391562203	1.660	3.970	0.001111	5	0.005556	EPA SOP; Cyclopoid copepodites								0.001111264	0.00555632
CRCO	Cyclopoida indet.	I-IV	15-25-07		4	1	4x	2.5		0.26	0.6500	-0.430782916	1.660	3.970	0.000951	5	0.004755	EPA SOP; Cyclopoid copepodites								0.000951031	0.004755157
CRCO	Cyclopoida indet.	I-IV	15-25-07		4	1	4x	2.4		0.26	0.6240	-0.471604911	1.660	3.970	0.000809	5	0.004044	EPA SOP; Cyclopoid copepodites								0.000808745	0.004043725
CRCO	Cyclopoida indet.	I-IV	15-25-07		4	1	4x	2.2		0.26	0.5720	-0.558616288	1.660	3.970	0.000573	5	0.002863	EPA SOP; Cyclopoid copepodites								0.000572521	0.002862603
CRCO	Cyclopoida indet.	I-IV	15-25-08		4	1	4x	2.3		0.26	0.5980	-0.514164525	1.660	3.970	0.000683	5	0.003415	EPA SOP; Cyclopoid copepodites								0.000683019	0.003415093
CRCO	Cyclopoida indet.	I-IV	15-25-08		4	1	4x	2.9		0.26	0.7540	-0.282362911	1.660	3.970	0.001714	5	0.008572	EPA SOP; Cyclopoid copepodites								0.001714325	0.008571624
CRCO	Cyclopoida indet.	I-IV	15-25-08		4	1	4x	2.6		0.26	0.6760	-0.391562203	1.660	3.970	0.001111	5	0.005556	EPA SOP; Cyclopoid copepodites								0.001111264	0.00555632
CRCO	Cyclopoida indet.	I-IV	15-25-08		4	1	4x	3		0.26	0.7800	-0.248461359	1.660	3.970	0.001961	5	0.009807	EPA SOP; Cyclopoid copepodites								0.001961302	0.009806509
CRCO	Cyclopoida indet.	I-IV	15-25-08		4	1	4x	2.4		0.26	0.6240	-0.471604911	1.660	3.970	0.000809	5	0.004044	EPA SOP; Cyclopoid copepodites								0.000808745	0.004043725
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	3.0		0.26	0.7800	-0.248461359	1.660	3.970	0.001961	5	0.009807	EPA SOP; Cyclopoid copepodites								0.001961302	0.009806509
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	2.2		0.26	0.5720	-0.558616288	1.660	3.970	0.000573	5	0.002863	EPA SOP; Cyclopoid copepodites								0.000572521	0.002862603
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	3		0.26	0.7800	-0.248461359	1.660	3.970	0.001961	5	0.009807	EPA SOP; Cyclopoid copepodites								0.001961302	0.009806509
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	3.1		0.26	0.8060	-0.215671536	1.660	3.970	0.002234	5	0.011170	EPA SOP; Cyclopoid copepodites								0.002233978	0.011169892
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	5.9		0.26	1.5340	0.427878703	1.660	3.970	0.028751	5	0.143756	EPA SOP; Cyclopoid copepodites								0.02875117	0.143755848
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	3.3		0.26	0.8580	-0.153151179	1.660	3.970	0.002863	5	0.014317	EPA SOP; Cyclopoid copepodites								0.002863343	0.014316715
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	3.6		0.26	0.9360	-0.066139803	1.660	3.970	0.004045	5	0.020224	EPA SOP; Cyclopoid copepodites								0.004044771	0.020223856

Zooplankton biomeasurements and conversions for calculation of biomass data, Azimuth Nunavut 2015

Groupcode	Taxon	Stage	Biologica Sample	Client Sample	Unit	Conversion (mm)	Objective	Length (units)	Width (units)	Calibration	Length (mm)	CRUSTACEA - Ln(Length)	CRUSTACEA - Ln(α)	CRUSTACEA - β	CRUSTACEA - mg DW	CRUSTACEA - WW:DW	CRUSTACEA - mg WW	CRUSTACEA α/β Reference	Rotifera - FF	Rotifera - %BV	Rotifera - WW:DW	Rotifera - mg DW	Rotifera - mg WW	Rotifera - FF/%BV Reference	Final Biomass - DW	Final Biomass - WW
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	3.9		0.26	1.0140	0.013902905	1.660	3.970	0.005558	5	0.027789	EPA SOP; Cyclopoid copepodites							0.005557757	0.027788783
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	4.4		0.26	1.1440	0.134530893	1.660	3.970	0.008972	5	0.044859	EPA SOP; Cyclopoid copepodites							0.008971812	0.044859059
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	3.7		0.26	0.9620	-0.038740828	1.660	3.970	0.004510	5	0.022548	EPA SOP; Cyclopoid copepodites							0.004509557	0.022547785
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	3		0.26	0.7800	-0.248461359	1.660	3.970	0.001961	5	0.009807	EPA SOP; Cyclopoid copepodites							0.001961302	0.009806509
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	3.7		0.26	0.9620	-0.038740828	1.660	3.970	0.004510	5	0.022548	EPA SOP; Cyclopoid copepodites							0.004509557	0.022547785
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	3.5		0.26	0.9100	-0.094310679	1.660	3.970	0.003617	5	0.018084	EPA SOP; Cyclopoid copepodites							0.003616789	0.018083945
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	4		0.26	1.0400	0.039220713	1.660	3.970	0.006145	5	0.030727	EPA SOP; Cyclopoid copepodites							0.006145415	0.030727074
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	3.5		0.26	0.9100	-0.094310679	1.660	3.970	0.003617	5	0.018084	EPA SOP; Cyclopoid copepodites							0.003616789	0.018083945
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	3.4		0.26	0.8840	-0.123298216	1.660	3.970	0.003224	5	0.016118	EPA SOP; Cyclopoid copepodites							0.003223624	0.016118118
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	2.9		0.26	0.7540	-0.282362911	1.660	3.970	0.001714	5	0.008572	EPA SOP; Cyclopoid copepodites							0.001714325	0.008571624
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	4.2		0.26	1.0920	0.088010877	1.660	3.970	0.007459	5	0.037294	EPA SOP; Cyclopoid copepodites							0.007458864	0.037294322
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	4.5		0.26	1.1700	0.157003749	1.660	3.970	0.009809	5	0.049045	EPA SOP; Cyclopoid copepodites							0.009809045	0.049045223
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	4.1		0.26	1.0660	0.063913326	1.660	3.970	0.006778	5	0.033892	EPA SOP; Cyclopoid copepodites							0.006778365	0.033891824
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	4.9		0.26	1.2740	0.242161557	1.660	3.970	0.013755	5	0.068774	EPA SOP; Cyclopoid copepodites							0.013754711	0.068773555
CRCO	Cyclopoida indet.	V	15-25-05		4	1	4x	3.9		0.26	1.0140	0.013902905	1.660	3.970	0.005558	5	0.027789	EPA SOP; Cyclopoid copepodites							0.005557757	0.027788783
CRCO	Cyclopoida indet.	V	15-25-07		4	1	4x	3.2		0.26	0.8320	-0.183922838	1.660	3.970	0.002534	5	0.012670	EPA SOP; Cyclopoid copepodites							0.002534069	0.012670345
CRCO	Cyclopoida indet.	V	15-25-07		4	1	4x	3.5		0.26	0.9100	-0.094310679	1.660	3.970	0.003617	5	0.018084	EPA SOP; Cyclopoid copepodites							0.003616789	0.018083945
CRCO	Cyclopoida indet.	V	15-25-07		4	1	4x	3		0.26	0.7800	-0.248461359	1.660	3.970	0.001961	5	0.009807	EPA SOP; Cyclopoid copepodites							0.001961302	0.009806509
CRCO	Cyclopoida indet.	V	15-25-07		4	1	4x	3.1		0.26	0.8060	-0.215671536	1.660	3.970	0.002234	5	0.011170	EPA SOP; Cyclopoid copepodites							0.002233978	0.011169892
CRCO	Cyclopoida indet.	V	15-25-07		4	1	4x	3.6		0.26	0.9360	-0.066139803	1.660	3.970	0.004045	5	0.020224	EPA SOP; Cyclopoid copepodites							0.004044771	0.020223856
CRCO	Cyclopoida indet.	V	15-25-07		4	1	4x	3.1		0.26	0.8060	-0.215671536	1.660	3.970	0.002234	5	0.011170	EPA SOP; Cyclopoid copepodites							0.002233978	0.011169892
CRCO	Cyclopoida indet.	V	15-25-07		4	1	4x	3.2		0.26	0.8320	-0.183922838	1.660	3.970	0.002534	5	0.012670	EPA SOP; Cyclopoid copepodites							0.002534069	0.012670345
CRCO	Cyclopoida indet.	V	15-25-07		4	1	4x	3.6		0.26	0.9360	-0.066139803	1.660	3.970	0.004045	5	0.020224	EPA SOP; Cyclopoid copepodites							0.004044771	0.020223856
CRCO	Cyclopoida indet.	V	15-25-07		4	1	4x	5		0.26	1.3000	0.262364264	1.660	3.970	0.014903	5	0.074517	EPA SOP; Cyclopoid copepodites							0.014903352	0.074516758
CRCO	Cyclopoida indet.	V	15-25-07		4	1	4x	2.6		0.26	0.6760	-0.391562203	1.660	3.970	0.001111	5	0.005556	EPA SOP; Cyclopoid copepodites							0.001111264	0.00555632
CRCO	Cyclopoida indet.	V	15-25-07		4	1	4x	3.8		0.26	0.9880	-0.012072581	1.660	3.970	0.005013	5	0.025066	EPA SOP; Cyclopoid copepodites							0.005013187	0.025065935
CRCO	Cyclopoida indet.	V	15-25-07		4	1	4x	3.6		0.26	0.9360	-0.066139803	1.660	3.970	0.004045	5	0.020224	EPA SOP; Cyclopoid copepodites							0.004044771	0.020223856
CRCO	Cyclopoida indet.	V	15-25-07		4	1	4x	3		0.26	0.7800	-0.248461359	1.660	3.970	0.001961	5	0.009807	EPA SOP; Cyclopoid copepodites							0.001961302	0.009806509
CRCO	Cyclopoida indet.	V	15-25-07		4	1	4x	3.9		0.26	1.0140	0.013902905	1.660	3.970	0.005558	5	0.027789	EPA SOP; Cyclopoid copepodites							0.005557757	0.027788783
CRCO	Cyclopoida indet.	V	15-25-07		4	1	4x	4		0.26	1.0400	0.039220713	1.660	3.970	0.006145	5	0.030727	EPA SOP; Cyclopoid copepodites							0.006145415	0.030727074
CRCO	Cyclopoida indet.	V	15-25-08		4	1	4x	4.1		0.26	1.0660	0.063913326	1.660	3.970	0.006778	5	0.033892	EPA SOP; Cyclopoid copepodites							0.006778365	0.033891824
CRCO	Cyclopoida indet.	V	15-25-08		4	1	4x	3.2		0.26	0.8320	-0.183922838	1.660	3.970	0.002534	5	0.012670	EPA SOP; Cyclopoid copepodites							0.002534069	0.012670345
CRCO	Cyclopoida indet.	V	15-25-08		4	1	4x	4		0.26	1.0400	0.039220713	1.660	3.970	0.006145	5	0.030727	EPA SOP; Cyclopoid copepodites							0.006145415	0.030727074
CRCO	Cyclopoida indet.	V	15-25-08		4	1	4x	3		0.26	0.7800	-0.248461359	1.660	3.970	0.001961	5	0.009807	EPA SOP; Cyclopoid copepodites							0.001961302	0.009806509
CRCO	Cyclopoida indet.	V	15-25-08		4	1	4x	3.3		0.26	0.8580	-0.153151179	1.660	3.970	0.002863	5	0.014317	EPA SOP; Cyclopoid copepodites							0.002863343	0.014316715
ROTI	Rotifer indet.	n/a	15-25-01		4	1	4x	1.6		0.26	0.4160					5			0.000	0.000	0.100	0.00000	0.00000	EPA SOP	0	0
ROTI	Rotifer indet.	n/a	15-25-01		4	1	4x	0.5		0.26	0.1300					5			0.000	0.000	0.100	0.00000	0.00000	EPA SOP	0	0
ROTI	Rotifer indet.	n/a	15-25-05		4	1	4x	0.4		0.26	0.1040					5			0.000	0.000	0.100	0.00000	0.00000	EPA SOP	0	0
ROTI	Rotifer indet.	n/a	15-25-06		4	1	4x	0.6		0.26	0.1560					5			0.000	0.000	0.100	0.00000	0.00000	EPA SOP	0	0
ROTI	Rotifer indet.	n/a	15-25-09		4	1	4x	0.6		0.26	0.1560					5			0.000	0.000	0.100	0.00000	0.00000	EPA SOP	0	0
ROTI	Rotifer indet.	n/a	15-25-09		4	1	4x	0.8		0.26	0.2080					5			0.000	0.000	0.100	0.00000	0.00000	EPA SOP	0	0
CRCO	Calanoida indet.	I-IV	15-25-01		4	1	4x	7.0		0.26	1.8200	0.598836501	1.050	2.460	0.012468	5	0.062338	EPA SOP; *Diaptomus copepodites*							0.012467656	0.062338281
CRCO	Calanoida indet.	I-IV	15-25-01		4	1	4x	6.6		0.26	1.7160	0.539996001	1.050	2.460	0.010788	6	0.064725	EPA SOP; *Diaptomus copepodites*							0.010787523	0.064725136
CRCO	Calanoida indet.	I-IV	15-25-01		4	1	4x	4.7		0.26	1.2220	0.200488861	1.050	2.460	0.004680	7	0.032757	EPA SOP; *Diaptomus copepodites*							0.004679553	0.032756871
CRCO	Calanoida indet.	I-IV	15-25-01		4	1	4x	5		0.26	1.3000	0.262364264	1.050	2.460	0.005449	8	0.043591	EPA SOP; *Diaptomus copepodites*							0.005448913	0.043591302
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	8.8		0.26	2.2880	0.827678074	1.050	2.460	0.021891	10	0.218913	EPA SOP; *Diaptomus copepodites*							0.021891273	0.218912729
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	5.5		0.26	1.4300	0.357674444	1.050	2.460	0.006889	11	0.075775	EPA SOP; *Diaptomus copepodites*							0.006888678	0.075775453
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	4.9		0.26	1.2740	0.242161557	1.050	2.460	0.005185	12	0.062217	EPA SOP; *Diaptomus copepodites*							0.005184728	0.062216739
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	2.2		0.26	0.5720	-0.558616288	1.050	2.460	0.000723	13	0.009400	EPA SOP; *Diaptomus copepodites*							0.000723108	0.00940041
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	2.9		0.26	0.7540	-0.282362911	1.050	2.460	0.001427	14	0.019974	EPA SOP; *Diaptomus copepodites*							0.001426733	0.019974262
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	3.5		0.26	0.9100	-0.094310679	1.050	2.460	0.002266	15	0.033989	EPA SOP; *Diaptomus copepodites*							0.002265954	0.033989305
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	2.2		0.26	0.5720	-0.558616288	1.050	2.460	0.000723	16	0.011570	EPA SOP; *Diaptomus copepodites*							0.000723108	0.011569735
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	2.2		0.26	0.5720	-0.558616288	1.050	2.460	0.000723	17	0.012293	EPA SOP; *Diaptomus copepodites*							0.000723108	0.012292844
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	2.5		0.26	0.6500	-0.430782916	1.050	2.460	0.000990	19	0.018816	EPA SOP; *Diaptomus copepodites*							0.000990321	0.018816102
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	2.2		0.26	0.5720	-0.558616288	1.050	2.460	0.000723	20	0.014462	EPA SOP; *Diaptomus copepodites*							0.000723108	0.014462169
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	4.2		0.26	1.0920	0.088010877	1.050	2.460	0.003548	21	0.074517	EPA SOP; *Diaptomus copepodites*							0.003548435	0.074517142
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	4.4		0.26	1.1440	0.134530893	1.050	2.460	0.003979	22	0.087531	EPA SOP; *Diaptomus copepodites*							0.003978664	0.0875306
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	5.2		0.26	1.3520	0.301584978	1.050	2.460	0.006001	23	0.138019	EPA SOP; *Diaptomus copepodites*							0.006000838	0.138019263
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	3.9		0.26	1.0140	0.013902905	1.050	2.460	0.002957	24	0.070970	EPA SOP; *Diaptomus copepodites*							0.002957077	0.070969839
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	3.9		0.26	1.0140	0.013902905	1.050	2.460	0.002957	25	0.073927	EPA SOP; *Diaptomus copepodites*							0.002957077	0.073926915
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	4.8		0.26	1.2480	0.22154227	1.050	2.460	0.004928	26	0.128136	EPA SOP; *Diaptomus copepodites*							0.004928299	0.128135785
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	2.4		0.26	0.6240	-0.471604911	1.050	2.460	0.000896	27	0.024184	EPA SOP; *Diaptomus copepodites*							0.000895701	0.02418394
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	3		0.26	0.7800	-0.248461359	1.050	2.460	0.001551	28	0.043423	EPA SOP; *Diaptomus copepodites*							0.001550822	0.043423014
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	3.9		0.26	1.0140	0.013902905	1.050	2.460	0.002957	29	0.085755	EPA SOP; *Diaptomus copepodites*							0.002957077	0.085755222
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	2.5		0.26	0.6500	-0.430782916	1.050	2.460	0.000990	30	0.029710	EPA SOP; *Diaptomus copepodites*							0.000990321	0.029709635
CRCO	Calanoida indet.	I-IV	15-25-02		4	1	4x	2.3		0.26	0.5980	-0.514164525	1.050	2.460	0.000807	31	0.025007	EPA SOP; *Diaptomus copepodites*							0.000806667	0.025006667
CRCO	Calanoida indet.	I-IV	15-25-03		4	1	4x	5.4		0.26	1.4040	0.339325306	1.050	2.460	0.006585	33	0.217293	EPA SOP; *Diaptomus copepodites*							0.006584644	0.217293248
CRCO	Calanoida indet.	I-IV	15-25-03		4	1	4x	4		0.26	1.0400	0.039220713	1.050	2.460	0.003147	34	0.107002	EPA SOP; *Diaptomus copepodites*							0.003147105	0.107001567
CRCO	Calanoida indet.	I-IV	15-25-03		4	1	4x	5		0.26	1.3000	0.262364264	1.050	2.460	0.005449	35	0.190712	EPA SOP; *Diaptomus copepodites*							0.005448913	0.190711946
CRCO	Calanoida indet.	I-IV	15-25-03		4	1	4x	4		0.26	1.0400	0.039220713	1.050	2.460	0.003147	36	0.113296	EPA SOP; *Diaptomus copepodites*							0.003147105	0.113295777
CRCO	Calanoida indet.	I-IV	15-25-05		4	1	4x	5		0.26	1.3000	0.262364264	1.050	2.460	0.005449	33	0.179814	EPA SOP; *Diaptomus copepodites*							0.005448913	0.17981412
CRCO	Calanoida indet.	I-IV	15-25-05		4	1	4x	6.8		0.26	1.7680	0.569848964	1.050	2.460	0.011610	34	0.394725	EPA SOP; *Diaptomus copepodites*							0.011609555	0.394724864
CRCO	Calanoida indet.	I-IV	15-25-05		4	1	4x	5.5		0.26	1.4300	0.357674444	1.050	2.460	0.006889	35	0.241104	EPA SOP; *Diaptomus copepodites*							0.006888678	0.241103715
CRCO	Calanoida indet.	I-IV	15-25-05		4	1	4x	5.2		0.26	1.3520	0.301584978	1.050	2.460	0.006001	36	0.216030	EPA SOP; *Diaptomus copepodites*							0.006000838	0.21603015
CRCO	Calanoida indet.	I-IV	15-25-05		4	1	4x	2.9		0.26	0.7540	-0.282362911	1.050	2.460	0.001427	37	0.052789	EPA SOP; *Diaptomus copepodites*							0.001426733	0.052789122
CRCO	Calanoida indet.	I-IV	15-25-05		4	1	4x	2.9		0.26	0.7540	-0.282362911	1.050	2.460	0.001427	38	0.054216	EPA SOP; *Diaptomus copepodites*							0.001426733	0.054215855
CRCO	Calanoida indet.	I-IV	15-25-05		4	1	4x	2.8		0.26	0.7280	-0.317454231	1.050	2.460	0.001309	39	0.051041	EPA SOP; *Diaptomus copepodites*							0.001308737	0.051040745
CRCO	Calanoida indet.	I-IV	15-25-05		4	1	4x	2.7		0.26	0.7020	-0.353821875	1.050	2.460	0.001197	40	0.047869	EPA SOP; *Diaptomus copepodites*							0.001196736	0.047869456
CRCO	Calanoida indet.	I-IV	15-25-06		4	1	4x	7		0.26	1.8200	0.598836501	1.050	2.460	0.012468	41	0.511174	EPA SOP; *Diaptomus copepodites*							0.012467656	0.511173907
CRCO	Calanoida indet.	I-IV	15-25-06		4	1	4x	5.7		0.26	1.4820	0.393392527	1.050	2.460	0.007521	42	0.315897	EPA SOP; *Diaptomus copepodites*							0.00752135	0.315896691
CRCO	Calanoida indet.	I-IV	15-25-06		4	1	4x	5.3		0.26	1.3780	0.320633173	1.050	2.460	0.006289	43	0.270415	EPA SOP; *Diaptomus copepodites*							0.00628872	0.270414974
CRCO	Calanoida indet.	I-IV	15-25-06		4	1	4x	5.7		0.26	1.4820	0.393392527	1.050	2.460	0.007521	44	0.330939	EPA SOP; *Diaptomus copepodites*							0.00752135	0.330939391
CRCO	Calanoida indet.	I-IV	15-25-06		4	1	4x	6.2		0.26	1.6120	0.477475644	1.050	2.460	0.009250	45	0.416236	EPA SOP; *Diaptomus copepodites*							0.00924969	0.41623607

Report on subsampling error and internal taxonomic consistency

Subsampling Accuracy

QA Sample	Abundance (Original Replicate) (A)	Abundance (QA Replicate) (B)	Accuracy 1-(A/B)*100
MAM-02-S	16393	18903	15.3
WTS-05-S	7055	7852	10.2
MAM-05-S	7327	7833	6.5
Mean Subsampling Error (%)			**10.6**

Taxonomic Accuracy - Internal

QA Sample	Number of Unique Taxa (B)	Number of disagreements (A)	% Accuracy 1-(A/B)*100
MAM-02-S	7	0	100.0
WTS-05-S	7	0	100.0
MAM-05-S	6	0	100.0
Mean Internal Taxonomic Accuracy (%)			**100.0**

APPENDIX G2

Zooplankton Taxonomy, Meadowbank Study Lakes, 2010

Zooplankton biomass (mg/m^3) (wet and dry weights), Meadowbank study lakes, 2010.

Station	Date	Water Depth (m)	Tow Depth (m)	Wet biomass (mg ww / tows)	Wet biomass (mg/m^3 ww)	Dry biomass (mg/m^3 dw)
Inuggugayualik Lake						
INUG-1	25-Aug-10	11.4	8	943	834	46.0
INUG-2	25-Aug-10	10.4	8	860	761	24.8
INUG-3	25-Aug-10	10.4	8	1394	1233	46.0
INUG-4	25-Aug-10	10.1	8	545	482	16.8
INUG-5	25-Aug-10	10.4	8	1553	1374	45.1
					Mean	***35.7***
Pipedream Lake						
PDL-1	24-Aug-10	10.6	8	140	124	7.1
PDL-2	24-Aug-10	28.2	8	210	186	8.0
PDL-3	24-Aug-10	10.7	8	235	208	23.0
PDL-4	24-Aug-10	11.4	8	124	110	5.3
PDL-5	24-Aug-10	23.7	8	227	201	8.8
					Mean	***10.4***

Zooplankton mean abundance (#/m^3) and taxonomy, Meadowbank study lakes, 2010.

Station	INUG	PDL
Date	25-Aug-10	24-Aug-10
CLADOCERA		
Daphniidae		
Daphnia longiremis Sars	0	0
Daphnia middendorffiana Fischer	124	11
Bosminidae		
Bosmina longirostris (O.F. Muller)	95	28
Chydoridae		
Chydorus sp.	0	0
Holopedidae		
Holopedium gibberum Zaddach	203	157
% CLADOCERA:	***8.8%***	***18%***
COPEPODA		
Calanoida		
Calanoida copepodite	45	33
Diaptomidae		
Diaptomus ashlandi Marsh	0	0
Diaptomus minutus Lilljeborg	823	116
Diaptomus sicilis S.A. Forbes	13	2.5
Diaptomus probilifensis Juday and Muttkowski	18	8.5
Diaptomus spp. (unid. Females)	1216	170
Temoridae		
Epischura lacustris Forbes	51	47
Heterocope septentrionalis Juday and Muttkow	56	61
Cyclopoida		
Cyclopoid copepodite	272	76
Cyclopidae		
Cyclops scutifer Sars	1865	388
% COPEPODA:	***91%***	***82%***
TOTAL ABUNDANCE / m^3:	**4780**	**1097**

APPENDIX G3

Zooplankton Taxonomy, Meadowbank Study Lakes, 2011

Zooplankton biomass (mg/m^3) (wet and dry weights), Meadowbank study lakes, 2011.

Area-Replicate	Date	Water Depth	Tow Depth	Total Wet biomass	Wet biomass (volume-normalized)		Dry biomass (volume-normalized)
		(m)	(m)	(mg ww)	(mg/m^3 ww)		(mg/m^3 dw)
Inuggugayualik Lake							
INUG-1	13-Aug-11	11.9	8	1193	1055		42.5
INUG-2	13-Aug-11	10.4	8	728	644		25.7
INUG-3	13-Aug-11	10.1	8	1479	1308		68.1
INUG-4	13-Aug-11	10.7	8	1028	909		40.7
INUG-5	13-Aug-11	13.3	8	935	827		39.8
INUG-6	13-Aug-11	10.6	8	1078	954		46.0
INUG-7	13-Aug-11	15.8	8	1030	911		35.4
INUG-8	13-Aug-11	10.3	8	1190	1053		44.2
INUG-9	13-Aug-11	11.0	8	1526	1350		54.8
INUG-10	13-Aug-11	10.7	8	1027	909		31.8
						Mean	***42.9***
Pipedream Lake							
PDL-1	11-Aug-11	12.0	8	1562	1382		23.0
PDL-2	11-Aug-11	30.5	8	575	509		14.2
PDL-3	11-Aug-11	21.4	8	533	472		13.3
PDL-4	11-Aug-11	11.1	8	1795	1588		34.5
PDL-5	11-Aug-11	23.0	8	1215	1075		13.3
PDL-6	11-Aug-11	17.9	8	1249	1105		12.4
PDL-7	11-Aug-11	23.7	8	3995	3534		36.3
PDL-8	11-Aug-11	23.9	8	2372	2098		28.3
PDL-9	11-Aug-11	16.2	8	3484	3082		38.0
PDL-10	11-Aug-11	12.0	8	2839	2512		35.4
						Mean	***24.9***

Zooplankton mean abundance (#/m^3) and taxonomy, Meadowbank study lakes, 2011.

	Area	INUG	PDL
	Date	13-Aug-11	11-Aug-11
CLADOCERA			
Daphniidae			
Daphnia longiremis Sars		0.18	0
Daphnia middendorffiana Fischer		6.5	1.2
Bosminidae			
Bosmina longirostris (O.F. Muller)		2.3	16
Chydoridae			
Acroperus harpae Baird		0	0
Alona guttata Sars		0	0
Chydorus sp.		0	0
Holopedidae			
Holopedium gibberum Zaddach		7.3	226
% CLADOCERA:		***0.1%***	***15.3%***
COPEPODA			
Calanoida			
Calanoida copepodite		6774	988
Diaptomidae			
Diaptomus ashlandi Marsh		0	3.5
Diaptomus minutus Lilljeborg		586	0
Diaptomus probilifensis Juday and Muttkowski		0	1.8
Diaptomus sicilis S.A. Forbes		5.7	2.1
Diaptomus sp. (unid. Females)		2541	44
Temoridae			
Epischura lacustris Forbes		296	89
Heterocope septentrionalis Juday and Muttkowski		57	44
Cyclopoida			
Cyclopoid copepodite		835	30
Cyclopidae			
Cyclops scutifer Sars		2884	143
% COPEPODA:		***99.9%***	***84.7%***
TOTAL ABUNDANCE / m^3:		**13994**	**1588**

APPENDIX H

Qualitative Periphyton Survey Results, Whale Tail Pit Baseline, 2015

Summary of the qualitative periphyton survey results, Whale Tail Pit Baseline, 2015.

Station ID:	WTS-1	Sand:	
Date:	7/17/2015	Small Gravel:	
GPS:	14W0607869 7254134	Large Gravel:	
		Small Cobble:	20%
		Large Cobble:	30%
		Boulder:	50%
		Bedrock:	
Microhabitat - Periphyton Cover:	Low and Moderate - Coverage is complete but not dense. Some evidence of ice scour. Below 30 cm remnant evidence of dense matting.		
Colour:	Muddy Green		
Macrohabitat- Periphyton Cover:	Sparse and Moderate - Appears to cover all boulders and cobble except in extreme shallows. Consistent mix of substrate in area. Some larger boulders breaking the surface		
Aspect/Terrain	Clear shoreline with low slope.		

Station ID:	WTS-2	Sand:	
Date:	7/17/2015	Small Gravel:	
GPS:	14W0607412 7253418	Large Gravel:	
		Small Cobble:	10%
		Large Cobble:	80%
		Boulder:	5%
		Bedrock:	5%
Microhabitat - Periphyton Cover:	Sparse and Moderate - Ice scour seems to extend down to 50 cm. Rocks are mostly flat and angular with minimal growth except deeper.		
Colour:	Muddy Green		
Macrohabitat- Periphyton Cover:	Sparse and Moderate - Where rocks haven't been scoured by ice there is evidence of growth.		
Aspect/Terrain	Evidence of rocks pushed up on shoreline. Layered bedrock extends into water and seems to have provided most of the rocks which are flat and angular. Area is tucked behind a prominent point.		

Station ID:	WTS3	Sand:	
Date:	7/17/2015	Small Gravel:	
GPS:	14W0607235 7254428	Large Gravel:	
		Small Cobble:	5%
		Large Cobble:	90%
		Boulder:	5%
		Bedrock:	
Microhabitat - Periphyton Cover:	Sparse and Moderate - Mostly sparse where shallower than 30 cm but moderate deeper. Evidence of remnant dense matting deeper.		
Colour:	Muddy Green		
Macrohabitat- Periphyton Cover:	Sparse, Low, and Moderate - evidence of ice scour. Consistent substrate with patches of boulders and patches of sand/gravel.		
Aspect/Terrain	Rocks and cobble are rounded. Shoreline is exposed except for a small area to the south that is protected by a small point.		

Summary of the qualitative periphyton survey results, Whale Tail Pit Baseline, 2015.

Station ID:	WTN1	Sand:	
Date:	7/17/2015	Small Gravel:	30%
GPS:	14W0607100 7254934	Large Gravel:	
Number of Pictures:	Eleven	Small Cobble:	15%
		Large Cobble:	15%
		Boulder:	
		Bedrock:	30%
Microhabitat - Periphyton Cover:	None, Sparse, and Low - Shallow depths had no growth but it was better deeper.		
Colour:	Muddy Green		
Macrohabitat- Periphyton Cover:	None and Sparse - Consistently better deeper.		
Aspect/Terrain	Shoreline was made up of bedrock outcropping which provided a point of land behind which there was more periphyton growth. It appears that there was more ice scour effect on the North side.		
Station ID:	WTN2	Sand:	
Date:	7/17/2015	Small Gravel:	
GPS:	14W0607153 7255340	Large Gravel:	5%
Number of Pictures:	Seven	Small Cobble:	20%
		Large Cobble:	70%
		Boulder:	5%
		Bedrock:	
Microhabitat - Periphyton Cover:	Sparse, Low, and Moderate - Growth was Moderate below 20 cm.		
Colour:	Muddy Green		
Macrohabitat- Periphyton Cover:	Sparse and Moderate - Growth depended on depth. Nice area with evidence of dense mats deeper. Probably effects of ice scour shallower. Consistent mix of cobble.		
Aspect/Terrain	This was the most northerly section of the lake. It appears to be less weathered though the cobbles are rounded.		
Station ID:	WTN3	Sand:	
Date:	7/17/2015	Small Gravel:	
GPS:	14W0607579 7255098	Large Gravel:	
Number of Pictures:	Seven	Small Cobble:	20%
		Large Cobble:	30%
		Boulder:	50%
		Bedrock:	
Microhabitat - Periphyton Cover:	Low and Moderate - Better than most areas especially when greater than 20 cm deep.		
Colour:	Muddy Green		
Macrohabitat- Periphyton Cover:	Sparse, Low, and Moderate - Consistent mix though where the shoreline varies so does the coverage.		
Aspect/Terrain	Open shoreline on the East Side. Rocks are a mix of rounded and angular. Sections where it drops off and sections where it is shallow.		

Summary of the qualitative periphyton survey results, Whale Tail Pit Baseline, 2015.

Station ID:	NEM-1	Sand:	
Date:	7/18/2015	Small Gravel:	10%
GPS:	14W0606618 7257076	Large Gravel:	30%
		Small Cobble:	30%
		Large Cobble:	30%
		Boulder:	
		Bedrock:	
Microhabitat - Periphyton Cover:	Low and Moderate - > than 20 cm depth is moderate. Dark brown and green. Growth increases with depth.		
Colour:	Dark brown and green		
Macrohabitat- Periphyton Cover:	Low and Moderate - Consistent cover		
Aspect/Terrain	This is a small bay near the moraine that stretches across the lake. The shore is a slow even slope to deeper water. Smaller substrate near the shore. Further out there are some boulders. (Great boat launch)		

Station ID:	NEM2	Sand:	
Date:	7/18/2015	Small Gravel:	
GPS:	14W0606929 7257969	Large Gravel:	5%
Number of Pictures:	Nine	Small Cobble:	30%
		Large Cobble:	50%
		Boulder:	15%
		Bedrock:	
Microhabitat - Periphyton Cover:	Sparse and Moderate - Thin coating on most surfaces but is moderate > than 30 cm depth. Growth is concentrated in pockets between rocks/boulders where you can see dense, tufts		
Colour:	Dark brown and green		
Macrohabitat- Periphyton Cover:	Sparse and Moderate - Consistent cover patterns		
Aspect/Terrain	This is near a small cobble covered point. East side has more large cobble with lower slope. Rocks/cobble are mostly very rounded.		

Station ID:	NEM3	Sand:	
Date:	7/18/2015	Small Gravel:	
GPS:	14W0605925 7257554	Large Gravel:	5%
		Small Cobble:	10%
		Large Cobble:	10%
		Boulder:	75%
		Bedrock:	
Microhabitat - Periphyton Cover:	None and Low - growth is limited to deep pockets between boulders. In the pockets you can see longer strands of periphyton matting on the sides of boulders.		
Colour:	Dark brown and green		
Macrohabitat- Periphyton Cover:	None and Low - This is a field of boulders with limited smaller substrate, as such there are patches of growth where it is deep but it is not consistent.		
Aspect/Terrain	Fairly exposed section of lake. There is a shallow patch with boulders breaking the surface. It would be a hard place to sample.		

Summary of the qualitative periphyton survey results, Whale Tail Pit Baseline, 2015.

Station ID:	MAM-1	Sand:	5%
Date:	7/18/2015	Small Gravel:	
GPS:	14W0604720 7254796	Large Gravel:	5%
		Small Cobble:	30%
		Large Cobble:	30%
		Boulder:	30%
		Bedrock:	
Microhabitat - Periphyton Cover:	Non, Sparse, and Low - no evidence of deep cover but mostly a thin layer at > 20 cm depth. More growth on sides and in deeper sheltered pockets.		
Colour:	Brown/Olive Colour		
Macrohabitat- Periphyton Cover:	Sparse and Low -Consistent for > 20 cm depth otherwise more patchy		
Aspect/Terrain	Shallow patch with large boulders offshore. Muddy banks extend into water.		

Station ID:	MAM-2	Sand:	
Date:	7/18/2015	Small Gravel:	
GPS:	14W0604537 7254030	Large Gravel:	
		Small Cobble:	5%
		Large Cobble:	10%
		Boulder:	85%
		Bedrock:	
Microhabitat - Periphyton Cover:	None and Moderate - no cover in shallower than 30 cm. Otherwise, good growth with evidence of deep matting.		
Colour:	Brown/Olive Colour		
Macrohabitat- Periphyton Cover:	None and Moderate - Consistent based on substrate.		
Aspect/Terrain	There are many larger boulders but that tends to be representative of this lake's shoreline.		

Station ID:	MAM-3	Sand:	
Date:	7/18/2015	Small Gravel:	
GPS:	14W0605020 7254596	Large Gravel:	
		Small Cobble:	5%
		Large Cobble:	15%
		Boulder:	80%
		Bedrock:	
Microhabitat - Periphyton Cover:	None, Sparse, Low, and Moderate - really mixed. Further out and deeper there is more. Where there is more there are thick tufts.		
Colour:	Brown/Olive Colour		
Macrohabitat- Periphyton Cover:	None, Sparse, and Low - Similar to the rest of the lake where growth is dependent on depth and substrate.		
Aspect/Terrain	Big boulders and shallow slope. The topography around the lake is representative of the shoreline. Lake is generally very shallow.		

Summary of the qualitative periphyton survey results, Whale Tail Pit Baseline, 2015.

Station ID:	C-2	Sand:	
Date:	7/19/2015	Small Gravel:	
GPS:	14W0638199 7221598	Large Gravel:	5%
		Small Cobble:	10%
		Large Cobble:	25%
		Boulder:	60%
		Bedrock:	
Microhabitat - Periphyton Cover:	Sparse growth with a thin film on most of the surface of the rock but some tufts of denser growth evident in patches		
Colour:			
Macrohabitat- Periphyton Cover:	Growth is limited to pools so it is patchy overall and pretty sparse.		
Aspect/Terrain	Fairly small stream with a larger pond area just upstream		

Station ID:	C-14	Sand:	
Date:	7/19/2015	Small Gravel:	
GPS:	14W0632916 7232202	Large Gravel:	10%
		Small Cobble:	10%
		Large Cobble:	60%
		Boulder:	20%
		Bedrock:	
Microhabitat - Periphyton Cover:	Moderate growth covering surfaces of rock particularly on the sides		
Colour:	Muddy-green-olive colour		
Macrohabitat- Periphyton Cover:	Pretty fast flowing but consistently good growth even in shallower sections		
Aspect/Terrain	Wide and shallow stream		

Station ID:	C-17	Sand:	
Date:	7/19/2015	Small Gravel:	
GPS:	14W0630583 7234684	Large Gravel:	
		Small Cobble:	20%
		Large Cobble:	30%
		Boulder:	50%
		Bedrock:	
Microhabitat - Periphyton Cover:	Moderate to high growth with some very dense matting that is peeling off		
Colour:	Muddy green colour		
Macrohabitat- Periphyton Cover:	Consistent cover in this shallow slow flowing stream		
Aspect/Terrain			

Summary of the qualitative periphyton survey results, Whale Tail Pit Baseline, 2015.

Station ID:	C-20	Sand:	
Date:	7/19/2015	Small Gravel:	
GPS:	14W0627265 7236464	Large Gravel:	5%
		Small Cobble:	15%
		Large Cobble:	30%
		Boulder:	50%
		Bedrock:	
Microhabitat - Periphyton Cover:	Sparse to moderate cover because it depends where you look. There is dense matting in deeper section (side of rocks) but really low growth on top sections		
Colour:			
Macrohabitat- Periphyton Cover:	Patchy growth - very dependent on area		
Aspect/Terrain	Wide larger stream/river and it is fairly fast flowing		

Station ID:	C-41	Sand:	
Date:	7/19/2015	Small Gravel:	
GPS:	14W0620601 7244690	Large Gravel:	
		Small Cobble:	10%
		Large Cobble:	40%
		Boulder:	50%
		Bedrock:	
Microhabitat - Periphyton Cover:	Moderate to high - lots of growth with dense matting that is firmly attached and evidence of some kind of lighter green algae		
Colour:	more green than most		
Macrohabitat- Periphyton Cover:	Some bright green (algae?) patches but overall good consistent growth with some old mats of periphyton in deeper sections		
Aspect/Terrain	Small but fast flowing		

Station ID:	WTS-1	Sand:	
Date:	8/22/2015	Small Gravel:	
GPS:	14W0607170 7253398	Large Gravel:	
		Small Cobble:	
		Large Cobble:	10%
		Boulder:	90%
		Bedrock:	
Microhabitat - Periphyton Cover:	Low cover; Thickness 1-5 mm; flat coverage of most rocks; uniform thickness; some filamentous periphyton, but no longer than 5 mm		
Colour:	green/brown colour		
Macrohabitat- Periphyton Cover:	Low cover; Clear water; coverage looks relatively homogenous along the south shore of the south basin of Whale Tail		
Aspect/Terrain			

Summary of the qualitative periphyton survey results, Whale Tail Pit Baseline, 2015.

Station ID:	WTN-1	Sand:	
Date:	8/22/2015	Small Gravel:	
GPS:	14W0606784 7255760	Large Gravel:	
		Small Cobble:	30%
		Large Cobble:	50%
		Boulder:	20%
		Bedrock:	
Microhabitat - Periphyton Cover:	Moderate Cover; Periphyton covering most rocks. 1-5 mm layer.		
Colour:	green/brown colour		
Macrohabitat- Periphyton Cover:	Moderate cover; The north basin of Whale Tail Lake; Water is clear; Secchi depth was 6 m at the WQ station in the middle of the lake; Relatively uniform coverage along the lake		
Aspect/Terrain			

Station ID:	NEM-1	Sand:	30%
Date:	8/23/2015	Small Gravel:	
GPS:	14W606649 7257142	Large Gravel:	
		Small Cobble:	
		Large Cobble:	20%
		Boulder:	50%
		Bedrock:	
Microhabitat - Periphyton Cover:	Low Coverage; Uniform lateral coverage along the shore		
Colour:	green/brown colour		
Macrohabitat- Periphyton Cover:	Low Coverage; Clear water; Secchi down to > 7m at the nearby WQ station		
Aspect/Terrain			

Station ID:	MAM-1	Sand:	
Date:	8/24/2015	Small Gravel:	
GPS:	14W0604852 7254530	Large Gravel:	
		Small Cobble:	
		Large Cobble:	60%
		Boulder:	40%
		Bedrock:	
Microhabitat - Periphyton Cover:	Moderate Cover; Firmly attached periphyton cover; 1-3 mm thick; Uniform coverage on all rock surface.		
Colour:	green/brown colour		
Macrohabitat- Periphyton Cover:	Low Cover; Water is clear; Secchi down to 7 m in the lake; Homogenous cover along shore from what we surveyed; Rock coverage along the shoreline of the entire lake.		
Aspect/Terrain			

Summary of the qualitative periphyton survey results, Whale Tail Pit Baseline, 2015.

Station ID:	C-2	Sand:	
Date:	8/25/2015	Small Gravel:	
GPS:	14W0638217 7221627	Large Gravel:	
		Small Cobble:	
		Large Cobble:	
		Boulder:	100%
		Bedrock:	
Microhabitat - Periphyton Cover:	High cover; 2-5 mm thick periphyton layer; moderately attached		
Colour:	green/brown colour		
Macrohabitat- Periphyton Cover:	High cover; Low flow, clear water, stagnant; No visible water downstream from proposed crossing; Sampled upstream; Little variability along reach where water present.		
Aspect/Terrain			

Station ID:	C-14	Sand:	
Date:	8/25/2015	Small Gravel:	
GPS:	14W0632890 7232182	Large Gravel:	
		Small Cobble:	
		Large Cobble:	40%
		Boulder:	60%
		Bedrock:	
Microhabitat - Periphyton Cover:	Moderate cover; Predominantly green filamentous periphyton; Firmly attached; Prevalent in		
Colour:	Green		
Macrohabitat- Periphyton Cover:	Moderate cover; Low flow, clear water, lots of exposed rock		
Aspect/Terrain			

Station ID:	C-17	Sand:	
Date:	8/25/2015	Small Gravel:	
GPS:	14W0630557 7234667	Large Gravel:	30%
		Small Cobble:	40%
		Large Cobble:	20%
		Boulder:	
		Bedrock:	
Microhabitat - Periphyton Cover:	Moderate cover; Firmly attached; Slippery texture; some filamentous/moss clumps; 1-2 mm thick in most places		
Colour:	brown		
Macrohabitat- Periphyton Cover:	Moderate cover; Clear water; Low flow in August compared to July according to pilot; Uniform coverage throughout the stream.		
Aspect/Terrain			

Summary of the qualitative periphyton survey results, Whale Tail Pit Baseline, 2015.

Station ID:	C-20	Sand:	
Date:	8/25/2015	Small Gravel:	
GPS:	14W0627186 7236475	Large Gravel:	
		Small Cobble:	
		Large Cobble:	5%
		Boulder:	95%
		Bedrock:	
Microhabitat - Periphyton Cover:	Moderate cover; Filamentous periphyton covering most rocks in riffle glide; Firmly attached		
Colour:	green		
Macrohabitat- Periphyton Cover:	Moderate cover; Clear water; Some riffle sections, but mostly glide over large boulder; Homogenous growth on submerged rocks.		
Aspect/Terrain			

Station ID:	C-41	Sand:	
Date:	8/25/2015	Small Gravel:	15%
GPS:	14W0620637 7244668	Large Gravel:	20%
		Small Cobble:	70%
		Large Cobble:	5%
		Boulder:	
		Bedrock:	
Microhabitat - Periphyton Cover:	Low cover; Noticeable growth on large rocks; Some filamentous strands		
Colour:	green/brown		
Macrohabitat- Periphyton Cover:	Low cover; Clear water; Moderate flow; Some patchiness in cover; Denser in small pools than riffle areas.		
Aspect/Terrain			

Station ID:	WTN-1	Sand:	
Date:	9/18/2015	Small Gravel:	
GPS:	14W0607100 7254934	Large Gravel:	
		Small Cobble:	20%
		Large Cobble:	20%
		Boulder:	
		Bedrock:	60%
Microhabitat - Periphyton Cover:	Moderate cover; Thin mud like layer		
Colour:			
Macrohabitat- Periphyton Cover:	Low to Moderate cover; Lots of exposed bedrock; Pretty thin growth;		
Aspect/Terrain	Water level was noticeably higher in July (approximately 40-50 cm); As such, this isn't the same substrate and growth characterized in July.		

Summary of the qualitative periphyton survey results, Whale Tail Pit Baseline, 2015.

Station ID:	WTN-2	Sand:	
Date:	9/18/2015	Small Gravel:	
GPS:	14W0607153 7255340	Large Gravel:	
		Small Cobble:	
		Large Cobble:	
		Boulder:	
		Bedrock:	
Microhabitat - Periphyton Cover:	High cover; Dense tufty growth; Some muddy/slimy growth, but pretty consistent		
Colour:	Dark olive green colour		
Macrohabitat- Periphyton Cover:	High cover; Consistent growth all depths; Evidence of dried up periphyton on exposed rocks along shore to 10-20 cm above current water level.		
Aspect/Terrain			

Station ID:	WTN-3	Sand:	
Date:	9/18/2015	Small Gravel:	
GPS:	14W0607579 7255098	Large Gravel:	
		Small Cobble:	30%
		Large Cobble:	40%
		Boulder:	30%
		Bedrock:	
Microhabitat - Periphyton Cover:	High cover; Thick matting with mix of colours from muddy green to lighter green		
Colour:	Muddy green to lighter green		
Macrohabitat- Periphyton Cover:	High cover; Thick consistent cover at all depths		
Aspect/Terrain			

Station ID:	WTS-1	Sand:	
Date:	9/18/2015	Small Gravel:	
GPS:	14W0607869 7254134	Large Gravel:	5%
		Small Cobble:	10%
		Large Cobble:	30%
		Boulder:	55%
		Bedrock:	
Microhabitat - Periphyton Cover:	High cover; Coating of fine growth on all surfaces; Growth is generally very poorly attached on shallow rocks		
Colour:	Muddy green		
Macrohabitat- Periphyton Cover:	Moderate to high cover; Appears consistent at > 10cm depth; Still some shallow parts of rocks have less growth		
Aspect/Terrain			

Summary of the qualitative periphyton survey results, Whale Tail Pit Baseline, 2015.

Station ID:	WTS-2	Sand:	
Date:	9/18/2015	Small Gravel:	
GPS:	14W0607412 7253418	Large Gravel:	
		Small Cobble:	
		Large Cobble:	
		Boulder:	
		Bedrock:	
Microhabitat - Periphyton Cover:	Moderate cover; Slimy coat of growth		
Colour:	Mix of olive/mud green and lighter green		
Macrohabitat-Periphyton Cover:	High cover; Appears consistent across all depths; Looks like mud green and appears denser from afar than it does up close		
Aspect/Terrain			

Station ID:	WTS-3	Sand:	
Date:	9/18/2015	Small Gravel:	
GPS:	14W0607235 7254428	Large Gravel:	10%
		Small Cobble:	45%
		Large Cobble:	40%
		Boulder:	5%
		Bedrock:	
Microhabitat - Periphyton Cover:	High cover; Looks well attached and yet scrapes off easily to a muddy slime; Fairly thick; Mix of tufts and fine muddy stuff		
Colour:	There are lighter green patches		
Macrohabitat-Periphyton Cover:	High cover; more tufty and not as muddy looking; Consistent cover		
Aspect/Terrain			

Station ID:	NEM-1	Sand:	
Date:	9/19/2015	Small Gravel:	
GPS:	14W0606618 7257076	Large Gravel:	20%
		Small Cobble:	50%
		Large Cobble:	30%
		Boulder:	
		Bedrock:	
Microhabitat - Periphyton Cover:	High cover; Dark with lots of growth; Scrapes into a slimy pile easily		
Colour:	Dark green		
Macrohabitat-Periphyton Cover:	High cover; Consistent coverage; Fairly dense with tufts and matting		
Aspect/Terrain			

Summary of the qualitative periphyton survey results, Whale Tail Pit Baseline, 2015.

Station ID:	NEM-2	Sand:	
Date:	9/19/2015	Small Gravel:	
GPS:	14W0606929 7257969	Large Gravel:	10%
		Small Cobble:	50%
		Large Cobble:	40%
		Boulder:	
		Bedrock:	
Microhabitat - Periphyton Cover:	High to low cover; Surprisingly spars especially in shallows; Also tufty with some fine slime		
Colour:	Dark mud/green colour		
Macrohabitat- Periphyton Cover:	Consistent cover but dependent on depth		
Aspect/Terrain			

Station ID:	NEM-3	Sand:	
Date:	9/19/2015	Small Gravel:	
GPS:	14W0605925 7257554	Large Gravel:	
		Small Cobble:	5%
		Large Cobble:	15%
		Boulder:	80%
		Bedrock:	
Microhabitat - Periphyton Cover:	Moderate cover		
Colour:	Dark green muddy colour		
Macrohabitat- Periphyton Cover:	Moderate to high cover; Dense tufts of growth on sides of boulders, but it is not matting except on some flat surfaces;		
Aspect/Terrain	Lower lake level means only deeper pools between boulders remain		

Station ID:	MAM-1	Sand:	
Date:	9/19/2015	Small Gravel:	
GPS:	14W0604720 7254796	Large Gravel:	10%
		Small Cobble:	40%
		Large Cobble:	30%
		Boulder:	20%
		Bedrock:	
Microhabitat - Periphyton Cover:	Moderate to high cover; Thick well attached growth		
Colour:	Muddy green colour		
Macrohabitat- Periphyton Cover:	High cover; Coverage is pretty dense especially at > 10cm depth		
Aspect/Terrain			

Summary of the qualitative periphyton survey results, Whale Tail Pit Baseline, 2015.

Station ID:	MAM-2	Sand:	
Date:	9/19/2015	Small Gravel:	
GPS:	14W0604538 7254030	Large Gravel:	
		Small Cobble:	
		Large Cobble:	20%
		Boulder:	80%
		Bedrock:	
Microhabitat - Periphyton Cover:	High cover; Dense and consistent on each rock though coverage type varies a bit between rocks		
Colour:	Dark olive green		
Macrohabitat- Periphyton Cover:	High cover; Lots of growth; Thick matting with tufts		
Aspect/Terrain			

Station ID:	MAM-3	Sand:	
Date:	9/19/2015	Small Gravel:	
GPS:	14W0605021 7254596	Large Gravel:	
		Small Cobble:	10%
		Large Cobble:	20%
		Boulder:	70%
		Bedrock:	
Microhabitat - Periphyton Cover:	High cover; Thick cover; Some tufts, but mostly loose mats		
Colour:	Brownish/green colour		
Macrohabitat- Periphyton Cover:	High cover; Dense matting; Consistent cover		
Aspect/Terrain	No the lake level is lower it is very sheltered at this location		

Station ID:	C-2	Sand:	
Date:	9/20/2015	Small Gravel:	
GPS:	14W0603828 7221902	Large Gravel:	
		Small Cobble:	
		Large Cobble:	
		Boulder:	
		Bedrock:	
Microhabitat - Periphyton Cover:	Dense growth particularly on sides of rocks		
Colour:			
Macrohabitat- Periphyton Cover:	Peril mats exposed on many rocks		
Aspect/Terrain	Water level much lower than July; had to move station upstream and felt more like a lake than a stream		

Summary of the qualitative periphyton survey results, Whale Tail Pit Baseline, 2015.

Station ID:	C-14	Sand:
Date:	9/20/2015	Small Gravel:
GPS:	14W0632916 7232202	Large Gravel:
		Small Cobble:
		Large Cobble:
		Boulder:
		Bedrock:
Microhabitat - Periphyton Cover:	Moderate Cover; Slimy growth; Not well attached	
Colour:		
Macrohabitat- Periphyton Cover:	Moderate cover; Not as much as other stream crossings; Appears to be more like the lake growth	
Aspect/Terrain		

Station ID:	C-17	Sand:
Date:	9/20/2015	Small Gravel:
GPS:	14W0632916 7232202	Large Gravel:
		Small Cobble:
		Large Cobble:
		Boulder:
		Bedrock:
Microhabitat - Periphyton Cover:	High cover; Appears fine with less filamentous growth (macrophyte growth in appearance)	
Colour:	Mud coloured growth	
Macrohabitat- Periphyton Cover:	High cover; Easily disturbed; Lots of growth	
Aspect/Terrain		

Station ID:	C-20	Sand:
Date:	9/20/2015	Small Gravel:
GPS:	14W0627264 7236464	Large Gravel:
Number of Pictures:		Small Cobble:
		Large Cobble:
		Boulder:
		Bedrock:
Microhabitat - Periphyton Cover:	Moderate cover; Dense "snotty" growth	
Colour:	some light green long strands	
Macrohabitat- Periphyton Cover:	Moderate to high cover; Some matting in deep sections; Long strands of growth	
Aspect/Terrain		

Summary of the qualitative periphyton survey results, Whale Tail Pit Baseline, 2015.

Station ID:	C-41	Sand:	
Date:	9/20/2015	Small Gravel:	
GPS:	14W0620607 7244690	Large Gravel:	
		Small Cobble:	
		Large Cobble:	
		Boulder:	
		Bedrock:	
Microhabitat - Periphyton Cover:	Moderate to high cover; Long strands; Lots of organic matter in flow on very windy day (suspect wave action is dislodging growth)		
Colour:	Very dark green; Some light green		
Macrohabitat- Periphyton Cover:	High cover; Macrophyte or filamentous growth evident; Very dense consistent cover		
Aspect/Terrain			

Notes:

Periphyton cover (in percent) defined as follows:

None	0
Sparse	< 5
Low	5-25
Moderate	25-75
High/Dense	> 75

Substrate cover not recorded at some lake and sentinel stations in September as the same locations were sampled in July and September.

APPENDIX 6-H

Mine Site and Receiving Environment Water Quality Predictions

June 2016
Report No. 1541520

AGNICO EAGLE

Golder Associates

June 2016

REPORT ON

Mine Site and Downstream Receiving Water Quality Predictions Whale Tail Deposit Project, Meadowbank Division

Submitted to:
Ryan Vanengen
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10200, route de Preissac
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REPORT

Report Number: 1520817

Distribution:
1 e-copy: Agnico Eagle
Associates

Golder Associates

Executive Summary

Agnico Eagle Mines Limited Meadowbank Division (Agnico Eagle) is proposing to develop the Whale Tail Pit (the Project) in continuation of mine operations and milling of the Meadowbank Mine. Whale Tail is a satellite deposit located on the Amaruq exploration property, which is a 408-square kilometre (km^2) site located on Inuit Owned Land approximately 150 kilometres (km) north of the hamlet of Baker Lake and approximately 50 km northwest of the Meadowbank Mine, in the Kivalliq region of Nunavut. The property was acquired by Agnico Eagle in April 2013 subject to a mineral exploration agreement with Nunavut Tungavik Incorporated.

Water quality predictions for the Project were generated using the GoldSim database management and simulations code combined with baseline data collected from the mine site. A mass balance model was constructed in the GoldSim platform using the operations and post-closure water balance for the site. The model and results are a representation of the mine water and mine waste management plans for the Project.

This report provides a summary of the main mine components relevant to the water quality predictions, including; the Whale Tail Pit, the Whale Tail Waste Rock Storage Facility (WRSF), the Attenuation Pond, and temporary stockpiles of construction material and ore. Post-closure water quality is also estimated, and includes water quality predictions for the flooded Whale Tail Pit, the re-flooded Whale Tail Lake, and downstream lakes. The parameters and assumptions adopted in the mass balance model, and a summary of the results are also presented.

Water quality model results are included for the Whale Tail Pit sump, the Whale Tail WRSF pond, and the Attenuation Pond during operations. Results are provided for dissolved parameter concentrations. Given the uncertainties associated with the modelling exercise and the use of a maximum footprint year for operations and an average climate year in the water balance, the predicted concentrations are considered to be order-of-magnitude estimates for the last year of operations, in closure (for downstream receiving Lakes) and in post-closure.

Total suspended solids (TSS) are not considered in the mass load model but a sensitivity analysis was completed to evaluate the effect of suspended solids of an assumed composition on the total parameter concentrations in mine discharges during operations closure (for downstream receiving Lakes only) and post-closure. Total concentrations are higher than dissolved concentrations for aluminum, iron, chromium and arsenic. Without treatment, aluminum and iron could exceed effluent criteria but no new exceedances are predicted as a result of the Project for chromium and arsenic. The concentration of TSS in effluents is regulated. It is anticipated that suspended solids will require monitoring and proper management based on experience at other arctic mine sites.

During operations, Whale Tail Pit sump water quality is predicted to meet all Meadowbank Type A Water Licence Portage effluent limits, with the exception of total dissolved solids (TDS) and arsenic. Elevated concentrations of these parameters in the summer months are related to loading from increased pit wall runoff. Flooded pit water quality is predicted to exceed Canadian Environmental Quality Guidelines for Aquatic Life (CEQG-AL) for arsenic only; as per NWB Type A Water Licence Part E Item 8 requirements, end pit water quality modelling will be conducted to update these predictions.

The Attenuation Pond predictions for arsenic reflect dilution of inflows from the Whale Tail WRSF pond and Whale Tail Pit sump pond when combined with various runoff contributions having lower arsenic concentrations.

The quality of Whale Tail WRSF drainage during operations, if any is generated, is treated for arsenic to meet Portage effluent. In post-closure, the Whale Tail WRSF pond shows exceedances of the CEQG-AL including cadmium, and fluoride, and more sporadically for chromium, copper, molybdenum, nickel, silver, lead, mercury, selenium, and uranium and shows an exceedance of the Site-specific Water Quality Objective (SSWQO) for arsenic in post-closure.

In closure, there are no discharges from the mine to the downstream Lakes; site waters are being used to flood the open pit, thus, water quality in downstream Lakes is conservatively predicted to be similar than during operations.

In post-closure, Whale Tail WRSF contact water quality is conservatively predicted to meet most CEQG-AL parameter concentrations except for arsenic, cadmium, and fluoride. The water qualities in the fully flooded Whale Tail Pit and Whale Tail Lake (North Basin) are predicted to be relatively constant throughout the year. Arsenic concentrations are below the SSWQO in Whale Tail Lake (North Basin) and are suitable for overflow to Mammoth Lake, assuming that diffusion from the pit wall rock will not occur, nor any exchanges between the Whale Tail Pit and above lake water. As per NWB Type A Water Licence Part E Item 6 and 8 requirements, a site wide water balance will be updated as part of the annual water management plan and end pit water quality modelling will be conducted to update these predictions. As per Part E Item 6, dikes shall not be breached until the water quality in the flooded area meets CEQG-AL, baseline concentrations, or appropriate SSWQOs.

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ATTACHMENTS

Attachment A
Water Quality Input Parameters

Attachment B
Water Quality Model Results

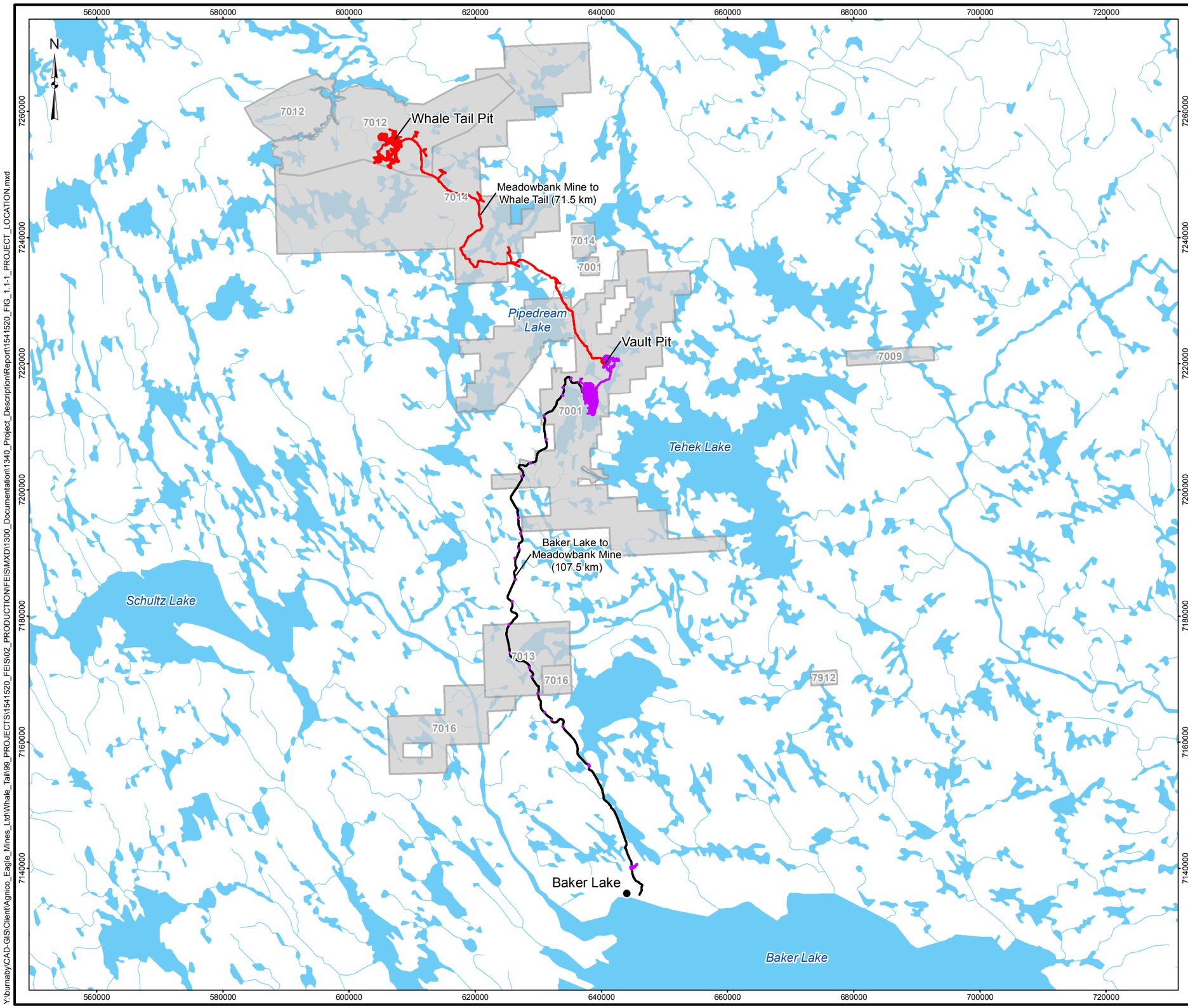
1.0 INTRODUCTION

Agnico Eagle Mines Limited Meadowbank Division (Agnico Eagle) is proposing to develop the Whale Tail Pit in continuation of mine operations and milling of the Meadowbank Mine. Whale Tail is a satellite deposit located on the Amaruq exploration property, which is a 408-square kilometre (km^2) site located on Inuit Owned Land approximately 150 kilometres (km) north of the hamlet of Baker Lake and approximately 50 km northwest of the Meadowbank Mine, in the Kivalliq region of Nunavut (Figure 1). The property was acquired by Agnico Eagle in April 2013 subject to a mineral exploration agreement with Nunavut Tungavik Incorporated.

The Meadowbank Mine is an approved mining operation and Agnico Eagle is looking to extend the life of the mine by constructing and operating Whale Tail Pit (referred to in this document as 'the Project'). As an amendment to the existing operations at the Meadowbank Mine, the Project is subject to an Environmental Review established by Article 12, Part 5 of the Nunavut Land Claims Agreement (NLCA).

The current mining plan indicates that approximately 8.3 Mt of ore will be mined over a mine life of approximately 4 years. The deposit will be mined using conventional open pit mining methods. Approximately 51.7 Mt of waste rock and overburden will be generated and stored in a rock storage facility (Whale Tail Waste Rock Storage Facility [WRSF]) adjacent to the Whale Tail Pit (Figure 2). The ore will be processed at the existing mill in the Portage area of the Meadowbank Mine, and tailings will be deposited in the existing Meadowbank Mine tailings storage facility.

Golder Associated Ltd. (Golder) was retained to forecast the probable quality of mine contact water to support Agnico Eagle in the design of water management plans for the Project. This report describes the mine site components and mine operation procedures relevant to the water quality predictions (Section 2.0); provides a description of the input values and geochemical controls specified in the model (Section 3.0); and summarizes all assumptions made in the modelling process (Section 4.0). A summary of the predicted mine contact water quality for select mine components during operations and post-closure, and at downstream locations is included in Section 5.0.



LEGEND

- COMMUNITY
- PROPOSED HAUL ROAD
- ALL WEATHER ROAD
- WHALE TAIL PIT
- MEADOWBANK OPERATION AND INFRASTRUCTURE
- CLAIM BOUNDARY
- WATERCOURSE
- WATERBODY



REFERENCE

1. HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200_R0.dwg
2. CLAIM BOUNDARIES OBTAINED FROM AGNICO EAGLE MINES LIMITED.
3. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
4. INSET MAP DATA OBTAINED FROM ESRI.

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

12 0 12
KILOMETRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

PROJECT LOCATION AND CLAIM BOUNDARIES

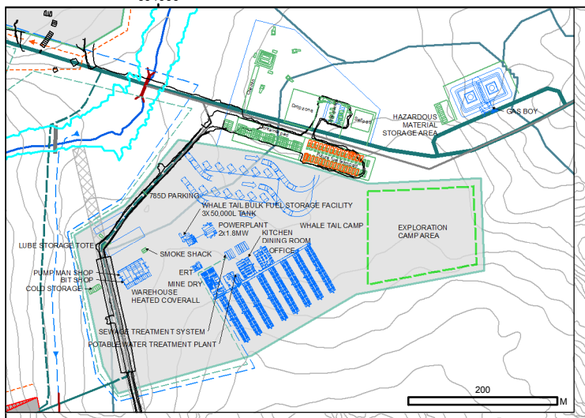
Golder Associates

PROJECT		1541520	FILE No.	
DESIGN	JR	24 Mar. 2016	SCALE AS SHOWN	REV. 0
GIS	CDB	24 Mar. 2016		
CHECK	JR	09 May 2016		
REVIEW	LY	09 May 2016		

FIGURE 1

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604000
606000
608000
7256000
7254000



NEMO FRESHWATER INTAKE
NEMO LAKE
C38
ROAD AROUND WRSF
SADDLE / COFFER DAM #1
WHALE TAIL WASTE ROCK STORAGE FACILITY
WHALE TAIL LANDFILL
WRSF POND
WRSF DIKE
NORTH CHANNEL
MAMMOTH CHANNEL CULVERT
MAMMOTH DIKE
MAMMOTH CHANNEL CULVERT
MAMMOTH LAKE DIFFUSER
MAMMOTH LAKE
A16
NORTHEAST POND
NORTHEAST LAKE
STORM WATER STORAGE POND
WASTE ROCK EXPLORATION PAD
BERM
EXPLORATION RAMP PORTAL
EXPLORATION LAYDOWN AREA
COMMUNICATION TOWER
CRUSHING AREA (2X CRUSHER)
ORE STOCKPILE 1
ORE STOCKPILE 2
6508-WHL-001-001
EXPLORATION RAMP VENT RAISE
WHALE TAIL ATTENUATION POND
WATER TREATMENT PLANT
SADDLE / COFFER DAM
ORE STOCKPILE 3
OVERBURDEN STORAGE
WHALE TAIL DIKE
WHALE TAIL EAST CHANNEL
WHALE TAIL CAMP
WHALE TAIL BULK FUEL STORAGE FACILITY
HAUL ROAD
EXPLOSIVE MAGAZINE 35,000kg
CAP MAGAZINE
CAP MAGAZINE
EXPLOSIVE MAGAZINE 35,000kg
EXPLOSIVE MAGAZINE 35,000kg
EXPLOSIVE MAGAZINE 35,000kg
WHALE TAIL DIVERSION CHANNEL
WHALE TAIL LAKE (SOUTH BASIN)
A17
ELEVATION ZONE EL. 156m
ARCHAEOLOGICAL SITE 2015-14
A18
184
185
186
183
182
181

LEGEND

- FINAL WHALE TAIL WASTE ROCK STORAGE FACILITY
- WHALE TAIL LAKE (SOUTH BASIN) FLOODED LIMIT (WATER LEVEL 156.0m)
- NATURAL WATERSHED
- DIKE
- POND/SUMP
- ARCHAEOLOGICAL SITE
- ROAD
- TEMPORARY ROAD
- DIVERSION CHANNEL
- COLLECTION CHANNEL
- CULVERT
- INTAKE WATER PIPE
- CONTACT WATER PIPE
- FRESHWATER PIPE
- WATERCOURSE
- WATERBODY

REFERENCE

1. INFRASTRUCTURE OBTAINED FROM AGNICO EAGLE MINES LIMITED FROM 6108-600-210-002_R2(2019)s.dwg.
2. WATERCOURSE AND WATERBODY DATA OBTAINED FROM PHOTOSAT
DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

400 0 400
METRES

PROJECT
AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

SITE LAYOUT

Golder Associates

PROJECT		1541520	FILE No.	
DESIGN	JR	24 Mar. 2016	SCALE AS SHOWN	REV. 0
GIS	CDB	05 May 2016		
CHECK	JR	09 May 2016		
REVIEW	LY	09 May 2016		

FIGURE 2

Y:\burnaby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Whale_Tail\99_PROJECTS\1541520_FEIS\02_PRODUCTION\FEIS\MXD\1300_Documentation\1340_Project_Description\Report\1541520_FIG_1-2-1_SITE_LAYOUT.mxd

2.0 MINE COMPONENTS RELEVANT TO WATER QUALITY PREDICTIONS

This section provides an overview of the mine water management plan, focusing on those aspects relevant to the mine site water quality predictions.

For operations, the following infrastructure components are considered in the prediction of mine site water quality:

- Whale Tail Pit;
- Whale Tail WRSF, where waste rock and overburden stripped from the Whale Tail Pit will be permanently stored;
- temporary stockpiles of ore and construction materials (esker material);
- operations pads, including the camp area and roads;
- mine water Attenuation Pond (the final collection point for all mine contact waters); and
- water treatment plant to treat water prior to discharge to Mammoth Lake.

For closure and post-closure, the following infrastructure components and receiving environments are considered:

- the flooded Whale Tail Pit;
- Whale Tail Lake (North Basin) (i.e., Lake A17 North or the portion of Whale Tail Lake located north of the dike). This portion of Whale Tail Lake pertains to the water volume above the flooded Whale Tail Pit and the Attenuation Pond post-closure;
- Whale Tail Lake (South Basin) (i.e., Lake A17 South or the portion of Whale Tail Lake located south of the dike);
- Mammoth Lake (Lake A16);
- Lake A15;
- Lake A12; and
- two downstream locations immediately before discharge to Lake DS1, which will be the final monitoring point for downstream water quality.

A discussion on key components of the mine site is included in Sections 3.0 and 4.0. A discussion on flows and water management plans during operations and post-closure is presented in the Water Management Plan (Volume 8, Appendix 8-B.2).

2.1 Water Balance Elements

The operational mine site water balance for the Project was completed. It provides monthly average flow volumes from each infrastructure component using average precipitation year climate data for the maximum mine footprint (the last year of operation). Post-closure flows were provided by Agnico Eagle using the same assumptions and hydrology input data as for the operational water balance, but based on a mine footprint that represents post-

closure conditions. Water quality predictions for closure are not provided since there is no water treatment plan effluent discharge to the receiving environment at that time.

Table 1 summarizes the assumptions made in model development that are related to the water balance. The water balance that was used to create the water quality model for the purposes of the FEIS outlines these modifications.

Table 1: General Water Balance Assumptions

Property	Assumption	Operations	Closure	Post-Closure
On-Site Assumptions:				
Whale Tail WRSF pond discharge	Pumped to the Attenuation Pond.	x		
	Pumped to Whale Tail Lake (North Basin) to accelerate filling once pit is full.		x	
	Naturally overflows to Mammoth Lake once Whale Tail Lake (North Basin) is full.			x
Pit watershed runoff	Reports directly to Attenuation Pond, does not contact the Whale Tail Pit.	x		
Pit Lake groundwater inflows	Assumed no groundwater inflow or outflow from the fully flooded pit lake.			x
Pit geometry	Pit flooding (and fully flooded pit) is modelled assuming the pit geometry is cylindrical with a base area of 43.5 ha (Water Management Plan [Volume 8, Appendix 8-B.2]). The annual flooded surface area is used in mass loading estimates. The pit is considered fully flooded once water reaches an elevation of 138.2 m: the bottom of Whale Tail Lake.		x	x
Fully flooded Whale Tail Lake (North Basin)	This represents the water at an elevation above the flooded pit lake (between 138.2 m and 152.5 m). It covers the area of Whale Tail Lake (North Basin).			x
Attenuation Pond	Precipitation over the Attenuation Pond watershed area (80 ha): 60% of the area is the pond and is assigned a lake evaporation water loss; 40% of the area is land and is assigned an evapotranspiration water loss.	x	x	
Attenuation Pond discharge	Pumping rate is higher than calculated in water balance by approximately 1.5 to account for flows not considered in the water balance (groundwater flows and freshwater uses).	x		
Grey water	Biodisk outflow is pumped to the Attenuation Pond until Whale Tail Lake (North Basin) has filled, after which the camp is closed and grey water is no longer produced nor discharged.	x	x	
Off-Site / Downstream Assumptions:				
Volume of downstream lakes	Where lake bathymetry and volumes were not available, an average depth of 3 m multiplied by the lake area was used to calculate each lake volume.	x	x	x
Climate Inputs	Water Management Plan (Volume 8, Appendix 8-B.2).	x	x	x
Storage and Sublimation Losses	Storage was accounted for and sublimation losses were based on snowpack accumulation (Water Management Plan [Volume 8, Appendix 8-B.2]).	x	x	x
Drainage areas	Based on the Hydrology Baseline Report (Volume 6, Appendix 6-C).	x	x	x
Attenuation Pond discharge	Discharges in summer only to treated water concentrations (Agnico Eagle, pers. comm. email dated March 21, 2016).	x	x	

Table 1: General Water Balance Assumptions

Property	Assumption	Operations	Closure	Post-Closure
Whale Tail Lake (South Basin) outflow	Overflows to Mammoth Lake.	x		
	Overflow used to fill Whale Tail Lake (North Basin), minor flow to Mammoth Lake.		x	
	Flows to Whale Tail Lake (North Basin) after the Whale Tail Dike is breached; volumes derived from the water balance for Whale Tail Lake (South Basin) flowing to Mammoth Lake.			x
Mammoth Lake effective mixing zone (EMZ)[a]	The Lake area within a 100-m radius from the effluent discharge point (Golder calculation based on lake bathymetry).	x		x
Mammoth Lake	Receives inflow from Mammoth Lake EMZ and assumed to be fully mixed instantly.	x		x

[a] The effective mixing zone is the area of Mammoth Lake where the discharge is planned. This model assumes an effective mixing zone with a radius of 100 m and variable depth (maximum depth 4.43 m; average depth 2.07 m), which equates to approximately 1.2% of the total volume of Mammoth Lake (Lake A16).

WRSF = waste rock storage facility; ha = hectares; m = metres; % = percent.

2.2 On-Site Facilities

2.2.1 Mine Operation Period

Table 2 describes the flows to the Whale Tail Pit sump pond, the Attenuation Pond, and the Whale Tail WRSF pond during operations.

Waste rock generated by mining and stripped overburden will be stored in one Whale Tail WRSF adjacent to the pit. During operations, the Whale Tail WRSF pond receives runoff from the waste rock pile (includes waste rock and overburden), natural runoff from the surrounding area (runoff that contacts natural ground only), and direct precipitation.

During operations, the Whale Tail WRSF pond is assumed to be kept at a low operating capacity (77 m^3) and acts as a flow through point rather than a reservoir that could offer any substantial residence time. Water from the Whale Tail WRSF pond is pumped to the Attenuation Pond.

The Whale Tail Pit will receive direct precipitation on the pit walls (accounted for as pit wall runoff) and on the pit sump pond itself, as well as groundwater inflow and drilling water year-round. The pit wall runoff contacts rock on the pit walls and in a portion of the pit bottom that is not submerged by the Whale Tail Pit sump pond. The water collected in the Whale Tail Pit sump will be pumped to the Attenuation Pond. Overland non-contact water flows (natural runoff) will be diverted away from the Whale Tail Pit and report directly to the Attenuation Pond.

Ore will be stockpiled within the catchment area of the Attenuation Pond prior to hauling and processing at the Meadowbank Mine plant. The tailings resulting from processing will be discharged to the existing Meadowbank Mine tailings storage facility, and are not considered in this model. A stockpile of clean esker material for construction use will also be present within the catchment area of the Attenuation Pond. All stockpiles and pads are assumed to produce contact water runoff in freshet and the summer months only.

Table 2: On-Site Modeled Flows during Operations

Location	Description of Inflows
Whale Tail WRSF pond	• Whale Tail WRSF contact runoff • Natural runoff • Direct precipitation
Whale Tail Pit sump pond	• Pit wall runoff • Groundwater inflow to pit[a] • Drilling water
Attenuation Pond	• Pumped water from the Whale Tail WRSF pond • Pumped water from the Whale Tail Pit sump pond • Runoff from natural ground • Runoff from developed ground (main sector, industrial sector) • Runoff from stockpiles (clean materials and ore) • Pumped water from the exploration ramp development • Pumped water from treatment plant (recirculated) • Pumped water from the campsite treatment plant (including grey water and oil trap water from the truck shop) • Direct precipitation on the Pond

[a] from Volume 6, Appendix 6-B.
WRSF = waste rock storage facility

2.2.2 Closure and Post-Closure

Mining is expected to cease at the end of 2021 and closure activities will commence as detailed in the Water Management Plan (Volume 8, Appendix 8-B.2). Closure activities will occur over 6.5 years and will include decommissioning of site facilities (with the exception of the water treatment plant and part of the camp infrastructure), removal of temporary stockpiles (ore and construction materials), completion of the Whale Tail WRSF cover (initiated during operations), and water diversion to flood the Whale Tail Pit and Whale Tail Lake (North Basin).

The following outlines water management aspects that pertain to the closure and post-closure periods:

- The Whale Tail Pit will flood over 3.5 years using a combination of pumped water from the Northeast Pond, treated Attenuation Pond water, pumped water from Whale Tail Lake (South Basin), Whale Tail Pit groundwater, direct precipitation, and natural runoff from the pit watershed.
- After the Whale Tail Pit is fully flooded, the larger surface area of Whale Tail Lake (North Basin) will start to be flooded. This is estimated to take three years using water from the following sources:
  - pumped water from Whale Tail Lake (South Basin);
  - pumped and treated water from the Whale Tail WRSF;
  - direct precipitation on the lake surface; and
  - natural runoff from the northeast sector, east sector, and north sector of the North Whale Tail watershed.

- Treatment of Attenuation Pond water is assumed to stop when the Whale Tail Lake (North Basin) area starts flooding, but treatment of the Whale Tail WRSF pond water will continue during the closure period when it is pumped to Whale Tail Lake (North Basin) to contribute to filling, and during post-closure when Whale Tail WRSF contact water flows to Mammoth Lake (Section 3.2.2.2). That is to say that Agnico Eagle commits to a maximum concentration in the Whale Tail WRSF pond water through either source control or passive treatment; the need for which will be evaluated during operations.
- Once the Whale Tail Lake (North Basin) has flooded to pre-mining levels, the Mammoth Lake Dike and the Whale Tail Dike will be breached, and natural flows from Whale Tail Lake (South Basin) and into Mammoth Lake will be re-established.

The flooded Whale Tail Pit and Whale Tail Lake (North Basin) were modelled as two separate entities that do not mix vertically (Section 4.0). It is assumed that the fully flooded Whale Tail Lake (after the dike breach, when Whale Tail Lake (South Basin) and Whale Tail Lake (North Basin) are hydrologically connected) will overflow naturally to Mammoth Lake. Rock storage facility pond water will also flow directly to Mammoth Lake post-closure.

Table 3 describes the flows included in the model post-closure.

Table 3: On-Site Modeled Flows in Post-Closure

Location	Description of Inflows	Discharge / Outflow
Whale Tail WRSF pond	• Whale Tail WRSF Cover Runoff • Natural runoff • Direct precipitation	Discharge to Mammoth Lake
Flooded Whale Tail Pit	• No inflows, no exchanges with overlying Whale Tail Pit Lake • Fully mixed conditions within pit	No outflows, no exchanges with overlying Whale Tail Pit Lake
Whale Tail Lake (North Basin) (Attenuation Pond Catchment Area)	• Runoff from natural ground • Runoff from developed ground (main sector, industrial sector) • Inflow from watersheds to north, northeast, east of pit, and Whale Tail Lake (North Basin) • Exposed high wall runoff • Whale Tail Lake (South Basin) water (after dike breach) • Direct precipitation	Discharge to Mammoth Lake through dike breach

WRSF = waste rock storage facility.

2.3 Off-Site / Downstream

Table 4 describes the flows into the receiving environment downstream of the mine lease during operations and post-closure. The water balance was extended downstream of the Project area using input parameters and assumptions from the baseline water balance model described in the Hydrology Baseline Report (Volume 6, Appendix 6-C). Lake locations are shown on Figure 3.

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597500 600000 602500 605000 607500

7260000 7257500 7255000 7252500

N

Downstream Node 2

Downstream Node 1

A5 A6 A8 A9 A10 A11 A12 A15 A16 Mammoth Lake A17 Whale Tail Lake (South Basin) A69 A76

Downstream Path 1

Downstream Path 2

A B C

NEMO FRESHWATER INTAKE

NORTHEAST POND

ORE STOCKPILE 1

ORE STOCKPILE 2

WATER TREATMENT PLANT

WHALE TAIL WASTE ROCK STORAGE FACILITY

WHALE TAIL ATTENUATION POND

WRSF POND

NORTH CHANNEL

WHALE TAIL PIT

ORE STOCKPILE 3

MAMMOTH DIKE

WHALE TAIL DIKE

WHALE TAIL DIVERSION CHANNEL

ELEVATION ZONE EL. 156m

LEGEND

- MINE SITE PREDICTION LOCATION
- RECEIVING ENVIRONMENT PREDICTION LOCATION
- FLOW PATH
- WATERCOURSE
- WATERSHED
- WATERBODY

REFERENCE

1. INFRASTRUCTURE OBTAINED FROM AGNICO EAGLE MINES LIMITED FROM 6108-600-210-002_R2(2019)s.dwg
2. WATERCOURSE AND WATERBODY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

750 0 750

METRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

WATER QUALITY PREDICTION LOCATIONS

Golder Associates

PROJECT		1541520	FILE No.	
DESIGN	CP	28 Apr. 2016	SCALE AS SHOWN	REV. 0
GIS	CD/GI	02 Jun. 2016		
CHECK	JR	06 Jun. 2016		
REVIEW	LY	06 Jun. 2016		

FIGURE 3

Table 4: Off-Site Water Quality Model Flows during Post-Closure

Location	Description of Inflows (in addition to direct precipitation and watershed runoff)	Discharge / Outflow
Mammoth Lake (Lake A16) Effective Mixing Zone[a]	• Pumped (treated) flow from Attenuation Pond in operations • Natural flow from Whale Tail Lake (North Basin) in post-closure • Whale Tail WRSF contact water drainage in post-closure	Mammoth Lake (Lake A16)
Mammoth Lake (Lake A16)[b]	• Mammoth Lake Effective Mixing Zone • Diverted flow from Whale Tail Lake (South Basin) during operations • Lake A43	Lake A15
Lake A15	• Mammoth Lake (Lake A16)	Lake A12
Lake A12	• Lake A15	Lake A11 and Lake 76
Lake A11	• Lake A12	Lake A10
Lake A10	• Lake A11 • Lake A76	Lake A9
Lake A9	• Lake A10	Lake A8
Lake A8	• Lake A9	Lake A6
Lake A6	• Lake A8 • Lake A32	Lake A5
Lake A5	• Lake A6	Downstream Node 2[c]
Downstream Node 2	• Lake A5 • Lake A24	Lake DS1
Lake A76	• Lake A12	Lake A75 and Lake A10
Lake A75	• Lake A76	Lake A69
Lake A69	• Lake A75 • Lake A81 • Lake A106	Downstream Node 1[c]
Downstream Node 1	• Lake A69 • Lake B1 • Lake B5 • Lake B7	Lake DS1

[a] The effective mixing zone is the area of Mammoth Lake where the discharge is planned. This model assumes an effective mixing zone with a radius of 100 m and variable depth (maximum depth 4.43 m; average depth 2.07 m), which equates to approximately 1.2% of the total volume of Mammoth Lake (Lake A16).

[b] Volume is that of Mammoth Lake (Lake A16) as a whole, minus the effective mixing zone.

[c] Downstream Nodes represent selected monitoring points immediately upstream of Lake DS1. Downstream Node 1 and 2 are downstream of Lake A69 and A5, respectively.

WRSF = waste rock storage facility.

Following Lake A12, the downstream water flow splits into two pathways, where downstream path 1 flows to Downstream Node 1 and downstream path 2 flows to Downstream Node 2 (Figure 3).

3.0 MODEL INPUT PARAMETERS

3.1 Mine Plan and Waste Rock Management

The composition and lithological proportions of waste rock in the Whale Tail WRSF and exposed in the pit walls are expected to change as mining progresses. However, only the total tonnages of each rock type mined over the life of mine and their representative area exposed in the final pit shell were provided at the time of modelling, as shown in Table 5. Thus, for the operational period, these maximum footprint tonnages and area proportions were applied.

Table 5: Total Tonnage in the Rock Storage Facility and Exposed in Final Pit Walls by Lithology

Lithology / Material Type	Total Tonnage Reporting to Rock Storage Facility[a]		Exposed Pit Wall Rock Area[a]	
	Tonnes	Approximate Proportion	Area (m^2)	Approximate Proportion
Greywacke (S3S) – south	9,707,441	21%	91,915	14.7%
Greywacke (S3C) – centre	3,167,882	6.9%	51,006	8.2%
Chert (S10e)	9,069,203	19.7%	65,152	10.4%
Ultramafic (0a)	7,839,953	17%	157,539	25.2%
Ultramafic (0b)	6,292,816	13.6%	50,161	8.0%
Iron Formation (0a-alt)	7,080,011	15.4%	74,331	11.9%
Mafic Volcanic (1b)	2,324,150	5.0%	20,769	3.3%
Intermediate Intrusive (8b)	622,937	1.4%	24,208	3.9%
Overburden	5,618,358	- [b]	88,940[b]	14.3%[b]
Total:	**51,722,752**	**100%**	**535,081**	**100%**

[a] Values from *6108_PJS-002_R3.xlsx (*dated February 22, 2016, Agnico Eagle pers. comm.).

[b] The overburden is stored in a separate area of the Whale Tail WRSF and is not mixed with waste rock. In the pit wall, the overburden is pushed back from the pit wall and does not contribute chemical load to the runoff flowing into the Whale Tail Pit.

3.2 Model Water Quality Inputs

3.2.1 Loading Rates and Concentrations

Table 6 summarizes the water quality related input parameters used in the water quality model. Loading rates are calculated for waste rock (based on large column leaching tests[1]), ore (based on humidity cell tests [HCT] leach), and overburden (based on shake flask extraction [SFE] leach test results). Concentrations were input for lake sediments (average SFE) and ramp water (average HCT results for intermediate intrusive). All leach tests (large columns, HCTs, SFE) are described in Volume 5, Appendix 5-E. Loading rates and concentrations used as inputs in the water quality model are tabulated in Attachment A, including the unique sample identifiers used to develop each input value.

[1] With the exception of the intermediate intrusive unit, which is based on humidity cell test results

Table 6: Water Quality and Chemical Loading Rate Input Parameters

Modelled Flow	Type	Source	Reference	Operations	Closure	Post-Closure
Non-Contact Runoff	Concentration	Average water quality of Watershed A tributaries upstream of Mammoth Lake	Volume 6, Appendix 6-G	x	x	x
Developed Ground Runoff	Loading Rate	Weighted average load of greywacke (S3S) and intermediate intrusive (8b) mixed based on total proportion (Table 5).	Volume 5, Appendix 5-E; Table 5; and Agnico Eagle mine plan[a] (Attachment A)	x	x	x
Whale Tail WRSF Cover						x
Pit Wall Runoff	Loading Rate	Weighted average load from exposed rock types based on their expected proportion in pit walls (Table 5) over entire surface area of the Whale Tail Pit in operations, and over high wall in post-closure		x	x	
High Wall Runoff					x	x
Waste Rock Runoff at Whale Tail WRSF	Loading Rate	Weighted average load from rock types based on the total tonnage to be mined over mine life (Table 5) applied to the waste rock area of the Whale Tail WRSF		x		
Overburden Runoff at Whale Tail WRSF	Loading Rate	Average load of SFE for overburden samples; applied to the overburden area of the Whale Tail WRSF		x		
Construction Overburden Stockpile Runoff	Loading Rate	Average load from SFE leach results for esker samples; applied to the full quantity of esker material stockpile. Being a rolling stockpile, it is assumed to not freeze at the core.	Golder 2014	x	Non-Contact Runoff applied	Submerged (no contribution)
Ore Stockpile Runoff	Loading Rate	Average load from composite humidity cell test sample of ore.	Volume 5, Appendix 5-E	x		
Lake Sediments contact water quality	Concentration	Average SFE leach results for lake sediments samples	Volume 5, Appendix 5-E	x		

Table 6: Water Quality and Chemical Loading Rate Input Parameters

Modelled Flow	Type	Source	Reference	Operations	Closure	Post-Closure
Groundwater quality inflow to Whale Tail Pit	Concentration	75th percentile of Meadowbank groundwater quality (as calculated by Knight Piésold Consulting)	Knight Piésold Consulting 2015	x	x	
Ramp dewatering	Concentration	Average of humidity cell test data for intermediate intrusive (8b) which is the predominant rock type in ramp	Volume 5, Appendix 5-E	x		
Drilling Fluid	Concentration	Average of Whale Tail South water quality, where drilling water will be sourced. No drilling additives (i.e., salt) assumed.	Volume 6, Appendix 6-G	x		
Grey Water	Concentrations of phosphorus and nitrate as nitrogen	Expected concentrations of nutrients (phosphorus, total nitrogen, nitrite/nitrate as nitrogen) based on information provided by Biotest for the Meadowbank Mine	Agnico Eagle (email comm. 26 and 30 July, 2012)	x	x	
Residual explosives in Whale Tail WRSF pond and Whale Tail Pit sump pond	Concentrations of ammonia and nitrate	Whale Tail Pit and Whale Tail WRSF: Average of monitoring values observed in operating open pits at the Meadowbank Mine	Meadowbank Mine water quality monitoring data from Agnico Eagle (email comm. 25 February 2016)	x		x
Direct precipitation	Concentration	Assumed pristine water (0 mg/L for all parameters)		x	x	x

[a-]Values from 6108_PJS-002_R3.xlsx (dated February22, 2016, Agnico Eagle pers. comm.).

WRSF = waste rock storage facility; SFE = shake flask extraction; mg/L = milligrams per litre.

The weekly analytical results (for the full duration of testing available at the time of this report) were used to calculate an average weekly leaching rate per unit mass for each parameter and each leaching cell or column as reported in Volume 5, Appendix 5-E. These leaching rates were applied as a monthly loading rate in the model in consideration of the drier climate at site where much less precipitation falls on a unit surface area than in the laboratory leaching column. One weekly leaching cycle in the laboratory represents the volume of water that is received in 2 to 3 months of exposure in the pile for the same unit surface area[1]. The laboratory leaching rate is repeated 4 times in one month; therefore, time in the laboratory test does not correspond to mine waste exposure time in the field. Based on the liquid to solid ratio of one cycle relative to the monthly average precipitation, the chemical load associated with one cycle of leaching was conservatively assumed to represent the load released from one month of precipitation in the field. Loading rates were calculated from the large column data as follows:

$$Loading\ Rate\left(\frac{\frac{mg}{kg}}{week}\right) = average\ of\ weekly\ rate, as: \left\{\frac{\left(concentration\left(\frac{mg}{L}\right) \times\ leachate\ volume\ (L)\right)}{(mass\ of\ charge\ material\ (kg))}\right\}$$

Diffusion rates were calculated from a submerged column test conducted for the ultramafic and iron formation units (Volume 5, Appendix 5-E) and applied to the area of exposed ultramafic rock in the submerged pit wall, which is equivalent to 45.1% of the final pit wall area (Table 5). The remaining submerged pit wall (54.9%) is assumed to not contribute to diffusion. Diffusion rates were calculated as follows:

$$Diffusion\ Rate\ Flux\left(\frac{\frac{mg}{m^2}}{year}\right) = \ average\ of\ rate\ at\ each\ timestep, as: \left\{\left(\frac{D^oJ}{F}\right) \times\ (n\ \times \frac{dc}{dz})\right\}$$

Where:

- D^oJ = temperature dependent diffusion coefficient for each parameter (from Li and Gregory 1974);
- F = formation factor (or tortuosity), assumed to be 1 for crushed waste rock;
- n= porosity, assumed to be 0.5 for crushed waste rock accumulated on the pit wall; and
- dc/dz = concentration gradient across the sediment-water interface or change in concentration (dc) over gradient distance at the sediment-water interface (dz); from the submerged leaching test.

3.2.2 Geochemical Controls on Water Quality

3.2.2.1 Solubility Limits

Evaporation and recirculation of water increase concentrations of some parameters to beyond their solubility limits. Geochemical modelling was carried out on the modelled quality of Whale Tail WRSF pond water, Attenuation Pond water, and Whale Tail Pit sump water to define the likely upper concentration limit for parameters controlled by solubility. The USGS mass transfer and speciation modelling code PhreeqC (Version 2.15.0) (Parkhurst and Appelo 1999) was used for this purpose. PhreeqC calculates aqueous speciation and solubility indices of solutions using the thermodynamic equations of mineral phases, assuming equilibrium conditions between mineral and soluble phases. The user specifies credible mineral phases that are allowed to precipitate. PhreeqC returns

[1] Based on an average climate year, total precipitations (rain and snow) for frost-free months of June to September when Whale Tail WRSF contact water may be released. This applies to the surface area of all mine wastes: Whale Tail WRSF, pads, and stockpiles.

concentrations remaining after precipitation of the specified mineral phases and solubility indices for all mineral phases in the PhreeqC database. This code is widely used and accepted by the scientific and regulatory community.

GoldSim water quality results consisting of the water quality output from distinct time-steps for each of the stated ponds were used as input to PhreeqC. Pond waters were assumed to have a pH of 7 based on observed pH ranges in kinetic testing (Volume 5, Appendix 5-E), and to be fully oxidizing.

The PhreeqC results identified iron (Fe) and aluminum (Al) as being supersaturated in predicted water quality, and subject to solubility control through the precipitation of diaspore [AlO(OH)], hematite (Fe_2O_3), ferrihydrite and/or goethite [FeO(OH)] in the expected neutral pH and oxidizing conditions in the ponds. The precipitates formed were assumed to be permanently removed from the mass balance and the remaining aqueous concentration of iron and aluminum were considered to represent maximum concentrations in these ponds at any time. These solubility limits were applied to aluminum and iron as summarized in Table 7, and were hardwired into the GoldSim model as upper concentration limits for these parameters in water. The GoldSim model was then re-run with these fixed upper concentration limits.

Table 7: Solubility Limits Applied in the Water Quality Model

Parameter	Unit	Waste Rock Storage Facility Pond	Whale Tail Pit Sump Pond	Attenuation Pond
Aluminum	mg/L	0.0003	0.0002	0.0001
Iron	mg/L	0.06	0.7	0.3

mg/L = milligrams per litre

3.2.2.2 Water Treatment Levels

Agnico Eagle is applying to the NWB to treat effluent discharges to the receiving environment to levels stipulated in Meadowbank Water Licence Type A 2AM MEA1525 (NWB 2015) Part F, Item 3 for Portage Effluent (Table 8). In the model, concentration limits were imposed on parameters that exceeded the Portage Effluent limits. To ensure Part F, Item 3 limits are met at the final discharge point, for modelling purposes, treated water concentration maxima were fixed at half the maximum monthly mean limit according to typical water treatment plant performance observed at other mine sites (Mario Drapeau, Agnico Eagle pers. comm).

Agnico Eagle also is applying to the NWB to consider Whale Tail WRSF drainage quality meeting the Portage Effluent Limits either through modified water or waste management, or through water treatment. In the model, the same treated water concentration maxima were imposed on closure and post-closure discharges from the Whale Tail WRSF. This affected the concentration of predicted arsenic concentrations only. As per NWB Type A Water Licence Part E Item 6 and 8 requirements, a site wide water balance will be updated as part of the annual water management plan and end pit water quality modelling will be conducted to update these predictions.

Table 8: Portage Effluent Limits and Treatment Concentrations Applied to Effluent and Site Discharge

Parameter	Units	Portage Effluent Limits (Maximum Monthly Average Concentration)	Assumed Treatment Concentration[a]
Arsenic (As)	mg/L	0.3	0.15

[a] This is an assigned treatment concentration that is calculated as half of the Portage Effluent Limit, as per Water Licence 2AM MEA1525 (NWB 2015). The level of treatment may depend on empirical monitoring data during operations.

[b] Limit for dissolved aluminum used, all other effluent limits are for total.

mg/L = milligrams per litre

4.0 MODEL ASSUMPTIONS

Table 9 summarizes the water quality assumptions applied in the model.

Table 9: Water Quality Assumptions

Property	Assumption	Rationale	Operations	Closure	Post-Closure
On-Site Assumptions:					
Temperature Control	Loading rates are multiplied by: 0.5 for July and August 0.25 for June and September 0 for October to June	Loading rates are halved for every 10˚C decrease in temperature from 25˚C[a], based on monthly average temperatures[b]. Factor is 0 in winter months as average monthly temperatures are below 0°C	x	x	x
	Pit lake diffusion and submerged load are multiplied by 0.25 year round	Assumes temperature of water at depth in contact with pit walls is 5˚C all year (does not freeze but is not affected by warming surface temperatures)		x	x
Rock Density	2 tonnes/m^3 applied to all stockpiled rock material and pit walls	"Loose Density" of Whale Tail WRSF per the design criteria[c]	x	x	
Grain size/ channelization factor	Channelling factor of 0.3[d] applied to loading rate of construction material, ore, waste rock including the cover	Represents the percentage of rock with grain size small enough that its surface contributes to the mass load and movement or flow of mass through the Whale Tail WRSF	x	x	x
	Channeling factor of 1 applied for overburden (assumed 100% contact with grains, no channelization)		x		
Active Layer Depth	2 m for waste rock stockpiles including cover and developed areas	Within the active thaw depth range for flat surfaces at Meadowbank Mine	x	x	x
	0.15 m for overburden stockpile	Assumes contact of runoff with compacted overburden. Thickness of layer through which runoff will flow and contact soil particles.	x		
	1 m for pit wall rock[e]	Represents the depth of penetration of blasting-induced fractures. This was assumed to have the porosity of waste rock in consideration of the rubble that will remain on pit wall benches.	x	x	x
Ore Stockpile	1.14 Mt ore tonnage used to determine loading rate	Mass contribution to chemical load was derived from the mine plan[f] and conservatively assumes the maximum expected tonnage to be stockpiled in any given quarter-year for the three years of mine life. It is assumed that the ore stockpile will not freeze during the winter months	x		

Table 9: Water Quality Assumptions

Property	Assumption	Rationale	Operations	Closure	Post-Closure
		as its contents are expected to be continually refreshed.			
Clean Material Stockpile	100,000 m^3 clean construction material (esker) tonnage used to determine loading rate	Mass contribution to chemical load was based on an anticipated tonnage provided by Agnico Eagle (pers. com., January, 2016).	x		
Whale Tail WRSF cover	2 - 4 m of cover over the Whale Tail WRSF	Assumed greater thickness than the active layer depth		x	x
Water Treatment	Assumes Portage effluent levels for arsenic are met at the point of discharge.	Applied to Attenuation Pond water discharged to the downstream receiving environment	x		x
		Applied to Whale Tail WRSF pond water in closure when it is pumped back to Whale Tail Lake (North Basin) to contribute to filling, and in post-closure when it overflows to Mammoth Lake, assuming the Whale Tail WRSF contact water quality will be managed to meet effluent discharge criteria at that time.		x	x
	Discharge Velocity	Assumed to not be discharged through diffusion.			
Pit Wall	Loading rate applied to area of exposed pit wall rock by rock type (Section 3.1)	Assumed to stop once the pit walls are submerged due to flooding	x	x	
	5 m height of perpetually exposed high wall around the pit	High wall assumed to be the average height of ground above 152.5 masl (the maximum flooded lake surface elevation). Average height was applied around entire circumference of Whale Tail Pit footprint.	x	x	x
	Loading rate for submerged pit walls during pit filling	One time mass “flushed” from the pit walls upon submersion as the pit and Whale Tail Lake (North Basin) fill. The submerged pit wall is assumed to no longer contribute load after flooding, except in sensitivity analysis on diffusion from submerged pit wall.			
	Sensitivity analysis on diffusive mass loading from submerged pit walls	Mass addition through diffusion from exposed ultramafic rock in the submerged pit walls that continues in perpetuity in the model.			

Table 9: Water Quality Assumptions

Property	Assumption	Rationale	Operations	Closure	Post-Closure
Ore and construction material stockpile areas	Developed area runoff water quality	Ore stockpile and clean material pile are removed from pad. Pad remains in place.		x	
	Natural runoff water quality	Stockpile pads are removed			x
Lakebed sediments	Sediment loading rate	Lakebed sediments provide load until attenuation pond is full, and then provide natural runoff water quality thereafter (i.e. baseline water quality).		x	
	Natural runoff water quality	Assumes water quality returns to baseline conditions when pit is full.		x	x
Industrial Sector / Main Camp Sector	Natural runoff water quality	Assumes water quality returns to baseline conditions when pit is full.		x	x
Off-Site / Downstream Assumptions:					
Downstream watersheds	Watershed runoff water quality	Applying average "Watershed A" water quality to all runoff and initial lake concentrations in downstream model. Average water quality developed from tributary samples taken within watershed A in 2015 (Volume 6, Appendix 6-G)	x	x	x
Mammoth Lake	Water quality of diverted flow from Whale Tail Lake (South Basin)	Diverted flow from Whale Tail Lake (South Basin) to Mammoth Lake is assigned an average Whale Tail Lake (South Basin) water quality, developed from samples taken in Whale Tail Lake (South Basin) in 2015 (Volume 6, Appendix 6-G).	x		
		Receives treated effluent and natural outflows from Whale Tail Lake (North Basin).			x
Whale Tail Lake (North Basin)	Water quality of flow from Whale Tail Lake (South Basin) following breach of Whale Tail dike	Assigned an average Whale Tail Lake (South Basin) water quality, developed from samples taken in Whale Tail Lake (South Basin) in 2015. (Volume 6, Appendix 6-G)			x

[a] Diavik (1998); Davé and Clulow (1996); Davé and Blanchette (1999).
[b] Water Management Plan (Volume 8, Appendix 8-B.2).
[c] Volume 2, Appendix 2-J.
[d] Kempton (2012); and Beddoes et al. (2013).
[e] Siskind and Fumanti (1974).
[f] Values from *6108_PJS-002_R3.xlsx (*dated February22, 2016, Agnico Eagle pers. comm.).
[g] Per Water Licence 2AM MEA1525 (NWB 2015).

5.0 WATER QUALITY PREDICTIONS

Water quality model results for on-site facilities and downstream lakes during operations and post-closure are presented in Attachment B as tables containing all model output results. Time series figures are included for the parameters of interest in water quality as identified in the mine waste geochemistry study (Volume 5, Appendix 5-E) and the downstream water quality impact assessment. These include arsenic, nitrate and sulphate, and aluminum and phosphorus, respectfully.

Model predictions represent dissolved parameter concentrations. Those that are predicted to exceed the applicable criteria are highlighted in Attachment B. On-site water quality predictions are compared to the Portage effluent limits (Table 8; NWB 2015) in operations and post-closure, while the downstream predictions are compared to the CCME Canadian Environmental Quality Guidelines for the Protection of Aquatic Life (CCME 2002; CEQG-AL) for applicable parameters, and to the Site-specific Water Quality Objective (SSWQO) for Arsenic (Volume 6, Appendix 6-N).

Predicted concentrations are monthly mean values during operations, and open water (summer time) mean values in post-closure. Individual grab sample concentrations may vary from the monthly or summer averages predicted. Given the uncertainties associated with the modeling exercise, and use of an average climate year on the maximum mine operation footprint in the water balance, the predicted concentrations are considered to be order-of-magnitude estimates. As such, concentrations that are predicted to meet water quality criteria may exceed them on occasion within a given month.

The pH of most contact water streams is expected to be circum-neutral given the low sulphide content and ample carbonate mineral buffering capacity of mine wastes. The rock types that have been identified as potentially acid generating (PAG) demonstrate slow reaction rates in kinetic testing (Volume 5, Appendix 5-E). In the model it has been assumed that PAG rock is managed to prevent the development of ARD in the long term, as is done at the Meadowbank Mine. This includes segregating and covering the Whale Tail WRSF with a non-PAG waste rock cover between 2 and 4 m in thickness (Table 9) that encompasses the full depth of the anticipated active thaw layer (assumed 2 m; Table 9) allowing the centre of the pile to freeze.

The concentration of explosives by-products (ammonia and nitrate) in site contact water is sensitive to the management of blasting agents during their use. Given the proximity and similarity both in setting and operation of the Project to the Meadowbank Mine, it was assumed that similar nitrogen contents would occur in the waste rock and open pit drainages. Average concentrations of ammonia and nitrate observed at Meadowbank Mine pit sump monitoring locations were used as input chemistry in the model, and constant concentrations were maintained in the pit sump and Whale Tail WRSF pond. However, the predicted concentrations of these parameters could differ from those recorded at the Meadowbank Mine if the explosives management practices implemented at the Project differ from those at Meadowbank Mine.

Total suspended solids (TSS) were not considered in the mass load model, but TSS concentration is regulated in effluents. Based on experience at other mine sites, it is anticipated that suspended solids will require monitoring and management or attenuation before discharge. TSS can contribute to chemical loading of water (i.e., can increase the total concentration of chemicals). The effect of 15 mg/L TSS on effluent water quality was assessed as a sensitivity analysis on the effluent water quality (Section 5.3.3); results of the sensitivity analysis are presented in together with dissolved parameters concentrations in Table B.3 of Attachment B.

Water quality predictions for on-site mine contact waters and downstream receiving lakes for the operations phase and post-closure are discussed in the next sections.

5.1 Operations Phase

The water qualities of the Whale Tail WRSF pond, Whale Tail Pit sump pond, and the Attenuation Pond are all expected to meet the Portage effluent limits for all parameters except arsenic and total dissolved solids (TDS). Predicted average arsenic concentrations are above the Portage effluent limit at all locations at some point in the year. Exceedances are discussed further below.

In the Whale Tail WRSF, TDS, which is primarily composed of sulphate, shows marginal exceedances of the Portage effluent limit in July and August when pond volumes are low and the evaporation rate is high.

The water quality model suggests that mercury concentrations are above the Portage effluent limit for the Whale Tail WRSF but this is an artefact of the approach taken on non-detected analytical results. Mercury was often identified in laboratory leachates as being below the analytical detection limit. Where this was the case however, the full method detection limit value was assumed. Predicted concentrations are below the Portage effluent limit when the half method detection limit value is used; however, the full method detection limit concentration was kept for consistency with other parameters. Therefore, mercury is not expected to be present at concentrations above the Portage effluent limit in site waters.

Average and maxima TDS and arsenic concentrations are summarized in Table 10 for the Whale Tail WRSF pond, Whale Tail Pit sump, and Attenuation Pond. Figure 4 illustrates the predicted arsenic concentrations with time in the mine contact water ponds and in untreated effluent.

Table 10: Summary of Predicted Concentrations from Point Sources During Operations for Parameters of Interest

Location	Units	TDS[a]		Arsenic	
		Average	Maximum	Average	Maximum
Whale Tail WRSF Pond	mg/L	665	2814	4.9	21
Whale Tail Pit Sump	mg/L	465	962	1.9	7.5
Attenuation Pond	mg/L	384	751	1.5	3.2

[a] TDS calculated from model results

[b] Per Water Licence 2AM MEA1525 (NWB 2015).

mg/L = milligrams per litre

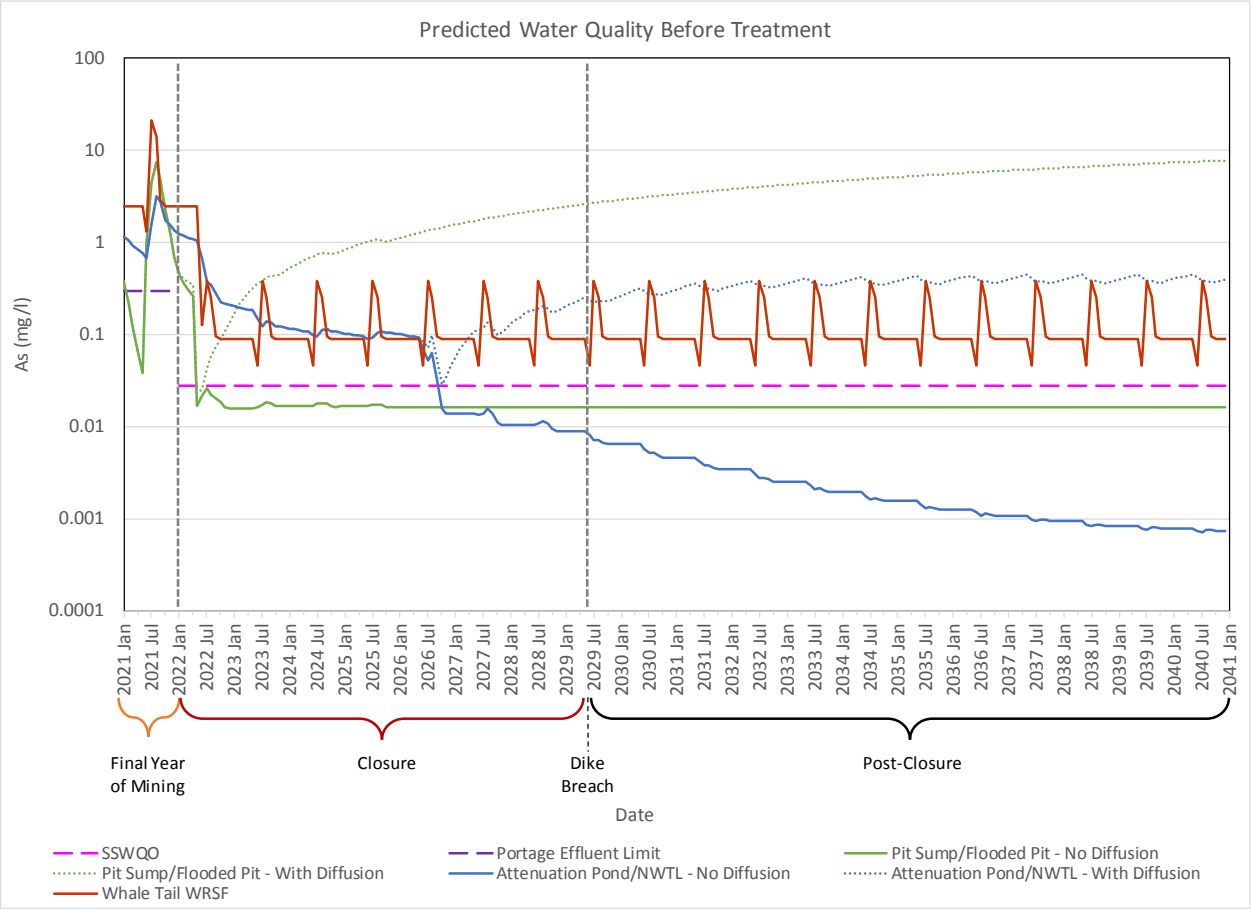


Figure 4: Predicted Dissolved Arsenic Concentrations in Mine Site Ponds

Note that results presenting diffusion should be considered conservative and representative of a worst-case scenario of the "maximum, fully mixed concentration" in the flooded Whale Tail Pit and Whale Tail Lake (North Basin). A Site-specific Water Quality Objective of 0.028 mg/L was developed for the Project (Volume 6, Appendix 6-N).

In the Whale Tail WRSF pond, predicted arsenic concentrations are lowest during the spring freshet due to dilution by melt water and non-contact flows. Concentrations are higher in the summer months when there is a lower contact water runoff volume. Maximum concentrations are reached in July and August, when rainfall is the lowest and there is less runoff from the pile. This is consistent with the observed increase in chemical load with lower water volume contact in kinetic leaching tests on Whale Tail waste rock under laboratory conditions, where the liquid to solid ratio was purposefully varied to assess this potential (Volume 5, Appendix 5-E). However, the extrapolation and scaling of this trend to site conditions carries uncertainty, and will need to be verified during operations.

In the Whale Tail Pit sump pond, predicted arsenic concentrations are lowest during the spring freshet and increase through the summer months, reaching a peak in August before decreasing from September through the winter months. Elevated concentrations in the summer months are related to loading from increased pit wall runoff. Arsenic concentrations are lower (and below Portage effluent limits) from February to May, when there is no pit

wall runoff and proportionally more contribution of arsenic-poor groundwater and drilling water to the Whale Tail Pit sump pond.

The Attenuation Pond predictions for arsenic reflect dilution of inflows from the Whale Tail WRSF pond and Whale Tail Pit sump pond when combined with various runoff contributions having lower arsenic loads. Arsenic concentrations increase from July through August, and decrease again from September through the winter months. During operations, this water is expected to require treatment for arsenic before discharge to the receiving environment.

5.2 Post-Closure

5.2.1 On-Site Predicted Water Quality

Post-closure results provide a preliminary estimate of water quality after the end of mine life, and reflect assumed steady state conditions ten years after closure has been completed.

At the Whale Tail WRSF pond, some parameters exhibit average predicted concentrations that are above the CEQG-AL, including: cadmium, copper, fluoride, lead, mercury, selenium, and uranium. Arsenic concentrations (Table 11) are above the SSWQO. All average concentrations are within the same order of magnitude as the CEQG-AL guidelines, with the exception of fluoride and cadmium.

Table 11: Predicted Concentrations for Parameters Exceeding CEQG-AL Post-Closure

Location	Units	Arsenic	
		Average	Maximum
SSWQO	mg/L	***0.028***[a]	
Whale Tail WRSF pond	mg/L	**0.12**	**0.38**
Pit Lake (below Whale Tail Lake (North Basin))	mg/L	0.016	0.016
Whale Tail Lake (North Basin)	mg/L	0.00082	0.00084

Note: **Bolded** values are above SSWQO

a Site-specific Water Quality Objective of 0.028 mg/L developed for the Project (Volume 6, Appendix 6-N).

mg/L = milligrams per litre

In the fully flooded pit lake below the base of Whale Tail Lake (North Basin), as well as in Whale Tail Lake (North Basin) above the Whale Tail Pit, there are no exceedances of the CEQG-AL criteria or the SSWQO for arsenic. As per NWB Type A Water Licence Part E Item 6, Agnico Eagle will continue to evaluate the actual interaction between the two water bodies (water within the pit and water above it forming Whale Tail Lake) as well as possible chemical stratification of the flooded pit lake (which would result in improved water quality in the shallow pit lake). As per Part E Item 6, the dikes shall not be breached until the water quality in the flooded area meets CEQG-AL criteria, baseline concentrations or appropriate SSWQOs.

The water qualities in the fully flooded Whale Tail Pit and Whale Tail Lake (North Basin) are predicted to be relatively constant throughout the year. Arsenic concentrations are below the SSWQO in Whale Tail Lake (North Basin) and are suitable for overflow to Mammoth Lake, assuming that diffusion from the pit wall rock will not occur, nor any exchanges between the Whale Tail Pit and above lake water in a fully mixed pit Lake scenario (which is a conservative assumption. In reality, stratification is expected which is likely to improve water quality in the upper contact zone with Whale Tail Lake (North Basin) water). The results of the sensitivity analysis on diffusion from pit walls are discussed in Section 5.3.2.and shown in Figure 4.

Whale Tail WRSF pond drainage average water quality is predicted to meet CEQG-AL concentrations for most parameters, except cadmium and fluoride. Arsenic exceeds the SSWQO. Sporadic concentrations above CEQG-AL are predicted for other parameters (e.g., chromium, copper, molybdenum, nickel, silver, lead, mercury, selenium, and uranium), based on the maximum predicted concentrations.

As stated earlier, for the purpose of modeling downstream water quality, it is assumed that concentrations in the treated water (from the Whale Tail WRSF pond and the Attenuation pond) will be equal to half the Portage effluent limit when concentrations are predicted to exceed the effluent limit for regulated parameters (Section 5.2.2).

5.2.2 Off-Site and Downstream Predicted Water Quality

During operations and post-closure, treated mine effluent is discharged in Mammoth Lake (Lake A16). Initially it mixes in the Effluent Mixing Zone (EMZ) of Mammoth Lake, the zone in the vicinity of the discharge point, then mixes with the rest of Mammoth Lake and further downstream lakes until the final modelling nodes located at inlets to Lake DS1. Results are presented for lakes shown in Figure 3.

As indicated in Table 9, treated Whale Tail WRSF water in post-closure was assumed to meet half the Portage effluent limit for arsenic, where the predicted concentrations were above the Portage effluent limit. Other inflows were input as modelled. As required in the Type A Water Licence, Agnico Eagle will control site contact water, (including the Whale Tail WRSF pond) during operations and post-closure through either source control or passive treatment; the need for which will be evaluated during operations.

When the mine is at its maximum footprint, the predicted concentrations at downstream locations are below CEQG-AL for all applicable parameters and below the SSWQO for arsenic. This is an estimate of water quality under fully mixed conditions where the effluent and downstream lake overflows are being mixed instantaneously in the downstream receiving water body. In reality, mixing will occur over time and could result in sporadic elevated or reduced concentrations at various locations at any given time. Post-closure, all applicable dissolved parameters concentrations are predicted to meet CEQG-AL, and arsenic is predicted to meet the SSWQO.

Predicted dissolved arsenic concentrations in downstream Lakes are summarized in Table 12 and shown schematically (not to horizontal scale) in Figure 5.

Table 12: Predicted Dissolved Arsenic Concentrations in Downstream Lakes

Location	Units	Operations		Closure		Post-Closure	
		Average	Maximum	Average	Maximum	Average	Maximum
SSWQO[a]	mg/L	***0.028***					
Mammoth Lake	mg/L	0.016	0.018	0.0096	0.018	0.0029	0.0030
Lake A15	mg/L	0.015	0.016	0.0088	0.016	0.0027	0.0028
Lake A12	mg/L	0.014	0.015	0.0085	0.015	0.0026	0.0026
Downstream Node 1	mg/L	0.00096	0.0012	0.00063	0.0010	0.00040	0.00044
Downstream Node 2	mg/L	0.0048	0.0063	0.0030	0.0058	0.0013	0.0015

Note: **Bolded** values are above SSWQO.
a Site-specific Water Quality Objective of 0.028 mg/L developed for the Project (Volume 6, Appendix 6-N).
mg/L = milligrams per litre

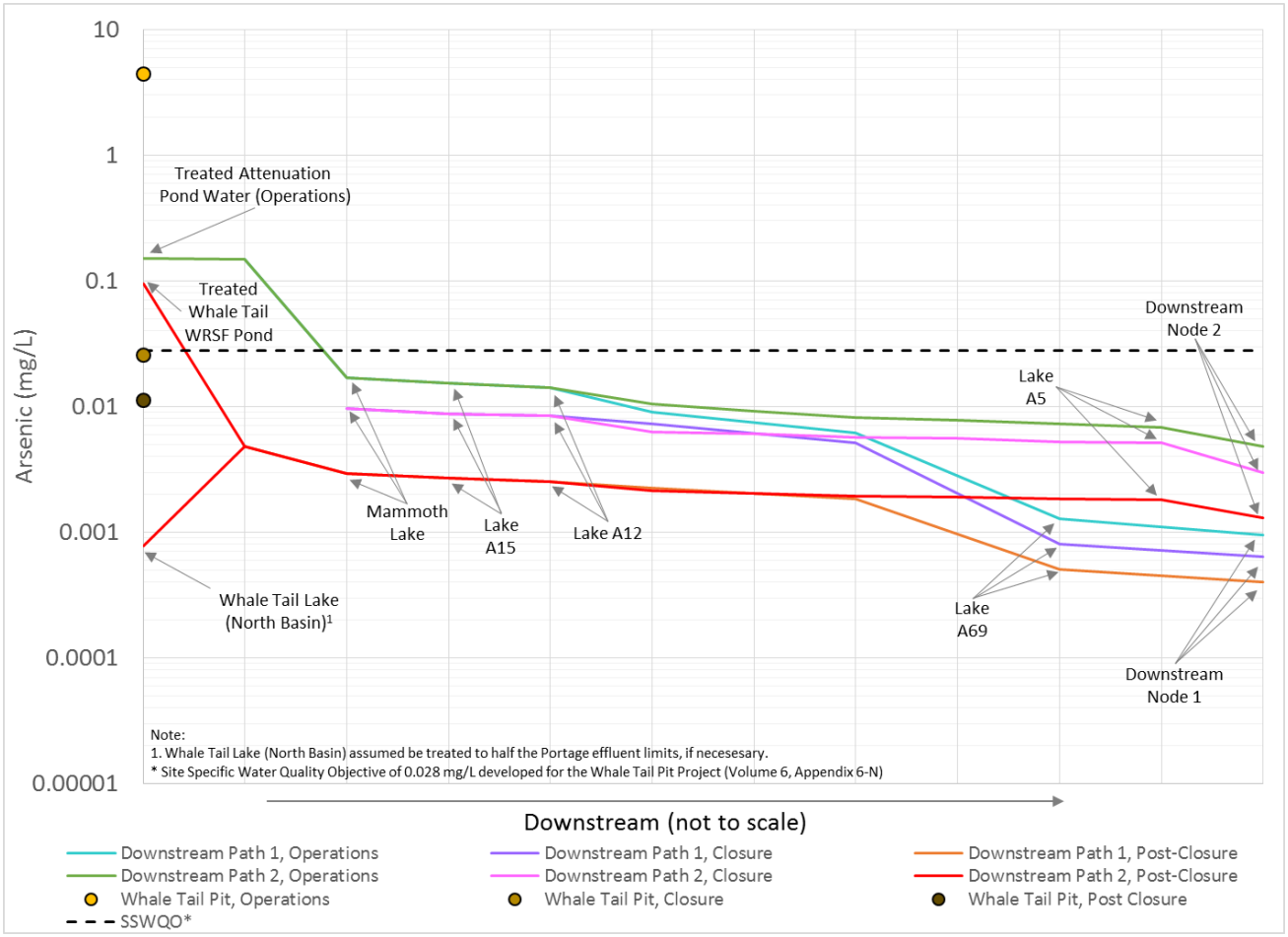


Figure 5: Operations Period: Predicted Arsenic Concentration in Downstream Lakes From Effluent Discharges During Operations

5.3 Sensitivity of Model to Assumptions

5.3.1 Overburden Contact Water Quality – Operations

The use of SFE leach test results in the modelling exercise yielded relatively high loading rates per unit weight of overburden compared with what would be anticipated from kinetic testing, the latter more representative of leaching under ambient site conditions. This is an artefact of the nature of the SFE leaching test (i.e. intimate contact and vigorous agitation of water with soil particles). Overburden contact water quality is highly sensitive to degree of compaction, which affects the soil to water contact. This is a source of uncertainty in the model.

5.3.2 Diffusion from Submerged Pit Walls – Closure and Post-Closure

Arsenic was observed to leach under stagnant water conditions in a submerged column leaching test conducted on a composite of ultramafic and iron formation rock (Volume 5, Appendix 5-E). The ultramafic and iron formation rocks comprise approximately 45% of the Whale Tail Pit walls; therefore, calculated diffusion rates were applied in the model to 45% of the submerged pit wall during pit filling and under fully mixed conditions.

The diffusive transfer of arsenic (and other chemicals) from the submerged pit walls to the Whale Tail Pit Lake and Whale Tail Lake (North Basin) could result in elevated arsenic concentrations in the pit lake under some conditions, as shown by the dotted line on Figure 4. The direct extrapolation and scaling of laboratory results to field conditions are, however, uncertain, and would require field verification. Similarly uncertain are the hydrogeological and hydrodynamic conditions that will be established in the pit lake: these may mitigate arsenic concentrations relative to those observed in the column test and used in this modelling exercise.

Post-closure hydrodynamic conditions in the fully flooded pit lake and Whale Tail Lake should be evaluated once field data is available in order to better understand whether diffusion would occur under anticipated conditions. Diffusion rates are particularly sensitive to the flooded Whale Tail Pit being a groundwater recharge or discharge zone, as well as whether chemical and/or temperature stratification occurs in the lake. This should be further evaluated.

The water quality predictions presented herein do not account for diffusion from the pit wall rock in the post-closure pit and Whale Tail Lake (North Basin) because it is assumed that the pit and Whale Tail Lake (North Basin) are not recharged with groundwater, but rather, groundwater recharge points at the north end where ultramafic and iron formation rock are exposed, based on a comparative evaluation of surrounding Lake levels (Table 3; Volume 6, Appendix 6-B). However, a model simulation was completed using conservative assumptions for diffusion and these results are included on Figure 4. Due to the assumptions and uncertainty surrounding the influence of diffusion on water quality in the flooded pit and Whale Tail Lake (North Basin), results presenting diffusion should be considered conservative and representative of a scenario where the pit and Whale Tail Lake (North Basin) are groundwater discharge points and where there is vertical exchange of water between the flooded pit lake and overlying Whale Tail Lake water.

5.3.3 Effect of Total Suspended Solids on Total Parameter Concentrations

Total metal concentrations for Project discharges were estimated by adding a calculated particulate fraction to the dissolved concentration results from the model. Particulate fractions for the relevant parameters were based on solid phase geochemistry of each rock type, the proportion of each rock type in the final waste rock mass, and an assumed TSS concentration of 15 mg/L in the Project discharge, the maximum monthly average limit in Type A Water Licence Part F Item 3 Portage effluent (NWB, 2015).

During operations, the addition of the particulate fraction did not produce any substantial change from the dissolved concentrations for most parameters except Al and Fe which showed a substantial increase in total concentration. Chromium also showed an increase, but to a lesser extent. This is expected for Al and Fe as they are estimated to make up the bulk of TSS while aqueous concentrations are low. Thus any presence of total Al or Fe in effluent would be attributed to particulates rather than the dissolved phase given the anticipated neutral pH and oxidative environment. Calcium and magnesium also comprise an important part of the suspended solids chemical composition, but their concentration is predicted to be elevated such that the additional contribution from TSS is not significant.

In post-closure, modelled aluminum, chromium, and iron indicate higher total concentrations than dissolved concentrations, and exceed CEQG criteria in both the Whale Tail WRSF Pond and Whale Tail Lake (North Basin). In the Whale Tail WRSF Pond, the total arsenic concentrations do not differ much from dissolved concentrations which are already predicted to exceed the SSWQO (their concentration may need to be controlled at the source in the long-term). Total arsenic concentrations could be lower than predicted if TSS in Project discharge is lower

than 15 mg/L, but there is also the potential for the concentrations to be higher if the main contributor to TSS contains more arsenic than estimated (if TSS is derived principally from ultramafic rock). Table 13 summarizes the results for total concentrations of aluminum, arsenic, chromium, and iron for operations, while the total concentrations for post-closure are presented in Table 14.

Table 13: Predicted Discharge Water Quality during Operations – Effect (Sensitivity) of TSS on Predicted Total Concentrations

Location	Units	Aluminum		Arsenic		Chromium		Iron	
		Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
Portage Effluent Limit[a]	mg/L	***1.5***		***0.3***		**-**		**-**	
Attenuation Pond discharge after treatment (dissolved)	mg/L	0.0001	0.0001	0.15	0.15	0.0071	0.016	0.3	0.3
Attenuation Pond discharge (total)	mg/L	0.32	0.32	0.16	0.16	0.016	0.025	1.1	1.1

Note: **Bolded** values are above Portage effluent limits.

[a] Maximum average concentration, Meadowbank Water Licence 2AM MEA1525 (NWB 2015).

mg/L= milligrams per litre

Table 14: Project Discharges Post-Closure – Effect (sensitivity) of TSS on Predicted Total Concentrations

Location	Units	Aluminum		Arsenic		Chromium		Iron	
		Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
CEQG-AL	mg/L	***0.1***		***0.028***[a]		***0.001***		***0.3***	
Whale Tail Lake (North Basin) - dissolved	mg/L	0.0001	0.0001	0.00079	0.000081	0.000073	0.000073	0.020	0.020
Whale Tail Lake (North Basin) - total	mg/L	**0.32**	**0.32**	0.0059	0.0059	**0.0091**	**0.0091**	**0.77**	**0.77**
Whale Tail WRSF Pond - dissolved	mg/L	0.0003	0.0003	**0.095**	**0.15**	0.00046	**0.0014**	0.058	0.060
Whale Tail WRSF Pond - total	mg/L	**0.32**	**0.32**	**0.10**	**0.16**	**0.0094**	**0.010**	**0.81**	**0.81**

Note: **Bolded** values are above CEQG-AL

[a] Site-specific Water Quality Objective of 0.028 mg/L developed for the Project (Volume 6, Appendix 6-N).

mg/L= milligrams per litre

5.4 Limitations of Predicted Results

Given the complex interplay of climate, the geochemical nature of the rock materials, and the physical characteristics of the mine facilities, several simplifying and conservative assumptions were included in the modelling process. The water quality predictions presented in this report are a reflection of these assumptions.

While it is believed that the modelling approach and resulting water quality predictions presented herein are consistent with industry practices and appropriate for evaluating potential impacts associated with the Project, actual contact water quality during construction, operations, closure, and post-closure may differ from the predictions presented.

Actual water quality will largely depend on the mine plan and management practices followed during mining, and on site conditions related to water movement and chemical loading. In that respect, the extent to which actual dissolution of rock particles in waste rock piles and the subsequent release of chemical constituents into drainage water will affect water quality will depend on the volume of water infiltrating into the rock pile, the contact surface between water and rock, the dissolution kinetics under site conditions, and the internal characteristics of the piles themselves (e.g., temperature, degree of saturation, presence of ice). This, in turn, will depend largely on climate, particularly the amount of precipitation and evaporation, and the ambient air temperature. In wet years, for example, larger volumes of water may enter waste rock piles and result in the mobilization of greater volumes of mineral dissolution products than in drier years. Likewise, the presence of permafrost and/or ice within the rock voids may inhibit water movement and the mobilization of dissolution products in drainage reporting from the facility, or the use of drilling brines or underground development and saline groundwater production could require different handling procedures. This has not been accounted for in the model.

Given the above, the mine site contact water flow volumes and quality will need to be monitored throughout the mine life, and the management of contact water will need to be adaptive.

6.0 CONCLUSIONS AND WATER MANAGEMENT CONSIDERATIONS

This report presents the results of predictive water quality modelling for future mine site water collection ponds and lakes that receive mine contact water downstream of the effluent discharge point for the Project. The model was built using the GoldSim simulation code for the mine site and uses a downstream water balance onto which were superimposed mass load components from Whale Tail baseline water quality investigations and mine waste geochemistry studies (Volume 5, Appendix 5-E).

The water balance provided monthly average flow volumes from each infrastructure component using average precipitation year climate data. Flows were provided for the maximum mine footprint during operations (i.e., year 4 of operations). Post-closure flows were provided by Agnico Eagle using the same assumptions and hydrology input data as for the operations water balance, but on a mine footprint that represents post-closure conditions.

The water quality model provides a forecast of the predicted quality of mine site contact water in the last year of operations and at steady-state conditions post-closure, when flows have returned to normal, pre-mining conditions. The mine construction and early operations periods were not modelled, nor is the mine closure period.

6.1 Results Summary

The Whale Tail area covers a small watershed area with limited dilution potential. Mine wastes are shown to have a relatively benign composition. Arsenic is an element of interest in most Whale Tail waste rock types. Laboratory testing has demonstrated that it can be released at relatively high concentrations from ultramafic and iron formation rock (Volume 5, Appendix 5-E). A few other elements are also released at concentrations that exceed the applicable water quality criteria, but at a smaller scale and less pervasively than arsenic.

Results from laboratory leaching tests are not guarantors of the site contact water quality because of their limited ability to reproduce field conditions. Differences in climate and scale of mine facilities at Whale Tail influence the hydrological processes that dictate water to rock and soil contact, which in turn affect the release and transport of chemicals in contact waters. No field trials are available at this time to validate and accurately scale laboratory results to the anticipated cold and dry field conditions at Whale Tail. Long-term exposure data to accurately estimate operational and post-closure chemical loading rates are also not currently available. Consequently, a conservative number of assumptions were made in the modelling exercise based on literature, good practice, and comparisons between laboratory results and actual water quality data from the Meadowbank Mine and the Meliadine project (Bertrand et al. 2012), both of which have similar rock types that leach arsenic. These assumptions, together with those on site hydrology and proposed mine waste management practices, introduce uncertainty in the model and will need to be verified through operational monitoring.

The results are considered accurate within one order of magnitude for the conditions and site configuration that were modelled. The prediction of monthly average results implies that actual concentrations can be higher or lower at any given time during the month.

The following is a summary of key considerations in the interpretation of the water quality predictions presented herein:

- Modelling results are sensitive to the mine plan, mine layer and waste management plans. Any changes in these conditions will affect the accuracy of predictions.

- During operation, arsenic in the Attenuation Pond is predicted to require treatment before discharge to meet the Portage effluent limits. A significant proportion of the arsenic comes from leaching of the ultramafic and iron formation rock exposed in a large section of the Whale Tail Pit wall and stored in the Whale Tail WRSF. Experience at the Meadowbank Mine and Meliadine project (Bertrand et al. 2012) suggests that field conditions are likely to show much lower concentrations in contact water than predicted. The assumptions used in the model may be overly conservative and results may represent worst case water quality, should there be any water at all seeping out of the Whale Tail WRSF and the Whale Tail Pit walls. Experience at Meadowbank Mine suggest there is likely to be very little water reporting to the base of the Whale Tail WRSF during operations.
- It is expected, and was assumed in the model, that ARD will not develop during mining and that PAG waste rock will be managed effectively, as it is at the Meadowbank Mine. The cover of waste rock is assumed to effectively host the active thaw depth in perpetuity over the entire Whale Tail WRSF. The rock type used for the cover is predicted to release arsenic at concentrations that may exceed the Portage effluent limit. Fluoride concentrations are relatively elevated but are predicted to meet CEQG-AL in the receiving environment.
- Arsenic release from submerged Whale Tail Pit walls is a source of uncertainty in the prediction of the long-term water quality of the flooded pit lake and Whale Tail Lake (North Basin). The source of the uncertainty lies in the occurrence of arsenic in waste rock and its leachability, which is currently being investigated (Volume 5, Appendix 5-E). There is also uncertainty in the hydrogeochemical and hydrological conditions that will occur in the waste stockpiles and pit walls, and in the hydrological conditions in the Pit Lake and Whale Tail Lake, neither of which have been studied in detail. The base-case scenario results presented herein assume that arsenic diffusion is not significant post-flooding because the Whale Tail Pit is assumed to act as a groundwater recharge zone. This assumption is based on an overview of area lake water elevations, but disregards the possible effects of differing pit and groundwater densities.
- As per NWB Type A Water Licence Part E Item 6 and 8 requirements, Agnico Eagle will continue to conduct a site wide water balance will be updated as part of the annual water management plan and end pit water quality modelling will be conducted to update these predictions. As per Part E Item 6, the shall not breach dikes until the water quality in the flooded area meets CCME Water Quality Guidelines, baseline concentrations or appropriate SSWQOs.
- Nitrate, ammonia and phosphorous in mine site contact waters are sourced mostly from explosives residues and grey water treated effluent. The model input for these sources is from Meadowbank Mine operational data. The concentration of nitrate, ammonia and phosphorous in the Attenuation Pond is predicted to meet the Portage effluent water quality limits such that additional treatment is not predicted to be necessary. The model results may not apply if explosives or grey water management practices at the Project differ from those of the Meadowbank Mine.
- Underground mining has not been accounted for in this model. Should underground development occur, saline waters may be generated from drilling fluids, saline groundwater, or a combination thereof and may require additional management prior to discharge off-site.
- The volume of Mammoth Lake is low compared to the volume of effluent discharged during operations. Modelling indicates that water quality in Mammoth Lake will be sensitive to the quality of the effluent

discharged from the Project during operations, and overflow from Whale Tail Lake (North Basin) in post-closure.

- Water quality monitoring should be carried out as described in the Water Management Plan during construction, operations, closure and post-closure. As per NWB Type A Water Licence requirements, this information will be collected to verify the mass load inputs to the model and calibrate forecasted water qualities.

7.0 CLOSURE

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ATTACHMENT A

Water Quality Input Parameters

Appendix A
Water Quality Model Inputs
Whale Tail Project, Meadowbank Division
Agnico-Eagle Mines Limited

GOLDSIM INPUT:	ORE	GREYWACKE (S3S)	GREYWACKE (S3C)	CHERT (S10e)	ULTRAMAFIC (0a)	IRON FORMATION (0a-alt)	ULTRAMAFIC (0b)	MAFIC VOLCANIC (1b)	INTERMEDIATE INTRUSIVE (8b)	OVERBURDEN	LAKE SEDIMENT	CONSTRUCTION MATERIAL FOR PADS	"OVBN PILE" CONSTRUCTION MATERIAL	RAMP (Intermediate Intrusive - 8b)	ULTRAMAFIC SUBMERGED PIT WALL DIFFUSION
DATA SOURCE:	HCT (AMQ-ENV15-089 076 Composite)	Column #4 Grewake (Outside ore)	Column #3 Greywake (Inside Ore)	Column #6 Chert (S10e)	Column #1 Ultramafic (Oa)	Column #2 Ultramafic (Oa alt)	Column #5 Ultramafic (Ob)	Column #7 Mafic Volcanic (1b)	HCT (AMQ-ENV-114)	SFE average (pit overburden)	SFE average (lake sediment)	GW S3S (Column #3) and 8B (HCT AMQ-ENV-114)	SFE Average (eskers)	HCT (AMQ-ENV-114)	Submerged Column
UNITS:	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/L	mg/kg/wk	mg/kg/wk	mg/L	$mg/cm^2/sec$
Alkalinity	6.9	4.2	5.3	7.1	3.8	4.3	4.9	3.7	3.6	185	64	4.1	112	3.7	0.000017
Aluminum	0.021	0.0052	0.0043	0.0019	0.00078	0.0012	0.0024	0.0012	0.051	3.0	0.63	0.0080	3.4	0.052	5.0E-09
Antimony	0.0019	0.00045	0.00068	0.00096	0.010	0.018	0.0012	0.00036	0.00047	0.014	0.0019	0.00045	0.0031	0	1.3E-08
Arsenic	0.079	0.0021	0.0050	0.0079	1.1	1.1	0.13	0.021	0.0062	1.2	0.17	0.0023	0.0090	0.0065	0.00000077
Barium	0.0062	0.0034	0.0021	0.0030	0.0032	0.0015	0.0046	0.0060	0.0025	0.046	0.12	0.0034	0.029	0.0026	2.6E-09
Beryllium	0.0000073	0.00000066	0.0000007	0.00000067	0.00000068	0.00000067	0.00000063	0.00000054	0.0000068	0.000034	0.000036	0.0000010	0.000074	0.0000070	0
Bismuth	0.000020	0.00000077	0.00000084	0.00000082	0.0000014	0.0000022	0.00000087	0.00000058	0.0000068	0.000031	0.000034	0.0000011	0.000030	0.0000070	0
Boron	0.015	0.0038	0.0069	0.0099	0.0075	0.0074	0.0035	0.0026	0.0015	0.10	0.56	0.0036	1.5	0.0016	0
Cadmium	0.0000064	0.0000024	0.0000023	0.0000034	0.0000007	0.00000038	0.00000081	0.0000014	0.0000030	0.000012	0.00013	0.0000025	0.000043	0.0000031	0
Calcium	9.5	2.8	8.2	14	1.2	1.6	2.3	4.6	1.2	18	8.7	2.7	2.8	1.3	0.0000023
Chloride	7.6	0.48	0.65	1.1	0.76	1.5	0.74	0.54	0.97	25	3.8	0.51	0	1.0	0
Chromium	0.000052	0.0000071	0.0000032	0.0000030	0.000032	0.000022	0.000014	0.000011	0.000029	0.0017	0.0047	0.0000084	0.015	0.000030	0
Cobalt	0.00032	0.000044	0.000069	0.00025	0.00016	0.00016	0.00013	0.00013	0.00016	0.00038	0.010	0.000050	0.0040	0.00016	1.1E-10
Copper	0.00034	0.000094	0.000056	0.000027	0.00010	0.000029	0.000046	0.00017	0.00025	0.0012	0.012	0.00010	0.011	0.00026	1.1E-10
Fluoride	0.085	0.029	0.043	0.057	0.010	0.010	0.019	0.024	0.058	0.71	0.40	0.031	0	0.060	0
Iron	0.018	0.0011	0.0018	0.00076	0.0011	0.0011	0.00089	0.00054	0.0076	0.45	1.6	0.0015	2.5	0.0079	0
Lead	0.000096	0.000034	0.0000071	0.0000060	0.0000079	0.0000033	0.000010	0.000049	0.000020	0.00054	0.0034	0.000033	0.0039	0.000021	0
Lithium	0.0017	0.00069	0.00088	0.00079	0.00031	0.00038	0.00097	0.0013	0.00078	0.0043	0.0047	0.00070	0.0030	0.00080	1.4E-08
Magnesium	2.2	0.81	1.0	1.8	0.76	0.84	1.3	1.3	0.16	3.0	1.8	0.77	1.6	0.17	0.0000011
Manganese	0.080	0.0034	0.015	0.032	0.0011	0.0020	0.0036	0.0029	0.0029	0.0084	3.0	0.0033	0.15	0.0030	-1.6E-09
Mercury	0.0000097	0.0000010	0.00000097	0.00000089	0.0000011	0.00000093	0.0000009	0.00000077	0.0000097	0.00014	0.000010	0.0000016	0.000040	0.000010	0
Molybdenum	0.0035	0.00100	0.0011	0.00083	0.00020	0.00037	0.0012	0.0011	0.0020	0.0075	0.00036	0.0011	0.0026	0.0021	1.7E-09
Nickel	0.0080	0.00031	0.00044	0.0026	0.0033	0.0058	0.0018	0.0012	0.00037	0.0016	0.12	0.00032	0.0092	0.00039	1.5E-09
Nitrate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phosphorus	0.0029	0.00097	0.00056	0.00036	0.00063	0.00090	0.00035	0.00100	0.0029	0.091	0.19	0.0011	0	0.0030	0
Potassium	6.0	2.6	8.4	9.8	2.8	3.5	4.0	3.1	1.3	46	2.1	2.5	5.4	1.3	0.000015
Selenium	0.00040	0.00018	0.00038	0.00031	0.00014	0.00010	0.00025	0.0017	0.000085	0.00029	0.0012	0.00017	0.0040	0.000089	2.3E-10
Silver	0.000034	0.00000071	0.0000006	0.00000073	0.00000073	0.0000074	0.0000015	0.00000041	0.0000019	0.000015	0.000061	0.00000079	0.00015	0.0000020	0
Sodium	0.38	0.57	2.9	8.1	0.52	1.1	0.58	0.49	0.15	40	37	0.54	39	0.16	0.0000024
Strontium	0.036	0.017	0.021	0.033	0.020	0.014	0.022	0.037	0.0037	0.16	0.044	0.016	0.0067	0.0038	0
Sulphate	23	8.3	29	54	3.7	6.2	8.4	17	1.9	4.7	42	7.9	8.0	1.9	0.0000092
Thallium	0.00011	0.0000042	0.0000017	0.0000019	0.0000050	0.0000015	0.0000077	0.0000054	0.0000053	0.000028	0.000018	0.0000042	0.000046	0.0000054	0
Tin	0.000095	0.000024	0.00030	0.000046	0.0000045	0.0000054	0.000034	0.000062	0.00015	0.000067	0.00025	0.000032	0.00017	0.00016	0
Uranium	0.000086	0.0010	0.0017	0.00090	0.000012	0.000052	0.00063	0.00072	0.00051	0.0015	0.00069	0.00098	0.00050	0.00052	1.4E-10
Vanadium	0.00032	0.00026	0.000039	0.000026	0.0017	0.0012	0.00097	0.0010	0.00071	0.040	0.00098	0.00029	0.0054	0.00074	0
Zinc	0.0019	0.00018	0.00018	0.00022	0.00019	0.00019	0.00018	0.00015	0.0019	0.0080	0.0068	0.00029	0.011	0.0020	0

Appendix A
Water Quality Model Inputs
Whale Tail Project, Meadowbank Division
Agnico-Eagle Mines Limited

GOLDSIM INPUT:	Whale Tail Lake (South Basin) sourced water[1]	Natural Runoff to Site	Initial Mammoth Lake Water Quality; Natural Runoff to Mammoth Lake	Initial Downstream Lakes Water Quality; Natural Runoff to all other downstream lakes	Natural Groundwater
DATA SOURCE:	Average of monitoring data, 2015	Average of monitoring data, 2015	Average of monitoring data, 2015	Average of monitoring data, 2015	75th Percentile of Meadowbank Groundwater Monitoring Results (Knight Piésold Consulting, 2015)
UNITS:	mg/L	mg/L	mg/L	mg/L	mg/L
Alkalinity	4.2	4.9	4.9	5.6	102
Aluminum	0.0068	0.019	0.0039	0.0037	0.04
Antimony	0.00005	0.00005	0.00005	0.00005	0.00028
Arsenic	0.00014	0.00019	0.00033	0.00016	0.003
Barium	0.0033	0.0048	0.0044	0.0055	0.13
Beryllium	0.000012	0.00001	0.00001	0.00001	0.0001
Bismuth	0.000025	0.000025	0.000025	0.000025	0.0001
Boron	0.005	0.005	0.005	0.005	0.46
Cadmium	0.0000025	0.0000025	0.0000025	0.000003	0.00012
Calcium	1.6	1.8	2.3	1.9	73
Chloride	1.6	2.3	2.3	1.2	255
Chromium	0.00005	0.00018	0.00005	0.00005	0.0012
Cobalt	0.00005	0.00005	0.00005	0.00005	0.0018
Copper	0.00033	0.00069	0.0004	0.0006	0.0039
Fluoride	0.025	0.032	0.025	0.027	0.37
Iron	0.012	0.057	0.005	0.0096	0.05
Lead	0.000039	0.000064	0.000066	0.000041	0.001
Lithium	0.0005	0.00067	0.0005	0.0005	0.018
Magnesium	0.62	0.85	0.76	0.64	30
Manganese	0.002	0.0021	0.0014	0.00066	0.32
Mercury	0.0000025	0.0000025	0.0000036	0.0000025	0.000005
Molybdenum	0.000025	0.000034	0.000025	0.000029	0.027
Nickel	0.00043	0.00096	0.00065	0.0004	0.0058
Nitrate	0.0025	0.0063	0.0025	0.0063	0.13
Phosphorus	0.0016	0.0015	0.0017	0.0012	0.2
Potassium	0.35	0.42	0.49	0.48	6.4
Selenium	0.000025	0.000025	0.000025	0.000025	0.00075
Silver	0.000005	0.000005	0.000005	0.000005	0.000025
Sodium	0.5	0.67	0.52	0.65	56
Strontium	0.0097	0.011	0.012	0.0084	0.62
Sulphate	1.3	1.4	2.2	2.1	46
Thallium	0.000005	0.000005	0.000005	0.000005	0.00001
Tin	0.00005	0.00007	0.00005	0.00011	0.0001
Uranium	0.000034	0.000074	0.000021	0.000025	0.0078
Vanadium	0.00025	0.00025	0.00025	0.00025	0.00053
Zinc	0.0005	0.00083	0.0005	0.0007	0.012

ATTACHMENT B

Water Quality Model Results

June 2016
Report No. 1520817

Appendix B
Water Quality Model Predictions - On-site Facilities (no Treatment)
Whale Tail Project, Meadowbank Division
Agnico-Eagle Mines Limited

Portage Effluent Limits maximum average[1] (mg/L)			**1400**	**1000**			**16**	**20**	**1**			**0.3**					**0.002**				**0.1**
CEQG aquatic life (long-term)[2] (mg/L)				**120**	**0.12**			**2.93**	**0.004 to 0.01**	**0.1**		***0.028***				**1.5**	**0.000012**		**0.001**		**0.002**
			TDS	**Cl**	**F**	**SO4**	**NH3 (as N)**	**NO3**	**P_total[3]**	**Al[4]**	**Sb**	**As[7]**	**Ba**	**Be**	**Bi**	**B**	**Cd[6]**	**Ca**	**Cr[5]**	**Co**	**Cu[6]**
LOCATION	**Time Period**	**Month**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg N/L**	**mg N/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Whale Tail WRSF Pond	***Operations Water Quality (maximum mine footprint)***	**October**	340	11	0.84	121	0.27	11	0.097	0.0003	0.034	**2.5**	0.045	0.00013	0.000056	0.16	0.000028	34	0.0071	0.0029	0.011
		November	340	11	0.84	121	0.27	11	0.097	0.0003	0.034	**2.5**	0.045	0.00013	0.000056	0.16	0.000028	34	0.0071	0.0029	0.011
		December	340	11	0.84	121	0.27	11	0.097	0.0003	0.034	**2.5**	0.045	0.00013	0.000056	0.16	0.000028	34	0.0071	0.0029	0.011
		January	340	11	0.84	121	0.27	11	0.097	0.0003	0.034	**2.5**	0.045	0.00013	0.000056	0.16	0.000028	34	0.0071	0.0029	0.011
		February	340	11	0.84	121	0.27	11	0.097	0.0003	0.034	**2.5**	0.045	0.00013	0.000056	0.16	0.000028	34	0.0071	0.0029	0.011
		March	340	11	0.84	121	0.27	11	0.097	0.0003	0.034	**2.5**	0.045	0.00013	0.000056	0.16	0.000028	34	0.0071	0.0029	0.011
		April	340	11	0.84	121	0.27	11	0.097	0.0003	0.034	**2.5**	0.045	0.00013	0.000056	0.16	0.000028	34	0.0071	0.0029	0.011
		May	340	11	0.84	121	0.27	11	0.097	0.0003	0.034	**2.5**	0.045	0.00013	0.000056	0.16	0.000028	34	0.0071	0.0029	0.011
		June	183	5.9	0.44	63	0.27	11	0.051	0.0003	0.018	**1.3**	0.023	0.000066	0.00003	0.083	0.000015	18	0.0037	0.0015	0.0059
		July	**2814**	93	7.2	1033	0.27	11	0.83	0.0003	0.29	**21**	0.38	0.0011	0.00046	1.4	0.00024	291	0.06	0.025	0.096
		August	**1869**	62	4.7	685	0.27	11	0.55	0.0003	0.19	**14**	0.25	0.00071	0.0003	0.9	0.00016	193	0.04	0.017	0.064
		September	390	13	0.97	139	0.27	11	0.11	0.0003	0.039	**2.9**	0.051	0.00014	0.000064	0.18	0.000032	39	0.0081	0.0034	0.013
		MAXIMUM	**2814**	93	7.2	1033	0.27	11	0.83	0.0003	0.29	**21**	0.38	0.0011	0.00046	1.4	0.00024	291	0.06	0.025	0.096
		AVERAGE	665	22	1.7	241	0.27	11	0.19	0.0003	0.067	**4.9**	0.088	0.00025	0.00011	0.32	0.000055	68	0.014	0.0058	0.022
	Long Term Water Quality, no Water Treatment (Years 10+)	MINIMUM	386	10	**0.61**	157	0.0091	0.019	**0.022**	0.0003	0.009	**0.046**	0.067	0.000021	0.000025	0.072	**0.000049**	53	0.00018	0.001	**0.0021**
		MAXIMUM	3161	83	**5.0**	1292	0.0091	0.019	**0.18**	0.0003	0.074	**0.38**	0.55	0.00017	0.00019	0.59	**0.0004**	438	**0.0014**	0.0082	**0.017**
		AVERAGE	1027	27	**1.6**	420	0.0091	0.019	**0.058**	0.0003	0.024	**0.12**	0.18	0.000055	0.000062	0.19	**0.00013**	142	0.00046	0.0027	**0.0055**
Pit Sump	***Operations Water Quality (maximum mine footprint)***	**October**	417	87	0.92	83	0.3	12	0.16	0.0002	0.028	**2.3**	0.077	0.00016	0.000089	0.29	0.000061	42	0.0077	0.0033	0.013
		November	401	121	0.62	59	0.3	12	0.14	0.0002	0.016	**1.2**	0.079	0.00012	0.000082	0.3	0.000068	45	0.0046	0.0023	0.0083
		December	392	140	0.45	46	0.3	12	0.14	0.0002	0.0088	**0.69**	0.08	0.000097	0.000078	0.3	0.000073	46	0.0029	0.0018	0.0058
		January	387	151	0.36	39	0.3	12	0.13	0.0002	0.0049	**0.38**	0.081	0.000084	0.000076	0.3	0.000075	46	0.0019	0.0015	0.0043
		February	384	157	0.31	35	0.3	12	0.13	0.0002	0.0028	0.21	0.081	0.000077	0.000075	0.3	0.000076	47	0.0014	0.0013	0.0036
		March	383	160	0.28	33	0.3	12	0.13	0.0002	0.0017	0.12	0.081	0.000073	0.000074	0.3	0.000077	47	0.0011	0.0013	0.0032
		April	382	162	0.27	32	0.3	12	0.13	0.0002	0.001	0.068	0.081	0.000071	0.000074	0.3	0.000077	47	0.00096	0.0012	0.0029
		May	382	163	0.26	31	0.3	12	0.13	0.0002	0.00065	0.038	0.081	0.00007	0.000073	0.3	0.000078	47	0.00087	0.0012	0.0028
		June	258	70	0.44	41	0.3	12	0.093	0.0002	0.012	**0.96**	0.049	0.000082	0.000052	0.18	0.000041	27	0.0034	0.0016	0.006
		July	593	74	1.7	146	0.3	12	0.24	0.0002	0.056	**4.5**	0.1	0.00028	0.00013	0.4	0.000074	56	0.015	0.0058	0.024
		August	962	110	2.8	244	0.3	12	0.4	0.0002	0.094	**7.5**	0.17	0.00047	0.00022	0.65	0.00012	90	0.025	0.0097	0.04
		September	635	80	1.8	156	0.3	12	0.26	0.0002	0.059	**4.7**	0.11	0.0003	0.00014	0.43	0.000079	60	0.016	0.0062	0.025
		MAXIMUM	962	163	2.8	244	0.3	12	0.4	0.0002	0.094	**7.5**	0.17	0.00047	0.00022	0.65	0.00012	90	0.025	0.0097	0.04
		AVERAGE	465	123	0.84	79	0.3	12	0.17	0.0002	0.024	**1.9**	0.089	0.00016	0.000097	0.34	0.000075	50	0.0067	0.0031	0.012
Flooded Pit	***Long Term Water Quality (Years 10+)***	MINIMUM	37	3.9	0.066	11	0.0029	0.11	**0.039**	0.0002	0.00068	0.016	0.0093	0.000014	0.000026	0.02	0.0000076	5.1	0.00016	0.00026	0.00067
		MAXIMUM	37	3.9	0.066	11	0.0029	0.11	**0.039**	0.0002	0.00068	0.016	0.0093	0.000014	0.000026	0.02	0.0000076	5.1	0.00016	0.00026	0.00067
		AVERAGE	37	3.9	0.066	11	0.0029	0.11	**0.039**	0.0002	0.00068	0.016	0.0093	0.000014	0.000026	0.02	0.0000076	5.1	0.00016	0.00026	0.00067
Attenuation Pond	***Operations Water Quality (maximum mine footprint)***	**October**	387	36	0.78	110	0.14	5.6	0.36	0.0001	0.025	**1.7**	0.071	0.00012	0.000082	0.49	0.000063	39	0.0082	0.0046	0.012
		November	356	44	0.69	94	0.14	5.8	0.51	0.0001	0.021	**1.5**	0.066	0.00011	0.000076	0.42	0.000059	37	0.007	0.0039	0.011
		December	335	51	0.62	83	0.14	6.0	0.6	0.0001	0.018	**1.3**	0.063	0.0001	0.000071	0.38	0.000056	35	0.0061	0.0034	0.0095
		January	319	56	0.56	74	0.14	6.1	0.67	0.0001	0.016	**1.2**	0.061	0.000096	0.000068	0.35	0.000054	34	0.0054	0.0031	0.0085
		February	308	60	0.51	68	0.15	6.2	0.72	0.0001	0.014	**1.0**	0.059	0.00009	0.000066	0.33	0.000053	33	0.0048	0.0028	0.0077
		March	299	64	0.48	63	0.15	6.3	0.75	0.0001	0.013	**0.93**	0.058	0.000085	0.000064	0.31	0.000052	33	0.0044	0.0026	0.0071
		April	292	67	0.45	58	0.15	6.3	0.78	0.0001	0.012	**0.84**	0.057	0.000081	0.000062	0.3	0.000052	32	0.004	0.0024	0.0066
		May	286	69	0.42	55	0.15	6.4	0.81	0.0001	0.011	**0.77**	0.056	0.000078	0.000061	0.29	0.000051	32	0.0037	0.0022	0.0061
		June	238	47	0.37	51	0.14	5.8	0.5	0.0001	0.0095	**0.67**	0.052	0.000064	0.000051	0.29	0.000049	25	0.0036	0.0027	0.0061
		July	414	38	0.75	120	0.14	5.5	0.32	0.0001	0.023	**1.6**	0.074	0.00012	0.000086	0.58	0.000068	43	0.0085	0.0048	0.012
		August	751	57	1.4	228	0.14	5.7	0.44	0.0001	0.047	**3.2**	0.12	0.00022	0.00015	1.0	0.00011	78	0.016	0.0079	0.022
		September	622	47	1.2	187	0.14	5.6	0.36	0.0001	0.041	**2.8**	0.11	0.00019	0.00013	0.81	0.000092	64	0.014	0.007	0.019
		MAXIMUM	751	69	1.4	228	0.15	6.4	0.81	0.0001	0.047	**3.2**	0.12	0.00022	0.00015	1.0	0.00011	78	0.016	0.0079	0.022
		AVERAGE	384	53	0.69	99	0.14	5.9	0.57	0.0001	0.021	**1.5**	0.07	0.00011	0.000081	0.46	0.000063	40	0.0071	0.0039	0.011
Whale Tail Lake (North Basin)	***Long Term Water Quality (Years 10+)***	MINIMUM	11.78	1.762	0.0279	1.71	0.00003	0.0065	0.0031	0.0001	0.000078	0.00075	0.00379	0.00001168	0.00002552	0.00538	0.0000027	1.82	0.0000726	0.000055	0.00040
		MAXIMUM	12.1	1.785	0.0285	1.85	0.000042	0.0078	0.0036	0.0001	0.000086	0.00084	0.00387	0.00001179	0.00002575	0.0055	0.00000275	1.87	0.0000734	0.0000565	0.000405
		AVERAGE	12.0	1.78	0.0284	1.81	0.000039	0.0075	0.0034	0.0001	0.000084	0.00082	0.00385	0.00001177	0.00002569	0.00547	0.00000274	1.85	0.0000733	0.0000561	0.000404

Notes:

[1] Portage effluent limits (NWB, 2015). Maximum average. Operational phase only - exceedances shown as bold-underlined-highlighted cells

[2] CEQG (2002) freshwater guidelines. Post-closure exceedances to freshwater CEQG's shown in bold-underlined type

[3] CEQG Freshwater Aquatic Life Trigger Ranges are dependent on trophic status; oligotrophic status assumed

[4] CEQG Freshwater Aquatic Life Criterion for aluminun is pH dependant; assumes pH>6.5.

