# Appendix V5-6H

Doris North Gold Mine Project:
2011 Tail Lake Fish-out Report

Hope Bay Mining Limited

# DORIS NORTH GOLD MINE PROJECT
# 2011 Tail Lake Fish-out Report

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# DORIS NORTH GOLD MINE PROJECT
# 2011 TAIL LAKE FISH-OUT REPORT

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# Executive Summary

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# Executive Summary

The Tail Lake fish-out program was a legal requirement under Schedule 2 of the Metal Mining Effluent Regulations for the conversion of Tail Lake to a Tailings Impoundment Area (TIA).

The protocol for the Tail Lake fish-out was guided by DFO's General Fish-Out Protocol for Lakes and Impoundments in the Northwest Territories and Nunavut. This document specifies that the fish-out must be done in a manner that provides DFO with scientific information that will help it manage Canada's northern aquatic resources.

The Tail Lake fish-out program collected the following:

- data on the number, age, sex, growth and condition of the fish being removed;
- data to test the accuracy of mark-recapture methods of population estimation, as well as methods of population estimation that are based on the time trends of catch-per-unit-effort (CPUE);
- data on the physical and biological features of the aquatic ecosystem of the lake; and
- data to test the predictive ability of regression models of lake fish biomass and production.

Physical limnology, water quality and primary producer (phytoplankton) data were collected from Tail Lake on three separate occasions, in July, August, and September. In addition, benthic macro-invertebrate and zooplankton communities were sampled once during August.

The fish assemblage of Tail Lake was simple and included only two species: lake trout and ninespine stickleback. In total, 1,490 lake trout were captured and removed using gillnets. Only 15 ninespine stickleback were captured and removed during the fish-out gillnetting program. No additional effort was expended to capture and remove ninespine stickleback from Tail Lake. Approximately 75% of the lake trout taken from Tail Lake were judged to be of sufficient size and quality to be donated to local Inuit communities. Lake trout unsuitable for consumption (i.e., very poor condition, decomposed, etc.) were killed and disposed of in Tail Lake.

Six estimates of the initial lake trout population were produced from mark-recapture, removal/depletion, and catch curve data (Table 1). The final lake trout population number for both the Petersen and Bayesian Maximum Likelihood mark-recapture estimate was 1,521 lake trout at the conclusion of the CPUE/Removal phase. The Leslie and DeLury removal/depletion estimates provided similar population numbers of 1,081 and 1,094, respectively. The K-Pass removal/depletion estimate produced a lake trout population number of 1,397.

Catch curve analysis was conducted to estimate the total lake trout population and to determine the length and age of lake trout fully recruited into the gillnet gear. This same length and age was used to validate mark-recapture and removal/depletion population estimates. Catch curve analysis showed that lake trout were fully recruited into the gillnet gear at approximately 480 mm FL or 15 years of age. The catch curve analysis also produced a total lake trout population number of 4,834. Thus, the mark-recapture and removal/depletion estimates were valid for the proportion of the lake trout population equal to or greater than 480 mm FL. Lake trout smaller than 480 mm FL were not effectively captured by the gillnet gear, resulting in an underestimation of the total lake trout population number (and lake trout biomass) produced by mark-recapture and removal/depletion methods. These underestimates were attributed to violations of the assumptions of constant catchability and the probability of capture being equal among fish (i.e., gillnet size selectivity and bias for large lake trout).

**Table 1. Summary of Lake Trout Population Estimates, Tail Lake Fish-out, Doris North Project, 2011**

| Estimate | Method | Lake Trout Population Estimate* | 95% Confidence Intervals | |
|---|---|---|---|---|
| | | | Lower | Upper |
| Petersen | Mark-recapture | 1,521 | 1,443 | 1,599 |
| Bayesian Maximum Likelihood | Mark-recapture | 1,521 | 1,450 | 1,607 |
| Leslie | Removal/Depletion | 1,081 | 818 | 1,344 |
| DeLury | Removal/Depletion | 1,094 | 672 | 1,517 |
| K-Pass | Removal/Depletion | 1,397 | 1,305 | 1,489 |
| Catch Curve | Catch Curve Model | 4,834 | – | – |

*Notes:*
** final lake trout population estimate upon the conclusion of the CPUE/Removal phase*
*- dashes indicate no data available*

The Tail Lake lake trout population was defined by a uni-modal length-frequency distribution that was heavily skewed toward large, adult fish. The highest proportion (71%) of lake trout range from 500 to 620 mm FL, while relatively few lake trout are represented in smaller or larger size ranges. Lake trout in Tail Lake were likely prevented from attaining a large size due to the simple fish community, poor forage, and competition between conspecifics (i.e., cannibalism by larger lake trout). Lake trout less than 120 mm FL were absent in the fish-out catch data. The absence of small lake trout may indicate that recruitment of juveniles is limited by a combination of predation and a lack of juvenile lake trout habitat or because lake trout less than 120 mm FL were too small to be captured effectively by the fishing gear.

The age of sampled lake trout ranged from 2 to 56 years. von Bertalanffy growth models showed two distinct growth trajectories within the lake trout population. These trajectories were attributed to relatively rapid pre-maturation (age 0+ to ~10+ years) growth and relatively slow and stable post-maturation (~10+ years onward) growth. Therefore, length-at-age for sexually mature lake trout was highly variable. The lake trout mortality rate (Z) was 13.5% per year.

The ratio of female to male lake trout was 52% to 48%. The majority of sampled lake trout were mature (58% of females and 69% of males). Length at 50% maturity of sampled females was 477 mm, while length at 50% maturity of sampled males was 460 mm.

Lake trout diet was primarily composed of *Gammarus lacustris*, *Triops longicaudatus*, and ninespine stickleback. Lake trout muscle samples showed a non-significant relationship between mercury and fork length, suggesting that mercury was not accumulating in the muscle tissues of sampled lake trout. All lake trout muscle samples were below the Health Canada guideline of 0.5 mg/kg WW. Thus, based on this sub-sample of tissues, lake trout from Tail Lake were suitable for consumption.

Models developed to estimate fish biomass available in published literature were also tested against the total lake trout biomass removed from Tail Lake. Model biomass estimates ranged from zero to 8,723 kg. Model 2 (which used total phosphorus to directly predict fish biomass) produced the most plausible estimate of 2,784 kg of fish biomass. The remaining model estimates were grossly inaccurate, with most predictions underestimating the landed lake trout biomass by a factor of 20. Results of the model predictions suggest caution when using fishery yield as a proxy for biomass or production. The conversion of fishery yield to production by simply multiplying by 10 is a gross generalization and may not apply to Arctic lakes which are oligotrophic, support very few species, and are usually un-fished and unmanaged. The conversion of fish yield to production and biomass appears to be a source of error or uncertainty.

