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*Via email and Xpresspost*

Mr. Richard Dwyer
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Nunavut Water Board
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Phone: (867) 360-6338

Dear Mr. Dwyer,

**Re: Meadowbank Water License 2AM-MEA0815: Document Submission**

As required by Water license 2AM-MEA0815, Part D, Item 11, Agnico-Eagle Mines Limited (AEM) is submitting a Final Water Quality Monitoring and Management Plan for Dike Construction and Dewatering.

Please note that a draft version of this document was originally sent to the Nunavut Water Board (NWB) on March 7, 2008, in response to the Table of Commitments generated during the Meadowbank Pre-Hearing Technical Meeting held in Baker Lake on February 24th and 25th, 2008. The document was included as Appendix A in the supplemental information provided.

This final version of the document addresses the comments AEM received from interveners on the draft document, and includes the rationale and location of the upstream turbidity barrier for the east dike. It also includes the protocols for monitoring and maintaining water levels in Third Portage Lake within natural variation during the dewatering process. This information was also provided to the NWB in the March 7, 2008 submission, as Appendix N.

Should you have any questions regarding this submission, please contact me directly at 604-622-6527 or via email at rgould@agnico-eagle.com.

Regards,

RL Gould

Rachel Lee Gould, M.Sc.
Project Manager, Environmental Permitting and Compliance Monitoring

**AGNICO-EAGLE MINES LTD.**
**Meadowbank Division**

# WATER QUALITY MONITORING AND MANAGEMENT PLAN FOR DIKE CONSTRUCTION AND DEWATERING AT THE MEADOWBANK MINE.

REVISED FINAL
JULY 2008

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# SECTION 1 • INTRODUCTION

Agnico-Eagle Mines Ltd. (AEM) is pleased to submit this water quality monitoring and management plan for dike construction and dewatering at the Meadowbank mine site from mid-2008 to early 2009. The plan has been prepared on behalf of AEM by the Azimuth Consulting Group Inc. (Azimuth). The plan does not cover the complementary monitoring of limnological parameters in Second Portage Lake (which is contained in the Fish-Out Program) nor does it cover AEMP-related routine water quality monitoring of both Second and Third Portage lakes.

Water quality monitoring will include several parameters (e.g., nutrients and metals), but TSS (total suspended sediments) and turbidity[1] (primarily as a surrogate for TSS) will be the major driver of management actions during construction and dewatering. The TSS/turbidity focus allows for direct monitoring of the major potential stressor in "real time", thus allowing timely identification and mitigation of potential issues related to dike construction or dewatering.

This memo includes the following components:

- Review of key literature regarding effects of suspended sediment (**Section 2**)
- Review and discussion of existing guidelines for suspended sediment (**Section 3)**
- Present suspended sediment triggers for protection of fish and fish habitat at Meadowbank **(Section 4 and Appendix A)**
- Water quality monitoring and management plan for dike construction (**Section 5**)
- Water quality monitoring and management plan for dewatering (**Section 6**)
- References (**Section 7**)

The monitoring and management plans are detailed and should serve as operating procedures for real-time actions in the field. This revised final plan has been revised to reflect discussions with regulatory agencies and the requirements of the final Nunavut Water Board A Licence (2AM-MEA0815) for the Meadowbank Gold Project.

[1] The precise method that will be used to relate TSS and turbidity is explained in Section 4 of this memo.

# SECTION 2 • REVIEW OF TSS/TURBIDITY EFFECTS

Suspended solids, and associated effects on water clarity, have the potential to affect fish and fish habitat in a variety of ways, including but not limited to:

- Smothering of deposited eggs or siltation of spawning habitats
- Smothering of benthic invertebrate communities
- Decreased productivity caused by reduced light penetration
- Reduced visibility, which may decrease feeding efficiency and/or increase predator avoidance
- Clogging and abrasion of gills

DFO has produced a report on effects of sediment on fish and their habitat (DFO 2000). That report is based primarily on a more detailed paper by Birtwell (1999). The review by Birtwell is in turn based on a few sources, the most recent and comprehensive of which was prepared by Caux et al. (1997). Birtwell (1999) notes that the TSS guidelines developed by the CCME (1999) and the BC Ministry of Environment, Lands and Parks (1998) are the most recent available, and that both are based in part on the review by Caux et al (1997). Not surprisingly, then, there is a high degree of consistency among past reviews of the effects of TSS. We did a literature review to find more recent articles specific to species of interest at the Meadowbank mine, but did not find any articles.

The general findings for effects of TSS on fish and fish habitat indicate the following:

- Effects of TSS depend on both concentration of TSS and duration of exposure.
- Effects of TSS can also be influenced by the size and shape of suspended particles.
- Concentrations of TSS that are lethal to fish over acute exposures (i.e., hours) range from hundreds to hundreds of thousands of mg/L.
- Sublethal effects on fish (e.g., reduced growth, changes in blood chemistry, histological changes) associated with chronic (weeks to months) exposures tend to be exhibited at TSS concentrations ranging from the tens to hundreds of mg/L.
- There is considerable uncertainty about potential effects of very low TSS concentrations (less than tens of mg/L) over very long time periods.
- Overall, the most sensitive group of aquatic organisms to TSS appears to be salmonids, and guidelines discussed below are designed to protect this group.
- Adult salmonids are generally more sensitive to short duration, high concentrations of suspended sediments than juvenile salmonids. However, both juvenile and adult fish have potential to avoid high concentrations of suspended sediments.
- Very low suspended sediment levels are known to cause egg mortality (40%) to rainbow trout at long durations (7mg/L at 48 days). Guidelines for long-term exposure reflect these findings.

## SECTION 3 • EXISTING GUIDELINES FOR TSS AND TURBIDITY

Based on the findings regarding effects of suspended sediment, guidelines for TSS as well as turbidity have been put forth by various agencies.

***TSS***

In the case of TSS, CCME and BCMELP specify separate guidelines for TSS for clear flow and high flow periods. The guidelines are derived primarily from Caux et al. 1997, with application intended mainly for British Columbia streams. Caux et al. 1997 refer to clear flow periods and/or clear water. In the case of application to the Meadowbank Project Lakes, the clear flow or clear water guidelines would be most relevant – even during freshet we would not expect to see large natural fluctuations in TSS except in localized areas for short periods.

The guidelines put forth by CCME and BCMELP recognize that the severity of effects of suspended sediments is a function of both the concentration of suspended sediments and the duration of exposure. Guidelines are intended to protect the most sensitive taxonomic group (salmonids) and the most sensitive life history stages. The following table summarizes the available guidelines applicable to clear water (CCME and BCMELP) and to mine-related effluent discharges (MMER).

| Source | Short-Term Exposure | Long-Term Exposure |
|---|---|---|
| CCME 1999 | Anthropogenic activities should not increase suspended sediment concentrations by more than 25mg/L over background levels during any short-term exposure period (e.g., 24-hr) | For longer term exposure (e.g., 30 days or more), average suspended sediment concentrations should not be increased by more than 5mg/L over background levels |
| BCMELP 1998 | Maximum increase over background of 25 mg/L during any 24 hour period (hourly sampling preferred). | Average sediment concentration should not exceed background by more than 5 mg/L for sediment inputs lasting between 24 hours and 30 days (daily sampling preferred). |
| MMER 2002 | Maximum authorized concentration in a composite effluent sample = 22.5 mg/L.<br><br>Maximum authorized concentration in a grab sample of effluent = 30 mg/L. | Maximum authorized monthly mean effluent concentration = 15 mg/L [2]. |

[2] For purposes of calculating monthly means, any values below detection limits are set at one-half of the detection limit.

The guidelines above are intended to be protective of the most sensitive taxonomic groups and life stages, and are based on hundreds of studies in different environments (see Caux et al. 1997). Some of the studies may not be particularly relevant to the case of suspended sediment associated with dike construction and dewatering in a lake environment. Consequently, it is worth considering whether all aspects of existing guidelines are applicable to dike construction and monitoring at the Meadowbank mine. There are two particular aspects that warrant discussion.

First, in relation to short-term exposure guidelines, it is important to note that guidance is based on findings for adults and juveniles (which are more sensitive than eggs and larvae over short durations), and that the guidance is based primarily on reviews looking at application to stream environments. In a stream environment, compared to a lake environment, it is difficult for fish to swim away from suspended sediments because the high degree of mixing in the water column facilitates higher uniformity in TSS concentrations. In contrast, in lakes, in particular for sediment plumes associated with construction activities or discharges, high TSS concentrations would generally be expected to be localized, with dilution over distance. In a lake situation, adult and juvenile fish (the most sensitive life stages to short-term exposure) should readily be able to swim away from a sediment plume.

Second, in relation to long-term exposure guidelines, it is important to note that guidance is heavily influenced by findings indicating the sensitivity of eggs to low-level exposure to TSS over long durations. Consequently, the long-term exposure guidelines would be rather conservative if applied during times when eggs are not present, or in areas of a lake or stream that are not spawning habitat.

In Section 4, we develop site-specific TSS triggers for Meadowbank.

***Turbidity***

Turbidity guidelines put forth by CCME (1999) and BCMELP (1998) are based on extrapolation from the TSS guidance above, adjusted by a factor of about 3:1 (a typical average ratio for TSS: turbidity). In the case of turbidity for clear water, CCME (1999) recommends a maximum increase of 8 NTUs from background levels for a short-term exposure (e.g., 24-h period), and a maximum average increase of 2 NTUs from background levels for a longer term exposure (e.g., 30-d period). The BCMELP (1998) guidance is virtually identical to that of CCME.

It should be noted that DFO's report on effects of sediment on fish and their habitat (DFO 2000) endorses the guidelines for TSS put forth by BCMELP (1998) and CCME (1999), but does not recommend following guidelines for turbidity. Rather, turbidity may be used as a surrogate for suspended sediment only when the relationship between the two parameters is established for a particular waterbody. CCME (1999) provides an example regression calculation where the base 10 logarithm of turbidity is a function of the base 10 logarithm of TSS.

Existing guidance documents, as well as the Caux et al (1997) analysis which formed most of the basis for the guidance, recognize that in general, suspended sediments result in reduced light penetration which in turn results in reduced primary production (DFO 2000; CCME 1999). CCME (1999) notes, however, that in some cases short-term resuspension of sediments and nutrients in the water column can augment primary productivity, and in other cases changes in light penetration may be inconsequential if a system is limited by other factors such as nutrients. The Caux et al. (1997) study considered effects of suspended sediment not only on fish but also on algae and zooplankton.

In the end, the recommendations put forth by Caux et al. (1997) are based mainly on the most sensitive taxonomic group, which is salmonids.

While the CCME guideline for turbidity is based on TSS and is meant to be protective of fish and fish habitat (i.e., including the food chain), research has shown that widespread, chronic turbidity can result in reductions of primary productivity (e.g., Lloyd et al., 1987). Consequently, water clarity is of concern at broader spatial scales and longer timeframes. For example, it would not be a concern for dike construction due to the expected localized nature and short duration of any sediment incursions past the turbidity barriers. For dewatering, however, there is the potential for discharges to occur throughout an open water season. The potential impacts of these discharges on primary productivity will be monitored as part of the core AEMP program. Turbidity data will be compared to CCME guidance and scientific literature relating productivity to turbidity, while direct measures of primary productivity will be assessed using spatial and temporal analyses as part of the AEMP.

# SECTION 4 • RECEIVING ENVIRONMENT[3] SUSPENDED SEDIMENT TRIGGERS FOR PROTECTION OF FISH AND FISH HABITAT AT MEADOWBANK

The TSS guidelines reported above are based mainly on the analysis by Caux et al. (1997). That analysis was intended to support derivation of generic guidelines that would be protective of the most sensitive taxonomic groups and life stages, and that would be applicable to a wide range of water bodies. In addition, the methodology of Caux et al. evaluated the expected change in response associated with a given change in TSS concentration (i.e., the slope of the concentration-duration response curves). This approach using the slope is therefore based on *relative* changes in response, and is appropriate for a generic guideline because it can be applied to systems with varying baseline TSS concentrations and varying baseline response (if applicable). In the case of Meadowbank, however, we are less interested in *relative* changes in response than in the *absolute* responses at low TSS concentrations[4].

For these reasons, we re-evaluated the data to develop site-specific TSS thresholds for Meadowbank. The rationale and analysis are contained in Appendix A. Based on the analysis, we will use (as now approved in the NWB A Licence) the following TSS thresholds for the aquatic environments at Meadowbank:

*Short Term Maximum* – For durations up to and including 24 hours, we recommend a TSS threshold of 25mg/L, to be applied in areas where there is spawning habitat and at times when eggs or larvae would be expected to be present (i.e., this threshold of 25 mg/L will be applied to monitoring stations that are located closest to the high value shoal areas, starting 1 September 2008).
In all other areas and at times when eggs/larvae are not present, we recommend a TSS threshold of 50 mg/L. For impounded areas (e.g., northwest arm of Second Portage Lake), the threshold of 50 mg/L would apply at all times and in all areas, because any eggs deposited in impoundments will not survive dewatering.

*Maximum Monthly Mean* – For long-term exposure, we recommend a monthly mean TSS threshold of 6 mg/L, to be applied in areas where there is spawning habitat and at times when eggs or larvae would be expected to be present (i.e., this threshold of 6 mg/L will be applied to monitoring stations that are located closest to the high value shoal areas, starting 1 September 2008). In all other areas and at times when eggs/larvae are not present, we recommend a TSS threshold of 15 mg/L as a maximum monthly mean. For impounded areas (e.g., northwest arm of Second Portage Lake), the threshold of 15 mg/L would apply at all times and in all areas, because any eggs deposited in impoundments will not survive dewatering.

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[3] TSS limits for dewatering impoundments are addressed in Section 6.
[4] Mean background TSS concentrations in baseline studies for Second Portage Lake ranged from <1 to 3 mg/L. The majority of the measured values were below the method detection limit of 1 mg/L. While existing guidance values are intended to be applied relative to background, we propose to initially ignore background concentrations and assume they are near zero (with a single exception for maximum monthly means as explained in Appendix A). This conservative assumption addresses uncertainties in actual TSS concentrations. Background TSS concentrations will be measured in Second Portage Lake (i.e., in an area outside the influence of construction activities, such as the south-eastern end of the lake) and considered if warranted.

As AEM is committed to proactive and efficient response to any potential TSS problems, the monitoring program must be designed to provide quick feedback. This is not possible using TSS as a direct measure, because of the time required to analyze TSS in the field. Consequently, and consistent with the recommendations of DFO (DFO 2000), we propose to develop a relationship between turbidity and TSS that will allow the use of turbidity as a surrogate for TSS. The relationship will be developed as soon as possible during the construction phase. In order to establish the relationship with some confidence, we will generate data across a range of TSS levels by sampling both inside and outside of silt curtains. Prior to development of a site-specific TSS-turbidity relationship, we propose to use 2007 monitoring data gathered from the All Weather Private Access Road[5]. Linear regression of those data generates a relationship of

$$\text{Log (turb)} = -0.089 + (1.19 \times \log(\text{TSS})), [n=37, r\text{-squared} = 0.86, p<0.001]$$

where turbidity is measured in NTUs and TSS in mg/L.

Once a statistically significant relationship between turbidity and TSS is established (i.e., statistical p value <0.10) using data specific to Second Portage Lake, we will use that relationship to relate the two parameters.

It should be noted that these TSS thresholds are intended for application to the aquatic receiving environments. TSS limits for dewatering discharges are discussed separately in Section 6.

[5] Additional data from 2008 site and road monitoring may also be included if available and deemed appropriate.

# SECTION 5 • WATER QUALITY MONITORING AND MANAGEMENT PLAN FOR DIKE CONSTRUCTION

During dike construction, the dike material itself as well as the disturbed material on the lake floor will both contribute to increases in concentrations of suspended sediments in the water column. In the absence of sediment control measures, suspended sediment plumes would be expected to migrate to the southeast with wind-driven (prevailing winds from the northwest) currents and the prevailing flow direction to the outlet at the southeast side of Second Portage Lake.

The key means for minimizing suspended sediment discharges from the dike construction zone during dike construction will be deployment of silt curtains to form a continuous barrier. The silt curtains will be placed as close as possible to the construction zone (except for the portion of the east curtain that will be anchored to the small island) without risking direct incidental physical contact with construction materials (**Figure 1**), and allowing sufficient room for anchor placement on both sides of the curtains. The original design only allowed space for anchors on the exterior side of the curtains due to being closer to the dike construction zone. While such a layout definitely works well once the initial rockfill berm is completed across the lake, there is a short period of time just after deployment of the curtain when the curtains could be exposed to strong currents and pushed backward toward the lakebed anchors. In such conditions, the sag is no longer distributed amongst several anchors. As a result, the stresses in the curtain increase rapidly and the risk of rupture becomes significant during periods of high winds. While the risks of wind storms occurring before completion of the first phase embankment are moderate, the consequence on the environment would be serious in case of an uncontrolled release of a turbid plume in the lake. It is therefore preferable to anchor the silt curtains from both sides in order to make them more stable under all weather conditions.

The silt curtains will be suspended off of the lake floor to allow some passage of water and to avoid resuspension of sediment associated with contact between the curtains and the bottom sediments. If there are no silt curtain failures, we do not expect any significant sediment plumes, although minor seepage of suspended sediments under silt curtains may result in localized elevated TSS concentrations outside the barrier. However, strong winds are not uncommon on the lake and will need to be addressed with sufficient anchoring of the silt curtains. Wind-related stresses on the silt curtains, and the related risk of curtain failure, will decrease significantly as the first rock wall portion of the dike is constructed. Furthermore, the east curtain will be deployed in two sections, with both anchoring to the small island to increase security and redundancy (i.e., if there is a failure, it will most likely be only one of the sections that fails). Notwithstanding, silt curtain integrity will be monitored closely throughout the construction period.

The Standard Operating Procedure (SOP) for monitoring and management of suspended sediments during dike construction is shown in **Figure 2**. Importantly, the SOP strives for proactive prevention and mitigation of problems. Monitoring will be conducted during daylight hours when conditions are safe for small craft. Within these constraints, we will attempt to provide round-the-clock sampling by a two-person crew (a total of four people will be dedicated to this task – a day crew and a night crew). The monitoring crew will have dedicated access to a boat, and possibly to more than one boat in order to have access to both sides of dikes.

The SOP contains the following key elements:

1. Routine TSS monitoring will include three monitoring events per day (weather/logistics permitting), approximately every six hours during daylight. Each monitoring event will include (a) inspection of silt curtain integrity/deployment, and (b) measurement of TSS/turbidity at one or more established stations (see #3 for more details).

2. Routine water quality sampling for nutrients and metals (total and dissolved) will also be conducted on a weekly basis[6].

3. Stations for routine monitoring will be established on the outside of silt curtains, at a distance of about 50 meters from the silt curtains (**Figure 1**; see W, NE, and SE station series with crossed circle markers). Not all stations would be sampled every event – for example, at the start of construction, stations that are located near the opposite side of the lake from the construction area might be sampled only periodically.

4. In addition, construction crews will be responsible for immediately reporting any obvious silt curtain problems if they observe problems before the monitoring crew.

5. If there is a silt curtain problem, it will be immediately fixed.

6. If TSS levels (or turbidity as a surrogate) in a single sample exceed the *Short Term Maximum* (see below), this will trigger a series of actions. First, the silt curtain will be inspected in more detail to identify any obvious problems. If there are no obvious problems, mitigative measures will be considered such as adjusting construction practices (e.g., more careful placement of materials), modification of silt curtain deployment, or deployment of additional silt curtains. Second, monitoring frequency for the affected area (the station of interest plus direct neighbour stations) will be increased (1 to 4 hour intervals depending on the magnitude). Third, any plumes will be delineated spatially using a grid of monitoring stations (see station series A through F with clear circle markers in **Figure 1**) and taking the maximum TSS (turbidity) concentration in the water column (based on depth profiling). Field crews will carry a map showing the map grid with the names of each station and GPS units with pre-entered coordinates.

7. As monitoring continues, a moving 24-hour average TSS concentration will be estimated at each monitoring station. If the 24-hour average exceeds the *Short Term Maximum*, construction will shut down while (a) mitigative measures are considered, (b) monitoring continues, (c) weather shifts (if weather is a factor), and (d) AEM provides a recommended course of action to regulators. Construction will resume once AEM is confident that the conditions that led to the elevated TSS levels have been addressed.

8. In addition to short-term effects of TSS, there is potential for long-term effects that occur at lower concentrations. For this, we propose to calculate a 7-day moving average TSS concentration and compare this to a *Maximum Monthly Mean*. If the 7-day moving average

[6] Water quality sampling parameters will include (a) physical parameters - hardness, pH, total dissolved solids, total suspended solids, (b) Anions and nutrients - ammonia, alkalinity – bicarbonate, alkalinity – carbonate, alkalinity – hydroxide, alkalinity – total, chloride, silicate, sulfate, nitrate, nitrite, total kjeldahl nitrogen, ortho phosphate, total phosphate; (c) Organic parameters: chlorophyll a, dissolved organic carbon, total organic carbon; (d) Total and dissolved metals

TSS concentration exceeds the maximum monthly mean, we will first determine if the average has been heavily influenced by one or more events that have been addressed. If not, we will consider mitigative options such as re-deployment of silt curtains, deployment of additional silt curtains, and possible adjustments to construction practices. If there is still a problem with the 7-day moving average TSS concentration, we will shutdown construction (until the TSS source has been identified and addressed) and provide an appropriate course of action to regulators.

9. Follow-up monitoring of the benthic community will be conducted if significant sediment plumes are identified. While it would be expected that any adverse effects from sediment deposition would not be permanent, plume deposition areas will be monitored in the year following construction (and the next year if significant adverse effects are found). A control-impact design will be used to test for differences in benthic community (e.g., abundance and diversity) between the deposition area and an area (similar depth and substrate characteristics) unaffected by construction activities.

10. Three high value shoal areas were identified in close proximity to the construction area (**Figure 1**). While these areas will be subject to a higher level of protection (i.e., lower trigger values for TSS; monitoring to occur at HVH station series on **Figure 1**) than other areas during the fall spawning season, sediment deposition rates will also be monitored using sediment traps. Results will be compared across monitoring points and to existing literature on effects of deposited sediment[7].

Raw turbidity data will be handled in the following manner to facilitate comparisons to trigger values:

- *Comparisons to Short-Term Maximum (STM)*

    1. Calculate 24-hr station mean for turbidity for each station based on measured values over the past 24 hours.

    2. Use TSS-turbidity regression to estimate 24-hr mean TSS.

    3. Compare to appropriate STM value.

    *Example: Maximum turbidity values of 2.4, 3.0 and 1.2 NTUs were measured in depth profiles at Station Y over the last 24 hours, for a 24-hr mean of 2.2 NTU. Using the 3:1 CCME TSS:Turbidity relationship (n.b., a site-specific relationship will be developed once appropriate data are available), the 24-hr mean TSS concentration would be 6.6 mg/L. This value would be compared against the appropriate STM trigger value. This example is a slight simplification because it assumes that the samples taken are equally spaced in time. In reality, we will estimate a weighted moving average TSS concentration where the weight of a given sample will be proportional to the time window that it covers.*

- *Comparisons to Maximum Monthly Mean (MMM)*

    1. Calculate 7-day moving average by taking the average of the 24-hr mean TSS values for the previous 7 days for each station.

[7] Caux et al. (1997) reviewed literature on effects of sediment deposition. Data are considered insufficient for development of guidance, but nevertheless a comparison of Meadowbank data to existing literature may be useful.

2. Compare this to the appropriate MMM value.

*Example: Station Y had 24-hr mean TSS concentrations of 20.3, 6.6, 2.1, 5.0, 13.2, 2.0, and 4.0 over the past week, resulting in a 7-day moving average of 7.6 mg/L. The following day 24-hr mean was 3.0; a new 7-day moving average of 5.1 is calculated. The 7-day moving average values would be compared to the appropriate MMM value. As with the STM case, this example is a slight simplification. In reality, we will estimate a weighted moving average TSS concentration where the weight of a given sample will be proportional to the time window that it covers.*

# SECTION 6 • WATER QUALITY MONITORING AND MANAGEMENT PLAN FOR DEWATERING DISCHARGES

During dewatering, there is potential for sediment to become suspended as exposed substrates slump. Suspended sediment could then enter the water intake(s) and be discharged to 3PL. In addition, the discharge itself could disturb the bottom sediments in 3PL and lead to increased levels of suspended sediment. The following plans will mitigate against possible problems with suspended sediment and other key parameters (i.e., pH and aluminum) during dewatering:

1. Intake barge(s) will be located at a sufficient distance from shore (minimum 10 meters) and, to the extent possible, in areas with highest water depth. As dewatering progresses, intakes can only be located in deep basins.

2. If necessary, silt curtains will be deployed around intake barge(s) in order to prevent silt-laden water from entering the intake.

3. The discharge will be located in an area of 3PL where there is deep, low-value habitat. In addition, the direction of the discharge pipe may be angled up, away from the lake bottom, to minimize any probability of sediment resuspension.

Monitoring during dewatering will be primarily focused at the barge intakes, but will also include the receiving environment of Third Portage Lake. Unlike monitoring during dike construction, where turbidity was used solely as a real-time surrogate for estimating TSS (see Section 5), turbidity measurements will be used two-fold: as a surrogate for TSS (using an established site-specific relationship) and directly as an indicator of water clarity.

Monitoring and management of receiving environment water levels, a requirement of the NWB A Licence, has been addressed by Golder (Appendix B).

Our Standard Operating Procedure (SOP) for monitoring and management of suspended sediments and other key parameters during dewatering is shown in **Figure 3**. Importantly, the SOP strives for proactive prevention and mitigation of problems. Monitoring will be conducted under direction of AEM's environmental supervisor on-site. Note that while **Figure 3** focuses on TSS, turbidity and the other dewatering parameters specified in the A Licence follow a similar approach. Senior biologists from Azimuth will become involved only if elevated levels of suspended sediments are detected at the barge intake.

The SOP contains the following key elements:

1. Routine monitoring will involve measuring TSS/turbidity in the intake barge(s) once each day, and visually inspecting the impounded area for sediment slumps and/or resulting plumes. Turbidity can be measured by extracting a sample of water collected using a bucket inside the intake barge.

2. The following TSS/turbidity management thresholds will be applied to the intake pipe during dewatering:

*Intake Short Term Maximum* (ISTM) – We suggest a short-term maximum for TSS concentrations of 22.5 mg/L that applies for durations up to 24 hours. This is equivalent to the MMER limit for composite samples, and slightly lower than the MMER limit for individual grab samples (i.e., 25 mg/L). The turbidity value will be 30 NTU.

*Intake Maximum Monthly Mean* (IMMM) – Consistent with MMER limits, we suggest a maximum monthly (30-day) mean TSS concentration of 15 mg/L be applied during dewatering. The turbidity value will be 15 NTU.

3. Monitoring for other required parameters (i.e., pH and aluminum) will occur once a week; results will be evaluated against the limits specified in the A Licence following the same strategy as that for TSS/turbidity outlined in items 6 through 10 below.

4. Initial confirmation monitoring in the receiving environment to ensure that the discharge is not re-suspending sediment from the bottom of 3PL. From three days before dewatering begins until 5 days after dewatering begins, we will monitor TSS daily in the receiving environment (30 meters out) to ensure that TSS/turbidity in the receiving environment are not being affected by the physical location of the discharge pipe.

5. Continuous monitoring in the receiving environment. Once ice-up begins, we plan to deploy a turbidity station and data logger through the ice, in the closest stable ice area but no closer than 30 meters from the end-of-pipe. The station will record turbidity regularly. As long as intake water meets the intake thresholds for TSS and turbidity, the receiving environment turbidity data will be downloaded only periodically (e.g., weekly). This unit would be also be deployed during dewatering during the open water season.

6. If parameter levels in a single sample of the intake water exceed the ISTM, this will trigger a series of actions. First, visual inspections will try to identify any obvious source of slumping on the lake edges to determine if the source of sediment is likely to be short-term or more continuous. Second, monitoring frequency for the intake will be increased to hourly. Third, mitigative measures will be considered, such as deployment of silt curtains around the intake barge(s) or movement of the intake barge(s).

7. If the moving 24-hour average TSS or turbidity value exceeds the ISTM, then dewatering will shut down while (a) mitigative measures are considered, (b) monitoring continues, (c) weather shifts (if weather is a factor), and (d) AEM provides an appropriate course of action to regulators. Dewatering will resume once the conditions that led to the elevated TSS/turbidity levels have been addressed.

8. At the same time, whenever the moving 24-hour average TSS/turbidity value in the intake exceeds the ISTM, we will attempt (if can be done safely) to delineate any plumes spatially. Before ice-up, this would involve sampling turbidity at 100-m intervals from the main receiving environment station, along a grid pattern until the plume is bounded. The grid at 100-m intervals will be mapped before construction begins, so that each point has a name (letter and number combination) and a GPS coordinate and can be located easily while in the field. After ice-up, monitoring will be more challenging. At the least, we will drill holes through the ice at two of the stations adjacent to the end-of-pipe receiving environment station. If elevated TSS concentrations are detected at these stations (based on maximum along the depth profile), we will try to move outwards along the 100-m grid, subject to safety concerns on the ice. All receiving environment TSS/turbidity values will be compared to the respective receiving environment triggers (see Section 4) for plume delineation.

9. A 14-day moving average will be used as an internal trigger to prompt consideration of mitigation measures in advance of the 30-day *Intake Maximum Monthly Mean* (IMMM). We will also determine if the average has been heavily influenced by one or more short-term events that are no longer relevant.

10. If the 30-day moving average *Intake Maximum Monthly Mean* is exceeded, then dewatering will shut down while (a) mitigative measures are considered, (b) monitoring continues, and (c) AEM provides an appropriate course of action to regulators. Dewatering will resume once the conditions that led to the elevated TSS levels have been addressed.

11. Follow-up monitoring of the benthic community will be conducted if significant sediment plumes are identified. While it would be expected that any adverse effects from sediment deposition would not be permanent, plume deposition areas will be monitored in the year following construction (and the next year if significant adverse effects are found). A control-impact design will be used to test for differences in benthic community (e.g., abundance and diversity) between the deposition area and an area (similar depth and substrate characteristics) unaffected by construction activities.

Raw turbidity data sampled from the barge intake will be handled in the following manner to facilitate comparisons to trigger values:

- *Comparison to Intake Short-Term Maximum (ISTM)*

    1. Calculate 24-hr mean for turbidity for each operating barge based on measured values over the past 24 hours.

    2. Use TSS-turbidity regression to estimate 24-hr mean TSS.

    3. Compare to ISTM.

    *Example: Turbidity was measured at 10 NTUs during the daily sampling event at 0800. Five other measurements were collected over the next 24 hours: 8, 4, 1, 2.5, and 2. The 24-hr mean turbidity value was 4.6, resulting in an estimated 24-hr mean TSS concentration of 13.8 mg/L. This example is a slight simplification because it assumes that the samples taken are equally spaced in time. In reality, we will estimate a weighted moving average TSS concentration where the weight of a given sample will be proportional to the time window that it covers.*

- *Comparison to Intake Monthly Mean Value (IMMM)*

    1. Calculate the 30-day moving average TSS for each operating barge based on the 24-hr mean TSS values reported over the last 30 days.