[5] CEQG Freshwater aquatic life criteria for chromium depends on the valence of chromium ion. In the above table, the Cr(VI) criterion of 0.001 mg/L is shown.

[6] CEQG Freshwater Aquatic Life Criteria are hardness dependant; assumes a hardness of 30 mg/L.

[7] The CEQG aquatic life criterion for Arsenic is replaced by the Site Specific Water Quality Objective of 0.028 mg/L developed for the Whale Tail Pit Project (Volume 6, Appendix 6-N)

Appendix B
Water Quality Model Predictions - On-site Facilities (no Treatment)
Whale Tail Project, Meadowbank Division
Agnico-Eagle Mines Limited

Portage Effluent Limits maximum average[1] (mg/L)				**0.1**					**0.0004**		**0.2**									**0.4**
CEQG aquatic life (long-term)[2] (mg/L)			**0.3**	**0.001**					**0.000026**	**0.073**	**0.038**		**0.001**	**0.0001**			**0.0008**		**0.015**		**0.03**
			Fe	Pb[6]	Li	Mg	Mn	Hg	Mo	Ni[6]	K	Se	Ag	Na	Sr	Tl	Sn	U	V	Zn
LOCATION	**Time Period**	**Month**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Whale Tail WRSF Pond	***Operations Water Quality (maximum mine footprint)***	**October**	0.06	0.0018	0.0079	8.3	0.11	0.000049	0.0062	0.023	33	0.0023	0.000042	40	0.26	0.000046	0.00036	0.0053	0.034	0.0073
		November	0.06	0.0018	0.0079	8.3	0.11	0.000049	0.0062	0.023	33	0.0023	0.000042	40	0.26	0.000046	0.00036	0.0053	0.034	0.0073
		December	0.06	0.0018	0.0079	8.3	0.11	0.000049	0.0062	0.023	33	0.0023	0.000042	40	0.26	0.000046	0.00036	0.0053	0.034	0.0073
		January	0.06	0.0018	0.0079	8.3	0.11	0.000049	0.0062	0.023	33	0.0023	0.000042	40	0.26	0.000046	0.00036	0.0053	0.034	0.0073
		February	0.06	0.0018	0.0079	8.3	0.11	0.000049	0.0062	0.023	33	0.0023	0.000042	40	0.26	0.000046	0.00036	0.0053	0.034	0.0073
		March	0.06	0.0018	0.0079	8.3	0.11	0.000049	0.0062	0.023	33	0.0023	0.000042	40	0.26	0.000046	0.00036	0.0053	0.034	0.0073
		April	0.06	0.0018	0.0079	8.3	0.11	0.000049	0.0062	0.023	33	0.0023	0.000042	40	0.26	0.000046	0.00036	0.0053	0.034	0.0073
		May	0.06	0.0018	0.0079	8.3	0.11	0.000049	0.0062	0.023	33	0.0023	0.000042	40	0.26	0.000046	0.00036	0.0053	0.034	0.0073
		June	0.06	0.00097	0.0042	4.3	0.057	0.000026	0.0032	0.012	17	0.0012	0.000022	21	0.14	0.000024	0.00019	0.0028	0.018	0.0039
		July	0.06	0.016	0.067	70	0.94	**0.00041**	0.053	0.19	280	0.02	0.00036	344	2.2	0.00039	0.003	0.045	0.29	0.062
		August	0.06	0.01	0.045	46	0.62	0.00028	0.035	0.13	186	0.013	0.00024	228	1.5	0.00026	0.002	0.03	0.19	0.041
		September	0.06	0.0021	0.0091	9.5	0.13	0.000056	0.0071	0.026	38	0.0027	0.000049	46	0.3	0.000053	0.00041	0.0061	0.039	0.0084
		MAXIMUM	0.06	0.016	0.067	70	0.94	**0.00041**	0.053	0.19	280	0.02	0.00036	344	2.2	0.00039	0.003	0.045	0.29	0.062
		AVERAGE	0.06	0.0037	0.016	16	0.22	0.000097	0.012	0.045	65	0.0046	0.000084	80	0.52	0.000091	0.0007	0.011	0.068	0.015
	Long Term Water Quality, no Water Treatment (Years 10+)	MINIMUM	0.034	0.00066	0.014	15	0.066	**0.000031**	0.021	0.0064	49	**0.0035**	0.000016	11	0.31	0.000084	0.00064	**0.019**	0.0057	0.0058
		MAXIMUM	0.06	**0.0054**	0.11	126	0.54	**0.00025**	**0.17**	**0.052**	405	**0.028**	**0.00013**	89	2.6	0.00069	0.0052	**0.16**	0.047	**0.047**
		AVERAGE	0.058	**0.0018**	0.037	41	0.18	**0.000082**	0.056	0.017	132	**0.0092**	0.000042	29	0.84	0.00022	0.0017	**0.052**	0.015	0.015
Pit Sump	***Operations Water Quality (maximum mine footprint)***	**October**	0.7	0.0022	0.012	15	0.18	0.000052	0.012	0.02	23	0.0019	0.000048	52	0.4	0.000043	0.00033	0.0061	0.035	0.011
		November	0.7	0.0015	0.012	17	0.19	0.00003	0.014	0.013	15	0.0013	0.000034	45	0.4	0.000028	0.00022	0.0056	0.02	0.0096
		December	0.64	0.0011	0.012	18	0.2	0.000019	0.016	0.0089	10	0.00091	0.000027	41	0.4	0.000019	0.00016	0.0053	0.011	0.0088
		January	0.39	0.00093	0.011	19	0.2	0.000012	0.016	0.0066	7.4	0.00072	0.000023	39	0.4	0.000014	0.00012	0.0052	0.0062	0.0084
		February	0.23	0.00082	0.011	19	0.2	0.0000086	0.017	0.0054	6.0	0.00062	0.000021	37	0.4	0.000012	0.00011	0.0051	0.0037	0.0082
		March	0.15	0.00075	0.011	19	0.2	0.0000066	0.017	0.0047	5.2	0.00056	0.000019	37	0.4	0.00001	0.000095	0.0051	0.0023	0.008
		April	0.098	0.00072	0.011	19	0.21	0.0000055	0.017	0.0043	4.8	0.00053	0.000019	36	0.4	0.0000092	0.000089	0.005	0.0014	0.008
		May	0.07	0.0007	0.011	19	0.21	0.0000049	0.017	0.0041	4.5	0.00051	0.000018	36	0.4	0.0000088	0.000086	0.005	0.00099	0.0079
		June	0.63	0.0011	0.0073	10	0.12	0.000023	0.0087	0.0094	11	0.00089	0.000024	29	0.25	0.00002	0.00016	0.0036	0.015	0.0063
		July	0.7	0.004	0.017	17	0.23	0.000099	0.014	0.038	43	0.0034	0.000083	80	0.56	0.000081	0.0006	0.009	0.069	0.017
		August	0.7	0.0066	0.027	28	0.38	0.00017	0.023	0.064	73	0.0057	0.00014	133	0.91	0.00014	0.001	0.015	0.12	0.028
		September	0.7	0.0042	0.018	19	0.25	0.00011	0.016	0.04	46	0.0036	0.000089	86	0.6	0.000086	0.00064	0.0097	0.073	0.018
		MAXIMUM	0.7	0.0066	0.027	28	0.38	0.00017	0.023	0.064	73	0.0057	0.00014	133	0.91	0.00014	0.001	0.015	0.12	0.028
		AVERAGE	0.48	0.0021	0.013	18	0.21	0.000045	0.016	0.018	21	0.0017	0.000045	54	0.46	0.000039	0.0003	0.0066	0.029	0.012
Flooded Pit	***Long Term Water Quality (Years 10+)***	MINIMUM	0.03	0.00013	0.0014	1.7	0.047	0.0000043	0.0013	0.0025	3.1	0.00023	0.0000069	2.0	0.031	0.0000099	0.000087	0.0011	0.00066	0.0010
		MAXIMUM	0.03	0.00013	0.0014	1.7	0.047	0.0000043	0.0013	0.0025	3.1	0.00023	0.0000069	2.0	0.031	0.0000099	0.000087	0.0011	0.00066	0.0010
		AVERAGE	0.03	0.00013	0.0014	1.7	0.047	0.0000043	0.0013	0.0025	3.1	0.00023	0.0000069	2.0	0.031	0.0000099	0.000087	0.0011	0.00066	0.0010
Attenuation Pond	***Operations Water Quality (maximum mine footprint)***	**October**	0.3	0.0027	0.01	11	0.62	0.000054	0.011	0.041	29	0.0029	0.000098	43	0.28	0.00015	0.00044	0.0052	0.026	0.011
		November	0.3	0.0023	0.0095	11	0.52	0.000046	0.01	0.034	25	0.0024	0.000082	40	0.27	0.00012	0.00038	0.0048	0.022	0.01
		December	0.3	0.002	0.009	11	0.45	0.000041	0.01	0.029	22	0.0021	0.000071	37	0.26	0.0001	0.00033	0.0045	0.02	0.0093
		January	0.3	0.0018	0.0087	11	0.4	0.000036	0.01	0.026	19	0.0019	0.000063	35	0.26	0.00009	0.0003	0.0043	0.017	0.0087
		February	0.3	0.0016	0.0085	11	0.37	0.000032	0.01	0.023	17	0.0017	0.000057	33	0.26	0.00008	0.00027	0.0042	0.015	0.0082
		March	0.3	0.0015	0.0083	11	0.34	0.000029	0.01	0.021	16	0.0015	0.000052	32	0.26	0.000073	0.00025	0.004	0.014	0.0079
		April	0.3	0.0014	0.0081	11	0.32	0.000027	0.01	0.019	15	0.0014	0.000048	31	0.25	0.000066	0.00023	0.0039	0.013	0.0076
		May	0.3	0.0013	0.008	11	0.3	0.000025	0.01	0.018	14	0.0013	0.000045	30	0.25	0.000061	0.00022	0.0038	0.012	0.0073
		June	0.3	0.0014	0.0065	8.3	0.48	0.000023	0.0077	0.025	12	0.0013	0.000047	26	0.19	0.000063	0.00021	0.0031	0.0098	0.0064
		July	0.3	0.0028	0.011	12	0.68	0.000056	0.012	0.044	32	0.0032	0.00012	43	0.28	0.00019	0.00048	0.0055	0.023	0.012
		August	0.3	0.0049	0.019	21	0.87	0.00011	0.022	0.069	62	0.0061	0.00022	78	0.51	0.00036	0.00088	0.01	0.046	0.022
		September	0.3	0.0042	0.016	17	0.84	0.000091	0.018	0.062	51	0.005	0.00017	67	0.43	0.00028	0.00073	0.0085	0.041	0.018
		MAXIMUM	0.3	0.0049	0.019	21	0.87	0.00011	0.022	0.069	62	0.0061	0.00022	78	0.51	0.00036	0.00088	0.01	0.046	0.022
		AVERAGE	0.3	0.0023	0.01	12	0.52	0.000047	0.012	0.034	26	0.0026	0.000089	41	0.29	0.00014	0.00039	0.0052	0.022	0.011
Whale Tail Lake (North Basin)	***Long Term Water Quality (Years 10+)***	MINIMUM	0.01953	0.0000456	0.000572	0.709	0.00261	2.6E-06	0.000078	0.000555	0.492	0.000034	0.00000514	0.57	0.01093	0.00000531	0.0000556	0.000086	0.00027	0.000577
		MAXIMUM	0.0197	0.0000465	0.000585	0.725	0.00281	0.00000266	0.000096	0.000567	0.53	0.000037	0.00000519	0.583	0.01122	0.0000054	0.0000564	0.000103	0.000275	0.000585
		AVERAGE	0.0197	0.0000463	0.000582	0.721	0.00275	0.00000266	0.000092	0.000564	0.52	0.0000362	0.00000518	0.579	0.01115	0.00000538	0.0000563	0.000099	0.000274	0.000583

Notes:

[1] Portage effluent limits (NWB, 2015). Maximum average. Operational phase only - exceedances shown as bold-underlined-highlighted cells

[2]CEQG (2002) freshwater guidelines. Post-closure exceedances to freshwater CEQG's shown in bold-underlined type

[3] CEQG Freshwater Aquatic Life Trigger Ranges are dependent on trophic status; oligotrophic status assumed

[4] CEQG Freshwater Aquatic Life Criterion for aluminun is pH dependant; assumes pH>6.5.

[5] CEQG Freshwater aquatic life criteria for chromium depends on the valence of chromium ion. In the above table, the Cr(VI) criterion of 0.001 mg/L is shown.

[6] CEQG Freshwater Aquatic Life Criteria are hardness dependant; assumes a hardness of 30 mg/L.

[7] The CEQG aquatic life criterion for Arsenic is replaced by the Site Specific Water Quality Objective of 0.028 mg/L developed for the Whale Tail Pit Project (Volume 6, Appendix 6-N)

Water Quality Model Predictions - On-Site Facilities (with Treatment) and Off-site Monitoring Locations
Whale Tail Project, Meadowbank Division
Agnico-Eagle Mines Limited

		CEQG aquatic life (long-term)[2] (mg/L)		120	0.12			2.93	0.004 to 0.01	0.1		0.028			
			TDS	Cl	F	SO4	NH3 (as N)	NO3	P_total[3]	Al[4]	Sb	As[7]	Ba	Be	Bi
LOCATION	Time Period	Statistic	mg/L	mg/L	mg/L	mg/L	mg N/L	mg N/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Mammoth Lake Proper	Closure (January 2022 to May 2029, inclusive)	MAXIMUM (Dissolved)	59	7.1	0.11	15	0.016	0.66	**0.051**	0.0051	0.0028	0.018	0.012	0.000024	0.000033
		AVERAGE (Dissolved)	39	5.0	0.073	9.2	0.0085	0.35	**0.028**	0.0046	0.0015	0.0096	0.0089	0.000018	0.00003
Lake A15	Closure (January 2022 to May 2029, inclusive)	MAXIMUM (Dissolved)	54	6.7	0.1	13	0.015	0.61	**0.048**	0.005	0.0024	0.016	0.012	0.000023	0.000032
		AVERAGE (Dissolved)	36	4.5	0.069	8.5	0.0078	0.33	**0.026**	0.0046	0.0014	0.0088	0.0087	0.000017	0.00003
Lake A12	Closure (January 2022 to May 2029, inclusive)	MAXIMUM (Dissolved)	51	6.4	0.095	12	0.014	0.57	**0.045**	0.005	0.0022	0.015	0.011	0.000022	0.000032
		AVERAGE (Dissolved)	36	4.4	0.068	8.3	0.0075	0.32	**0.025**	0.0047	0.0013	0.0085	0.0089	0.000018	0.000031
Downstream Node 1	Closure (January 2022 to May 2029, inclusive)	MAXIMUM (Dissolved)	15	1.5	0.031	2.8	0.00078	0.038	0.0037	0.0039	0.00017	0.001	0.0059	0.000011	0.000026
		AVERAGE (Dissolved)	14	1.4	0.029	2.5	0.00042	0.024	0.0026	0.0038	0.00012	0.00063	0.0058	0.000011	0.000026
Downstream Node 2	Closure (January 2022 to May 2029, inclusive)	MAXIMUM (Dissolved)	28	3.2	0.054	6.1	0.005	0.21	**0.017**	0.0045	0.00087	0.0058	0.0079	0.000015	0.00003
		AVERAGE (Dissolved)	21	2.3	0.043	4.4	0.0025	0.11	0.0094	0.0044	0.00048	0.003	0.0071	0.000013	0.000029

				0.002				0.1		0.1				0.0004
		CEQG aquatic life (long-term)[2] (mg/L)	1.5	0.000012		0.001		0.002	0.3	0.001				0.000026
			B	Cd[6]	Ca	Cr[5]	Co	Cu[6]	Fe	Pb[6]	Li	Mg	Mn	Hg
LOCATION	Time Period	Statistic	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Mammoth Lake Proper	Closure (January 2022 to May 2029, inclusive)	MAXIMUM (Dissolved)	0.067	0.00001	6.8	0.0010	0.00058	0.0017	0.043	0.00036	0.0017	2.1	0.076	0.000009
		AVERAGE (Dissolved)	0.039	0.0000068	4.8	0.00057	0.00034	0.0011	0.025	0.00023	0.0012	1.5	0.042	0.0000067
Lake A15	Closure (January 2022 to May 2029, inclusive)	MAXIMUM (Dissolved)	0.06	0.0000095	6.3	0.00088	0.00052	0.0016	0.041	0.00032	0.0016	1.9	0.069	0.0000082
		AVERAGE (Dissolved)	0.036	0.0000065	4.5	0.00052	0.00031	0.0011	0.025	0.00021	0.0011	1.4	0.038	0.0000062
Lake A12	Closure (January 2022 to May 2029, inclusive)	MAXIMUM (Dissolved)	0.055	0.000009	5.9	0.00081	0.00048	0.0015	0.038	0.0003	0.0015	1.8	0.063	0.0000078
		AVERAGE (Dissolved)	0.035	0.0000065	4.5	0.0005	0.0003	0.0011	0.025	0.0002	0.0011	1.4	0.036	0.0000061
Downstream Node 1	Closure (January 2022 to May 2029, inclusive)	MAXIMUM (Dissolved)	0.0079	0.0000034	2.2	0.000094	0.000075	0.00066	0.011	0.000057	0.00056	0.72	0.0042	0.0000029
		AVERAGE (Dissolved)	0.0067	0.0000033	2.1	0.000075	0.000065	0.00064	0.011	0.00005	0.00054	0.69	0.0026	0.0000027
Downstream Node 2	Closure (January 2022 to May 2029, inclusive)	MAXIMUM (Dissolved)	0.024	0.0000054	3.6	0.00034	0.00021	0.00097	0.021	0.00014	0.00091	1.1	0.024	0.0000047
		AVERAGE (Dissolved)	0.015	0.0000045	2.9	0.0002	0.00014	0.00084	0.016	0.000096	0.00075	0.94	0.013	0.0000039

				0.2										0.4
		CEQG aquatic life (long-term)[2] (mg/L)	0.073	0.038		0.001	0.0001			0.0008		0.015		0.03
			Mo	Ni[6]	K	Se	Ag	Na	Sr	Tl	Sn	U	V	Zn
LOCATION	Time Period	Statistic	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Mammoth Lake Proper	Closure (January 2022 to May 2029, inclusive)	MAXIMUM (Dissolved)	0.0015	0.0053	3.9	0.00037	0.000017	5.7	0.045	0.000024	0.000098	0.00067	0.003	0.0018
		AVERAGE (Dissolved)	0.00081	0.0032	2.4	0.00022	0.000012	3.3	0.03	0.000015	0.000078	0.00037	0.0017	0.0012
Lake A15	Closure (January 2022 to May 2029, inclusive)	MAXIMUM (Dissolved)	0.0013	0.0048	3.5	0.00033	0.000015	5.1	0.041	0.000021	0.0001	0.0006	0.0026	0.0017
		AVERAGE (Dissolved)	0.00074	0.0029	2.2	0.0002	0.000011	3.1	0.028	0.000015	0.000089	0.00034	0.0016	0.0012
Lake A12	Closure (January 2022 to May 2029, inclusive)	MAXIMUM (Dissolved)	0.0012	0.0044	3.2	0.0003	0.000015	4.7	0.038	0.00002	0.00011	0.00055	0.0024	0.0016
		AVERAGE (Dissolved)	0.00071	0.0028	2.1	0.00019	0.000011	3.0	0.027	0.000014	0.000098	0.00033	0.0016	0.0012
Downstream Node 1	Closure (January 2022 to May 2029, inclusive)	MAXIMUM (Dissolved)	0.000097	0.00064	0.65	0.000041	0.0000056	0.88	0.01	0.0000059	0.00012	0.000055	0.00038	0.00076
		AVERAGE (Dissolved)	0.000067	0.00054	0.58	0.000035	0.0000054	0.79	0.0096	0.0000056	0.00011	0.000042	0.00033	0.00074
Downstream Node 2	Closure (January 2022 to May 2029, inclusive)	MAXIMUM (Dissolved)	0.00047	0.0019	1.5	0.00013	0.0000089	2.2	0.02	0.000011	0.00012	0.00022	0.0011	0.0011
		AVERAGE (Dissolved)	0.00026	0.0012	1.1	0.000082	0.0000074	1.5	0.015	0.0000085	0.00012	0.00013	0.0007	0.00095

Notes:

[1] Portage effluent limits (NWB, 2015). Maximum average. Operational phase only - exceedances shown as bold-underlined-highlighted cells

[2] CEQG (2002) freshwater guidelines. Post-closure exceedances to freshwater CEQG's shown in bold-underlined type

[3] CEQG Freshwater Aquatic Life Trigger Ranges are dependent on trophic status; oligotrophic status assumed

[4] CEQG Freshwater Aquatic Life Criterion for aluminun is pH dependant; assumes pH>6.5.

[5] CEQG Freshwater aquatic life criteria for chromium depends on the valence of chromium ion. In the above table, the Cr(VI) criterion of 0.001 mg/L is shown.

[6] CEQG Freshwater Aquatic Life Criteria are hardness dependant; assumes a hardness of 30 mg/L.

[7] The CEQG aquatic life criterion for Arsenic is replaced by the Site Specific Water Quality Objective of 0.028 mg/L developed for the Whale Tail Pit Project (Volume 6, Appendix 6-N)

Appendix B
Water Quality Model Predictions - On-Site Facilities (with Treatment) and Off-site Monitoring Locations
Whale Tail Project, Meadowbank Division
Agnico-Eagle Mines Limited

Portage Effluent Limits maximum average[1] (mg/L)			1400	1000			16	20	1			0.3					0.002				0.1		0.1				0.0004		0.2	
CEOG aquatic life (long-term)[2] (mg/L)				120	0.12			2.93	0.004 to 0.01	0.1		*0.028*				1.5	0.000012		0.001		0.002	0.3	0.001				0.000026	0.073	0.038	
			TDS	Cl	F	SO4	NH3 (as N)	NO3	P_total[3]	Al[4]	Sb	As[7]	Ba	Be	Bi	B	Cd[6]	Ca	Cr[5]	Co	Cu[5]	Fe	Pb[6]	Li	Mg	Mn	Hg	Mo	Ni[5]	K
LOCATION	Time Period	Month	mg/L	mg/L	mg/L	mg/L	mg N/L	mg N/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Whale Tail WRSF Pond	*Operations Water Quality - with Water Treatment (maximum mine footprint)*	October	340	11	0.84	121	0.27	11	0.097	0.0003	0.034	2.5	0.045	0.00013	0.000056	0.16	0.000028	34	0.0071	0.0029	0.011	0.06	0.0018	0.0079	8.3	0.11	0.000049	0.0062	0.023	33
		November	340	11	0.84	121	0.27	11	0.097	0.0003	0.034	2.5	0.045	0.00013	0.000056	0.16	0.000028	34	0.0071	0.0029	0.011	0.06	0.0018	0.0079	8.3	0.11	0.000049	0.0062	0.023	33
		December	340	11	0.84	121	0.27	11	0.097	0.0003	0.034	2.5	0.045	0.00013	0.000056	0.16	0.000028	34	0.0071	0.0029	0.011	0.06	0.0018	0.0079	8.3	0.11	0.000049	0.0062	0.023	33
		January	340	11	0.84	121	0.27	11	0.097	0.0003	0.034	2.5	0.045	0.00013	0.000056	0.16	0.000028	34	0.0071	0.0029	0.011	0.06	0.0018	0.0079	8.3	0.11	0.000049	0.0062	0.023	33
		February	340	11	0.84	121	0.27	11	0.097	0.0003	0.034	2.5	0.045	0.00013	0.000056	0.16	0.000028	34	0.0071	0.0029	0.011	0.06	0.0018	0.0079	8.3	0.11	0.000049	0.0062	0.023	33
		March	340	11	0.84	121	0.27	11	0.097	0.0003	0.034	2.5	0.045	0.00013	0.000056	0.16	0.000028	34	0.0071	0.0029	0.011	0.06	0.0018	0.0079	8.3	0.11	0.000049	0.0062	0.023	33
		April	340	11	0.84	121	0.27	11	0.097	0.0003	0.034	2.5	0.045	0.00013	0.000056	0.16	0.000028	34	0.0071	0.0029	0.011	0.06	0.0018	0.0079	8.3	0.11	0.000049	0.0062	0.023	33
		May	340	11	0.84	121	0.27	11	0.097	0.0003	0.034	2.5	0.045	0.00013	0.000056	0.16	0.000028	34	0.0071	0.0029	0.011	0.06	0.0018	0.0079	8.3	0.11	0.000049	0.0062	0.023	33
		June	183	5.9	0.44	63	0.27	11	0.051	0.0003	0.018	1.3	0.023	0.000066	0.00003	0.083	0.000015	18	0.0037	0.0015	0.0059	0.06	0.00097	0.0042	4.3	0.057	0.000026	0.0032	0.012	17
		July	2814	93	7.2	1033	0.27	11	0.83	0.0003	0.29	21	0.38	0.0011	0.00046	1.4	0.00024	291	0.06	0.025	0.096	0.06	0.016	0.067	70	0.94	0.00041	0.053	0.19	280
		August	1869	62	4.7	685	0.27	11	0.55	0.0003	0.19	14	0.25	0.00071	0.0003	0.9	0.00016	193	0.04	0.017	0.064	0.06	0.01	0.045	46	0.62	0.00028	0.035	0.13	186
		September	390	13	0.97	139	0.27	11	0.11	0.0003	0.039	2.9	0.051	0.00014	0.000064	0.18	0.000032	39	0.0081	0.0034	0.013	0.06	0.0021	0.0091	9.5	0.13	0.000056	0.0071	0.026	38
		MAXIMUM	2814	93	7.2	1033	0.27	11	0.83	0.0003	0.29	21	0.38	0.0011	0.00046	1.4	0.00024	291	0.06	0.025	0.096	0.06	0.016	0.067	70	0.94	0.00041	0.053	0.19	280
		AVERAGE	665	22	1.7	241	0.27	11	0.19	0.0003	0.067	4.9	0.088	0.00025	0.00011	0.32	0.000055	68	0.014	0.0058	0.022	0.06	0.0037	0.016	16	0.22	0.000097	0.012	0.045	65
	First Year, Post-Closure	MINIMUM	386	10	0.61	157	0.0091	0.019	0.022	0.0003	0.009	0.046	0.067	0.000021	0.000025	0.072	0.000049	53	0.00018	0.001	0.0021	0.034	0.00066	0.014	15	0.066	0.000031	0.021	0.0064	49
		MAXIMUM	3161	83	5.0	1292	0.0091	0.019	0.18	0.0003	0.074	0.15	0.55	0.00017	0.00019	0.59	0.0004	438	0.0014	0.0082	0.017	0.06	0.0054	0.11	126	0.54	0.00025	0.17	0.052	405
		AVERAGE	1027	27	1.6	420	0.0091	0.019	0.058	0.0003	0.024	0.095	0.18	0.000055	0.000062	0.19	0.00013	142	0.00046	0.0027	0.0055	0.058	0.0018	0.037	41	0.18	0.000082	0.056	0.017	132
		MAXIMUM (total)	3161	83	5.0	1292	0.0091	0.019	0.19	0.32	0.074	0.16	0.55	0.00018	0.00019	0.59	0.00041	438	0.01	0.0087	0.017	0.81	0.0055	0.11	126	0.56	0.00025	0.17	0.056	405
		AVERAGE (total)	1027	27	1.6	420	0.0091	0.019	0.068	0.32	0.024	0.1	0.18	0.000063	0.000064	0.19	0.00013	143	0.0094	0.0032	0.006	0.81	0.0019	0.037	41	0.19	0.000082	0.056	0.021	132
	Long Term Water Quality (Years 10+)	MINIMUM	386	10	0.61	157	0.0091	0.019	0.022	0.0003	0.009	0.046	0.067	0.000021	0.000025	0.072	0.000049	53	0.00018	0.001	0.0021	0.034	0.00066	0.014	15	0.066	0.000031	0.021	0.0064	49
		MAXIMUM	3161	83	5.0	1292	0.0091	0.019	0.18	0.0003	0.074	0.15	0.55	0.00017	0.00019	0.59	0.0004	438	0.0014	0.0082	0.017	0.06	0.0054	0.11	126	0.54	0.00025	0.17	0.052	405
		AVERAGE	1027	27	1.6	420	0.0091	0.019	0.058	0.0003	0.024	0.095	0.18	0.000055	0.000062	0.19	0.00013	142	0.00046	0.0027	0.0055	0.058	0.0018	0.037	41	0.18	0.000082	0.056	0.017	132
		MAXIMUM (total)	3161	83	5.0	1292	0.0091	0.019	0.19	0.32	0.074	0.16	0.55	0.00018	0.00019	0.59	0.00041	438	0.01	0.0087	0.017	0.81	0.0055	0.11	126	0.56	0.00025	0.17	0.056	405
		AVERAGE (total)	1027	27	1.6	420	0.0091	0.019	0.068	0.32	0.024	0.1	0.18	0.000063	0.000064	0.19	0.00013	143	0.0094	0.0032	0.006	0.81	0.0019	0.037	41	0.19	0.000082	0.056	0.021	132
Flooded Pit	*First Year Post-Closure*	MINIMUM	37	3.9	0.066	11	0.0029	0.11	0.039	0.0002	0.00068	0.011	0.0093	0.000014	0.000026	0.02	0.0000076	5.1	0.00016	0.00026	0.00067	0.03	0.00013	0.0014	1.7	0.047	0.0000043	0.0013	0.0025	3.1
		MAXIMUM	37	3.9	0.066	11	0.0029	0.11	0.039	0.0002	0.00068	0.011	0.0093	0.000014	0.000026	0.02	0.0000076	5.1	0.00016	0.00026	0.00067	0.03	0.00013	0.0014	1.7	0.047	0.0000043	0.0013	0.0025	3.1
		AVERAGE	37	3.9	0.066	11	0.0029	0.11	0.039	0.0002	0.00068	0.011	0.0093	0.000014	0.000026	0.02	0.0000076	5.1	0.00016	0.00026	0.00067	0.03	0.00013	0.0014	1.7	0.047	0.0000043	0.0013	0.0025	3.1
	Long Term Water Quality (Years 10+)	MINIMUM	37	3.9	0.066	11	0.0029	0.11	0.039	0.0002	0.00068	0.011	0.0093	0.000014	0.000026	0.02	0.0000076	5.1	0.00016	0.00026	0.00067	0.03	0.00013	0.0014	1.7	0.047	0.0000043	0.0013	0.0025	3.1
		MAXIMUM	37	3.9	0.066	11	0.0029	0.11	0.039	0.0002	0.00068	0.011	0.0093	0.000014	0.000026	0.02	0.0000076	5.1	0.00016	0.00026	0.00067	0.03	0.00013	0.0014	1.7	0.047	0.0000043	0.0013	0.0025	3.1
		AVERAGE	37	3.9	0.066	11	0.0029	0.11	0.039	0.0002	0.00068	0.011	0.0093	0.000014	0.000026	0.02	0.0000076	5.1	0.00016	0.00026	0.00067	0.03	0.00013	0.0014	1.7	0.047	0.0000043	0.0013	0.0025	3.1
Attenuation Pond	*Operations Water Quality - with Water Treatment (maximum mine footprint)*	October	387	36	0.78	110	0.14	5.6	0.36	0.0001	0.025	0.15	0.071	0.00012	0.000082	0.49	0.000063	39	0.0082	0.0046	0.012	0.3	0.0027	0.01	11	0.62	0.000054	0.011	0.041	29
		November	356	44	0.69	94	0.14	5.8	0.51	0.0001	0.021	0.15	0.066	0.00011	0.000076	0.42	0.000059	37	0.007	0.0039	0.011	0.3	0.0023	0.0095	11	0.52	0.000046	0.01	0.034	25
		December	335	51	0.62	83	0.14	6.0	0.6	0.0001	0.018	0.15	0.063	0.0001	0.000071	0.38	0.000056	35	0.0061	0.0034	0.0095	0.3	0.002	0.009	11	0.45	0.000041	0.01	0.029	22
		January	319	56	0.56	74	0.14	6.1	0.67	0.0001	0.016	0.15	0.061	0.000096	0.000068	0.35	0.000054	34	0.0054	0.0031	0.0085	0.3	0.0018	0.0087	11	0.4	0.000036	0.01	0.026	19
		February	308	60	0.51	68	0.15	6.2	0.72	0.0001	0.014	0.15	0.059	0.00009	0.000066	0.33	0.000053	33	0.0048	0.0028	0.0077	0.3	0.0016	0.0085	11	0.37	0.000032	0.01	0.023	17
		March	299	64	0.48	63	0.15	6.3	0.75	0.0001	0.013	0.15	0.058	0.000085	0.000064	0.31	0.000052	33	0.0044	0.0026	0.0071	0.3	0.0015	0.0083	11	0.34	0.000029	0.01	0.021	16
		April	292	67	0.45	58	0.15	6.3	0.78	0.0001	0.012	0.15	0.057	0.000081	0.000062	0.3	0.000052	32	0.004	0.0024	0.0066	0.3	0.0014	0.0081	11	0.32	0.000027	0.01	0.019	15
		May	286	69	0.42	55	0.15	6.4	0.81	0.0001	0.011	0.15	0.056	0.000078	0.000061	0.29	0.000051	32	0.0037	0.0022	0.0061	0.3	0.0013	0.008	11	0.3	0.000025	0.01	0.018	14
		June	238	47	0.37	51	0.14	5.8	0.5	0.0001	0.0095	0.15	0.052	0.000064	0.000051	0.29	0.000049	25	0.0036	0.0027	0.0061	0.3	0.0014	0.0065	8.3	0.48	0.000023	0.0077	0.025	12
		July	414	38	0.75	120	0.14	5.5	0.32	0.0001	0.023	0.15	0.074	0.00012	0.000086	0.58	0.000068	43	0.0085	0.0048	0.012	0.3	0.0028	0.011	12	0.68	0.000056	0.012	0.044	32
		August	751	57	1.4	228	0.14	5.7	0.44	0.0001	0.047	0.15	0.12	0.00022	0.00015	1.0	0.00011	78	0.016	0.0079	0.022	0.3	0.0049	0.019	21	0.87	0.00011	0.022	0.069	62
		September	622	47	1.2	187	0.14	5.6	0.36	0.0001	0.041	0.15	0.11	0.00019	0.00013	0.81	0.000092	64	0.014	0.007	0.019	0.3	0.0042	0.016	17	0.84	0.000091	0.018	0.062	51
		MAXIMUM	751	69	1.4	228	0.15	6.4	0.81	0.0001	0.047	0.15	0.12	0.00022	0.00015	1.0	0.00011	78	0.016	0.0079	0.022	0.3	0.0049	0.019	21	0.87	0.00011	0.022	0.069	62
		AVERAGE	384	53	0.69	99	0.14	5.9	0.57	0.0001	0.021	0.15	0.07	0.00011	0.000081	0.46	0.000063	40	0.0071	0.0039	0.011	0.3	0.0023	0.01	12	0.52	0.000047	0.012	0.034	26
		MAXIMUM (total)	751	69	1.4	228	0.15	6.4	0.82	0.32	0.047	0.16	0.12	0.00023	0.00015	1.0	0.00011	79	0.025	0.0084	0.023	1.1	0.0051	0.02	21	0.89	0.00011	0.022	0.074	63
		AVERAGE (total)	384	53	0.69	99	0.14	5.9	0.58	0.32	0.021	0.16	0.074	0.00012	0.000083	0.46	0.000064	41	0.016	0.0045	0.011	1.1	0.0024	0.011	13	0.53	0.000047	0.012	0.039	26
Whale Tail Lake (North Basin)	*First Year Post-Closure*	MINIMUM	49	3.3	0.086	16	0.0012	0.14	0.059	0.0001	0.00092	0.0059	0.011	0.000014	0.000027	0.016	0.0000081	6.9	0.00011	0.0002	0.00065	0.029	0.00012	0.0019	2.2	0.024	0.0000054	0.0021	0.0017	5.0
		MAXIMUM	65	4.0	0.11	23	0.0017	0.2	0.083	0.0001	0.0013	0.0081	0.014	0.000014	0.000028	0.02	0.00001	9.0	0.00013	0.00026	0.00076	0.034	0.00016	0.0025	2.8	0.034	0.0000066	0.0029	0.0022	7.0
		AVERAGE	60	3.7	0.1	21	0.0016	0.18	0.075	0.0001	0.0012	0.0073	0.013	0.000014	0.000027	0.019	0.0000096	8.3	0.00012	0.00024	0.00072	0.032	0.00015	0.0023	2.6	0.031	0.0000062	0.0026	0.0021	6.3
		MAXIMUM (total)	65	4.0	0.11	23	0.0017	0.2	0.093	0.32	0.0013	0.013	0.017	0.000022	0.00003	0.02	0.000012	9.3	0.0091	0.00079	0.0013	0.79	0.00027	0.0027	3.2	0.046	0.0000066	0.0029	0.0069	7.2
		AVERAGE (total)	60	3.7	0.11	21	0.0016	0.18	0.085	0.32	0.0012	0.012	0.016	0.000021	0.00003	0.019	0.000011	8.6	0.0091	0.00077	0.0012	0.79	0.00026	0.0025	3.0	0.043	0.0000062	0.0027	0.0067	6.5
	Long Term Water Quality (Years 10+)	MINIMUM	12	1.8	0.028	1.7	0.00003	0.0065	0.0031	0.0001	0.000078	0.00073	0.0038	0.000012	0.000026	0.0054	0.0000027	1.8	0.000073	0.000055	0.0004	0.02	0.000046	0.00057	0.71	0.0026	0.0000026	0.000078	0.00055	0.49
		MAXIMUM	12	1.8	0.029	1.8	0.000042	0.0078	0.0036	0.0001	0.000086	0.00081	0.0039	0.000012	0.000026	0.0055	0.0000028	1.9	0.000073	0.000056	0.0004	0.02	0.000047	0.00059	0.72	0.0028	0.0000027	0.000096	0.00057	0.53
		AVERAGE	12	1.8	0.028	1.8	0.000039	0.0075	0.0034	0.0001	0.000084	0.00079	0.0038	0.000012	0.000026	0.0055	0.0000027	1.9	0.000073	0.000056	0.0004	0.02	0.000046	0.00058	0.72	0.0028	0.0000027	0.000092	0.00056	0.52
		MAXIMUM (total)	12	1.8	0.031	1.8	0.000042	0.0078	0.014	0.32	0.0001	0.0059	0.007	0.000019	0.000028	0.0055	0.0000043	2.2	0.0091	0.00058	0.00093	0.77	0.00016	0.00087	1.1	0.015	0.0000027	0.00011	0.0052	0.7
		AVERAGE (total)	12	1.8	0.031	1.8	0.000039	0.0075	0.014	0.32	0.0001	0.0059	0.007	0.000019	0.000028	0.0055	0.0000043	2.1	0.0091	0.00058	0.00092	0.77	0.00016	0.00087	1.1	0.015	0.0000027	0.00011	0.0052	0.69

Appendix B
Water Quality Model Predictions - On-Site Facilities (with Treatment) and Off-site Monitoring Locations
Whale Tail Project, Meadowbank Division
Agnico-Eagle Mines Limited

Portage Effluent Limits maximum average[1] (mg/L)												**0.4**
CEOG aquatic life (long-term)[2] (mg/L)			**0.001**	**0.0001**			**0.0008**		**0.015**			**0.03**
			Se	**Ag**	**Na**	**Sr**	**Tl**	**Sn**	**U**	**V**	**Zn**
LOCATION	**Time Period**	**Month**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Whale Tail WRSF Pond	***Operations Water Quality - with Water Treatment (maximum mine footprint)***	**October**	0.0023	0.000042	40	0.26	0.000046	0.00036	0.0053	0.034	0.0073
		November	0.0023	0.000042	40	0.26	0.000046	0.00036	0.0053	0.034	0.0073
		December	0.0023	0.000042	40	0.26	0.000046	0.00036	0.0053	0.034	0.0073
		January	0.0023	0.000042	40	0.26	0.000046	0.00036	0.0053	0.034	0.0073
		February	0.0023	0.000042	40	0.26	0.000046	0.00036	0.0053	0.034	0.0073
		March	0.0023	0.000042	40	0.26	0.000046	0.00036	0.0053	0.034	0.0073
		April	0.0023	0.000042	40	0.26	0.000046	0.00036	0.0053	0.034	0.0073
		May	0.0023	0.000042	40	0.26	0.000046	0.00036	0.0053	0.034	0.0073
		June	0.0012	0.000022	21	0.14	0.000024	0.00019	0.0028	0.018	0.0039
		July	0.02	0.00036	344	2.2	0.00039	0.003	0.045	0.29	0.062
		August	0.013	0.00024	228	1.5	0.00026	0.002	0.03	0.19	0.041
		September	0.0027	0.000049	46	0.3	0.000053	0.00041	0.0061	0.039	0.0084
		MAXIMUM	0.02	0.00036	344	2.2	0.00039	0.003	0.045	0.29	0.062
		AVERAGE	0.0046	0.000084	80	0.52	0.000091	0.0007	0.011	0.068	0.015
	First Year, Post-Closure	MINIMUM	**0.0035**	0.000016	11	0.31	0.000084	0.00064	**0.019**	0.0057	0.0058
		MAXIMUM	**0.028**	**0.00013**	89	2.6	0.00069	0.0052	**0.16**	0.047	**0.047**
		AVERAGE	**0.0092**	0.000042	29	0.84	0.00022	0.0017	**0.052**	0.015	0.015
		MAXIMUM (total)	**0.028**	**0.00013**	89	2.6	0.00069	0.0052	**0.16**	0.048	**0.048**
		AVERAGE (total)	**0.0092**	0.000045	29	0.84	0.00023	0.0017	**0.052**	0.016	0.016
	Long Term Water Quality (Years 10+)	MINIMUM	**0.0035**	0.000016	11	0.31	0.000084	0.00064	**0.019**	0.0057	0.0058
		MAXIMUM	**0.028**	**0.00013**	89	2.6	0.00069	0.0052	**0.16**	0.047	**0.047**
		AVERAGE	**0.0092**	0.000042	29	0.84	0.00022	0.0017	**0.052**	0.015	0.015
		MAXIMUM (total)	**0.028**	**0.00013**	89	2.6	0.00069	0.0052	**0.16**	0.048	**0.048**
		AVERAGE (total)	**0.0092**	0.000045	29	0.84	0.00023	0.0017	**0.052**	0.016	0.016
Flooded Pit	***First Year Post-Closure***	MINIMUM	0.00023	0.0000069	2.0	0.031	0.0000099	0.000087	0.0011	0.00066	0.0010
		MAXIMUM	0.00023	0.0000069	2.0	0.031	0.0000099	0.000087	0.0011	0.00066	0.0010
		AVERAGE	0.00023	0.0000069	2.0	0.031	0.0000099	0.000087	0.0011	0.00066	0.0010
	Long Term Water Quality (Years 10+)	MINIMUM	0.00023	0.0000069	2.0	0.031	0.0000099	0.000087	0.0011	0.00066	0.0010
		MAXIMUM	0.00023	0.0000069	2.0	0.031	0.0000099	0.000087	0.0011	0.00066	0.0010
		AVERAGE	0.00023	0.0000069	2.0	0.031	0.0000099	0.000087	0.0011	0.00066	0.0010
Attenuation Pond	***Operations Water Quality - with Water Treatment (maximum mine footprint)***	**October**	0.0029	0.000098	43	0.28	0.00015	0.00044	0.0052	0.026	0.011
		November	0.0024	0.000082	40	0.27	0.00012	0.00038	0.0048	0.022	0.01
		December	0.0021	0.000071	37	0.26	0.0001	0.00033	0.0045	0.02	0.0093
		January	0.0019	0.000063	35	0.26	0.00009	0.0003	0.0043	0.017	0.0087
		February	0.0017	0.000057	33	0.26	0.00008	0.00027	0.0042	0.015	0.0082
		March	0.0015	0.000052	32	0.26	0.000073	0.00025	0.004	0.014	0.0079
		April	0.0014	0.000048	31	0.25	0.000066	0.00023	0.0039	0.013	0.0076
		May	0.0013	0.000045	30	0.25	0.000061	0.00022	0.0038	0.012	0.0073
		June	0.0013	0.000047	26	0.19	0.000063	0.00021	0.0031	0.0098	0.0064
		July	0.0032	0.00012	43	0.28	0.00019	0.00048	0.0055	0.023	0.012
		August	0.0061	0.00022	78	0.51	0.00036	0.00088	0.01	0.046	0.022
		September	0.005	0.00017	67	0.43	0.00028	0.00073	0.0085	0.041	0.018
		MAXIMUM	0.0061	0.00022	78	0.51	0.00036	0.00088	0.01	0.046	0.022
		AVERAGE	0.0026	0.000089	41	0.29	0.00014	0.00039	0.0052	0.022	0.011
		MAXIMUM (total)	0.0061	0.00022	78	0.51	0.00037	0.00089	0.01	0.047	0.022
		AVERAGE (total)	0.0026	0.000092	41	0.29	0.00014	0.0004	0.0052	0.022	0.011
Whale Tail Lake (North Basin)	***First Year Post-Closure***	MINIMUM	0.00036	0.0000067	1.9	0.041	0.000013	0.00011	0.0019	0.00079	0.0012
		MAXIMUM	0.0005	0.0000074	2.4	0.054	0.000016	0.00014	0.0027	0.001	0.0014
		AVERAGE	0.00045	0.0000072	2.2	0.05	0.000015	0.00013	0.0024	0.00094	0.0013
		MAXIMUM (total)	0.0005	0.000011	2.4	0.055	0.000021	0.00014	0.0027	0.0018	0.0021
		AVERAGE (total)	0.00046	0.00001	2.2	0.051	0.00002	0.00014	0.0024	0.0018	0.002
	Long Term Water Quality (Years 10+)	MINIMUM	0.000034	0.0000051	0.57	0.011	0.0000053	0.000056	0.000086	0.00027	0.00058
		MAXIMUM	0.000037	0.0000052	0.58	0.011	0.0000054	0.000056	0.0001	0.00028	0.00059
		AVERAGE	0.000036	0.0000052	0.58	0.011	0.0000054	0.000056	0.000099	0.00027	0.00058
		MAXIMUM (total)	0.000042	0.0000083	0.59	0.012	0.000011	0.000062	0.00012	0.0011	0.0012
		AVERAGE (total)	0.000041	0.0000083	0.58	0.012	0.000011	0.000062	0.00011	0.0011	0.0012

Appendix B
Water Quality Model Predictions - On-Site Facilities (with Treatment) and Off-site Monitoring Locations
Whale Tail Project, Meadowbank Division
Agnico-Eagle Mines Limited

Portage Effluent Limits maximum average[1] (mg/L)			1400	1000			16	20	1			0.3					0.002				0.1		0.1				0.0004		0.2	
CEOG aquatic life (long-term)[2] (mg/L)				120	0.12			2.93	0.004 to 0.01	0.1		*0.028*				1.5	0.000012		0.001		0.002	0.3	0.001				0.000026	0.073	0.038	
			TDS	Cl	F	SO4	NH3 (as N)	NO3	P_total[3]	Al[4]	Sb	As[7]	Ba	Be	Bi	B	Cd[6]	Ca	Cr[5]	Co	Cu[6]	Fe	Pb[6]	Li	Mg	Mn	Hg	Mo	Ni[6]	K
LOCATION	Time Period	Month	mg/L	mg/L	mg/L	mg/L	mg N/L	mg N/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Mammoth Lake Proper	*Operations Water Quality - with Water Treatment (maximum mine footprint)*	**October**	54	6.6	0.1	14	0.014	0.6	**0.046**	0.005	0.0025	0.016	0.012	0.000023	0.000032	0.061	0.0000095	6.3	0.00091	0.00053	0.0016	0.04	0.00033	0.0016	1.9	0.069	0.0000085	0.0013	0.0049	3.6
		November	54	6.6	0.1	14	0.014	0.6	**0.046**	0.005	0.0025	0.016	0.012	0.000023	0.000032	0.061	0.0000095	6.3	0.00091	0.00053	0.0016	0.04	0.00033	0.0016	1.9	0.069	0.0000085	0.0013	0.0049	3.6
		December	54	6.6	0.1	14	0.014	0.6	**0.046**	0.005	0.0025	0.016	0.012	0.000023	0.000032	0.061	0.0000095	6.3	0.00091	0.00053	0.0016	0.04	0.00033	0.0016	1.9	0.069	0.0000085	0.0013	0.0049	3.6
		January	54	6.6	0.1	14	0.014	0.6	**0.046**	0.005	0.0025	0.016	0.012	0.000023	0.000032	0.061	0.0000095	6.3	0.00091	0.00053	0.0016	0.04	0.00033	0.0016	1.9	0.069	0.0000085	0.0013	0.0049	3.6
		February	54	6.6	0.1	14	0.014	0.6	**0.046**	0.005	0.0025	0.016	0.012	0.000023	0.000032	0.061	0.0000095	6.3	0.00091	0.00053	0.0016	0.04	0.00033	0.0016	1.9	0.069	0.0000085	0.0013	0.0049	3.6
		March	54	6.6	0.1	14	0.014	0.6	**0.046**	0.005	0.0025	0.016	0.012	0.000023	0.000032	0.061	0.0000095	6.3	0.00091	0.00053	0.0016	0.04	0.00033	0.0016	1.9	0.069	0.0000085	0.0013	0.0049	3.6
		April	54	6.6	0.1	14	0.014	0.6	**0.046**	0.005	0.0025	0.016	0.012	0.000023	0.000032	0.061	0.0000095	6.3	0.00091	0.00053	0.0016	0.04	0.00033	0.0016	1.9	0.069	0.0000085	0.0013	0.0049	3.6
		May	54	6.6	0.1	14	0.014	0.6	**0.046**	0.005	0.0025	0.016	0.012	0.000023	0.000032	0.061	0.0000095	6.3	0.00091	0.00053	0.0016	0.04	0.00033	0.0016	1.9	0.069	0.0000085	0.0013	0.0049	3.6
		June	54	6.7	0.1	13	0.015	0.61	**0.048**	0.005	0.0025	0.016	0.011	0.000023	0.000032	0.06	0.0000094	6.3	0.00089	0.00052	0.0016	0.04	0.00032	0.0016	1.9	0.068	0.0000083	0.0013	0.0048	3.5
		July	52	6.8	0.096	13	0.015	0.62	**0.05**	0.005	0.0023	0.017	0.011	0.000022	0.000031	0.057	0.0000093	6.0	0.00083	0.0005	0.0015	0.041	0.00031	0.0015	1.9	0.067	0.0000079	0.0013	0.0046	3.3
		August	53	7.0	0.099	13	0.016	0.65	**0.052**	0.005	0.0024	0.017	0.012	0.000022	0.000032	0.059	0.0000096	6.2	0.00086	0.00052	0.0016	0.042	0.00032	0.0016	1.9	0.07	0.0000081	0.0013	0.0048	3.4
		September	57	7.2	0.11	14	0.016	0.67	**0.052**	0.005	0.0026	0.018	0.012	0.000024	0.000033	0.064	0.00001	6.6	0.00094	0.00056	0.0017	0.043	0.00034	0.0017	2.0	0.074	0.0000087	0.0014	0.0051	3.7
		MAXIMUM	57	7.2	0.11	14	0.016	0.67	**0.052**	0.005	0.0026	0.018	0.012	0.000024	0.000033	0.064	0.00001	6.6	0.00094	0.00056	0.0017	0.043	0.00034	0.0017	2.0	0.074	0.0000087	0.0014	0.0051	3.7
		AVERAGE	54	6.7	0.1	14	0.015	0.61	**0.048**	0.005	0.0025	0.016	0.012	0.000023	0.000032	0.061	0.0000095	6.3	0.0009	0.00053	0.0016	0.04	0.00033	0.0016	1.9	0.069	0.0000084	0.0013	0.0049	3.5
	First Year Post-Closure	MINIMUM	27	3.7	0.05	5.8	0.0032	0.16	**0.014**	0.0032	0.0008	0.0048	0.0068	0.000014	0.000028	0.022	0.0000047	3.7	0.00026	0.0002	0.00079	0.015	0.00015	0.00086	1.2	0.021	0.0000054	0.00041	0.0019	1.5
		MAXIMUM	45	3.8	0.079	14	0.0041	0.18	**0.029**	0.0044	0.0011	0.006	0.010	0.000015	0.000029	0.023	0.0000072	6.2	0.00031	0.00023	0.00082	0.019	0.00016	0.0016	1.9	0.024	0.0000063	0.0015	0.0021	4.0
		AVERAGE	30	3.7	0.056	7.5	0.0039	0.17	**0.018**	0.0041	0.00087	0.0051	0.0075	0.000014	0.000029	0.022	0.0000052	4.2	0.0003	0.0002	0.0008	0.016	0.00015	0.001	1.3	0.022	0.0000056	0.00065	0.002	2.0
	Long Term Water Quality (Years 10+)	MINIMUM	33	2.5	0.06	10	0.00029	0.0085	0.005	0.0014	0.00056	0.0026	0.0076	0.000012	0.000026	0.0092	0.0000053	4.9	0.000075	0.00011	0.00051	0.016	0.000089	0.0013	1.6	0.0061	0.0000046	0.0012	0.00094	3.2
		MAXIMUM	39	2.7	0.069	13	0.00032	0.01	0.0059	0.0015	0.00069	0.003	0.0086	0.000013	0.000027	0.01	0.0000061	5.7	0.000078	0.00012	0.00055	0.016	0.000099	0.0015	1.8	0.0073	0.0000051	0.0015	0.001	3.9
		AVERAGE	38	2.6	0.068	12	0.00031	0.0099	0.0057	0.0014	0.00067	0.0029	0.0085	0.000013	0.000027	0.01	0.0000059	5.5	0.000078	0.00012	0.00054	0.016	0.000097	0.0015	1.7	0.0071	0.000005	0.0015	0.001	3.8
Lake A15	*Operations Water Quality - with Water Treatment (maximum mine footprint)*	**October**	49	6.2	0.092	12	0.013	0.54	**0.043**	0.0049	0.0021	0.015	0.011	0.000021	0.000031	0.053	0.0000087	5.8	0.00078	0.00047	0.0014	0.037	0.00029	0.0015	1.8	0.061	0.0000077	0.0012	0.0043	3.1
		November	49	6.2	0.092	12	0.013	0.54	**0.043**	0.0049	0.0021	0.015	0.011	0.000021	0.000031	0.053	0.0000087	5.8	0.00078	0.00047	0.0014	0.037	0.00029	0.0015	1.8	0.061	0.0000077	0.0012	0.0043	3.1
		December	49	6.2	0.092	12	0.013	0.54	**0.043**	0.0049	0.0021	0.015	0.011	0.000021	0.000031	0.053	0.0000087	5.8	0.00078	0.00047	0.0014	0.037	0.00029	0.0015	1.8	0.061	0.0000077	0.0012	0.0043	3.1
		January	49	6.2	0.092	12	0.013	0.54	**0.043**	0.0049	0.0021	0.015	0.011	0.000021	0.000031	0.053	0.0000087	5.8	0.00078	0.00047	0.0014	0.037	0.00029	0.0015	1.8	0.061	0.0000077	0.0012	0.0043	3.1
		February	49	6.2	0.092	12	0.013	0.54	**0.043**	0.0049	0.0021	0.015	0.011	0.000021	0.000031	0.053	0.0000087	5.8	0.00078	0.00047	0.0014	0.037	0.00029	0.0015	1.8	0.061	0.0000077	0.0012	0.0043	3.1
		March	49	6.2	0.092	12	0.013	0.54	**0.043**	0.0049	0.0021	0.015	0.011	0.000021	0.000031	0.053	0.0000087	5.8	0.00078	0.00047	0.0014	0.037	0.00029	0.0015	1.8	0.061	0.0000077	0.0012	0.0043	3.1
		April	49	6.2	0.092	12	0.013	0.54	**0.043**	0.0049	0.0021	0.015	0.011	0.000021	0.000031	0.053	0.0000087	5.8	0.00078	0.00047	0.0014	0.037	0.00029	0.0015	1.8	0.061	0.0000077	0.0012	0.0043	3.1
		May	49	6.2	0.092	12	0.013	0.54	**0.043**	0.0049	0.0021	0.015	0.011	0.000021	0.000031	0.053	0.0000087	5.8	0.00078	0.00047	0.0014	0.037	0.00029	0.0015	1.8	0.061	0.0000077	0.0012	0.0043	3.1
		June	50	6.2	0.094	12	0.013	0.55	**0.044**	0.0049	0.0022	0.015	0.011	0.000022	0.000031	0.055	0.0000089	5.9	0.00081	0.00048	0.0015	0.037	0.0003	0.0015	1.8	0.062	0.0000078	0.0012	0.0044	3.2
		July	50	6.3	0.093	12	0.013	0.56	**0.045**	0.0049	0.0022	0.015	0.011	0.000021	0.000031	0.054	0.0000088	5.8	0.0008	0.00047	0.0015	0.038	0.00029	0.0015	1.8	0.062	0.0000077	0.0012	0.0043	3.2
		August	50	6.3	0.093	12	0.013	0.56	**0.045**	0.0049	0.0022	0.015	0.011	0.000021	0.000032	0.054	0.0000089	5.9	0.00079	0.00047	0.0015	0.038	0.00029	0.0015	1.8	0.062	0.0000077	0.0012	0.0043	3.1
		September	52	6.6	0.097	13	0.014	0.59	**0.047**	0.005	0.0023	0.016	0.011	0.000022	0.000032	0.057	0.0000092	6.1	0.00083	0.0005	0.0015	0.039	0.00031	0.0015	1.9	0.065	0.000008	0.0013	0.0046	3.3
		MAXIMUM	52	6.6	0.097	13	0.014	0.59	**0.047**	0.005	0.0023	0.016	0.011	0.000022	0.000032	0.057	0.0000092	6.1	0.00083	0.0005	0.0015	0.039	0.00031	0.0015	1.9	0.065	0.000008	0.0013	0.0046	3.3
		AVERAGE	49	6.2	0.093	12	0.013	0.55	**0.044**	0.0049	0.0022	0.015	0.011	0.000021	0.000031	0.054	0.0000088	5.8	0.00079	0.00047	0.0015	0.037	0.00029	0.0015	1.8	0.061	0.0000077	0.0012	0.0043	3.1
	First Year Post-Closure	MINIMUM	25	3.3	0.048	5.5	0.0033	0.16	**0.013**	0.0035	0.00073	0.0044	0.0069	0.000014	0.000028	0.02	0.0000047	3.5	0.00026	0.00018	0.00079	0.015	0.00014	0.00083	1.1	0.019	0.000005	0.00038	0.0018	1.4
		MAXIMUM	37	3.6	0.067	11	0.0038	0.17	**0.024**	0.0044	0.00095	0.0053	0.0088	0.000014	0.000029	0.021	0.0000062	5.2	0.0003	0.00021	0.00081	0.018	0.00015	0.0013	1.6	0.022	0.0000058	0.0011	0.002	3.0
		AVERAGE	28	3.4	0.052	6.5	0.0037	0.16	**0.016**	0.0042	0.00078	0.0046	0.0073	0.000014	0.000029	0.021	0.000005	3.8	0.00028	0.00019	0.0008	0.016	0.00014	0.00093	1.2	0.02	0.0000052	0.00052	0.0018	1.7
	Long Term Water Quality (Years 10+)	MINIMUM	33	2.4	0.06	10	0.00028	0.0089	0.0049	0.0016	0.00055	0.0025	0.0077	0.000012	0.000027	0.0092	0.0000053	4.8	0.000074	0.00011	0.00053	0.015	0.000087	0.0013	1.5	0.006	0.0000046	0.0012	0.00092	3.1
		MAXIMUM	37	2.6	0.066	12	0.0003	0.011	0.0058	0.0017	0.00063	0.0028	0.0084	0.000012	0.000027	0.010	0.0000058	5.3	0.000077	0.00012	0.00055	0.016	0.000094	0.0014	1.7	0.0068	0.0000049	0.0014	0.0010	3.6
		AVERAGE	36	2.5	0.064	11	0.0003	0.01	0.0056	0.0016	0.00061	0.0027	0.0082	0.000012	0.000027	0.0098	0.0000057	5.2	0.000076	0.00012	0.00055	0.016	0.000093	0.0014	1.7	0.0066	0.0000048	0.0013	0.00098	3.5
Lake A12	*Operations Water Quality - with Water Treatment (maximum mine footprint)*	**October**	45	5.8	0.085	11	0.012	0.49	**0.039**	0.0049	0.0019	0.013	0.01	0.00002	0.000031	0.048	0.0000081	5.4	0.0007	0.00042	0.0014	0.034	0.00026	0.0014	1.7	0.054	0.0000072	0.001	0.0039	2.8
		November	45	5.8	0.085	11	0.012	0.49	**0.039**	0.0049	0.0019	0.013	0.01	0.00002	0.000031	0.048	0.0000081	5.4	0.0007	0.00042	0.0014	0.034	0.00026	0.0014	1.7	0.054	0.0000072	0.001	0.0039	2.8
		December	45	5.8	0.085	11	0.012	0.49	**0.039**	0.0049	0.0019	0.013	0.01	0.00002	0.000031	0.048	0.0000081	5.4	0.0007	0.00042	0.0014	0.034	0.00026	0.0014	1.7	0.054	0.0000072	0.001	0.0039	2.8
		January	45	5.8	0.085	11	0.012	0.49	**0.039**	0.0049	0.0019	0.013	0.01	0.00002	0.000031	0.048	0.0000081	5.4	0.0007	0.00042	0.0014	0.034	0.00026	0.0014	1.7	0.054	0.0000072	0.001	0.0039	2.8
		February	45	5.8	0.085	11	0.012	0.49	**0.039**	0.0049	0.0019	0.013	0.01	0.00002	0.000031	0.048	0.0000081	5.4	0.0007	0.00042	0.0014	0.034	0.00026	0.0014	1.7	0.054	0.0000072	0.001	0.0039	2.8
		March	45	5.8	0.085	11	0.012	0.49	**0.039**	0.0049	0.0019	0.013	0.01	0.00002	0.000031	0.048	0.0000081	5.4	0.0007	0.00042	0.0014	0.034	0.00026	0.0014	1.7	0.054	0.0000072	0.001	0.0039	2.8
		April	45	5.8	0.085	11	0.012	0.49	**0.039**	0.0049	0.0019	0.013	0.01	0.00002	0.000031	0.048	0.0000081	5.4	0.0007	0.00042	0.0014	0.034	0.00026	0.0014	1.7	0.054	0.0000072	0.001	0.0039	2.8
		May	45	5.8	0.085	11	0.012	0.49	**0.039**	0.0049	0.0019	0.013	0.01	0.00002	0.000031	0.048	0.0000081	5.4	0.0007	0.00042	0.0014	0.034	0.00026	0.0014	1.7	0.054	0.0000072	0.001	0.0039	2.8
		June	47	5.9	0.089	12	0.012	0.51	**0.041**	0.0048	0.0021	0.014	0.01	0.000021	0.000031	0.051	0.0000084	5.6	0.00075	0.00045	0.0014	0.035	0.00028	0.0014	1.7	0.057	0.0000074	0.0011	0.0041	3.0
		July	48	6.0	0.091	12	0.013	0.53	**0.042**	0.0049	0.0021	0.014	0.011	0.000021	0.000031	0.052	0.0000086	5.7	0.00077	0.00046	0.0014	0.036	0.00028	0.0014	1.8	0.059	0.0000075	0.0011	0.0042	3.1
		August	49	6.1	0.092	12	0.013	0.53	**0.042**	0.005	0.0021	0.014	0.011	0.000021	0.000032	0.052	0.0000087	5.8	0.00077	0.00046	0.0015	0.036	0.00029	0.0015	1.8	0.059	0.0000076	0.0011	0.0042	3.1
		September	49	6.2	0.093	12	0.013	0.55	**0.044**	0.005	0.0022	0.015	0.011	0.000022	0.000032	0.053	0.0000088	5.8	0.00078	0.00047	0.0015	0.037	0.00029	0.0015	1.8	0.061	0.0000077	0.0012	0.0043	3.1
		MAXIMUM	49	6.2	0.093	12	0.013	0.55	**0.044**	0.005	0.0022	0.015	0.011	0.000022	0.000032	0.053	0.0000088	5.8	0.00078	0.00047	0.0015	0.037	0.00029	0.0015	1.8	0.061	0.0000077	0.0012	0.0043	3.1
		AVERAGE	46	5.9	0.087	11	0.012	0.5	**0.04**	0.0049	0.002	0.014	0.01	0.00002	0.000031	0.049	0.0000083	5.5	0.00072	0.00043	0.0014	0.035	0.00027	0.0014	1.7	0.056	0.0000073	0.0011	0.004	2.9
	First Year Post-Closure	MINIMUM	25	3.2	0.049	5.5	0.0034	0.15	**0.013**	0.0039	0.00071	0.0043	0.0071	0.000014	0.000029	0.02	0.0000048	3.5	0.00027	0.00018	0.0008	0.016	0.00013	0.00085	1.1	0.019	0.0000049	0.00037	0.0017	1.4
		MAXIMUM	33	3.5	0.061	8.7	0.0036	0.16	**0.021**	0.0045	0.00086	0.0049	0.0082	0.000015	0.00003	0.021	0.0000057	4.6	0.00028	0.0002	0.00084	0.017	0.00015	0.0011	1.4	0.021	0.0000055	0.00083	0.0019	2.4
		AVERAGE	27	3.3	0.051	6.1	0.0036	0.16	**0.015**	0.0044	0.00074	0.0044	0.0074	0.000014	0.000029	0.02	0.000005	3.7	0.00028	0.00019	0.00083	0.016	0.00014	0.0009	1.2	0.019	0.0000051	0.00046	0.0018	1.6
	Long Term Water Quality (Years 10+)	MINIMUM	33	2.4	0.06	10	0.00027	0.0093	0.0049	0.0017	0.00055	0.0025	0.0079	0.000012	0.000027	0.0093	0.0000054	4.9	0.000074	0.00011	0.00055	0.015	0.000088	0.0013	1.6	0.006	0.0000046	0.0012	0.00092	3.1
		MAXIMUM	35	2.5	0.063	11	0.00029	0.011	0.0057	0.0019	0.00059	0.0026	0.0082	0.000013	0.000028	0.0097	0.0000056	5.1	0.000076	0.00011	0.00057	0.016	0.000092	0.0014	1.6	0.0065	0.0000048	0.0013	0.00097	3.3
		AVERAGE	35	2.5	0.062	11	0.00029	0.011	0.0055	0.0018	0.00058	0.0026	0.0081	0.000012	0.000027	0.0096	0.0000056	5.1	0.000076	0.00011	0.00056	0.016	0.000091	0.0013	1.6	0.0063	0.0000048	0.0012	0.00096	3.3

Appendix B
Water Quality Model Predictions - On-Site Facilities (with Treatment) and Off-site Monitoring Locations
Whale Tail Project, Meadowbank Division
Agnico-Eagle Mines Limited

Portage Effluent Limits maximum average[1] (mg/L)											0.4
CEOG aquatic life (long-term)[2] (mg/L)			0.001	0.0001			0.0008		0.015		0.03
			Se	Ag	Na	Sr	Tl	Sn	U	V	Zn
LOCATION	Time Period	Month	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Mammoth Lake Proper	*Operations Water Quality - with Water Treatment (maximum mine footprint)*	October	0.00034	0.000016	5.2	0.041	0.000022	0.000094	0.00061	0.0027	0.0017
		November	0.00034	0.000016	5.2	0.041	0.000022	0.000094	0.00061	0.0027	0.0017
		December	0.00034	0.000016	5.2	0.041	0.000022	0.000094	0.00061	0.0027	0.0017
		January	0.00034	0.000016	5.2	0.041	0.000022	0.000094	0.00061	0.0027	0.0017
		February	0.00034	0.000016	5.2	0.041	0.000022	0.000094	0.00061	0.0027	0.0017
		March	0.00034	0.000016	5.2	0.041	0.000022	0.000094	0.00061	0.0027	0.0017
		April	0.00034	0.000016	5.2	0.041	0.000022	0.000094	0.00061	0.0027	0.0017
		May	0.00034	0.000016	5.2	0.041	0.000022	0.000094	0.00061	0.0027	0.0017
		June	0.00033	0.000015	5.1	0.041	0.000022	0.000092	0.0006	0.0027	0.0017
		July	0.00031	0.000015	4.9	0.04	0.00002	0.000089	0.00057	0.0025	0.0016
		August	0.00032	0.000015	5.1	0.041	0.000021	0.000091	0.00059	0.0026	0.0017
		September	0.00035	0.000016	5.4	0.043	0.000023	0.000096	0.00064	0.0028	0.0018
		MAXIMUM	0.00035	0.000016	5.4	0.043	0.000023	0.000096	0.00064	0.0028	0.0018
		AVERAGE	0.00034	0.000016	5.1	0.041	0.000022	0.000093	0.00061	0.0027	0.0017
	First Year Post-Closure	MINIMUM	0.00012	0.0000083	1.9	0.022	0.00001	0.000066	0.0002	0.001	0.00089
		MAXIMUM	0.0003	0.0000087	2.2	0.037	0.000014	0.000099	0.0013	0.0011	0.0011
		AVERAGE	0.00016	0.0000085	2.0	0.025	0.000011	0.000073	0.00043	0.001	0.00094
	Long Term Water Quality (Years 10+)	MINIMUM	0.00022	0.0000059	1.1	0.028	0.0000097	0.000088	0.0011	0.00057	0.00086
		MAXIMUM	0.00027	0.0000062	1.3	0.033	0.000011	0.000097	0.0014	0.00066	0.00095
		AVERAGE	0.00026	0.0000062	1.3	0.032	0.000011	0.000096	0.0013	0.00064	0.00094
Lake A15	*Operations Water Quality - with Water Treatment (maximum mine footprint)*	October	0.00029	0.000014	4.5	0.037	0.000019	0.000092	0.00053	0.0023	0.0015
		November	0.00029	0.000014	4.5	0.037	0.000019	0.000092	0.00053	0.0023	0.0015
		December	0.00029	0.000014	4.5	0.037	0.000019	0.000092	0.00053	0.0023	0.0015
		January	0.00029	0.000014	4.5	0.037	0.000019	0.000092	0.00053	0.0023	0.0015
		February	0.00029	0.000014	4.5	0.037	0.000019	0.000092	0.00053	0.0023	0.0015
		March	0.00029	0.000014	4.5	0.037	0.000019	0.000092	0.00053	0.0023	0.0015
		April	0.00029	0.000014	4.5	0.037	0.000019	0.000092	0.00053	0.0023	0.0015
		May	0.00029	0.000014	4.5	0.037	0.000019	0.000092	0.00053	0.0023	0.0015
		June	0.00031	0.000015	4.7	0.038	0.00002	0.000093	0.00055	0.0024	0.0016
		July	0.0003	0.000014	4.6	0.038	0.00002	0.000093	0.00054	0.0024	0.0016
		August	0.0003	0.000014	4.6	0.038	0.00002	0.000095	0.00054	0.0024	0.0016
		September	0.00031	0.000015	4.9	0.039	0.00002	0.000096	0.00057	0.0025	0.0016
		MAXIMUM	0.00031	0.000015	4.9	0.039	0.00002	0.000096	0.00057	0.0025	0.0016
		AVERAGE	0.0003	0.000014	4.6	0.038	0.00002	0.000093	0.00054	0.0024	0.0016
	First Year Post-Closure	MINIMUM	0.00011	0.0000083	1.8	0.02	0.00001	0.000078	0.00018	0.00095	0.0009
		MAXIMUM	0.00023	0.0000084	2.1	0.031	0.000012	0.000092	0.00087	0.001	0.001
		AVERAGE	0.00014	0.0000083	1.9	0.022	0.00001	0.000081	0.00032	0.00097	0.00093
	Long Term Water Quality (Years 10+)	MINIMUM	0.00022	0.0000059	1.1	0.028	0.0000097	0.000092	0.0011	0.00057	0.00087
		MAXIMUM	0.00025	0.0000061	1.3	0.031	0.00001	0.000098	0.0013	0.00062	0.00093
		AVERAGE	0.00024	0.0000061	1.2	0.03	0.00001	0.000097	0.0012	0.00061	0.00092
Lake A12	*Operations Water Quality - with Water Treatment (maximum mine footprint)*	October	0.00026	0.000013	4.1	0.035	0.000018	0.000093	0.00047	0.0021	0.0015
		November	0.00026	0.000013	4.1	0.035	0.000018	0.000093	0.00047	0.0021	0.0015
		December	0.00026	0.000013	4.1	0.035	0.000018	0.000093	0.00047	0.0021	0.0015
		January	0.00026	0.000013	4.1	0.035	0.000018	0.000093	0.00047	0.0021	0.0015
		February	0.00026	0.000013	4.1	0.035	0.000018	0.000093	0.00047	0.0021	0.0015
		March	0.00026	0.000013	4.1	0.035	0.000018	0.000093	0.00047	0.0021	0.0015
		April	0.00026	0.000013	4.1	0.035	0.000018	0.000093	0.00047	0.0021	0.0015
		May	0.00026	0.000013	4.1	0.035	0.000018	0.000093	0.00047	0.0021	0.0015
		June	0.00028	0.000014	4.4	0.036	0.000019	0.000094	0.00051	0.0023	0.0015
		July	0.00029	0.000014	4.5	0.037	0.000019	0.000096	0.00052	0.0023	0.0016
		August	0.00029	0.000014	4.5	0.037	0.000019	0.0001	0.00052	0.0023	0.0016
		September	0.00029	0.000014	4.6	0.038	0.00002	0.00010	0.00053	0.0024	0.0016
		MAXIMUM	0.00029	0.000014	4.6	0.038	0.00002	0.0001	0.00053	0.0024	0.0016
		AVERAGE	0.00027	0.000014	4.2	0.035	0.000018	0.000095	0.00049	0.0022	0.0015
	First Year Post-Closure	MINIMUM	0.00011	0.0000083	1.8	0.02	0.00001	0.000083	0.00018	0.00093	0.00093
		MAXIMUM	0.00018	0.0000084	2.0	0.027	0.000011	0.000091	0.00062	0.0010	0.001
		AVERAGE	0.00013	0.0000084	1.9	0.021	0.00001	0.000089	0.00027	0.00095	0.00095
	Long Term Water Quality (Years 10+)	MINIMUM	0.00022	0.000006	1.2	0.028	0.0000097	0.000097	0.0011	0.00057	0.00089
		MAXIMUM	0.00023	0.0000062	1.2	0.029	0.00001	0.0001	0.0012	0.0006	0.00092
		AVERAGE	0.00023	0.0000061	1.2	0.029	0.00001	0.00010	0.0012	0.00059	0.00092

Appendix B
Water Quality Model Predictions - On-Site Facilities (with Treatment) and Off-site Monitoring Locations
Whale Tail Project, Meadowbank Division
Agnico-Eagle Mines Limited

Portage Effluent Limits maximum average[1] (mg/L)			**1400**	**1000**			**16**	**20**	**1**			**0.3**					**0.002**				**0.1**		**0.1**				**0.0004**		**0.2**	
CEQG aquatic life (long-term)[2] (mg/L)				**120**	**0.12**			**2.93**	**0.004 to 0.01**	**0.1**		***0.028***				**1.5**	**0.000012**		**0.001**		**0.002**	**0.3**	**0.001**				**0.000026**	**0.073**	**0.038**	
			TDS	Cl	F	SO4	NH3 (as N)	NO3	P_total[3]	Al[4]	Sb	As[7]	Ba	Be	Bi	B	Cd[6]	Ca	Cr[5]	Co	Cu[6]	Fe	Pb[6]	Li	Mg	Mn	Hg	Mo	Ni[6]	K
LOCATION	**Time Period**	**Month**	mg/L	mg/L	mg/L	mg/L	mg N/L	mg N/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Downstream Node 1	***Operations Water Quality - with Water Treatment (maximum mine footprint)***	**October**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		November	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		December	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		January	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		February	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		March	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		April	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		May	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		June	15	1.5	0.03	2.7	0.00065	0.033	0.0033	0.0038	0.00015	0.00092	0.0058	0.000011	0.000026	0.0075	0.0000034	2.2	0.000086	0.000071	0.00065	0.011	0.000055	0.00056	0.71	0.0037	0.0000028	0.000085	0.0006	0.62
		July	15	1.4	0.03	2.6	0.00062	0.032	0.0032	0.0038	0.00015	0.00087	0.0058	0.000011	0.000026	0.0074	0.0000034	2.2	0.000085	0.00007	0.00065	0.011	0.000054	0.00055	0.71	0.0035	0.0000028	0.000083	0.00059	0.61
		August	15	1.4	0.03	2.6	0.00059	0.031	0.0031	0.0039	0.00014	0.00084	0.0059	0.000011	0.000026	0.0073	0.0000034	2.2	0.000084	0.00007	0.00065	0.011	0.000054	0.00056	0.71	0.0034	0.0000028	0.00008	0.00059	0.61
		September	16	1.6	0.032	2.9	0.0009	0.044	0.0042	0.0039	0.0002	0.0012	0.006	0.000011	0.000026	0.0085	0.0000035	2.3	0.0001	0.00008	0.00068	0.012	0.00006	0.00058	0.74	0.0049	0.000003	0.00011	0.00068	0.68
		MAXIMUM	16	1.6	0.032	2.9	0.0009	0.044	0.0042	0.0039	0.0002	0.0012	0.006	0.000011	0.000026	0.0085	0.0000035	2.3	0.0001	0.00008	0.00068	0.012	0.00006	0.00058	0.74	0.0049	0.000003	0.00011	0.00068	0.68
		AVERAGE	15	1.5	0.031	2.7	0.00069	0.035	0.0035	0.0039	0.00016	0.00096	0.0059	0.000011	0.000026	0.0077	0.0000034	2.2	0.000089	0.000073	0.00066	0.011	0.000056	0.00056	0.72	0.0039	0.0000029	0.000089	0.00062	0.63
	First Year Post-Closure	MINIMUM	14	1.3	0.029	2.5	0.00032	0.02	0.0023	0.0038	0.00011	0.00053	0.0057	0.000011	0.000026	0.0064	0.0000033	2.1	0.000071	0.000062	0.00064	0.01	0.000049	0.00054	0.69	0.0022	0.0000027	0.00006	0.00052	0.57
		MAXIMUM	15	1.4	0.03	2.6	0.00043	0.024	0.0027	0.0039	0.00013	0.00066	0.0059	0.000011	0.000026	0.007	0.0000034	2.2	0.000079	0.000067	0.00065	0.011	0.000053	0.00056	0.72	0.0028	0.0000028	0.000073	0.00056	0.61
		AVERAGE	14	1.4	0.029	2.5	0.00036	0.021	0.0024	0.0039	0.00011	0.00056	0.0058	0.000011	0.000026	0.0066	0.0000033	2.1	0.000073	0.000064	0.00064	0.011	0.00005	0.00055	0.7	0.0024	0.0000028	0.000064	0.00053	0.58
	Long Term Water Quality (Years 10+)	MINIMUM	15	1.3	0.03	2.9	0.000027	0.0071	0.0017	0.0036	0.000096	0.00037	0.0058	0.00001	0.000026	0.0055	0.0000033	2.2	0.000053	0.000056	0.00061	0.01	0.000046	0.00058	0.73	0.0012	0.0000027	0.00013	0.00045	0.73
		MAXIMUM	15	1.4	0.031	3.2	0.000035	0.0074	0.0019	0.0037	0.00011	0.00044	-	0.000011	0.000026	0.0057	0.0000034	2.3	0.000055	0.000059	0.00062	0.011	0.000048	0.00061	0.77	0.0014	0.0000028	0.00017	0.00047	0.81
		AVERAGE	15	1.3	0.031	3.0	0.000031	0.0073	0.0018	0.0036	0.0001	0.0004	0.0059	0.00001	0.000026	0.0056	0.0000034	2.3	0.000054	0.000057	0.00061	0.01	0.000047	0.00059	0.75	0.0013	0.0000028	0.00015	0.00046	0.77
Downstream Node 2	***Operations Water Quality - with Water Treatment (maximum mine footprint)***	**October**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		November	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		December	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		January	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		February	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		March	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		April	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		May	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		June	26	3.1	0.05	5.6	0.0045	0.19	**0.016**	0.0044	0.00077	0.0053	0.0075	0.000014	0.000029	0.022	0.0000051	3.4	0.0003	0.0002	0.00091	0.019	0.00013	0.00086	1.1	0.021	0.0000045	0.00042	0.0018	1.4
		July	21	2.3	0.042	4.3	0.0025	0.11	0.0095	0.0043	0.00046	0.003	0.007	0.000013	0.000029	0.015	0.0000044	2.9	0.0002	0.00014	0.00082	0.016	0.000094	0.00074	0.93	0.012	0.0000038	0.00025	0.0012	1.0
		August	24	2.8	0.048	5.2	0.0038	0.16	**0.014**	0.0044	0.00066	0.0045	0.0074	0.000014	0.000029	0.019	0.0000049	3.2	0.00027	0.00017	0.00089	0.018	0.00012	0.00082	1.0	0.018	0.0000043	0.00036	0.0016	1.3
		September	29	3.4	0.056	6.4	0.0055	0.23	**0.019**	0.0046	0.00093	0.0063	0.0081	0.000016	0.00003	0.026	0.0000057	3.7	0.00036	0.00023	0.001	0.022	0.00015	0.00095	1.2	0.026	0.000005	0.00051	0.0021	1.6
		MAXIMUM	29	3.4	0.056	6.4	0.0055	0.23	**0.019**	0.0046	0.00093	0.0063	0.0081	0.000016	0.00003	0.026	0.0000057	3.7	0.00036	0.00023	0.001	0.022	0.00015	0.00095	1.2	0.026	0.000005	0.00051	0.0021	1.6
		AVERAGE	25	2.9	0.049	5.4	0.0041	0.17	**0.014**	0.0044	0.0007	0.0048	0.0075	0.000014	0.000029	0.02	0.000005	3.3	0.00028	0.00018	0.00091	0.019	0.00012	0.00084	1.1	0.019	0.0000044	0.00038	0.0017	1.3
	First Year Post-Closure	MINIMUM	18	1.9	0.036	3.4	0.0012	0.055	0.0051	0.0043	0.00027	0.0015	0.0066	0.000012	0.000029	0.01	0.0000039	2.6	0.00013	0.000097	0.00074	0.013	0.000074	0.00066	0.85	0.0065	0.0000035	0.00014	0.00085	0.81
		MAXIMUM	21	2.3	0.041	4.1	0.0019	0.085	0.0076	0.0044	0.0004	0.0023	0.0069	0.000013	0.00003	0.013	0.0000043	2.9	0.00017	0.00012	0.00079	0.014	0.000092	0.00073	0.95	0.01	0.000004	0.00022	0.0011	1.0
		AVERAGE	20	2.1	0.039	3.8	0.0016	0.074	0.0067	0.0044	0.00035	0.002	0.0068	0.000013	0.000029	0.012	0.0000041	2.8	0.00016	0.00011	0.00077	0.014	0.000085	0.0007	0.9	0.0088	0.0000038	0.00019	0.001	0.93
	Long Term Water Quality (Years 10+)	MINIMUM	21	1.7	0.041	5.2	0.000098	0.0089	0.003	0.0029	0.00023	0.00097	0.0069	0.000012	0.000028	0.007	0.0000042	3.1	0.000063	0.000075	0.00062	0.012	0.000061	0.00082	1.0	0.0026	0.0000035	0.00043	0.00062	1.4
		MAXIMUM	25	2.0	0.048	6.9	0.00016	0.011	0.0041	0.0034	0.00034	0.0015	0.0074	0.000012	0.000028	0.0079	0.0000046	3.7	0.000068	0.000088	0.00065	0.014	0.000071	0.00099	1.2	0.0039	0.0000039	0.00068	0.00073	2.0
		AVERAGE	24	1.9	0.045	6.4	0.00014	0.0097	0.0036	0.0031	0.0003	0.0013	0.0072	0.000012	0.000028	0.0076	0.0000045	3.5	0.000066	0.000083	0.00063	0.013	0.000067	0.00093	1.1	0.0034	0.0000037	0.00059	0.00069	1.8

Notes:

[1] Portage effluent limits (NWB, 2015). Maximum average. Operational phase only - exceedances shown as bold-underlined-highlighted cells

[2] CEQG (2002) freshwater guidelines. Post-closure exceedances to freshwater CEQG's shown in bold-underlined type

[3] CEQG Freshwater Aquatic Life Trigger Ranges are dependent on trophic status; oligotrophic status assumed

[4] CEQG Freshwater Aquatic Life Criterion for aluminun is pH dependant; assumes pH>6.5.

[5] CEQG Freshwater aquatic life criteria for chromium depends on the valence of chromium ion. In the above table, the Cr(VI) criterion of 0.001 mg/L is shown.

[6] CEQG Freshwater Aquatic Life Criteria are hardness dependant; assumes a hardness of 30 mg/L.

[7] The CEQG aquatic life criterion for Arsenic is replaced by the Site Specific Water Quality Objective of 0.028 mg/L developed for the Whale Tail Pit Project (Volume 6, Appendix 6-N)

Appendix B
Water Quality Model Predictions - On-Site Facilities (with Treatment) and Off-site Monitoring Locations
Whale Tail Project, Meadowbank Division
Agnico-Eagle Mines Limited

Portage Effluent Limits maximum average[1] (mg/L)												**0.4**
CEQG aquatic life (long-term)[2] (mg/L)			**0.001**	**0.0001**			**0.0008**		**0.015**			**0.03**
			Se	**Ag**	**Na**	**Sr**	**Tl**	**Sn**	**U**	**V**	**Zn**
LOCATION	**Time Period**	**Month**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Downstream Node 1	***Operations Water Quality - with Water Treatment (maximum mine footprint)***	**October**	0	0	0	0	0	0	0	0	0
		November	0	0	0	0	0	0	0	0	0
		December	0	0	0	0	0	0	0	0	0
		January	0	0	0	0	0	0	0	0	0
		February	0	0	0	0	0	0	0	0	0
		March	0	0	0	0	0	0	0	0	0
		April	0	0	0	0	0	0	0	0	0
		May	0	0	0	0	0	0	0	0	0
		June	0.000039	0.0000055	0.84	0.01	0.0000058	0.00011	0.00005	0.00036	0.00075
		July	0.000038	0.0000055	0.84	0.01	0.0000058	0.00011	0.000049	0.00035	0.00075
		August	0.000038	0.0000056	0.83	0.01	0.0000058	0.00011	0.000048	0.00035	0.00076
		September	0.000044	0.0000058	0.93	0.011	0.0000062	0.00011	0.000061	0.0004	0.00078
		MAXIMUM	0.000044	0.0000058	0.93	0.011	0.0000062	0.00011	0.000061	0.0004	0.00078
		AVERAGE	0.00004	0.0000056	0.86	0.01	0.0000059	0.00011	0.000052	0.00036	0.00076
	First Year Post-Closure	MINIMUM	0.000033	0.0000054	0.76	0.0095	0.0000055	0.00011	0.000039	0.00031	0.00074
		MAXIMUM	0.000036	0.0000056	0.81	0.01	0.0000058	0.00012	0.000047	0.00034	0.00076
		AVERAGE	0.000034	0.0000055	0.78	0.0097	0.0000056	0.00011	0.000042	0.00032	0.00075
	Long Term Water Quality (Years 10+)	MINIMUM	0.000042	0.0000052	0.7	0.01	0.0000055	0.00011	0.00012	0.00028	0.00073
		MAXIMUM	0.000048	0.0000053	0.73	0.011	0.0000057	0.00012	0.00015	0.0003	0.00075
		AVERAGE	0.000045	0.0000052	0.72	0.011	0.0000056	0.00011	0.00013	0.00029	0.00074
Downstream Node 2	***Operations Water Quality - with Water Treatment (maximum mine footprint)***	**October**	0	0	0	0	0	0	0	0	0
		November	0	0	0	0	0	0	0	0	0
		December	0	0	0	0	0	0	0	0	0
		January	0	0	0	0	0	0	0	0	0
		February	0	0	0	0	0	0	0	0	0
		March	0	0	0	0	0	0	0	0	0
		April	0	0	0	0	0	0	0	0	0
		May	0	0	0	0	0	0	0	0	0
		June	0.00012	0.0000085	2.0	0.019	0.00001	0.00011	0.0002	0.00098	0.001
		July	0.00008	0.0000073	1.5	0.015	0.0000083	0.00012	0.00013	0.00068	0.00093
		August	0.0001	0.0000081	1.8	0.018	0.0000097	0.00011	0.00017	0.00088	0.001
		September	0.00014	0.0000093	2.3	0.022	0.000012	0.00011	0.00024	0.0011	0.0011
		MAXIMUM	0.00014	0.0000093	2.3	0.022	0.000012	0.00012	0.00024	0.0011	0.0011
		AVERAGE	0.00011	0.0000083	1.9	0.018	0.000010	0.00011	0.00018	0.00092	0.001
	First Year Post-Closure	MINIMUM	0.000055	0.0000066	1.1	0.013	0.0000071	0.00011	0.000079	0.00049	0.00085
		MAXIMUM	0.000074	0.0000072	1.3	0.015	0.0000081	0.00012	0.00012	0.00063	0.0009
		AVERAGE	0.000066	0.000007	1.2	0.014	0.0000077	0.00012	0.0001	0.00058	0.00088
	Long Term Water Quality (Years 10+)	MINIMUM	0.000093	0.0000058	0.89	0.016	0.0000071	0.00011	0.0004	0.00039	0.00084
		MAXIMUM	0.00013	0.000006	1.0	0.02	0.0000081	0.00012	0.00063	0.00045	0.00088
		AVERAGE	0.00012	0.0000059	0.96	0.019	0.0000077	0.00012	0.00055	0.00043	0.00086

Notes:

[1] Portage effluent limits (NWB, 2015). Maximum average. Operational phase only - exceedances shown as bold-underlined-highlighted cells

[2]CEQG (2002) freshwater guidelines. Post-closure exceedances to freshwater CEQG's shown in bold-underlined type

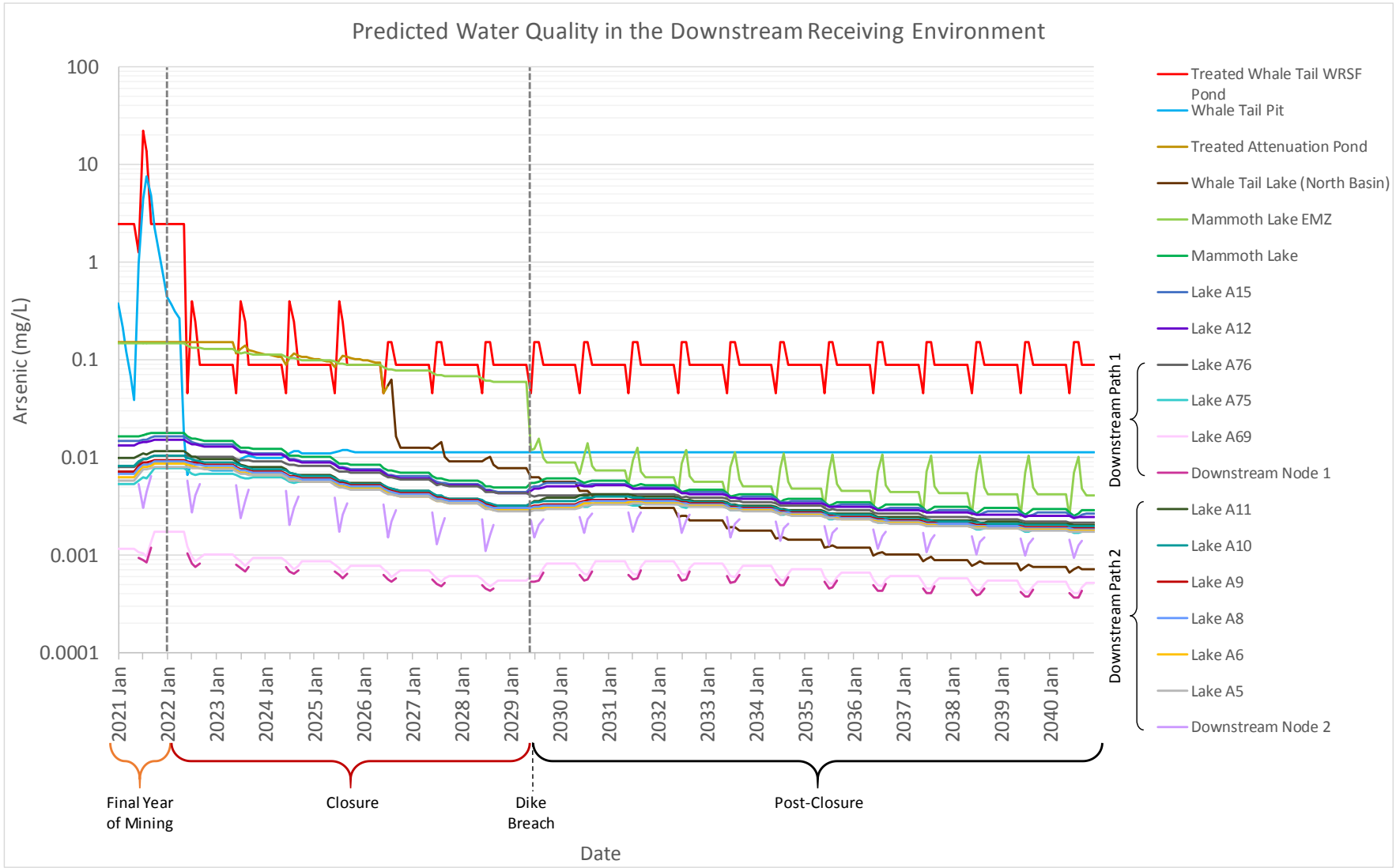
[3] CEQG Freshwater Aquatic Life Trigger Ranges are dependent on trophic status; oligotrophic status assumed

[4] CEQG Freshwater Aquatic Life Criterion for aluminun is pH dependant; assumes pH>6.5.

[5] CEQG Freshwater aquatic life criteria for chromium depends on the valence of chromium ion. In the above table, the Cr(VI) criterion of 0.001 mg/L is shown.

[6] CEQG Freshwater Aquatic Life Criteria are hardness dependant; assumes a hardness of 30 mg/L.

[7] The CEQG aquatic life criterion for Arsenic is replaced by the Site Specific Water Quality Objective of 0.028 mg/L developed for the Whale Tail Pit Project (Volume 6, Appendix 6-N)



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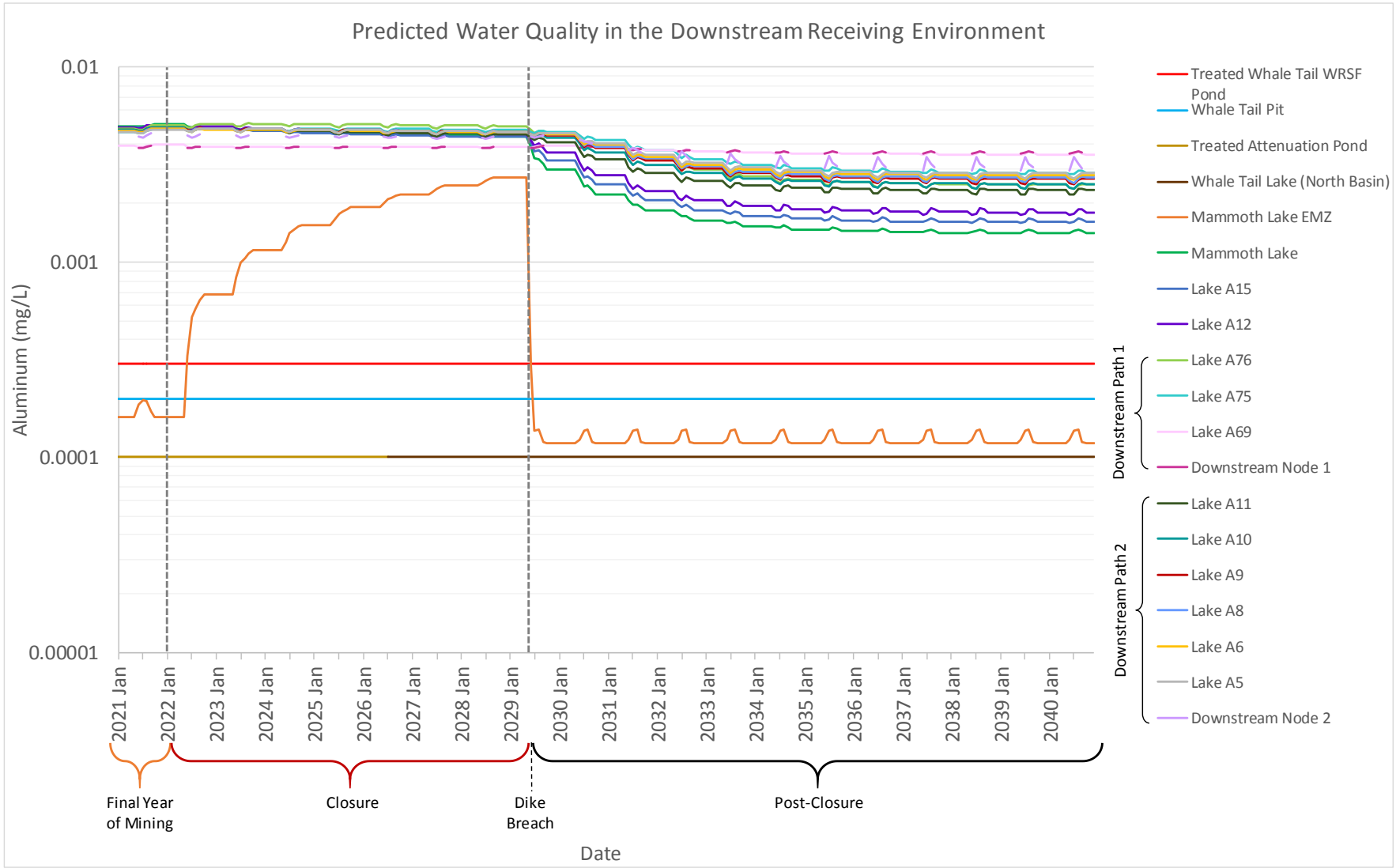
PROJECT
MINE SITE WATER QUALITY PREDICTIONS
WHALE TAIL PROJECT

YYYY-MM-DD	2016-06-10
PREPARED	SG
DESIGNED	KS
REVIEWED	VJB
APPROVED	DW

TITLE
Predicted Water Quality in the Downstream Receiving Environment - Arsenic

PROJECT NO.		REV.	FIGURE
1520817	5000	0	**B-1**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0



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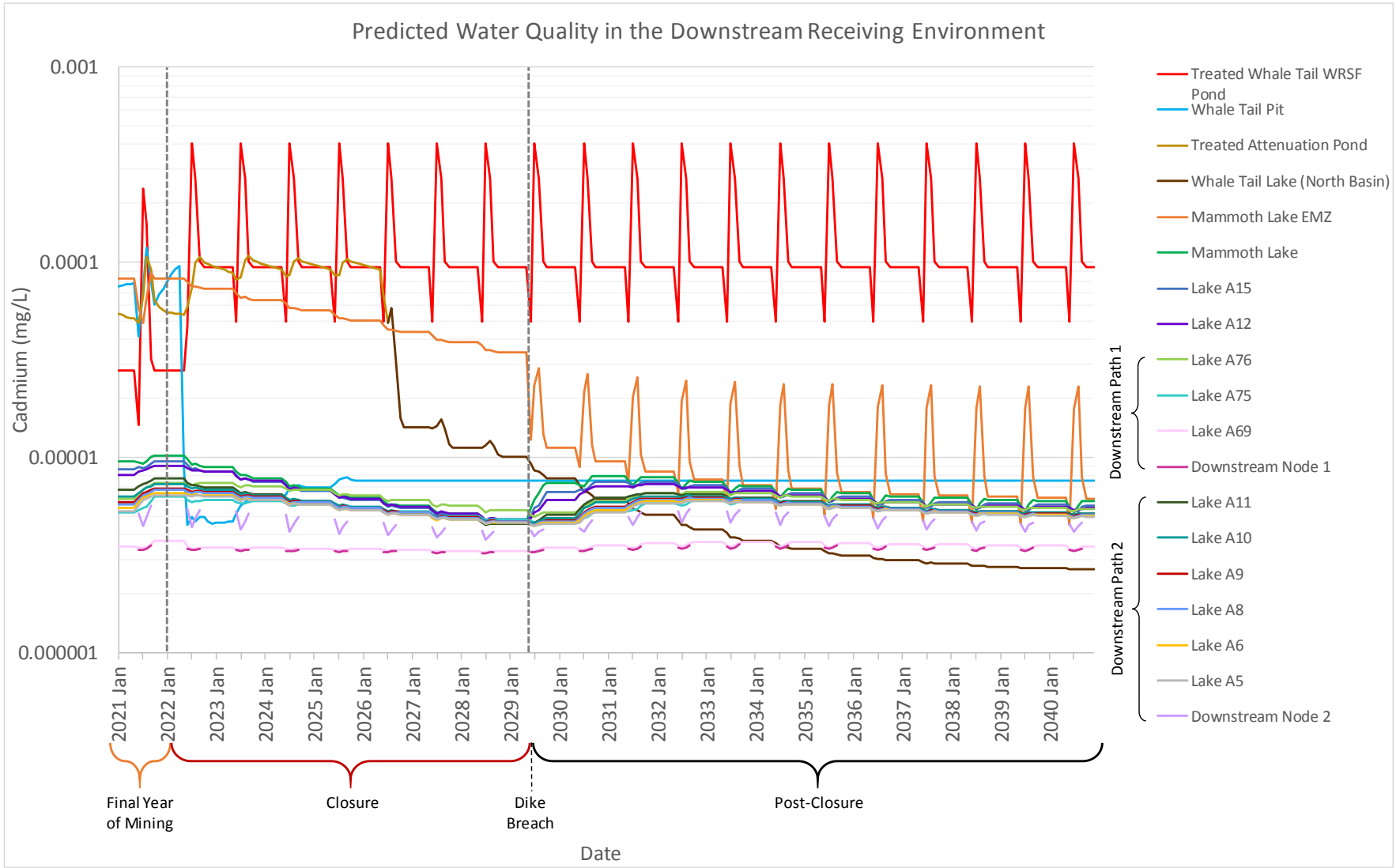
PROJECT
MINE SITE WATER QUALITY PREDICTIONS
WHALE TAIL PROJECT

YYYY-MM-DD	2016-06-10
PREPARED	SG
DESIGNED	KS
REVIEWED	VJB
APPROVED	DW

TITLE
Predicted Water Quality in the Downstream Receiving Environment - Aluminum

PROJECT NO.		REV.	FIGURE
1520817	5000	0	**B-2**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0



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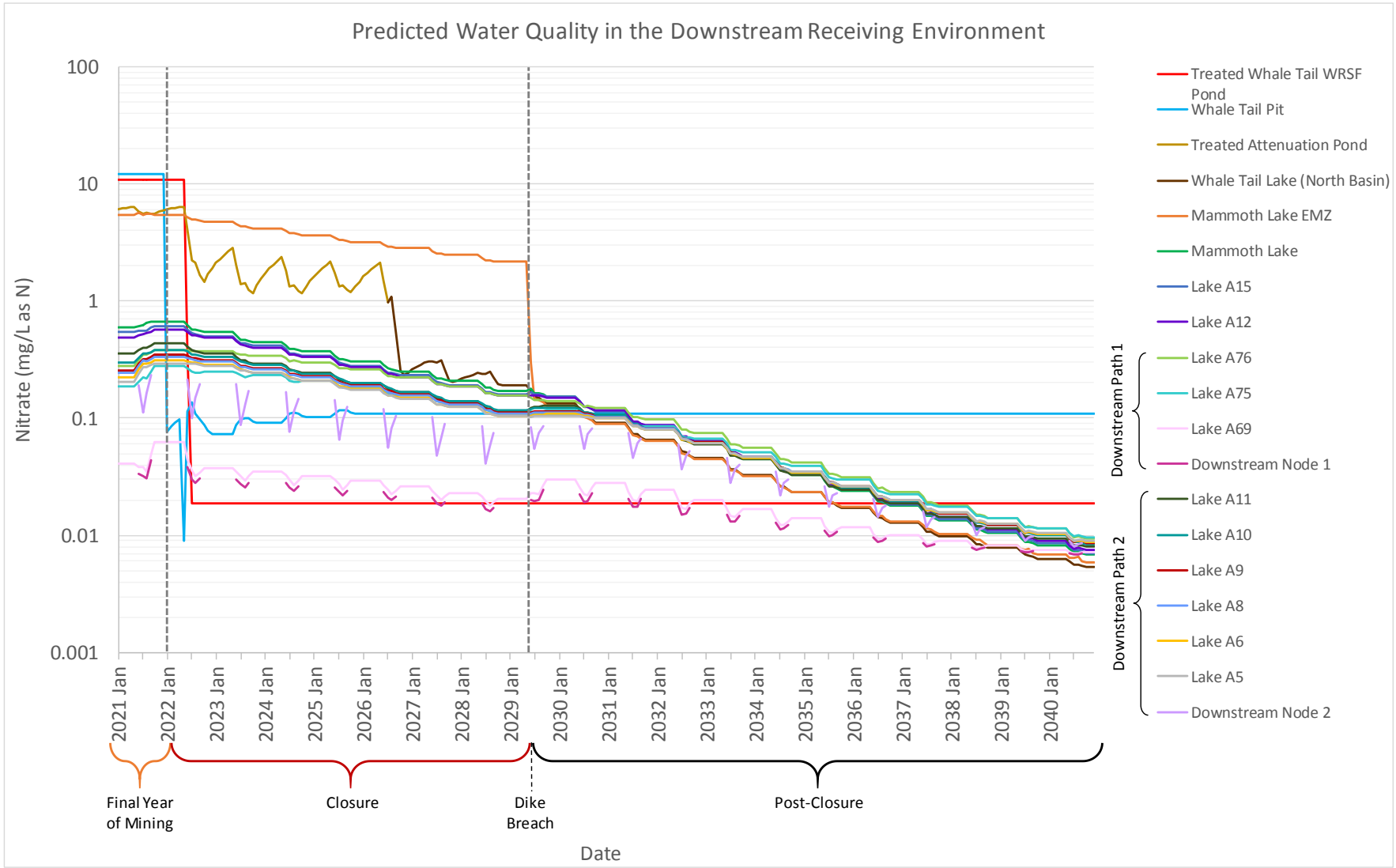
PROJECT
MINE SITE WATER QUALITY PREDICTIONS
WHALE TAIL PROJECT

YYYY-MM-DD	2016-06-10
PREPARED	SG
DESIGNED	KS
REVIEWED	VJB
APPROVED	DW

TITLE
Predicted Water Quality in the Downstream Receiving Environment - Cadmium

PROJECT NO.		REV.	FIGURE
1520817	5000	0	**B-3**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0



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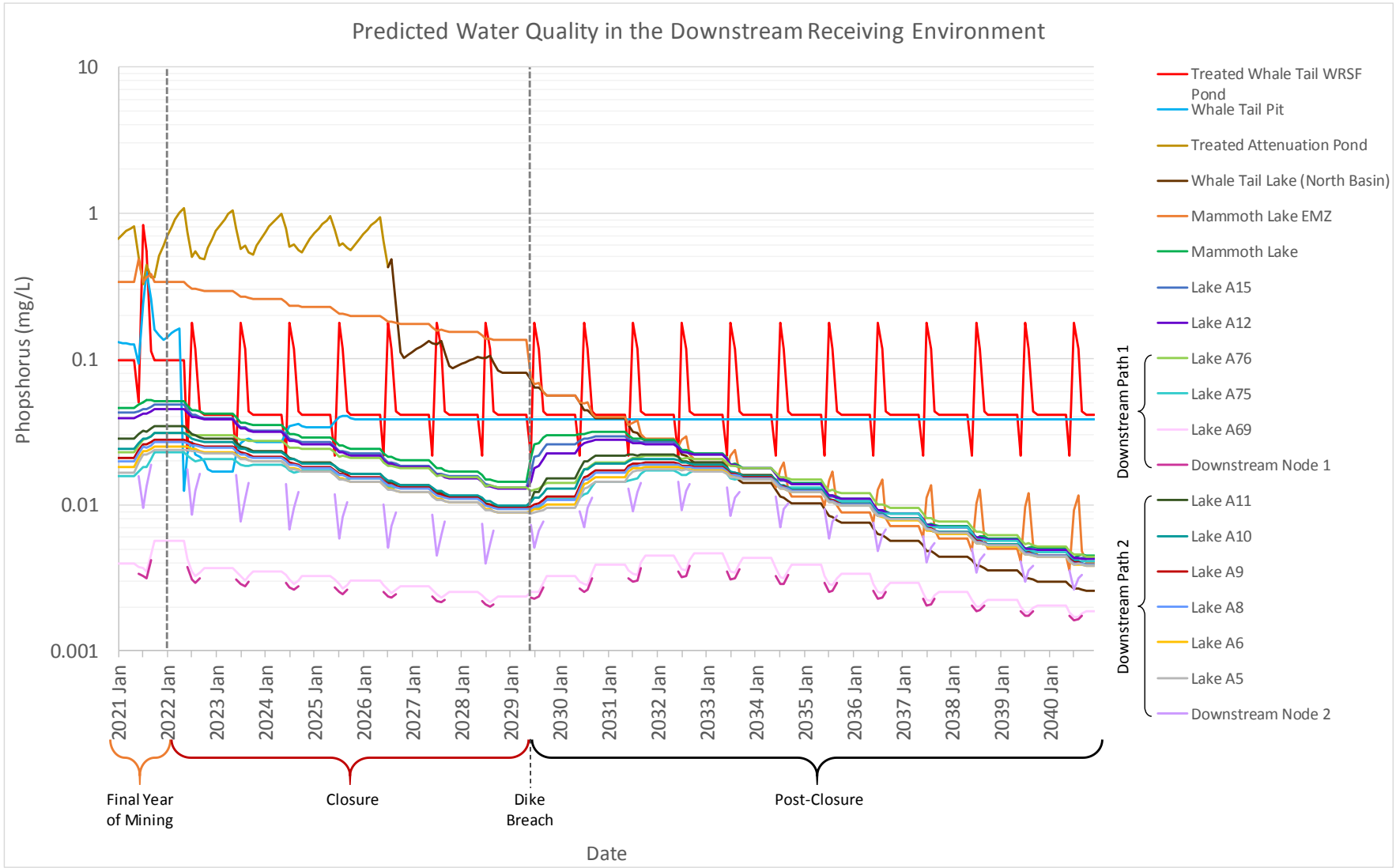
YYYY-MM-DD	2016-06-10
PREPARED	SG
DESIGNED	KS
REVIEWED	VJB
APPROVED	DW

PROJECT
MINE SITE WATER QUALITY PREDICTIONS
WHALE TAIL PROJECT

TITLE
Predicted Water Quality in the Downstream Receiving Environment - Nitrate

PROJECT NO.		REV.	FIGURE
1520817	5000	0	**B-4**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
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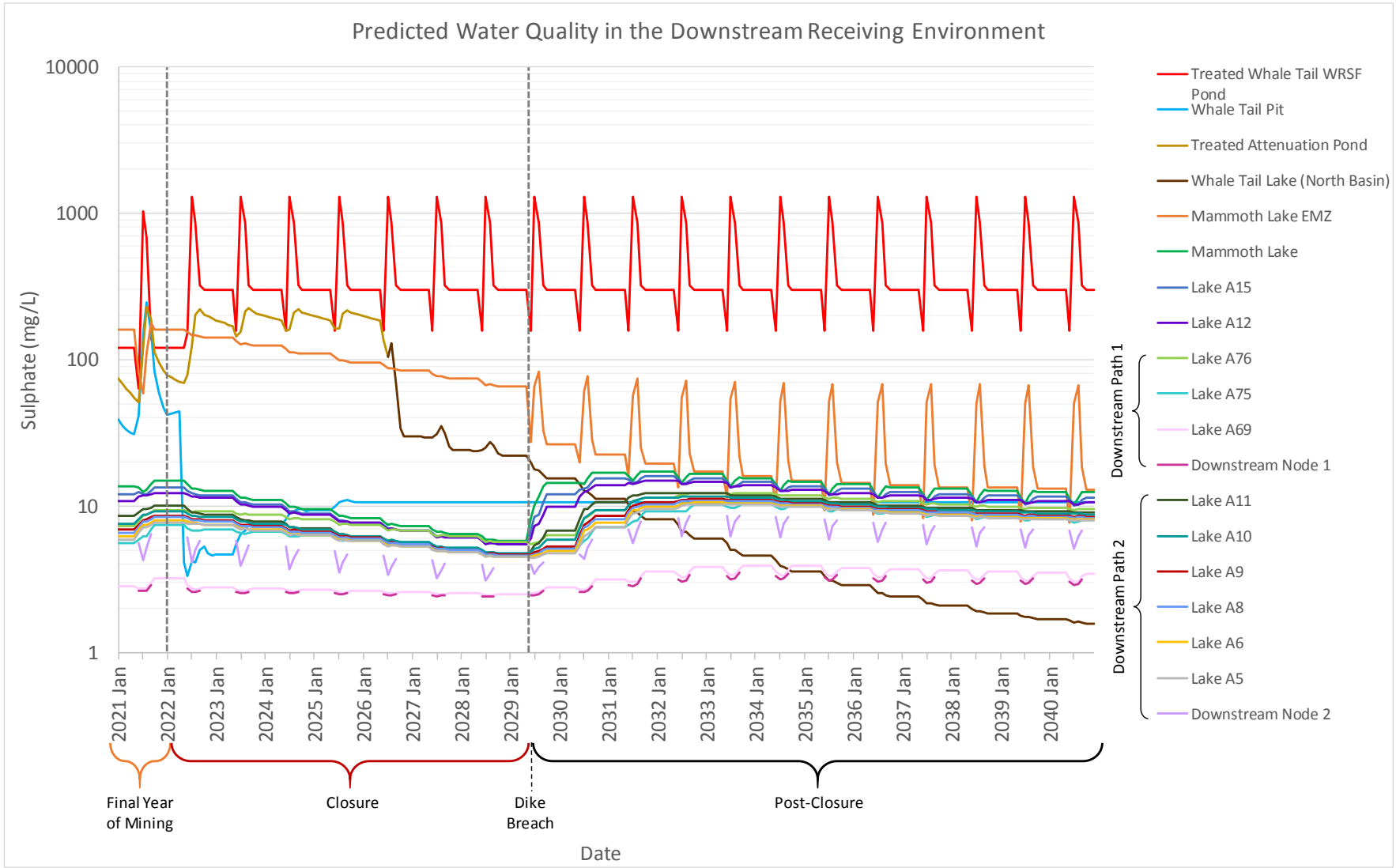
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PREPARED	SG
DESIGNED	KS
REVIEWED	VJB
APPROVED	DW

PROJECT
MINE SITE WATER QUALITY PREDICTIONS
WHALE TAIL PROJECT

TITLE
Predicted Water Quality in the Downstream Receiving Environment - Phosphorus

PROJECT NO.		REV.	FIGURE
1520817	5000	0	**B-5**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
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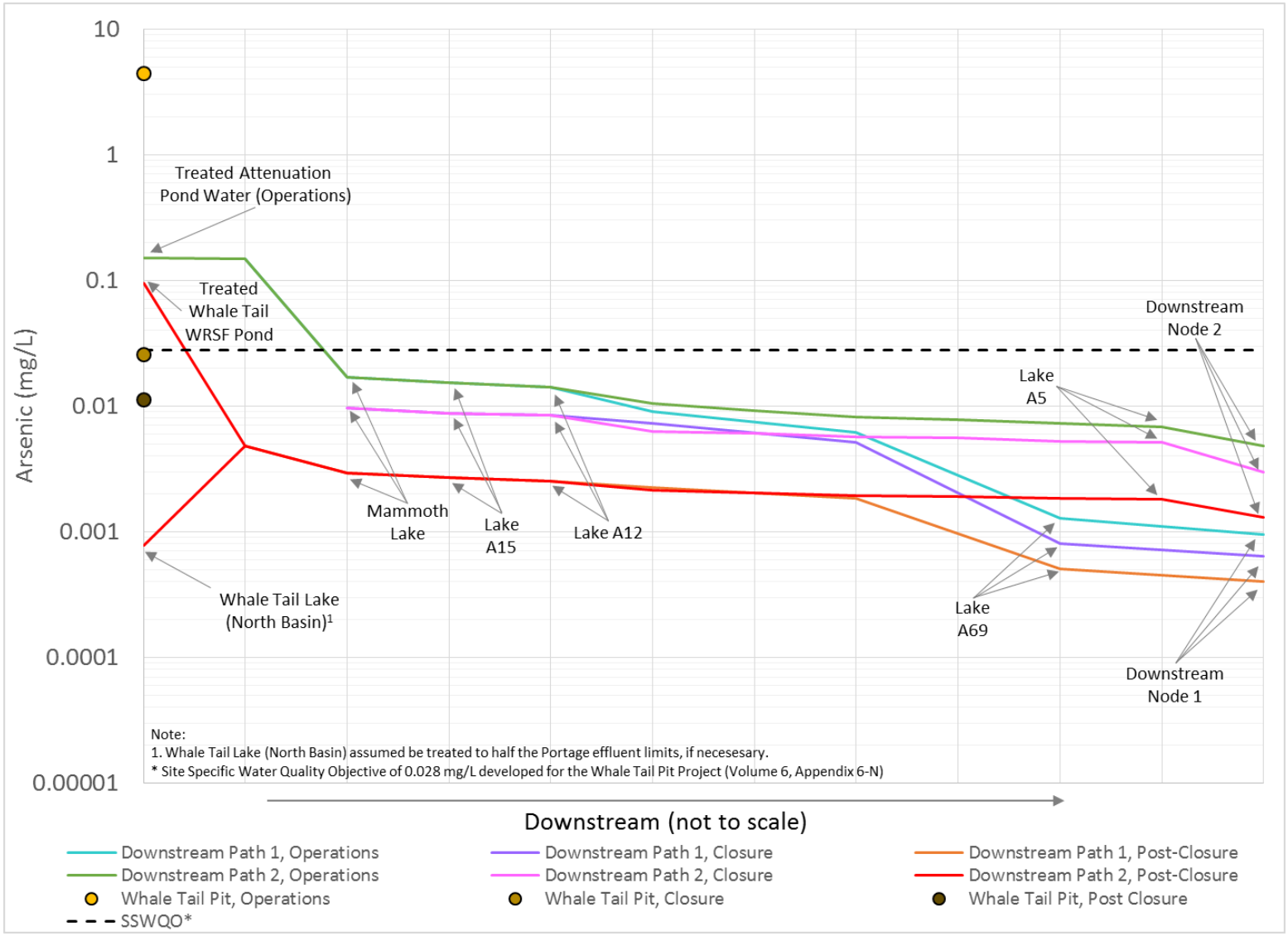
PROJECT
MINE SITE WATER QUALITY PREDICTIONS
WHALE TAIL PROJECT

YYYY-MM-DD	2016-06-10
PREPARED	SG
DESIGNED	KS
REVIEWED	VJB
APPROVED	DW

TITLE
Predicted Water Quality in the Downstream Receiving Environment - Sulphate

PROJECT NO.		REV.	FIGURE
1520817	5000	0	**B-6**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
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PROJECT
MINE SITE WATER QUALITY PREDICTIONS
WHALE TAIL PROJECT

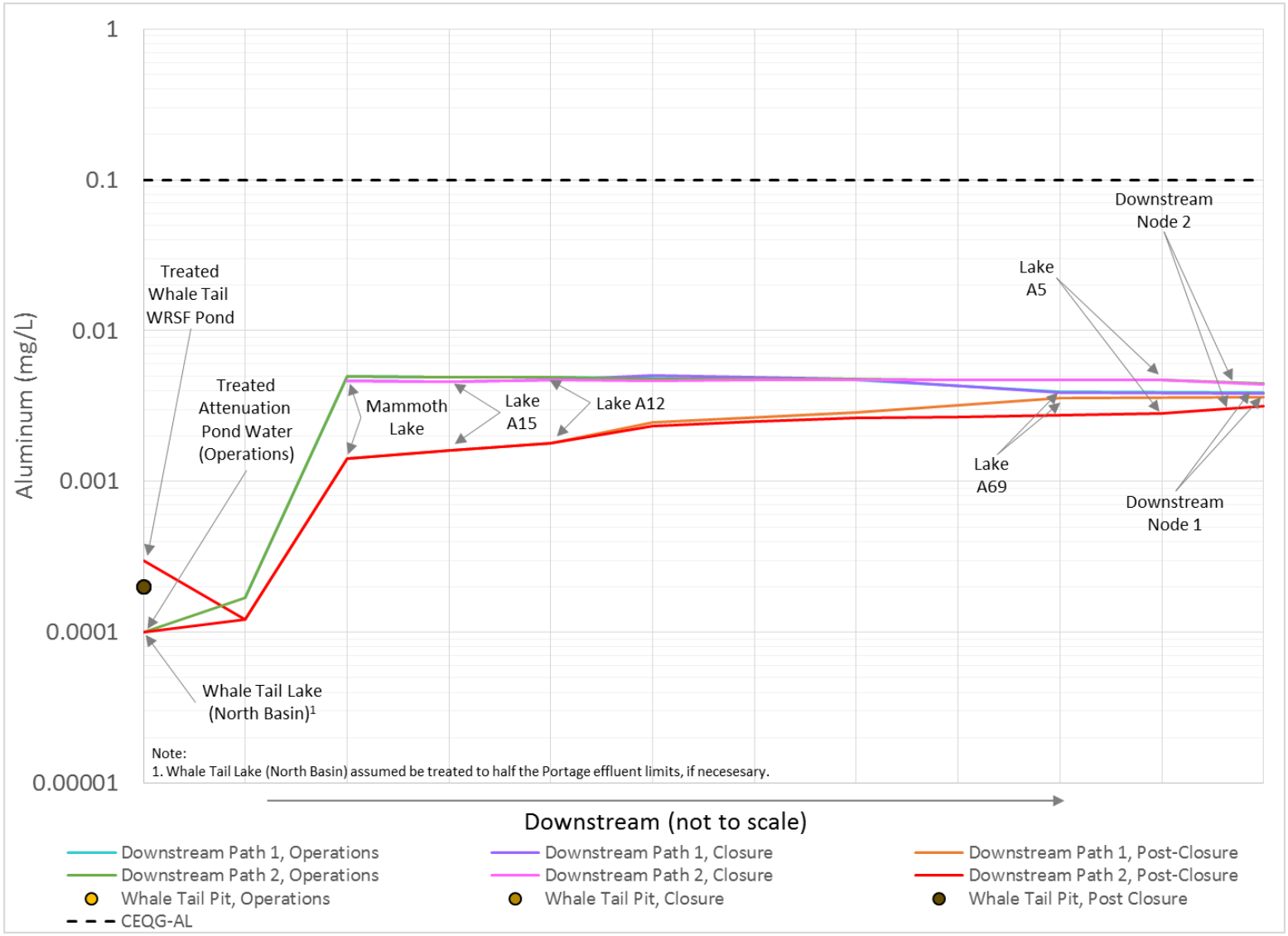
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YYYY-MM-DD	2016-06-10
PREPARED	SG
DESIGNED	KS
REVIEWED	VJB
APPROVED	DW

TITLE
Predicted Water Quality of Downstream Receiving Environment Water Pathways - Arsenic

PROJECT NO.		REV.	FIGURE
1520817	5000	0	**B-7**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0



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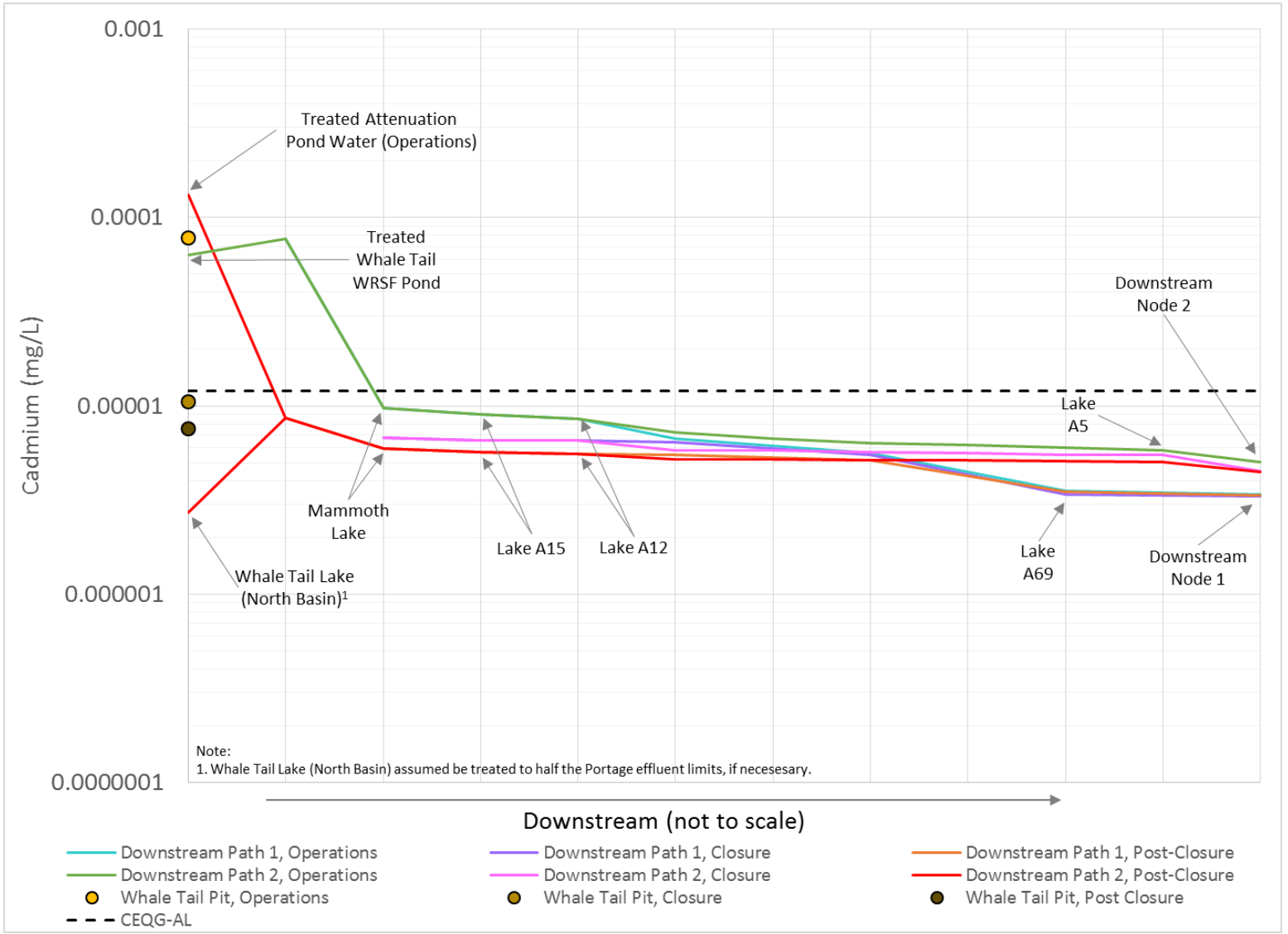
YYYY-MM-DD	2016-06-10
PREPARED	SG
DESIGNED	KS
REVIEWED	VJB
APPROVED	DW

PROJECT
MINE SITE WATER QUALITY PREDICTIONS
WHALE TAIL PROJECT

TITLE
Predicted Water Quality of Downstream Receiving Environment Water Pathways - Aluminum

PROJECT NO.		REV.	FIGURE
1520817	5000	0	**B-8**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
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WHALE TAIL PROJECT

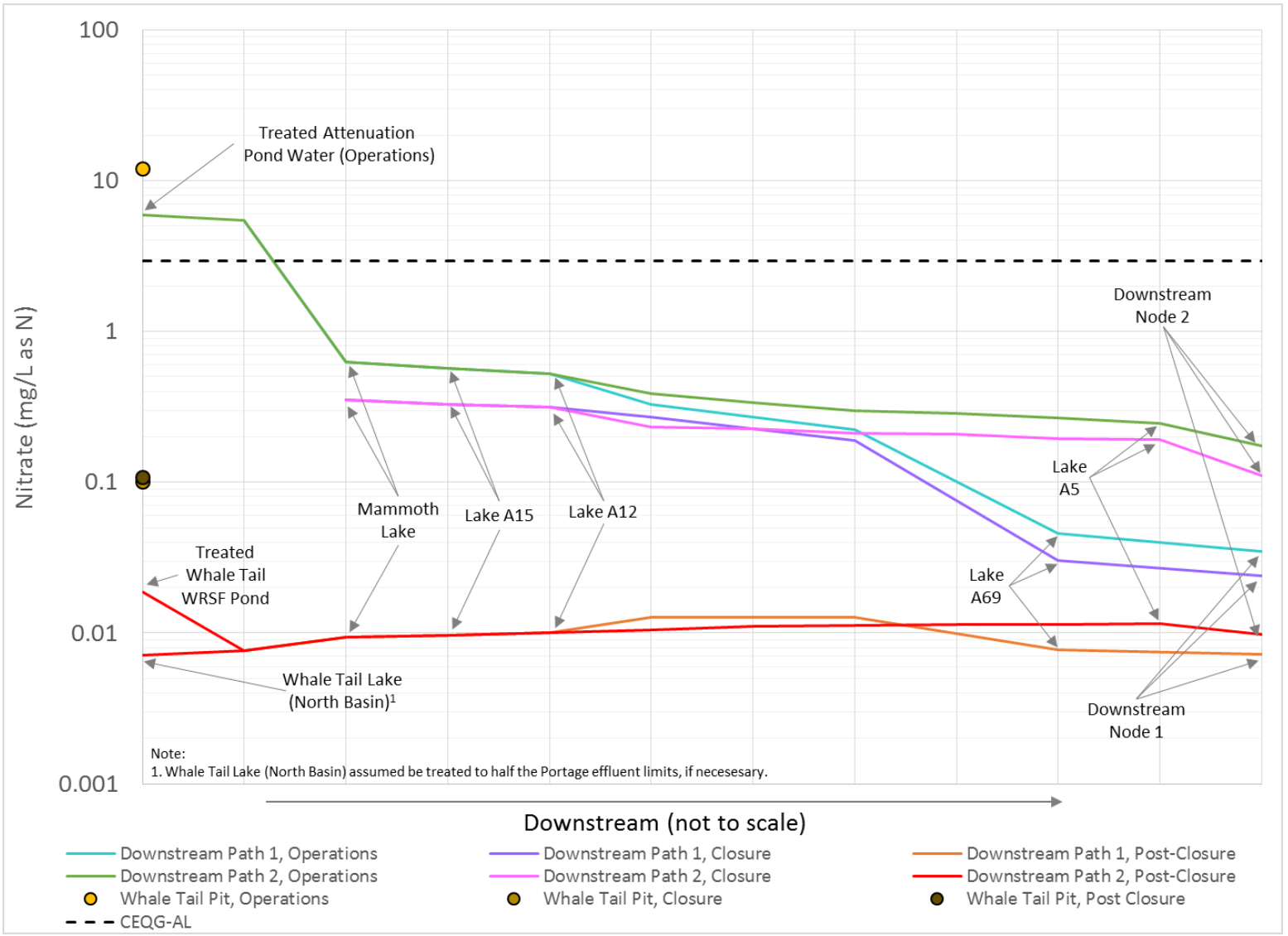
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PREPARED	SG
DESIGNED	KS
REVIEWED	VJB
APPROVED	DW

TITLE
Predicted Water Quality of Downstream Receiving Environment Water Pathways - Cadmium

PROJECT NO.		REV.	FIGURE
1520817	5000	0	**B-9**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A
1 in
0



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WHALE TAIL PROJECT

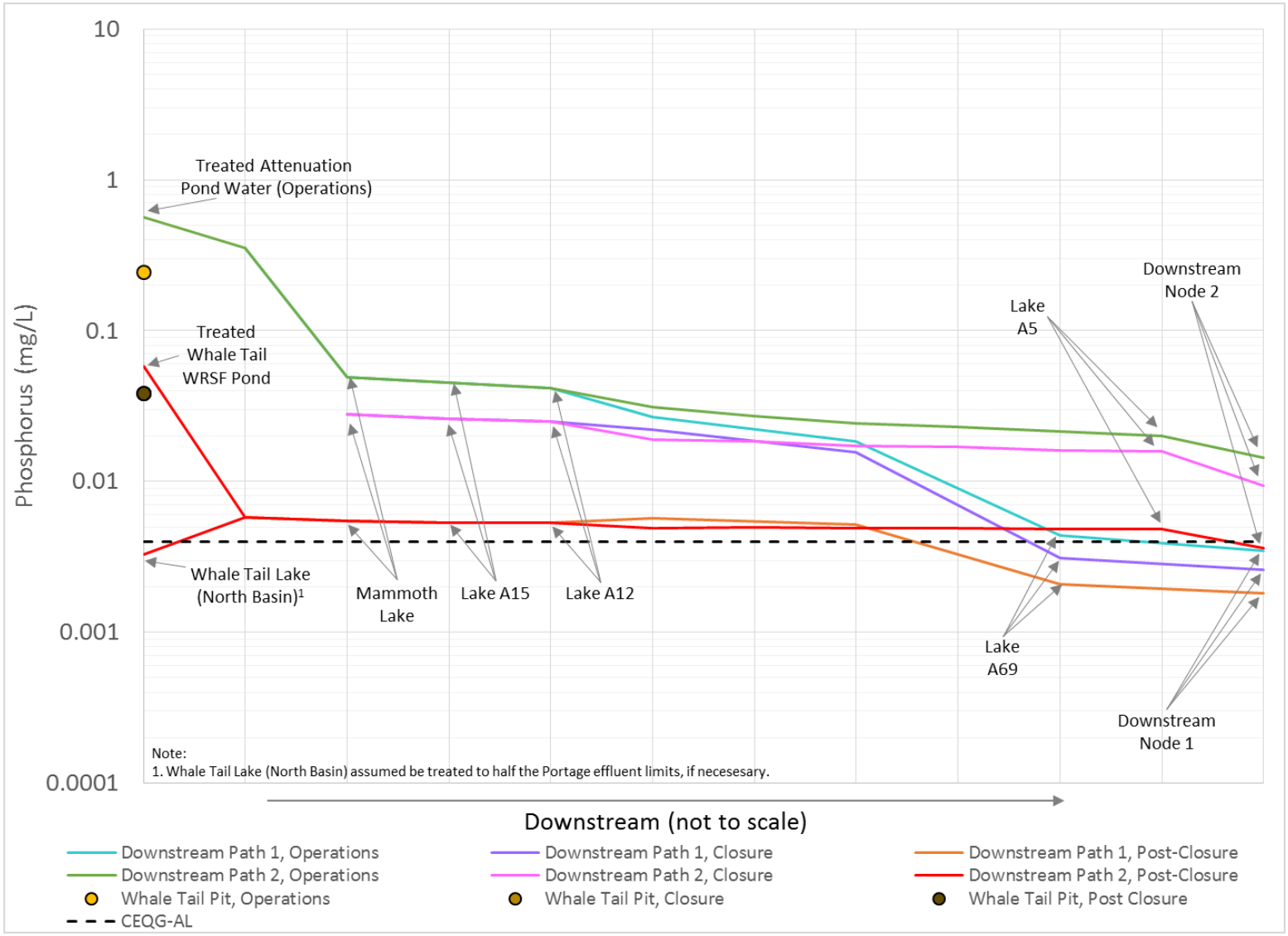
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YYYY-MM-DD	2016-06-10
PREPARED	SG
DESIGNED	KS
REVIEWED	VJB
APPROVED	DW

TITLE
Predicted Water Quality of Downstream Receiving Environment Water Pathways - Nitrate

PROJECT NO.		REV.	FIGURE
1520817	5000	0	**B-10**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A/B/I/A
1 in
0



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PROJECT
MINE SITE WATER QUALITY PREDICTIONS
WHALE TAIL PROJECT

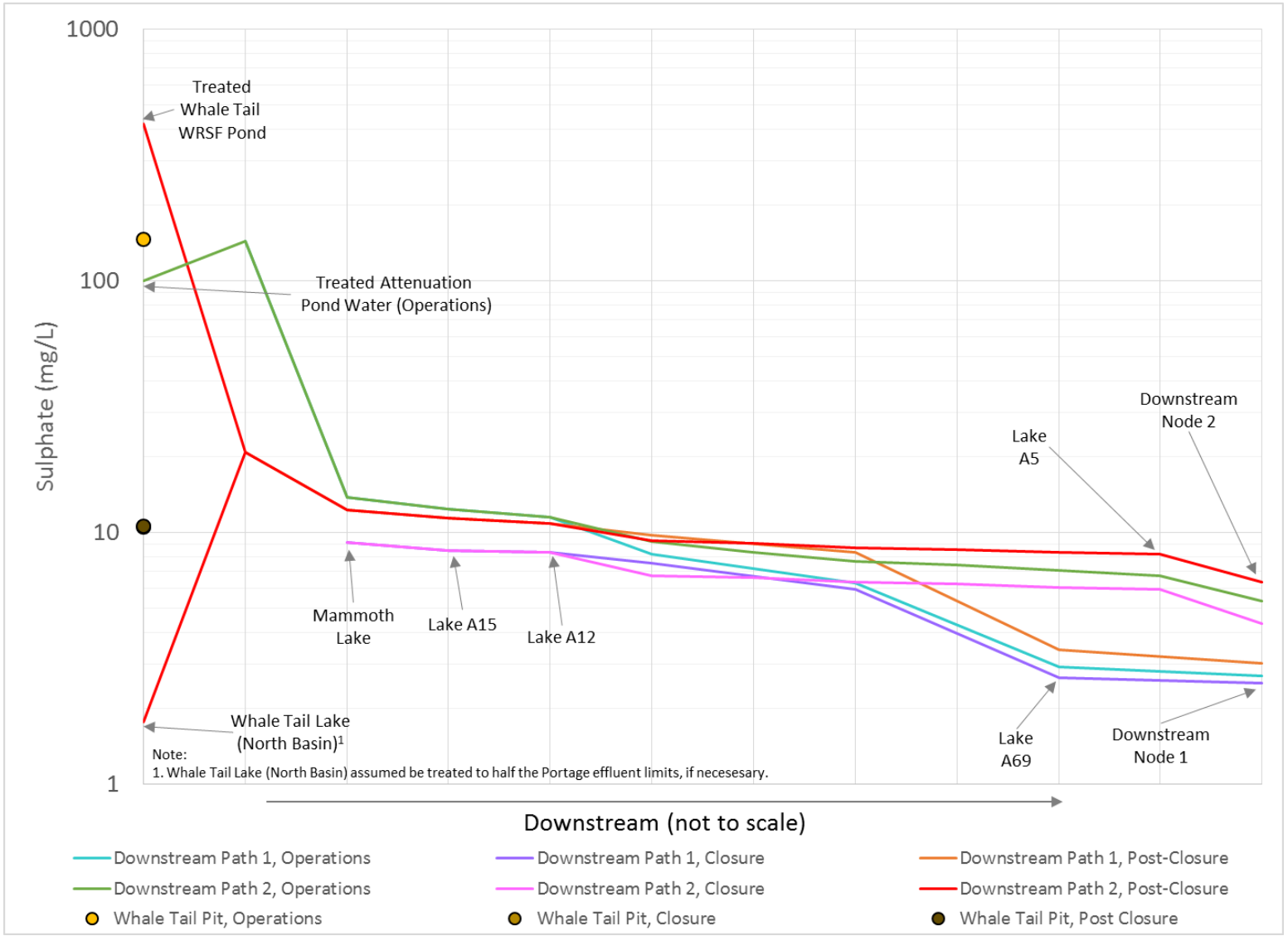
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YYYY-MM-DD	2016-06-10
PREPARED	SG
DESIGNED	KS
REVIEWED	VJB
APPROVED	DW

TITLE
Predicted Water Quality of Downstream Receiving Environment Water Pathways - Phosphorus

PROJECT NO.		REV.	FIGURE
1520817	5000	0	**B-11**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0



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YYYY-MM-DD	2016-06-10
PREPARED	SG
DESIGNED	KS
REVIEWED	VJB
APPROVED	DW

PROJECT
MINE SITE WATER QUALITY PREDICTIONS
WHALE TAIL PROJECT

TITLE
Predicted Water Quality of Downstream Receiving Environment Water Pathways - Sulphate

PROJECT NO.		REV.	FIGURE
1520817	5000	0	**B-12**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A
1 in
0

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APPENDIX 6-I

Water Quality Prediction Summary Tables

Table 6-I-1. Water Quality Predictions (Treated; Average and Maximum) for the Attenuation Pond for Operations

Parameter	Unit	Portage Effluent Limits		Guidelines for the Protection of:				Attenuation Pond Operations (Treated Effluent)	
		Maximum Concentration in a Grab Sample (MC)	Maximum Average Concentration (MAC)	Aquatic Life	Aquatic Life (CCME 1999)		Drinking Water (HC 2014)		
				SSWQO[a]	Acute	Chronic		Maximum	Average
Conventional Parameters									
Total dissolved solids	mg/L	1,400	1,400	-	-	-	-	751	384
Major Ions									
Calcium	mg/L	-	-	-	-	-	-	79	41
Magnesium	mg/L	-	-	-	-	-	-	21	13
Potassium	mg/L	-	-	-	-	-	-	63	26
Sodium	mg/L	-	-	-	-	-	-	78	41
Chloride	mg/L	2,000	1,000	-	640	120	-	69	53
Fluoride	mg/L	-	-	-	-	0.12	1.5	**1.4**[(C)]	**0.69**[(C)]
Sulphate	mg/L	-	-	-	-	-	-	228	99
Nutrients									
Nitrate	mg-N/L	-	-	-	124	2.9	10	**6.4**[(C)]	**5.9**[(C)]
Total ammonia	mg-N/L	32	16	-	-	7.7 - 17	-	0.15	0.14
Total phosphorus	mg-P/L	2	1	-	-	0.004 to 0.1	-	**0.82**[(C)]	**0.58**[(C)]
Dissolved phosphorus	mg-P/L	2	1	-	-	0.004 to 0.1	-	**0.81**[(C)]	**0.57**[(C)]
Total Metals									
Aluminum	µg/L	1,500	1,500	-	-	100	100	**322**[(C, D)]	**322**[(C, D)]
Antimony	µg/L	-	-	-	-	-	6.0	**47**[(D)]	**21**[(D)]
Arsenic	µg/L	600	300	28	-	5.0	10	155[(C, D)]	155[(C, D)]
Barium	µg/L	-	-	-	-	-	1,000	124	74
Beryllium	µg/L	-	-	-	-	-	-	0.23	0.12
Bismuth	µg/L	-	-	-	-	-	-	0.15	0.08
Boron	µg/L	-	-	-	29,000	1,500	5,000	1,007	464
Cadmium	µg/L	4.0	2.0	-	0.34	0.04	5.0	**0.11**[(C)]	**0.064**[(C)]
Chromium	µg/L	-	-	-	-	1.0	50	**25**[(C)]	**16**[(C)]
Cobalt	µg/L	-	-	-	-	-	-	8.4	4.5
Copper	µg/L	200	100	-	-	2.0	-	**23**[(C)]	**11**[(C)]
Iron	µg/L	-	-	-	-	300	-	**1,053**[(C)]	**1,053**[(C)]
Lead	µg/L	200	100	-	-	1.0	10	**5.1**[(C)]	**2.4**[(C)]
Lithium	µg/L	-	-	-	-	-	-	20	11
Manganese	µg/L	-	-	-	-	-	-	886	530
Mercury	µg/L	0.8	0.4	-	-	0.026	1.0	**0.11**[(C)]	**0.047**[(C)]
Molybdenum	µg/L	-	-	-	-	73	-	22	12
Nickel	µg/L	400	200	-	-	25	-	**74**[(C)]	**39**[(C)]
Selenium	µg/L	-	-	-	-	1.0	50	**6.1**[(C)]	**2.6**[(C)]
Silver	µg/L	-	-	-	-	0.25	-	0.22	0.09
Strontium	µg/L	-	-	-	-	-	-	511	293
Thallium	µg/L	-	-	-	-	0.8	-	0.37	0.14
Tin	µg/L	-	-	-	-	-	-	0.89	0.4
Uranium	µg/L	-	-	-	33	15	20	10	5.2
Vanadium	µg/L	-	-	-	-	-	-	47	22
Zinc	µg/L	800	400	-	-	30	-	22	11

Concentrations are higher than relevant water quality guidelines are indicated by superscripts. The COPCs are indicated by the bolded values

[(MC)] = concentration higher than the relevant discharge criteria maximum concentration in a grab sample.