# Acknowledgements

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# DORIS NORTH GOLD MINE PROJECT
# 2011 TAIL LAKE FISH-OUT REPORT

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# Glossary and Abbreviations

# Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

| | |
|---|---|
| **AEMP** | Aquatic Effects Monitoring Program |
| **ALS** | ALS Environmental Laboratories |
| **Ao** | Surface Area |
| **BC** | British Columbia |
| **Benthos** | Benthic Invertebrates |
| **CCME** | Canadian Council of Ministers of the Environment |
| **Chl *a*** | Chlorophyll *a* (used as an estimate of algal biomass) |
| **CI** | Confidence Interval |
| **CPUE** | Catch per Unit Effort |
| **CRM** | Comparison Reference Material |
| **DDW** | Double Deionized Water |
| **DELT** | Deformities, Erosions, Lesions and Tumours |
| **DFO** | Fisheries and Oceans Canada |
| **DO** | Dissolved Oxygen |
| **EHTO** | Ekaluktutiak Hunters and Trappers Association |
| **ESR** | Environmental and Social Responsibility |
| **FB** | Fish Biomass |
| **FL** | Fork Length |
| **FY** | Fish Yield |
| **GIS** | Geographic Information System |
| **GSI** | Gonadosomatic Index |
| **HBML** | Hope Bay Mining Limited |
| **HSI** | Hepatosomatic Index |
| **ISQG** | Interim Sediment Quality Guideline (SQ guideline defined by CCME) |
| **k'** | Light extinction coefficient ($m^{-1}$) |
| **KHS** | Kitikmeot Heritage Society |
| **M** | Macrobenthos |
| **MB** | Method Blank |
| **MDL** | Mean Detection Limit |

| | |
|---|---|
| **MEI** | Morphoedaphic Index |
| **MMER** | Metal Mining Effluent Regulations |
| **PEL** | Probable Effects Level (SQ guideline defined by CCME) |
| **QA/QC** | Quality Assurance/Quality Control |
| **Rescan** | Rescan Environmental Services Ltd. |
| **RPD** | Relative Percent Difference |
| **SE** | Standard Error |
| **SQ** | Sediment Quality |
| **TIA** | Tailings Impoundment Area |
| **TDS** | Total Dissolved Solids |
| **TKN** | Total Kjeldahl Nitrogen |
| **TOC** | Total Organic Carbon |
| **TP** | Total Phosphorus |
| **TSS** | Total Suspended Solids |
| **UTM** | Universal Transverse Mercator |
| **WAD** | Weak Acid-Dissociable |
| **WQ** | Water Quality |
| **WW** | Wet Weight |
| **Z** | Mortality Rate |
| **z** | Mean Depth |

# 1. Introduction

# 1. Introduction

## 1.1 INTRODUCTION

A fish-out is a total removal of fish from a lake, and is a legal requirement under Schedule 2 of the Metal Mining Effluent Regulations (MMER) when a natural water body is converted into a Tailings Impoundment Area (TIA) that cannot support fish. Tail Lake is the designated TIA for the Doris North Project.

Tail Lake was added to Schedule 2 of the MMER on June 19, 2008 (Government of Canada 2008). Section 27.1 of the MMER requires the development and implementation of a fish Habitat Compensation Plan (also called a No Net Loss Plan) which must be approved by the Minister of Fisheries and Oceans Canada (DFO). Section 27.1 is based on The Policy for the Management of Fish Habitat (DFO 1986) that was developed by DFO to ensure that there is no net loss of fish habitat as a result of various development projects. The No Net Loss Plan for the Doris North Project is described in Golder (2007) and Rescan (2010a). The fish-out program is an integral part of the No Net Loss Plan.

One of the major purposes of a fish-out is to avoid "wastage" or the killing of fish for no purpose by making the fish available for traditional use by local communities (Tyson et al. 2011).

The protocol for the Tail Lake fish-out was guided by DFO's General Fish-Out Protocol for Lakes and Impoundments in the Northwest Territories and Nunavut (Tyson et al. 2011). This document specifies that the fish-out must be done in a manner that provides DFO will scientific information that will help it manage Canada's northern aquatic resources. Specifically, the data will:

"establish a database of biotic and abiotic characteristics of Arctic lakes that will be used to determine linkages between fish populations and assemblages and the biotic and abiotic characteristics of northern lakes, and thereby provide reference data for Aquatic Effects Monitoring Programs (AEMP) and compensation initiatives" (Tyson et al. 2011).

Fish-out programs, as specified in the DFO protocol, provide a unique opportunity to:

- collect data on the number, age, sex, growth and condition of the fish being removed;
- test the accuracy of mark-recapture methods of fish population estimation, as well as methods of population estimation that are based on the time trends of catch-per-unit-effort (CPUE);
- test hypothesized links between the spatial distribution of fish and habitat characteristics such as depth and substrate characteristics;
- characterize the physical and biological features of the aquatic ecosystem of the lake; and
- test the predictive ability of regression models of lake fish biomass and production.

## 1.2 BACKGROUND

Construction of the North Dam used to convert Tail Lake into a TIA began during the winter of 2010/2011. The dam is being built across the upstream end of Tail Outflow during winter when Tail Outflow is frozen to the streambed. Upon completion, the North Dam will be approximately 11.4 m high and 190 m long with a minimum freeboard of 1 m above the full supply water elevation of 33.5 m. As a result of the construction of North Dam, Tail Outflow will cease to flow, at least until North Dam is

breached after mine closure when water quality in the TIA meets acceptable standards. The South Dam, at the upstream end of the lake, will not be built on any natural water bodies.

The Doris North Mine was expected to be in operation for two years, but was placed in a state of "care and maintenance" on January 31, 2012. The project plan consisted of an underground mine as well as a crushing and milling plant with a capacity of 668 tonnes per day. If mining recommences, ore will be processed using cyanide to recover the gold. Tailings from the ore processing will be treated to destroy residual cyanide and precipitate heavy metals. Following treatment, the tailings will be deposited underwater in the TIA through a slurry pipeline from the process plant. All tailings will be contained in the TIA under a water cover of at least 3 m to prevent acid generation.

In anticipation of using the TIA for water management purposes, fish were removed from the TIA in 2011, in accordance with DFO's General Fish-Out Protocol for Lakes and Impoundments in the Northwest Territories and Nunavut (Tyson et al. 2011). All landed lake trout (*Salvelinus namaycush*) were provided to local communities for either human or dog consumption.