    2. Compare this value to the IMMM.

    *Example: Barge A had 24-hr mean TSS concentrations ranging from 2 to 7 over the last 30 days. The monthly mean was calculated using all these values. The calculation for the next day would involve dropping the oldest value and adding the newest 24-hr mean value. Each newly calculated 30-day average value is compared to the IMMM. As with the STM case, this example is a slight simplification. In reality, we will estimate a weighted moving average TSS concentration where the weight of a given sample will be proportional to the time window that it covers.*

## SECTION 7 • REFERENCES

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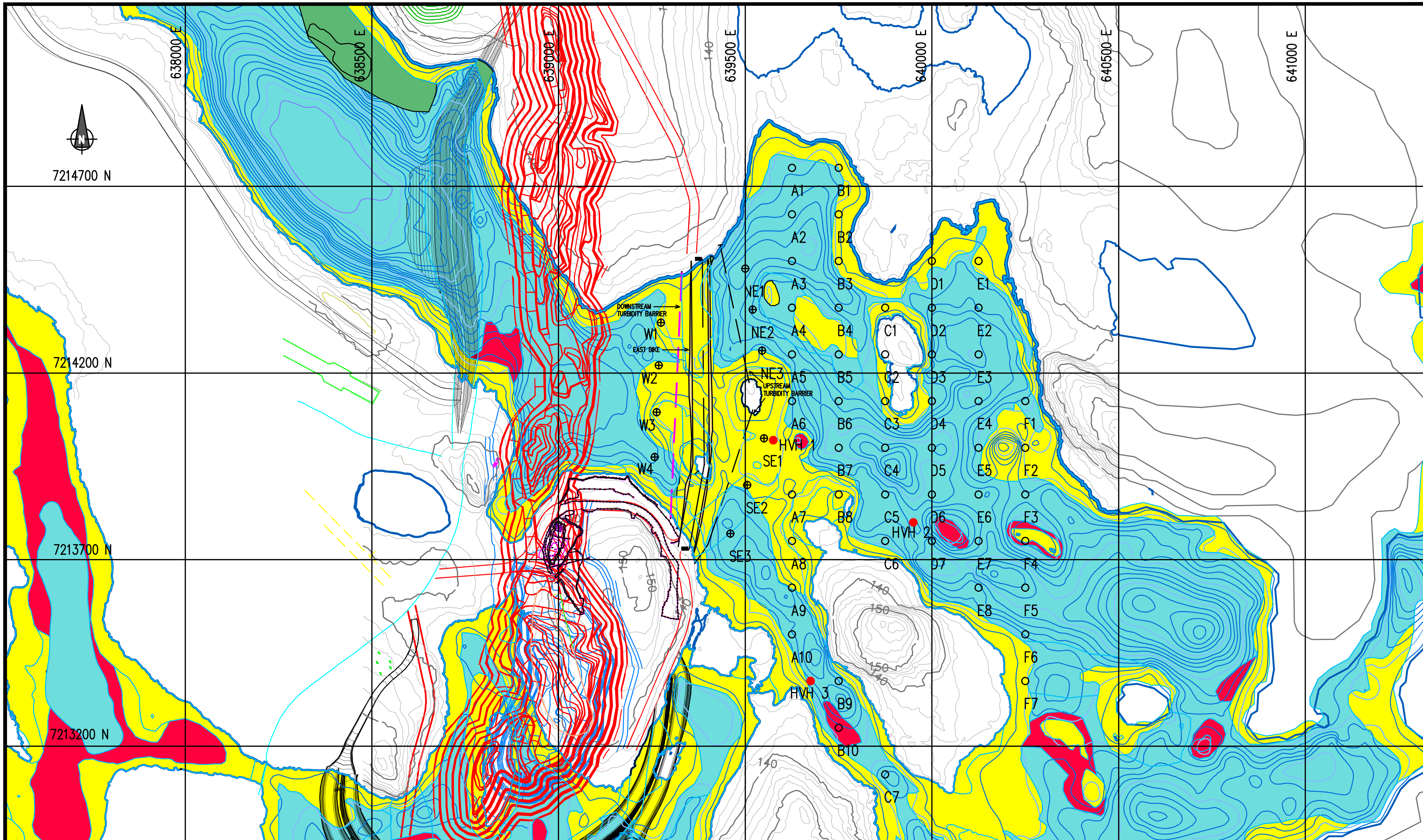



| TITRE / TITLE | # DWG |
|---|---|
| DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS | |

| REV | DESCRIPTION |
|---|---|
| REVISIONS | |

AGNICO-EAGLE
DIVISION MEADOWBANK

DESSINÉ PAR / DRAWN BY: JMARSTON
DATE
VÉRIFIÉ PAR / CHECKED BY
APPROUVÉ PAR / APPROVED BY
No. PROJET / PROJECT NO.
DATE: 16-JULY-08



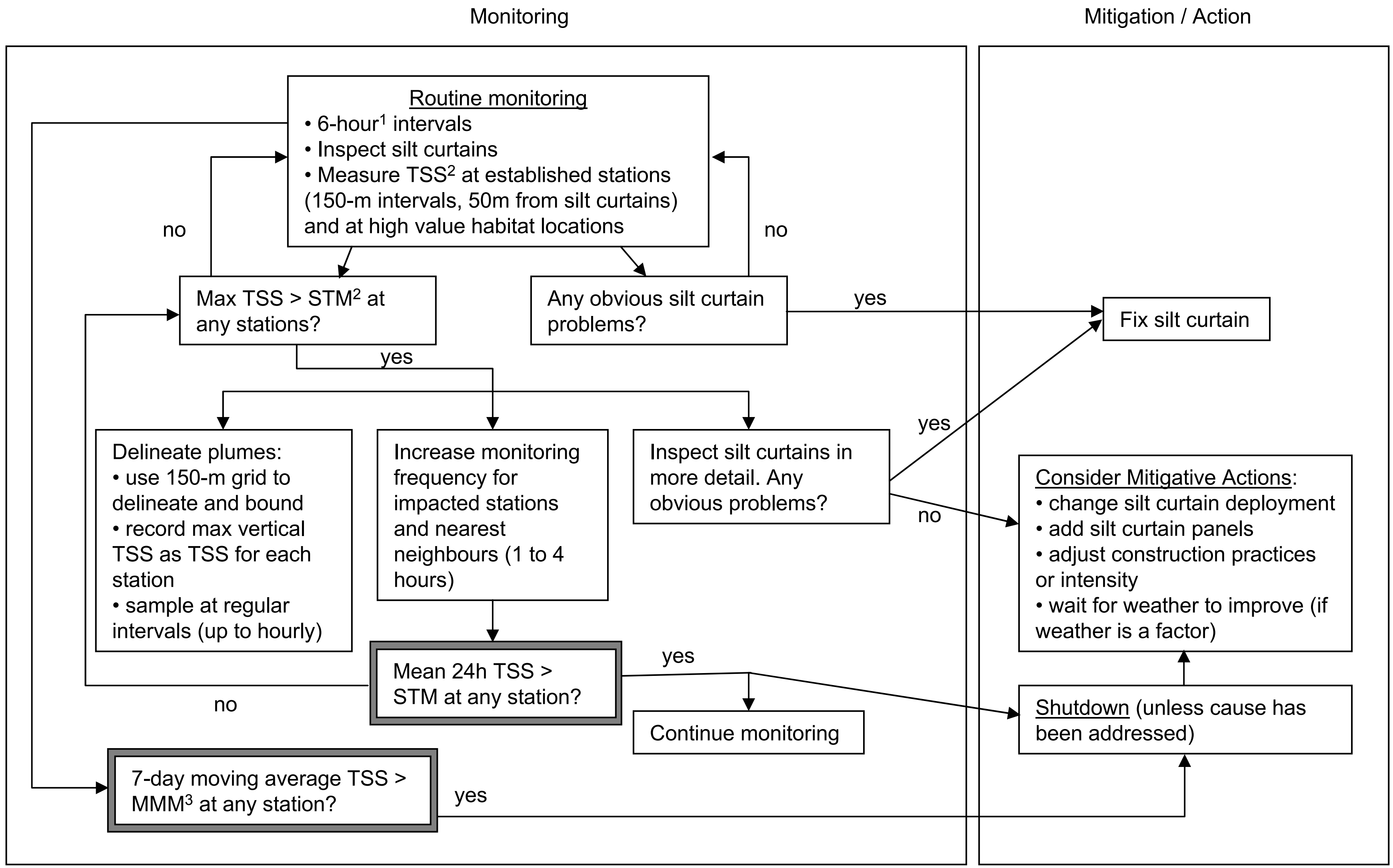
TITRE / TITLE
MEADOWBANK_GOLD_PROJECT
EAST_DIKE_CONTSTRUCTION
MONITORING_LOCATIONS

ÉCHELLE / SCALE: 1:10000
FICHIER / FILE: FCH_DESSIN
REVISION
FEUILLE/SHT PAGE/PAGES

FIGURE 1

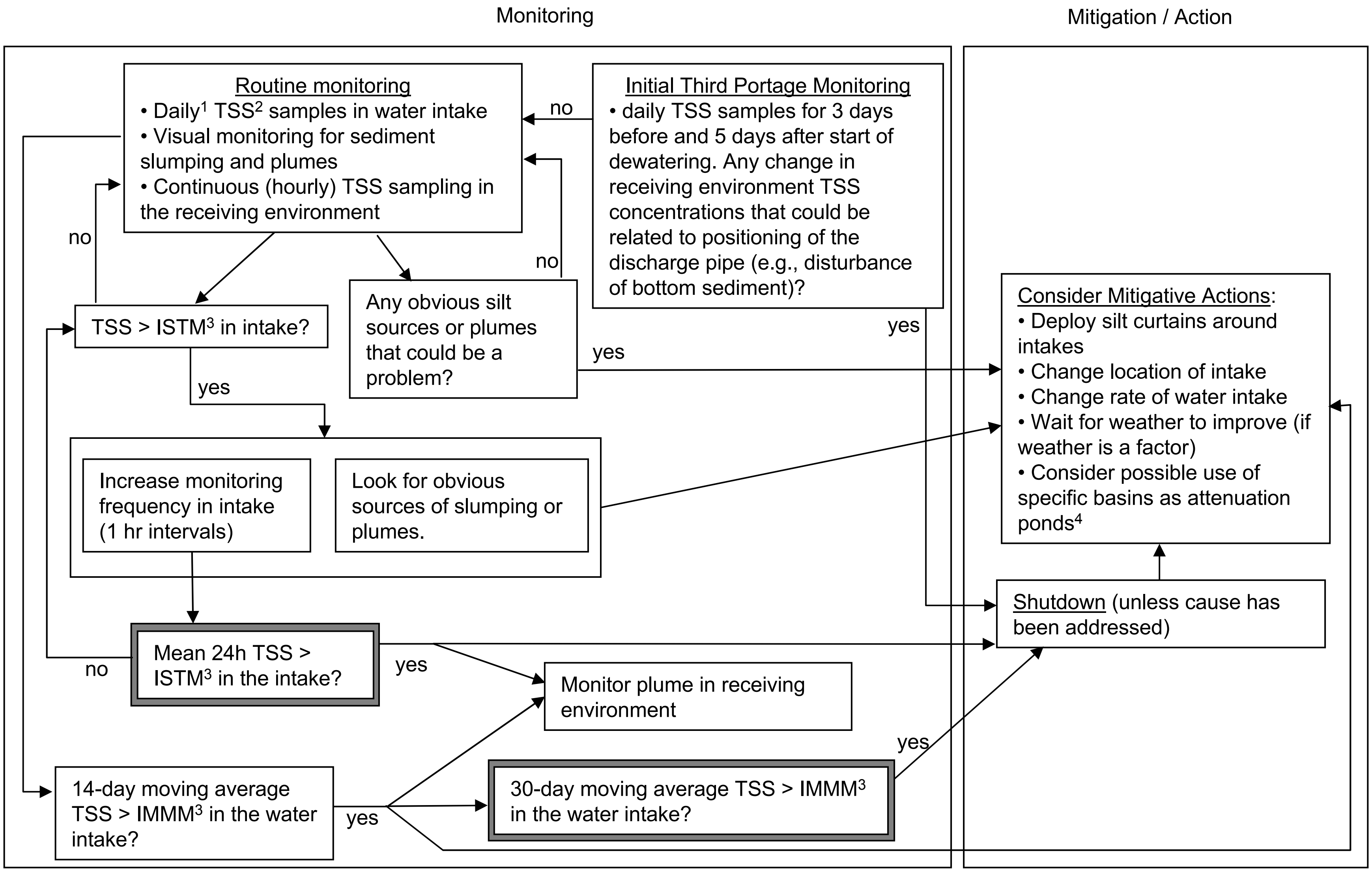
AE-CART-ANSI B

Figure 2. Standard Operating Procedures for Suspended Sediment Monitoring and Management During Dike Construction.




Notes: 1. During daylight hours and/or weather/logistics permitting. 2. TSS will be measured using turbidity as a surrogate once a relationship is established. 3. STM = short term maximum concentration of TSS. MMM = maximum monthly mean TSS concentration.

Figure 3. Standard Operating Procedures for Suspended Sediment Monitoring and Management During Lake Dewatering.




Notes: 1. Daily monitoring will be attempted; frequency will not be less than once every 6 days. 2. TSS will be measured using turbidity as a surrogate once a relationship is established. 3. ISTM = intake short term maximum concentration of TSS; IMMM = intake maximum monthly mean TSS concentration. 4. This option would require liaison with regulators and would require that the final fish removal has occurred in the specific basin.

# APPENDIX A – ANALYSIS OF CAUX ET AL (1997) DATA FOR DERIVATION OF PROJECT-SPECIFIC TSS THRESHOLD

## APPENDIX A – ANALYSIS OF CAUX ET AL (1997) DATA FOR DERIVATION OF PROJECT-SPECIFIC TSS THRESHOLDS

Existing TSS guidelines are based mainly on a review and analysis conducted by Caux et al. (1997). That analysis was intended to support derivation of generic guidelines that would be protective of the most sensitive taxonomic groups and life stages, and that would be applicable to a wide range of water bodies. In addition, the methodology of Caux et al. evaluated the expected change in response associated with a given change in TSS concentration (i.e., the slope of the concentration-duration response curves). This approach using the slope is therefore based on *relative* changes in response, and is appropriate for a generic guideline because it can be applied to systems with varying baseline TSS concentrations and varying baseline response (if applicable). In the case of Meadowbank, however, we are less interested in *relative* changes in response than in the *absolute* responses at low TSS concentrations.

Appendix 1 of Caux et al. 1997 summarizes over 300 data points for fish that include TSS concentration, duration of exposure, and response. Response is estimated using a scale of 0 to 14 to indicate the "severity of ill effects" (SIE). SIE scores of 1 to 3 are behavioural responses such as alarm reaction, abandonment of cover or avoidance response. SIE scores from 4 to 8/9 indicate increasingly severe sub-lethal effects. SIE scores of 10 to 14 indicate mortality, ranging from 0 to 20% (for SIE score =10) to >80% (SIE score = 14). In order to make recommendations for generic TSS guidelines for fish, Caux et al. fit a curve to the dose-response data, and for the most sensitive sub-group (salmonids), they estimated the change in TSS concentration needed to change an SIE score by one point. In our case, however, we are not particularly interested in the *relative* change in SIE score, but rather the absolute SIE score. In the project lakes, TSS concentration is very close to zero except possibly in localized areas during freshet. Consequently, we can focus on absolute SIE score assuming a starting point of zero. Many of the data points in the Caux et al. data base apply to TSS concentrations that are quite high (e.g., close to half are in the thousands) and outside the range that will trigger management actions at Meadowbank. For example, the change in TSS concentration required to change an SIE score from 12 to 13 is not relevant at Meadowbank, because both SIE scores are clearly unacceptable when the starting point is zero.

We collated the Caux et al. (1997) data in order to evaluate them more carefully for application to dike construction and dewatering monitoring. Existing guidance on TSS is heavily influenced by a small number of data points indicating effects on eggs/larvae. Consequently, it is important to differentiate between those areas where there is spawning habitat (i.e., where there is potential exposure of eggs/larvae) and those areas where there is no spawning habitat, and it is equally important to differentiate between times when eggs/larvae may be present and times when they will not be present. As a result, we identified four different scenarios for which TSS thresholds were needed:

1. Short-term exposures in areas that include spawning habitat and occur during the time when eggs/larvae could be present

2. Short-term exposures in areas not used for spawning or during periods when eggs/larvae would not be present

3. Long-term exposures in areas that include spawning habitat and occur during the time when eggs/larvae could be present

4. Long-term exposures in areas not used for spawning or during periods when eggs/larvae would not be present

*1. Short-term exposure scenario that includes spawning habitat and egg/larva windows*

In the case of short-term exposure, we initially considered all data points except those that had duration greater than 24 hours. This resulted in a list of 116 data points. **Figure A-1** shows the severity of ill effects (SIE) score observed at various responses, for the 48 cases where TSS concentration was 300 mg/L or less. The remaining data points apply to concentrations ranging from 305 mg/L to 330,000 mg/L. **Figure A-1** shows that at TSS concentrations of less than 100 mg/L, most SIE scores are in the range of 1 to 4 (a score of 4 indicates a short-term reduction in feeding rates or feeding success, a score of 3 corresponds to avoidance response, a score of 2 corresponds to abandonment of cover, while a score of 1 refers to alarm reaction). All of these responses are short-term behavioural responses or extremely mild sub-lethal responses which are reversible and would not be expected to have important consequences. However, there are four data points with a higher SIE score than 4 at TSS concentrations below 100 mg/L. The most sensitive among these (SIE = 10, TSS concentration = 25 mg/L) is a study indicating a mortality rate of 5.7% for Arctic grayling sac-fry. Another data point (SIE = 10, TSS concentration = 65 mg/L) from the same study indicated a mortality rate of 15% for Arctic grayling sac-fry. The reference for that study is a personal communication so there is no report where we can look at the original data. The other two cases indicate mortality rate of 10% (SIE = 10) for adult silverside at a TSS concentration of 58 mg/L, and increased physiological stress (SIE = 6) for juvenile salmon at a TSS concentration of 54 mg/L. Based on these findings, and to be consistent with the findings of the study showing sensitivity of arctic grayling sac-fry, we would recommend a short-term (24 hour) TSS threshold of 25 mg/L.

*2. Short-term exposure in areas without spawning habitat, or at times when eggs/larvae not present. This case applies also to the entire impounded NW arm of 2PL since any eggs deposited in 2008 will not survive.*

For this case, we excluded data points that had duration greater than 24 hours and all data points that were specific to eggs or larvae. This resulted in a list of 102 data points – importantly, among the data points that are not applicable to this scenario are the data for Arctic grayling sac-fry highlighted above. **Figure A-2** shows the severity of ill effects (SIE) score observed at various responses, for the 41 cases where TSS concentration was 300 mg/L or less. **Figure A-2** shows that at TSS concentrations of less than 100 mg/L, SIE scores usually range from 1 to 4, indicating short-term responses which are reversible and would not be expected to have important consequences. However, there are two data points with a higher SIE score than 4 at TSS concentrations below 100 mg/L. In one case (SIE score = 6), a TSS concentration of 54 mg/L for 24 hours resulted in increased physiological stress in juvenile coho salmon. In the second case (SIE score = 10), a TSS concentration of 58 mg/L for 24h resulted in 10% mortality of adult Atlantic silverside. Silverside are a non-salmonid marine fish, whereas the fish that will be caught and sacrificed in the impoundment are freshwater fish and primarily salmonids (trout, char, and whitefish). Among our 102 data points, the lowest TSS concentration at which mortality in salmonids has been observed is 200 mg/L. In addition, in a lake situation fish are capable of avoiding high TSS concentrations by swimming away from the construction zone. Given all of these factors, we believe that a short-term (24 hour) TSS threshold of 100 mg/L would be protective of fish in areas where there is no spawning habitat or at times when eggs/larvae are not present. However, to add an extra degree of conservatism, we recommend a 24-hr TSS threshold of 50 mg/L.

It should be noted that for impoundments, this threshold would apply to all areas, even spawning areas, because any eggs that are deposited will not survive dewatering.

*3. Long-term exposure scenario that includes spawning habitat and egg/larva windows*

In the case of long-term exposure, we initially considered all data points with duration greater than 24 hours. This resulted in a list of 187 data points. **Figure A-3** shows the severity of ill effects (SIE) score observed at various responses, for the 38 cases where TSS concentration was 100 mg/L or less. The remaining data points apply to concentrations ranging from 101 mg/L to 100,000 mg/L. It is important to note that the concentration-response curve in this case appears to be quite flat except at very low TSS concentrations – the mean SIE score for the data points shown in **Figure A-3** is 9.4, while the mean SIE score for the remaining data points (>100 mg/L TSS) is only slightly higher at 10.1. However, the SIE scale is not really linear, because direct measures of mortality apply only to SIE scores of 10 to 14.

Clearly there are variable, sometimes significant effects (e.g., mortality, SIE = 10 or more) that result from long-term exposure to TSS concentrations above around 15 mg/L. However, effects at concentrations of 12 mg/L or lower warrant a more detailed analysis. There are six data points where TSS concentrations are equal to or less than 12 mg/L. The details of these data points are as follows:

| Species | Life Stage | TSS (mg/L) | Exposure Duration (days) | SIE Score | Response |
|---|---|---|---|---|---|
| Smelt | Adult | 4 | 7 | 7 | Increased vulnerability to predation |
| Lake Trout | Adult | 4 | 7 | 3 | Fish avoided turbid areas |
| Brook Trout | Adult | 5 | 7 | 3 | Fish more active and less dependent on cover |
| Chinook Salmon | Juv | 6 | 60 | 9 | Growth rate reduced |
| Rainbow Trout | Egg | 7 | 48 | 11 | Mortality rate 40% |
| Brook Trout | Fry | 12 | 245 | 9 | Growth rates declined |

Among these cases, the most significant study and one that drives existing guidance, is the study showing 40% mortality of rainbow trout eggs at a TSS concentration of 7 mg/L. Since eggs are incapable of avoiding TSS, we believe that this study justifies application of the CCME (1999) and BCMELP (1999) guidance for long-term (e.g., 30-day) exposures. The guidance calls for up to 5 mg/L increase over background. Baseline TSS concentrations in 2PL range from <1 mg/L to about 3 mg/L. These baseline numbers are not insignificant relative to a change of 5 mg/L, therefore we suggest that for practical purposes, the long-term exposure threshold be set at 6 mg/L (a change of 5 mg/L applied to an assumed background TSS concentration of 1 mg/L).

*4. Long-term exposure in areas without spawning habitat, or at times when eggs/larvae not present. This case applies also to the entire impounded NW arm of 2PL since any eggs deposited in 2008 will not survive.*

For this case, we excluded data points that had duration less than or equal to 24 hours, and all data points that were specific to eggs or larvae. This resulted in a list of 158 data points. **Figure A-4** shows the severity of ill effects (SIE) score observed at various responses, for the 28 cases where TSS concentration was 100 mg/L or less. There are limited data at low TSS concentrations. The first five are shown in the table generated above (i.e., only the study showing effects of rainbow trout eggs is no longer relevant). None of the measured responses indicate mortality. At slightly higher TSS concentrations (18 mg/L) reduced abundance has been observed (SIE = 10, 30 day exposure for adult brown trout and rainbow trout). Mortality is first observed at 22 mg/L, but that data point involved a full year (365 days) of exposure and applies to a warmwater fish species. Beyond that, the next study showing mortality occurs at a TSS concentration of 90 mg/L (<20% mortality of rainbow trout under-yearlings exposed for 19 days). These data suggest that direct mortality may be quite unlikely at TSS concentrations < 20 mg/L. Nevertheless, reduced growth, which is observed at lower TSS concentrations, can be a significant sub-lethal effect.

A key consideration in deriving a long-term TSS threshold that excludes eggs and fry, is whether juveniles and adults would be able to swim to avoid turbid waters. The project lakes are large whereas construction zones are in particular areas, so we would not expect any suspended sediment plumes to impact large portions of the lake. This, coupled with the ability of fish to easily swim away from turbid waters over moderate to long time periods (i.e., days to months), means that it is unlikely that individual fish would be exposed continuously to high TSS concentrations.

Consequently, we recommend a long-term (i.e., 30-day average) TSS threshold of 15 mg/L in places or at times when eggs/larva are not a concern. This threshold is lower than the lowest TSS concentration at which reduced abundance or mortality has been observed for a long-term study; behavioural or reduced growth have been observed at lower TSS levels, but these are less significant than mortality and should be mitigated by the ability of fish to swim away from turbid waters.

**Figure A-1: Fish Concentration-Response Data for Short-Term (max 24hr) Exposure to TSS (source: Caux et al. 1997; data for TSS concentrations > 300 mg/L not shown)**

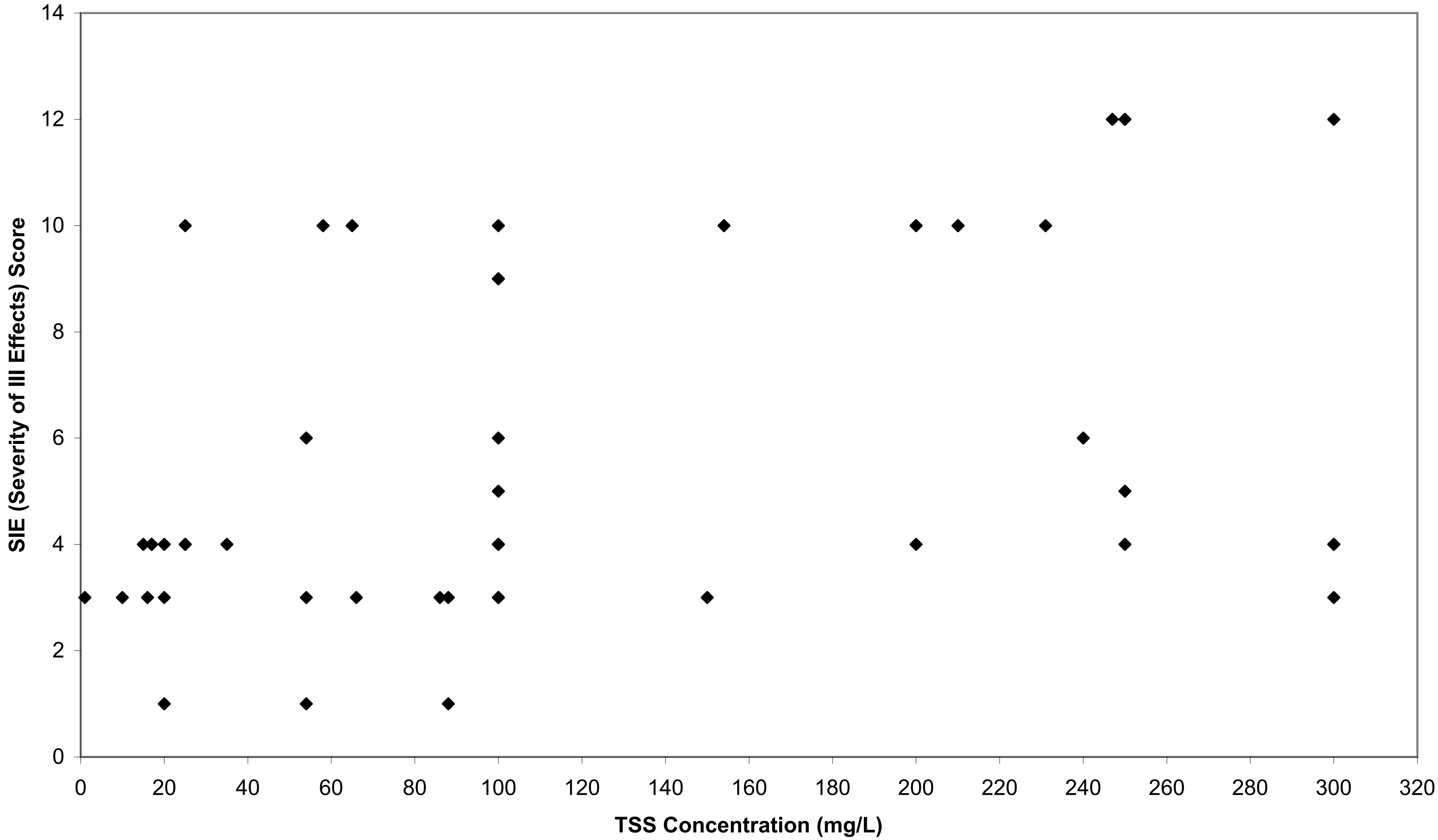


**Figure A-2: Fish Concentration-Response Data for Short-Term (max 24hr) Exposure to TSS, Excluding Data Points for Eggs/Larvae (source: Caux et al. 1997; data for TSS concentrations > 300 mg/L not shown)**

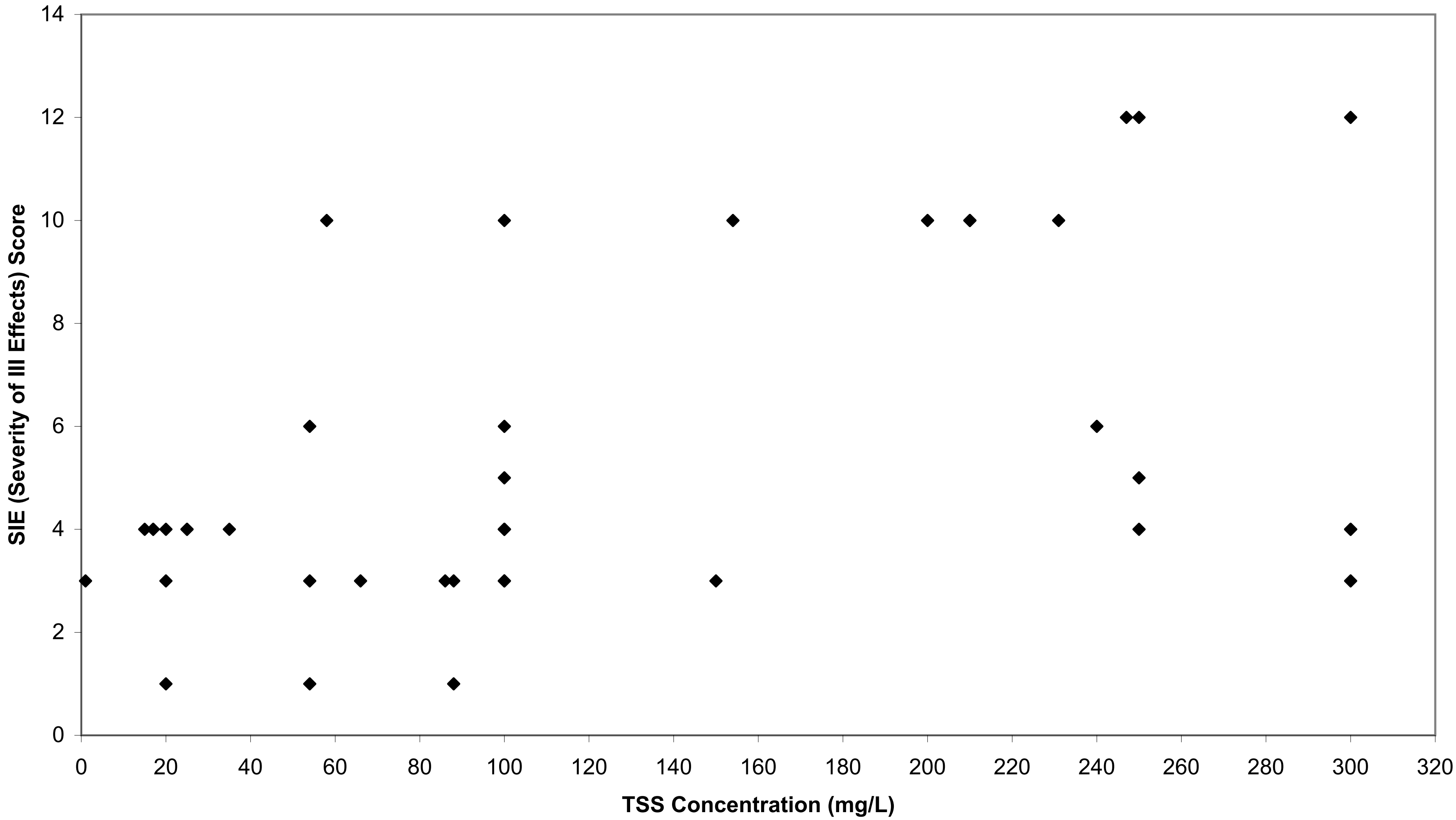


Figure A-3: Fish Concentration-Response Data for Long-Term (> 24hr) Exposure to TSS
(source: Caux et al. 1997; data for TSS concentrations > 100 mg/L not shown)