[(MAC)] = concentration higher than the relevant discharge criteria maximum average concentration from four consecutive samples.

[(C)] = concentration higher than the relevant chronic aquatic life guideline or beyond the recommended pH, DO or total alkalinity concentration range.

[(D)] = concentration higher than the relevant drinking water guideline or beyond the recommended pH or DO concentration range.

- = no guideline or data.

a) Site-specific Water Quality Objective (SSWQO) developed for the Whale Tail Project (Volume 6, Appendix 6-N).

Table 6-I-2. Water Quality Predictions for the Flooded Pit for Early and Late Post-closure

Parameter	Unit	Guidelines for the protection of:				Flooded Pit Post-closure			
		Aquatic Life	Aquatic Life (CCME 1999)		Drinking Water (HC 2014)	Early (Year 11)		Late (Year 21)	
		SSWQO[a]	Acute	Chronic		Maximum	Average	Maximum	Average
Conventional Parameters									
Total dissolved solids	mg/L	-	-	-	-	37	37	37	37
Major Ions		-							
Calcium	mg/L	-	-	-	-	5.1	5.1	5.1	5.1
Magnesium	mg/L	-	-	-	-	1.7	1.7	1.7	1.7
Potassium	mg/L		-	14	-	3.1	3.1	3.1	3.1
Sodium	mg/L	-	-	-	-	2.0	2.0	2.0	2.0
Chloride	mg/L	-	640	120	-	3.9	3.9	3.9	3.9
Fluoride	mg/L	-	-	0.12	1.5	0.066	0.066	0.066	0.066
Sulphate	mg/L		-	-	-	11	11	11	11
Nutrients		-							
Nitrate	mg-N/L	-	124	2.9	10	0.11	0.11	0.11	0.11
Total ammonia	mg-N/L	-	-	7.7	-	0.0029	0.0029	0.0029	0.0029
Total phosphorus	mg-P/L	-	-	0.004 to 0.1	-	**0.039**[(C)]	**0.039**[(C)]	**0.039**[(C)]	**0.039**[(C)]
Dissolved Metals		-							
Aluminum	µg/L	-	-	-	-	0.2	0.2	0.2	0.2
Antimony	µg/L	-	-	-	6.0	0.68	0.68	0.68	0.68
Arsenic	µg/L	28	-	5.0	10	11[(C, D)]	11[(C, D)]	11[(C, D)]	11[(C, D)]
Barium	µg/L	-	-	31	1,000	9.3	9.3	9.3	9.3
Beryllium	µg/L	-	0.34	0.04	-	0.014	0.01	0.014	0.014
Bismuth	µg/L	-	-	1.0	-	0.026	0.03	0.026	0.026
Boron	µg/L	-	29,000	1,500	5,000	20	20	20	20
Cadmium	µg/L	-	0.34	2.0	5.0	0.0076	0.0076	0.0076	0.0076
Chromium	µg/L	-	-	1.0	50	0.16	0.16	0.16	0.16
Cobalt	µg/L	-	-	1.0	-	0.26	0.26	0.26	0.26
Copper	µg/L	-	-	2.0	-	0.67	0.67	0.67	0.67
Iron	µg/L	-	-	300	-	30	30	30	30
Lead	µg/L	-	-	1.0	10	0.13	0.13	0.13	0.13
Lithium	µg/L	-	-	-	-	1.4	1.4	1.4	1.4
Manganese	µg/L	-	-	-	-	47	47	47	47
Mercury	µg/L	-	-	25	1.0	0.0043	0.0044	0.0043	0.0043
Molybdenum	µg/L	-	-	73	-	1.3	1.3	1.3	1.3
Nickel	µg/L	-	-	25	-	2.5	2.5	2.5	2.5
Selenium	µg/L	-	-	1.0	50	0.23	0.23	0.23	0.23
Silver	µg/L	-	-	0.25	-	0.0069	0.0068	0.0069	0.0069
Strontium	µg/L	-	-	-	-	31	31	31	31
Thallium	µg/L	-	-	0.8	-	0.0099	0.0099	0.0099	0.0099
Tin	µg/L	-	-	-	-	0.087	0.0870	0.087	0.087
Uranium	µg/L	-	33	15	20	1.1	1.1	1.1	1.1
Vanadium	µg/L	-	-	-	-	0.66	0.66	0.66	0.66
Zinc	µg/L	-	-	30	-	1.0	1.0	1.0	1.0

Concentrations are higher than relevant water quality guidelines are indicated by superscripts. The COPCs are indicated by the bolded values

[(C)] = concentration higher than the relevant chronic aquatic life guideline or beyond the recommended pH, DO or total alkalinity concentration range.

[(D)] = concentration higher than the relevant drinking water guideline or beyond the recommended pH or DO concentration range.

[(H)] = concentration higher than the relevant r trigger meadowbank or beyond the recommended pH or DO concentration range.

[(I)] = concentration higher than the relevant threshold or beyond the recommended pH or DO concentration range.

[(B)] = concentration higher than the relevant baseline level or beyond the recommended pH or DO concentration range.

- = no guideline or data.

a) Site-specific Water Quality Objective (SSWQO) developed for the Whale Tail Project (Volume 6, Appendix 6-N).

Table 6-I-3. Water Quality Predictions for Whale Tail Lake (North Basin) for Early and Lake Post-closure

Parameter	Unit	Guidelines for the protection of:				Meadowbank (Azimuth 2015b)		Baseline (Whale Tail)	Whale Tail Lake (North Basin) Post-Closure			
		Aquatic Life	Aquatic Life (CCME 1999)		Drinking Water (HC 2014)				Early (Year 11)		Late (Year 21)	
		SSWQO[a]	Acute	Chronic		Trigger	Threshold		Maximum	Average	Maximum	Average
Conventional Parameters												
Total dissolved solids	mg/L	-	-	-	-	18	-	21	55[R, B]	50[R, B]	12	12
Major Ions												
Calcium	mg/L	-	-	-	-	-	-	2.2	7.5[B]	6.8[B]	2.2	2.1
Magnesium	mg/L	-	-	-	-	0.83	-	0.79	2.2[R, B]	2.0[R, B]	1.1	1.1
Potassium	mg/L	-	-	-	-	0.5	-	0.44	6.7[R, B]	6.0[R, B]	0.7	0.7
Sodium	mg/L	-	-	-	-	0.98	-	0.55	1.9[R, B]	1.7[R, B]	0.59	0.58
Chloride	mg/L	-	640	120	-	60	120	3.0	2.4	2.2	1.8	1.8
Fluoride	mg/L	-	-	0.12	1.5	-	-	0.034	0.087[B]	0.078[B]	0.031	0.031
Sulphate	mg/L	-	-	-	-	65	128	2.6	22[B]	19[B]	1.8	1.8
Nutrients												
Nitrate	mg-N/L	-	124	2.9	10	1.5	3.0	0.0025	0.19[B]	0.17[B]	0.0078[B]	0.0075[B]
Total ammonia	mg-N/L	-	-	7.7	-	0.065	0.13	0.1	0.0017	0.0016	0.000042	0.000039
Total phosphorus	mg-P/L	-	-	0.004 to 0.1	-	0.006	0.004	0.003	**0.091[C]**	**0.084[C]**	**0.014[C]**	**0.014[C]**
Total Metals												
Aluminum	µg/L	-	-	100	100	54	100	22	**322[C, D, R, T, B]**	**322[C, D, R, T, B]**	**322[C, D, R, T, B]**	**322[C, D, R, T, B]**
Antimony	µg/L	-	-	-	6.0	10	20	0.22	1.3[B]	1.1[B]	0.1	0.1
Arsenic	µg/L	28	-	5.0	10	2.6	5.0	0.29	13[C, D, R, T, B]	12[C, D, R, T, B]	5.9[C, R, T, B]	5.9[C, R, T, B]
Barium	µg/L	-	-	-	1,000	501	1,000	4.4	13[B]	12[B]	7	7
Beryllium	µg/L	-	-	-	-	2.7	5.3	0.05	0.011	0.010	0.019	0.019
Bismuth	µg/L	-	-	-	-	-	-	0.25	0.007	0.007	0.003	0.003
Boron	µg/L	-	29,000	1,500	5,000	760	1,500	5.0	16[B]	14[B]	5.6	5.5
Cadmium	µg/L	-	0.34	0.04	5.0	0.025	0.04	0.005	0.009[B]	0.0088[B]	0.004	0.004
Chromium	µg/L	-	-	31	50	0.56	1.0	0.14	**9.1[C, R, T, B]**	**9.0[C, R, T, B]**	**9.1[C, R, T, B]**	**9.1[C, R, T, B]**
Cobalt	µg/L	-	-	-	-	-	-	0.05	0.74[B]	0.72[B]	0.58[B]	0.58[B]
Copper	µg/L	-	-	2.0	-	1.2	2.0	0.55	0.92[B]	0.88[B]	0.93	0.92
Iron	µg/L	-	-	300	-	155	300	37	**769[C, R, T, B]**	**767[C, R, T, B]**	**773[C, R, T, B]**	**773[C, R, T, B]**
Lead	µg/L	-	-	1.0	10	0.53	1.0	6.9	0.23	0.22	0.16	0.16
Lithium	µg/L	-	-	-	-	48	96	0.5	2.3[B]	2.1[B]	0.87	0.87
Manganese	µg/L	-	-	-	-	316	679	6.4	44[B]	41[B]	15[B]	15[B]
Mercury	µg/L	-	-	0.026	1.0	0.018	0.026	0.005	0.0041	0.0037	0.0027	0.0027
Molybdenum	µg/L	-	-	73	-	37	73	0.059	2.9[B]	2.6[B]	0.11[B]	0.11[B]
Nickel	µg/L	-	-	25	-	13	25	0.86	6.4[B]	6.2[B]	5.2[B]	5.2[B]
Selenium	µg/L	-	-	1.0	50	0.55	1.0	0.05	0.48[B]	0.43[B]	0.042	0.041
Silver	µg/L	-	-	0.25	-	-	-	0.005	0.0059[B]	0.0057[B]	0.008	0.008
Strontium	µg/L	-	-	-	-	28	49	15	46[R, B]	42[R, B]	12.5	12.4
Thallium	µg/L	-	-	0.8	-	0.41	0.8	0.005	0.017[B]	0.015[B]	0.011[B]	0.011[B]

Table 6-I-3. Water Quality Predictions for Whale Tail Lake (North Basin) for Early and Lake Post-closure

Parameter	Unit	Guidelines for the protection of:				Meadowbank (Azimuth 2015b)		Baseline (Whale Tail)	Whale Tail Lake (North Basin) Post-Closure			
		Aquatic Life	Aquatic Life (CCME 1999)		Drinking Water (HC 2014)				Early (Year 11)		Late (Year 21)	
		SSWQO[a]	Acute	Chronic		Trigger	Threshold		Maximum	Average	Maximum	Average
Tin	µg/L	-	-	-	-	0.2	-	0.05	0.095[(B)]	0.085[(B)]	0.062	0.062
Uranium	µg/L	-	33	15	20	7.5	15	0.045	2.6[(B)]	2.4[(B)]	0.12[(B)]	0.11[(B)]
Vanadium	µg/L	-	-	-	-	3.5	6.0	0.5	1.6[(B)]	1.5[(B)]	1.1[(B)]	1.1[(B)]
Zinc	µg/L	-	-	30	-	6.3	24	1.5	1.5[(B)]	1.5	1.24	1.24

Concentrations are higher than relevant water quality guidelines are indicated by superscripts. The COPCs are indicated by the bolded values

[(C)] = concentration higher than the relevant chronic aquatic life guideline or beyond the recommended pH, DO or total alkalinity concentration range.

[(D)] = concentration higher than the relevant drinking water guideline or beyond the recommended pH or DO concentration range.

[(R)] = concentration higher than the relevant trigger meadowbank or beyond the recommended pH or DO concentration range.

[(T)] = concentration higher than the relevant threshold or beyond the recommended pH or DO concentration range.

[(B)] = concentration higher than the relevant baseline level or beyond the recommended pH or DO concentration range.

- = no guideline or data.

a) Site-specific Water Quality Objective (SSWQO) developed for the Whale Tail Project (Volume 6, Appendix 6-N).

Table 6-I-4. Water Quality Predictions for the Waste Rock Storage Facility Pond for Early and Late Post-closure

Parameter	Unit	Guidelines for the protection of:				Waste Rock Storage Facility Pond Post-Closure			
		Aquatic Life	Aquatic Life		Health Canada Drinking Water	Early (Year 11)		Late (Year 21)	
		SSWQO[a]	Acute (CCME)	Chronic (CCME)		Maximum	Average	Maximum	Average
Conventional Parameters									
Total dissolved solids	mg/L	-	-	-	-	3,161	1,027	3,161	1,027
Major Ions									
Calcium	mg/L	-	-	-	-	438	142	438	142
Magnesium	mg/L	-	-	-	-	126	41	126	41
Potassium	mg/L	-	-	-	-	405	132	405	132
Sodium	mg/L	-	-	-	-	89	29	89	29
Chloride	mg/L	-	640	120	-	83	27	83	27
Fluoride	mg/L	-	-	0.12	1.5	**5.0**[C, D]	**1.6**[C, D]	**5.0**[C, D]	**1.6**[C, D]
Sulphate	mg/L	-	-	-	-	1,292	420	1,292	420
Nutrients									
Nitrate	mg-N/L	-	124	2.9	10	0.019	0.019	0.019	0.019
Total ammonia	mg-N/L	-	-	7.7	-	0.0091	0.0090	0.0091	0.0090
Total phosphorus	mg-P/L	-	-	0.004 to 0.1	-	**0.19**[C]	**0.07**[C]	**0.19**[C]	**0.07**[C]
Total Metals									
Aluminum	µg/L	-	-	100	100	**322**[C, D]	**322**[C, D]	**322**[C, D]	**322**[C, D]
Antimony	µg/L	-	-	-	6.0	**74**[D]	**24**[D]	**74**[D]	**24**[D]
Arsenic	µg/L	28	-	5.0	10	155[C, D]	101[C, D]	155[C, D]	101[C, D]
Barium	µg/L	-	-	-	1000	549	181	549	181
Beryllium	µg/L	-	-	-	-	0.18	0.06	0.18	0.06
Bismuth	µg/L	-	-	-	-	0.19	0.07	0.19	0.07
Boron	µg/L	-	29,000	1,500	5000	591	192	591	192
Cadmium	µg/L	-	0.34	0.04	5.0	**0.41**[A, C]	**0.13**[C]	**0.41**[A, C]	**0.13**[C]
Chromium	µg/L	-	-	1.0	50	**10**[C]	**9.4**[C]	**10**[C]	**9.4**[C]
Cobalt	µg/L	-	-	-	-	8.7	3.2	8.7	3.2
Copper	µg/L	-	-	2.0	-	**17**[C]	**6.0**[C]	**17**[C]	**6.0**[C]
Iron	µg/L	-	-	300	-	**813**[C]	**811**[C]	**813**[C]	**811**[C]
Lead	µg/L	-	-	1.0	10	**5.5**[C]	**1.9**[C]	**5.5**[C]	**1.9**[C]
Lithium	µg/L	-	-	-	-	114	37	114	37
Manganese	µg/L	-	-	-	-	557	189	557	189
Mercury	µg/L	-	-	0.026	1.0	**0.19**[C]	**0.078**[C]	**0.19**[C]	**0.078**[C]
Molybdenum	µg/L	-	-	73	-	**172**[C]	56	**172**[C]	56
Nickel	µg/L	-	-	25	-	**56**[C]	21	**56**[C]	21
Selenium	µg/L	-	-	1.0	50	**28**[C]	**9.2**[C]	**28**[C]	**9.2**[C]
Silver	µg/L	-	-	0.25	-	0.13	0.05	0.13	0.05

Table 6-I-4. Water Quality Predictions for the Waste Rock Storage Facility Pond for Early and Late Post-closure

Parameter	Unit		Guidelines for the protection of:			Waste Rock Storage Facility Pond Post-Closure			
		Aquatic Life	Aquatic Life		Health Canada Drinking Water	Early (Year 11)		Late (Year 21)	
		SSWQO[a]	Acute (CCME)	Chronic (CCME)		Maximum	Average	Maximum	Average
Strontium	µg/L	-	-	-	-	2,581	840	2,581	840
Thallium	µg/L	-	-	0.8	-	0.69	0.23	0.69	0.23
Tin	µg/L	-	-	-	-	5.2	1.7	5.2	1.7
Uranium	µg/L	-	33	15	20	**159**[(A, C, D)]	**52**[(A, C, D)]	**159**[(A, C, D)]	**52**[(A, C, D)]
Vanadium	µg/L	-	-	-	-	48	16	48	16
Zinc	µg/L	-	-	30	-	**48**[(C)]	16	**48**[(C)]	16

Concentrations are higher than relevant water quality guidelines are indicated by superscripts. The COPCs are indicated by the bolded values

[(MC)] = concentration higher than the relevant discharge criteria maximum concentration in a grab sample.

[(MAC)] = concentration higher than the relevant discharge criteria maximum average concentration from four consecutive samples.

[(A)] = concentration higher than the relevant acute aquatic life guideline or beyond the recommended pH, DO or total alkalinity concentration range.

[(C)] = concentration higher than the relevant chronic aquatic life guideline or beyond the recommended pH, DO or total alkalinity concentration range.

[(D)] = concentration higher than the relevant drinking water guideline or beyond the recommended pH or DO concentration range.

- = no guideline or data.

a) Site-specific Water Quality Objective (SSWQO) developed for the Whale Tail Project (Volume 6, Appendix 6-N).

Table 6-I-5. Water Quality Predictions (Average and Maximum) for Mammoth Lake for Operations, Closure, and Post-closure (Early and Late)

Parameter	Unit	Guidelines for the protection of:							Mammoth Lake (Early Post-closure)		Mammoth Lake (Late Post-closure)	
		Aquatic Life	Aquatic Life (CCME 1999)		Drinking Water (HC 2014)	Meadowbank (Azimuth 2015b)		Baseline (Mammoth)	Maximum	Average	Maximum	Average
		SSWQO[a]	Acute	Chronic		Trigger	Threshold					
Conventional Parameters												
Total dissolved solids	mg/L	-	-	-	-	18	-	22	42[(R, B)]	30[(R, B)]	39[(R, B)]	38[(R, B)]
Major Ions												
Calcium	mg/L	-	-	-	-	-	-	2.4	5.8[(B)]	4.1[(B)]	5.7[(B)]	5.5[(B)]
Magnesium	mg/L	-	-	-	-	0.83	-	0.79	1.8[(R, B)]	1.3[(R, B)]	1.8[(R, B)]	1.7[(R, B)]
Potassium	mg/L	-	-	-	-	0.5	-	0.53	3.9[(R, B)]	2.0[(R, B)]	3.9[(R, B)]	3.8[(R, B)]
Sodium	mg/L	-	-	-	-	0.98	-	0.55	2.1[(R, B)]	2.0[(R, B)]	1.3[(B)]	1.3[(B)]
Chloride	mg/L	-	640	120	-	60	120	2.6	3.7[(B)]	3.6[(B)]	2.6[(B)]	2.6
Fluoride	mg/L	-	-	0.12	1.5	-	-	0.033	0.072[(B)]	0.055[(B)]	0.069[(B)]	0.068[(B)]
Sulphate	mg/L	-	-	-	-	65	128	2.9	13[(B)]	7.4[(B)]	13[(B)]	12[(B)]
Nutrients												
Nitrate	mg-N/L	-	124	2.9	10	1.5	3.0	0.0025	0.18[(B)]	0.17[(B)]	0.010[(B)]	0.0099[(B)]
Total ammonia	mg-N/L	-	-	7.7	-	0.065	0.13	0.035	0.0041	0.004	0.0003	0.0003
Dissolved phosphorus	mg-P/L	-	-	0.004 to 0.1	-	0.006	0.004	0.0038	**0.029[(C, R, T, B)]**	**0.019[(C, R, T, B)]**	**0.006[(C, T, B)]**	**0.006[(C, T, B)]**
Dissolved Metals												
Aluminum	µg/L	-	-	100	100	26	50	10	4.4	4.1	1.5	1.4
Antimony	µg/L	-	-	-	6.0	10	20	0.05	1.1[(B)]	0.87[(B)]	0.69[(B)]	0.67[(B)]
Arsenic	µg/L	28	-	5.0	10	2.6	5.0	0.47	5.9[(C, R, T, B)]	5.1[(C, R, T, B)]	3.0[(R, B)]	2.9[(R, B)]
Barium	µg/L	-	-	-	1000	501	1000	4.7	9.1[(B)]	7.3[(B)]	8.6[(B)]	8.4[(B)]
Beryllium	µg/L	-	-	-	-	2.7	5.3	0.05	0.014	0.013	0.013	0.013
Bismuth	µg/L	-	-	-	-	-	-	0.025	0.029	0.027	0.027	0.027
Boron	µg/L	-	29,000	1,500	5000	760	1500	5.0	23[(B)]	22[(B)]	10.4[(B)]	10.2[(B)]
Cadmium	µg/L	-	0.34	0.04	5.0	0.025	0.04	0.005	0.007[(B)]	0.005[(B)]	0.006[(B)]	0.006[(B)]
Chromium	µg/L	-	-	31	50	0.56	1.0	0.05	0.31[(B)]	0.3[(B)]	0.08	0.08
Cobalt	µg/L	-	-	-	-	-	-	0.05	0.21[(B)]	0.2[(B)]	0.1[(B)]	0.09[(B)]
Copper	µg/L	-	-	2.0	-	1.2	2.0	0.54	0.79[(B)]	0.77[(B)]	0.54	0.54
Iron	µg/L	-	-	300	-	155	300	15	15[(B)]	15[(B)]	16[(B)]	16[(B)]
Lead	µg/L	-	-	1.0	10	0.53	1.0	0.27	0.15	0.15	0.09	0.090
Lithium	µg/L	-	-	-	-	48	96	0.5	1.4[(B)]	0.98[(B)]	1.5[(B)]	1.5[(B)]
Manganese	µg/L	-	-	-	-	316	679	3.2	24[(B)]	22[(B)]	7.3[(B)]	7.1[(B)]
Mercury	µg/L	-	-	0.026	1.0	0.018	0.026	0.0063	0.0056	0.005	0.005	0.005
Molybdenum	µg/L	-	-	73	-	37	73	0.025	1.5[(B)]	0.65[(B)]	1.5[(B)]	1.4[(B)]
Nickel	µg/L	-	-	25	-	13	25	0.89	2.0[(B)]	2.0[(B)]	1.0[(B)]	1.0[(B)]
Selenium	µg/L	-	-	1.0	50	0.55	1.0	0.025	0.29[(B)]	0.16[(B)]	0.25[(B)]	0.24[(B)]
Silver	µg/L	-	-	0.25	-	-	-	0.005	0.0085[(B)]	0.0082[(B)]	0.006	0.006
Strontium	µg/L	-	-	-	-	28	49	13	34[(R, B)]	24[(B)]	33[(B)]	32[(B)]
Thallium	µg/L	-	-	0.8	-	0.41	0.8	0.005	0.012[(B)]	0.011[(B)]	0.011[(B)]	0.011[(B)]

Table 6-I-5. Water Quality Predictions (Average and Maximum) for Mammoth Lake for Operations, Closure, and Post-closure (Early and Late)

Parameter	Unit	Guidelines for the protection of:							Mammoth Lake (Early Post-closure)		Mammoth Lake (Late Post-closure)	
		Aquatic Life	Aquatic Life (CCME 1999)		Drinking Water (HC 2014)	Meadowbank (Azimuth 2015b)		Baseline (Mammoth)	Maximum	Average	Maximum	Average
		SSWQO[a]	Acute	Chronic		Trigger	Threshold					
Tin	µg/L	-	-	-	-	0.2	-	0.05	0.085[B]	0.07[B]	0.097[B]	0.096[B]
Uranium	µg/L	-	33	15	20	7.5	15	0.03	1.3[B]	0.43[B]	1.4[B]	1.3[B]
Vanadium	µg/L	-	-	-	-	3.5	6.0	0.25	1.1[B]	1.0[B]	0.65	0.64
Zinc	µg/L	-	-	30	-	6.3	24	0.5	1.0[B]	0.91[B]	0.95[B]	0.94[B]

Concentrations are higher than relevant water quality guidelines are indicated by superscripts. The COPCs are indicated by the bolded values
[C] = concentration higher than the relevant chronic aquatic life guideline or beyond the recommended pH, DO or total alkalinity concentration range
[D] = concentration higher than the relevant drinking water guideline or beyond the recommended pH or DO concentration range
[R] = concentration higher than the relevant trigger meadowbank or beyond the recommended pH or DO concentration range
[T] = concentration higher than the relevant threshold or beyond the recommended pH or DO concentration range
[B] = concentration higher than the relevant baseline level or beyond the recommended pH or DO concentration range
- = no guideline or data.
a) Site-specific Water Quality Objective (SSWQO) developed for the Whale Tail Project (Volume 6, Appendix 6-N).

Table 6-I-6. Water Quality Predictions (Average and Maximum) for Lake A15 for Operations, Closure, and Post-closure (Early and Late)

Parameter	Unit	Guidelines for the protection of:							Lake A15 (Operations)		Lake A15 (Closure)		Lake A15 (Early Post-closure)		Lake A15 (Late Post-closure)	
		Aquatic Life	Aquatic Life (CCME 1999)		Drinking Water (HC 2014)	Meadowbank (Azimuth 2015b)		Baseline (A15-A14, A14-A13)	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average
		SSWQO[a]	Acute	Chronic		Trigger	Threshold									
Conventional Parameters																
Total dissolved solids	mg/L	-	-	-	-	18	-	18	52$^{(R, B)}$	49$^{(R, B)}$	54$^{(R, B)}$	36$^{(R, B)}$	35$^{(R, B)}$	27$^{(R, B)}$	30$^{(R, B)}$	29$^{(R, B)}$
Major Ions																
Calcium	mg/L	-	-	-	-	-	-	2.5	6.1$^{(B)}$	5.8$^{(B)}$	6.3$^{(B)}$	4.5$^{(B)}$	4.9$^{(B)}$	3.8$^{(B)}$	4.3$^{(B)}$	4.2$^{(B)}$
Magnesium	mg/L	-	-	-	-	0.83	-	0.86	1.9$^{(R, B)}$	1.8$^{(R, B)}$	1.9$^{(R, B)}$	1.4$^{(R, B)}$	1.5$^{(R, B)}$	1.2$^{(R, B)}$	1.3$^{(R, B)}$	1.3$^{(R, B)}$
Potassium	mg/L	-	-	-	-	0.5	-	0.57	3.3$^{(R, B)}$	3.1$^{(R, B)}$	3.5$^{(R, B)}$	2.2$^{(R, B)}$	2.9$^{(R, B)}$	1.7$^{(R, B)}$	3.4$^{(R, B)}$	3.3$^{(R, B)}$
Sodium	mg/L	-	-	-	-	0.98	-	0.58	4.9$^{(R, B)}$	4.6$^{(R, B)}$	5.1$^{(R, B)}$	3.1$^{(R, B)}$	2.0$^{(R, B)}$	1.9$^{(R, B)}$	0.93$^{(B)}$	0.91$^{(B)}$
Chloride	mg/L	-	640	120	-	60	120	2.1	6.6$^{(B)}$	6.2$^{(B)}$	6.7$^{(B)}$	4.5$^{(B)}$	3.4$^{(B)}$	3.3$^{(B)}$	1.5	1.5
Fluoride	mg/L	-	-	0.12	1.5	-	-	0.025	0.097$^{(B)}$	0.093$^{(B)}$	0.1$^{(B)}$	0.068$^{(B)}$	0.062$^{(B)}$	0.051$^{(B)}$	0.05$^{(B)}$	0.048$^{(B)}$
Sulphate	mg/L	-	-	-	-	65	128	3.3	13$^{(B)}$	12$^{(B)}$	13$^{(B)}$	8.5$^{(B)}$	10$^{(B)}$	6.5$^{(B)}$	11$^{(B)}$	11$^{(B)}$
Nutrients																
Nitrate	mg-N/L	-	124	2.9	10	1.5	3.0	0.014	0.59$^{(B)}$	0.55$^{(B)}$	0.61$^{(B)}$	0.33$^{(B)}$	0.17$^{(B)}$	0.16$^{(B)}$	0.0089	0.008
Total ammonia	mg-N/L	-	-	7.7	-	0.065	0.13	0.0073	0.014$^{(B)}$	0.013$^{(B)}$	0.015$^{(B)}$	7.70E-03$^{(B)}$	0.0038	3.60E-03	0.0003	0.0003
Dissolved phosphorus	mg-P/L	-	-	0.004 to 0.1	-	0.006	0.004	0.001	**0.048$^{(C, R, T, B)}$**	**0.045$^{(C, R, T, B)}$**	**0.049$^{(C, R, T, B)}$**	**0.026$^{(C, R, T, B)}$**	**0.024$^{(C, R, T, B)}$**	**0.016$^{(C, R, T, B)}$**	**0.005$^{(C, T, B)}$**	**0.0048$^{(C, T, B)}$**
Dissolved Metals																
Aluminum	µg/L	-	-	100	100	26	50	3.2	5.0$^{(B)}$	4.9$^{(B)}$	5.0$^{(B)}$	4.6$^{(B)}$	4.4$^{(B)}$	4.2$^{(B)}$	1.7	1.6
Antimony	µg/L	-	-	-	6.0	10	20	0.05	2.3$^{(B)}$	2.2$^{(B)}$	2.4$^{(B)}$	1.4$^{(B)}$	0.94$^{(B)}$	0.78$^{(B)}$	0.6$^{(B)}$	0.58$^{(B)}$
Arsenic	µg/L	28	-	5.0	10	2.6	5.0	0.32	16$^{(C, D, R, T, B)}$	15$^{(C, D, R, T, B)}$	16$^{(C, D, R, T, B)}$	8.8$^{(C, R, T, B)}$	5.3$^{(C, R, T, B)}$	4.6$^{(R, B)}$	2.7$^{(R, B)}$	2.6$^{(R, B)}$
Barium	µg/L	-	-	-	1000	501	1000	6.1	11$^{(B)}$	11$^{(B)}$	12$^{(B)}$	8.7$^{(B)}$	8.2$^{(B)}$	7.1$^{(B)}$	6.2$^{(B)}$	6.1
Beryllium	µg/L	-	-	-	-	2.7	5.3	0.01	0.022$^{(B)}$	0.022$^{(B)}$	0.023$^{(B)}$	0.017$^{(B)}$	0.014$^{(B)}$	0.013$^{(B)}$	0.0054	0.005
Bismuth	µg/L	-	-	-	-	-	-	0.025	0.032$^{(B)}$	0.031$^{(B)}$	0.032$^{(B)}$	0.030$^{(B)}$	0.029$^{(B)}$	0.028$^{(B)}$	0.012	0.012
Boron	µg/L	-	29,000	1,500	5000	760	1500	5.0	57$^{(B)}$	54$^{(B)}$	60$^{(B)}$	36$^{(B)}$	21$^{(B)}$	21$^{(B)}$	6.9$^{(B)}$	6.7$^{(B)}$
Cadmium	µg/L	-	0.34	0.04	5.0	0.025	0.04	0.0025	0.0092$^{(B)}$	0.0088$^{(B)}$	0.0095$^{(B)}$	0.0065$^{(B)}$	0.0058$^{(B)}$	0.0048$^{(B)}$	0.0043$^{(B)}$	0.0042$^{(B)}$
Chromium	µg/L	-	-	31	50	0.56	1.0	0.05	0.83$^{(R, B)}$	0.79$^{(R, B)}$	0.88$^{(R, B)}$	0.52$^{(B)}$	0.29$^{(B)}$	0.28$^{(B)}$	0.034	0.034
Cobalt	µg/L	-	-	-	-	-	-	0.05	0.5$^{(B)}$	0.47$^{(B)}$	0.52$^{(B)}$	0.31$^{(B)}$	0.2$^{(B)}$	0.19$^{(B)}$	0.088$^{(B)}$	0.0086$^{(B)}$
Copper	µg/L	-	-	2.0	-	1.2	2.0	0.8	1.5$^{(R, B)}$	1.5$^{(R, B)}$	1.6$^{(R, B)}$	1.1$^{(B)}$	0.8$^{(B)}$	0.79	0.32	0.31
Iron	µg/L	-	-	300	-	155	300	5.0	39$^{(B)}$	37$^{(B)}$	41$^{(B)}$	25$^{(B)}$	15$^{(B)}$	15$^{(B)}$	4.5	4.5
Lead	µg/L	-	-	1.0	10	0.53	1.0	0.025	0.31$^{(B)}$	0.29$^{(B)}$	0.32$^{(B)}$	0.21$^{(B)}$	0.14$^{(B)}$	0.14$^{(B)}$	0.068$^{(B)}$	0.0066$^{(B)}$
Lithium	µg/L	-	-	-	-	48	96	0.5	1.5$^{(B)}$	1.5$^{(B)}$	1.6$^{(B)}$	1.1$^{(B)}$	1.2$^{(B)}$	0.9$^{(B)}$	1.1$^{(B)}$	1.1$^{(B)}$
Manganese	µg/L	-	-	-	-	316	679	0.59	65$^{(B)}$	61$^{(B)}$	69$^{(B)}$	38$^{(B)}$	22$^{(B)}$	20$^{(B)}$	5.6$^{(B)}$	5.4$^{(B)}$
Mercury	µg/L	-	-	0.026	1.0	0.018	0.026	0.0025	0.008$^{(B)}$	0.0077$^{(B)}$	0.0082$^{(B)}$	0.0062$^{(B)}$	0.0053$^{(B)}$	0.0051$^{(B)}$	0.0033$^{(B)}$	0.0032$^{(B)}$
Molybdenum	µg/L	-	-	73	-	37	73	0.025	1.3$^{(B)}$	1.2$^{(B)}$	1.3$^{(B)}$	0.74$^{(B)}$	1.1$^{(B)}$	0.52$^{(B)}$	1.4$^{(B)}$	1.3$^{(B)}$
Nickel	µg/L	-	-	25	-	13	25	0.65	4.6$^{(B)}$	4.3$^{(B)}$	4.8$^{(B)}$	2.9$^{(B)}$	1.9$^{(B)}$	1.8$^{(B)}$	0.69$^{(B)}$	0.67$^{(B)}$
Selenium	µg/L	-	-	1.0	50	0.55	1.0	0.025	0.31$^{(B)}$	0.3$^{(B)}$	0.33$^{(B)}$	0.2$^{(B)}$	0.22$^{(B)}$	0.14$^{(B)}$	0.23$^{(B)}$	0.22$^{(B)}$
Silver	µg/L	-	-	0.25	-	-	-	0.005	0.015$^{(B)}$	0.015$^{(B)}$	0.015$^{(B)}$	0.011$^{(B)}$	0.0083$^{(B)}$	0.0081$^{(B)}$	0.0031	0.003
Strontium	µg/L	-	-	-	-	28	49	11	39$^{(R, B)}$	38$^{(R, B)}$	41$^{(R, B)}$	28$^{(R, B)}$	29$^{(R, B)}$	22$^{(B)}$	25$^{(B)}$	24$^{(B)}$
Thallium	µg/L	-	-	0.8	-	0.41	0.8	0.005	0.02$^{(B)}$	0.019$^{(B)}$	0.021$^{(B)}$	0.015$^{(B)}$	0.011$^{(B)}$	0.010$^{(B)}$	0.0074$^{(B)}$	0.0073$^{(B)}$
Tin	µg/L	-	-	-	-	0.2	-	0.12	0.096	0.092	0.1	0.089	0.082	0.078	0.066	0.065
Uranium	µg/L	-	33	15	20	7.5	15	0.023	0.57$^{(B)}$	0.54$^{(B)}$	0.6$^{(B)}$	0.34$^{(B)}$	0.86$^{(B)}$	0.32$^{(B)}$	1.3$^{(B)}$	1.2$^{(B)}$
Vanadium	µg/L	-	-	-	-	3.5	6.0	0.25	2.5$^{(B)}$	2.4$^{(B)}$	2.6$^{(B)}$	1.6$^{(B)}$	1.0$^{(B)}$	0.96$^{(B)}$	0.47$^{(B)}$	0.46$^{(B)}$
Zinc	µg/L	-	-	30	-	6.3	24	1.2	1.6$^{(B)}$	1.6$^{(B)}$	1.7$^{(B)}$	1.2$^{(B)}$	0.95	0.91	0.59	0.58

Concentrations are higher than relevant water quality guidelines are indicated by superscripts. The COPCs are indicated by the bolded values
(C) = concentration higher than the relevant chronic aquatic life guideline or beyond the recommended pH, DO or total alkalinity concentration range.
(D) = concentration higher than the relevant drinking water guideline or beyond the recommended pH or DO concentration range.
(R) = concentration higher than the relevant trigger meadowbank or beyond the recommended pH or DO concentration range.
(T) = concentration higher than the relevant threshold or beyond the recommended pH or DO concentration range.
(B) = concentration higher than the relevant baseline level or beyond the recommended pH or DO concentration range.
- = no guideline or data.
a) Site-specific Water Quality Objective (SSWQO) developed for the Whale Tail Project (Volume 6, Appendix 6-N).

Table 6-I-7. Water Quality Predictions (Average and Maximum) for Lake A12 for Operations, Closure, and Post-closure (Early and Late)

Parameter	Unit	Guidelines for the protection of:							Lake A12 (Operations)		Lake A12 (Closure)		Lake A12 (Early Post-closure)		Lake A12 (Late Post-closure)	
		Aquatic Life	Aquatic Life (CCME 1999)		Drinking Water (HC 2014)	Meadowbank (Azimuth 2015b)		Baseline (A15 A14, A14-A13)	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average
		SSWQO[a]	Acute	Chronic		Trigger	Threshold									
Conventional Parameters																
Total dissolved solids	mg/L	-	-	-	-	18	-	18	49$^{(R, B)}$	46$^{(R, B)}$	51$^{(R, B)}$	36$^{(R, B)}$	32$^{(R, B)}$	27$^{(R, B)}$	29$^{(R, B)}$	29$^{(R, B)}$
Major Ions																
Calcium	mg/L	-	-	-	-	-	-	2.5	5.8$^{(B)}$	5.5$^{(B)}$	5.9$^{(B)}$	4.5$^{(B)}$	4.4$^{(B)}$	3.7$^{(B)}$	4.2$^{(B)}$	4.1$^{(B)}$
Magnesium	mg/L	-	-	-	-	0.83	-	0.86	1.8$^{(R, B)}$	1.7$^{(R, B)}$	1.8$^{(R, B)}$	1.4$^{(R, B)}$	1.4$^{(R, B)}$	1.2$^{(R, B)}$	1.2$^{(R, B)}$	1.2$^{(R, B)}$
Potassium	mg/L	-	-	-	-	0.5	-	0.57	3.1$^{(R, B)}$	2.9$^{(R, B)}$	3.2$^{(R, B)}$	2.1$^{(R, B)}$	2.4$^{(R, B)}$	1.6$^{(R, B)}$	3.1$^{(R, B)}$	3.1$^{(R, B)}$
Sodium	mg/L	-	-	-	-	0.98	-	0.58	4.6$^{(R, B)}$	4.2$^{(R, B)}$	4.7$^{(R, B)}$	3.0$^{(R, B)}$	1.9$^{(R, B)}$	1.8$^{(R, B)}$	0.91$^{(B)}$	0.9$^{(B)}$
Chloride	mg/L	-	640	120	-	60	120	2.1	6.2$^{(B)}$	5.9$^{(B)}$	6.4$^{(B)}$	4.4$^{(B)}$	3.3$^{(B)}$	3.3$^{(B)}$	1.5	1.5
Fluoride	mg/L	-	-	0.12	1.5	-	-	0.025	0.093$^{(B)}$	0.087$^{(B)}$	0.095$^{(B)}$	0.068$^{(B)}$	0.057$^{(B)}$	0.051$^{(B)}$	0.048$^{(B)}$	0.047$^{(B)}$
Sulphate	mg/L	-	-	-	-	65	128	3.3	12$^{(B)}$	11$^{(B)}$	12$^{(B)}$	8.3$^{(B)}$	8.6$^{(B)}$	6.1$^{(B)}$	10$^{(B)}$	10$^{(B)}$
Nutrients																
Nitrate	mg-N/L	-	124	2.9	10	1.5	3.0	0.014	0.55$^{(B)}$	0.5$^{(B)}$	0.57$^{(B)}$	0.32$^{(B)}$	0.16$^{(B)}$	0.16$^{(B)}$	0.0094	0.009
Total ammonia	mg-N/L	-	-	7.7	-	0.065	0.13	0.0073	0.013$^{(B)}$	0.012$^{(B)}$	0.014$^{(B)}$	0.008$^{(B)}$	0.004	0.004	0.00029	0.000
Dissolved phosphorus	mg-P/L	-	-	0.004 to 0.1	-	0.006	0.004	0.001	**0.044$^{(C, R, T, B)}$**	**0.040$^{(C, R, T, B)}$**	**0.046$^{(C, R, T, B)}$**	**0.026$^{(C, R, T, B)}$**	**0.021$^{(C, R, T, B)}$**	**0.014$^{(C, R, T, B)}$**	**0.005$^{(C, T, B)}$**	**0.0048$^{(C, T, B)}$**
Dissolved Metals																
Aluminum	µg/L	-	-	100	100	26	50	3.2	5.0$^{(B)}$	4.9$^{(B)}$	5.0$^{(B)}$	4.7$^{(B)}$	4.5$^{(B)}$	4.4$^{(B)}$	1.9	1.8
Antimony	µg/L	-	-	-	6.0	10	20	0.05	2.2$^{(B)}$	2.0$^{(B)}$	2.2$^{(B)}$	1.3$^{(B)}$	0.86$^{(B)}$	0.74$^{(B)}$	0.56$^{(B)}$	0.55$^{(B)}$
Arsenic	µg/L	28	-	5.0	10	2.6	5.0	0.32	15$^{(C, D, R, T, B)}$	14$^{(C, D, R, T, B)}$	15$^{(C, D, R, T, B)}$	8.5$^{(C, R, T, B)}$	4.9$^{(R, B)}$	4.4$^{(R, B)}$	2.5$^{(B)}$	2.5$^{(B)}$
Barium	µg/L	-	-	-	1000	501	1000	6.1	11$^{(B)}$	10$^{(B)}$	11$^{(B)}$	8.9$^{(B)}$	7.8$^{(B)}$	7.3$^{(B)}$	6.2$^{(B)}$	6.1
Beryllium	µg/L	-	-	-	-	2.7	5.3	0.01	0.022$^{(B)}$	0.020$^{(B)}$	0.022$^{(B)}$	0.018$^{(B)}$	0.015$^{(B)}$	0.014$^{(B)}$	0.006	0.006
Bismuth	µg/L	-	-	-	-	-	-	0.025	0.032$^{(B)}$	0.032$^{(B)}$	0.032$^{(B)}$	0.031$^{(B)}$	0.03$^{(B)}$	0.029$^{(B)}$	0.013	0.012
Boron	µg/L	-	29,000	1,500	5000	760	1500	5.0	53$^{(B)}$	49$^{(B)}$	55$^{(B)}$	35$^{(B)}$	20$^{(B)}$	20$^{(B)}$	6.8$^{(B)}$	6.7$^{(B)}$
Cadmium	µg/L	-	0.34	0.04	5.0	0.025	0.04	0.0025	0.0088$^{(B)}$	0.0083$^{(B)}$	0.009$^{(B)}$	0.0065$^{(B)}$	0.0054$^{(B)}$	0.0048$^{(B)}$	0.0042$^{(B)}$	0.0042$^{(B)}$
Chromium	µg/L	-	-	31	50	0.56	1.0	0.05	0.78$^{(R, B)}$	0.72$^{(R, B)}$	0.81$^{(R, B)}$	0.5$^{(B)}$	0.28$^{(B)}$	0.28$^{(B)}$	0.036	0.036
Cobalt	µg/L	-	-	-	-	-	-	0.05	0.47$^{(B)}$	0.43$^{(B)}$	0.48$^{(B)}$	0.3$^{(B)}$	0.19$^{(B)}$	0.18$^{(B)}$	0.085$^{(B)}$	0.084$^{(B)}$
Copper	µg/L	-	-	2.0	-	1.2	2.0	0.8	1.5$^{(R, B)}$	1.4$^{(R, B)}$	1.5$^{(R, B)}$	1.1$^{(B)}$	0.84$^{(B)}$	0.82$^{(B)}$	0.35	0.34
Iron	µg/L	-	-	300	-	155	300	5.0	37$^{(B)}$	35$^{(B)}$	38$^{(B)}$	25$^{(B)}$	16$^{(B)}$	16$^{(B)}$	5.1$^{(B)}$	5.0
Lead	µg/L	-	-	1.0	10	0.53	1.0	0.025	0.29$^{(B)}$	0.27$^{(B)}$	0.3$^{(B)}$	0.2$^{(B)}$	0.14$^{(B)}$	0.14$^{(B)}$	0.067$^{(B)}$	0.066$^{(B)}$
Lithium	µg/L	-	-	-	-	48	96	0.5	1.5$^{(B)}$	1.4$^{(B)}$	1.5$^{(B)}$	1.1$^{(B)}$	1.1$^{(B)}$	0.89$^{(B)}$	1.1$^{(B)}$	1.0$^{(B)}$
Manganese	µg/L	-	-	-	-	316	679	0.59	61$^{(B)}$	56$^{(B)}$	63$^{(B)}$	36$^{(B)}$	21$^{(B)}$	19$^{(B)}$	5.3$^{(B)}$	5.2$^{(B)}$
Mercury	µg/L	-	-	0.026	1.0	0.018	0.026	0.0025	0.0077$^{(B)}$	0.0073$^{(B)}$	0.0078$^{(B)}$	0.0061$^{(B)}$	0.0052$^{(B)}$	0.005$^{(B)}$	0.0032$^{(B)}$	0.0032$^{(B)}$
Molybdenum	µg/L	-	-	73	-	37	73	0.025	1.2$^{(B)}$	1.1$^{(B)}$	1.2$^{(B)}$	0.71$^{(B)}$	0.83$^{(B)}$	0.46$^{(B)}$	1.2$^{(B)}$	1.2$^{(B)}$
Nickel	µg/L	-	-	25	-	13	25	0.65	4.3$^{(B)}$	4.0$^{(B)}$	4.4$^{(B)}$	2.8$^{(B)}$	1.8$^{(B)}$	1.8$^{(B)}$	0.67$^{(B)}$	0.66$^{(B)}$
Selenium	µg/L	-	-	1.0	50	0.55	1.0	0.025	0.29$^{(B)}$	0.27$^{(B)}$	0.3$^{(B)}$	0.19$^{(B)}$	0.18$^{(B)}$	0.13$^{(B)}$	0.22$^{(B)}$	0.21$^{(B)}$
Silver	µg/L	-	-	0.25	-	-	-	0.005	0.014$^{(B)}$	0.014$^{(B)}$	0.015$^{(B)}$	0.012$^{(B)}$	0.0084$^{(B)}$	0.0083$^{(B)}$	0.0033	3.30E-03
Strontium	µg/L	-	-	-	-	28	49	11	38$^{(R, B)}$	35$^{(R, B)}$	38$^{(R, B)}$	27$^{(B)}$	26$^{(B)}$	21$^{(B)}$	24$^{(B)}$	23$^{(B)}$
Thallium	µg/L	-	-	0.8	-	0.41	0.8	0.005	0.02$^{(B)}$	0.019$^{(B)}$	0.02$^{(B)}$	0.014$^{(B)}$	0.011$^{(B)}$	0.011$^{(B)}$	0.0073$^{(B)}$	0.0071$^{(B)}$
Tin	µg/L	-	-	-	-	0.2	-	0.12	0.1	0.095	0.11	0.099	0.09	0.087	0.069	0.069
Uranium	µg/L	-	33	15	20	7.5	15	0.023	0.53$^{(B)}$	0.49$^{(B)}$	0.55$^{(B)}$	0.33$^{(B)}$	0.62$^{(B)}$	0.27$^{(B)}$	1.1$^{(B)}$	1.1$^{(B)}$
Vanadium	µg/L	-	-	-	-	3.5	6.0	0.25	2.4$^{(B)}$	2.2$^{(B)}$	2.4$^{(B)}$	1.6$^{(B)}$	0.97$^{(B)}$	0.94$^{(B)}$	0.45$^{(B)}$	0.45$^{(B)}$
Zinc	µg/L	-	-	30	-	6.3	24	1.2	1.6$^{(B)}$	1.5$^{(B)}$	1.6$^{(B)}$	1.2$^{(B)}$	0.95	0.94	0.61	0.6

Concentrations are higher than relevant water quality guidelines are indicated by superscripts. The COPCs are indicated by the bolded values

$^{(C)}$ = concentration higher than the relevant chronic aquatic life guideline or beyond the recommended pH, DO or total alkalinity concentration range.

$^{(D)}$ = concentration higher than the relevant drinking water guideline or beyond the recommended pH or DO concentration range.

$^{(R)}$ = concentration higher than the relevant trigger meadowbank or beyond the recommended pH or DO concentration range.

$^{(T)}$ = concentration higher than the relevant threshold or beyond the recommended pH or DO concentration range.

$^{(B)}$ = concentration higher than the relevant baseline level or beyond the recommended pH or DO concentration range.

- = no guideline or data.

a) Site-specific Water Quality Objective (SSWQO) developed for the Whale Tail Project (Volume 6, Appendix 6-N).

Table 6-I-8. Water Quality Predictions (Average and Maximum) for Downstream Node 1 for Operations, Closure, and Post-closure (Early and Late)

Parameter	Unit	Guidelines for the protection of:							DS1 (Operations)		DS1 (Closure)		DS1 (Early Post-closure)		DS1 (Late Post-closure)	
		Aquatic Life	Aquatic Life (CCME 1999)		Drinking Water (HC 2014)	Meadowbank (Azimuth 2015b)		Baseline (DS1)	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average
		SSWQO[a]	Acute	Chronic		Trigger	Threshold									
Conventional Parameters																
Total dissolved solids	mg/L	-	-	-	-	18	-	20	16	15	15	14	15	14	15	15
Major Ions																
Calcium	mg/L	-	-	-	-	-	-	2.0	2.3[B]	2.2[B]	2.2[B]	2.1[B]	2.2[B]	2.1[B]	2.2[B]	2.2[B]
Magnesium	mg/L	-	-	-	-	0.83	-	0.85	0.74	0.72	0.72	0.69	0.72	0.7	0.73	0.71
Potassium	mg/L	-	-	-	-	0.5	-	0.34	0.68[R, B]	0.63[R, B]	0.65[R, B]	0.58[R, B]	0.61[R, B]	0.58[R, B]	0.79[R, B]	0.75[R, B]
Sodium	mg/L	-	-	-	-	0.98	-	0.73	0.93[B]	0.86[B]	0.88[B]	0.79[B]	0.81[B]	0.78[B]	0.7	0.69
Chloride	mg/L	-	640	120	-	60	120	0.95	1.6[B]	1.5[B]	1.5[B]	1.4[B]	1.4[B]	1.4[B]	1.3[B]	1.2[B]
Fluoride	mg/L	-	-	0.12	1.5	-	-	0.038	0.032	0.031	0.031	0.03	0.03	0.029	0.03	0.029
Sulphate	mg/L	-	-	-	-	65	128	1.2	2.9[B]	2.7[B]	2.8[B]	2.5[B]	2.6[B]	2.5[B]	3.1[B]	3.0[B]
Nutrients																
Nitrate	mg-N/L	-	124	2.9	10	1.5	3.0	0.0025	0.044[B]	0.035[B]	0.038[B]	2.40E-02[B]	0.024[B]	0.021[B]	0.0072[B]	0.0071[B]
Total ammonia	mg-N/L	-	-	7.7	-	0.065	0.13	0.0057	0.0009	0.00069	0.00078	0.00042	0.00043	0.00036	0.000035	0.000031
Dissolved phosphorus	mg-P/L	-	-	0.004 to 0.1	-	0.006	0.004	0.001	**0.0046[C, I, B]**	0.0039[B]	**0.0042[C, I, B]**	0.0031[B]	0.0031[B]	0.0028[B]	0.0022[B]	0.0021[B]
Dissolved Metals																
Aluminum	µg/L	-	-	100	100	26	50	5.4	3.9	3.9	3.9	3.8	3.9	3.9	3.7	3.6
Antimony	µg/L	-	-	-	6.0	10	20	0.05	0.2[B]	0.16[B]	0.17[B]	0.12[B]	0.13[B]	0.11[B]	0.11[B]	0.1[B]
Arsenic	µg/L	28	-	5.0	10	2.6	5.0	0.15	1.2[B]	0.96[B]	1.0[B]	0.63[B]	0.66[B]	0.56[B]	0.43[B]	0.39[B]
Barium	µg/L	-	-	-	1000	501	1000	3.1	6.0[B]	5.9[B]	5.9[B]	5.8[B]	5.9[B]	5.8[B]	5.7[B]	5.7[B]
Beryllium	µg/L	-	-	-	-	2.7	5.3	0.01	0.011[B]	0.011[B]	0.011[B]	0.011[B]	0.011[B]	0.011[B]	0.01	0.0099
Bismuth	µg/L	-	-	-	-	-	-	0.025	0.026[B]	0.026[B]	0.026[B]	0.025[B]	0.026[B]	0.026[B]	0.025	0.024
Boron	µg/L	-	29,000	1,500	5000	760	1500	5.0	8.5[B]	7.7[B]	7.9[B]	6.7[B]	7.0[B]	6.6[B]	5.4[B]	5.3[B]
Cadmium	µg/L	-	0.34	0.04	5.0	0.025	0.04	0.0025	0.0035[B]	0.0034[B]	0.0034[B]	0.0034[B]	0.0034[B]	0.0033[B]	0.0033[B]	0.0032[B]
Chromium	µg/L	-	-	31	50	0.56	1.0	0.05	0.1[B]	0.089[B]	0.094[B]	0.076[B]	0.079[B]	0.073[B]	0.051[B]	0.05[B]
Cobalt	µg/L	-	-	-	-	-	-	0.05	0.08[B]	0.073[B]	0.075[B]	0.064[B]	0.067[B]	0.064[B]	0.056[B]	0.055[B]
Copper	µg/L	-	-	2.0	-	1.2	2.0	0.64	0.68[B]	0.66[B]	0.66[B]	0.64[B]	0.65[B]	0.64[B]	0.6	0.59
Iron	µg/L	-	-	300	-	155	300	11	12[B]	11[B]	11[B]	11	11	11	9.5	9.4
Lead	µg/L	-	-	1.0	10	0.53	1.0	0.025	0.06[B]	0.056[B]	0.057[B]	0.050[B]	0.053[B]	0.05[B]	0.045[B]	0.045[B]
Lithium	µg/L	-	-	-	-	48	96	0.5	0.58[B]	0.56[B]	0.56[B]	0.54[B]	0.56[B]	0.55[B]	0.58[B]	0.56[B]
Manganese	µg/L	-	-	-	-	316	679	0.68	4.9[B]	3.9[B]	4.2[B]	2.6[B]	2.8[B]	2.4[B]	1.2[B]	1.2[B]
Mercury	µg/L	-	-	0.026	1.0	0.018	0.026	0.0025	0.003[B]	0.0029[B]	0.0029[B]	0.0028[B]	0.0028[B]	0.0028[B]	0.0027[B]	0.0026[B]
Molybdenum	µg/L	-	-	73	-	37	73	0.025	0.11[B]	0.089[B]	0.097[B]	0.067[B]	0.073[B]	0.064[B]	0.16[B]	0.15[B]
Nickel	µg/L	-	-	25	-	13	25	0.25	0.68[B]	0.62[B]	0.64[B]	0.54[B]	0.56[B]	0.53[B]	0.44[B]	0.43[B]
Selenium	µg/L	-	-	1.0	50	0.55	1.0	0.025	0.044[B]	0.04[B]	0.041[B]	0.034[B]	0.036[B]	0.034[B]	0.047[B]	0.044[B]
Silver	µg/L	-	-	0.25	-	-	-	0.005	0.0058[B]	0.0056[B]	0.0056[B]	0.0055[B]	0.0056[B]	0.0054[B]	0.005[B]	0.005
Strontium	µg/L	-	-	-	-	28	49	6.2	11[B]	10[B]	10[B]	9.6[B]	10[B]	9.7[B]	10[B]	10[B]
Thallium	µg/L	-	-	0.8	-	0.41	0.8	0.005	0.0062[B]	0.0059[B]	0.0059[B]	0.0056[B]	0.0058[B]	0.0056[B]	0.0054[B]	0.0053[B]
Tin	µg/L	-	-	-	-	0.2	-	0.13	0.11	0.11	0.12	0.11	0.12	0.11	0.11	0.11
Uranium	µg/L	-	33	15	20	7.5	15	0.043	0.061[B]	0.052[B]	0.055[B]	0.043[B]	0.047[B]	0.042	0.15[B]	0.13[B]
Vanadium	µg/L	-	-	-	-	3.5	6.0	0.25	0.4[B]	0.36[B]	0.38[B]	0.33[B]	0.34[B]	0.32[B]	0.28[B]	0.28[B]
Zinc	µg/L	-	-	30	-	6.3	24	0.5	0.78[B]	0.76[B]	0.76[B]	0.74[B]	0.76[B]	0.75[B]	0.71[B]	0.71[B]

Concentrations are higher than relevant water quality guidelines are indicated by superscripts. The COPCs are indicated by the bolded values

[C] = concentration higher than the relevant chronic aquatic life guideline or beyond the recommended pH, DO or total alkalinity concentration range.

[D] = concentration higher than the relevant drinking water guideline or beyond the recommended pH or DO concentration range.

[R] = concentration higher than the relevant trigger meadowbank or beyond the recommended pH or DO concentration range.

[T] = concentration higher than the relevant threshold or beyond the recommended pH or DO concentration range.

[B] = concentration higher than the relevant baseline level or beyond the recommended pH or DO concentration range.

- = no guideline or data.

a) Site-specific Water Quality Objective (SSWQO) developed for the Whale Tail Project (Volume 6, Appendix 6-N).

Table 6-I-9. Water Quality Predictions (Average and Maximum) for Downstream Node 2 for Operations, Closure, and Post-closure (Early and Late)

Parameter	Unit	Guidelines for the protection of:							DS2 (Operations)		DS2 (Closure)		DS2 (Early Post-closure)		DS2 (Late Post-closure)	
		Aquatic Life	Aquatic Life (CCME 1999)		Drinking Water (HC 2014)	Meadowbank (Azimuth 2015b)		Baseline (DS1, A5-A4)	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average
		SSWQO[a]	Acute	Chronic		Trigger	Threshold									
Conventional Parameters																
Total dissolved solids	mg/L	-	-	-	-	18	-	20	29[R, B]	25[R, B]	28[R, B]	21[R, B]	21[R, B]	20[R]	22[R, B]	21[R, B]
Major Ions																
Calcium	mg/L	-	-	-	-	-	-	2.0	3.7[B]	3.3[B]	3.6[B]	2.9[B]	2.9[B]	2.8[B]	3.3[B]	3.1[B]
Magnesium	mg/L	-	-	-	-	0.83	-	0.85	1.2[R, B]	1.1[R, B]	1.1[R, B]	0.94[R, B]	0.94[R, B]	0.9[R, B]	1.0[R, B]	0.97[R, B]
Potassium	mg/L	-	-	-	-	0.5	-	0.59	1.6[R, B]	1.3[R, B]	1.5[R, B]	1.1[R, B]	1.0[R, B]	0.93[R, B]	1.9[R, B]	1.7[R, B]
Sodium	mg/L	-	-	-	-	0.98	-	0.73	2.3[R, B]	1.9[R, B]	2.2[R, B]	1.5[R, B]	1.3[R, B]	1.2[R, B]	0.84[B]	0.82[B]
Chloride	mg/L	-	640	120	-	60	120	1.1	3.4[B]	2.9[B]	3.2[B]	2.3[B]	2.3[B]	2.1[B]	1.5[B]	1.4[B]
Fluoride	mg/L	-	-	0.12	1.5	-	-	0.038	0.056[B]	0.049[B]	0.054[B]	0.042[B]	0.041[B]	0.039[B]	0.04[B]	0.038[B]
Sulphate	mg/L	-	-	-	-	65	128	2.4	6.4[B]	5.4[B]	6.1[B]	4.4[B]	4.1[B]	3.8[B]	6.6[B]	6.0[B]
Nutrients																
Nitrate	mg-N/L	-	124	2.9	10	1.5	3.0	0.0025	0.23[B]	0.17[B]	0.21[B]	0.11[B]	0.085[B]	0.074[B]	0.0096[B]	0.0089[B]
Total ammonia	mg-N/L	-	-	7.7	-	0.065	0.13	0.0057	0.0055	0.0041	0.005	2.60E-03	0.0019	0.0016	0.00016	0.00014
Dissolved phosphorus	mg-P/L	-	-	0.004 to 0.1	-	0.006	0.004	0.001	**0.019[C, R, I, B]**	**0.015[C, R, I, B]**	**0.018[C, R, I, B]**	**0.0098[C, R, I, B]**	**0.0081[C, R, I, B]**	**0.0071[C, R, I, B]**	**0.004[C, B]**	0.0036[B]
Dissolved Metals																
Aluminum	µg/L	-	-	100	100	26	50	5.4	4.6	4.4	4.5	4.4	4.4	4.4	3.4	3.1
Antimony	µg/L	-	-	-	6.0	10	20	0.05	0.93[B]	0.7[B]	0.87[B]	0.48[B]	0.4[B]	0.35[B]	0.32[B]	0.29[B]
Arsenic	µg/L	28	-	5.0	10	2.6	5.0	0.16	6.3[C, R, I, B]	4.8[R, B]	5.8[C, R, I, B]	3.0[R, B]	2.3[B]	2.0[B]	1.4[B]	1.3[B]
Barium	µg/L	-	-	-	1000	501	1000	7.4	8.1[B]	7.5[B]	7.9[B]	7.1	6.9	6.8	6.3	6.2
Beryllium	µg/L	-	-	-	-	2.7	5.3	0.01	0.016[B]	0.014[B]	0.015[B]	0.014[B]	0.013[B]	0.013[B]	0.0096	0.0089
Bismuth	µg/L	-	-	-	-	-	-	0.025	0.03[B]	0.029[B]	0.03[B]	0.029[B]	0.03[B]	0.029[B]	0.023	0.022
Boron	µg/L	-	29,000	1,500	5000	760	1500	5.0	26[B]	20[B]	24[B]	15[B]	13[B]	12[B]	6.4[B]	6.2[B]
Cadmium	µg/L	-	0.34	0.04	5.0	0.025	0.04	0.0063	0.0057	0.005	0.0054	0.0045	0.0043	0.0041	0.0039	0.0038
Chromium	µg/L	-	-	31	50	0.56	1.0	0.05	0.36[B]	0.28[B]	0.34[B]	0.2[B]	0.17[B]	0.16[B]	0.05[B]	0.048
Cobalt	µg/L	-	-	-	-	-	-	0.05	0.23[B]	0.18[B]	0.21[B]	0.14[B]	0.12[B]	0.11[B]	0.073[B]	0.07[B]
Copper	µg/L	-	-	2.0	-	1.2	2.0	0.82	1.0[B]	0.91[B]	0.97[B]	0.84[B]	0.78	0.77	0.58	0.53
Iron	µg/L	-	-	300	-	155	300	12	22[B]	19[B]	21[B]	16[B]	14[B]	14[B]	9.0	8.3
Lead	µg/L	-	-	1.0	10	0.53	1.0	0.14	0.15[B]	0.12	0.14[B]	0.096	0.092	0.085	0.058	0.056
Lithium	µg/L	-	-	-	-	48	96	0.5	0.95[B]	0.84[B]	0.91[B]	0.75[B]	0.73[B]	0.7[B]	0.83[B]	0.79[B]
Manganese	µg/L	-	-	-	-	316	679	0.68	26[B]	19[B]	24[B]	13[B]	10[B]	8.8[B]	3.3[B]	2.9[B]
Mercury	µg/L	-	-	0.026	1.0	0.018	0.026	0.0025	0.005[B]	0.0044[B]	0.0047[B]	0.0038[B]	0.0039[B]	0.0037[B]	0.0031[B]	0.003[B]
Molybdenum	µg/L	-	-	73	-	37	73	0.025	0.51[B]	0.38[B]	0.47[B]	0.26[B]	0.22[B]	0.19[B]	0.67[B]	0.59[B]
Nickel	µg/L	-	-	25	-	13	25	0.25	2.1[B]	1.7[B]	1.9[B]	1.2[B]	1.1[B]	1.0[B]	0.57[B]	0.56[B]
Selenium	µg/L	-	-	1.0	50	0.55	1.0	0.025	0.14[B]	0.11[B]	0.13[B]	0.081[B]	0.074[B]	0.066[B]	0.13[B]	0.11[B]
Silver	µg/L	-	-	0.25	-	-	-	0.005	0.0093[B]	0.0083[B]	0.0089[B]	0.0074[B]	0.0072[B]	0.007[B]	0.0049	0.0046
Strontium	µg/L	-	-	-	-	28	49	8.2	22[B]	18[B]	20[B]	15[B]	15[B]	14[B]	17[B]	16[B]
Thallium	µg/L	-	-	0.8	-	0.41	0.8	0.005	0.012[B]	0.01[B]	0.011[B]	0.0085[B]	0.0081[B]	0.0077[B]	0.0066[B]	0.0064[B]
Tin	µg/L	-	-	-	-	0.2	-	0.27	0.12	0.11	0.12	0.12	0.12	0.12	0.11	0.1
Uranium	µg/L	-	33	15	20	7.5	15	0.043	0.24[B]	0.18[B]	0.22[B]	0.13[B]	0.12[B]	0.1[B]	0.62[B]	0.54[B]
Vanadium	µg/L	-	-	-	-	3.5	6.0	0.25	1.1[B]	0.92[B]	1.1[B]	0.7[B]	0.63[B]	0.58[B]	0.38[B]	0.36[B]
Zinc	µg/L	-	-	30	-	6.3	24	0.5	**1.1[B]**	**1.0[B]**	**1.1[B]**	**0.95[B]**	**0.9[B]**	**0.88[B]**	**0.74[B]**	**0.72[B]**

Concentrations are higher than relevant water quality guidelines are indicated by superscripts. The COPCs are indicated by the bolded values

[C] = concentration higher than the relevant chronic aquatic life guideline or beyond the recommended pH, DO or total alkalinity concentration range.

[D] = concentration higher than the relevant drinking water guideline or beyond the recommended pH or DO concentration range.

[R] = concentration higher than the relevant trigger meadowbank or beyond the recommended pH or DO concentration range.

[I] = concentration higher than the relevant threshold or beyond the recommended pH or DO concentration range.

[B] = concentration higher than the relevant baseline level or beyond the recommended pH or DO concentration range.

- = no guideline or data.

a) Site-specific Water Quality Objective (SSWQO) developed for the Whale Tail Project (Volume 6, Appendix 6-N).

APPENDIX 6-J

Portt 2014 Baseline Road Report

June 2016
Report No. 1541520

AGNICO EAGLE

Golder Associates

AMARUQ EXPLORATION ROAD AQUATICS BASELINE REPORT 2014
AGNICO EAGLE MINES LTD. - MEADOWBANK DIVISION



Submitted to:

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EXECUTIVE SUMMARY

The Meadowbank Mine is one of Canada's most northerly operating mines, located approximately 75 km north of the Hamlet of Baker Lake, Kivalliq District, Nunavut. It has been in operation since 2009, with open pit mining activities underway since March 2010. The Amaruq project is a 408-square-kilometre exploration property located approximately 50 kilometres northwest of the Meadowbank Mine, where a drilling program started in July 2013 has revealed promising gold mineralization.

In the event that an advanced exploration all-weather road is deemed necessary to facilitate year-round exploration activities, an evaluation was initiated to examine locations where aquatic habitat might be affected along the approximate route of the proposed all-weather road between the Meadowbank mine and the Amaruq exploration site. This includes water-crossing assessments and fish community and habitat surveys in support of preliminary engineering for road feasibility and design. This report details the results of the assessment of the aquatic resources along the 61.3 km route of the proposed road that was conducted from August 29 to September 2, 2014, which will contribute to the baseline environmental information.

Field investigations, conducted from August 30 to September 2, 2014, included reconnaissance and photographing all locations where the approximate corridor intersected water bodies or watercourses from a helicopter and on-the-ground investigations, that included electrofishing, at 8 watercourses that were considered to be the most likely to support fish. An assessment of fish habitat potential was based on the field investigations and aerial photography. Factors considered included the presence or absence of late summer flow, the presence or absence of reaches where only interstitial flow was occurring in late summer, and the potential that the watercourse provides a migration corridor to upstream habitats.

A total of 53 locations were identified where a lake, pond or watercourse was intersected by the proposed road corridor. Of these, 13 were either the shorelines of larger lakes or small lakes or ponds. It is expected that the final road alignment will avoid these.

Fish were captured at seven of the eight locations that were electrofished. Adult Slimy Sculpin were present at all seven locations where fish were captured and adult Ninespine Stickleback were captured at two locations. Juvenile Arctic char were captured at two locations and a juvenile Arctic Grayling and a juvenile Burbot were each captured at one location. Based on their habitat characteristics and upstream drainage areas, it is likely that many of the watercourses crossed by the proposed route are only inhabited seasonally by small, non-game, non-commercial species. The fact that many of the smaller watercourses are frozen to the permafrost every winter reduces their potential utilization by aquatic organisms.

Three of the 40 watercourses crossed are large (i.e. rivers) that could provide habitat and a migratory route for both large-bodied and small-bodied fish. Bridges are the recommended for those crossings. The other 37 watercourses are smaller and range from open, flowing channels to boulder fields where no water was visible.

Twelve watercourses are considered to be potential migration routes and/or to potentially provide spawning or nursery habitat for large-bodied fish. At eight of these it is recommended that the crossing employ an open-bottomed structure that spans the bankfull channel. At the other four the open channel is bordered by interstitial flow, and it is recommended that the interstitial flow be maintained and the open channel spanned by an open-bottomed structure.

Seventeen watercourses were identified as having the potential to support only small-bodied fish that may move into them during the open-water season. For these watercourses the crossing recommendation depends on the type of habitat at the crossing location. If the habitat is boulder and normally there is only interstitial flow, the recommendation is to maintain the interstitial flow at the crossing and use corrugated steel pipes to provide additional conveyance for occasional high flows, if necessary. If the habitat is graminoid at the crossing then the recommendation is to use appropriately sized corrugated steel pipes that are inset at least 0.3 m below the stream invert. Use of an open-bottomed structure instead of inset corrugated steel pipes is acceptable. Eleven watercourses are not thought to provide fish habitat and no crossing recommendations are provided. It should be noted that, with the exception of the three river crossings where bridges are clearly required, the crossing recommendations are based solely on fish habitat and do not take into account conveyance needs or other hydrologic or engineering considerations.

Additional field work, conducted in the spring, will be necessary to confirm the appropriateness of the final crossing locations and crossing type recommendations to mitigate impacts to valued fishery functions. The results of this initial assessment indicate that, with appropriate mitigation, it will be possible to construct the proposed road in a manner that will not result in serious harm to fish or fish habitat.

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1.0 INTRODUCTION

The Amaruq project (formerly the "IVR project"), is an exploration property located approximately 50 kilometres northwest of the Meadowbank mine in Nunavut as shown in **Figure 1-1**. The 408-square-kilometre Amaruq property is located on Inuit Owned Land, and was acquired by Agnico Eagle in April 2013 subject to a mineral exploration agreement with Nunavut Tunngavik Incorporated.

A drilling program started in July 2013 has revealed promising gold mineralization. Given the size and scope of the discovery, studies are currently underway to evaluate how Amaruq could be incorporated into the Meadowbank mine operational plan.

If advanced exploration proceeds, an all-weather road is deemed necessary to facilitate year-round exploration activities. Therefore, an evaluation was initiated to look at possible locations of an all-weather exploration road between the Meadowbank mine and the Amaruq exploration site. This includes water-crossing assessments and fish surveys in support of preliminary engineering for a possible all-weather exploration road feasibility and design. The intention is to prepare to permit and build a road linking the Amaruq exploration project site to the Meadowbank mine for the transport of fuel, equipment and personnel. This report details the results of the assessment of the aquatic resources along the 61.3 km route of the proposed road, which will contribute to the baseline environmental information.

1.1 Background

The Meadowbank Mine (65°N, 96°W) is one of Canada’s most northerly operating mines, located approximately 75-km north of the Hamlet of Baker Lake, Kivalliq District, Nunavut (Figure 1-2). Mine construction began in 2008 under Nunavut Water Board Type A License 2AM-MEA0815 and Fisheries and Oceans Canada Authorization for Works or Undertaking Affecting Fish Habitat NU-03-0191.3 and NU-03-0191.4. Meadowbank has been in operation since 2009, with mining activities formally underway since March 2010, and projected to occur until February 2018. Meadowbank is an open pit operation, with most of the pit development located in close proximity to the mill, office and lodging infrastructure, with the exception of the Vault Pit which is approximately 10 km northeast of the main mine site. The southern terminus of the proposed Amaruq exploration road is at the Vault Pit and the northern terminus is at the Amaruq exploration site.

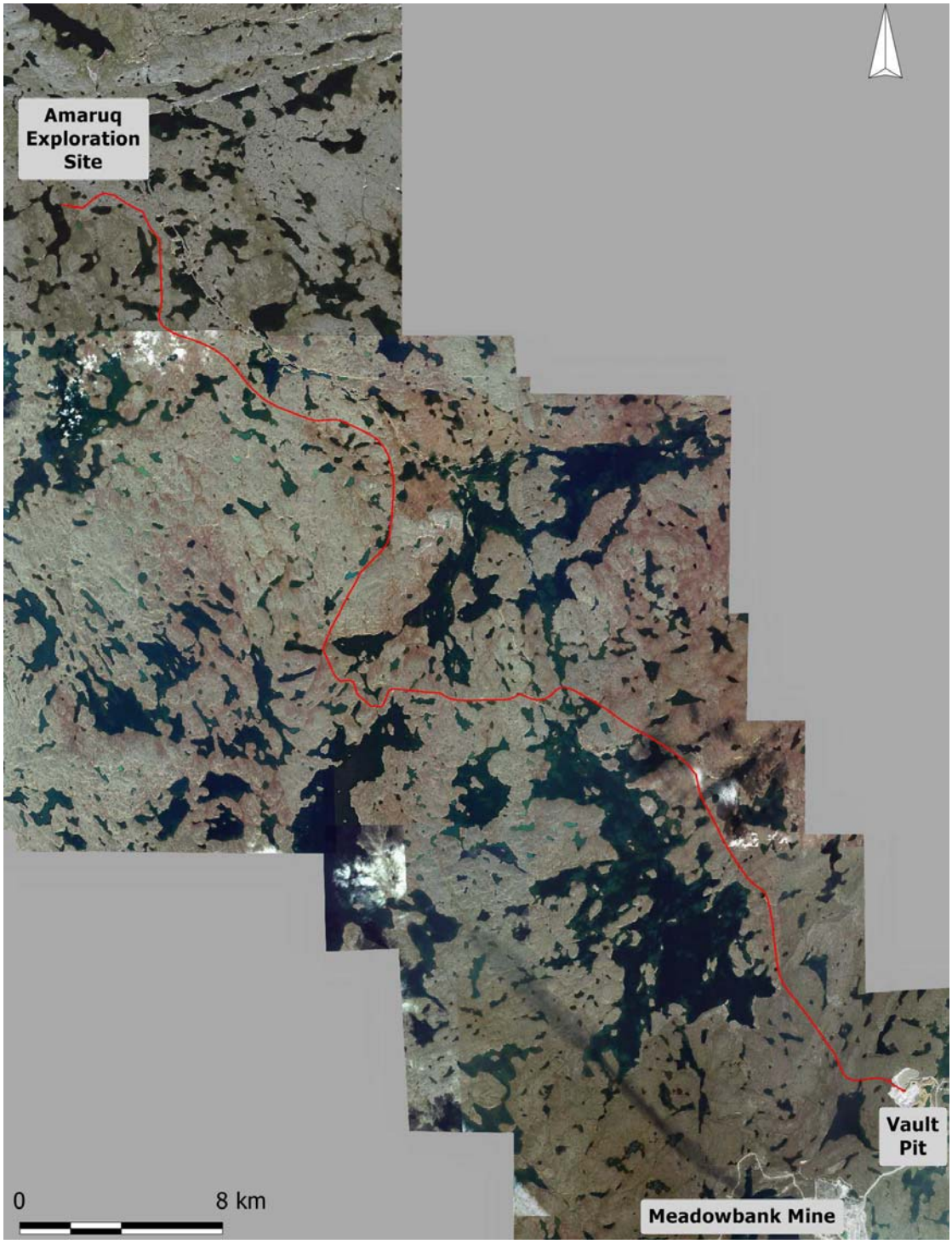


Figure 1-1. Location of proposed Amaruq exploration road corridor.

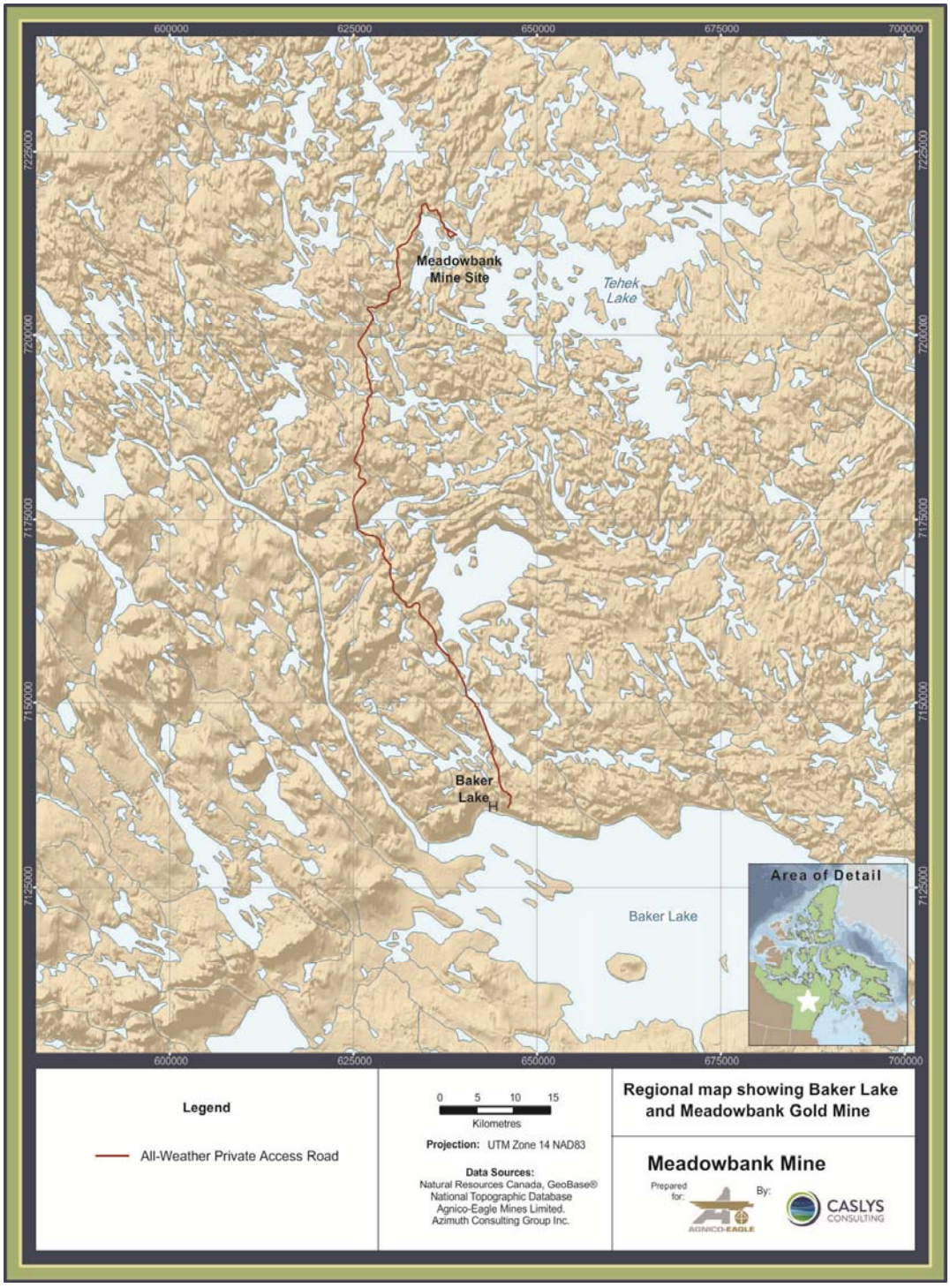


Figure 1-2. Map showing the location of the permitted and licensed Meadowbank Mine that includes an operational all-weather access road to Baker Lake.

1.2 Scope

This report presents an assessment of the watercourses along the proposed Amaruq Road corridor, based on field work conducted from August 29 to September 2, 2014.

1.3 Objectives

- Characterize the existing conditions
- Identify potential impacts
- Recommend mitigation

1.4 Physical Setting

The Meadowbank Mine is located on the Canadian Shield within a Low Arctic ecoclimate of continuous permafrost, which is one of the coldest and driest regions of Canada (Azimuth, 2010). The lakes within the Meadowbank project area are ultra-oligotrophic/oligotrophic (nutrient poor, unproductive) headwater lakes that are typical of the Arctic. The ice-free season on the lakes is very short. Ice break-up usually occurs during mid- to late-June, and ice begins to form again on the lakes in late September or early October. Complete ice cover is attained by late October, with maximum ice thickness of about 2 m occurring in March/April (Azimuth, 2013). Many small watercourses become dry once the land begins to freeze in the fall and, where water is present, most freeze to the bottom during the winter (BAER, 2005; Jones *et al*, 2010). Flows during the spring melt and the summer vary with drainage area.

The southern terminus of the proposed Amaruq road is at the Vault Pit and the northern terminus is at the Amaruq exploration site. The most southern watercourse crossing along the proposed road is within the headwater area of the Chesterfield Inlet watershed that flows to Hudson Bay (referred to as fisheries assessment - Location 1). All of the other locations examined along the proposed road alignment are within the Meadowbank River watershed which flows to the Back River and then to the Arctic Ocean.

There are no known anthropogenic influences between the Vault Pit and the Amaruq exploration site. The nearest community is Baker Lake, 75 km south of the Meadowbank Mine. At the present time, the only practical way of accessing the proposed road alignment is by helicopter.

2.0 METHODS

2.1 Preparation for Field Work

Due to the remote nature of the field work, in an area with few landmarks, it was essential to have proper maps and navigational equipment to locate the proposed road alignment and to assess the connectivity of aquatic habitats. This road route, presented as a red line in Appendix A, is an approximate alignment provided as a shapefile to field staff by Agnico Eagle Mines Ltd. while the final road route was being surveyed. For field orientation this road alignment was overlain on digital topographic mapping of the area (Garmin Topo Canada) and uploaded to a Garmin GPSmap76CSx hand-held GPS receiver. Potential watercourse crossings and waterbodies in close proximity to the road were identified on the topographic maps supplemented with examination of satellite images. These were located on printed copies of the same topographic mapping, which were also taken into the field.

2.2 Aerial Reconnaissance

The proposed road alignment was examined from the air by helicopter on August 29 and 30, 2014. Each of the previously identified watercourse crossings and waterbodies was located and oblique aerial photographs were taken of each as well as upstream and downstream of watercourse crossings, to include the entire length of watercourse between lakes or to the watercourse's upstream limit. At some locations additional potential crossings were identified and documented in the same manner. The photographs taken during this reconnaissance and during the on-the-ground investigations (see below) were reviewed and supplemental aerial photographs were taken on September 2, 2014, when the entire corridor was flown once more to ensure no important features were overlooked.

2.3 Habitat Characterization

Watercourses which were considered to have the greatest potential to support fish were examined on the ground from August 30 to September 2, 2014. These locations were selected based upon apparent flow and channel morphology and proximity to lakes that are deep enough to not freeze completely during the winter, as observed during the aerial reconnaissance. Each of these watercourses was examined visually in the immediate location of the proposed road crossing and, typically, for several hundred metres upstream and downstream. In most cases where watercourses joined lakes, the entire watercourse between the upstream and downstream lakes was examined. Observations of habitat characteristics including channel dimensions, channel form, and substrate, were recorded and photographs were taken. A Garmin GPSmap76CSx hand-held GPS unit was used to record the location of all observations and photographs, and aid in the stream width and distance measurements. The final habitat characterization for all watercourses was a desktop process that combined field observations with GIS analysis utilizing an orthorectified aerial photograph mosaic. The mosaic components covering

Locations 47 to 53 were taken on July 21, 2011, while those covering Locations 1 to 46 were taken at approximately the time of the field investigations in 2014.

Lakes or ponds were identified as such and relative waterbody size and shoreline substrate were noted. It was assumed that these waterbodies would be avoided by adjusting the road alignment. The watercourses were characterized in terms of their flow condition, channel configuration, dominant habitat type in the vicinity of the proposed crossing location (which is approximate), active channel width and connection to potentially fish-bearing lakes upstream. Potential fish utilization was subsequently inferred based on the habitat characteristics.

Flow condition indicates the state of flow at the time of the field investigations. "Surface flow" indicates that surface water was seen in the watercourse from the helicopter and/or can be seen in the aerial photographs. "Interstitial flow" refers to flow through the interstitial spaces of the boulders and cobble that make up many of the streambeds along the proposed route, which was often not visible. Interstitial flow through boulder or cobble sections was assumed if surface water was visible elsewhere along the watercourse. Interstitial flow was deemed to be ”possible” if no surface water was detected anywhere along a boulder watercourse. Those watercourses may be dry, but this was not confirmed on the ground. Occasionally, if there did not appear to be a defined channel but at least seasonal flow was suspected, the flow was characterized as "potential diffuse".

Channel configuration was characterized as single channel (one flow path), multiple channels (more than one flow path, or what is often termed a "braided" channel), or a diffuse channel (insufficient flow to form an obvious, defined flow path). For a few watercourses the additional descriptor "poorly defined" is used, which indicates that the edge or path of the active channel is unclear, suggesting that surface flow rarely occurs.

The watercourse habitats were divided into three categories, river, boulder, and graminoid. Examples of each are shown in **Figure 2-1**. River habitats were large, flowing, open channels, which occurred at only three locations. Boulder habitats typically appear in the aerial photographs as well-defined, linear, boulder fields associated with depressions on the landscape. Often there is no water visible along some or most of their length, but there may be interstitial flow that is obscured by the upper boulder layers. The size of most of these boulder features appears disproportionately large relative to the magnitude of the flows observed in late summer, which were small. It is not known if the boulder field widths are the result of higher flows during spring freshet or if these features were formed by post-glacial meltwater or periglacial processes. Graminoid habitats are reaches of small watercourses whose banks are vegetated primarily by graminoids growing on peat. Often there are multiple smaller channels that branch and coalesce. Some of these habitats that were examined on the ground have a significant sand/gravel fraction in the substrate.



Figure 2-1. Examples of habitat types encountered. From top left, moving clockwise: river, river, boulder, graminoid with coarse substrate, graminoid with organic substrate, boulder.

Approximate active channel width was measured using GIS with the orthorectified aerial photograph mosaic. Channels that were reasonably uniform in width have been assigned a single number, while those channels of widely varying width have been assigned a range. The width of boulder channels was discerned in the aerial photography by the colouration of the boulders or the absence of vegetation. Rivers and graminoid single channels were measured directly in GIS. Multiple channel watercourses were measured from the outer edge of the first channel on one side, to the outer edge of the last channel on the opposite side. Width could not be accurately determined from the aerial photographs for diffuse channels.

2.4 Fish Community Assessment

Each of the locations examined on the ground was electrofished using a Halltech Model HT 2000 backpack electrofisher and a dipnet. Electrofishing was conducted with the two-person crew moving in an upstream direction, sampling as many habitat types as possible. After investigating a number of electrofisher settings in the low conductivity waters of the study area, it was found that settings of 950 volts and 250 hertz, resulting in approximately 3-4 amperes of current, were most effective at immobilizing or drawing fish out of their hiding locations. These settings were used at all locations. The number of electroseconds (amount of time power was applied to the water) and the length of watercourse electrofished were recorded for each location electrofished. Most fish were identified to species in-situ and released, but some were photographed and the photographs were used to confirm identity at a later time using keys in Scott and Crossman (1973) and McPhail and Lindsey (1970). The number of adults and juveniles captured, distinguished on the basis of size, was recorded for each species.

2.5 Assessment of Fish Habitat Significance and Crossing Recommendation

The significance of fish habitat in each watercourse was evaluated based upon the habitat in the vicinity of the proposed road crossing, the potential for the watercourse being a migratory route for large-bodied or small-bodied fish between habitats upstream and downstream of the crossing, the life histories and habitat requirements of the fish species present in the study area, and the ecology of Arctic streams. The type of crossing structure recommended was selected to protect the habitat attributes and functions for the maintenance of existing fish populations. The recommended crossing structures are discussed in Section 4.0 (Mitigation and Impact Assessment) and listed for each watercourse crossing in Table 3-2.

3.0 RESULTS

3.1 Overview of Waterbodies and Watercourses Intersected by the Proposed Road Corridor

A total of 53 locations were examined along the proposed road alignment (Figure 3-1). Of these, 7 are along shorelines of larger lakes, 6 are portions of small lakes or ponds less than 150 m wide, and 40 are

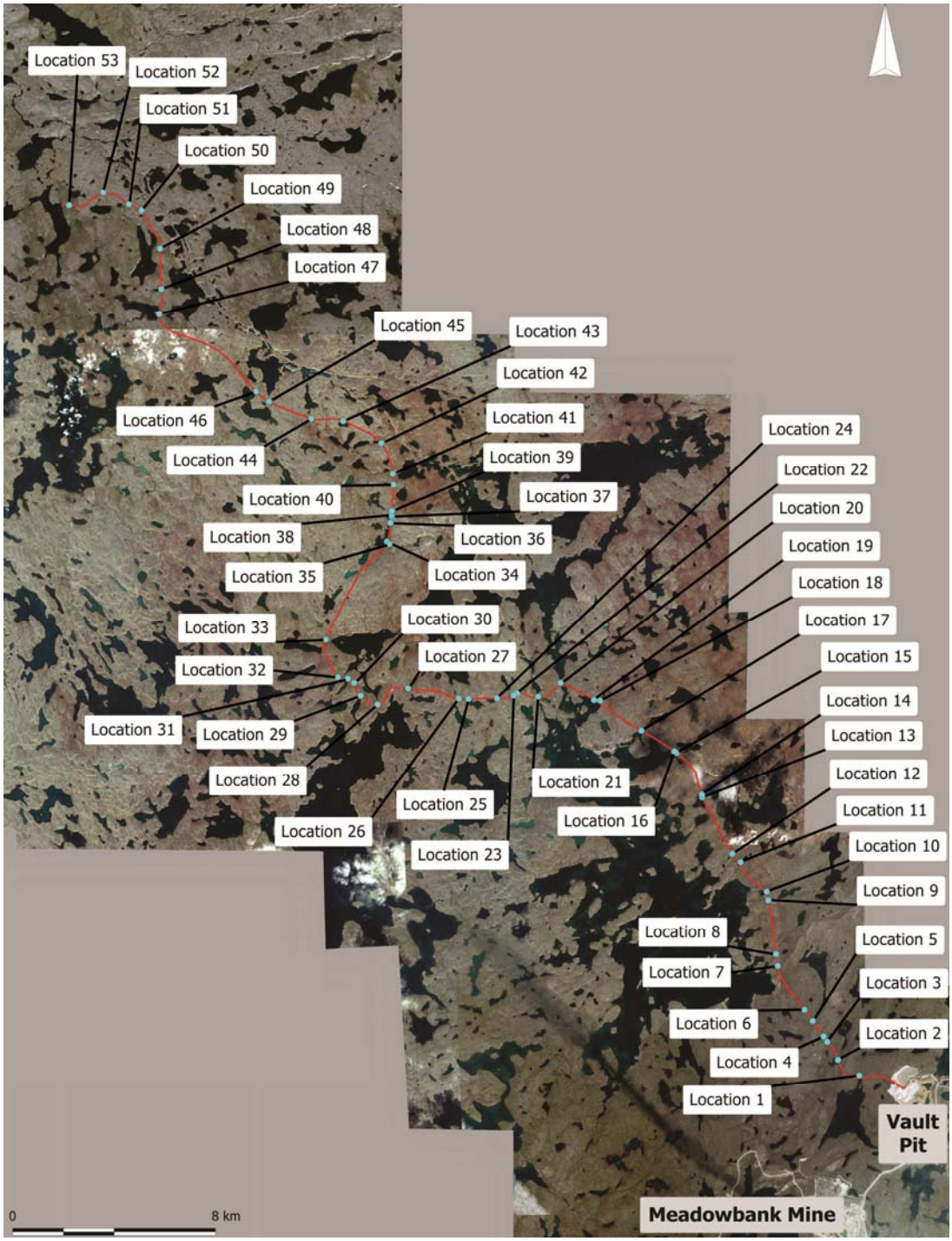


Figure 3-1. Route of the proposed Amaruq Exploration Road (red line) and the 53 locations examined (blue dots).

watercourses. The watercourses range from poorly defined features that may only experience seasonal diffuse flow to river channels with substantial late summer flow. Based on their potential to be fish habitat, a total of eight watercourses were sampled on the ground during this study.

3.2 Fish Communities

The relatively recent glaciation and the harsh winters of northern Canada have resulted in a fairly short list of fishes that occur in the vicinity of the Meadowbank mine (McPhail and Lindsey, 1970; Scott and Crossman, 1973). The effect of long cold winters upon fish communities is further amplified in small streams and shallow lakes which freeze completely each winter (Haynes *et al*, 2014; Jones *et al*, 2010). In total, five fish species were captured in one or more of the eight watercourses sampled during the field investigations.

3.2.1 Species

The number of individuals of each fish species collected in each watercourse sampled are provided in Table 3-1. The sampling effort, expressed as electroseconds, and the length of channel sampled, are also provided. Based on their size, all of the Slimy Sculpin and Ninespine stickleback were adults and the Burbot, Arctic Char and Arctic Grayling were juveniles. Fish were captured in all but one of the locations that were electrofished. The most species captured at a site was three at location 17, which is a short watercourse connecting two lakes. Slimy sculpin was the most commonly captured species; individuals were captured at seven of the eight sites sampled.

Table 3-1. Electrofishing catch and effort. Fisheries Assessment Locations are shown in **Figure 3-1**.

Location	Electro-seconds (s)	Channel length sampled (m)	Slimy Sculpin (*Cottus cognatus*)	Ninespine Stickleback (*Pungitius pungitius*)	Burbot (*Lota lota*)	Arctic Char (*Salvelinus alpinus*)	Arctic Grayling (*Thymallus arcticus*)
2	416	66	2	0	0	0	0
14	438	88	4	0	1	1	0
17	353	20	13	0	0	1	0
18	368	70	0	0	0	0	0
20	590	95	5	1	0	0	0
28	626	135	2	0	0	0	0
41	249	47	7	0	0	0	1
53	369	88	15	3	0	0	0

3.2.2 Biological Characteristics

The following presents an overview of the fish species that were captured in this study. The natural history of these fishes was considered during the habitat assessment and in determining mitigation recommendations. In addition to these 5 species, lakes in the vicinity of the Meadowbank Mine that have been sampled also contain Lake Trout (*Salvelinus namaycush*) and Round Whitefish (*Prosopium cylindraceum*).

Slimy Sculpin

This species is widespread in rivers and streams of the north, and prefers running water with rocky, gravelly or sandy substrate (McPhail and Lindsey, 1970; Scott and Crossman, 1973). It spawns in the early spring under rocks in shallow shore areas of lakes or in streams (McPhail and Lindsey, 1970; Scott and Crossman, 1973). Slimy Sculpin may be less tolerant of winter conditions than Ninespine Stickleback (Haynes *et al*. 2014), and may be restricted to areas with large amounts of overwintering habitat (Haynes *et al*. 2014; Hershey *et al*. 2006). Based upon the ecology of Slimy Sculpin in the Arctic, as presented in Haynes *et al*. (2014) and Hershey *et al*. (2006), it is speculated that they were captured at almost all electrofished locations because of those locations' close proximity to winter refugia in upstream and/or downstream lakes.

Ninespine Stickleback

The Ninespine Stickleback is found in the shallow bays of lakes, slow flowing streams, and tundra ponds. It apparently is most associated with aquatic vegetation, but is also found in lower numbers over sand and gravel. It spawns during the spring and summer, usually in dense vegetation (McPhail and Lindsey, 1970). Haynes *et al*. (2014) suggest that Ninespine Stickleback is widely distributed in the Arctic because it can tolerate low oxygen concentrations and high salinity which allows the species to overwinter in lakes where others cannot, as well as its ability to rapidly recolonize de-populated waterbodies via shallow and ephemeral connections during the spring, and then build populations rapidly due to short generation time and rapid growth.

Burbot

Adult Burbot tend to inhabit lakes and large rivers (McPhail and Lindsey, 1970; Scott and Crossman, 1973), but are also known to occur in small streams in the north (McPhail and Lindsey, 1970). Burbot spawn under the ice in late winter, in streams or lake shallows (McPhail and Lindsey, 1970). In the study area spawning is probably limited to deeper lake habitats that do not freeze.

Arctic Char

Freshwater Arctic Char are most commonly lake-dwellers, but they will also live in rivers (Stewart and Watkinson, 2004). They must overwinter in water deep enough to not freeze to the bottom (Stewart

and Watkinson, 2004). Spawning occurs in the fall, over gravel beds or rocky shoals in lakes and in quiet pools below rapids in rivers, where water depth is sufficient to prevent the embryos from freezing over the winter (McPhail and Lindsey, 1970; Scott and Crossman, 1973).

Arctic Grayling

Arctic Grayling are typically found in schools in clear-water lakes, large rivers and streams (McPhail and Lindsey, 1970; Scott and Crossman, 1973). They spawn during the spring at about the time that the lake ice is breaking-up, usually in small streams over a gravel or rocky bottom (McPhail and Lindsey, 1970), but will spawn in larger rivers if smaller streams are not available (Scott and Crossman, 1973). Arctic Grayling is the only species captured that spawns exclusively in streams.

3.2.3 Abundance

Fish abundance was low at all of the locations sampled. Slimy Sculpin was the most abundant of the fish species captured, and adults were collected in every watercourse where fish were captured (Table 3-1). Adult Ninespine Stickleback were collected at two locations. One juvenile Arctic Char was captured at each of two locations, and a juvenile Arctic Grayling and a juvenile Burbot were captured at one location each.

3.2.4 Fish Movement

No attempt was made to investigate fish movement. Because most small arctic streams freeze down to the permafrost every winter (Jones *et al*, 2010), the fish in those streams are thought to be present as a consequence of either directed seasonal movement (i.e. spawning or feeding migrations) or non-directed seasonal dispersal which, in the case of Ninespine Stickleback, may include dispersal to sink habitats where individuals perish during the winter (Haynes *et al*, 2014). The movement of large-bodied fish may be precluded in the smaller streams by the shallow depth. Also, in many of the smaller streams examined in this study there are reaches where there is no surface flow, only interstitial flow among boulders and cobbles. The extent of movement by small-bodied fish through the interstitial spaces is not known but it is unlikely that there is movement through those spaces by large-bodied fish. Large fish passage might occur if there is flow on top of the boulders or around the boulders during the spring freshet. As part of the habitat assessment provided below in **Table 3-2**, the potential importance of a watercourse as a migration route is assessed based upon the continuity of surface flow and the presence of suitable upstream lakes or potential instream spawning habitat.

3.3 Habitat Characterization

The habitat characterization for each of the locations examined along the route of the proposed Amaruq Exploration Road are provided in Table 3-2. A close-up of the orthophoto at each location, as well as oblique aerial photographs taken from the helicopter and on-the-ground photographs, where available, are presented in Appendix A.

As stated above, 7 locations are shorelines of lakes, 6 are portions of small lakes or ponds, and 40 are watercourses. The watercourses at three of the crossing locations were characterized as rivers. These provide habitat for small-bodied fish, and potentially also for large-bodied fish, throughout the open-water period. Due to their depth and flow, these watercourses are also potential migration routes for large-bodied fish throughout the open water period.

The remaining 37 watercourses are smaller and provide more local drainage. Nine of these were identified as potentially having functions that extend beyond the immediate area of the proposed crossing because they are potential spawning areas for Arctic Grayling and/or potentially important migration routes within a river system, or to upstream lakes capable of supporting fish, when water levels or flows are high. For these smaller watercourses, the dominant habitat types at the crossing were approximately equally divided between boulder (n=20) and graminoid (n=17). Surface flow was evident in the vicinity of the proposed crossing in 6 of the boulder locations. All but one of the boulder watercourses is thought to have had interstitial flow during the field investigations; one was suspected to be dry. All of the watercourses with boulder habitat dominant in the vicinity of the proposed crossing had at least one section with only interstitial flow. Surface flow was present at all but one of the watercourses where the graminoid habitat type was dominant at the proposed crossing location, although in a few cases there was no defined channel evident.

3.4 Assessment of Fish Habitat Significance

The significance of fish habitat in each watercourse was assessed based upon the habitat in the vicinity of the proposed road crossing, the potential for the watercourse being a migratory route between habitats upstream and downstream of the crossing, the life histories and habitat requirements of the fish species present in the study area, and the ecology of Arctic streams. Most Arctic streams freeze down to the permafrost every winter (Jones *et al*, 2010). Consequently, fish that are present in those streams during the open water period must move into the stream after the ice melts in the spring and either move to deeper lake habitats to overwinter in the autumn or perish.

Lake fish communities are determined by factors affecting connectivity and extinction (Hershey *et al*, 2006). Harsh winter conditions are a primary cause of extinction in Arctic lakes and depth is a major determinant. Shallow lakes freeze to the bottom and therefore do not provide overwintering habitat. Consequently they are usually either fishless or contain fish seasonally as a result of recolonization. Overwinter survival requires the presence of deeper areas that remain unfrozen, with sufficiently high dissolved oxygen concentrations.

Connectivity between lakes is influenced by the depth and duration of the surface connections and, potentially, by velocity barriers in reaches with high gradients or falls. The movement of large-bodied fish may also be restricted by the size of spaces between boulder and cobble substrates in reaches where only interstitial flow occurs.

The three watercourses classified as rivers are probably passable by large-bodied fish throughout the ice-free period and therefore have the potential to be seasonal migration routes between spawning, feeding and over-wintering areas. They also provide habitat for small-bodied fish and, potentially, for large-bodied fish during the ice-free period.

The extent to which small-bodied fish (Slimy Sculpin and Ninespine Stickleback) utilize the boulder habitats where only interstitial flow occurs is not known; it is not possible to sample these reaches using any conventional means. Likewise the extent of movement through these reaches by small-bodied fish is unknown. For this assessment, it is conservatively assumed that the boulder reaches with only interstitial spaces may provide habitat for small-bodied species, particularly Slimy Sculpin, during the open water period. Ninespine Stickleback is unlikely to reside in these reaches due to its preference for vegetated habitats. Occupancy by large-bodied fish is not feasible, as is movement by large-bodied fish through the interstitial spaces. Migration of large-bodied fish might occur in the spring if water levels and/or flows are high enough.

It is postulated, based on their bank vegetation, that most of the graminoid watercourses exhibit relatively stable flows during the open-water months. Based on our sampling results, most of these watercourses probably support low numbers of Slimy Sculpin and/or Ninespine Stickleback if they are accessible from over-wintering habitats in lakes. Where accessible, and where water levels are high enough and suitable substrate is present, these watercourses may also provide spawning habitat for Arctic Grayling. If flow and depth are adequate they may also function as migration routes if suitable habitats are available upstream and downstream.

Table 3-2. Habitat characterization and assessment and crossing recommendations. Maps and photographs for each location are presented in Appendix A.

Crossing	Latitude	Longitude	Feature type	Flow characteristics	Channel configuration	Dominant habitat	Approximate active channel width (m)	Potential fish-bearing lake upstream	Examined on ground	Fish captured	Comment	Habitat assessment. Functional considerations that extend beyond the crossing footprint are in bold.	Minimum crossing type recommended to mitigate potential impacts to fish.
1	65.08255	-96.04183	Watercourse	No surface flow. May be interstitial flow	Single	Boulder	25	Yes	No		Surface flow is infrequent	May not provide fish habitat most of the time due to lack of flow. Fish passage also unlikely.	Maintain interstitial flow. If additional capacity required, can use corrugated steel pipe(s) on top of channel boulders.
2	65.08841	-96.05928	Watercourse	Mainly surface flow, but short sections of interstitial flow near proposed crossing.	Single	Boulder	20-50	Yes	Yes	2 Slimy Sculpin	Upstream of crossing is open with boulder and cobble, with some patches of graminoid. In boulder section, lichen suggest flow rarely covers boulders. Higher gradient.	Provides seasonal small-bodied fish habitat and a **potential migration route for fish**, but upstream lakes not extensive or deep and so may have limited fish habitat.	Maintain interstitial flow, and use an open-bottom structure to span open channel.
3	65.09496	-96.06739	Watercourse	Surface flow at crossing, but short sections of interstitial flow where boulders dominate upstream and downstream	Single	Graminoid	10-20	No	No		Graminoid at crossing. Boulder sections upstream and downstream, therefore the final crossing location may be in boulder or graminoid habitat.	May provide seasonal small-bodied fish habitat only. Upstream migration by large-bodied fish unlikely. Only small, shallow lake upstream.	If crossed in graminoid reach, corrugated steel pipes inset 0.3 m below the channel invert. If crossed in boulder reach maintain interstitial flow and use corrugated pipe on top of boulders if required to convey flows in excess of what is conveyed through boulders.
4	65.09695	-96.07033	Lake	na	na	na	na	No	No		Small, shallow lake. Bedrock/ boulder substrate	May provide seasonal small-bodied fish habitat only.	Avoid road footprint in lake if feasible.
5	65.10256	-96.07876	Watercourse	No surface flow. May be interstitial flow	Single	Boulder	11-19	Yes	No		Small gorge with boulder substrate rarely has surface flow, based upon presence of tundra vegetation.	Not fish habitat. Fish passage is unlikely.	No fish habitat considerations.
6	65.10667	-96.08533	Watercourse	Some surface water at crossing. May be interstitial flow.	Single/Diffuse	Graminoid	Not determinable	No	No		Poorly defined watercourse. Likely little or no flow most of the time	Not fish habitat.	No fish habitat considerations.
7	65.12255	-96.10623	Lake	na	na	na	na	No	No		Small lake approximately 150 m wide	May provide seasonal small fish habitat.	Road footprint to avoid lake.
8	65.12674	-96.10721	Watercourse	Surface flow at crossing. Interstitial flow where boulders dominate downstream	Multiple	Graminoid	Not determinable	Yes	No		Watercourse poorly defined, and upstream lake is small	May provide seasonal small-bodied fish habitat only. Upstream migration by large-bodied fish unlikely. Only small lake upstream.	Corrugated steel pipes inset 0.3 m below channel invert
9	65.14604	-96.11164	Watercourse	Interstitial flow at crossing. Surface flow in upstream bedrock sections	Single	Boulder	25-90	Yes	No		Flow may rarely cover boulders. Bedrock sections upstream of crossing.	May provide seasonal small fish habitat. **Possible upstream migration route for fish during spring freshet or during other periods of high flow.**	Span bankfull channel with bridge or open-bottom culvert.
10	65.14912	-96.1126	Watercourse	Surface flow	Single	Graminoid	1-8	No	No			May provide seasonal small-bodied fish habitat only.	Corrugated steel pipes inset 0.3 m below channel invert. Avoid fill in adjacent lake.
11	65.15995	-96.13325	Watercourse	Surface flow, but diffuse in places.	Multiple/ Diffuse	Graminoid	30	No	No		Poorly defined channel resembles wetland	May provide seasonal small-bodied fish habitat only. No upstream migration of large fish due to unsuitable stream and upstream lake habitats.	Corrugated steel pipes inset 0.3 m below channel invert. Avoid lake.
12	65.16303	-96.13991	Watercourse	No surface flow. May be interstitial flow	Diffuse	Graminoid	Not determinable	No	No		No defined watercourse. Graminoid and tundra vegetation.	Not fish habitat.	No fish habitat considerations.

Crossing	Latitude	Longitude	Feature type	Flow characteristics	Channel configuration	Dominant habitat	Approximate active channel width (m)	Potential fish-bearing lake upstream	Examined on ground	Fish captured	Comment	Habitat assessment. Functional considerations that extend beyond the crossing footprint are in bold.	Minimum crossing type recommended to mitigate potential impacts to fish.
13	65.18345	-96.16312	Lake	na	na	na	na	Yes	No		Shallow boulder shoreline of small lake	Fish habitat. Probably not spawning habitat for Lake Trout or Whitefish due to shallow nature of nearshore area.	Road footprint to avoid lake.
14	65.18445	-96.16333	Watercourse	Surface flow	Single	River	71	Yes	Yes	4 Slimy Sculpin, 1 Burbot, 1 Arctic Char	Wide, shallow, flowing watercourse with cobble/gravel/boulder substrate and graminoid patches	**Watercourse provides seasonal small fish habitat and contains gravel substrate that may be suitable for Arctic Grayling spawning. Potential migration route between lakes.**	Span bankfull channel with bridge
15	65.19967	-96.18315	Lake	na	na	na	na	Yes	No		Steep bedrock shoreline of large lake	Fish habitat. Probably not spawning habitat for Lake Trout or Whitefish due to bedrock substate.	Road footprint to avoid lake.
16	65.20026	-96.18477	Watercourse	Mainly interstitial flow.	Single	Boulder	40	Yes	No		Boulder/cobble substrate. Tundra vegetation in parts of wide channel suggest surface flow is infrequent. Some sections may have high gradient.	Small wetted channel within the larger feature may provide seasonal habitat for small-bodied fishes only. High flows may be infrequent. **Potential upstream migration route for fish during spring freshet or other periods of high flow.**	Span bankfull channel with bridge or open-bottom culvert.
17	65.20813	-96.21188	Watercourse	Mainly surface flow, but section of interstitial flow where boulders dominate on slope near proposed crossing	Multiple	Boulder	18-50	Yes	Yes	13 Slimy Sculpin, 1 juvenile Arctic Char	Steeper sections have shrubs and other tundra vegetation perched on top of boulders, with water flowing beneath. Upstream of crossing is open with boulder and cobble, with some areas of graminoid.	Provides seasonal small fish habitat, as well as **potential spawning habitat with cobble/gravel substrate in places for Arctic Grayling. Potential migration route for large-bodied fishes.**	Maintain interstitial flow, and use an open-bottom structure to span open channel. Significant gradient at proposed crossing location.
18	65.21944	-96.24559	Watercourse	Surface flow, but diffuse in some locations	Multiple/ Diffuse	Graminoid	Not determinable	No	Yes	no fish captured	Invertebrates observed	May provide seasonal small-bodied fish habitat only. Upstream migration likely not possible or important due to channel configuration and flow volume. Upstream lake is small.	Corrugated steel pipes inset 0.3 m below channel invert
19	65.21969	-96.25025	Lake	na	na	na	na	No	No		Shallow boulder shoreline of large lake	Fish habitat. Probably not spawning habitat for Lake Trout or Whitefish due to shallow nature of nearshore area.	Road footprint will be located outside of lake. Fish access to watercourse must be maintained.
20	65.22636	-96.27828	Watercourse	Surface flow	Single	River	100-120	Yes	Yes	5 Slimy Sculpin, 1 Ninespine Stickle-back	Short watercourse between lakes. Flow from south to north. Some algae on rocks. Boulder/cobble substrate	Fish habitat. Broad, short section of river between two large lake systems. Therefore **fish passage is an important function.**	Span bankfull channel with bridge
21	65.22177	-96.29755	Watercourse	Diffuse minor surface flow	Diffuse	Graminoid	Not determinable	Yes	No		Poorly defined watercourse.	Not fish habitat at crossing location. No upstream migration potential.	No fish habitat considerations.
22	65.2233	-96.31499	Lake	na	na	na	na	No	No		Small isolated pond	Small isolated pond (max 100 m wide). May provide small-bodied fish habitat only.	Road footprint to avoid pond.
23	65.22259	-96.31832	Watercourse	No surface water except at crossing. May be interstitial flow.	Single	Boulder	17-72	Yes	No			May not provide fish habitat most of the time, however, **it appears as if flows may occasionally be substantial and fish passage may occur at that time, as this is a connection between two potentially fish-bearing lakes.**	Maintain interstitial flow, and use an open-bottom structure to span open channel.
24	65.22189	-96.33241	Watercourse	Surface flow	Multiple/ Diffuse	Graminoid	Not determinable	No	No		Seepage area with a small watercourse.	Not fish habitat at crossing location	No fish habitat considerations.
25	65.22204	-96.35627	Lake	na	na	na	na	No	No		Shallow boulder shoreline of large lake	Fish habitat.	Road footprint will be located outside of lake.

Crossing	Latitude	Longitude	Feature type	Flow characteristics	Channel configuration	Dominant habitat	Approximate active channel width (m)	Potential fish-bearing lake upstream	Examined on ground	Fish captured	Comment	Habitat assessment. Functional considerations that extend beyond the crossing footprint are in bold.	Minimum crossing type recommended to mitigate potential impacts to fish.
26	65.22235	-96.3647	Watercourse	No surface flow. May be interstitial flow	Single	Boulder	20-60	Yes	No			May not provide fish habitat most of the time, however, **it appears as if flows may occasionally be substantial and fish passage may occur at that time, as this is a connection between two potentially fish-bearing lakes.**	Maintain interstitial flow, and use an open-bottom structure to span open channel.
27	65.22661	-96.4071	Watercourse	No surface flow. May be interstitial flow	Single	Boulder	50	No	No			May not provide fish habitat most of the time due to lack of flow. Fish passage also unlikely.	Maintain interstitial flow. If additional capacity required, can use corrugated steel pipe(s) on top of channel boulders.
28	65.22133	-96.43345	Watercourse	Surface flow	Single	River	13-25	Yes	Yes	2 Slimy Sculpins	Meadowbank River. Flowing south to north. Boulder/cobble/bedrock substrate	**Large flowing river, with large lakes upstream and downstream. Important fish habitat. May provide spawning habitat for large-bodied fishes and likely is an important migration route for fishes.**	Span bankfull channel with bridge
29	65.22481	-96.44724	Watercourse	No surface flow. May be interstitial flow	Single. Poorly defined	Boulder	30	Yes	No		Tundra vegetation over boulders at crossing location indicates that substantial flow is rare. 150 m downstream of crossing is a section of open multi-channel graminoid habitat.	Not fish habitat at the crossing location. Surface flow possibly during an extreme flow-generating event. Fish passage is likely not an issue due to shallowness of the small upstream lake and the lack of flow in the watercourse.	No fish habitat considerations except keep to south to avoid potential habitat in the graminoid channel section.
30	65.22941	-96.45226	Watercourse	No surface flow. May be interstitial flow	Single	Boulder	20-55	No	No		1 of 2 flow paths from lake.	Not fish habitat at the crossing location. Surface flow at crossing is unlikely except possibly during an extreme flow-generating event. Fish passage is likely not an issue due to shallowness of small upstream lake and the lack of flow in the watercourse.	No fish habitat considerations.
31	65.23097	-96.45748	Watercourse	No surface flow. May be interstitial flow	Single	Boulder	27-62	No	No		2 of 2 flow paths from lake	Not fish habitat at the crossing location. Surface flow at crossing is unlikely except possibly during an extreme flow-generating event. Fish passage is likely not an issue due to shallowness of small upstream lake and the lack of flow in the watercourse.	No fish habitat considerations.
32	65.23161	-96.46593	Watercourse	No surface flow. May be interstitial flow	Single	Boulder	11-35	Yes	No		May not flow often, as it appears to be a secondary outlet for lake to south	Likely does not provide fish habitat. Surface flow is unlikely except possibly during an extreme flow-generating event, as this watercourse appears to be the secondary outlet of the small upstream lake. Fish passage is likely not an issue due the lack of flow in the watercourse.	No fish habitat considerations.
33	65.24516	-96.47481	Watercourse	Surface water at crossing. May have interstitial flow upstream and downstream	Single	Boulder	31-71	Yes	No		Seepage area with a small watercourse just west of crossing on south side of the channel appears to provide water to shallow pool at crossing.	Shallow pools may be seasonal habitat for small-bodied fishes only. Remainder of watercourse is likely not fish habitat most of the year, though the channel size suggests that flows are substantial periodically. Based upon the small size of the upstream watershed, flows may be insufficient most years to provide for fish passage.	Maintain interstitial flow. If additional capacity required can use corrugated steel pipe(s) placed on top of channel boulders. Road should be moved 50-100 m east of alignment shown to allow only one crossing and avoid pool areas.
34	65.27907	-96.41976	Lake	na	na	na	na	No	No		Boulder/cobble shoreline of large lake	Fish habitat.	Road footprint to avoid lake.
35	65.27809	-96.41784	Watercourse	Surface flow, but diffuse in some locations	Multiple/ Diffuse	Graminoid	Not determinable	No	No		Broad seepage area	May provide seasonal small-bodied fish habitat only. Migration of large-bodied fish unlikely due to channel configuration, low flow volume, and the fact that there is no significant upstream habitats.	Corrugated steel pipe inset 0.3 m below channel invert

Crossing	Latitude	Longitude	Feature type	Flow characteristics	Channel configuration	Dominant habitat	Approximate active channel width (m)	Potential fish-bearing lake upstream	Examined on ground	Fish captured	Comment	Habitat assessment. Functional considerations that extend beyond the crossing footprint are in bold.	Minimum crossing type recommended to mitigate potential impacts to fish.
36	65.28555	-96.41613	Watercourse	Surface flow, but diffuse in some locations	Multiple/ Diffuse	Graminoid	Not determinable	No	No		Two broad seepage areas	May provide seasonal small-bodied fish habitat only. Migration of large-bodied fish unlikely due to channel configuration, low flow volume, and the fact that there is no significant upstream habitats.	Corrugated steel pipe inset 0.3 m below channel invert
37	65.2878	-96.41476	Watercourse	Surface flow, but diffuse in some locations	Multiple/ Diffuse	Graminoid	Not determinable	No	No		Three broad seepage areas	May provide seasonal small-bodied fish habitat only. Migration of large-bodied fish unlikely due to channel configuration, low flow volume, and the fact that there is no significant upstream habitats.	Corrugated steel pipe inset 0.3 m below channel invert
38	65.2885	-96.41504	Lake	na	na	na	na	No	No		Boulder/cobble shoreline of small lake.	Fish habitat.	Road footprint to avoid lake.
39	65.28983	-96.41449	Watercourse	Surface flow at crossing and other discrete locations, but interstitial flow through much of watercourse	Single	Boulder	50-90	Yes	No			May provide seasonal fish habitat. **Fish passage may be possible during the spring freshet, and may be important for the chain of upstream lakes.**	Span bankfull channel with bridge or open-bottom culvert.
40	65.29906	-96.41242	Watercourse	Surface flow, but diffuse in some locations	Multiple/ Diffuse	Graminoid	14-50	No	Yes	Not electro-fished	One channel examined had rock substrate, but others had organic (peat) substrate.	May provide seasonal small-bodied fish habitat only. Upstream migration probably not important due shallowness of small upstream lake. No spawning habitat for large-bodied fish downstream of crossing due to lack of suitable substrate.	Corrugated steel pipes inset 0.3 m below channel invert
41	65.30285	-96.41258	Watercourse	Surface flow	Multiple	Graminoid	30	Yes	Yes	7 Slimy Sculpin, 1 juvenile Arctic Grayling	Variety of substrate sizes (gravel/cobble). Caddisflies on rocks.	**Seasonal small-bodied fish habitat and potential spawning habitat for Arctic Grayling. Likely provides fish passage upstream to a number of small lakes**	Span bankfull channel with bridge or open-bottom culvert.
42	65.31409	-96.42112	Watercourse	Surface flow, but diffuse.	Single	Graminoid	Not determinable	No	No		Poorly defined channel resembles wetland.	May provide seasonal small-bodied fish habitat only, Upstream migration for large-bodied fishes unlikely due to absence of instream spawning habitat, small shallow upstream lake, and the fact that watercourse appears to be a secondary drainage connection to upstream lakes.	Corrugated steel pipes inset 0.3 m below channel invert
43	65.32243	-96.4526	Lake	na	na	na	na	No	No		Shallow boulder shoreline of small lake.	May be fish habitat. Probably not spawning habitat for Lake Trout or Whitefish due to shallow nearshore area and the shallowness of the small lake.	Road footprint to avoid lake.
44	65.32362	-96.47974	Watercourse	Surface flow, but diffuse or interstitial in many locations	Multiple/ Diffuse	Graminoid	Not determinable	Yes	No		Poorly defined channel resembles wetland	May provide seasonal habitat for small-bodied fish. Migration of large-bodied fish unlikely due to nature of channel, which resembles a wetland.	Corrugated steel pipes inset 0.3 m below channel invert
45	65.33033	-96.51472	Watercourse	No surface flow. May be interstitial flow	Single	Boulder	65-100	Yes	No		May be connection when lake levels high	May not provide fish habitat most of the time, though the channel size suggests that flows or flooding are substantial periodically. May contain insufficient water most years to provide for fish passage.	Maintain interstitial flow. If additional capacity required, can use corrugated steel pipe(s) on top of channel boulders.
46	65.33403	-96.52536	Watercourse	No surface flow. May be interstitial flow	Single	Boulder	20	Yes	No		Connection between upstream and downstream lakes may only occur during extreme flow generating events.	Flows may be insufficient most years to provide fish habitat or fish passage, although the channel size suggests that flows or flooding are substantial periodically.	Maintain interstitial flow. If additional capacity required, can use corrugated steel pipe(s) on top of channel boulders.

Crossing	Latitude	Longitude	Feature type	Flow characteristics	Channel configuration	Dominant habitat	Approximate active channel width (m)	Potential fish-bearing lake upstream	Examined on ground	Fish captured	Comment	Habitat assessment. Functional considerations that extend beyond the crossing footprint are in bold.	Minimum crossing type recommended to mitigate potential impacts to fish.
47	65.36276	-96.605	Watercourse	Some surface flow at crossing and other discrete locations, but interstitial flow through much of watercourse	Single	Boulder	60-85	Yes	No		Maybe connection between lakes when lake levels high	May not provide fish habitat, though the channel size suggests that flows or flooding are substantial periodically. May contain insufficient water most years to provide for fish passage.	Maintain interstitial flow. If additional capacity required, can use corrugated steel pipe(s) on top of channel boulders.
48	65.37164	-96.60231	Watercourse	No surface flow, and likely no interstitial flow	Single. Poorly defined	Boulder	40	No	No		Poorly defined watercourse with some tundra vegetation	Not fish habitat at crossing location. Surface flow at crossing is unlikely except possibly during an extreme flow-generating event. Fish passage is not an issue due to the very small and shallow upstream lake and the lack of flow in the watercourse.	No fish habitat considerations.
49	65.38595	-96.60224	Lake	na	na	na	na	No	No		Very small (approx 100 m across) isolated pond. Boulder substrate.	May provide seasonal habitat for small-bodied fishes.	Road footprint will be located outside of pond.
50	65.39969	-96.61648	Watercourse	No surface flow. May be interstitial flow	Single. Poorly defined	Boulder	30	No	No		Poorly defined feature with some tundra vegetation. Very small drainage area	Does not provide fish habitat at the crossing location. Surface flow at crossing is unlikely except possibly during an extreme flow-generating event. Fish passage is not an issue due to the very small and shallow upstream lake and the lack of flow in the watercourse.	No fish habitat considerations.
51	65.40204	-96.62716	Lake	na	na	na	na	No	No		Very small (approx 100 m across) isolated pond. Boulder substrate.	Unlikely to provide any fish habitat because this small shallow pond is isolated and probably freezes to bottom every winter.	No fish habitat considerations.
52	65.40652	-96.64856	Lake	na	na	na	na	No	No		Very small (approx 100 m across) isolated pond. Boulder substrate.	Unlikely to provide any fish habitat because this small shallow pond is isolated and probably freezes to bottom every winter.	No fish habitat considerations.
53	65.40245	-96.678	Watercourse	Surface flow	Multiple	Graminoid	24-60	Yes	Yes	15 Slimy Sculpin, 3 Ninespine Stickle-back	Some sections with relatively high gradient.	**Seasonal habitat for small-bodied fishes, and limited potential spawning substrate for Arctic Grayling. May provide fish passage upstream to a number of small lakes.**	Span bankfull channel with bridge or open-bottom culvert

4.0 MITIGATION AND IMPACT ASSESSMENT

There are three principal mechanisms by which road crossings can impact fish productivity. These are:

- by altering the habitat and its use in the portion of the watercourse directly altered at the crossing,
- by interfering with or preventing fish passage and
- by causing sediment or other deleterious substances to enter the watercourse and affect downstream habitat.

Minimum crossing type recommendations for the mitigation of the potential negative effects of the watercourse/waterbody crossings along the proposed Amaruq Exploration Road have been developed and are presented in Table 3-2 above.

Fisheries and Oceans Canada provides advice to avoid serious harm to fish and comply with the *Fisheries Act.* A Fisheries and Oceans Canada review is not required for a clear-span bridge where there will be no earth fill below the high water mark, no complete obstruction to fish passage during the appropriate timing window, and, all "measures to avoid harm" are implemented. Measures to avoid harm are detailed on the Projects Near Water webpage (http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/measures-mesures-eng.html), and include measures related to Project Planning (timing, site selection, contaminant and spill management), Erosion and Sediment Control, Shoreline Re-vegetation and Stabilization, Fish protection, and Operation of Machinery.

Based on the field investigations undertaken from August 29 to September 2, 2014, twelve of the 40 watercourses were assessed to potentially have valued fisheries functions that extend beyond the immediate area of the proposed crossing, due to the possibility that they provide spawning, rearing or nursery habitat and/or a migration corridor for large bodied fish. For eight of these an open-bottomed structure (i.e. a bridge or open-bottomed culvert) spanning the bankfull channel is recommended to avoid impacts. For the other four of these crossings, where interstitial flow through boulders occurs adjacent to an open channel, spanning the open channel with an open-bottomed structure and maintaining interstitial flows where they now occur is recommended, provided that this approach is adequate to pass the spring freshet without high velocities through the structure obstructing upstream fish movement. If a critical habitat that is in limited supply is present within the crossing footprint, the potential impact is obviously much greater, and if such habitats are identified the road alignment should be adjusted to avoid them.

For the remaining 28 smaller watercourse crossings, unless a critical habitat (for example spawning habitat) that is in limited supply is located at the crossing, the footprint of the road can be expected to have little effect upon overall aquatic productivity. This is because the footprint area will be small relative to the entire area of similar aquatic habitat available, and also because of the low diversity and density of the fish community in these seasonal habitats that are frozen solid for more than half of the year.

The potential for impact from the road crossings of watercourses on upstream migration is a significant concern because the impact can extend well beyond the footprint of the road. This is particularly critical where spawning migrations or other directed seasonal migrations occur. Barriers can also prevent non-directed dispersal to seasonal habitats. This assessment has taken the position that a crossing should not create an additional impediment to fish migration. For boulder watercourses, if flow is only through interstitial spaces then, at a minimum, the interstitial spaces should be maintained through the crossing. If surface flow occurs seasonally and there is suitable habitat upstream for large-bodied fish then a structure or structures should convey this seasonal flow without impeding their upstream movement. If there is not suitable habitat upstream for large-bodied fish, then maintaining the interstitial spaces should be adequate and higher flows can be conveyed using one or more corrugated steel pipes or open-bottomed structures above the boulders. Graminoid streams where only small-bodied fish occur should, at a minimum, employ corrugated steel pipes sized to match or slightly exceed the wetted channel widths of the existing channels and embedded at least 0.3 m below the existing stream invert to maintain habitat and fish passage through the culvert.

The field work for this assessment was undertaken during the late summer low-flow period. While it was possible to infer some aspects of flow history at some crossing locations, it was generally not possible to determine the range of flows that may occur. Hydrological investigations by others will determine the necessary conveyance capacity. Where upstream fish movement during spring freshet is a concern, structures should be sized so as not to cause higher flow velocities than in the existing channel.

The hierarchy of crossing structures, in order of decreasing potential to negatively affect fish and fish habitat is:

- clear-span bridge,
- open-bottom culvert, and
- embedded corrugated steel pipe.

Switching to a structure with less potential to affect fish and fish habitat for hydrological or engineering reasons will generally be acceptable. Switching to a structure with more potential to affect fish habitat will not be acceptable unless supported by additional field investigations.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on their habitat characteristics and upstream drainage areas, it is likely that many of the watercourses crossed by the proposed route are only inhabited seasonally by small, non-game, non-commercial species. Some of the watercourses, based on their flow characteristics and habitats, and/or connections to upstream waterbodies, are potential spawning habitat and/or potential migration routes for larger fish species.

The proposed Amaruq Exploration Road route is 62.3 km long, and runs from the Vault Pit of the Meadowbank Mine to the Amaruq project exploration property, which is located approximately 50 kilometres northwest of the Meadowbank mine.

A total of 53 locations have been identified along the proposed Amaruq exploration road route during the course of this investigation where watercourses are crossed or lakeshores or ponds are directly on the proposed route. The road alignment used for this assessment is approximate, and the findings of this study will be integrated into the selection of the final proposed road alignment during the final design to minimize the potential to harm fish and fish habitat. It is expected that the lakes and ponds will be avoided by adjusting the road alignment away from the high water mark. Of the 40 watercourses that are crossed by the approximate route, 12 were assessed to have significant fisheries value due to the possibility that they provide spawning, rearing or nursery habitat and/or may provide a migration corridor for large-bodied fish. The remaining 28 watercourses are not thought to provide fish habitat, or are thought to provide habitat for only small-bodied species, which are Slimy Sculpin and Ninespine Stickleback.

Recommendations have been provided regarding the types of crossing structure to be used in order to mitigate the road's potential impact upon aquatic resources.

There are limitations and uncertainties in this assessment which is based upon the results of a single field investigation undertaken at the transition between summer and autumn, 2014. It is recommended that an additional field assessment be undertaken during the spring freshet to assess the potential for fish movement under high flow conditions. The crossing structure recommendations should be re-evaluated after those investigations. It is also recommended that the route alignment be “field fit” to locate crossings where potential crossing impacts are least, given other constraints.

Based on the knowledge of the habitat conditions and fish communities gathered to date, it is our opinion that it will be possible, with appropriate mitigation, to construct the proposed road in a manner that will not result in serious harm to fish or fish habitat.

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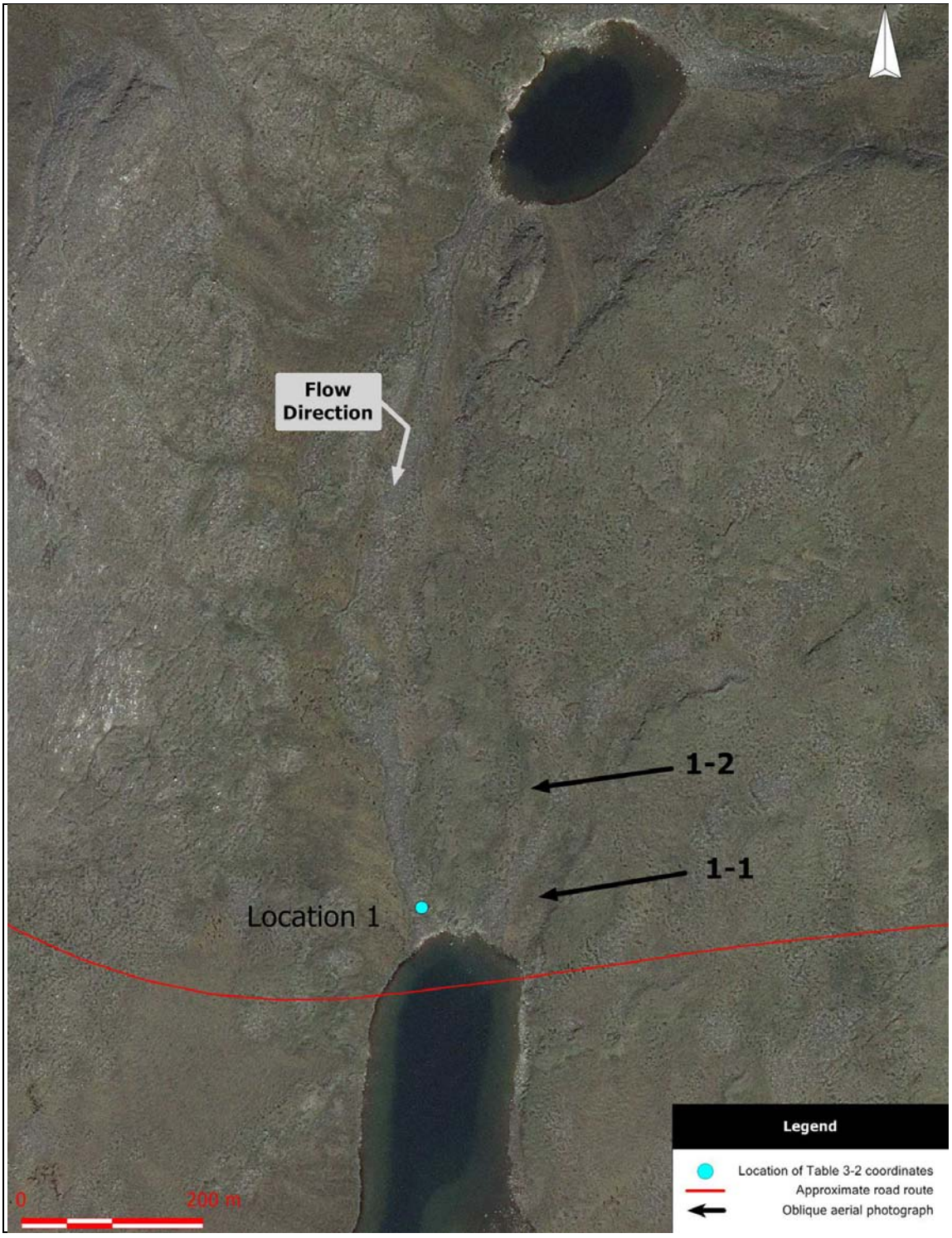
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APPENDIX A - PHOTOGRAPHS



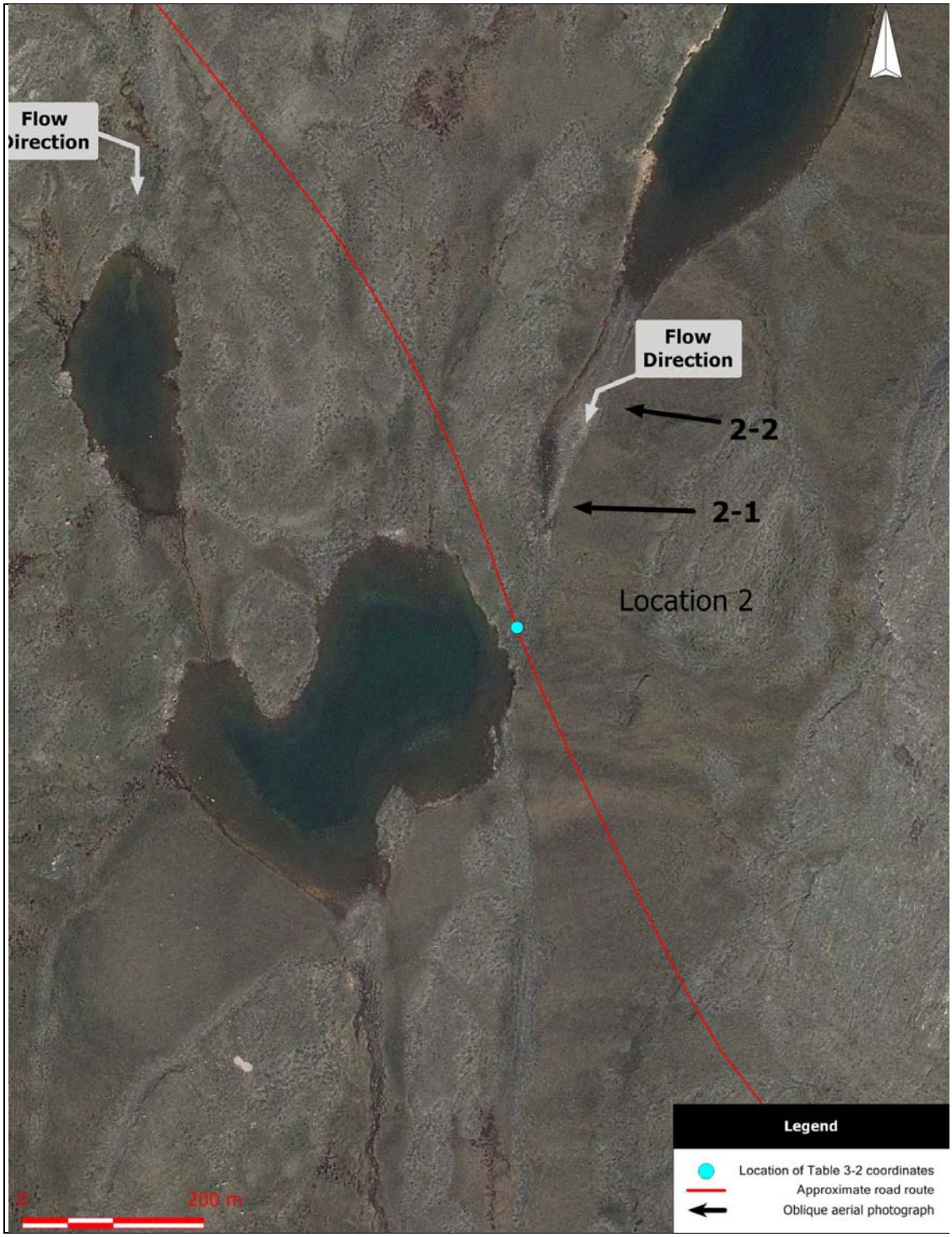
Location 1. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs. Lake near Location 1 will be avoided.



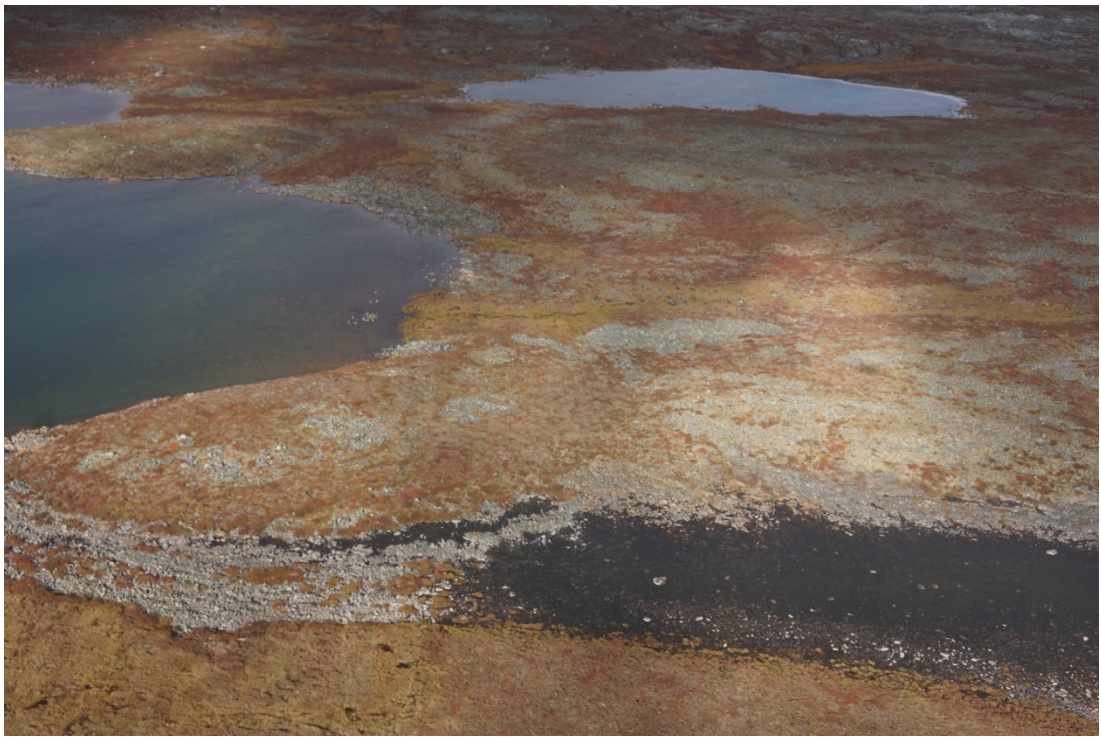
Location 1. Oblique aerial photograph 1-1.



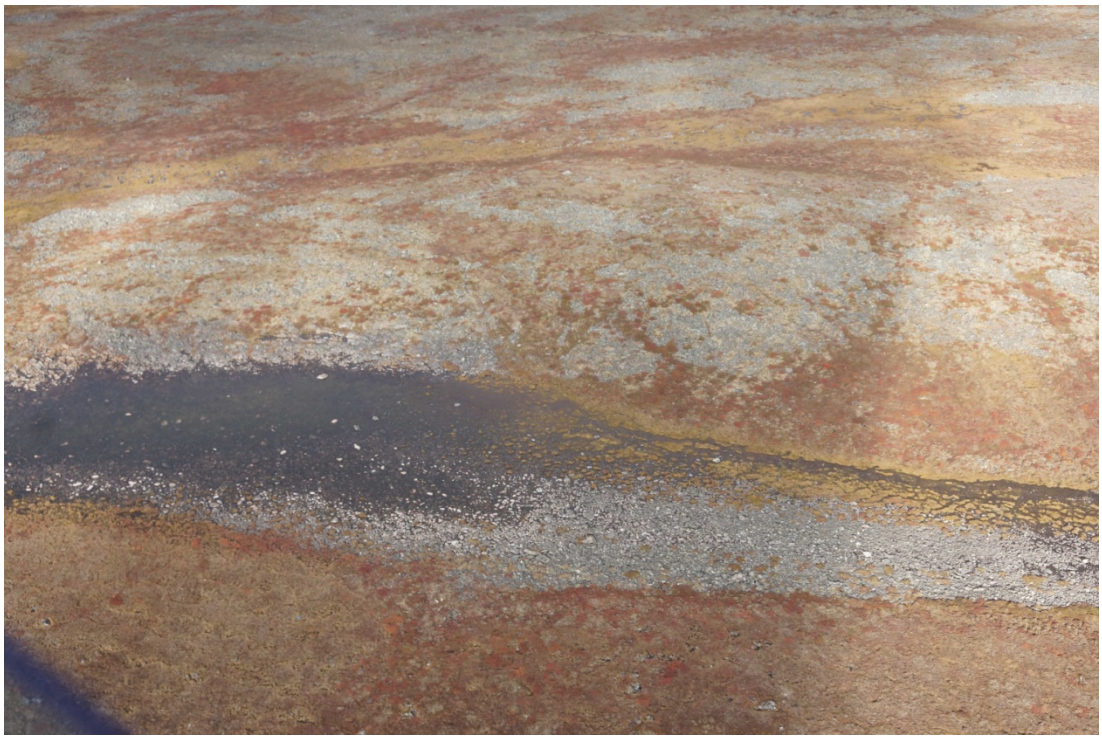
Location 1. Oblique aerial photograph 1-2.



Location 2. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



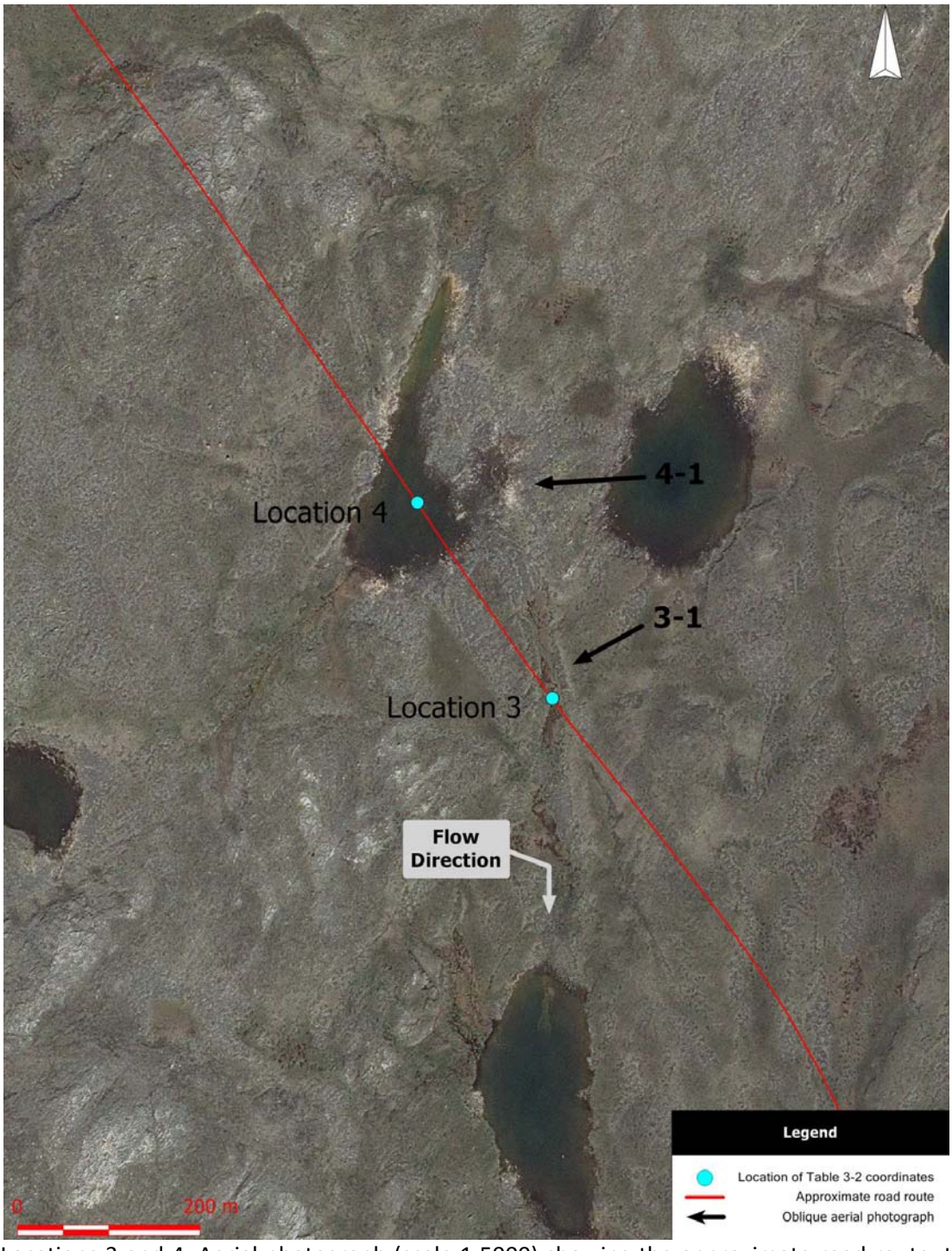
Location 2. Oblique aerial photograph 2-1.



Location 2. Oblique aerial photograph 2-2.



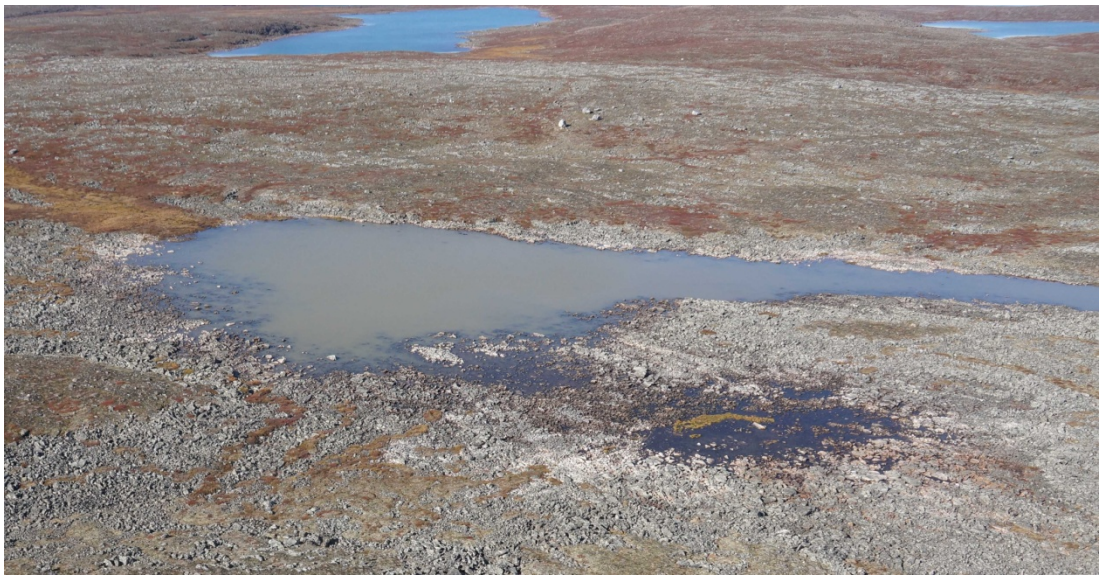
Location 2. Photograph from the ground. Upstream view approximately 100 m upstream from the proposed road crossing.