## 1.3 STUDY AREA

Tail Lake is located at 68°7'25.8" north latitude and 106°33'31.2" west longitude. It has a surface area of 77 ha and a maximum depth of 6.5 m. A walking survey of the shoreline showed there are three types of fish habitat in the lake (Rescan 2001; Golder 2007):

- Nearshore habitat from the water's edge to a depth of 2.5 m with a substrate that is predominantly fine sediment or bedrock (i.e., poor quality habitat).
- Nearshore habitat from the water's edge to a depth of 4 m with a substrate that is predominantly cobble and boulder (i.e., good quality habitat).
- Deep water habitat (>4 m deep) with a substrate composed mainly of fine sediment (i.e., poor quality habitat).

Tail Lake contains only two species of fish: lake trout and ninespine stickleback (*Pungitius pungitius*). In 2002, an intensive short-set gillnetting and angling program was conducted in Tail Lake to calculate the number of lake trout using mark-recapture procedures (Golder 2007). The number was estimated to be 2,350 to 2,650 fish, depending on the use of different estimating methods and assumptions regarding fish mortality rates over the 2000 to 2002 period. The 95% confidence intervals for the estimates ranged between 1,313 and 5,511 fish. A population number of 2,500 was assumed for the purposes of the 2011 Tail Lake fish-out program.

An unknown number of ninespine sticklebacks are also present in Tail Lake. Population estimates have not been attempted because ninespine sticklebacks are too small to be captured by gillnets or angling gear. Sticklebacks are ubiquitous in freshwater and brackish environments of Nunavut and have no commercial, recreational, food or ceremonial value.

## 1.4 OBJECTIVES

The objectives of the fish-out program for Tail Lake included the following:

- Fulfill HBML's legal obligations to conduct a fish-out program in Tail Lake, as required under the MMER Schedule 2 classification of Tail Lake as a TIA.
- Follow DFO's fish-out protocol (Tyson et al. 2011), designed to collect unique scientific information on fish populations and aquatic ecosystems of TIAs such as Tail Lake.

- Salvage the lake trout of Tail Lake for the benefit of local communities. The collection of ninespine stickleback was not included in the program.
- Use mark-recapture methods to calculate the number of lake trout in Tail Lake, and use that number to confirm that the fish-out had successfully removed all harvestable lake trout from the lake.
- Use the decline in CPUE over the duration of the fishing period as a second method of confirming that the fish-out successfully removed all lake trout from the lake.
- Collect information on physical limnology, water quality, primary production (as indicated by chlorophyll *a*) and secondary production (as indicated by biomass and taxonomic composition of zooplankton and benthic invertebrates) of Tail Lake. The purpose is to characterize the support system for the lake trout of Tail Lake.
- Compare lake trout biomass in Tail Lake with the biomass predicted by regression models in the scientific literature, thereby assessing the validity of those models for Arctic systems such as Tail Lake. This is not a stated objective of the DFO fish-out protocol, but it is a logical extension of DFO's goal of characterizing the links between fish populations and their aquatic environment. This task was conducted as part of the fish-out for the Meadowbank Gold Project (Azimuth 2009).

# 2. Methodology

# 2. Methodology

## 2.1 GENERAL

The following methods sections follow the protocols specified in DFO's General Fish-Out Protocol for Lakes and Impoundments in the Northwest Territories and Nunavut (Tyson et al. 2011). This protocol is provided as Appendix 2.1-1.

The fish-out program is divided into three components:

1. Fish community. This is divided into two phases:
   - Mark-Recapture phase. The goal of this phase was to mark and live release approximately 10% of the lake trout population in Tail Lake or 250 fish based upon past population estimates (Golder 2007).
   - CPUE/Removal phase. Tail Lake was intensively fished with gillnets beginning approximately one week after the end of the marking phase to remove all lake trout from the lake. In addition, as many ninespine stickleback as possible were collected from shallow water sites with other gear such as minnow traps.
2. Physical limnology and aquatic sampling. Characterization of the physical limnology, water quality and aquatic resources of Tail Lake.
3. Habitat inventory, which included the characterization of substrate and aquatic vegetation of Tail Lake.

## 2.2 FISH COMMUNITY AND HABITAT

### 2.2.1 Mark-recapture Phase

The mark-recapture phase was initiated on July 13, shortly after the ice thawed from Tail Lake. Three field crews, each consisting of one Rescan fisheries biologist and one Inuit field assistant, sampled the lake trout population over a period of six days, ending on July 18, 2012. A sub-sample of the lake trout population of Tail Lake was captured by angling and gillnetting, marked and released live back to the lake. The objective of the marking phase was to tag ten percent of the lake trout population or 250 fish - assuming a population size of approximately 2,500 lake trout (Golder 2007).

Angling and gillnets were the primary gear used to sample lake trout during this phase. Small-mesh gillnets of a variety of mesh sizes (to a maximum of 32 mm or 1.5 inches) were used and set for short durations (e.g., 30 to 60 min.) to reduce lake trout mortalities. Nets were periodically moved so that all available habitats were surveyed. Date, location, time of set and time of retrieval were recorded for each gillnet gang. For angling, spinning rods and reels paired with small spoons were used. A single, barbless hook was affixed to all spoons to reduce hooking injuries and expedite the marking process. All fish captured by angling were quickly played and handled in water to minimize air exposure. Upon capture, all lake trout were swiftly placed into a cooler filled with ambient lake water (temperature ranged from 6-8°C) and a lid was fitted over the cooler to reduce stress (Plate 2.2-1). Each fish was allowed to recover for a period of one to two minutes. All attempts were made to minimize stress to fish and to return marked lake trout to the water as quickly, and in the best condition, as possible.

*Plate 2.2-1. A lake trout recovering from the capture and marking process.*

Each fish was identified to species, measured for fork length to the nearest 1 mm, and examined for bleeding or other signs of handling stress. Any lake trout showing visible signs of bleeding from the gills or stress due to exhaustive exercise, handling, air exposure or other wounds were not tagged and released if recovery was possible. If recovery was not possible, these lake trout were lethally sampled for the presence of obvious internal and external deformities, erosions, lesions and tumours (i.e., DELT), ageing structures (otoliths, fin rays and/or scales, depending on the fish size), sex, sexual maturity, reproductive status, gonad weight (for calculation of gonadosomatic index), liver weight (for calculation of hepatosomatic index), and tissue contaminants. Obvious external and internal abnormalities included:

- tumours and/or lesions on the body surface (including the eyes, lips, snout, gills);
- spinal column malformations;
- eroded, frayed or hemorrhagic fins;
- other physical abnormalities; or
- obvious parasites.

All lake trout that did not show signs of bleeding or handling stress were marked with a uniquely numbered T-bar anchor tag (30 mm in length) inserted through the dorsal sinus under the base of the dorsal fin (Plate 2.2-2). A small portion of the posterior section of the adipose fin was removed from each marked fish to provide a secondary mark in the event of tag loss. The fate of each fish – marked and released live, released and not marked, killed by capture or handling (and not marked), or captured but lost before it could be marked – were recorded in accordance with the DFO fish-out protocol (Tyson et al. 2011). Photographs were taken of representative members of the fish population and for reporting purposes.