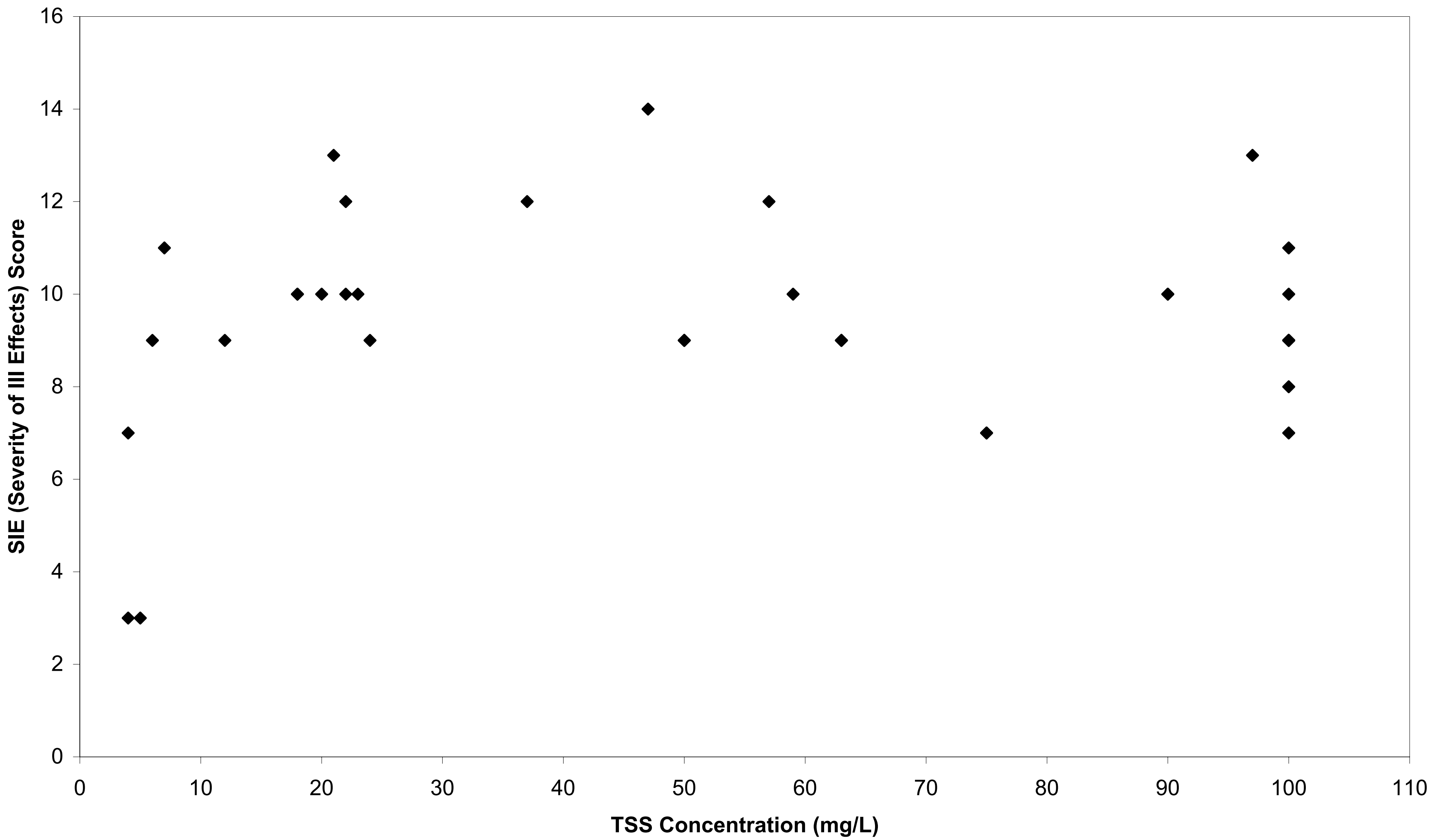
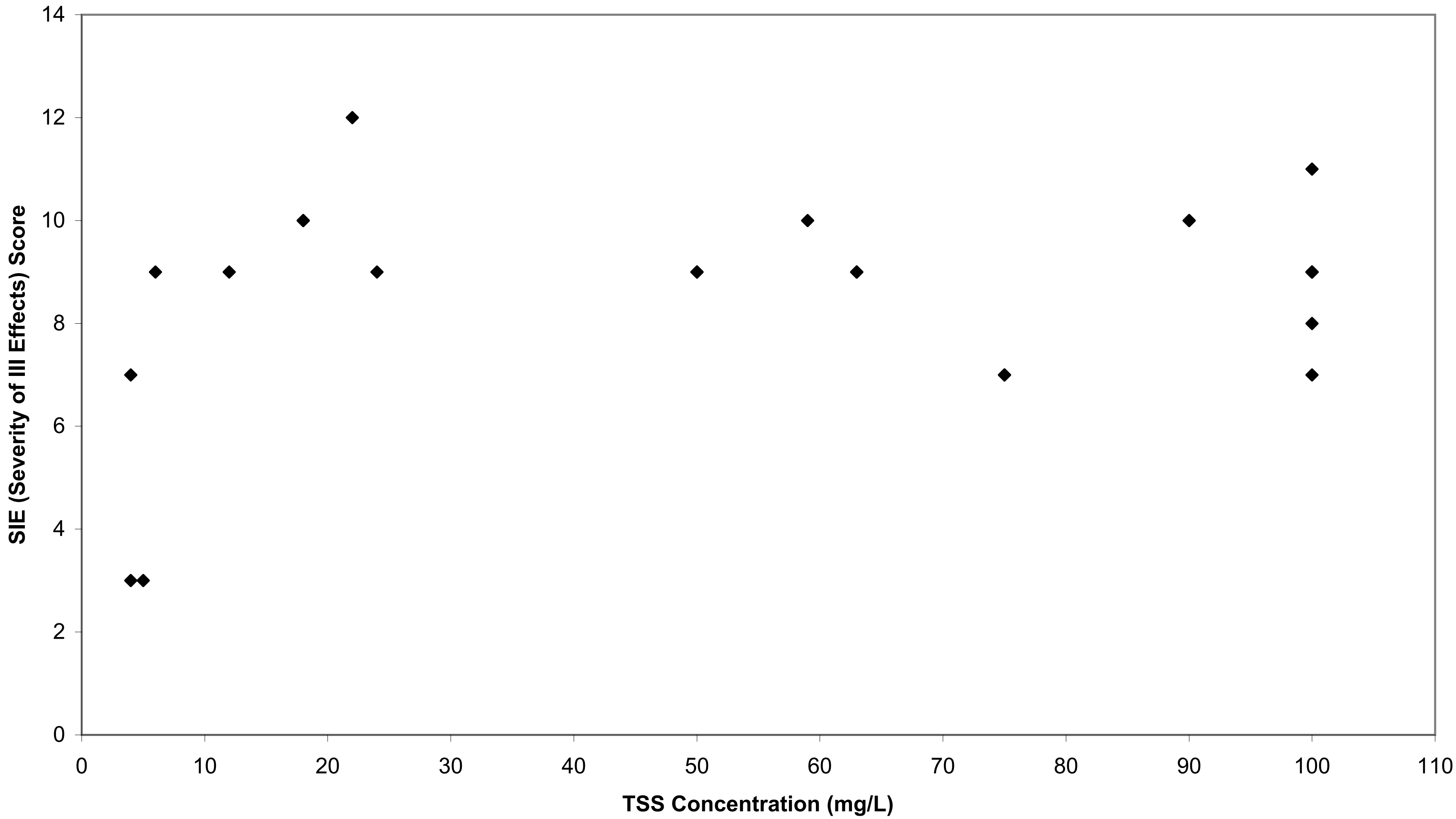


**Figure A-4: Fish Concentration-Response Data for Long-Term (> 24hr) Exposure to TSS, Excluding Data Points for Eggs/Larvae (source: Caux et al. 1997; data for TSS concentrations > 100 mg/L not shown)**



# APPENDIX B – THIRD PORTAGE LAKE OUTLET CAPACITY AND STABILITY ASSESSMENT, MEADOWBANK GOLD PROJECT

See Technical Memorandum from Golder Associates Ltd. March 03, 2008 appended.

# TECHNICAL MEMORANDUM

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| | | | |
|---|---|---|---|
| **TO:** | Larry Connell | **DATE:** | March 03, 2008 |
| **CC:** | Gary Mann | **JOB NO:** | 07-1413-0047 |
| **FROM:** | Mike Paget, Dan Walker, and John Hull | **DOC NO:** | 575 |
| **EMAIL:** | mpaget@golder.com<br>drwalker@golder.com | **VERSION:** | 0 |

**RE:** **THIRD PORTAGE LAKE OUTLET CAPACITY AND STABILITY ASSESSMENT, MEADOWBANK GOLD PROJECT**

Agnico-Eagle Mines Ltd. Meadowbank Division (AEM) [formerly Meadowbank Mining Corp. (MMC), formerly known as Cumberland Resources Ltd. (Cumberland)] is planning to develop the Meadowbank Gold Project (the Project); an open pit gold mine located on Inuit-owned land in the Kivalliq Region of Nunavut, approximately 70 km north of the hamlet of Baker Lake (refer to Figure 1).

A component of the Project will involve blocking off one of three existing channel outlets from Third Portage (3PL) to Second Portage (2PL) lakes through the construction of the Bay Zone Dike (refer to Figure 2). As a result, outflows from 3PL will be confined to the central and easternmost outlet channels during operations and post-closure (refer to Figure 3).

During the environmental impact review process for the Project, a commitment was made on behalf of AEM to maintain natural water levels within 3PL during lake dewatering, and mine operations and closure. Specifically, Cumberland proposed to increase the capacity of the easternmost channel, if necessary, in order to offset the outlet capacity loss of the westernmost channel.

Accordingly, Item 47 of Nunavut Impact Review Board (NIRB) requirements for a Type A Water License for the Project requires AEM to develop an adaptive approach to managing the water flow from 3PL, including:

- the consideration of alternatives to deepen the easternmost channel;
- submission of detailed design for easternmost channel modifications (if any);
- a monitoring program for channel erosion, verification of the maintenance of water levels in 3PL, and the success of fish habitat enhancements (if any); and
- contingencies in the event of channel failure.

The following summarizes field observations, and the hydraulic analysis and modelling results completed, to assess the stability and capacity of the existing channel outlets and to evaluate the potential impacts, if any, on 3PL water levels during dewatering and mine operations. Also included is a proposed monitoring plan for erosion and verification of lake levels, and design recommendations with respect to the capacity upgrade of the easternmost outlet channel.

## 1.0 SITE VISIT

A site visit was completed by Golder Associates (Golder) between July 20 and 21, 2007. The objectives of the site visit were to characterize the hydraulic conditions and capacity of the remaining two outlets from 3PL and to identify potential design options for outlet stability and capacity upgrade, if necessary.

A topographic survey of the central and easternmost channels was completed during the site visit to assist with hydraulic analysis of the capacity of the 3PL outlets (Figure 3). Due to time and access constraints, a topographic survey of the westernmost channel was not possible during the site visit, but was subsequently completed by AEM at the request of Golder. The topographic surveys were used during hydraulic analysis of the outlets to evaluate channel capacity and stability, and potential water levels within 3PL following blocking of the westernmost channel.

Limited pebble counts were also performed in the central and easternmost outlets during the site visit in order to assess the stability of the channels when subjected to increased outflow rates. The pebble counts consisted of measuring the b-axis diameter of random samples of outlet substrate materials. The data were used to develop a preliminary estimate of the gradation of the bed surface material. The pebble count results are summarized in Table 1, where $D_x$ is the grain size at which x% of the sampled bed material is finer.

**TABLE 1: Pebble Count Results[a]**

| Station | Sample Count | $D_{10}$ (mm) | $D_{30}$ (mm) | $D_{50}$ (mm) | $D_{70}$ (mm) | $D_{90}$ (mm) |
|---|---|---|---|---|---|---|
| Eastern | 20 | 40 | 60 | 80 | 240 | 600 |
| Central | 20 | 80 | 200 | 250 | 350 | 690 |
| Combined | 40 | 60 | 80 | 200 | 320 | 690 |

[a]$D_x$ – estimated diameter D at which x% of the bed material is finer

It should be noted that due to the limited number of bed material measurements collected, the gradations presented in Table 1 are approximate estimates of actual site conditions. Nevertheless, the bed material substrate measurements support observations made during the site visit indicating that the outlet bed materials are typically characterized by large cobbles and boulders (see field photos provided in Appendix I).

## 2.0 HYDRAULIC ASSESSMENT

Hydraulic analysis and modelling of the 3PL outlets was conducted to evaluate average hydraulic conditions within the outlets over a range of upstream lake levels. The modelling was completed using the topographic survey collected from site during the field survey and subsequently by AEM. This information, together with the field observations, was used to estimate the discharge capacity and stability of the existing outlets and evaluate the need for a capacity/stability upgrade to the easternmost outlet in order to maintain natural water levels within 3PL.

The hydraulic modelling was completed using HEC-RAS, a one-dimensional hydraulic modelling system developed by the US Army Corps for natural and constructed channels. Three model scenarios were evaluated:

1. existing conditions (i.e., three channel outlets; used for model calibration);

2. blocked conditions (i.e., central and easternmost outlets only; westernmost channel blocked); and;

3. blocked conditions during dewatering (i.e., central and easternmost channels only during dewatering of the northwestern arm of 2PL to 3PL).

For each scenario, five runoff conditions were modelled (100-yr wet through to 100-yr dry). AMEC Consultants (AMEC) provided maximum lake levels for the various runoff conditions based on lake routing model results (AMEC 2005). The HEC-RAS model results for each scenario are provided in Appendix II and are summarized below. In each scenario, the outlets were modelled simultaneously (i.e., a combined total discharge from all operating outlets) rather than each outlet individually.

### 2.1 Natural Lake Level Variability

The increase in water elevation within 3PL is dependent on the existing lake volume, the rate of water added to the lake from runoff and dewatering, and the flow capacity of the lake outlets. As indicated in Table 2, the natural annual (spring to fall) variability of 3PL varies from approximately 32 cm for a 100-yr wet year to 17 cm for a 100-yr dry year (AMEC, 2005). The variability between the 100-yr dry fall water level and the 100-yr wet spring water level is approximately 37 cm, while the seasonal variability year-to-year is less dramatic with fall water levels varying by approximately 5 cm across the climate scenarios considered, and spring levels varying by approximately 20 cm.

**TABLE 2: Seasonal Variations in 3PL's Water Elevation (Existing Outlet Conditions)**

| Runoff Condition | Spring Water Level (masl)[a,b] | Fall Water Level (masl)[a,b] | Natural Seasonal Variability (m) |
|---|---|---|---|
| 100 yr wet | 134.19 | 133.87 | 0.32 |
| 10 yr wet | 134.14 | 133.85 | 0.29 |
| Average | 134.09 | 133.84 | 0.25 |
| 10 yr dry | 134.03 | 133.83 | 0.20 |
| 100 yr dry | 133.99 | 133.82 | 0.17 |

[a]masl: metres above sea level
[b]AMEC (2005)

### 2.2 Existing Outlet Conditions

Existing outlet conditions were modelled in order to calibrate the model for the remaining scenarios. A uniform Manning's channel roughness coefficient of 0.15 was assumed based on literature values for channels with similar channel characteristics (Hicks and Manson 1998). Model inputs defining flow roughness and ineffective flow areas were systematically adjusted until computed flow rates for the spring freshet period roughly equalled discharge rates computed using the stage-discharge relationship for the existing outlets reported by AMEC (2005). The estimated maximum (spring) water level in 3PL under each runoff condition was then compared to the model results. The final results of the model calibration process are summarized in Table 3.

**TABLE 3: Hydraulic Model Calibration Results**

| Runoff Condition | Existing Conditions | | |
|---|---|---|---|
| | Spring Water Level (masl)[a,b] | Model Predicted Discharge ($m^3/s$) | Discharge Relationship ($m^3/s$)[b] |
| 100 yr wet | 134.19 | 5.17 | 5.14 |
| 10 yr wet | 134.14 | 3.68 | 3.64 |
| Average | 134.09 | 2.58 | 2.51 |
| 10 yr dry | 134.03 | 1.51 | 1.55 |
| 100 yr dry | 133.99 | 1.09 | 1.10 |

[a]masl: metres above sea level

[b]AMEC (2005)

### 2.3 Blocked Western Channel

In order to simulate lake and outlet conditions during mine operations (no dewatering), the westernmost channel was blocked within the calibrated HEC-RAS model and corresponding potential increases in 3PL water levels were evaluated for each of the spring runoff conditions.

The model results indicate relatively minor increases in water levels, on the order of 8 to 15 cm, would be expected during mine operations in the absence of dewatering (Table 4), and that the potential increases would be within the natural annual spring lake level variability for 3PL (Table 2).

**TABLE 4: Hydraulic Model Results Blocked Western Channel**

| Runoff Condition | Spring Water Level Existing Conditions (masl)[a,b] | Model Predicted Discharge Existing Conditions ($m^3/s$) | Model Predicted Spring Lake Level Blocked Conditions (masl)[a,c] |
|---|---|---|---|
| 100 yr wet | 134.19 | 5.17 | 134.34(+0.15) |
| 10 yr wet | 134.14 | 3.68 | 134.27 (+0.13) |
| Average | 134.09 | 2.58 | 134.22(+0.13) |
| 10 yr dry | 134.03 | 1.51 | 134.14 (+0.11) |
| 100 yr dry | 133.99 | 1.09 | 134.07(+0.08) |

[a]masl: metres above sea level

[b]AMEC (2005)

[c]water elevation change in metres from existing spring conditions (Table 2) shown in brackets

### 2.4 Blocked Western Channel during Dewatering

A simple routing model was developed using a daily time step to determine the maximum discharge from 3PL during the dewatering process based on a predicted stage-discharge relationship for the combined central and easternmost outlets as derived from the model results for the blocked westernmost outlet with no dewatering scenario (Section 2.2). The spring lake levels listed in Table 3 were conservatively assumed to represent the initial conditions within the lake at the start of dewatering for the routing exercise.

A total dewatering/routing volume of 14.5 $Mm^3$ was conservatively assumed in the analysis. Based on available bathymetric data (Golder, 2006, Doc. 309), this represents the estimated total water volume within the East and Bay Zone dikes down to elevation 105 masl. Actual dewatering volumes may be less depending upon the requirement to maintain additional water within the northwest arm of 2PL to satisfy process water makeup requirements at the start of mine operations (MMC, 2007, Doc. 500).

For the purposes of the routing analysis, it was conservatively assumed that the total dewatering volume would occur over 100 days, approximately 3 months, starting during the freshet period (i.e., with peak spring lake levels in 3PL). It is understood that dewatering rates and periods are currently being evaluated by AEM, and that actual dewatering volumes, rates and timing may differ than what has been assumed. However, the above assumptions are considered to be conservative with respect to estimating potential 3PL water levels during dewatering.

The routing was completed assuming the surface area of 3PL would not increase significantly during the dewatering process. This assumption is considered reasonable given the relatively large surface area and volume of 3PL (approximately 33 $km^2$ and 446 $Mm^3$, respectively; Golder, 2006, Doc. 309).

The resulting combined peak discharges through the remaining two outlets (i.e., the central and easternmost outlets) and corresponding 3PL levels during dewatering are provided in Table 5. The routing analysis indicates that water levels within 3PL would return to pre-dewatering levels approximately 120 days after the start of dewatering, assuming a 100-day dewatering period (i.e., 20 days after the completion of dewatering).

The peak discharges were input within the calibrated HEC-RAS model to confirm estimated lake levels within 3PL during the dewatering process. The results indicate an estimated rise in the lake levels of approximately 17 cm to 18 cm for the runoff conditions modelled (Table 5). As was the case for the blocked westernmost outlet with no dewatering scenario (Section 2.3), the model predicted increases shown in Table 5 are within the expected natural annual spring lake level variability for 3PL (see Table 2).

**TABLE 5: Hydraulic Model Results with Blocked Western Channel during Dewatering**

| Runoff Condition | Peak Discharge ($m^3/s$) | Model Predicted Peak Lake Level (masl)[a,b] |
|---|---|---|
| 100 yr wet | 6.37 | 134.37 (+0.18) |
| 10 yr wet | 4.87 | 134.33 (+0.19) |
| Average | 3.71 | 134.28 (+0.19) |
| 10 yr dry | 2.52 | 134.21 (+0.18) |
| 100 yr dry | 1.74 | 134.16 (+0.17) |

[a]masl: metres above sea level

[b]water elevation change in metres from existing conditions (Table 2) shown in brackets

For comparison purposes, the routing model was also re-run in order to evaluate the potential effect of dewatering rate/duration on the predicted 3PL water levels. Specifically, the minimum dewatering duration that would result in a predicted water level equal to the peak spring water level for each runoff condition plus the natural spring annual variability (20 cm; see Table 2) was computed.

As indicated in Table 6, the resulting minimum dewatering periods ranged from 98 days during the average condition to 78 days during the 100 yr dry condition.

**TABLE 6: Sensitivity of Third Portage Lake Levels to Dewatering Duration**

| Run off Condition | Peak Discharge ($m^3/s$) | Maximum Lake levels within Seasonal Variation Lake Level (masl)[a,b] | Minimum Dewatering Duration (days) |
|---|---|---|---|
| 100 yr wet | 6.84 | 134.39(+0.20) | 90 |
| 10 yr wet | 5.25 | 137.34(+0.20) | 91 |
| Average | 3.78 | 134.29(+0.20) | 98 |
| 10 yr dry | 2.69 | 134.23(+0.20) | 94 |
| 100 yr dry | 2.23 | 134.19(+0.20) | 78 |

[a]masl: metres above sea level

[b]water elevation change in metres from existing conditions (see Table 2) shown in brackets

### 2.5 Channel Stability

The HEC-RAS model results for each outlet condition and cross-section are presented in Appendices II to IV. It should be noted that the HEC-RAS predicted water velocities provided are cross-sectional averages only. It is expected that there will be localized areas of higher flow velocity within the outlets than the average values modelled.

With increased flows in the central and easternmost outlets resulting from the closure of the westernmost outlet, it is likely there will be regions of higher velocity flow than compared to existing conditions. Nevertheless, it is anticipated that the outlets will remain stable at the modelled flows and depths given the comparatively large size of the materials currently making up the bed and banks of the channels.

The increased flow through the easternmost channel may result initially in fine sediment release into 2PL as previously inactive portions of the channel become active. The easternmost channel is expected to more susceptible to this type of sediment release because of its less defined channel and banks (see field photos in Appendix I).

## 3.0 DESIGN RECOMMENDATIONS

Based on the results of the hydraulic assessment described above, an increase in the capacity of the easternmost channel is not considered necessary at this time. However, in order to minimize the potential for channel bank erosion and release of fine sediments from the easternmost outlet during high flow events, it is recommended that the vegetation on the banks of the easternmost outlet be removed to minimum of 300mm above the vegetation line and in locations having vegetation where higher flows are expected. Approximate rock placement locations have been provided in Figure 4 but will need to be confirmed in the field. The approximate locations are based on photographs taken during the July site visit and the survey data. The vegetation should be replaced with large sub-angular rock with gradation equal to that shown in Table 7 below for the combined outlets (refer to Figure 4). It is recommended that the rock be sourced from the westernmost channel outlet during construction of the western channel culvert crossing and West Channel Dike. The rock should be temporarily stockpiled for placement during the following winter period prior to dewatering. An estimated 6,600 $m^3$ of rock would be required assuming a rock layer thickness of 0.7 m.

**TABLE 7: Pebble Count Combined Results[a]**

| Station | Sample Count | $D_{10}$ (mm) | $D_{30}$ (mm) | $D_{50}$ (mm) | $D_{70}$ (mm) | $D_{90}$ (mm) |
|---|---|---|---|---|---|---|
| Combined | 40 | 60 | 80 | 200 | 320 | 690 |

[a]$D_x$ – estimated diameter D at which x% of the bed material is finer

It is further recommended that an adaptive management approach involving the monitoring of outlet flow conditions and 3PL lake levels during dewatering and mine operations be adopted. The adaptive management plan would need to allow for potential adjustments to the outlet channel capacity, if required, through select removal of large substrate or accumulated debris, and/or other suitable means, and would need to provide for potential contingencies in the event of outlet channel failure.

Recommended contingencies to be included within the adaptive management plan in the event of outlet channel failure include, but are not necessarily limited to:

- Upgrade to central and/or easternmost outlet channel capacity as required;
- Temporary suspension of dewatering operations until necessary repairs and capacity upgrades are complete;
- Temporary blocking of outlet channel with rock or sand bags and pumping outflow from 3PL to 2PL (may require outsourcing of additional pumps if insufficient number are available on site);
- Stockpiling of large rock and/or sand bags for emergency repairs to the channel bed and banks of existing outlets (additional suitable rock may be available from lake beds exposed during the dewatering process); and
- Construction of a separate outlet channel(s).

The potential impact on fisheries and fish migration of potential adaptive management alternatives or solutions would need to be assessed prior to initiation of any works within the outlets. It understood that monitoring of fish use and migration within the outlets during dewatering and mine operations would be completed under the Meadowbank Gold Project Aquatic Effects Management Program (Cumberland, 2005).

A proposed hydraulic monitoring plan for 3PL lake levels and outlet channel stability is provided in Section 4 below. A general erosion and sediment management plan in the event that monitoring indicates that outlet remediation and/or modification is required is provided in Section 5.

## 4.0 HYDRAULIC MONITORING PLAN

The following section presents a proposed hydraulic monitoring plan consisting of regular and event based visual inspections and measurements of the outlet channels and 3PL water levels. It is understood that the management and execution of the proposed monitoring plan would be the responsibility of AEM.

The proposed hydraulic monitoring plan has three main components:

- A lake level monitoring plan to monitor lake levels within 3PL and 2PL on a regular and event basis (Section 4.1);

- An outlet flow monitoring plan to monitor water flow within the outlets during the freshet and ice-free periods (Section 4.2); and

- An outlet erosion inspection plan to monitor outlet stability, including potential erosion and/or debris accumulation within the outlets, once the westernmost channel is blocked off (Section 4.3).

The data and observations collected from the hydraulic monitoring plan will be recorded and provided to the Nunavut Water Board (NWB) and Fisheries & Oceans Canada (DFO) annually as a component of the annual monitoring report for the Project. The results will also be used to confirm the model predictions and reassess the need for additional capacity within the outlets. Remediation of any detected problems and necessary repairs will be undertaken as soon as possible in consultation with the NWB and DFO.

As noted above, it is understood that monitoring of fish use and migration within the outlets during dewatering and mine operations would be completed under the Meadowbank Gold Project Aquatic Effects Management Program (Cumberland, 2005).

### 4.1 Lake Level Monitoring Plan

Lake levels will be monitored by visual inspection of a staff gauge located in both 3PL and 2PL. The staff gauges will be located at sufficient distance from the outlets to limit potential lake level drawdown effects, and will be surveyed in actual elevation to ensure that the water elevation can be calculated from the reading. Consideration may also be given to the installation of a permanent GPS/pressure transducer and data logger system on the freshwater intake barge or piping in order to continuously record lake levels within 3PL.

The lake level monitoring plan will consist of:

- A regular lake level inspection program during the freshet and ice-free periods (Section 4.1.1); and

- An event based lake level inspection program following heavy rainfall or prolonged rainfall events (Section 4.2.2).

### 4.1.1 Regular Lake Level Inspection Program

The regular inspection program during the freshet and ice-free period will be based on scheduled visual readings of the staff gauge twice weekly during periods of high flow in freshet (mid-May to June) and weekly during the remainder of the ice free period prior to freeze up. Visual inspection and recording of lake levels within both 3PL and 2PL will be completed.

### 4.1.2 Event Based Lake Level Inspection Program

The event based lake level inspection program will take place following heavy rainfall or prolonged rainfall events as they occur.

## 4.2 Outlet Flow Monitoring Plan

Water flow within the outlets will be monitored through the development of a stage-discharge relationship(s) that is correlated to observe water levels within 3PL. A manual flow measurement program consisting of a defined measurement location within each outlet will be established in order to construct the stage-discharge relationship required to convert the measured 3PL lake levels to discharge rates. Potential manual flow measurement locations will be evaluated based on observed hydraulic conditions within the channels.

When safe to do so, the manual flow measurements will be completed using a hand-held velocity probe. Early in the mine life, more frequent manual flow measurements will be completed in order to cover the full range of anticipated flows within the channel and develop the stage-discharge relationships. Flow measurements by salt dilution or dye tracer techniques will be considered during peak flow events when it is unsafe to wade the channels.

It is anticipated that manual flow measurement will be comparatively straightforward for the central outlet. The easternmost channel however, is characterized by relatively broad, shallow flow and emerging boulders and cobbles; conditions that are not conducive to establishing a suitable flow measurement station. It this case, salt dilution or dye tracer techniques may be necessary across the entire range of anticipated flows in order to develop a stage-discharge relationship for the channel.

The practicality of installing continuous flow monitoring station within each of the outlets is considered to be low given the existing channel characteristics and the significant set-up and maintenance requirements anticipated for an arctic environment. As noted in Section 4.1 however, consideration may be given to the installation of a permanent GPS/pressure transducer and data logger system on the freshwater intake barge or piping to continuously record lake levels within 3PL. If necessary, this data can be used in conjunction with the stage-discharge relationships described above to derive a corresponding continuous flow record for each of the outlets.

### 4.3 Outlet Erosion Inspection Plan

An erosion inspection plan for the central and easternmost outlets will be established to monitor outlet stability once the westernmost channel is blocked off. Specifically, the central and eastern outlets will be visually inspected to confirm that no significant erosion of the channel bed or channel banks, or accumulation of debris (including ice blocks), has occurred since the last inspection that warrants remediation, and that the channel capacity is adequate for the anticipated discharges.

The outlet erosion inspection program has two components:

- A regular inspection program to confirm that no significant erosion, sediment transport, or debris accumulation is occurring (Section 4.3.1); and

- An event inspection program to observe the impacts of large flows on erosion and outlet stability during the ice free period (Section 4.3.2).

### 4.3.1 Regular Erosion Inspection Program

The regular inspection program during the snowmelt and ice free period will be based on a schedule of visual inspections twice weekly during the freshet period (approximately mid-May to June) and minimum every two weeks during the remainder of the ice-free period prior to freeze up.

Significant debris accumulations observed within the outlets will be removed as soon as possible in order to minimize potential reductions in channel capacity.

### 4.3.2 Event based Erosion Inspection Program

Additional visual inspections of each outlet will be completed following heavy rainfall or prolonged rainfall events as they occur.

## 5.0 EROSION AND SEDIMENT CONTROL PLAN

The following preliminary sediment and erosion plan has been developed in the event that monitoring indicates that remediation or modification of the central and/or easternmost outlets is required. A task specific erosion and sediment control plan will be developed prior to the initiation of any construction works within the outlets. The plan will incorporate where feasible, best management practices for controlling the potential release of sediment and/or sediment-laden water during all site access and construction activities, and confirm that appropriate erosion control measures will be in place prior to commencement of any construction activities within or nearby the outlets.

The following general sediment and erosion control practices are applicable to the prevailing site conditions during equipment access and construction activities:

- Construction activities within the wetted channel will be kept to a minimum;
- Any required stockpiles of materials will be located away from watercourses and stabilized against erosion as soon as possible by temporarily covering with a geotextile or by placing of a perimeter sediment control structure;
- Disturbed areas will be minimized as much as possible;
- Silt fences will be installed to control the release of eroded sediments from the site during non-frozen conditions;

- Turbidity curtains (or suitable alternative) will be installed if appropriate upstream and downstream of site during the construction period;

- Additional erosion and sediment control structures to contain eroded sediments on site will be installed as required;

- Upon completion of construction all accumulated sediment, debris, and work-related material will be removed for proper disposal at approved locations; and

- Regular site inspections will be conducted during the construction activities to determine compliance with the above.

## 6.0 CLOSURE

We trust the information contained in this document meets your requirements at this time. Should you have any questions relating to the above, please do not hesitate to contact the undersigned.

The reader is referred to the "Important Information and Limitations of This Report" which follows the text but forms an integral part of this document.

**GOLDER ASSOCIATES LTD.**

ORIGINAL SIGNED BY

Mike Paget, E.I.T. (BC)
Water Resources Specialist

ORIGINAL SIGNED BY

Dan Walker, Ph.D., P.Eng. (BC)
Sr. Water Resources Engineer

ORIGINAL SIGNED AND SEALED BY

John Hull, P.Eng. (NU/NT)
Principal

MP/DRW/lw
O:\FINAL\2007\1413\07-1413-0047\DOC 575 VER.0\575 03MAR_08 TM VER 0 OUTLET HYDRAULIC ANALYSIS.DOC

## REFERENCES

AMEC, 2005. *Meadowbank Gold Project Mine Pit Dewatering Analysis of Effects*. AMEC Earth and Environmental, December 2005.

Cumberland Resources Ltd. (Cumberland), 2005. *Meadowbank Gold Project Aquatic Effects Management Program*. October, 2005.

Golder Associates Ltd. (Golder), 2006. *Bathymetric Surveys Meadowbank Project Nunavut*, Doc. 309, Ver. O, dated 24 November, 2006

Meadowbank Mining Corporation (MMC), 2007. *Meadowbank Gold Project Mine Waste & Water Management*, Doc. 500, Ver. 0, dated August 2007.