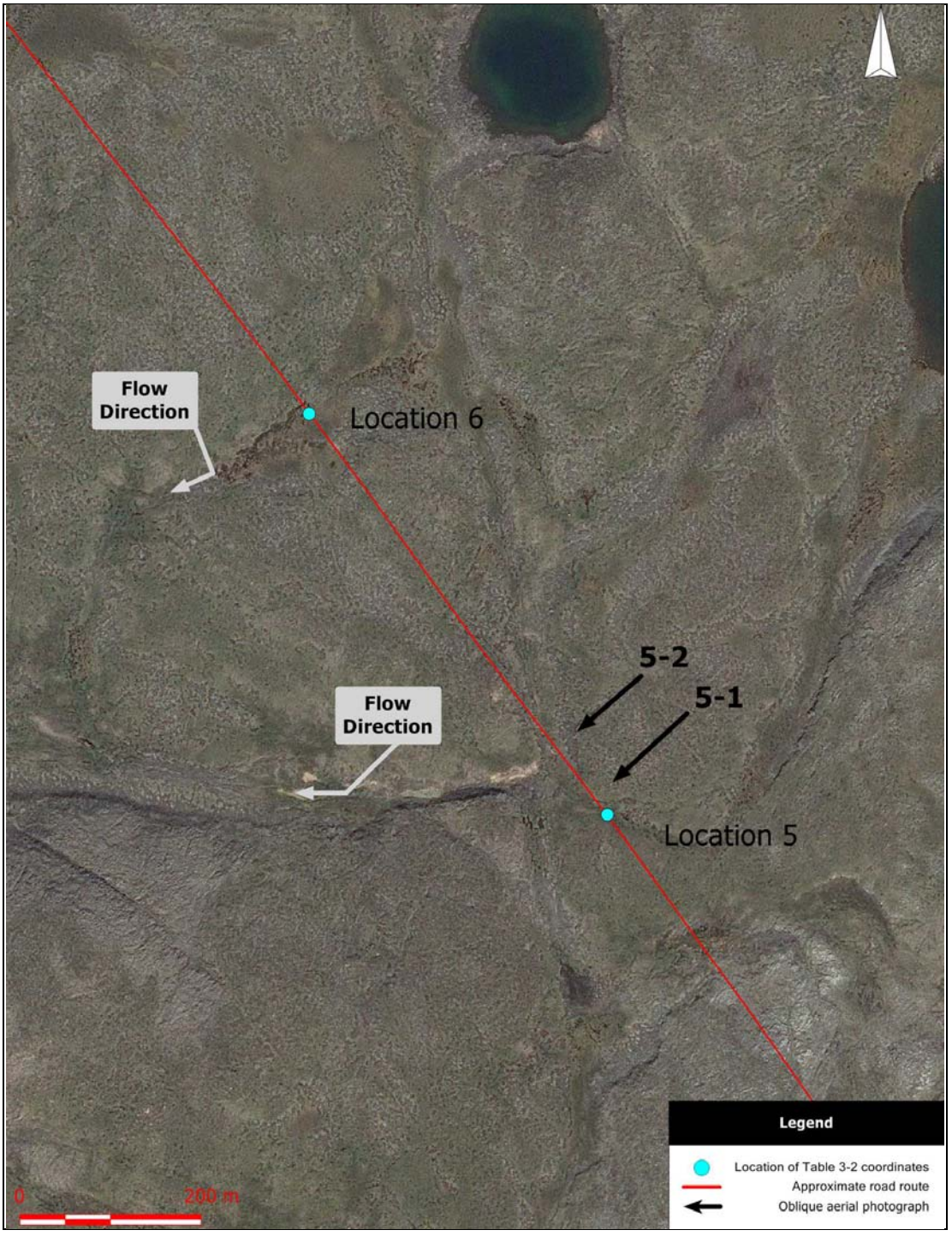
Locations 3 and 4. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs. Lake at Location 4 will be avoided if feasible.



Location 3. Oblique aerial photograph 3-1.



Location 4. Oblique aerial photograph 4-1.



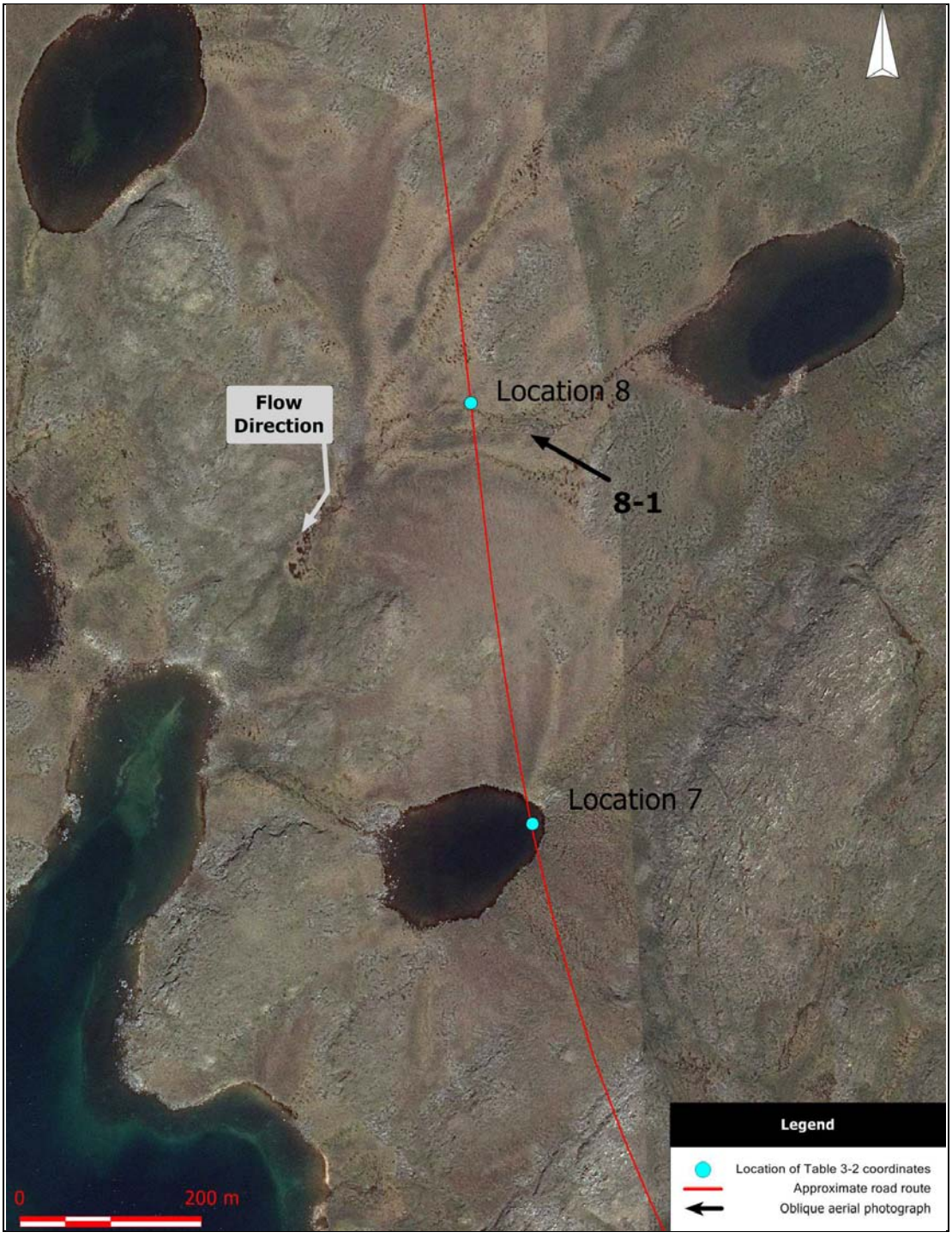
Locations 5 and 6. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



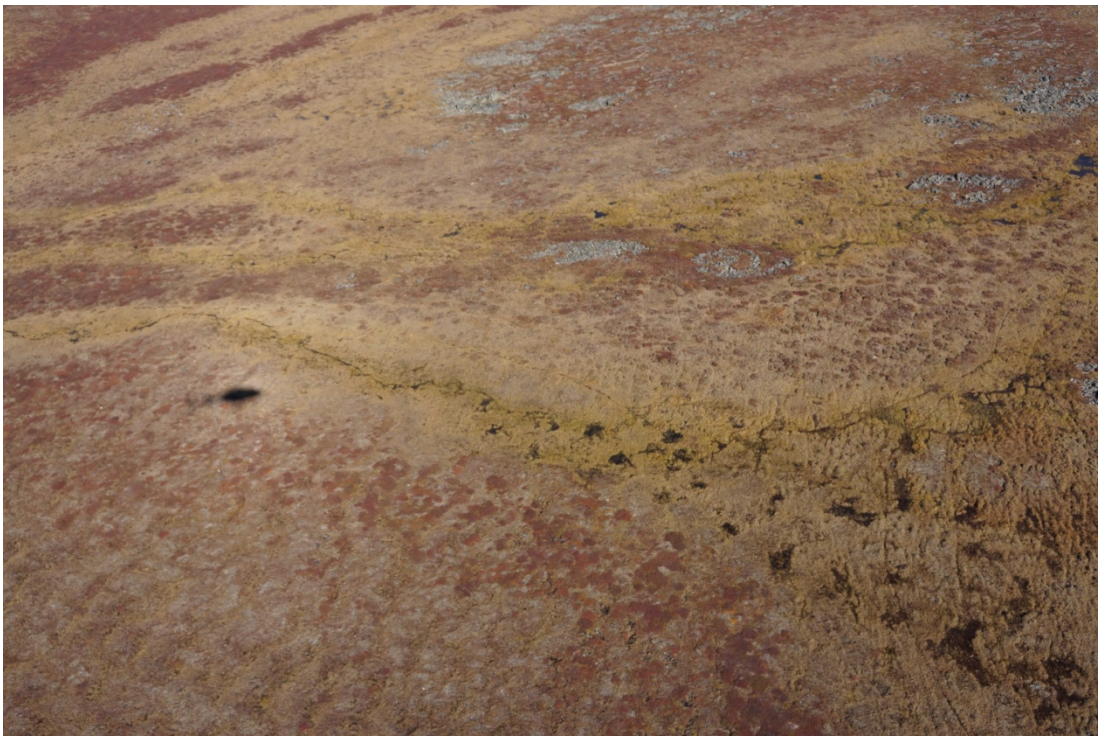
Location 5. Oblique aerial photograph 5-1.



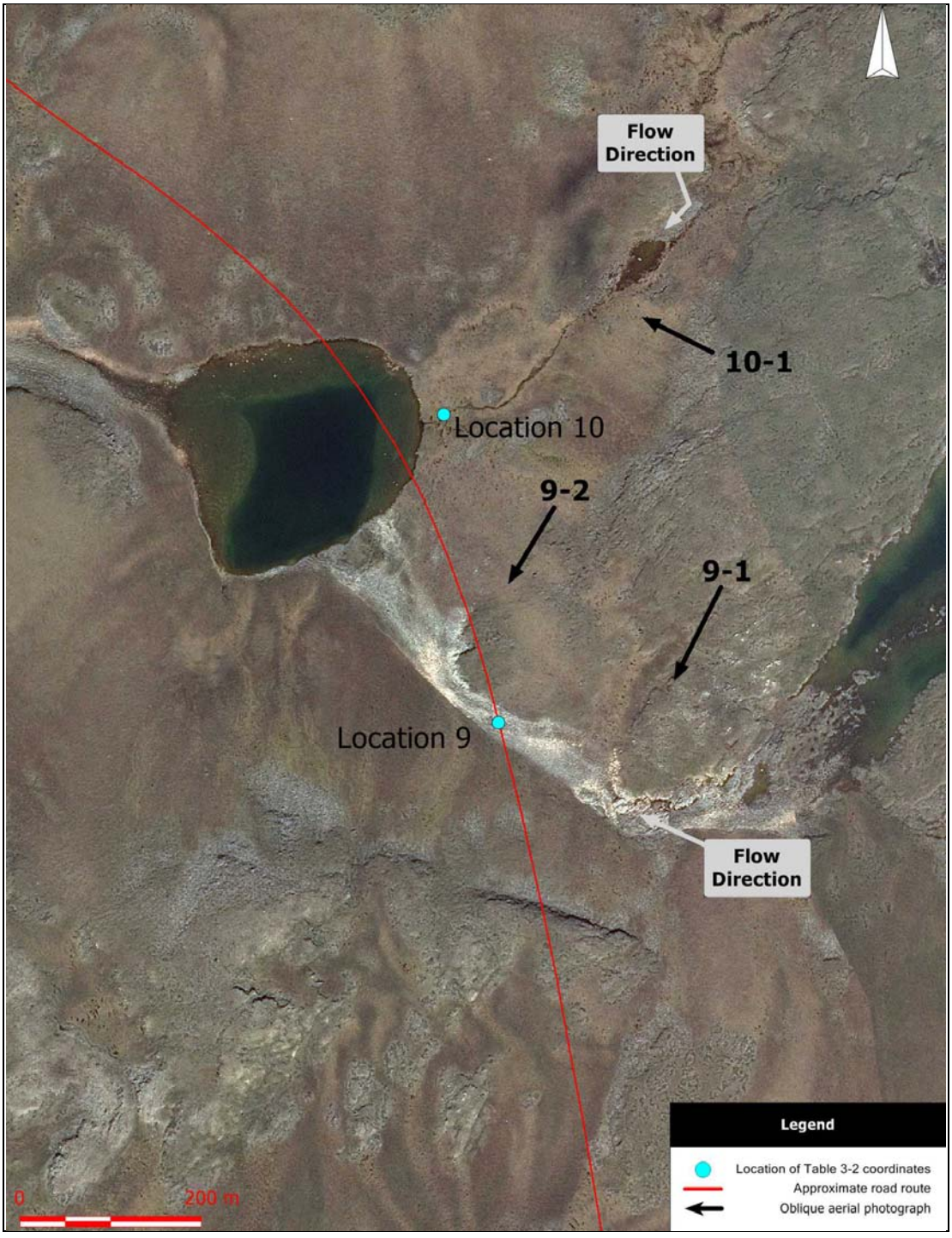
Location 5. Oblique aerial photograph 5-2.



Locations 7 and 8. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs. Lake at Location 7 will be avoided.



Location 8. Oblique aerial photograph 8-1.



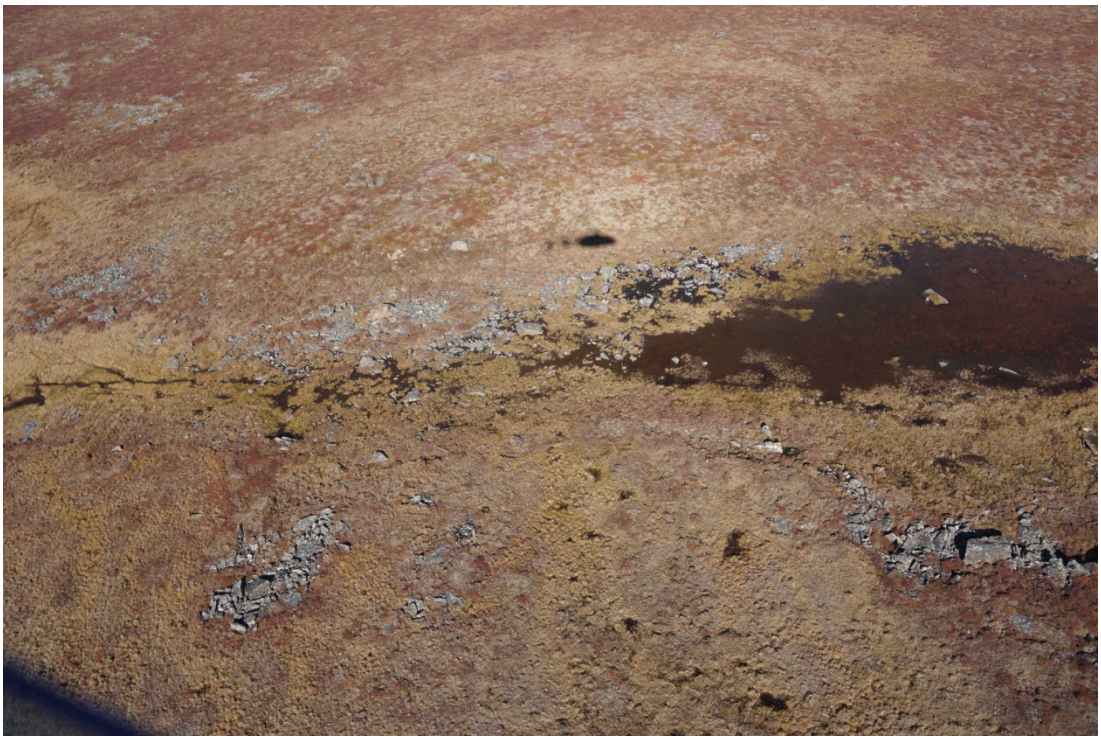
Locations 9 and 10. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs. Lake near Location 10 will be avoided.



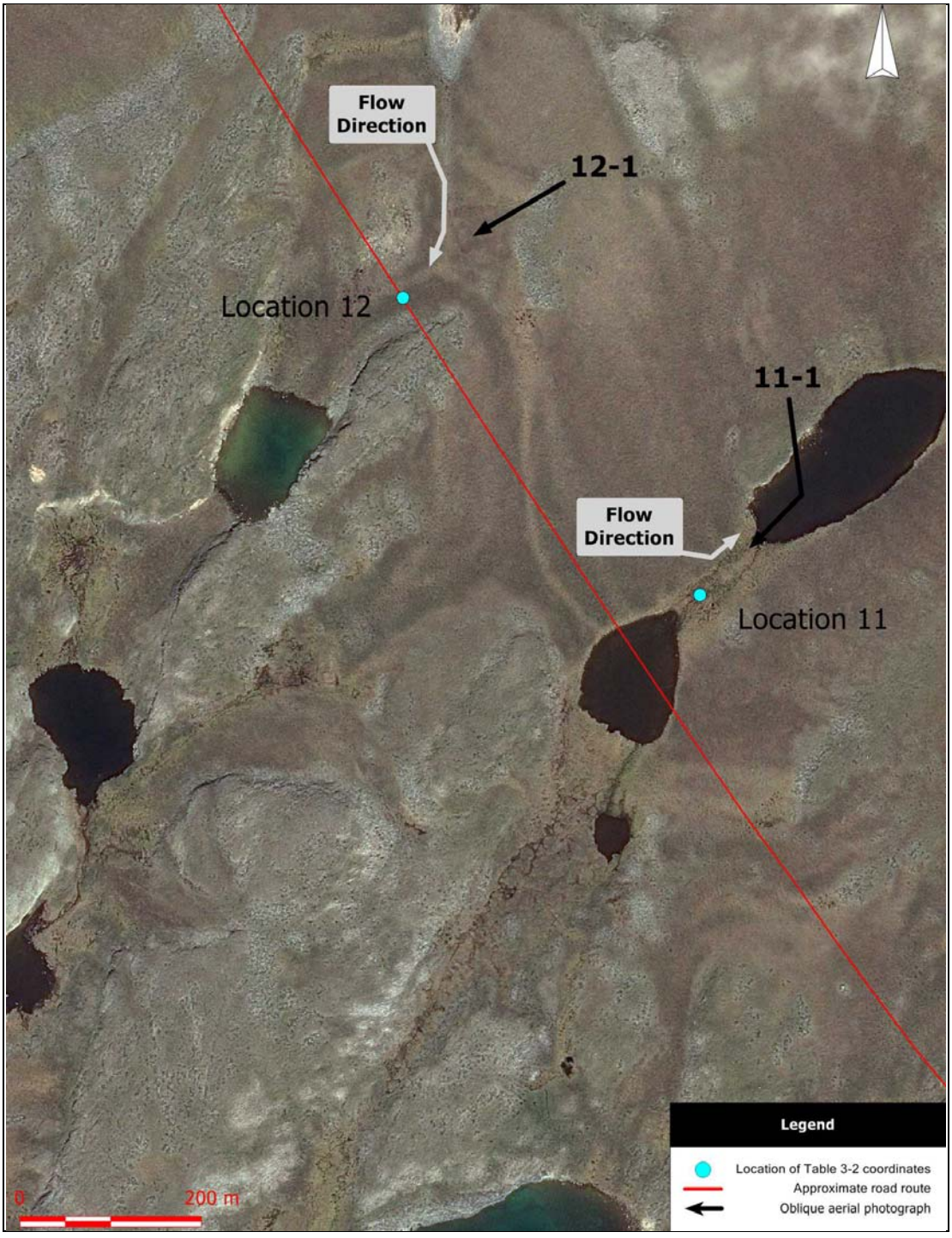
Location 9. Oblique aerial photograph 9-1.



Location 9. Oblique aerial photograph 9-2.



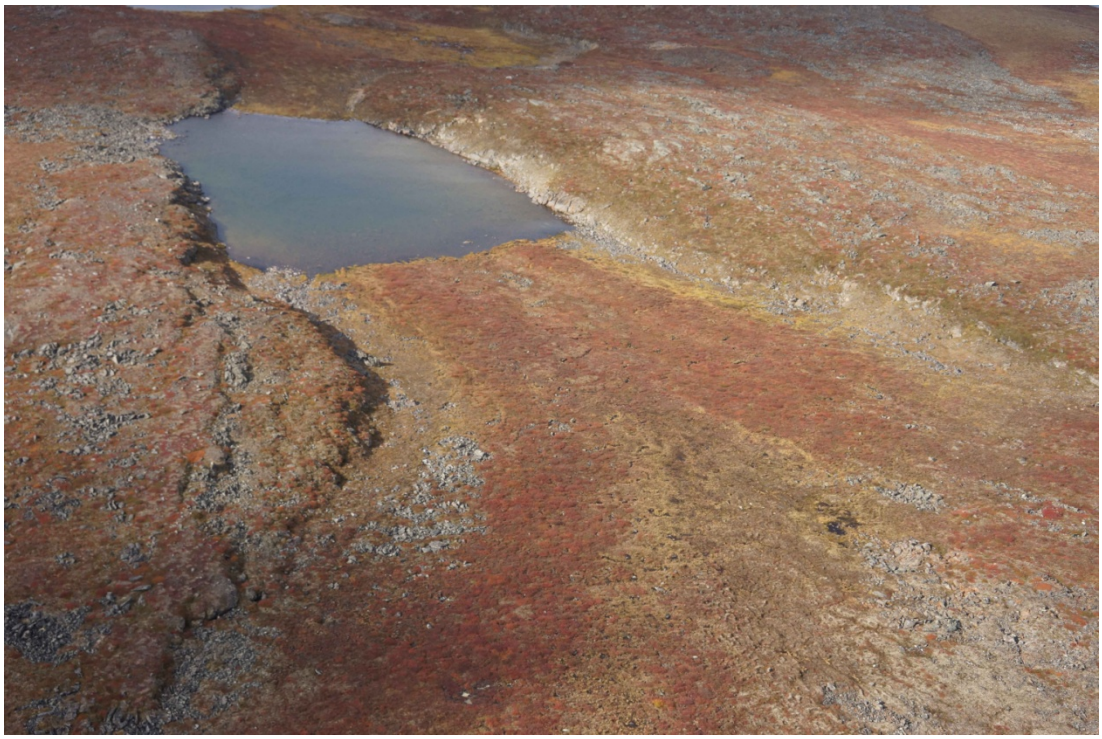
Location 10. Oblique aerial photograph 10-1.



Locations 11 and 12. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs. Lake near Location 11 will be avoided.



Location 11. Oblique aerial photograph 11-1.



Location 12. Oblique aerial photograph 12-1.



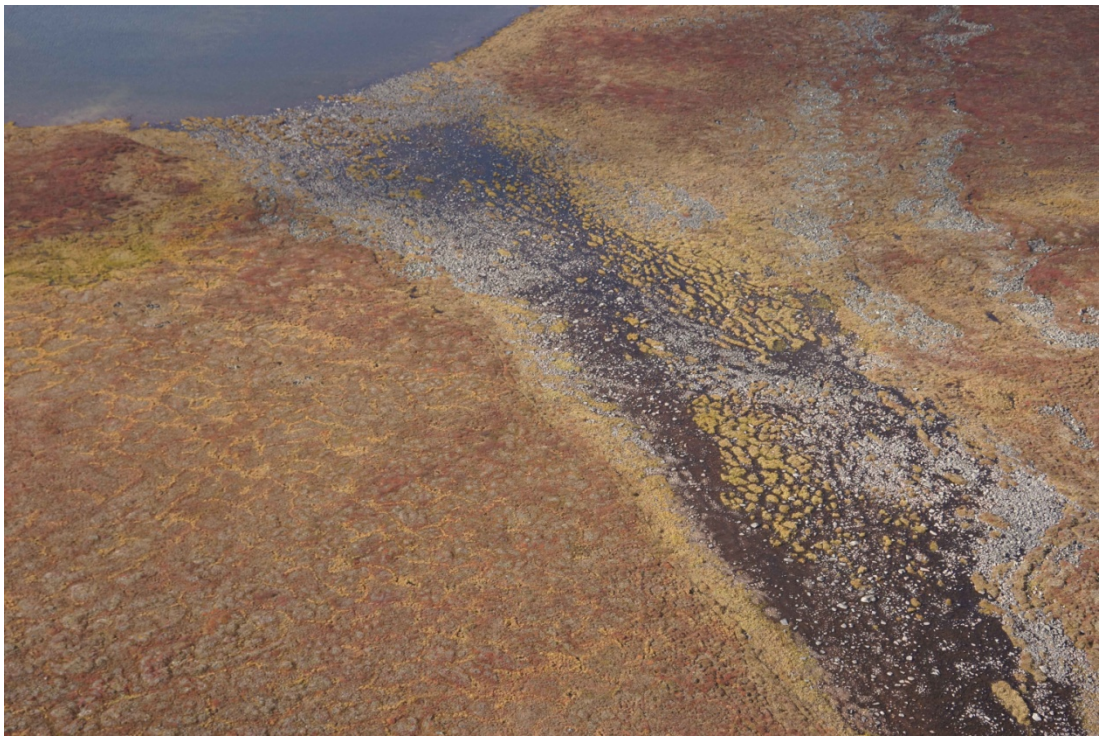
Locations 13 and 14. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs. Lake at Location 13 will be avoided.



Location 13. Photograph from the ground. View south along lakeshore from watercourse.



Location 13. Photograph from the ground. View north along lakeshore from watercourse.



Location 14. Oblique aerial photograph 14-1.



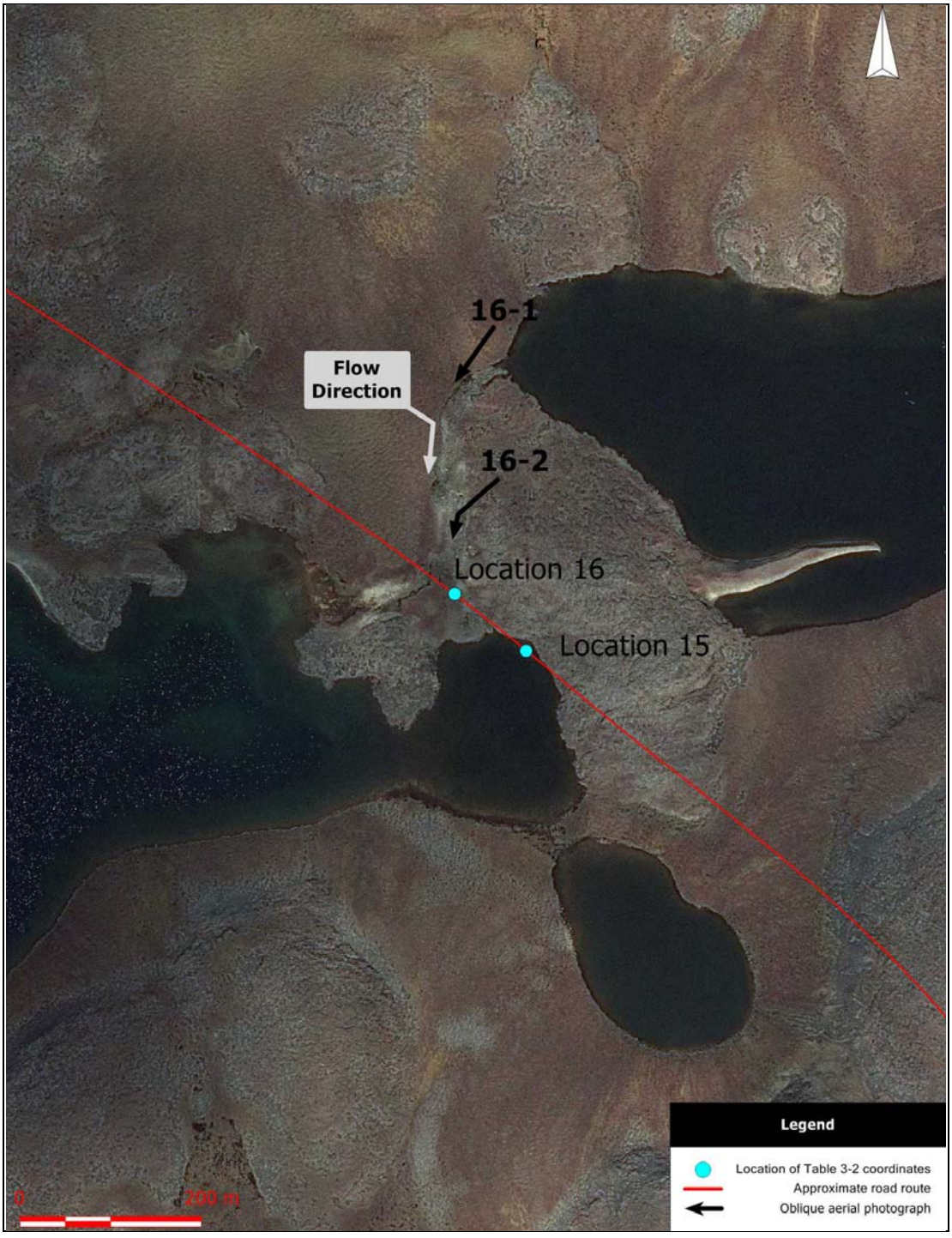
Location 14. Photograph from the ground. Approximately 100 m upstream from lake.



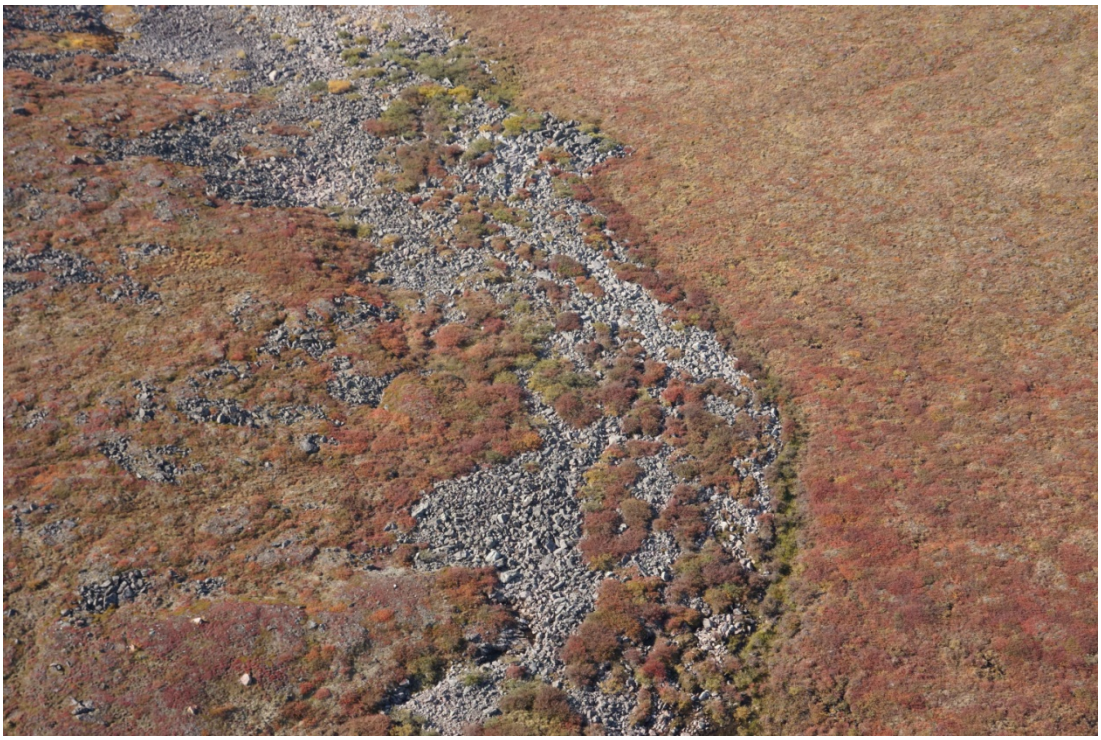
Location 14. Photograph from the ground. Approximately 150 m upstream from lake.



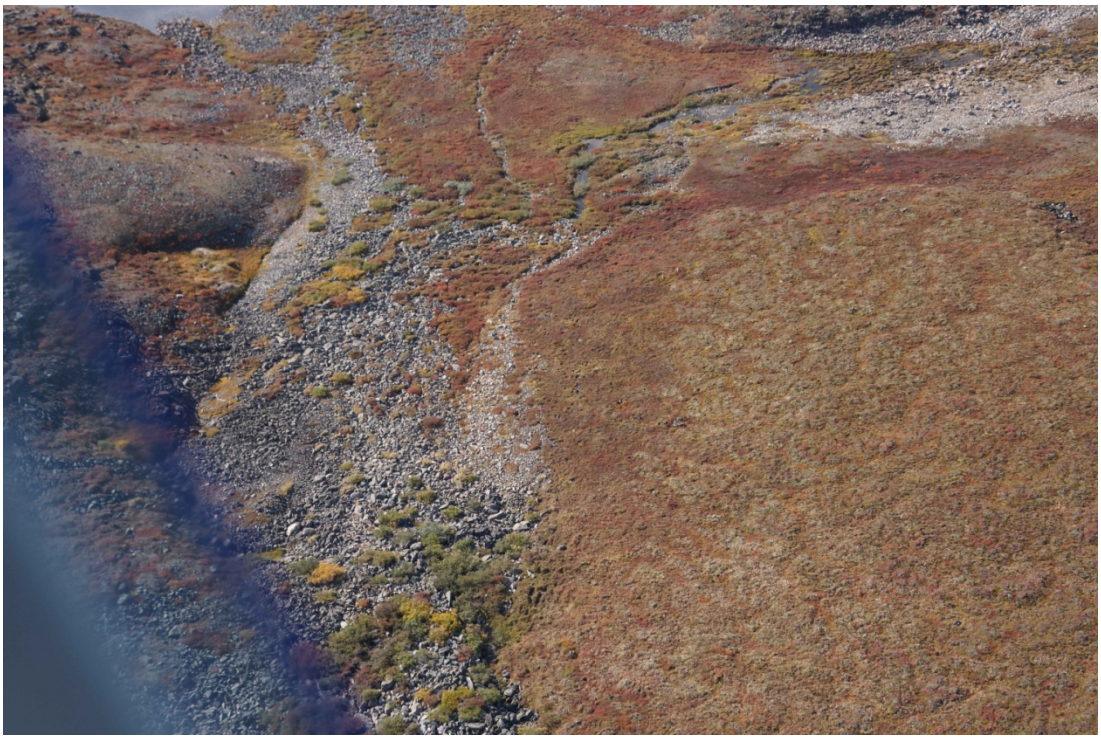
Location 14. Photograph from the ground. Gravel substrate 150 m upstream from lake.



Locations 15 and 16. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs. Lake at Location 15 will be avoided.



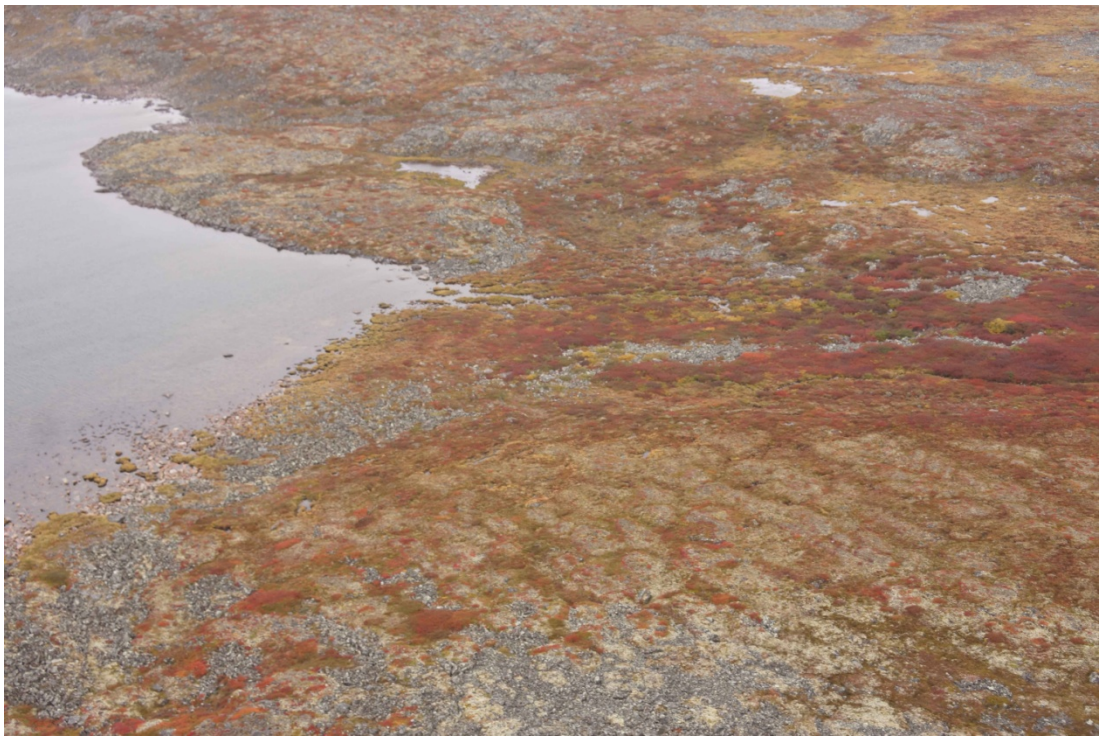
Location 16. Oblique aerial photograph 16-1.



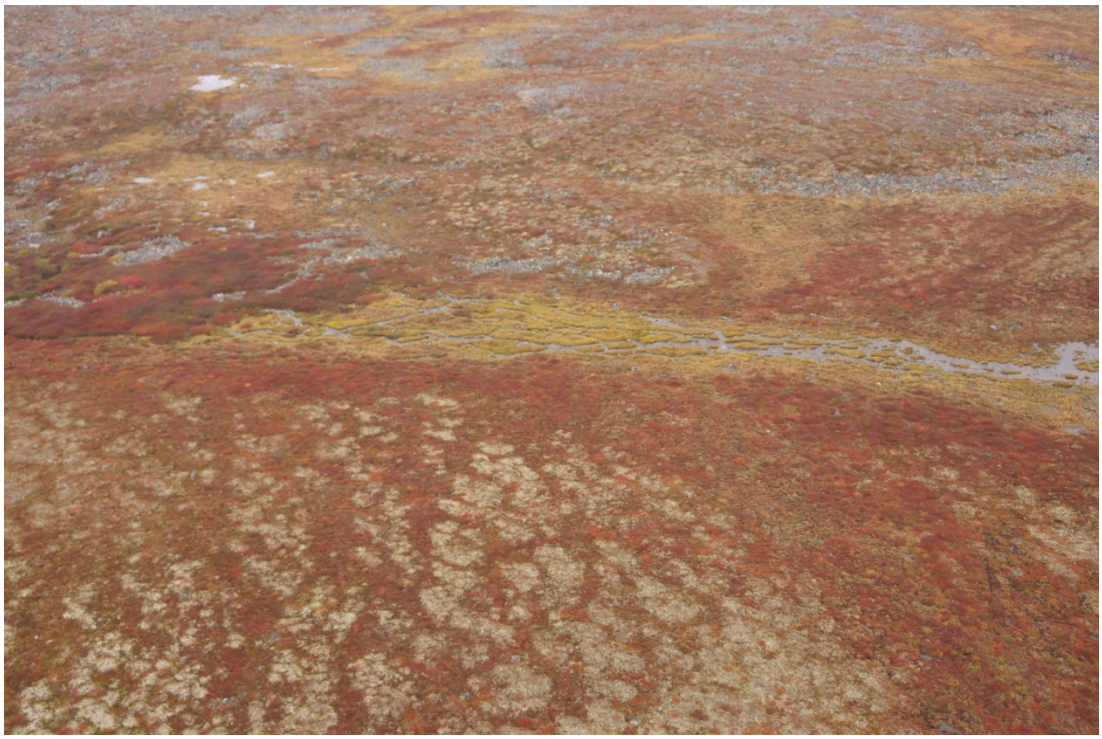
Location 16. Oblique aerial photograph 16-2.



Location 17. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



Location 17. Oblique aerial photograph 17-1.



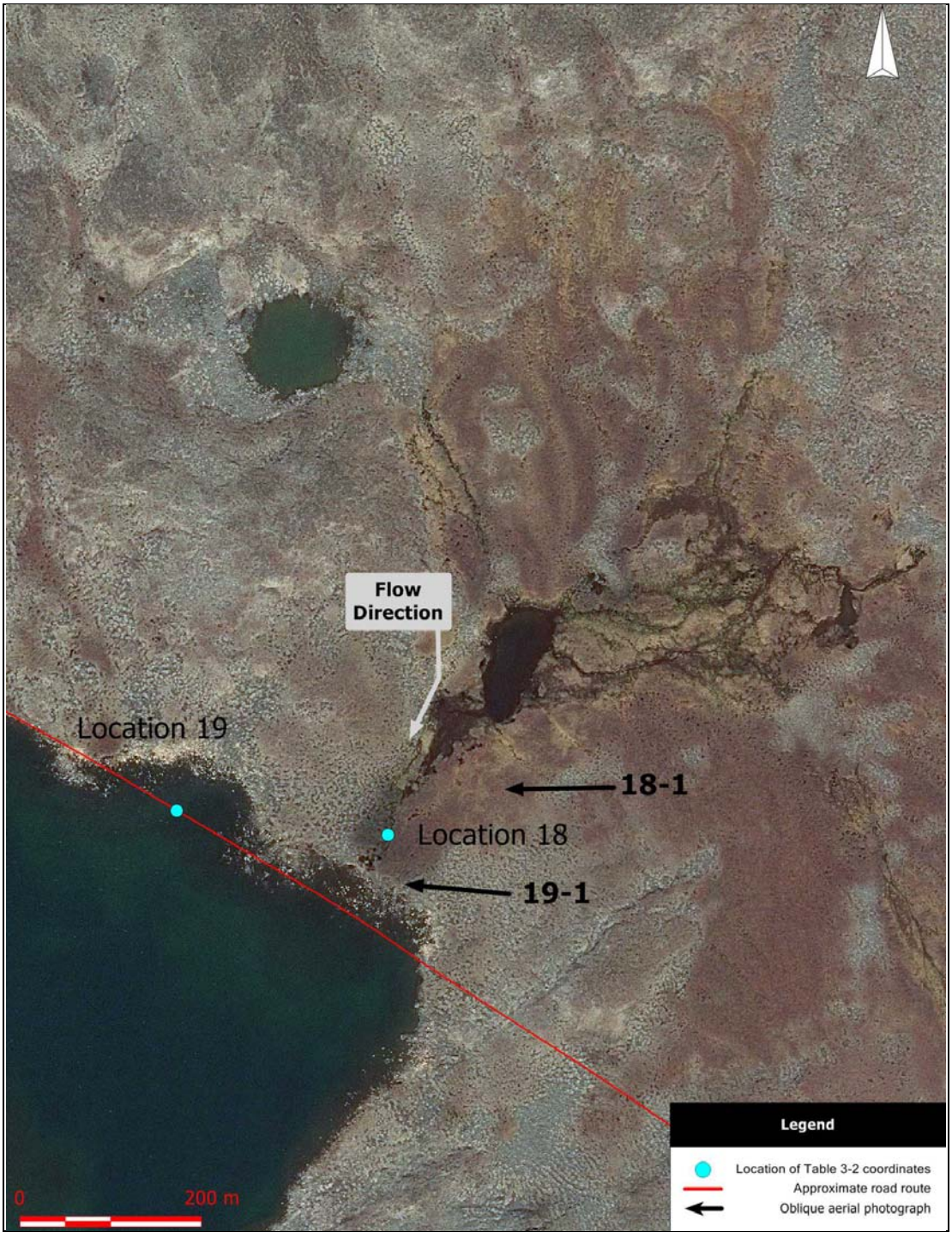
Location 17. Oblique aerial photograph 17-2.



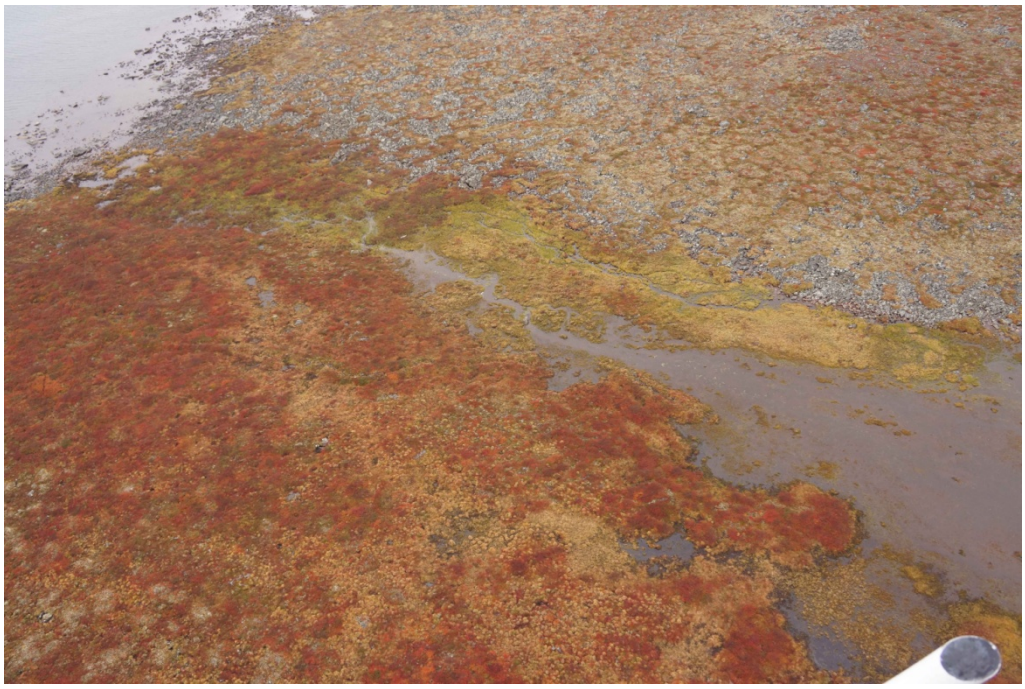
Location 17. Photograph from the ground. Near watercourse mouth and road crossing.



Location 17. Photograph from the ground. Upstream view approximately 200 m upstream of watercourse mouth.



Locations 18 and 19. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs. Lake at Location 19 will be avoided.



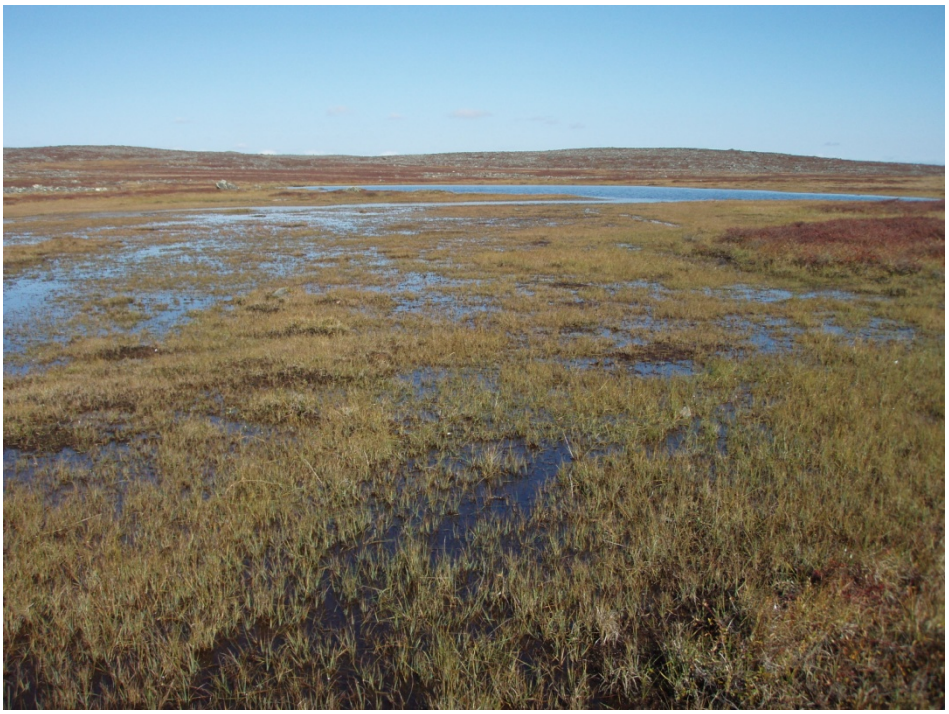
Location 18. Oblique aerial photograph 18-1.



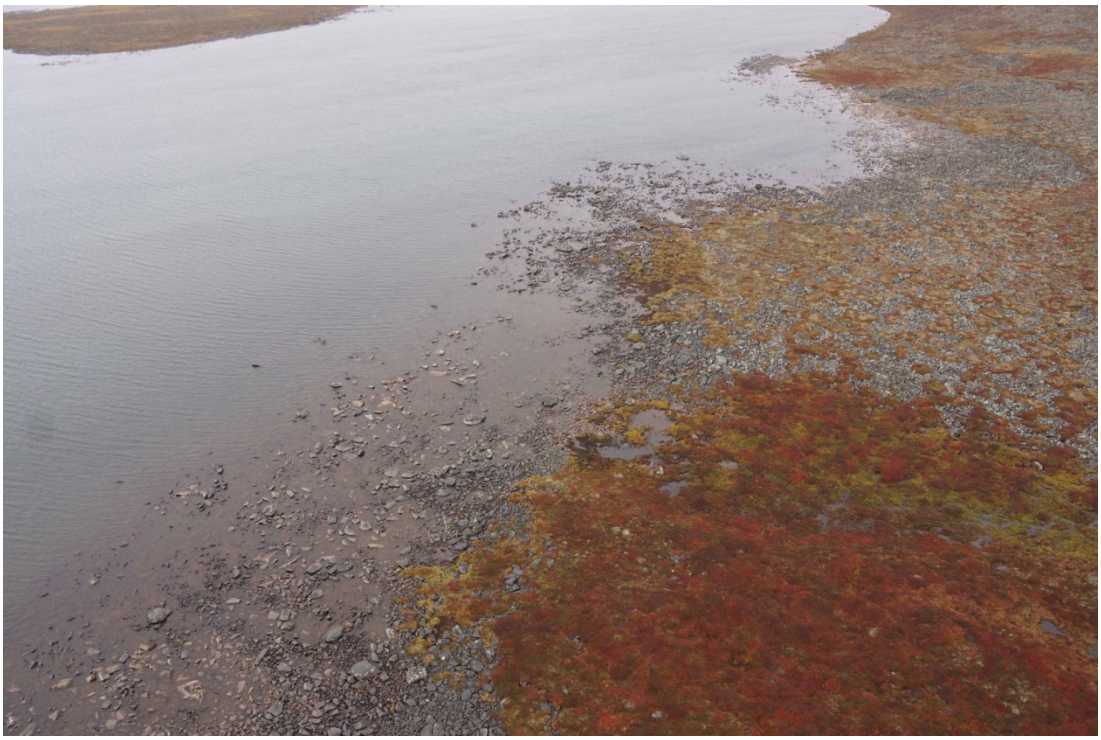
Location 18. Photograph from the ground. Upstream view approximately 100 m upstream of watercourse mouth.



Location 18. Photograph from the ground. Approximately 100 m upstream of watercourse mouth.



Location 18. Photograph from the ground. Upstream view approximately 180 m upstream of watercourse mouth.



Location 19. Oblique aerial photograph 19-1.



Location 19. Photograph from the ground. Watercourse mouth.



Location 20. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs. Lakes near Location 20 will be avoided.



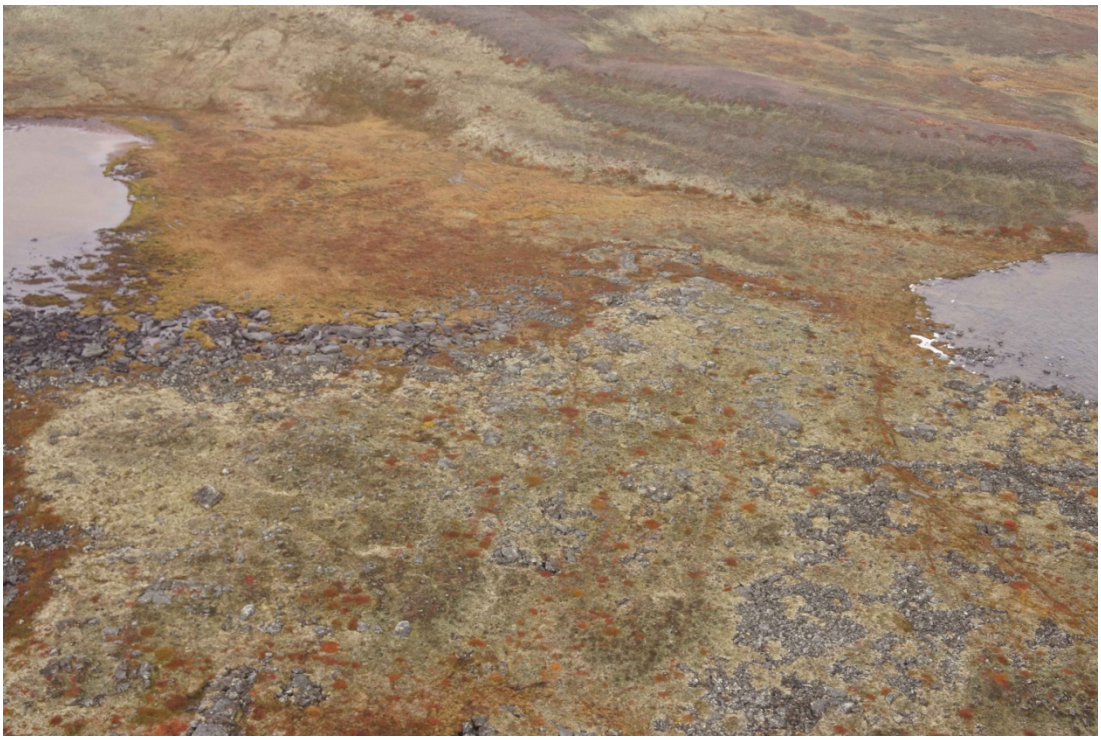
Location 20. Oblique aerial photograph 20-1.



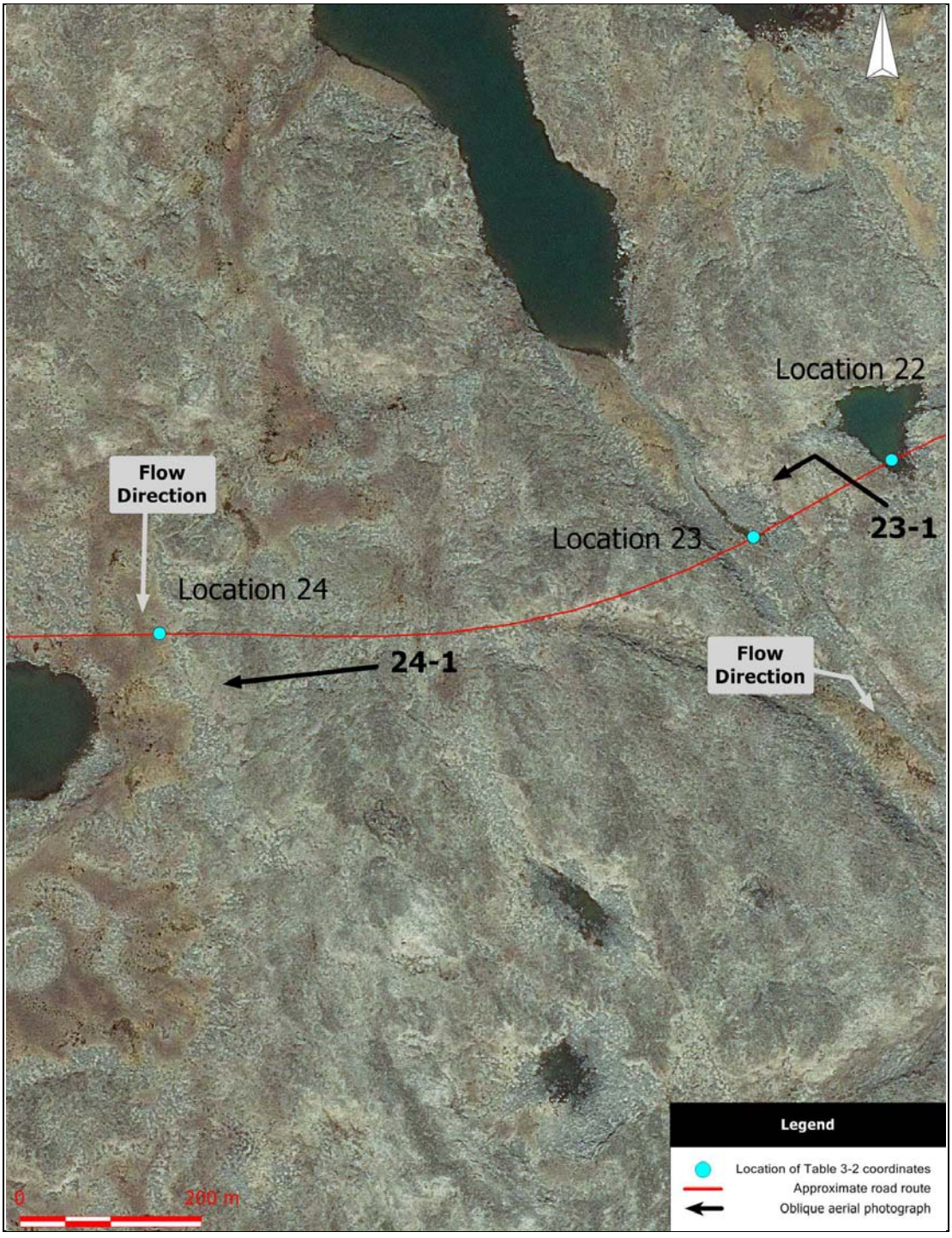
Location 20. Photograph from the ground. Note flow through narrows.



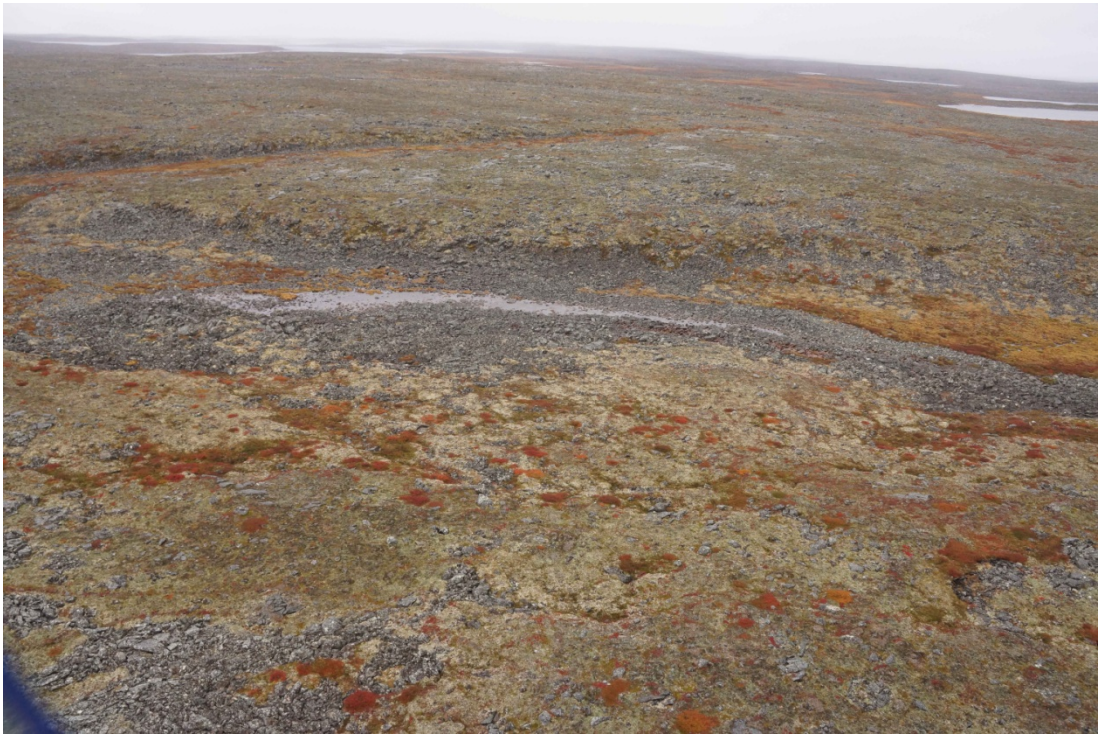
Location 21. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs. Lake near Location 21 will be avoided.



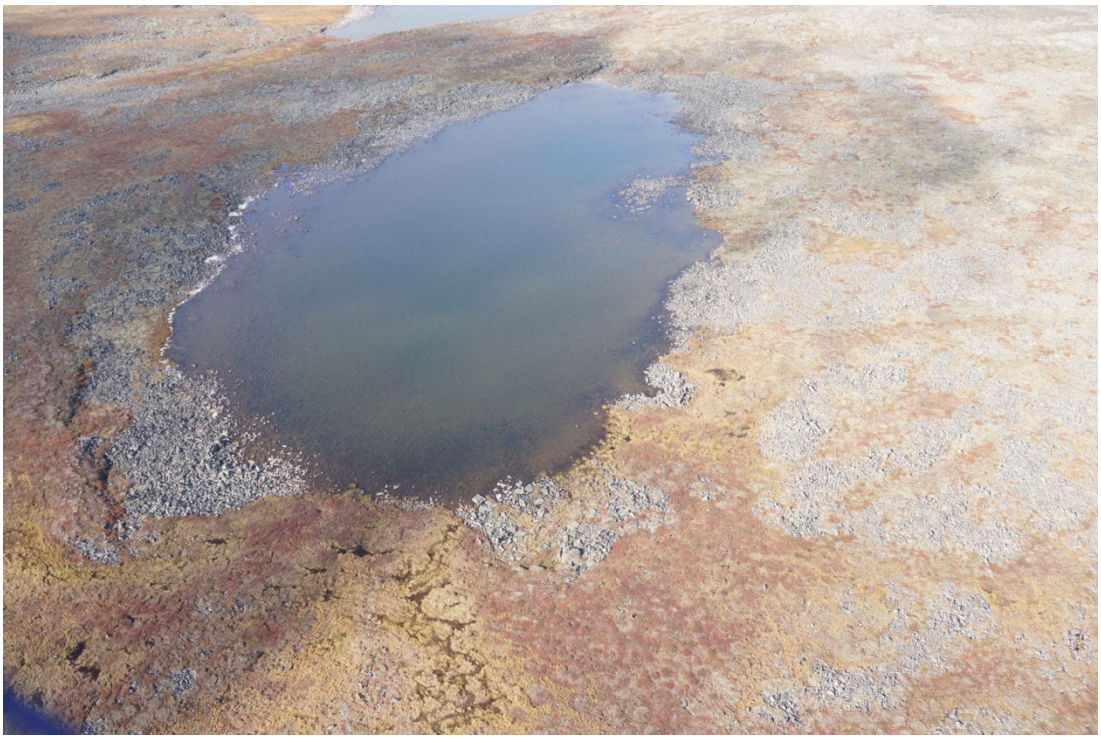
Location 21. Oblique aerial photograph 21-1.



Locations 22, 23 and 24. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs. Pond at Location 22 will be avoided.



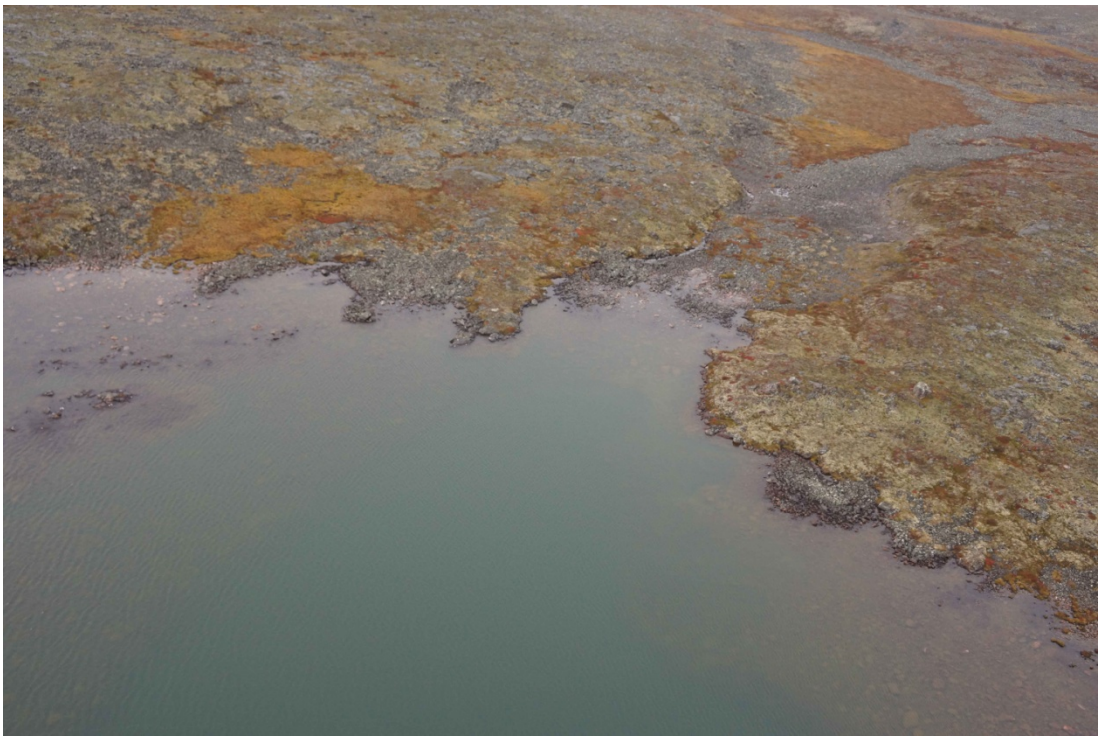
Location 23. Oblique aerial photograph 23-1.



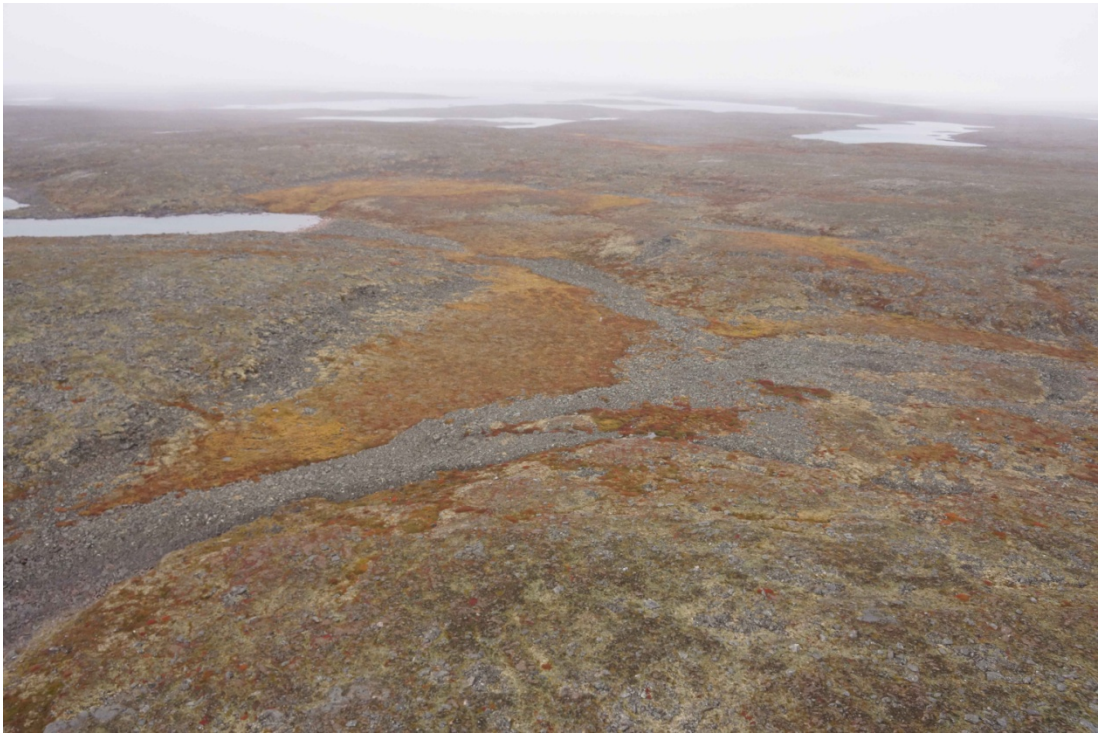
Location 24. Oblique aerial photograph 24-1.



Locations 25 and 26. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs. Lake at Location 25 will be avoided.



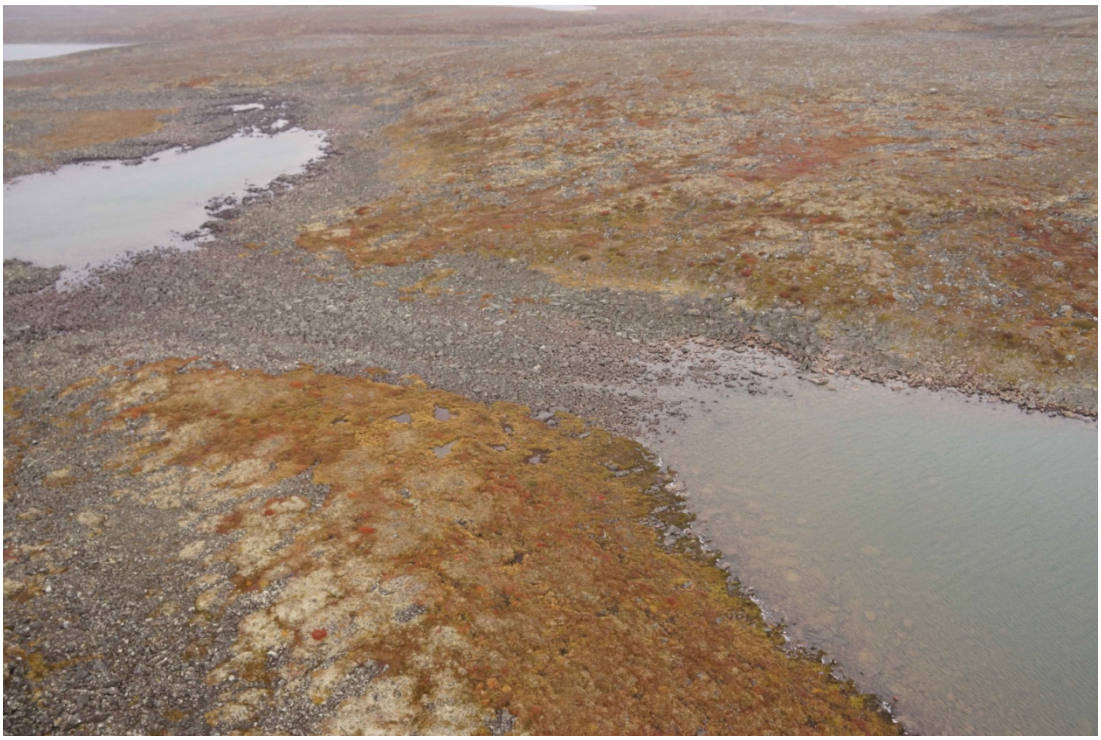
Location 25. Oblique aerial photograph 25-1.



Location 26. Oblique aerial photograph 26-1.



Location 27. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



Location 27. Oblique aerial photograph 27-1.



Location 28. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



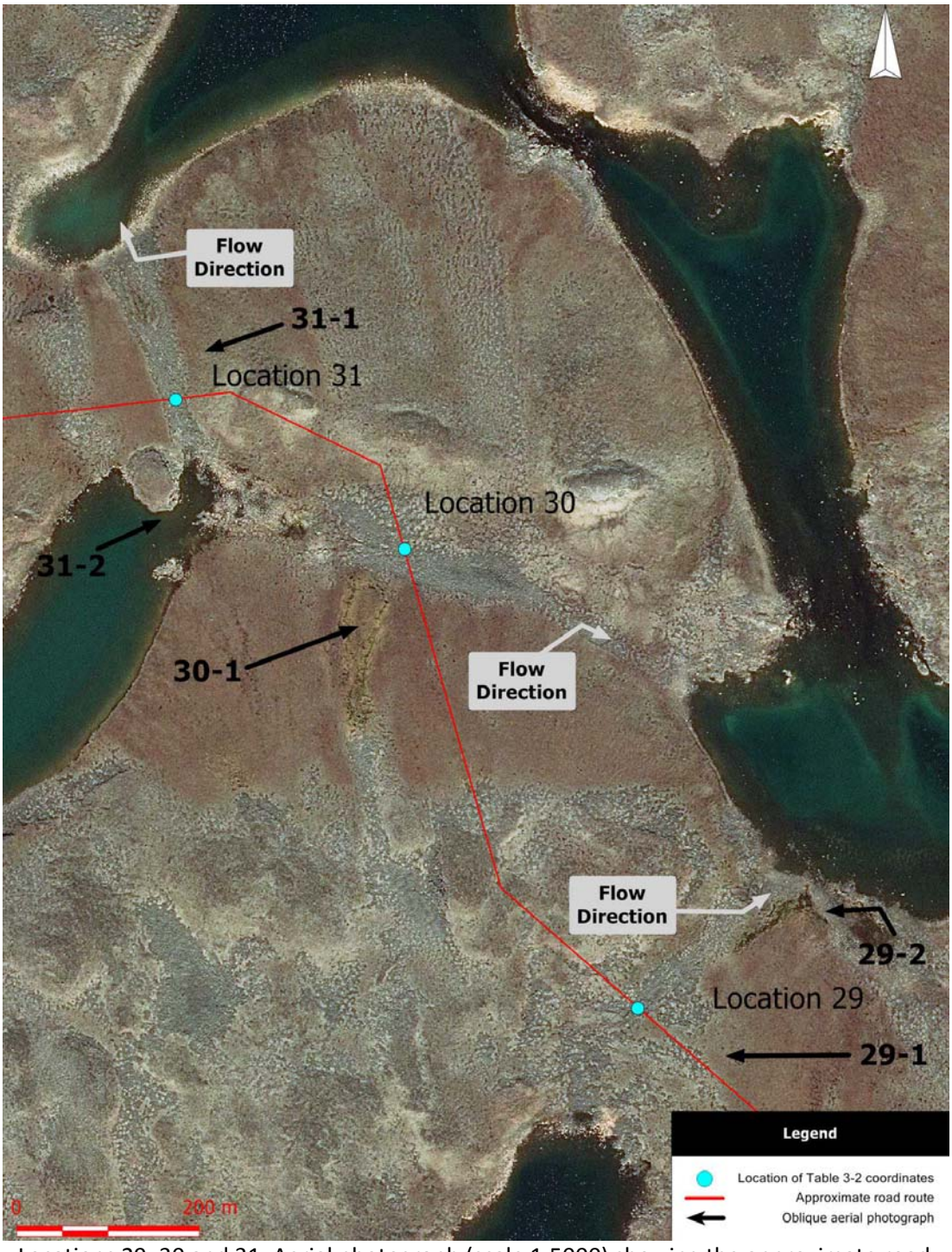
Location 28. Oblique aerial photograph 28-1.



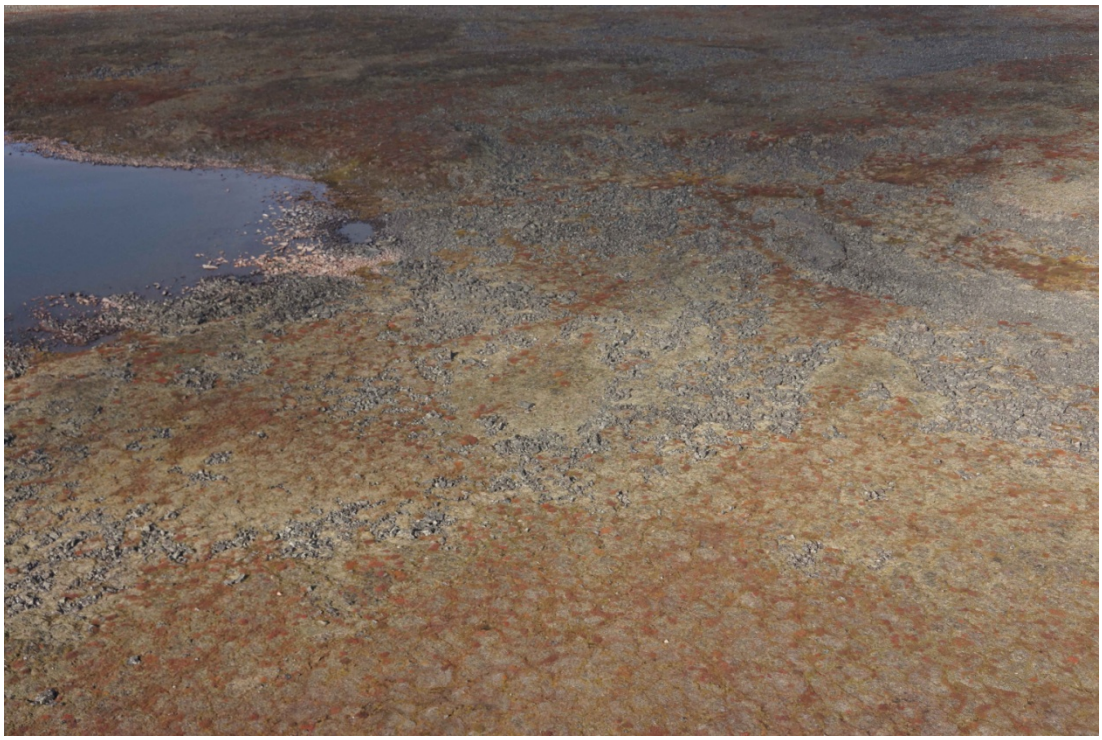
Location 28. Photograph from the ground. Downstream view through approximate crossing location.



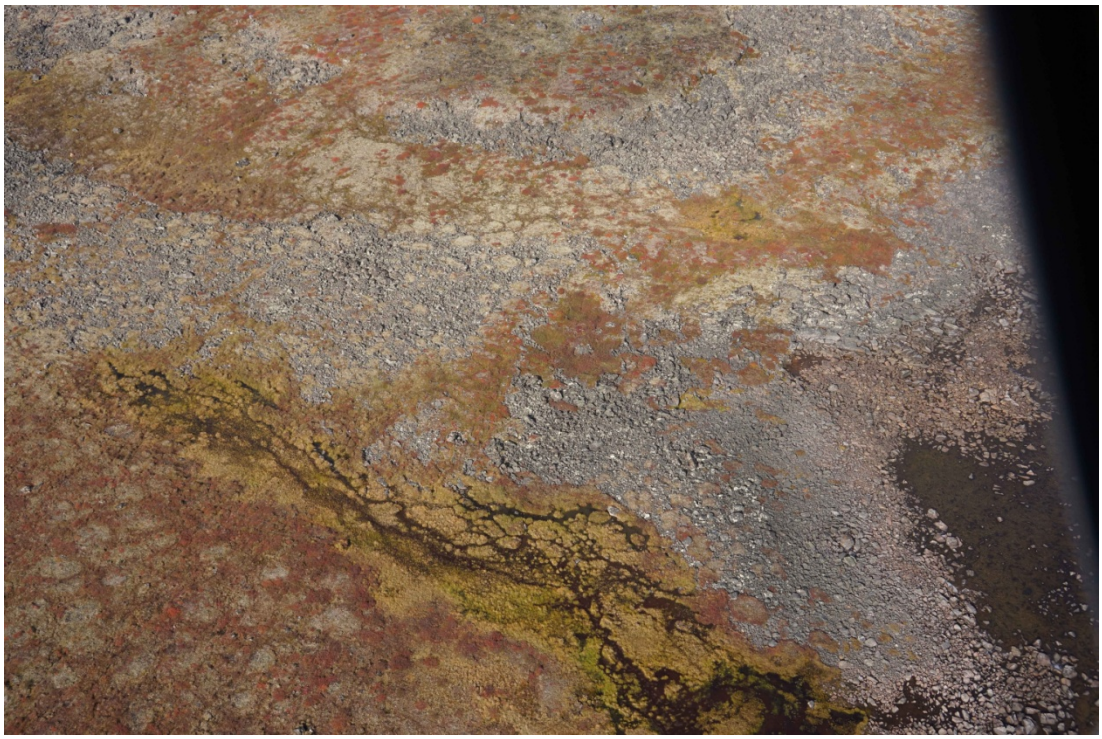
Location 28. Photograph from the ground. Upstream view from previous photograph location.



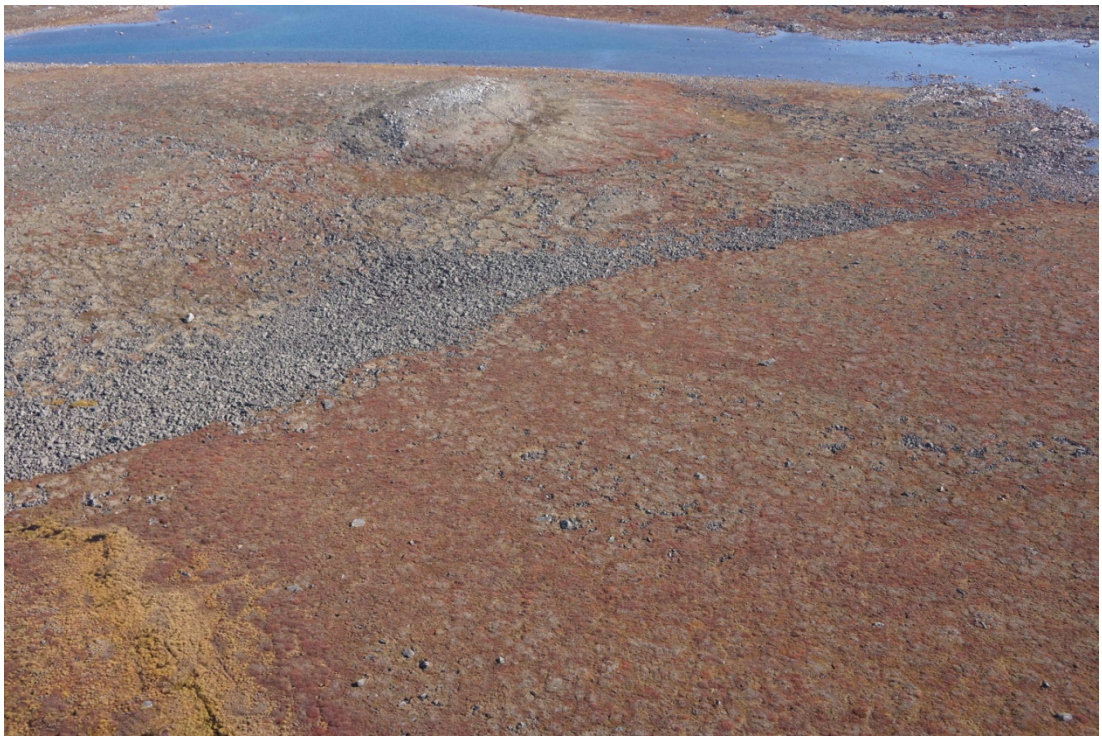
Locations 29, 30 and 31. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



Location 29. Oblique aerial photograph 29-1.



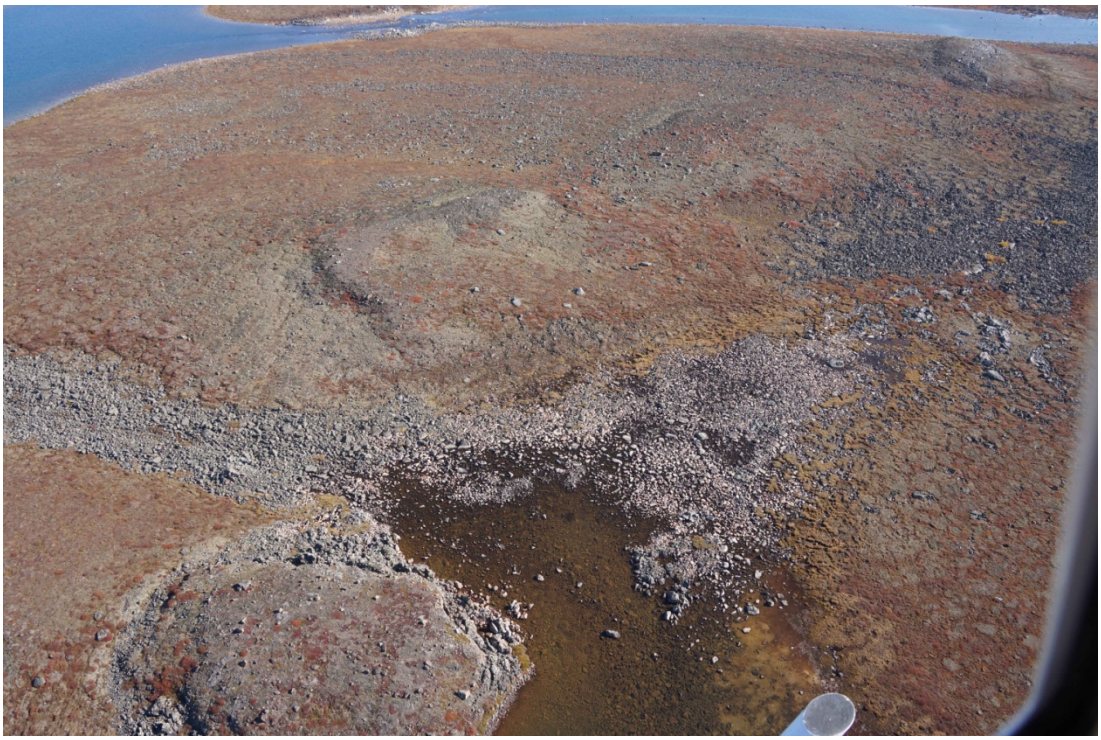
Location 29. Oblique aerial photograph 29-2.



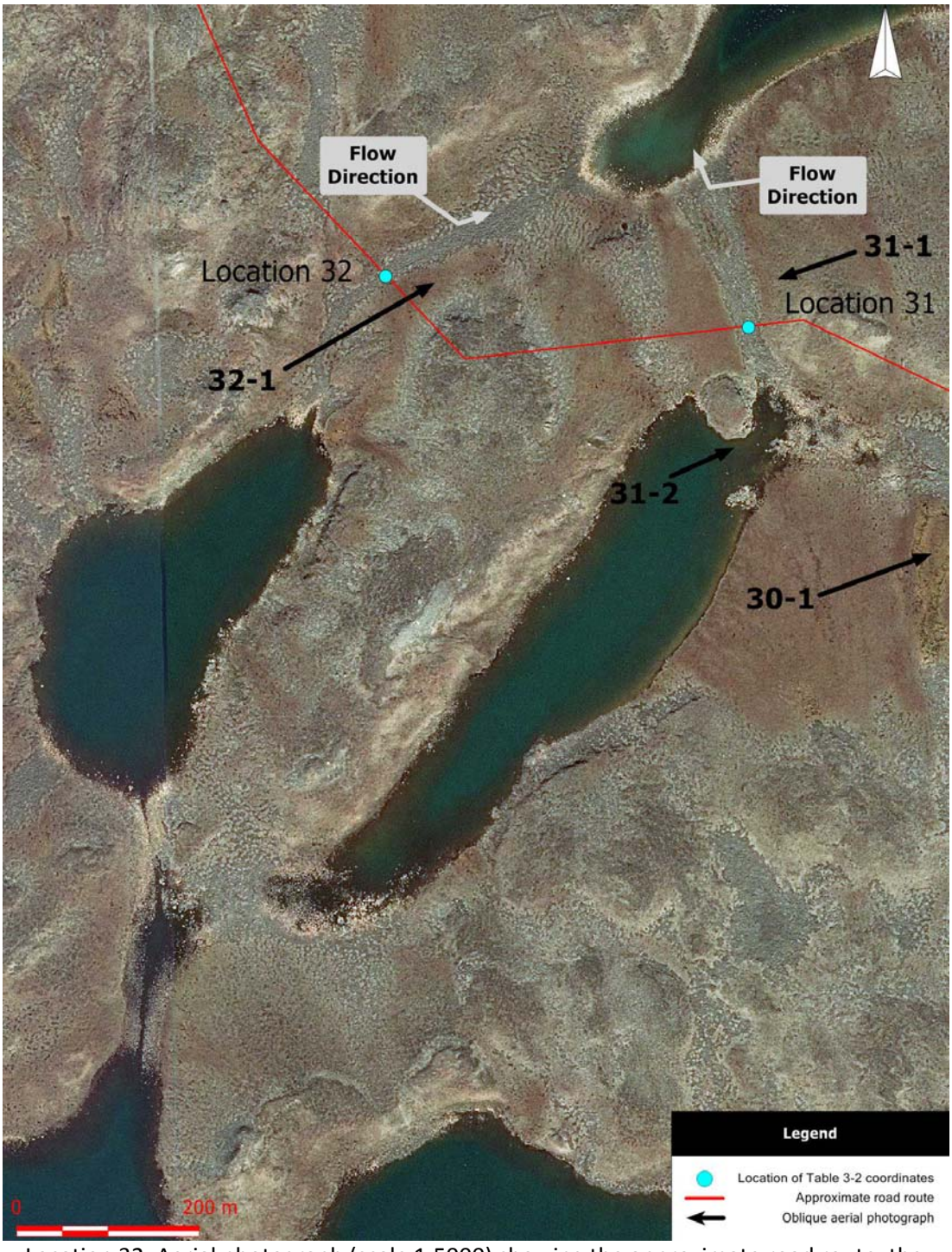
Location 30. Oblique aerial photograph 30-1.



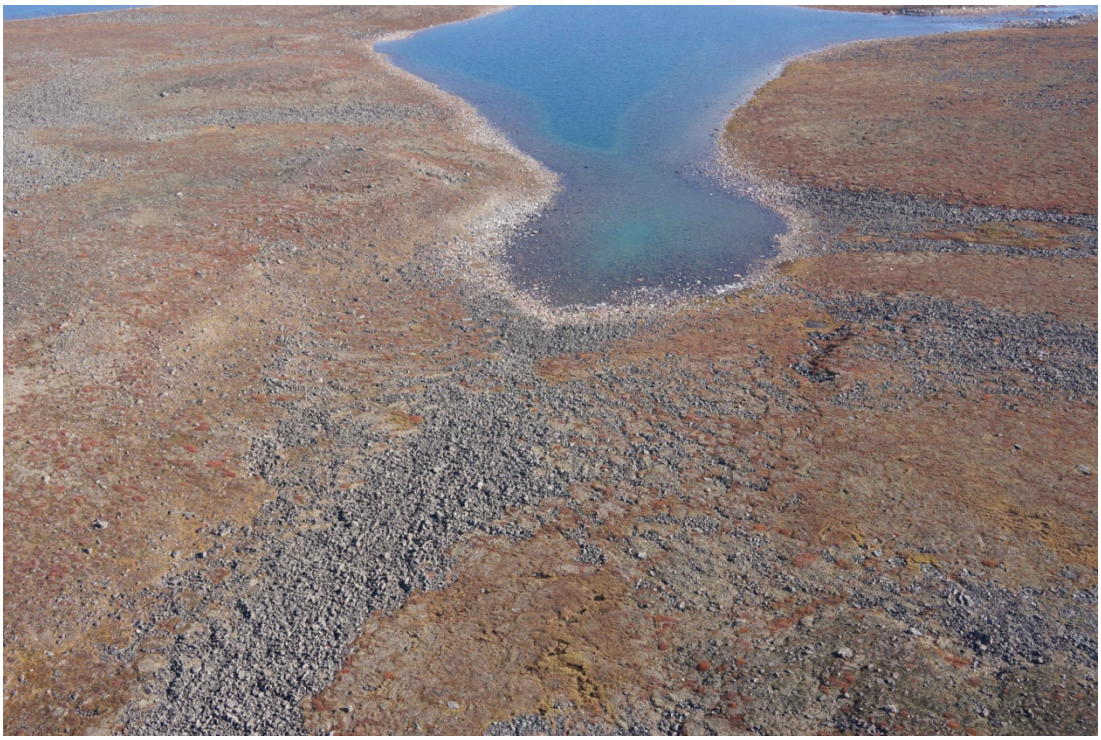
Location 31. Oblique aerial photograph 31-1.



Location 31. Oblique aerial photograph 31-2. Left is watercourse 31. Right is watercourse 30.



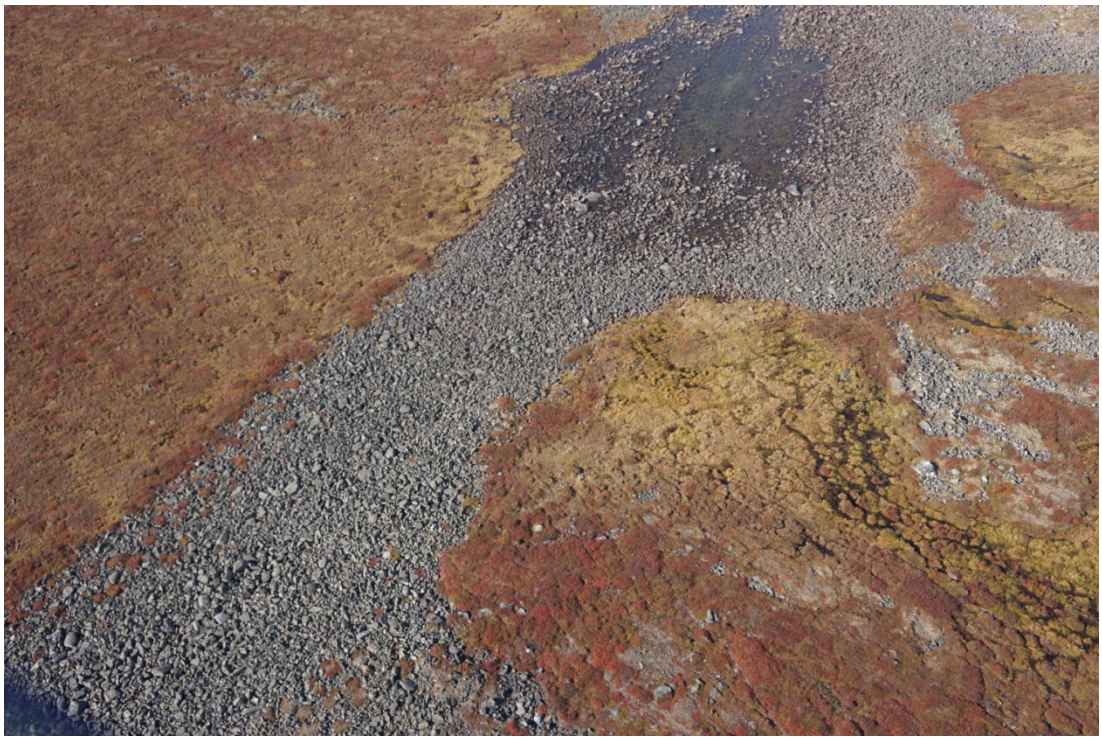
Location 32. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



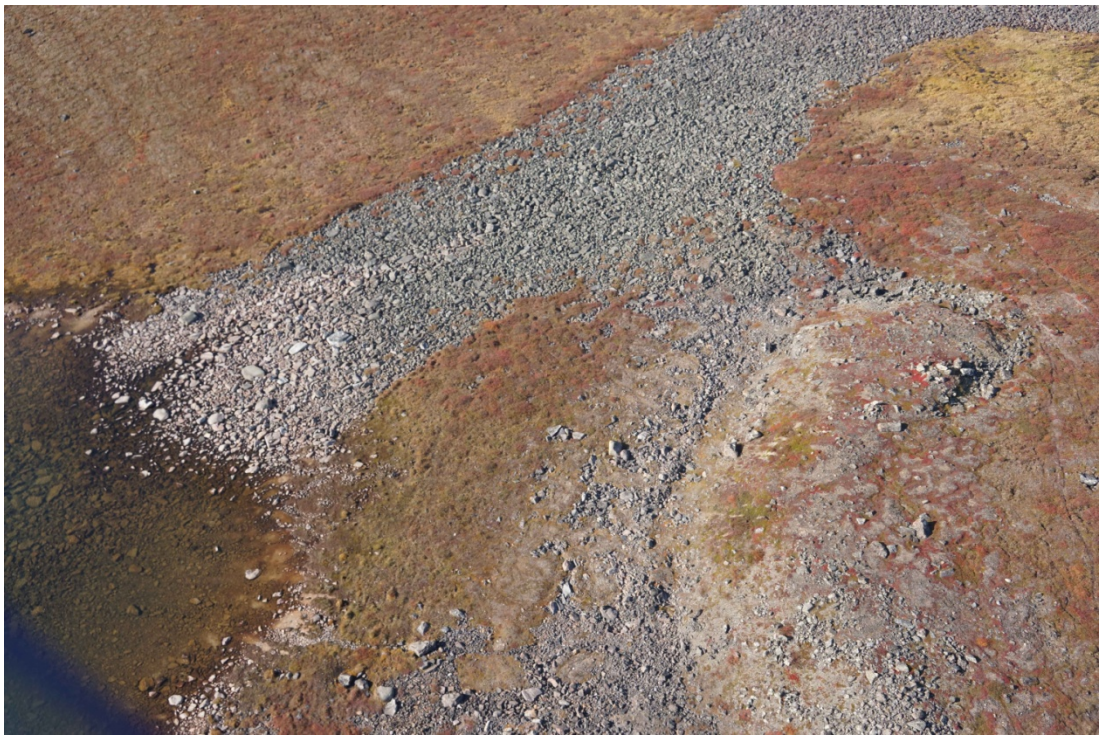
Location 32. Oblique aerial photograph 32-1.



Location 33. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



Location 33. Oblique aerial photograph 33-1.



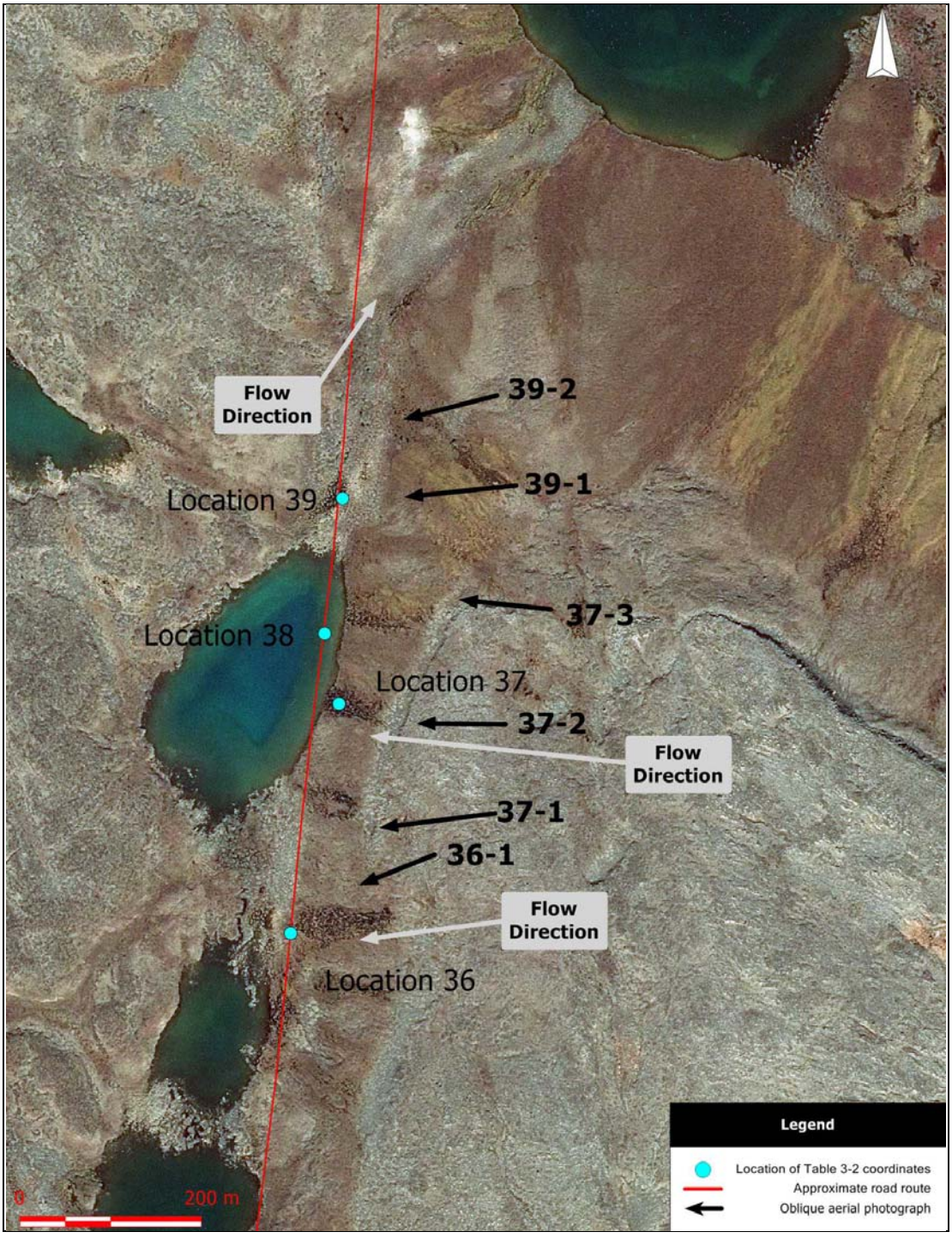
Location 33. Oblique aerial photograph 33-2.



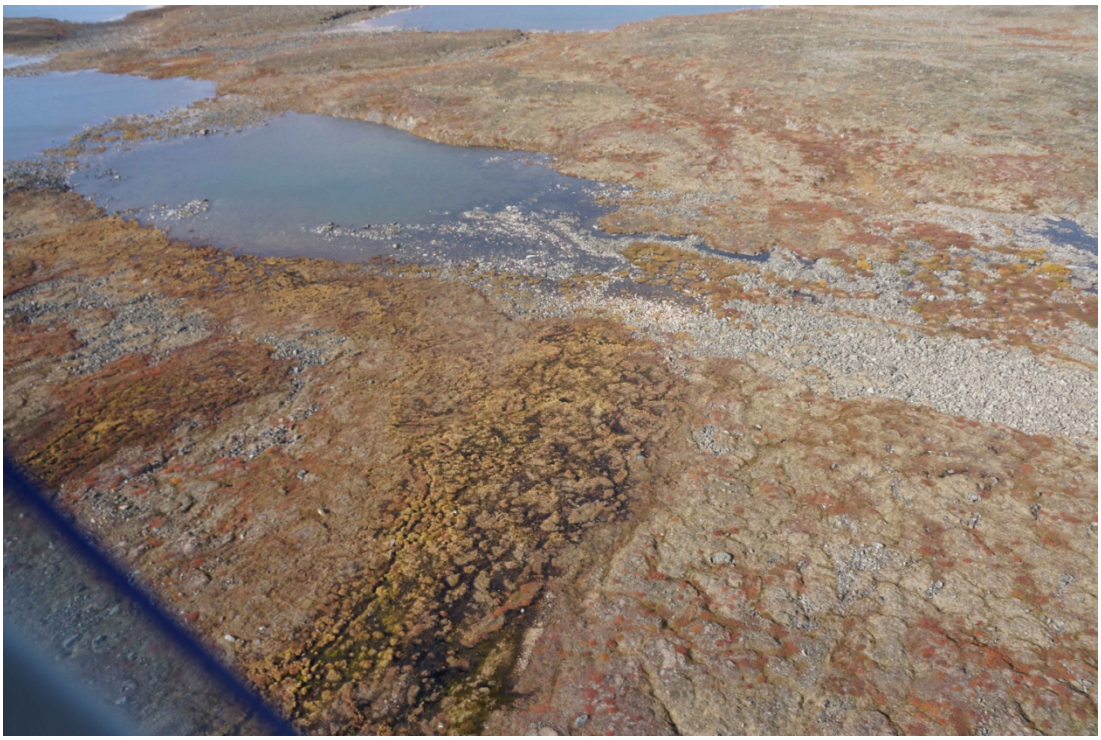
Locations 34 and 35. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs. Lake at Location 34 will be avoided.



Locations 34 and 35. Oblique aerial photograph 35-1. Location 35 is the watercourses in foreground. Location 34 is the lake nearshore.



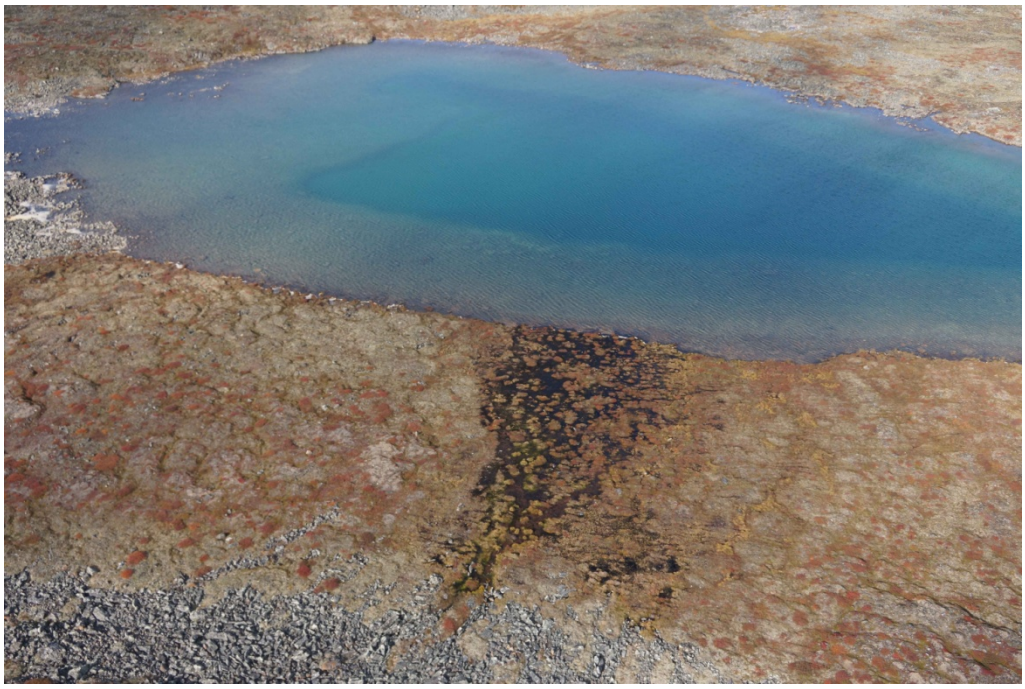
Locations 36, 37, 38 and 39. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs. Lake at Location 38 will be avoided.



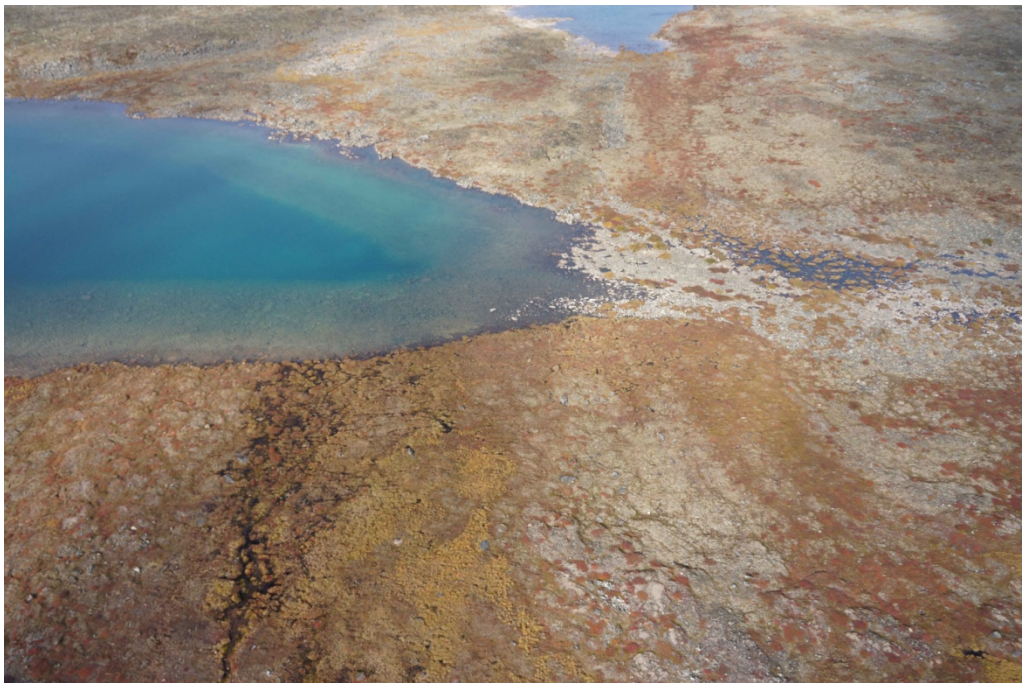
Location 36. Oblique aerial photograph 36-1.



Location 37. Oblique aerial photograph 37-1. One of the three watercourses/seeps included in Location 37.



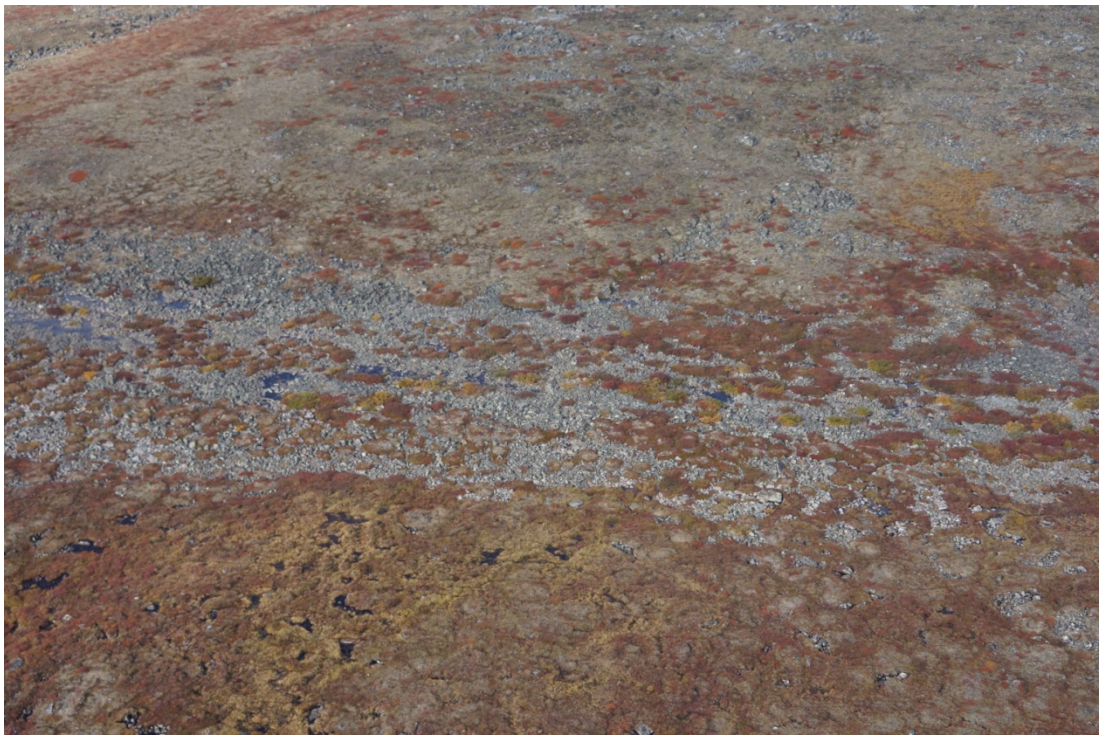
Location 37. Oblique aerial photograph 37-2. One of the three watercourses/seeps included in Location 37. Location 38 is the nearshore of the lake.



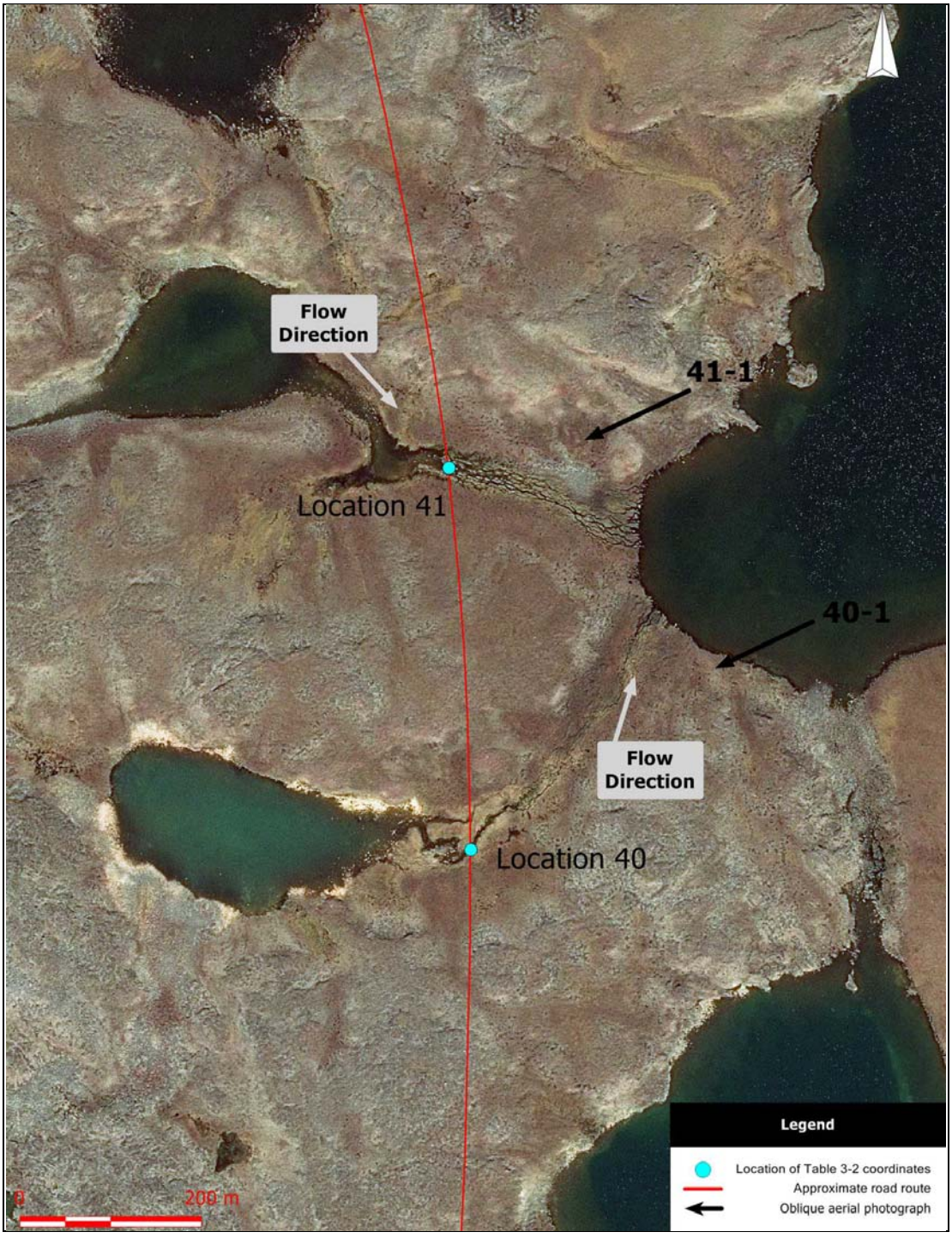
Location 37. Oblique aerial photograph 37-3. One of the three watercourses/seeps included in Location 37. Location 38 is the nearshore of the lake.



Location 39. Oblique aerial photograph 39-1.



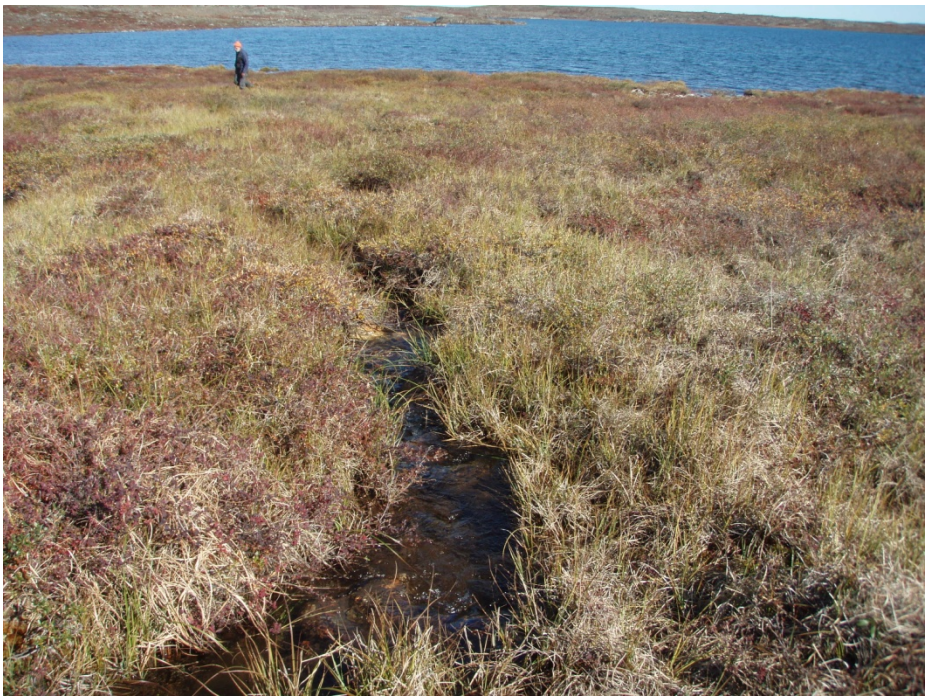
Location 39. Oblique aerial photograph 39-2.



Locations 40 and 41. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



Location 40. Oblique aerial photograph 40-1.



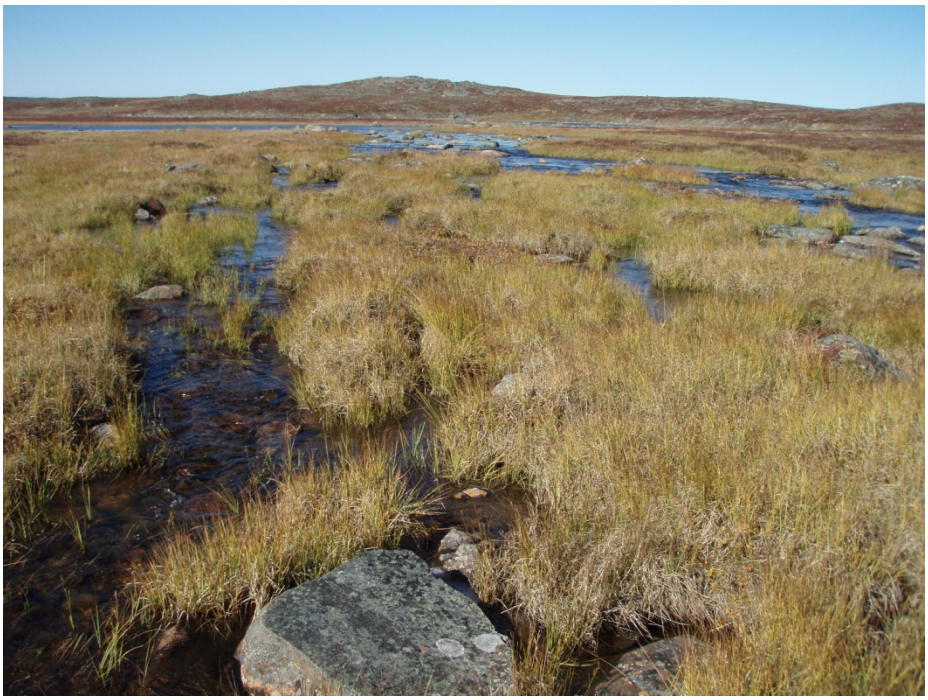
Location 40. Photograph from the ground. Downstream view of one channel from 280 m downstream from the approximate crossing location. Rocky section of watercourse.



Location 40. Photograph from the ground. Downstream view of one channel from 280 m downstream from the approximate crossing location. Diffuse flow through vegetation.



Location 41. Oblique aerial photograph 41-1



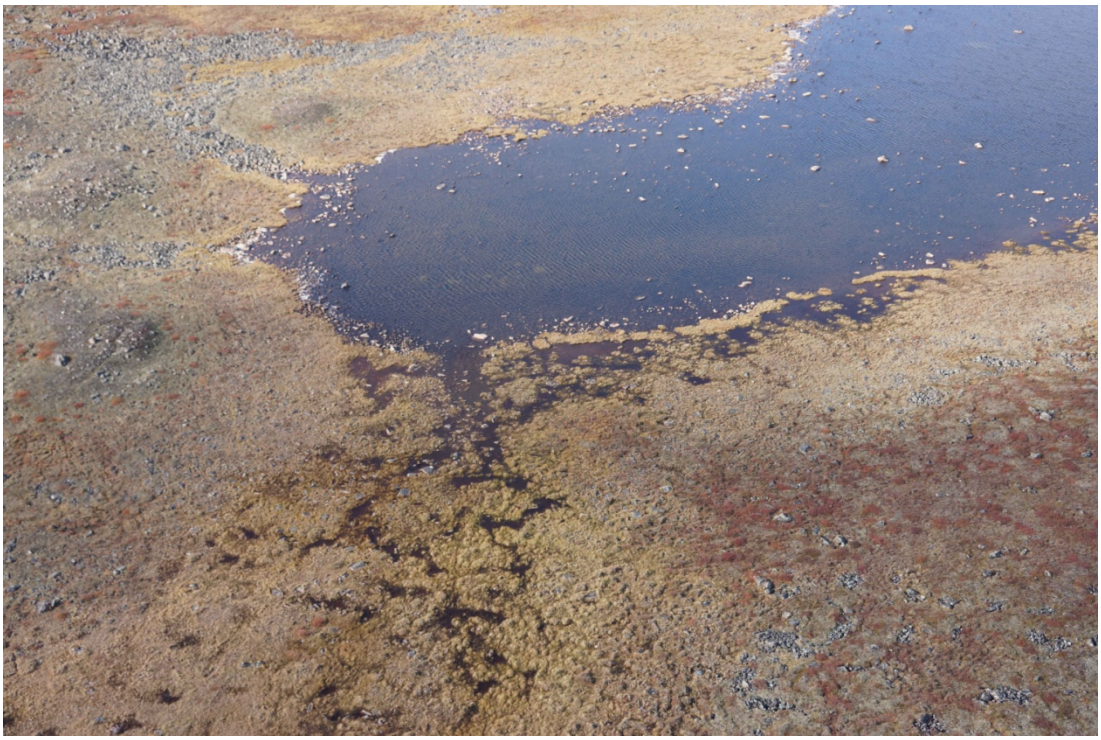
Location 41. Photograph from the ground. Upstream view from 30 m downstream of the approximate road crossing location.



Location 41. Photograph from the ground. Upstream view from 30 m downstream of the approximate road crossing location.



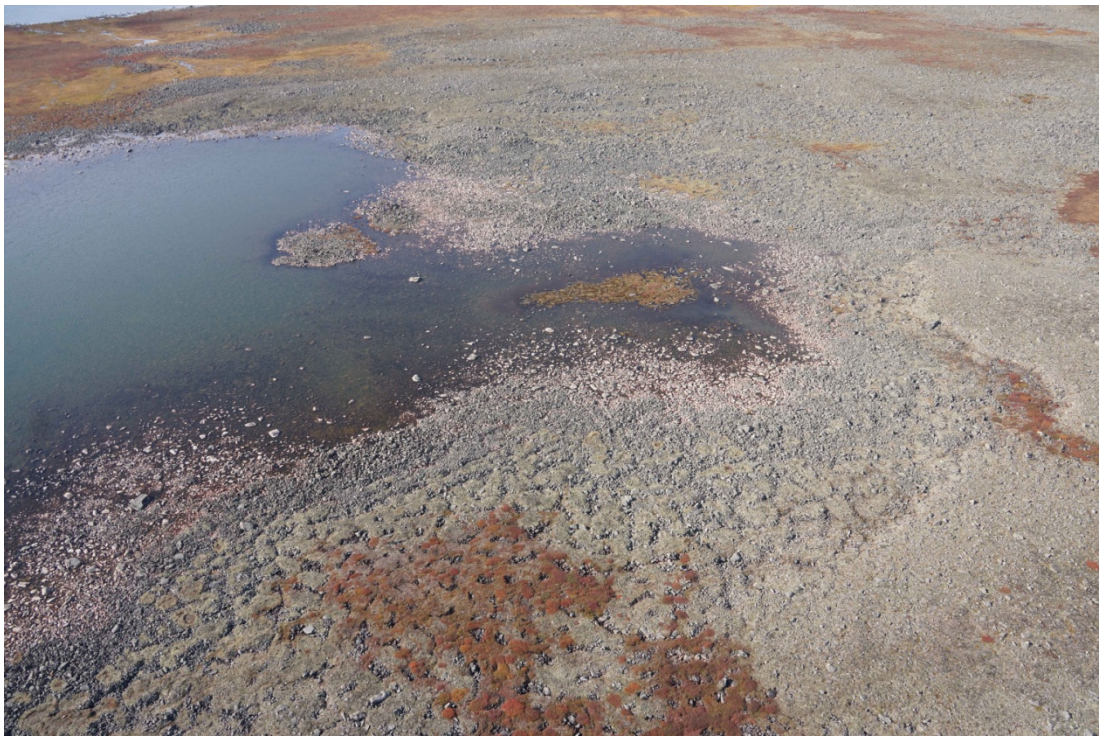
Location 42. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



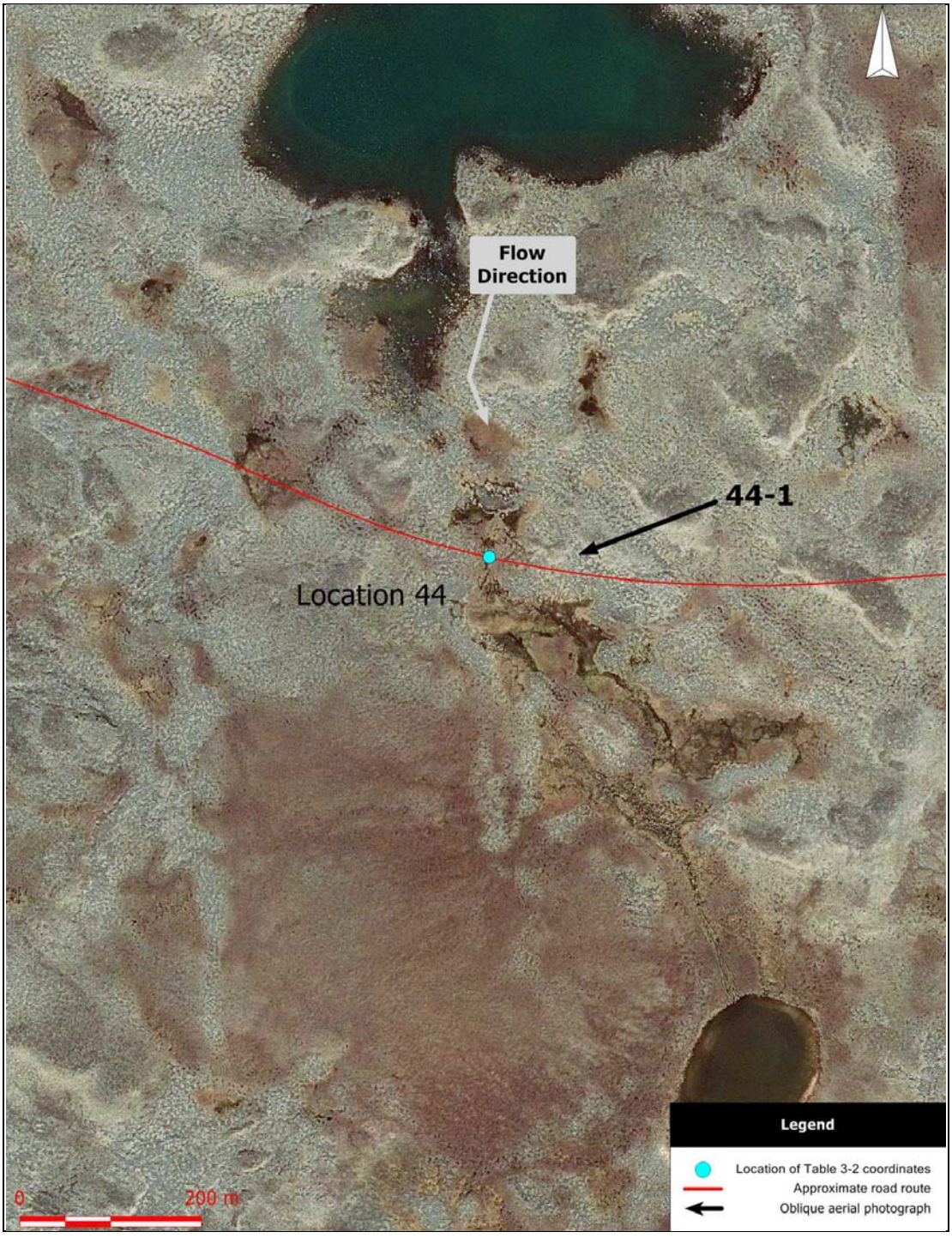
Location 42. Oblique aerial photograph 42-1.



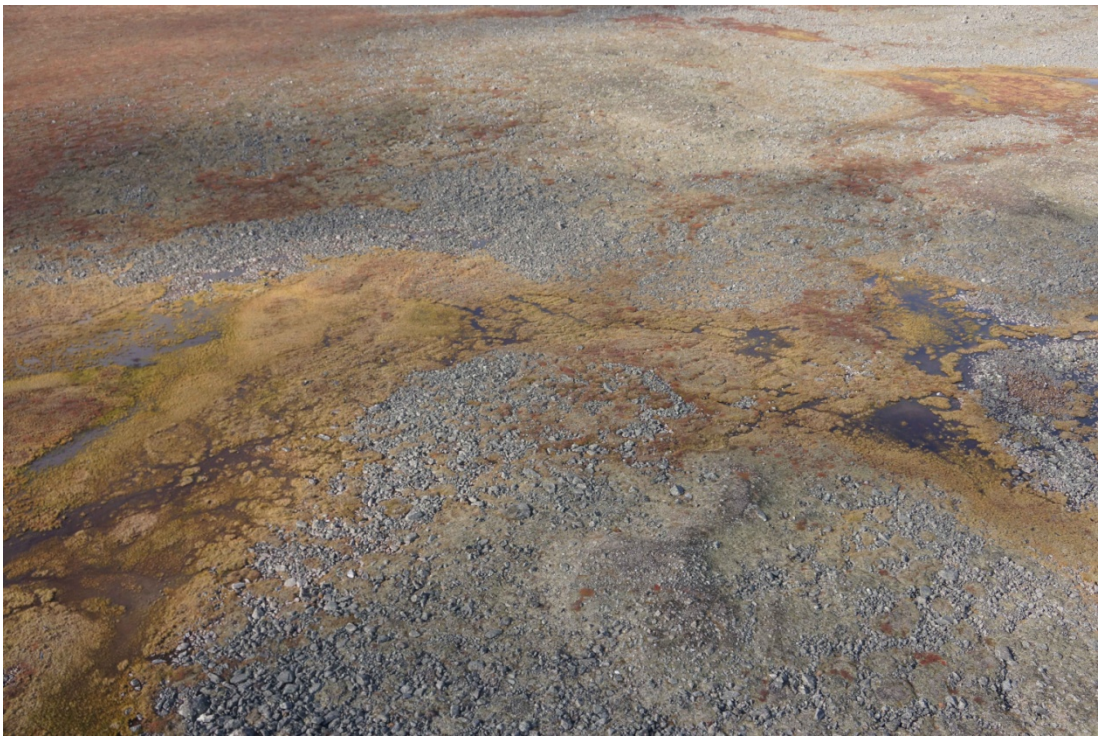
Location 43. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs. Lake at Location 43 will be avoided.



Location 43. Oblique aerial photograph 43-1.



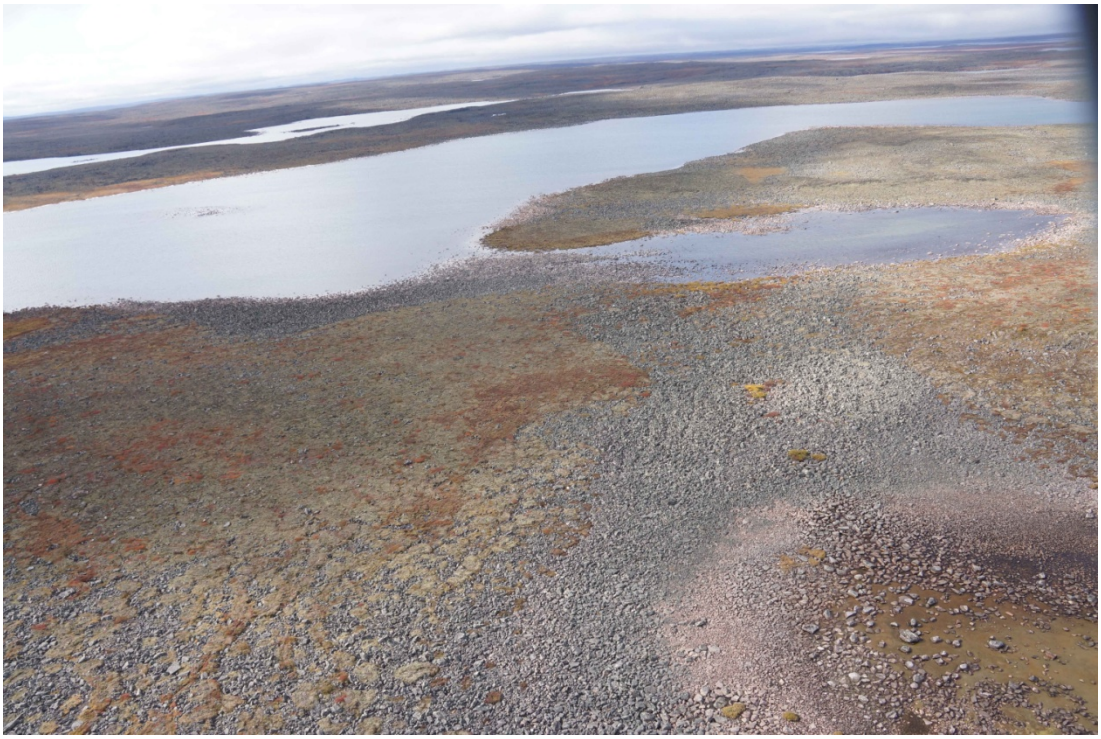
Location 44. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



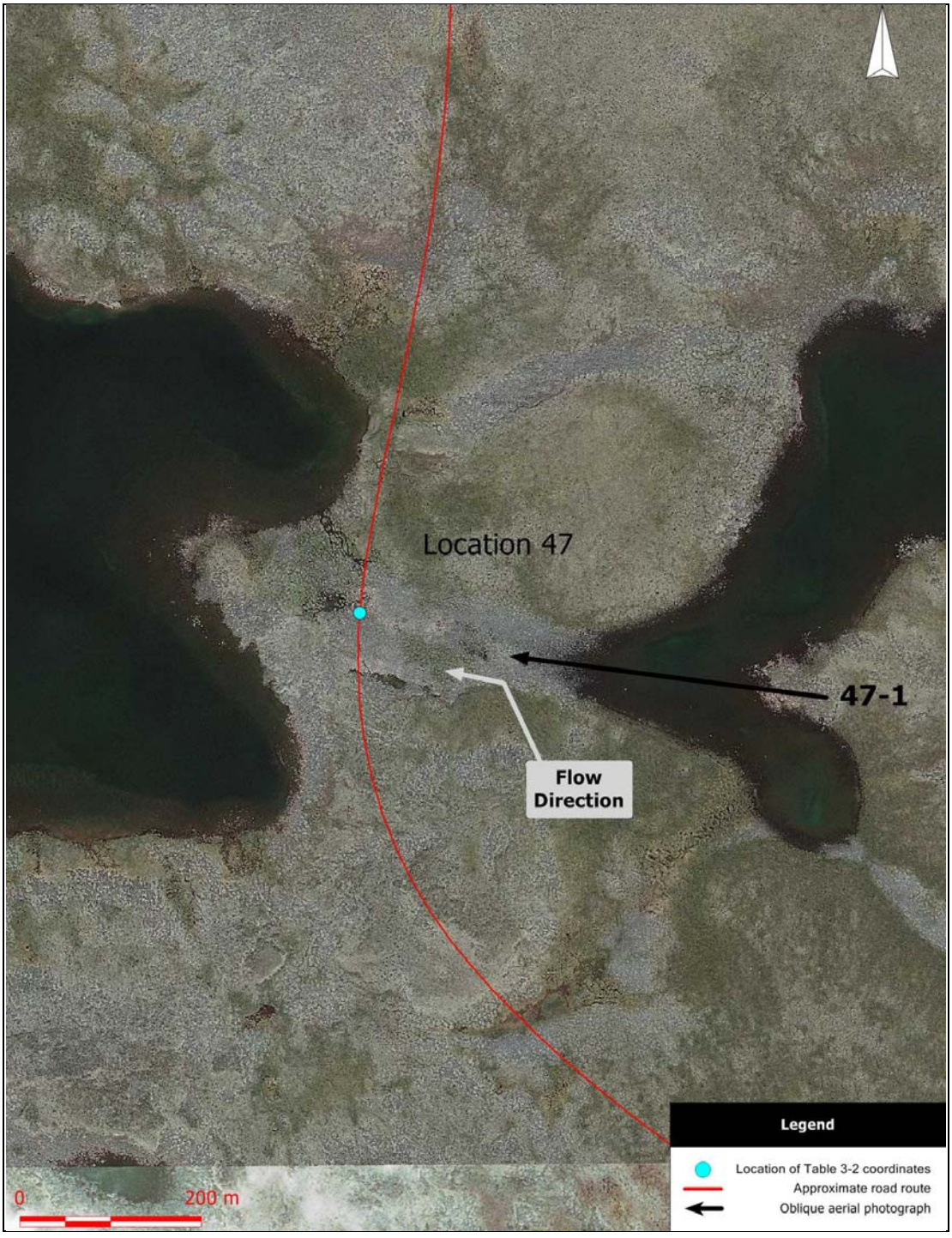
Location 44. Oblique aerial photograph 44-1.



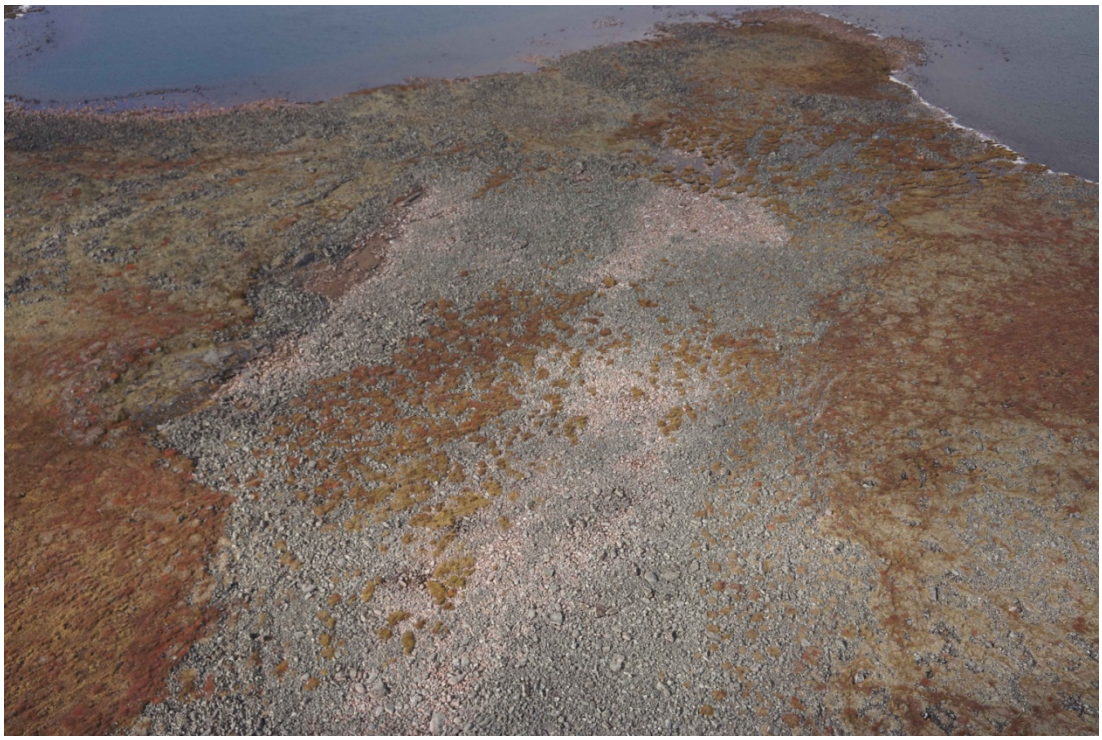
Locations 45 and 46. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



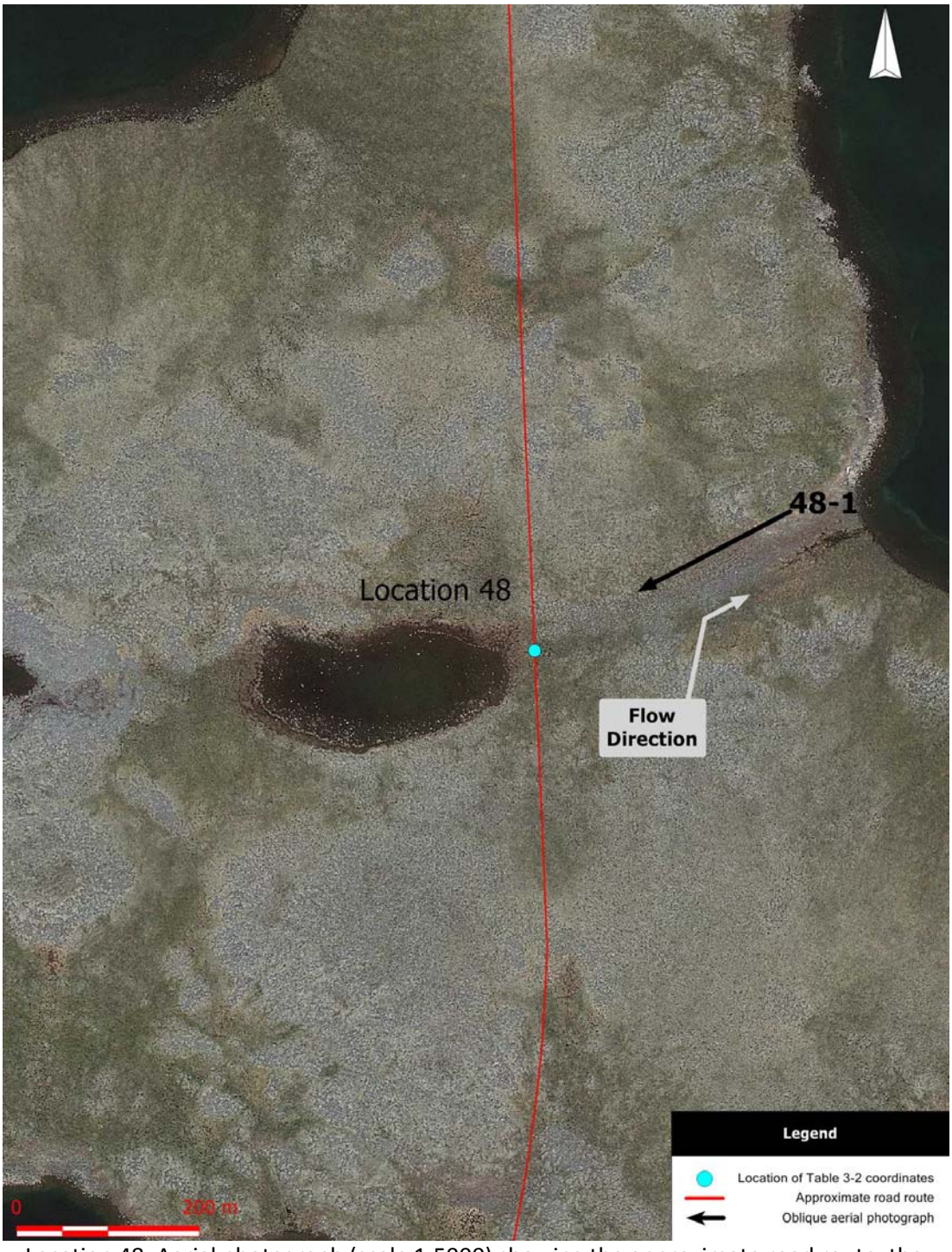
Location 45. Oblique aerial photograph 45-1.



Location 47. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



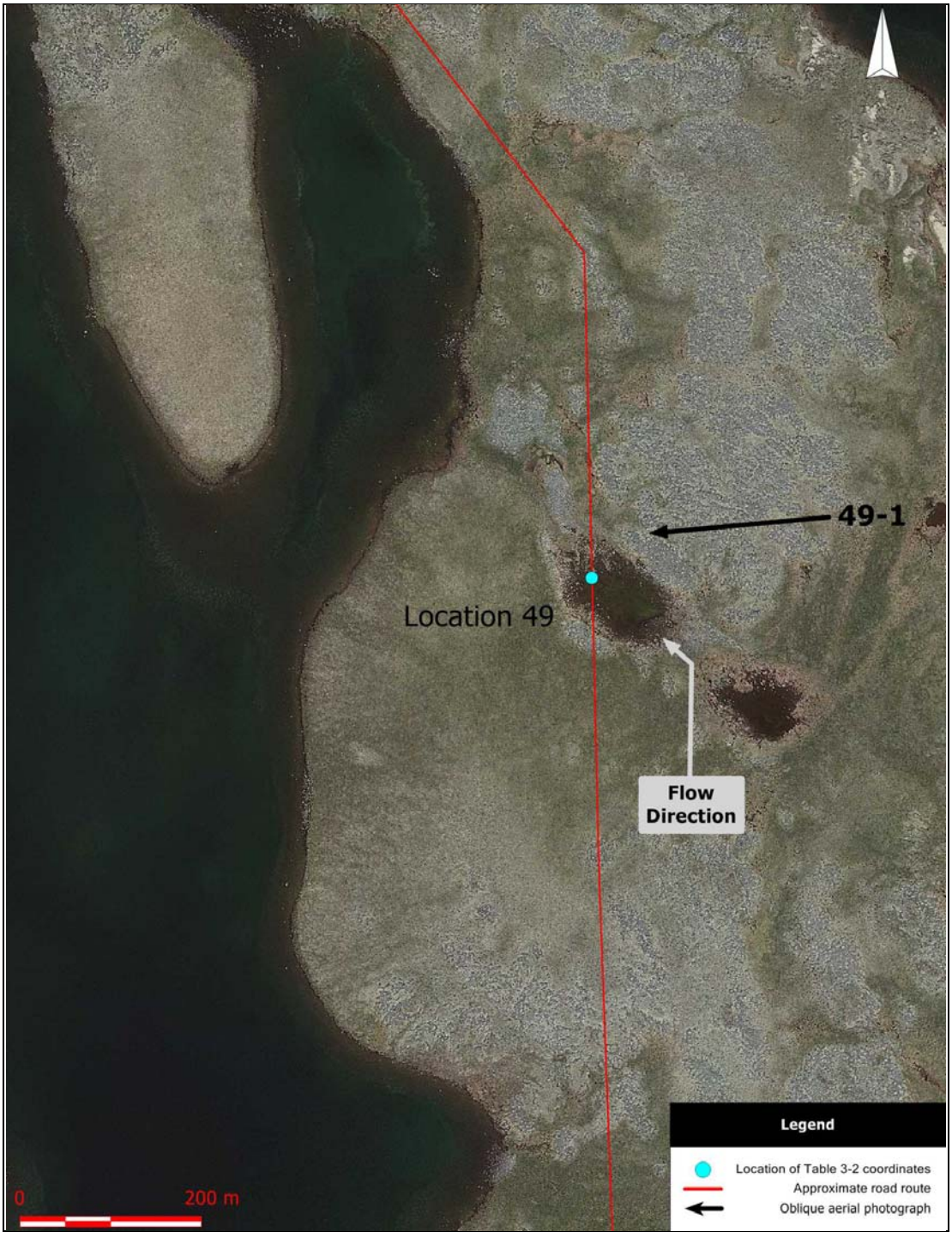
Location 47. Oblique aerial photograph 47-1.



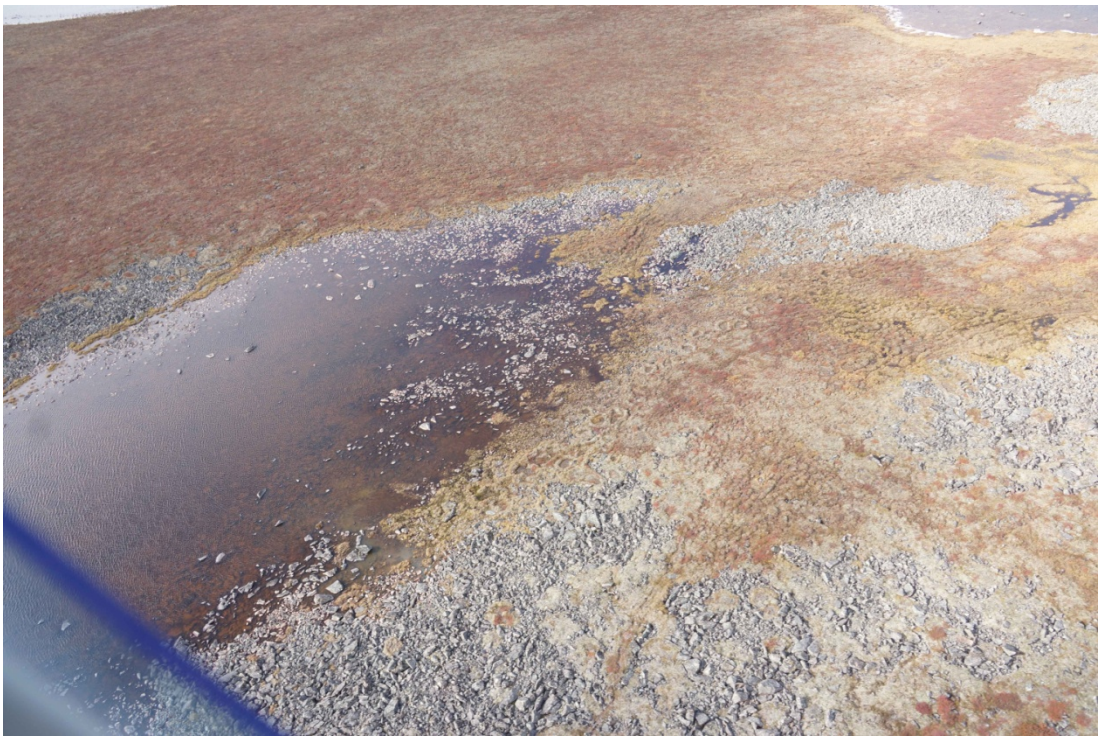
Location 48. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs.