*Plate 2.2-2. A uniquely numbered T-bar tag inserted into the base of a lake trout's dorsal fin.*

A subsample of 15 lake trout were euthanized during the marking phase to be analyzed for tissue contaminants. Samples of dorsal muscle from these fish were sent (with requested rapid turn-around) to ALS Laboratory (Burnaby, BC, Canada) for analysis of metal concentrations and moisture as precautionary testing to confirm that the fish were safe for human and/or dog consumption. The results of these tests were reviewed prior to initiation of the CPUE/Removal phase of the fish-out program to determine the appropriate use of the fish removed.

### 2.2.2 CPUE/Removal Phase

The goal of the CPUE/Removal Phase was to ensure that nearly all lake trout were removed from the lake. The CPUE phase was initiated on August 5, 2011 and concluded on August 28, 2011. The marking phase was completed on July 18, 2011, thus the lake was left undisturbed for 17 days to allow marked fish to recover and to reduce gear avoidance.

Tail Lake remained chemically and physically unchanged during the marking and CPUE/Removal phases. Therefore, environmental variables such as turbidity and lake volume did not alter fish distribution and interfere with CPUE. For the purposes of population estimation, the standard unit of fishing effort remained unchanged throughout the CPUE/Removal phase (Tyson et al. 2011). The standard gillnet gang used throughout the CPUE/Removal Phase included one panel of each of the following stretched mesh sizes: 102 mm (4"), 76 mm (3"), 51 mm (2"), 38 mm (1 ½"), 25 mm (1"), and 13 mm (1/2"). All gillnet panels were bottom setting (i.e., sinking) and constructed of monofilament. Panel seams were sewn together with twine to prevent gaps between panels (Plate 2.2-3) and arranged in random order. Each standard mesh panel used for the Tail Lake fish-out measured 15.2 m (50') long by 2.4 m (8') deep for an area of 36.48 $m^2$ and a total area of 218.88 $m^2$ per gang. Marker buoys with a unique identification number were affixed to each end of each gillnet gang.

*Plate 2.2-3. Mesh panels of all standard gillnet gangs were sewn together with net twine.*

The only variable that changed throughout the CPUE/Removal phase was the number of standard gillnets (i.e., units of effort) fished on a daily basis. During the initial days of the CPUE/Removal phase, only two standard gillnet gangs were fished because catches were relatively high, and to ensure that biological sampling crews were not overwhelmed. Additional standard gillnet gangs were added as catch declined in attempt to balance daily fishing effort, catch, and biological sampling for field crews. Upon the completion of the CPUE phase, ten standard gillnet gangs were fished in Tail Lake.

Gee minnow traps were also used within the littoral zone; mainly for purposes of removing ninespine stickleback from the lake. Standard traps were constructed of 6.4 mm (1/4") square galvanized wire mesh and measured 42 cm (16") long and 23 cm (9") wide with a 22 mm (7/8") entrance hole. Trap cylinders were locked together using a clip attached to a rope and marker buoy. Each trap was baited with a small amount of dry crab bait. Minnow traps were then placed along the lake's littoral zone such that the trap was resting on the substrate.

Gillnet set and retrieval was conducted by two-person crews, with each crew consisting of a boat operator and a net handler. Standard gillnet gangs were set in random locations, as selected by the gillnetting crews, throughout Tail Lake. Figures 2.2-1a through 2.2-1d show the set locations of standard gillnet gangs in the CPUE/Removal Phase. Gillnet set and catch data were recorded on field data sheets provided in the fish-out protocol (Tyson et al. 2011). Date, location, time of set, and time of retrieval were recorded for each gillnet gang. Information collected during gillnet sets also included water depth and UTM coordinates at the beginning and end of each net, and surface water temperature. Each gillnet set number and mesh size were recorded for each fish captured.