Hicks D.M., and P.D. Mason, 1998. Roughness Characteristics of New Zealand Rivers, National Institute of Water and Atmospheric Research Ltd. September 1998.

## IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

**Standard of Care:** Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

**Basis and Use of the Report:** This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, and safety and equipment capabilities.

**Soil, Rock and Groundwater Conditions:** Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

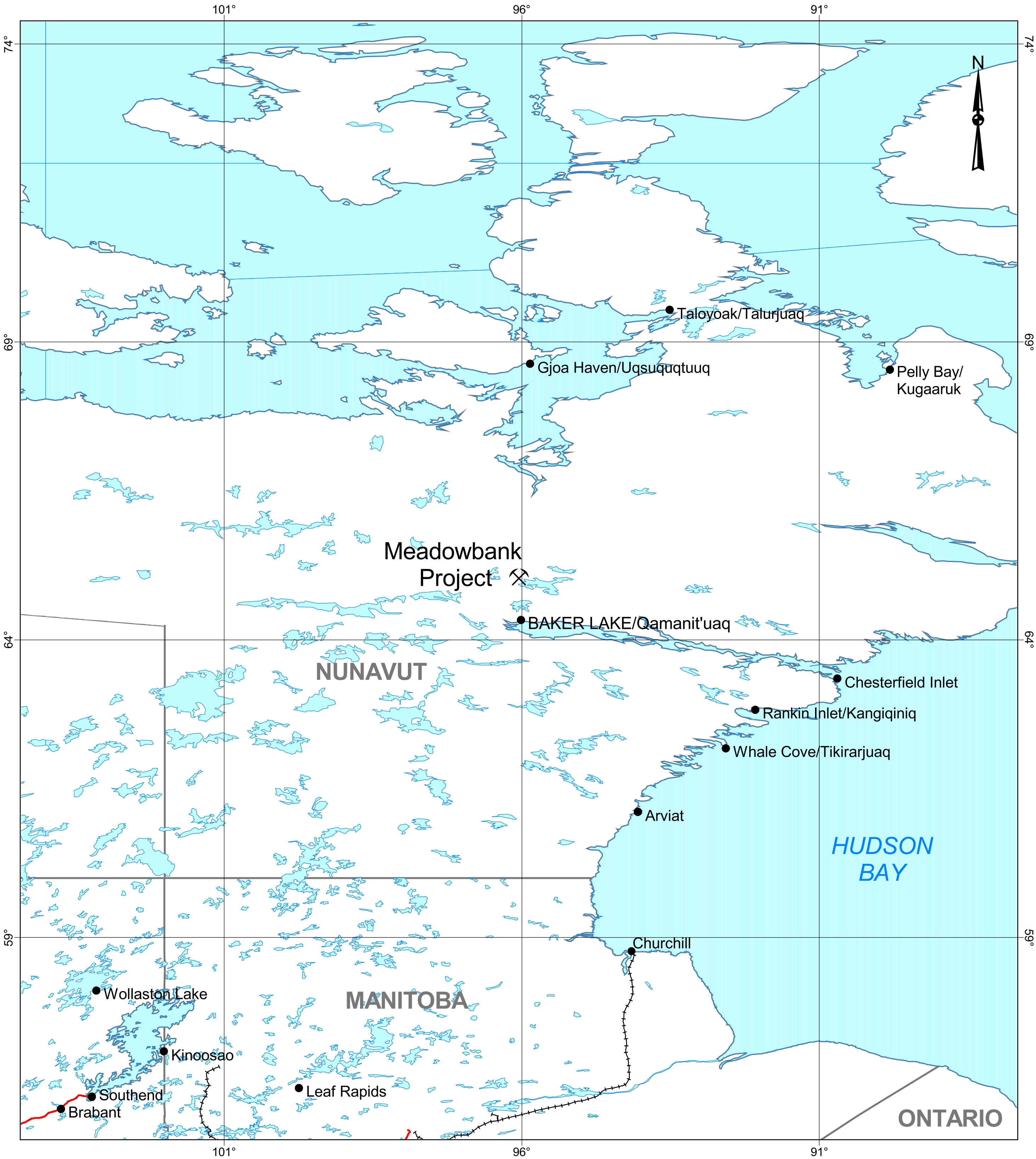
**Sample Disposal:** Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

**Follow-Up and Construction Services:** All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

**Changed Conditions and Drainage:** Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.




## LEGEND

- Meadowbank Project
- Town/Village
- Provincial Border
- Water
- Primary Highway
- Railroad

200 0 200 Kilometers

Scale - 1:10,000,000

PROJECT

AEM

**AGNICO-EAGLE MINES LIMITED**
**MEADOWBANK DIVISION**

TITLE

**MEADOWBANK PROJECT**
**LOCATION PLAN**

Golder Associates

| | | | | |
|---|---|---|---|---|
| PROJECT No. 07-1413-0047 | | | SCALE AS SHOWN | REV. 0 |
| DESIGN | DW | 19 Dec. 2007 | **FIGURE 1** | |
| GIS | CDB | 19 Dec. 2007 | | |
| CHECK | | | | |
| REVIEW | | | | |

**REFERENCE**

Base digital data obtained from ESRI Inc.,
DATUM: WGS84 PROJECTION: Geographic

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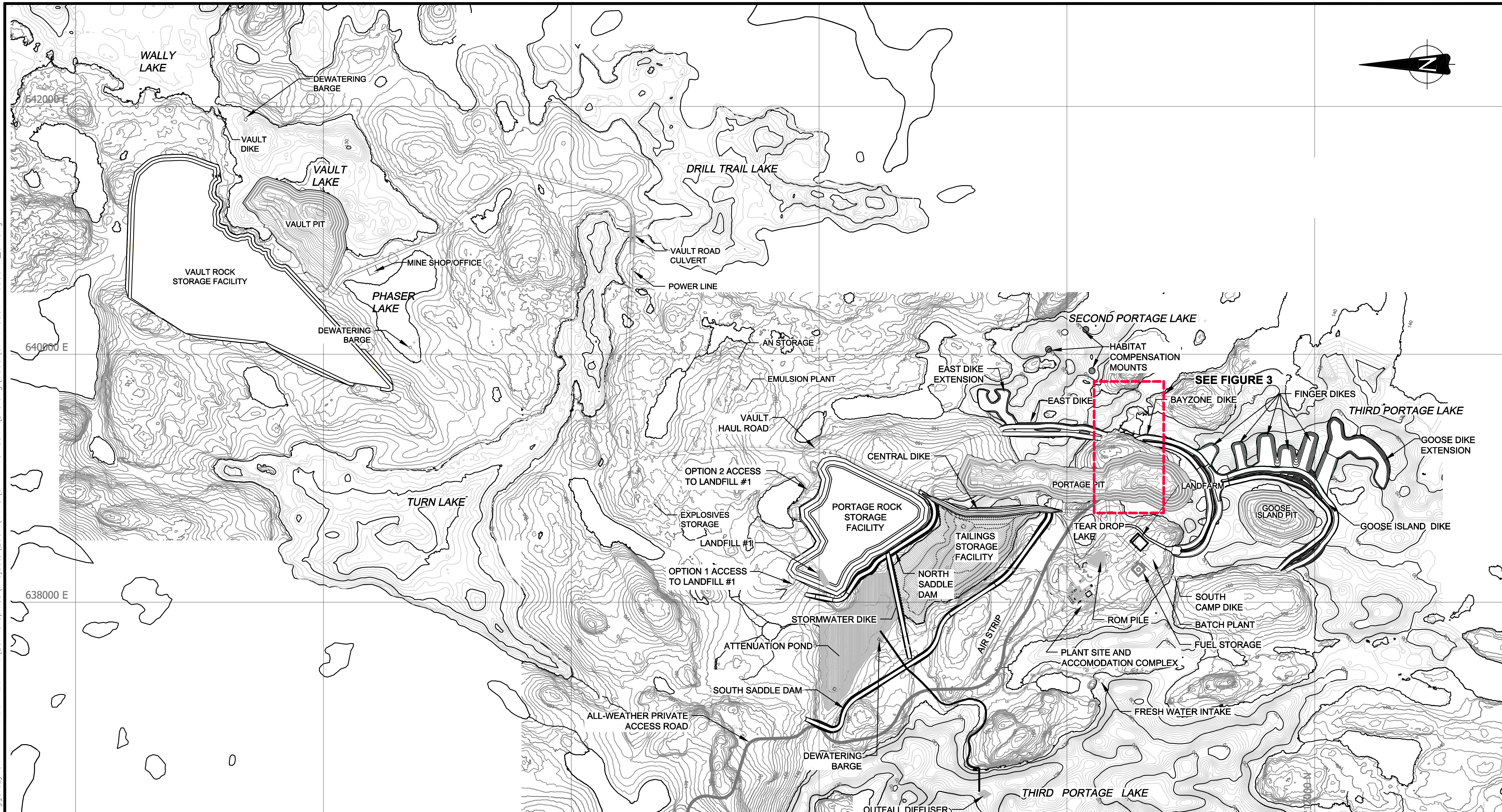


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## NOTES

1) ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2) ALL ELEVATIONS ARE IN METRES ABOVE SEA LEVEL (masl), UNLESS OTHERWISE NOTED.
3) GRID REFERENCE: NAD 83, UTM ZONE 14
4) CONTOUR INFORMATION ON LAND SUPPLIED BY MEADOWBANK MINING CORPORATION.
5) CONTOURS BELOW LAKE SURFACE ARE BASED ON BATHYMETRIC SURVEYS BY GOLDER ASSOCIATES LTD., 2002, 2003, 2006.
6) LAKE CONTOURS ARE BASED ON REGIONAL PLAN MAPS OF LAKE SURFACE ELEVATIONS:
   2ND PORTAGE LAKE = 133.1M,
   3RD PORTAGE LAKE = 134.1M
7) TOPOGRAPHIC CONTOUR INTERVAL 2M.
8) BATHYMETRIC CONTOUR INTERVAL 1M.

**NOT FOR CONSTRUCTION**

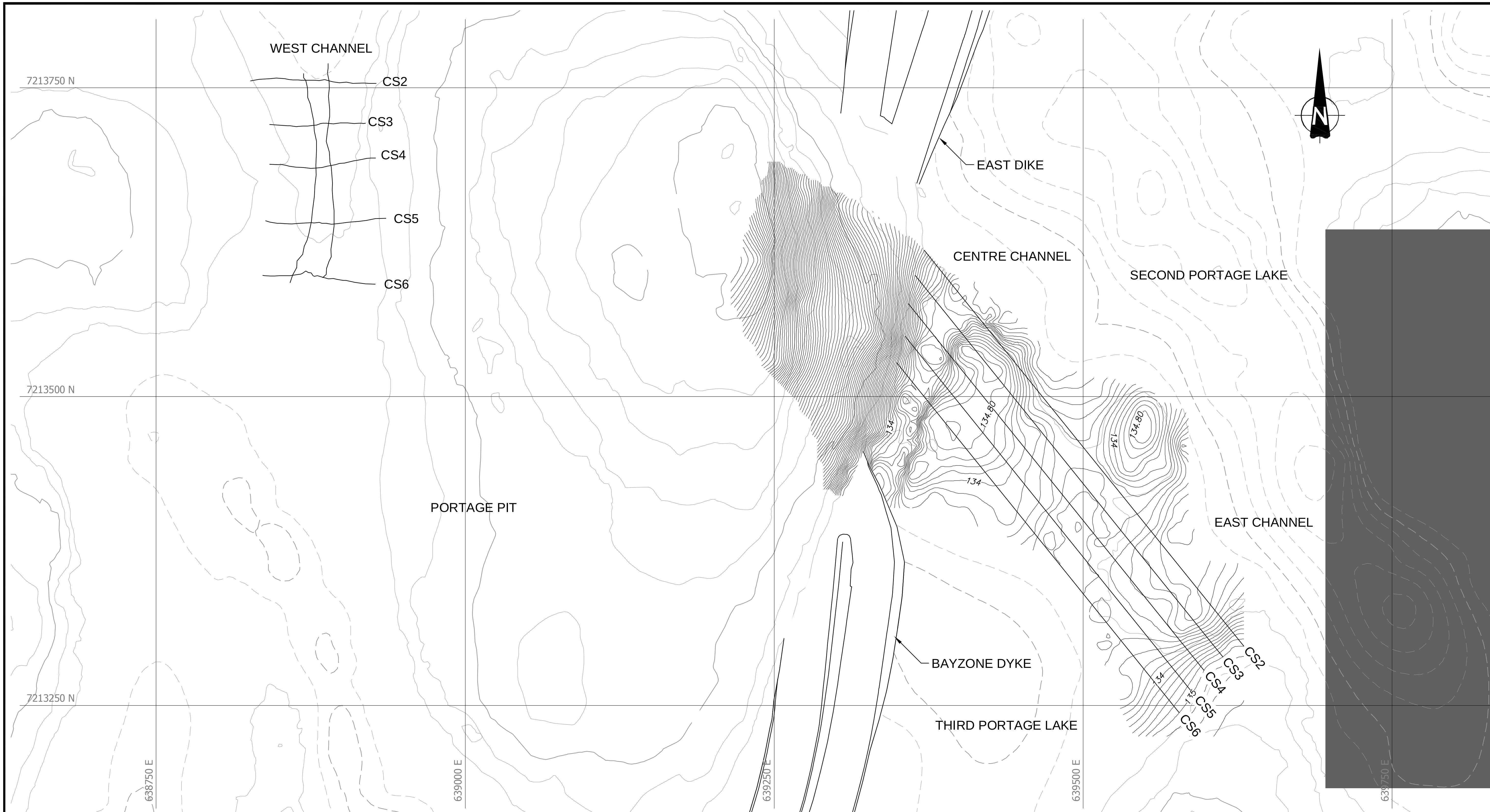
0 300 600 900 1200 1500
Scale in Metres

PROJECT
AEM
**AGNICO-EAGLE MINES LIMITED**
**MEADOWBANK DIVISION**

TITLE
**SITE PLAN**

Golder Associates

| PROJECT No. 07-1413-0047 | | | FILE No. | |
|---|---|---|---|---|
| DESIGN | JV | 27NOV07 | SCALE AS SHOWN | REV. – |
| CADD | SRR | 27NOV07 | | |
| CHECK | | | FIGURE 2 | |
| REVIEW | | | | |




0 30 60 90 120 150

Scale in Metres

## NOTES

1) ALL DIMENSIONS AND ELEVATIONS IN METRES.
2) WEST CHANNEL SURVEY PROVIDED BY AEM 23 OCTOBER, 2007.
3) EAST AND CENTRAL CHANNEL SURVEY PERFORMED BY GOLDER 21 JULY, 2007.

**NOT FOR CONSTRUCTION**

| PROJECT | |
|---|---|
| AEM | AGNICO-EAGLE MINES LIMITED<br>MEADOWBANK DIVISION |
| TITLE | HEC-RAS SECTIONS IN PLAN |

Golder Associates

| | | | | |
|---|---|---|---|---|
| PROJECT No. | | 07-1413-0047 | FILE No. | |
| DESIGN | MP | 18DEC07 | SCALE AS SHOWN | REV. |
| CADD | EA | 18DEC07 | FIGURE 3 | |
| CHECK | | | | |
| REVIEW | | | | |

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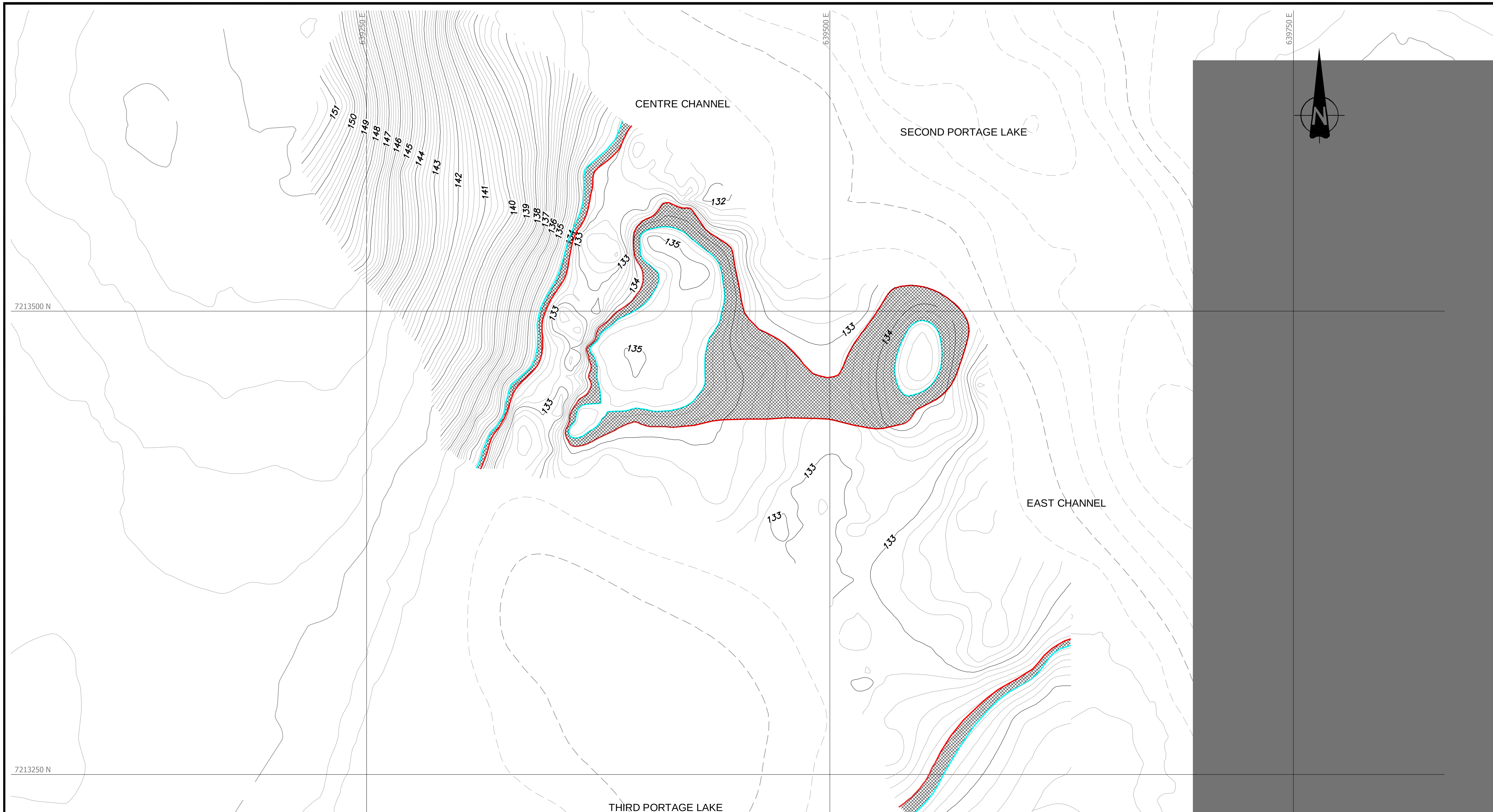


0 20 40 60 80 100
Scale in Metres

## LEGEND

- LOWER ROCK PLACEMENT LIMIT
- UPPER ROCK PLACEMENT LIMIT
- ROCK PLACEMENT AREA (TO BE CONFIRMED IN FIELD BASED ON OBSERVED GROUND CONDITIONS)

## NOTES

1) ALL DIMENSIONS AND ELEVATIONS IN METRES.
2) EAST AND CENTRAL CHANNEL SURVEY PERFORMED BY GOLDER 21 JULY, 2007.

**NOT FOR CONSTRUCTION**

| | | | | |
|---|---|---|---|---|
| PROJECT | AEM | AGNICO-EAGLE MINES LIMITED<br>MEADOWBANK DIVISION | | |
| TITLE | ROCK PLACEMENT LOCATION | | | |
| Golder Associates | PROJECT No. | 07-1413-0047 | FILE No. | |
| | DESIGN | MP | 18DEC07 | SCALE AS SHOWN REV. |
| | CADD | EA | 18DEC07 | FIGURE 4 |
| | CHECK | | | |
| | REVIEW | | | |

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# APPENDIX I

## SITE VISIT PHOTOGRAPHS – JULY 20 AND 21, 2007

REVISION DATE: BY: FILE:

**Outlet Substrates**

**Eastern Outlet**

PROJECT **MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE

## Outlet Substrate

Golder Associates

| | | | | |
|---|---|---|---|---|
| PROJECT No. | 07-1413-0047 | | PHASE / TASK No. | 5300 |
| DESIGN | -- | 11DEC07 | SCALE NTS | REV. |
| CADD | -- | | **FIGURE I-1** | |
| CHECK | -- | | | |
| REVIEW | | | | |

REVISION DATE: BY: FILE:

Looking South and Southeast with a View of the Easternmost Outlet and Third Portage Lake

Eastern Outlet

PROJECT **MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE

## Easternmost Outlet

Golder Associates

| | | | | |
|---|---|---|---|---|
| PROJECT No. | 07-1413-0047 | | PHASE / TASK No. | 5300 |
| DESIGN | -- | 11DEC07 | SCALE NTS | REV. |
| CADD | -- | | **FIGURE I-2** | |
| CHECK | -- | | | |
| REVIEW | | | | |

REVISION DATE: BY: FILE:

Looking to the East towards Central and Easternmost Outlets

Central Outlet

Central Outlet

PROJECT

**MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE

## View East with Central Outlets

Golder Associates

| | | | | |
|---|---|---|---|---|
| PROJECT No. 07-1413-0047 | | | PHASE / TASK No. 5300 | |
| DESIGN | -- | 11DEC07 | SCALE NTS | REV. |
| CADD | -- | | **FIGURE I-3** | |
| CHECK | -- | | | |
| REVIEW | | | | |

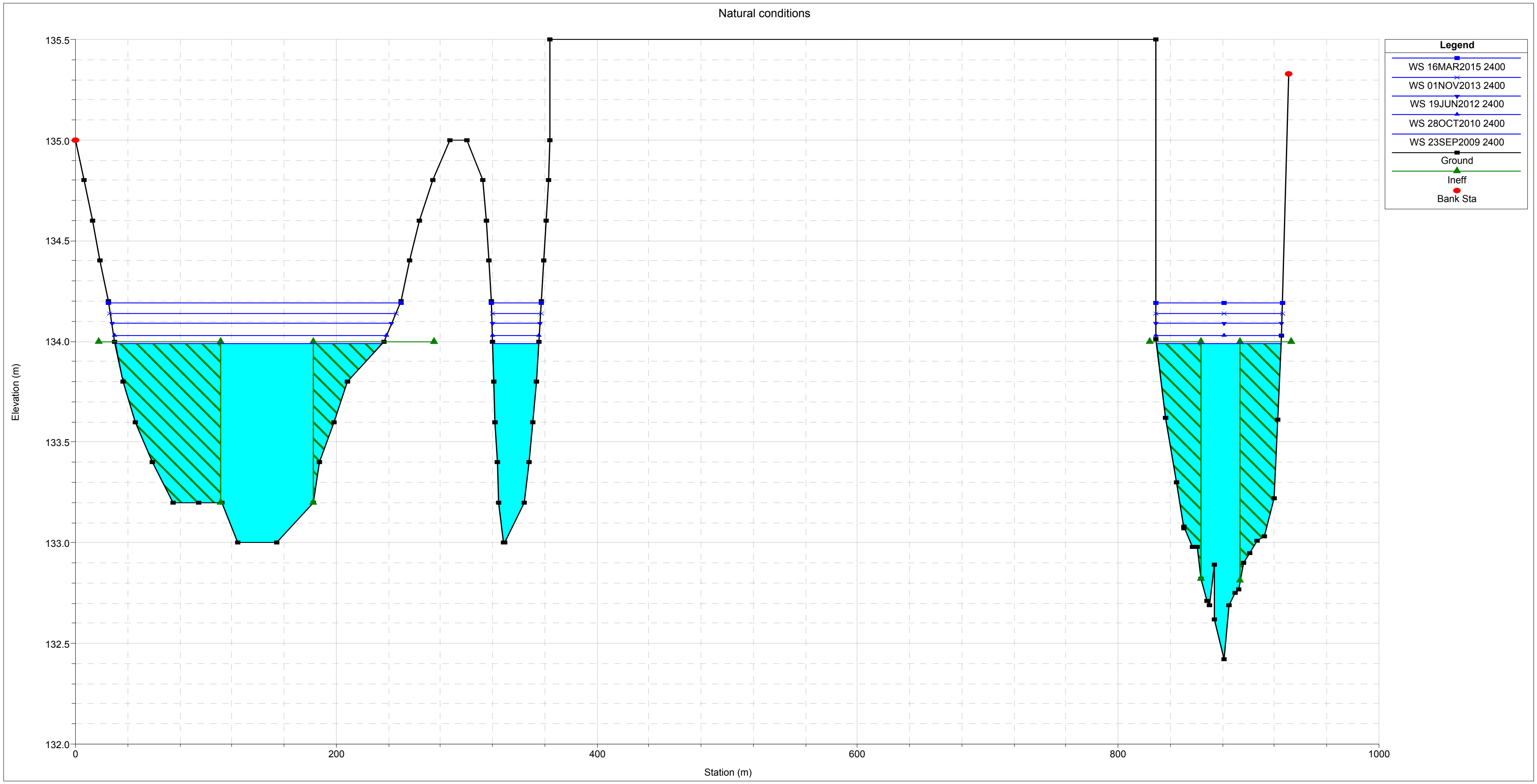
# APPENDIX II

## HEC-RAS MODEL RESULTS
## EXISTING OUTLET CONDITIONS

REVISION DATE: BY: FILE:

# Natural Conditions

## Water Elevations: 134.19m, 134.14m, 134.09m, 134.03m, 133.99m




| | |
|---|---|
| PROJECT | **MEADOWBANK MINING CORPORATION**<br>**MEADOWBANK GOLD PROJECT**<br>**THIRD PORTAGE LAKE OUTLETS** |
| TITLE | **Natural Conditions**<br>**Cross Section 6 Profile** |

Golder Associates

| | | | | |
|---|---|---|---|---|
| PROJECT No. | 07-1413-0047 | | PHASE / TASK No. | 5300 |
| DESIGN | -- | 11DEC07 | SCALE NTS | REV. |
| CADD | -- | | **FIGURE II-1** | |
| CHECK | -- | | | |
| REVIEW | | | | |

| Runoff Condition | Q Total (m3/s) | Min Ch Elevation (m) | Max Depth (m) | W.S. Elevation (m) | E.G. Elevation (m) | E.G. Slope (m/m) | Velocity Channel (m/s) | Flow Area (m2) | Top Width (m) | Froude # |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0.98 | 132.42 | 1.55 | 133.97 | 133.97 | 0.0056 | 0.01 | 127.85 | 330.52 | 0.00 |
| | 1.02 | 132.42 | 1.56 | 133.98 | 133.98 | 0.0058 | 0.01 | 129.22 | 332.64 | 0.00 |
| 100 yr Dry Channel | 1.09 | 132.42 | 1.57 | 133.99 | 133.99 | 0.0061 | 0.01 | 130.60 | 334.76 | 0.00 |
| | 1.18 | 132.42 | 1.58 | 134.00 | 134.00 | 0.0065 | 0.01 | 131.98 | 336.88 | 0.00 |
| | 1.28 | 132.42 | 1.59 | 134.01 | 134.01 | 0.0028 | 0.01 | 251.00 | 338.23 | 0.00 |
| | 1.39 | 132.42 | 1.60 | 134.02 | 134.02 | 0.0029 | 0.01 | 254.40 | 339.44 | 0.00 |
| 10 Yr Dry Channel | 1.51 | 132.42 | 1.61 | 134.03 | 134.03 | 0.0030 | 0.01 | 257.82 | 340.65 | 0.00 |
| | 1.67 | 132.42 | 1.62 | 134.04 | 134.04 | 0.0031 | 0.01 | 261.26 | 341.82 | 0.00 |
| | 2.00 | 132.42 | 1.63 | 134.05 | 134.05 | 0.0032 | 0.01 | 264.70 | 342.99 | 0.00 |
| | 2.13 | 132.42 | 1.64 | 134.06 | 134.06 | 0.0033 | 0.01 | 268.05 | 344.12 | 0.00 |
| | 2.27 | 132.42 | 1.65 | 134.07 | 134.07 | 0.0034 | 0.01 | 271.52 | 345.29 | 0.00 |
| | 2.44 | 132.42 | 1.66 | 134.08 | 134.08 | 0.0034 | 0.01 | 275.00 | 346.46 | 0.00 |
| Average Channel | 2.58 | 132.42 | 1.67 | 134.09 | 134.09 | 0.0035 | 0.01 | 278.49 | 347.63 | 0.00 |
| | 2.70 | 132.42 | 1.68 | 134.10 | 134.10 | 0.0035 | 0.01 | 281.99 | 348.80 | 0.00 |
| | 2.83 | 132.42 | 1.69 | 134.11 | 134.11 | 0.0036 | 0.01 | 285.40 | 349.93 | 0.00 |
| | 2.98 | 132.42 | 1.70 | 134.12 | 134.12 | 0.0036 | 0.01 | 288.93 | 351.10 | 0.00 |
| | 3.60 | 132.42 | 1.71 | 134.13 | 134.13 | 0.0037 | 0.01 | 292.46 | 352.27 | 0.00 |
| 10 Yr Wet Channel | 3.68 | 132.42 | 1.72 | 134.14 | 134.14 | 0.0037 | 0.01 | 296.01 | 353.44 | 0.00 |
| | 3.77 | 132.42 | 1.73 | 134.15 | 134.15 | 0.0038 | 0.01 | 299.57 | 354.61 | 0.00 |
| | 3.86 | 132.42 | 1.74 | 134.16 | 134.16 | 0.0038 | 0.01 | 303.14 | 355.78 | 0.00 |
| | 3.95 | 132.42 | 1.75 | 134.17 | 134.17 | 0.0038 | 0.01 | 306.62 | 356.91 | 0.00 |
| | 4.52 | 132.42 | 1.76 | 134.18 | 134.18 | 0.0039 | 0.01 | 310.22 | 358.08 | 0.01 |
| 100Yr Wet Channel | 5.17 | 132.42 | 1.77 | 134.19 | 134.19 | 0.0039 | 0.02 | 313.83 | 359.25 | 0.01 |
| | 5.39 | 132.42 | 1.78 | 134.20 | 134.20 | 0.0040 | 0.02 | 317.44 | 360.42 | 0.01 |
| | 6.26 | 132.42 | 1.79 | 134.21 | 134.21 | 0.0040 | 0.02 | 321.07 | 361.25 | 0.01 |