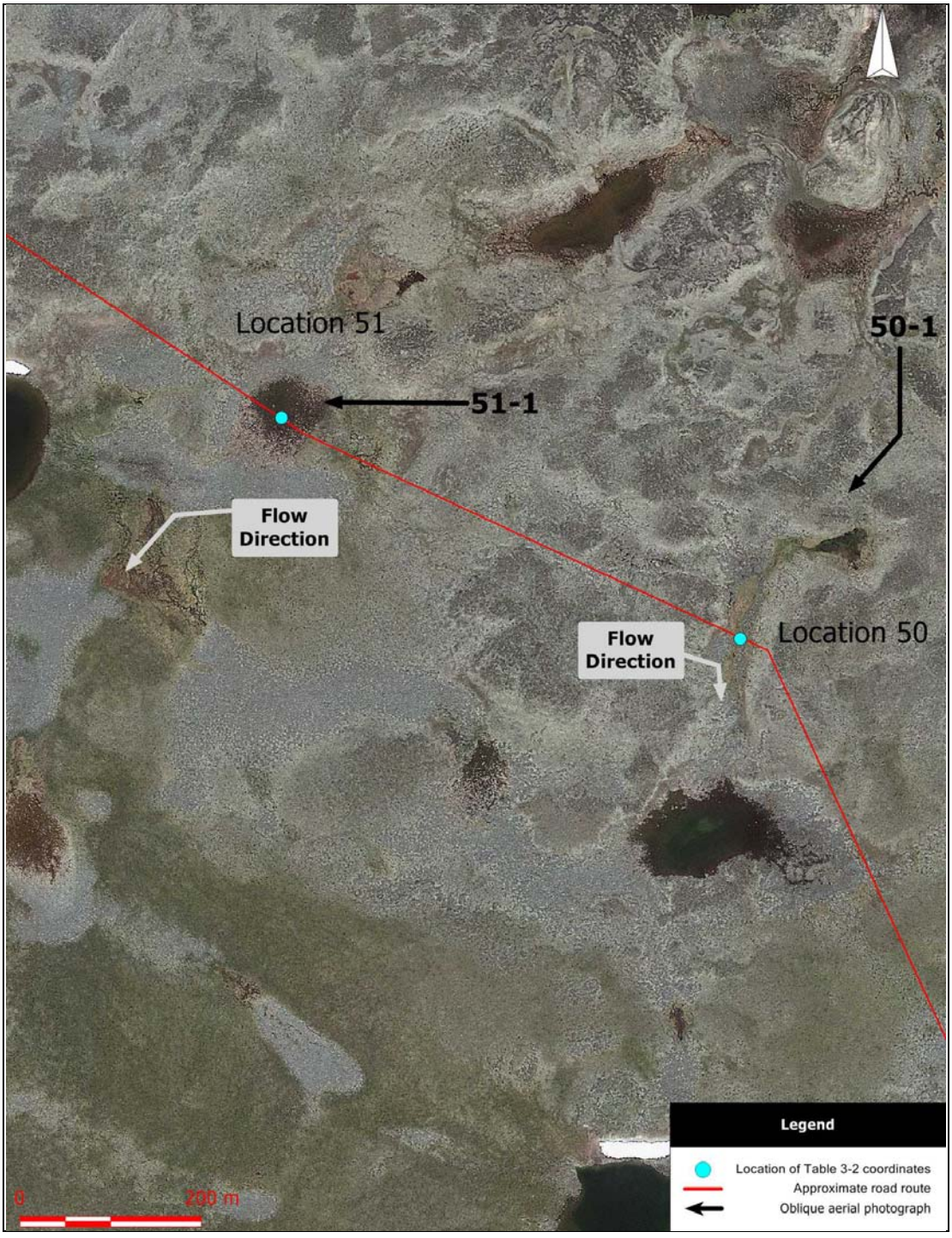
Location 48. Oblique aerial photograph 48-1.



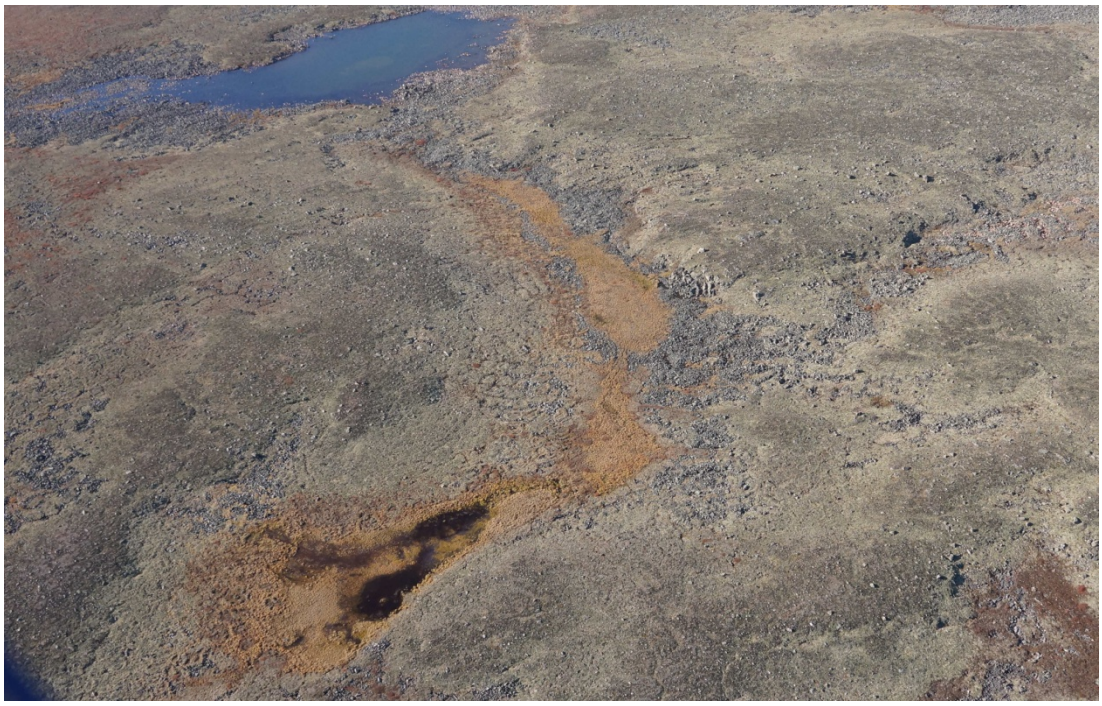
Location 49. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, the flow direction, and the location of oblique aerial photographs. Lake at Location 49 will be avoided.



Location 49. Oblique aerial photograph 49-1.



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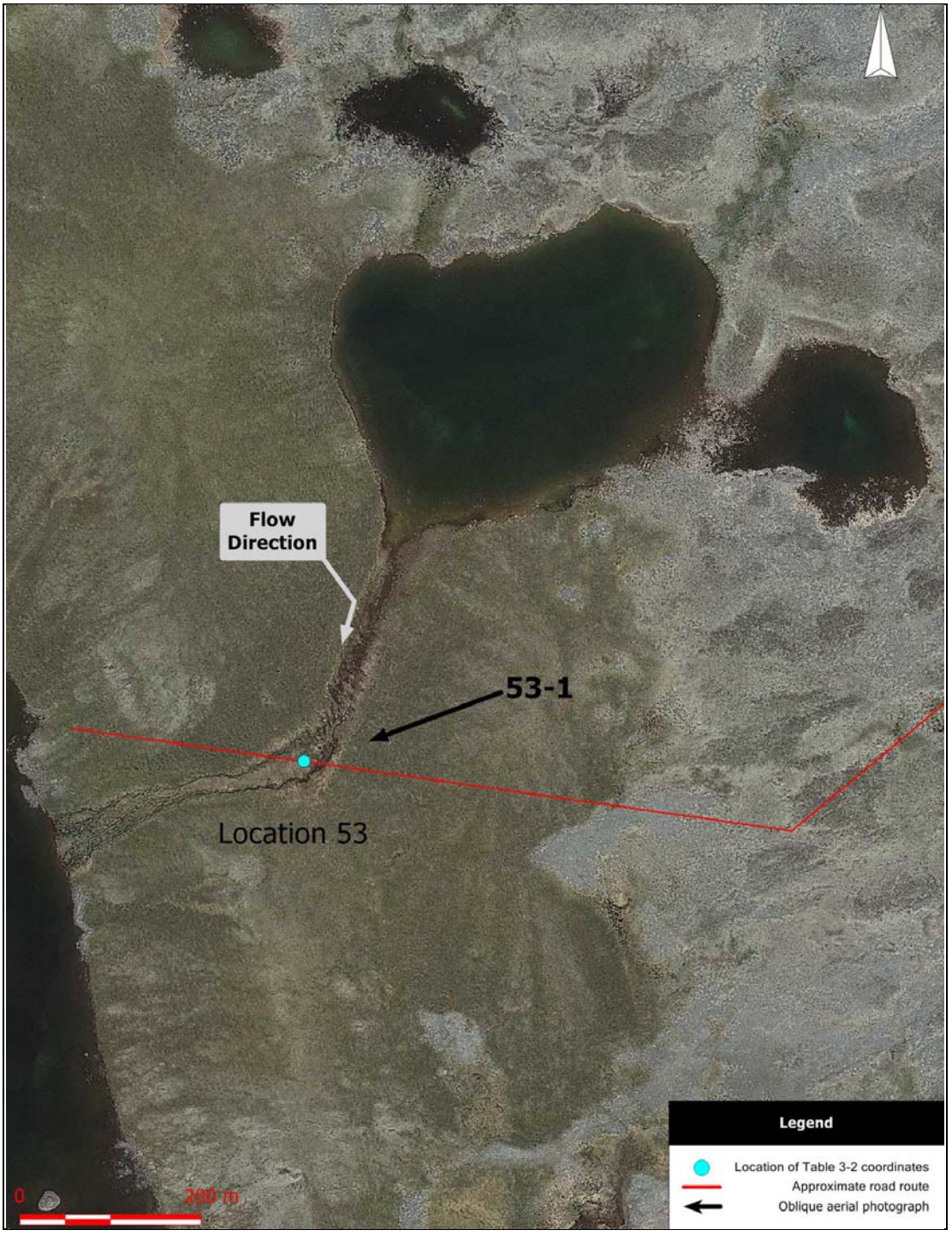
Location 50. Oblique aerial photograph 50-1.



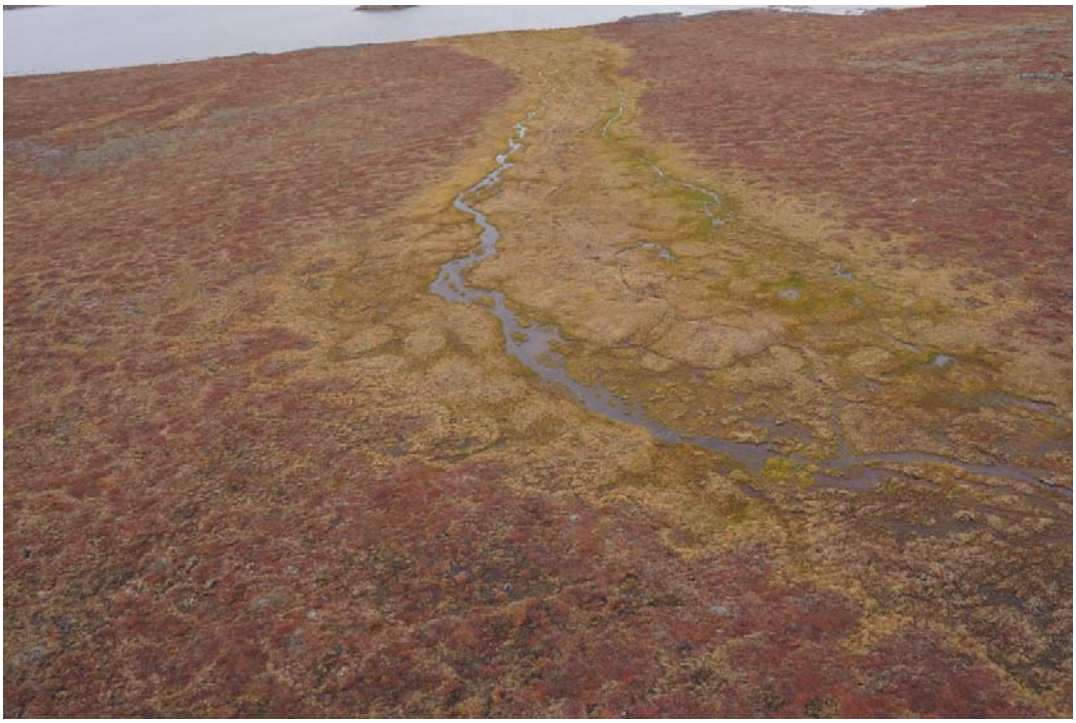
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Location 52. Aerial photograph (scale 1:5000) showing the approximate road route, the location of coordinates provided in Table 3-2, and the flow direction. Pond at Location 52 will be avoided.



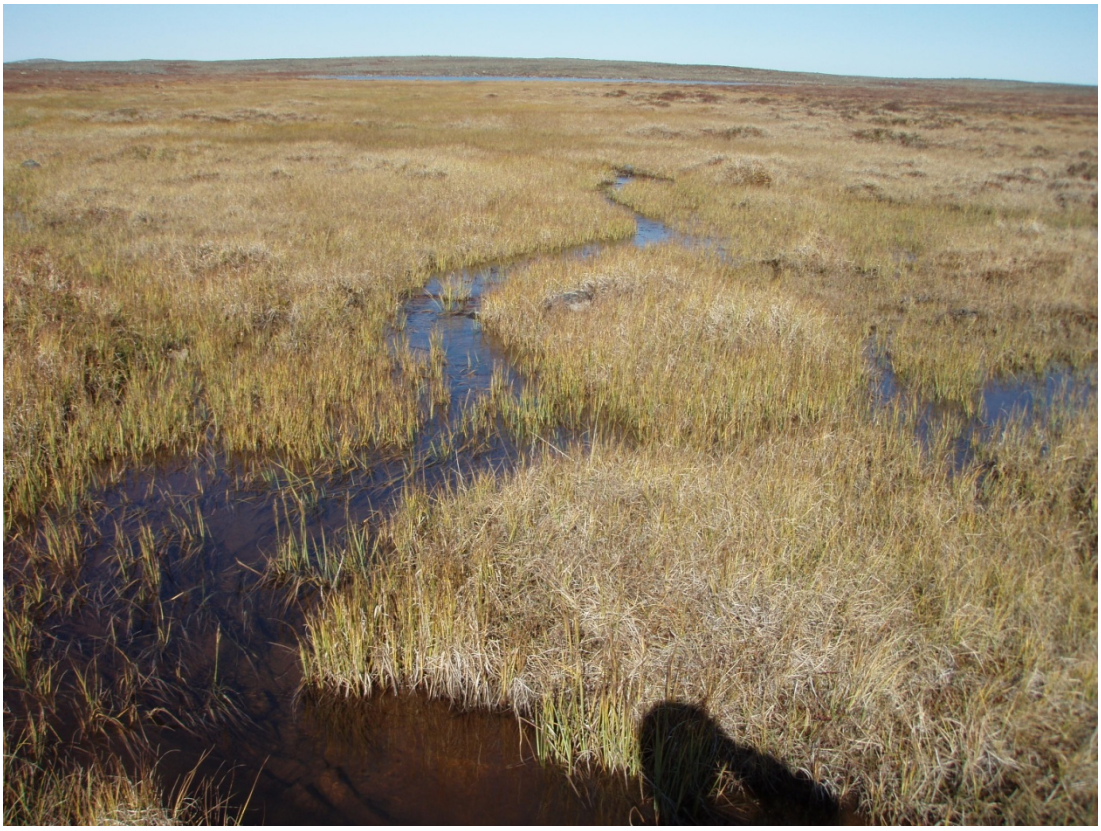
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Location 53. Photograph from the ground. Upstream view from watercourse mouth.



Location 53. Photograph from the ground. Upstream view from 65 m upstream from the approximate crossing location.

APPENDIX 6-K

Portt 2015 Whale Tail Pit Baseline Report

June 2016
Report No. 1541520

AGNICO EAGLE

Golder Associates

WHALE TAIL PIT 2015 FISH AND FISH HABITAT FIELD INVESTIGATIONS: AGNICO EAGLE MINES LTD. - MEADOWBANK DIVISION



Submitted to:

Agnico Eagle Mines Ltd: Meadowbank Division
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December 20, 2015.

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EXECUTIVE SUMMARY

Agnico Eagle Mines Limited: Meadowbank Division (Agnico Eagle) is proposing to develop Whale Tail Pit, a satellite deposit on the Amaruq property, in continuation of mine operations and milling of the Meadowbank Mine. Preliminary field investigations were undertaken in September 2014, which included aerial reconnaissance and photographing the study area by helicopter and two gill net sets in the three largest lakes in the study area. In 2015, field investigations examining fish and fish habitat in the Whale Tail Pit study area were undertaken during the period June 19 – August 30. The 2015 field investigations focussed on Whale Tail Lake and Mammoth Lake, and the tributary watercourses and smaller lakes within the study area that are most likely to be affected by future mining activity.

The primary activities conducted in 2015 were:

- downstream reconnaissance to determine if there are barriers to upstream fish migration,
- deployment of hoop nets on potential migration routes at the beginning of the field season to detect spring migrations if they occurred,
- habitat characterization, visual inspections for spawning fishes, and fish sampling to determine seasonal fish use using electrofishing and large minnow traps, in the tributaries to Whale Tail Lake,
- fish sampling in Whale Tail Lake and Mammoth Lake using gill nets, shoreline electrofishing and minnow traps to characterize the fish community,
- habitat characterization and fish sampling to determine species presence:absence, by gill netting and shoreline electrofishing, in smaller lakes and ponds with surface connections to Whale Tail Lake during the summer,
- collection of tissue samples from Lake Trout in Whale Tail Lake and Mammoth Lake for the determination of the concentrations of mercury and other metals,
- characterization of periphyton development at locations in Whale Tail Lake, Lake A53 and Mammoth Lake.

A total of six fish species were captured, comprised of four large-bodied species (Lake Trout , Arctic Char, Round Whitefish and Burbot) and two small-bodies species (Slimy Sculpin and Ninespine Stickleback). Lake Trout were the most abundant in gill net catches and the most widely distributed among the lakes, followed by Round Whitefish and Arctic Char. Only one Burbot was captured. Low numbers of juvenile Arctic Char and juvenile Lake Trout were captured in some of the Whale Tail Lake tributaries. Ninespine Stickleback and Slimy Sculpin were widely distributed in the larger lakes and in the tributaries.

Netting catch per unit effort was low for all species. In Mammoth, Whale Tail and Nemo Lakes combined, average catch per unit effort in gill nets, calculated as the number of individuals captured per hour of soak time using a standard AEM gill net was 0.5, 0.1 and 0.01 for Lake Trout, Round Whitefish and Arctic Char, respectively. Large mesh hoop nets set between June 19 and July 13, 2015, in areas where there was thought to be potential for fish movement between lakes caught one Lake Trout and one Arctic Char in 3000 hours of soak time. In total, electrofishing 1,978 m of lake shoreline resulted in

the capture of 145 Ninespine Stickleback, 55 Slimy Sculpin, 2 juvenile Arctic Char and 3 juvenile salmonids, either Arctic Char or Lake Trout, which were not identified to species. There were, however, several isolated or nearly isolated small lakes and ponds in which no fish were captured. Most of these were located north of Whale Tail Lake.

Electrofishing effort on study area tributaries over the 2015 field season totalled 24,709 electroseconds and 3,569 m. The most abundant species in the catches was Ninespine Stickleback (n=469) followed by Slimy Sculpin (n=237). Low numbers of juvenile Arctic Char (n=13), juvenile Lake Trout (n=8), as well as one juvenile each of Round Whitefish and Burbot were captured in the tributaries. Juvenile Arctic Char were captured by electrofishing in five of the tributaries to Whale Tail Lake and juvenile Lake Trout were captured in three. Large minnow traps set in tributaries caught 9 Slimy Sculpin and 1 juvenile Round Whitefish in 2640 hours of soak time.

There were several isolated or nearly isolated small lakes and ponds in which no fish were captured. There was only interstitial flow connection during the 2015 spring freshet between Whale Tail Lake and four of the larger lakes that drain to it. This was also the case for two lakes that drain to Mammoth Lake. The connection between Whale Tail and Mammoth Lake had only interstitial flow once water levels and flows subsided.

No Arctic Grayling were observed or captured in the study area. Their apparent absence is consistent with the paucity of suitable spawning habitat and absence of riverine adult habitat in the tributaries to Mammoth and Whale Tail Lake.

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1.0 INTRODUCTION

Agnico Eagle Mines Limited: Meadowbank Division (Agnico Eagle) is proposing to develop Whale Tail Pit, a satellite deposit on the Amaruq property, in continuation of mine operations and milling of the Meadowbank Mine. The Amaruq Exploration property is a 408 square kilometre (km^2) site located on Inuit Owned Land approximately 150 kilometres (km) north of the hamlet of Baker Lake and approximately 50 km northwest of the Meadowbank Mine in the Kivalliq region of Nunavut (**Figure 1-1**). The property was acquired by Agnico Eagle in April 2013 subject to a mineral exploration agreement with Nunavut Tunngavik Incorporated.

The Meadowbank Mine is an approved mining operation and Agnico Eagle is looking to extend the life of the mine by constructing and operating Whale Tail Pit (referred to in this document as the Project). As an amendment to the existing operations at the Meadowbank mine, it is subject to an environmental review established by Article 12, Part 5 of the *Nunavut Land Claims Agreement* (NLCA). Baseline data have been collected in support of the Environmental Review to document existing conditions and to provide the foundation for a qualitative and quantitative assessment of project operations and the extension of the mine development, to be evaluated in the Environmental Impact Statement (EIS) for the Project.

Preliminary field investigations were undertaken by C. Portt and Associates in September 2014. On September 2, 2014, oblique aerial photographs were taken from a helicopter of the shoreline and near-shore of Mammoth Lake, Whale Tail Lake, Nemo Lake and adjacent smaller lakes and ponds. In addition, two gill net sets were conducted in each of Mammoth Lake, Whale Tail Lake and Nemo Lake from September 4-6, 2014. In 2015, field investigations examining fish and fish habitat in the Whale Tail Pit study area were undertaken by C. Portt and Associates during the period June 19 – August 30. The 2015 field investigations focussed on Whale Tail Lake and Mammoth Lake, and the tributary watercourses and smaller lakes within the study area that are most likely to be affected by future mining activity. Preliminary field investigations conducted in September of 2014 had determined that Lake Trout (*Salvelinus namaycush*) and Arctic Char (*Salvelinus alpinus*) were present in Whale Tail Lake.

The primary activities conducted in 2015 were:

- downstream reconnaissance to determine if there are barriers to upstream fish migration,
- deployment of hoop nets on potential migration routes at the beginning of the field season to detect spring migrations if they occurred,
- habitat characterization, visual inspections for spawning fishes, and fish sampling to determine seasonal fish use using electrofishing and large minnow traps, in the tributaries to Whale Tail Lake,
- fish sampling in Whale Tail Lake and Mammoth Lake using gill nets, shoreline electrofishing and minnow traps to characterize the fish community,
- habitat characterization and fish sampling to determine species presence:absence, by gill netting and shoreline electrofishing, in smaller lakes and ponds with surface connections to Whale Tail Lake during the summer,

- collection of tissue samples from Lake Trout in Whale Tail Lake and Mammoth Lake for the determination of the concentrations of mercury and other metals,
- characterization of periphyton development at locations in Whale Tail Lake, Lake A53 and Mammoth Lake.

This report documents the methods and results of these investigations.

1.1 Scope

This report presents the investigations of fish and fish habitat conducted in the Whale Tail Pit study area based on field work conducted during the period June 19 to August 30, 2015.

1.2 Objectives

- Characterize the existing fish and fish habitat conditions in Mammoth Lake, Whale Tail Lake, and smaller lakes and watercourses that would potentially be impacted by future mining.

- Collect fish tissue samples from Mammoth Lake and Whale Tail Lake for metals, including mercury, determinations.

1.3 Physical Setting

The study area is located on the Canadian Shield within a Low Arctic ecoclimate of continuous permafrost, which is one of the coldest and driest regions of Canada (Azimuth, 2010). The lakes within the Whale Tail pit study area are ultra-oligotrophic/oligotrophic (nutrient poor, unproductive) headwater lakes that are typical of the Arctic. The ice-free season on the lakes is very short. Ice break-up usually occurs during mid- to late-June, and ice begins to form again on the lakes in late September or early October. Complete ice cover is attained by late October, with maximum ice thickness of about 2 m occurring in March/April (Azimuth, 2013). Many small watercourses become dry once the land begins to freeze in the fall and, where water is present, most freeze to the bottom during the winter (BAER, 2005; Jones *et al*, 2010). Flows during the spring melt and the summer vary with drainage area.

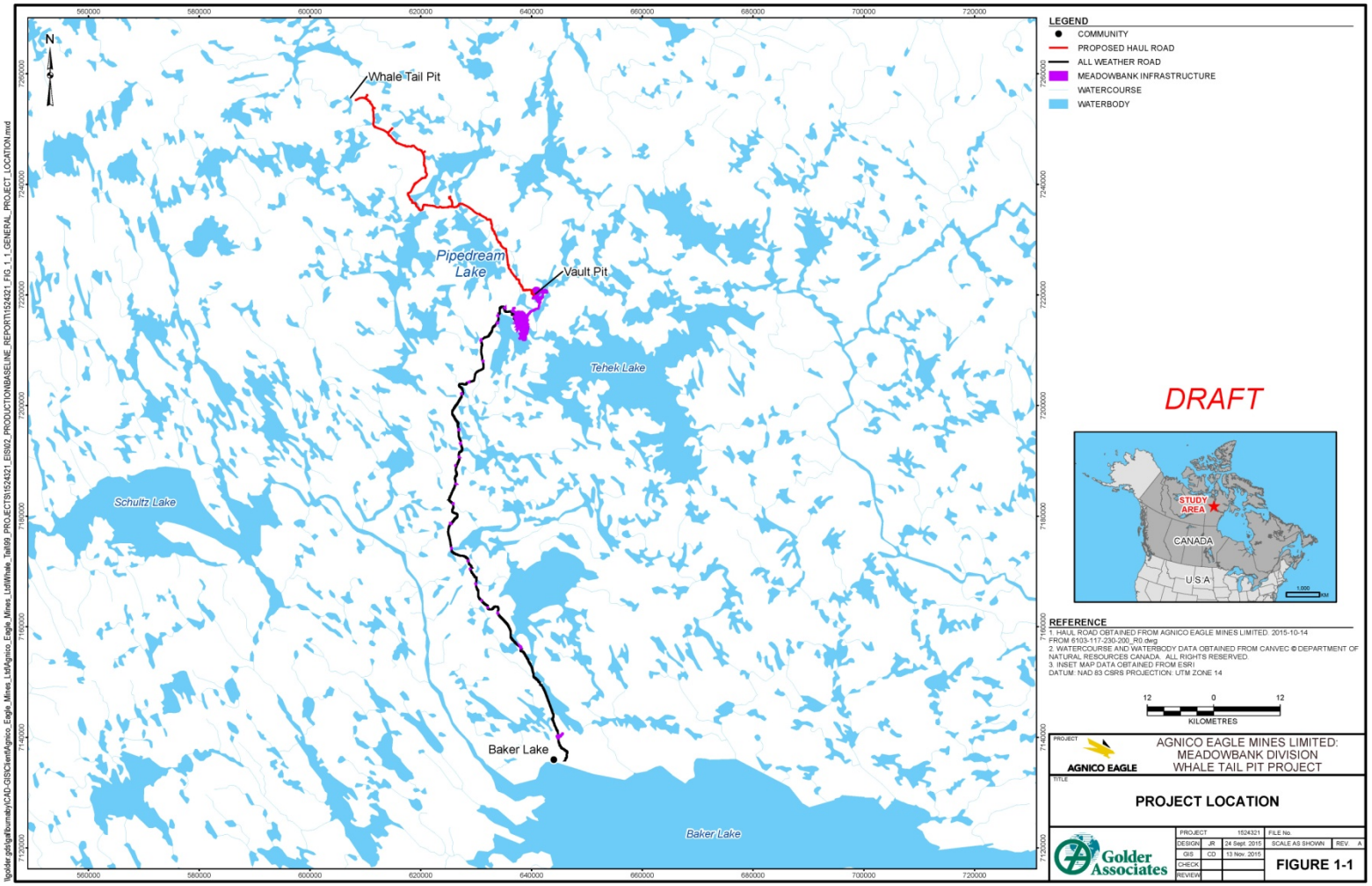


Figure 1-1. Location of the proposed Whale Tail Pit Study Area.

2.0 RECONNAISANCE TO ASSESS THE POTENTIAL FOR FISH PASSAGE FROM DOWNSTREAM

2.1 Methods

The hydrologic setting of the study area is shown in **Figure 2-1**. The lakes were assigned alpha-numeric codes to facilitate discussion, with the letter designating the subwatershed and, within each branch, the number increasing in an upstream direction. The primary study area is in the headwaters of subwatershed A, which drains via a series of lakes and connecting channels to a large lake downstream, labelled DS1.

On June 19, 2015, the lakes and connecting channels were observed and photographed, from the air, from the outlet of Mammoth Lake downstream to the connecting channel between lakes A10 and A9. On that date the spring melt was well underway, but ice still covered most of the surface of the lakes. No barriers to fish movement were observed. On July 4, 2015, the outlet of Mammoth Lake was examined and photographed on the ground. On July 12, 2015, the connecting watercourses from the outlet of Mammoth Lake downstream to the outlets of lake A75 were observed and photographed from the air, and the channel connecting lakes A76 and A75 was examined on the ground on July 13, 2015. On July 23, 2015, a video was taken from the air, flying from lake DS1 upstream along the lakes and connecting channels to lake A11, and the two outlets of lakes A12 and A76 were examined on the ground.

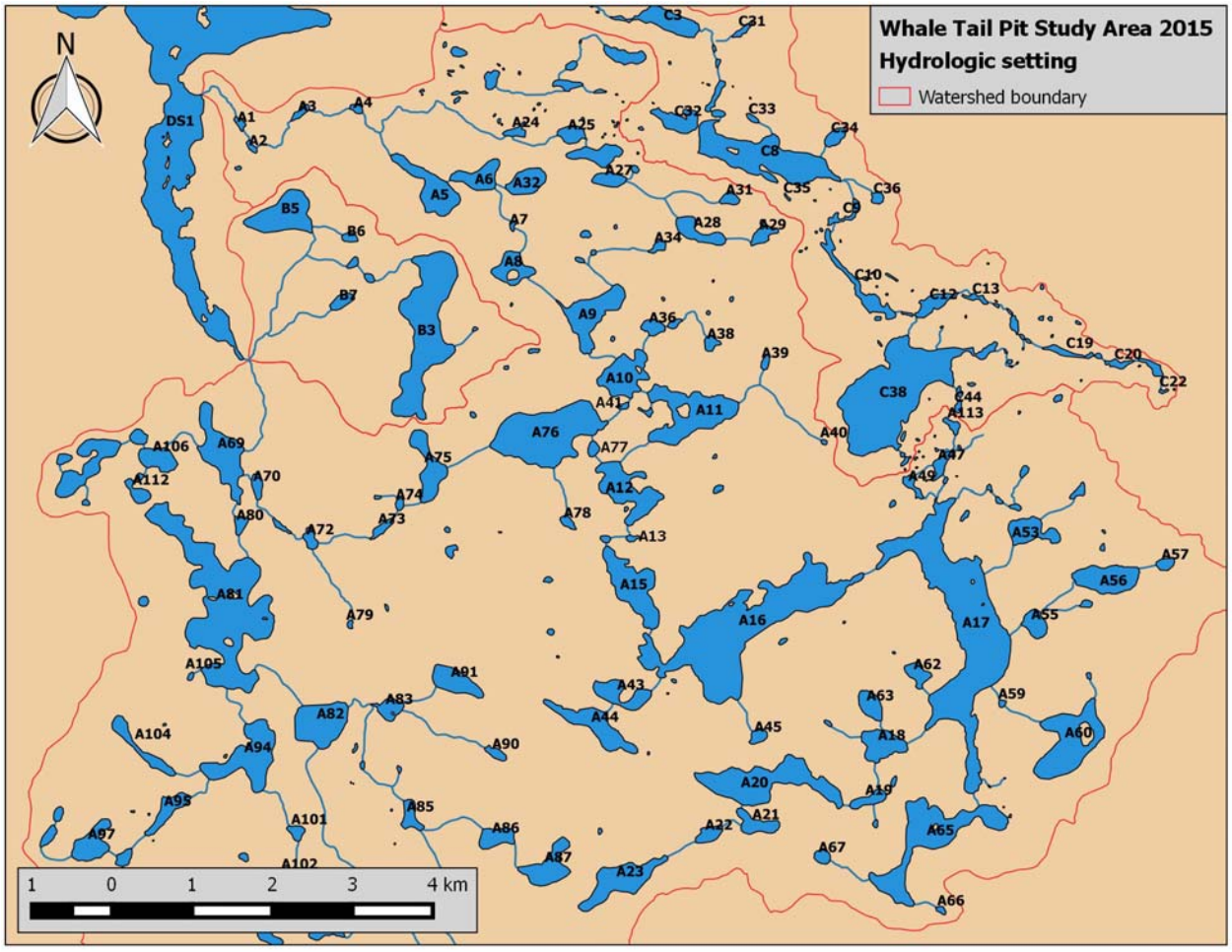


Figure 2-1. Hydrologic setting and lake identification codes. Mammoth Lake is A16 and Whale Tail Lake is A17.

2.2 Results

There was surface flow through the connecting channels and no barriers to fish movement were observed between lake A9 and Mammoth Lake on June 19, 2015. There was no barrier to fish movement between Mammoth Lake and lake A15 on July 4, 2015, although most of the rapids was less than 20 cm deep.

There are two locations downstream from Mammoth Lake where water flows out of a lake in two directions. There is flow from lake A12 to lake A11 and also to lake A77. There is flow from lake A76 to lake A75 and to lake A10. The connection between lakes A76 and A75 is via a boulder feature that is over 0.5 km long (**Figure 2-2**). Based on the aerial reconnaissance on July 12 and examination of watercourse A76-A75 on the ground on July 13 and July 23, 2015, it

is considered unlikely that there is ever a surface connection that would allow large fish passage between these two lakes.

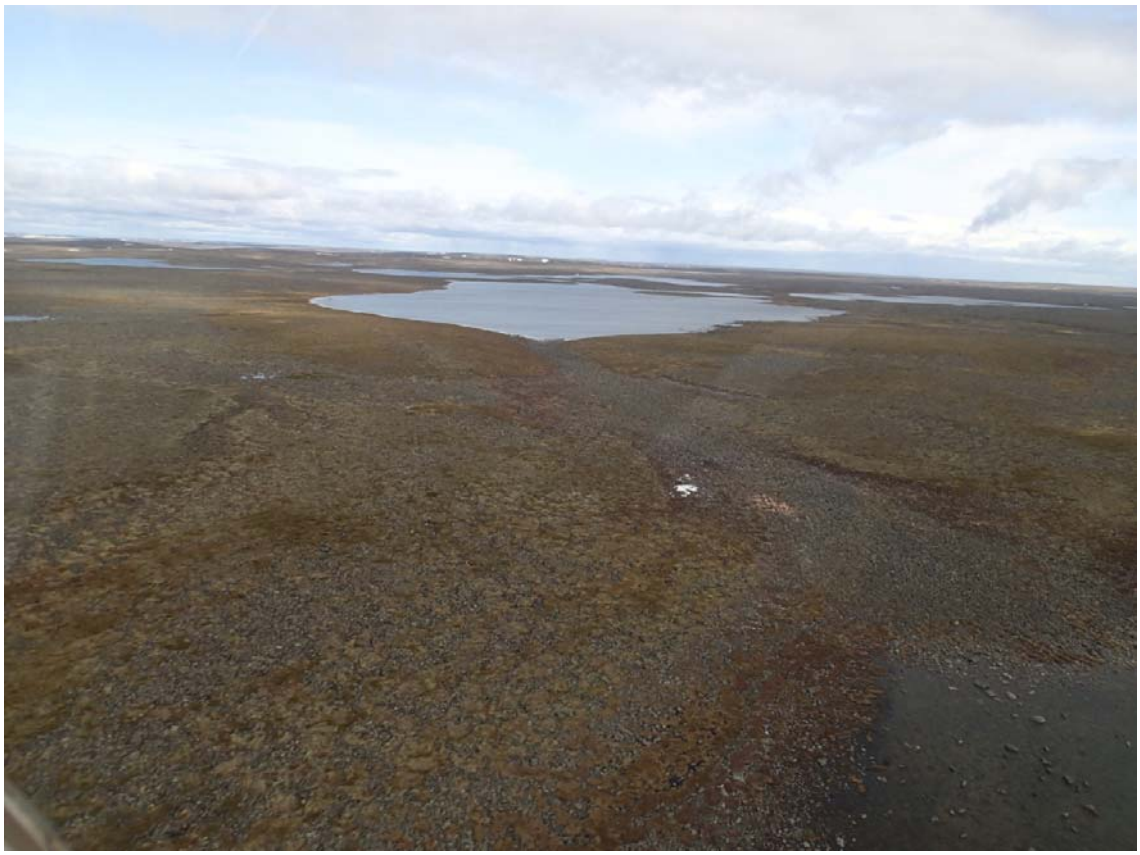


Figure 2-2. Connecting channel between lake A75 (foreground) and lake A76. July 12, 2015.

The primary flow path and the most likely route for fish passage, if it occurs, between lake DS1 and Mammoth Lake is via lakes A1-A2. . . . A10-A11-A12, etc. Via this route, the distance between lake DS1 and the outlet of Mammoth Lake, estimated from satellite imagery, is approximately 12.2 km. No waterfall or other vertical barrier to upstream fish migration was observed between lake DS1 and Mammoth Lake along this route, and large fish passage may be possible during the spring freshet. There are, however, a number of connecting channels where there is no surface connection, only interstitial flow, after water levels and flows decrease. Based on the July 12, 2015, aerial reconnaissance and photographs, large fish passage between lakes A13 and A12, between lakes A12 and A11, and between lakes A76 and A41 would have been difficult, if not impossible, under the prevailing flow conditions because there was only interstitial flow in portions of those connecting channels. The connections between lakes A10 and A76 (**Figure 2-3**), lakes A11 and A12 (**Figure 2-4**) and lakes A77 and A12 (**Figure 2-5**) were all considered impassable to large fish when examined on the ground on July 23, 2015. Based on the July 23, 2015, observations and a review of the aerial video taken on that date, it is thought that large fish passage would have been difficult or impossible on that date due to interstitial flow in portions of each of the connecting channels from lake A10

downstream to lake A6 and from the downstream end of lake A5 to where the tributary from lake A24 enters, approximately 9 km downstream from the Mammoth Lake outlet. There were no significant impediments to flow observed from that point downstream to Lake DS1.



Figure 2-3. Connecting channel between lake A10 and lake A76. July 23, 2015.



Figure 2-4. Connecting channel between lakes A11 and A12. July 23, 2015.

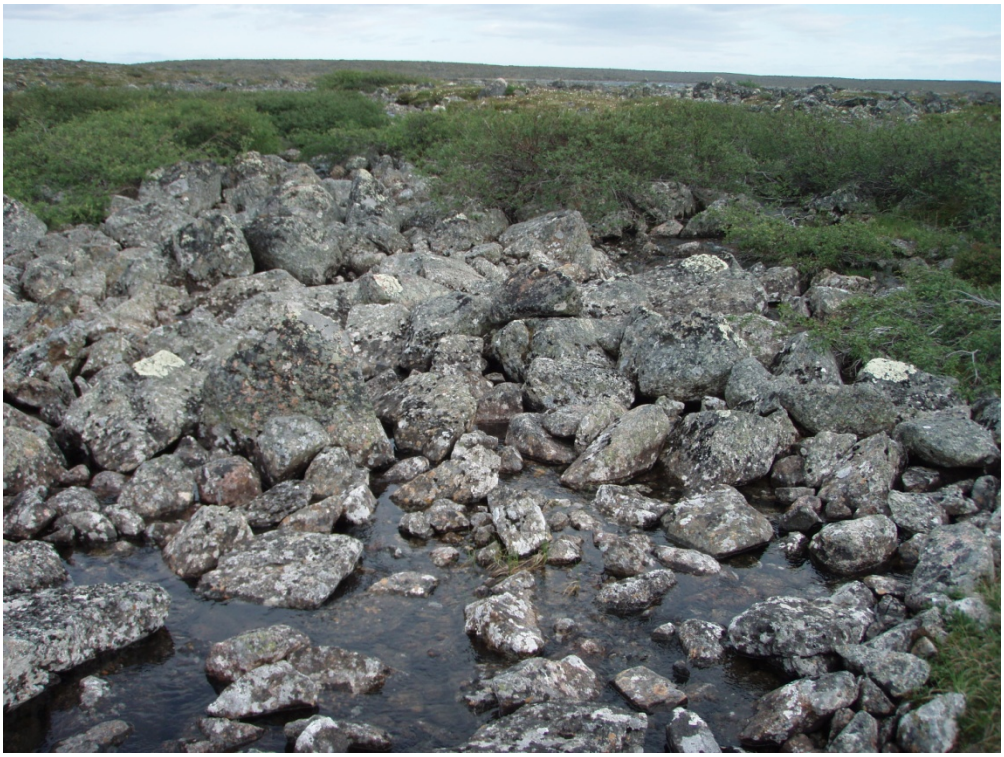


Figure 2-5. Connecting channel between lakes A77 and A12. July 23, 2015.

3.0 HOOP NETTING ON POTENTIAL MIGRATION ROUTES

3.1 Methods

Large-mesh hoop nets were set at four general locations (**Figure 3-1**): in the outlet from Mammoth Lake (LHN1; June 19-July 4), in the narrows between Mammoth and Whale Tail Lake (LHN2 and LHN3; June 19 – July 13), at the south end of Whale Tail Lake near the mouth of tributary A18-A17 (LHN4; June 26-July 13) and at the mouth of tributary A55-A17 (LHN5, June 26-July 13). These nets were constructed of 4.75 cm stretch mesh and are 3 m long. The D-shaped front 'hoop' was 0.76 m high with a 0.51 m base, followed by four circular hoops, with 0.14 m diameter funnel throats attached to the first and third circular hoops. The wings were 0.76 m high and constructed of the same 4.75 cm stretch mesh. Four of these nets (nets 2, 3, 4 and 5, **Table 3-1**) had 3 m long wings and two (nets 1 and 6, **Table 3-1**) had 6 m long wings. No leaders were attached.

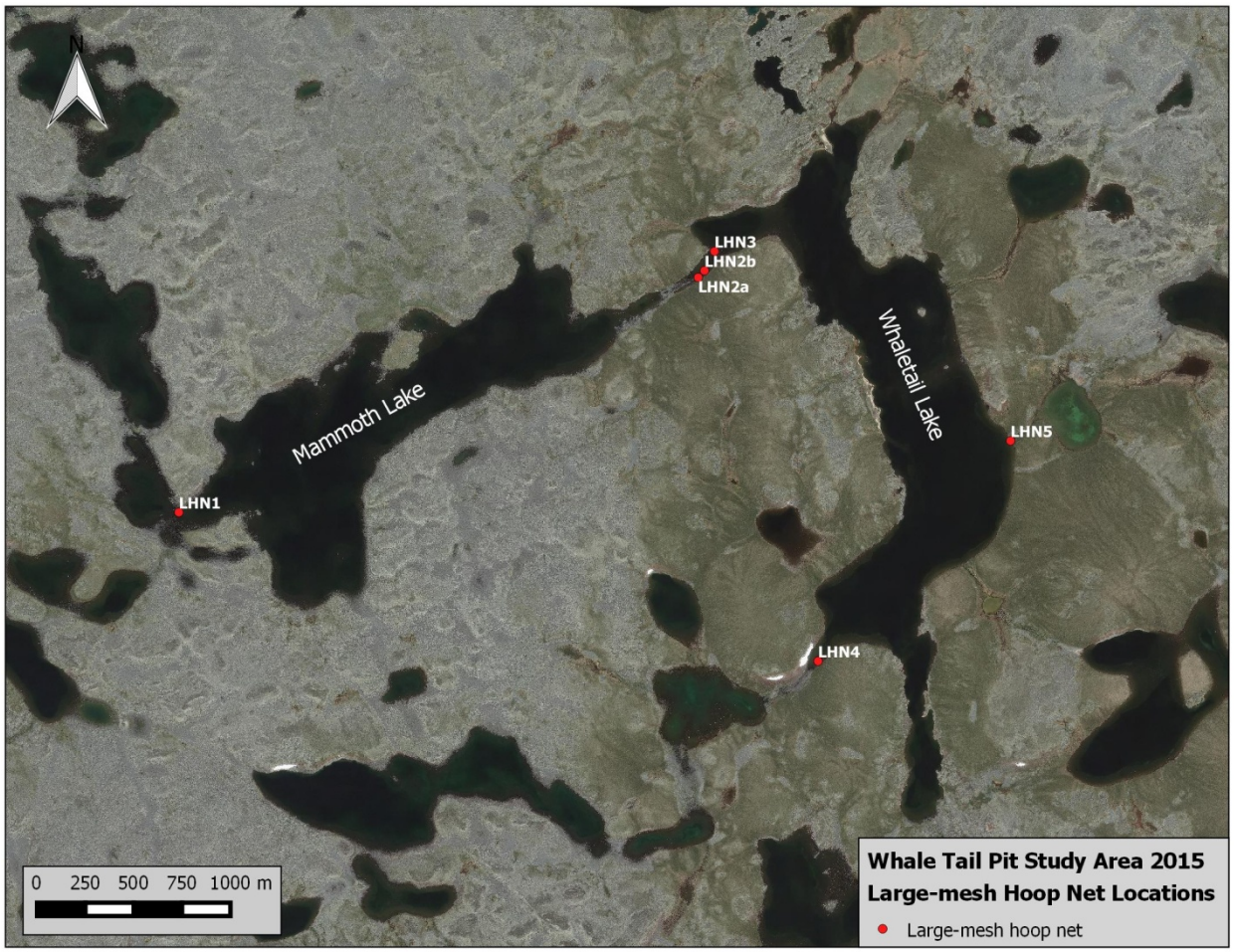


Figure 3-1. Locations where large-mesh hoop nets were set in 2015.

One net was deployed, facing downstream, in a narrows near the outlet of Mammoth Lake (LHN1) and in the narrows between Whale Tail and Mammoth lakes (LHN2a) on June 19, 2015. A second net was deployed at each of these locations, also facing downstream, on June 21, 2015. On June 27, 2015, one net at each of those locations was reversed to face upstream. At the outlet of Mammoth Lake water levels fell to below the first funnel in the net that was facing upstream between June 27 and July 3. The net was repositioned so that the funnels were all at least half submerged when it was lifted and redeployed on July 3. By July 4, 2015, however, the water level at the narrows near the outlet of Mammoth Lake had fallen to the point that there was no longer sufficient depth to deploy the large-mesh hoop nets. The two nets from that location were removed and redeployed, at Location LHN3, in the narrows between Whale Tail and Mammoth lakes, with one net facing upstream and the other facing downstream. The large-mesh hoop nets initially set in the narrows between Whale Tail and Mammoth lakes were moved to a deeper area (from LHN2a to LHN2b), approximately 50 m upstream from where they were originally deployed, on June 28, 2015. The net deployed in Whale Tail Lake near the mouth of tributary A18-A17 (LHN4) and at the mouth of tributary A55-A17 both faced downstream and remained in the same location for the duration of their deployments. The nets were typically lifted and redeployed daily, but longer soak times occurred on occasion due to weather conditions and other logistic factors.

3.2 Results

Dates of deployment and removal, the direction (upstream or downstream) that the opening of the net was facing, and total soak time are provided in Table 3-1. The dates and times that each net was checked for fish are provided in Appendix A. In a total of 3000 hours of soak time, only two fish were captured by the large-mesh hoop nets. Both of these fish, one lake trout (fork length=69 cm) and one Arctic Char (fork length=27cm) were entangled in a wing of the net at LHN5, at the mouth of tributary A55-A17, on July 6, 2015, while the net was being checked.

Table 3-1. Large-mesh hoop nets locations, deployment and removal dates, net orientation and total soak time. Refer to Figure 3-1 for locations.

Location description	Location code	Net #	Opening facing	Date set	Date removed	Total soak time (days)
Narrows near outlet of Mammoth Lake	LHN1	1	downstream	June 19, 2015	July 4, 2015	15
		3	downstream	June 21, 2015	June 27, 2015	6
			upstream	June 27, 2015	July 4, 2015	7[1]
Between Whale Tail and Mammoth Lakes	LHN2a	2	downstream	June 19, 2015	June 27, 2015	8
			upstream	June 27, 2015	June 28, 2015	1
		4	downstream	June 21, 2015	June 28, 2015	7
	LHN2b	2	upstream	June 28, 2015	July 13, 2015	15
		4	downstream	June 28, 2015	July 13, 2015	15
	LHN3	1	upstream	July 4, 2015	July 13, 2015	9
		3	downstream	July 4, 2015	July 13, 2015	9
South end of Whale Tail Lake	LHN4	6	downstream	June 26, 2015	July 13, 2015	17
Whale Tail tributary A55-A17	LHN5	5	downstream	June 26, 2015	July 13, 2015	17

1. Front funnel was not submerged when lifted on July 3.

4.0 FISH SAMPLING IN WHALE TAIL, MAMMOTH AND NEMO LAKES

In 2014 fish sampling was limited to two gill net sets in each of Whale Tail, Mammoth and Nemo Lakes. In 2015, short-duration and overnight gill netting, shoreline electrofishing and minnow trapping were undertaken to characterize the fish communities in Whale Tail and Mammoth Lakes. Two overnight sets of small-mesh hoop nets were also conducted in Whale Tail Lake in 2015. Fish sampling in Nemo Lake, which is not expected to be directly affected by the project, was limited to two gill net sets in 2015. The sampling locations are shown in Figure 4-1, Figure 4-2, and **Figure 4-3** for Mammoth, Whale Tail and Nemo Lakes, respectively.

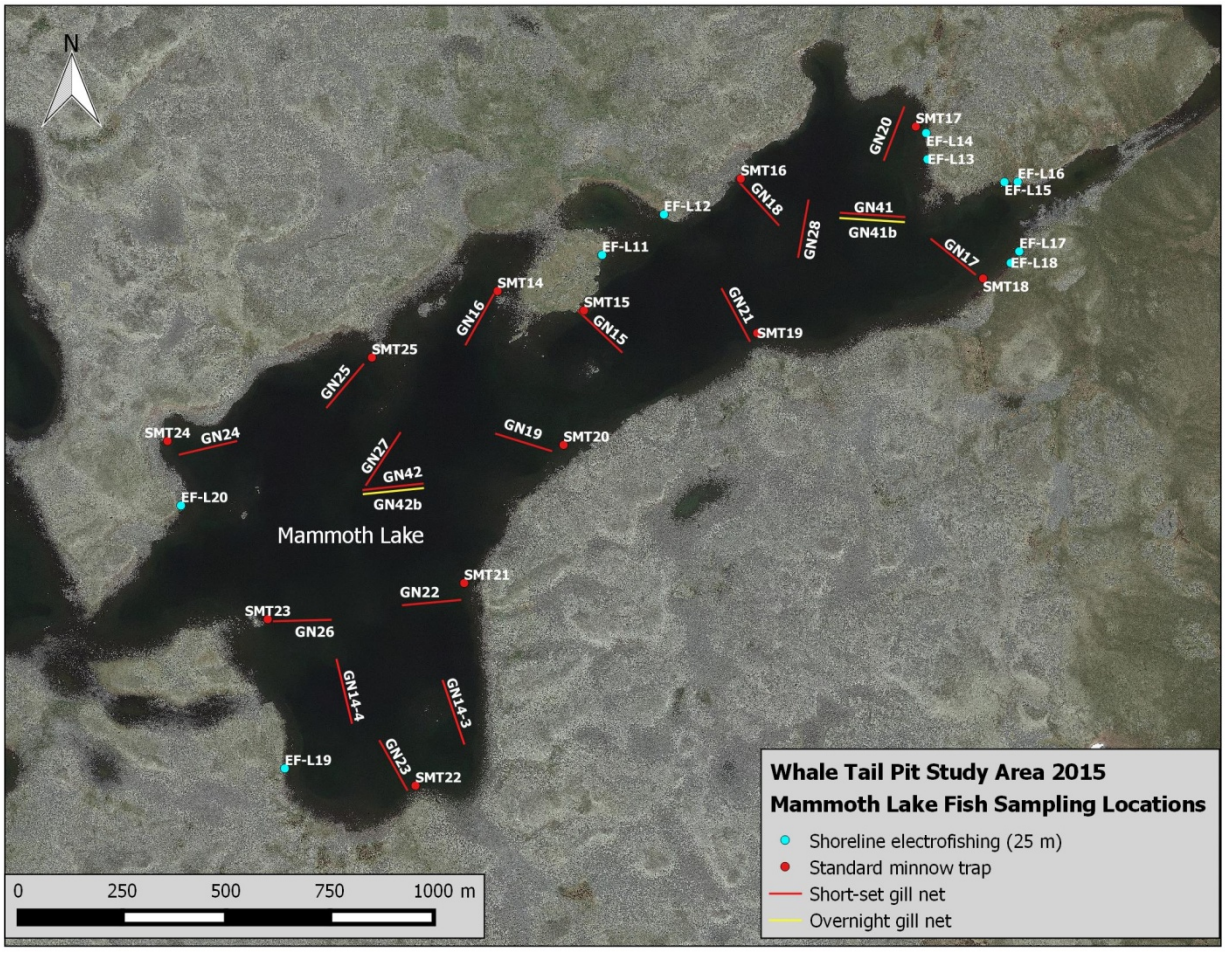


Figure 4-1. Fish sampling locations in Mammoth Lake in 2014 and 2015.

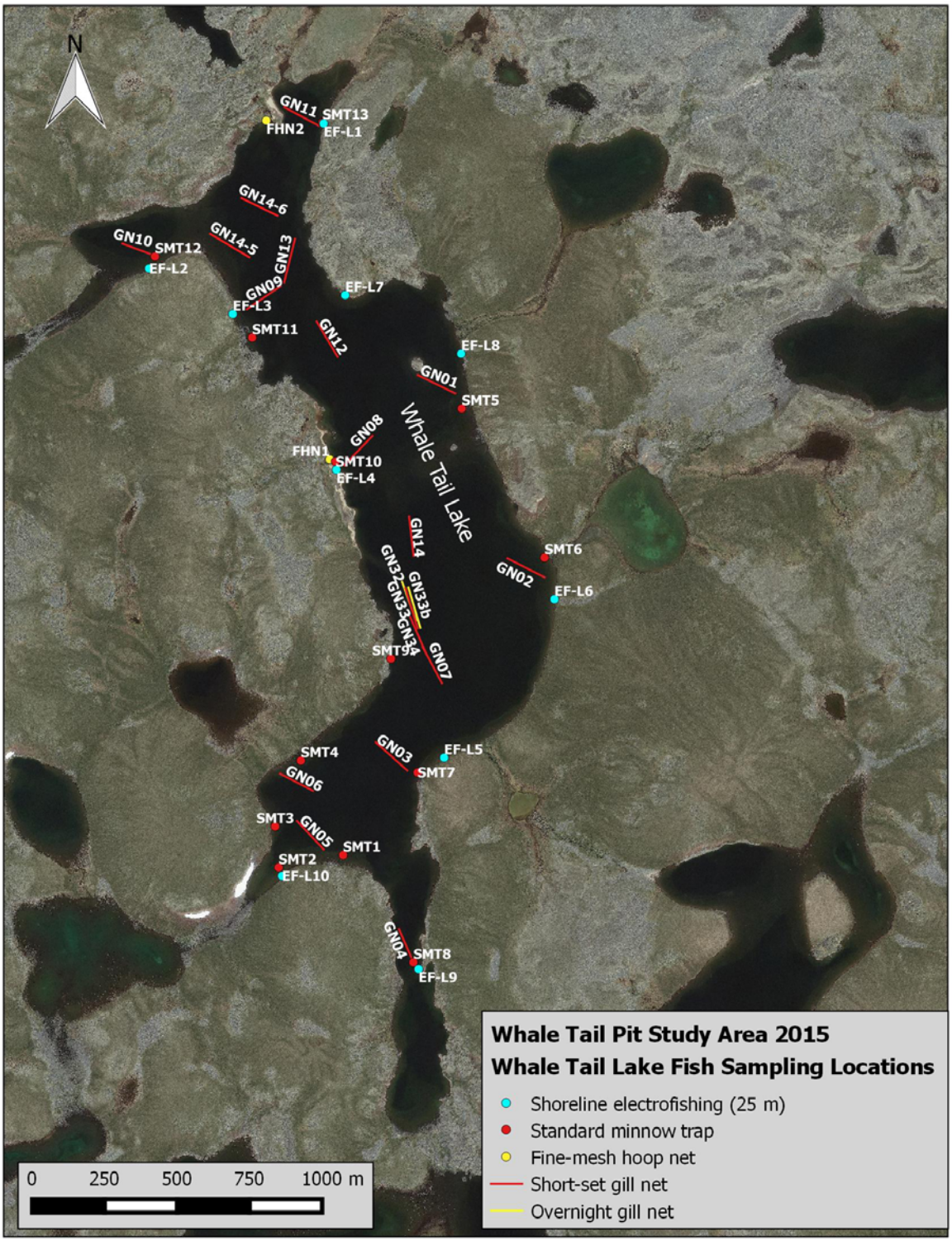


Figure 4-2. Fish sampling locations in Whale Tail Lake in 2014 and 2015.

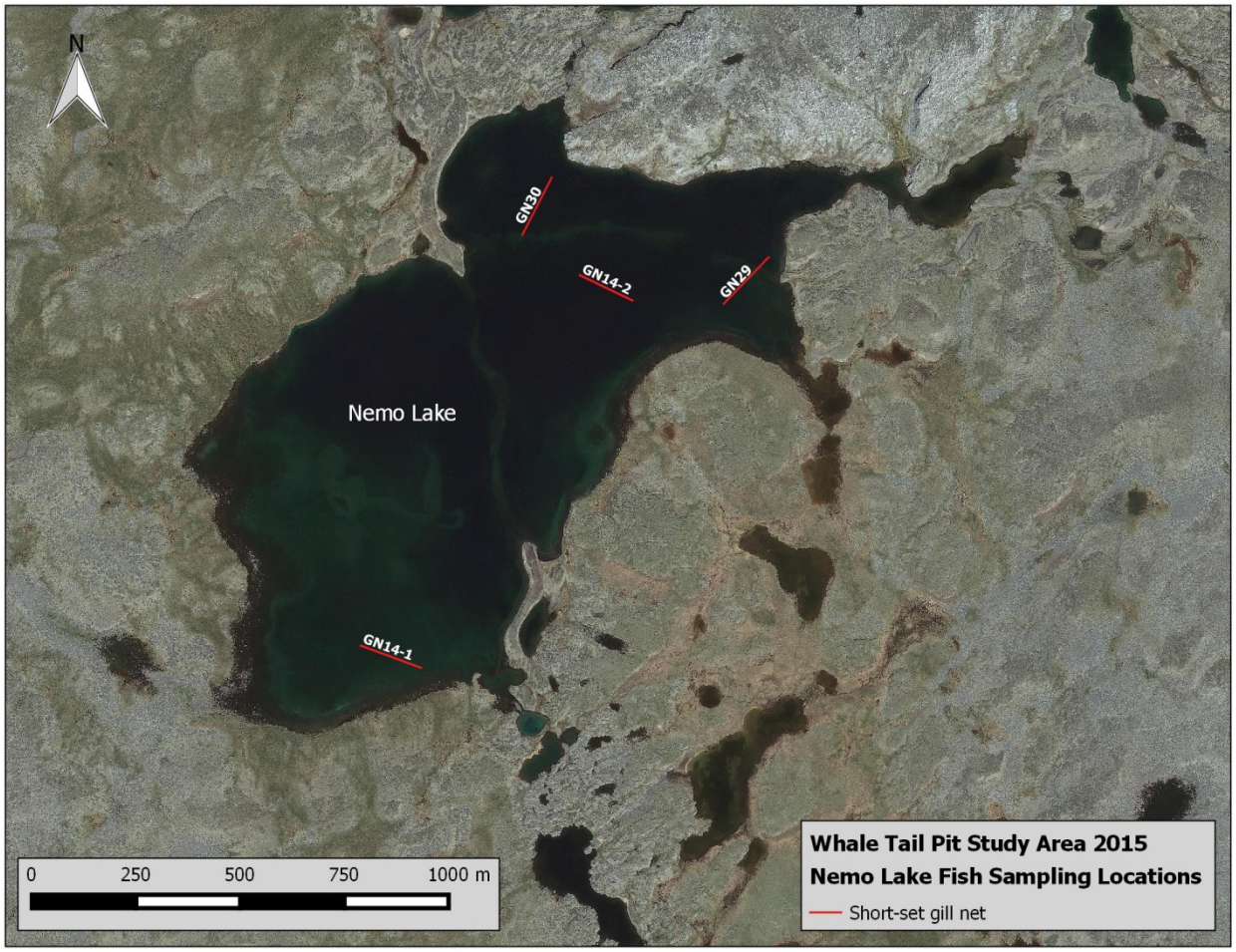


Figure 4-3. Fish sampling locations in Nemo Lake in 2014 and 2015.

4.1 Gill netting

4.1.1 Methods

All gill netting, unless otherwise noted, was conducted using standard AEM index gill nets comprised of six panels of stretched mesh (sizes 126, 102, 76, 51, 38, and 25 mm). Each panel of was 1.8 m (6 feet) deep by 22.7 m (25 yards) long, so that the length of a six-panel gang was 136.4 m (150 yards).

Two daytime gill net sets were conducted in each of Mammoth Lake, Whale Tail Lake, and Nemo Lake on September 4, 5 and 6, 2014, respectively. One gill net was set in a shallow shoal area and the second was set to sample a deeper part of each lake. The date and time of deployment and lifts were recorded as were the coordinates of each end of each net, determined using a Garmin GPSmap 76CSx hand-held receiver, and the depth, determined using a portable sonar unit. The gill nets were lifted after soak times of approximately 6.5

hours (range 6.3 – 6.7 hours). Each fish captured was identified to species and, with the exception of individuals that escaped during handling, its fork length was determined to the nearest mm using a standard fish measuring board and its weight was determined to the nearest gram using a Rapala digital hanging scale. Live fish were released immediately and dead fish were retained for later disposal.

Short-duration gill netting was conducted on Whale Tail Lake on July 24-26, 2015 and on Mammoth Lake on July 28 and 29, 2015. To select the gill net locations, the shoreline of each lake was divided into 12 segments of equal length. A gill net was set in each segment, approximately perpendicular to the depth contours, within the limitations imposed by shallow areas and wind conditions. Two additional sets were located in the deepest areas of each lake for a total of 14 net sets per lake (Figure 4-1, Figure 4-2). The date and time of deployment and lifts were recorded. The coordinates at each end of each net were determined using a Garmin Oregon 650 gps, and the depth at each end was determined using a Humminbird 798ci HD SI Sonar unit. These nets were set for a mean of 2.25 hours (range 1.92 hours – 2.83 hours).

The number of individuals of each species captured in each net was recorded. Each fish was examined for external anomalies and fork length was determined to the nearest mm using a standard fish measuring board. The total weight of each individual weighing more than 500 g was determined to the nearest 10 grams using a Rapala digital hanging scale. The total weight of individuals weighing less than 500 g was determined to the nearest g, or in some cases nearest 0.1 g, using an Ohaus Scout Pro Model 6001 electronic balance. Fish that were alive were tagged with a numbered Floy tag and released.

The body cavity of dead fish was opened and the viscera were examined for any anomalies. The gonads were examined to determine the sex and maturity of the specimen. Females with opaque ovaries containing developing eggs visible with the naked eye were considered to be sexually mature. Females with translucent ovaries that did not contain eggs which were visible to the naked eye were considered to be immature. Males with opaque testes were considered to be mature, and males with small translucent testes were considered to be immature. The liver and gonads were removed and weighed to the nearest 0.1 g using an Ohaus Scout Pro Model SP6001 electronic balance. One or both otoliths and the leading ray from the right pectoral fin were taken from the majority of the dead Lake Trout for subsequent aging.

Lake Trout were aged by Louise Stanley, a fish aging expert who provides consulting services. Otoliths were mounted whole on a glass slide with CrystalBond thermoplastic adhesive, ground to the core on one side, flipped to adhere the core area to the glass, and then ground to a thin section on the other side. The proximal end of each fin ray was ground flat and then cut away from the rest of the ray with wire cutters. The flat proximal end was mounted on a glass slide with CrystalBond thermoplastic adhesive and the remaining fin ray ground away to leave a thin section. Age was estimated based on the number of annuli counted using transmitted light and a Leica GZ6 Stereo Zoom microscope. The number of annuli on fin rays and otoliths were determined independently (i.e. without reference to each other) when both were available for a fish.

One overnight gill net set was conducted on Whale Tail Lake on August 17-18 and another on August 18-19 to determine the CPUE in overnight sets and to obtain Lake Trout tissue samples for mercury and metals analysis. Unlike the short duration gill net sets which were distributed about the lakes, these nets were set in locations thought to be good Lake Trout habitat. Each of these nets was reset for several hours at the same location on the second day in order to obtain a sufficient number of samples for mercury and metals analyses. These are referred to as miscellaneous gill net sets. Two overnight gill net sets were conducted in Mammoth Lake on August 26-26, preceded by daytime (miscellaneous) sets of 5.4 and 5.5 hours duration at the same locations, also in locations considered to be good Lake Trout habitat, to obtain Lake Trout tissue samples for mercury and metals analysis.

The Lake Trout captured were euthanized with a blow to the head followed by cervical severance and processed in the same manner as dead fish from the short gill net sets. Tissue samples for mercury and metals analyses were collected from these fish as described in Section 4.5. Live Round Whitefish (*Prosopium cylindraceum*) from these nets were released without being measured, weighed or tagged.

On August 2, 2015, short duration gill net sets were conducted at two locations in Nemo Lake (**Figure 4-3**). Each net was lifted once and reset at the same location, resulting in a total of four net sets with a mean soak time of 3.5 hours (range 3.33 hours – 3.63 hours). The catches were processed in the same manner as for Whale Tail and Mammoth Lakes.

4.1.2 Results

The gill netting results for Whale Tail, Mammoth and Nemo Lakes are summarized in Table 4-1. The data for individual net sets are provided in Appendix A (Table A 2). Lake Trout was the most abundant species in the gill net catches in all three lakes, followed by Round Whitefish. Arctic Char were only captured in Whale Tail. Only Lake Trout were captured in Nemo Lake. CPUE in the short-duration gill net sets was higher in Mammoth Lake than in Whale Tail Lake for both Lake Trout and Round Whitefish. Lake Trout CPUE was the same in both lakes for the overnight gill net sets. This may reflect the fact that the overnight sets targeted good Lake Trout habitat unlike the short-duration sets, which were distributed more or less evenly around the lakes.

The data for individual fish captured in gill nets are provided in Appendix A (**Table A 3** and **Table A 4**). The length distributions of Lake Trout captured by gill nets in 2015 differed between Whale Tail and Mammoth Lakes (Figure 4-4), with individuals 400 mm or shorter accounting for 81% of the catch in Mammoth Lake and only 36% of the catch in Whale Tail Lake. The Lake Trout age distributions in 2015 catches are consistent with the length distributions, with Lake Trout 15 years of age or younger, based on otolith ages, dominant in the catches from Mammoth Lake, and Lake Trout older than 15 years of age dominant in the Whale Tail Lake catches. As is typically the case, ages determined from fin rays tended to be younger than those determined from otoliths (Figure 4-6). There were too few individuals of other species captured to allow meaningful comparisons of length distributions to be made.

Table 4-1. Summary of gill net catches and catch per unit effort (CPUE; number of fish caught per hour of soak time), by lake, year, set duration and species.

Lake and year	Set duration	Number of sets	Total soak time (hours)	Lake Trout		Arctic Char		Round Whitefish	
				catch	CPUE	catch	CPUE	catch	CPUE
Whale Tail 2014	miscellaneous	2	12.7	5	0.39	1	0.08	0	0.00
Mammoth 2014	miscellaneous	2	13.2	13	0.98	0	0.00	0	0.00
Nemo 2014	miscellaneous	2	13.3	15	1.13	0	0.00	0	0.00
Whale Tail 2015	short-duration	14	30.5	5	0.15	1	0.03	3	0.09
	overnight	2	34.1	23	0.67	0	0.00	2	0.06
	miscellaneous	3	12.2	1	0.08	0	0.00	0	0.00
	all	19	76.8	29	0.38	1	0.01	5	0.07
Mammoth 2015	short-duration	14	32.5	8	0.25	0	0.00	16	0.59
	overnight	2	35.8	24	0.67	0	0.00	4	0.11
	miscellaneous	2	10.9	4	0.37	0	0.00	0	0.00
	all	18	79.2	36	0.45	0	0.00	20	0.25
Nemo 2015	miscellaneous	4	14.06	7	0.50	0	0.00	0	0.00

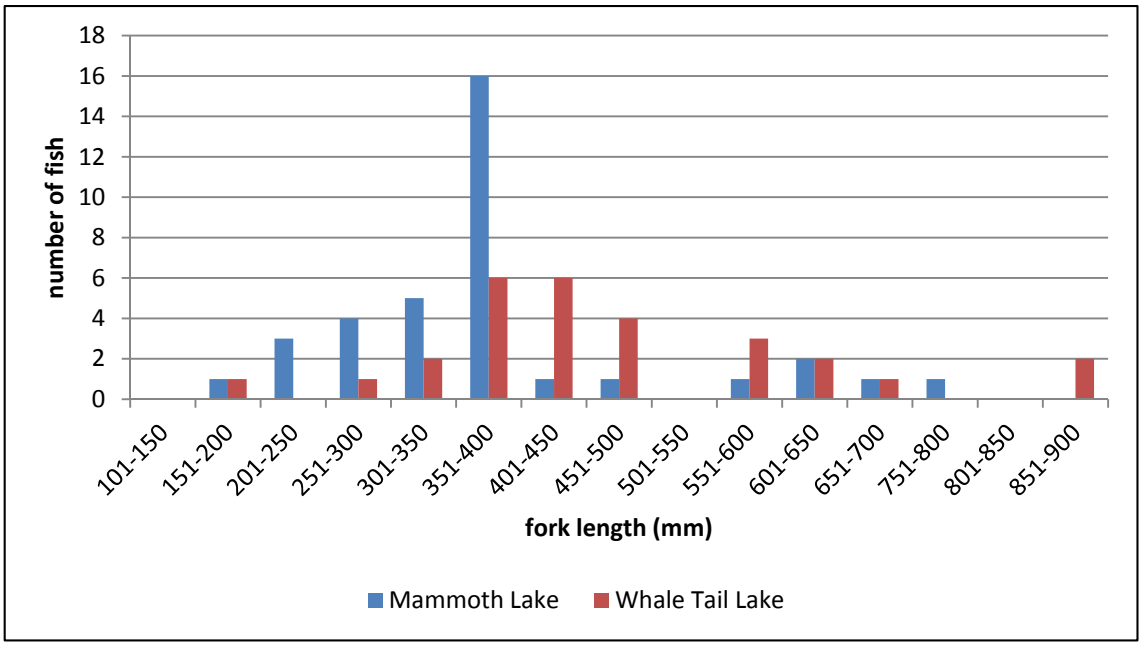


Figure 4-4. Length-frequency distributions of the Lake Trout captured by gill netting in Whale Tail and Mammoth Lakes in 2015.

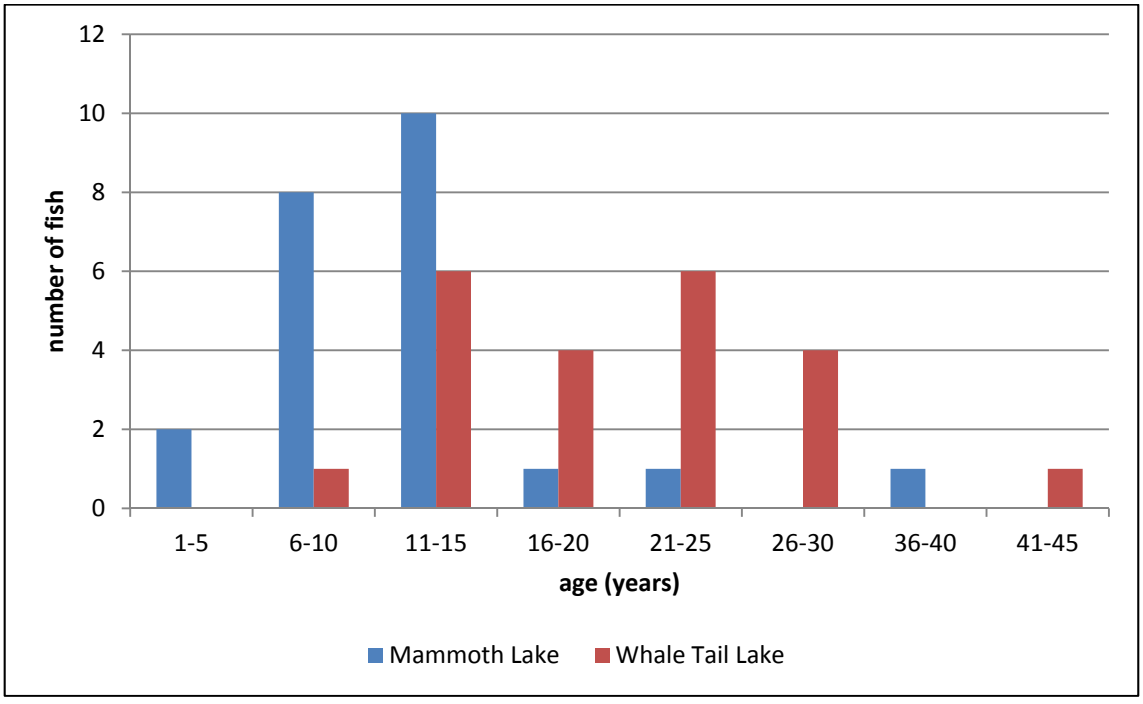


Figure 4-5. Age-frequency distributions, based on otolith ages, of Lake Trout from Mammoth and Whale Tail Lakes.

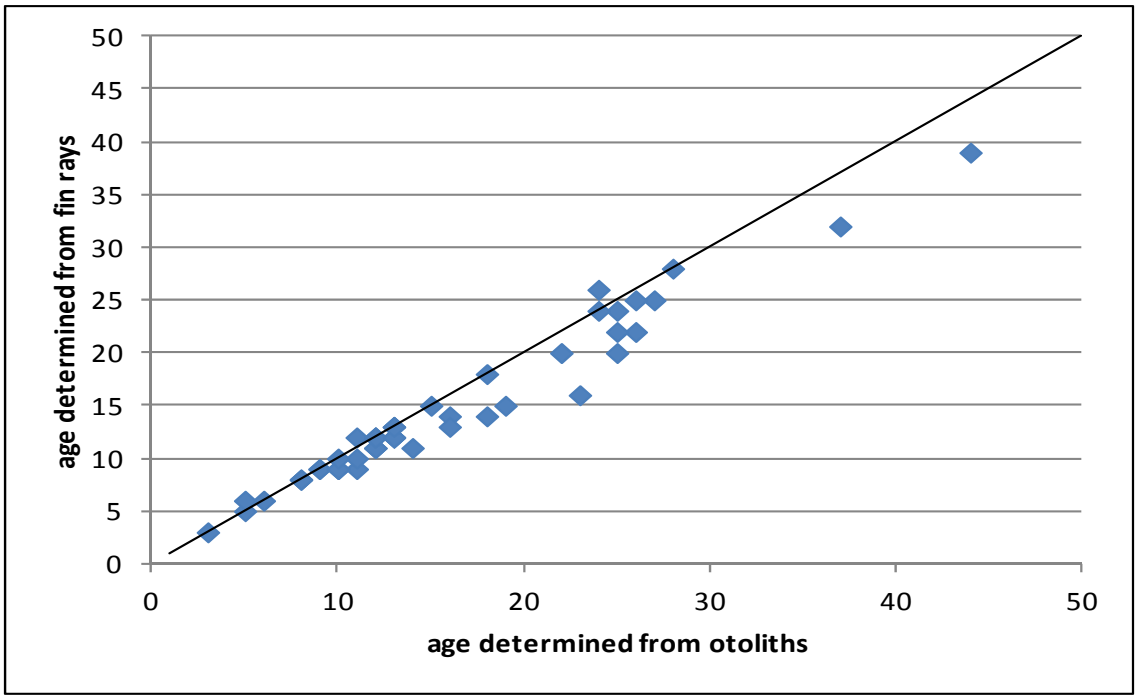


Figure 4-6. Lake Trout ages for individual fish determined from fin rays versus those determined from otoliths. The black line represents identical ages determined from both structures.

4.2 Shoreline Electrofishing

4.2.1 Methods

Shoreline electrofishing was conducted at 10 locations in Whale Tail Lake (Figure 4-1) on July 26-27 and at ten locations in Mammoth Lake on July 29-30 (Figure 4-2). The locations were selected with the objective of distributing them as widely as possible on each lake while taking safety considerations (substrate and slope) into account. At each location, 25 m was measured along the shoreline and a transect extending approximately 4 m out from the shore, was electrofished over the 25 m distance. The coordinates of the start location were determined with a Garmin Model 650 gps. The dominant substrate materials were visually identified and noted and each location was photographed. One member of a two-person crew operated the Halltech Model 200T backpack electrofisher, set at 950 volts and 60 hertz, and the second person netted immobilized fish with a dip net. The number of electroseconds was recorded at each location. The fish captured at each location were identified to species in the field. Ninespine Stickleback (*Pungitius pungitius*) were euthanized and retained for metals analyses (see Section 4.5). The other species captured were counted and released.

4.2.2 Results

The shoreline electrofishing effort and catches are summarized in Table 4-2. The data for individual transects are provided in Appendix A (Table A 5). The numbers of fish captured were

similar between the two lakes. Ninespine Stickleback was the most frequently caught species in both lakes, followed by Slimy Sculpin (*Cottus cognatus*). Two juvenile salmonids were captured in Whale Tail Lake and one was captured in Mammoth Lake. All three are thought to have been Arctic Char based on their parr marks, where the width of the dark areas along the lateral line is greater than the width of the light areas (McPhail and Lindsey, 1970), and the sparsity of melanophores on the lower jaw. Catches were highly variable among individual transects, ranging from none to 15 for Ninespine Stickleback and none to six for Slimy Sculpin and did not appear to correlate with substrate.

Table 4-2. Number of individuals captured by electrofishing ten 25-meter long segments (250 m total) of shoreline in Whale Tail Lake and Mammoth Lake on July 26-27 and July 29-30, 2015, respectively.

Lake	Total eseconds	Ninespine Stickleback	Slimy Sculpin	juvenile salmonids
Mammoth	3922	41	13	1
Whale Tail	3403	55	14	2

4.3 Minnow Traps

4.3.1 Methods

Unbaited standard (Gee) minnow traps were deployed at 13 locations in Whale Tail Lake (**Figure 4-2**) on July 25, 2015, lifted and redeployed on July 26, and lifted and removed on July 27. Unbaited standard (Gee) minnow traps were deployed at 12 locations in Mammoth Lake (Figure 4-1) on July 28, 2015, and lifted and removed on July 29. The date and time of deployments and lifts were recorded and the coordinates at each net location were determined using a Garmin Oregon 650 gps. Depth was estimated visually if the depth was 1.5 m or less and determined using a Humminbird 798ci HD SI Sonar unit if the depth was greater than 1.5 m. The dominant substrates at each set location were visually assessed.

4.3.2 Results

The standard minnow trap effort and catch data are summarized in **Table 4-3** and the data for individual sets are provided in Appendix A (Table A 6). Mean soak time per set was 22.7 hours in Mammoth Lake and 22.5 hours in Whale Tail Lake. Total soak time was 273 hours in Mammoth Lake and 586 hours in Whale Tail Lake. The total catches were one Ninespine Stickleback in Mammoth Lake and one Slimy Sculpin in Whale Tail Lake.

Table 4-3. Number of overnight sets, mean and total soak time, and total catch for overnight sets of standard minnow traps set in Mammoth Lake (July 28-29) and Whale Tail Lake (July 25-27).

Lake	Number of overnight sets	Mean soak time (hours)	Total soak time (hours)	catch	
				Slimy Sculpin	Ninespine Stickleback
Whale Tail	26	22.5	586.0	1	0
Mammoth	12	22.7	273.0	0	1

4.4 Fine-mesh hoop nets

4.4.1 Methods

Fine-mesh hoop nets, 2.5 m long, were constructed of 1.27 cm stretch mesh with two 1 m diameter hoops and a third 0.75 m diameter hoop at the rear of the trap. These nets had 4 m long by 1 m high wings and a 10 m long by 1 m high leader of the same 1.27 cm stretch mesh. Two of these nets were deployed for one overnight set each in Whale Tail Lake on August 18-19, 2015. Set locations, shown in **Figure 4-2**, were selected where the substrate was sand and gravel, adjacent to areas of cobble and boulder substrate. The lead was set perpendicular to the shoreline, with the trap located at the offshore end.

4.4.2 Results

The fine-mesh hoop net at FHN1 caught one Round Whitefish (fl=2.7 cm), and one Round Whitefish (fl=12.3 cm) and one Slimy Sculpin were captured at SHN2. The set locations, dates and times, depth, substrate and catches are provided in Appendix A (Table A 7).

4.5 Fish Tissue Samples for Mercury and Metals Analyses

4.5.1 Methods

Samples of skinless, boneless dorsal muscle were collected from 23 lake trout from Whale Tail Lake and 25 lake trout from Mammoth Lake and analyzed for total mercury. A second sample of skinless, boneless dorsal muscle was collected from a subset of ten of the same Lake Trout from each lake and analyzed for a suite of metals. The muscle samples were removed from each fish using a standard filleting knife and individually sealed in Whirl-Pak bags. The sealed Whirl-pak bags were sealed inside larger Ziplock bags and frozen in a -20°C freezer. The frozen samples were subsequently transported to Guelph, Ontario, in coolers with ice packs and held at -20°C prior to shipping to ALS Laboratories in Burnaby, BC, in coolers with dry ice.

Seven and eight composite samples, each composed of 4 to 6 Ninespine Stickleback, were submitted for metals analysis from Whale Tail Lake and Mammoth Lake respectively. The total length in mm was determined for each individual using a standard fish measuring board and the total weight to the nearest 0.1 g was determined for the individuals in all but one of the

composite samples using an Ohaus Scout Pro Model 60001 electronic balance. The number of individuals and the total length in mm of the largest and smallest individual in each composite sample are presented in **Table 4-4**. The composite samples were sealed in individual whirl-pak bags and frozen in a -20°C freezer. The samples were transported to Guelph, Ontario, in a cooler with frozen ice packs, and then stored in a -20°C freezer until they were shipped to ALS Laboratories in Burnaby, BC, in a cooler with dry ice. The laboratory methods, provided by ALS Laboratories, are provided in Appendix B.

Table 4-4. Number of and minimum and maximum fork length of Ninespine Stickleback in composite samples analyzed for metals.

Lake	Sample #	Number of individuals	minimum total length (mm)	maximum total length (mm)
Whale Tail	Composite # 1	5	53	68
	Composite # 2	5	45	55
	Composite # 3	5	40	46
	Composite # 4	5	37	41
	Composite # 5	5	36	45
	Composite # 6	5	31	40
	Composite # 7	8	30	47
Mammoth	Composite # 8	6	39	70
	Composite # 9	5	45	59
	Composite # 10	5	43	51
	Composite # 11	5	42	46
	Composite # 12	5	41	45
	Composite # 13	5	37	44
	Composite # 14	5	34	41
	Composite # 15	4	30	35

4.5.2 Results

The metal concentrations were determined by ALS Laboratories. The methods used to determine mercury and metals concentrations in the tissues and the results of those analyses, provided by ALS Laboratories, are presented in Appendix B. Due to a labelling error, two of the Lake Trout samples from Whale Tail Lake that were analyzed for mercury cannot be related to an individual fish. For the remaining Lake Trout samples the sample number corresponds to the fish numbers in Table A 4.

5.0 TRIBUTARY INVESTIGATIONS

Habitat was characterized in the tributaries to Whale Tail and Mammoth Lakes and fish sampling was conducted in the direct tributaries of Whale Tail and Mammoth Lakes that had surface flow and appeared capable of supporting fish during the open-water season. In most cases, these watercourses were walked from Whale Tail and Mammoth Lakes to the next lake upstream, often while electrofishing, to search for spawning grayling or potential grayling spawning habitat during the latter part of June. Most of the watercourses with areas of gravel substrate were electrofished in the latter part of June, in early July, and again in August to search for young-of-the-year (YOY) fishes and to characterize the stream habitat under low flow conditions. Digital photographs were taken of representative habitats. Large minnow traps were deployed in the lower reaches of several of these watercourses during the early part of the field season, in an attempt to capture fishes moving into these watercourses during the spring. Other direct tributaries of Whale Tail and Mammoth Lakes that were smaller and unlikely to provide upstream fish passage, as well as indirect tributaries located farther upstream were examined visually at least once during the 2015 open-water season. All of these additional tributaries were characterized with respect to habitat and photographed, and several were electrofished.

5.1 Habitat Characterization

5.1.1 Methods

Field observations of habitat characteristics including channel form, flow conditions, and substrate were recorded and photographs were taken. A Garmin Oregon 650 hand-held GPS unit was used to record the location of all observations and photographs, and aid in the distance measurements. Stream length was measured from an orthorectified aerial photograph taken on July 21, 2011, using GIS.

Flow was characterized as “surface” when water was present above the substrate and “interstitial” when surface flow was absent but there was water flowing through the interstitial spaces among boulders and cobbles. Typically, there were multiple observations of the state of flow over the open water season.

The dominant watercourse types were characterized as boulder or graminoid, examples of which are shown in Figure 5-1. Boulder habitats occur where the watercourse flows within a boulder deposit and in these watercourses the interstitial spaces are often sufficient to convey all of the flow, at least seasonally. In some of these watercourses there is no surface water visible along some or all of their length, even during the spring freshet. Graminoid habitats are typically found where finer substrates dominate. The banks are defined by graminoid vegetation and surface flow is typically present unless the stream goes dry. Some watercourses are a combination of both habitat types.



Figure 5-1. Examples of the stream habitat types encountered. The top row is boulder. The middle row is a mixture of boulder and graminoid. The bottom row is multiple channel graminoid (left) and single channel graminoid (right).

Channel configuration was characterized as single (one defined flow path), multiple (more than one defined flow path), or poorly defined (no obvious, defined flow path, suggesting that surface flow is ephemeral). Dominant and sub-dominant substrates were characterized based on particle size, following the modified Wentworth scale (Wentworth, 1922), with the additional category “peat”, which is a cohesive mat of vegetation-derived organic material that was the substrate in a number of the smaller watercourses.

5.1.2 Results

The watercourse characteristics are summarized in Table 5-1 and photographs of each are provided in Appendix B. Coarse substrates dominated and gravel substrate which might be suitable for Arctic Grayling spawning was relatively uncommon. Several of the watercourses were observed to have only interstitial flow, which would prevent the passage of large fish, during part or all of the open-water season.

Table 5-1. Habitat characteristics and length of watercourses examined during the 2015 field season. Refer to Figure 2-1 for lake identification codes. Watercourse ID is assigned as "downstream lake code-upstream lake code".

Water-course ID	Flow characteristics	Channel configuration	Dominant habitat	Substrate in order of dominance	Length (m)
A0-A48	Surface flow	Single	Graminoid	Peat with occasional patch of cobble.	357
A113-A47	Surface flow on June 28. Dry on August 1.	Poorly defined	Graminoid	Peat/tundra	198
A16-A15	Surface flow during high lake water levels in spring. Interstitial flow during lower summer and fall water levels.	Single	Boulder	Boulder/ cobble	60
A17-A16	Surface flow during high lake water levels in spring. Interstitial flow during lower summer and fall water levels.	Single	Boulder	Boulder/ cobble	172
A18-A17	Shallow surface flow during spring freshet. Only interstitial flow by August.	Single	Boulder	Boulder/ cobble with 3 small patches of gravel	296
A19-A18	Shallow surface flow during spring freshet. Interstitial sections on July 9.	Single	Boulder/ graminoid	Cobble/ boulder with tundra hummocks	338
A20-A19	Surface flow during spring freshet. Interstitial flow July 9.	Single	Boulder	Cobble/ boulder	78
A21-A20	Surface flow during spring freshet. Interstitial flow during lower summer lake water levels.	Single	Boulder	Boulder/ cobble	40
A22-A21	Interstitial flow	Single	Boulder	Boulder/ cobble	285
A23-A22	Interstitial flow	Not visible	Boulder	Boulder/ cobble	396
A43-A16	Interstitial	Not visible	Boulder	Boulder/ cobble	199
A45-A16	Interstitial	Not visible	Boulder	Boulder/ cobble	446
A46-A17	Surface flow	Multiple	Graminoid	Peat substrate in some sections and cobble/ boulder/gravel/sand in others	206
A47-A46	Surface flow	Multiple	Graminoid	Peat substrate in some sections and cobble/ boulder/gravel/sand in others	43

Water-course ID	Flow characteristics	Channel configuration	Dominant habitat	Substrate in order of dominance	Length (m)
A48-A47	Surface flow	Multiple. Poorly defined	Graminoid	Peat	53
A49-A17	Surface flow only during spring freshet. Interstitial flow.	Single	Boulder	Cobble/ boulder over bedrock	214
A49-A47	Not a watercourse				
A50-A17	Surface flow	Single near downstream lake. Multiple and poorly defined upstream	Graminoid	Lower 100 m section of watercourse with single channel has sand/cobble/gravel substrate. Upstream is primarily peat.	509
A53-A17	Surface flow	Multiple	Graminoid	Mainly peat with cobble/ boulder/gravel patches	577
A54-A53	Interstitial	Not visible	Boulder	Boulder/ cobble.	518
A55-A17	Surface flow in spring and early summer, but some short sections had become interstitial by the end of August	Multiple, with one main channel and a few smaller side channels	Graminoid	Cobble/ boulder. Total of ~5 m^2 of gravel	195
A56-A55	Sections of surface flow. Sections of interstitial flow.	Multiple. Poorly defined.	Boulder/ graminoid	Boulder/ cobble, with tundra in places.	610
A59-A17	Surface flow	Multiple	Graminoid	Peat with embedded boulder/cobble and 5 patches of gravel	205
A60-A59	Surface flow in graminoid sections. Interstitial flow in boulder sections	Multiple	Graminoid/ boulder	Peat/cobble/ boulder/near Lake 59. Then boulder/ cobble.	510
A62-A17	Surface flow during spring freshet and on July 7, but likely dry later in summer based upon vegetation.	Poorly defined	Graminoid	Peat/tundra	86
A63-A18	Surface flow during spring freshet and on July 5.	Multiple	Graminoid	Peat with 2 small areas of cobble/gravel/sand	122
A65-A17	Surface flow at isolated locations, but predominantly interstitial flow.	Single. Poorly defined	Boulder	Boulder/ cobble	176
A-P21-A52	Interstitial flow, except for short section of surface flow	Single	Boulder	Boulder/ cobble/peat	371

Water-course ID	Flow characteristics	Channel configuration	Dominant habitat	Substrate in order of dominance	Length (m)
A-P23-A17	Surface flow in June. Dry by mid-July.	Single	Boulder/ graminoid	Gravel/cobble in upstream section. Cobble/gravel/peat in mid-section, and then cobble/ boulder near Lake A17.	122
A-P38-A47	Surface flow on June 19. Dry on August 1.	Single. Poorly defined	Graminoid	Peat	157
A-P54-A-P23	Surface flow during spring freshet in downstream peat section, but predominantly interstitial flow. Dry by mid-July.	Single. Poorly defined	Boulder/ graminoid	Boulder/ cobble/peat	208

5.2 Visual Searches for Evidence of Arctic Grayling Spawning

5.2.1 Methods

As indicated in the previous section, gravel substrate was uncommon in the tributaries to Whale Tail Lake. Where surface flow and gravel substrate were present in early July, the watercourses were examined for areas of disturbed substrate that could indicate locations where Arctic Graying spawning had occurred. Disturbance was indicated by the presence of particles with little or no periphyton on their upper surface, indicating that they had recently been overturned. Where an area of disturbed gravel substrate was observed kick samples were collected by vigorously disturbing the substrate while holding a fine-meshed dip net immediately downstream in order to collect Arctic Grayling eggs if they were present.

5.2.2 Results

Only two areas of disturbed gravel were observed, both in the watercourse between lakes A63 and A18 on July 5, 2015. One area was 0.5 m wide by 1.5 m long in approximately 0.4 m of water and the other was 0.4 m wide by 0.6 m long in slightly shallower water. Multiple kick samples were collected at both of the areas but no fish eggs were observed in the samples.

5.3 Large Minnow Traps

5.3.1 Methods

Unbaited, large minnow traps were deployed in seven tributaries to Whale Tail Lake (**Figure 5-2**) for periods of seven to sixteen days in late June and early July. These traps, constructed of 0.9 cm (3/8 inch) square steel mesh, were 91.4 cm long and 31.5 cm in diameter, with a 22.0 cm long funnel at one end with a 7.0 cm diameter opening into the trap. Two traps were deployed in watercourse A53-A16 (locations MT2 and MT3) and in watercourse A63-A18 (location MT7). A single trap was deployed at the other locations. The traps were deployed with the funnel facing downstream except at location MT 7 (Tributary A63-A18), where one of the two traps was deployed with the funnel facing upstream. The traps were lifted periodically and captured fish were enumerated and identified to species. With the exception of one voucher specimen, the captured fish were released near their capture location. The trap in watercourse AP23-A17 (location MT1) was not fishing for an unknown period of time between June 26 and July 3 because falling water levels left the funnel opening above the water. At the other locations the traps' funnels openings were submerged throughout their deployments.

5.3.2 Results

The large minnow trap effort and catches are summarized in Table 5-2 sampling locations are shown in Figure 5-2. Detailed set, lift and catch data are provided in Appendix A (Table A 8). A total of nine Slimy Sculpin and one juvenile Round Whitefish (fork length = 8 cm) were captured by 109 nine trap-days of effort. At least one Slimy Sculpin was captured in four of the

seven watercourses where traps were deployed, but catch-per-unit-effort (CPUE) was very low at all locations.

Table 5-2. Summary of large minnow trap deployments and catches. Trap locations are shown in Figure 5-2. Data for individual sets and lifts are provided in Appendix A.

Watercourse	Location	Date deployed	Date removed	Soak time (days)	Funnel direction	Slimy Sculpin	juvenile Round Whitefish
A46-A17	MT4	27/06/15	13/07/15	16	downstream	3	0
A50-A17	MT5	28/06/15	13/07/15	15	downstream	1	0
A53-A17	MT3	27/06/15	13/07/15	16	downstream	2	0
A55-A17	MT9	03/07/15	13/07/15	10	downstream	0	0
A59-A17	MT2	27/06/15	13/07/15	16	downstream	1	0
	MT6	28/06/15	13/07/15	15	downstream	2	0
A63-A18	MT7	05/07/15	13/07/15	8	upstream	0	0
	MT8	05/07/15	13/07/15	8	downstream	0	1
AP23-A17	MT1	26/06/15	03/07/15	7	downstream	0	0
Total				110		9	1



Figure 5-2. Locations where large minnow traps were set in June-July of 2015.

5.4 Stream electrofishing

5.4.1 Methods

The stream electrofishing typically began near the lake to which the watercourse drained and progressed upstream. One member of the two-person crew operated the Halltech Model 200T backpack electrofisher, set at 950 volts and 60 hertz, and the second person netted the immobilized fish. The coordinates of the sampling sites were determined using a Garmin Oregon 650 gps and the length of watercourse sampled was determined from these coordinates superimposed on a photo-mosaic of the study area using GIS, unless the distance sampled was very short (<10 m), in which case the distance sampled was estimated in the field. The number of electroseconds was also recorded at each location. Slimy Sculpin and Ninespine Stickleback were identified and released as they were captured. Most juvenile salmonids were photographed and released but some were retained as voucher specimens. The identities of voucher specimens were confirmed by opening the abdominal cavity and counting the pyloric caeca using a dissecting microscope. Arctic Char have 20-74 pyloric caeca and Lake Trout typically have 93-208 (Scott and Crossman, 1973). The identities of photographed salmonids were confirmed by comparison to the voucher specimens, as well as using the juvenile salmonid key in McPhail and Lindsey (1970).

5.4.2 Results

The stream electrofishing effort and catches are summarized in **Table 5-3** and the sampling locations are shown in **Figure 5-3** and **Figure 5-4** (June), **Figure 5-5** and **Figure 5-6** (July), and **Figure 5-7**, **Figure 5-8** and **Figure 5-9** (August). The coordinates of the sampling locations are provided in Appendix A. A total of 17 watercourses were electrofished on one or more occasions. Slimy Sculpin and Ninespine Stickleback were the most widely distributed species, and were captured in 11 and 10 different streams respectively. Overall, Ninespine Stickleback were the most abundant species, although this was strongly influenced by the very large catches in watercourse A46-A17 in July. Juvenile Arctic Char and Lake Trout were each captured in low numbers from five watercourses. One juvenile Burbot (*Lota lota*), one juvenile Round Whitefish, and one 32 mm long (TL) juvenile salmonid, not identified to species, were also captured.

Table 5-3. Summary of stream electrofishing effort and catches. Based on size, all of the salmonids and the Burbot are juveniles while the Slimy Sculpin and Ninespine Stickleback are adults. Locations are shown in Figure 5-3 - Figure 5-9.

Watercourse	Location	Date (2015)	distance (m)	electro-seconds	Ninespine Stickleback	Slimy Sculpin	Arctic Char	Lake Trout	Unidentified Salmonid	Burbot	Round Whitefish
A0-A48	**EF-S1**	01-Aug	10	196	2	0	0	0	0	0	0
A113-A47	**EF-S2**	01-Aug	10	68	1	0	0	0	0	0	0
A16-A15	**EF-S3**	25-Aug	43	690	2	5	0	1	0	0	0
A17-A16	**EF-S4**	25-Aug	240	950	0	4	0	1	0	0	0
A18-A17	**EF-S32**	26-Jun	100	878	0	1	0	0	0	0	0
	EF-S5	05-Jul	112	1648	0	5	0	0	0	0	0
	EF-S6	30-Aug	30	210	6	0	0	1	0	0	0
		Total	242	1859	6	5	0	1	0	0	0
A19-A18	**EF-S7**	09-Jul	32	423	0	0	0	0	0	0	0
A46-A17	**EF-S8**	28-Jun	201	579	11	8	1	0	0	0	0
	EF-S9-10	09-Jul	148	925	153	8	1	0	0	0	0
	EF-S11	12-Jul	<10	85	100	0	0	0	0	0	0
	EF-S12	30-Aug	36	470	0	0	0	0	0	0	0
		Total	394	2059	264	16	2	0	0	0	0
A47-A46	**EF-S13**	09-Jul	17	136	0	1	0	0	0	0	0
A50-A17	**EF-S14**	28-Jun	51	265	5	0	0	0	0	0	0
	EF-S15	09-Jul	163	1204	56	9	2	1	0	0	0
	EF-S16	30-Aug	52	180	2	0	1	0	0	1	0
		Total	266	1649	**63**	9	**3**	**1**	0	**1**	0
A53-A17	**EF-S17**	20-Jun	571	1664	7	0	0	0	0	0	0
	EF-S18	08-Jul	182	2142	78	77	5	0	0	0	0
	EF-S19	30-Aug	359	518	0	26	0	4	0	0	0
		Total	**1112**	**4324**	**85**	**103**	**5**	**4**	0	0	0

Watercourse	Location	Date (2015)	distance (m)	electro-seconds	Ninespine Stickleback	Slimy Sculpin	Arctic Char	Lake Trout	Unidentified Salmonid	Burbot	Round Whitefish
A55-A17	**EF-S20**	21-Jun	166	996	6	0	0	0	0	0	0
	EF-S21	06-Jul	167	3330	20	50	1	0	1		0
	EF-S22	30-Aug	46	483	17	1	0	0	0	0	1
		Total	**379**	**4809**	**43**	**51**	**1**	0	**1**	0	**1**
A56-A55	**EF-S23**	08-Jul	60	634	0	0	0	0	0	0	0
A59-A17	**EF-S24**	27-Jun	126	730	0	6	1	0	0	0	0
	EF-S25	09-Jul	97	1444	2	21	0	0	0	0	0
	EF-S26	30-Aug	181	535	0	7	1	0	0	0	0
		Total	**404**	**2709**	**2**	**34**	**2**	0	0	0	0
A62-A17	**EF-S27**	07-Jul	107	1025	1	0	0	0	0	0	0
A63-A18	**EF-S28**	05-Jul	81	848	0	3	0	0	0	0	0
	EF-S29	07-Jul	81	793	0	3	0	0	0	0	0
		Total	**162**	**1641**	0	**6**	0	0	0	0	0
A-P21-A52	**EF-S30**	01-Aug	5	78	0	0	0	0	0	0	0
A-P23-A17	**EF-S31**	26-Jun	95	582	0	2	0	0	0	0	0
Grand Total			**3569**	**23832**	**469**	**236**	**13**	**8**	**1**	**1**	**1**



Figure 5-3. June 2015 electrofishing locations on tributaries at the north end of Whale Tail Lake.



Figure 5-4. June 2015 electrofishing locations on tributaries at the south end of Whale Tail Lake.

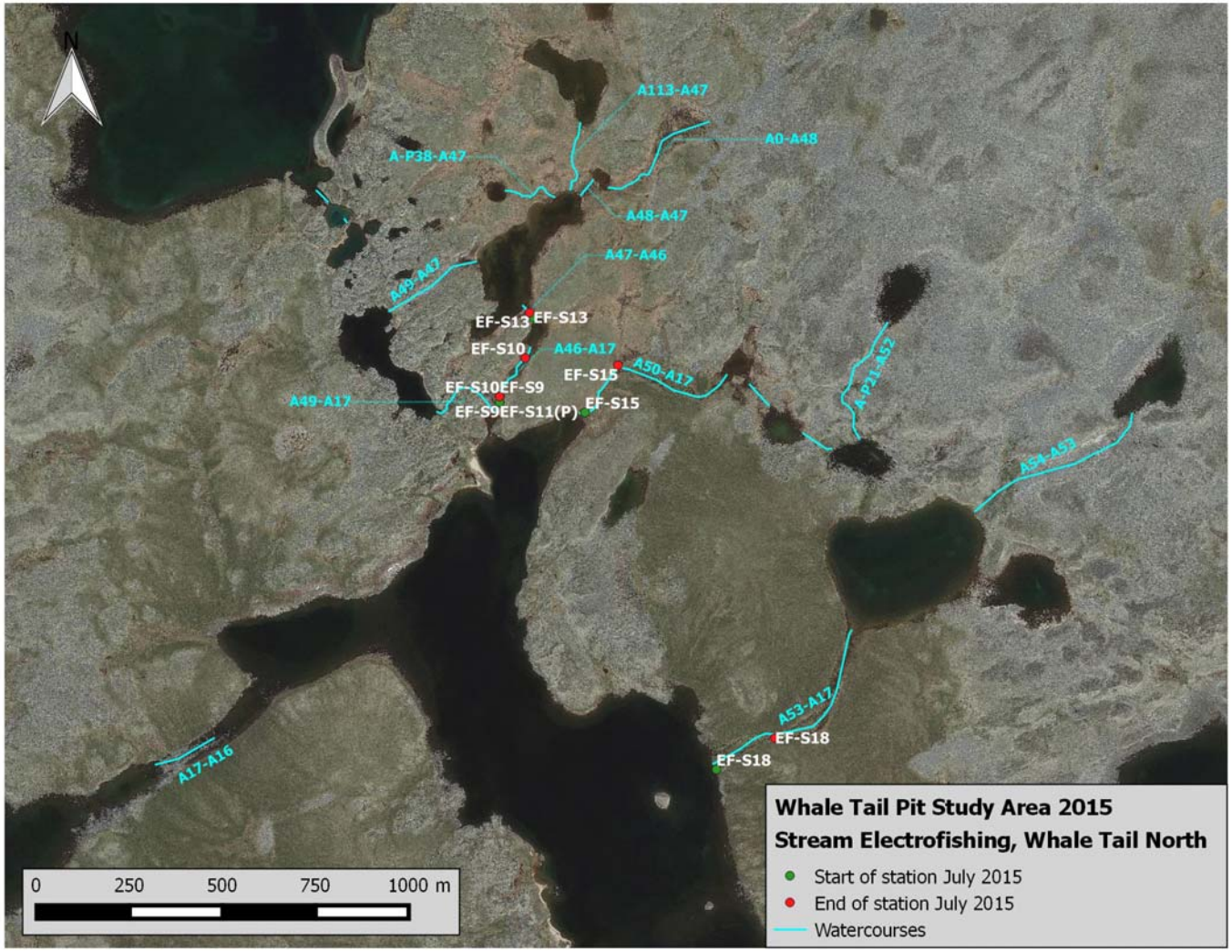


Figure 5-5. July 2015 electrofishing locations on tributaries at the north end of Whale Tail Lake.



Figure 5-6. July 2015 electrofishing locations on tributaries at the south end of Whale Tail Lake.

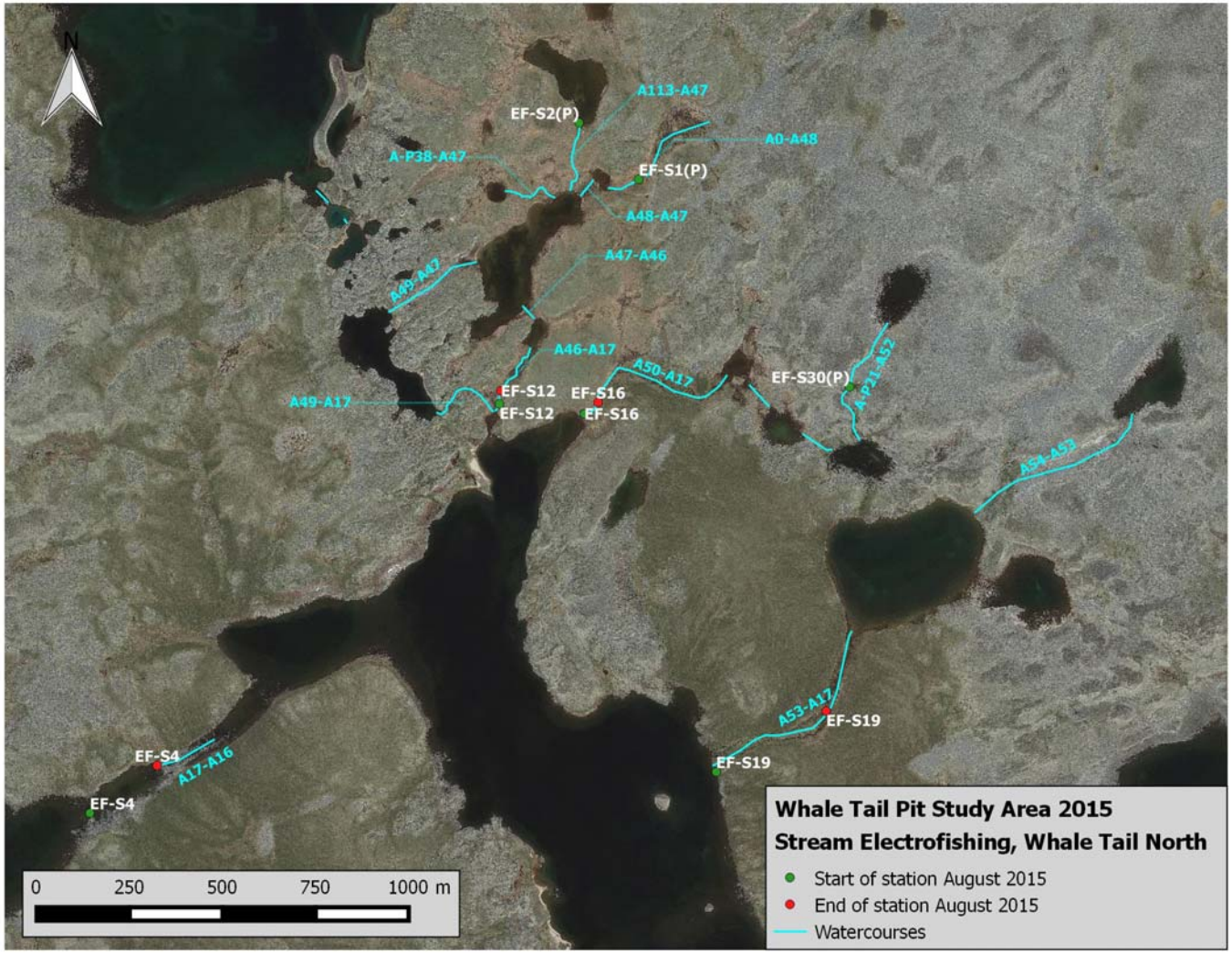


Figure 5-7. August 2015 electrofishing locations on tributaries at the north end of Whale Tail Lake.



Figure 5-8. August 2015 electrofishing locations on tributaries at the south end of Whale Tail Lake.

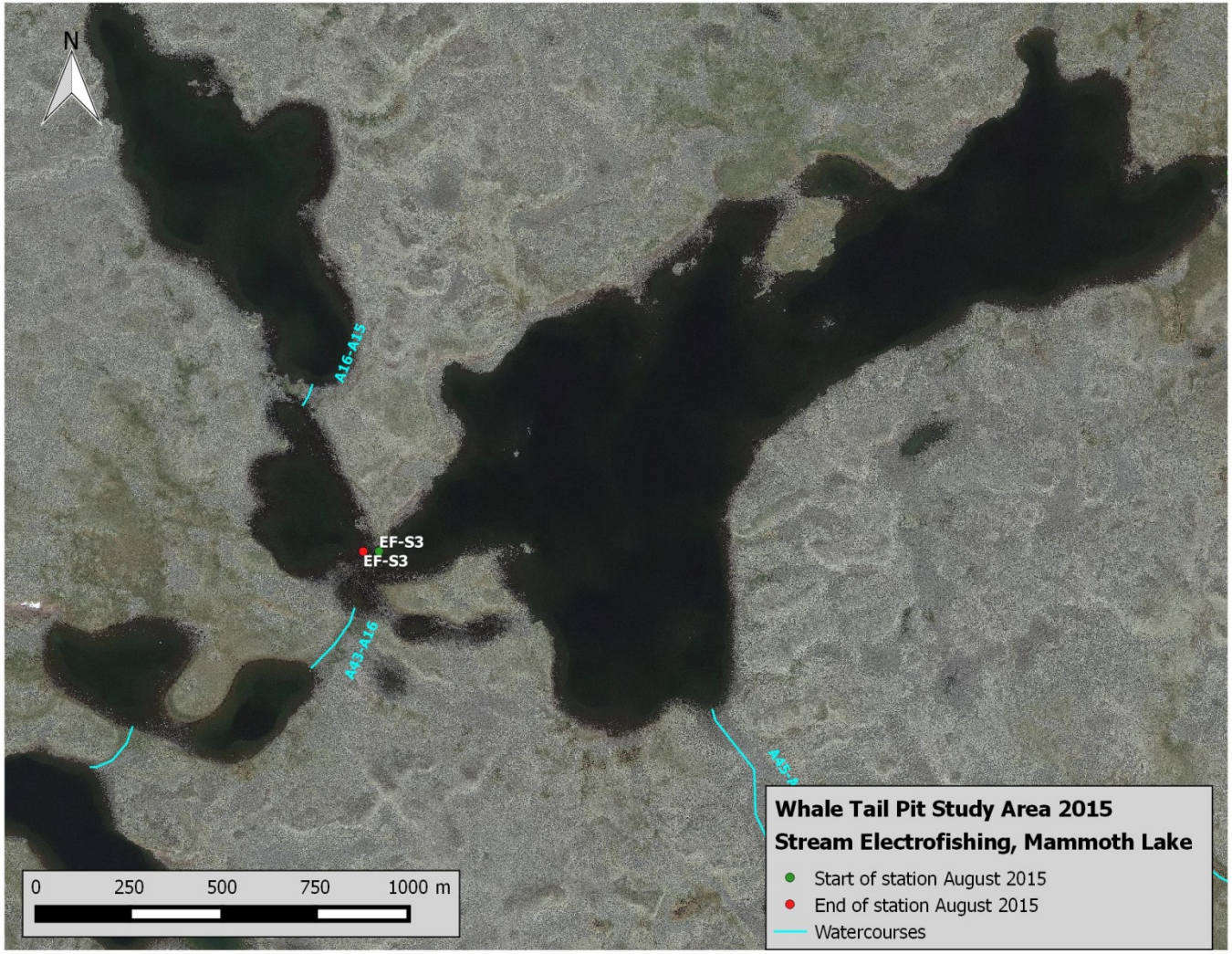


Figure 5-9. August 2015 electrofishing location near the outlet of Mammoth Lake.

6.0 HABITAT CHARACTERIZATION AND FISH SAMPLING OF SMALL LAKES AND PONDS

6.1 Methods

Fish sampling was conducted and the habitat was characterized on a number of lakes that are connected by surface flow to Whale Tail and Mammoth Lakes and two small lakes that drain to Nemo Lake. Where depth was sufficient, a jon boat powered by an outboard motor and equipped with a Humminbird 798ci HD SI Sonar unit was used to conduct the work.

In lakes with adequate depth, a standard AEM index gill net gang comprised of 22.7 m long and 1.8 m deep panels of 126, 102, 76, 51, 38, and 25 mm stretched mesh (total gang length = 136.4 m) was set, orientated to cross a deep (usually the deepest) portion of the lake and a shallow near-shore or shoal area, to maximize the variety of habitat fished. In lake A113 only three panels of gill net were set (38 mm, 51 mm and 76 mm) due to the small size of the lake. Most net sets were of short duration (range 1.6 – 3.3 hours) but occasionally sets were overnight. The date and time of deployment and lifts were recorded, the coordinates at each end of each net were determined using a Garmin Oregon 650 gps, and the depth at each end was determined using the sonar unit. The number of individuals of each species captured in each net was recorded. Each fish was examined for external anomalies and fork length was determined to the nearest mm using a standard fish measuring board. The total weight of each individual weighing more than 500 g was determined to the nearest 10 grams using a Rapala digital hanging scale. The total weight of individuals weighing less than 500 g was determined to the nearest g, or in some cases nearest 0.1 g, using an Ohaus Scout Pro Model 6001 electronic balance. Fish that were alive were tagged with a numbered Floy tag and released.

A section of shoreline was electrofished with a Halltech Model 200T backpack electrofisher, set at 950 volts and 250 hertz. The intent was primarily to determine what species were present, so the length of shoreline electrofished varied with habitat diversity and catch. The number of individuals of each species were recorded, as were the coordinates at each end of the electrofished shoreline, determined using a Garmin Oregon 650 gps unit.

The sonar unit was used to record georeferenced standard and side-scan sonar data. Straight, parallel boat runs, orientated to best characterize the lake's features, were used to record slightly overlapping side-scan images of the lake bottom. Additional sonar recordings were then made to obtain standard sonar data for as much of the lake bottom as was practical. In lakes for which these data were to be used to prepare bathymetric maps, a higher density of sonar transects were collected and a stake was driven into the ground at the water’s edge. This elevation was later determined by a survey crew so that the depth data could be converted to elevations. Visual point observations of the substrate were also made, either from the surface where the water was clear and shallow enough, or using an Aqua-Vu 740c underwater colour video system where the water was deeper. All visual substrate observations were georeferenced with a Garmin GPSmap76CSx gps unit.

The side-scan images were processed using ReefMaster software (ver. 1.8) to create a single georeferenced side-scan mosaic of the lake's bottom, and the standard sonar data were processed to create maps of bottom hardness and water depth. ReefMaster determines bottom hardness by an analysis of the sonar output/input ratio, and lag, to calculate a unitless relative hardness and roughness value that is displayed as a colour-coded map. The georeferenced data (side-scan image, bottom hardness and water depth maps, and visual point observations) were layered using GIS software (QGIS version 2.8). Using the overlaid data, with reference to the oblique aerial photographs, the various substrate types were identified and hand digitized into substrate maps. The water depth data for selected lakes was extracted from the sonar recordings and provided to AEM in ASCI file format for use by the sub-consultant undertaking the bathymetric mapping of all the Whale Tail Pit Study Area Lakes.

A number of smaller, shallow ponds near the north end of Whale Tail Lake were also investigated, some on two occasions. The substrates in these ponds were visually assessed from shore, and a portion of shoreline was electrofished. Images of these ponds were included in the oblique aerial photographs taken in 2014 and 2015.

6.2 Results

The fish catches for each of the small lakes and ponds that were sampled are presented in **Table 6-1** and the sampling locations are shown in **Figure 6-1**, **Figure 6-2**, **Figure 6-3** and **Figure 6-4**. The information for individual gill nets and electrofishing transects are provided in Appendix A (**Table A 2** and **Table A 5** respectively). The substrate maps have been provided to AEM under separate cover.

Table 6-1. Summary of 2015 gill net and electrofishing catches in small lakes and ponds (na indicates the gear type was not used).

	Gill net catches				Electrofishing catches	
Lake	Lake Trout	Arctic Char	Round Whitefish	Burbot	Ninespine Stickleback	Slimy Sculpin
A18	0	0	0	0	16	3
A19	0	0	0	0	7	1
A20	10	0	6	0	0	0
A22	2	1	0	0	1	10
A45	0	0	0	0	3	0
A47	0	1	0	0	>100	0
A49	0	0	0	0	0	3
A50	na	na	na	na	0	0
A51	na	na	na	na	0	0
A52	na	na	na	na	0	0
A53	1	1	0	0	2	0
A54	na	na	na	na	0	0
A55	5	0	0	1	0	2
A62	3	0	0	0	na	na
A63	1	0	0	0	0	3
A65	2	0	2	0	3	6
A113[1]	0	0	0	0	16	0
A-P5	na	na	na	na	0	0
A-P18	na	na	na	na	0	0
A-P21	na	na	na	na	0	0
A-P33	na	na	na	na	0	0
A-P37	na	na	na	na	0	0
A-P38	na	na	na	na	1	0
A-P49	na	na	na	na	0	0
A-P51	na	na	na	na	0	0
A-P67	dry on August 1, 2015					
C40	na	na	na	na	0	0
C42	na	na	na	na	0	0

1. Only 3 panels of net set (38 mm, 51 mm and 76 mm)

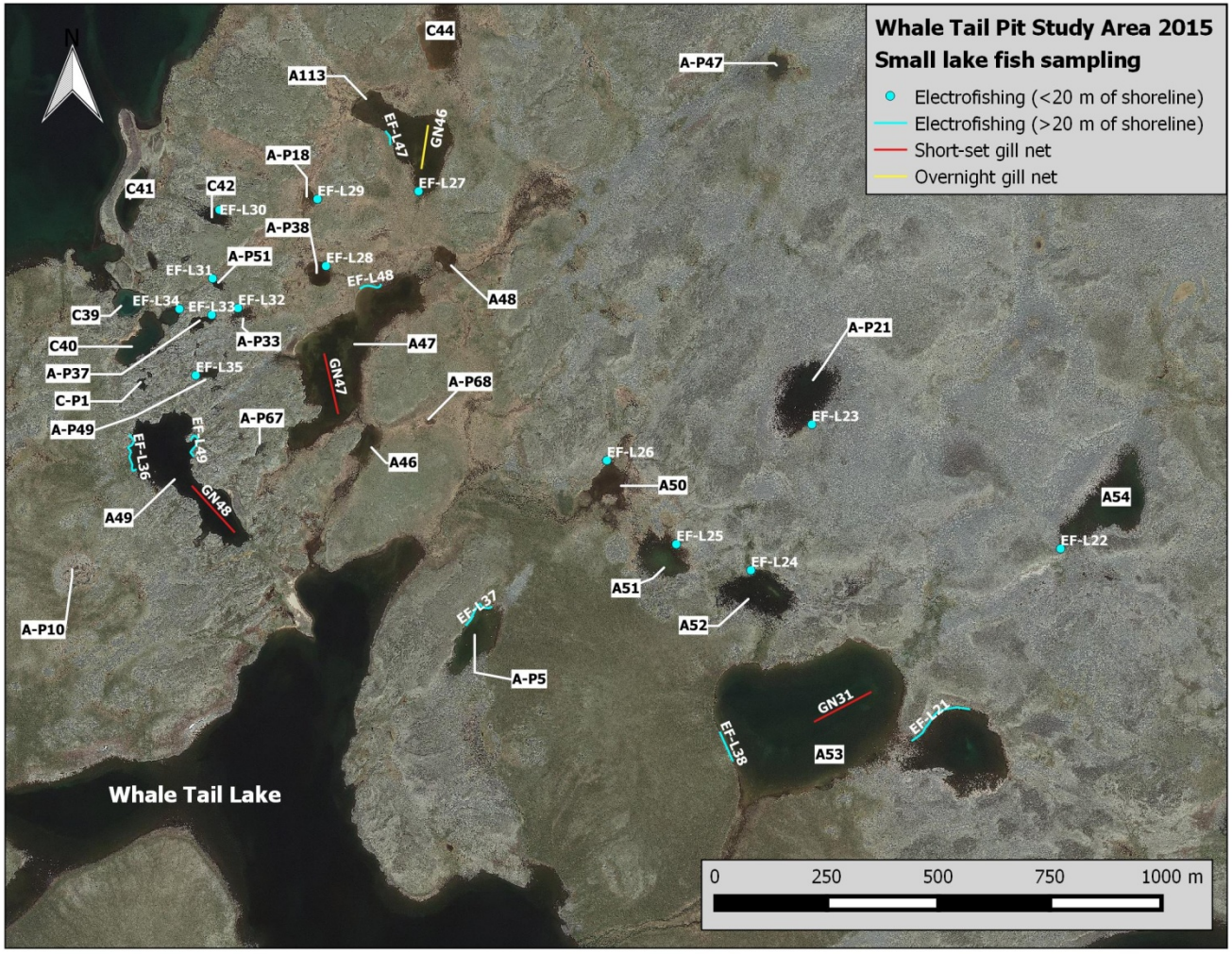


Figure 6-1. Fish sampling locations in lakes A47, A49, and A53 and smaller lake and ponds near the north end of Whale Tail Lake, 2015.

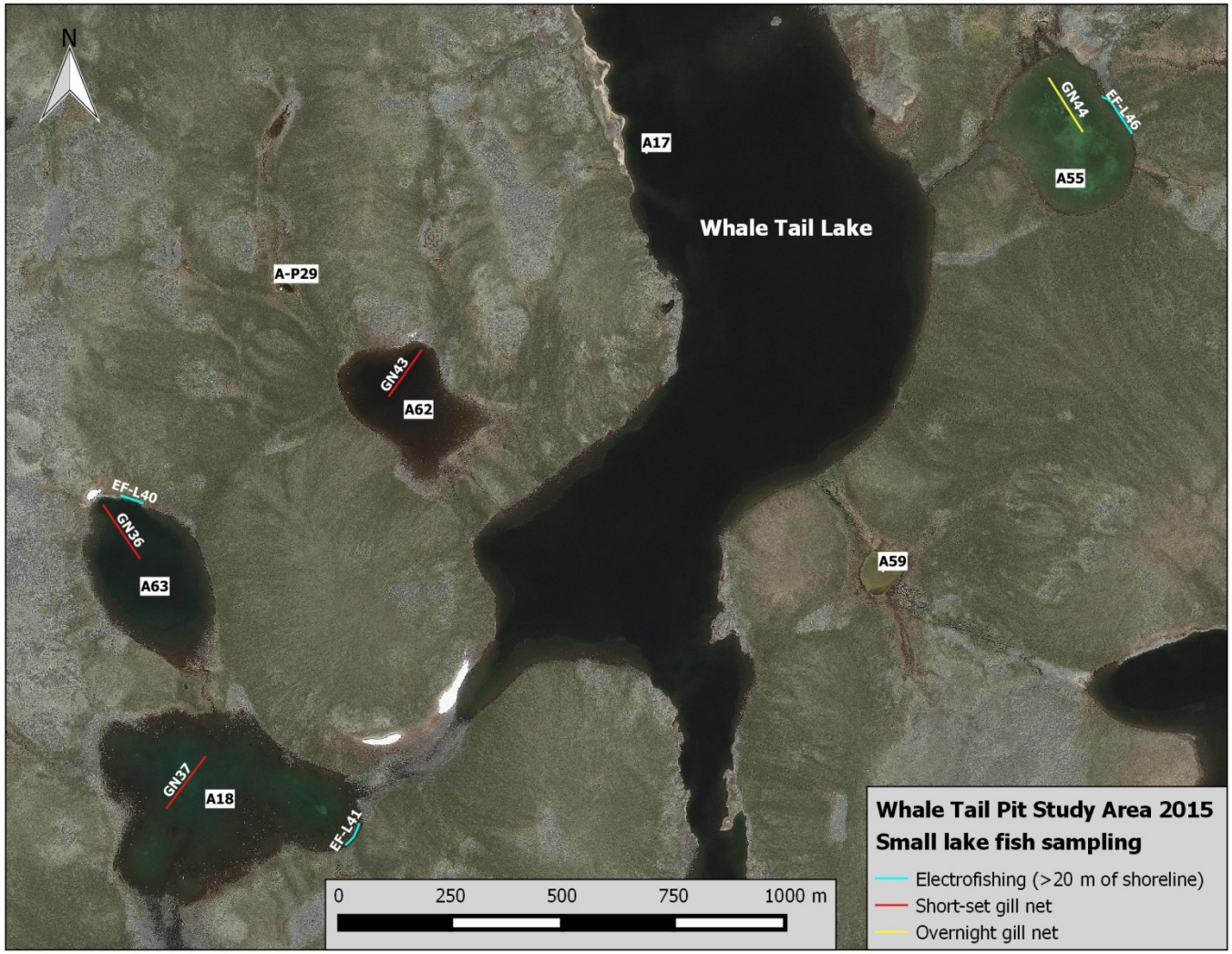


Figure 6-2. Fish sampling locations in lakes A18, A55, A62, and A63, 2015.



Figure 6-3. Fish sampling locations in lakes A19 and A65, 2015.



Figure 6-4. Fish sampling locations in lakes A20, A22 and A45, 2015.

7.0 WATER TEMPERATURE MONITORING

7.1 Methods

Temperature loggers (WaterTemp Pro V2, Onset Corporation) were deployed in the narrows between Whale Tail Lake and Mammoth Lake, and near the outlet of Mammoth Lake, on June 21, 2015 (**Figure 7-1**). Temperature loggers were also deployed at the south end of Whale Tail Lake and in five tributaries to Whale Tail Lake (**Figure 7-1**) on June 26 and 27, 2015. The loggers deployed between Whale Tail and Mammoth Lakes and in the Mammoth Lake outlet recorded the temperature at one minute intervals and the others recorded the temperature at 15 minute intervals. The logger between Whale Tail Lake and Mammoth Lake was moved to a deeper location, approximately 50 metres upstream, on June 28 and again, to a third location approximately 100 m farther upstream on July 13. The logger in watercourse A-P93-A17 was removed on July 3 because the watercourse was nearly dry and the logger was exposed to the air. The other loggers were removed in late August. The data were retrieved from the loggers on one or two occasions during their deployment using a Hobo waterproof shuttle (Onset Corporation).

The temperature data from the individual data retrievals for each temperature logger were combined and plotted using HOBOware Pro software (Version 3.7.5, Onset Corporation). The plots were examined to determine if there were temperatures logged during data retrievals when the loggers were exposed to the air, characterized by larger than expected deviations from the preceding and subsequent temperatures. When these were present, they were deleted from the dataset. Four aberrant values logged at Location L4 on August 22 that were probably the result of data corruption, as they were outside of the range of the loggers, were also deleted from the dataset. The 'clean' dataset was exported to Excel (Microsoft Corporation) for graphing and analysis. The datasets for the loggers that recorded at one minute intervals were reduced to include only those data recorded at 15 minute intervals, beginning on the hour.

As stated above, the temperature logger in watercourse A-P93-A17 was exposed to the air prior to its removal on July 3. Examination of the plotted data showed a marked increase in the diurnal fluctuations at that location on July 2. Therefore the data for dates/times after July 1 were deleted from the dataset. The temperature logger at the south end of Whale Tail Lake (L4) and in watercourse A46-A17 (L8) were partially exposed to the air when they were retrieved on August 30. To determine if and when the logged temperatures were influenced by exposure to the air the differences between temperatures logged at those locations and temperatures logged in watercourse A53-A17 (L7) where the logger was always submerged were calculated and plotted. The difference between the temperatures at L4 and L7 were consistent during the latter part of the deployment period, indicating that the logger at L4 was recording water temperature throughout the deployment. The difference between the temperatures at L7 and L8 were markedly greater on August 29 and 30, indicating that the logger in T8 was recording air temperature on those dates; therefore the data for T8 from those two dates were deleted from the dataset.

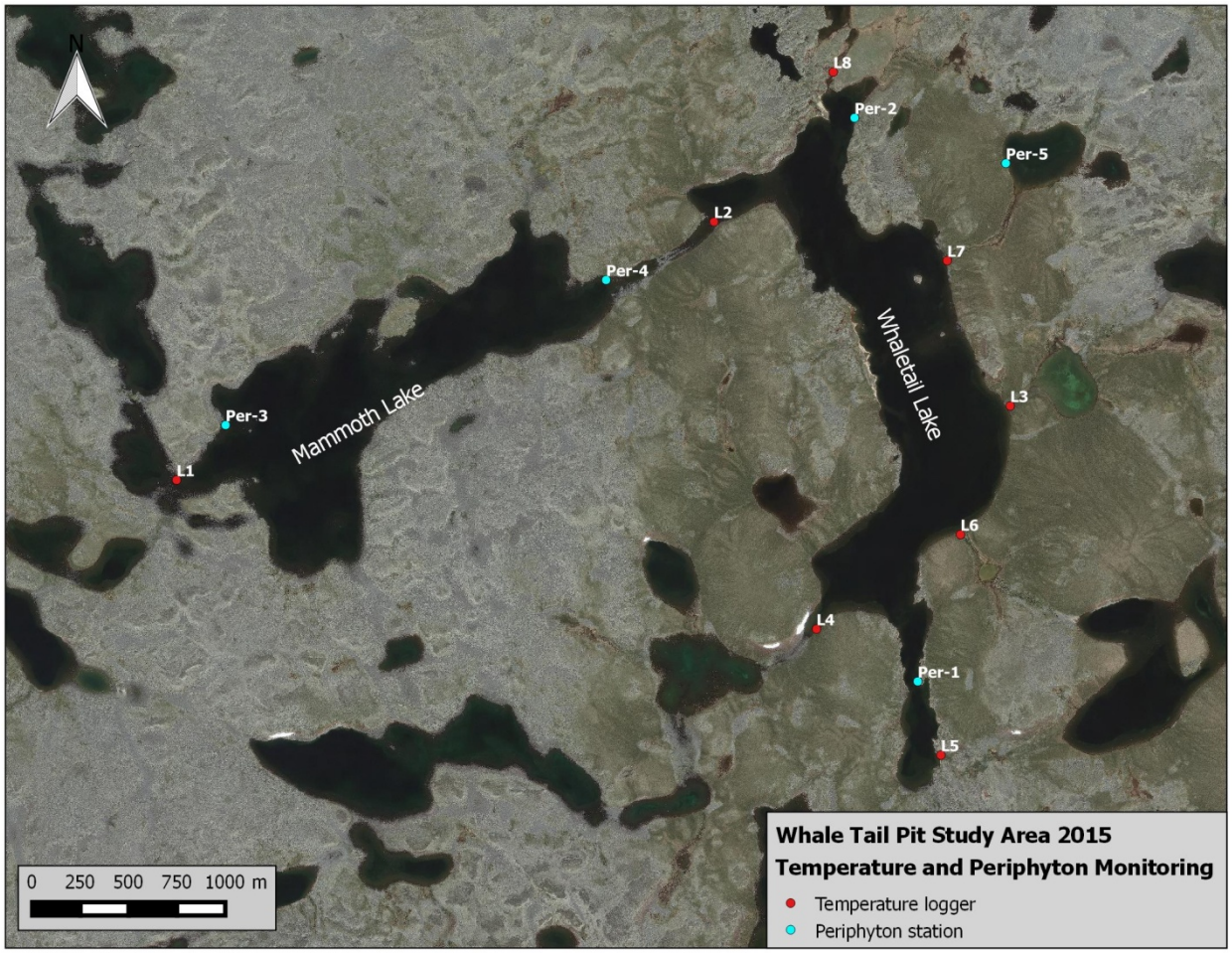


Figure 7-1. Temperature and periphyton monitoring locations in the Whale Tail Pit study area, 2015.

7.2 Results

The first and last complete day for which temperature data are available, the maximum water temperature recorded and the date on which the maximum temperature was recorded are presented for each location in Table 7-1. The temperature loggers at L1 and L2 stopped recording data on August 3 and August 12, respectively, when their memory capacity was reached. The other six loggers recorded temperatures from their deployment until their removal.

Table 7-1. The first and last full day for which temperature data are available, the maximum water temperature recorded and the day that the maximum water temperature was recorded at each location.

Location	Location ID	Start Date (2015)	End Date (2015)	Maximum temperature (°C)	Date of maximum temperature
Outlet of Mammoth Lake (A16-A17)	L1	June 22	August 2	17.1	July 29
Outlet of Whale Tail Lake (A17-A16)	L2	June 22	August 11	18.6	August 6
A55-A17	L3	June 27	August 29	19.5	August 4
South end of Whale Tail Lake (near mouth of A18-A17)	L4	June 27	August 29	20.5	July 29
A-P93-A17	L5	June 27	July 1	13.6	July 1
A59-A17	L6	June 28	August 29	21.1	August 6
A53-A17	L7	June 28	August 29	22.8	August 4
A46-A17	L8	June 28	August 27	24.5	July 27

The maximum water temperatures were recorded on July 29 in the outlet from Mammoth Lake (L1) and at the south end of Whale Tail Lake (L4) and were 17.1°C and 20.5°C respectively (Table 7-1). The maximum temperature in the outlet from Whale Tail Lake occurred on August 6 and was 18.6°C (Table 7-1). The maximum water temperatures in the four tributaries where temperatures were recorded from late June through late August and Whale Tail Lake (L2) occurred between July 27 and August 6 and ranged from 19.5°C to 24.5°C (Table 7-1).

The maximum daily water temperatures in the lake outlets were less than 3°C at the beginning of the deployments when the lakes were still ice-covered (**Figure 7-2**). Water temperatures in the outlets increased slowly until mid-July. Then a rapid increase in temperature occurred when the last of the ice in the lakes melted. The water temperature increased more rapidly at L4, at the south end of Whale Tail Lake, than it did in the lake outlet (**Figure 7-2**). This is probably because the ice melted from this arm of the lake sooner than it did on the main lake and also due to the influence of the warmer water from tributary A18-A17. After mid-July, when the last ice in the main part of Whale Tail Lake melted, the water temperatures at this location were more similar to those in the outlet from Whale Tail Lake.

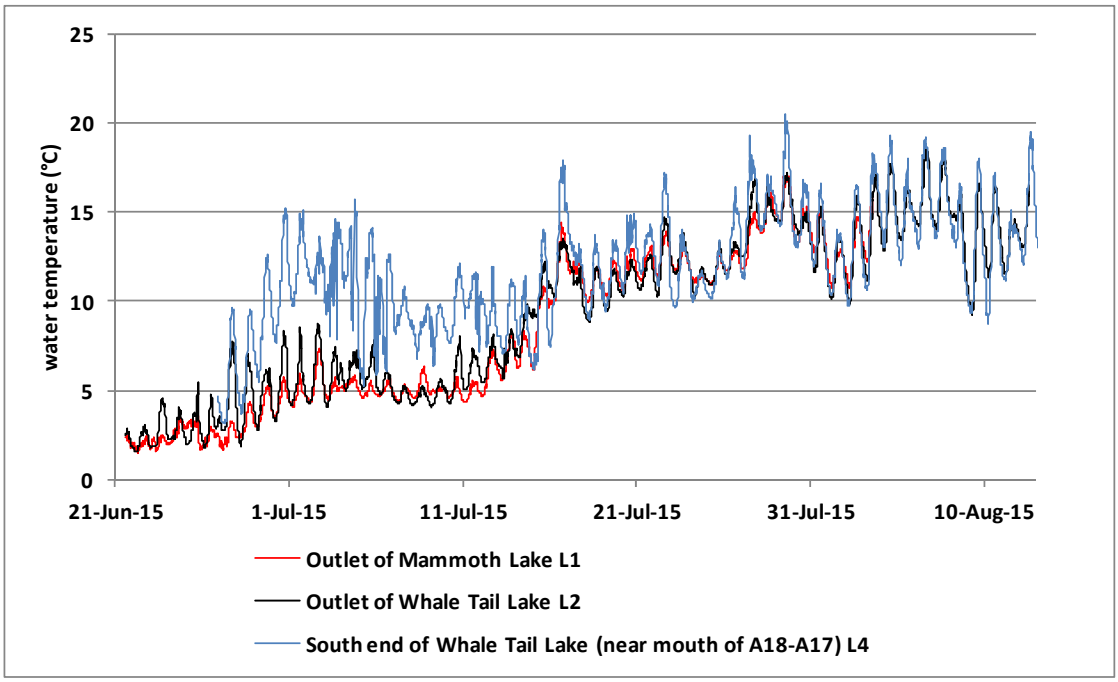


Figure 7-2. Water temperatures at the outlets of Mammoth (L1) and Whale Tail (L2) Lakes and at the south end of Whale Tail Lake (L4) for the period June 21 – August 12, 2015.

The daily mean, maximum and minimum water temperatures in the tributaries for the period June 27- August 28 are presented in Figure 7-3, Figure 7-4 and Figure 7-5 respectively. The rates of increase in temperature in late June and early July appear to be related to the duration of ice presence in the upstream lakes. Watercourse A55-A17, with only small shallow lakes and ponds upstream, warmed most quickly. Watercourse A59-A17, which has a large lake upstream, warmed most slowly. The mean temperatures of watercourses converged after mid-July and subsequently all four tributaries exhibited similar patterns in mean temperatures, presumably in response to weather conditions. In August, diurnal fluctuations were greatest in A53-17 and A46-17 (Figure 7-4 and Figure 7-5), which had the smallest drainage areas and shallow lakes upstream. Diurnal fluctuations were least in A55-A17.

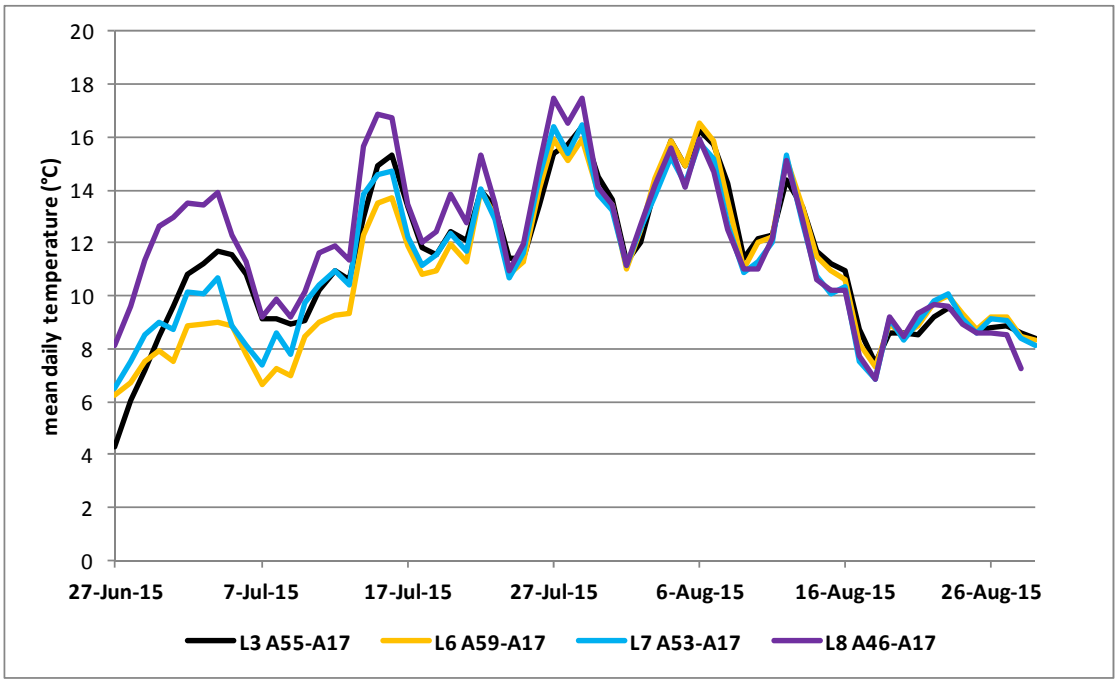


Figure 7-3. Mean daily water temperature in four tributaries to Whale Tail Lake for the period June 27 – August 28, 2015.

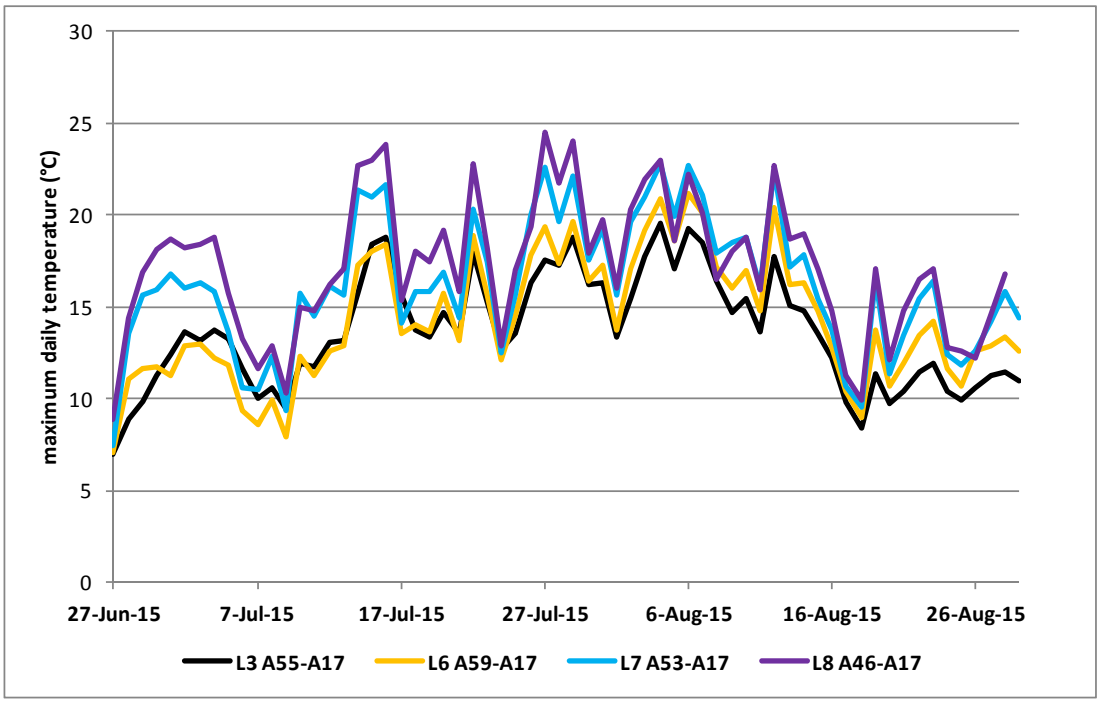


Figure 7-4. Maximum daily water temperature in four tributaries to Whale Tail Lake for the period June 27 – August 28, 2015.

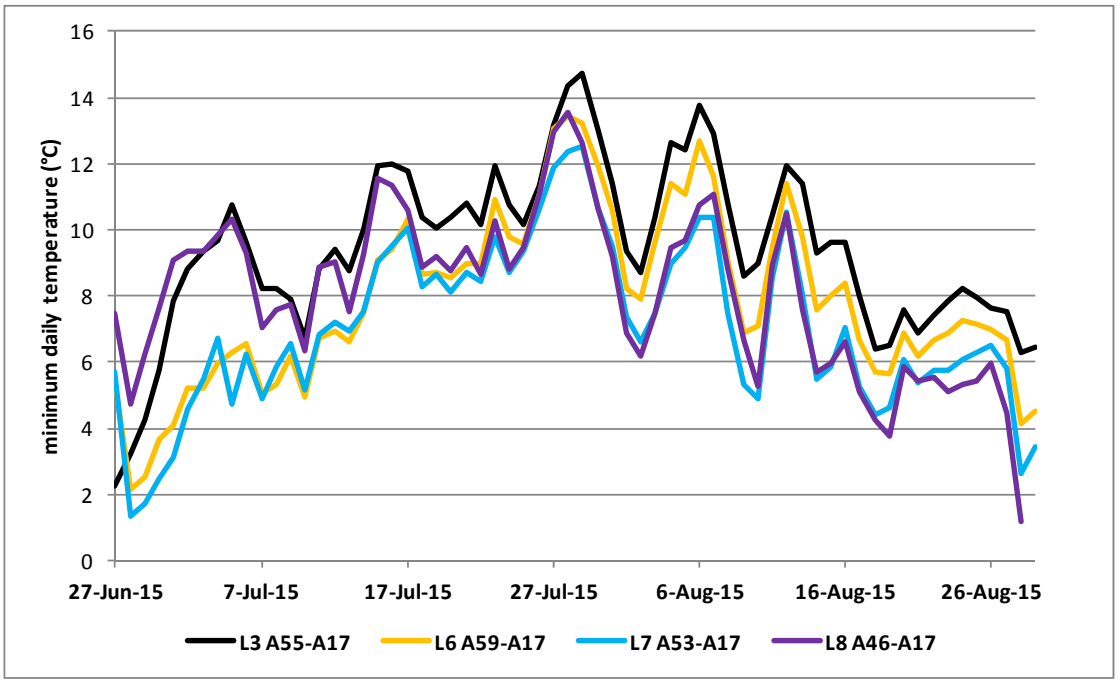


Figure 7-5. Minimum daily water temperature in four tributaries to Whale Tail Lake for the period June 27 – August 28, 2015.

8.0 PERIPHYTON MONITORING

8.1 Methods

Periphyton monitoring stations were established on Mammoth Lake, Whale Tail Lake, and Lake A53 (Figure 7-1). Stations were situated close to an accessible shore area, in water deep enough that the station would not become dry as water levels fell through the summer. The coordinates of each station were determined using a Garmin Oregon 650 gps, and a rectangular plot, approximately 2-3 m^2 in area, was established, marking each corner with flagging tape tied to a rock to ensure that the same location was examined and photographed over the course of the monitoring. Substrate type was characterized in each plot, following the Wentworth (1922) scale. Monitoring occurred when it corresponded with other field work being conducted in the vicinity, resulting in four monitoring occasions in Whale Tail Lake, two in Mammoth Lake, and three in Lake A53. Using the methods provided by Golder Associates Ltd., photographs of the substrate were taken and the following information was recorded during each monitoring event:

- date
- periphyton coverage (none 0%, sparse <5%, low 5-25%, moderate 25-75%, high >75%)
- colour of periphyton layer
- thickness (mm) of Periphyton layer
- water clarity and colour
- evenness of periphyton coverage over the broader surrounding area (even - patchy)

8.2 Results

The latitude and longitude, substrate composition and macro-scale photograph numbers are provided in Table 8-1 **and the periphyton observations and photograph numbers for each station and date are provided in**

Table 8-2. The photographs have been provided digitally. In all cases the periphyton was a spongy, non-filamentous mat that broke away in flat chunks when disturbed, and coverage was even in the vicinity of all of the plots on all occasions.

Table 8-1. Location of and substrate composition at the periphyton monitoring locations. The locations are shown in Figure 7-1.

Lake	Location	Latitude	Longitude	Substrate composition (%)				Photographs
				Large gravel	Small cobble	Large cobble	Boulder	
Whale Tail	**Per-1**	-96.688532	65.382087	0	40	60	0	4389, 4390
	Per-2	-96.693274	65.408335	0	20	75	5	4415
Mammoth	**Per-3**	-96.76458	65.395138	0	0	30	70	4441-4443
	Per-4	-96.721609	65.401235	0	0	20	80	4448-4450
Lake A53	**Per-5**	-96.676592	65.405969	10	70	20	0	4595, 4596

Table 8-2. Periphyton characteristics and numbers of the photographs that document the conditions. The locations are shown in Figure 7-1.

Lake	Location	Date (2015)	Periphyton characteristics			Photographs
			Cover (%)	Colour	Thickness (mm)	
Whale Tail	Per-1	July 26	50	olive	1-3	4382-4388
		August 4	>75	olive	1-5	4601-4605
		August 19	>75	olive-brown	1-5	4618-4625
		August 30	>75	brown	1-4	4767-4770
	Per-2	July 27	>75	olive	1-2	4412-4414
		August 4	>75	olive	1-2	4597-4600
		August 19	>75	olive	1-2	4626-4630
		August 30	>75	olive-brown	1-4	4782-4784
Mammoth Lake	Per-3	July 30	>75	olive	3-4	4437-4440
		August 25	>75	olive-brown	4-7	4678-4683
	Per-4	July 30	50	olive	1-2	4444-4447
		August 25	>75	olive-brown	1-2	4705-4709
Lake A53	Per-5	August 3	>75	brown	1	4591-4594
		August 20	>75	brown	1	27, 28
		August 31	>75	brown	1	4800, 4801

9.0 SUMMARY

In total, individuals of six fish species were captured during the 2014 and 2015 sampling. These were comprised of four large-bodied species (Lake Trout , Arctic Char, Round Whitefish and Burbot) and two small-bodies species (Slimy Sculpin and Ninespine Stickleback). Lake Trout were the most abundant in gill net catches and were captured in Mammoth, Whale Tail and Nemo Lakes and in seven of the smaller lakes (Table 6-1). Round Whitefish were captured in Mammoth and Whale Tail Lakes and in two of the smaller lakes (Table 6-1). Arctic Char were captured in Whale Tail Lake and in three of the smaller lakes. The Arctic Char are presumed to be land-locked, given the distance to a marine environment.

Netting catch per unit effort was low for all species. In Mammoth, Whale Tail and Nemo Lakes combined, average catch per unit effort in gill nets, calculated as the number of individuals captured per hour of soak time using a standard AEM gill net, was 0.5, 0.1 and 0.01 for Lake Trout, Round Whitefish and Arctic Char, respectively. Large mesh hoop nets set between June 19 and July 13, 2015, in areas where there was thought to be potential for fish movement between lakes caught one Lake Trout and one Arctic Char in 3000 hours of soak time. In total, electrofishing 1,978 m of lake shoreline resulted in the capture of 145 Ninespine Stickleback, 55 Slimy Sculpin, 2 juvenile Arctic Char and 3 juvenile salmonids, either Arctic Char or Lake Trout, which were not identified to species. There were, however, several isolated or nearly isolated small lakes and ponds in which no fish were captured. Most of these were located north of Whale Tail Lake.