PROJECT #1009-008-14 GIS # HB-06-137a May 25 2012

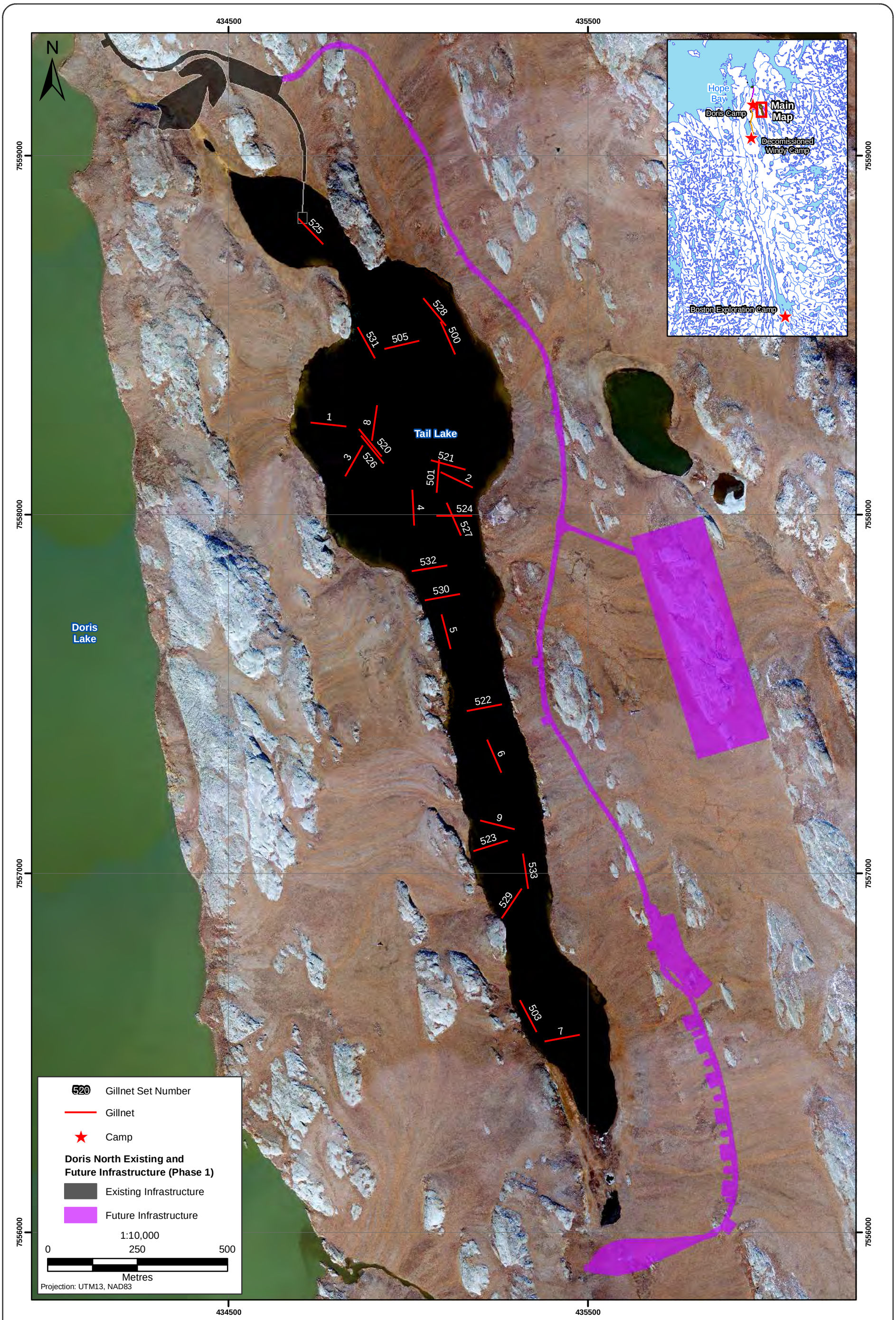


Figure 2.2-1a

NEWMONT NORTH AMERICA

# CPUE/Removal Phase Gillnet Set Locations, Tail Lake Fish-out, August 5 to August 10, 2011

Figure 2.2-1a

Rescan™ Engineers & Scientists

PROJECT #1009-008-14 GIS # HB-06-137b May 25 2012

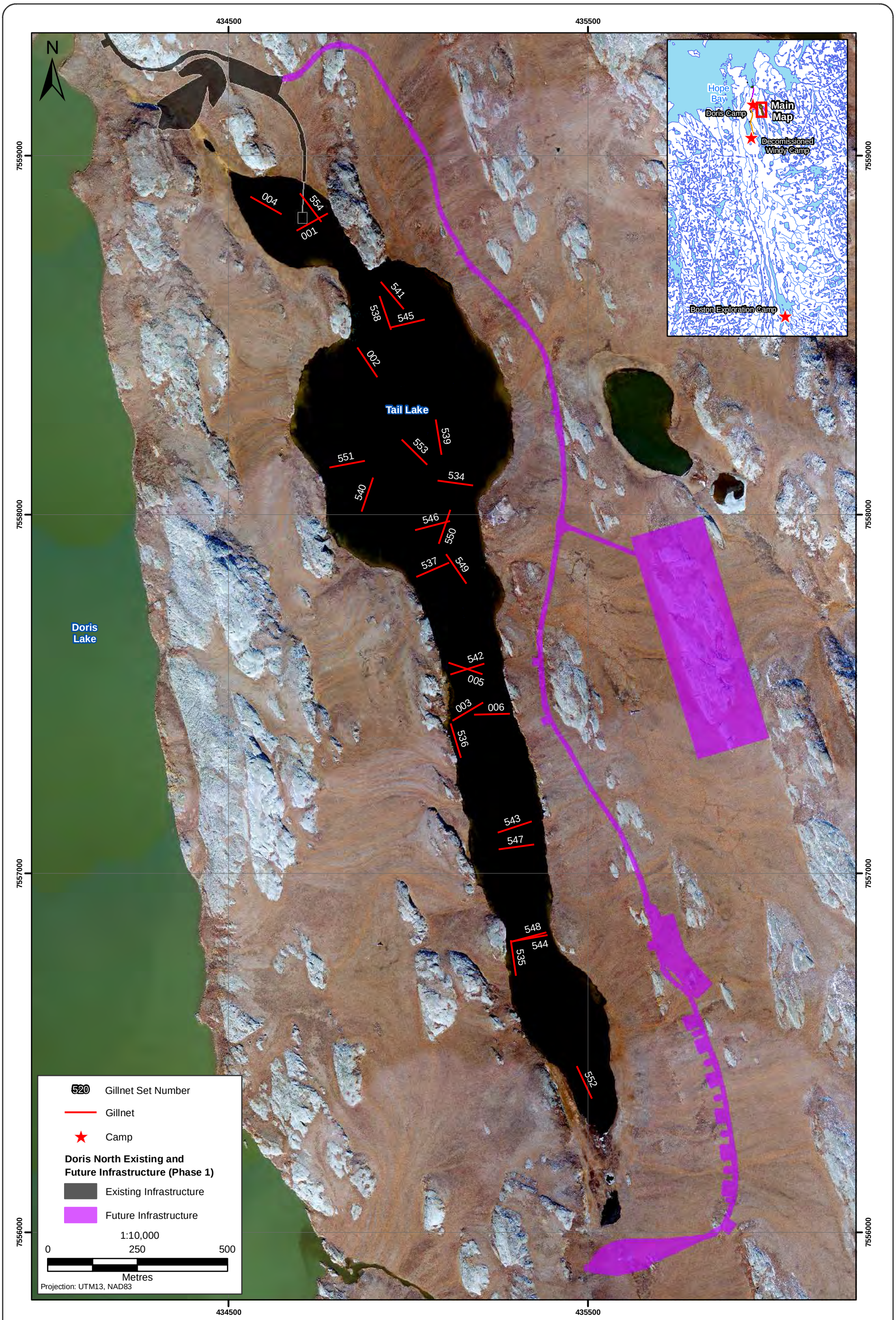


Figure 2.2-1b

NEWMONT NORTH AMERICA

## CPUE/Removal Phase Gillnet Set Locations, Tail Lake Fish-out, August 11 to August 15, 2011

Figure 2.2-1b

Rescan™ Engineers & Scientists

PROJECT #1009-008-14 GIS # HB-06-137c May 25 2012

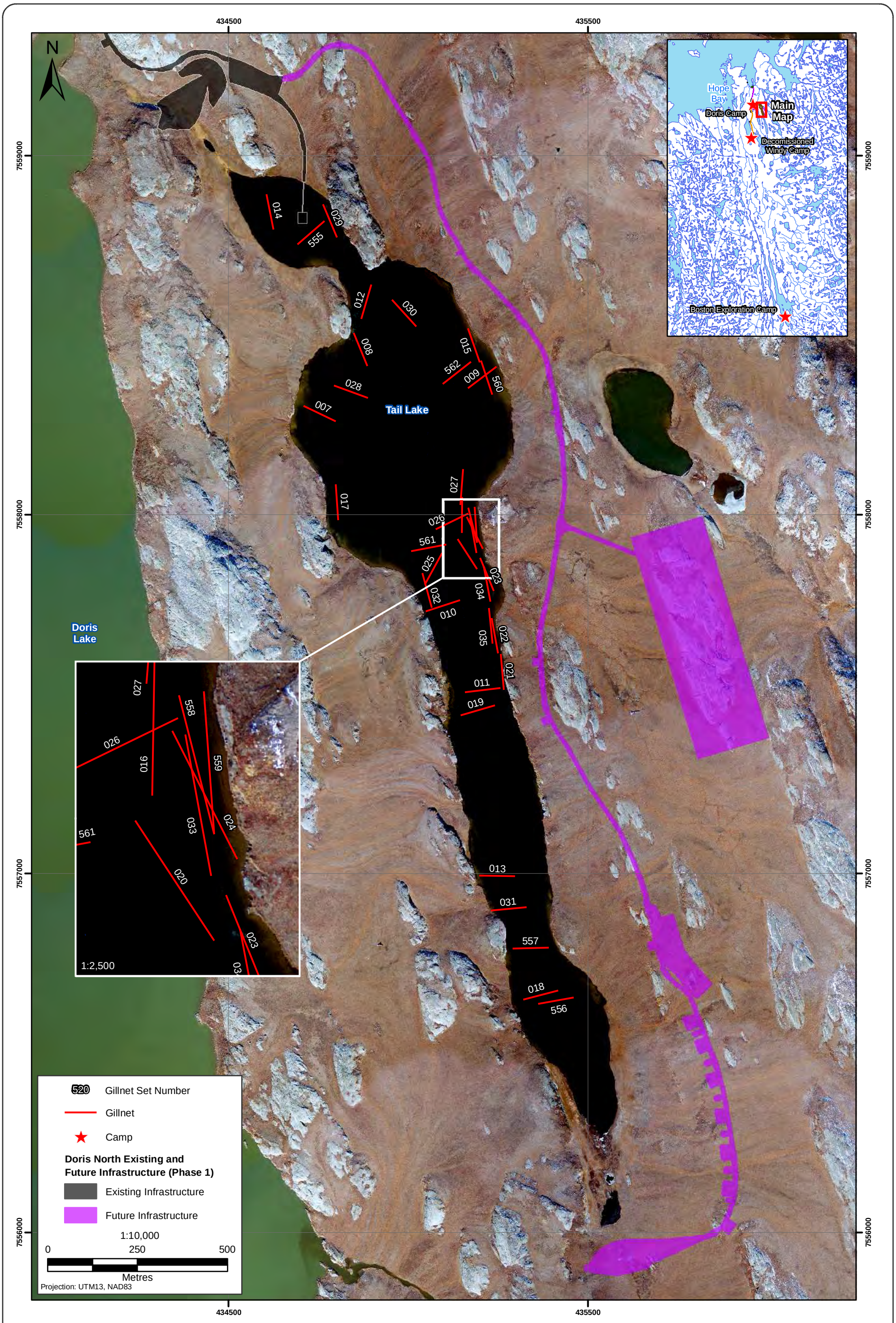


Figure 2.2-1c

NEWMONT NORTH AMERICA

# CPUE/Removal Phase Gillnet Set Locations, Tail Lake Fish-out, August 16 to August 20, 2011

Figure 2.2-1c

Rescan™ Engineers & Scientists

PROJECT #1009-008-14 GIS # HB-06-137d May 25 2012

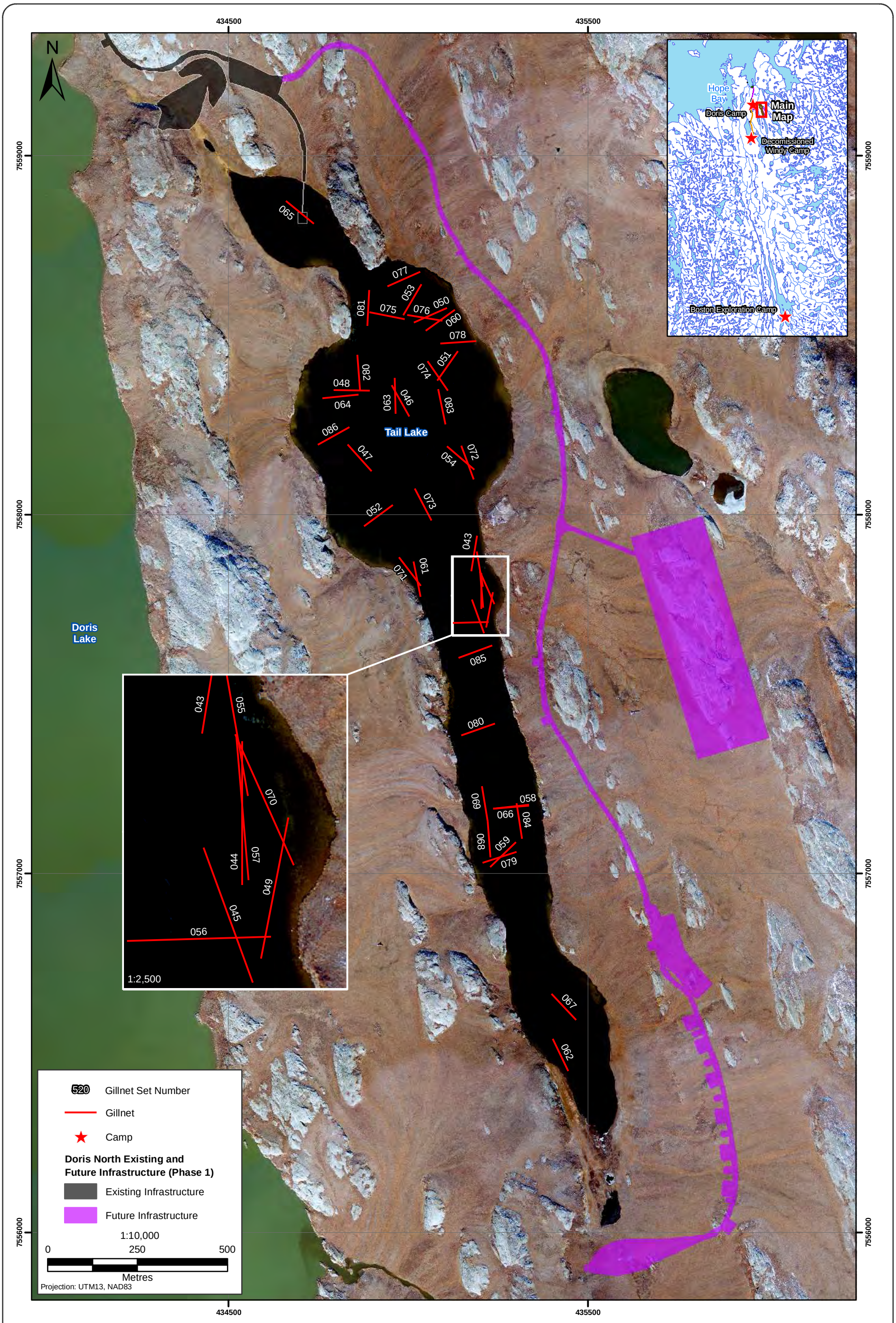


Figure 2.2-1d

NEWMONT NORTH AMERICA

## CPUE/Removal Phase Gillnet Set Locations, Tail Lake Fish-out, August 23 to August 27, 2011

Figure 2.2-1d

Rescan Engineers & Scientists

Upon the retrieval of each standard gillnet gang, the unique gillnet gang number was recorded, the number of fish captured by each gillnet panel was recorded, and the number of marked and unmarked fish were recorded. Fish catch data were recorded on the 'Gear Set Data and Fish Count Record' data sheet provided in the fish-out protocol (Tyson et al. 2011). Captured fish were then removed from each mesh panel, swiftly killed by a blow to the head (if they were not already killed by capture and handling) and placed in the appropriate storage bin for each mesh size (i.e., 4" to 0.5"; Plate 2.2-4. Fish were then transported to a processing station/dock located on the northern shoreline of Tail Lake for biological sampling (Plate 2.2-5). If the catch of an individual gillnet was extremely high, the net was retrieved without removing the fish and placed in a large gillnet storage tub. Gillnets with high catches were taken immediately to the processing