PROJECT
MEADOWBANK MINING CORPORATION
MEADOWBANK GOLD PROJECT
THIRD PORTAGE LAKE OUTLETS

TITLE

# NATURAL HEC-RAS MODEL RESULTS FOR CROSS SECTION 6

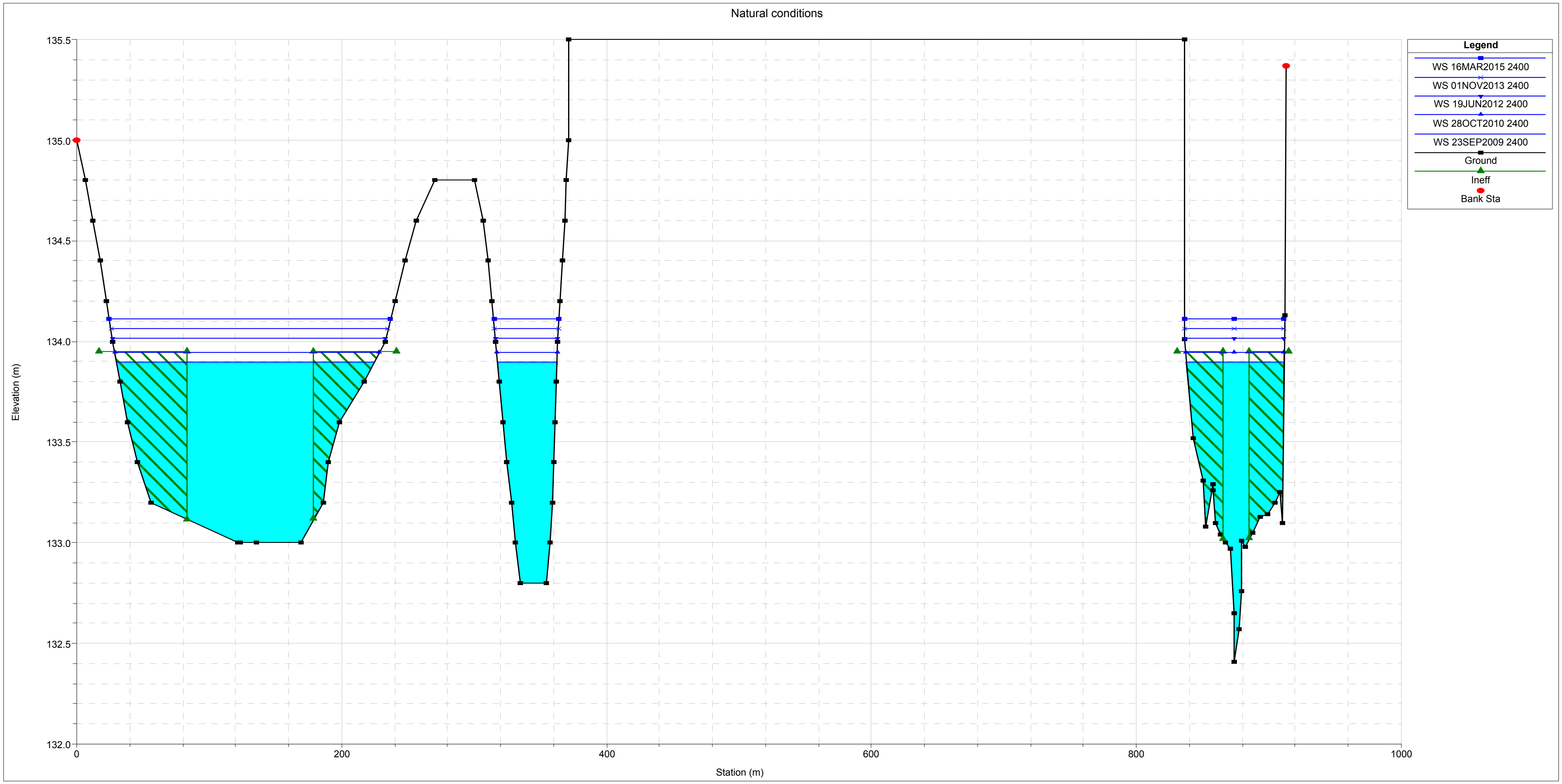
Golder Associates

| | | | |
|---|---|---|---|
| PROJECT No. 07-1413-0047 | | PHASE / TASK No. 5300 | |
| DESIGN | -- | SCALE NTS | REV. |
| CADD | -- | FIGURE II-2 | |
| CHECK | -- | | |
| REVIEW | | | |

REVISION DATE: BY: FILE:

REVISION DATE: BY: FILE:

# Natural Conditions
## Water Elevations: 134.19m, 134.14m, 134.09m, 134.03m, 133.99m




| | |
|---|---|
| PROJECT | **MEADOWBANK MINING CORPORATION**<br>**MEADOWBANK GOLD PROJECT**<br>**THIRD PORTAGE LAKE OUTLETS** |
| TITLE | **Natural Conditions**<br>**Cross Section 5 Profile** |

Golder Associates

| | | | | |
|---|---|---|---|---|
| PROJECT No. | 07-1413-0047 | | PHASE / TASK No. 5300 | |
| DESIGN | -- | 11DEC07 | SCALE NTS | REV. |
| CADD | -- | | **FIGURE II-3** | |
| CHECK | -- | | | |
| REVIEW | | | | |

| Runoff Condition | Q Total (m3/s) | Min Ch Elevation (m) | Max Depth (m) | W.S. Elevation (m) | E.G. Elevation (m) | E.G. Slope (m/m) | Velocity Channel (m/s) | Flow Area (m2) | Top Width (m) | Froude # |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0.98 | 132.41 | 1.47 | 133.88 | 133.88 | 0.0053 | 0.01 | 138.21 | 310.90 | 0.00 |
| | 1.02 | 132.41 | 1.48 | 133.89 | 133.89 | 0.0055 | 0.01 | 139.42 | 311.95 | 0.00 |
| 100 yr Dry Channel | 1.09 | 132.41 | 1.49 | 133.90 | 133.90 | 0.0058 | 0.01 | 140.89 | 313.22 | 0.00 |
| | 1.18 | 132.41 | 1.50 | 133.91 | 133.91 | 0.0062 | 0.01 | 142.84 | 314.90 | 0.00 |
| | 1.28 | 132.41 | 1.51 | 133.92 | 133.92 | 0.0065 | 0.01 | 144.75 | 316.54 | 0.00 |
| | 1.39 | 132.41 | 1.52 | 133.93 | 133.93 | 0.0067 | 0.01 | 146.71 | 318.22 | 0.00 |
| 10 Yr Dry Channel | 1.51 | 132.41 | 1.54 | 133.95 | 133.95 | 0.0070 | 0.01 | 148.68 | 319.91 | 0.00 |
| | 1.67 | 132.41 | 1.55 | 133.96 | 133.96 | 0.0038 | 0.01 | 241.28 | 321.54 | 0.00 |
| | 2.00 | 132.41 | 1.56 | 133.97 | 133.97 | 0.0038 | 0.01 | 245.21 | 323.23 | 0.00 |
| | 2.13 | 132.41 | 1.57 | 133.98 | 133.98 | 0.0039 | 0.01 | 248.77 | 324.74 | 0.00 |
| | 2.27 | 132.41 | 1.58 | 133.99 | 133.99 | 0.0040 | 0.01 | 252.34 | 326.26 | 0.00 |
| | 2.44 | 132.41 | 1.59 | 134.00 | 134.00 | 0.0040 | 0.01 | 256.03 | 327.66 | 0.00 |
| Average Channel | 2.58 | 132.41 | 1.61 | 134.02 | 134.02 | 0.0041 | 0.01 | 259.53 | 328.67 | 0.00 |
| | 2.70 | 132.41 | 1.62 | 134.03 | 134.03 | 0.0041 | 0.01 | 263.14 | 329.63 | 0.00 |
| | 2.83 | 132.41 | 1.63 | 134.04 | 134.04 | 0.0042 | 0.01 | 266.56 | 330.54 | 0.00 |
| | 2.98 | 132.41 | 1.64 | 134.05 | 134.05 | 0.0042 | 0.01 | 269.99 | 331.45 | 0.00 |
| | 3.60 | 132.41 | 1.65 | 134.06 | 134.06 | 0.0043 | 0.01 | 273.33 | 332.33 | 0.00 |
| 10 Yr Wet Channel | 3.68 | 132.41 | 1.66 | 134.07 | 134.07 | 0.0043 | 0.01 | 276.37 | 333.13 | 0.00 |
| | 3.77 | 132.41 | 1.67 | 134.08 | 134.08 | 0.0044 | 0.01 | 279.42 | 333.93 | 0.00 |
| | 3.86 | 132.41 | 1.67 | 134.08 | 134.08 | 0.0044 | 0.01 | 282.48 | 334.73 | 0.00 |
| | 3.95 | 132.41 | 1.68 | 134.09 | 134.09 | 0.0045 | 0.01 | 285.44 | 335.50 | 0.00 |
| | 4.52 | 132.41 | 1.69 | 134.10 | 134.10 | 0.0046 | 0.02 | 288.51 | 336.30 | 0.01 |
| 100Yr Wet Channel | 5.17 | 132.41 | 1.70 | 134.11 | 134.11 | 0.0046 | 0.02 | 291.59 | 337.11 | 0.01 |
| | 5.39 | 132.41 | 1.71 | 134.12 | 134.12 | 0.0047 | 0.02 | 294.68 | 337.91 | 0.01 |
| | 6.26 | 132.41 | 1.72 | 134.13 | 134.13 | 0.0047 | 0.02 | 297.77 | 338.71 | 0.01 |

PROJECT
**MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE

# NATURAL HEC-RAS MODEL RESULTS FOR CROSS SECTION 5

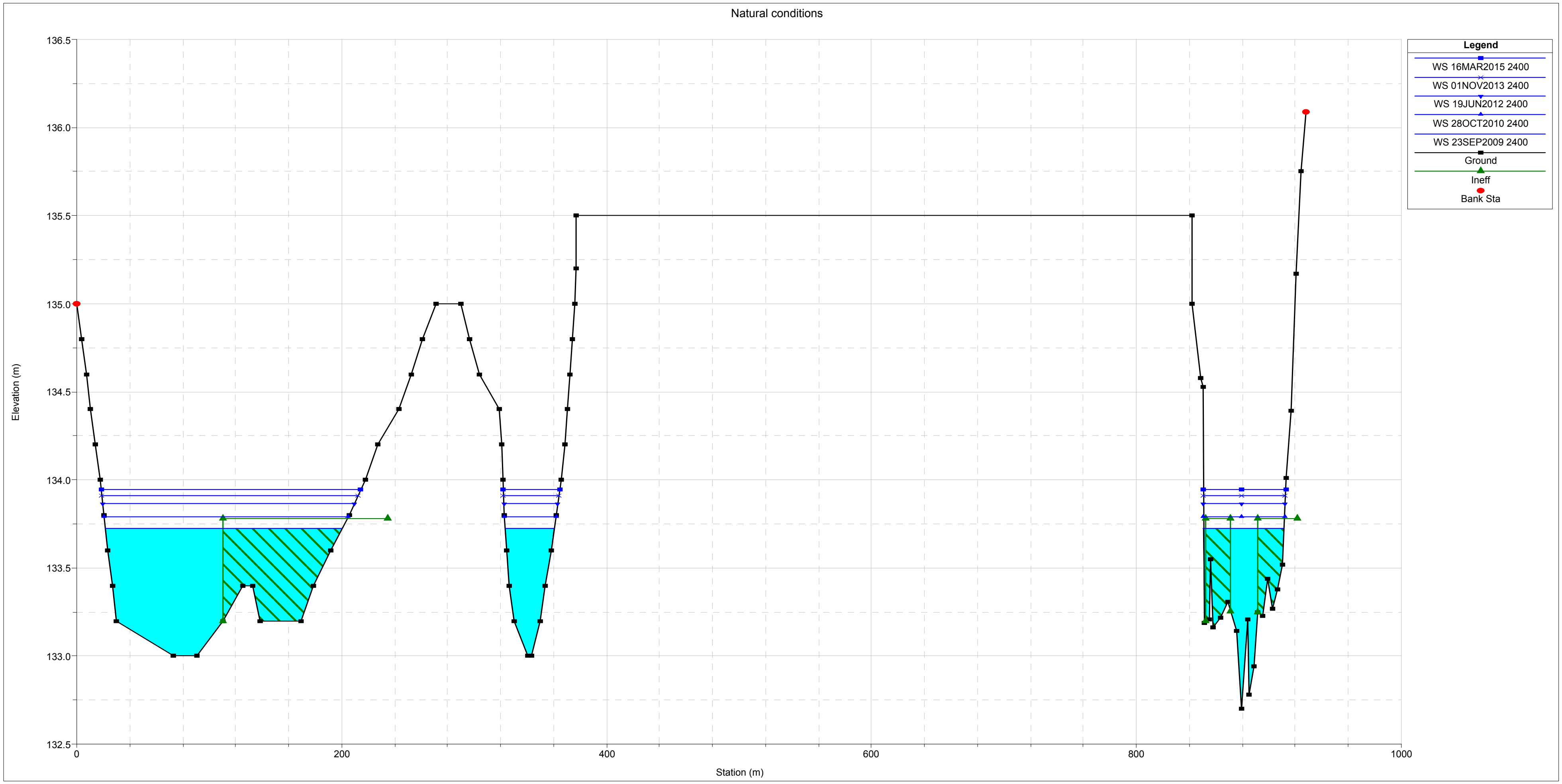
Golder Associates

| | | | |
|---|---|---|---|
| PROJECT No. 07-1413-0047 | | PHASE / TASK No. 5300 | |
| DESIGN | -- | SCALE NTS | REV. |
| CADD | -- | **FIGURE II-4** | |
| CHECK | -- | | |
| REVIEW | | | |

REVISION DATE: BY: FILE:

REVISION DATE: BY: FILE:

# Natural Conditions
## Water Elevations: 134.19m, 134.14m, 134.09m, 134.03m, 133.99m




| | |
|---|---|
| PROJECT | **MEADOWBANK MINING CORPORATION**<br>**MEADOWBANK GOLD PROJECT**<br>**THIRD PORTAGE LAKE OUTLETS** |
| TITLE | **Natural Conditions**<br>**Cross Section 4 Profile** |

Golder Associates

| | | | | |
|---|---|---|---|---|
| PROJECT No. | 07-1413-0047 | | PHASE / TASK No. | 5300 |
| DESIGN | -- | 11DEC07 | SCALE NTS | REV. |
| CADD | -- | | **FIGURE II-5** | |
| CHECK | -- | | | |
| REVIEW | | | | |

| Runoff Condition | Q Total (m3/s) | Min Ch Elevation (m) | Max Depth (m) | W.S. Elevation (m) | E.G. Elevation (m) | E.G. Slope (m/m) | Velocity Channel (m/s) | Flow Area (m2) | Top Width (m) | Froude # |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0.98 | 132.70 | 1.00 | 133.70 | 133.70 | 0.0256 | 0.01 | 83.19 | 273.35 | 0.00 |
| | 1.02 | 132.70 | 1.01 | 133.71 | 133.71 | 0.0260 | 0.01 | 84.85 | 274.64 | 0.01 |
| 100 yr Dry Channel | 1.09 | 132.70 | 1.02 | 133.72 | 133.72 | 0.0263 | 0.01 | 86.78 | 276.14 | 0.01 |
| | 1.18 | 132.70 | 1.04 | 133.74 | 133.74 | 0.0266 | 0.01 | 89.30 | 278.09 | 0.01 |
| | 1.28 | 132.70 | 1.06 | 133.76 | 133.76 | 0.0268 | 0.01 | 91.70 | 279.94 | 0.01 |
| | 1.39 | 132.70 | 1.07 | 133.77 | 133.77 | 0.0268 | 0.01 | 94.15 | 281.83 | 0.01 |
| 10 Yr Dry Channel | 1.51 | 132.70 | 1.09 | 133.79 | 133.79 | 0.0127 | 0.01 | 155.89 | 283.64 | 0.00 |
| | 1.67 | 132.70 | 1.10 | 133.80 | 133.80 | 0.0125 | 0.01 | 160.31 | 285.40 | 0.00 |
| | 2.00 | 132.70 | 1.12 | 133.82 | 133.82 | 0.0123 | 0.01 | 164.67 | 287.03 | 0.01 |
| | 2.13 | 132.70 | 1.13 | 133.83 | 133.83 | 0.0124 | 0.01 | 167.92 | 288.23 | 0.01 |
| | 2.27 | 132.70 | 1.14 | 133.84 | 133.84 | 0.0124 | 0.01 | 171.08 | 289.40 | 0.01 |
| | 2.44 | 132.70 | 1.15 | 133.85 | 133.85 | 0.0124 | 0.01 | 174.36 | 290.61 | 0.01 |
| Average Channel | 2.58 | 132.70 | 1.16 | 133.86 | 133.86 | 0.0124 | 0.01 | 177.55 | 291.78 | 0.01 |
| | 2.70 | 132.70 | 1.17 | 133.87 | 133.87 | 0.0123 | 0.01 | 180.85 | 292.99 | 0.01 |
| | 2.83 | 132.70 | 1.18 | 133.88 | 133.88 | 0.0123 | 0.02 | 183.98 | 294.13 | 0.01 |
| | 2.98 | 132.70 | 1.19 | 133.89 | 133.89 | 0.0124 | 0.02 | 186.67 | 295.10 | 0.01 |
| | 3.60 | 132.70 | 1.20 | 133.90 | 133.90 | 0.0125 | 0.02 | 188.93 | 295.92 | 0.01 |
| 10 Yr Wet Channel | 3.68 | 132.70 | 1.21 | 133.91 | 133.91 | 0.0127 | 0.02 | 191.00 | 296.67 | 0.01 |
| | 3.77 | 132.70 | 1.22 | 133.92 | 133.92 | 0.0129 | 0.02 | 193.18 | 297.45 | 0.01 |
| | 3.86 | 132.70 | 1.22 | 133.92 | 133.92 | 0.0130 | 0.02 | 195.36 | 298.23 | 0.01 |
| | 3.95 | 132.70 | 1.23 | 133.93 | 133.93 | 0.0132 | 0.02 | 197.63 | 299.05 | 0.01 |
| | 4.52 | 132.70 | 1.24 | 133.94 | 133.94 | 0.0133 | 0.02 | 199.91 | 299.86 | 0.01 |
| 100Yr Wet Channel | 5.17 | 132.70 | 1.25 | 133.95 | 133.95 | 0.0134 | 0.03 | 202.29 | 300.71 | 0.01 |
| | 5.39 | 132.70 | 1.25 | 133.95 | 133.95 | 0.0135 | 0.03 | 204.77 | 301.59 | 0.01 |
| | 6.26 | 132.70 | 1.26 | 133.96 | 133.96 | 0.0136 | 0.03 | 207.25 | 302.46 | 0.01 |

PROJECT
**MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE
# NATURAL HEC-RAS MODEL RESULTS FOR CROSS SECTION 4

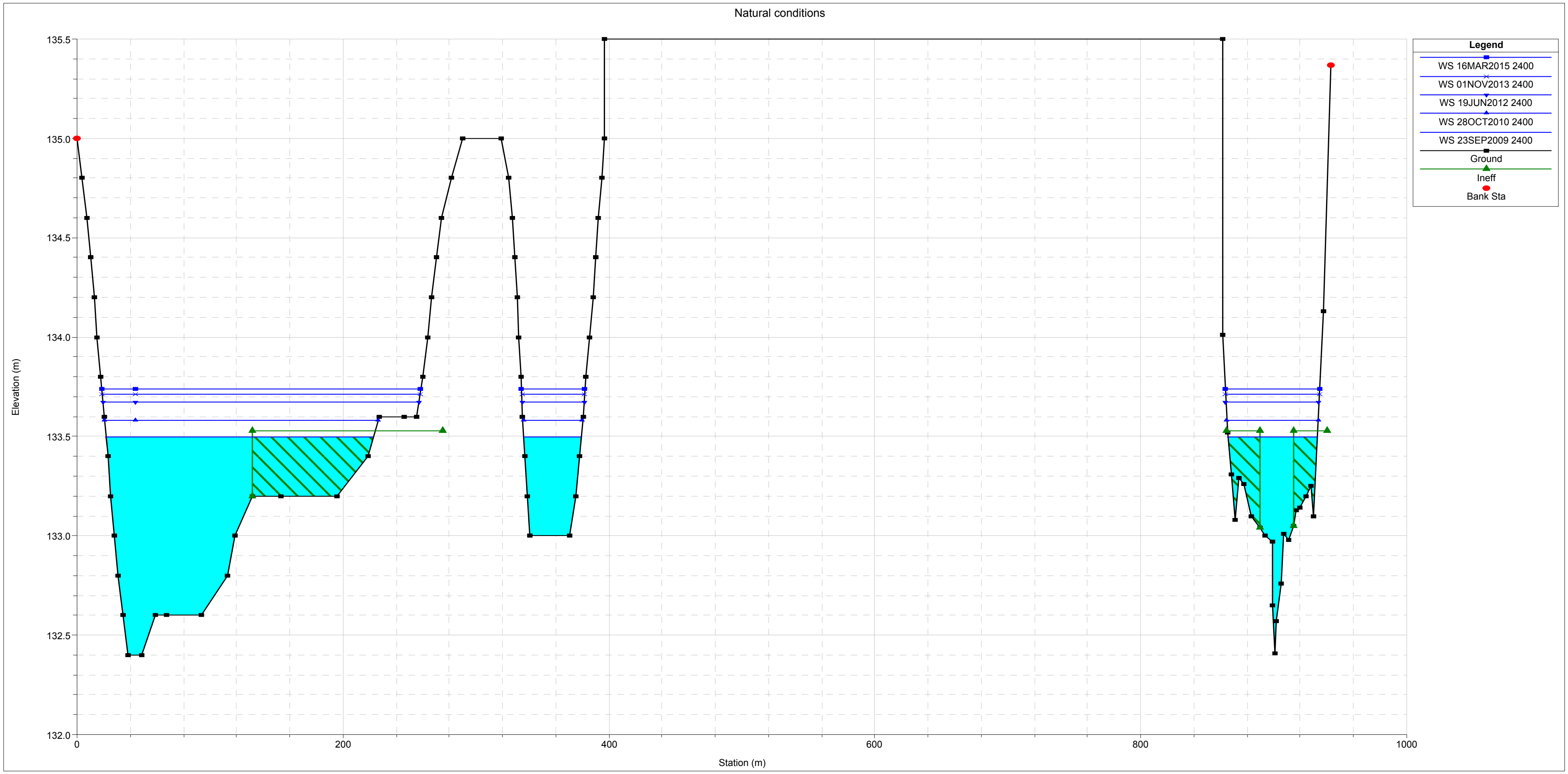
Golder Associates

| | | | |
|---|---|---|---|
| PROJECT No. 07-1413-0047 | | PHASE / TASK No. 5300 | |
| DESIGN | -- | SCALE NTS | REV. |
| CADD | -- | **FIGURE II-6** | |
| CHECK | -- | | |
| REVIEW | | | |

REVISION DATE: BY: FILE:

REVISION DATE: BY: FILE:

# Natural Conditions
## Water Elevations: 134.19m, 134.14m, 134.09m, 134.03m, 133.99m




| | |
|---|---|
| PROJECT | **MEADOWBANK MINING CORPORATION**<br>**MEADOWBANK GOLD PROJECT**<br>**THIRD PORTAGE LAKE OUTLETS** |
| TITLE | **Natural Conditions**<br>**Cross Section 3 Profile** |

Golder Associates

| | | | | |
|---|---|---|---|---|
| PROJECT No. | 07-1413-0047 | | PHASE / TASK No. | 5300 |
| DESIGN | -- | 11DEC07 | SCALE NTS | REV. |
| CADD | -- | | **FIGURE II-7** | |
| CHECK | -- | | | |
| REVIEW | | | | |

| Runoff Condition | Q Total (m3/s) | Min Ch Elevation (m) | Max Depth (m) | W.S. Elevation (m) | E.G. Elevation (m) | E.G. Slope (m/m) | Velocity Channel (m/s) | Flow Area (m2) | Top Width (m) | Froude # |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0.98 | 132.40 | 1.07 | 133.47 | 133.47 | 0.0113 | 0.01 | 114.79 | 308.55 | 0.00 |
| | 1.02 | 132.40 | 1.08 | 133.48 | 133.48 | 0.0112 | 0.01 | 117.55 | 310.06 | 0.00 |
| 100 yr Dry Channel | 1.09 | 132.40 | 1.10 | 133.50 | 133.50 | 0.0112 | 0.01 | 120.75 | 311.81 | 0.00 |
| | 1.18 | 132.40 | 1.12 | 133.52 | 133.52 | 0.0112 | 0.01 | 124.78 | 313.99 | 0.00 |
| | 1.28 | 132.40 | 1.14 | 133.54 | 133.54 | 0.0090 | 0.01 | 171.37 | 315.84 | 0.00 |
| | 1.39 | 132.40 | 1.16 | 133.56 | 133.56 | 0.0087 | 0.01 | 177.94 | 317.70 | 0.00 |
| 10 Yr Dry Channel | 1.51 | 132.40 | 1.18 | 133.58 | 133.58 | 0.0085 | 0.01 | 184.15 | 319.44 | 0.00 |
| | 1.67 | 132.40 | 1.20 | 133.60 | 133.60 | 0.0092 | 0.01 | 190.24 | 349.41 | 0.00 |
| | 2.00 | 132.40 | 1.22 | 133.62 | 133.62 | 0.0089 | 0.01 | 196.53 | 350.61 | 0.00 |
| | 2.13 | 132.40 | 1.23 | 133.63 | 133.63 | 0.0088 | 0.01 | 201.56 | 351.57 | 0.00 |
| | 2.27 | 132.40 | 1.25 | 133.65 | 133.65 | 0.0086 | 0.01 | 206.39 | 352.49 | 0.00 |
| | 2.44 | 132.40 | 1.26 | 133.66 | 133.66 | 0.0085 | 0.01 | 211.23 | 353.41 | 0.00 |
| Average Channel | 2.58 | 132.40 | 1.27 | 133.67 | 133.67 | 0.0083 | 0.01 | 216.08 | 354.32 | 0.00 |
| | 2.70 | 132.40 | 1.29 | 133.69 | 133.69 | 0.0082 | 0.01 | 220.73 | 355.20 | 0.00 |
| | 2.83 | 132.40 | 1.30 | 133.70 | 133.70 | 0.0080 | 0.01 | 225.29 | 356.06 | 0.01 |
| | 2.98 | 132.40 | 1.31 | 133.71 | 133.71 | 0.0082 | 0.01 | 227.89 | 356.55 | 0.01 |
| | 3.60 | 132.40 | 1.31 | 133.71 | 133.71 | 0.0084 | 0.02 | 229.20 | 356.79 | 0.01 |
| 10 Yr Wet Channel | 3.68 | 132.40 | 1.31 | 133.71 | 133.71 | 0.0087 | 0.02 | 230.29 | 357.00 | 0.01 |
| | 3.77 | 132.40 | 1.32 | 133.72 | 133.72 | 0.0090 | 0.02 | 231.59 | 357.24 | 0.01 |
| | 3.86 | 132.40 | 1.32 | 133.72 | 133.72 | 0.0092 | 0.02 | 233.22 | 357.55 | 0.01 |
| | 3.95 | 132.40 | 1.33 | 133.73 | 133.73 | 0.0094 | 0.02 | 234.97 | 357.88 | 0.01 |
| | 4.52 | 132.40 | 1.33 | 133.73 | 133.73 | 0.0095 | 0.02 | 237.04 | 358.26 | 0.01 |
| 100Yr Wet Channel | 5.17 | 132.40 | 1.34 | 133.74 | 133.74 | 0.0097 | 0.02 | 239.12 | 358.65 | 0.01 |
| | 5.39 | 132.40 | 1.35 | 133.75 | 133.75 | 0.0098 | 0.02 | 241.42 | 359.08 | 0.01 |
| | 6.26 | 132.40 | 1.35 | 133.75 | 133.75 | 0.0100 | 0.03 | 243.83 | 359.53 | 0.01 |

PROJECT
**MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE
# NATURAL HEC-RAS MODEL RESULTS FOR CROSS SECTION 3

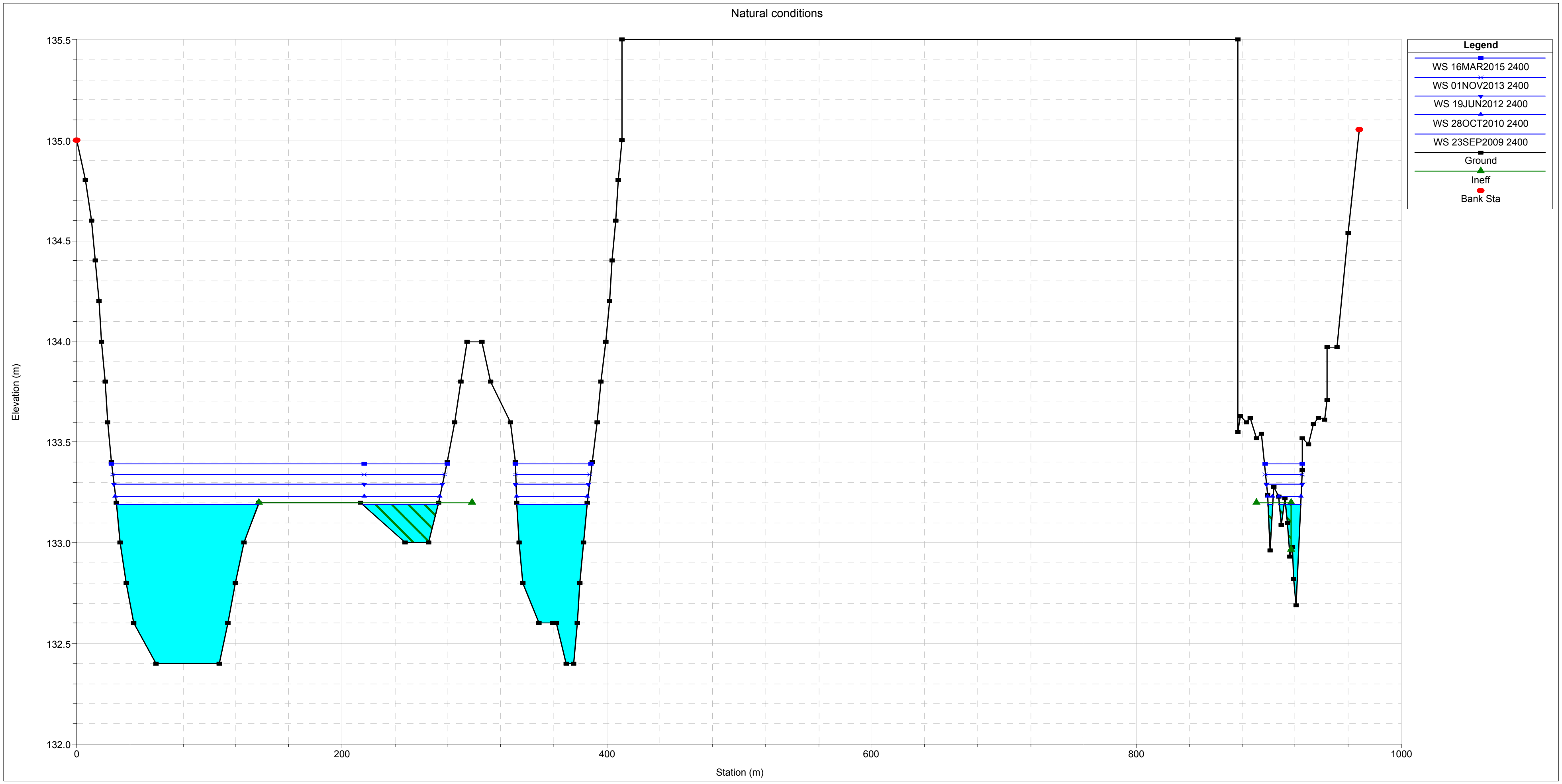
Golder Associates

| | | | |
|---|---|---|---|
| PROJECT No. 07-1413-0047 | | PHASE / TASK No. 5300 | |
| DESIGN | -- | SCALE NTS | REV. |
| CADD | -- | **FIGURE II-8** | |
| CHECK | -- | | |
| REVIEW | | | |

REVISION DATE: BY: FILE:

REVISION DATE: BY: FILE:

# Natural Conditions
## Water Elevations: 134.19m, 134.14m, 134.09m, 134.03m, 133.99m




PROJECT **MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE
**Natural Conditions**
**Cross Section 2 Profile**