Electrofishing effort on study area tributaries over the 2015 field season totalled 24,709 electroseconds and 3,569 m. The most abundant species in the catches was Ninespine Stickleback (n=469) followed by Slimy Sculpin (n=237). Low numbers of juvenile Arctic Char (n=13), juvenile Lake Trout (n=8), as well as one juvenile each of Round Whitefish and Burbot were captured in the tributaries. Juvenile Arctic Char were captured by electrofishing in five of the tributaries to Whale Tail Lake and juvenile Lake Trout were captured in three. Large minnow traps set in tributaries caught 9 Slimy Sculpin and 1 juvenile Round Whitefish in 2640 hours of soak time.

There was only an interstitial flow connection during the 2015 spring freshet between four of the larger tributary lakes (A21, A56, A60 and A65) and Whale Tail Lake. This was also the case for lakes A43 and A45 that drain to Mammoth Lake. The connection between Whale Tail and Mammoth Lake had only interstitial flow once water levels and flows subsided. This was also the case in a number of the connecting channels downstream from Mammoth Lake.

No Arctic Grayling were observed or captured in the study area. Their apparent absence is consistent with the paucity of suitable spawning habitat and absence of riverine adult habitat in the tributaries to Mammoth and Whale Tail Lake. Migrations by adults to and from downstream would be prevented by the absence of surface flow in several of the connecting channels except under freshet conditions.

10.0 LITERATURE CITED

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APPENDIX A – FISH SAMPLING DATA

Table A 1. Hoop net number, location ID (refer to Figure 3-1) and coordinates, set and lift dates and times, direction of opening, and catch for large-mesh hoop nets set in 2015. Nets 1 and 6 had six m long wings. Nets 2, 3, 4 and 5 had 3 m long wings.

Net Number	Location ID	Latitude	Longitude	Water-course	Date Set	Time Set	Date Lifted	Time lifted	Soak Time (hours)	Opening facing	Catch
1	LHN1	65.392670	-96.770258	A16-A15	19-Jun	14:35	20-Jun	14:30	24	downstream	none
1	LHN1	65.392670	-96.770258	A16-A15	20-Jun	14:30	21-Jun	12:00	22	downstream	none
1	LHN1	65.392670	-96.770258	A16-A15	21-Jun	12:00	27-Jun	13:15	145	downstream	none
1	LHN1	65.392670	-96.770258	A16-A15	27-Jun	13:15	28-Jun	15:21	26	downstream	none
1	LHN1	65.392670	-96.770258	A16-A15	28-Jun	15:21	03-Jul	15:35	120	downstream	none
1	LHN1	65.392670	-96.770258	A16-A15	03-Jul	15:35	04-Jul	9:30	18	downstream	none
3	LHN1	65.392670	-96.770258	A16-A15	21-Jun	12:30	27-Jun	13:15	145	downstream	none
3	LHN1	65.392670	-96.770258	A16-A15	27-Jun	13:15	28-Jun	15:03	26	upstream	none
3	LHN1	65.392670	-96.770258	A16-A15	28-Jun	15:03	03-Jul	15:45	121	upstream	none
3	LHN1	65.392670	-96.770258	A16-A15	03-Jul	15:45	04-Jul	9:30	18	upstream	none
1	LHN3	65.403864	-96.709527	A17-A16	04-Jul	14:30	06-Jul	15:00	49	upstream	none
1	LHN3	65.403864	-96.709527	A17-A16	06-Jul	15:00	07-Jul	15:30	25	upstream	none
1	LHN3	65.403864	-96.709527	A17-A16	07-Jul	15:30	08-Jul	15:20	24	upstream	none
1	LHN3	65.403864	-96.709527	A17-A16	08-Jul	15:20	09-Jul	12:10	21	upstream	none
1	LHN3	65.403864	-96.709527	A17-A16	09-Jul	12:10	10-Jul	13:45	26	upstream	none
1	LHN3	65.403864	-96.709527	A17-A16	10-Jul	13:45	12-Jul	16:17	51	upstream	none
1	LHN3	65.403864	-96.709527	A17-A16	12-Jul	16:17	13-Jul	9:15	17	upstream	none
3	LHN3	65.403948	-96.709764	A17-A16	04-Jul	14:30	06-Jul	15:00	49	downstream	none
3	LHN3	65.403948	-96.709764	A17-A16	06-Jul	15:00	07-Jul	15:30	25	downstream	none
3	LHN3	65.403948	-96.709764	A17-A16	07-Jul	15:30	08-Jul	15:20	24	downstream	none
3	LHN3	65.403948	-96.709764	A17-A16	08-Jul	15:20	09-Jul	12:10	21	downstream	none
3	LHN3	65.403948	-96.709764	A17-A16	09-Jul	12:10	10-Jul	13:45	26	downstream	none
3	LHN3	65.403948	-96.709764	A17-A16	10-Jul	13:45	12-Jul	16:17	51	downstream	none

Net Number	Location ID	Latitude	Longitude	Water-course	Date Set	Time Set	Date Lifted	Time lifted	Soak Time (hours)	Opening facing	Catch
3	LHN3	65.403948	-96.709764	A17-A16	12-Jul	16:17	13-Jul	9:15	17	downstream	none
2	LHN2a	65.402724	-96.711557	A17-A16	19-Jun	15:10	20-Jun	14:45	24	downstream	none
2	LHN2a	65.402724	-96.711557	A17-A16	20-Jun	14:45	21-Jun	13:00	22	downstream	none
2	LHN2a	65.402724	-96.711557	A17-A16	21-Jun	13:00	27-Jun	13:15	144	downstream	none
2	LHN2a	65.402724	-96.711557	A17-A16	27-Jun	13:15	28-Jun	15:21	26	upstream	none
2	LHN2b	65.403052	-96.710704	A17-A16	28-Jun	15:21	29-Jun	7:40	16	upstream	none
2	LHN2b	65.403052	-96.710704	A17-A16	29-Jun	7:40	03-Jul	15:15	104	upstream	none
2	LHN2b	65.403052	-96.710704	A17-A16	03-Jul	15:15	06-Jul	14:50	72	upstream	none
2	LHN2b	65.403052	-96.710704	A17-A16	06-Jul	14:50	07-Jul	15:15	24	upstream	none
2	LHN2b	65.403052	-96.710704	A17-A16	07-Jul	15:15	08-Jul	15:15	24	upstream	none
2	LHN2b	65.403052	-96.710704	A17-A16	08-Jul	15:15	09-Jul	12:10	21	upstream	none
2	LHN2b	65.403052	-96.710704	A17-A16	09-Jul	12:10	10-Jul	14:00	26	upstream	none
2	LHN2b	65.403052	-96.710704	A17-A16	10-Jul	14:00	12-Jul	16:07	50	upstream	none
2	LHN2b	65.403052	-96.710704	A17-A16	12-Jul	16:07	13-Jul	9:30	17	upstream	none
4	LHN2a	65.402724	-96.711557	A17-A16	21-Jun	13:45	27-Jun	13:15	144	downstream	none
4	LHN2a	65.402724	-96.711557	A17-A16	27-Jun	13:15	28-Jun	15:03	26	downstream	none
4	LHN2b	65.403006	-96.710979	A17-A16	28-Jun	15:03	29-Jun	7:45	17	downstream	none
4	LHN2b	65.403006	-96.710979	A17-A16	29-Jun	7:45	03-Jul	15:17	104	downstream	none
4	LHN2b	65.403006	-96.710979	A17-A16	03-Jul	15:17	06-Jul	14:50	72	downstream	none
4	LHN2b	65.403006	-96.710979	A17-A16	06-Jul	14:50	07-Jul	15:15	24	downstream	none
4	LHN2b	65.403006	-96.710979	A17-A16	07-Jul	15:15	08-Jul	15:15	24	downstream	none
4	LHN2b	65.403006	-96.710979	A17-A16	08-Jul	15:15	09-Jul	12:10	21	downstream	none
4	LHN2b	65.403006	-96.710979	A17-A16	09-Jul	12:10	10-Jul	14:00	26	downstream	none
4	LHN2b	65.403006	-96.710979	A17-A16	10-Jul	14:00	12-Jul	16:07	50	downstream	none
4	LHN2b	65.403006	-96.710979	A17-A16	12-Jul	16:07	13-Jul	9:30	17	downstream	none

Net Number	Location ID	Latitude	Longitude	Water-course	Date Set	Time Set	Date Lifted	Time lifted	Soak Time (hours)	Opening facing	Catch
5	LHN5	65.394604	-96.677482	A55-A17	26-Jun	8:40	27-Jun	10:30	26	downstream	none
5	LHN5	65.394604	-96.677482	A55-A17	27-Jun	10:30	28-Jun	13:45	27	downstream	none
5	LHN5	65.394604	-96.677482	A55-A17	28-Jun	13:45	29-Jun	10:45	21	downstream	none
5	LHN5	65.394604	-96.677482	A55-A17	29-Jun	10:45	03-Jul	7:55	93	downstream	none
5	LHN5	65.394604	-96.677482	A55-A17	03-Jul	7:55	06-Jul	8:30	73	downstream	1 Lake Trout toothed in wing - 69 cm 1 Arctic Char caught in wing 27 cm
5	LHN5	65.394604	-96.677482	A55-A17	06-Jul	8:30	07-Jul	15:50	31	downstream	none
5	LHN5	65.394604	-96.677482	A55-A17	07-Jul	15:50	08-Jul	14:50	23	downstream	none
5	LHN5	65.394604	-96.677482	A55-A17	08-Jul	14:50	09-Jul	16:15	25	downstream	none
5	LHN5	65.394604	-96.677482	A55-A17	09-Jul	16:15	12-Jul	11:34	67	downstream	none
5	LHN5	65.394604	-96.677482	A55-A17	12-Jul	11:34	13-Jul	12:40	25	downstream	none
6	LHN4	65.384689	-96.699785	A18-A17	26-Jun	10:40	29-Jun	9:47	71	downstream	none
6	LHN4	65.384689	-96.699785	A18-A17	29-Jun	9:47	04-Jul	15:10	125	downstream	none
6	LHN4	65.384689	-96.699785	A18-A17	04-Jul	15:10	05-Jul	15:35	24	downstream	none
6	LHN4	65.384689	-96.699785	A18-A17	05-Jul	15:35	08-Jul	14:58	71	downstream	none
6	LHN4	65.384689	-96.699785	A18-A17	08-Jul	14:58	09-Jul	14:55	24	downstream	none
6	LHN4	65.384689	-96.699785	A18-A17	09-Jul	14:55	13-Jul	11:30	93	downstream	none

Table A 2. Gill net set, lift and catch data. Refer to figures in the body of the report for locations.

Waterbody	Set type	Location ID	Start depth	Start latitude	Start longitude	End depth	End latitude	End longitude	Set date	Set time	Lift date	Lift time	Lake Trout	Arctic Char	Round Whitefish	Burbot
A113	miscellaneous gill net	GN46	0.6	65.417648	-96.690075	0.5	65.418488	-96.689693	28-Aug-15	15:14	29-Aug-15	7:50	0	0	0	0
A18	miscellaneous gill net	GN37	1	65.383806	-96.713253	1.1	65.382809	-96.715195	22-Aug-15	12:45	22-Aug-15	15:03	0	0	0	0
A19	miscellaneous gill net	GN38	1	65.377131	-96.713333	1	65.376886	-96.716198	23-Aug-15	9:36	23-Aug-15	11:30	0	0	0	0
A20	miscellaneous gill net	GN39a	2.4	65.379587	-96.746692	7.8	65.378869	-96.749023	23-Aug-15	14:16	23-Aug-15	16:01	0	0	1	0
A20	overnight gill net	GN39b	2.4	65.379587	-96.746692	7.8	65.378869	-96.749023	23-Aug-15	16:20	24-Aug-15	8:07	11	0	5	0
A22	miscellaneous gill net	GN40	3.5	65.373967	-96.757500	6.7	65.373660	-96.760268	24-Aug-15	15:02	24-Aug-15	16:38	2	1	0	0
A45	miscellaneous gill net	GN45	2	65.384859	-96.744752	3	65.384002	-96.746927	28-Aug-15	10:50	28-Aug-15	12:49	0	0	0	0
A47	miscellaneous gill net	GN47	0.7	65.412776	-96.694540	1	65.413968	-96.695097	29-Aug-15	9:25	29-Aug-15	11:40	0	1	0	0
A49	miscellaneous gill net	GN48	2.5	65.410462	-96.699762	3.5	65.411405	-96.701695	29-Aug-15	13:27	29-Aug-15	15:58	0	0	0	0
A53	miscellaneous gill net	GN31	1.2	65.406759	-96.669336	2	65.406215	-96.672075	03-Aug-15	14:28	03-Aug-15	16:51	1	2	0	0
A55	miscellaneous gill net	GN44	0.8	65.396819	-96.671340	0.7	65.395737	-96.669831	27-Aug-15	15:57	28-Aug-15	8:07	5	0	0	1
A62	miscellaneous gill net	GN43	1.5	65.391819	-96.702106	3.3	65.390929	-96.703743	27-Aug-15	11:49	27-Aug-15	13:46	3	0	0	0
A63	miscellaneous gill net	GN36	4.2	65.388938	-96.717718	3.3	65.387855	-96.716076	22-Aug-15	8:31	22-Aug-15	10:07	1	0	0	0
A65	miscellaneous gill net	GN35	1	65.373144	-96.694364	1.5	65.373712	-96.696831	20-Aug-15	10:37	20-Aug-15	13:57	2	0	2	0
Mammoth Lake	2014 miscellaneous gill net	GN14-5	3.2	65.389745	-96.750904	3.5	65.391114	-96.751886	04-Sep-14	11:03	04-Sep-14	17:35	7	0	0	0
Mammoth Lake	2014 miscellaneous gill net	GN14-6	5.3	65.390281	-96.756683	2	65.391654	-96.757351	04-Sep-14	11:23	04-Sep-14	18:03	6	0	0	0
Mammoth Lake	miscellaneous gill net	GN41a	2.5	65.400782	-96.727100	5	65.400924	-96.730386	25-Aug-15	8:48	25-Aug-15	14:11	1	0	0	0
Mammoth Lake	miscellaneous gill net	GN42a	8	65.395395	-96.752570	5.3	65.395304	-96.755652	25-Aug-15	9:07	25-Aug-15	14:36	3	0	0	0
Mammoth Lake	overnight gill net	GN41b	2.5	65.400782	-96.727100	5	65.400924	-96.730386	25-Aug-15	14:27	26-Aug-15	8:09	10	0	4	0
Mammoth Lake	overnight gill net	GN42b	8	65.395395	-96.752570	5.3	65.395304	-96.755652	25-Aug-15	14:45	26-Aug-15	8:50	14	0	0	0
Mammoth Lake	short-set gill net	GN15	1.3	65.399001	-96.744166	4.2	65.398085	-96.742010	28-Jul-15	8:24	28-Jul-15	10:39	1	0	3	0
Mammoth Lake	short-set gill net	GN16	1.4	65.399447	-96.748510	7.2	65.398371	-96.750074	28-Jul-15	8:39	28-Jul-15	11:15	3	0	5	0
Mammoth Lake	short-set gill net	GN17	0.9	65.399489	-96.723543	3.3	65.400282	-96.725747	28-Jul-15	9:23	28-Jul-15	12:02	0	0	0	0
Mammoth Lake	short-set gill net	GN18	1.8	65.401677	-96.735628	2.3	65.400710	-96.733640	28-Jul-15	11:10	28-Jul-15	13:30	0	0	1	0
Mammoth Lake	short-set gill net	GN19	1.5	65.396002	-96.745847	4.7	65.396414	-96.748668	28-Jul-15	11:50	28-Jul-15	13:51	1	0	1	0
Mammoth Lake	short-set gill net	GN20	2.7	65.403152	-96.726912	3	65.402034	-96.728046	28-Jul-15	12:19	28-Jul-15	14:26	1	0	4	0
Mammoth Lake	short-set gill net	GN21	1.7	65.398226	-96.735355	6.7	65.399367	-96.736694	28-Jul-15	13:47	28-Jul-15	15:46	0	0	0	0
Mammoth Lake	short-set gill net	GN22	3.1	65.392852	-96.750834	4.7	65.392783	-96.753812	28-Jul-15	14:15	28-Jul-15	16:11	2	0	2	0
Mammoth Lake	short-set gill net	GN23	2.1	65.388788	-96.753937	4.5	65.389863	-96.755265	29-Jul-15	7:59	29-Jul-15	10:13	0	0	0	0
Mammoth Lake	short-set gill net	GN24	1.8	65.396210	-96.765103	5.5	65.396455	-96.762148	29-Jul-15	8:40	29-Jul-15	10:38	0	0	0	0
Mammoth Lake	short-set gill net	GN25	2.1	65.398015	-96.755425	4.3	65.397118	-96.757389	29-Jul-15	8:49	29-Jul-15	11:10	0	0	0	0
Mammoth Lake	short-set gill net	GN26	3.8	65.392535	-96.760530	2.4	65.392523	-96.757591	29-Jul-15	10:30	29-Jul-15	12:33	0	0	0	0
Mammoth Lake	short-set gill net	GN27	6.8	65.396505	-96.753644	6	65.395413	-96.755496	29-Jul-15	11:08	29-Jul-15	13:08	0	0	0	0
Mammoth Lake	short-set gill net	GN28	8.7	65.401212	-96.732046	6.3	65.400005	-96.732679	29-Jul-15	11:36	29-Jul-15	13:36	0	0	0	0
Nemo Lake	2014 miscellaneous gill net	GN14-1	4.2	65.416952	-96.713128	2.3	65.416430	-96.710065	06-Sep-14	11:16	06-Sep-14	17:47	4	0	0	0

Waterbody	Set type	Location ID	Start depth	Start latitude	Start longitude	End depth	End latitude	End longitude	Set date	Set time	Lift date	Lift time	Lake Trout	Arctic Char	Round Whitefish	Burbot
Nemo Lake	2014 miscellaneous gill net	GN14-2	15	65.424743	-96.701119	17	65.424159	-96.698448	06-Sep-14	11:40	06-Sep-14	18:24	11	0	0	0
Nemo Lake	miscellaneous gill net	GN29a	3.4	65.424979	-96.691333	5.8	65.424018	-96.693733	02-Aug-15	8:00	02-Aug-15	11:20	2	0	0	0
Nemo Lake	miscellaneous gill net	GN29b	3.4	65.424979	-96.691333	5.8	65.424018	-96.693733	02-Aug-15	11:20	02-Aug-15	14:58	1	0	0	0
Nemo Lake	miscellaneous gill net	GN30a	16.7	65.426865	-96.702389	2.4	65.425660	-96.704009	02-Aug-15	8:22	02-Aug-15	11:50	1	0	0	0
Nemo Lake	miscellaneous gill net	GN30b	16.7	65.426865	-96.702389	2.4	65.425660	-96.704009	02-Aug-15	11:50	02-Aug-15	15:28	3	0	0	0
Whale Tail Lake	2014 miscellaneous gill net	GN14-3	1.2	65.405026	-96.701889	6	65.404261	-96.699056	05-Sep-14	13:39	05-Sep-14	20:00	4	1	0	0
Whale Tail Lake	2014 miscellaneous gill net	GN14-4	8.5	65.406093	-96.699462	5.5	65.405514	-96.696848	05-Sep-14	13:26	05-Sep-14	19:44	1	0	0	0
Whale Tail Lake	miscellaneous gill net	GN33a	3.3	65.393862	-96.688366	4.9	65.392600	-96.687569	18-Aug-15	9:34	18-Aug-15	14:43	0	0	0	0
Whale Tail Lake	miscellaneous gill net	GN34a	8.3	65.391789	-96.686985	3.2	65.392956	-96.688082	19-Aug-15	9:16	19-Aug-15	13:23	1	0	0	0
Whale Tail Lake	miscellaneous gill net	GN34b	8.3	65.391789	-96.686985	3.2	65.392956	-96.688082	19-Aug-15	13:40	19-Aug-15	16:37	0	0	0	0
Whale Tail Lake	overnight gill net	GN32	2.1	65.394058	-96.688595	6.3	65.392843	-96.687670	17-Aug-15	16:43	18-Aug-15	8:45	15	0	1	0
Whale Tail Lake	overnight gill net	GN33b	3.3	65.393862	-96.688366	4.9	65.392600	-96.687569	18-Aug-15	14:39	19-Aug-15	8:43	9	0	1	0
Whale Tail Lake	short-set gill net	GN01	1.5	65.399818	-96.684135	1.1	65.400431	-96.686871	24-Jul-15	9:23	24-Jul-15	11:21	0	0	0	0
Whale Tail Lake	short-set gill net	GN02	1.5	65.394034	-96.678016	2.4	65.394661	-96.680711	24-Jul-15	11:53	24-Jul-15	14:16	0	1	0	0
Whale Tail Lake	short-set gill net	GN03	4	65.388220	-96.688720	7.5	65.389392	-96.691743	24-Jul-15	14:10	24-Jul-15	16:05	0	0	0	0
Whale Tail Lake	short-set gill net	GN04	1	65.382051	-96.687806	7	65.383325	-96.689765	24-Jul-15	15:19	24-Jul-15	17:16	0	0	0	0
Whale Tail Lake	short-set gill net	GN05	1.5	65.385880	-96.695145	5.1	65.386787	-96.697035	25-Jul-15	9:35	25-Jul-15	11:54	0	0	0	0
Whale Tail Lake	short-set gill net	GN06	5.5	65.387701	-96.695769	0.6	65.388262	-96.698160	25-Jul-15	9:56	25-Jul-15	12:12	0	0	0	0
Whale Tail Lake	short-set gill net	GN07	8.8	65.390880	-96.685918	5.8	65.392023	-96.687253	25-Jul-15	11:23	25-Jul-15	14:07	1	0	0	0
Whale Tail Lake	short-set gill net	GN08	2	65.397723	-96.692555	4.7	65.398602	-96.690395	25-Jul-15	12:37	25-Jul-15	14:54	0	0	0	0
Whale Tail Lake	short-set gill net	GN09	4.2	65.402652	-96.699378	10.3	65.403331	-96.696805	25-Jul-15	12:48	25-Jul-15	15:38	2	0	1	0
Whale Tail Lake	short-set gill net	GN10	1.3	65.404365	-96.705779	4.3	65.404824	-96.708425	25-Jul-15	15:18	25-Jul-15	17:30	2	0	2	0
Whale Tail Lake	short-set gill net	GN11	1	65.408242	-96.693524	2.3	65.408855	-96.696033	25-Jul-15	15:34	25-Jul-15	18:07	0	0	0	0
Whale Tail Lake	short-set gill net	GN12	7.4	65.401087	-96.692770	3.5	65.402197	-96.694221	26-Jul-15	7:34	26-Jul-15	9:54	0	0	0	0
Whale Tail Lake	short-set gill net	GN13	11.2	65.403443	-96.696530	4.7	65.404775	-96.695607	26-Jul-15	7:46	26-Jul-15	10:08	0	0	0	0
Whale Tail Lake	short-set gill net	GN14	11.5	65.394851	-96.687671	6.3	65.396062	-96.687896	26-Jul-15	8:04	26-Jul-15	10:27	0	0	0	0

Table A 3. Capture location, net number and date of capture, mesh size, length and weight, liver weight, gonad weight, sex (male=m, female=f), maturity (m=mature, i=immature), age determined from fin rays and otoliths, and number of the tag applied to released individuals for fish captured in gill nets in 2015.

Waterbody name or code	Fish #	Net set # and lift	Date of lift	Mesh size (mm)	Species	Fork length (mm)	Weight (g)	Liver weight (g)	Gonad weight (g)	Sex	Maturity	Fin-ray age	Otolith age	Ext. DELT/ Parasites	Tag applied
Mammoth Lake	1	15	28-Jul-15	51	round whitefish	345	429	3.4	2	f	i	na	na	none	
Mammoth Lake	2	15	28-Jul-15	51	lake trout	497	860					na	na	none	0359
Mammoth Lake	3	15	28-Jul-15	51	round whitefish	342	435.2	3.2	1.3	m	i	na	na	none	
Mammoth Lake	4	15	28-Jul-15	38	round whitefish	272	198.8	1.8	na	m	i	na	na	none	
Mammoth Lake	5	16	28-Jul-15	76	lake trout	639	2920					na	na	none	0360
Mammoth Lake	6	16	28-Jul-15	51	lake trout	620	2570					na	na	none	0361
Mammoth Lake	7	16	28-Jul-15	51	lake trout	392	660					na	na	none	0362
Mammoth Lake	8	16	28-Jul-15	51	round whitefish	384	641.3	7	15.4	f	m	na	na	none	
Mammoth Lake	9	16	28-Jul-15	51	round whitefish	350	467.7	2.9	0.8	m	m	na	na	none	
Mammoth Lake	10	16	28-Jul-15	51	round whitefish	290	230.9	2.6	na	m	i	na	na	none	
Mammoth Lake	11	16	28-Jul-15	51	round whitefish	270	201.4	1.6	1.1	f	m	na	na	none	
Mammoth Lake	12	16	28-Jul-15	38	round whitefish	252	158.4	1	na	m	i	na	na	none	
Mammoth Lake	13	19	28-Jul-15	38	lake trout	752	3870					na	na	none	0363
Mammoth Lake	14	19	28-Jul-15	38	round whitefish	359	460	4.4	11.2	f	m	na	na	none	
Mammoth Lake	15	20	28-Jul-15	na	lake trout	311	323					na	na	none	0364
Mammoth Lake	16	20	28-Jul-15	na	round whitefish	310	333					na	na	none	0365
Mammoth Lake	17	20	28-Jul-15	na	round whitefish	284	238					na	na	none	
Mammoth Lake	18	20	28-Jul-15	na	round whitefish	296	256					na	na	none	
Mammoth Lake	19	20	28-Jul-15	na	round whitefish	328	362	2.7	4.9	f	m	na	na	none	
Mammoth Lake	20	21	28-Jul-15	51	round whitefish	353	281	4.2	1.6	m	i	na	na	none	
Mammoth Lake	21	21	28-Jul-15	38	lake trout	361	460					na	na	none	0366
Mammoth Lake	22	22	28-Jul-15	76	round whitefish	na	na					na	na	none	
Mammoth Lake	23	22	28-Jul-15	76	lake trout	414	675					na	na	none	
Mammoth Lake	24	22	28-Jul-15	38	round whitefish	na	na					na	na	none	
Mammoth Lake	25	22	28-Jul-15	38	lake trout	214	97					na	na	none	
Mammoth Lake	26	27	29-Jul-15	51	lake trout	342	475	6.6	na	m	i	7	na	none	
Nemo Lake	27	29a	02-Aug-15	102	lake trout	511	1290					na	na	none	0367
Nemo Lake	28	29a	02-Aug-15	102	lake trout	500	1290					na	na	none	0368
Nemo Lake	29	30a	02-Aug-15	76	lake trout	425	950					na	na	none	0369
Nemo Lake	30	29b	02-Aug-15	102	lake trout	483	1120					na	na	none	0370
Nemo Lake	31	30b	02-Aug-15	76	lake trout	800	7140					na	na	none	0371
Nemo Lake	32	30b	02-Aug-15	102	lake trout	828	7050					na	na	none	0372
Nemo Lake	33	30b	02-Aug-15	102	lake trout	612	2200	13.1	19.5	f	m	na	na	none	
A53	34	31	03-Aug-15	51	arctic char	433	970					na	na	none	0374

Waterbody name or code	Fish #	Net set # and lift	Date of lift	Mesh size (mm)	Species	Fork length (mm)	Weight (g)	Liver weight (g)	Gonad weight (g)	Sex	Maturity	Fin-ray age	Otolith age	Ext. DELT/ Parasites	Tag applied
A53	35	31	03-Aug-15	51	arctic char	515	1290					na	na	none	
A53	36	31	03-Aug-15	51	lake trout	580	2200					na	na	none	0375
Whale Tail Lake	37	7	25-Jul-15	76	lake trout	390	660					na	na	none	0352
Whale Tail Lake	38	9	25-Jul-15	51	lake trout	641	2710					na	na	none	0354
Whale Tail Lake	39	9	25-Jul-15	51	lake trout	880	8000					na	na	none	0353
Whale Tail Lake	40	9	25-Jul-15	51	round whitefish	411	775					na	na	none	
Whale Tail Lake	41	10	25-Jul-15	76	round whitefish	332	400					na	na	none	
Whale Tail Lake	42	10	25-Jul-15	51	round whitefish	388	590					na	na	none	0357
Whale Tail Lake	43	10	25-Jul-15	51	lake trout	263	170					na	na	none	0358
Whale Tail Lake	44	10	25-Jul-15	51	lake trout	355	440					na	na	none	
Whale Tail Lake	45	2	24-Jul-15	51	arctic char	453	780					na	na	none	0351
Whale Tail Lake	na	2	24-Jul-15	na	arctic char	510	780					na	na	none	0351
Whale Tail Lake	46	32	18-Aug-15	126	lake trout	568	1830	14	15.2	f	m	28	28	none	
Whale Tail Lake	47	32	18-Aug-15	102	lake trout	661	3110	22.2	3.3	m	m	26	24	none	
Whale Tail Lake	48	32	18-Aug-15	102	lake trout	581	2210	20	20.4	f	m	25	27	none	
Whale Tail Lake	49	32	18-Aug-15	76	lake trout	608	2230	35.4	194	f	m	25	26	none	
Whale Tail Lake	50	32	18-Aug-15	76	lake trout	481	1090		1	m	i	24	25	none	
Whale Tail Lake	51	32	18-Aug-15	76	round whitefish	na	na					na	na	na	
Whale Tail Lake	52	32	18-Aug-15	76	lake trout	445	1130	9.7	22	m	m	15	15	none	
Whale Tail Lake	53	32	18-Aug-15	76	lake trout	472	970	5.3	1	m	i	18	18	none	
Whale Tail Lake	54	32	18-Aug-15	76	lake trout	424	1060	14	130.1	f	m	20	22	none	
Whale Tail Lake	55	32	18-Aug-15	76	lake trout	396	778	11.3	91.3	f	m	14	16	none	
Whale Tail Lake	56	32	18-Aug-15	51	lake trout	407	775	5	25.1	m	m	16	23	none	
Whale Tail Lake	57	32	18-Aug-15	51	lake trout	388	607	4	34.5	m	m	12	13	none	
Whale Tail Lake	58	32	18-Aug-15	51	lake trout	469	987	11.5	0.7	m	i	14	18	none	
Whale Tail Lake	59	32	18-Aug-15	51	lake trout	380	655	3.6	15.6	m	m	11	12	none	
Whale Tail Lake	60	32	18-Aug-15	51	lake trout	430	687	6.1	4.5	f	m	12	13	none	
Whale Tail Lake	61	33b	19-Aug-15	25	lake trout	860	7320	55.6	371.4	m	m	39	44	none	
Whale Tail Lake	62	33b	19-Aug-15	38	lake trout	585	2110	14.6	74.7	m	m	22	26	none	
Whale Tail Lake	63	33b	19-Aug-15	38	lake trout	475	1020	6.7	25	m	m	20	25	none	
Whale Tail Lake	64	33b	19-Aug-15	38	lake trout	410	745	5.9	8.9	f	m	22	25	none	
Whale Tail Lake	65	33b	19-Aug-15	51	lake trout	423	693	5.3	3.6	f	m	11	14	none	
Whale Tail Lake	66	33b	19-Aug-15	51	lake trout	335	427	3.3		m	i	11	12	none	
Whale Tail Lake	67	33b	19-Aug-15	76	round whitefish	na	na					na	na	na	
Whale Tail Lake	68	33b	19-Aug-15	102	lake trout	319	348	2.5		m	i	9	9	none	
Whale Tail Lake	69	33b	19-Aug-15	102	lake trout	159	37.4	0.5		u	i	4	na	none	

Waterbody name or code	Fish #	Net set # and lift	Date of lift	Mesh size (mm)	Species	Fork length (mm)	Weight (g)	Liver weight (g)	Gonad weight (g)	Sex	Maturity	Fin-ray age	Otolith age	Ext. DELT/ Parasites	Tag applied
Whale Tail Lake	70	34b	19-Aug-15	51	lake trout	390	672	9.6	71	f	r	15	19	none	
A65	71	35	20-Aug-15	38	round whitefish	na	na					na	na	na	
A65	72	35	20-Aug-15	38	round whitefish	na	na					na	na	na	
A65	73	35	20-Aug-15	51	lake trout	na	na					na	na	na	
A65	74	35	20-Aug-15	51	lake trout	na	na					na	na	na	
A63	75	36	22-Aug-15	38	lake trout	na	na					na	na	na	
A20	76	39a	23-Aug-15	25	round whitefish	137	na					na	na	na	
A20	77	39b	24-Aug-15	76	round whitefish	na	na					na	na	na	
A20	78	39b	24-Aug-15	76	lake trout	349	420					na	na	none	0376
A20	79	39b	24-Aug-15	51	lake trout	549	1920					na	na	none	0377
A20	80	39b	24-Aug-15	51	lake trout	378	620					na	na	none	0378
A20	81	39b	24-Aug-15	51	lake trout	351	430					na	na	none	0379
A20	82	39b	24-Aug-15	51	lake trout	545	1980					na	na	none	0380
A20	83	39b	24-Aug-15	51	round whitefish	365	510					na	na	none	
A20	84	39b	24-Aug-15	51	round whitefish	369	530					na	na	none	
A20	85	39b	24-Aug-15	51	lake trout	381	500					12	12	none	
A20	86	39b	24-Aug-15	51	lake trout	305	280					na	na	none	0381
A20	87	39b	24-Aug-15	51	round whitefish	278	210					na	na	none	
A20	88	39b	24-Aug-15	51	lake trout	369	570					12	11	none	
A20	89	39b	24-Aug-15	38	round whitefish	230	120					na	na	none	
A20	90	39b	24-Aug-15	38	lake trout	189	80					3	3	none	
A20	91	39b	24-Aug-15	38	lake trout	250	170					na	na	none	
A20	92	39b	24-Aug-15	38	lake trout	366	550					na	na	none	0382
A22	93	40	24-Aug-15	51	lake trout	445	870					na	na	none	0383
A22	94	40	24-Aug-15	51	lake trout	na	na					na	na	na	
A22	95	40	24-Aug-15	28	arctic char	376	520					na	na	none	0384
Mammoth Lake	96	41a	25-Aug-15	38	lake trout	na	na					na	na	na	
Mammoth Lake	97	42a	25-Aug-15	51	lake trout	370	510	3.2	4.5	f	m	13	13	none	
Mammoth Lake	98	42a	25-Aug-15	51	lake trout	369	501	4	6.1	f	m	12	13	none	
Mammoth Lake	99	42a	25-Aug-15	51	lake trout	373	550	6.2	48.3	f	m	9	11	none	
Mammoth Lake	100	41b	26-Aug-15	126	lake trout	363	542	4.1	13	m	m	9	na	none	
Mammoth Lake	101	41b	26-Aug-15	76	lake trout	343	460	2.6	5.7	f	m	9	9	none	
Mammoth Lake	102	41b	26-Aug-15	76	lake trout	353	433	2.3	2	f	m	9	10	none	
Mammoth Lake	103	41b	26-Aug-15	76	lake trout	373	474	3.6	12	f	m	13	16	none	
Mammoth Lake	104	41b	26-Aug-15	76	round whitefish	430	763					na	na	none	
Mammoth Lake	105	41b	26-Aug-15	76	lake trout	385	612	3.5	12.1	f	m	10	11	none	

Waterbody name or code	Fish #	Net set # and lift	Date of lift	Mesh size (mm)	Species	Fork length (mm)	Weight (g)	Liver weight (g)	Gonad weight (g)	Sex	Maturity	Fin-ray age	Otolith age	Ext. DELT/ Parasites	Tag applied
Mammoth Lake	106	41b	26-Aug-15	76	lake trout	395	692	9.3	63	f	m	11	12	none	
Mammoth Lake	107	41b	26-Aug-15	76	round whitefish	390	596					na	na	none	
Mammoth Lake	108	41b	26-Aug-15	76	lake trout	351	474	2.2	8.5	m	m	8	na	none	
Mammoth Lake	109	41b	26-Aug-15	76	round whitefish	na	na					na	na	none	
Mammoth Lake	110	41b	26-Aug-15	76	lake trout	346	478	7.6	45	f	m	9	10	none	
Mammoth Lake	111	41b	26-Aug-15	51	lake trout	365	504	2.8	14.2	m	m	12	12	none	
Mammoth Lake	112	41b	26-Aug-15	51	lake trout	365	504	7.1	5.2	f	m	13	13	none	
Mammoth Lake	113	41b	26-Aug-15	51	round whitefish	na	na					na	na	none	
Mammoth Lake	114	42b	26-Aug-15	126	lake trout	590	2110	10.9	2.3	m	m	24	24	none	
Mammoth Lake	115	42b	26-Aug-15	76	lake trout	369	511	2.8	12.3	m	m	12	12	none	
Mammoth Lake	116	42b	26-Aug-15	76	lake trout	354	472	3.2	11.1	m	m	12	13	none	
Mammoth Lake	117	42b	26-Aug-15	76	lake trout	366	534	2.1		m	i	13	13	none	
Mammoth Lake	118	42b	26-Aug-15	76	lake trout	316	319	1.6		m	i	10	10	none	
Mammoth Lake	119	42b	26-Aug-15	76	lake trout	290	269	2.5		m	i	8	8	none	
Mammoth Lake	120	42b	26-Aug-15	76	lake trout	290	287	2.8	0.7	f	i	8	8	none	
Mammoth Lake	121	42b	26-Aug-15	51	lake trout	285	239	1.7		u	i	8	8	none	
Mammoth Lake	122	42b	26-Aug-15	51	lake trout	254	181	1.5	0.2	u	i	6	6	none	
Mammoth Lake	123	42b	26-Aug-15	51	lake trout	215	96.2	0.6		u	i	5	5	none	
Mammoth Lake	124	42b	26-Aug-15	38	lake trout	700	4670	51.5	630	f	m	32	37	none	
Mammoth Lake	125	42b	26-Aug-15	38	lake trout	176	50.1					4	na	none	
Mammoth Lake	126	42b	26-Aug-15	38	lake trout	218	111	0.5		u	i	6	5	none	
Mammoth Lake	127	42b	26-Aug-15	38	lake trout	na	na					na	na	na	
A62	129	43	27-Aug-15	102	lake trout	434	870					na	na	none	0385
A62	130	43	27-Aug-15	102	lake trout	440	980			f	m	na	na	none	0386
A62	131	43	27-Aug-15	102	lake trout	413	760					na	na	none	
A55	132	44	28-Aug-15	51	lake trout	267	210					na	na	none	
A55	133	44	28-Aug-15	51	lake trout	278	240					na	na	none	
A55	134	44	28-Aug-15	38	burbot	na	na					na	na	na	
A55	135	44	28-Aug-15	38	lake trout	181	na					na	na	none	
A55	136	44	28-Aug-15	38	lake trout	190	80					na	na	none	
A55	137	44	28-Aug-15	25	lake trout	127	na					na	na	none	
A47	138	47	29-Aug-15	51	arctic char	283	110					na	na	none	0388

Table A 4. Waterbody, net set ID, species, fork length and weight of fish captured by gill netting in 2014.

Waterbody	Net set ID	Species	Fork length (mm)	Weight (g)
Nemo Lake	GN14-1	lake trout	879	8510
Nemo Lake	GN14-1	lake trout	639	2580
Nemo Lake	GN14-1	lake trout	430	840
Nemo Lake	GN14-1	lake trout	855	8140
Nemo Lake	GN14-2	lake trout	478	1280
Nemo Lake	GN14-2	lake trout	395	750
Nemo Lake	GN14-2	lake trout	472	1300
Nemo Lake	GN14-2	lake trout	481	1180
Nemo Lake	GN14-2	lake trout	520	1520
Nemo Lake	GN14-2	lake trout	766	5290
Nemo Lake	GN14-2	lake trout	878	5840
Nemo Lake	GN14-2	lake trout	678	3100
Nemo Lake	GN14-2	lake trout	540	1600
Nemo Lake	GN14-2	lake trout	476	1310
Nemo Lake	GN14-2	lake trout	465	1220
Whale Tail Lake	GN14-3	Arctic char	424	850
Whale Tail Lake	GN14-3	lake trout	736	4450
Whale Tail Lake	GN14-3	lake trout	646	2940
Whale Tail Lake	GN14-3	lake trout	500	1190
Whale Tail Lake	GN14-3	lake trout	510	1180
Whale Tail Lake	GN14-4	lake trout	570	1790
Mammoth Lake	GN14-5	lake trout	700	3670
Mammoth Lake	GN14-5	lake trout	705	3480
Mammoth Lake	GN14-5	lake trout	629	2680
Mammoth Lake	GN14-5	lake trout	619	2310
Mammoth Lake	GN14-5	lake trout	464	1240
Mammoth Lake	GN14-6	lake trout	323	410
Mammoth Lake	GN14-6	lake trout	305	350
Mammoth Lake	GN14-6	lake trout	427	760
Mammoth Lake	GN14-6	lake trout	850	6200
Mammoth Lake	GN14-6	lake trout	255	170

Table A 5. Lake electrofishing locations, dates, effort, catches and dominant substrates at the sampling locations. All Lake Trout and Arctic Char were juveniles. Juvenile salmonids are individuals that were released and could not be identified to species in the field.

waterbody / watercourse	location ID	Date (2015)	Start latitude	Start longitude	distance (m)	e-seconds	Nine-spine Stickle-back	Slimy Sculpin	Lake Trout	Arctic Char	juvenile salmonid	dominant substrates
Whale Tail	EF-L1	26-Jul	65.408307	-96.693163	25	195	0	0	0	0	0	cobble
Whale Tail	EF-L2	26-Jul	65.404024	-96.706512	25	458	11	1	0	0	0	cobble/boulder
Whale Tail	EF-L3	26-Jul	65.402524	-96.700425	25	616	12	1	0	0	0	cobble/boulder
Whale Tail	EF-L4	26-Jul	65.397592	-96.693160	25	264	0	2	0	2	2	sand/gravel/cobble
Whale Tail	EF-L5	26-Jul	65.388576	-96.685952	25	248	3	4	0	0	0	gravel/cobble/few boulders
Whale Tail	EF-L6	26-Jul	65.393346	-96.677342	25	755	15	6	0	0	0	boulder/cobble
Whale Tail	EF-L7	27-Jul	65.402980	-96.692034	25	287	11	0	0	0	0	cobble/boulder
Whale Tail	EF-L8	27-Jul	65.401038	-96.683590	25	180	1	0	0	0	0	cobble/some boulder
Whale Tail	EF-L9	27-Jul	65.382070	-96.688423	25	170	0	0	0	0	0	cobble
Whale Tail	EF-L10	27-Jul	65.385106	-96.698296	25	230	2	0	0	0	0	cobble/gravel/boulder
Mammoth	EF-L11	29-Jul	65.400198	-96.742841	25	464	4	1	0	0	0	peat/cobble/gravel
Mammoth	EF-L12	29-Jul	65.401025	-96.739563	25	357	1	0	0	0	0	cobble/boulder/peat
Mammoth	EF-L13	29-Jul	65.402013	-96.725795	25	441	15	1	0	0	0	cobble/gravel/peat/boulder
Mammoth	EF-L14	29-Jul	65.402580	-96.725815	25	445	14	0	0	0	0	cobble/gravel/boulder/peat/ soil
Mammoth	EF-L15	30-Jul	65.401459	-96.721846	25	448	1	4	0	0	0	peat/cobble/boulder
Mammoth	EF-L16	30-Jul	65.401453	-96.721162	25	417	2	2	0	0	0	peat/cobble/boulder
Mammoth	EF-L17	30-Jul	65.399949	-96.721210	25	344	2	0	0	0	0	cobble/boulder/peat
Mammoth	EF-L18	30-Jul	65.399708	-96.721674	25	219	1	2	0	0	0	cobble/boulder/peat
Mammoth	EF-L19	30-Jul	65.389346	-96.760241	25	455	0	2	0	0	1	cobble/boulder
Mammoth	EF-L20	30-Jul	65.395107	-96.765136	25	332	1	1	0	0	0	cobble/boulder/peat

waterbody / watercourse	location ID	Date (2015)	Start latitude	Start longitude	distance (m)	e-seconds	Nine-spine Stickle-back	Slimy Sculpin	Lake Trout	Arctic Char	juvenile salmonid	dominant substrates
A53	EF-L21	01-Aug	65.405909	-96.666885	150	930	0	0	0	0	0	peats with protruding rocks and graminoid shoreline
A54	EF-L22	01-Aug	65.409510	-96.659912	40	301	0	0	0	0	0	na
A-P21	EF-L23	01-Aug	65.412196	-96.671690	25	372	0	0	0	0	0	boulder/cobble with some peat
A52	EF-L24	01-Aug	65.409306	-96.674894	34	360	0	0	0	0	0	boulder/cobble and peat with graminoid along shore.
A51	EF-L25	01-Aug	65.409886	-96.678449	44	200	0	0	0	0	0	cobble/boulder
A50	EF-L26	01-Aug	65.411624	-96.681647	54	284	0	0	0	0	0	boulder/cobble with graminoid vegetation along 80% of shoreline
A113	EF-L27	01-Aug	65.417182	-96.690260	31	68	1	0	0	0	0	na
A-P38	EF-L28	01-Aug	65.415746	-96.694860	55	306	1	0	0	0	0	detritus with some boulder/cobble
A-P18	EF-L29	01-Aug	65.417099	-96.695154	33	130	0	0	0	0	0	detritus with some boulder/cobble/gravel. Anaerobic beneath top layer of substrate
C42	EF-L30	01-Aug	65.416955	-96.699902	40	207	0	0	0	0	0	boulder/cobble
A-P51	EF-L31	01-Aug	65.415578	-96.700354	20	98	0	0	0	0	0	pelagic inverts observed
A-P33	EF-L32	01-Aug	65.414962	-96.699182	30	170	0	0	0	0	0	cobble/boulder. Very shallow
A-P37	EF-L33	01-Aug	65.414846	-96.700462	21	155	0	0	0	0	0	boulder/cobble. Very shallow.
C40	EF-L34	01-Aug	65.414989	-96.702009	45	181	0	0	0	0	0	cobble/gravel/boulder. Shallow, but deeper area to south
A-P49	EF-L35	01-Aug	65.413640	-96.701340	20	126	0	0	0	0	0	boulder/cobble. Isolated on bedrock

waterbody / watercourse	location ID	Date (2015)	Start latitude	Start longitude	distance (m)	e-seconds	Nine-spine Stickle-back	Slimy Sculpin	Lake Trout	Arctic Char	juvenile salmonid	dominant substrates
A49	EF-L36	01-Aug	65.412482	-96.704629	93	580	0	0	0	0	0	bedrock/cobble/boulder with graminoid patches.
A-P51	EF-L37	01-Aug	65.408414	-96.688723	88	668	0	0	0	0	0	most is shallow but may be up to 1.5 m max depth in small area
A53	EF-L38	20-Aug	65.406061	-96.676669	69	404	2	0	0	0	0	cobble/gravel/peat/boulder
A65	EF-L39	21-Aug	65.371734	-96.695557	36	342	3	6	0	0	0	na
A63	EF-L40	22-Aug	65.388957	-96.715819	51	332	0	3	0	0	0	boulder/cobble
A18	EF-L41	22-Aug	65.382344	-96.705942	54	483	16	3	0	0	0	na
A19	EF-L42	23-Aug	65.377185	-96.717139	49	437	7	1	0	0	0	na
A45	EF-L43	24-Aug	65.383594	-96.748582	47	239	3	0	0	0	0	boulder
A20	EF-L44	24-Aug	65.380931	-96.752270	43	324	0	0	0	0	0	na
A22	EF-L45	24-Aug	65.374540	-96.759132	45	409	1	10	0	0	0	na
A55	EF-L46	28-Aug	65.395661	-96.667459	111	417	0	2	0	0	0	cobble/boulder/peat
A113	EF-L47	28-Aug	65.418406	-96.691724	33	184	15	0	0	0	0	cobble/gravel/peat
A47	EF-L48	28-Aug	65.415275	-96.693228	51	244	>100	0	0	0	0	na
A49	EF-L49	29-Aug	65.412019	-96.701603	66	313	0	3	0	0	0	na

Table A 6. Standard minnow trap set locations, date and time of lifts and sets, soak times, depths, substrate and catches.

Waterbody	Location ID	Latitude	Longitude	Date Set (2015)	Time Set	Date Lifted (2015)	Time lifted	Soak Time (hours)	Depth	Substrate	Slimy Sculpin	Ninespine Stickleback
Whale Tail	SMT1	65.385682	-96.693709	25-Jul	10:08	26-Jul	9:04	22.93	0.5	boulder	0	0
Whale Tail	SMT2	65.385370	-96.698520	25-Jul	10:37	26-Jul	9:10	22.55	0.7	boulder	0	0
Whale Tail	SMT3	65.386642	-96.698668	25-Jul	10:39	26-Jul	9:14	22.58	0.7	boulder	0	0
Whale Tail	SMT4	65.388648	-96.696584	25-Jul	10:43	26-Jul	10:53	24.17	0.7	boulder	0	0
Whale Tail	SMT5	65.399344	-96.683697	25-Jul	10:55	26-Jul	11:20	24.42	0.7	cobble	0	0
Whale Tail	SMT6	65.394644	-96.677961	25-Jul	11:01	26-Jul	11:07	24.10	0.7	boulder	0	0
Whale Tail	SMT7	65.388146	-96.687963	25-Jul	11:09	26-Jul	10:59	23.83	0.7	cobble/boulder	0	0
Whale Tail	SMT8	65.382286	-96.688790	25-Jul	11:31	26-Jul	8:17	20.77	1.7	boulder/cobble	0	0
Whale Tail	SMT9	65.391694	-96.689627	25-Jul	17:08	26-Jul	10:44	17.60	0.7	cobble/boulder	0	0
Whale Tail	SMT10	65.397849	-96.693197	25-Jul	17:17	26-Jul	11:27	18.17	0.8	sand	1	0
Whale Tail	SMT11	65.401774	-96.699048	25-Jul	17:22	26-Jul	11:37	18.25	1.4	boulder	0	0
Whale Tail	SMT12	65.404388	-96.706044	25-Jul	17:46	26-Jul	11:45	17.98	1.5	boulder	0	0
Whale Tail	SMT13	65.408332	-96.693251	25-Jul	18:19	26-Jul	11:51	17.53	0.4	cobble	0	0
Whale Tail	SMT1	65.385682	-96.693709	26-Jul	9:04	27-Jul	10:15	25.18	0.5	boulder	0	0
Whale Tail	SMT2	65.385370	-96.698520	26-Jul	9:10	27-Jul	10:25	25.25	0.7	boulder	0	0
Whale Tail	SMT3	65.386642	-96.698668	26-Jul	9:14	27-Jul	10:43	25.48	0.7	boulder	0	0
Whale Tail	SMT4	65.388648	-96.696584	26-Jul	10:53	27-Jul	10:47	23.90	0.7	boulder	0	0
Whale Tail	SMT5	65.399344	-96.683697	26-Jul	11:20	27-Jul	9:30	22.17	0.7	cobble	0	0
Whale Tail	SMT6	65.394644	-96.677961	26-Jul	11:07	27-Jul	9:41	22.57	0.7	boulder	0	0
Whale Tail	SMT7	65.388146	-96.687963	26-Jul	10:59	27-Jul	9:48	22.82	0.7	cobble/boulder	0	0
Whale Tail	SMT8	65.382286	-96.688790	26-Jul	8:17	27-Jul	9:54	25.62	1.7	boulder/cobble	0	0
Whale Tail	SMT9	65.391694	-96.689627	26-Jul	10:44	27-Jul	10:51	24.12	0.7	cobble/boulder	0	0
Whale Tail	SMT10	65.397849	-96.693197	26-Jul	11:27	27-Jul	10:59	23.53	0.8	sand	0	0

Waterbody	Location ID	Latitude	Longitude	Date Set (2015)	Time Set	Date Lifted (2015)	Time lifted	Soak Time (hours)	Depth	Substrate	Slimy Sculpin	Ninespine Stickleback
Whale Tail	SMT11	65.401774	-96.699048	26-Jul	11:37	27-Jul	11:04	23.45	1.4	boulder	0	0
Whale Tail	SMT12	65.404388	-96.706044	26-Jul	11:45	27-Jul	11:13	23.47	1.5	boulder	0	0
Whale Tail	SMT13	65.408332	-96.693251	26-Jul	11:51	27-Jul	11:24	23.55	0.4	cobble	0	0
Mammoth	SMT14	65.399497	-96.748329	28-Jul	8:42	29-Jul	9:00	24.30	1	boulder	0	0
Mammoth	SMT15	65.399013	-96.743882	28-Jul	8:51	29-Jul	10:02	25.18	1	boulder	0	0
Mammoth	SMT16	65.401738	-96.735509	28-Jul	9:02	29-Jul	9:59	24.95	1.5	boulder	0	0
Mammoth	SMT17	65.402729	-96.726339	28-Jul	9:06	29-Jul	9:54	24.80	1	boulder	0	1
Mammoth	SMT18	65.399393	-96.723136	28-Jul	9:15	29-Jul	9:51	24.60	0.5	boulder/cobble	0	0
Mammoth	SMT19	65.398389	-96.734949	28-Jul	9:35	29-Jul	9:43	24.13	3.7	boulder	0	0
Mammoth	SMT20	65.396123	-96.745191	28-Jul	9:41	29-Jul	9:07	23.43	1.5	na	0	0
Mammoth	SMT21	65.393214	-96.750599	28-Jul	9:46	29-Jul	8:54	23.13	1	boulder	0	0
Mammoth	SMT22	65.388874	-96.753499	28-Jul	9:51	29-Jul	8:03	22.20	1	cobble/boulder	0	0
Mammoth	SMT23	65.392583	-96.760847	28-Jul	9:55	29-Jul	8:08	22.22	1	bedrock/cobble	0	0
Mammoth	SMT24	65.396511	-96.765716	28-Jul	15:36	29-Jul	8:33	16.95	1	na	0	0
Mammoth	SMT25	65.398159	-96.754967	28-Jul	15:40	29-Jul	8:43	17.05	1	boulder/cobble	0	0

Table A 7. Fine-mesh hoop net set locations, dates and times of sets and lifts, soak times, orientation and catches.

Waterbody	location ID	Latitude	Longitude	Date Set (2015)	Time Set	Date Lifted (2015)	Time lifted	Soak Time (hours)	Opening facing	Slimy Sculpin	Round Whitefish
Whale Tail	FH1	65.397921	-96.693629	18-Aug	16:00	19-Aug	14:00	22.00	toward shore	0	1
	FH2	65.408464	-96.697416	18-Aug	17:00	19-Aug	14:30	21.50	toward shore	1	1

Table A 8. Large minnow trap set locations, dates and times of sets and lifts, soak times, orientation and catches.

Watercourse code	Location ID	Latitude	Longitude	Date set (2015)	Time set	Date lifted (2015)	Time lifted	Soak time (hours)	Opening facing	Slimy Sculpin	Juvenile Round Whitefish
A46-A17	MT4	65.4105	-96.6955	27-Jun	15:48	28-Jun	12:32	20.73	downstream	0	0
A46-A17	MT4	65.4105	-96.6955	28-Jun	12:32	29-Jun	11:21	22.82	downstream	0	0
A46-A17	MT4	65.4105	-96.6955	29-Jun	11:21	03-Jul	14:00	98.65	downstream	0	0
A46-A17	MT4	65.4105	-96.6955	03-Jul	14:00	06-Jul	14:35	72.58	downstream	0	0
A46-A17	MT4	65.4105	-96.6955	06-Jul	14:35	07-Jul	16:10	25.58	downstream	0	0
A46-A17	MT4	65.4105	-96.6955	07-Jul	16:10	08-Jul	15:50	23.67	downstream	0	0
A46-A17	MT4	65.4105	-96.6955	08-Jul	15:50	09-Jul	11:20	19.50	downstream	0	0
A46-A17	MT4	65.4105	-96.6955	09-Jul	11:20	11-Jul	8:30	45.17	downstream	2	0
A46-A17	MT4	65.4105	-96.6955	11-Jul	8:30	12-Jul	13:20	28.83	downstream	1	0
A46-A17	MT4	65.4105	-96.6955	12-Jul	13:20	13-Jul	8:21	19.02	downstream	0	0
A50-A17	MT5	65.4104	-96.6898	28-Jun	13:25	29-Jun	11:30	22.08	downstream	0	0
A50-A17	MT5	65.4104	-96.6898	29-Jun	11:30	03-Jul	13:15	97.75	downstream	0	0
A50-A17	MT5	65.4104	-96.6898	03-Jul	13:15	06-Jul	14:20	73.08	downstream	0	0
A50-A17	MT5	65.4104	-96.6898	06-Jul	14:20	07-Jul	16:00	25.67	downstream	1	0
A50-A17	MT5	65.4104	-96.6898	07-Jul	16:00	08-Jul	15:50	23.83	downstream	0	0
A50-A17	MT5	65.4104	-96.6898	08-Jul	15:50	09-Jul	11:08	19.30	downstream	0	0
A50-A17	MT5	65.4104	-96.6898	09-Jul	11:08	11-Jul	8:50	45.70	downstream	0	0
A50-A17	MT5	65.4104	-96.6898	11-Jul	8:50	12-Jul	13:10	28.33	downstream	0	0
A50-A17	MT5	65.4104	-96.6898	12-Jul	13:10	13-Jul	8:10	19.00	downstream	0	0
A53-A17	MT3	65.4016	-96.6838	27-Jun	10:43	03-Jul	12:50	146.12	downstream	1	0
A53-A17	MT3	65.4016	-96.6838	03-Jul	12:50	06-Jul	13:50	73.00	downstream	1	0
A53-A17	MT3	65.4016	-96.6838	06-Jul	13:50	07-Jul	15:55	26.08	downstream	0	0

Watercourse code	Location ID	Latitude	Longitude	Date set (2015)	Time set	Date lifted (2015)	Time lifted	Soak time (hours)	Opening facing	Slimy Sculpin	Juvenile Round Whitefish
A53-A17	MT3	65.4016	-96.6838	07-Jul	15:55	08-Jul	11:35	19.67	downstream	0	0
A53-A17	MT3	65.4016	-96.6838	08-Jul	11:35	11-Jul	10:00	70.42	downstream	0	0
A53-A17	MT3	65.4016	-96.6838	11-Jul	10:00	13-Jul	7:30	45.50	downstream	0	0
A55-A17	MT9	65.3946	-96.6775	03-Jul	12:00	07-Jul	15:50	99.83	downstream	0	0
A55-A17	MT9	65.3946	-96.6775	07-Jul	15:50	08-Jul	14:50	23.00	downstream	0	0
A55-A17	MT9	65.3946	-96.6775	08-Jul	14:50	09-Jul	16:15	25.42	downstream	0	0
A55-A17	MT9	65.3946	-96.6775	09-Jul	16:15	12-Jul	11:00	66.75	downstream	0	0
A55-A17	MT9	65.3946	-96.6775	12-Jul	11:00	13-Jul	12:40	25.67	downstream	0	0
A59-A17	MT2	65.3888	-96.6832	27-Jun	9:00	28-Jun	13:55	28.92	downstream	0	0
A59-A17	MT2	65.3888	-96.6832	28-Jun	13:55	03-Jul	9:30	115.58	downstream	1	0
A59-A17	MT2	65.3888	-96.6832	03-Jul	9:30	06-Jul	9:10	71.67	downstream	0	0
A59-A17	MT2	65.3888	-96.6832	06-Jul	9:10	08-Jul	14:35	53.42	downstream	0	0
A59-A17	MT2	65.3888	-96.6832	08-Jul	14:35	09-Jul	15:10	24.58	downstream	0	0
A59-A17	MT2	65.3888	-96.6832	09-Jul	15:10	12-Jul	10:02	66.87	downstream	0	0
A59-A17	MT2	65.3888	-96.6832	12-Jul	10:02	13-Jul	12:15	26.22	downstream	0	0
A59-A17	MT6	65.3890	-96.6835	28-Jun	14:00	03-Jul	9:20	115.33	downstream	0	0
A59-A17	MT6	65.3890	-96.6835	03-Jul	9:20	06-Jul	9:10	71.83	downstream	2	0
A59-A17	MT6	65.3890	-96.6835	06-Jul	9:10	07-Jul	15:45	30.58	downstream	0	0
A59-A17	MT6	65.3890	-96.6835	07-Jul	15:45	08-Jul	14:35	22.83	downstream	0	0
A59-A17	MT6	65.3890	-96.6835	08-Jul	14:35	09-Jul	15:10	24.58	downstream	0	0
A59-A17	MT6	65.3890	-96.6835	09-Jul	15:10	12-Jul	10:00	66.83	downstream	0	0
A59-A17	MT6	65.3890	-96.6835	12-Jul	10:00	13-Jul	12:15	26.25	downstream	0	0
A63-A18	MT7	65.3848	-96.7127	05-Jul	15:12	06-Jul	15:50	24.63	upstream	0	0
A63-A18	MT7	65.3848	-96.7127	06-Jul	15:50	07-Jul	13:14	21.40	upstream	0	0

Watercourse code	Location ID	Latitude	Longitude	Date set (2015)	Time set	Date lifted (2015)	Time lifted	Soak time (hours)	Opening facing	Slimy Sculpin	Juvenile Round Whitefish
A63-A18	MT7	65.3848	-96.7127	07-Jul	13:14	08-Jul	15:00	25.77	upstream	0	0
A63-A18	MT7	65.3848	-96.7127	08-Jul	15:00	09-Jul	15:00	24.00	upstream	0	0
A63-A18	MT7	65.3848	-96.7127	09-Jul	15:00	13-Jul	12:00	93.00	upstream	0	0
A63-A18	MT8	65.3848	-96.7127	05-Jul	15:12	06-Jul	15:50	24.63	downstream	0	0
A63-A18	MT8	65.3848	-96.7127	06-Jul	15:50	07-Jul	13:14	21.40	downstream	0	1
A63-A18	MT8	65.3848	-96.7127	07-Jul	13:14	08-Jul	15:00	25.77	downstream	0	0
A63-A18	MT8	65.3848	-96.7127	08-Jul	15:00	09-Jul	15:00	24.00	downstream	0	0
A63-A18	MT8	65.3848	-96.7127	09-Jul	15:00	13-Jul	12:00	93.00	downstream	0	0
AP23-A17	MT1	65.3786	-96.6862	26-Jun	13:54	03-Jul	10:40	164.77	downstream	0	0

Table A 9. Stream electrofishing locations, dates, effort, and catches. All Arctic Char, Lake Trout, Round Whitefish, and Burbot were juveniles. Juvenile salmonids were either Arctic Char or Lake Trout that were released and could not be identified to species with certainty. Refer to Figure 5-3 and Figure 5-4 for June sampling locations, Figure 5-5 and Figure 5-6 for July sampling locations, and Figure 5-7, Figure 5-8 and Figure 5-9 for August sampling locations.

Watercourse	Location ID	Date (2015)	Start latitude	Start longitude	Voltage	Frequency	Electroseconds	Distance (m)	Slimy Sculpin	Arctic Char	Lake Trout	Round Whitefish	juvenile salmonid	Ninespine Stickleback	Burbot
A0-A48	EF-S1	01-Aug	65.415765	-96.686928	950	250	196	10						2	
A113-A47	EF-S2	01-Aug	65.417182	-96.690260	950	250	68	10						1	
A16-A15	EF-S3	25-Aug	65.392606	-96.770026	950	250	690	43	5		1			2	
A17-A16	EF-S4	25-Aug	65.400991	-96.720011	950	250	950	240	4		1				
A18-A17	EF-S32	26-Jun	65.384374	-96.700225	950	250	878	100	1						
A18-A17	EF-S5	05-Jul	65.383288	-96.703374	950	250	1648	112	5						
A18-A17	EF-S6	30-Aug	65.384323	-96.700957	950	250	210	30			1			6	
A19-A18	EF-S7	09-Jul	65.378628	-96.714845	950	250	423	32							
A46-A17	EF-S8	28-Jun	65.410496	-96.695450	950	250	579	201	8	1				11	
A46-A17	EF-S9	09-Jul	65.410496	-96.695450	950	250	393	16	8	1				153	
A46-A17	EF-S10	09-Jul	65.410634	-96.695442	950	250	532	132							
A46-A17	EF-S11	12-Jul	65.410496	-96.695450	950	250	85	<10 m						100	
A46-A17	EF-S12	30-Aug	65.410477	-96.695459	550	130	470	36							
A47-A46	EF-S13	09-Jul	65.412515	-96.693319	950	250	136	17	1						
A50-A17	EF-S14	28-Jun	65.410174	-96.690529	950	250	265	51						5	
A50-A17	EF-S15	09-Jul	65.410174	-96.690529	950	250	1204	163	9	2	1			56	
A50-A17	EF-S16	30-Aug	65.410162	-96.690570	550	130	180	52		1				2	1
A53-A17	EF-S17	20-Jun	65.401450	-96.683688	450	60	1664	571						7	
A53-A17	EF-S18	08-Jul	65.401450	-96.683688	950	250	2142	182	77	5				78	
A53-A17	EF-S19	30-Aug	65.401432	-96.683701	950	250	518	359	26		4				
A55-A17	EF-S20	21-Jun	65.394604	-96.677482	950	250	996	166						6	
A55-A17	EF-S21	06-Jul	65.394604	-96.677482	950	250	3330	167	50	1			1	20	
A55-A17	EF-S22	30-Aug	65.394722	-96.677244	950	250	483	46	1			1		17	
A56-A55	EF-S23	08-Jul	65.397864	-96.666318	950	250	634	60							
A59-A17	EF-S24	27-Jun	65.388830	-96.683468	950	250	730	126	6	1					
A59-A17	EF-S25	09-Jul	65.388829	-96.683167	950	250	1444	97	21					2	
A59-A17	EF-S26	30-Aug	65.388820	-96.683208	950	250	535	181	7	1					
A62-A17	EF-S27	07-Jul	65.388363	-96.699974	950	250	1025	107						1	
A63-A18	EF-S28	05-Jul	65.384819	-96.712699	950	250	848	81	3						
A63-A18	EF-S29	07-Jul	65.384819	-96.712699	950	250	793	81	3						
A-P21-A52	EF-S30	01-Aug	65.410581	-96.675165	950	250	78	5							
A-P23-A17	EF-S31	26-Jun	65.378590	-96.686449	950	250	582	95	2						

APPENDIX B – WATERCOURSE PHOTOGRAPHS



Watercourse A0-A48. Downstream view. August 1, 2015.



Watercourse A16-A15. Aerial view of outlet of Mammoth Lake. June 19, 2015. Flow is from left to right.



Watercourse A16-A15. Outlet of Mammoth Lake. July 4, 2015.



Watercourse A17-A16. Narrows between Whale Tail and Mammoth Lakes. July 4, 2015.



Watercourse A17-A16. Narrows between Whale Tail and Mammoth Lakes. August 25, 2015.



Watercourse A18-A17. Downstream view. June 26, 2015.



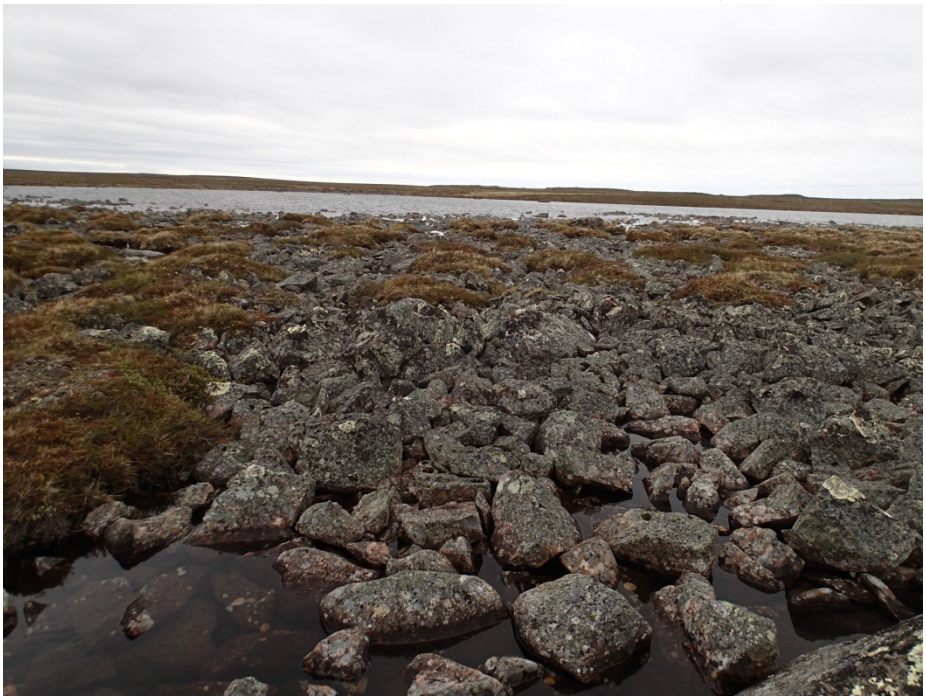
Watercourse A18-A17. Upstream view. August 30, 2015.



Watercourse A19-A18. Aerial view upstream. June 19, 2015.



Watercourse A19-A18. Downstream view. June 26, 2015.



Watercourse A19-A18. Upstream view. July 9, 2015.



Watercourse A20-A19. Aerial view. Flow from right to left. June 19, 2015.



Watercourse A21-A20. Flow from right to left. July 10, 2015.



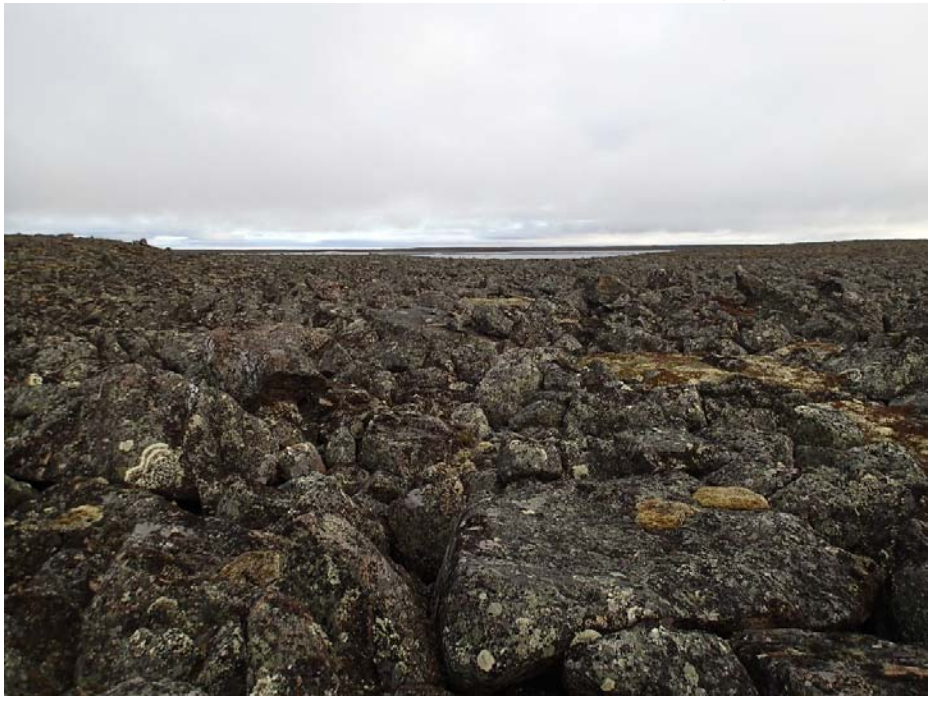
Watercourse A22-A21. Upstream view. July 10, 2015.



Watercourse A23-A22. Downstream view. July 10, 2015.



Watercourse A43-A16. Downstream view. June 29, 2015.



Watercourse A45-A16. Downstream view. July 11, 2015.



Watercourse A46-A17. Downstream view. June 28, 2015.



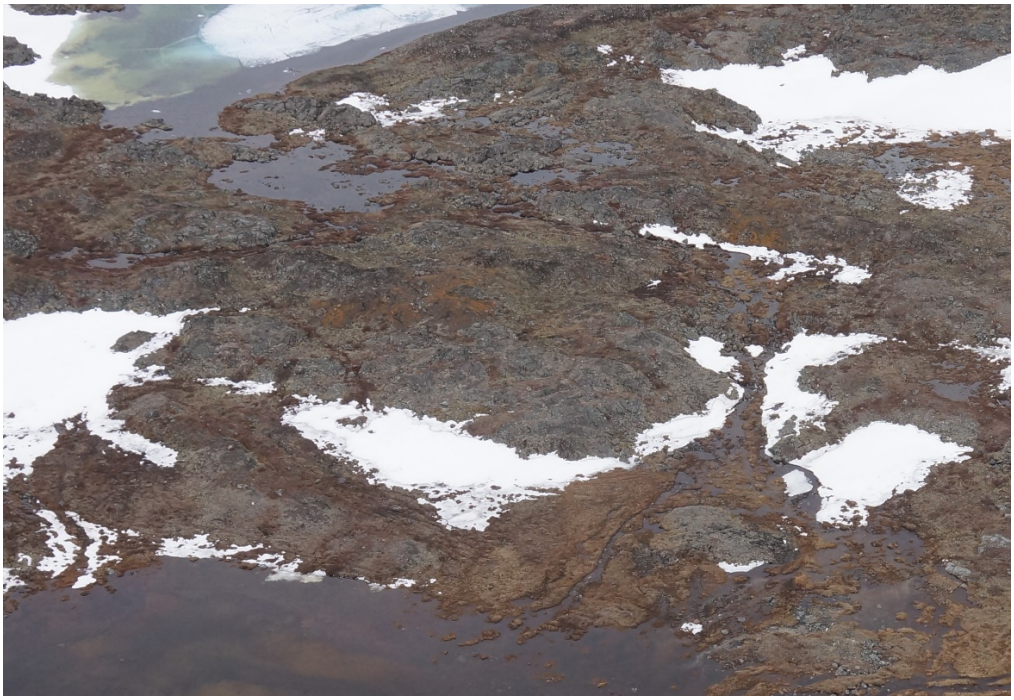
Watercourse A46-A17. Downstream view. August 30, 2015.



Watercourse A47-A46. Upstream view. July 9, 2015.



Watercourse A48-A47. Downstream view. August 1, 2015.



Watercourse A49-A17. A49 at top of photo, and A17 at bottom. June 19, 2015.



Watercourse A49-A17. Upstream view. August 1, 2015.



Watercourse A49-A47. Upstream view to A49. June 28, 2015.



Watercourse A50-A17. Upstream view. June 28, 2015.



Watercourse A50-A17. Upstream view. August 30, 2015.



Watercourse A53-A17. Upstream view. June 28, 2015.



Watercourse A53-A17. Upstream view. August 30, 2015.



Watercourse A54-A53. Downstream view. August 1, 2015.



Watercourse A55-A17. Upstream view. August 30, 2015.



Watercourse A56-A55. Downstream view. July 8, 2015.



Watercourse A59-A17. Upstream view. June 27, 2015.



Watercourse A59-A17. Upstream view. August 30, 2015.



Watercourse A60-A59. Downstream view. July 6, 2015.



Watercourse A62-A17. Aerial view. Flow from right to left. June 19, 2015.



Watercourse A62-A17. Upstream view from near Lake A17. July 7, 2015.



Watercourse A63-A18. Downstream view from near Lake A63. July 5, 2015.



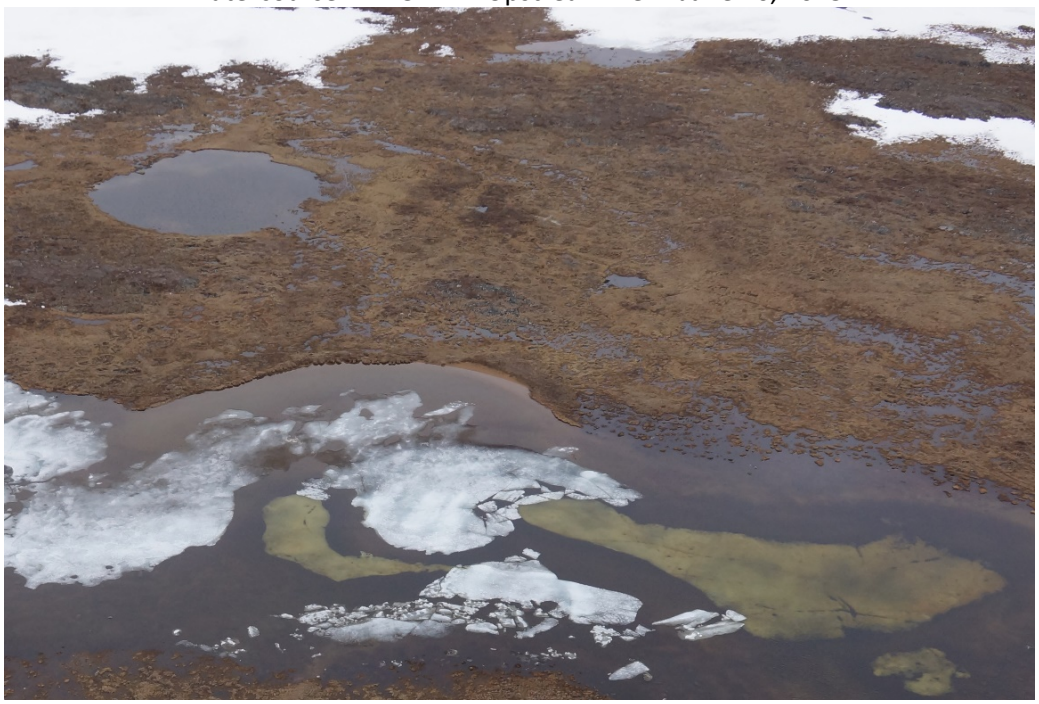
Watercourse A65-A17. Downstream view. June 27 2015.



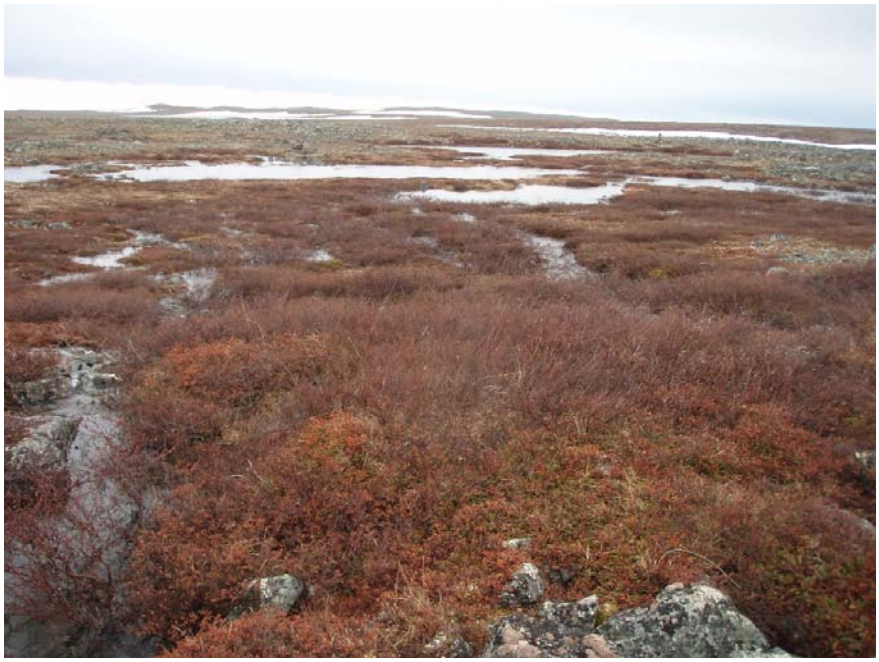
Watercourse A-P21-A52. Downstream view. August 1, 2015.



Watercourse A-P23-A17. Upstream view. June 26, 2015.



Watercourse A-P38-A47. Aerial photo shows A-P38 as small pond in upper-left, with poorly defined watercourse flowing down to the right to A47 across bottom. June 19, 2015.



Watercourse A-P54-A-P23. Downstream view. June 26, 2015.



Watercourse A113-A47. Downstream view. June 28, 2015.



Watercourse A113-A47. Downstream view. August 1, 2015.

APPENDIX C. MERCURY AND METALS ANALYSES

Table C-1. Total length and weight of Ninespine Stickleback in composite samples submitted for mercury and metals analyses.

Lake	Composite Sample #	total length (mm)	weight (g)	Lake	Composite Sample #	total length (mm)	weight (g)
Whale Tail	1	68	2.2	Mammoth	8	64	na
		53	1.0			70	na
		58	1.1			60	na
		55	0.9			52	na
		56	1.0			53	na
	2	55	1.0			39	na
		45	0.5		9	47	0.5
		51	0.8			45	0.7
		53	0.7			51	0.9
		47	0.5			59	1.1
	3	45	0.5			47	0.5
		40	0.4		10	51	0.7
		40	0.3			46	0.6
		46	0.5			43	0.5
		45	0.5			45	0.6
	4	37	0.3			44	0.6
		37	0.3		11	46	0.6
		39	0.3			43	0.5
		40	0.4			42	0.6
		41	0.4			44	0.6
	5	44	0.5			43	0.5
		40	0.3		12	45	0.7
		36	0.2			42	0.4
		37	0.4			44	0.5
		45	0.6			45	0.5
	6	37	0.2			41	0.4
		31	0.1		13	38	0.4
		40	0.4			39	0.4
		37	0.3			38	0.3
		38	0.3			44	0.6
	7	31	<0.1			37	0.4
		40	0.4		14	37	0.3
		35	0.1			40	0.4
		42	0.5			40	0.4
		36	0.2			41	0.4
		30	<0.1			34	0.2
		47	0.3		15	30	0.2
		35	0.3			34	0.3
						35	0.3
						33	0.3

C. PORTT & ASSOCIATES
ATTN: Cameron Portt
56 Waterloo Avenue
Guelph ON N1H 3H5

Date Received: 23-SEP-15
Report Date: 10-NOV-15 11:49 (MT)
Version: FINAL

Client Phone: 519-824-8227

Certificate of Analysis

Lab Work Order #: L1677176

Project P.O. #: NOT SUBMITTED
Job Reference: AMARUQ 2015
C of C Numbers: 1, 2, 3, 4, 5, 6, 7
Legal Site Desc:

Courtney Duncan
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1677176-1	L1677176-2	L1677176-3	L1677176-4	L1677176-5
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	18-AUG-15	18-AUG-15	18-AUG-15	18-AUG-15	18-AUG-15
	Sampled Time					
	Client ID	WHALE TAIL LAKE LAKE TROUT #46	WHALE TAIL LAKE LAKE TROUT #47	WHALE TAIL LAKE LAKE TROUT #48	WHALE TAIL LAKE LAKE TROUT #49	WHALE TAIL LAKE LAKE TROUT #50
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	80.4	78.3	79.1	80.1	78.4
Metals	Aluminum (Al)-Total (mg/kg)					
	Aluminum (Al)-Total (mg/kg wwt)					
	Antimony (Sb)-Total (mg/kg)					
	Antimony (Sb)-Total (mg/kg wwt)					
	Arsenic (As)-Total (mg/kg)					
	Arsenic (As)-Total (mg/kg wwt)					
	Barium (Ba)-Total (mg/kg)					
	Barium (Ba)-Total (mg/kg wwt)					
	Beryllium (Be)-Total (mg/kg)					
	Beryllium (Be)-Total (mg/kg wwt)					
	Bismuth (Bi)-Total (mg/kg)					
	Bismuth (Bi)-Total (mg/kg wwt)					
	Boron (B)-Total (mg/kg)					
	Boron (B)-Total (mg/kg wwt)					
	Cadmium (Cd)-Total (mg/kg)					
	Cadmium (Cd)-Total (mg/kg wwt)					
	Calcium (Ca)-Total (mg/kg)					
	Calcium (Ca)-Total (mg/kg wwt)					
	Cesium (Cs)-Total (mg/kg)					
	Cesium (Cs)-Total (mg/kg wwt)					
	Chromium (Cr)-Total (mg/kg)					
	Chromium (Cr)-Total (mg/kg wwt)					
	Cobalt (Co)-Total (mg/kg)					
	Cobalt (Co)-Total (mg/kg wwt)					
	Copper (Cu)-Total (mg/kg)					
	Copper (Cu)-Total (mg/kg wwt)					
	Iron (Fe)-Total (mg/kg)					
	Iron (Fe)-Total (mg/kg wwt)					
	Lead (Pb)-Total (mg/kg)					
	Lead (Pb)-Total (mg/kg wwt)					
	Lithium (Li)-Total (mg/kg)					
	Lithium (Li)-Total (mg/kg wwt)					
	Magnesium (Mg)-Total (mg/kg)					
	Magnesium (Mg)-Total (mg/kg wwt)					
	Manganese (Mn)-Total (mg/kg)					
	Manganese (Mn)-Total (mg/kg wwt)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1677176-6	L1677176-7	L1677176-8	L1677176-9	L1677176-10
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	18-AUG-15	18-AUG-15	18-AUG-15	18-AUG-15	18-AUG-15
	Sampled Time					
	Client ID	WHALE TAIL LAKE LAKE TROUT #52	WHALE TAIL LAKE LAKE TROUT #53	WHALE TAIL LAKE LAKE TROUT #54A	WHALE TAIL LAKE LAKE TROUT #54B	WHALE TAIL LAKE LAKE TROUT #56
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	69.6	78.5	75.1	75.3	74.8
Metals	Aluminum (Al)-Total (mg/kg)					
	Aluminum (Al)-Total (mg/kg wwt)					
	Antimony (Sb)-Total (mg/kg)					
	Antimony (Sb)-Total (mg/kg wwt)					
	Arsenic (As)-Total (mg/kg)					
	Arsenic (As)-Total (mg/kg wwt)					
	Barium (Ba)-Total (mg/kg)					
	Barium (Ba)-Total (mg/kg wwt)					
	Beryllium (Be)-Total (mg/kg)					
	Beryllium (Be)-Total (mg/kg wwt)					
	Bismuth (Bi)-Total (mg/kg)					
	Bismuth (Bi)-Total (mg/kg wwt)					
	Boron (B)-Total (mg/kg)					
	Boron (B)-Total (mg/kg wwt)					
	Cadmium (Cd)-Total (mg/kg)					
	Cadmium (Cd)-Total (mg/kg wwt)					
	Calcium (Ca)-Total (mg/kg)					
	Calcium (Ca)-Total (mg/kg wwt)					
	Cesium (Cs)-Total (mg/kg)					
	Cesium (Cs)-Total (mg/kg wwt)					
	Chromium (Cr)-Total (mg/kg)					
	Chromium (Cr)-Total (mg/kg wwt)					
	Cobalt (Co)-Total (mg/kg)					
	Cobalt (Co)-Total (mg/kg wwt)					
	Copper (Cu)-Total (mg/kg)					
	Copper (Cu)-Total (mg/kg wwt)					
	Iron (Fe)-Total (mg/kg)					
	Iron (Fe)-Total (mg/kg wwt)					
	Lead (Pb)-Total (mg/kg)					
	Lead (Pb)-Total (mg/kg wwt)					
	Lithium (Li)-Total (mg/kg)					
	Lithium (Li)-Total (mg/kg wwt)					
	Magnesium (Mg)-Total (mg/kg)					
	Magnesium (Mg)-Total (mg/kg wwt)					
	Manganese (Mn)-Total (mg/kg)					
	Manganese (Mn)-Total (mg/kg wwt)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1677176-11 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #57	L1677176-12 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #58	L1677176-13 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #59	L1677176-14 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #60	L1677176-15 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #61
TISSUE						
Physical Tests	% Moisture (%)	72.7	75.3	76.0	78.7	77.0
Metals	Aluminum (Al)-Total (mg/kg)			<2.0		<2.0
	Aluminum (Al)-Total (mg/kg wwt)			<0.40		<0.40
	Antimony (Sb)-Total (mg/kg)			<0.010		<0.010
	Antimony (Sb)-Total (mg/kg wwt)			<0.0020		<0.0020
	Arsenic (As)-Total (mg/kg)			0.033		0.025
	Arsenic (As)-Total (mg/kg wwt)			0.0079		0.0058
	Barium (Ba)-Total (mg/kg)			0.090		<0.050
	Barium (Ba)-Total (mg/kg wwt)			0.022		<0.010
	Beryllium (Be)-Total (mg/kg)			<0.010		<0.010
	Beryllium (Be)-Total (mg/kg wwt)			<0.0020		<0.0020
	Bismuth (Bi)-Total (mg/kg)			<0.010		<0.010
	Bismuth (Bi)-Total (mg/kg wwt)			<0.0020		<0.0020
	Boron (B)-Total (mg/kg)			<1.0		<1.0
	Boron (B)-Total (mg/kg wwt)			<0.20		<0.20
	Cadmium (Cd)-Total (mg/kg)			<0.0050		<0.0050
	Cadmium (Cd)-Total (mg/kg wwt)			<0.0010		<0.0010
	Calcium (Ca)-Total (mg/kg)			508		261
	Calcium (Ca)-Total (mg/kg wwt)			122		60.0
	Cesium (Cs)-Total (mg/kg)			0.0273		0.0801
	Cesium (Cs)-Total (mg/kg wwt)			0.0066		0.0185
	Chromium (Cr)-Total (mg/kg)			<0.050		<0.050
	Chromium (Cr)-Total (mg/kg wwt)			<0.010		<0.010
	Cobalt (Co)-Total (mg/kg)			<0.020		<0.020
	Cobalt (Co)-Total (mg/kg wwt)			<0.0040		<0.0040
	Copper (Cu)-Total (mg/kg)			0.91		1.48
	Copper (Cu)-Total (mg/kg wwt)			0.218		0.341
	Iron (Fe)-Total (mg/kg)			12.9		10.5
	Iron (Fe)-Total (mg/kg wwt)			3.10		2.42
	Lead (Pb)-Total (mg/kg)			<0.020		<0.020
	Lead (Pb)-Total (mg/kg wwt)			<0.0040		<0.0040
	Lithium (Li)-Total (mg/kg)			<0.50		<0.50
	Lithium (Li)-Total (mg/kg wwt)			<0.10		<0.10
	Magnesium (Mg)-Total (mg/kg)			1270		1150
	Magnesium (Mg)-Total (mg/kg wwt)			306		266
	Manganese (Mn)-Total (mg/kg)			0.302		0.328
	Manganese (Mn)-Total (mg/kg wwt)			0.072		0.076

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1677176-16 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #62	L1677176-17 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #63	L1677176-18 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #64	L1677176-19 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #65	L1677176-20 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #66
TISSUE						
Physical Tests	% Moisture (%)	77.3	77.1	78.6	75.7	77.5
Metals	Aluminum (Al)-Total (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Aluminum (Al)-Total (mg/kg wwt)	<0.40	<0.40	<0.40	<0.40	<0.40
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	0.100	0.114	0.030	0.029	0.038
	Arsenic (As)-Total (mg/kg wwt)	0.0226	0.0261	0.0065	0.0071	0.0086
	Barium (Ba)-Total (mg/kg)	0.093	0.116	<0.050	<0.050	0.074
	Barium (Ba)-Total (mg/kg wwt)	0.021	0.027	0.010	<0.010	0.017
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	0.020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	0.0046
	Boron (B)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Cadmium (Cd)-Total (mg/kg wwt)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Calcium (Ca)-Total (mg/kg)	306	419	239	463	660
	Calcium (Ca)-Total (mg/kg wwt)	69.3	96.0	51.2	113	148
	Cesium (Cs)-Total (mg/kg)	0.114	0.0704	0.0372	0.107	0.0421
	Cesium (Cs)-Total (mg/kg wwt)	0.0259	0.0161	0.0080	0.0260	0.0094
	Chromium (Cr)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chromium (Cr)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cobalt (Co)-Total (mg/kg)	<0.020	<0.020	0.022	<0.020	<0.020
	Cobalt (Co)-Total (mg/kg wwt)	<0.0040	<0.0040	0.0048	<0.0040	<0.0040
	Copper (Cu)-Total (mg/kg)	1.49	0.68	0.75	0.94	0.92
	Copper (Cu)-Total (mg/kg wwt)	0.338	0.157	0.161	0.230	0.206
	Iron (Fe)-Total (mg/kg)	11.4	13.1	12.6	10.6	10.4
	Iron (Fe)-Total (mg/kg wwt)	2.59	3.00	2.69	2.58	2.35
	Lead (Pb)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Lead (Pb)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	1390	1290	989	1150	1260
	Magnesium (Mg)-Total (mg/kg wwt)	316	296	212	281	284
	Manganese (Mn)-Total (mg/kg)	0.468	0.611	0.444	0.471	0.593
	Manganese (Mn)-Total (mg/kg wwt)	0.106	0.140	0.095	0.115	0.133

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1677176-21 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #68	L1677176-22 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #69	L1677176-23 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #70	L1677176-24 Tissue 25-AUG-15 MAMMOTH LAKE LAKE TROUT #97	L1677176-25 Tissue 25-AUG-15 MAMMOTH LAKE LAKE TROUT #98
TISSUE						
Physical Tests	% Moisture (%)	77.8	76.9	75.3	74.8	75.1
Metals	Aluminum (Al)-Total (mg/kg)	<2.0	<5.0	2.3	<2.0	<2.0
	Aluminum (Al)-Total (mg/kg wwt)	<0.40	<1.0	0.56	<0.40	<0.40
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	0.031	<0.030	0.034	0.113	0.182
	Arsenic (As)-Total (mg/kg wwt)	0.0068	<0.0060	0.0084	0.0286	0.0453
	Barium (Ba)-Total (mg/kg)	0.146	0.162	0.080	0.095	0.159
	Barium (Ba)-Total (mg/kg wwt)	0.033	0.037	0.020	0.024	0.040
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg)	<0.0050	<0.010	<0.0050	<0.0050	<0.0050
	Cadmium (Cd)-Total (mg/kg wwt)	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010
	Calcium (Ca)-Total (mg/kg)	760	1350	647	499	549
	Calcium (Ca)-Total (mg/kg wwt)	169	312	160	126	137
	Cesium (Cs)-Total (mg/kg)	0.0335	0.0279	0.0339	0.0533	0.0832
	Cesium (Cs)-Total (mg/kg wwt)	0.0075	0.0064	0.0084	0.0134	0.0207
	Chromium (Cr)-Total (mg/kg)	<0.050	<0.20	<0.050	<0.050	<0.050
	Chromium (Cr)-Total (mg/kg wwt)	<0.010	<0.040	<0.010	<0.010	<0.010
	Cobalt (Co)-Total (mg/kg)	<0.020	<0.020	<0.020	0.029	0.049
	Cobalt (Co)-Total (mg/kg wwt)	<0.0040	0.0043	<0.0040	0.0072	0.0122
	Copper (Cu)-Total (mg/kg)	0.93	0.85	0.79	0.75	0.76
	Copper (Cu)-Total (mg/kg wwt)	0.207	0.196	0.195	0.188	0.188
	Iron (Fe)-Total (mg/kg)	9.7	10.8	16.6	11.6	9.5
	Iron (Fe)-Total (mg/kg wwt)	2.15	2.5	4.10	2.93	2.36
	Lead (Pb)-Total (mg/kg)	<0.020	<0.050	<0.020	<0.020	<0.020
	Lead (Pb)-Total (mg/kg wwt)	<0.0040	<0.010	<0.0040	<0.0040	<0.0040
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	1340	1020	1130	1130	1230
	Magnesium (Mg)-Total (mg/kg wwt)	298	235	280	284	307
	Manganese (Mn)-Total (mg/kg)	0.533	0.543	0.538	0.676	0.539
	Manganese (Mn)-Total (mg/kg wwt)	0.119	0.125	0.133	0.171	0.134

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1677176-26 Tissue 25-AUG-15 MAMMOTH LAKE LAKE TROUT #99	L1677176-27 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #100	L1677176-28 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #101	L1677176-29 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #102	L1677176-30 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #103
TISSUE						
Physical Tests	% Moisture (%)	76.0	74.8	75.9	76.1	75.7
Metals	Aluminum (Al)-Total (mg/kg)	<2.0	3.5	<2.0	3.3	<2.0
	Aluminum (Al)-Total (mg/kg wwt)	0.42	0.89	<0.40	0.80	<0.40
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	0.0023	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	0.470	0.108	0.055	0.227	0.363
	Arsenic (As)-Total (mg/kg wwt)	0.113	0.0273	0.0134	0.0543	0.0883
	Barium (Ba)-Total (mg/kg)	0.126	0.154	0.067	0.210	0.058
	Barium (Ba)-Total (mg/kg wwt)	0.030	0.039	0.016	0.050	0.014
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	0.0021	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Cadmium (Cd)-Total (mg/kg wwt)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Calcium (Ca)-Total (mg/kg)	856	1030	294	1360	455
	Calcium (Ca)-Total (mg/kg wwt)	206	259	70.6	325	111
	Cesium (Cs)-Total (mg/kg)	0.0889	0.0650	0.0618	0.0827	0.0864
	Cesium (Cs)-Total (mg/kg wwt)	0.0213	0.0163	0.0149	0.0198	0.0210
	Chromium (Cr)-Total (mg/kg)	0.057	0.074	<0.050	0.060	<0.050
	Chromium (Cr)-Total (mg/kg wwt)	0.014	0.019	<0.010	0.014	<0.010
	Cobalt (Co)-Total (mg/kg)	0.054	<0.020	<0.020	0.043	0.070
	Cobalt (Co)-Total (mg/kg wwt)	0.0130	<0.0040	0.0041	0.0102	0.0171
	Copper (Cu)-Total (mg/kg)	0.95	0.69	1.16	0.85	0.85
	Copper (Cu)-Total (mg/kg wwt)	0.229	0.174	0.280	0.204	0.208
	Iron (Fe)-Total (mg/kg)	12.8	16.3	11.9	19.5	11.3
	Iron (Fe)-Total (mg/kg wwt)	3.08	4.11	2.86	4.65	2.74
	Lead (Pb)-Total (mg/kg)	<0.020	0.120	<0.020	0.042	0.029
	Lead (Pb)-Total (mg/kg wwt)	<0.0040	0.0302	0.0044	0.0102	0.0070
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	1440	1210	1290	1250	1300
	Magnesium (Mg)-Total (mg/kg wwt)	347	304	310	299	317
	Manganese (Mn)-Total (mg/kg)	0.756	1.05	0.443	1.23	0.467
	Manganese (Mn)-Total (mg/kg wwt)	0.181	0.263	0.107	0.294	0.114

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1677176-31 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #105	L1677176-32 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #106	L1677176-33 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #108	L1677176-34 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #110	L1677176-35 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #111
TISSUE						
Physical Tests	% Moisture (%)	75.4	80.0	77.4	74.0	75.9
Metals	Aluminum (Al)-Total (mg/kg)	<2.0	<2.0	<2.0		
	Aluminum (Al)-Total (mg/kg wwt)	<0.40	<0.40	0.44		
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010		
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020		
	Arsenic (As)-Total (mg/kg)	0.188	0.358	0.109		
	Arsenic (As)-Total (mg/kg wwt)	0.0462	0.0715	0.0247		
	Barium (Ba)-Total (mg/kg)	0.053	0.152	0.153		
	Barium (Ba)-Total (mg/kg wwt)	0.013	0.030	0.035		
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010		
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020		
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010		
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020		
	Boron (B)-Total (mg/kg)	<1.0	<1.0	<1.0		
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20		
	Cadmium (Cd)-Total (mg/kg)	0.0130	<0.0050	<0.0050		
	Cadmium (Cd)-Total (mg/kg wwt)	0.0032	<0.0010	<0.0010		
	Calcium (Ca)-Total (mg/kg)	381	550	641		
	Calcium (Ca)-Total (mg/kg wwt)	93.7	110	145		
	Cesium (Cs)-Total (mg/kg)	0.0594	0.0598	0.0682		
	Cesium (Cs)-Total (mg/kg wwt)	0.0146	0.0120	0.0154		
	Chromium (Cr)-Total (mg/kg)	<0.050	<0.050	<0.050		
	Chromium (Cr)-Total (mg/kg wwt)	<0.010	<0.010	<0.010		
	Cobalt (Co)-Total (mg/kg)	0.049	0.063	0.051		
	Cobalt (Co)-Total (mg/kg wwt)	0.0119	0.0126	0.0115		
	Copper (Cu)-Total (mg/kg)	0.88	0.98	1.00		
	Copper (Cu)-Total (mg/kg wwt)	0.217	0.196	0.227		
	Iron (Fe)-Total (mg/kg)	15.8	21.4	15.7		
	Iron (Fe)-Total (mg/kg wwt)	3.89	4.27	3.57		
	Lead (Pb)-Total (mg/kg)	<0.020	0.047	0.024		
	Lead (Pb)-Total (mg/kg wwt)	<0.0040	0.0094	0.0054		
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50		
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10		
	Magnesium (Mg)-Total (mg/kg)	1210	1360	1420		
	Magnesium (Mg)-Total (mg/kg wwt)	297	271	321		
	Manganese (Mn)-Total (mg/kg)	0.622	0.474	0.677		
	Manganese (Mn)-Total (mg/kg wwt)	0.153	0.095	0.153		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1677176-36 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #112	L1677176-37 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #114	L1677176-38 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #115	L1677176-39 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #116	L1677176-40 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #117
TISSUE						
Physical Tests	% Moisture (%)	74.8	80.0	77.2	77.0	74.6
Metals	Aluminum (Al)-Total (mg/kg)					
	Aluminum (Al)-Total (mg/kg wwt)					
	Antimony (Sb)-Total (mg/kg)					
	Antimony (Sb)-Total (mg/kg wwt)					
	Arsenic (As)-Total (mg/kg)					
	Arsenic (As)-Total (mg/kg wwt)					
	Barium (Ba)-Total (mg/kg)					
	Barium (Ba)-Total (mg/kg wwt)					
	Beryllium (Be)-Total (mg/kg)					
	Beryllium (Be)-Total (mg/kg wwt)					
	Bismuth (Bi)-Total (mg/kg)					
	Bismuth (Bi)-Total (mg/kg wwt)					
	Boron (B)-Total (mg/kg)					
	Boron (B)-Total (mg/kg wwt)					
	Cadmium (Cd)-Total (mg/kg)					
	Cadmium (Cd)-Total (mg/kg wwt)					
	Calcium (Ca)-Total (mg/kg)					
	Calcium (Ca)-Total (mg/kg wwt)					
	Cesium (Cs)-Total (mg/kg)					
	Cesium (Cs)-Total (mg/kg wwt)					
	Chromium (Cr)-Total (mg/kg)					
	Chromium (Cr)-Total (mg/kg wwt)					
	Cobalt (Co)-Total (mg/kg)					
	Cobalt (Co)-Total (mg/kg wwt)					
	Copper (Cu)-Total (mg/kg)					
	Copper (Cu)-Total (mg/kg wwt)					
	Iron (Fe)-Total (mg/kg)					
	Iron (Fe)-Total (mg/kg wwt)					
	Lead (Pb)-Total (mg/kg)					
	Lead (Pb)-Total (mg/kg wwt)					
	Lithium (Li)-Total (mg/kg)					
	Lithium (Li)-Total (mg/kg wwt)					
	Magnesium (Mg)-Total (mg/kg)					
	Magnesium (Mg)-Total (mg/kg wwt)					
	Manganese (Mn)-Total (mg/kg)					
	Manganese (Mn)-Total (mg/kg wwt)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1677176-41	L1677176-42	L1677176-43	L1677176-44	L1677176-45
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	26-AUG-15	26-AUG-15	26-AUG-15	26-AUG-15	26-AUG-15
	Sampled Time					
	Client ID	MAMMOTH LAKE LAKE TROUT #118	MAMMOTH LAKE LAKE TROUT #119	MAMMOTH LAKE LAKE TROUT #120	MAMMOTH LAKE LAKE TROUT #121	MAMMOTH LAKE LAKE TROUT #122
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	77.8	75.4	75.3	74.6	76.1
Metals	Aluminum (Al)-Total (mg/kg)					
	Aluminum (Al)-Total (mg/kg wwt)					
	Antimony (Sb)-Total (mg/kg)					
	Antimony (Sb)-Total (mg/kg wwt)					
	Arsenic (As)-Total (mg/kg)					
	Arsenic (As)-Total (mg/kg wwt)					
	Barium (Ba)-Total (mg/kg)					
	Barium (Ba)-Total (mg/kg wwt)					
	Beryllium (Be)-Total (mg/kg)					
	Beryllium (Be)-Total (mg/kg wwt)					
	Bismuth (Bi)-Total (mg/kg)					
	Bismuth (Bi)-Total (mg/kg wwt)					
	Boron (B)-Total (mg/kg)					
	Boron (B)-Total (mg/kg wwt)					
	Cadmium (Cd)-Total (mg/kg)					
	Cadmium (Cd)-Total (mg/kg wwt)					
	Calcium (Ca)-Total (mg/kg)					
	Calcium (Ca)-Total (mg/kg wwt)					
	Cesium (Cs)-Total (mg/kg)					
	Cesium (Cs)-Total (mg/kg wwt)					
	Chromium (Cr)-Total (mg/kg)					
	Chromium (Cr)-Total (mg/kg wwt)					
	Cobalt (Co)-Total (mg/kg)					
	Cobalt (Co)-Total (mg/kg wwt)					
	Copper (Cu)-Total (mg/kg)					
	Copper (Cu)-Total (mg/kg wwt)					
	Iron (Fe)-Total (mg/kg)					
	Iron (Fe)-Total (mg/kg wwt)					
	Lead (Pb)-Total (mg/kg)					
	Lead (Pb)-Total (mg/kg wwt)					
	Lithium (Li)-Total (mg/kg)					
	Lithium (Li)-Total (mg/kg wwt)					
	Magnesium (Mg)-Total (mg/kg)					
	Magnesium (Mg)-Total (mg/kg wwt)					
	Manganese (Mn)-Total (mg/kg)					
	Manganese (Mn)-Total (mg/kg wwt)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1677176-46	L1677176-47	L1677176-48	L1677176-49	L1677176-50
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	26-AUG-15	26-AUG-15	26-AUG-15	26-AUG-15	26-AUG-15
Sampled Time					
Client ID	MAMMOTH LAKE LAKE TROUT #123	MAMMOTH LAKE LAKE TROUT #124	MAMMOTH LAKE LAKE TROUT #126	WHALE TAIL LAKE SMALL FISH COMPOSITE #1	WHALE TAIL LAKE SMALL FISH COMPOSITE #2
Grouping / **Analyte**					
TISSUE					
Physical Tests % Moisture (%)	78.0	78.7	78.1	74.4	74.0
Metals Aluminum (Al)-Total (mg/kg)				8.0	<5.0
Aluminum (Al)-Total (mg/kg wwt)				2.1	<1.0
Antimony (Sb)-Total (mg/kg)				<0.010	<0.010
Antimony (Sb)-Total (mg/kg wwt)				<0.0020	<0.0020
Arsenic (As)-Total (mg/kg)				0.521	0.538
Arsenic (As)-Total (mg/kg wwt)				0.133	0.140
Barium (Ba)-Total (mg/kg)				19.1	16.0
Barium (Ba)-Total (mg/kg wwt)				4.89	4.16
Beryllium (Be)-Total (mg/kg)				<0.010	<0.010
Beryllium (Be)-Total (mg/kg wwt)				<0.0020	<0.0020
Bismuth (Bi)-Total (mg/kg)				<0.010	<0.010
Bismuth (Bi)-Total (mg/kg wwt)				<0.0020	<0.0020
Boron (B)-Total (mg/kg)				<1.0	<1.0
Boron (B)-Total (mg/kg wwt)				<0.20	<0.20
Cadmium (Cd)-Total (mg/kg)				0.140	0.233
Cadmium (Cd)-Total (mg/kg wwt)				0.0360	0.0604
Calcium (Ca)-Total (mg/kg)				50300	40500
Calcium (Ca)-Total (mg/kg wwt)				12900	10500
Cesium (Cs)-Total (mg/kg)				0.0427	0.0310
Cesium (Cs)-Total (mg/kg wwt)				0.0109	0.0081
Chromium (Cr)-Total (mg/kg)				<0.20	<0.20
Chromium (Cr)-Total (mg/kg wwt)				0.041	<0.040
Cobalt (Co)-Total (mg/kg)				0.071	0.057
Cobalt (Co)-Total (mg/kg wwt)				0.0182	0.0148
Copper (Cu)-Total (mg/kg)				6.89	6.81
Copper (Cu)-Total (mg/kg wwt)				1.76	1.77
Iron (Fe)-Total (mg/kg)				87.2	72.7
Iron (Fe)-Total (mg/kg wwt)				22.3	18.9
Lead (Pb)-Total (mg/kg)				0.066	0.057
Lead (Pb)-Total (mg/kg wwt)				0.017	0.015
Lithium (Li)-Total (mg/kg)				<0.50	<0.50
Lithium (Li)-Total (mg/kg wwt)				<0.10	<0.10
Magnesium (Mg)-Total (mg/kg)				1960	1570
Magnesium (Mg)-Total (mg/kg wwt)				503	409
Manganese (Mn)-Total (mg/kg)				59.3	63.8
Manganese (Mn)-Total (mg/kg wwt)				15.2	16.6

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1677176-51	L1677176-52	L1677176-53	L1677176-54	L1677176-55
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	26-AUG-15	26-AUG-15	26-AUG-15	26-AUG-15	26-AUG-15
	Sampled Time					
	Client ID	WHALE TAIL LAKE SMALL FISH COMPOSITE #3	WHALE TAIL LAKE SMALL FISH COMPOSITE #4	WHALE TAIL LAKE SMALL FISH COMPOSITE #5	WHALE TAIL LAKE SMALL FISH COMPOSITE #6	WHALE TAIL LAKE SMALL FISH COMPOSITE #7
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	73.7	73.6	74.1	74.4	74.8
Metals	Aluminum (Al)-Total (mg/kg)	15.2	11.8	9.4	8.6	9.4
	Aluminum (Al)-Total (mg/kg wwt)	4.0	3.1	2.4	2.2	2.4
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	0.447	0.442	0.398	0.426	0.501
	Arsenic (As)-Total (mg/kg wwt)	0.118	0.117	0.103	0.109	0.126
	Barium (Ba)-Total (mg/kg)	13.8	15.8	13.1	18.8	18.3
	Barium (Ba)-Total (mg/kg wwt)	3.63	4.18	3.41	4.82	4.60
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg)	0.293	0.255	0.199	0.228	0.251
	Cadmium (Cd)-Total (mg/kg wwt)	0.0771	0.0673	0.0515	0.0584	0.0632
	Calcium (Ca)-Total (mg/kg)	37000	44500	36000	47000	40000
	Calcium (Ca)-Total (mg/kg wwt)	9740	11800	9340	12000	10100
	Cesium (Cs)-Total (mg/kg)	0.0238	0.0204	0.0226	0.0198	0.0227
	Cesium (Cs)-Total (mg/kg wwt)	0.0063	0.0054	0.0059	0.0051	0.0057
	Chromium (Cr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Chromium (Cr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040
	Cobalt (Co)-Total (mg/kg)	0.061	0.056	0.058	0.059	0.064
	Cobalt (Co)-Total (mg/kg wwt)	0.0161	0.0148	0.0150	0.0152	0.0161
	Copper (Cu)-Total (mg/kg)	4.77	5.03	4.54	4.67	5.70
	Copper (Cu)-Total (mg/kg wwt)	1.25	1.33	1.18	1.19	1.44
	Iron (Fe)-Total (mg/kg)	81.2	83.2	76.1	83.1	84.1
	Iron (Fe)-Total (mg/kg wwt)	21.3	22.0	19.7	21.3	21.2
	Lead (Pb)-Total (mg/kg)	0.084	0.060	0.063	0.059	0.060
	Lead (Pb)-Total (mg/kg wwt)	0.022	0.016	0.016	0.015	0.015
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	1600	1600	1510	1720	1560
	Magnesium (Mg)-Total (mg/kg wwt)	420	423	392	440	394
	Manganese (Mn)-Total (mg/kg)	42.9	48.1	46.8	64.5	56.8
	Manganese (Mn)-Total (mg/kg wwt)	11.3	12.7	12.1	16.5	14.3

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1677176-56	L1677176-57	L1677176-58	L1677176-59	L1677176-60
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	30-AUG-15	29-AUG-15	29-AUG-15	29-AUG-15	29-AUG-15
	Sampled Time					
	Client ID	MAMMOTH LAKE SMALL FISH COMPOSITE #8	MAMMOTH LAKE SMALL FISH COMPOSITE #9	MAMMOTH LAKE SMALL FISH COMPOSITE #10	MAMMOTH LAKE SMALL FISH COMPOSITE #11	MAMMOTH LAKE SMALL FISH COMPOSITE #12
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	73.8	73.0	73.6	74.0	73.3
Metals	Aluminum (Al)-Total (mg/kg)	<5.0	11.6	8.4	14.8	12.8
	Aluminum (Al)-Total (mg/kg wwt)	<1.0	3.1	2.2	3.8	3.4
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	0.483	0.568	0.558	0.602	0.577
	Arsenic (As)-Total (mg/kg wwt)	0.127	0.154	0.148	0.156	0.154
	Barium (Ba)-Total (mg/kg)	13.5	10.9	12.2	11.5	14.4
	Barium (Ba)-Total (mg/kg wwt)	3.54	2.94	3.21	2.99	3.84
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg)	0.121	0.203	0.253	0.309	0.266
	Cadmium (Cd)-Total (mg/kg wwt)	0.0316	0.0549	0.0670	0.0803	0.0710
	Calcium (Ca)-Total (mg/kg)	37400	34200	33300	34400	37600
	Calcium (Ca)-Total (mg/kg wwt)	9800	9240	8790	8940	10100
	Cesium (Cs)-Total (mg/kg)	0.0519	0.0583	0.0661	0.0620	0.0595
	Cesium (Cs)-Total (mg/kg wwt)	0.0136	0.0158	0.0175	0.0161	0.0159
	Chromium (Cr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Chromium (Cr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040
	Cobalt (Co)-Total (mg/kg)	0.038	0.075	0.064	0.086	0.087
	Cobalt (Co)-Total (mg/kg wwt)	0.0101	0.0204	0.0169	0.0224	0.0234
	Copper (Cu)-Total (mg/kg)	5.77	7.66	3.58	4.70	4.78
	Copper (Cu)-Total (mg/kg wwt)	1.51	2.07	0.947	1.22	1.28
	Iron (Fe)-Total (mg/kg)	48.9	74.2	52.8	77.4	77.4
	Iron (Fe)-Total (mg/kg wwt)	12.8	20.1	14.0	20.1	20.7
	Lead (Pb)-Total (mg/kg)	<0.050	0.091	0.076	0.069	0.079
	Lead (Pb)-Total (mg/kg wwt)	<0.010	0.025	0.020	0.018	0.021
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	1560	1370	1360	1380	1410
	Magnesium (Mg)-Total (mg/kg wwt)	410	370	359	358	378
	Manganese (Mn)-Total (mg/kg)	45.0	55.7	53.4	57.8	47.7
	Manganese (Mn)-Total (mg/kg wwt)	11.8	15.1	14.1	15.0	12.7

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1677176-61	L1677176-62	L1677176-63		
	Description	Tissue	Tissue	Tissue		
	Sampled Date	29-AUG-15	29-AUG-15	29-AUG-15		
	Sampled Time					
	Client ID	MAMMOTH LAKE SMALL FISH COMPOSITE #13	MAMMOTH LAKE SMALL FISH COMPOSITE #14	MAMMOTH LAKE SMALL FISH COMPOSITE #15		
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	73.2	73.9	74.7		
Metals	Aluminum (Al)-Total (mg/kg)	8.8	15.9	10.2		
	Aluminum (Al)-Total (mg/kg wwt)	2.4	4.1	2.6		
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010		
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020		
	Arsenic (As)-Total (mg/kg)	0.615	0.654	0.582		
	Arsenic (As)-Total (mg/kg wwt)	0.164	0.171	0.147		
	Barium (Ba)-Total (mg/kg)	13.5	15.0	14.4		
	Barium (Ba)-Total (mg/kg wwt)	3.61	3.91	3.66		
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010		
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020		
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010		
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020		
	Boron (B)-Total (mg/kg)	<1.0	<1.0	<1.0		
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20		
	Cadmium (Cd)-Total (mg/kg)	0.223	0.359	0.207		
	Cadmium (Cd)-Total (mg/kg wwt)	0.0597	0.0937	0.0525		
	Calcium (Ca)-Total (mg/kg)	32900	39400	34900		
	Calcium (Ca)-Total (mg/kg wwt)	8810	10300	8830		
	Cesium (Cs)-Total (mg/kg)	0.0563	0.0636	0.0624		
	Cesium (Cs)-Total (mg/kg wwt)	0.0151	0.0166	0.0158		
	Chromium (Cr)-Total (mg/kg)	<0.20	<0.20	<0.20		
	Chromium (Cr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040		
	Cobalt (Co)-Total (mg/kg)	0.081	1.51	0.143		
	Cobalt (Co)-Total (mg/kg wwt)	0.0216	0.393	0.0362		
	Copper (Cu)-Total (mg/kg)	5.45	4.80	4.38		
	Copper (Cu)-Total (mg/kg wwt)	1.46	1.25	1.11		
	Iron (Fe)-Total (mg/kg)	69.2	83.1	74.6		
	Iron (Fe)-Total (mg/kg wwt)	18.5	21.7	18.9		
	Lead (Pb)-Total (mg/kg)	0.088	0.102	0.103		
	Lead (Pb)-Total (mg/kg wwt)	0.023	0.027	0.026		
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50		
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10		
	Magnesium (Mg)-Total (mg/kg)	1370	1560	1680		
	Magnesium (Mg)-Total (mg/kg wwt)	368	408	426		
	Manganese (Mn)-Total (mg/kg)	55.4	71.3	61.8		
	Manganese (Mn)-Total (mg/kg wwt)	14.8	18.6	15.7		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1677176-1	L1677176-2	L1677176-3	L1677176-4	L1677176-5
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	18-AUG-15	18-AUG-15	18-AUG-15	18-AUG-15	18-AUG-15
	Sampled Time					
	Client ID	WHALE TAIL LAKE LAKE TROUT #46	WHALE TAIL LAKE LAKE TROUT #47	WHALE TAIL LAKE LAKE TROUT #48	WHALE TAIL LAKE LAKE TROUT #49	WHALE TAIL LAKE LAKE TROUT #50
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	3.01	3.84	4.13	4.84	2.20
	Mercury (Hg)-Total (mg/kg wwt)	0.590	0.831	0.863	0.965	0.474
	Molybdenum (Mo)-Total (mg/kg)					
	Molybdenum (Mo)-Total (mg/kg wwt)					
	Nickel (Ni)-Total (mg/kg)					
	Nickel (Ni)-Total (mg/kg wwt)					
	Phosphorus (P)-Total (mg/kg)					
	Phosphorus (P)-Total (mg/kg wwt)					
	Potassium (K)-Total (mg/kg)					
	Potassium (K)-Total (mg/kg wwt)					
	Rubidium (Rb)-Total (mg/kg)					
	Rubidium (Rb)-Total (mg/kg wwt)					
	Selenium (Se)-Total (mg/kg)					
	Selenium (Se)-Total (mg/kg wwt)					
	Sodium (Na)-Total (mg/kg)					
	Sodium (Na)-Total (mg/kg wwt)					
	Strontium (Sr)-Total (mg/kg)					
	Strontium (Sr)-Total (mg/kg wwt)					
	Tellurium (Te)-Total (mg/kg)					
	Tellurium (Te)-Total (mg/kg wwt)					
	Thallium (Tl)-Total (mg/kg)					
	Thallium (Tl)-Total (mg/kg wwt)					
	Tin (Sn)-Total (mg/kg)					
	Tin (Sn)-Total (mg/kg wwt)					
	Uranium (U)-Total (mg/kg)					
	Uranium (U)-Total (mg/kg wwt)					
	Vanadium (V)-Total (mg/kg)					
	Vanadium (V)-Total (mg/kg wwt)					
	Zinc (Zn)-Total (mg/kg)					
	Zinc (Zn)-Total (mg/kg wwt)					
	Zirconium (Zr)-Total (mg/kg)					
	Zirconium (Zr)-Total (mg/kg wwt)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1677176-6	L1677176-7	L1677176-8	L1677176-9	L1677176-10
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	18-AUG-15	18-AUG-15	18-AUG-15	18-AUG-15	18-AUG-15
	Sampled Time					
	Client ID	WHALE TAIL LAKE LAKE TROUT #52	WHALE TAIL LAKE LAKE TROUT #53	WHALE TAIL LAKE LAKE TROUT #54A	WHALE TAIL LAKE LAKE TROUT #54B	WHALE TAIL LAKE LAKE TROUT #56
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.444	1.71	1.33	1.16	1.30
	Mercury (Hg)-Total (mg/kg wwt)	0.135	0.368	0.331	0.286	0.328
	Molybdenum (Mo)-Total (mg/kg)					
	Molybdenum (Mo)-Total (mg/kg wwt)					
	Nickel (Ni)-Total (mg/kg)					
	Nickel (Ni)-Total (mg/kg wwt)					
	Phosphorus (P)-Total (mg/kg)					
	Phosphorus (P)-Total (mg/kg wwt)					
	Potassium (K)-Total (mg/kg)					
	Potassium (K)-Total (mg/kg wwt)					
	Rubidium (Rb)-Total (mg/kg)					
	Rubidium (Rb)-Total (mg/kg wwt)					
	Selenium (Se)-Total (mg/kg)					
	Selenium (Se)-Total (mg/kg wwt)					
	Sodium (Na)-Total (mg/kg)					
	Sodium (Na)-Total (mg/kg wwt)					
	Strontium (Sr)-Total (mg/kg)					
	Strontium (Sr)-Total (mg/kg wwt)					
	Tellurium (Te)-Total (mg/kg)					
	Tellurium (Te)-Total (mg/kg wwt)					
	Thallium (Tl)-Total (mg/kg)					
	Thallium (Tl)-Total (mg/kg wwt)					
	Tin (Sn)-Total (mg/kg)					
	Tin (Sn)-Total (mg/kg wwt)					
	Uranium (U)-Total (mg/kg)					
	Uranium (U)-Total (mg/kg wwt)					
	Vanadium (V)-Total (mg/kg)					
	Vanadium (V)-Total (mg/kg wwt)					
	Zinc (Zn)-Total (mg/kg)					
	Zinc (Zn)-Total (mg/kg wwt)					
	Zirconium (Zr)-Total (mg/kg)					
	Zirconium (Zr)-Total (mg/kg wwt)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1677176-11 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #57	L1677176-12 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #58	L1677176-13 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #59	L1677176-14 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #60	L1677176-15 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #61
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	1.03	1.49	0.727	2.13	9.52
	Mercury (Hg)-Total (mg/kg wwt)	0.281	0.370	0.175	0.453	2.19
	Molybdenum (Mo)-Total (mg/kg)			<0.020		<0.020
	Molybdenum (Mo)-Total (mg/kg wwt)			<0.0040		<0.0040
	Nickel (Ni)-Total (mg/kg)			<0.20		<0.20
	Nickel (Ni)-Total (mg/kg wwt)			<0.040		<0.040
	Phosphorus (P)-Total (mg/kg)			10500		10600
	Phosphorus (P)-Total (mg/kg wwt)			2520		2450
	Potassium (K)-Total (mg/kg)			16700		17500
	Potassium (K)-Total (mg/kg wwt)			4020		4030
	Rubidium (Rb)-Total (mg/kg)			12.1		19.1
	Rubidium (Rb)-Total (mg/kg wwt)			2.91		4.40
	Selenium (Se)-Total (mg/kg)			1.16		2.14
	Selenium (Se)-Total (mg/kg wwt)			0.279		0.494
	Sodium (Na)-Total (mg/kg)			603		1280
	Sodium (Na)-Total (mg/kg wwt)			145		294
	Strontium (Sr)-Total (mg/kg)			0.594		0.245
	Strontium (Sr)-Total (mg/kg wwt)			0.143		0.056
	Tellurium (Te)-Total (mg/kg)			<0.020		<0.020
	Tellurium (Te)-Total (mg/kg wwt)			<0.0040		<0.0040
	Thallium (Tl)-Total (mg/kg)			0.0149		0.0215
	Thallium (Tl)-Total (mg/kg wwt)			0.00359		0.00495
	Tin (Sn)-Total (mg/kg)			<0.10		<0.10
	Tin (Sn)-Total (mg/kg wwt)			0.023		<0.020
	Uranium (U)-Total (mg/kg)			<0.0020		<0.0020
	Uranium (U)-Total (mg/kg wwt)			<0.00040		<0.00040
	Vanadium (V)-Total (mg/kg)			<0.10		<0.10
	Vanadium (V)-Total (mg/kg wwt)			<0.020		<0.020
	Zinc (Zn)-Total (mg/kg)			12.4		13.8
	Zinc (Zn)-Total (mg/kg wwt)			2.98		3.19
	Zirconium (Zr)-Total (mg/kg)			<0.20		<0.20
	Zirconium (Zr)-Total (mg/kg wwt)			<0.040		<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1677176-16 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #62	L1677176-17 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #63	L1677176-18 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #64	L1677176-19 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #65	L1677176-20 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #66
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	3.52	2.12	1.36	1.26	0.614
	Mercury (Hg)-Total (mg/kg wwt)	0.798	0.486	0.292	0.306	0.138
	Molybdenum (Mo)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Nickel (Ni)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Nickel (Ni)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040
	Phosphorus (P)-Total (mg/kg)	11800	10600	8460	10400	11100
	Phosphorus (P)-Total (mg/kg wwt)	2680	2430	1810	2520	2490
	Potassium (K)-Total (mg/kg)	19300	17900	13900	17300	18000
	Potassium (K)-Total (mg/kg wwt)	4370	4100	2980	4210	4050
	Rubidium (Rb)-Total (mg/kg)	27.2	19.5	9.74	22.5	17.5
	Rubidium (Rb)-Total (mg/kg wwt)	6.16	4.48	2.09	5.48	3.92
	Selenium (Se)-Total (mg/kg)	1.58	2.26	1.18	1.44	1.41
	Selenium (Se)-Total (mg/kg wwt)	0.358	0.519	0.252	0.350	0.317
	Sodium (Na)-Total (mg/kg)	1130	866	545	741	704
	Sodium (Na)-Total (mg/kg wwt)	256	199	117	180	158
	Strontium (Sr)-Total (mg/kg)	0.265	0.368	0.180	0.543	0.836
	Strontium (Sr)-Total (mg/kg wwt)	0.060	0.084	0.038	0.132	0.188
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0246	0.0152	0.0176	0.0191	0.0287
	Thallium (Tl)-Total (mg/kg wwt)	0.00557	0.00349	0.00378	0.00464	0.00645
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	0.10	<0.10	0.15
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	0.022	<0.020	0.034
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Zinc (Zn)-Total (mg/kg)	14.4	12.5	9.93	12.8	16.1
	Zinc (Zn)-Total (mg/kg wwt)	3.26	2.87	2.13	3.11	3.61
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	0.26
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	0.058

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1677176-21 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #68	L1677176-22 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #69	L1677176-23 Tissue 18-AUG-15 WHALE TAIL LAKE LAKE TROUT #70	L1677176-24 Tissue 25-AUG-15 MAMMOTH LAKE LAKE TROUT #97	L1677176-25 Tissue 25-AUG-15 MAMMOTH LAKE LAKE TROUT #98
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.711	0.334	1.29	0.902	0.625
	Mercury (Hg)-Total (mg/kg wwt)	0.158	0.0771	0.318	0.227	0.156
	Molybdenum (Mo)-Total (mg/kg)	<0.020	<0.040	<0.020	<0.020	<0.020
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0040	<0.0080	<0.0040	<0.0040	<0.0040
	Nickel (Ni)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Nickel (Ni)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040
	Phosphorus (P)-Total (mg/kg)	11300	8620	9110	9460	10600
	Phosphorus (P)-Total (mg/kg wwt)	2510	1990	2250	2380	2640
	Potassium (K)-Total (mg/kg)	18200	16600	14600	15300	17200
	Potassium (K)-Total (mg/kg wwt)	4040	3830	3610	3860	4280
	Rubidium (Rb)-Total (mg/kg)	16.9	13.0	11.4	12.1	13.3
	Rubidium (Rb)-Total (mg/kg wwt)	3.75	3.01	2.82	3.06	3.31
	Selenium (Se)-Total (mg/kg)	1.25	1.58	0.981	1.03	1.24
	Selenium (Se)-Total (mg/kg wwt)	0.278	0.365	0.243	0.259	0.310
	Sodium (Na)-Total (mg/kg)	696	2770	831	896	822
	Sodium (Na)-Total (mg/kg wwt)	155	639	206	226	205
	Strontium (Sr)-Total (mg/kg)	0.999	4.30	0.728	0.448	0.490
	Strontium (Sr)-Total (mg/kg wwt)	0.222	0.992	0.180	0.113	0.122
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0177	0.0126	0.0151	0.0203	0.0137
	Thallium (Tl)-Total (mg/kg wwt)	0.00393	0.00292	0.00372	0.00512	0.00341
	Tin (Sn)-Total (mg/kg)	0.16	<0.10	0.13	0.11	0.11
	Tin (Sn)-Total (mg/kg wwt)	0.035	<0.020	0.031	0.027	0.028
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Zinc (Zn)-Total (mg/kg)	14.8	46.0	9.77	15.3	12.5
	Zinc (Zn)-Total (mg/kg wwt)	3.28	10.6	2.42	3.86	3.10
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1677176-26 Tissue 25-AUG-15 MAMMOTH LAKE LAKE TROUT #99	L1677176-27 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #100	L1677176-28 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #101	L1677176-29 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #102	L1677176-30 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #103
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.655	0.504	0.566	0.578	0.739
	Mercury (Hg)-Total (mg/kg wwt)	0.157	0.127	0.136	0.138	0.180
	Molybdenum (Mo)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Nickel (Ni)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Nickel (Ni)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040
	Phosphorus (P)-Total (mg/kg)	12300	10900	10700	11400	11300
	Phosphorus (P)-Total (mg/kg wwt)	2940	2740	2570	2720	2750
	Potassium (K)-Total (mg/kg)	20300	16200	17000	17800	18400
	Potassium (K)-Total (mg/kg wwt)	4880	4090	4080	4250	4470
	Rubidium (Rb)-Total (mg/kg)	19.4	12.4	15.0	14.6	21.4
	Rubidium (Rb)-Total (mg/kg wwt)	4.66	3.12	3.61	3.49	5.20
	Selenium (Se)-Total (mg/kg)	1.62	1.31	1.22	1.42	1.57
	Selenium (Se)-Total (mg/kg wwt)	0.388	0.330	0.293	0.339	0.380
	Sodium (Na)-Total (mg/kg)	884	922	664	656	1020
	Sodium (Na)-Total (mg/kg wwt)	212	232	160	157	249
	Strontium (Sr)-Total (mg/kg)	0.944	1.27	0.298	1.72	0.396
	Strontium (Sr)-Total (mg/kg wwt)	0.227	0.321	0.072	0.411	0.096
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0257	0.0123	0.0155	0.0253	0.0184
	Thallium (Tl)-Total (mg/kg wwt)	0.00617	0.00309	0.00373	0.00604	0.00448
	Tin (Sn)-Total (mg/kg)	0.12	0.10	0.14	0.18	0.11
	Tin (Sn)-Total (mg/kg wwt)	0.028	0.025	0.033	0.043	0.026
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	0.0026	<0.0020
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	0.00063	<0.00040
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Zinc (Zn)-Total (mg/kg)	12.1	13.1	13.6	14.6	13.3
	Zinc (Zn)-Total (mg/kg wwt)	2.90	3.30	3.28	3.49	3.23
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1677176-31	L1677176-32	L1677176-33	L1677176-34	L1677176-35
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	26-AUG-15	26-AUG-15	26-AUG-15	26-AUG-15	26-AUG-15
	Sampled Time					
	Client ID	MAMMOTH LAKE LAKE TROUT #105	MAMMOTH LAKE LAKE TROUT #106	MAMMOTH LAKE LAKE TROUT #108	MAMMOTH LAKE LAKE TROUT #110	MAMMOTH LAKE LAKE TROUT #111
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.700	1.34	0.531	0.602	0.785
	Mercury (Hg)-Total (mg/kg wwt)	0.172	0.268	0.120	0.156	0.189
	Molybdenum (Mo)-Total (mg/kg)	<0.020	<0.020	<0.020		
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040		
	Nickel (Ni)-Total (mg/kg)	<0.20	<0.20	<0.20		
	Nickel (Ni)-Total (mg/kg wwt)	<0.040	<0.040	<0.040		
	Phosphorus (P)-Total (mg/kg)	10400	11500	12000		
	Phosphorus (P)-Total (mg/kg wwt)	2560	2300	2720		
	Potassium (K)-Total (mg/kg)	17100	18700	20000		
	Potassium (K)-Total (mg/kg wwt)	4200	3730	4520		
	Rubidium (Rb)-Total (mg/kg)	12.8	13.2	13.7		
	Rubidium (Rb)-Total (mg/kg wwt)	3.15	2.63	3.09		
	Selenium (Se)-Total (mg/kg)	1.49	1.29	1.26		
	Selenium (Se)-Total (mg/kg wwt)	0.365	0.258	0.286		
	Sodium (Na)-Total (mg/kg)	759	742	614		
	Sodium (Na)-Total (mg/kg wwt)	187	148	139		
	Strontium (Sr)-Total (mg/kg)	0.328	0.610	0.702		
	Strontium (Sr)-Total (mg/kg wwt)	0.081	0.122	0.159		
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020		
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040		
	Thallium (Tl)-Total (mg/kg)	0.0167	0.0156	0.0184		
	Thallium (Tl)-Total (mg/kg wwt)	0.00411	0.00312	0.00417		
	Tin (Sn)-Total (mg/kg)	0.11	0.20	0.16		
	Tin (Sn)-Total (mg/kg wwt)	0.028	0.039	0.035		
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020		
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040		
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10		
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	<0.020		
	Zinc (Zn)-Total (mg/kg)	12.3	13.6	13.2		
	Zinc (Zn)-Total (mg/kg wwt)	3.01	2.72	2.99		
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20		
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1677176-36	L1677176-37	L1677176-38	L1677176-39	L1677176-40
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	26-AUG-15	26-AUG-15	26-AUG-15	26-AUG-15	26-AUG-15
	Sampled Time					
	Client ID	MAMMOTH LAKE LAKE TROUT #112	MAMMOTH LAKE LAKE TROUT #114	MAMMOTH LAKE LAKE TROUT #115	MAMMOTH LAKE LAKE TROUT #116	MAMMOTH LAKE LAKE TROUT #117
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.693	2.91	0.572	0.811	0.845
	Mercury (Hg)-Total (mg/kg wwt)	0.175	0.583	0.130	0.187	0.215
	Molybdenum (Mo)-Total (mg/kg)					
	Molybdenum (Mo)-Total (mg/kg wwt)					
	Nickel (Ni)-Total (mg/kg)					
	Nickel (Ni)-Total (mg/kg wwt)					
	Phosphorus (P)-Total (mg/kg)					
	Phosphorus (P)-Total (mg/kg wwt)					
	Potassium (K)-Total (mg/kg)					
	Potassium (K)-Total (mg/kg wwt)					
	Rubidium (Rb)-Total (mg/kg)					
	Rubidium (Rb)-Total (mg/kg wwt)					
	Selenium (Se)-Total (mg/kg)					
	Selenium (Se)-Total (mg/kg wwt)					
	Sodium (Na)-Total (mg/kg)					
	Sodium (Na)-Total (mg/kg wwt)					
	Strontium (Sr)-Total (mg/kg)					
	Strontium (Sr)-Total (mg/kg wwt)					
	Tellurium (Te)-Total (mg/kg)					
	Tellurium (Te)-Total (mg/kg wwt)					
	Thallium (Tl)-Total (mg/kg)					
	Thallium (Tl)-Total (mg/kg wwt)					
	Tin (Sn)-Total (mg/kg)					
	Tin (Sn)-Total (mg/kg wwt)					
	Uranium (U)-Total (mg/kg)					
	Uranium (U)-Total (mg/kg wwt)					
	Vanadium (V)-Total (mg/kg)					
	Vanadium (V)-Total (mg/kg wwt)					
	Zinc (Zn)-Total (mg/kg)					
	Zinc (Zn)-Total (mg/kg wwt)					
	Zirconium (Zr)-Total (mg/kg)					
	Zirconium (Zr)-Total (mg/kg wwt)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1677176-41	L1677176-42	L1677176-43	L1677176-44	L1677176-45
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	26-AUG-15	26-AUG-15	26-AUG-15	26-AUG-15	26-AUG-15
	Sampled Time					
	Client ID	MAMMOTH LAKE LAKE TROUT #118	MAMMOTH LAKE LAKE TROUT #119	MAMMOTH LAKE LAKE TROUT #120	MAMMOTH LAKE LAKE TROUT #121	MAMMOTH LAKE LAKE TROUT #122
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.986	0.523	0.492	0.531	0.325
	Mercury (Hg)-Total (mg/kg wwt)	0.219	0.129	0.122	0.135	0.0777
	Molybdenum (Mo)-Total (mg/kg)					
	Molybdenum (Mo)-Total (mg/kg wwt)					
	Nickel (Ni)-Total (mg/kg)					
	Nickel (Ni)-Total (mg/kg wwt)					
	Phosphorus (P)-Total (mg/kg)					
	Phosphorus (P)-Total (mg/kg wwt)					
	Potassium (K)-Total (mg/kg)					
	Potassium (K)-Total (mg/kg wwt)					
	Rubidium (Rb)-Total (mg/kg)					
	Rubidium (Rb)-Total (mg/kg wwt)					
	Selenium (Se)-Total (mg/kg)					
	Selenium (Se)-Total (mg/kg wwt)					
	Sodium (Na)-Total (mg/kg)					
	Sodium (Na)-Total (mg/kg wwt)					
	Strontium (Sr)-Total (mg/kg)					
	Strontium (Sr)-Total (mg/kg wwt)					
	Tellurium (Te)-Total (mg/kg)					
	Tellurium (Te)-Total (mg/kg wwt)					
	Thallium (Tl)-Total (mg/kg)					
	Thallium (Tl)-Total (mg/kg wwt)					
	Tin (Sn)-Total (mg/kg)					
	Tin (Sn)-Total (mg/kg wwt)					
	Uranium (U)-Total (mg/kg)					
	Uranium (U)-Total (mg/kg wwt)					
	Vanadium (V)-Total (mg/kg)					
	Vanadium (V)-Total (mg/kg wwt)					
	Zinc (Zn)-Total (mg/kg)					
	Zinc (Zn)-Total (mg/kg wwt)					
	Zirconium (Zr)-Total (mg/kg)					
	Zirconium (Zr)-Total (mg/kg wwt)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1677176-46 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #123	L1677176-47 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #124	L1677176-48 Tissue 26-AUG-15 MAMMOTH LAKE LAKE TROUT #126	L1677176-49 Tissue 26-AUG-15 WHALE TAIL LAKE SMALL FISH COMPOSITE #1	L1677176-50 Tissue 26-AUG-15 WHALE TAIL LAKE SMALL FISH COMPOSITE #2
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.340	4.99	0.329	0.252	0.270
	Mercury (Hg)-Total (mg/kg wwt)	0.0747	1.07	0.0722	0.0645	0.0701
	Molybdenum (Mo)-Total (mg/kg)				0.129	0.128
	Molybdenum (Mo)-Total (mg/kg wwt)				0.0329	0.0332
	Nickel (Ni)-Total (mg/kg)				0.22	<0.20
	Nickel (Ni)-Total (mg/kg wwt)				0.057	0.042
	Phosphorus (P)-Total (mg/kg)				33800	28000
	Phosphorus (P)-Total (mg/kg wwt)				8660	7270
	Potassium (K)-Total (mg/kg)				10500	9820
	Potassium (K)-Total (mg/kg wwt)				2690	2550
	Rubidium (Rb)-Total (mg/kg)				17.4	14.2
	Rubidium (Rb)-Total (mg/kg wwt)				4.44	3.70
	Selenium (Se)-Total (mg/kg)				1.64	1.86
	Selenium (Se)-Total (mg/kg wwt)				0.419	0.484
	Sodium (Na)-Total (mg/kg)				4470	4080
	Sodium (Na)-Total (mg/kg wwt)				1140	1060
	Strontium (Sr)-Total (mg/kg)				68.1	59.1
	Strontium (Sr)-Total (mg/kg wwt)				17.4	15.3
	Tellurium (Te)-Total (mg/kg)				<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)				<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)				0.0101	0.0101
	Thallium (Tl)-Total (mg/kg wwt)				0.00259	0.00262
	Tin (Sn)-Total (mg/kg)				0.11	0.14
	Tin (Sn)-Total (mg/kg wwt)				0.028	0.036
	Uranium (U)-Total (mg/kg)				0.0300	0.0361
	Uranium (U)-Total (mg/kg wwt)				0.00768	0.00938
	Vanadium (V)-Total (mg/kg)				<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)				<0.020	<0.020
	Zinc (Zn)-Total (mg/kg)				173	151
	Zinc (Zn)-Total (mg/kg wwt)				44.4	39.2
	Zirconium (Zr)-Total (mg/kg)				<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)				<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1677176-51 Tissue 26-AUG-15 WHALE TAIL LAKE SMALL FISH COMPOSITE #3	L1677176-52 Tissue 26-AUG-15 WHALE TAIL LAKE SMALL FISH COMPOSITE #4	L1677176-53 Tissue 26-AUG-15 WHALE TAIL LAKE SMALL FISH COMPOSITE #5	L1677176-54 Tissue 26-AUG-15 WHALE TAIL LAKE SMALL FISH COMPOSITE #6	L1677176-55 Tissue 26-AUG-15 WHALE TAIL LAKE SMALL FISH COMPOSITE #7
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.212	0.300	0.209	0.218	0.255
	Mercury (Hg)-Total (mg/kg wwt)	0.0557	0.0794	0.0543	0.0559	0.0643
	Molybdenum (Mo)-Total (mg/kg)	0.125	0.120	0.114	0.131	0.117
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0330	0.0317	0.0296	0.0335	0.0295
	Nickel (Ni)-Total (mg/kg)	0.24	0.24	0.29	0.20	0.21
	Nickel (Ni)-Total (mg/kg wwt)	0.063	0.064	0.075	0.052	0.053
	Phosphorus (P)-Total (mg/kg)	27100	30000	26400	32100	28600
	Phosphorus (P)-Total (mg/kg wwt)	7130	7930	6850	8220	7200
	Potassium (K)-Total (mg/kg)	9790	10100	9550	11200	10100
	Potassium (K)-Total (mg/kg wwt)	2570	2660	2480	2870	2550
	Rubidium (Rb)-Total (mg/kg)	13.9	11.4	12.1	13.1	12.2
	Rubidium (Rb)-Total (mg/kg wwt)	3.66	3.01	3.14	3.34	3.08
	Selenium (Se)-Total (mg/kg)	1.60	1.64	1.50	1.63	1.38
	Selenium (Se)-Total (mg/kg wwt)	0.420	0.433	0.390	0.417	0.348
	Sodium (Na)-Total (mg/kg)	3740	3790	3490	4280	4000
	Sodium (Na)-Total (mg/kg wwt)	982	1000	906	1090	1010
	Strontium (Sr)-Total (mg/kg)	55.2	59.7	51.4	65.2	56.3
	Strontium (Sr)-Total (mg/kg wwt)	14.5	15.8	13.3	16.7	14.2
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0110	0.0102	0.0128	0.0125	0.0115
	Thallium (Tl)-Total (mg/kg wwt)	0.00288	0.00269	0.00332	0.00320	0.00291
	Tin (Sn)-Total (mg/kg)	0.25	0.29	0.32	0.25	0.30
	Tin (Sn)-Total (mg/kg wwt)	0.067	0.076	0.082	0.063	0.075
	Uranium (U)-Total (mg/kg)	0.0299	0.0544	0.0414	0.0652	0.0384
	Uranium (U)-Total (mg/kg wwt)	0.00787	0.0144	0.0108	0.0167	0.00966
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Zinc (Zn)-Total (mg/kg)	146	167	153	180	161
	Zinc (Zn)-Total (mg/kg wwt)	38.5	44.0	39.7	46.1	40.6
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1677176-56	L1677176-57	L1677176-58	L1677176-59	L1677176-60
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	30-AUG-15	29-AUG-15	29-AUG-15	29-AUG-15	29-AUG-15
	Sampled Time					
	Client ID	MAMMOTH LAKE SMALL FISH COMPOSITE #8	MAMMOTH LAKE SMALL FISH COMPOSITE #9	MAMMOTH LAKE SMALL FISH COMPOSITE #10	MAMMOTH LAKE SMALL FISH COMPOSITE #11	MAMMOTH LAKE SMALL FISH COMPOSITE #12
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.307	0.196	0.206	0.189	0.155
	Mercury (Hg)-Total (mg/kg wwt)	0.0805	0.0531	0.0544	0.0490	0.0414
	Molybdenum (Mo)-Total (mg/kg)	0.098	0.111	0.118	0.112	0.118
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0256	0.0301	0.0313	0.0292	0.0314
	Nickel (Ni)-Total (mg/kg)	<0.20	0.29	0.28	0.38	0.32
	Nickel (Ni)-Total (mg/kg wwt)	<0.040	0.077	0.075	0.099	0.085
	Phosphorus (P)-Total (mg/kg)	24000	26700	24200	24000	25900
	Phosphorus (P)-Total (mg/kg wwt)	6290	7230	6390	6230	6930
	Potassium (K)-Total (mg/kg)	9300	8760	9100	10700	9200
	Potassium (K)-Total (mg/kg wwt)	2440	2370	2410	2780	2460
	Rubidium (Rb)-Total (mg/kg)	15.2	12.4	13.6	13.9	13.1
	Rubidium (Rb)-Total (mg/kg wwt)	3.97	3.36	3.59	3.62	3.49
	Selenium (Se)-Total (mg/kg)	1.61	1.48	1.61	1.66	1.54
	Selenium (Se)-Total (mg/kg wwt)	0.423	0.400	0.425	0.431	0.413
	Sodium (Na)-Total (mg/kg)	3720	3360	3800	4270	3770
	Sodium (Na)-Total (mg/kg wwt)	975	908	1000	1110	1010
	Strontium (Sr)-Total (mg/kg)	45.7	45.7	41.6	43.1	51.3
	Strontium (Sr)-Total (mg/kg wwt)	12.0	12.4	11.0	11.2	13.7
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0094	0.0115	0.0130	0.0137	0.0141
	Thallium (Tl)-Total (mg/kg wwt)	0.00246	0.00310	0.00343	0.00355	0.00377
	Tin (Sn)-Total (mg/kg)	0.11	0.17	0.14	0.14	0.10
	Tin (Sn)-Total (mg/kg wwt)	0.028	0.047	0.036	0.035	0.027
	Uranium (U)-Total (mg/kg)	0.0222	0.0247	0.0232	0.0268	0.0270
	Uranium (U)-Total (mg/kg wwt)	0.00583	0.00667	0.00613	0.00697	0.00720
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Zinc (Zn)-Total (mg/kg)	154	157	120	140	133
	Zinc (Zn)-Total (mg/kg wwt)	40.3	42.5	31.8	36.4	35.6
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1677176-61	L1677176-62	L1677176-63		
	Description	Tissue	Tissue	Tissue		
	Sampled Date	29-AUG-15	29-AUG-15	29-AUG-15		
	Sampled Time					
	Client ID	MAMMOTH LAKE SMALL FISH COMPOSITE #13	MAMMOTH LAKE SMALL FISH COMPOSITE #14	MAMMOTH LAKE SMALL FISH COMPOSITE #15		
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.192	0.193	0.205		
	Mercury (Hg)-Total (mg/kg wwt)	0.0513	0.0503	0.0520		
	Molybdenum (Mo)-Total (mg/kg)	0.115	0.130	0.154		
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0308	0.0338	0.0390		
	Nickel (Ni)-Total (mg/kg)	0.27	0.38	0.52		
	Nickel (Ni)-Total (mg/kg wwt)	0.073	0.100	0.132		
	Phosphorus (P)-Total (mg/kg)	24600	27600	26700		
	Phosphorus (P)-Total (mg/kg wwt)	6570	7200	6770		
	Potassium (K)-Total (mg/kg)	9480	9440	11200		
	Potassium (K)-Total (mg/kg wwt)	2540	2460	2840		
	Rubidium (Rb)-Total (mg/kg)	12.3	13.9	14.3		
	Rubidium (Rb)-Total (mg/kg wwt)	3.29	3.63	3.62		
	Selenium (Se)-Total (mg/kg)	1.59	1.79	1.51		
	Selenium (Se)-Total (mg/kg wwt)	0.427	0.467	0.382		
	Sodium (Na)-Total (mg/kg)	3540	3890	4140		
	Sodium (Na)-Total (mg/kg wwt)	946	1010	1050		
	Strontium (Sr)-Total (mg/kg)	45.8	49.3	43.6		
	Strontium (Sr)-Total (mg/kg wwt)	12.3	12.9	11.1		
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020		
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040		
	Thallium (Tl)-Total (mg/kg)	0.0128	0.0168	0.0146		
	Thallium (Tl)-Total (mg/kg wwt)	0.00343	0.00438	0.00370		
	Tin (Sn)-Total (mg/kg)	0.19	0.76	0.17		
	Tin (Sn)-Total (mg/kg wwt)	0.051	0.199	0.042		
	Uranium (U)-Total (mg/kg)	0.0229	0.0417	0.0357		
	Uranium (U)-Total (mg/kg wwt)	0.00612	0.0109	0.00905		
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10		
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	<0.020		
	Zinc (Zn)-Total (mg/kg)	139	155	154		
	Zinc (Zn)-Total (mg/kg wwt)	37.1	40.5	39.1		
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20		
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Copper (Cu)-Total	DUP-H	L1677176-22, -49, -50, -51, -52, -53, -54, -55, -56, -57, -58, -59, -60, -61, -62, -63
Duplicate	Copper (Cu)-Total	DUP-H	L1677176-22, -49, -50, -51, -52, -53, -54, -55, -56, -57, -58, -59, -60, -61, -62, -63

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-DRY-CVAFS-N-VA	Tissue	Mercury in Tissue by CVAFS (DRY)	EPA 200.3, EPA 245.7

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.

HG-DRY-MICR-CVAF-VA	Tissue	Mercury in Tissue by CVAFS Micro (DRY)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.

HG-WET-CVAFS-N-VA	Tissue	Mercury in Tissue by CVAFS (WET)	EPA 200.3, EPA 245.7

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.

HG-WET-MICR-CVAF-VA	Tissue	Mercury in Tissue by CVAFS Micro (WET)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.

MET-DRY-CCMS-N-VA	Tissue	Metals in Tissue by CRC ICPMS (DRY)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MET-DRY-MICR-HRMS-VA	Tissue	Metals in Tissue by HR-ICPMS Micro (DRY)	EPA 200.3/200.8

Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on dry weight basis.

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MET-WET-CCMS-N-VA	Tissue	Metals in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MET-WET-MICR-HRMS-VA	Tissue	Metals in Tissue by HR-ICPMS Micro (WET)	EPA 200.3/200.8

Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals.