station where a dedicated sampling crew removed all fish, recorded the catch for each mesh panel, and conducted biological sampling of the catch (Plate 2.2-6). This system was only utilized during the early portion of the CPUE/Removal phase when CPUE was relatively high. Once CPUE diminished, captured fish from each gillnet were organized and recorded by mesh size onboard the sampling boat.


*Plate 2.2-4. Labeled storage bins used to separate fish catches for each gillnet mesh panel.*

Biological sampling was conducted on a large dock located on the northern shoreline of Tail Lake (Plate 2.2-5). A dedicated biological sampling crew consisting of the Lead Project Biologist and assistants capable of accurate data recording processed fish as they were brought to the dock by the gillnet retrieval crews. In the early portion of the CPUE/Removal phase two biological sampling crews were required to keep pace with high catches. As CPUE declined through the CPUE/Removal phase, only one biological sampling crew was necessary. Additional standard gillnet gangs were added as CPUE declined in attempt to balance crew workload between gillnet set/retrieval and biological processing.

*Plate 2.2-5. Fish biological sampling station.*

*Plate 2.2-6. Biological sampling and data recording of the catch.*

At the biological sampling station, the gillnet retrieval crew transferred data for all gillnet set locations, set and lift times, and catch to the appropriate 'Gear Set Data and Fish Sample Record' provided in DFO's fish-out protocol. Biological sampling crews then began processing the catch for each gillnet mesh panel and recording data to the appropriate 'Gear Set Data and Fish Sample Record' data sheet exactly as outlined in the protocol. Fish were identified to species, given a unique sample number, measured for fork length to the nearest 1 mm and weighed to the nearest 0.1 g using a calibrated electronic balance. The presence of tags (and tag numbers) and fin punches were recorded. Information on the incidence of