Golder Associates

| PROJECT No. | 07-1413-0047 | | PHASE / TASK No. | 5300 |
|---|---|---|---|---|
| DESIGN | -- | 11DEC07 | SCALE NTS | REV. |
| CADD | -- | | **FIGURE II-9** | |
| CHECK | -- | | | |
| REVIEW | | | | |

| Runoff Condition | Q Total (m3/s) | Min Ch Elevation (m) | Max Depth (m) | W.S. Elevation (m) | E.G. Elevation (m) | E.G. Slope (m/m) | Velocity Channel (m/s) | Flow Area (m2) | Top Width (m) | Froude # |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0.98 | 132.40 | 0.77 | 133.17 | 133.17 | 0.0224 | 0.01 | 90.78 | 228.68 | 0.00 |
| | 1.02 | 132.40 | 0.78 | 133.18 | 133.18 | 0.0229 | 0.01 | 92.45 | 232.47 | 0.00 |
| 100 yr Dry Channel | 1.09 | 132.40 | 0.79 | 133.19 | 133.19 | 0.0236 | 0.01 | 94.13 | 236.26 | 0.00 |
| | 1.18 | 132.40 | 0.80 | 133.20 | 133.20 | 0.0248 | 0.01 | 95.82 | 240.05 | 0.01 |
| | 1.28 | 132.40 | 0.81 | 133.21 | 133.21 | 0.0423 | 0.01 | 108.12 | 318.07 | 0.01 |
| | 1.39 | 132.40 | 0.82 | 133.22 | 133.22 | 0.0421 | 0.01 | 111.23 | 319.44 | 0.01 |
| 10 Yr Dry Channel | 1.51 | 132.40 | 0.83 | 133.23 | 133.23 | 0.0416 | 0.01 | 114.44 | 320.49 | 0.01 |
| | 1.67 | 132.40 | 0.84 | 133.24 | 133.24 | 0.0411 | 0.01 | 117.68 | 322.19 | 0.01 |
| | 2.00 | 132.40 | 0.85 | 133.25 | 133.25 | 0.0405 | 0.02 | 120.93 | 323.96 | 0.01 |
| | 2.13 | 132.40 | 0.86 | 133.26 | 133.26 | 0.0397 | 0.02 | 124.19 | 325.73 | 0.01 |
| | 2.27 | 132.40 | 0.87 | 133.27 | 133.27 | 0.0388 | 0.02 | 127.48 | 327.50 | 0.01 |
| | 2.44 | 132.40 | 0.88 | 133.28 | 133.28 | 0.0381 | 0.02 | 130.68 | 329.22 | 0.01 |
| Average Channel | 2.58 | 132.40 | 0.89 | 133.29 | 133.29 | 0.0371 | 0.02 | 134.00 | 330.14 | 0.01 |
| | 2.70 | 132.40 | 0.90 | 133.30 | 133.30 | 0.0361 | 0.02 | 137.32 | 331.06 | 0.01 |
| | 2.83 | 132.40 | 0.91 | 133.31 | 133.31 | 0.0351 | 0.02 | 140.66 | 331.97 | 0.01 |
| | 2.98 | 132.40 | 0.92 | 133.32 | 133.32 | 0.0343 | 0.02 | 144.00 | 332.90 | 0.01 |
| | 3.60 | 132.40 | 0.93 | 133.33 | 133.33 | 0.0337 | 0.02 | 147.25 | 333.79 | 0.01 |
| 10 Yr Wet Channel | 3.68 | 132.40 | 0.94 | 133.34 | 133.34 | 0.0329 | 0.02 | 150.62 | 334.71 | 0.01 |
| | 3.77 | 132.40 | 0.95 | 133.35 | 133.35 | 0.0321 | 0.02 | 153.99 | 335.63 | 0.01 |
| | 3.86 | 132.40 | 0.96 | 133.36 | 133.36 | 0.0314 | 0.02 | 157.36 | 336.55 | 0.01 |
| | 3.95 | 132.40 | 0.97 | 133.37 | 133.37 | 0.0307 | 0.02 | 160.76 | 337.41 | 0.01 |
| | 4.52 | 132.40 | 0.98 | 133.38 | 133.38 | 0.0301 | 0.03 | 164.05 | 338.24 | 0.01 |
| 100Yr Wet Channel | 5.17 | 132.40 | 0.99 | 133.39 | 133.39 | 0.0295 | 0.03 | 167.46 | 339.10 | 0.01 |
| | 5.39 | 132.40 | 1.00 | 133.40 | 133.40 | 0.0289 | 0.03 | 170.87 | 339.97 | 0.01 |
| | 6.26 | 132.40 | 1.01 | 133.41 | 133.41 | 0.0284 | 0.04 | 174.30 | 340.87 | 0.02 |

PROJECT
**MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE
# NATURAL HEC-RAS MODEL RESULTS FOR CROSS SECTION 2

Golder Associates

| | | | |
|---|---|---|---|
| PROJECT No. 07-1413-0047 | | PHASE / TASK No. 5300 | |
| DESIGN | -- | SCALE NTS | REV. |
| CADD | -- | **FIGURE II-10** | |
| CHECK | -- | | |
| REVIEW | | | |

REVISION DATE: BY: FILE:

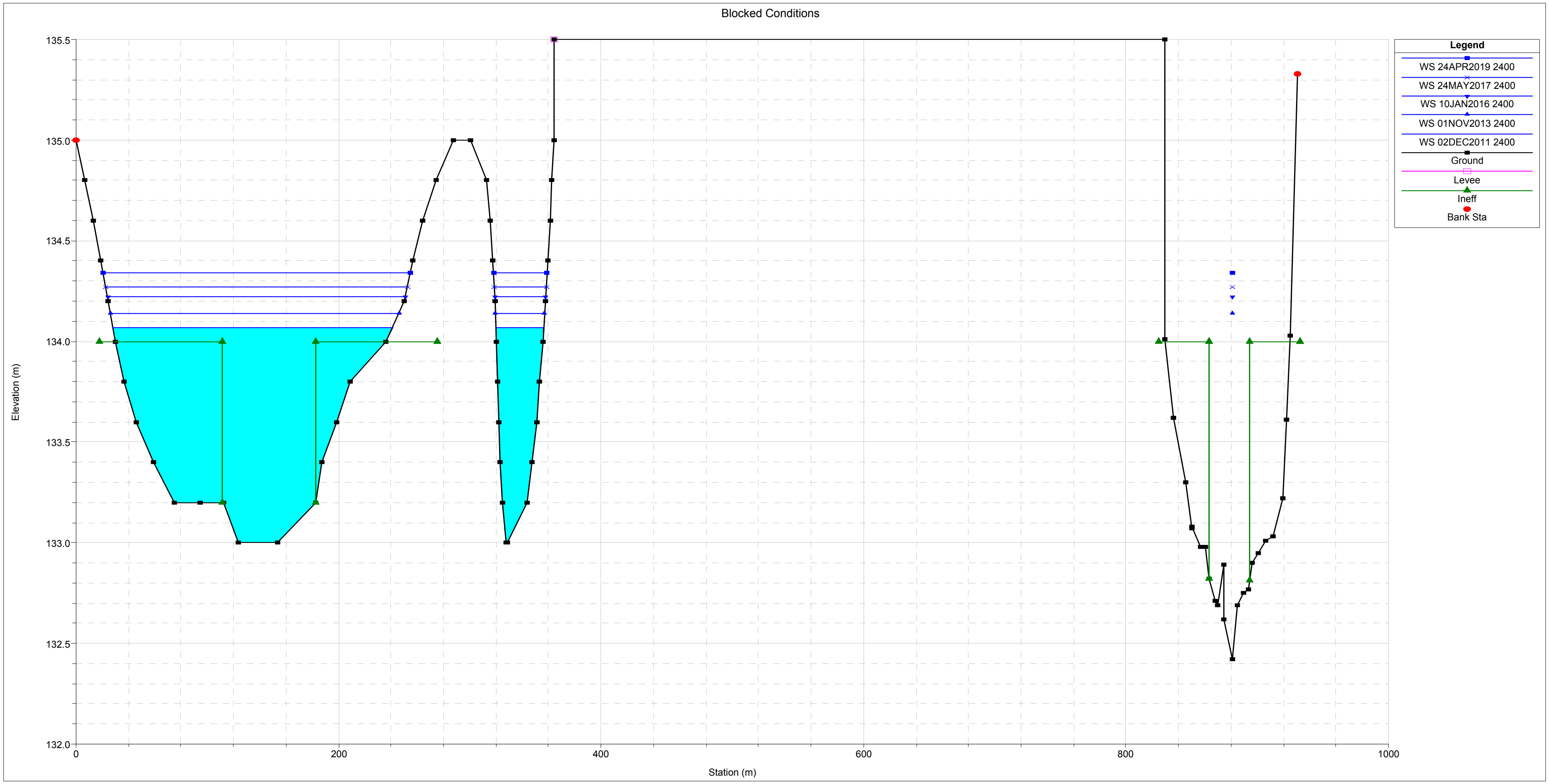
# APPENDIX III

## HEC-RAS MODEL RESULTS
## BLOCKED WESTERNMOST CHANNEL (NO DEWATERING)

REVISION DATE: BY: FILE:

# Blocked Conditions

## Water Elevations: 134.34m, 134.27m, 134.22m, 134.14m, 133.07m




PROJECT **MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE

**Blocked Conditions**
**Cross Section 6 Profile**

Golder Associates

| | | | | |
|---|---|---|---|---|
| PROJECT No. | 07-1413-0047 | | PHASE / TASK No. | 5300 |
| DESIGN | -- | 11DEC07 | SCALE NTS | REV. |
| CADD | -- | | **FIGURE III-1** | |
| CHECK | -- | | | |
| REVIEW | | | | |

| Runoff Condition | Q Total (m3/s) | Min Ch Elevation (m) | Max Depth (m) | W.S. Elevation (m) | E.G. Elevation (m) | E.G. Slope (m/m) | Velocity Channel (m/s) | Flow Area (m2) | Top Width (m) | Froude # |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0.99 | 132.42 | 1.63 | 134.05 | 134.05 | 0.00 | 0.01 | 168.66 | 246.80 | 0.00 |
| | 1.03 | 132.42 | 1.64 | 134.06 | 134.06 | 0.01 | 0.01 | 171.08 | 247.89 | 0.00 |
| 100 yr Dry Blocked Channel | 1.09 | 132.42 | 1.65 | 134.07 | 134.07 | 0.01 | 0.01 | 173.58 | 249.02 | 0.00 |
| | 1.14 | 132.42 | 1.66 | 134.08 | 134.08 | 0.01 | 0.01 | 176.09 | 250.15 | 0.00 |
| | 1.20 | 132.42 | 1.67 | 134.09 | 134.09 | 0.01 | 0.01 | 178.61 | 251.27 | 0.00 |
| | 1.26 | 132.42 | 1.68 | 134.10 | 134.10 | 0.01 | 0.01 | 181.14 | 252.40 | 0.00 |
| | 1.32 | 132.42 | 1.69 | 134.11 | 134.11 | 0.01 | 0.01 | 183.61 | 253.49 | 0.00 |
| | 1.39 | 132.42 | 1.70 | 134.12 | 134.12 | 0.01 | 0.01 | 186.16 | 254.62 | 0.00 |
| | 1.47 | 132.42 | 1.71 | 134.13 | 134.13 | 0.01 | 0.01 | 188.73 | 255.75 | 0.00 |
| 10 Yr Dry Blocked Channel | 1.55 | 132.42 | 1.72 | 134.14 | 134.14 | 0.01 | 0.01 | 191.31 | 256.87 | 0.00 |
| | 1.66 | 132.42 | 1.73 | 134.15 | 134.15 | 0.01 | 0.01 | 193.90 | 258.00 | 0.00 |
| | 1.81 | 132.42 | 1.74 | 134.16 | 134.16 | 0.01 | 0.01 | 196.50 | 259.13 | 0.00 |
| | 2.03 | 132.42 | 1.75 | 134.17 | 134.17 | 0.01 | 0.01 | 199.03 | 260.22 | 0.00 |
| | 2.12 | 132.42 | 1.76 | 134.18 | 134.18 | 0.01 | 0.01 | 201.65 | 261.35 | 0.00 |
| | 2.23 | 132.42 | 1.77 | 134.19 | 134.19 | 0.01 | 0.01 | 204.29 | 262.47 | 0.00 |
| | 2.34 | 132.42 | 1.78 | 134.20 | 134.20 | 0.01 | 0.01 | 206.94 | 263.60 | 0.00 |
| | 2.48 | 132.42 | 1.79 | 134.21 | 134.21 | 0.01 | 0.01 | 209.59 | 264.39 | 0.00 |
| Average Blocked Channel | 2.58 | 132.42 | 1.80 | 134.22 | 134.22 | 0.01 | 0.01 | 212.17 | 265.16 | 0.00 |
| | 2.69 | 132.42 | 1.81 | 134.23 | 134.23 | 0.01 | 0.01 | 214.84 | 265.95 | 0.00 |
| | 2.80 | 132.42 | 1.82 | 134.24 | 134.24 | 0.01 | 0.01 | 217.52 | 266.74 | 0.00 |
| | 2.92 | 132.42 | 1.83 | 134.25 | 134.25 | 0.01 | 0.01 | 220.21 | 267.52 | 0.00 |
| | 3.55 | 132.42 | 1.84 | 134.26 | 134.26 | 0.01 | 0.02 | 222.90 | 268.31 | 0.01 |
| 10 Yr Wet Blocked Channel | 3.62 | 132.42 | 1.85 | 134.27 | 134.27 | 0.01 | 0.02 | 225.53 | 269.08 | 0.01 |
| | 3.70 | 132.42 | 1.86 | 134.28 | 134.28 | 0.01 | 0.02 | 228.24 | 269.87 | 0.01 |
| | 3.78 | 132.42 | 1.87 | 134.29 | 134.29 | 0.01 | 0.02 | 230.96 | 270.66 | 0.01 |
| | 3.85 | 132.42 | 1.88 | 134.30 | 134.30 | 0.01 | 0.02 | 233.68 | 271.45 | 0.01 |
| | 3.93 | 132.42 | 1.89 | 134.31 | 134.31 | 0.01 | 0.02 | 236.41 | 272.24 | 0.01 |
| | 4.04 | 132.42 | 1.90 | 134.32 | 134.32 | 0.01 | 0.02 | 239.07 | 273.01 | 0.01 |
| | 5.07 | 132.42 | 1.91 | 134.33 | 134.33 | 0.01 | 0.02 | 241.82 | 273.80 | 0.01 |
| 100Yr Wet Blocked Channel | 5.25 | 132.42 | 1.92 | 134.34 | 134.34 | 0.01 | 0.02 | 244.58 | 274.58 | 0.01 |
| | 5.44 | 132.42 | 1.93 | 134.35 | 134.35 | 0.01 | 0.02 | 247.35 | 275.37 | 0.01 |
| | 6.26 | 132.42 | 1.94 | 134.36 | 134.36 | 0.01 | 0.03 | 250.12 | 276.16 | 0.01 |
| | 6.37 | 132.42 | 1.95 | 134.37 | 134.37 | 0.01 | 0.03 | 252.82 | 276.93 | 0.01 |

PROJECT

**MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE

# BLOCKED HEC-RAS MODEL RESULTS FOR CROSS SECTION 6

Golder Associates

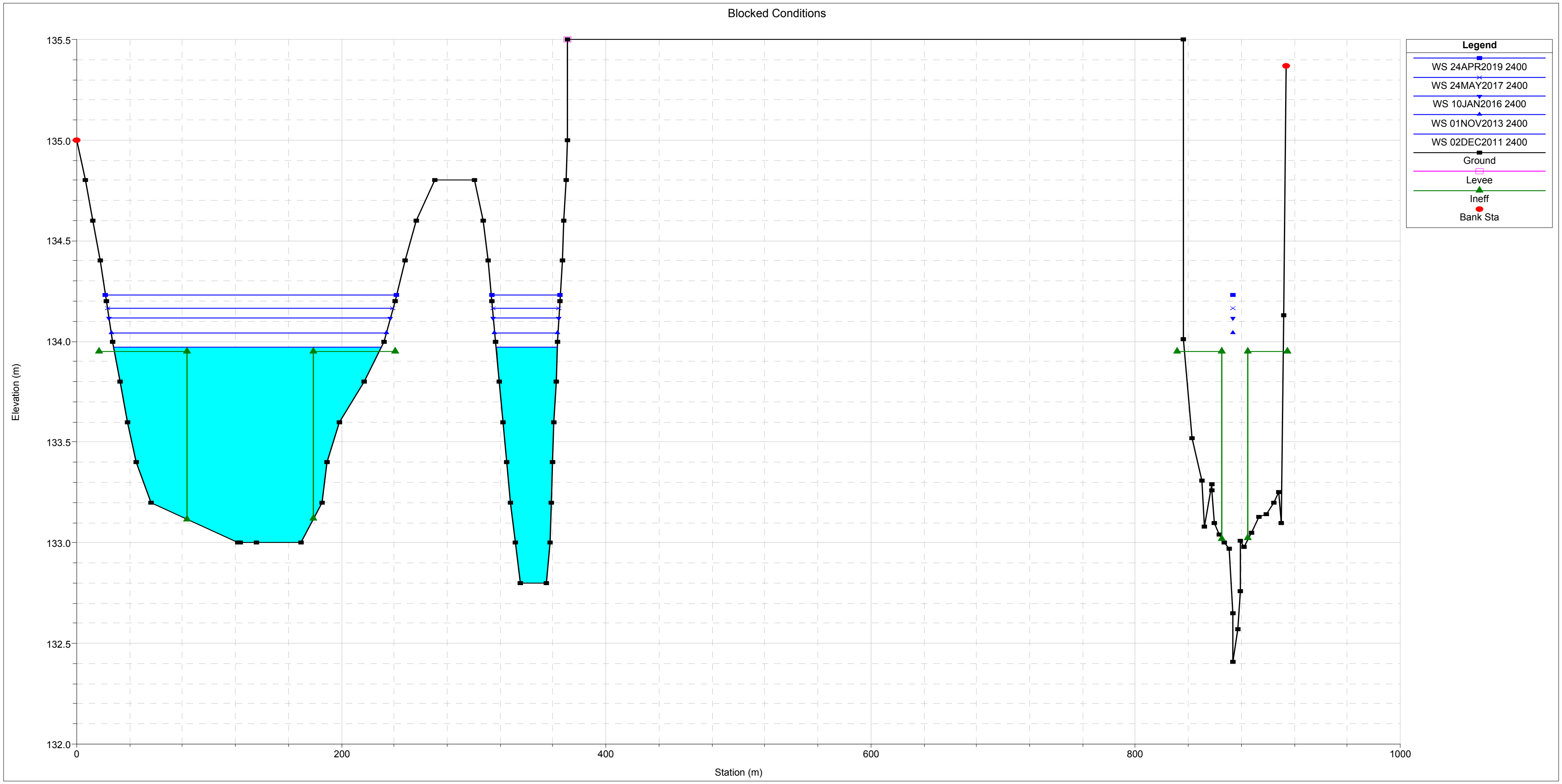
| | | | |
|---|---|---|---|
| PROJECT No. 07-1413-0047 | | PHASE / TASK No. 5300 | |
| DESIGN | -- | SCALE NTS | REV. |
| CADD | -- | **FIGURE III-2** | |
| CHECK | -- | | |
| REVIEW | | | |

REVISION DATE: BY: FILE:

REVISION DATE: BY: FILE:

# Blocked Conditions

## Water Elevations: 134.34m, 134.27m, 134.22m, 134.14m, 133.07m




| | | | | | |
|---|---|---|---|---|---|
| PROJECT | **MEADOWBANK MINING CORPORATION**<br>**MEADOWBANK GOLD PROJECT**<br>**THIRD PORTAGE LAKE OUTLETS** | | | | |
| TITLE | **Blocked Conditions**<br>**Cross Section 5 Profile** | | | | |
| Golder Associates | PROJECT No. 07-1413-0047 | | | PHASE / TASK No. 5300 | |
| | DESIGN | -- | 11DEC07 | SCALE NTS | REV. |
| | CADD | -- | | **FIGURE III-3** | |
| | CHECK | -- | | | |
| | REVIEW | | | | |

| Runoff Condition | Q Total (m3/s) | Min Ch Elevation (m) | Max Depth (m) | W.S. Elevation (m) | E.G. Elevation (m) | E.G. Slope (m/m) | Velocity Channel (m/s) | Flow Area (m2) | Top Width (m) | Froude # |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0.99 | 132.41 | 1.54 | 133.95 | 133.95 | 0.00 | 0.01 | 178.28 | 245.80 | 0.00 |
| | 1.03 | 132.41 | 1.55 | 133.96 | 133.96 | 0.00 | 0.01 | 180.83 | 247.07 | 0.00 |
| 100 yr Dry Blocked Channel | 1.09 | 132.41 | 1.56 | 133.97 | 133.97 | 0.00 | 0.01 | 183.55 | 248.42 | 0.00 |
| | 1.14 | 132.41 | 1.57 | 133.98 | 133.98 | 0.00 | 0.01 | 186.21 | 249.73 | 0.00 |
| | 1.20 | 132.41 | 1.58 | 133.99 | 133.99 | 0.00 | 0.01 | 188.88 | 251.04 | 0.00 |
| | 1.26 | 132.41 | 1.59 | 134.00 | 134.00 | 0.00 | 0.01 | 191.57 | 252.22 | 0.00 |
| | 1.32 | 132.41 | 1.60 | 134.01 | 134.01 | 0.00 | 0.01 | 194.11 | 253.09 | 0.00 |
| | 1.39 | 132.41 | 1.61 | 134.02 | 134.02 | 0.00 | 0.01 | 196.81 | 254.01 | 0.00 |
| | 1.47 | 132.41 | 1.62 | 134.03 | 134.03 | 0.00 | 0.01 | 199.37 | 254.88 | 0.00 |
| 10 Yr Dry Blocked Channel | 1.55 | 132.41 | 1.63 | 134.04 | 134.04 | 0.00 | 0.01 | 201.78 | 255.70 | 0.00 |
| | 1.66 | 132.41 | 1.64 | 134.05 | 134.05 | 0.00 | 0.01 | 204.13 | 256.49 | 0.00 |
| | 1.81 | 132.41 | 1.65 | 134.06 | 134.06 | 0.00 | 0.01 | 206.55 | 257.31 | 0.00 |
| | 2.03 | 132.41 | 1.66 | 134.07 | 134.07 | 0.00 | 0.01 | 208.83 | 258.07 | 0.00 |
| | 2.12 | 132.41 | 1.67 | 134.08 | 134.08 | 0.00 | 0.01 | 211.27 | 258.89 | 0.00 |
| | 2.23 | 132.41 | 1.68 | 134.09 | 134.09 | 0.01 | 0.01 | 213.64 | 259.68 | 0.00 |
| | 2.34 | 132.41 | 1.69 | 134.10 | 134.10 | 0.01 | 0.01 | 216.10 | 260.50 | 0.00 |
| | 2.48 | 132.41 | 1.70 | 134.11 | 134.11 | 0.01 | 0.01 | 218.49 | 261.29 | 0.00 |
| Average Blocked Channel | 2.58 | 132.41 | 1.71 | 134.12 | 134.12 | 0.01 | 0.01 | 220.80 | 262.05 | 0.00 |
| | 2.69 | 132.41 | 1.72 | 134.13 | 134.13 | 0.01 | 0.01 | 223.12 | 262.82 | 0.00 |
| | 2.80 | 132.41 | 1.73 | 134.14 | 134.14 | 0.01 | 0.01 | 225.53 | 263.61 | 0.00 |
| | 2.92 | 132.41 | 1.73 | 134.14 | 134.14 | 0.01 | 0.01 | 227.86 | 264.37 | 0.00 |
| | 3.55 | 132.41 | 1.74 | 134.15 | 134.15 | 0.01 | 0.02 | 230.28 | 265.16 | 0.01 |
| 10 Yr Wet Blocked  Channel | 3.62 | 132.41 | 1.75 | 134.16 | 134.16 | 0.01 | 0.02 | 232.63 | 265.93 | 0.01 |
| | 3.70 | 132.41 | 1.76 | 134.17 | 134.17 | 0.01 | 0.02 | 235.06 | 266.72 | 0.01 |
| | 3.78 | 132.41 | 1.77 | 134.18 | 134.18 | 0.01 | 0.02 | 237.59 | 267.54 | 0.01 |
| | 3.85 | 132.41 | 1.78 | 134.19 | 134.19 | 0.01 | 0.02 | 240.04 | 268.33 | 0.01 |
| | 3.93 | 132.41 | 1.79 | 134.20 | 134.20 | 0.01 | 0.02 | 242.58 | 269.15 | 0.01 |
| | 4.04 | 132.41 | 1.80 | 134.21 | 134.21 | 0.01 | 0.02 | 244.96 | 269.91 | 0.01 |
| | 5.07 | 132.41 | 1.81 | 134.22 | 134.22 | 0.01 | 0.02 | 247.51 | 270.72 | 0.01 |
| 100Yr Wet Blocked Channel | 5.25 | 132.41 | 1.82 | 134.23 | 134.23 | 0.01 | 0.02 | 250.07 | 271.53 | 0.01 |
| | 5.44 | 132.41 | 1.83 | 134.24 | 134.24 | 0.01 | 0.02 | 252.64 | 272.35 | 0.01 |
| | 6.26 | 132.41 | 1.84 | 134.25 | 134.25 | 0.01 | 0.02 | 255.14 | 273.13 | 0.01 |
| | 6.37 | 132.41 | 1.84 | 134.25 | 134.26 | 0.01 | 0.02 | 257.64 | 273.92 | 0.01 |

PROJECT
**MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE
# BLOCKED HEC-RAS MODEL RESULTS FOR CROSS SECTION 5

Golder Associates

PROJECT No. 07-1413-0047 | PHASE / TASK No. 5300
DESIGN -- | SCALE NTS | REV.
CADD --
CHECK --
REVIEW

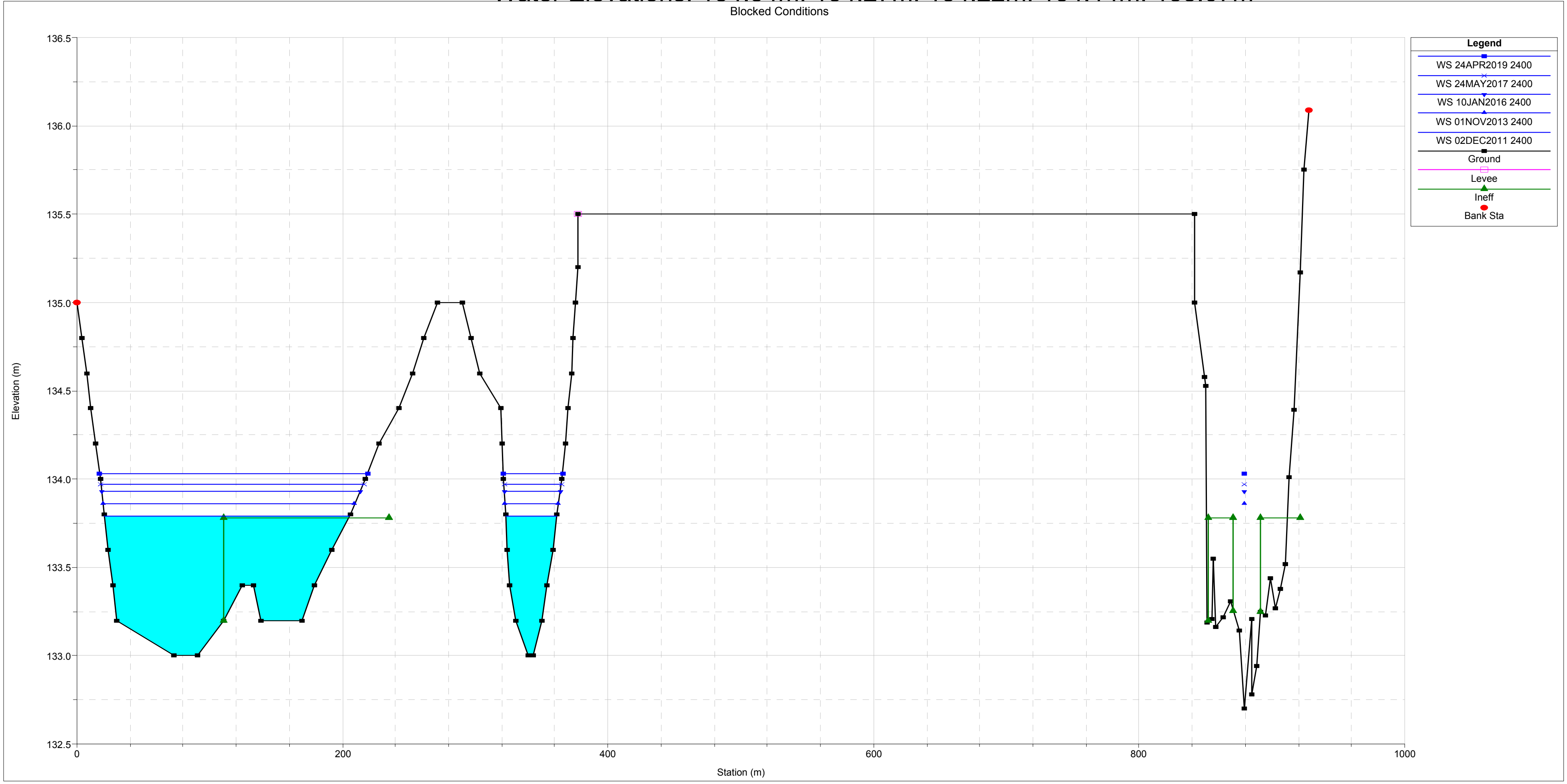
**FIGURE III-4**

REVISION DATE: BY: FILE:

REVISION DATE: BY: FILE:

# Blocked Conditions

## Water Elevations: 134.34m, 134.27m, 134.22m, 134.14m, 133.07m




| | | | | | |
|---|---|---|---|---|---|
| PROJECT | MEADOWBANK MINING CORPORATION<br>MEADOWBANK GOLD PROJECT<br>THIRD PORTAGE LAKE OUTLETS | | | | |
| TITLE | **Blocked Conditions<br>Cross Section 4 Profile** | | | | |
| Golder Associates | PROJECT No. | 07-1413-0047 | | PHASE / TASK No. 5300 | |
| | DESIGN | -- | 11DEC07 | SCALE NTS | REV. |
| | CADD | -- | | **FIGURE III-5** | |
| | CHECK | -- | | | |
| | REVIEW | | | | |

| Runoff Condition | Q Total (m3/s) | Min Ch Elevation (m) | Max Depth (m) | W.S. Elevation (m) | E.G. Elevation (m) | E.G. Slope (m/m) | Velocity Channel (m/s) | Flow Area (m2) | Top Width (m) | Froude # |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0.99 | 132.70 | 1.06 | 133.76 | 133.76 | 0.03 | 0.01 | 76.12 | 219.63 | 0.01 |
| | 1.03 | 132.70 | 1.07 | 133.77 | 133.77 | 0.03 | 0.01 | 77.75 | 221.00 | 0.01 |
| 100 yr Dry Blocked Channel | 1.09 | 132.70 | 1.09 | 133.79 | 133.79 | 0.02 | 0.01 | 119.90 | 222.40 | 0.00 |
| | 1.14 | 132.70 | 1.10 | 133.80 | 133.80 | 0.02 | 0.01 | 122.69 | 223.74 | 0.00 |
| | 1.20 | 132.70 | 1.11 | 133.81 | 133.81 | 0.02 | 0.01 | 125.42 | 224.96 | 0.00 |
| | 1.26 | 132.70 | 1.12 | 133.82 | 133.82 | 0.01 | 0.01 | 128.17 | 226.17 | 0.00 |
| | 1.32 | 132.70 | 1.13 | 133.83 | 133.83 | 0.01 | 0.01 | 130.87 | 227.35 | 0.00 |
| | 1.39 | 132.70 | 1.15 | 133.85 | 133.85 | 0.01 | 0.01 | 133.30 | 228.41 | 0.00 |
| | 1.47 | 132.70 | 1.16 | 133.86 | 133.86 | 0.01 | 0.01 | 135.53 | 229.38 | 0.00 |
| 10 Yr Dry Blocked Channel | 1.55 | 132.70 | 1.16 | 133.86 | 133.86 | 0.01 | 0.01 | 137.56 | 230.26 | 0.00 |
| | 1.66 | 132.70 | 1.17 | 133.87 | 133.87 | 0.01 | 0.01 | 139.39 | 231.05 | 0.00 |
| | 1.81 | 132.70 | 1.18 | 133.88 | 133.88 | 0.02 | 0.01 | 141.23 | 231.84 | 0.01 |
| | 2.03 | 132.70 | 1.19 | 133.89 | 133.89 | 0.02 | 0.01 | 143.00 | 232.59 | 0.01 |
| | 2.12 | 132.70 | 1.20 | 133.90 | 133.90 | 0.02 | 0.01 | 144.77 | 233.35 | 0.01 |
| | 2.23 | 132.70 | 1.20 | 133.90 | 133.90 | 0.02 | 0.02 | 146.62 | 234.14 | 0.01 |
| | 2.34 | 132.70 | 1.21 | 133.91 | 133.91 | 0.02 | 0.02 | 148.48 | 234.93 | 0.01 |
| | 2.48 | 132.70 | 1.22 | 133.92 | 133.92 | 0.02 | 0.02 | 150.42 | 235.74 | 0.01 |
| Average Blocked Channel | 2.58 | 132.70 | 1.23 | 133.93 | 133.93 | 0.02 | 0.02 | 152.22 | 236.50 | 0.01 |
| | 2.69 | 132.70 | 1.23 | 133.93 | 133.93 | 0.02 | 0.02 | 154.17 | 237.32 | 0.01 |
| | 2.80 | 132.70 | 1.24 | 133.94 | 133.94 | 0.02 | 0.02 | 156.12 | 238.14 | 0.01 |
| | 2.92 | 132.70 | 1.25 | 133.95 | 133.95 | 0.02 | 0.02 | 158.16 | 238.98 | 0.01 |
| | 3.55 | 132.70 | 1.26 | 133.96 | 133.96 | 0.02 | 0.02 | 160.13 | 239.80 | 0.01 |
| 10 Yr Wet Blocked Channel | 3.62 | 132.70 | 1.27 | 133.97 | 133.97 | 0.02 | 0.02 | 162.11 | 240.62 | 0.01 |
| | 3.70 | 132.70 | 1.28 | 133.98 | 133.98 | 0.02 | 0.02 | 164.16 | 241.47 | 0.01 |
| | 3.78 | 132.70 | 1.29 | 133.99 | 133.99 | 0.02 | 0.02 | 166.30 | 242.35 | 0.01 |
| | 3.85 | 132.70 | 1.29 | 133.99 | 133.99 | 0.02 | 0.02 | 168.45 | 243.23 | 0.01 |
| | 3.93 | 132.70 | 1.30 | 134.00 | 134.00 | 0.02 | 0.02 | 170.53 | 244.03 | 0.01 |
| | 4.04 | 132.70 | 1.31 | 134.01 | 134.01 | 0.02 | 0.02 | 172.61 | 244.77 | 0.01 |
| | 5.07 | 132.70 | 1.32 | 134.02 | 134.02 | 0.02 | 0.03 | 174.78 | 245.52 | 0.01 |
| 100Yr Wet Blocked Channel | 5.25 | 132.70 | 1.33 | 134.03 | 134.03 | 0.02 | 0.03 | 176.95 | 246.28 | 0.01 |
| | 5.44 | 132.70 | 1.34 | 134.04 | 134.04 | 0.02 | 0.03 | 179.13 | 247.03 | 0.01 |
| | 6.26 | 132.70 | 1.35 | 134.05 | 134.05 | 0.02 | 0.03 | 181.32 | 247.79 | 0.01 |
| | 6.37 | 132.70 | 1.36 | 134.06 | 134.06 | 0.02 | 0.03 | 183.51 | 248.54 | 0.01 |