Reference Information

Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MOISTURE-TISS-VA Tissue % Moisture in Tissues ASTM D2974-00 Method A

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location

Chain of Custody Numbers:

1 2 3 4 5

6 7

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analyti Request Form

ALS Environmental

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L1677176-COFC

COC Number: 14 -

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Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	C. Portt and Associates	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)		R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Cam Portt	Quality Control (QC) Report with Report		P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	56 Waterloo Avenue Guelph, ON N1H 3H5	☐ Criteria on Report - provide details below if box checked Select Distribution: ☑ EMAI ☐ MAI ☐ FAX		E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:		Email 1 or Fax cportt@sentex.net		Specify Date Required for E2,E or P:
		Email 2		

Invoice To	Same as Report To	Invoice Distribution	
	Copy of Invoice with Report	Select Invoice Distribution: ☑ EMAI ☐ MAIL ☐ FAX	
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q52131	Approver ID:	Cost Center:
Job #:	Amaruq 2015	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only): L1677176 | ALS Contact: | Sampler: George Coker

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Moisture	Mercury (Wet and Dry)	Number of Containers
	Whale Tail Lake Lake Trout #46	18-Aug-15		Tissue	R	R	1
	Whale Tail Lake Lake Trout #47	18-Aug-15		Tissue	R	R	1
	Whale Tail Lake Lake Trout #48	18-Aug-15		Tissue	R	R	1
	Whale Tail Lake Lake Trout #49	18-Aug-15		Tissue	R	R	1
	Whale Tail Lake Lake Trout #50	18-Aug-15		Tissue	R	R	1
	Whale Tail Lake Lake Trout #52	18-Aug-15		Tissue	R	R	1
	Whale Tail Lake Lake Trout #53	18-Aug-15		Tissue	R	R	1
	Whale Tail Lake Lake Trout #54A	18-Aug-15		Tissue	R	R	1
	Whale Tail Lake Lake Trout #54B	18-Aug-15		Tissue	R	R	1
	Whale Tail Lake Lake Trout #56	18-Aug-15		Tissue	R	R	1
	Whale Tail Lake Lake Trout #57	18-Aug-15		Tissue	R	R	1
	Whale Tail Lake Lake Trout #58	18-Aug-15		Tissue	R	R	1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System?	Please report wet and dry weight concentrations for Hg and metals.
Are samples for human drinking water use?	

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice packs Yes ☐ No ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			-2		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: C. Portt	Date: Sept. 22/15	Time:	Received by:	Date:	Time:	Received by: DY	Date: Sep 23/15	Time: 8:45

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytic Request Form

ALS Environmental

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Canada Toll Free: 1 800 668 9878

L1677176-COFC

COC Number: 14 -

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Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	C. Portt and Associates	Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Cam Portt	Quality Control (QC) Report with Report		P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	56 Waterloo Avenue	☐ Criteria on Report - provide details below if box checked		E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
	Guelph, ON N1H 3H5	Select Distribution:	☑ EMAI ☐ MAI ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:		Email 1 or Fax	cportt@sentex.net	Specify Date Required for E2,E or P:
		Email 2		

Invoice To	Same as Report To	Invoice Distribution	
	Copy of Invoice with Report	Select Invoice Distribution:	☑ EMAI ☐ MAIL ☐ FAX
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q52131	Approver ID:	Cost Center:
Job #:	Amaruq 2015	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only)		ALS Contact:	Sampler: George Coker

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Mercury (Wet and Dry)	Metals scan (Wet and Dry)	Moisture	Number of Containers
	Whale Tail Lake Lake Trout #59	18-Aug-15		Tissue	R		R	1
	Whale Tail Lake Lake Trout #60	18-Aug-15		Tissue	R		R	1
	Whale Tail Lake Lake Trout #61	18-Aug-15		Tissue	R	R	R	2
	Whale Tail Lake Lake Trout #62	18-Aug-15		Tissue	R	R	R	2
	Whale Tail Lake Lake Trout #63	18-Aug-15		Tissue	R	R	R	2
	Whale Tail Lake Lake Trout #64	18-Aug-15		Tissue	R	R	R	2
	Whale Tail Lake Lake Trout #65	18-Aug-15		Tissue	R	R	R	2
	Whale Tail Lake Lake Trout #66	18-Aug-15		Tissue	R	R	R	2
	Whale Tail Lake Lake Trout #68	18-Aug-15		Tissue	R	R	R	2
	Whale Tail Lake Lake Trout #69	18-Aug-15		Tissue	R	R	R	2
	Whale Tail Lake Lake Trout #70	18-Aug-15		Tissue	R	R	R	2

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System?	Fish 69 is a small, whole fish. I would like to have a dorsal skinless boneless fillet analysed for both Hg and metals from this fish if possible, but if insufficient tissue Hg is the priority. Otherwise there are two samples, each in a separate bag, from fish for which metals are requested. I would like to have 10 metal analyses from Whale Tail lake trout, so if there is one sample (or two if fish 69 is too small to do metals) that is large enough for both Hg and metals to be done, please do that. Please report wet and dry weight concentrations for Hg and metals.
Are samples for human drinking water use?	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☑	SIF Observations	Yes ☐	No ☐
Ice packs	Yes ☐	No ☐	Custody seal intact	Yes ☐ No ☐
Cooling Initiated	☐			

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			-2°		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: C. Portt	Date: Sept. 22/15	Time:	Received by:	Date:	Time:	Received by: DJ	Date: Sep 23/15	Time: 8:45

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

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Canada Toll Free: 1 800 668 9878

L1677176-COFC

COC Number: 14 -

Page 3 of 7

Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	C. Portt and Associates	Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Cam Portt	Quality Control (QC) Report with Report		P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	56 Waterloo Avenue	☐ Criteria on Report - provide details below if box checked		E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
	Guelph, ON N1H 3H5	Select Distribution:	☑ EMAI ☐ MAI ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:		Email 1 or Fax	cportt@sentex.net	Specify Date Required for E2,E or P:
		Email 2		
Invoice To	Same as Report To	Invoice Distribution		
	Copy of Invoice with Report	Select Invoice Distribution:	☑ EMAI ☐ MAIL ☐ FAX	
Company:		Email 1 or Fax		
Contact:		Email 2		

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q52131	Approver ID:	Cost Center:
Job #:	Amaruq 2015	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact:	Sampler: George Coker

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Mercury (Wet and Dry)	Metals scan (Wet and Dry)	Moisture	Number of Containers
	Mammoth Lake Lake Trout #97	25-Aug-15		Tissue	R	R	R	2
	Mammoth Lake Lake Trout #98	25-Aug-15		Tissue	R	R	R	2
	Mammoth Lake Lake Trout #99	25-Aug-15		Tissue	R	R	R	2
	Mammoth Lake Lake Trout #100	26-Aug-15		Tissue	R	R	R	2
	Mammoth Lake Lake Trout #101	26-Aug-15		Tissue	R	R	R	2
	Mammoth Lake Lake Trout #102	26-Aug-15		Tissue	R	R	R	2
	Mammoth Lake Lake Trout #103	26-Aug-15		Tissue	R	R	R	2
	Mammoth Lake Lake Trout #105	26-Aug-15		Tissue	R	R	R	2
	Mammoth Lake Lake Trout #106	26-Aug-15		Tissue	R	R	R	2
	Mammoth Lake Lake Trout #108	26-Aug-15		Tissue	R	R	R	2
	Mammoth Lake Lake Trout #110	26-Aug-15		Tissue	R		R	1
	Mammoth Lake Lake Trout #111	26-Aug-15		Tissue	R		R	1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System?	There are two samples, each in a separate bag, from fish for which metals are requested. Please report wet and dry weight concentrations for Hg and metals.
Are samples for human drinking water use?	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐			SIF Observations	Yes ☐	No ☐	
Ice packs	Yes ☐	No ☐		Custody seal intact	Yes ☐	No ☐	
Cooling Initiated	☐						

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			-2		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: C. Portt	Date: Sept. 22/15	Time:	Received by:	Date:	Time:	Received by: DJ	Date: Sep 23/15	Time: 8:45

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ALS Environmental

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Chain of Custody (COC) / Analyti Request Form

Canada Toll Free: 1 800 668 9878

L1677176-COFC

COC Number: 14 -

Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	C. Portt and Associates	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)		R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Cam Portt	Quality Control (QC) Report with Report		P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	56 Waterloo Avenue	☐ Criteria on Report - provide details below if box checked		E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
	Guelph, ON N1H 3H5	Select Distribution: ☑ EMAI ☐ MAI ☐ FAX		E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:		Email 1 or Fax cportt@sentex.net		Specify Date Required for E2,E or P:
		Email 2		Analysis Request
Invoice To	Same as Report To	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
	Copy of Invoice with Report	Select Invoice Distribution: ☑ EMAI ☐ MAIL ☐ FAX		
Company:		Email 1 or Fax		
Contact:		Email 2		

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q52131	Approver ID:	Cost Center:
Job #:	Amaruq 2015	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only):

ALS Contact:

Sampler: George Coker

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Mercury (Wet and Dry)	Moisture	Number of Containers
	Mammoth Lake Lake Trout #112	26-Aug-15		Tissue	R	R	1
	Mammoth Lake Lake Trout #114	26-Aug-15		Tissue	R	R	1
	Mammoth Lake Lake Trout #115	26-Aug-15		Tissue	R	R	1
	Mammoth Lake Lake Trout #116	26-Aug-15		Tissue	R	R	1
	Mammoth Lake Lake Trout #117	26-Aug-15		Tissue	R	R	1
	Mammoth Lake Lake Trout #118	26-Aug-15		Tissue	R	R	1
	Mammoth Lake Lake Trout #119	26-Aug-15		Tissue	R	R	1
	Mammoth Lake Lake Trout #120	26-Aug-15		Tissue	R	R	1
	Mammoth Lake Lake Trout #121	26-Aug-15		Tissue	R	R	1
	Mammoth Lake Lake Trout #122	26-Aug-15		Tissue	R	R	1
	Mammoth Lake Lake Trout #123	26-Aug-15		Tissue	R	R	1
	Mammoth Lake Lake Trout #124	26-Aug-15		Tissue	R	R	1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System?	Please report wet and dry weight concentrations for Hg and metals.
Are samples for human drinking water use?	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☑ SIF Observations Yes ☐ No ☐

Ice packs Yes ☐ No ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			-2		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: C. Portt	Date: Sept. 22/15	Time:	Received by:	Date:	Time:	Received by: DJ	Date: Sept 23	Time: 8:45

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ALS FM-0223e v08 Front01 January 2014

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

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COC Number: 14 -

Report To		Report		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	C. Portt and Associates	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)		R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Cam Portt	Quality Control (QC) Report with Report		P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	56 Waterloo Avenue	☐ Criteria on Report - provide details below if box checked		E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
	Guelph, ON N1H 3H5	Select Distribution: ☑ EMAI ☐ MAI ☐ FAX		E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:		Email 1 or Fax cportt@sentex.net		Specify Date Required for E2,E or P:
		Email 2		
Invoice To	Same as Report To	**Invoice Distribution**		**Analysis Request**
	Copy of Invoice with Report	Select Invoice Distribution: ☑ EMAI ☐ MAIL ☐ FAX		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:		Email 1 or Fax		
Contact:		Email 2		
Project Information		**Oil and Gas Required Fields (client use)**		
ALS Quote #:	Q52131	Approver ID:	Cost Center:	
Job #:	Amaruq 2015	GL Account:	Routing Code:	
PO / AFE:		Activity Code:		
LSD:		Location:		
ALS Lab Work Order # (lab use only)		**ALS Contact:**	**Sampler:** George Coker	

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Mercury (Wet and Dry)	Moisture	Number of Containers
	Mammoth Lake Lake Trout #126	26-Aug-15		Tissue	R	R	1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System?	Please report wet and dry weight concentrations for Hg and metals.
Are samples for human drinking water use?	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐			SIF Observations	Yes ☐	No	☐
Ice packs	Yes ☐	No	☐	Custody seal intact	Yes ☐	No	☐
Cooling Initiated	☐						

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			-2		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: C. Portt	Date: Sept. 22/15	Time:	Received by:	Date:	Time:	Received by: DJ	Date: Sept 23/15	Time: 8:45

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ALS Canada Ltd. Form04 January 2014

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

ALS Environmental — Chain of Custody (COC) / Analytical Request Form

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Report To		Report Format / Distribution	Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	C. Portt and Associates	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Cam Portt	Quality Control (QC) Report with Report	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	56 Waterloo Avenue Guelph, ON N1H 3H5	☐ Criteria on Report - provide details below if box checked Select Distribution: ☑ EMAI ☐ MAI ☐ FAX	E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:		Email 1 or Fax cportt@sentex.net	Specify Date Required for E2,E or P:
		Email 2	

Invoice To	Same as Report To	Invoice Distribution	Analysis Request
	Copy of Invoice with Report	Select Invoice Distribution: ☑ EMAI ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q52131	Approver ID:	Cost Center:
Job #:	Amaruq 2015	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD		Location:	

ALS Lab Work Order # (lab use only)		ALS Contact:	Sampler: George Coker

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Mercury (Wet and Dry)	Metals scan (Wet and Dry)	Moisture	Number of Containers
	Whale Tail Lake Small Fish composite #1	26-Jul-15		Tissue	R	R	R	1
	Whale Tail Lake Small Fish composite #2	26-Jul-15		Tissue	R	R	R	1
	Whale Tail Lake Small Fish composite #3	26-Jul-15		Tissue	R	R	R	1
	Whale Tail Lake Small Fish composite #4	26-Jul-15		Tissue	R	R	R	1
	Whale Tail Lake Small Fish composite #5	26-Jul-15		Tissue	R	R	R	1
	Whale Tail Lake Small Fish composite #6	26-Jul-15		Tissue	R	R	R	1
	Whale Tail Lake Small Fish composite #7	26-Jul-15		Tissue	R	R	R	1
	Mammoth Lake Small Fish composite #8	30-Jul-15		Tissue	R	R	R	1
	Mammoth Lake Small Fish composite #9	29-Jul-15		Tissue	R	R	R	1
	Mammoth Lake Small Fish composite #10	29-Jul-15		Tissue	R	R	R	1
	Mammoth Lake Small Fish composite #11	29-Jul-15		Tissue	R	R	R	1
	Mammoth Lake Small Fish composite #12	29-Jul-15		Tissue	R	R	R	1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System?	Please report wet and dry weight concentrations for Hg and metals.
Are samples for human drinking water use?	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☑ SIF Observations Yes ☐ No ☐

Ice packs Yes ☐ No ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			-2°		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: C. Portt	Date: Sept. 22/15	Time:	Received by:	Date:	Time:	Received by: DJ	Date: Sept 23/15	Time: 8:45

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

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COC Number: 14 -

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Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	C. Portt and Associates	Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Cam Portt	Quality Control (QC) Report with Report		P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	56 Waterloo Avenue Guelph, ON N1H 3H5	☐ Criteria on Report - provide details below if box checked		E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
		Select Distribution:	☑ EMAI ☐ MAI ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:		Email 1 or Fax	cportt@sentex.net	Specify Date Required for E2,E or P:
		Email 2		

Invoice To	Same as Report To	Invoice Distribution		
	Copy of Invoice with Report	Select Invoice Distribution:	☑ EMAI ☐ MAIL ☐ FAX	
Company:		Email 1 or Fax		
Contact:		Email 2		

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q52131	Approver ID:	Cost Center:
Job #:	Amaruq 2015	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only)		ALS Contact:	Sampler: George Coker

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Mercury (Wet and Dry)	Metals scan (Wet and Dry)	Moisture	Number of Containers
	Mammoth Lake Small Fish composite #12	29-Jul-15		Tissue	R	R	R	1
	Mammoth Lake Small Fish composite #13	29-Jul-15		Tissue	R	R	R	1
	Mammoth Lake Small Fish composite #14	29-Jul-15		Tissue	R	R	R	1
	Mammoth Lake Small Fish composite #15	29-Jul-15		Tissue	R	R	R	1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System?	Please report wet and dry weight concentrations for Hg and metals.
Are samples for human drinking water use?	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☑			SIF Observations	Yes ☐	No ☐	
Ice packs	Yes ☐	No ☐		Custody seal intact	Yes ☐	No ☐	
Cooling Initiated	☐						

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			-2°		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: C. Portt	Date: Sept. 22/15	Time:	Received by:	Date:	Time:	Received by: DJ	Date: Sep 23/15	Time: 8:45

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

APPENDIX 6-L

Fish Capture Data

Table 6-L-1: Gill Net Sampling Locations, Effort, and Catch Data for the A and C Watersheds, 2014-2015

		Location		Effort					Number of fish captured					
Lake	Set Number	Latitude	Longitude	Set date	Set time	Lift date	Lift time	Soak Time (hrs)	LKTR	ARCH	RNWH	BURB	Total	Total CPUE (fish/hr of soak time)
Overnight sets														
A113	GN46	65.41765	-96.69008	28-Aug-15	15:14	29-Aug-15	7:50	**16.60**	**0**	**0**	**0**	**0**	**0**	**0.00**
A16 (Mammoth)	GN41b	65.40078	-96.72710	25-Aug-15	14:27	26-Aug-15	8:09	17.70	10	0	4	0	14	0.79
A16 (Mammoth)	GN42b	65.39540	-96.75257	25-Aug-15	14:45	26-Aug-15	8:50	18.08	14	0	0	0	14	0.77
A16 (Mammoth) Total								**35.78**	**24**	**0**	**4**	**0**	**28**	**0.78**
A17 (Whale Tail)	GN32	65.39406	-96.68860	17-Aug-15	16:43	18-Aug-15	8:45	16.03	15	0	1	0	16	1.00
A17 (Whale Tail)	GN33b	65.39386	-96.68837	18-Aug-15	14:39	19-Aug-15	8:43	18.07	9	0	1	0	10	0.55
A17 (Whale Tail) Total								**34.10**	**24**	**0**	**2**	**0**	**26**	**0.76**
A20	GN39b	65.37959	-96.74669	23-Aug-15	16:20	24-Aug-15	8:07	**15.78**	**11**	**0**	**5**	**0**	**16**	**1.01**
A55	GN44	65.39682	-96.67134	27-Aug-15	15:57	28-Aug-15	8:07	**16.17**	**5**	**0**	**0**	**1**	**6**	**0.37**
Short-duration sets														
A16 (Mammoth)	GN22	65.39285	-96.75083	28-Jul-15	14:15	28-Jul-15	16:11	1.93	2	0	2	0	4	2.07
A16 (Mammoth)	GN24	65.39621	-96.76510	29-Jul-15	8:40	29-Jul-15	10:38	1.97	0	0	0	0	0	0.00
A16 (Mammoth)	GN21	65.39823	-96.73536	28-Jul-15	13:47	28-Jul-15	15:46	1.98	0	0	0	0	0	0.00
A16 (Mammoth)	GN27	65.39651	-96.75364	29-Jul-15	11:08	29-Jul-15	13:08	2.00	0	0	0	0	0	0.00
A16 (Mammoth)	GN28	65.40121	-96.73205	29-Jul-15	11:36	29-Jul-15	13:36	2.00	0	0	0	0	0	0.00
A16 (Mammoth)	GN19	65.39600	-96.74585	28-Jul-15	11:50	28-Jul-15	13:51	2.02	1	0	1	0	2	0.99
A16 (Mammoth)	GN26	65.39254	-96.76053	29-Jul-15	10:30	29-Jul-15	12:33	2.05	0	0	0	0	0	0.00
A16 (Mammoth)	GN20	65.40315	-96.72691	28-Jul-15	12:19	28-Jul-15	14:26	2.12	1	0	4	0	5	2.36
A16 (Mammoth)	GN23	65.38879	-96.75394	29-Jul-15	7:59	29-Jul-15	10:13	2.23	0	0	0	0	0	0.00
A16 (Mammoth)	GN15	65.39900	-96.74417	28-Jul-15	8:24	28-Jul-15	10:39	2.25	1	0	3	0	4	1.78
A16 (Mammoth)	GN18	65.40168	-96.73563	28-Jul-15	11:10	28-Jul-15	13:30	2.33	0	0	1	0	1	0.43
A16 (Mammoth)	GN25	65.39802	-96.75543	29-Jul-15	8:49	29-Jul-15	11:10	2.35	0	0	0	0	0	0.00
A16 (Mammoth)	GN16	65.39945	-96.74851	28-Jul-15	8:39	28-Jul-15	11:15	2.60	3	0	5	0	8	3.08
A16 (Mammoth)	GN17	65.39949	-96.72354	28-Jul-15	9:23	28-Jul-15	12:02	2.65	0	0	0	0	0	0.00
A16 (Mammoth)	GN41a	65.40078	-96.72710	25-Aug-15	8:48	25-Aug-15	14:11	5.38	1	0	0	0	1	0.19
A16 (Mammoth)	GN42a	65.39540	-96.75257	25-Aug-15	9:07	25-Aug-15	14:36	5.48	3	0	0	0	3	0.55
A16 (Mammoth)	GN14-5	65.38975	-96.75090	04-Sep-14	11:03	04-Sep-14	17:35	6.53	7	0	0	0	7	1.07
A16 (Mammoth)	GN14-6	65.39028	-96.75668	04-Sep-14	11:23	04-Sep-14	18:03	6.67	6	0	0	0	6	0.90
A16 (Mammoth) Total								**54.54**	**25**	**0**	**16**	**0**	**41**	**0.75**
A17 (Whale Tail)	GN03	65.38822	-96.68872	24-Jul-15	14:10	24-Jul-15	16:05	1.92	0	0	0	0	0	0.00
A17 (Whale Tail)	GN04	65.38205	-96.68781	24-Jul-15	15:19	24-Jul-15	17:16	1.95	0	0	0	0	0	0.00
A17 (Whale Tail)	GN01	65.39982	-96.68414	24-Jul-15	9:23	24-Jul-15	11:21	1.97	0	0	0	0	0	0.00
A17 (Whale Tail)	GN10	65.40437	-96.70578	25-Jul-15	15:18	25-Jul-15	17:30	2.20	2	0	2	0	4	1.82
A17 (Whale Tail)	GN06	65.38770	-96.69577	25-Jul-15	9:56	25-Jul-15	12:12	2.27	0	0	0	0	0	0.00
A17 (Whale Tail)	GN08	65.39772	-96.69256	25-Jul-15	12:37	25-Jul-15	14:54	2.28	0	0	0	0	0	0.00

Table 6-L-1: Gill Net Sampling Locations, Effort, and Catch Data for the A and C Watersheds, 2014-2015

		Location		Effort					Number of fish captured					
Lake	Set Number	Latitude	Longitude	Set date	Set time	Lift date	Lift time	Soak Time (hrs)	LKTR	ARCH	RNWH	BURB	Total	Total CPUE (fish/hr of soak time)
A17 (Whale Tail)	GN05	65.38588	-96.69515	25-Jul-15	9:35	25-Jul-15	11:54	2.32	0	0	0	0	0	0.00
A17 (Whale Tail)	GN12	65.40109	-96.69277	26-Jul-15	7:34	26-Jul-15	9:54	2.33	0	0	0	0	0	0.00
A17 (Whale Tail)	GN13	65.40344	-96.69653	26-Jul-15	7:46	26-Jul-15	10:08	2.37	0	0	0	0	0	0.00
A17 (Whale Tail)	GN02	65.39403	-96.67802	24-Jul-15	11:53	24-Jul-15	14:16	2.38	0	1	0	0	1	0.42
A17 (Whale Tail)	GN14	65.39485	-96.68767	26-Jul-15	8:04	26-Jul-15	10:27	2.38	0	0	0	0	0	0.00
A17 (Whale Tail)	GN11	65.40824	-96.69352	25-Jul-15	15:34	25-Jul-15	18:07	2.55	0	0	0	0	0	0.00
A17 (Whale Tail)	GN07	65.39088	-96.68592	25-Jul-15	11:23	25-Jul-15	14:07	2.73	1	0	0	0	1	0.37
A17 (Whale Tail)	GN09	65.40265	-96.69938	25-Jul-15	12:48	25-Jul-15	15:38	2.83	2	0	1	0	3	1.06
A17 (Whale Tail)	GN34b	65.39179	-96.68699	19-Aug-15	13:40	19-Aug-15	16:37	2.95	0	0	0	0	0	0.00
A17 (Whale Tail)	GN34a	65.39179	-96.68699	19-Aug-15	9:16	19-Aug-15	13:23	4.12	1	0	0	0	1	0.24
A17 (Whale Tail)	GN33a	65.39386	-96.68837	18-Aug-15	9:34	18-Aug-15	14:43	5.15	0	0	0	0	0	0.00
A17 (Whale Tail)	GN14-4	65.40609	-96.69946	05-Sep-14	13:26	05-Sep-14	19:44	6.30	1	0	0	0	1	0.16
A17 (Whale Tail)	GN14-3	65.40503	-96.70189	05-Sep-14	13:39	05-Sep-14	20:00	6.35	4	1	0	0	5	0.79
A17 (Whale Tail) Total								**57.35**	**11**	**2**	**3**	**0**	**16**	**0.28**
A18	GN37	65.38381	-96.71325	22-Aug-15	12:45	22-Aug-15	15:03	**2.3**	**0**	**0**	**0**	**0**	**0**	**0.00**
A19	GN38	65.37713	-96.71333	23-Aug-15	9:36	23-Aug-15	11:30	**1.9**	**0**	**0**	**0**	**0**	**0**	**0.00**
A20	GN39a	65.37959	-96.74669	23-Aug-15	14:16	23-Aug-15	16:01	**1.75**	**0**	**0**	**1**	**0**	**1**	**0.57**
A22	GN40	65.37397	-96.75750	24-Aug-15	15:02	24-Aug-15	16:38	**1.6**	**2**	**1**	**0**	**0**	**3**	**1.88**
A45	GN45	65.38486	-96.74475	28-Aug-15	10:50	28-Aug-15	12:49	**1.98**	**0**	**0**	**0**	**0**	**0**	**0.00**
A47	GN47	65.41278	-96.69454	29-Aug-15	9:25	29-Aug-15	11:40	**2.25**	**0**	**1**	**0**	**0**	**1**	**0.44**
A49	GN48	65.41046	-96.69976	29-Aug-15	13:27	29-Aug-15	15:58	**2.52**	**0**	**0**	**0**	**0**	**0**	**0.00**
A53	GN31	65.40676	-96.66934	03-Aug-15	14:28	03-Aug-15	16:51	**2.38**	**1**	**2**	**0**	**0**	**3**	**1.26**
A62	GN43	65.39182	-96.70211	27-Aug-15	11:49	27-Aug-15	13:46	**1.95**	**3**	**0**	**0**	**0**	**3**	**1.54**
A63	GN36	65.38894	-96.71772	22-Aug-15	8:31	22-Aug-15	10:07	**1.6**	**1**	**0**	**0**	**0**	**1**	**0.63**
A65	GN35	65.37314	-96.69436	20-Aug-15	10:37	20-Aug-15	13:57	**3.33**	**2**	**0**	**2**	**0**	**4**	**1.20**
C38 (Nemo)	GN29a	65.42498	-96.69133	02-Aug-15	8:00	02-Aug-15	11:20	3.33	2	0	0	0	2	0.60
C38 (Nemo)	GN30a	65.42687	-96.70239	02-Aug-15	8:22	02-Aug-15	11:50	3.47	1	0	0	0	1	0.29
C38 (Nemo)	GN29b	65.42498	-96.69133	02-Aug-15	11:20	02-Aug-15	14:58	3.63	1	0	0	0	1	0.28
C38 (Nemo)	GN30b	65.42687	-96.70239	02-Aug-15	11:50	02-Aug-15	15:28	3.63	3	0	0	0	3	0.83
C38 (Nemo)	GN14-1	65.41695	-96.71313	06-Sep-14	11:16	06-Sep-14	17:47	6.52	4	0	0	0	4	0.61
C38 (Nemo)	GN14-2	65.42474	-96.70112	06-Sep-14	11:40	06-Sep-14	18:24	6.73	11	0	0	0	11	1.63
C38 (Nemo) Total								**27.31**	**22**	**0**	**0**	**0**	**22**	**0.81**

LKTR = Lake Trout; ARCH = Arctic Char; RNWH = Round Whitefish; BURB = Burbot; CPUE = catch-per-unit effort.

Table 6-L-2: Large Mesh Hoop Net Sampling Locations, Effort, and Catch Data for the A Watershed, 2014-2015

			Location		Effort					Number of fish captured					Total CPUE (fish/24 hrs of soak time)
Lake/ Stream	Gear Number	Direction	Latitude	Longitude	Date Set	Time Set	Date Lifted	Time Lifted	Soak Time (hrs)	LKTR	ARCH	RNWH	SLSC	Total	
A17 (Whale Tail)	SHN2	toward shore	65.40846	-96.69742	18-Aug-15	17:00	19-Aug-15	14:30	21.50	0	0	1	1	2	2.23
A17 (Whale Tail)	SHN1	toward shore	65.39792	-96.69363	18-Aug-15	16:00	19-Aug-15	14:00	22.00	0	0	1	0	1	1.09
A17 (Whale Tail) Total									**43.50**	**0**	**0**	**2**	**1**	**3**	**1.66**
A55-A17	LHN5	downstream	65.39460	-96.67748	3-Jul-15	7:55	6-Jul-15	8:30	**72.58**	**1**	**1**	**0**	**0**	**2**	**0.66**
A16-A15	LHN1	downstream	65.39267	-96.77026	19-Jun-15	14:35	20-Jun-15	14:30	23.92	0	0	0	0	0	0.00
A16-A15	LHN1	downstream	65.39267	-96.77026	20-Jun-15	14:30	21-Jun-15	12:00	21.50	0	0	0	0	0	0.00
A16-A15	LHN1	downstream	65.39267	-96.77026	21-Jun-15	12:00	27-Jun-15	13:15	145.25	0	0	0	0	0	0.00
A16-A15	LHN1	downstream	65.39267	-96.77026	27-Jun-15	13:15	28-Jun-15	15:21	26.10	0	0	0	0	0	0.00
A16-A15	LHN1	downstream	65.39267	-96.77026	28-Jun-15	15:21	3-Jul-15	15:35	120.23	0	0	0	0	0	0.00
A16-A15	LHN1	downstream	65.39267	-96.77026	3-Jul-15	15:35	4-Jul-15	9:30	17.92	0	0	0	0	0	0.00
A16-A15	LHN1	downstream	65.39267	-96.77026	21-Jun-15	12:30	27-Jun-15	13:15	144.75	0	0	0	0	0	0.00
A16-A15	LHN1	upstream	65.39267	-96.77026	27-Jun-15	13:15	28-Jun-15	15:03	25.80	0	0	0	0	0	0.00
A16-A15	LHN1	upstream	65.39267	-96.77026	28-Jun-15	15:03	3-Jul-15	15:45	120.70	0	0	0	0	0	0.00
A16-A15	LHN1	upstream	65.39267	-96.77026	3-Jul-15	15:45	4-Jul-15	9:30	17.75	0	0	0	0	0	0.00
A16-A15									**663.92**	**0**	**0**	**0**	**0**	**0**	**0.00**
A17-A16	LHN3	upstream	65.40386	-96.70953	4-Jul-15	14:30	6-Jul-15	15:00	48.50	0	0	0	0	0	0.00
A17-A16	LHN3	upstream	65.40386	-96.70953	6-Jul-15	15:00	7-Jul-15	15:30	24.50	0	0	0	0	0	0.00
A17-A16	LHN3	upstream	65.40386	-96.70953	7-Jul-15	15:30	8-Jul-15	15:20	23.83	0	0	0	0	0	0.00
A17-A16	LHN3	upstream	65.40386	-96.70953	8-Jul-15	15:20	9-Jul-15	12:10	20.83	0	0	0	0	0	0.00
A17-A16	LHN3	upstream	65.40386	-96.70953	9-Jul-15	12:10	10-Jul-15	13:45	25.58	0	0	0	0	0	0.00
A17-A16	LHN3	upstream	65.40386	-96.70953	10-Jul-15	13:45	12-Jul-15	16:17	50.53	0	0	0	0	0	0.00
A17-A16	LHN3	upstream	65.40386	-96.70953	12-Jul-15	16:17	13-Jul-15	9:15	16.97	0	0	0	0	0	0.00
A17-A16	LHN3	downstream	65.40395	-96.70976	4-Jul-15	14:30	6-Jul-15	15:00	48.50	0	0	0	0	0	0.00
A17-A16	LHN3	downstream	65.40395	-96.70976	6-Jul-15	15:00	7-Jul-15	15:30	24.50	0	0	0	0	0	0.00
A17-A16	LHN3	downstream	65.40395	-96.70976	7-Jul-15	15:30	8-Jul-15	15:20	23.83	0	0	0	0	0	0.00
A17-A16	LHN3	downstream	65.40395	-96.70976	8-Jul-15	15:20	9-Jul-15	12:10	20.83	0	0	0	0	0	0.00
A17-A16	LHN3	downstream	65.40395	-96.70976	9-Jul-15	12:10	10-Jul-15	13:45	25.58	0	0	0	0	0	0.00
A17-A16	LHN3	downstream	65.40395	-96.70976	10-Jul-15	13:45	12-Jul-15	16:17	50.53	0	0	0	0	0	0.00
A17-A16	LHN3	downstream	65.40395	-96.70976	12-Jul-15	16:17	13-Jul-15	9:15	16.97	0	0	0	0	0	0.00
A17-A16	LHN2a	downstream	65.40272	-96.71156	19-Jun-15	15:10	20-Jun-15	14:45	23.58	0	0	0	0	0	0.00
A17-A16	LHN2a	downstream	65.40272	-96.71156	20-Jun-15	14:45	21-Jun-15	13:00	22.25	0	0	0	0	0	0.00
A17-A16	LHN2a	downstream	65.40272	-96.71156	21-Jun-15	13:00	27-Jun-15	13:15	144.25	0	0	0	0	0	0.00
A17-A16	LHN2a	upstream	65.40272	-96.71156	27-Jun-15	13:15	28-Jun-15	15:21	26.10	0	0	0	0	0	0.00
A17-A16	LHN2b	upstream	65.40305	-96.71070	28-Jun-15	15:21	29-Jun-15	7:40	16.32	0	0	0	0	0	0.00

Table 6-L-2: Large Mesh Hoop Net Sampling Locations, Effort, and Catch Data for the A Watershed, 2014-2015

			Location		Effort					Number of fish captured					Total CPUE (fish/24 hrs of soak time)
Lake/ Stream	Gear Number	Direction	Latitude	Longitude	Date Set	Time Set	Date Lifted	Time Lifted	Soak Time (hrs)	LKTR	ARCH	RNWH	SLSC	Total	
A17-A16	LHN2b	upstream	65.40305	-96.71070	29-Jun-15	7:40	3-Jul-15	15:15	103.58	0	0	0	0	0	0.00
A17-A16	LHN2b	upstream	65.40305	-96.71070	3-Jul-15	15:15	6-Jul-15	14:50	71.58	0	0	0	0	0	0.00
A17-A16	LHN2b	upstream	65.40305	-96.71070	6-Jul-15	14:50	7-Jul-15	15:15	24.42	0	0	0	0	0	0.00
A17-A16	LHN2b	upstream	65.40305	-96.71070	7-Jul-15	15:15	8-Jul-15	15:15	24.00	0	0	0	0	0	0.00
A17-A16	LHN2b	upstream	65.40305	-96.71070	8-Jul-15	15:15	9-Jul-15	12:10	20.92	0	0	0	0	0	0.00
A17-A16	LHN2b	upstream	65.40305	-96.71070	9-Jul-15	12:10	10-Jul-15	14:00	25.83	0	0	0	0	0	0.00
A17-A16	LHN2b	upstream	65.40305	-96.71070	10-Jul-15	14:00	12-Jul-15	16:07	50.12	0	0	0	0	0	0.00
A17-A16	LHN2b	upstream	65.40305	-96.71070	12-Jul-15	16:07	13-Jul-15	9:30	17.38	0	0	0	0	0	0.00
A17-A16	LHN2a	downstream	65.40272	-96.71156	21-Jun-15	13:45	27-Jun-15	13:15	143.50	0	0	0	0	0	0.00
A17-A16	LHN2a	downstream	65.40272	-96.71156	27-Jun-15	13:15	28-Jun-15	15:03	25.80	0	0	0	0	0	0.00
A17-A16	LHN2b	downstream	65.40301	-96.71098	28-Jun-15	15:03	29-Jun-15	7:45	16.70	0	0	0	0	0	0.00
A17-A16	LHN2b	downstream	65.40301	-96.71098	29-Jun-15	7:45	3-Jul-15	15:17	103.53	0	0	0	0	0	0.00
A17-A16	LHN2b	downstream	65.40301	-96.71098	3-Jul-15	15:17	6-Jul-15	14:50	71.55	0	0	0	0	0	0.00
A17-A16	LHN2b	downstream	65.40301	-96.71098	6-Jul-15	14:50	7-Jul-15	15:15	24.42	0	0	0	0	0	0.00
A17-A16	LHN2b	downstream	65.40301	-96.71098	7-Jul-15	15:15	8-Jul-15	15:15	24.00	0	0	0	0	0	0.00
A17-A16	LHN2b	downstream	65.40301	-96.71098	8-Jul-15	15:15	9-Jul-15	12:10	20.92	0	0	0	0	0	0.00
A17-A16	LHN2b	downstream	65.40301	-96.71098	9-Jul-15	12:10	10-Jul-15	14:00	25.83	0	0	0	0	0	0.00
A17-A16	LHN2b	downstream	65.40301	-96.71098	10-Jul-15	14:00	12-Jul-15	16:07	50.12	0	0	0	0	0	0.00
A17-A16	LHN2b	downstream	65.40301	-96.71098	12-Jul-15	16:07	13-Jul-15	9:30	17.38	0	0	0	0	0	0.00
A17-A16									**1515.58**	**0**	**0**	**0**	**0**	**0**	**0.00**
A18-A17	LHN4	downstream	65.38469	-96.69979	26-Jun-15	10:40	29-Jun-15	9:47	71.12	0	0	0	0	0	0.00
A18-A17	LHN4	downstream	65.38469	-96.69979	29-Jun-15	9:47	4-Jul-15	15:10	125.38	0	0	0	0	0	0.00
A18-A17	LHN4	downstream	65.38469	-96.69979	4-Jul-15	15:10	5-Jul-15	15:35	24.42	0	0	0	0	0	0.00
A18-A17	LHN4	downstream	65.38469	-96.69979	5-Jul-15	15:35	8-Jul-15	14:58	71.38	0	0	0	0	0	0.00
A18-A17	LHN4	downstream	65.38469	-96.69979	8-Jul-15	14:58	9-Jul-15	14:55	23.95	0	0	0	0	0	0.00
A18-A17	LHN4	downstream	65.38469	-96.69979	9-Jul-15	14:55	13-Jul-15	11:30	92.58	0	0	0	0	0	0.00
A18-A17									**408.83**	**0**	**0**	**0**	**0**	**0**	**0.00**
A55-A17	LHN5	downstream	65.39460	-96.67748	26-Jun-15	8:40	27-Jun-15	10:30	25.83	0	0	0	0	0	0.00
A55-A17	LHN5	downstream	65.39460	-96.67748	27-Jun-15	10:30	28-Jun-15	13:45	27.25	0	0	0	0	0	0.00
A55-A17	LHN5	downstream	65.39460	-96.67748	28-Jun-15	13:45	29-Jun-15	10:45	21.00	0	0	0	0	0	0.00
A55-A17	LHN5	downstream	65.39460	-96.67748	29-Jun-15	10:45	3-Jul-15	7:55	93.17	0	0	0	0	0	0.00
A55-A17	LHN5	downstream	65.39460	-96.67748	3-Jul-15	7:55	6-Jul-15	8:30	72.50	1	1	0	0	2	0.66
A55-A17	LHN5	downstream	65.39460	-96.67748	6-Jul-15	8:30	7-Jul-15	15:50	31.33	0	0	0	0	0	0.00
A55-A17	LHN5	downstream	65.39460	-96.67748	7-Jul-15	15:50	8-Jul-15	14:50	23.00	0	0	0	0	0	0.00
A55-A17	LHN5	downstream	65.39460	-96.67748	8-Jul-15	14:50	9-Jul-15	16:15	25.42	0	0	0	0	0	0.00
A55-A17	LHN5	downstream	65.39460	-96.67748	9-Jul-15	16:15	12-Jul-15	11:34	67.32	0	0	0	0	0	0.00
A55-A17	LHN5	downstream	65.39460	-96.67748	12-Jul-15	11:34	13-Jul-15	12:40	25.10	0	0	0	0	0	0.00
Total									**411.92**	**1**	**1**	**0**	**0**	**2**	**0.12**

LKTR = Lake Trout; ARCH = Arctic Char; RNWH = Round Whitefish; SLSC = Slimy Sculpin; CPUE = catch-per-unit effort.

Table 6-L-3: Minnow Trap Sampling Locations, Effort, and Catch Data for the A Watershed, 2014-2015

		Location		Effort									Total CPUE (fish/24 hr of soak time)
Lake/Stream	Gear Number	Latitude	Longitude	Set date	Set time	Lift date	Lift time	Soak Time (hrs)	RNWH	SLSC	NNST	Total	
A16 (Mammoth)	SMT14	65.39950	-96.74833	28-Jul-15	8:42	29-Jul-15	9:00	24.30	0	0	0	0	0.00
A16 (Mammoth)	SMT15	65.39901	-96.74388	28-Jul-15	8:51	29-Jul-15	10:02	25.18	0	0	0	0	0.00
A16 (Mammoth)	SMT16	65.40174	-96.73551	28-Jul-15	9:02	29-Jul-15	9:59	24.95	0	0	0	0	0.00
A16 (Mammoth)	SMT17	65.40273	-96.72634	28-Jul-15	9:06	29-Jul-15	9:54	24.80	0	0	1	1	0.97
A16 (Mammoth)	SMT18	65.39939	-96.72314	28-Jul-15	9:15	29-Jul-15	9:51	24.60	0	0	0	0	0.00
A16 (Mammoth)	SMT19	65.39839	-96.73495	28-Jul-15	9:35	29-Jul-15	9:43	24.13	0	0	0	0	0.00
A16 (Mammoth)	SMT20	65.39612	-96.74519	28-Jul-15	9:41	29-Jul-15	9:07	23.43	0	0	0	0	0.00
A16 (Mammoth)	SMT21	65.39321	-96.75060	28-Jul-15	9:46	29-Jul-15	8:54	23.13	0	0	0	0	0.00
A16 (Mammoth)	SMT22	65.38887	-96.75350	28-Jul-15	9:51	29-Jul-15	8:03	22.20	0	0	0	0	0.00
A16 (Mammoth)	SMT23	65.39258	-96.76085	28-Jul-15	9:55	29-Jul-15	8:08	22.22	0	0	0	0	0.00
A16 (Mammoth)	SMT24	65.39651	-96.76572	28-Jul-15	15:36	29-Jul-15	8:33	16.95	0	0	0	0	0.00
A16 (Mammoth)	SMT25	65.39816	-96.75497	28-Jul-15	15:40	29-Jul-15	8:43	17.05	0	0	0	0	0.00
A16 (Mammoth) Total								**272.95**	**0**	**0**	**1**	**1**	**0.09**
A17 (Whale Tail)	SMT1	65.38568	-96.69371	25-Jul-15	10:08	26-Jul-15	9:04	22.93	0	0	0	0	0.00
A17 (Whale Tail)	SMT2	65.38537	-96.69852	25-Jul-15	10:37	26-Jul-15	9:10	22.55	0	0	0	0	0.00
A17 (Whale Tail)	SMT3	65.38664	-96.69867	25-Jul-15	10:39	26-Jul-15	9:14	22.58	0	0	0	0	0.00
A17 (Whale Tail)	SMT4	65.38865	-96.69658	25-Jul-15	10:43	26-Jul-15	10:53	24.17	0	0	0	0	0.00
A17 (Whale Tail)	SMT5	65.39934	-96.68370	25-Jul-15	10:55	26-Jul-15	11:20	24.42	0	0	0	0	0.00
A17 (Whale Tail)	SMT6	65.39464	-96.67796	25-Jul-15	11:01	26-Jul-15	11:07	24.10	0	0	0	0	0.00
A17 (Whale Tail)	SMT7	65.38815	-96.68796	25-Jul-15	11:09	26-Jul-15	10:59	23.83	0	0	0	0	0.00
A17 (Whale Tail)	SMT8	65.38229	-96.68879	25-Jul-15	11:31	26-Jul-15	8:17	20.77	0	0	0	0	0.00
A17 (Whale Tail)	SMT9	65.39169	-96.68963	25-Jul-15	17:08	26-Jul-15	10:44	17.60	0	0	0	0	0.00
A17 (Whale Tail)	SMT10	65.39785	-96.69320	25-Jul-15	17:17	26-Jul-15	11:27	18.17	0	1	0	1	1.32
A17 (Whale Tail)	SMT11	65.40177	-96.69905	25-Jul-15	17:22	26-Jul-15	11:37	18.25	0	0	0	0	0.00
A17 (Whale Tail)	SMT12	65.40439	-96.70604	25-Jul-15	17:46	26-Jul-15	11:45	17.98	0	0	0	0	0.00
A17 (Whale Tail)	SMT13	65.40833	-96.69325	25-Jul-15	18:19	26-Jul-15	11:51	17.53	0	0	0	0	0.00
A17 (Whale Tail)	SMT1	65.38568	-96.69371	26-Jul-15	9:04	27-Jul-15	10:15	25.18	0	0	0	0	0.00
A17 (Whale Tail)	SMT2	65.38537	-96.69852	26-Jul-15	9:10	27-Jul-15	10:25	25.25	0	0	0	0	0.00
A17 (Whale Tail)	SMT3	65.38664	-96.69867	26-Jul-15	9:14	27-Jul-15	10:43	25.48	0	0	0	0	0.00
A17 (Whale Tail)	SMT4	65.38865	-96.69658	26-Jul-15	10:53	27-Jul-15	10:47	23.90	0	0	0	0	0.00
A17 (Whale Tail)	SMT5	65.39934	-96.68370	26-Jul-15	11:20	27-Jul-15	9:30	22.17	0	0	0	0	0.00
A17 (Whale Tail)	SMT6	65.39464	-96.67796	26-Jul-15	11:07	27-Jul-15	9:41	22.57	0	0	0	0	0.00
A17 (Whale Tail)	SMT7	65.38815	-96.68796	26-Jul-15	10:59	27-Jul-15	9:48	22.82	0	0	0	0	0.00
A17 (Whale Tail)	SMT8	65.38229	-96.68879	26-Jul-15	8:17	27-Jul-15	9:54	25.62	0	0	0	0	0.00
A17 (Whale Tail)	SMT9	65.39169	-96.68963	26-Jul-15	10:44	27-Jul-15	10:51	24.12	0	0	0	0	0.00

Table 6-L-3: Minnow Trap Sampling Locations, Effort, and Catch Data for the A Watershed, 2014-2015

		Location		Effort									Total CPUE (fish/24 hr of soak time)
Lake/Stream	Gear Number	Latitude	Longitude	Set date	Set time	Lift date	Lift time	Soak Time (hrs)	RNWH	SLSC	NNST	Total	
A17 (Whale Tail)	SMT10	65.39785	-96.69320	26-Jul-15	11:27	27-Jul-15	10:59	23.53	0	0	0	0	0.00
A17 (Whale Tail)	SMT11	65.40177	-96.69905	26-Jul-15	11:37	27-Jul-15	11:04	23.45	0	0	0	0	0.00
A17 (Whale Tail)	SMT12	65.40439	-96.70604	26-Jul-15	11:45	27-Jul-15	11:13	23.47	0	0	0	0	0.00
A17 (Whale Tail)	SMT13	65.40833	-96.69325	26-Jul-15	11:51	27-Jul-15	11:24	23.55	0	0	0	0	0.00
A17 (Whale Tail) Total								**585.98**	**0**	**1**	**0**	**1**	**0.04**
A46-A17	MT4	65.41050	-96.69545	27-Jun-15	15:48	28-Jun-15	12:32	20.73	0	0	0	0	0.00
A46-A17	MT4	65.41050	-96.69545	28-Jun-15	12:32	29-Jun-15	11:21	22.82	0	0	0	0	0.00
A46-A17	MT4	65.41050	-96.69545	29-Jun-15	11:21	3-Jul-15	14:00	98.65	0	0	0	0	0.00
A46-A17	MT4	65.41050	-96.69545	3-Jul-15	14:00	6-Jul-15	14:35	72.58	0	0	0	0	0.00
A46-A17	MT4	65.41050	-96.69545	6-Jul-15	14:35	7-Jul-15	16:10	25.58	0	0	0	0	0.00
A46-A17	MT4	65.41050	-96.69545	7-Jul-15	16:10	8-Jul-15	15:50	23.67	0	0	0	0	0.00
A46-A17	MT4	65.41050	-96.69545	8-Jul-15	15:50	9-Jul-15	11:20	19.50	0	0	0	0	0.00
A46-A17	MT4	65.41050	-96.69545	9-Jul-15	11:20	11-Jul-15	8:30	45.17	0	2	0	2	1.06
A46-A17	MT4	65.41050	-96.69545	11-Jul-15	8:30	12-Jul-15	13:20	28.83	0	1	0	1	0.83
A46-A17	MT4	65.41050	-96.69545	12-Jul-15	13:20	13-Jul-15	8:21	19.02	0	0	0	0	0.00
A46-A17 Total								**376.55**	**0**	**3**	**0**	**3**	**0.19**
A50-A17	MT5	65.41040	-96.68982	28-Jun-15	13:25	29-Jun-15	11:30	22.08	0	0	0	0	0.00
A50-A17	MT5	65.41040	-96.68982	29-Jun-15	11:30	3-Jul-15	13:15	97.75	0	0	0	0	0.00
A50-A17	MT5	65.41040	-96.68982	3-Jul-15	13:15	6-Jul-15	14:20	73.08	0	0	0	0	0.00
A50-A17	MT5	65.41040	-96.68982	6-Jul-15	14:20	7-Jul-15	16:00	25.67	0	1	0	1	0.94
A50-A17	MT5	65.41040	-96.68982	7-Jul-15	16:00	8-Jul-15	15:50	23.83	0	0	0	0	0.00
A50-A17	MT5	65.41040	-96.68982	8-Jul-15	15:50	9-Jul-15	11:08	19.30	0	0	0	0	0.00
A50-A17	MT5	65.41040	-96.68982	9-Jul-15	11:08	11-Jul-15	8:50	45.70	0	0	0	0	0.00
A50-A17	MT5	65.41040	-96.68982	11-Jul-15	8:50	12-Jul-15	13:10	28.33	0	0	0	0	0.00
A50-A17	MT5	65.41040	-96.68982	12-Jul-15	13:10	13-Jul-15	8:10	19.00	0	0	0	0	0.00
A50-A17								**354.75**	**0**	**1**	**0**	**1**	**0.07**
A53-A17	MT3	65.40159	-96.68379	27-Jun-15	10:43	3-Jul-15	12:50	146.12	0	1	0	1	0.16
A53-A17	MT3	65.40159	-96.68379	3-Jul-15	12:50	6-Jul-15	13:50	73.00	0	1	0	1	0.33
A53-A17	MT3	65.40159	-96.68379	6-Jul-15	13:50	7-Jul-15	15:55	26.08	0	0	0	0	0.00
A53-A17	MT3	65.40159	-96.68379	7-Jul-15	15:55	8-Jul-15	11:35	19.67	0	0	0	0	0.00
A53-A17	MT3	65.40159	-96.68379	8-Jul-15	11:35	11-Jul-15	10:00	70.42	0	0	0	0	0.00
A53-A17	MT3	65.40159	-96.68379	11-Jul-15	10:00	13-Jul-15	7:30	45.50	0	0	0	0	0.00
A53-A17 Total								**380.78**	**0**	**2**	**0**	**2**	**0.13**
A55-A17	MT9	65.39460	-96.67748	3-Jul-15	12:00	7-Jul-15	15:50	99.83	0	0	0	0	0.00
A55-A17	MT9	65.39460	-96.67748	7-Jul-15	15:50	8-Jul-15	14:50	23.00	0	0	0	0	0.00

Table 6-L-3: Minnow Trap Sampling Locations, Effort, and Catch Data for the A Watershed, 2014-2015

		Location		Effort									Total CPUE (fish/24 hr of soak time)
Lake/Stream	Gear Number	Latitude	Longitude	Set date	Set time	Lift date	Lift time	Soak Time (hrs)	RNWH	SLSC	NNST	Total	
A55-A17	MT9	65.39460	-96.67748	8-Jul-15	14:50	9-Jul-15	16:15	25.42	0	0	0	0	0.00
A55-A17	MT9	65.39460	-96.67748	9-Jul-15	16:15	12-Jul-15	11:00	66.75	0	0	0	0	0.00
A55-A17	MT9	65.39460	-96.67748	12-Jul-15	11:00	13-Jul-15	12:40	25.67	0	0	0	0	0.00
A55-A17								**240.67**	**0**	**0**	**0**	**0**	**0.00**
A59-A17	MT2	65.38883	-96.68317	27-Jun-15	9:00	28-Jun-15	13:55	28.92	0	0	0	0	0.00
A59-A17	MT2	65.38883	-96.68317	28-Jun-15	13:55	3-Jul-15	9:30	115.58	0	1	0	1	0.21
A59-A17	MT2	65.38883	-96.68317	3-Jul-15	9:30	6-Jul-15	9:10	71.67	0	0	0	0	0.00
A59-A17	MT2	65.38883	-96.68317	6-Jul-15	9:10	8-Jul-15	14:35	53.42	0	0	0	0	0.00
A59-A17	MT2	65.38883	-96.68317	8-Jul-15	14:35	9-Jul-15	15:10	24.58	0	0	0	0	0.00
A59-A17	MT2	65.38883	-96.68317	9-Jul-15	15:10	12-Jul-15	10:02	66.87	0	0	0	0	0.00
A59-A17	MT2	65.38883	-96.68317	12-Jul-15	10:02	13-Jul-15	12:15	26.22	0	0	0	0	0.00
A59-A17	MT6	65.38897	-96.68355	28-Jun-15	14:00	3-Jul-15	9:20	115.33	0	0	0	0	0.00
A59-A17	MT6	65.38897	-96.68355	3-Jul-15	9:20	6-Jul-15	9:10	71.83	0	2	0	2	0.67
A59-A17	MT6	65.38897	-96.68355	6-Jul-15	9:10	7-Jul-15	15:45	30.58	0	0	0	0	0.00
A59-A17	MT6	65.38897	-96.68355	7-Jul-15	15:45	8-Jul-15	14:35	22.83	0	0	0	0	0.00
A59-A17	MT6	65.38897	-96.68355	8-Jul-15	14:35	9-Jul-15	15:10	24.58	0	0	0	0	0.00
A59-A17	MT6	65.38897	-96.68355	9-Jul-15	15:10	12-Jul-15	10:00	66.83	0	0	0	0	0.00
A59-A17	MT6	65.38897	-96.68355	12-Jul-15	10:00	13-Jul-15	12:15	26.25	0	0	0	0	0.00
A59-A17 Total								**745.50**	**0**	**3**	**0**	**3**	**0.10**
A63-A18	MT7	65.38482	-96.71270	5-Jul-15	15:12	6-Jul-15	15:50	24.63	0	0	0	0	0.00
A63-A18	MT7	65.38482	-96.71270	6-Jul-15	15:50	7-Jul-15	13:14	21.40	0	0	0	0	0.00
A63-A18	MT7	65.38482	-96.71270	7-Jul-15	13:14	8-Jul-15	15:00	25.77	0	0	0	0	0.00
A63-A18	MT7	65.38482	-96.71270	8-Jul-15	15:00	9-Jul-15	15:00	24.00	0	0	0	0	0.00
A63-A18	MT7	65.38482	-96.71270	9-Jul-15	15:00	13-Jul-15	12:00	93.00	0	0	0	0	0.00
A63-A18	MT8	65.38482	-96.71270	5-Jul-15	15:12	6-Jul-15	15:50	24.63	0	0	0	0	0.00
A63-A18	MT8	65.38482	-96.71270	6-Jul-15	15:50	7-Jul-15	13:14	21.40	1	0	0	1	1.12
A63-A18	MT8	65.38482	-96.71270	7-Jul-15	13:14	8-Jul-15	15:00	25.77	0	0	0	0	0.00
A63-A18	MT8	65.38482	-96.71270	8-Jul-15	15:00	9-Jul-15	15:00	24.00	0	0	0	0	0.00
A63-A18	MT8	65.38482	-96.71270	9-Jul-15	15:00	13-Jul-15	12:00	93.00	0	0	0	0	0.00
A63-A18 Total								**377.60**	**1**	**0**	**0**	**1**	**0.06**
AP23-A17	MT1	65.37863	-96.68625	26-Jun-15	13:54	3-Jul-15	10:40	**164.77**	**0**	**0**	**0**	**0**	**0.00**

RNWH = Round Whitefish; BURB = Burbot; SLSC = Slimy Sculpin; NNST = Ninespine Stickleback; CPUE = catch-per-unit effort.

Table 6-L-4: Backpack Electrofishing Sampling Locations, Effort, and Catch Data for the A and C Watersheds, 2014-2015

		Location		Effort			Number of fish captured								
Lake/Stream	Gear Number	Latitude	Longitude	Date	Distance (m)	Time (secs)	LKTR	ARCH	RNWH	BURB	SLSC	NNST	Unidentified Salmonid	Total	Total CPUE (fish/100 secs)
A113	EF-L27	65.41718	-96.69026	1-Aug-15	31	68	0	0	0	0	0	1	0	1	1.47
A113	EF-L47	65.41841	-96.69172	28-Aug-15	33	184	0	0	0	0	0	15	0	15	8.15
A113 Total						**252**	**0**	**0**	**0**	**0**	**0**	**16**	**0**	**16**	**6.35**
A16 (Mammoth)	EF-L11	65.40020	-96.74284	29-Jul-15	25	464	0	0	0	0	1	4	0	5	1.08
A16 (Mammoth)	EF-L12	65.40103	-96.73956	29-Jul-15	25	357	0	0	0	0	0	1	0	1	0.28
A16 (Mammoth)	EF-L13	65.40201	-96.72580	29-Jul-15	25	441	0	0	0	0	1	15	0	16	3.63
A16 (Mammoth)	EF-L14	65.40258	-96.72582	29-Jul-15	25	445	0	0	0	0	0	14	0	14	3.15
A16 (Mammoth)	EF-L15	65.40146	-96.72185	30-Jul-15	25	448	0	0	0	0	4	1	0	5	1.12
A16 (Mammoth)	EF-L16	65.40145	-96.72116	30-Jul-15	25	417	0	0	0	0	2	2	0	4	0.96
A16 (Mammoth)	EF-L17	65.39995	-96.72121	30-Jul-15	25	344	0	0	0	0	0	2	0	2	0.58
A16 (Mammoth)	EF-L18	65.39971	-96.72167	30-Jul-15	25	219	0	0	0	0	2	1	0	3	1.37
A16 (Mammoth)	EF-L19	65.38935	-96.76024	30-Jul-15	25	455	0	0	0	0	2	0	1	3	0.66
A16 (Mammoth)	EF-L20	65.39511	-96.76514	30-Jul-15	25	332	0	0	0	0	1	1	0	2	0.60
A16 (Mammoth) Total						**3922**	**0**	**0**	**0**	**0**	**13**	**41**	**1**	**55**	**1.40**
A17 (Whale Tail)	EF-L1	65.40831	-96.69316	26-Jul-15	25	195	0	0	0	0	0	0	0	0	0.00
A17 (Whale Tail)	EF-L2	65.40402	-96.70651	26-Jul-15	25	458	0	0	0	0	1	11	0	12	2.62
A17 (Whale Tail)	EF-L3	65.40252	-96.70043	26-Jul-15	25	616	0	0	0	0	1	12	0	13	2.11
A17 (Whale Tail)	EF-L4	65.39759	-96.69316	26-Jul-15	25	264	0	2	0	0	2	0	2	6	2.27
A17 (Whale Tail)	EF-L5	65.38858	-96.68595	26-Jul-15	25	248	0	0	0	0	4	3	0	7	2.82
A17 (Whale Tail)	EF-L6	65.39335	-96.67734	26-Jul-15	25	755	0	0	0	0	6	15	0	21	2.78
A17 (Whale Tail)	EF-L7	65.40298	-96.69203	27-Jul-15	25	287	0	0	0	0	0	11	0	11	3.83
A17 (Whale Tail)	EF-L8	65.40104	-96.68359	27-Jul-15	25	180	0	0	0	0	0	1	0	1	0.56
A17 (Whale Tail)	EF-L9	65.38207	-96.68842	27-Jul-15	25	170	0	0	0	0	0	0	0	0	0.00
A17 (Whale Tail)	EF-L10	65.38511	-96.69830	27-Jul-15	25	230	0	0	0	0	0	2	0	2	0.87
A17 (Whale Tail) Total						**3403**	**0**	**2**	**0**	**0**	**14**	**55**	**2**	**73**	**2.15**
A18	EF-L41	65.38234	-96.70594	22-Aug-15	54	**483**	**0**	**0**	**0**	**0**	**3**	**16**	**0**	**19**	**3.93**
A19	EF-L42	65.37719	-96.71714	23-Aug-15	49	**437**	**0**	**0**	**0**	**0**	**1**	**7**	**0**	**8**	**1.83**
A20	EF-L44	65.38093	-96.75227	24-Aug-15	43	**324**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.00**
A22	EF-L45	65.37454	-96.75913	24-Aug-15	45	**409**	**0**	**0**	**0**	**0**	**10**	**1**	**0**	**11**	**2.69**
A45	EF-L43	65.38359	-96.74858	24-Aug-15	47	**239**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**3**	**1.26**
A47	EF-L48	65.41528	-96.69323	28-Aug-15	51	**244**	**0**	**0**	**0**	**0**	**0**	**100[a]**	**0**	**0**	**0.00**
A49	EF-L36	65.41248	-96.70463	1-Aug-15	93	580	0	0	0	0	0	0	0	0	0.00
A49	EF-L49	65.41202	-96.70160	29-Aug-15	66	313	0	0	0	0	3	0	0	3	0.96

Table 6-L-4: Backpack Electrofishing Sampling Locations, Effort, and Catch Data for the A and C Watersheds, 2014-2015

		Location		Effort			Number of fish captured								
Lake/Stream	Gear Number	Latitude	Longitude	Date	Distance (m)	Time (secs)	LKTR	ARCH	RNWH	BURB	SLSC	NNST	Unidentified Salmonid	Total	Total CPUE (fish/100 secs)
A49 Total						**893**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**3**	**0.34**
A50	EF-L26	65.41162	-96.68165	1-Aug-15	54	**284**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.00**
A51	EF-L25	65.40989	-96.67845	1-Aug-15	44	**200**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.00**
A52	EF-L24	65.40931	-96.67489	1-Aug-15	34	**360**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.00**
A53	EF-L21	65.40591	-96.66689	1-Aug-15	150	930	0	0	0	0	0	0	0	0	0.00
A53	EF-L38	65.40606	-96.67667	20-Aug-15	69	404	0	0	0	0	0	2	0	2	0.50
A53 Total						**1334**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**0.15**
A54	EF-L22	65.40951	-96.65991	1-Aug-15	40	**301**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.00**
A55	EF-L46	65.39566	-96.66746	28-Aug-15	111	**417**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**2**	**0.48**
A63	EF-L40	65.38896	-96.71582	22-Aug-15	51	**332**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**3**	**0.90**
A65	EF-L39	65.37173	-96.69556	21-Aug-15	36	**342**	**0**	**0**	**0**	**0**	**6**	**3**	**0**	**9**	**2.63**
A-P5	EF-L37	65.40841	-96.68872	1-Aug-15	88	**668**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.00**
A-P18	EF-L29	65.41710	-96.69515	1-Aug-15	33	**130**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.00**
A-P21	EF-L23	65.41220	-96.67169	1-Aug-15	25	**372**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.00**
A-P33	EF-L32	65.41496	-96.69918	1-Aug-15	30	**170**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.00**
A-P37	EF-L33	65.41485	-96.70046	1-Aug-15	21	**155**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.00**
A-P38	EF-L28	65.41575	-96.69486	1-Aug-15	55	**306**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0.33**
A-P49	EF-L35	65.41364	-96.70134	1-Aug-15	20	**126**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.00**
A-P51	EF-L31	65.41558	-96.70035	1-Aug-15	20	**98**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.00**
C40	EF-L34	65.41499	-96.70201	1-Aug-15	45	**181**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.00**
C42	EF-L30	65.41696	-96.69990	1-Aug-15	40	**207**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.00**
A0-A48	EF-S1	65.41577	-96.68693	1-Aug-15	10	**196**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**1.02**
A113-A47	EF-S2	65.41718	-96.69026	1-Aug-15	10	**68**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**1.47**
A16-A15	EF-S3	65.39261	-96.77003	25-Aug-15	43	**690**	**1**	**0**	**0**	**0**	**5**	**2**	**0**	**8**	**1.16**
A17-A16	EF-S4	65.40099	-96.72001	25-Aug-15	240	**950**	**1**	**0**	**0**	**0**	**4**	**0**	**0**	**5**	**0.53**
A18-A17	EF-S32	65.38437	-96.70023	26-Jun-15	100	878	0	0	0	0	1	0	0	1	0.11
A18-A17	EF-S5	65.38329	-96.70337	5-Jul-15	112	1648	0	0	0	0	5	0	0	5	0.30
A18-A17	EF-S6	65.38432	-96.70096	30-Aug-15	30	210	1	0	0	0	0	6	0	7	3.33
A18-A17 Total						**2736**	**1**	**0**	**0**	**0**	**6**	**6**	**0**	**13**	**0.48**
A19-A18	EF-S7	65.37863	-96.71485	9-Jul-15	32	**423**	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0.00**
A46-A17	EF-S8	65.41050	-96.69545	28-Jun-15	201	579	0	1	0	0	8	11	0	20	3.45
A46-A17	EF-S9	65.41050	-96.69545	9-Jul-15	16	393	0	1	0	0	8	153	0	162	41.22
A46-A17	EF-S10	65.41063	-96.69544	9-Jul-15	132	532	0	0	0	0	0	0	0	0	0.00

Table 6-L-4: Backpack Electrofishing Sampling Locations, Effort, and Catch Data for the A and C Watersheds, 2014-2015

		Location		Effort			Number of fish captured								
Lake/Stream	Gear Number	Latitude	Longitude	Date	Distance (m)	Time (secs)	LKTR	ARCH	RNWH	BURB	SLSC	NNST	Unidentified Salmonid	Total	Total CPUE (fish/100 secs)
A46-A17	EF-S11	65.41050	-96.69545	12-Jul-15	<10	85	0	0	0	0	0	100	0	100	117.65
A46-A17	EF-S12	65.41048	-96.69546	30-Aug-15	36	470	0	0	0	0	0	0	0	0	0.00
A46-A17 Total						**2059**	**0**	**2**	**0**	**0**	**16**	**264**	**0**	**282**	**13.70**
A47-A46	EF-S13	65.41252	-96.69332	9-Jul-15	17	**136**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0.74**
A50-A17	EF-S14	65.41017	-96.69053	28-Jun-15	51	265	0	0	0	0	0	5	0	5	1.89
A50-A17	EF-S15	65.41017	-96.69053	9-Jul-15	163	1204	1	2	0	0	9	56	0	68	5.65
A50-A17	EF-S16	65.41016	-96.69057	30-Aug-15	52	180	0	1	0	1	0	2	0	4	2.22
A50-A17 Total						**1649**	**1**	**3**	**0**	**1**	**9**	**63**	**0**	**77**	**4.67**
A53-A17	EF-S17	65.40145	-96.68369	20-Jun-15	571	1664	0	0	0	0		7	0	7	0.42
A53-A17	EF-S18	65.40145	-96.68369	8-Jul-15	182	2142	0	5	0	0	77	78	0	160	7.47
A53-A17	EF-S19	65.40143	-96.68370	30-Aug-15	359	518	4	0	0	0	26	0	0	30	5.79
A53-A17 Total						**4324**	**4**	**5**	**0**	**0**	**103**	**85**	**0**	**197**	**4.56**
A55-A17	EF-S20	65.39460	-96.67748	21-Jun-15	166	996	0	0	0	0	0	6	0	6	0.60
A55-A17	EF-S21	65.39460	-96.67748	6-Jul-15	167	3330	0	1	0	0	50	20	1	72	2.16
A55-A17	EF-S22	65.39472	-96.67724	30-Aug-15	46	483	0	0	1	0	1	17	0	19	3.93
A55-A17 Total						**4809**	**0**	**1**	**1**	**0**	**51**	**43**	**1**	**97**	**2.02**
A56-A55	EF-S23	65.39786	-96.66632	8-Jul-15	60	**634**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.00**
A59-A17	EF-S24	65.38883	-96.68347	27-Jun-15	126	730	0	1	0	0	6	0	0	7	0.96
A59-A17	EF-S25	65.38883	-96.68317	9-Jul-15	97	1444	0	0	0	0	21	2	0	23	1.59
A59-A17	EF-S26	65.38882	-96.68321	30-Aug-15	181	535	0	1	0	0	7	0	0	8	1.50
A59-A17 Total						**2709**	**0**	**2**	**0**	**0**	**34**	**2**	**0**	**38**	**1.40**
A62-A17	EF-S27	65.38836	-96.69997	7-Jul-15	107	1025	0	0	0	0	0	1	0	1	0.10
A63-A18	EF-S28	65.38482	-96.71270	5-Jul-15	81	848	0	0	0	0	3	0	0	3	0.35
A63-A18	EF-S29	65.38482	-96.71270	7-Jul-15	81	793	0	0	0	0	3	0	0	3	0.38
A63-A18 Total						**1641**	**0**	**0**	**0**	**0**	**6**	**0**	**0**	**6**	**0.37**
A-P21-A52	EF-S30	65.41058	-96.67517	1-Aug-15	5	**78**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.00**
A-P23-A17	EF-S31	65.37859	-96.68645	26-Jun-15	95	**582**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**2**	**0.34**

LKTR = Lake Trout; ARCH = Arctic Char; RNWH = Round Whitefish; BURB = Burbot; SLSC = Slimy Sculpin; NNST = Ninespine Stickleback; CPUE = catch-per-unit effort.

(a) In Lake A47, greater than 100 Ninespine Stickleback were captured. However, field enumeration ceased at 100 individuals. For the purpose of this species summary, only 100 individuals were used in species composition calculations.

APPENDIX 6-M

2015 Baseline Bathymetry

June 2016
Report No. 1541520

AGNICO EAGLE

Golder Associates

6.M-1 BACKGROUND

Bathymetric data at the Whale Tail Pit and Haul Road Project (the Project) were collected in 2015; however, elevation-area-volume relationships were not reported in 2015. This appendix presents the results of the bathymetry analysis of 19 lakes (Lake A16, A17, A18, A19, A20, A22, A43, A44, A45, A47, A49, A53, A55, A56, A60, A62, A63, A65 and C38) at the Project.

6.M-2 METHODS

The following data sets were used to calculate the surface area-volume and elevation-volume curves at each lake:

- Project digital elevation surface satellite imagery from PhotoSat (PhotoSat 2015) in raster format;
- Project lake boundaries from PhotoSat (PhotoSat 2015) in vector format, captured under low water level conditions in August 2015;
- Project lake bathymetric contour lines (Agnico Eagle 2015) in vector format; and
- Project contour elevation lines from PhotoSat (PhotoSat 2015) in vector format.

At each lake with available bathymetric data, a database was built with the following layers: Project contour elevation lines, bathymetric contour lines, and lake boundaries. A shoreline layer was created by estimating the lake water surface elevation representative for high water levels for the bathymetry calculation using the satellite imagery and the contour line layer. This approach was selected to compensate for the fact that the bathymetry data were collected in August during the typical low water levels for the open water season.

Using the data sets created for each lake, a bathymetric surface was interpolated using the 3-D Surface-Volume analysis tool in ESRI's ArcGIS software. This tool calculates the lake surface area and volume at a specified elevation. At each lake, a 0.2 m interval was selected, that extended from the minimum lake elevation (maximum lake depth) to the lake water surface elevation (lake shoreline), for which lake surfaces and volumes were reported.

6.M-3 RESULTS

The results of the elevation-area-volume curve calculations are summarized in Table 6-M-1. The elevation-area and elevation-volume curves are presented in Figure 6-M-1 to Figure 6-M-38.

The bathymetric maps and the elevation-stage-volume curves are presented in Attachment A.

Table 6-M-1: Project Lake Bathymetry, 2015

Lake Name	Volume (m^3)	Representative Lake Water Surface Elevation (masl, geodetic)	Surface Area at Representative Lake Water Surface Elevation (km^2)	Mean Lake Depth (m)	Maximum Lake Depth (m)
Lake A16 (Mammoth Lake)	6,290,000	152.8	1.597	3.9	17.2
Lake A17 (Whale Tail Lake)	8,510,000	153.0	1.669	5.1	18.3
Lake A18	179,000	154.2	0.190	0.9	2.2
Lake A19	61,700	154.9	0.065	1.0	2.9
Lake A20	2,890,000	154.9	0.562	5.1	25.0
Lake A22	225,000	155.0	0.052	4.3	9.0
Lake A43	260,000	155.5	0.170	1.5	6.6
Lake A44	884,000	156.2	0.223	4.0	12.3
Lake A45	49,100	156.5	0.030	1.6	4.0
Lake A47	50,200	155.2	0.047	1.1	3.4
Lake A49	87,800	159.1	0.030	2.9	7.3
Lake A53	140,000	161.7	0.100	1.3	3.8
Lake A55	82,700	155.3	0.080	1.0	1.8
Lake A56	726,000	159.7	0.242	3.0	8.0
Lake A60	1,110,000	170.0	0.334	3.3	12.2
Lake A62	72,000	155.6	0.058	1.3	5.1
Lake A63	191,000	154.7	0.084	2.3	5.7
Lake A65	1,400,000	154.9	0.630	2.2	11.2
Lake C38 (Nemo Lake)	8,360,000	156.1	1.255	6.7	23.2

m^3 = cubic metres; masl = metres above sea level; km^2 = square kilometers; m = metre.

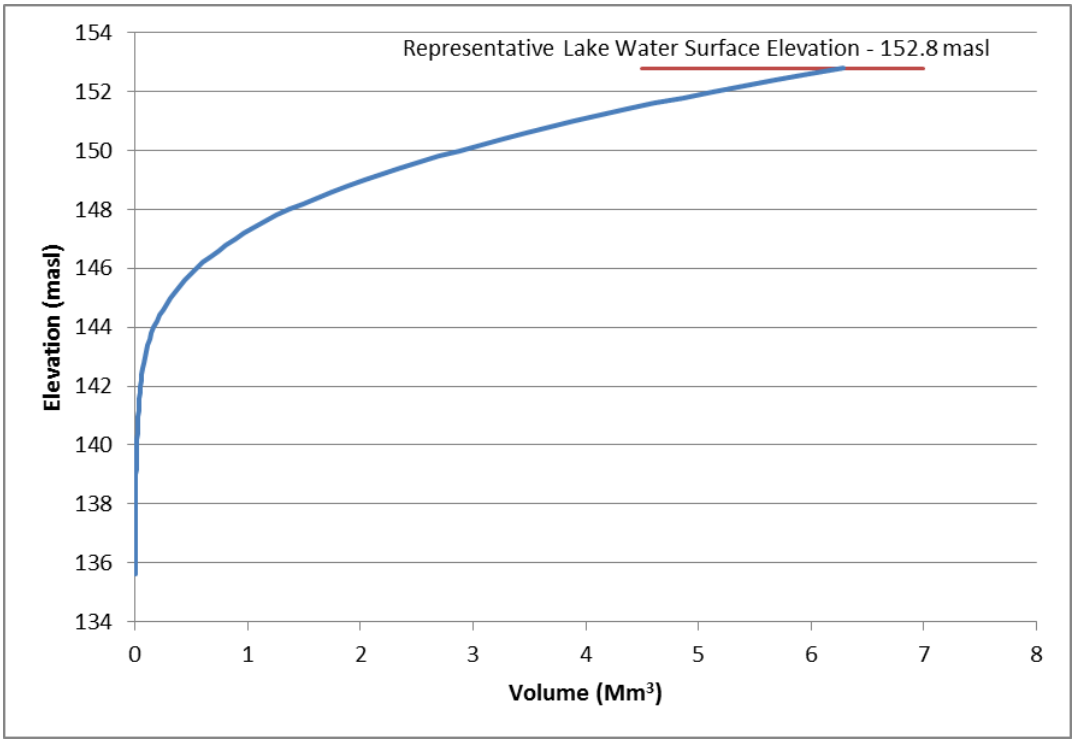


Figure 6-M-1: Lake A16 (Mammoth Lake), Elevation-Volume Curve

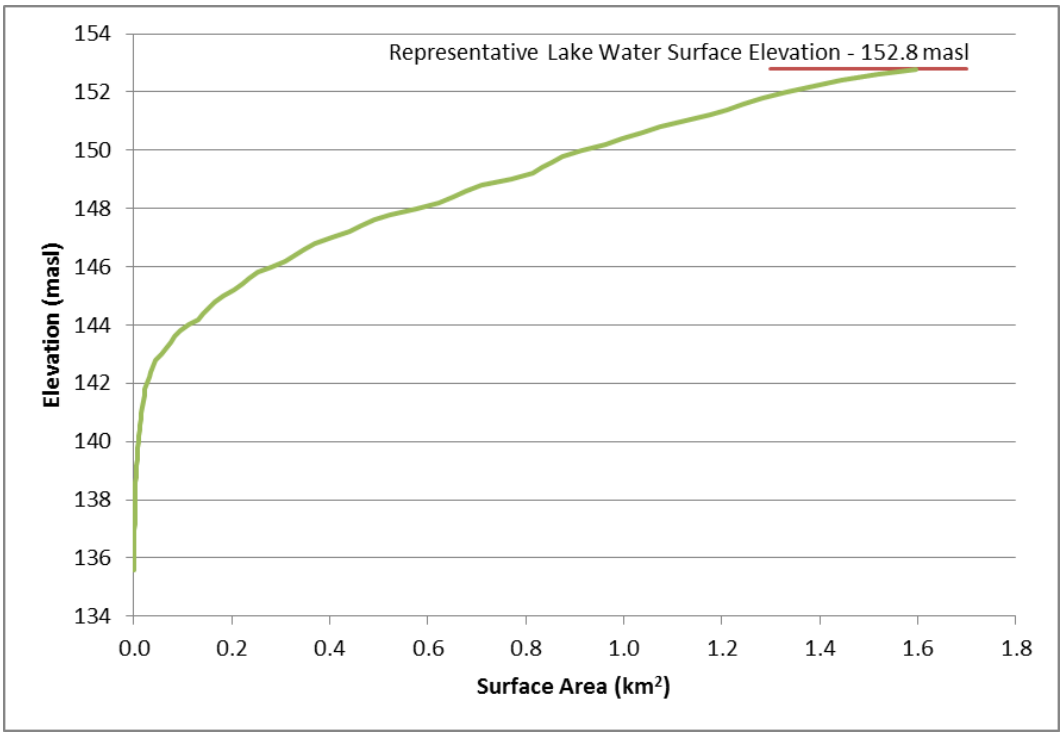


Figure 6-M-2: Lake A16 (Mammoth Lake), Elevation-Area Curve

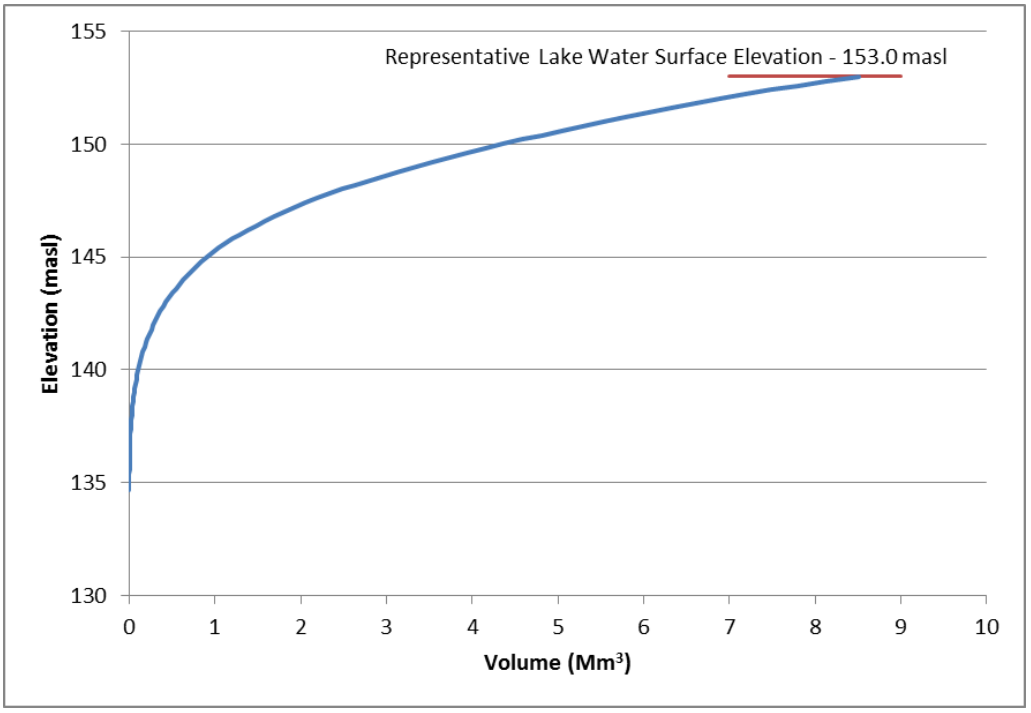


Figure 6-M-3: Lake A17 (Whale Tail Lake), Elevation-Volume Curve

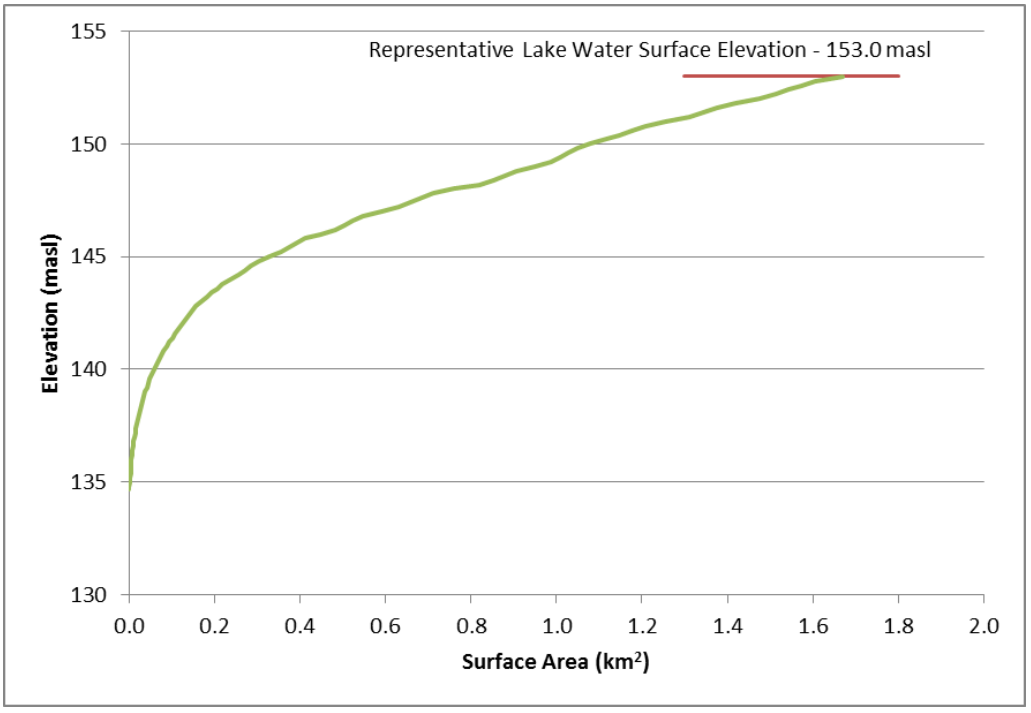


Figure 6-M-4: Lake A17 (Whale Tail Lake), Elevation-Area Curve

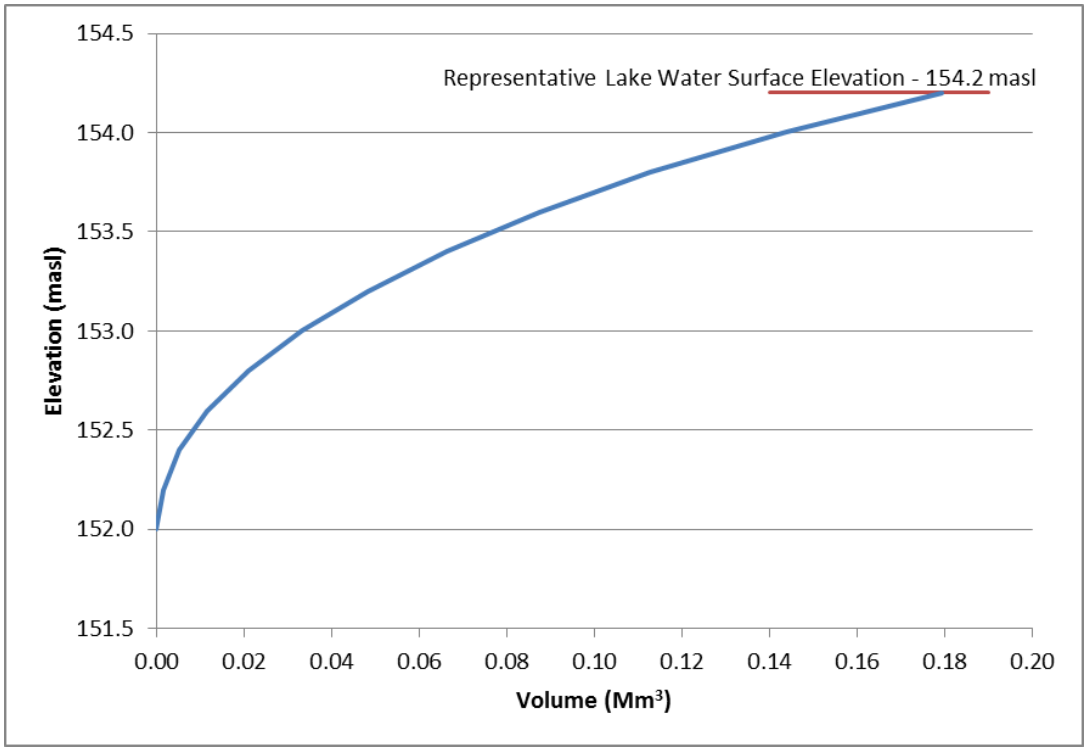


Figure 6-M-5: Lake A18, Elevation-Volume Curve

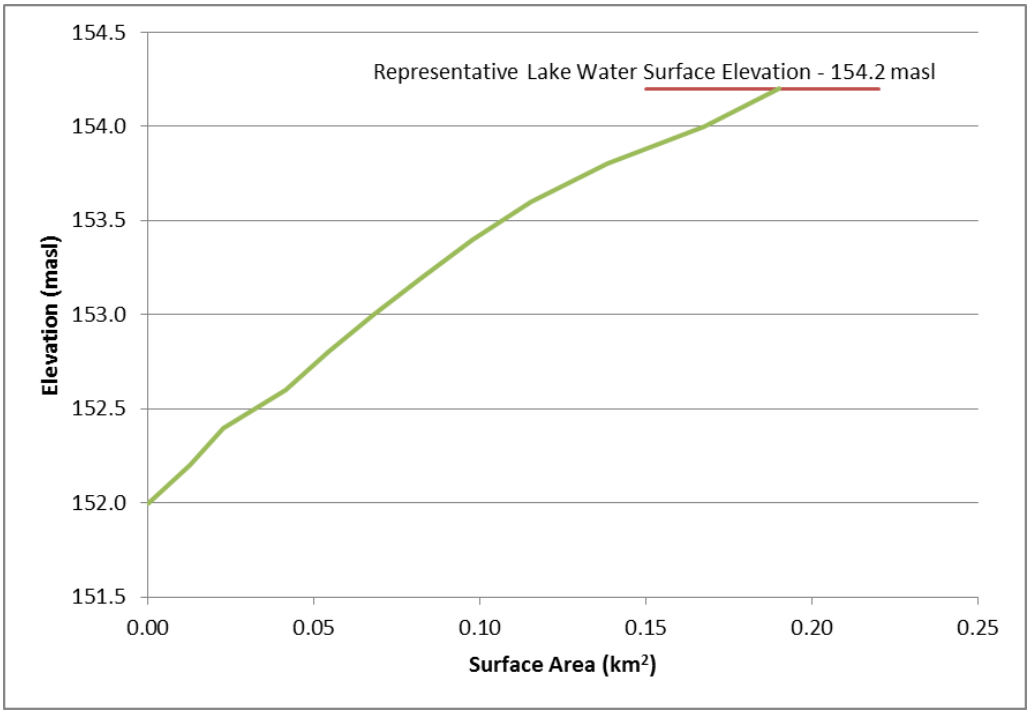


Figure 6-M-6: Lake A18, Elevation-Area Curve

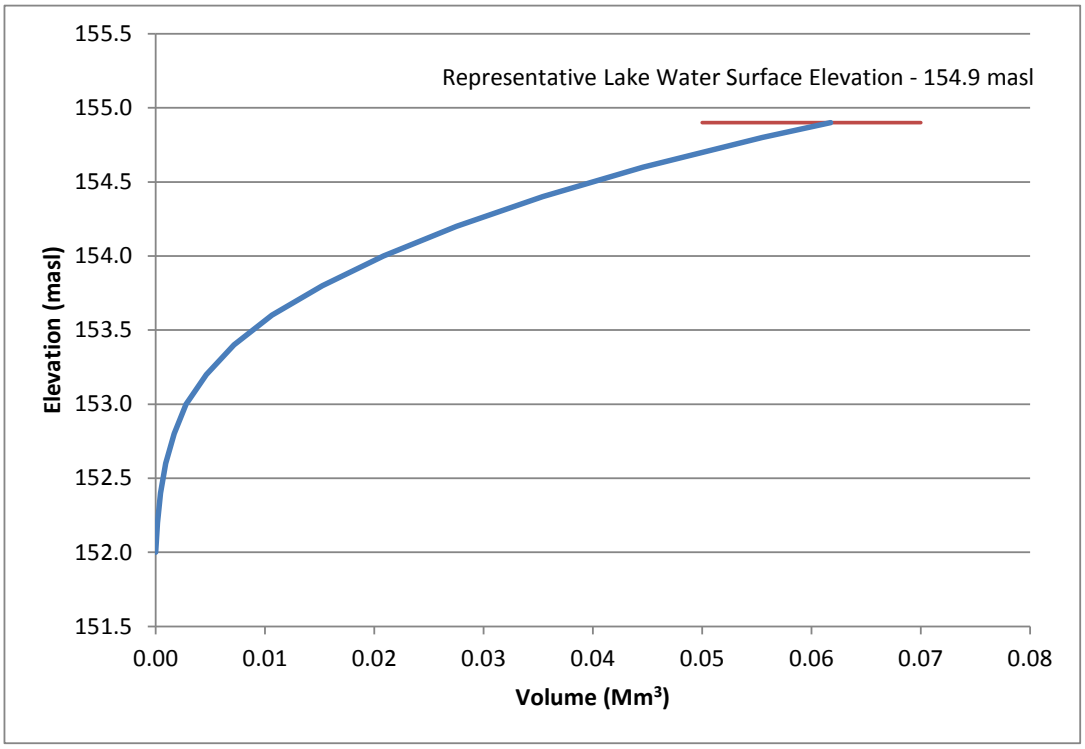


Figure 6-M-7: Lake A19, Elevation-Volume Curve

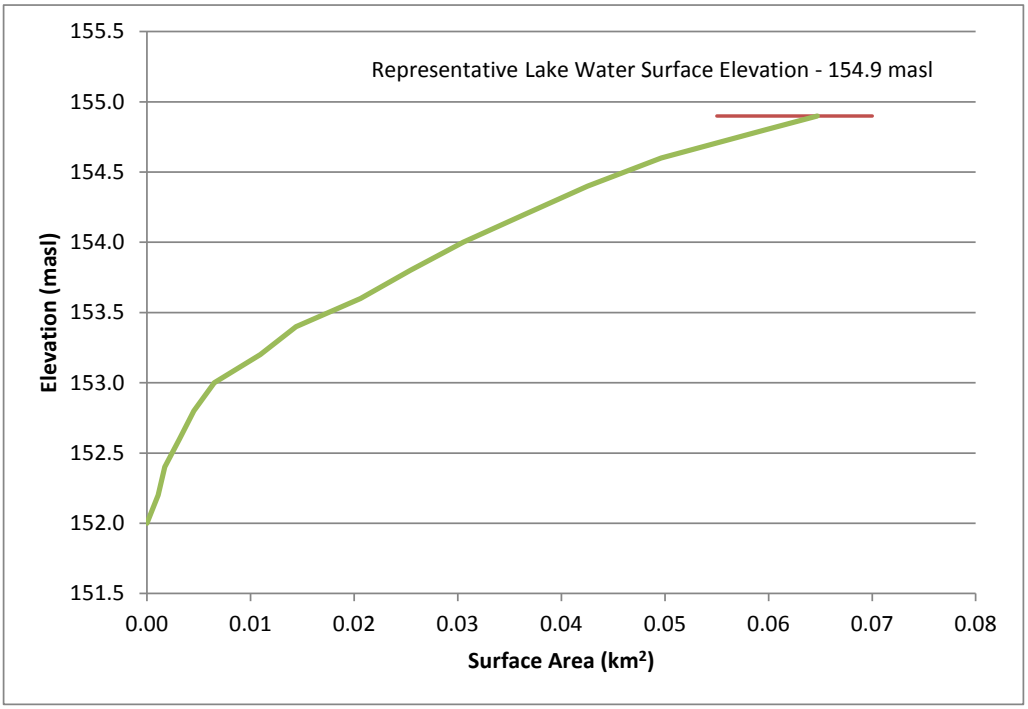


Figure 6-M-8: Lake A19, Elevation-Area Curve

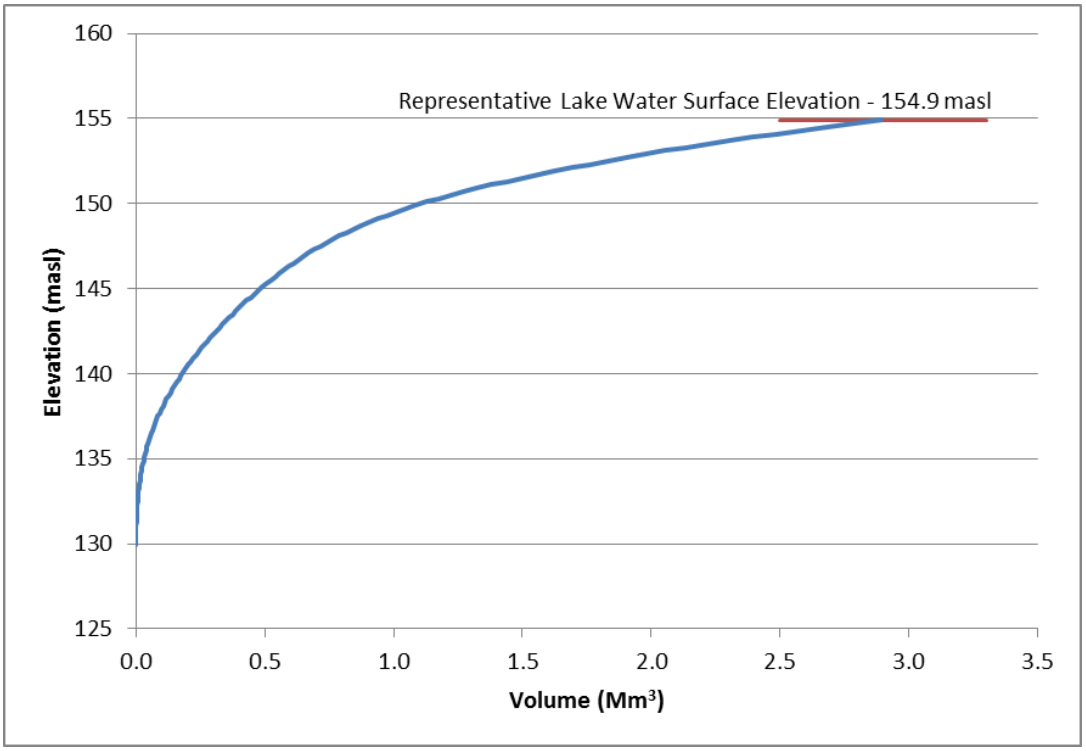


Figure 6-M-9: Lake A20, Elevation-Volume Curve

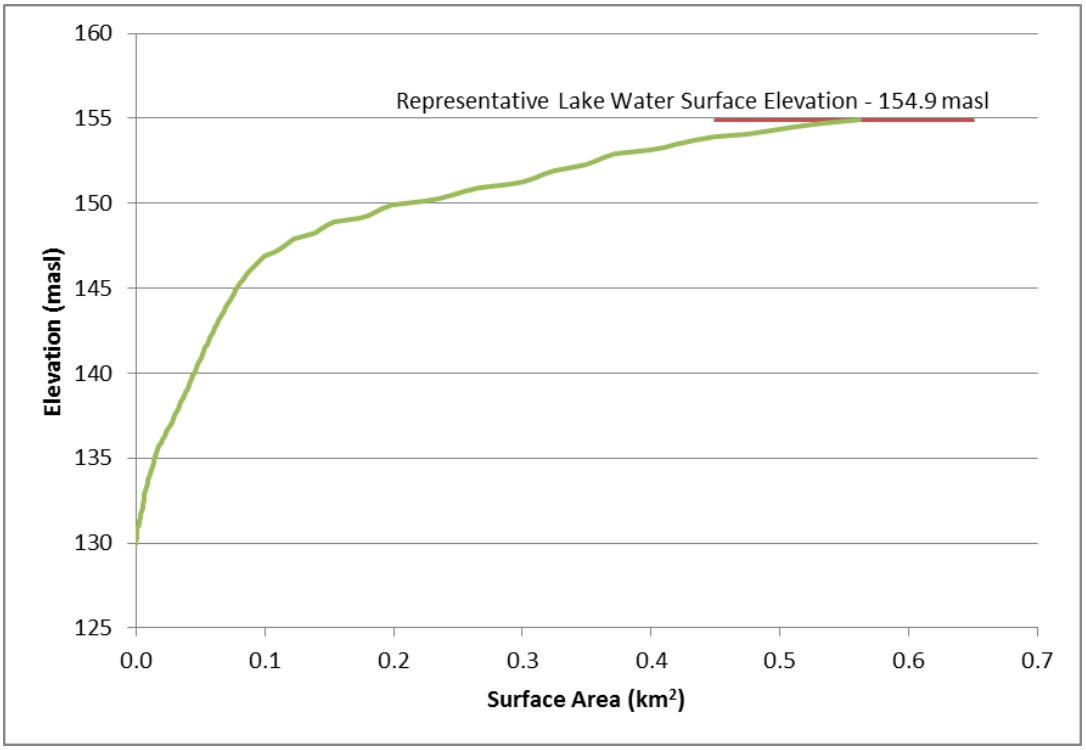


Figure 6-M-10: Lake A20, Elevation-Area Curve

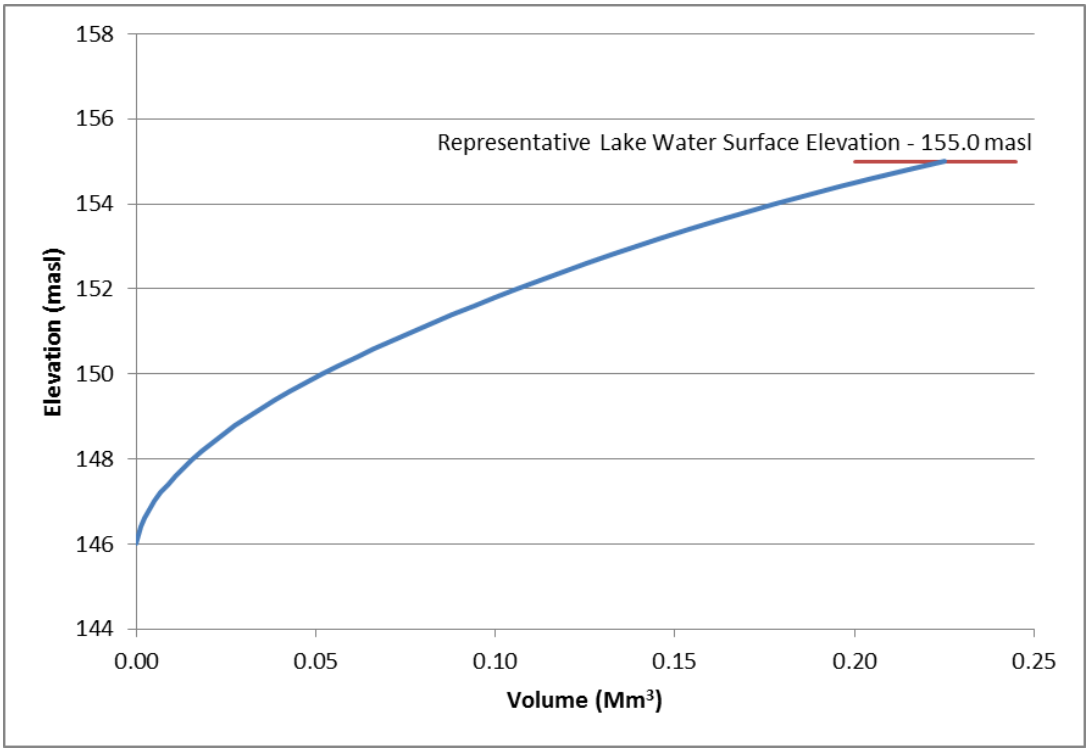


Figure 6-M-11: Lake A22, Elevation-Volume Curve

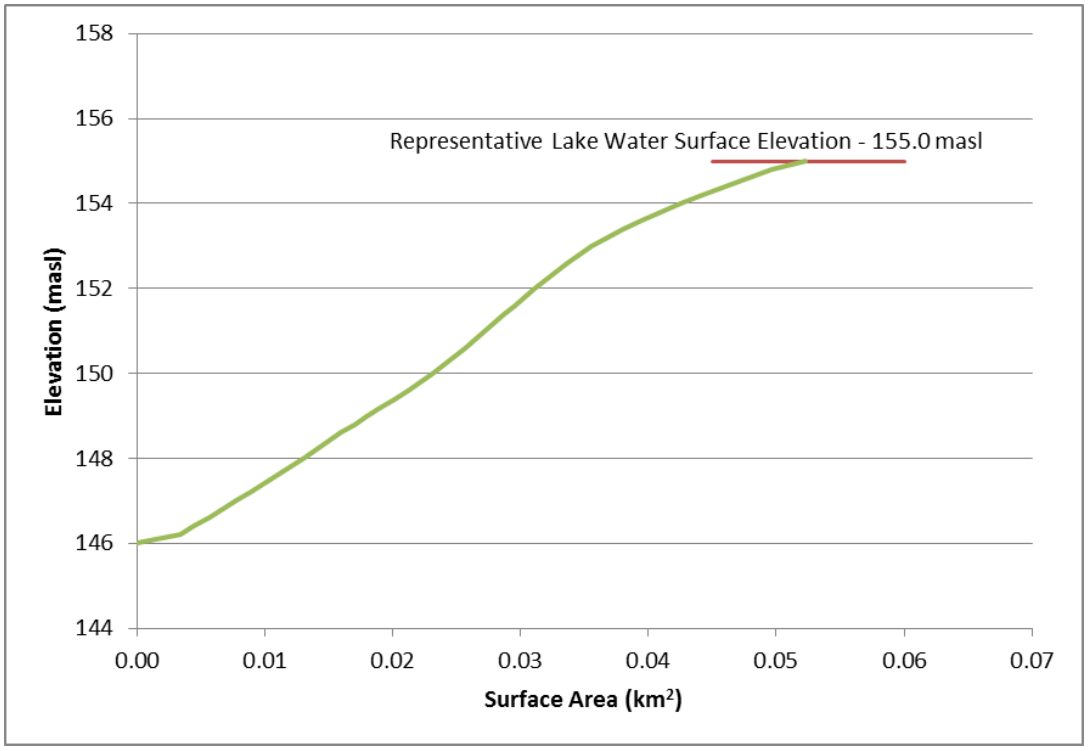


Figure 6-M-12: Lake A22, Elevation-Area Curve

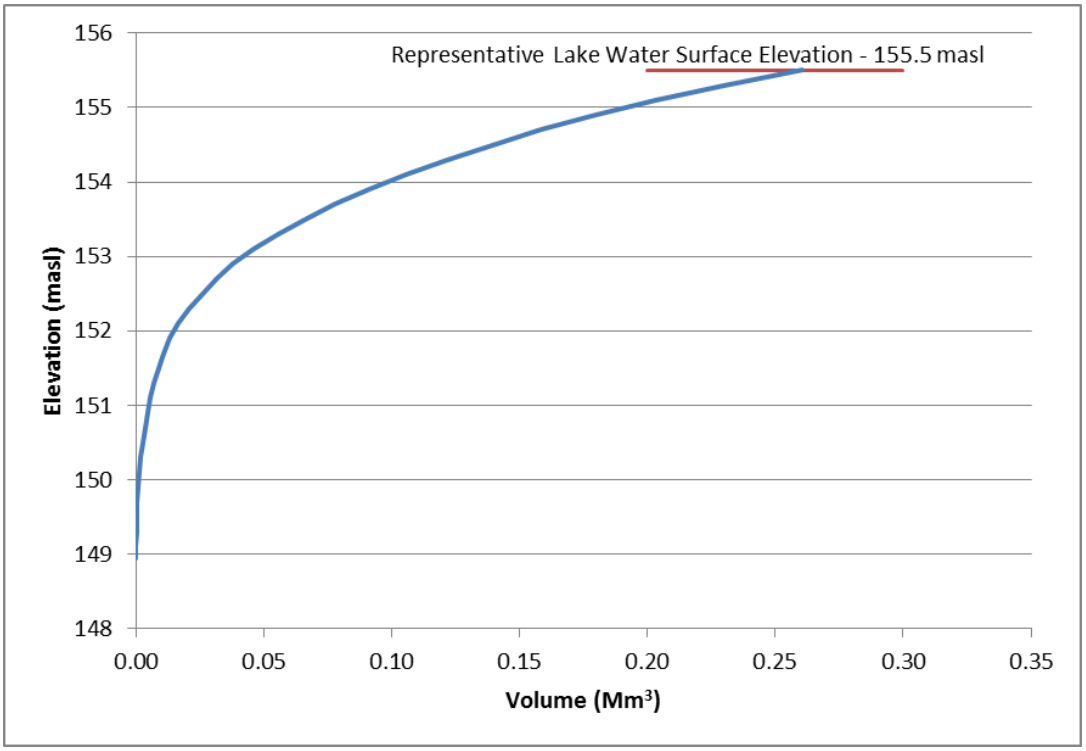


Figure 6-M-13: Lake A43, Elevation-Volume Curve

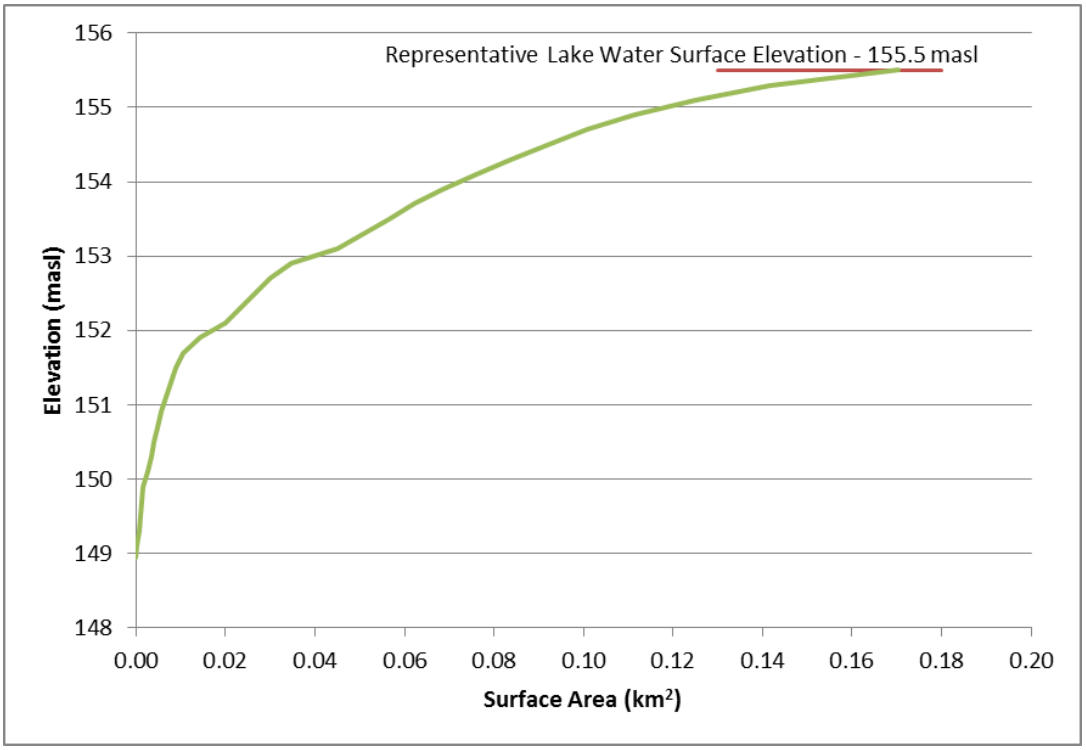


Figure 6-M-14: Lake A43, Elevation-Area Curve

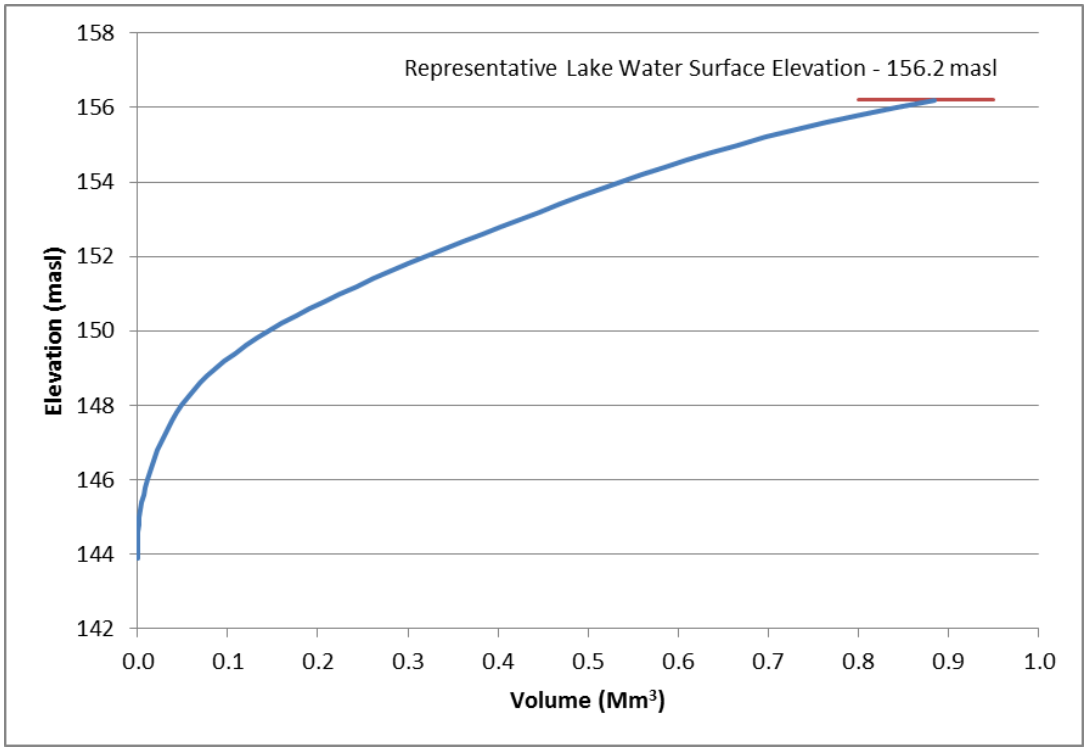


Figure 6-M-15: Lake A44, Elevation-Volume Curve

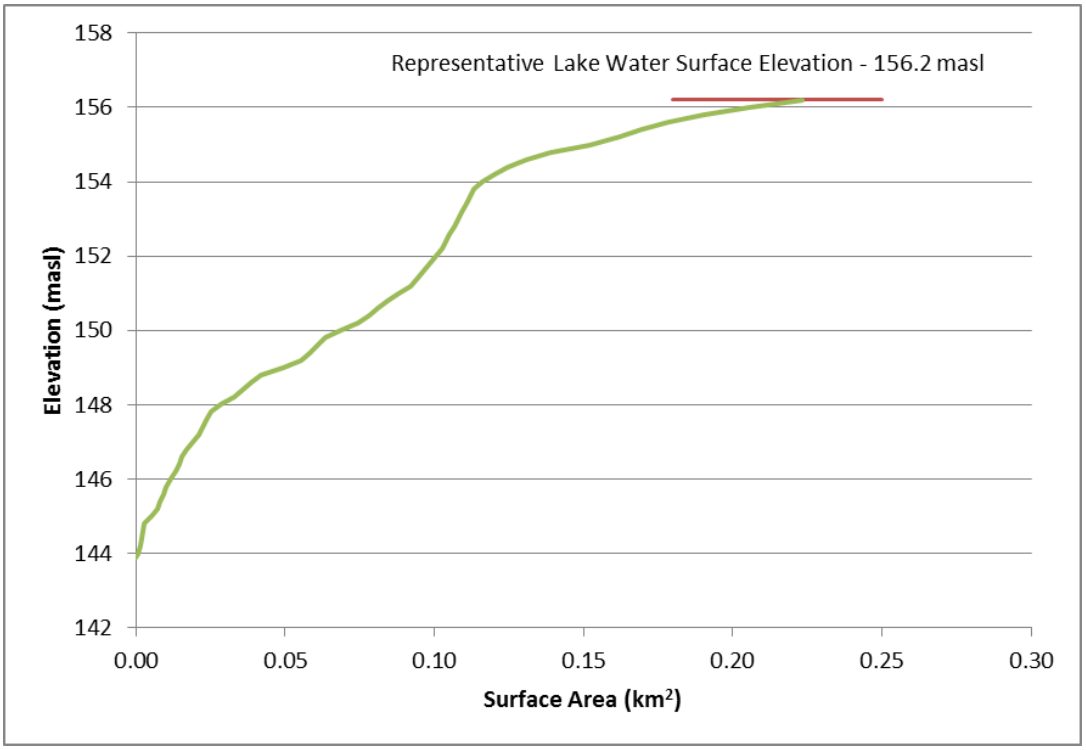


Figure 6-M-16: Lake A44, Elevation-Area Curve

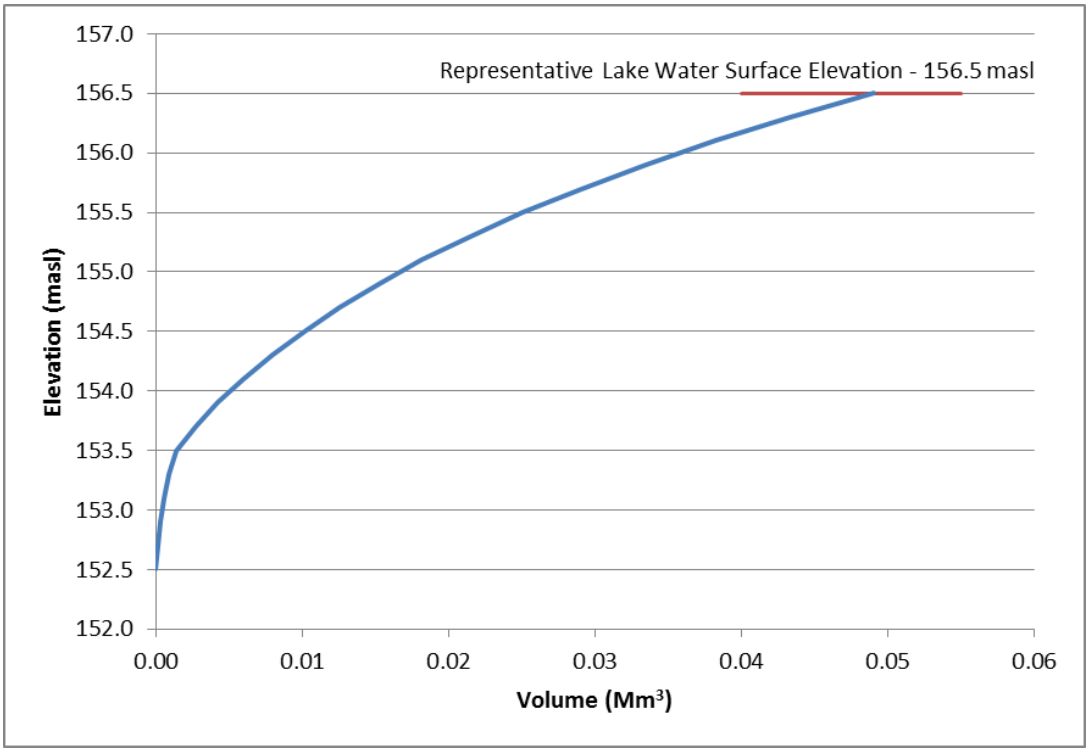


Figure 6-M-17: Lake A45, Elevation-Volume Curve

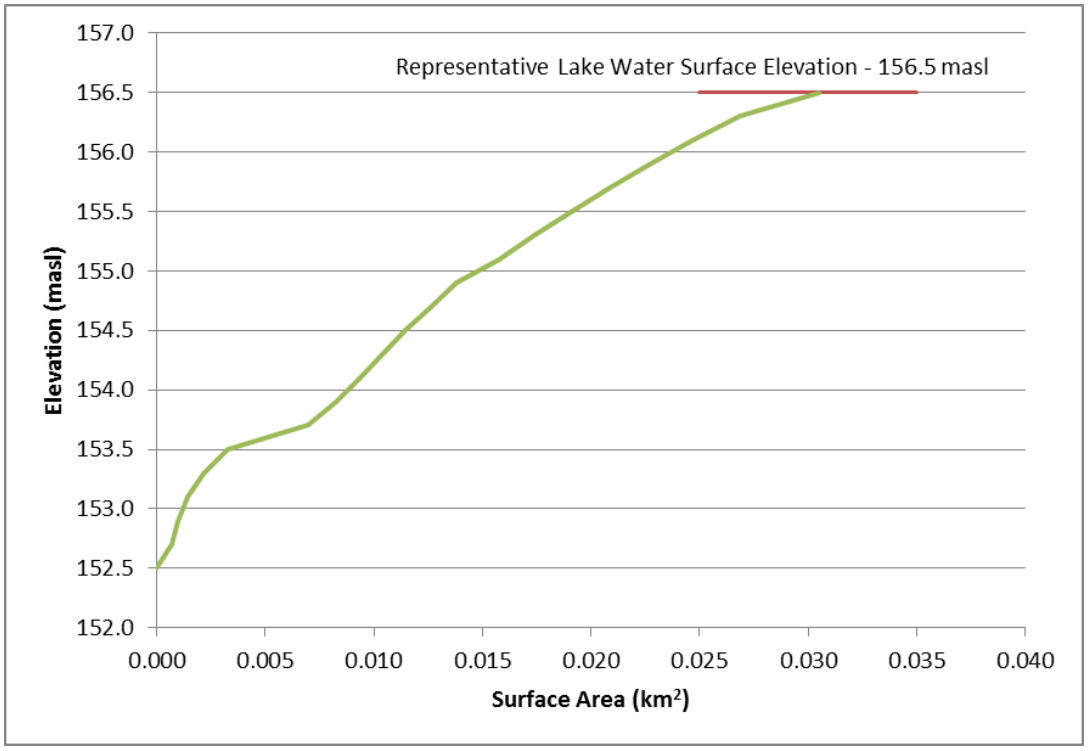


Figure 6-M-18: Lake A45, Elevation-Area Curve

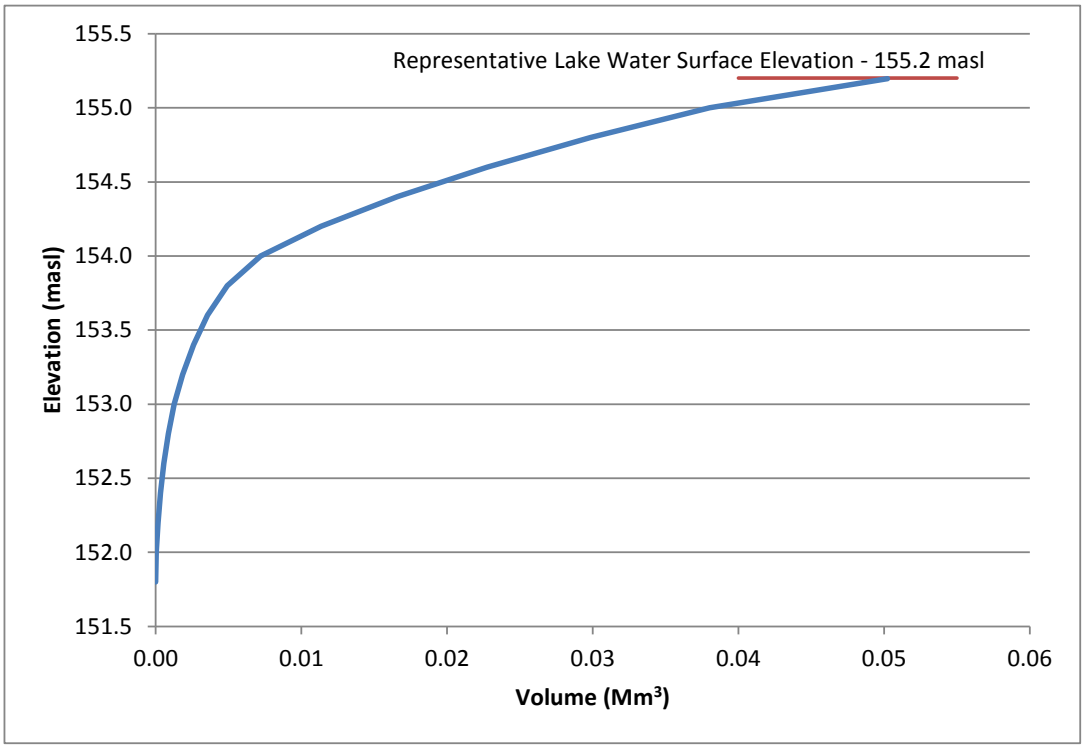


Figure 6-M-19: Lake A47, Elevation-Volume Curve

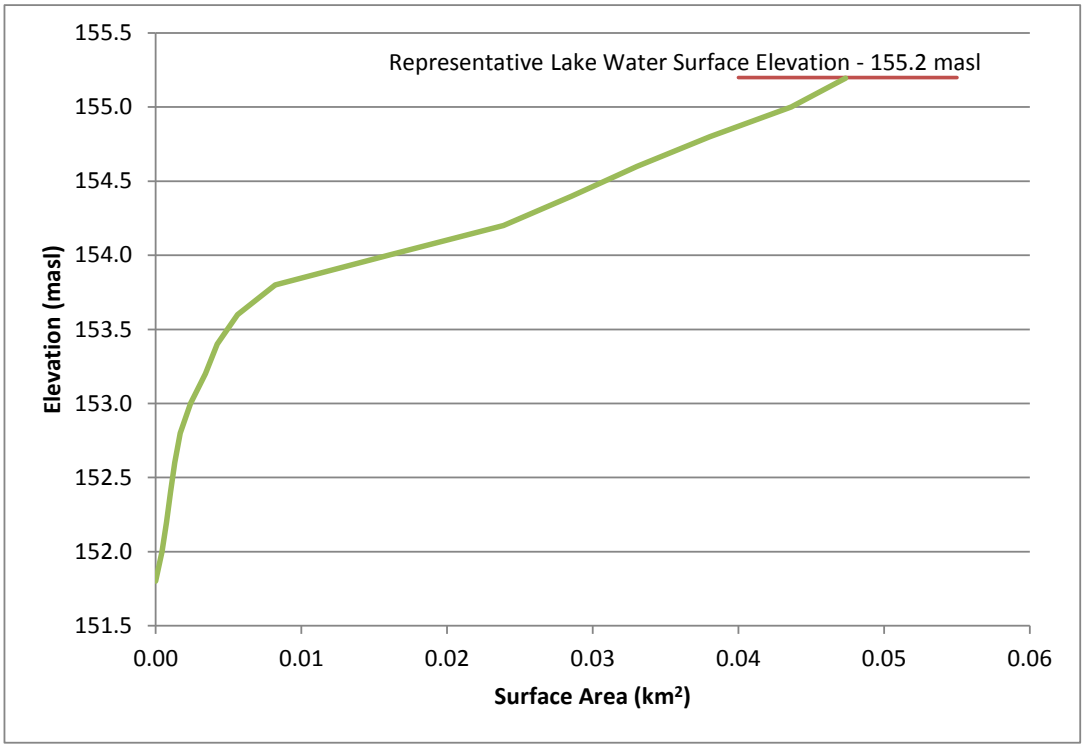


Figure 6-M-20: Lake A47, Elevation-Area Curve

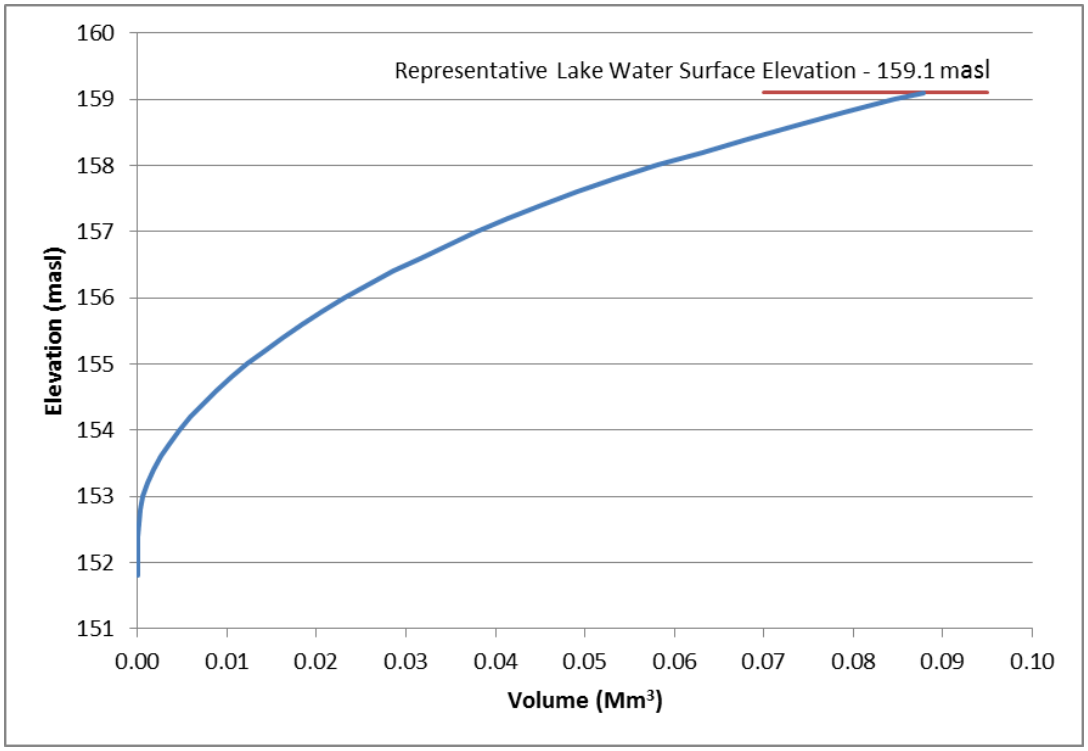


Figure 6-M-21: Lake A49, Elevation-Volume Curve

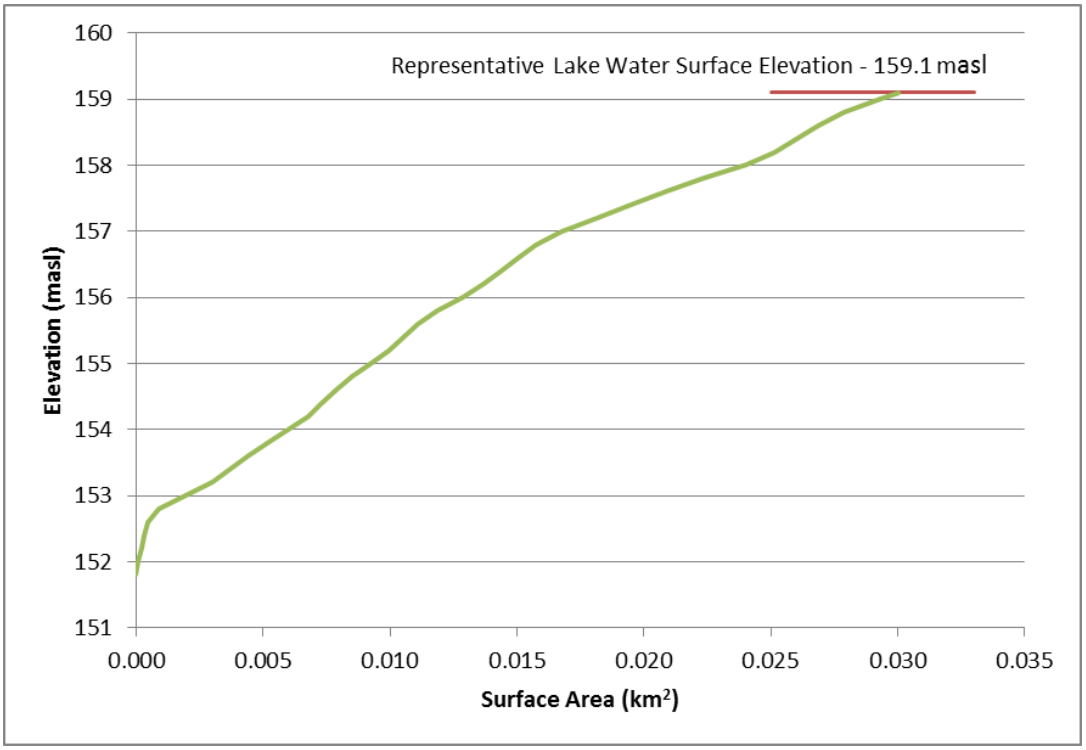


Figure 6-M-22: Lake A49, Elevation-Area Curve

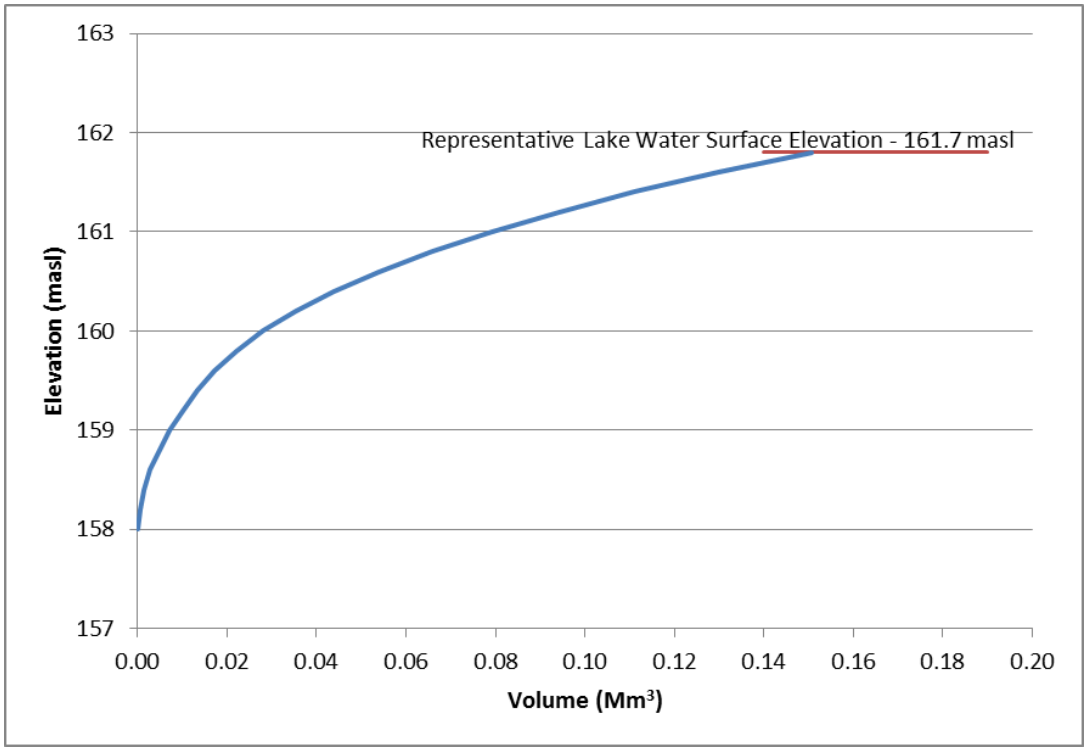


Figure 6-M-23: Lake A53, Elevation-Volume Curve

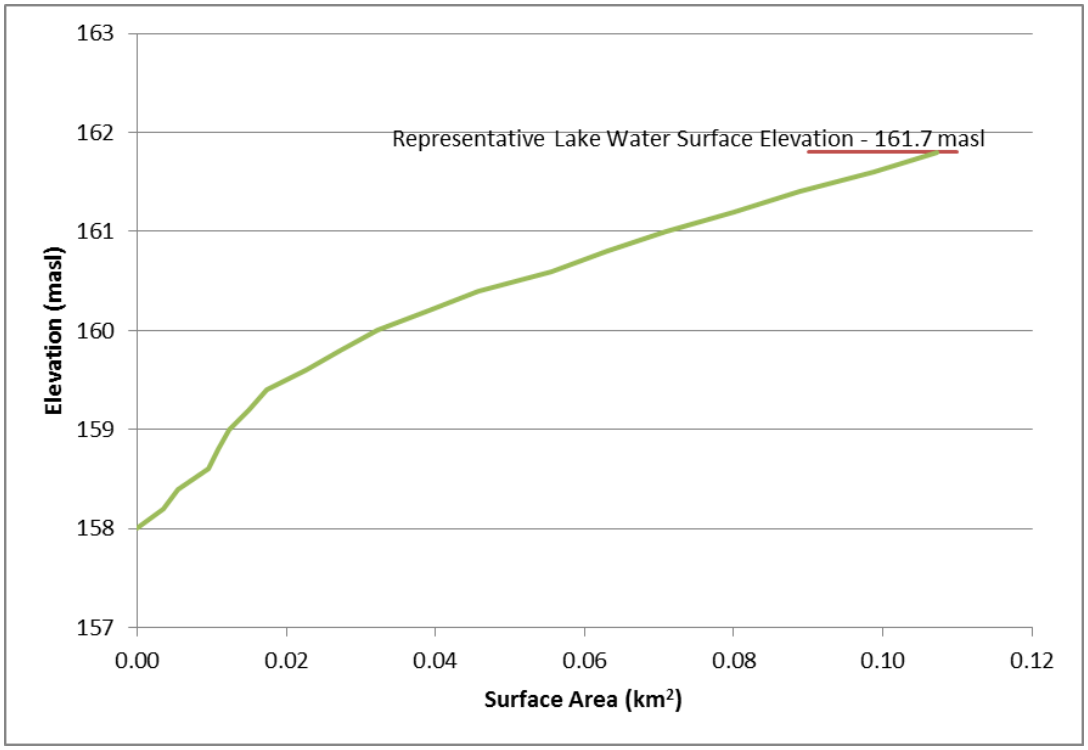


Figure 6-M-24: Lake A53, Elevation-Area Curve

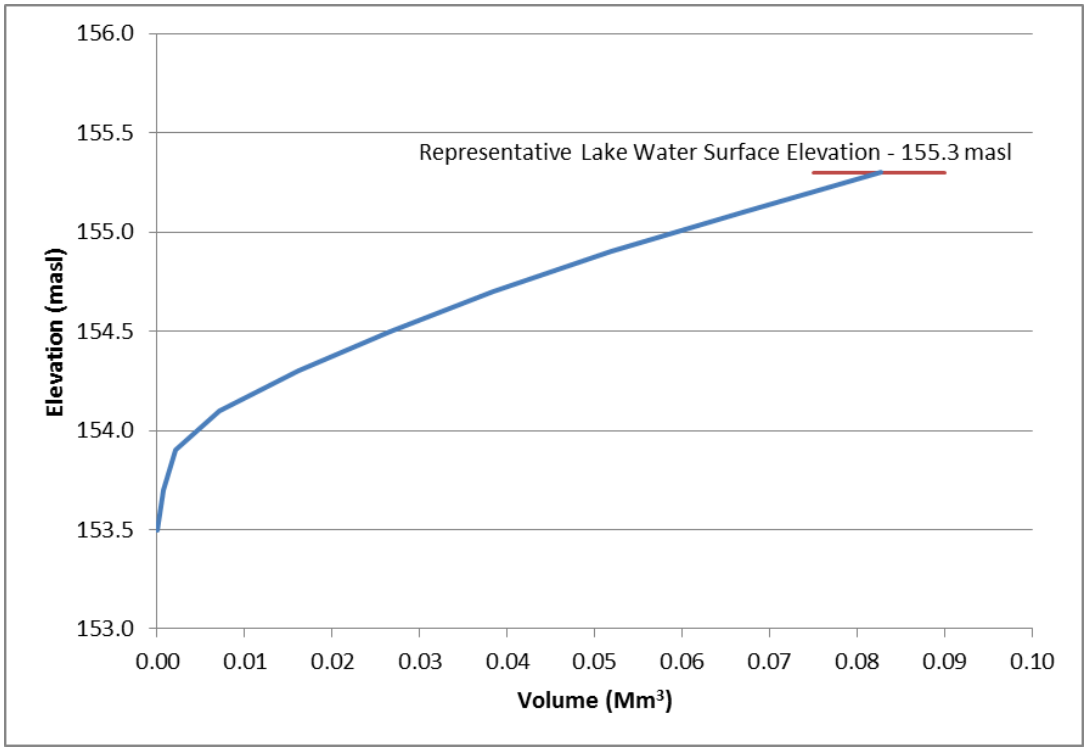


Figure 6-M-25: Lake A55, Elevation-Volume Curve

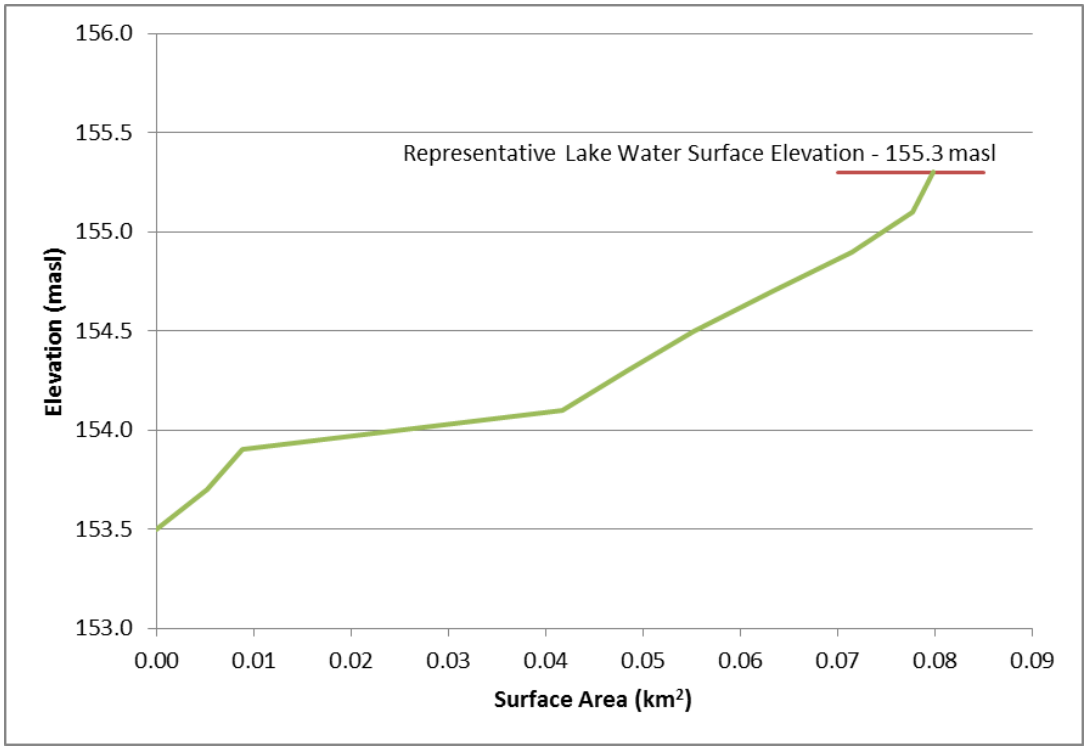


Figure 6-M-26: Lake A55, Elevation-Area Curve

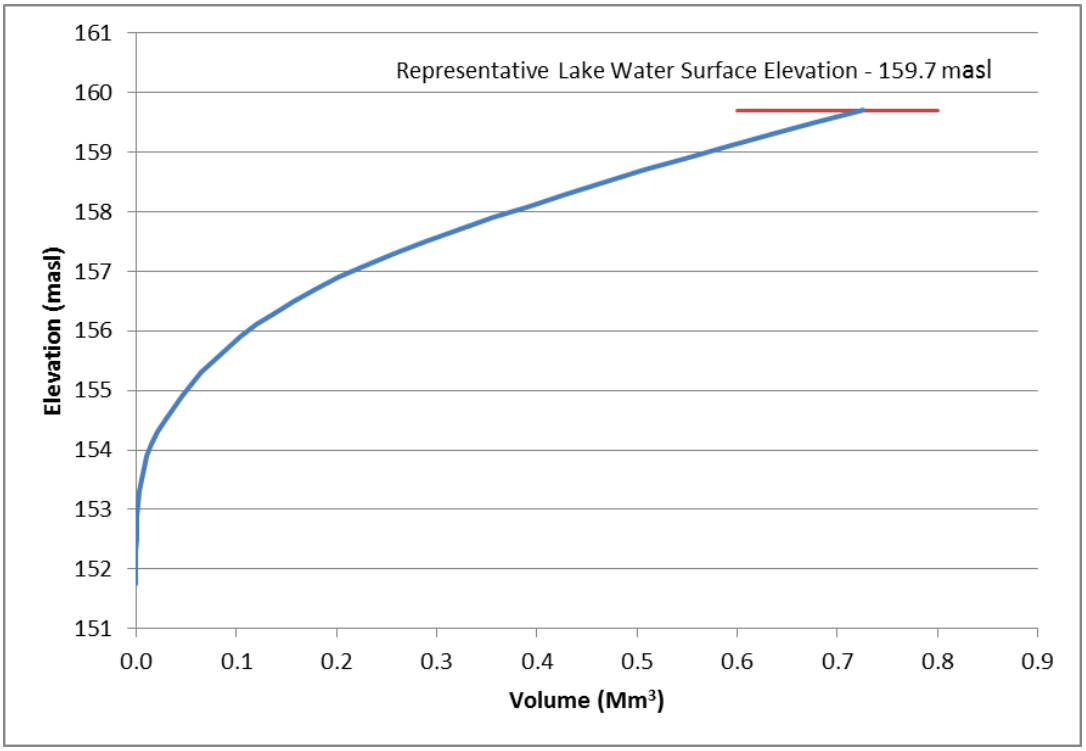


Figure 6-M-27: Lake A56, Elevation-Volume Curve

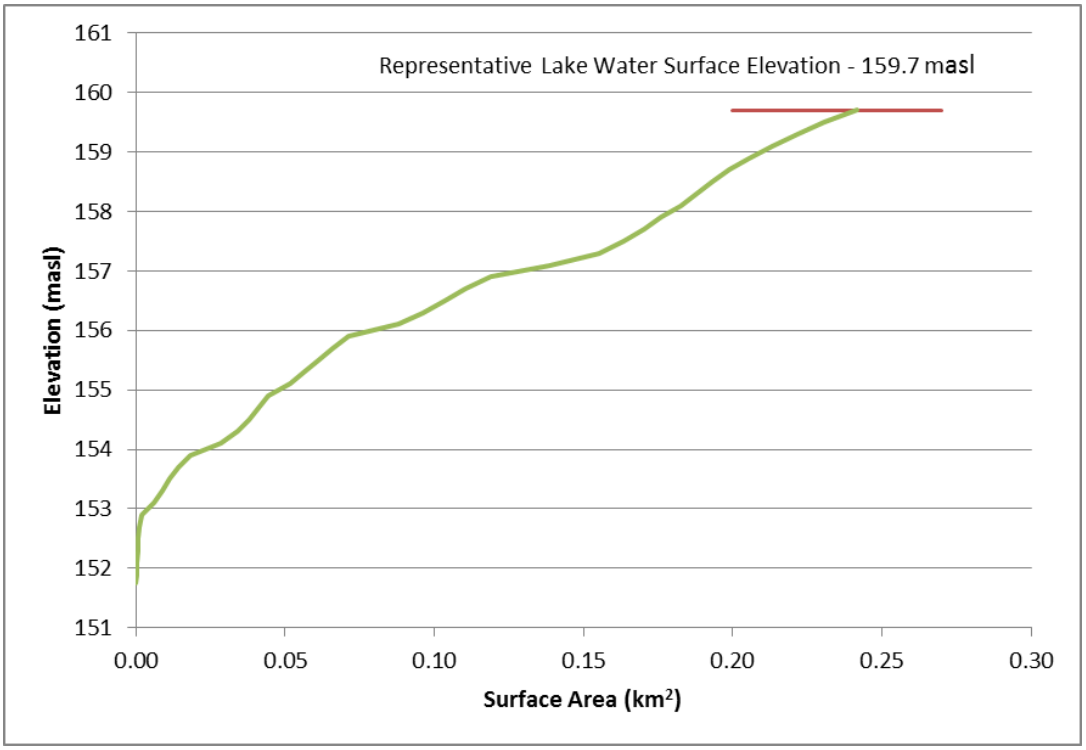


Figure 6-M-28: Lake A56, Elevation-Area Curve

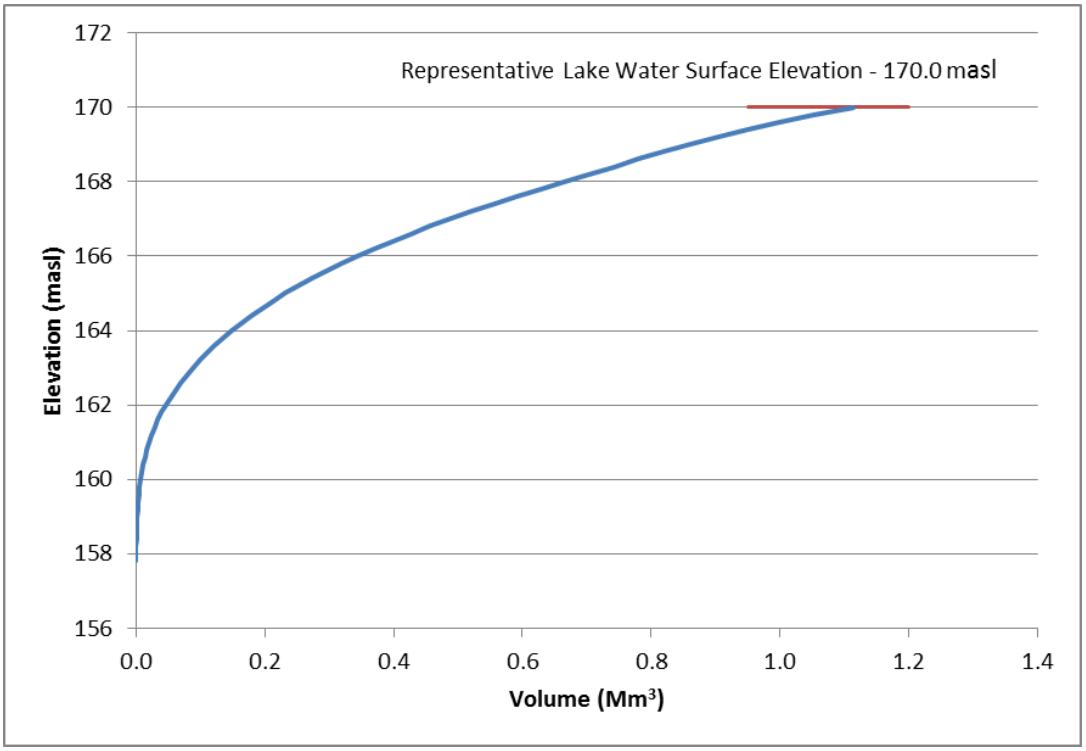


Figure 6-M-29: Lake A60, Elevation-Volume Curve

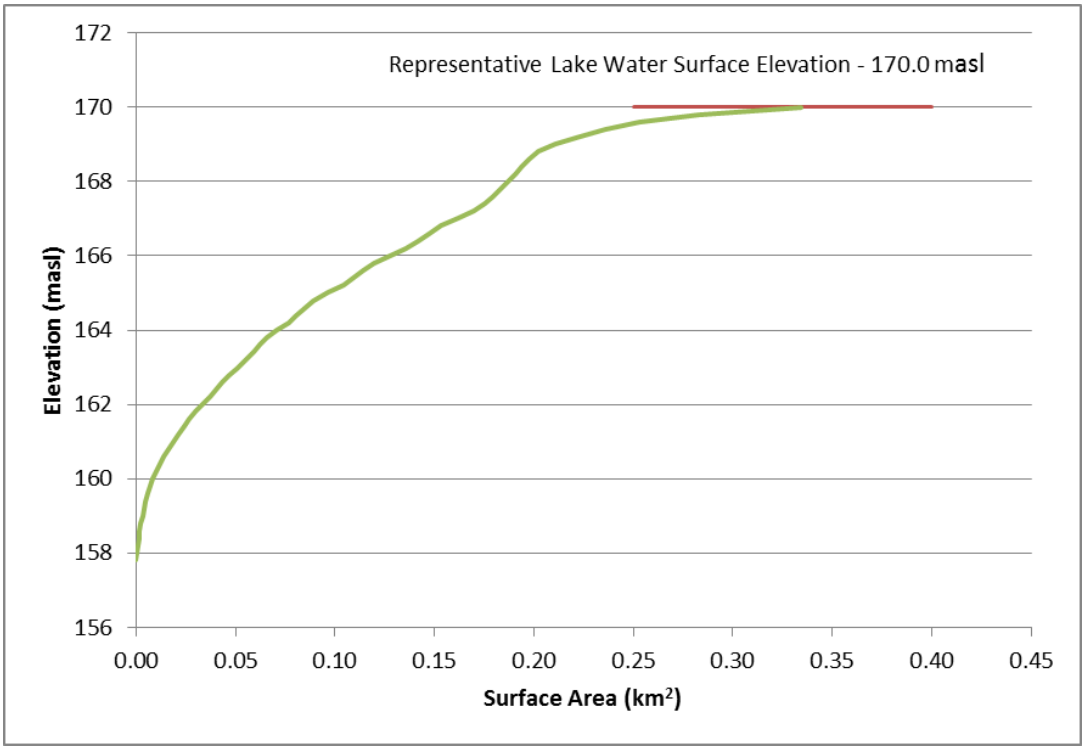


Figure 6-M-30: Lake A60, Elevation-Area Curve

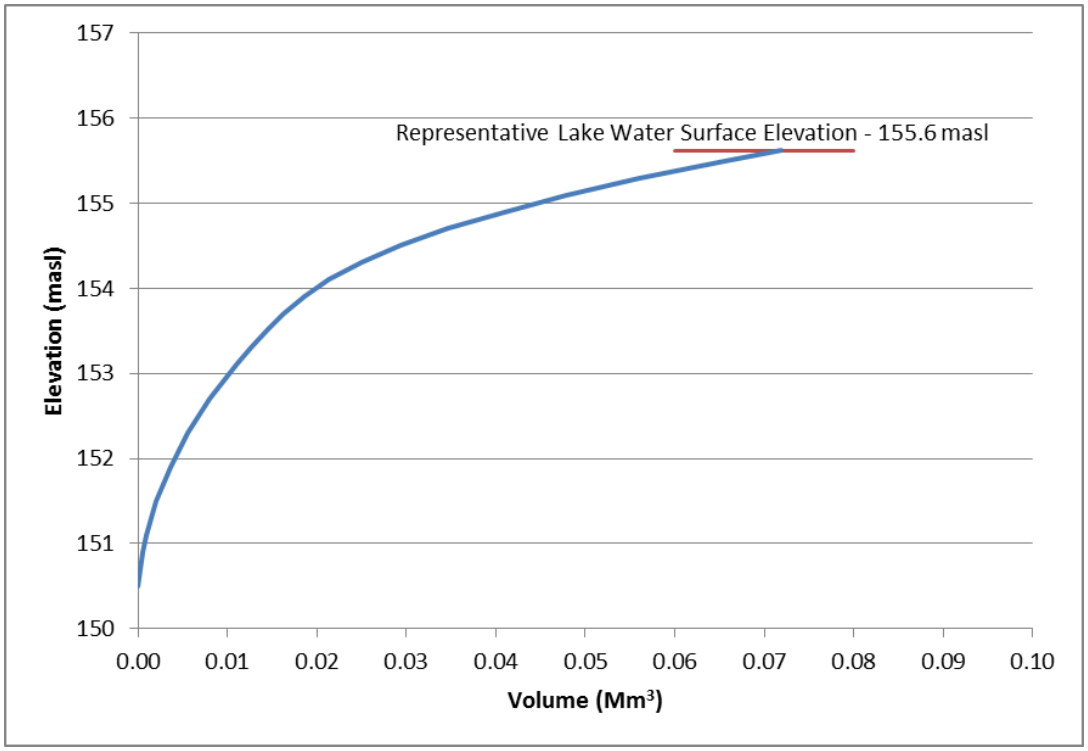


Figure 6-M-31: Lake A62, Elevation-Volume Curve

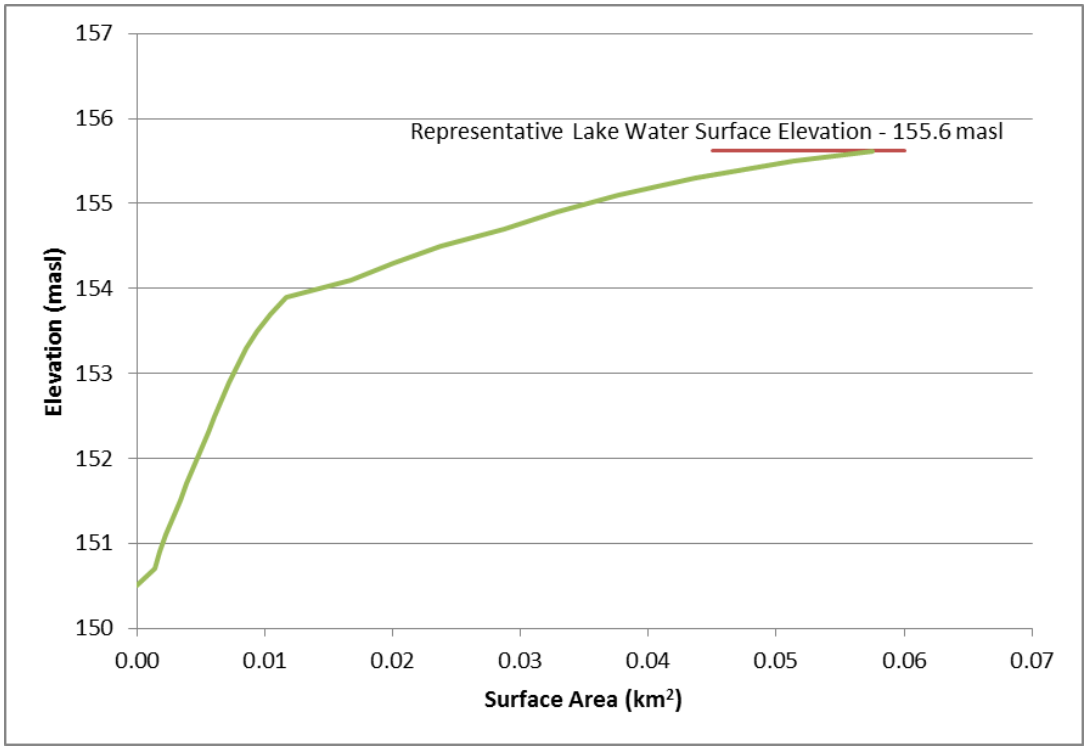


Figure 6-M-32: Lake A62, Elevation-Area Curve

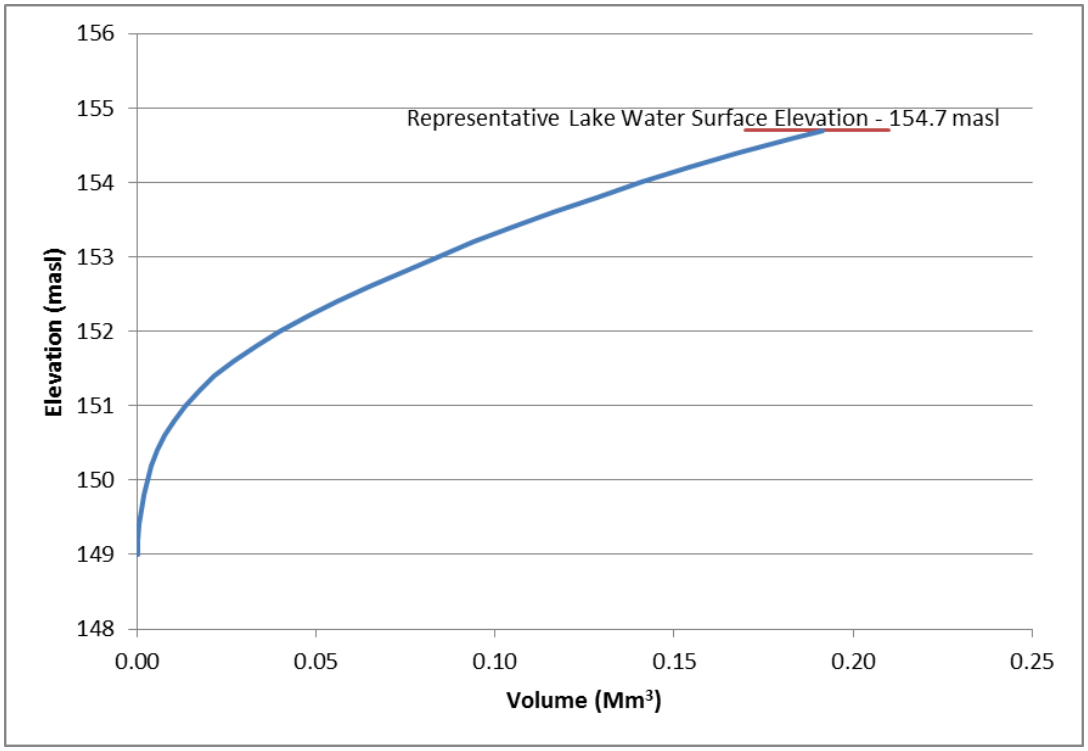


Figure 6-M-33: Lake A63, Elevation-Volume Curve

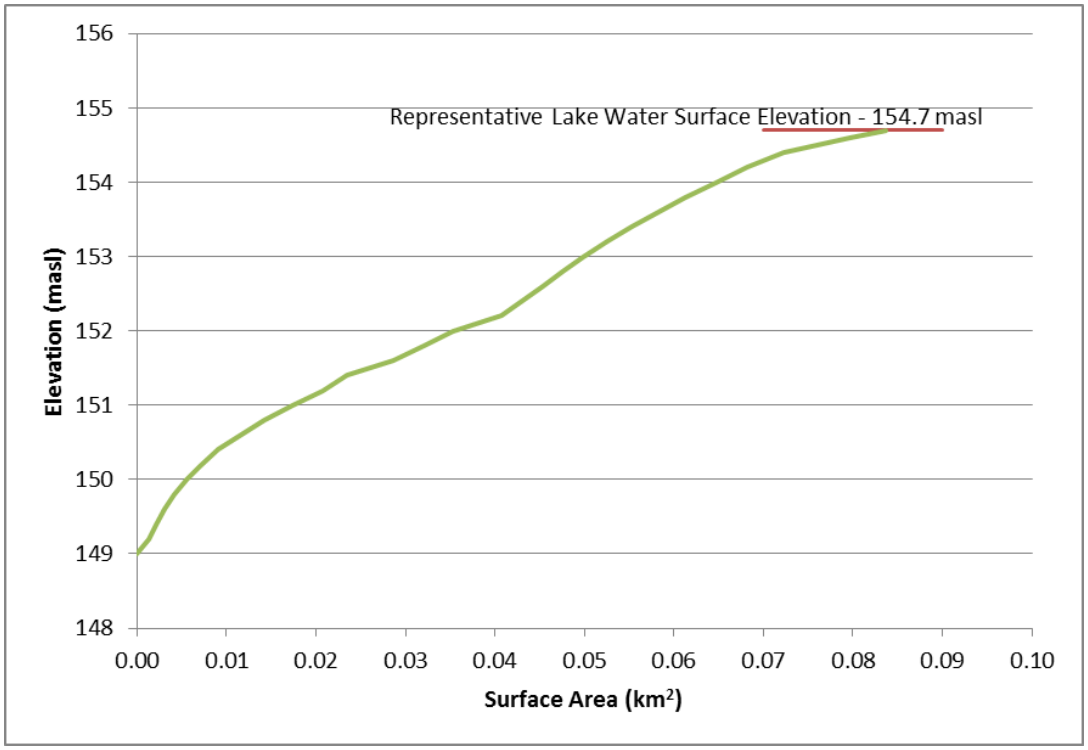


Figure 6-M-34: Lake A63, Elevation-Area Curve

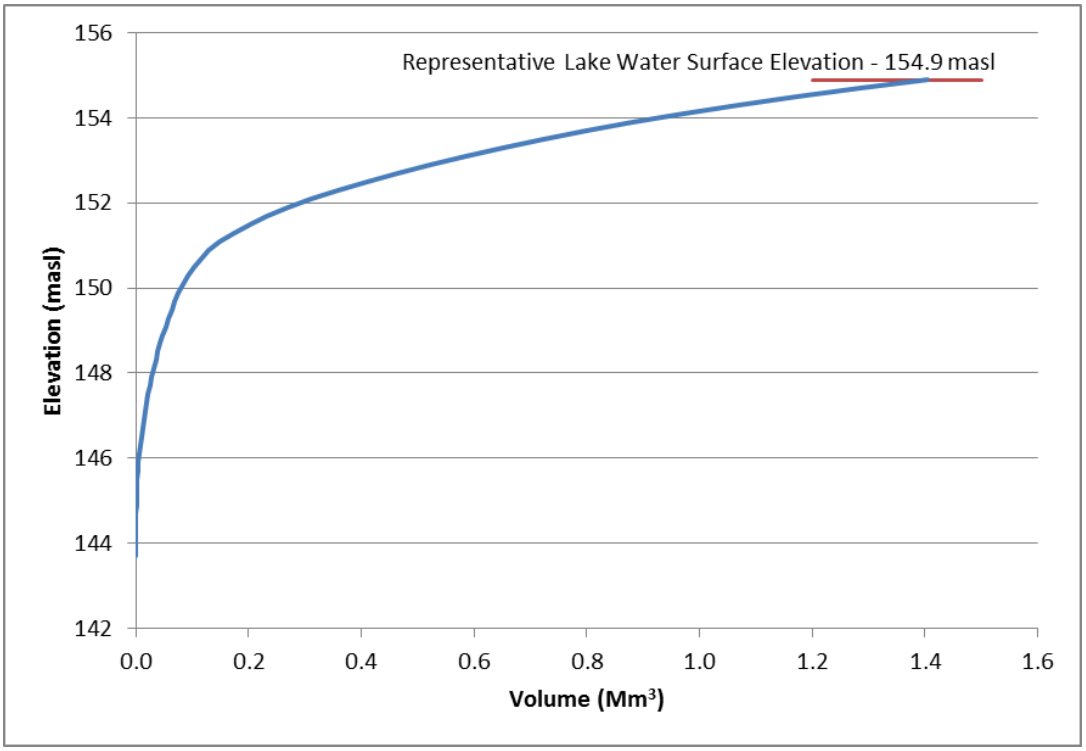


Figure 6-M-35: Lake A65, Elevation-Volume Curve

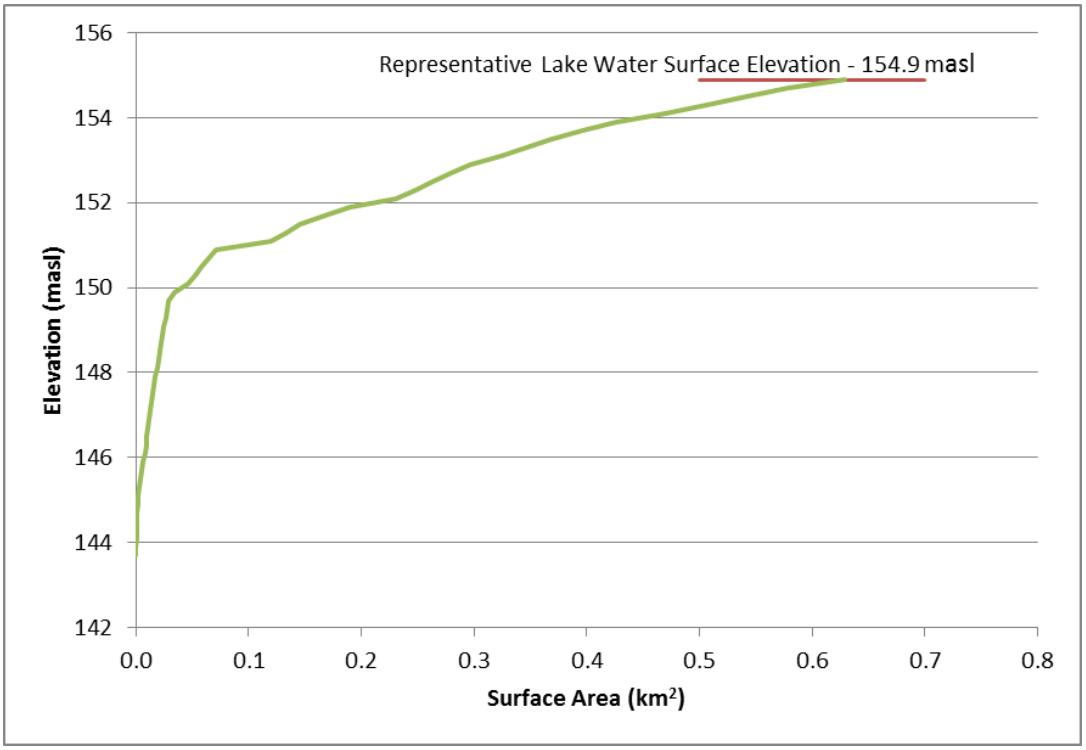


Figure 6-M-36: Lake A65, Elevation-Area Curve

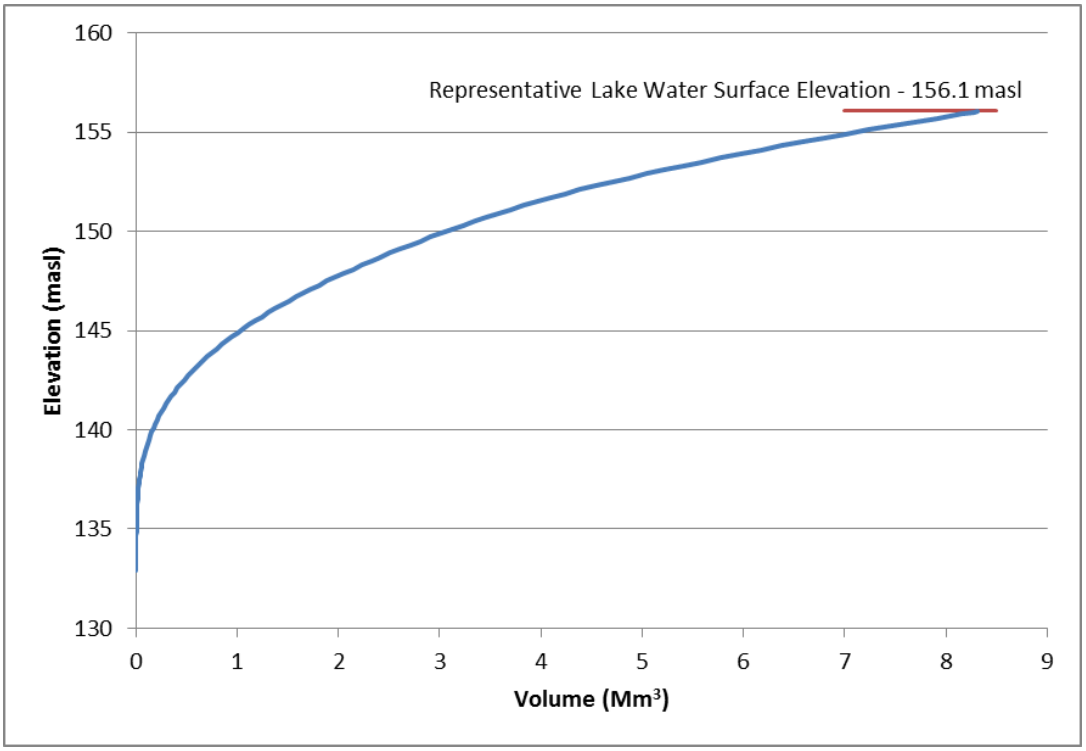


Figure 6-M-37: Lake C38, Elevation-Volume Curve

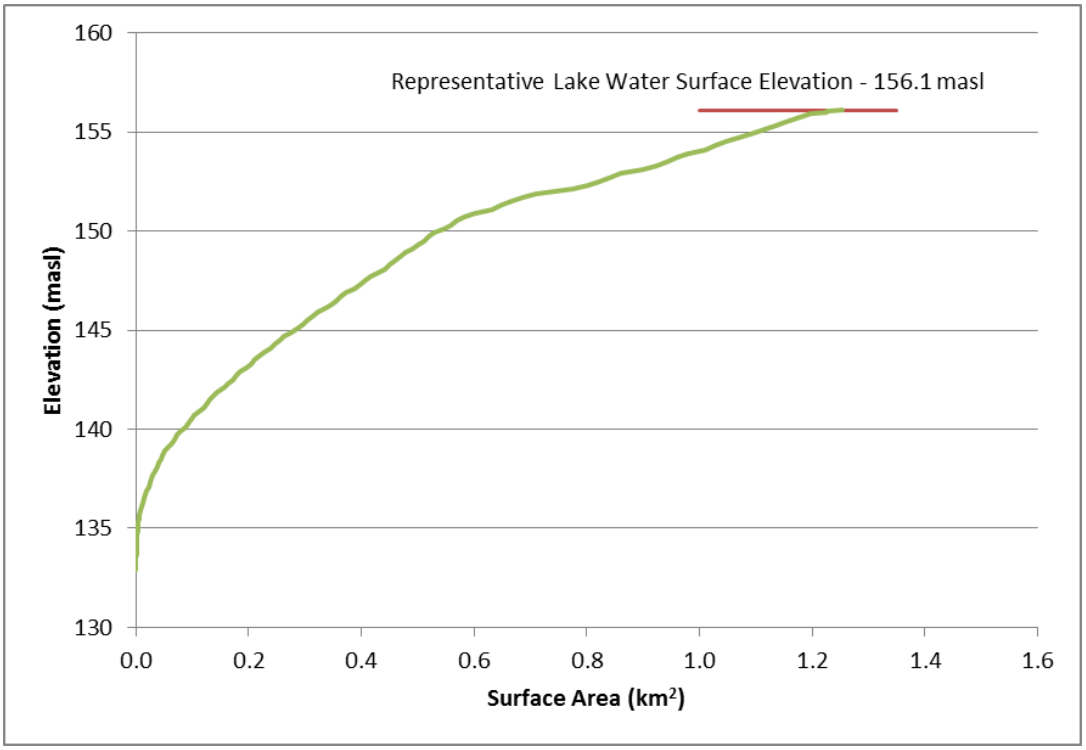


Figure 6-M-38: Lake C38 (Nemo Lake), Elevation-Area Curve

6.M-4 CLOSURE

Bathymetric relationships were derived for 19 lakes at the Project, including Lake A16 (Mammoth Lake), Lake A17 (Whale Tail Lake), Lake A18, Lake A19, Lake A20, Lake A22, Lake A43, Lake A44, Lake A45, Lake A47, Lake A49, Lake A53, Lake A55, Lake A56, Lake A60, Lake A62, Lake A63, Lake A65, and Lake C38 (Nemo Lake). Elevation-area-volume curves were calculated for each lake.