DELTs, sex, sexual maturity, reproductive status, gonad weight, and liver weight were collected. To expedite fish sampling, a target of 50 lake trout per 20 mm fork length-class was used. The number of lake trout sampled per size-class was tracked throughout the CPUE/Removal phase. Otoliths, pectoral fin rays and scale samples were collected and placed in labeled envelopes (Plate 2.2-7) from a sub-sample of lake trout based upon 20 mm fork length-class. A total of 20 pectoral fin rays and five otoliths were sampled from individual lake trout for each 20 mm fork length-class. Therefore, analysis of ageing structures was completed for 25 individuals from each 20 mm size-class. Lake trout aging structures were sent to North-South Consultants (Winnipeg, MB, Canada) and Stamford Environmental (Gibsons, BC, Canada) for age reading.

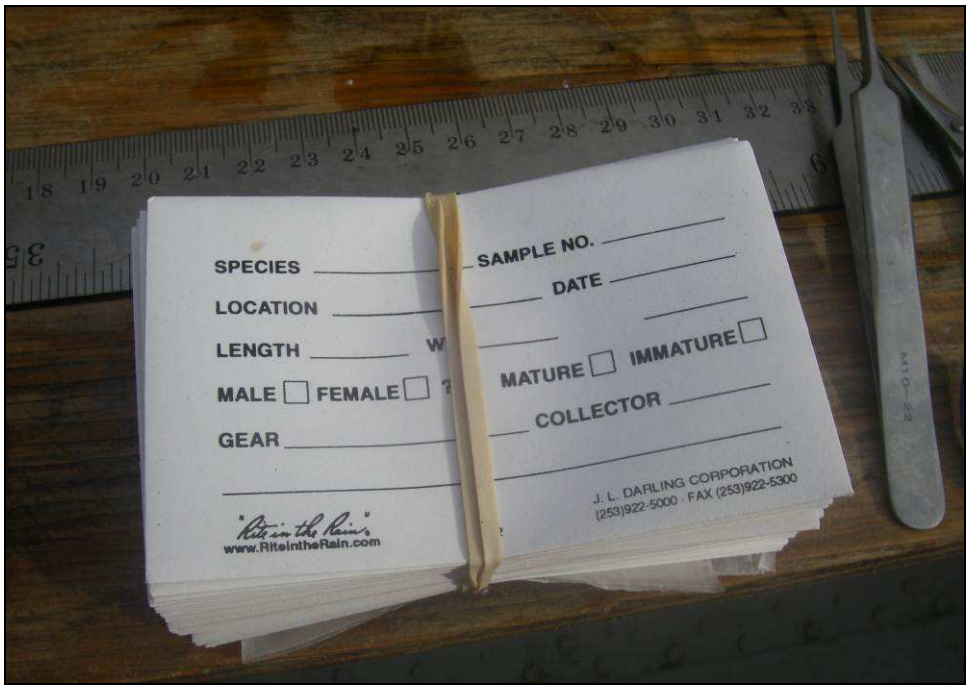


*Plate 2.2-7. Labeled scale envelopes used to store lake trout aging samples.*

Stomach samples were collected for future analysis from 50 lake trout. These samples were selected from fish encompassing the range of sizes captured from the lake. Previous sampling efforts in Tail Lake have identified a lack of small size-classes (<430 mm) for lake trout (Golder 2007); thus, analysis from small size-classes was limited. Ovaries from ripe females were collected, preserved in formalin and sent to Heidi Swanson (University of Alberta, Edmonton, AB, Canada) for estimation of fecundity.

Biologically sampled lake trout were then cleaned (i.e., eviscerated and gills removed; Plate 2.2-8). Cleaned lake trout were then washed, packed in coolers filled with crushed ice (Plate 2.2-9), and transported to a walk-in freezer at Doris Camp. Cleaned lake trout were separated and allowed to freeze for approximately two days. Completely frozen lake trout were then packed in Styrofoam™ fish cooler boxes and shipped to Cambridge Bay. Fish cooler boxes packed with frozen lake trout were then taken to the Cambridge Bay food bank for distribution to members of the community.