PROJECT

**MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE

# BLOCKED HEC-RAS MODEL RESULTS FOR CROSS SECTION 4

Golder Associates

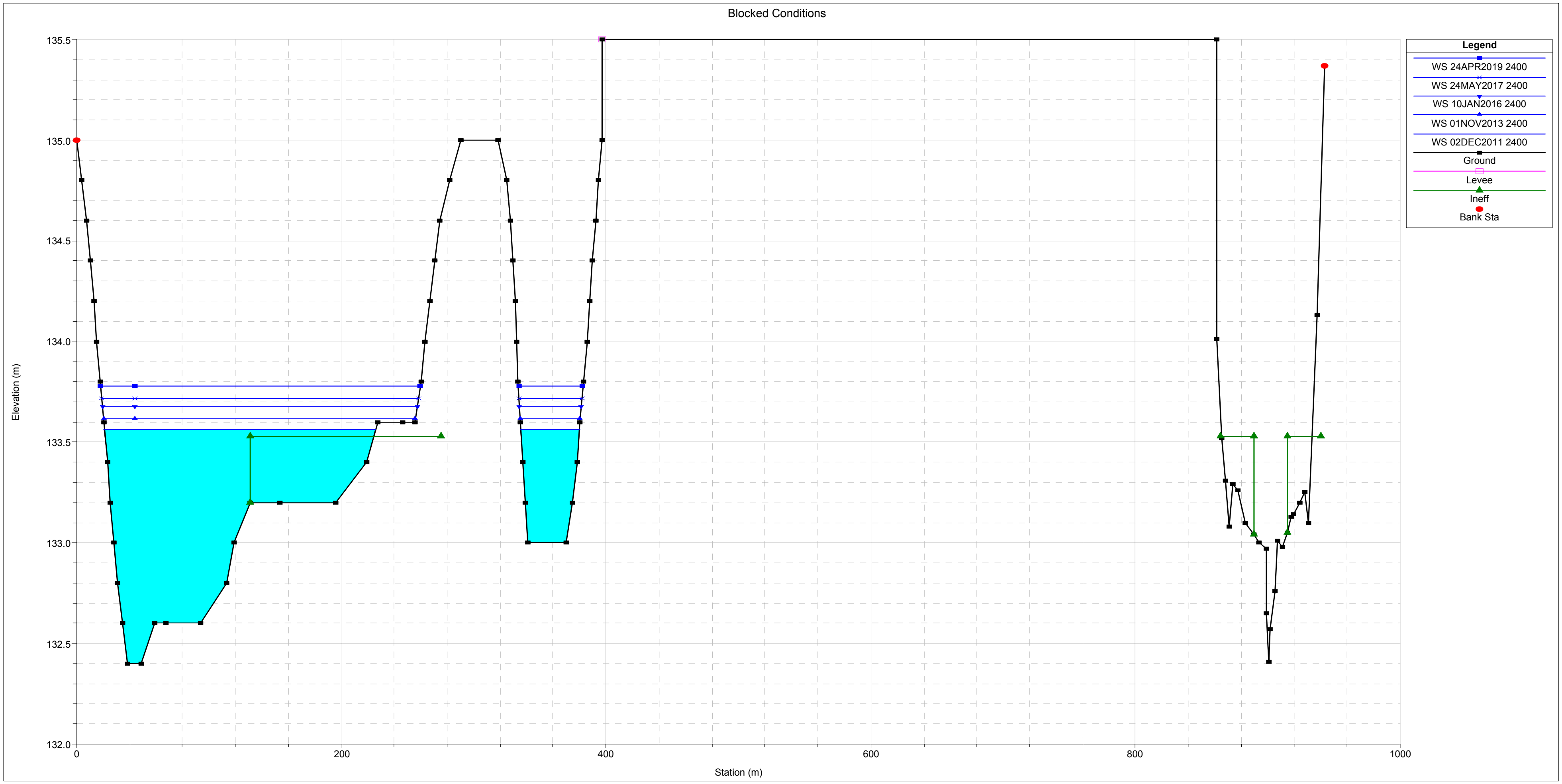
| | | | |
|---|---|---|---|
| PROJECT No. 07-1413-0047 | | PHASE / TASK No. 5300 | |
| DESIGN | -- | SCALE NTS | REV. |
| CADD | -- | **FIGURE III-6** | |
| CHECK | -- | | |
| REVIEW | | | |

REVISION DATE: BY: FILE:

REVISION DATE: BY: FILE:

# Blocked Conditions

## Water Elevations: 134.34m, 134.27m, 134.22m, 134.14m, 133.07m




PROJECT **MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE
**Blocked Conditions**
**Cross Section 3 Profile**

Golder Associates

| | | | | |
|---|---|---|---|---|
| PROJECT No. | 07-1413-0047 | PHASE / TASK No. | 5300 | |
| DESIGN | -- | 11DEC07 | SCALE NTS | REV. |
| CADD | -- | | **FIGURE III-7** | |
| CHECK | -- | | | |
| REVIEW | | | | |

| Runoff Condition | Q Total (m3/s) | Min Ch Elevation (m) | Max Depth (m) | W.S. Elevation (m) | E.G. Elevation (m) | E.G. Slope (m/m) | Velocity Channel (m/s) | Flow Area (m2) | Top Width (m) | Froude # |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0.99 | 132.40 | 1.11 | 133.51 | 133.51 | 0.01 | 0.01 | 106.64 | 244.88 | 0.00 |
| | 1.03 | 132.40 | 1.12 | 133.52 | 133.52 | 0.01 | 0.01 | 108.97 | 246.05 | 0.00 |
| 100 yr Dry Blocked Channel | 1.09 | 132.40 | 1.14 | 133.54 | 133.54 | 0.01 | 0.01 | 138.98 | 247.21 | 0.00 |
| | 1.14 | 132.40 | 1.15 | 133.55 | 133.55 | 0.01 | 0.01 | 142.61 | 248.33 | 0.00 |
| | 1.20 | 132.40 | 1.17 | 133.57 | 133.57 | 0.01 | 0.01 | 146.17 | 249.43 | 0.00 |
| | 1.26 | 132.40 | 1.18 | 133.58 | 133.58 | 0.01 | 0.01 | 149.68 | 250.50 | 0.00 |
| | 1.32 | 132.40 | 1.20 | 133.60 | 133.60 | 0.01 | 0.01 | 153.04 | 251.53 | 0.00 |
| | 1.39 | 132.40 | 1.20 | 133.60 | 133.60 | 0.01 | 0.01 | 155.64 | 280.46 | 0.00 |
| | 1.47 | 132.40 | 1.21 | 133.61 | 133.61 | 0.01 | 0.01 | 157.61 | 280.84 | 0.00 |
| 10 Yr Dry Blocked Channel | 1.55 | 132.40 | 1.22 | 133.62 | 133.62 | 0.01 | 0.01 | 159.49 | 281.20 | 0.00 |
| | 1.66 | 132.40 | 1.22 | 133.62 | 133.62 | 0.01 | 0.01 | 161.12 | 281.52 | 0.00 |
| | 1.81 | 132.40 | 1.23 | 133.63 | 133.63 | 0.01 | 0.01 | 162.84 | 281.85 | 0.00 |
| | 2.03 | 132.40 | 1.24 | 133.64 | 133.64 | 0.01 | 0.01 | 164.56 | 282.18 | 0.01 |
| | 2.12 | 132.40 | 1.24 | 133.64 | 133.64 | 0.01 | 0.01 | 166.45 | 282.54 | 0.01 |
| | 2.23 | 132.40 | 1.25 | 133.65 | 133.65 | 0.01 | 0.01 | 168.35 | 282.90 | 0.01 |
| | 2.34 | 132.40 | 1.26 | 133.66 | 133.66 | 0.01 | 0.01 | 170.33 | 283.28 | 0.01 |
| | 2.48 | 132.40 | 1.26 | 133.66 | 133.66 | 0.01 | 0.01 | 172.32 | 283.66 | 0.01 |
| Average Blocked Channel | 2.58 | 132.40 | 1.27 | 133.67 | 133.67 | 0.01 | 0.01 | 174.48 | 284.07 | 0.01 |
| | 2.69 | 132.40 | 1.28 | 133.68 | 133.68 | 0.01 | 0.02 | 176.73 | 284.50 | 0.01 |
| | 2.80 | 132.40 | 1.29 | 133.69 | 133.69 | 0.01 | 0.02 | 179.08 | 284.94 | 0.01 |
| | 2.92 | 132.40 | 1.30 | 133.70 | 133.70 | 0.01 | 0.02 | 181.42 | 285.39 | 0.01 |
| | 3.55 | 132.40 | 1.30 | 133.70 | 133.70 | 0.01 | 0.02 | 183.86 | 285.85 | 0.01 |
| 10 Yr Wet Blocked Channel | 3.62 | 132.40 | 1.31 | 133.71 | 133.71 | 0.01 | 0.02 | 186.22 | 286.29 | 0.01 |
| | 3.70 | 132.40 | 1.32 | 133.72 | 133.72 | 0.01 | 0.02 | 188.66 | 286.75 | 0.01 |
| | 3.78 | 132.40 | 1.33 | 133.73 | 133.73 | 0.01 | 0.02 | 191.20 | 287.23 | 0.01 |
| | 3.85 | 132.40 | 1.34 | 133.74 | 133.74 | 0.01 | 0.02 | 193.74 | 287.71 | 0.01 |
| | 3.93 | 132.40 | 1.35 | 133.75 | 133.75 | 0.01 | 0.02 | 196.28 | 288.18 | 0.01 |
| | 4.04 | 132.40 | 1.36 | 133.76 | 133.76 | 0.01 | 0.02 | 198.83 | 288.66 | 0.01 |
| | 5.07 | 132.40 | 1.37 | 133.77 | 133.77 | 0.01 | 0.03 | 201.39 | 289.14 | 0.01 |
| 100Yr Wet Blocked Channel | 5.25 | 132.40 | 1.37 | 133.77 | 133.77 | 0.01 | 0.03 | 203.94 | 289.62 | 0.01 |
| | 5.44 | 132.40 | 1.38 | 133.78 | 133.78 | 0.01 | 0.03 | 206.60 | 290.11 | 0.01 |
| | 6.26 | 132.40 | 1.39 | 133.79 | 133.79 | 0.01 | 0.03 | 209.25 | 290.60 | 0.01 |
| | 6.37 | 132.40 | 1.40 | 133.80 | 133.80 | 0.01 | 0.03 | 211.82 | 291.08 | 0.01 |

PROJECT

**MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE

# BLOCKED HEC-RAS MODEL RESULTS FOR CROSS SECTION 3

Golder Associates

| PROJECT No. | 07-1413-0047 | PHASE / TASK No. | 5300 |
|---|---|---|---|
| DESIGN | -- | SCALE | NTS |
| CADD | -- | REV. | |
| CHECK | -- | | |
| REVIEW | | | |

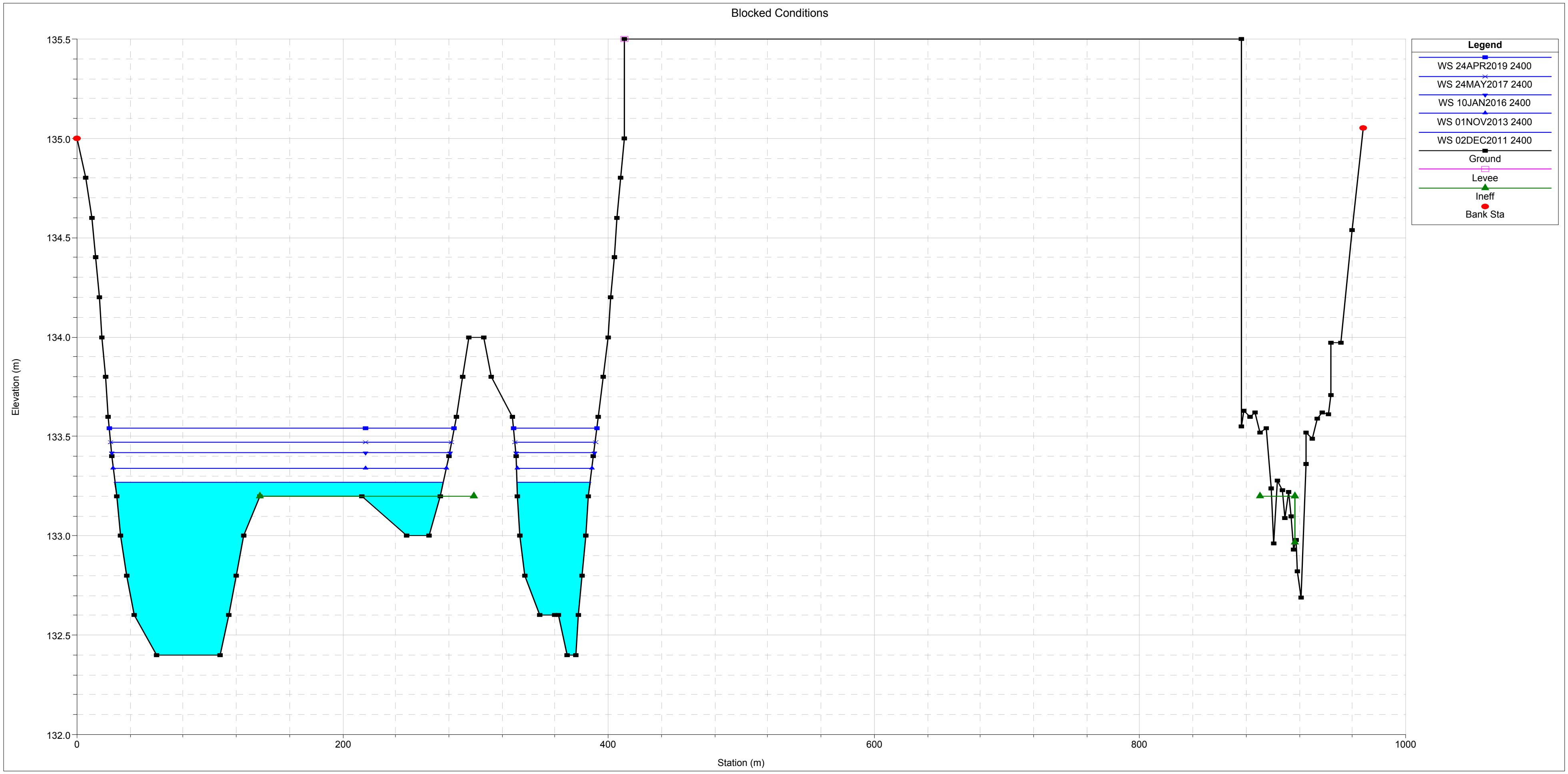
**FIGURE III-8**

REVISION DATE: BY: FILE:

REVISION DATE: BY: FILE:

# Blocked Conditions

## Water Elevations: 134.34m, 134.27m, 134.22m, 134.14m, 133.07m




| | |
|---|---|
| PROJECT | **MEADOWBANK MINING CORPORATION**<br>**MEADOWBANK GOLD PROJECT**<br>**THIRD PORTAGE LAKE OUTLETS** |
| TITLE | **Blocked Conditions**<br>**Cross Section 2 Profile** |

Golder Associates

| | | | | |
|---|---|---|---|---|
| PROJECT No. | 07-1413-0047 | | PHASE / TASK No. | 5300 |
| DESIGN | -- | 11DEC07 | SCALE NTS | REV. |
| CADD | -- | | **FIGURE III-9** | |
| CHECK | -- | | | |
| REVIEW | | | | |

| Runoff Condition | Q Total (m3/s) | Min Ch Elevation (m) | Max Depth (m) | W.S. Elevation (m) | E.G. Elevation (m) | E.G. Slope (m/m) | Velocity Channel (m/s) | Flow Area (m2) | Top Width (m) | Froude # |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0.99 | 132.40 | 1.11 | 133.51 | 133.51 | 0.01 | 0.01 | 106.64 | 244.88 | 0.00 |
| | 1.03 | 132.40 | 1.12 | 133.52 | 133.52 | 0.01 | 0.01 | 108.97 | 246.05 | 0.00 |
| 100 yr Dry Blocked Channel | 1.09 | 132.40 | 1.14 | 133.54 | 133.54 | 0.01 | 0.01 | 138.98 | 247.21 | 0.00 |
| | 1.14 | 132.40 | 1.15 | 133.55 | 133.55 | 0.01 | 0.01 | 142.61 | 248.33 | 0.00 |
| | 1.20 | 132.40 | 1.17 | 133.57 | 133.57 | 0.01 | 0.01 | 146.17 | 249.43 | 0.00 |
| | 1.26 | 132.40 | 1.18 | 133.58 | 133.58 | 0.01 | 0.01 | 149.68 | 250.50 | 0.00 |
| | 1.32 | 132.40 | 1.20 | 133.60 | 133.60 | 0.01 | 0.01 | 153.04 | 251.53 | 0.00 |
| | 1.39 | 132.40 | 1.20 | 133.60 | 133.60 | 0.01 | 0.01 | 155.64 | 280.46 | 0.00 |
| | 1.47 | 132.40 | 1.21 | 133.61 | 133.61 | 0.01 | 0.01 | 157.61 | 280.84 | 0.00 |
| 10 Yr Dry Blocked Channel | 1.55 | 132.40 | 1.22 | 133.62 | 133.62 | 0.01 | 0.01 | 159.49 | 281.20 | 0.00 |
| | 1.66 | 132.40 | 1.22 | 133.62 | 133.62 | 0.01 | 0.01 | 161.12 | 281.52 | 0.00 |
| | 1.81 | 132.40 | 1.23 | 133.63 | 133.63 | 0.01 | 0.01 | 162.84 | 281.85 | 0.00 |
| | 2.03 | 132.40 | 1.24 | 133.64 | 133.64 | 0.01 | 0.01 | 164.56 | 282.18 | 0.01 |
| | 2.12 | 132.40 | 1.24 | 133.64 | 133.64 | 0.01 | 0.01 | 166.45 | 282.54 | 0.01 |
| | 2.23 | 132.40 | 1.25 | 133.65 | 133.65 | 0.01 | 0.01 | 168.35 | 282.90 | 0.01 |
| | 2.34 | 132.40 | 1.26 | 133.66 | 133.66 | 0.01 | 0.01 | 170.33 | 283.28 | 0.01 |
| | 2.48 | 132.40 | 1.26 | 133.66 | 133.66 | 0.01 | 0.01 | 172.32 | 283.66 | 0.01 |
| Average Blocked Channel | 2.58 | 132.40 | 1.27 | 133.67 | 133.67 | 0.01 | 0.01 | 174.48 | 284.07 | 0.01 |
| | 2.69 | 132.40 | 1.28 | 133.68 | 133.68 | 0.01 | 0.02 | 176.73 | 284.50 | 0.01 |
| | 2.80 | 132.40 | 1.29 | 133.69 | 133.69 | 0.01 | 0.02 | 179.08 | 284.94 | 0.01 |
| | 2.92 | 132.40 | 1.30 | 133.70 | 133.70 | 0.01 | 0.02 | 181.42 | 285.39 | 0.01 |
| | 3.55 | 132.40 | 1.30 | 133.70 | 133.70 | 0.01 | 0.02 | 183.86 | 285.85 | 0.01 |
| 10 Yr Wet Blocked Channel | 3.62 | 132.40 | 1.31 | 133.71 | 133.71 | 0.01 | 0.02 | 186.22 | 286.29 | 0.01 |
| | 3.70 | 132.40 | 1.32 | 133.72 | 133.72 | 0.01 | 0.02 | 188.66 | 286.75 | 0.01 |
| | 3.78 | 132.40 | 1.33 | 133.73 | 133.73 | 0.01 | 0.02 | 191.20 | 287.23 | 0.01 |
| | 3.85 | 132.40 | 1.34 | 133.74 | 133.74 | 0.01 | 0.02 | 193.74 | 287.71 | 0.01 |
| | 3.93 | 132.40 | 1.35 | 133.75 | 133.75 | 0.01 | 0.02 | 196.28 | 288.18 | 0.01 |
| | 4.04 | 132.40 | 1.36 | 133.76 | 133.76 | 0.01 | 0.02 | 198.83 | 288.66 | 0.01 |
| | 5.07 | 132.40 | 1.37 | 133.77 | 133.77 | 0.01 | 0.03 | 201.39 | 289.14 | 0.01 |
| 100Yr Wet Blocked Channel | 5.25 | 132.40 | 1.37 | 133.77 | 133.77 | 0.01 | 0.03 | 203.94 | 289.62 | 0.01 |
| | 5.44 | 132.40 | 1.38 | 133.78 | 133.78 | 0.01 | 0.03 | 206.60 | 290.11 | 0.01 |
| | 6.26 | 132.40 | 1.39 | 133.79 | 133.79 | 0.01 | 0.03 | 209.25 | 290.60 | 0.01 |
| | 6.37 | 132.40 | 1.40 | 133.80 | 133.80 | 0.01 | 0.03 | 211.82 | 291.08 | 0.01 |

PROJECT
MEADOWBANK MINING CORPORATION
MEADOWBANK GOLD PROJECT
THIRD PORTAGE LAKE OUTLETS

TITLE
# BLOCKED HEC-RAS MODEL RESULTS FOR CROSS SECTION 2

Golder Associates

PROJECT No. 07-1413-0047 | PHASE / TASK No. 5300
DESIGN -- | SCALE NTS | REV.
CADD --
CHECK --
REVIEW

FIGURE III-10

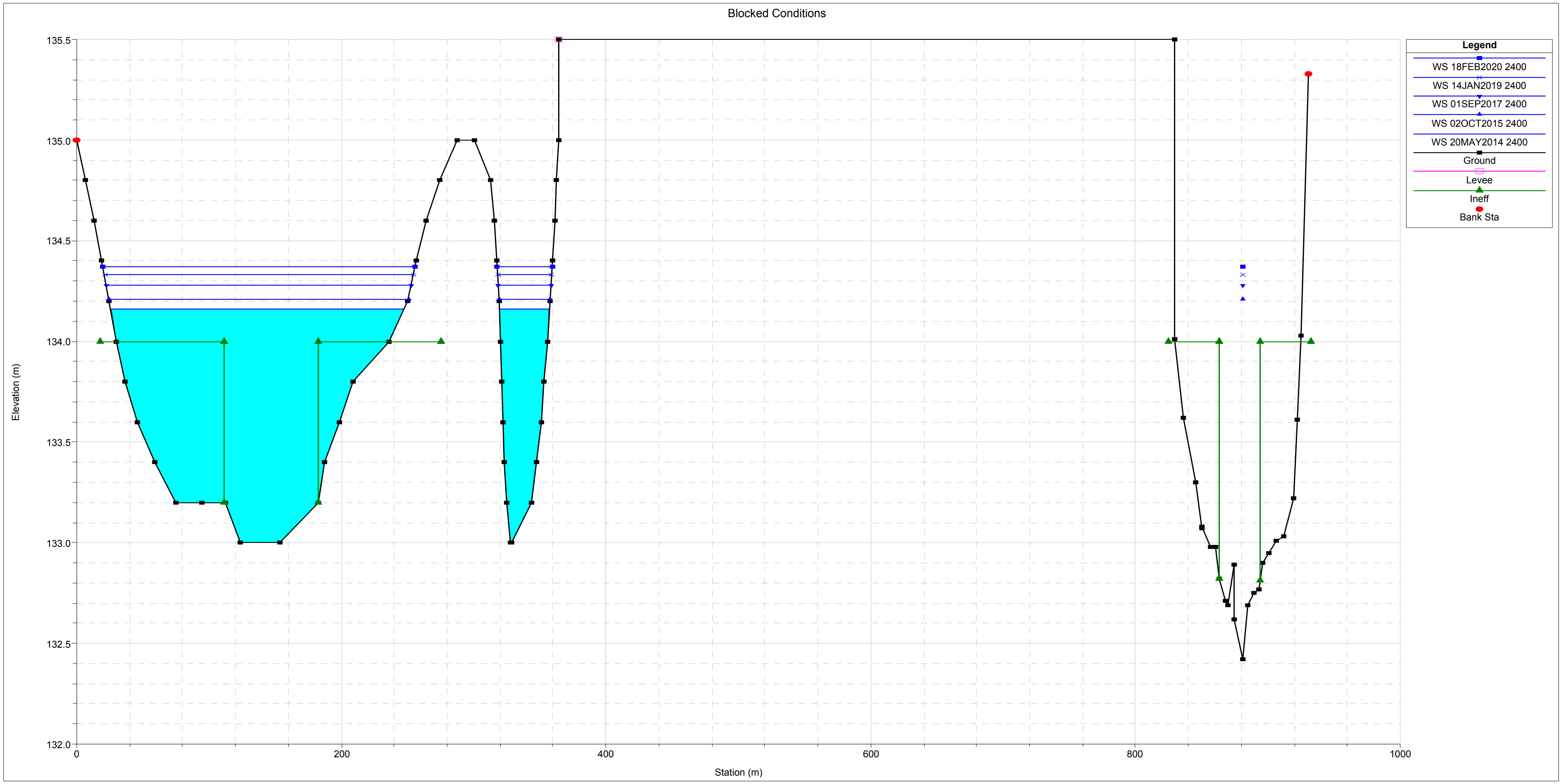
REVISION DATE: BY: FILE:

# APPENDIX IV

## HEC-RAS MODEL RESULTS
## BLOCKED WESTERNMOST CHANNEL WITH DEWATERING

REVISION DATE: BY: FILE:

# Blocked Conditions With Dewatering
## Water Elevations: 134.37m, 134.33m, 134.28m, 134.21m, 133.16m




| | |
|---|---|
| PROJECT | **MEADOWBANK MINING CORPORATION**<br>**MEADOWBANK GOLD PROJECT**<br>**THIRD PORTAGE LAKE OUTLETS** |
| TITLE | **Blocked Conditions With Dewatering**<br>**Cross Section 6 Profile** |

Golder Associates

| | | | | |
|---|---|---|---|---|
| PROJECT No. | 07-1413-0047 | | PHASE / TASK No. | 5300 |
| DESIGN | -- | 11DEC07 | SCALE NTS | REV. |
| CADD | -- | | **FIGURE IV-1** | |
| CHECK | -- | | | |
| REVIEW | | | | |

| Runoff Condition | Q Total (m3/s) | Min Ch Elevation (m) | Max Depth (m) | W.S. Elevation (m) | E.G. Elevation (m) | E.G. Slope (m/m) | Velocity Channel (m/s) | Flow Area (m2) | Top Width (m) | Froude # |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1.14 | 132.42 | 1.66 | 134.08 | 134.08 | 0.0053 | 0.01 | 176.09 | 250.15 | 0.00 |
| | 1.20 | 132.42 | 1.67 | 134.09 | 134.09 | 0.0054 | 0.01 | 178.61 | 251.27 | 0.00 |
| | 1.26 | 132.42 | 1.68 | 134.10 | 134.10 | 0.0055 | 0.01 | 181.14 | 252.40 | 0.00 |
| | 1.32 | 132.42 | 1.69 | 134.11 | 134.11 | 0.0055 | 0.01 | 183.61 | 253.49 | 0.00 |
| | 1.39 | 132.42 | 1.70 | 134.12 | 134.12 | 0.0056 | 0.01 | 186.16 | 254.62 | 0.00 |
| | 1.47 | 132.42 | 1.71 | 134.13 | 134.13 | 0.0057 | 0.01 | 188.73 | 255.75 | 0.00 |
| | 1.55 | 132.42 | 1.72 | 134.14 | 134.14 | 0.0057 | 0.01 | 191.31 | 256.87 | 0.00 |
| | 1.66 | 132.42 | 1.73 | 134.15 | 134.15 | 0.0058 | 0.01 | 193.90 | 258.00 | 0.00 |
| 100 yr Dry Blocked Channel | 1.81 | 132.42 | 1.74 | 134.16 | 134.16 | 0.0058 | 0.01 | 196.50 | 259.13 | 0.00 |
| | 2.03 | 132.42 | 1.75 | 134.17 | 134.17 | 0.0058 | 0.01 | 199.03 | 260.22 | 0.00 |
| | 2.12 | 132.42 | 1.76 | 134.18 | 134.18 | 0.0059 | 0.01 | 201.65 | 261.35 | 0.00 |
| | 2.23 | 132.42 | 1.77 | 134.19 | 134.19 | 0.0059 | 0.01 | 204.29 | 262.47 | 0.00 |
| | 2.34 | 132.42 | 1.78 | 134.20 | 134.20 | 0.0059 | 0.01 | 206.94 | 263.60 | 0.00 |
| 10 Yr Dry  Blocked Channel | 2.48 | 132.42 | 1.79 | 134.21 | 134.21 | 0.0059 | 0.01 | 209.59 | 264.39 | 0.00 |
| | 2.58 | 132.42 | 1.80 | 134.22 | 134.22 | 0.0060 | 0.01 | 212.17 | 265.16 | 0.00 |
| | 2.69 | 132.42 | 1.81 | 134.23 | 134.23 | 0.0060 | 0.01 | 214.84 | 265.95 | 0.00 |
| | 2.80 | 132.42 | 1.82 | 134.24 | 134.24 | 0.0061 | 0.01 | 217.52 | 266.74 | 0.00 |
| | 2.92 | 132.42 | 1.83 | 134.25 | 134.25 | 0.0061 | 0.01 | 220.21 | 267.52 | 0.00 |
| | 3.55 | 132.42 | 1.84 | 134.26 | 134.26 | 0.0061 | 0.02 | 222.90 | 268.31 | 0.01 |
| | 3.62 | 132.42 | 1.85 | 134.27 | 134.27 | 0.0062 | 0.02 | 225.53 | 269.08 | 0.01 |
| Average Blocked Channel | 3.70 | 132.42 | 1.86 | 134.28 | 134.28 | 0.0062 | 0.02 | 228.24 | 269.87 | 0.01 |
| | 3.78 | 132.42 | 1.87 | 134.29 | 134.29 | 0.0063 | 0.02 | 230.96 | 270.66 | 0.01 |
| | 3.85 | 132.42 | 1.88 | 134.30 | 134.30 | 0.0063 | 0.02 | 233.68 | 271.45 | 0.01 |
| | 3.93 | 132.42 | 1.89 | 134.31 | 134.31 | 0.0063 | 0.02 | 236.41 | 272.24 | 0.01 |
| | 4.04 | 132.42 | 1.90 | 134.32 | 134.32 | 0.0064 | 0.02 | 239.07 | 273.01 | 0.01 |
| 10 Yr Wet Blocked Channel | 5.07 | 132.42 | 1.91 | 134.33 | 134.33 | 0.0064 | 0.02 | 241.82 | 273.80 | 0.01 |
| | 5.25 | 132.42 | 1.92 | 134.34 | 134.34 | 0.0064 | 0.02 | 244.58 | 274.58 | 0.01 |
| | 5.44 | 132.42 | 1.93 | 134.35 | 134.35 | 0.0064 | 0.02 | 247.35 | 275.37 | 0.01 |
| | 6.26 | 132.42 | 1.94 | 134.36 | 134.36 | 0.0064 | 0.03 | 250.12 | 276.16 | 0.01 |
| 100Yr Wet Blocked Channel | 6.37 | 132.42 | 1.95 | 134.37 | 134.37 | 0.0065 | 0.03 | 252.82 | 276.93 | 0.01 |
| | 6.49 | 132.42 | 1.96 | 134.38 | 134.38 | 0.0065 | 0.03 | 255.61 | 277.72 | 0.01 |
| | 6.84 | 132.42 | 1.97 | 134.39 | 134.39 | 0.0065 | 0.03 | 258.40 | 278.51 | 0.01 |