6.M-5 REFERENCES

Agnico Eagle Mines (Agnico Eagle). 2015. Email communications from Serge Ouellet on September 4 and 8, 2015.

PhotoSat Information Ltd. (PhotoSat). 2015. PhotoSat Stereo Satellite Elevation Mapping Project Report. Reference No. 3631.

This attachment presents the bathymetric maps (Figure A-1 to Figure A-19), and the tables for the elevation-area-volume curves (Table A-1 to Table A-19) for the Project.

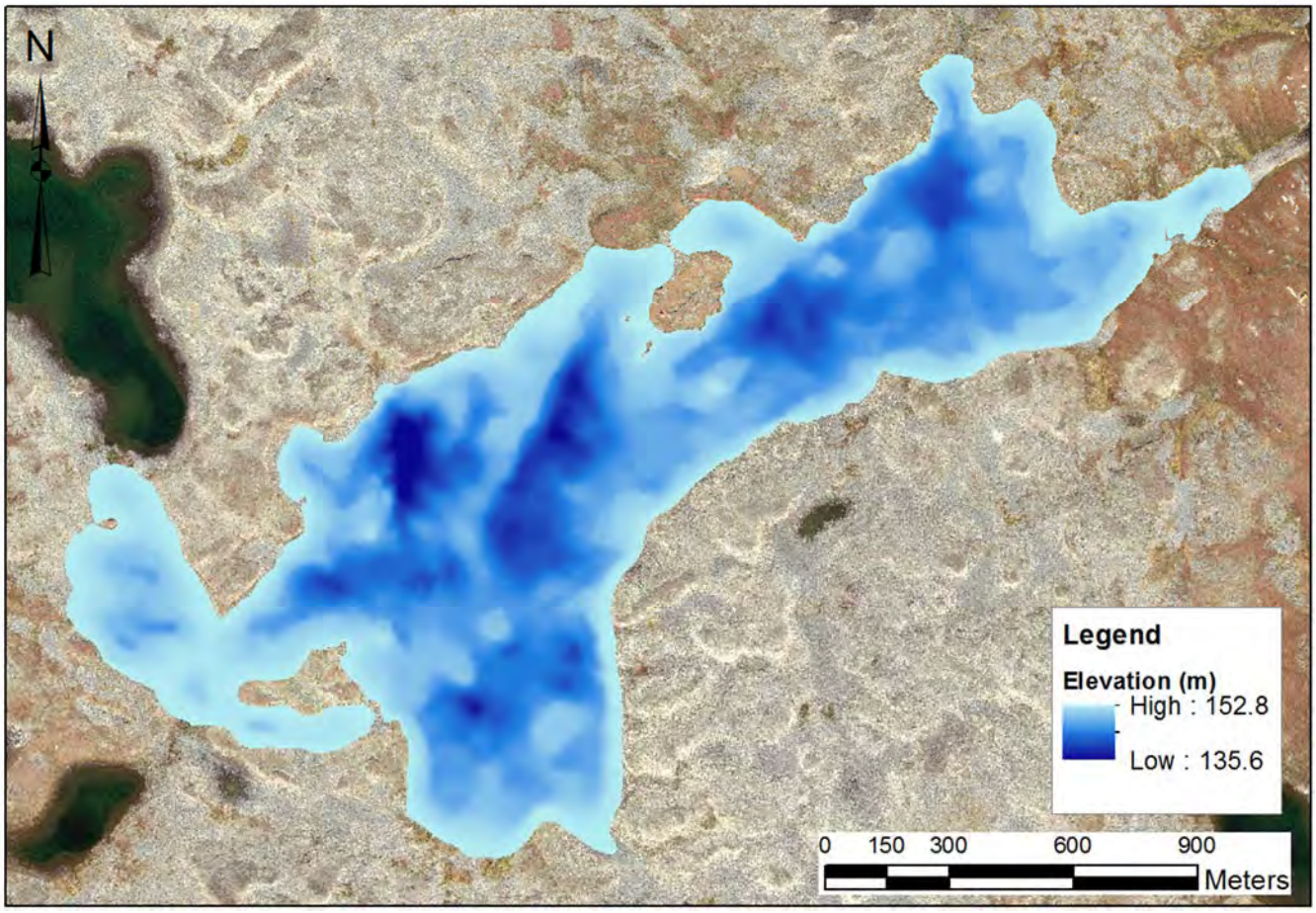


Figure A-1: Bathymetric Map Lake A16

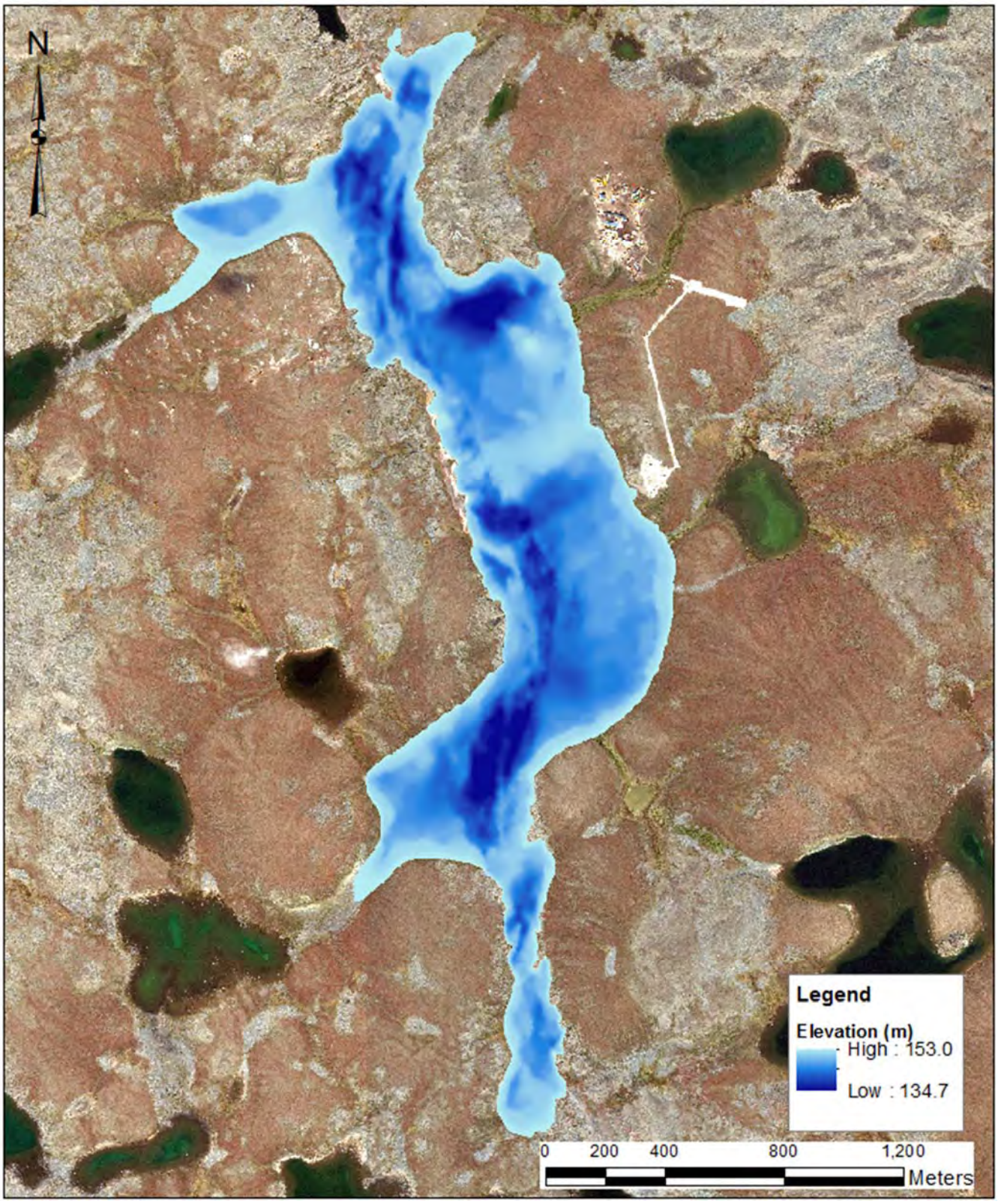


Figure A-2: Bathymetric Map Lake A17

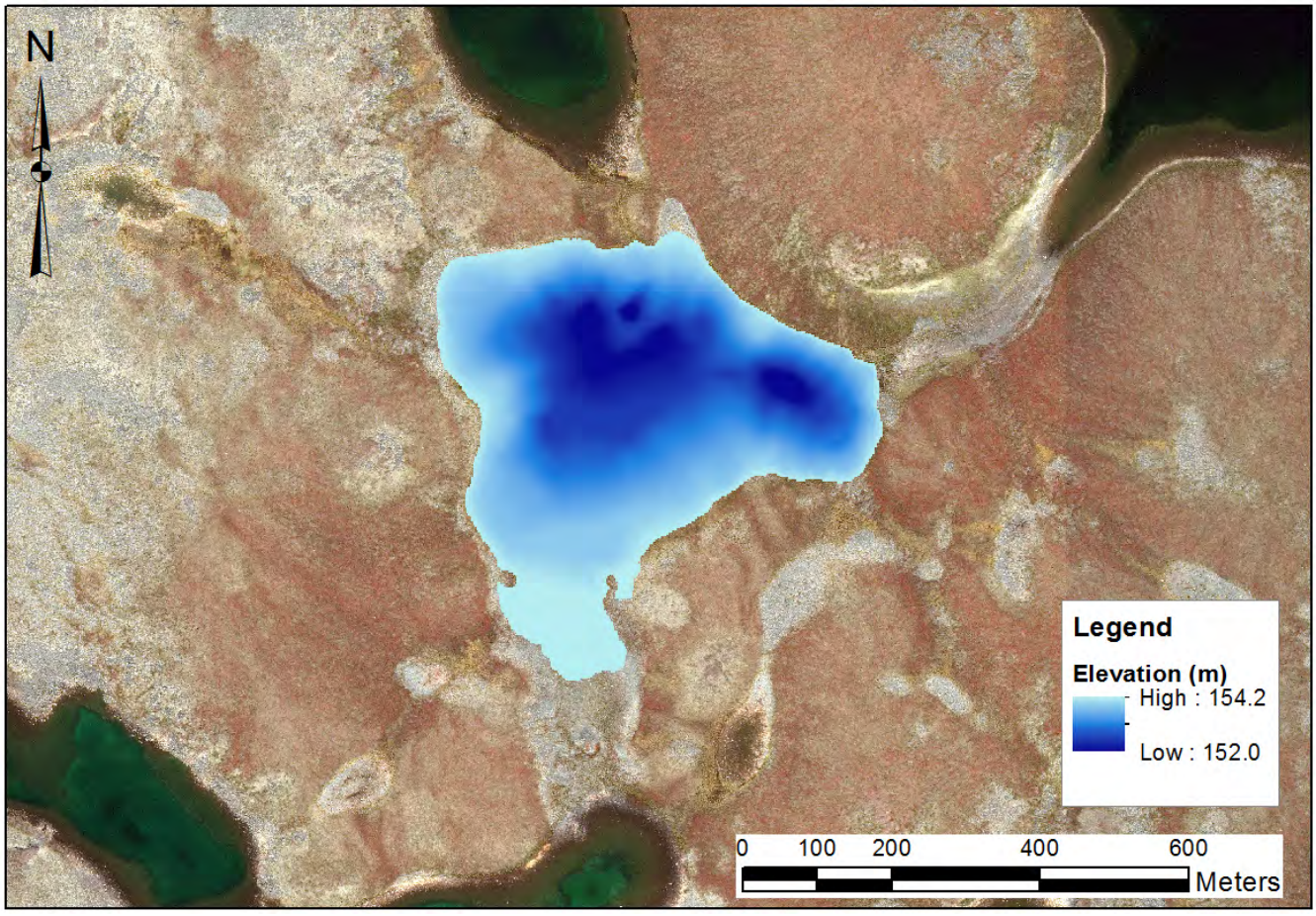


Figure A-3: Bathymetric Map Lake A18

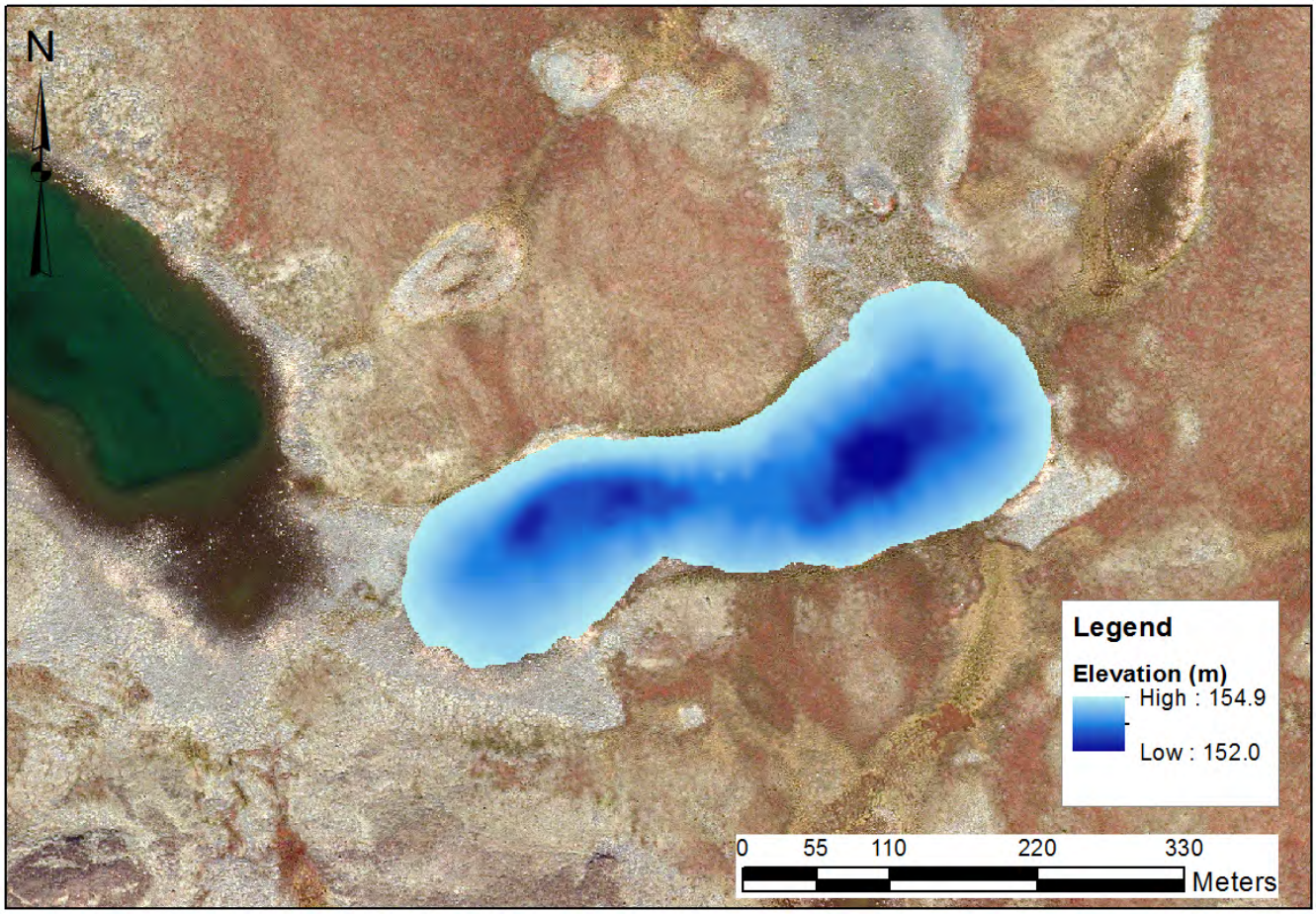


Figure A-4: Bathymetric Map Lake A19

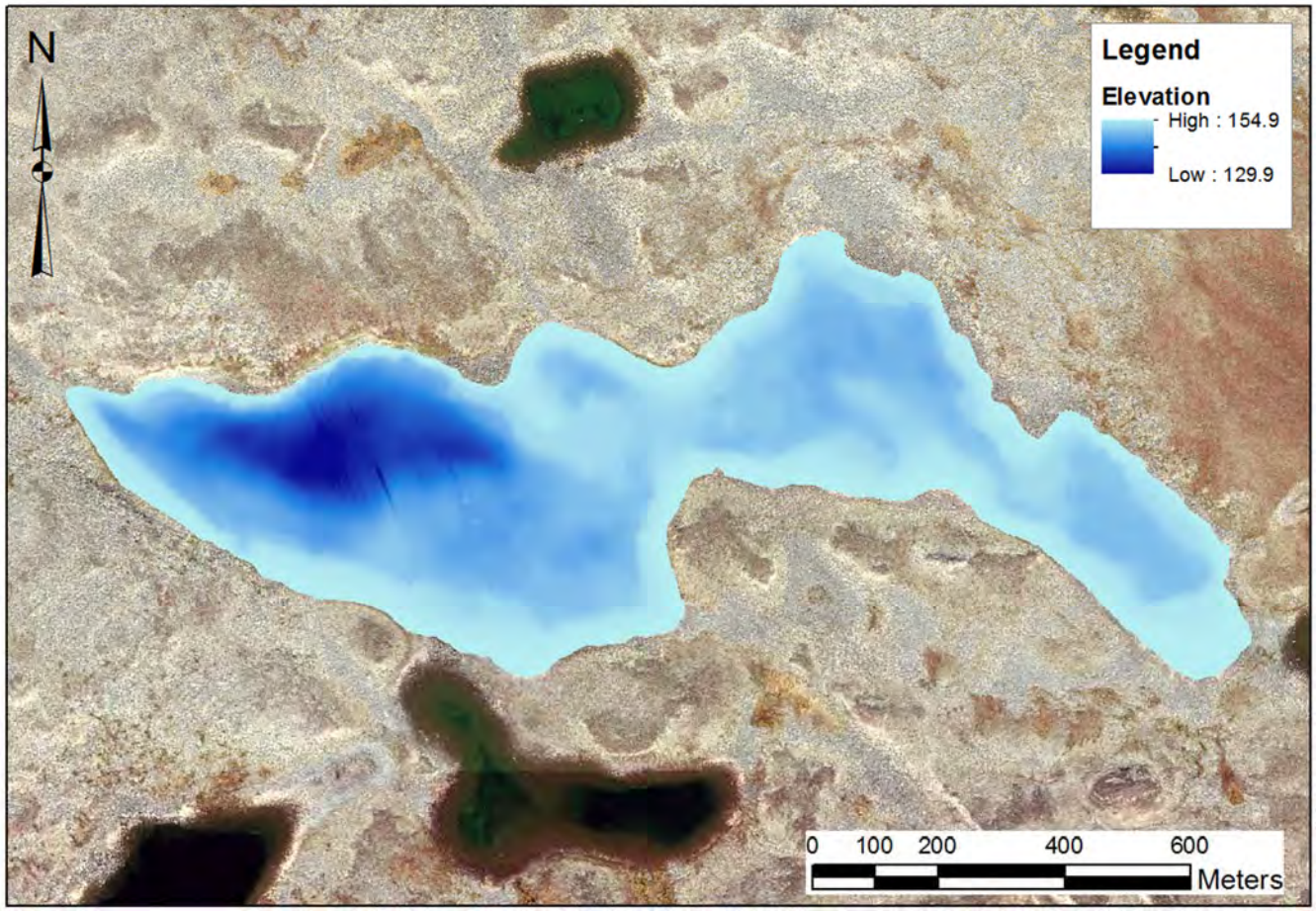


Figure A-5: Bathymetric Map Lake A20

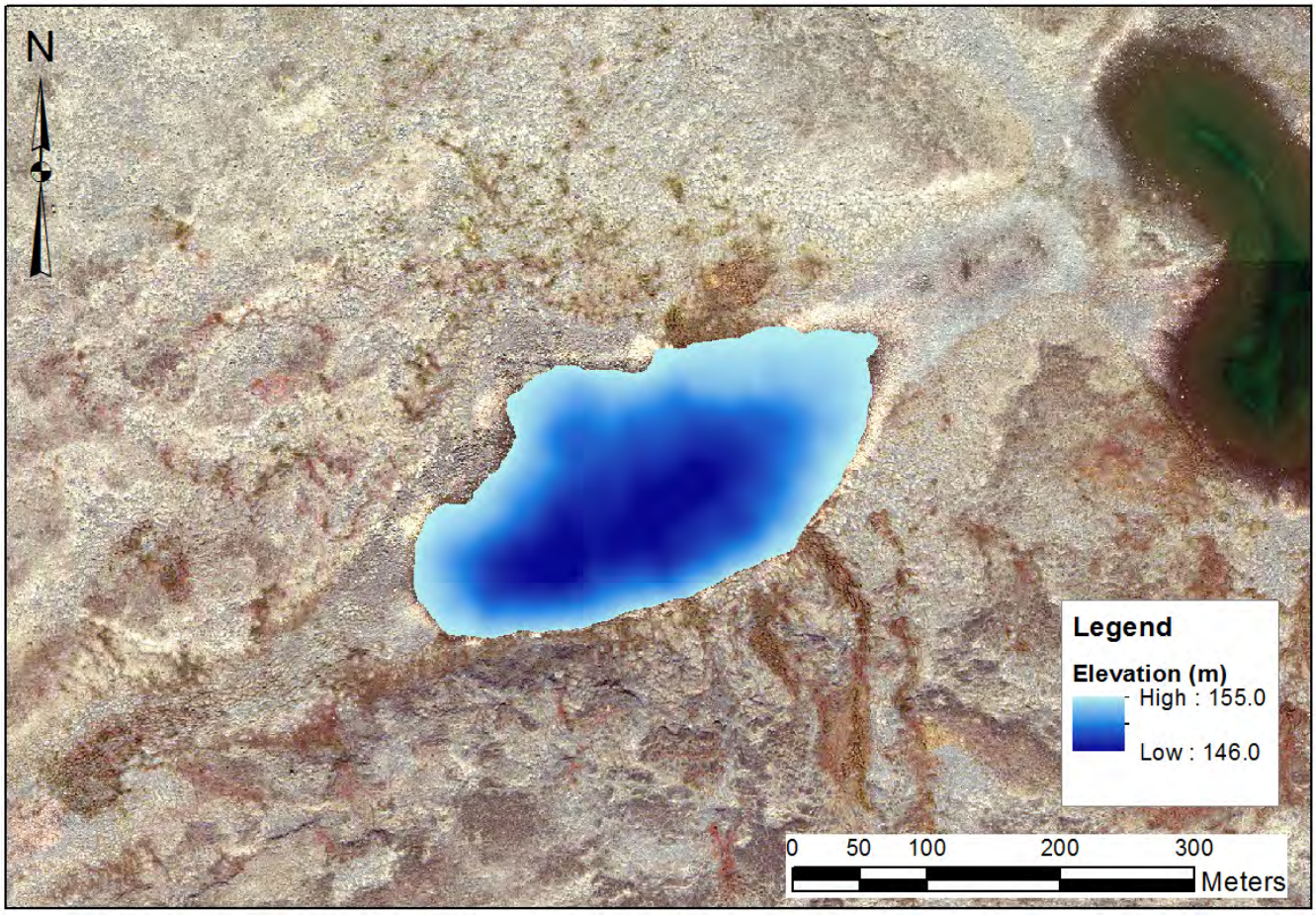


Figure A-6: Bathymetric Map Lake A22

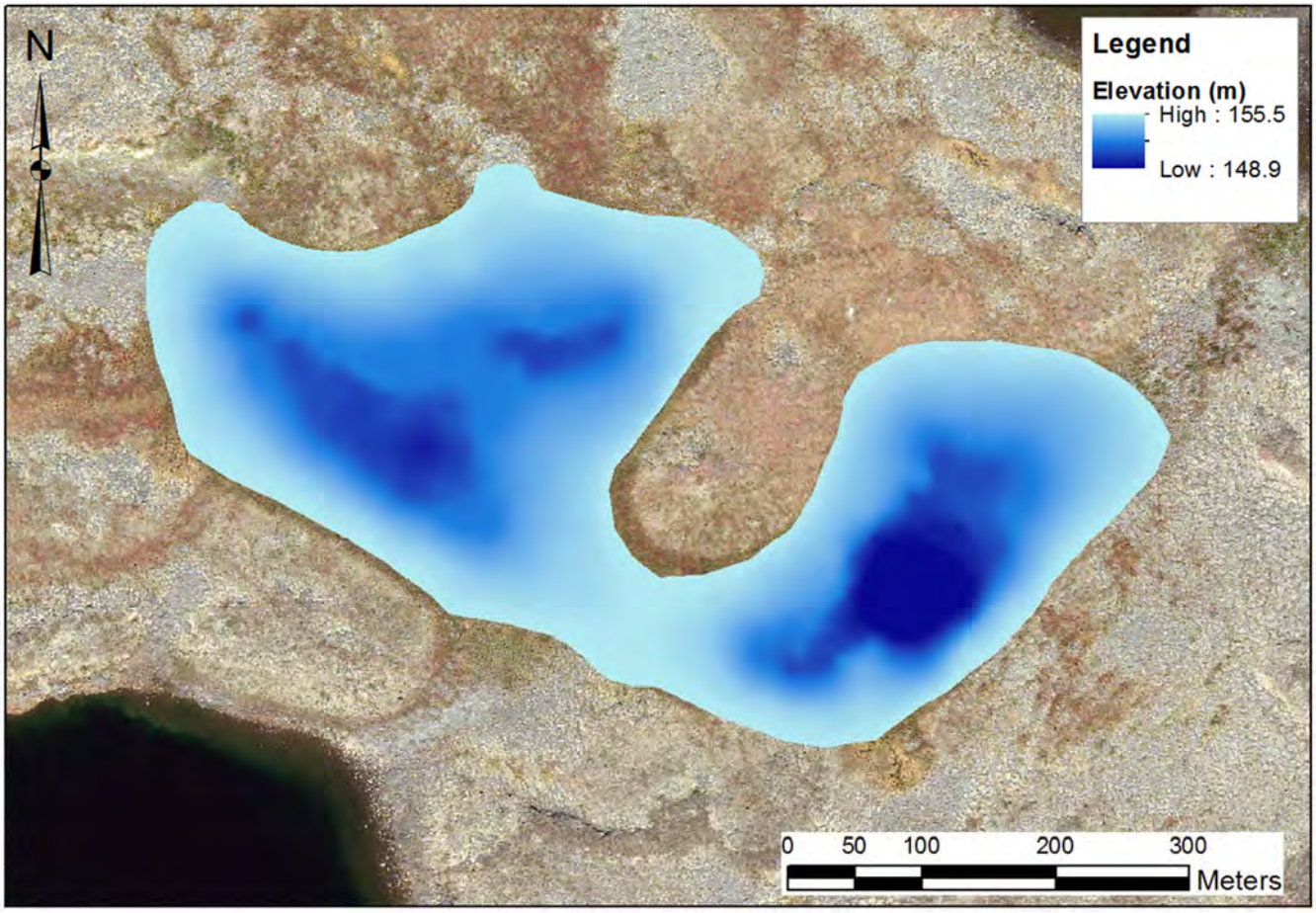


Figure A-7: Bathymetric Map Lake A43

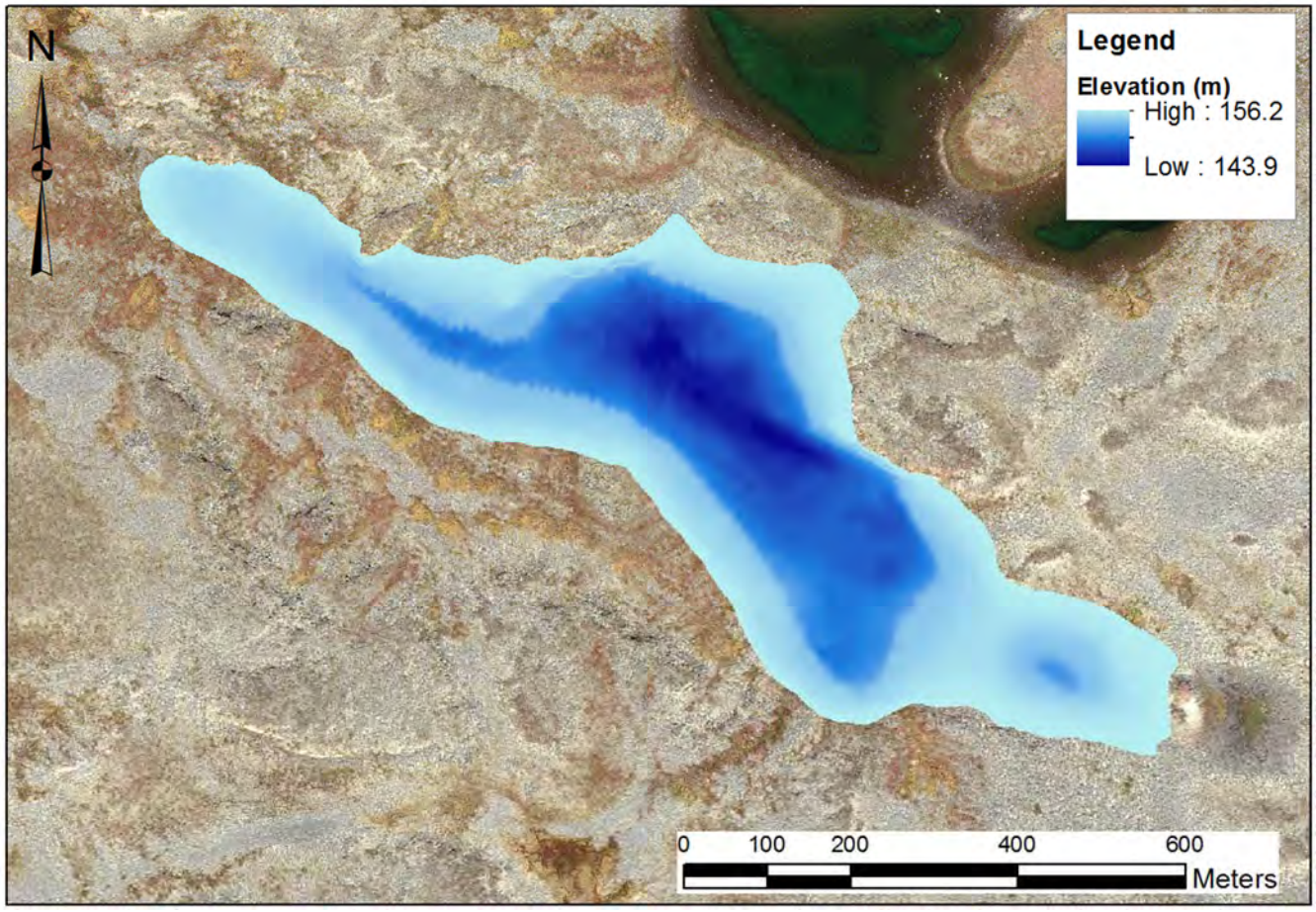


Figure A-8: Bathymetric Map Lake A44

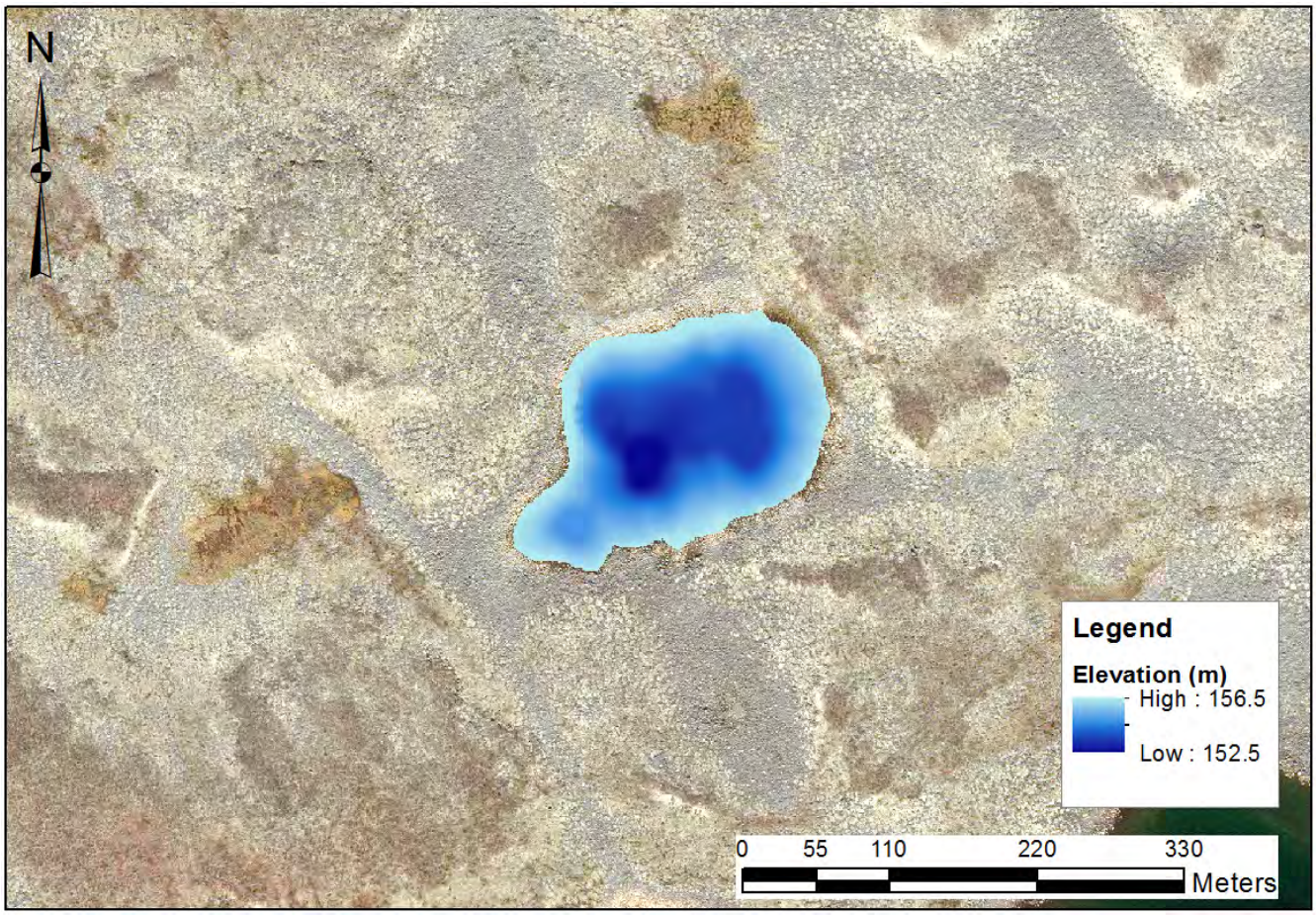


Figure A-9: Bathymetric Map Lake A45

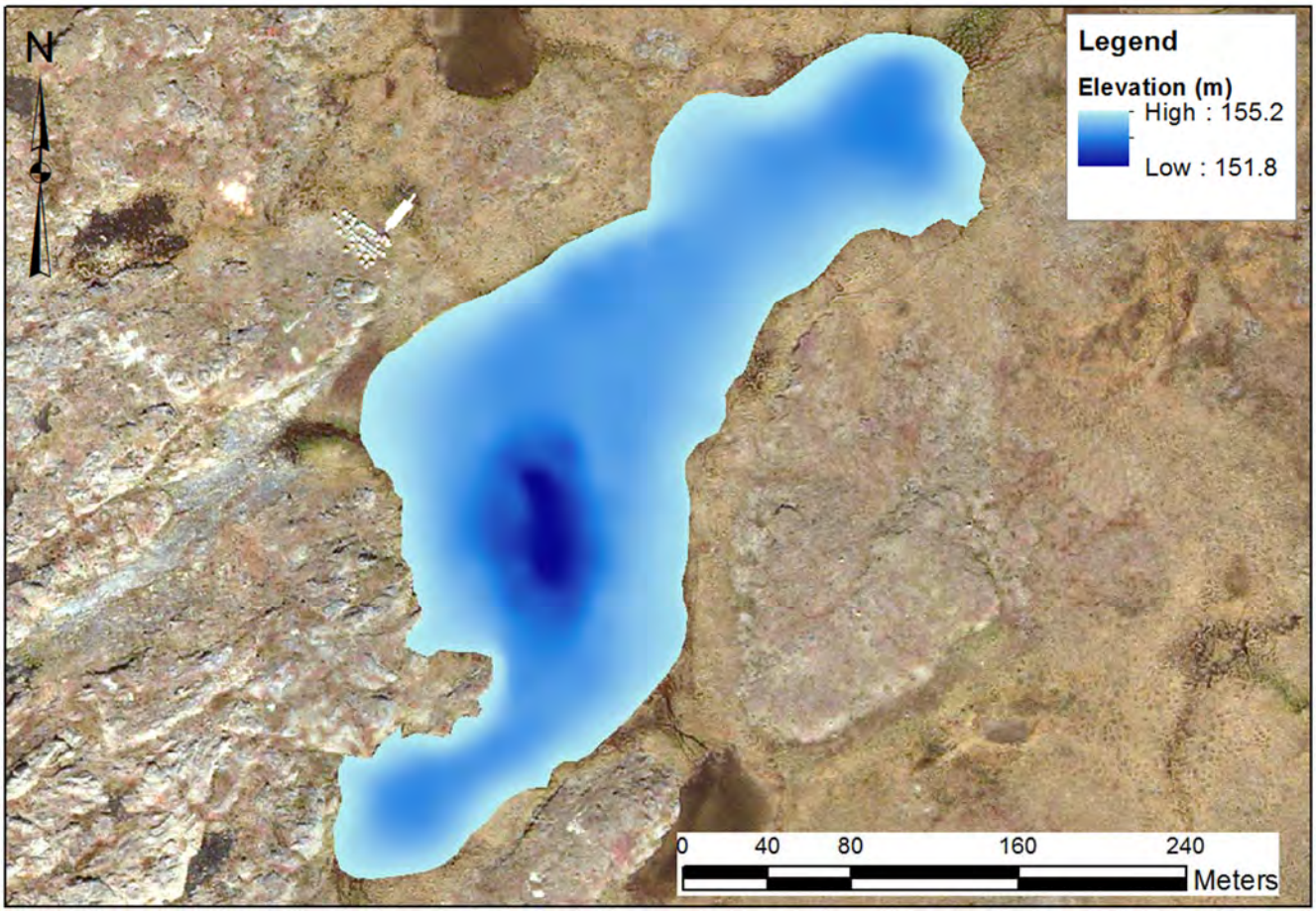


Figure A-10: Bathymetric Map Lake A47

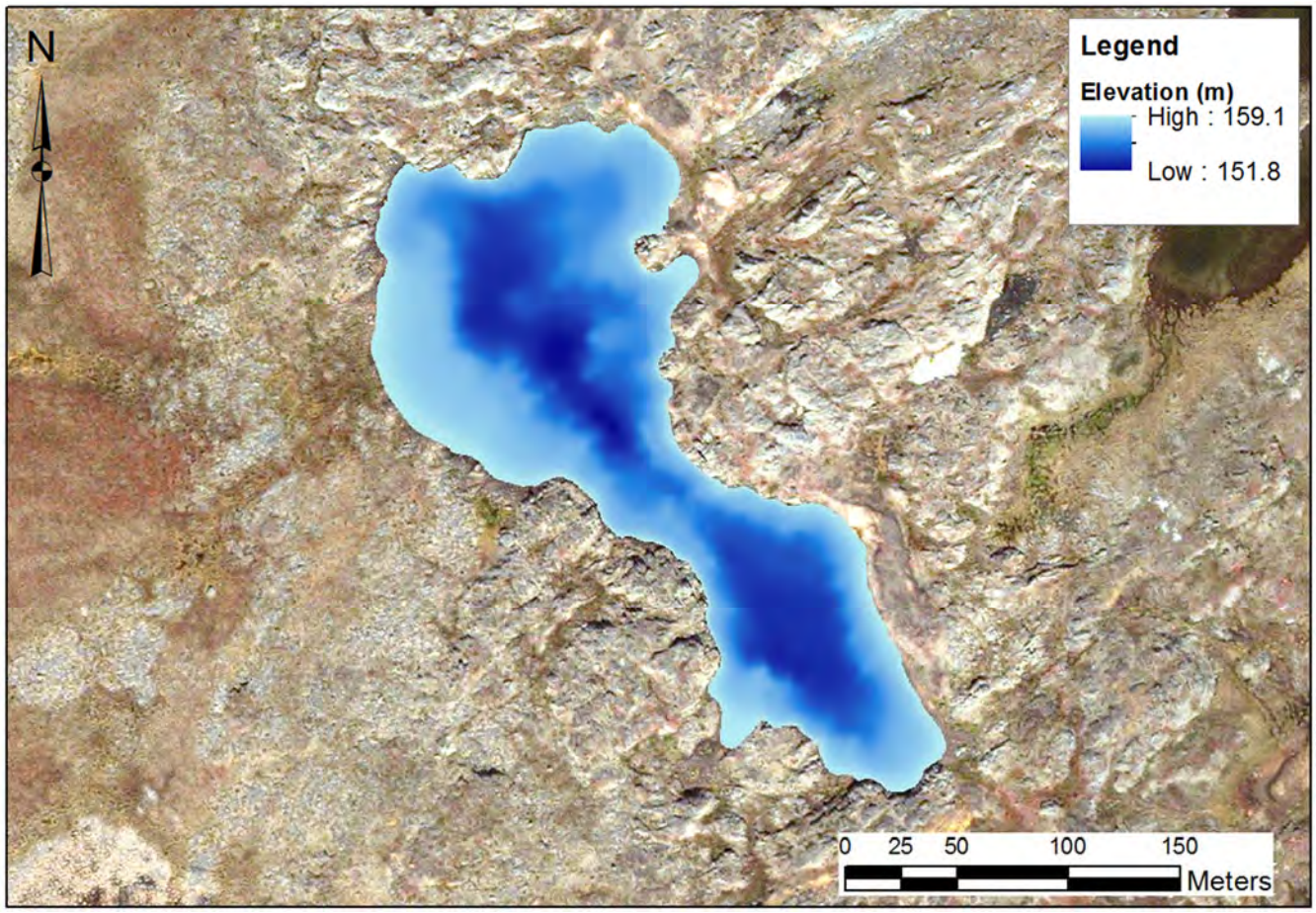


Figure A-11: Bathymetric Map Lake A49

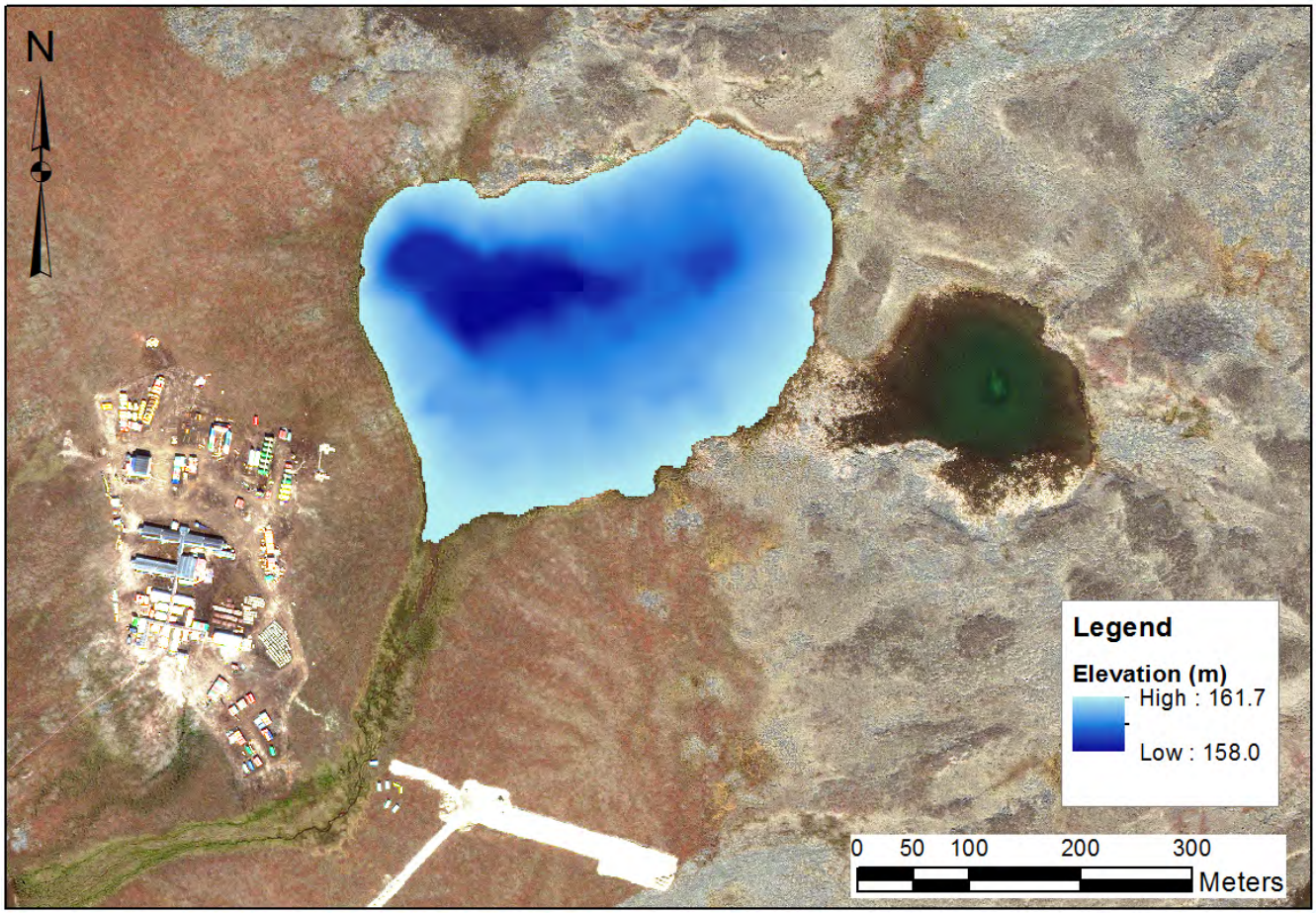


Figure A-12: Bathymetric Map Lake A53

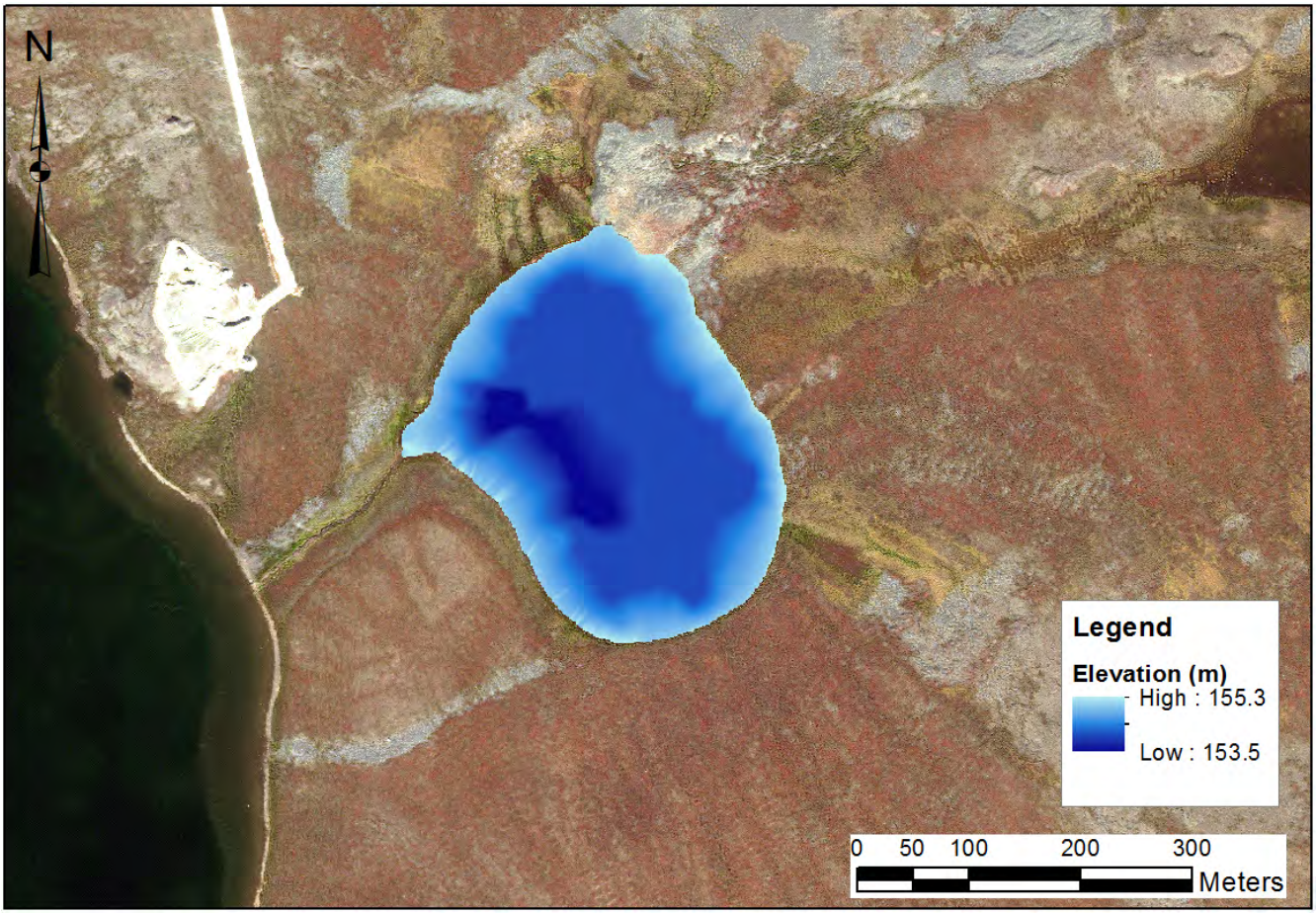


Figure A-13: Bathymetric Map Lake A55

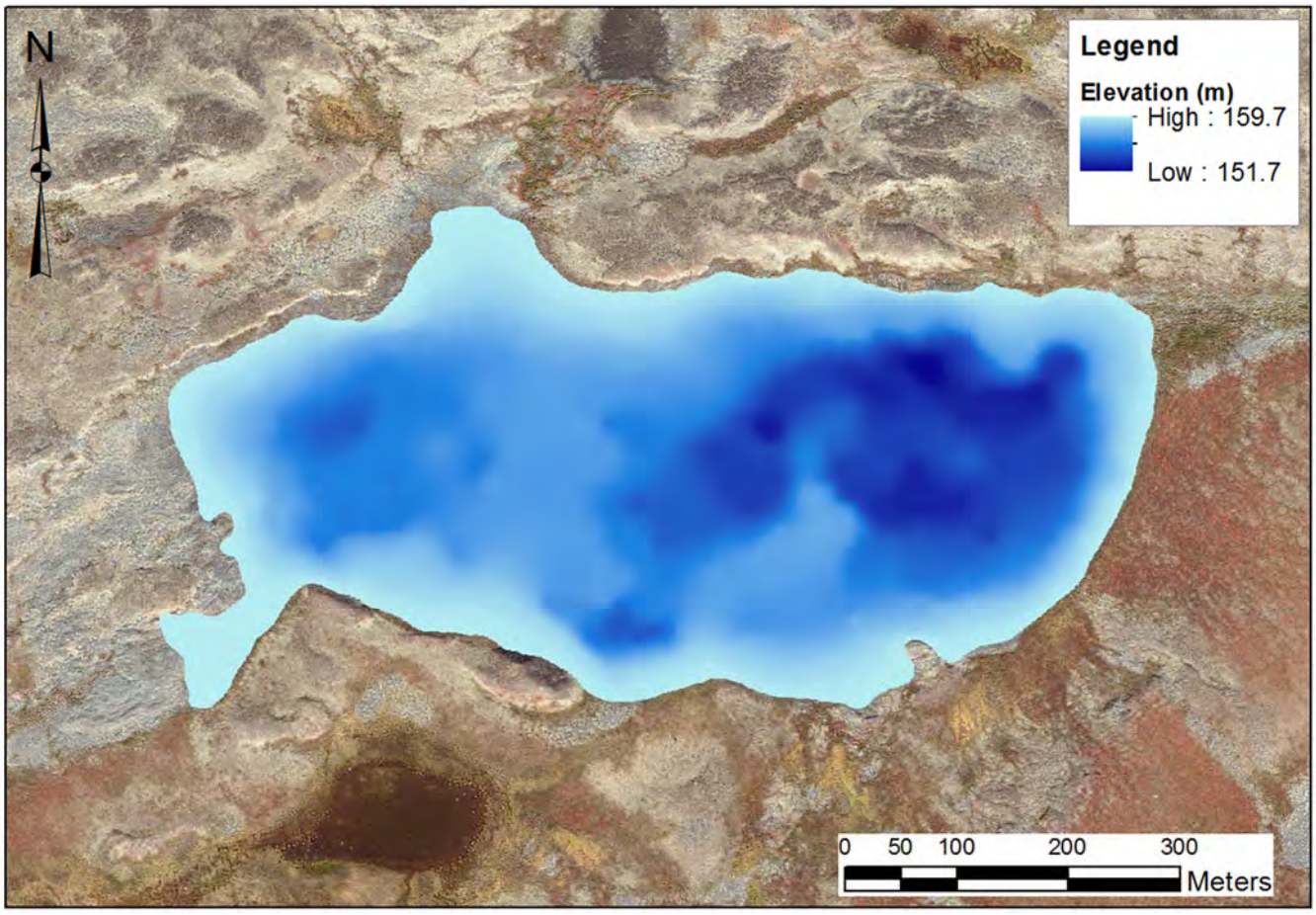


Figure A-14: Bathymetric Map Lake A56

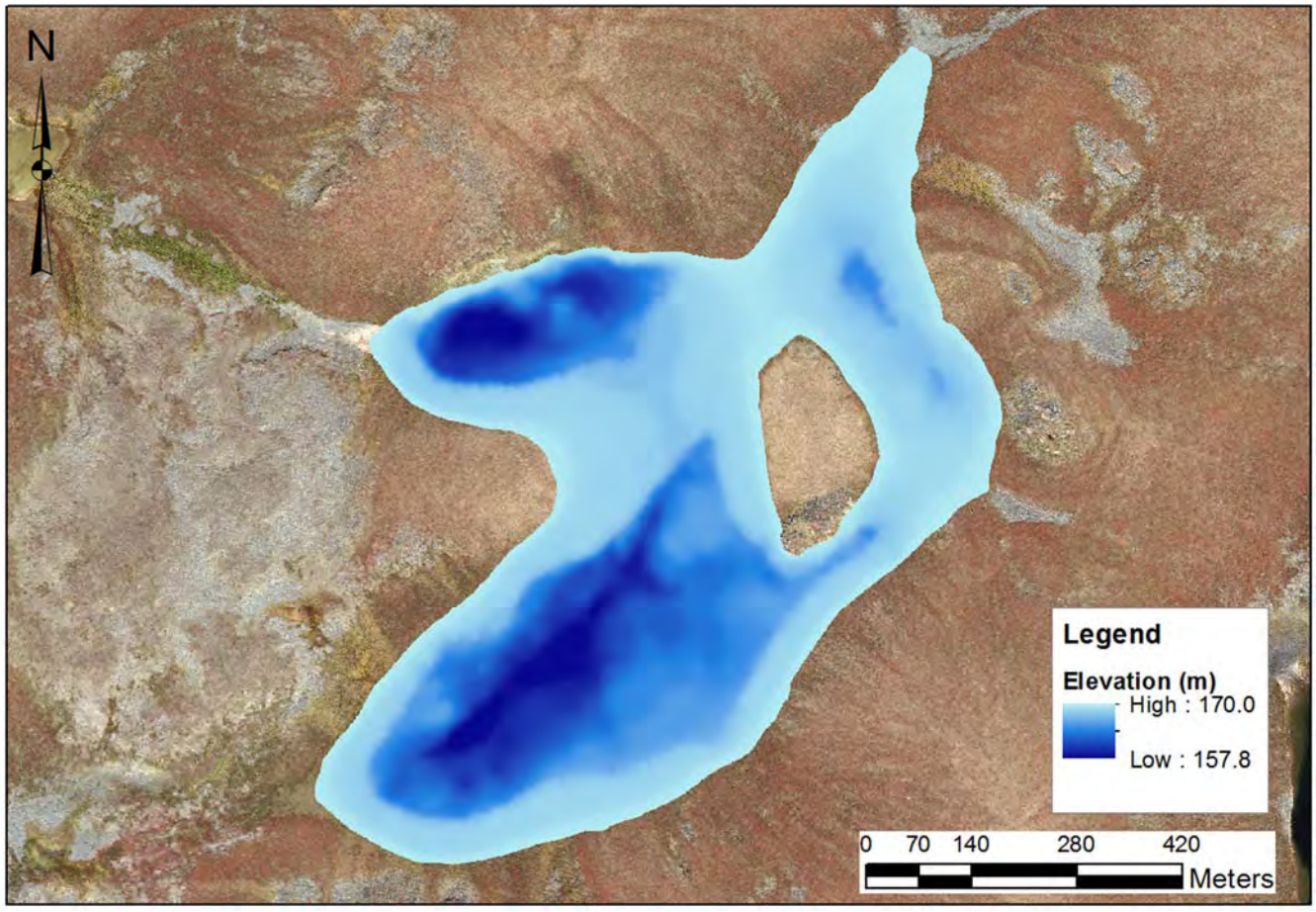


Figure A-15: Bathymetric Map Lake A60

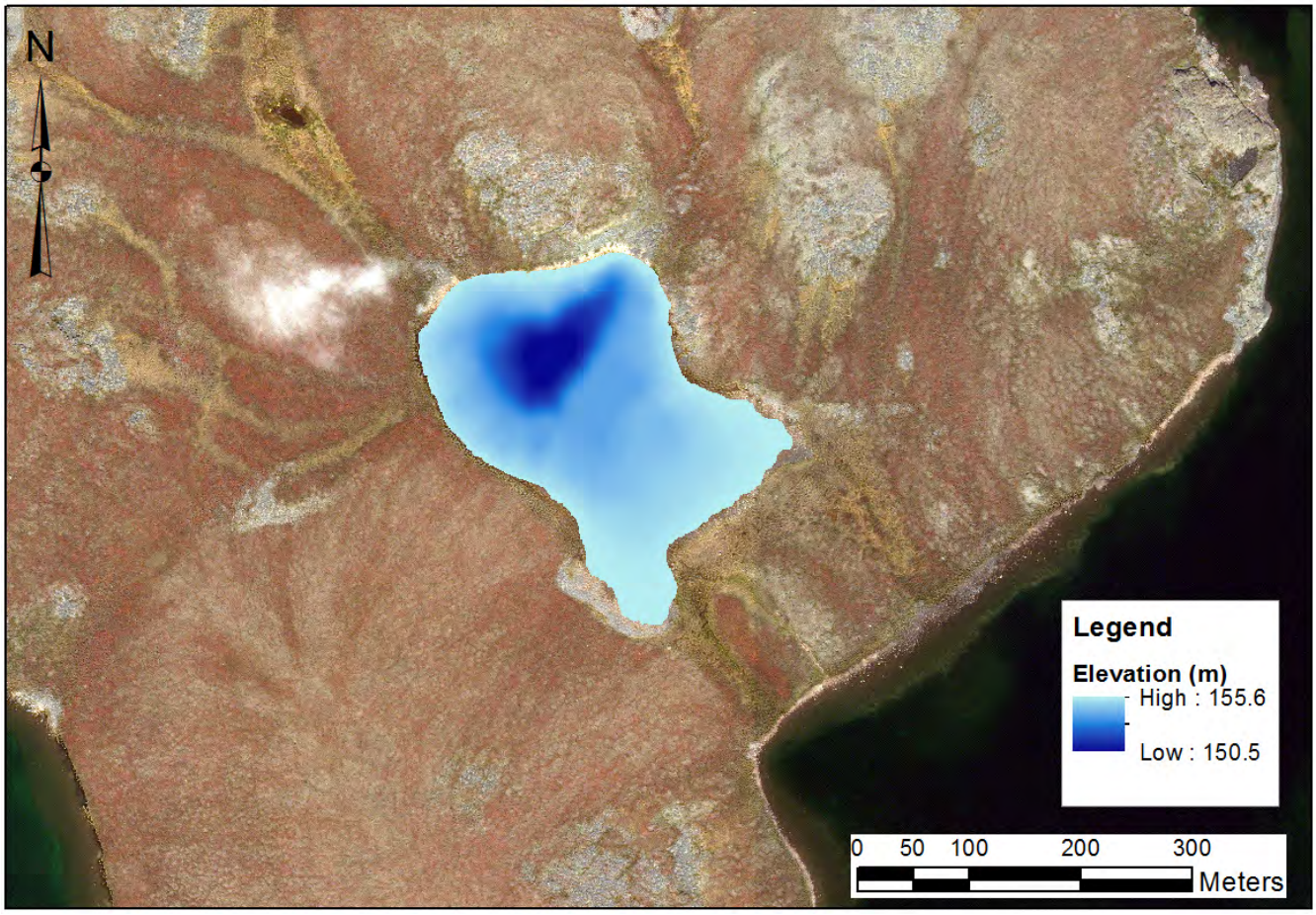


Figure A-16: Bathymetric Map Lake A62

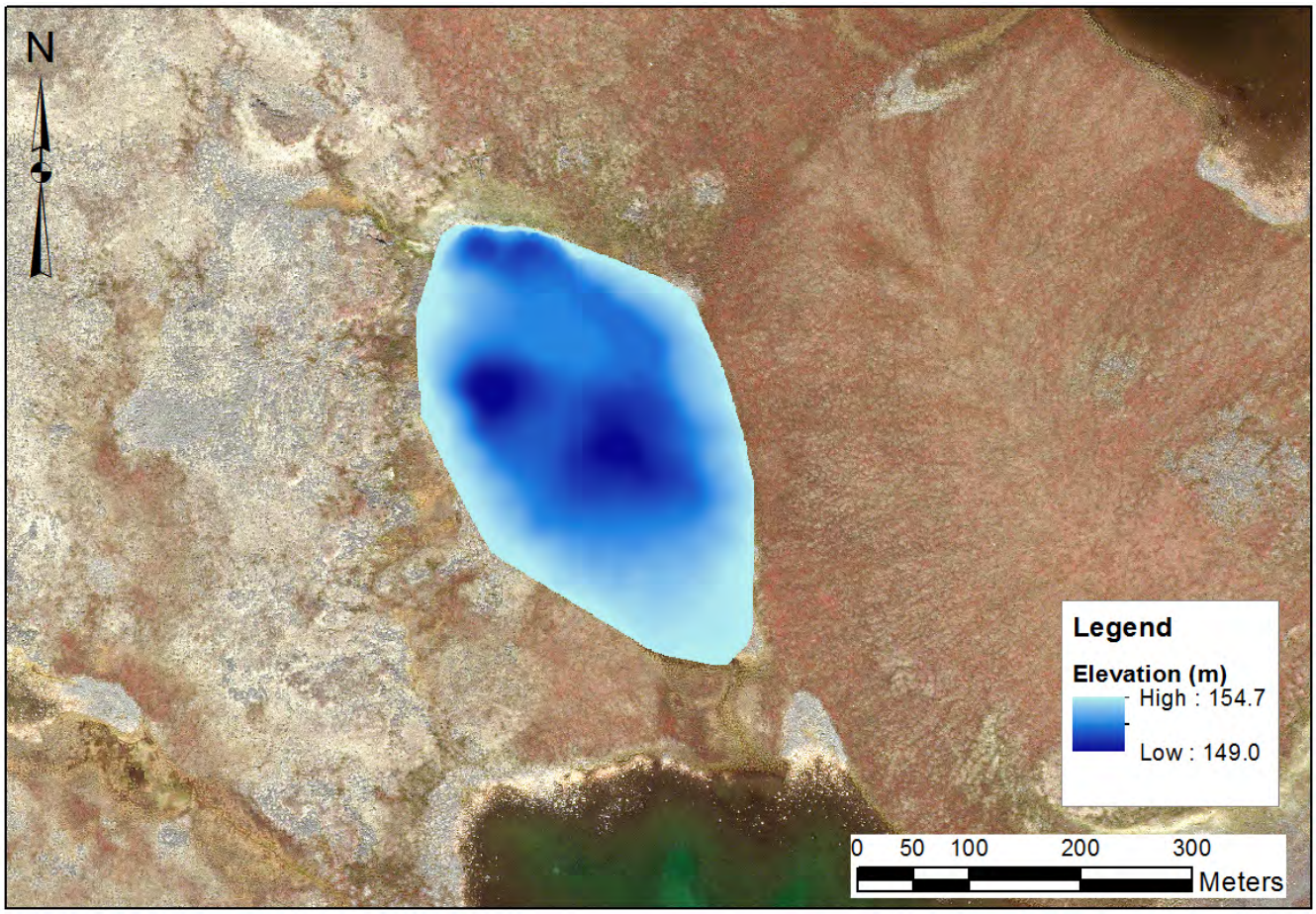


Figure A-17: Bathymetric Map Lake A63

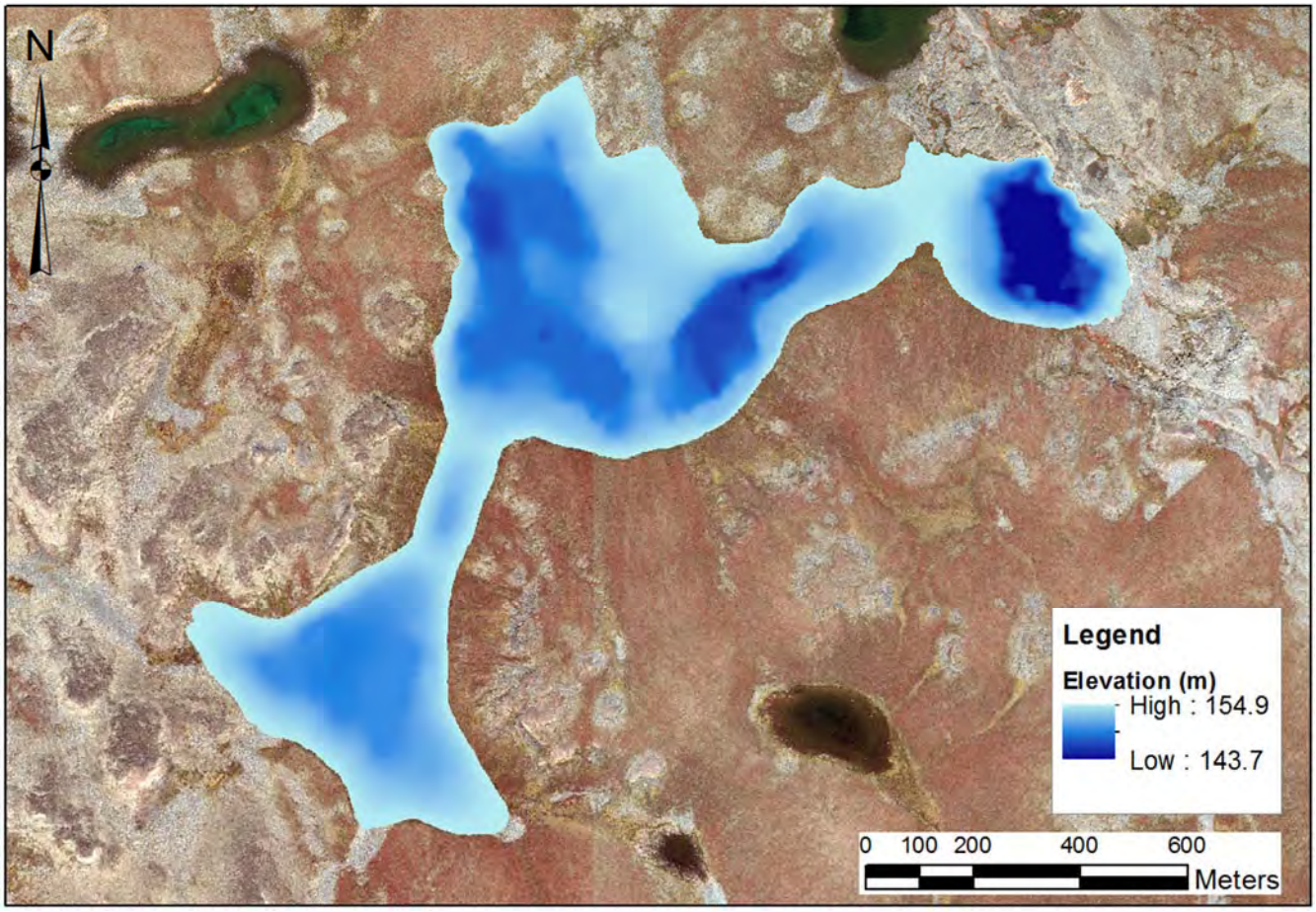


Figure A-18: Bathymetric Map Lake A65

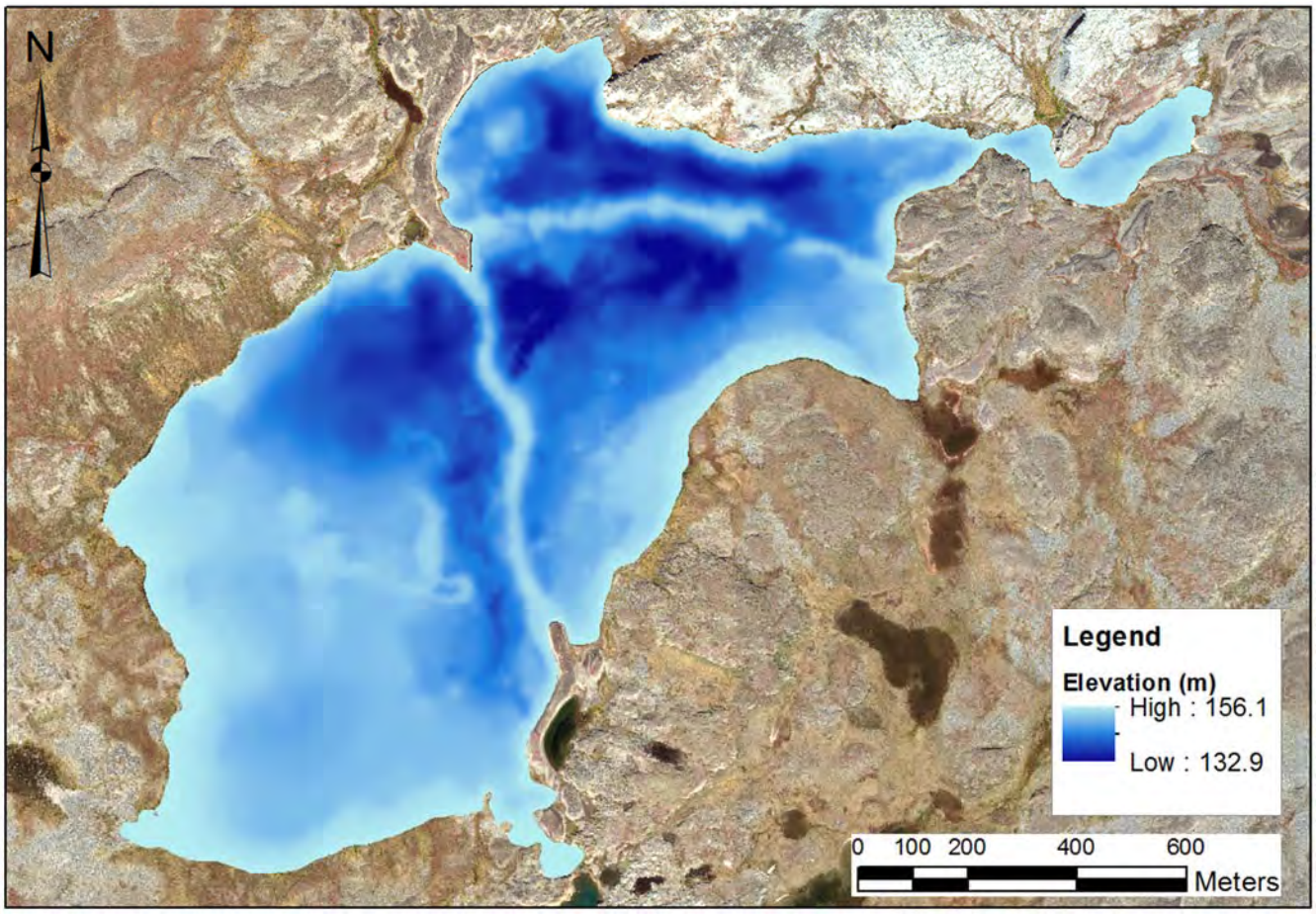


Figure A-19: Bathymetric Map Lake C38

Table A-1: Lake A16 (Mammoth Lake) Elevation-Volume-Surface Area Curve

Elevation (masl)	Volume (m^3)	Surface Area (m^2)	Elevation (masl)	Volume (m^3)	Surface Area (m^2)	Elevation (masl)	Volume (m^3)	Surface Area (m^2)
135.6	0	0	142.2	54801	31038	148.8	1885551	710977
135.8	14	223	142.4	61407	35110	149.0	2032071	769542
136.0	96	603	142.6	68891	39761	149.2	2191988	814749
136.2	248	900	142.8	77328	44958	149.4	2356977	834872
136.4	452	1136	143.0	87274	55677	149.6	2525817	853618
136.6	702	1366	143.2	99545	66186	149.8	2698598	874939
136.8	999	1606	143.4	113657	74990	150.0	2876630	913482
137.0	1346	1866	143.6	129578	84336	150.2	3065024	961868
137.2	1745	2127	143.8	147447	94585	150.4	3260924	997061
137.4	2196	2380	144.0	167805	113382	150.6	3464456	1038025
137.6	2698	2639	144.2	192629	131427	150.8	3675550	1073406
137.8	3253	2921	144.4	220065	142739	151.0	3894452	1126308
138.0	3868	3237	144.6	249708	153753	151.2	4125948	1176813
138.2	4548	3563	144.8	281630	165751	151.4	4364596	1209734
138.4	5294	3893	145.0	316294	183688	151.6	4609941	1244162
138.6	6106	4235	145.2	355397	205338	151.8	4862562	1283193
138.8	7000	4741	145.4	398132	221610	152.0	5123924	1332918
139.0	8014	5471	145.6	443970	236903	152.2	5395954	1387395
139.2	9212	6424	145.8	492940	253107	152.4	5679093	1444517
139.4	10573	7179	146.0	545646	280748	152.6	5975305	1518314
139.6	12084	7936	146.2	605206	309413	152.8	6286468	1596996
139.8	13750	8739	146.4	669037	328605			
140.0	15586	9648	146.6	736658	348072			
140.2	17619	10663	146.8	808468	370440			
140.4	19847	11622	147.0	885366	404134			
140.6	22276	12761	147.2	970120	439133			
140.8	24977	14313	147.4	1060536	464683			
141.0	28022	16235	147.6	1156072	491271			
141.2	31470	18169	147.8	1257325	522228			
141.4	35278	19910	148.0	1365895	575163			
141.6	39437	21699	148.2	1486455	622360			
141.8	43970	23675	148.4	1613797	650581			
142.0	48986	26943	148.6	1746700	678767			

Table A-2: Lake A17 (Whale Tail Lake) Elevation-Volume-Surface Area Curve

Elevation (masl)	Volume (m^3)	Surface Area (m^2)	Elevation (masl)	Volume (m^3)	Surface Area (m^2)	Elevation (masl)	Volume (m^3)	Surface Area (m^2)
134.7	0	0	141.2	196555	94545	147.8	2331006	710625
134.8	9	180	141.4	216079	100658	148.0	2476887	761323
135.0	147	1609	141.6	236800	106694	148.2	2636548	819954
135.2	613	2709	141.8	258825	113787	148.4	2803755	851027
135.4	1216	3310	142.0	282441	123106	148.6	2976742	878444
135.6	1938	3918	142.2	308025	132316	148.8	3155187	906629
135.8	2796	4730	142.4	335301	140195	149.0	3340078	950390
136.0	3837	5712	142.6	364099	147890	149.2	3534711	987788
136.2	5084	6760	142.8	394534	156789	149.4	3734448	1008876
136.4	6541	7814	143.0	427003	169311	149.6	3938133	1028078
136.6	8222	9095	143.2	462297	182792	149.8	4145788	1049136
136.8	10185	10567	143.4	500045	194506	150.0	4358343	1079474
137.0	12465	12305	143.6	540092	205957	150.2	4578091	1115451
137.2	15119	14182	143.8	582471	218065	150.4	4804365	1147179
137.4	18131	15920	144.0	627606	235357	150.6	5036804	1177002
137.6	21490	17699	144.2	676916	255593	150.8	5275280	1208113
137.8	25222	19666	144.4	729608	271182	151.0	5520632	1253121
138.0	29427	22643	144.6	785348	286295	151.2	5778178	1309604
138.2	34253	25560	144.8	844285	303970	151.4	6043386	1342396
138.4	39639	28309	145.0	907405	329543	151.6	6315249	1376728
138.6	45590	31223	145.2	976216	355582	151.8	6594543	1418248
138.8	52145	34375	145.4	1049289	374724	152.0	6883551	1475905
139.0	59377	38061	145.6	1126020	392515	152.2	7182987	1513969
139.2	67382	41886	145.8	1206442	412631	152.4	7488691	1542760
139.4	76099	45249	146.0	1291678	446361	152.6	7800092	1571543
139.6	85478	48560	146.2	1384886	480847	152.8	8117574	1604388
139.8	95545	52197	146.4	1483363	502808	153.0	8509682	1669380
140.0	106448	57470	146.6	1585930	523016			
140.2	118614	63635	146.8	1692801	547030			
140.4	131887	69108	147.0	1805643	590359			
140.6	146224	74157	147.2	1928415	631281			
140.8	161588	79884	147.4	2057439	658389			
141.0	178309	87533	147.6	2191652	683681			

Table A-3: Lake A18 Elevation-Volume-Surface Area Curve

Elevation (masl)	Volume (m^3)	Surface Area (m^2)
152.0	0	0
152.2	1639	12450
152.4	5112	22630
152.6	11483	41340
152.8	21036	54200
153.0	33189	67700
153.2	48311	82800
153.4	66336	97500
153.6	87475	115200
153.8	112775	138400
154.0	143731	167600
154.2	179470	190100

Table A-4: Lake A19 Elevation-Volume-Surface Area Curve

Elevation (masl)	Volume (m^3)	Surface Area (m^2)
152.0	0	0
152.2	168	1087
152.4	446	1720
152.6	921	3127
152.8	1678	4523
153.0	2761	6490
153.2	4636	10950
153.4	7162	14380
153.6	10637	20620
153.8	15238	25410
154.0	20817	30520
154.2	27526	36480
154.4	35423	42530
154.6	44592	49650
154.8	55516	59700
154.9	61742	64700

Table A-5: Lake A20 Elevation-Volume-Surface Area Curve

Elevation (masl)	Volume (m^3)	Surface Area (m^2)	Elevation (masl)	Volume (m^3)	Surface Area (m^2)	Elevation (masl)	Volume (m^3)	Surface Area (m^2)
129.9	0	0	136.7	63422	24521	143.5	374217	66933
130.1	4	50	136.9	68472	26079	143.7	387734	68256
130.3	23	157	137.1	73886	27923	143.9	401536	69806
130.5	66	268	137.3	79592	29099	144.1	415673	71556
130.7	132	406	137.5	85518	30160	144.3	430135	73038
130.9	243	843	137.7	91657	31236	144.5	444883	74435
131.1	554	2272	137.9	98020	32431	144.7	459910	75848
131.3	1063	2768	138.1	104647	33838	144.9	475231	77402
131.5	1655	3153	138.3	111540	35050	145.1	490891	79210
131.7	2326	3575	138.5	118660	36142	145.3	506903	80898
131.9	3095	4134	138.7	125996	37230	145.5	523250	82626
132.1	4007	4996	138.9	133558	38415	145.7	539991	84754
132.3	5058	5487	139.1	141385	39860	145.9	557164	87033
132.5	6197	5891	139.3	149481	41067	146.1	574838	89718
132.7	7413	6271	139.5	157805	42163	146.3	593021	92083
132.9	8708	6705	139.7	166345	43249	146.5	611672	94431
133.1	10124	7486	139.9	175110	44426	146.7	630793	96806
133.3	11690	8146	140.1	184133	45797	146.9	650422	99661
133.5	13375	8696	140.3	193413	46977	147.1	671129	107738
133.7	15170	9272	140.5	202917	48061	147.3	693104	111720
133.9	17103	10120	140.7	212637	49144	147.5	715779	115009
134.1	19246	11301	140.9	222580	50309	147.7	739111	118360
134.3	21600	12168	141.1	232774	51629	147.9	763178	122768
134.5	24098	12801	141.3	243219	52801	148.1	788682	132882
134.7	26717	13388	141.5	253890	53901	148.3	815926	139007
134.9	29459	14062	141.7	264780	55004	148.5	844198	143598
135.1	32369	15033	141.9	275897	56195	148.7	873350	147970
135.3	35456	15814	142.1	287270	57537	148.9	903443	153289
135.5	38699	16679	142.3	298903	58774	149.1	936084	173259
135.7	42149	17880	142.5	310778	59982	149.3	971447	180008
135.9	45852	19175	142.7	322899	61243	149.5	1008013	185567
136.1	49851	20769	142.9	335283	62623	149.7	1045669	191181
136.3	54129	21994	143.1	347968	64249	149.9	1084632	199007
136.5	58648	23221	143.3	360959	65636	150.1	1126753	223274

Table A-5: Lake A20 Elevation-Volume-Surface Area Curve (continued)

Elevation (masl)	Volume (m^3)	Surface Area (m^2)
150.3	1172683	235342
150.5	1220762	245387
150.7	1270778	254801
150.9	1322813	266158
151.1	1378463	291035
151.3	1437769	301146
151.5	1498818	309126
151.7	1561380	316475
151.9	1625447	324458
152.1	1691792	339803
152.3	1760745	349075
152.5	1831291	356294
152.7	1903259	363459
152.9	1976755	371943
153.1	2053669	398166
153.3	2134470	409523
153.5	2217461	420501
153.7	2302762	432869
153.9	2390848	449023
154.1	2483111	473594
154.3	2579798	492810
154.5	2680187	511138
154.7	2784425	532027
154.9	2893567	562011

Table A-6: Lake A22 Elevation-Volume-Surface Area Curve

Elevation (masl)	Volume (m^3)	Surface Area (m^2)	Elevation (masl)	Volume (m^3)	Surface Area (m^2)
146.0	0	0	152.8	132165	34580
146.2	575	3349	153.0	139179	35580
146.4	1350	4435	153.2	146412	36770
146.6	2365	5660	153.4	153890	38010
146.8	3600	6700	153.6	161627	39410
147.0	5046	7780	153.8	169660	40930
147.2	6719	8890	154.0	178003	42510
147.4	8604	9980	154.2	186676	44230
147.6	10708	11030	154.4	195699	46020
147.8	13014	12030	154.6	205089	47860
148.0	15522	13050	154.8	214838	49660
148.2	18229	14020	155.0	225033	52300
148.4	21131	15000			
148.6	24230	15980			
148.8	27523	16960			
149.0	31015	17970			
149.2	34716	19030			
149.4	38632	20140			
149.6	42773	21210			
149.8	47109	22150			
150.0	51634	23100			
150.2	56338	23940			
150.4	61211	24790			
150.6	66254	25620			
150.8	71457	26410			
151.0	76818	27210			
151.2	82336	27970			
151.4	88007	28740			
151.6	93833	29510			
151.8	99813	30290			
152.0	105949	31070			
152.2	112245	31900			
152.4	118708	32740			
152.6	125343	33630			

Table A-7: Lake A43 Elevation-Volume-Surface Area Curve

Elevation (masl)	Volume (m^3)	Surface Area (m^2)
148.9	0	0
149.1	20	276
149.3	108	584
149.5	253	868
149.7	458	1197
149.9	740	1654
150.1	1161	2627
150.3	1768	3418
150.5	2522	4117
150.7	3413	4792
150.9	4441	5497
151.1	5645	6600
151.3	7071	7675
151.5	8726	8911
151.7	10664	10577
151.9	13112	14178
152.1	16518	19944
152.3	20869	23381
152.5	25852	26473
152.7	31492	30024
152.9	37927	34599
153.1	45874	44901
153.3	55458	50833
153.5	66191	56489
153.7	78063	62290
153.9	91145	68674
154.1	105601	76014
154.3	121567	83679
154.5	139100	91754
154.7	158326	100705
154.9	179491	111330
155.1	203063	124870
155.3	229630	141590
155.5	260491	170235

Table A-8: Lake A44 Elevation-Volume-Surface Area Curve

Elevation (masl)	Volume (m^3)	Surface Area (m^2)	Elevation (masl)	Volume (m^3)	Surface Area (m^2)
143.9	0	0	150.4	175324	78016
144.0	10	550	150.6	191230	81023
144.2	215	1310	150.8	207738	84101
144.4	523	1774	151.0	224893	87947
144.6	925	2260	151.2	242951	91957
144.8	1439	2910	151.4	261599	94432
145.0	2153	5058	151.6	280694	96476
145.2	3433	7198	151.8	300189	98515
145.4	4978	8186	152.0	320099	100612
145.6	6701	9042	152.2	340415	102439
145.8	8601	9991	152.4	361050	103879
146.0	10727	11498	152.6	381960	105214
146.2	13211	13153	152.8	403134	106532
146.4	15964	14352	153.0	424576	107910
146.6	18950	15517	153.2	446297	109272
146.8	22177	16795	153.4	468281	110567
147.0	25706	18960	153.6	490527	111904
147.2	29744	21053	153.8	513054	113417
147.4	34092	22399	154.0	535941	116250
147.6	38702	23708	154.2	559621	120250
147.8	43584	25162	154.4	584076	124478
148.0	48820	28255	154.6	609532	130576
148.2	55031	32799	154.8	636436	138870
148.4	61878	35624	155.0	665304	152157
148.6	69279	38444	155.2	696874	162197
148.8	77295	41858	155.4	730062	169627
149.0	86182	49087	155.6	764799	178263
149.2	96807	55309	155.8	801594	190183
149.4	108175	58265	156.0	841019	205318
149.6	120091	60868	156.2	884016	223183
149.8	132526	63535			
150.0	145614	68912			
150.2	160049	74581			

Table A-9: Lake A45 Elevation-Volume-Surface Area Curve

Elevation (masl)	Volume (m^3)	Surface Area (m^2)
152.5	0	0
152.7	119	716
152.9	289	986
153.1	526	1430
153.3	880	2168
153.5	1416	3310
153.7	2685	6980
153.9	4208	8240
154.1	5977	9390
154.3	7957	10410
154.5	10143	11460
154.7	12550	12620
154.9	15194	13830
155.1	18144	15760
155.3	21460	17400
155.5	25100	19040
155.7	29091	20880
155.9	33455	22770
156.1	38201	24680
156.3	43333	26840
156.5	49068	30470

Table A-10: Lake A47 Elevation-Volume-Surface Area Curve

Elevation (masl)	Volume (m^3)	Surface Area (m^2)
151.8	0	0
152.0	34	427
152.2	154	746
152.4	330	1017
152.6	562	1307
152.8	859	1688
153.0	1254	2386
153.2	1839	3409
153.4	2603	4224
153.6	3559	5609
153.8	4907	8206
154.0	7193	15965
154.2	11340	23862
154.4	16592	28555
154.6	22749	33047
154.8	29844	38042
155.0	38008	43625
155.2	50238	47362

Table A-11: Lake A49 Elevation-Volume-Surface Area Curve

Elevation (masl)	Volume (m^3)	Surface Area (m^2)	Elevation (masl)	Volume (m^3)	Surface Area (m^2)
151.8	0	0	158.4	68165	26013
152.0	6	86	158.6	73454	26888
152.2	36	213	158.8	78928	27880
152.4	90	330	159.0	85693	29322
152.6	169	474	159.1	87804	30042
152.8	301	894			
153.0	568	1932			
153.2	1077	3019			
153.4	1752	3734			
153.6	2571	4451			
153.8	3531	5151			
154.0	4637	5960			
154.2	5919	6769			
154.4	7331	7333			
154.6	8852	7882			
154.8	10488	8506			
155.0	12264	9285			
155.2	14194	9972			
155.4	16245	10532			
155.6	18406	11085			
155.8	20690	11844			
156.0	23156	12864			
156.2	25814	13698			
156.4	28626	14388			
156.6	31567	15031			
156.8	34642	15737			
157.0	37879	16760			
157.2	41368	18121			
157.4	45128	19486			
157.6	49163	20862			
157.8	53479	22365			
158.0	58124	24053			
158.2	63050	25133			

Table A-12: Lake A53 Elevation-Volume-Surface Area Curve

Elevation (masl)	Volume (m^3)	Surface Area (m^2)
158.0	0	0
158.2	494	3445
158.4	1389	5530
158.6	2908	9490
158.8	4943	10860
159.0	7255	12270
159.2	10021	14930
159.4	13249	17400
159.6	17199	22540
159.8	22167	27180
160.0	28084	32190
160.2	35262	39080
160.4	43742	45770
160.6	53863	55500
160.8	65711	63000
161.0	79064	70800
161.2	94204	80000
161.4	111077	88800
161.6	129774	98700
161.7	140190	103000

Table A-13: Lake A55 Elevation-Volume-Surface Area Curve

Elevation (masl)	Volume (m^3)	Surface Area (m^2)
153.5	0	0
153.7	706	5200
153.9	2108	8880
154.1	7104	41770
154.3	16126	48440
154.5	26475	55200
154.7	38348	63300
154.9	51830	71500
155.1	66880	77700
155.3	82654	79900

Table A-14: Lake A56 Elevation-Volume-Surface Area Curve

Elevation (masl)	Volume (m^3)	Surface Area (m^2)	Elevation (masl)	Volume (m^3)	Surface Area (m^2)
151.7	0	0	158.3	430084	187927
151.9	13	173	158.5	468205	193315
152.1	69	375	158.7	507431	199031
152.3	161	539	158.9	547871	205544
152.5	286	717	159.1	589728	213177
152.7	451	1007	159.3	633188	221551
152.9	749	2089	159.5	678407	230820
153.1	1533	6058	159.7	725630	241836
153.3	3050	8925			
153.5	5081	11394			
153.7	7631	14244			
153.9	10843	18189			
154.1	15427	28508			
154.3	21747	33996			
154.5	28921	37635			
154.7	36775	40881			
154.9	45282	44405			
155.1	54872	51439			
155.3	65670	56459			
155.5	77417	61006			
155.7	90088	65779			
155.9	103777	71375			
156.1	119582	87757			
156.3	137998	95960			
156.5	157909	103252			
156.7	179258	110249			
156.9	202123	119046			
157.1	227631	138461			
157.3	257244	155172			
157.5	289138	163521			
157.7	322557	170339			
157.9	357188	176024			
158.1	393040	182441			

Table A-15: Lake A60 Elevation-Volume-Surface Area Curve

Elevation (masl)	Volume (m^3)	Surface Area (m^2)	Elevation (masl)	Volume (m^3)	Surface Area (m^2)	Elevation (masl)	Volume (m^3)	Surface Area (m^2)
157.8	0	0	162.0	46129	33593	166.2	370121	135782
158.0	18	286	162.2	53244	37306	166.4	397879	141716
158.2	140	897	162.4	61016	40413	166.6	426793	147412
158.4	365	1344	162.6	69403	43437	166.8	456853	153245
158.6	679	1805	162.8	78403	46659	167.0	488180	161668
158.8	1092	2360	163.0	88130	50863	167.2	521485	170074
159.0	1658	3279	163.2	98812	55630	167.4	556065	175619
159.2	2397	4105	163.4	110298	59109	167.6	591621	179629
159.4	3299	4925	163.6	122439	62300	167.8	627896	183154
159.6	4374	5848	163.8	135233	65703	168.0	664908	186973
159.8	5656	7033	164.0	148795	71018	168.2	702655	190468
160.0	7213	8619	164.2	163648	76752	168.4	741097	193968
160.2	9119	10412	164.4	179408	80780	168.6	780258	197703
160.4	11385	12262	164.6	195952	84671	168.8	820214	202004
160.6	14015	14081	164.8	213310	89221	169.0	861204	210527
160.8	17033	16127	165.0	231815	96707	169.2	904530	223017
161.0	20488	18623	165.2	251984	104193	169.4	950434	236067
161.2	24511	21405	165.4	273351	109360	169.6	999194	252709
161.4	29051	24077	165.6	295712	114330	169.8	1052300	282938
161.6	34141	26828	165.8	319112	119717	170.0	1114114	334342
161.8	39800	29853	166.0	343699	127344			

Table A-16: Lake A62 Elevation-Volume-Surface Area Curve

Elevation (masl)	Volume (m^3)	Surface Area (m^2)
150.5	0	0
150.7	227	1340
150.9	540	1796
151.1	948	2271
151.3	1450	2770
151.5	2060	3347
151.7	2784	3874
151.9	3613	4426
152.1	4561	5030
152.3	5618	5550
152.5	6781	6090
152.7	8054	6640
152.9	9438	7210
153.1	10943	7860
153.3	12584	8560
153.5	14371	9340
153.7	16345	10440
153.9	18551	11630
154.1	21335	16660
154.3	24994	19990
154.5	29355	23780
154.7	34692	28660
154.9	40837	32830
155.1	47863	37680
155.3	55981	43670
155.5	65434	51300
155.6	71951	57500

Table A-17: Lake A63 Elevation-Volume-Surface Area Curve

Elevation (masl)	Volume (m^3)	Surface Area (m^2)
149.0	0	0
149.2	208	1336
149.4	545	2068
149.6	1054	3063
149.8	1778	4207
150.0	2752	5580
150.2	4027	7200
150.4	5650	9070
150.6	7713	11650
150.8	10296	14240
151.0	13437	17320
151.2	17310	20730
151.4	21730	23470
151.6	26925	28650
151.8	32989	31980
152.0	39711	35330
152.2	47628	40750
152.4	56006	43030
152.6	64838	45290
152.8	74123	47560
153.0	83863	49880
153.2	94100	52500
153.4	104869	55200
153.6	116198	58200
153.8	128145	61300
154.0	140731	64600
154.2	154007	68200
154.4	168047	72200
154.6	183198	79600
154.7	191366	83700

Table A-18: Lake A65 Elevation-Volume-Surface Area Curve

Elevation (masl)	Volume (m^3)	Surface Area (m^2)	Elevation (masl)	Volume (m^3)	Surface Area (m^2)
143.7	0	0	150.3	92672	52519
143.9	3	56	150.5	103752	58241
144.1	29	200	150.7	115968	63933
144.3	83	351	150.9	129375	70513
144.5	173	558	151.1	148222	119767
144.7	310	825	151.3	173640	133506
144.9	515	1324	151.5	201548	145468
145.1	870	2216	151.7	232824	167072
145.3	1405	3184	151.9	268392	189448
145.5	2141	4152	152.1	310623	230145
145.7	3067	5156	152.3	358535	248226
145.9	4211	6332	152.5	409733	263476
146.1	5621	7726	152.7	463978	279203
146.3	7282	8825	152.9	521543	297056
146.5	9129	9646	153.1	583628	323805
146.7	11141	10478	153.3	650607	345884
146.9	13328	11430	153.5	722055	369038
147.1	15734	12675	153.7	798434	395388
147.3	18390	13792	153.9	880504	426278
147.5	21241	14714	154.1	969843	469119
147.7	24276	15661	154.3	1067485	506429
147.9	27515	16824	154.5	1172351	541497
148.1	31062	18660	154.7	1284284	578780
148.3	34912	19809	154.9	1404626	629529
148.5	38979	20848			
148.7	43252	21890			
148.9	47739	23039			
149.1	52526	24790			
149.3	57616	26098			
149.5	62967	27446			
149.7	68610	29198			
149.9	74844	33781			
150.1	82801	45904			

Table A-19: Lake C38 Elevation-Volume-Surface Area Curve

Elevation (masl)	Volume (m^3)	Surface Area (m^2)	Elevation (masl)	Volume (m^3)	Surface Area (m^2)	Elevation (masl)	Volume (m^3)	Surface Area (m^2)
132.9	0	0	139.5	124727	67758	146.1	1369129	335554
133.1	7	85	139.7	138755	72622	146.3	1437316	345935
133.3	32	165	139.9	153820	78309	146.5	1507385	354637
133.5	74	259	140.1	170329	86864	146.7	1579194	363660
133.7	141	427	140.3	188331	92947	146.9	1652912	373798
133.9	251	713	140.5	207457	98213	147.1	1728984	387078
134.1	464	1411	140.7	227632	103838	147.3	1807488	397611
134.3	781	1749	140.9	249062	110990	147.5	1887935	406905
134.5	1161	2048	141.1	272233	120065	147.7	1970286	416834
134.7	1601	2360	141.3	296881	126257	147.9	2054762	428237
134.9	2109	2739	141.5	322701	131909	148.1	2141730	441366
135.1	2735	3531	141.7	349650	137652	148.3	2231011	451124
135.3	3512	4246	141.9	377850	144660	148.5	2322113	459823
135.5	4441	5075	142.1	407939	156046	148.7	2414933	468494
135.7	5548	6022	142.3	439937	163884	148.9	2509604	478612
135.9	6879	7575	142.5	473428	170898	149.1	2606559	490999
136.1	8740	11031	142.7	508269	177562	149.3	2705787	500955
136.3	11135	12838	142.9	544522	185322	149.5	2806886	510004
136.5	13858	14360	143.1	582684	196453	149.7	2909782	518995
136.7	16893	16116	143.3	622848	204843	149.9	3014539	528988
136.9	20341	18608	143.5	664526	211834	150.1	3122078	546421
137.1	24415	22056	143.7	707590	218937	150.3	3232619	558681
137.3	29086	24593	143.9	752199	227496	150.5	3345492	570072
137.5	34245	27033	144.1	798825	238947	150.7	3460743	583021
137.7	39920	29804	144.3	847489	247490	150.9	3579043	601152
137.9	46219	33438	144.5	897757	255171	151.1	3702247	631214
138.1	53313	37412	144.7	949607	263601	151.3	3830384	649416
138.3	61140	40798	144.9	1003374	274752	151.5	3961986	666569
138.5	69611	43920	145.1	1059663	287595	151.7	4097097	685049
138.7	78715	47168	145.3	1118064	296250	151.9	4236381	709790
138.9	88536	51323	145.5	1178132	304384	152.1	4384933	774749
139.1	99462	58020	145.7	1239838	312801	152.3	4542745	801420
139.3	111607	63326	145.9	1303334	322629	152.5	4705112	821258

Table A-19: Lake C38 (Nemo Lake) Elevation-Volume-Surface Area Curve (continued)

Elevation (masl)	Volume (m^3)	Surface Area (m^2)
152.7	4871116	838950
152.9	5040950	860512
153.1	5217035	900351
153.3	5399508	922896
153.5	5585972	941699
153.7	5776140	960020
153.9	5970133	980502
154.1	6169226	1009900
154.3	6373125	1028767
154.5	6580723	1047329
154.7	6792149	1067275
154.9	7007790	1089678
155.1	7228254	1114598
155.3	7453178	1134167
155.5	7681833	1152388
155.7	7914208	1171772
155.9	8150891	1196613
156.1	8359828	1254532

APPENDIX 6-N

Site-specific Water Quality Objective – Arsenic

June 2016
Report No. 1541520

AGNICO EAGLE

Golder Associates

6.N-1 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by Agnico Eagle Mines Limited (Agnico Eagle) to develop a long-term site-specific water quality objective (SSWQO) for arsenic for the protection of freshwater aquatic life in Mammoth Lake and downstream lakes for the Environmental Impact Statement for the Whale Tail Pit and Haul Road. This technical memorandum describes the methods and results of the development of the long-term SSWQO for arsenic.

6.N-2 GENERAL APPROACH

The SSWQO for arsenic was developed in general accordance with standard methods provided for the development of a long-term guideline for freshwater environments by the Canadian Council of Ministers of the Environment (CCME) in the guidance document "*A Protocol for the Derivation of Water Quality Guidelines for the Protection of Aquatic Life 2007*" (CCME 2007). The CCME has developed a refined, stepwise method for site-specific derivations that is preferred by regulators and provides a consistent framework for evaluations. In an earlier guidance document, the CCME (2003) outlines several procedures that can be used to modify the generic water quality guidelines for the protection of freshwater aquatic life, including the background concentration procedure, recalculation procedure, water effect procedure, and resident species procedure. However, these approaches were not selected as options to develop the SSWQO for arsenic at this time. Where warranted, species resident in Mammoth Lake and downstream lakes as well as in the Project area and Nunavut were taken into consideration in the development of the SSWQO using the CCME (2007) protocol based on guidance provided by the CCME in their 2003 document.

The CCME (2007) guidance document provides two approaches for deriving water quality guidelines that depend on the adequacy of the toxicity data (availability and quality) for the substance. These approaches are:

- **Statistical Derivation Approach** – This approach is the preferred approach, when data are adequate, and is based on the statistical distribution (i.e., a species sensitivity distribution [SSD]) of the available and acceptable toxicity data. Guidelines derived using this approach are called Type A Guidelines; and
- **Lowest Endpoint Derivation Approach** – This approach is used if the data are inadequate for the Statistical Derivation Approach. This approach is based on extrapolation from the lowest available and acceptable toxicity data and application of uncertainty or safety factors, where warranted. This approach is based on the original federal guideline development protocol (CCME 1991). Guidelines derived using this approach are called Type B Guidelines, and are further divided into Type B1 and Type B2 guidelines based on the adequacy (availability and quality) of toxicity data.

Based on the CCME (2007) protocol, the general approach for development of the long-term SSWQO for arsenic followed a four-step process:

1) Toxicity data compilation – Available freshwater chronic toxicity data for arsenic was compiled into a database with a focus on data for algae, aquatic plants, aquatic invertebrates, fish and amphibians;

2) Toxicity data evaluation, categorization and endpoint selection – The available toxicity data was evaluated for suitability and categorized as acceptable or unacceptable for developing a long-term SSWQO. Once the data were evaluated and categorized, preferred endpoints were selected;

3) Determination of the applicable SSWQO derivation approach - Depending on the adequacy of the toxicity data, it was determined whether the Statistical Derivation Approach or the Lowest Endpoint Derivation Approach should be used to develop the SSWQO for arsenic; and

4) Development of the SSWQO for arsenic using the selected approach (Section 6.N-5).

These steps are described in detail in the sections below.

6.N-3 TOXICITY DATA COMPILATION

Available toxicity data for arsenic were compiled into a database with a focus on long-term or chronic data for algae, aquatic plants, invertebrates, fish and amphibians in freshwater environments, per the recommendations of CCME (2007). The compilation of toxicity data began with the primary chronic toxicity data from the fact sheet used to derive the current CCME Canadian Water Quality Guideline for the Protection of Freshwater Aquatic Life (CWQG-PFAL) for arsenic (CCME 2001). The compilation included querying the ECOTOX Database administered by the United States Environmental Protection Agency (U.S. EPA 2016) and other journal databases (e.g., PubMed, Cambridge Scientific Abstracts) for the time period prior to, coinciding with and subsequent to the CWQG-PAL derivation (from the year 1915 to the year 2016). The query for the time period subsequent to the CWQG-PAL derivation was done to include recently generated freshwater toxicity data in the development of the SSWQO.

The definitions of long-term exposure durations provided by the CCME (2007) were followed in identifying chronic toxicity data. The definitions are:

- For fish and amphibians, exposure durations of ≥21 days for tests with juvenile or adult life stages and ≥7 days for tests with eggs and larvae.
- For short-lived invertebrates (e.g., *Ceriodaphnia dubia*), exposure durations of ≥96 hours for non-lethal effects measures (e.g., growth, reproduction) and <21 days for lethality on a case-by-case basis.
- For long-lived invertebrates (e.g., *Daphnia magna*), exposure durations of ≥7 days for non-lethal effects measures and ≥21 days for lethality.
- For aquatic and semi-aquatic plants, exposure must be through the water column. All tests for *Lemna* sp. following standard test protocols are generally considered long-term exposures. Data for other species is considered on a case-by-case basis.
- For algae, exposure durations of >24 hours or on a case-by-case basis (e.g., >72 hour tests with *Pseudokirchneriella subcapitata* were considered chronic).

Arsenic naturally occurs in several valence states: elemental arsenic (As^0), trivalent arsenic (As^{+3} or As[III]), pentavalent arsenic (As^{+5} or As[V]) and arsenide (As^{-3}). The toxicity of arsenic is determined by its chemical form and valence state. In aquatic systems, As(III) and As(V) are the most common states, with As(V) dominating under oxidizing conditions (i.e., high pH, high redox potential (Eh), high dissolved oxygen [DO]) and As(III) dominating under reducing conditions (Eisler 1988). However, because the dissolved oxygen in an aquatic system varies both temporally and spatially, which affects the redox potential, the equilibrium position of the As(III) and As(V) reaction is constantly shifting (i.e., both As[III] and As[V] are thermodynamically unstable and interchangeable) (Fodor 2001; Smedley and Kinniburgh 2002). Consequently, aquatic biota are likely exposed to a mixture of As(III) and As(V), with the relative proportion dependent on, among other things, the dissolved oxygen concentration.

This coexistence of As(III) and As(V) has been observed in natural aquatic systems (Bright et al. 1994, Nagorski and Moore 1999). Some studies have demonstrated that As(V) is less toxic than As(III) in aquatic systems (Borgmann et al. 1980; Naumann et al. 2007).

Based on these considerations, arsenic speciation in lakes in the Project area likely includes both As (III) and As (V), and is likely somewhat variable depending upon the various modifying factors. As described above, it is possible that both oxic and anoxic conditions can potentially occur in freshwater systems and thus both As(V) and As(III) may occur in different areas or at different times in Mammoth Lake and downstream lakes. Thus, all available arsenic toxicity data, regardless of speciation were compiled in the database.

Aquatic organisms may be exposed to substances in water directly via uptake from the water or indirectly via diet. The SSWQO for arsenic is intended to be used in the assessment and management of arsenic in the water column. That is, the SSWQO is related to the concentration of arsenic in the water. The exposure pathway of greatest relevance to arsenic toxicity is via direct uptake from water, rather than through bioaccumulation or biomagnification into organism tissue (CCME 2001) supporting the development of an SSWQO rather than a tissue residue-based guideline. This approach is consistent with the CCME (2007) protocol, which indicates that while bioaccumulation is an important consideration, it is not part of the protocol for the derivation of a CWQG-PAL. Therefore, the compilation focussed on toxicity data where the route of uptake was directly from the water. Experiments in which test organisms were injected with arsenic or fed arsenic in the diet were not compiled because these types of exposure are not reflective of what would occur in the receiving environment.

6.N-4 TOXICITY DATA EVALUATION, CATEGORIZATION, AND ENDPOINT SELECTION

Once the available toxicity data were compiled in the database, the data were evaluated for suitability and categorized as acceptable (primary or secondary data) or unacceptable for developing a long-term SSWQO for consistent with CCME (2007) guidance. Data suitability was confirmed by consulting the original publication or report, reviewing the test methods and verifying the test results.

Consistent with CCME (2007) guidance, toxicity data for Canadian species were considered suitable for developing the long-term SSWQO for arsenic, and data for species non-resident to Canada were used if the species could be considered suitable surrogates for Canadian resident species (e.g., fall within the same taxonomic group) and the toxicity tests were conducted under exposure conditions representative of Canadian waters. The recalculation procedure for deriving SSWQOs provided in CCME (2003) allows removal of toxicity data from the data set on species that are known not to occur or do not have the potential to occur at a site; however, this was not done in the current assessment. This is because with removal of these data, the minimum data requirements for fish for development of an SSWQO would not be met. However, consideration was given to whether the species is known to occur or has the potential to occur in Nunavut. For example, Indian major carp (*Catla catla*) has not been identified in lakes in Mammoth Lake and downstream lakes; however, other fish species of this family (family Cyprinidae) are known to occur in Nunavut. Therefore, the toxicity data for this species were considered suitable for SSWQO development. Flagfish (*Jordanella floridae*) has not been identified Mammoth Lake and downstream lakes and other fish species of this family (family Cyprinodontidae) are not known to occur in Nunavut. Therefore, the toxicity data for this species were not considered to be suitable for SSWQO development.

Other criteria used to evaluate the suitability of the toxicity data included the following and are consistent with CCME (2007) guidance:

- The preferred test endpoints were measures of survival, growth, reproduction and development. Non-traditional endpoints, such as pathological changes or swimming speed were not considered suitable because the ecological relevance of these endpoints is uncertain.
- Appropriate documentation was required for test design/conditions (e.g., flow-through, renewal, static), test concentrations, environmental variables (e.g., temperature, hardness, pH, etc.), experimental design (controls, number of replicates) and description of statistics.
- Studies were considered suitable if they included control or reference organisms that have been exposed to similar conditions as the experimental organisms.
- Data generated from studies evaluating synergistic, antagonistic or compensatory responses of organisms, such as tolerance (acclimation, adaptation), were considered unsuitable.
- Tests using field-collected organisms were not considered suitable because the life history of these organisms and their rate of exposure to arsenic is not generally clearly defined.
- Tests using organic forms of arsenic were not considered suitable because inorganic arsenic is the form likely to be found in water.
- Tests were not considered suitable if the original publication or report could not be located because this prevented a review of the test methods and verification of the test results.

Once the data were evaluated and categorized, endpoints were selected. For the statistical derivation approach, the order of priority by which the endpoints are selected is as follows (CCME 2007):

- EC_x/IC_x representing a no-effects threshold;
- EC_{10}/IC_{10};
- EC_{11-25}/IC_{11-25};
- Maximum Allowable Toxicant Concentration (MATC), as defined below;
- No Observed Effect Concentration (NOEC);
- Lowest Observed Effect Concentration (LOEC);
- EC_{26-49}/IC_{26-49}; and
- Non-lethal EC_{50}/IC_{50}.

MATCs were calculated by taking the geometric mean of the NOEC and LOEC reported for a given test. The procedure can yield results that are comparable to IC_{25} results, as discussed for example in US EPA (2007).

If a study yielded multiple results for a single endpoint, then the results were reduced to a single measurement to avoid biasing the database towards the results of a single study. For example, if inhibition concentrations (ICs) to

10%, 25% and 50% of the test population were reported for the growth of fathead minnow exposed to arsenic, then only the most protective of the three values (i.e., the IC_{10} value) was included in the database.

The CCME (2007) protocol allows for the incorporation of exposure and toxicity modifying factors (ETMFs) in the development of water quality guidelines. As noted previously, chemical speciation of arsenic (i.e., valency) is an important ETMF; however, there is uncertainty as to whether As(V) or As(III) predominates Mammoth Lake and downstream lakes. Therefore, endpoints for both As(V) and As(III) were included in the database. If a toxicity study tested both arsenic species for a given test species, then the lower of the two endpoints was included in the database. For example, Naumann et al. (2007) reported EC_{10}s of 11,600 and 1,270 µg/L for growth of *Lemna minor* exposed to As(V) and As(III), respectively. The lower EC_{10} of 1,270 µg/L for *Lemna minor* exposed to As(III) was included in the database.

The bioavailability (and toxicity) of arsenic is reduced by the presence of phosphorus, organic matter and clays, metal sulfides, and iron, aluminum, and manganese oxides and oxyhydroxides (Eisler 1988; Senn and Hemond 2003; Sharma and Sohn 2009). Additionally, an increase in As(V) toxicity has been observed with increasing temperatures (ANZECC and ARMCANZ 2000; McGeachy and Dixon 1989). However, these parameters were reported in very few studies and their potential influence on arsenic toxicity could not be readily quantified. As such, the influence of these parameters were not incorporated into the development of the SSWQO for arsenic.

6.N-5 DETERMINATION OF THE APPLICABLE SSWQO DERIVATION APPROACH

The minimum data set requirements for the derivation of a long-term guideline for freshwater environments outlined in CCME (2007) were used to determine whether the statistical derivation approach or the lowest endpoint derivation approach should be used to develop the SSWQO for arsenic. The available chronic toxicity data for arsenic in freshwater met the minimum data set requirements for the derivation of a long-term guideline using the statistical derivation (SSD) approach. Therefore, the statistical derivation approach was used to derive a long-term SSWQO for arsenic.

6.N-6 DEVELOPMENT OF THE SSWQO FOR ARSENIC USING THE STATISTICAL DERIVATION APPROACH

The chronic toxicity data used in the SSD are summarized in Table 6-N-1. Table 6-N-1 provides only the chronic toxicity data that were used in the SSD to develop the SSWQO. It does not include all of the studies and data that were compiled and evaluated for suitability for developing the long-term SSWQO. A full description of how the data provided in Table 6-N-1 were selected was provided in Section 6.N-4. Therefore, all of the data presented in Table 6-N-1 are categorized as acceptable (i.e., primary or secondary data as per CCME [2007]).

Table 6-N-1: Chronic Toxicity Data used in the Development of the SSWQO for Arsenic

Test Species	Common Name	Taxa Group	Arsenic Species	Test Duration (days)	Biological Measurement	Endpoint	Effect Concentration (µg As/L)	Source	Rank
Daphnia pulex	Water Flea	Invertebrate	As(V)	26	Reproduction	LOEC	10	Chen et al. 1999	1
Scenedesmus obliquus	Green Algae	Aquatic Plant/Algae	As(V)	14	Growth	EC_{50}	48	Vocke et al. 1980; See note (a)	2
Melosira granulata	Algae	Aquatic Plant/Algae	As(V)	8-24	Growth	IC_{35}/LOEC	75	Planas and Healey 1978; See note (a)	3
Ochromonas valesiaca	Algae	Aquatic Plant/Algae	As(V)	8-24	Growth	IC_{20}/LOEC	75	Planas and Healey 1978; See note (a)	4
Monoraphidium arcuatum	Freshwater Algae	Aquatic Plant/Algae	As(V)	3	Growth	LOEC	81	Levy et al. 2005	5
Gammarus pseudolimnaeus	Scud	Invertebrate	As(III)	14	Survival	LC_{15}	88	Spehar et al. 1980	6
Lemna gibba	Inflated Duckweed	Aquatic Plant/Algae	As(V)	21	Growth	MATC	224	Mkandawire et al. 2006; See note (b)	7
Cryptomonas erosa	Algae	Aquatic Plant/Algae	As(V)	8-24	Growth	IC_{22}	225	Planas and Healey 1978	8
Ankistrodesmus falcatus	Green Algae	Aquatic Plant/Algae	As(V)	14	Growth	EC_{50}	256	Vocke et al. 1980	9
Baetis tricaudatus	Mayfly	Invertebrate	As(III)	12	Survival	MATC	300	Irving et al. 2008	10
Cyclops vernalis, C. bicuspidatus thomasi, Diaptomus sp.	Copepods	Invertebrate	As(III)	14	Growth	EC_{20}	320	Borgmann et al. 1980; See note (a)	11
Ceriodaphnia dubia	Water Flea	Invertebrate	As(III)	7	Reproduction	EC_{19}	891	Spehar and Fiandt 1986	12
Pimephales promelas	Fathead Minnow	Fish	As(V)	30	Growth	MATC	892	De Foe 1982; see Note (b)	13
Daphnia magna	Water Flea	Invertebrates	As(III)	28-31	Survival/Growth /Reproduction	MATC	914	Lima et al. (1984)	14
Pteronarcys dorsata	Stonefly	Invertebrate	As(III)	28	Survival	NOEC	961	Spehar et al. 1980	15
Helisorna campanulata	Snail	Invertebrate	As(III)	28	Survival	LC_{10}	973	Spehar et al. 1980	16
Stagnicola emarginata	Snail	Invertebrate	As(V)	28	Survival	LC_{10}	973	Spehar et al. 1980	16

Test Species	Common Name	Taxa Group	Arsenic Species	Test Duration (days)	Biological Measurement	Endpoint	Effect Concentration (µg As/L)	Source	Rank
Lithobates pipiens	Leopard Frog	Amphibian	As(V)	113	Growth	NOEC	1026	Chen et al. 2009	17
Chlorella sp.12	Green Algae	Aquatic Plant/Algae	As(V)	3	Growth	MATC	1243	Levy et al. 2005; See note (b)	18
Lemna minor	Duckweed	Aquatic Plant/Algae	As(III)	7	Growth	EC_{10}	1270	Naumann et al. 2007	19
Anabaena variabilis	Algae	Aquatic Plant/Algae	As(V)	8-24	Growth	IC_{10}	2250	Planas and Healey 1978	20
Chlamydomonas reinhardtii	Algae	Aquatic Plant/Algae	As(V)	8-24	Growth	MATC	3182	Planas and Healey 1978; See note (b)	21
Oncorhynchus mykiss	Rainbow Trout	Fish	As(III)	21	Growth	MATC	4243	Speyer 1975; See note (b)	22
Catla catla	Indian Major Carp	Fish	As(V)	35	Survival	NOEC	4378	Kavitha et al. 2010	23
Microcystis sp.	Blue-Green Algae	Aquatic Plant/Algae	As(V)	14	Growth	NOEC	7492	Gong et al. 2009	24
Selenastrum capricornutum	Green Algae	Aquatic Plant/Algae	As(V)	14	Growth	EC_{50}	30761	Vocke et al. 1980	25
Scenedesmus quadricauda	Algae	Aquatic Plant/Algae	As(V)	12	Growth	EC_{50}	61000	Fargasova 1994	26
Microcoleus vaginatus	Green Algae	Aquatic Plant/Algae	As(V)	14	Growth	NOEC	100000	Vocke et al. 1980	27

[a] Data used in the development of the current CWQG-PFAL for arsenic (CCME 2001).

[b] MATCs were calculated by Golder by taking the geometric mean of the NOEC and LOEC reported for a given study.

µg As/L = micrograms arsenic per litre; MATC = maximum acceptable toxicant concentration; As(V) = pentavalent arsenic; LOEC = lowest observed effect concentration; IC_X = X% inhibitory concentration; As(III) = trivalent arsenic; LC_X = X% lethal concentration; NOEC = no observed effect concentration; EC_x = X% effect concentration.

There were some studies that were included by the CCME in the development of the current CWQG-PFAL for arsenic that were not included in the SSD for the Project. These include the following:

- 28-d LC_{50} of 550 µg/L for rainbow trout (Birge et al. 1978);
- 7-d LOEC of 500 µg/L and a 72-h LOEC for survival for climbing perch (Jana and Sahana 1989);
- 7-d LOEC of 970 µg/L for catfish (Jana and Sahana 1989);
- 21-d EC_{16} (reproduction) of 520 µg/L for *Daphnia magna* (Biesinger and Christensen 1972);
- 96-h EC_{50} (immobility) of 850 µg/L for *Bosmina longirostris* (Passino and Novak 1984);
- 7-d LC_{80} of 960 µg/L for *Gammarus pseudolimnaeus* (Spehar et al. 1980);
- 7-d LOEC (immobilization) of 1000 µg/L for *Ceriodaphnia dubia* (Spehar and Fiant 1986); and
- 20-d VSUE (very severe unfavourable effect) of 960 µg/L for *Scenedesmus obliquus* (Fargasova 1993).

The 96-h LC_{50} for rainbow trout, the 7-d LC_{80} for *Gammarus pseudolimnaeus* and the 20-d VSUE for *Scenedesmus obliquus* were not included in the SSD because lethal effect levels of 50% or greater are not acceptable for guideline development using the SSD approach as per the CCME (2007) protocol. The data for climbing perch and catfish were not included in the SSD because the Jana and Sahana (1989) reference could not be located for review and verification of test methods and results. The 96-h EC_{50} for *Bosmina longirostris* was not included in the SSD because the exposure duration is considered to be short-term based on current CCME (2007) guidance. The 21-d EC_{16} for reproduction in *Daphnia magna* was not included in the SSD because a more applicable endpoint was identified for this species. While the 7-d LOEC for immobilization for *Ceriodaphnia dubia* from Spehar and Fiandt (1986) was not included in the SSD, the 7-d EC_{19} for reproduction of 819 µg/L from the same study was included. The EC_{19} rather than the LOEC was included in the SSD because an EC_{11-25}/IC_{11-25} endpoint is preferred over a LOEC endpoint based on CCME (2007) guidance.

Overall, 28 species were included in the SSD. The species list consisted of:

- three fish species (one salmonid and three non-salmonids);
- one amphibian species;
- nine aquatic invertebrate species (including crustaceans, insects [mayflies and stoneflies] and gastropods),
- two aquatic plant species; and
- 13 algal species.

The CCME (2007) protocol specifies that if multiple comparable records for the same endpoint are available for a species, they are to be combined by the geometric mean of the records to represent the averaged effects endpoint for that species. The determination of which records are “comparable” is subject to professional judgement; ideally, comparable records would have identical life stage, test duration, exposure protocol, biological endpoint, statistical response measure, and water quality characteristics. However, in practice, obtaining perfect concordance among toxicity data collected by different investigators is rare. There were no suitably comparable records identified in the arsenic toxicity dataset; therefore, no geometric means were calculated for the SSD.

The software package, SSD Master Version 3.0 (CCME 2013), was used to generate the SSD. In brief, the software ranks each species according to sensitivity to arsenic (from lowest effect concentration to highest effect concentration) and its centralized position on the SSD (Hazen plotting position) is determined using the following equation (Alderberg et al. 2002; Newman et al. 2002):

Percent Species Affected = (*X* - 0.5) / *N*

Where *X* is the species rank, with 1 being the most sensitive species (lowest effect concentration), and *N* is the total number of species included in the SSD. The percent species affected and the corresponding effect concentrations are then plotted in the SSD. Several cumulative distribution functions (Normal, Logistic, Extreme Value and Gumbel) are fit to the data (both in arithmetic and log space) using regression methods. One of the models is then chosen as the best fit to the data based on a goodness-of-fit test (Anderson-Darling Goodness-of-Fit) and an overall visual assessment of model fit.

Of the models tested, the Normal model was considered to provide the best fit of the data. The equation of the Normal model is:

$$F(x) = \frac{1}{2\left(1 + erf\left(\frac{x-\mu}{\alpha\sqrt{2}}\right)\right)}$$

Where:
F(x) = proportion of taxa affected at the given arsenic concentration; 0.05;
x = arsenic concentration (µg/L);
µ = mean or expectation of the distribution (also its median and mode); 2.9; and
α = standard deviation; 0.86.

The long-term SSD is shown on Figure 6-N-1.

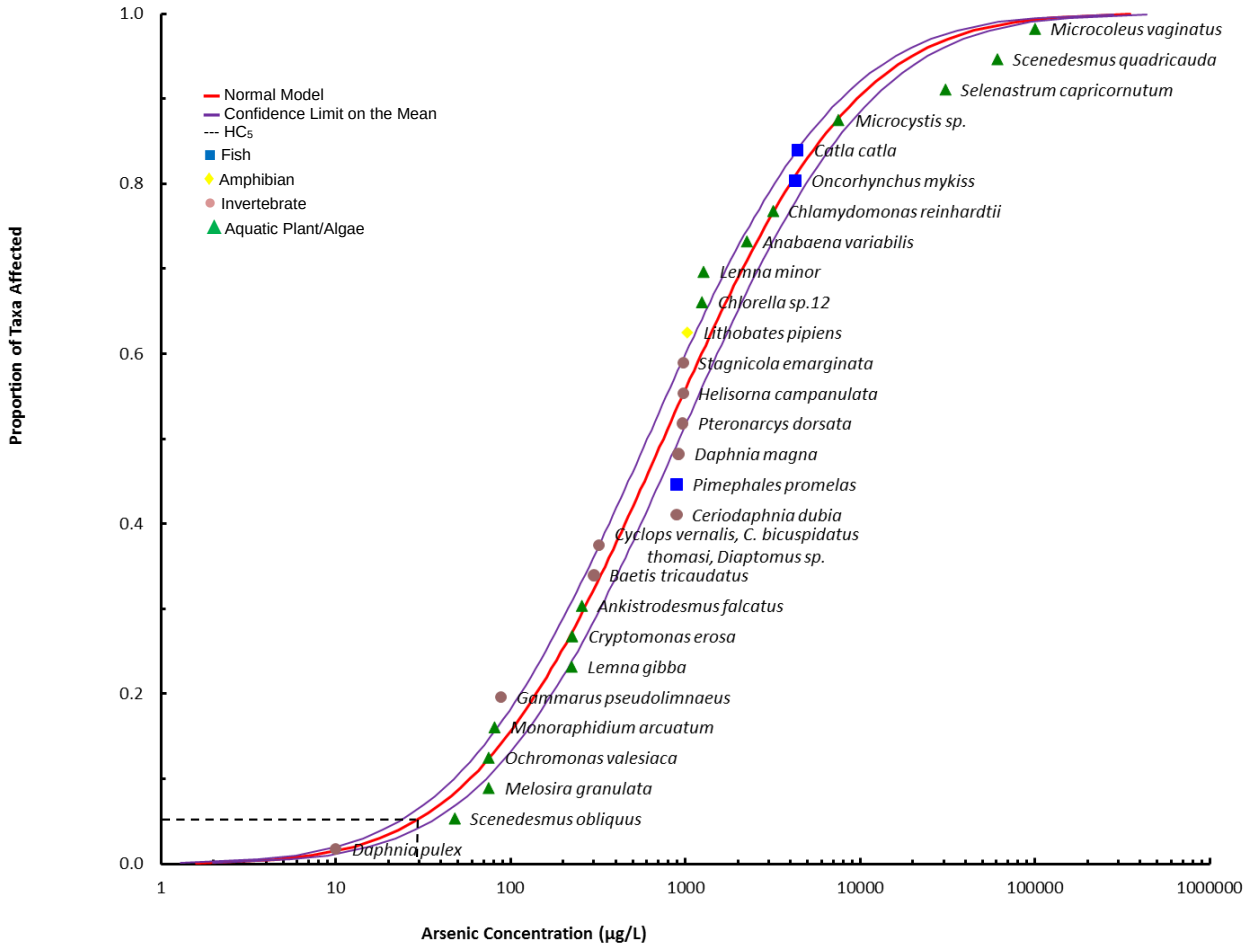


Figure 6-N-1: Species Sensitivity Distribution for Arsenic

CCME (2007) defines the long-term guideline as the intercept of the 5th percentile of the y-axis with the fitted SSD curve (or the HC_5, or hazardous concentration to 5% of species). The 5th percentile on the long-term SSD (HC_5) and the SSWQO for arsenic is 28 µg/L. The lower confidence limit on the mean is 22 µg/L and the upper confidence limit on the mean is 35 µg/L.

The HC_5 for arsenic is almost three times higher than the current CCME water quality guideline for the protection of freshwater aquatic life of 5 µg/L (CCME 1999/2016). The HC_5 is higher than the most sensitive species used in the SSD derivation. The most sensitive species used in the SSD was *Daphnia pulex*, with a 26-day LOEC for reproduction of 10 µg/L (Chen et al. 1999). Other daphnids were considerably less sensitive, with effect concentrations of 891 µg/L for *Ceriodaphnia dubia* (Spehar and Fiandt 1986) and 914 µg/L for *Daphnia magna* (Lima et al. 1984). The likelihood of an endpoint on an SSD falling below the 5th percentile increases with sample size, and is therefore inherent in the SSD approach.

In cases where an endpoint falls below the 5th percentile (or SSWQO), consideration may be given to applying the protection clause which was developed by the CCME (2007) to ensure that the long term guideline is sufficiently protective. The clause is invoked under the following circumstances:

- If an acceptable single (or, if applicable, geometric mean) no-effect or low-effect level endpoint (e.g., EC_x for growth) for a species at risk is lower than the proposed guideline, then that endpoint becomes the recommended guideline value. If the endpoint is a moderate- or severe-effect level endpoint (i.e., EC_x with x ≥50 or a lethality endpoint [LC_x]), then the guideline value is determined on a case-by-case basis (e.g., by using an appropriate safety factor).
- If an acceptable single (or, if applicable geometric mean) lethal-effects endpoint (i.e., LC_x, where x ≥15) for any species is below the proposed guideline, then that endpoint becomes the recommended guideline value.
- Special consideration is required if multiple endpoints for a single taxon (e.g., fish, invertebrates, plant/algae) and/or an elevated number of secondary studies are clustered around the 5th percentile.
- If it can be demonstrated that an endpoint below the 5th percentile is for a species at risk within a given province/territory or region/site, for a species of commercial or recreational importance, or for an "ecological important" species, than that data point may be used for deriving the guideline.

In considering the long-term acceptable dataset, only one endpoint fell below the 5th percentile on the SSD; the 26-d LOEC for reproduction in *Daphnia pulex* of 10 µg/L. The dataset did not contain any acceptable endpoints below the 5th percentile that represent effects to either species at risk or lethal effects, or for species of commercial, recreational or ecological importance. Multiple endpoints for a single taxon and an elevated number of secondary studies were not clustered around the 5th percentile. Therefore, the protection clause was not invoked in the development of the SSWQO for arsenic.

6.N-7 UNCERTAINTY

The main sources of uncertainty associated with the development of the long-term SSWQO for arsenic for the protection of freshwater aquatic life were:

- **Inclusion of Data for Both As(V) and As(III)** – Arsenic speciation is an important ETMF; however, arsenic speciation in lakes in Mammoth Lake is not well understood. It is possible that both oxic and anoxic conditions can potentially occur in freshwater systems and thus both As(V) and As(III) may occur in different areas or at different times. As a result, endpoints for both As(V) and As(III) were included in the development of the SSWQO. Some studies have demonstrated that As(V) is less toxic than As(III) in aquatic systems (Borgmann et al. 1980; Naumann et al. 2007). The SSWQO may be conservative if one species (e.g., As(V)) predominates Mammoth Lake and downstream lakes.
- **Lack of Incorporation of other ETMFs** –The toxicity of arsenic is ameliorated by the presence of phosphorus, organic matter and clays, metal sufides, and iron, aluminum and manganese oxides and oxyhydroxides. Given the limited data, it was not possible to quantify the effect of these ETMFs on arsenic bioavailability and toxicity. It is possible that these ETMFs are lower in concentration in laboratory toxicity tests relative to Mammoth Lake and downstream lakes; therefore, toxicity may be overestimated in the laboratory-based studies. As a result, the SSWQO may be conservative for the Project.

- **Selected SSD Model** – The Normal model was selected as the best fit to the toxicity data based on the Anderson-Darling Goodness-of-Fit test (A^2 = 0.456) and an overall visual assessment of model fit. It is noted that the Logistic model also provided a good fit to the data and yielded an HC_5 of 22 µg/L. For the Logistic Model, the Anderson-Darling Goodness-of-Fit test provided an A^2 of 0.370 which was lower than that for the Normal model; however, model fit in the lower tail of the distribution which determines the HC_5 was not as good as for the Normal model based on the visual assessment. This was supported by a slightly higher mean square error in the lower tail for the Logistic model (0.0386 versus 0.0374 for the Normal model). As well, the confidence limit on the mean was wider for the Logistic model (from 16.29 to 30.41 µg/L) than for the Normal model (from 22.96 to 35.06 µg/L).

6.N-8 SUMMARY

In summary, there were sufficient chronic toxicity data to derive a long-term SSWQO for arsenic for the protection of aquatic life using an SSD. In total, 28 aquatic species were included in the long-term SSD. The Normal model provided the best fit to the toxicity data and was used to derive the long-term SSWQO of 28 µg/L.

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