*Plate 2.2-8. Preparation and cleaning of removed lake trout.*

*Plate 2.2-9. Lake trout prepared for shipment to local Inuit communities.*

Gillnet CPUE was calculated as the number of fish caught per 24 hours. Effort and catch data for each gillnet was entered into a Microsoft Excel spreadsheet on a daily basis. CPUE was plotted against date until it declined close to zero. The number of unmarked (new mortalities) and marked (recapture mortalities) were also tracked in a separate MS Excel spreadsheet. These numbers, along with the number of lake trout marked during the Marking Phase, were used with the Peterson method to estimate and track the estimated lake trout population number throughout the fish-out program.

According to Tyson et al. (2011), the ideal CPUE/Removal phase objective is reached when no fish are captured for 24-48 hours of continuous netting, the nets are removed for 48 hours and then re-deployed for another 48 hours to confirm that no fish are captured. After no fish are captured for two consecutive 48 hour periods, the CPUE/Removal phase will cease. In the case of the Tail Lake fish-out, his ideal objective was not achieved. CPUE declined to near zero; however, some (e.g., one or two) lake trout catches were made on a daily basis during the conclusion of the CPUE/Removal Phase. Once CPUE declined and stabilized near zero, the DFO program representative was contacted and permission was granted to shift to the Final Removal Phase.

### 2.2.3 Final Removal Phase

The objective of the final removal phase was to capture all remaining lake trout in Tail Lake to provide a complete population census as conditions allow (Tyson et al. 2011). This final phase of the fish-out protocol was initiated after permission was granted by the DFO program representative on August 28, 2011. A rotation of the field crews also occurred on this date, providing a natural and logical transition in the fish-out program.

Gillnets remained the principle capture gear for the Final Removal phase. All standard gillnet gangs used in the CPUE/Removal phase were utilized along with all gillnet mesh panels available at the project site. Thus, gillnets used in the Final Removal phase were not standardized for mesh size and overall gang length or surface area. In total, 22 gillnet gangs were used. This number of gillnet gangs was sufficient to reach gear saturation for Tail Lake. Because gear saturation was attained, gillnet set locations remained relatively constant throughout the Final Removal phase (Figure 2.2-2).

Gillnetting data and biological sampling data collection was reduced during the Final Removal phase because the objective of this phase was simply to remove as many lake trout as possible. For gillnetting, this limited data collection included the collection of set and retrieval times, and overall catch per species. For biological sampling, all captured fish were identified to species, given a unique sample number, measured for fork length to the nearest 1 mm and weighed to the nearest 0.1 g using a calibrated electronic balance. The presence of tags (and tag numbers) and adipose fin clips were also recorded. Additional biological data (e.g., sex, maturity, etc.) were recorded only for lake trout belonging to 20 mm fork length-classes where the target of 50 lake trout per length-class was not yet achieved.

### 2.2.4 Quality Assurance/Quality Control (QA/QC)

Each field data sheet was subjected to several QA/QC reviews. The first opportunity for QA/QC occurred after an individual gillnet was processed and fish catches tallied. At the biological sampling station, the gillnetting crew would complete a ‘Gear Set Data and Fish Count Record’ data sheet and submit it to the Lead Project Biologist. The Lead Biologist would then critique the data sheet to ensure that information for all data fields were complete and examine each gillnet mesh size bin to ensure the catch tally for each mesh size was correct. Upon the completion of biological sampling for each gillnet, the Lead Biologist would examine the “Gear Set Data and Fish Sample Record” data sheet to ensure that the number of fish sampled equalled that of the catch tally, ensure that all data fields were complete, and ensure that information for each collected sample (e.g., aging structures) were in

agreement with the "Gear Set Data and Fish Sample Record". Any errors or omissions were corrected. The Lead Biologist then noted that QA/QC was completed for the data and signed the data sheet.

All data sheets were reviewed at the end of each field day to ensure data were complete and correct. As previously stated, gillnet effort, catch, fish fork length, aging structure samples, and the number of recapture mortalities and new mortalities were entered into separate MS Excel spreadsheets. The entry of these data into electronic spreadsheets offered another opportunity for data QA/QC as all transcriptions were cross-referenced against the field data sheet and any errors corrected. Data such as CPUE and fork length were also plotted to identify any outliers that may have resulted from transcription errors that occurred in the field.

To assess the accuracy of the fish tissue metal analyses, ALS conducted two measures of quality control: method blanks (or MB) and comparison with reference material (or CRM). A method blank is a test in which no tissue was added. Two method blanks were run with 25 metals measured for each blank, resulting in a total of 50 comparisons between measurements and targets. All results were below the method detection limit (or MDL) (Appendix 2.2-1).

To further assess the accuracy of the metal analyses, samples of a reference material, VA-NRC-TORT2 or lobster hepatopancreas, certified by the National Research Council of Canada, were subjected to the same analytical procedures as the lake trout tissue samples. The measured concentrations of each metal were then compared to the known metal concentrations in the certified material to determine if they fell within the 95% confidence limits expected for each metal. Of the 25 comparisons performed, all 25 fell within the 95% confidence limits around the target (Appendix 2.2-1). These results are considered to be an acceptable range of analytical accuracy.

To assess the variability of fish tissue metal analysis, and hence the homogeneity of the samples, one of the 16 samples (or ~6% of the total number of samples) was split into two replicates and the relative percent difference (RPD) between replicate metal concentrations (and percent moisture) was calculated as:

$$RPD = 100((sample - duplicate)/((sample + duplicate)/2))).$$

Since 25 metals were measured for a single sample, this gave a total of 25 potential RPD (Appendix 2.2-2).

However, 16 (64%) of those potential RPD were not calculated because one or both of the values were less than the MDL. In general, analytical variability is much higher near the MDL than is considered acceptable. Therefore, those RPD were classified as "RPD-not available" or RPD-NA (Table 2.2-1).

**Table 2.2-1. Tests of Variability of Fish Tissue Metal Concentrations from Tail Lake, Doris North Project, 2011**

| Qualifier | Number of Potential RPD | Percent |
|---|---|---|
| RPD-NA | 16 | 64 |
| J | 0 | 0 |
| RPD | 9 | 36 |
| DUP-H | 0 | 0 |
| **Total** | **26** | **100** |

*RPD = Relative Percent Difference.*
*RPD-NA = RPD Not Available because one or both values were at or below the MDL.*
*J = Absolute difference between duplicates. RPD not available because one or both values were less than five times greater than the MDL.*
*DUP-H = Duplicate results outside of ALS data quality objectives due to sample heterogeneity.*