PROJECT

**MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE

# BLOCKED WITH DEWATERING HEC-RAS MODEL RESULTS FOR CROSS SECTION 6

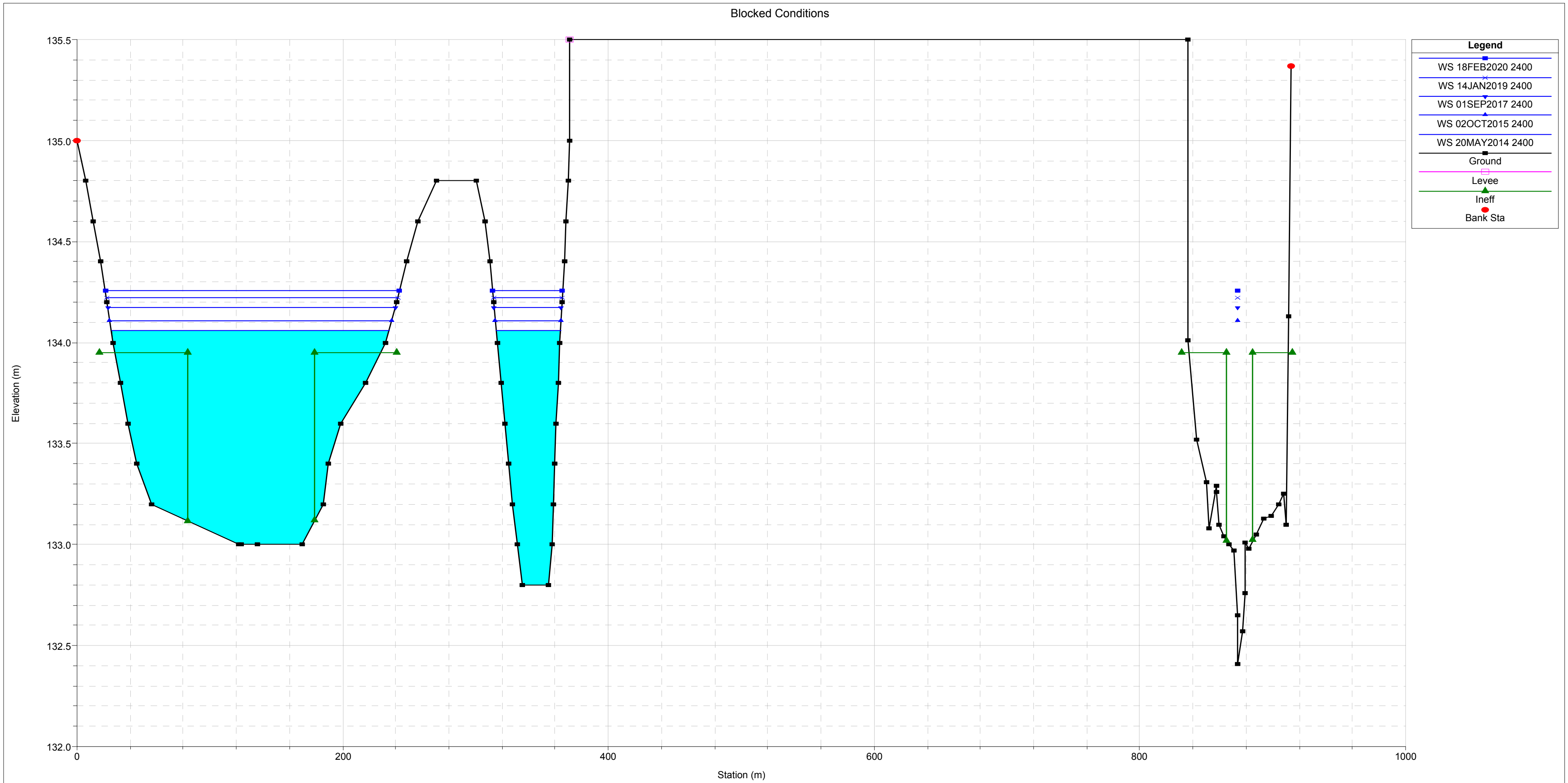
Golder Associates

| | | | |
|---|---|---|---|
| PROJECT No. 07-1413-0047 | | PHASE / TASK No. 5300 | |
| DESIGN | -- | SCALE NTS | REV. |
| CADD | -- | **FIGURE IV-2** | |
| CHECK | -- | | |
| REVIEW | | | |

REVISION DATE: BY: FILE:

REVISION DATE: BY: FILE:

# Blocked Conditions With Dewatering
## Water Elevations: 134.37m, 134.33m, 134.28m, 134.21m, 133.16m




| | |
|---|---|
| PROJECT | **MEADOWBANK MINING CORPORATION**<br>**MEADOWBANK GOLD PROJECT**<br>**THIRD PORTAGE LAKE OUTLETS** |
| TITLE | **Blocked Conditions With Dewatering**<br>**Cross Section 5 Profile** |

Golder Associates

| | | | | |
|---|---|---|---|---|
| PROJECT No. | 07-1413-0047 | | PHASE / TASK No. | 5300 |
| DESIGN | -- | 11DEC07 | SCALE NTS | REV. |
| CADD | -- | | **FIGURE IV-3** | |
| CHECK | -- | | | |
| REVIEW | | | | |

| Runoff Condition | Q Total (m3/s) | Min Ch Elevation (m) | Max Depth (m) | W.S. Elevation (m) | E.G. Elevation (m) | E.G. Slope (m/m) | Velocity Channel (m/s) | Flow Area (m2) | Top Width (m) | Froude # |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1.14 | 132.41 | 1.57 | 133.98 | 133.98 | 0.0044 | 0.01 | 186.21 | 249.73 | 0.00 |
| | 1.20 | 132.41 | 1.58 | 133.99 | 133.99 | 0.0045 | 0.01 | 188.88 | 251.04 | 0.00 |
| | 1.26 | 132.41 | 1.59 | 134.00 | 134.00 | 0.0045 | 0.01 | 191.57 | 252.22 | 0.00 |
| | 1.32 | 132.41 | 1.60 | 134.01 | 134.01 | 0.0046 | 0.01 | 194.11 | 253.09 | 0.00 |
| | 1.39 | 132.41 | 1.61 | 134.02 | 134.02 | 0.0046 | 0.01 | 196.81 | 254.01 | 0.00 |
| | 1.47 | 132.41 | 1.62 | 134.03 | 134.03 | 0.0047 | 0.01 | 199.37 | 254.88 | 0.00 |
| | 1.55 | 132.41 | 1.63 | 134.04 | 134.04 | 0.0048 | 0.01 | 201.78 | 255.70 | 0.00 |
| | 1.66 | 132.41 | 1.64 | 134.05 | 134.05 | 0.0048 | 0.01 | 204.13 | 256.49 | 0.00 |
| 100 yr Dry Blocked Channel | 1.81 | 132.41 | 1.65 | 134.06 | 134.06 | 0.0049 | 0.01 | 206.55 | 257.31 | 0.00 |
| | 2.03 | 132.41 | 1.66 | 134.07 | 134.07 | 0.0049 | 0.01 | 208.83 | 258.07 | 0.00 |
| | 2.12 | 132.41 | 1.67 | 134.08 | 134.08 | 0.0050 | 0.01 | 211.27 | 258.89 | 0.00 |
| | 2.23 | 132.41 | 1.68 | 134.09 | 134.09 | 0.0050 | 0.01 | 213.64 | 259.68 | 0.00 |
| | 2.34 | 132.41 | 1.69 | 134.10 | 134.10 | 0.0051 | 0.01 | 216.10 | 260.50 | 0.00 |
| 10 Yr Dry Blocked Channel | 2.48 | 132.41 | 1.70 | 134.11 | 134.11 | 0.0051 | 0.01 | 218.49 | 261.29 | 0.00 |
| | 2.58 | 132.41 | 1.71 | 134.12 | 134.12 | 0.0052 | 0.01 | 220.80 | 262.05 | 0.00 |
| | 2.69 | 132.41 | 1.72 | 134.13 | 134.13 | 0.0052 | 0.01 | 223.12 | 262.82 | 0.00 |
| | 2.80 | 132.41 | 1.73 | 134.14 | 134.14 | 0.0053 | 0.01 | 225.53 | 263.61 | 0.00 |
| | 2.92 | 132.41 | 1.73 | 134.14 | 134.14 | 0.0054 | 0.01 | 227.86 | 264.37 | 0.00 |
| | 3.55 | 132.41 | 1.74 | 134.15 | 134.15 | 0.0054 | 0.02 | 230.28 | 265.16 | 0.01 |
| | 3.62 | 132.41 | 1.75 | 134.16 | 134.16 | 0.0055 | 0.02 | 232.63 | 265.93 | 0.01 |
| Average Blocked Channel | 3.70 | 132.41 | 1.76 | 134.17 | 134.17 | 0.0056 | 0.02 | 235.06 | 266.72 | 0.01 |
| | 3.78 | 132.41 | 1.77 | 134.18 | 134.18 | 0.0056 | 0.02 | 237.59 | 267.54 | 0.01 |
| | 3.85 | 132.41 | 1.78 | 134.19 | 134.19 | 0.0057 | 0.02 | 240.04 | 268.33 | 0.01 |
| | 3.93 | 132.41 | 1.79 | 134.20 | 134.20 | 0.0057 | 0.02 | 242.58 | 269.15 | 0.01 |
| | 4.04 | 132.41 | 1.80 | 134.21 | 134.21 | 0.0058 | 0.02 | 244.96 | 269.91 | 0.01 |
| 10 Yr Wet Blocked Channel | 5.07 | 132.41 | 1.81 | 134.22 | 134.22 | 0.0058 | 0.02 | 247.51 | 270.72 | 0.01 |
| | 5.25 | 132.41 | 1.82 | 134.23 | 134.23 | 0.0059 | 0.02 | 250.07 | 271.53 | 0.01 |
| | 5.44 | 132.41 | 1.83 | 134.24 | 134.24 | 0.0059 | 0.02 | 252.64 | 272.35 | 0.01 |
| | 6.26 | 132.41 | 1.84 | 134.25 | 134.25 | 0.0059 | 0.02 | 255.14 | 273.13 | 0.01 |
| 100Yr Wet Blocked Channel | 6.37 | 132.41 | 1.84 | 134.25 | 134.26 | 0.0060 | 0.02 | 257.64 | 273.92 | 0.01 |
| | 6.49 | 132.41 | 1.85 | 134.26 | 134.26 | 0.0060 | 0.02 | 260.23 | 274.73 | 0.01 |
| | 6.84 | 132.41 | 1.86 | 134.27 | 134.27 | 0.0061 | 0.03 | 262.83 | 275.55 | 0.01 |

PROJECT
**MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE

# BLOCKED WITH DEWATERING HEC-RAS MODEL RESULTS FOR CROSS SECTION 5

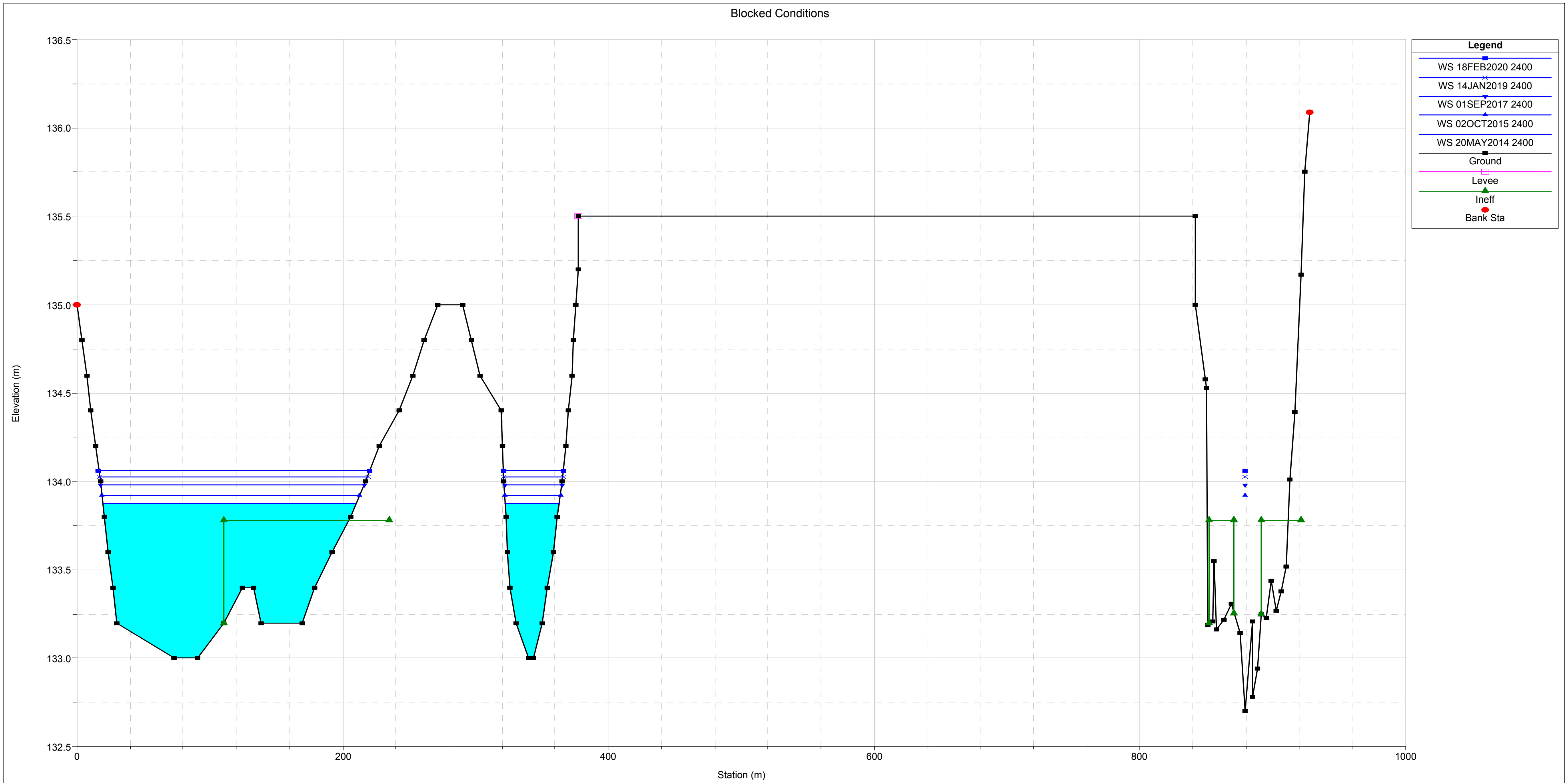
Golder Associates

| | | | |
|---|---|---|---|
| PROJECT No. 07-1413-0047 | | PHASE / TASK No. 5300 | |
| DESIGN | -- | SCALE NTS | REV. |
| CADD | -- | **FIGURE IV-4** | |
| CHECK | -- | | |
| REVIEW | | | |

REVISION DATE: BY: FILE:

REVISION DATE: BY: FILE:

# Blocked Conditions With Dewatering
## Water Elevations: 134.37m, 134.33m, 134.28m, 134.21m, 133.16m




| | |
|---|---|
| PROJECT | **MEADOWBANK MINING CORPORATION**<br>**MEADOWBANK GOLD PROJECT**<br>**THIRD PORTAGE LAKE OUTLETS** |
| TITLE | **Blocked Conditions With Dewatering**<br>**Cross Section 4 Profile** |

Golder Associates

| | | | | |
|---|---|---|---|---|
| PROJECT No. | 07-1413-0047 | | PHASE / TASK No. | 5300 |
| DESIGN | -- | 11DEC07 | SCALE NTS | REV. |
| CADD | -- | | **FIGURE IV-5** | |
| CHECK | -- | | | |
| REVIEW | | | | |

| Runoff Condition | Q Total (m3/s) | Min Ch Elevation (m) | Max Depth (m) | W.S. Elevation (m) | E.G. Elevation (m) | E.G. Slope (m/m) | Velocity Channel (m/s) | Flow Area (m2) | Top Width (m) | Froude # |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1.14 | 132.70 | 1.10 | 133.80 | 133.80 | 0.0152 | 0.01 | 122.69 | 223.74 | 0.00 |
| | 1.20 | 132.70 | 1.11 | 133.81 | 133.81 | 0.0151 | 0.01 | 125.42 | 224.96 | 0.00 |
| | 1.26 | 132.70 | 1.12 | 133.82 | 133.82 | 0.0150 | 0.01 | 128.17 | 226.17 | 0.00 |
| | 1.32 | 132.70 | 1.13 | 133.83 | 133.83 | 0.0148 | 0.01 | 130.87 | 227.35 | 0.00 |
| | 1.39 | 132.70 | 1.15 | 133.85 | 133.85 | 0.0148 | 0.01 | 133.30 | 228.41 | 0.00 |
| | 1.47 | 132.70 | 1.16 | 133.86 | 133.86 | 0.0148 | 0.01 | 135.53 | 229.38 | 0.00 |
| | 1.55 | 132.70 | 1.16 | 133.86 | 133.86 | 0.0148 | 0.01 | 137.56 | 230.26 | 0.00 |
| | 1.66 | 132.70 | 1.17 | 133.87 | 133.87 | 0.0149 | 0.01 | 139.39 | 231.05 | 0.00 |
| 100 yr Dry Blocked Channel | 1.81 | 132.70 | 1.18 | 133.88 | 133.88 | 0.0150 | 0.01 | 141.23 | 231.84 | 0.01 |
| | 2.03 | 132.70 | 1.19 | 133.89 | 133.89 | 0.0151 | 0.01 | 143.00 | 232.59 | 0.01 |
| | 2.12 | 132.70 | 1.20 | 133.90 | 133.90 | 0.0152 | 0.01 | 144.77 | 233.35 | 0.01 |
| | 2.23 | 132.70 | 1.20 | 133.90 | 133.90 | 0.0153 | 0.02 | 146.62 | 234.14 | 0.01 |
| | 2.34 | 132.70 | 1.21 | 133.91 | 133.91 | 0.0154 | 0.02 | 148.48 | 234.93 | 0.01 |
| 10 Yr Dry Blocked Channel | 2.48 | 132.70 | 1.22 | 133.92 | 133.92 | 0.0154 | 0.02 | 150.42 | 235.74 | 0.01 |
| | 2.58 | 132.70 | 1.23 | 133.93 | 133.93 | 0.0155 | 0.02 | 152.22 | 236.50 | 0.01 |
| | 2.69 | 132.70 | 1.23 | 133.93 | 133.93 | 0.0157 | 0.02 | 154.17 | 237.32 | 0.01 |
| | 2.80 | 132.70 | 1.24 | 133.94 | 133.94 | 0.0158 | 0.02 | 156.12 | 238.14 | 0.01 |
| | 2.92 | 132.70 | 1.25 | 133.95 | 133.95 | 0.0158 | 0.02 | 158.16 | 238.98 | 0.01 |
| | 3.55 | 132.70 | 1.26 | 133.96 | 133.96 | 0.0159 | 0.02 | 160.13 | 239.80 | 0.01 |
| | 3.62 | 132.70 | 1.27 | 133.97 | 133.97 | 0.0160 | 0.02 | 162.11 | 240.62 | 0.01 |
| Average Blocked Channel | 3.70 | 132.70 | 1.28 | 133.98 | 133.98 | 0.0161 | 0.02 | 164.16 | 241.47 | 0.01 |
| | 3.78 | 132.70 | 1.29 | 133.99 | 133.99 | 0.0161 | 0.02 | 166.30 | 242.35 | 0.01 |
| | 3.85 | 132.70 | 1.29 | 133.99 | 133.99 | 0.0162 | 0.02 | 168.45 | 243.23 | 0.01 |
| | 3.93 | 132.70 | 1.30 | 134.00 | 134.00 | 0.0162 | 0.02 | 170.53 | 244.03 | 0.01 |
| | 4.04 | 132.70 | 1.31 | 134.01 | 134.01 | 0.0163 | 0.02 | 172.61 | 244.77 | 0.01 |
| 10 Yr Wet Blocked Channel | 5.07 | 132.70 | 1.32 | 134.02 | 134.02 | 0.0163 | 0.03 | 174.78 | 245.52 | 0.01 |
| | 5.25 | 132.70 | 1.33 | 134.03 | 134.03 | 0.0163 | 0.03 | 176.95 | 246.28 | 0.01 |
| | 5.44 | 132.70 | 1.34 | 134.04 | 134.04 | 0.0163 | 0.03 | 179.13 | 247.03 | 0.01 |
| | 6.26 | 132.70 | 1.35 | 134.05 | 134.05 | 0.0163 | 0.03 | 181.32 | 247.79 | 0.01 |
| 100Yr Wet Blocked Channel | 6.37 | 132.70 | 1.36 | 134.06 | 134.06 | 0.0163 | 0.03 | 183.51 | 248.54 | 0.01 |
| | 6.49 | 132.70 | 1.36 | 134.06 | 134.06 | 0.0163 | 0.03 | 185.79 | 249.33 | 0.01 |
| | 6.84 | 132.70 | 1.37 | 134.07 | 134.07 | 0.0163 | 0.04 | 188.07 | 250.11 | 0.01 |

PROJECT
**MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE
# BLOCKED WITH DEWATERING HEC-RAS MODEL RESULTS FOR CROSS SECTION 4

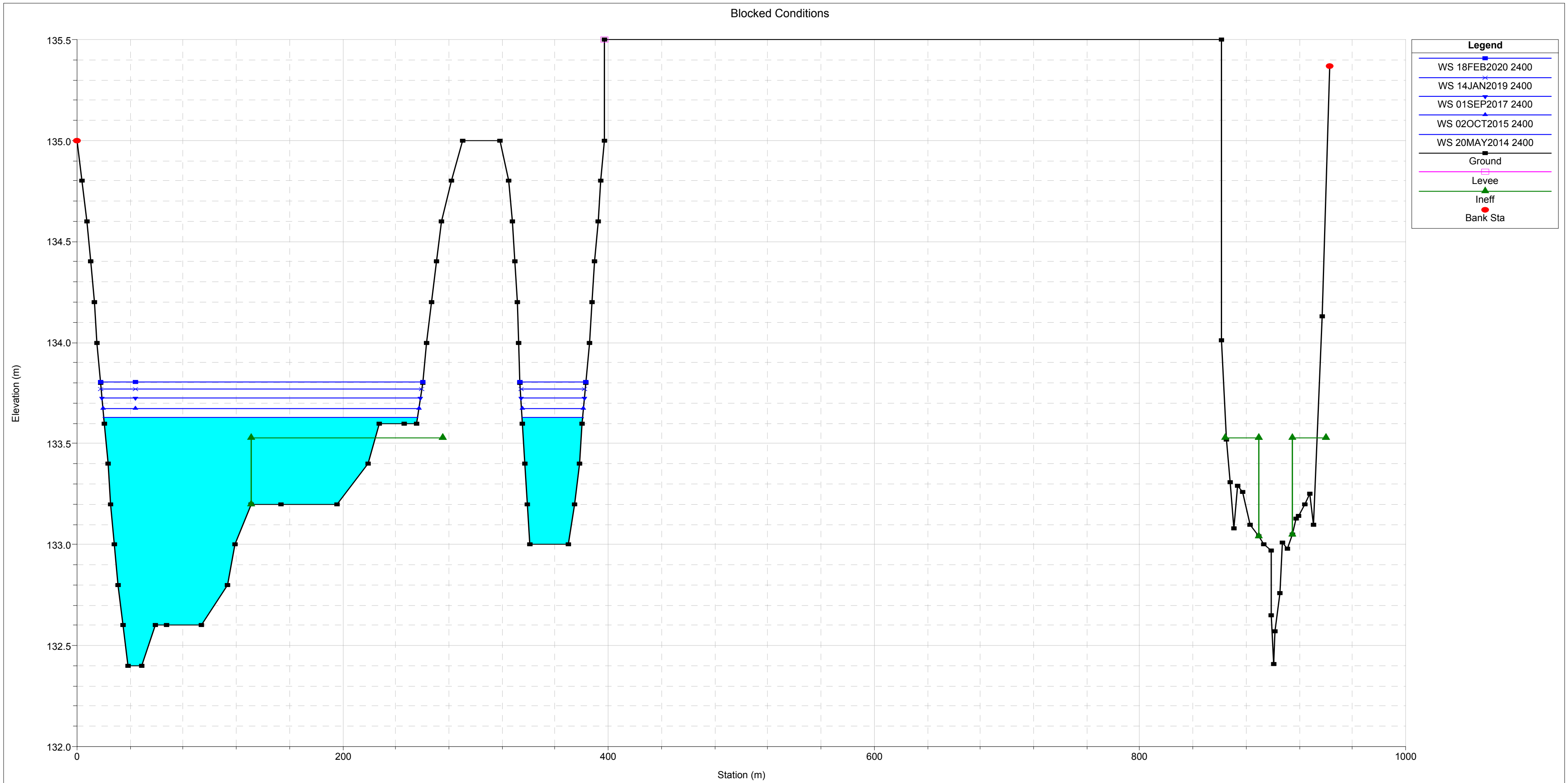
Golder Associates

| | | | |
|---|---|---|---|
| PROJECT No. 07-1413-0047 | | PHASE / TASK No. 5300 | |
| DESIGN | -- | SCALE NTS | REV. |
| CADD | -- | **FIGURE IV-6** | |
| CHECK | -- | | |
| REVIEW | | | |

REVISION DATE: BY: FILE:

REVISION DATE: BY: FILE:

# Blocked Conditions With Dewatering
## Water Elevations: 134.37m, 134.33m, 134.28m, 134.21m, 133.16m




| | |
|---|---|
| PROJECT | MEADOWBANK MINING CORPORATION<br>MEADOWBANK GOLD PROJECT<br>THIRD PORTAGE LAKE OUTLETS |
| TITLE | Blocked Conditions With Dewatering<br>Cross Section 3 Profile |

Golder Associates

| | | | | |
|---|---|---|---|---|
| PROJECT No. | 07-1413-0047 | | PHASE / TASK No. | 5300 |
| DESIGN | -- | 11DEC07 | SCALE NTS | REV. |
| CADD | -- | | FIGURE IV-7 | |
| CHECK | -- | | | |
| REVIEW | | | | |

| Runoff Condition | Q Total (m3/s) | Min Ch Elevation (m) | Max Depth (m) | W.S. Elevation (m) | E.G. Elevation (m) | E.G. Slope (m/m) | Velocity Channel (m/s) | Flow Area (m2) | Top Width (m) | Froude # |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1.14 | 132.40 | 1.15 | 133.55 | 133.55 | 0.0106 | 0.01 | 142.61 | 248.33 | 0.00 |
| | 1.20 | 132.40 | 1.17 | 133.57 | 133.57 | 0.0104 | 0.01 | 146.17 | 249.43 | 0.00 |
| | 1.26 | 132.40 | 1.18 | 133.58 | 133.58 | 0.0102 | 0.01 | 149.68 | 250.50 | 0.00 |
| | 1.32 | 132.40 | 1.20 | 133.60 | 133.60 | 0.0101 | 0.01 | 153.04 | 251.53 | 0.00 |
| | 1.39 | 132.40 | 1.20 | 133.60 | 133.60 | 0.0116 | 0.01 | 155.64 | 280.46 | 0.00 |
| | 1.47 | 132.40 | 1.21 | 133.61 | 133.61 | 0.0117 | 0.01 | 157.61 | 280.84 | 0.00 |
| | 1.55 | 132.40 | 1.22 | 133.62 | 133.62 | 0.0118 | 0.01 | 159.49 | 281.20 | 0.00 |
| | 1.66 | 132.40 | 1.22 | 133.62 | 133.62 | 0.0120 | 0.01 | 161.12 | 281.52 | 0.00 |
| 100 yr Dry Blocked Channel | 1.81 | 132.40 | 1.23 | 133.63 | 133.63 | 0.0121 | 0.01 | 162.84 | 281.85 | 0.00 |
| | 2.03 | 132.40 | 1.24 | 133.64 | 133.64 | 0.0122 | 0.01 | 164.56 | 282.18 | 0.01 |
| | 2.12 | 132.40 | 1.24 | 133.64 | 133.64 | 0.0123 | 0.01 | 166.45 | 282.54 | 0.01 |
| | 2.23 | 132.40 | 1.25 | 133.65 | 133.65 | 0.0124 | 0.01 | 168.35 | 282.90 | 0.01 |
| | 2.34 | 132.40 | 1.26 | 133.66 | 133.66 | 0.0125 | 0.01 | 170.33 | 283.28 | 0.01 |
| 10 Yr Dry Blocked Channel | 2.48 | 132.40 | 1.26 | 133.66 | 133.66 | 0.0125 | 0.01 | 172.32 | 283.66 | 0.01 |
| | 2.58 | 132.40 | 1.27 | 133.67 | 133.67 | 0.0126 | 0.01 | 174.48 | 284.07 | 0.01 |
| | 2.69 | 132.40 | 1.28 | 133.68 | 133.68 | 0.0126 | 0.02 | 176.73 | 284.50 | 0.01 |
| | 2.80 | 132.40 | 1.29 | 133.69 | 133.69 | 0.0127 | 0.02 | 179.08 | 284.94 | 0.01 |
| | 2.92 | 132.40 | 1.30 | 133.70 | 133.70 | 0.0127 | 0.02 | 181.42 | 285.39 | 0.01 |
| | 3.55 | 132.40 | 1.30 | 133.70 | 133.70 | 0.0127 | 0.02 | 183.86 | 285.85 | 0.01 |
| | 3.62 | 132.40 | 1.31 | 133.71 | 133.71 | 0.0127 | 0.02 | 186.22 | 286.29 | 0.01 |
| Average Blocked Channel | 3.70 | 132.40 | 1.32 | 133.72 | 133.72 | 0.0127 | 0.02 | 188.66 | 286.75 | 0.01 |
| | 3.78 | 132.40 | 1.33 | 133.73 | 133.73 | 0.0127 | 0.02 | 191.20 | 287.23 | 0.01 |
| | 3.85 | 132.40 | 1.34 | 133.74 | 133.74 | 0.0127 | 0.02 | 193.74 | 287.71 | 0.01 |
| | 3.93 | 132.40 | 1.35 | 133.75 | 133.75 | 0.0127 | 0.02 | 196.28 | 288.18 | 0.01 |
| | 4.04 | 132.40 | 1.36 | 133.76 | 133.76 | 0.0126 | 0.02 | 198.83 | 288.66 | 0.01 |
| 10 Yr Wet Blocked Channel | 5.07 | 132.40 | 1.37 | 133.77 | 133.77 | 0.0126 | 0.03 | 201.39 | 289.14 | 0.01 |
| | 5.25 | 132.40 | 1.37 | 133.77 | 133.77 | 0.0126 | 0.03 | 203.94 | 289.62 | 0.01 |
| | 5.44 | 132.40 | 1.38 | 133.78 | 133.78 | 0.0126 | 0.03 | 206.60 | 290.11 | 0.01 |
| | 6.26 | 132.40 | 1.39 | 133.79 | 133.79 | 0.0125 | 0.03 | 209.25 | 290.60 | 0.01 |
| 100Yr Wet Blocked Channel | 6.37 | 132.40 | 1.40 | 133.80 | 133.80 | 0.0125 | 0.03 | 211.82 | 291.08 | 0.01 |
| | 6.49 | 132.40 | 1.41 | 133.81 | 133.81 | 0.0124 | 0.03 | 214.57 | 291.54 | 0.01 |
| | 6.84 | 132.40 | 1.42 | 133.82 | 133.82 | 0.0124 | 0.03 | 217.24 | 291.99 | 0.01 |

PROJECT
**MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE
# BLOCKED WITH DEWATERING HEC-RAS MODEL RESULTS FOR CROSS SECTION 3

Golder Associates

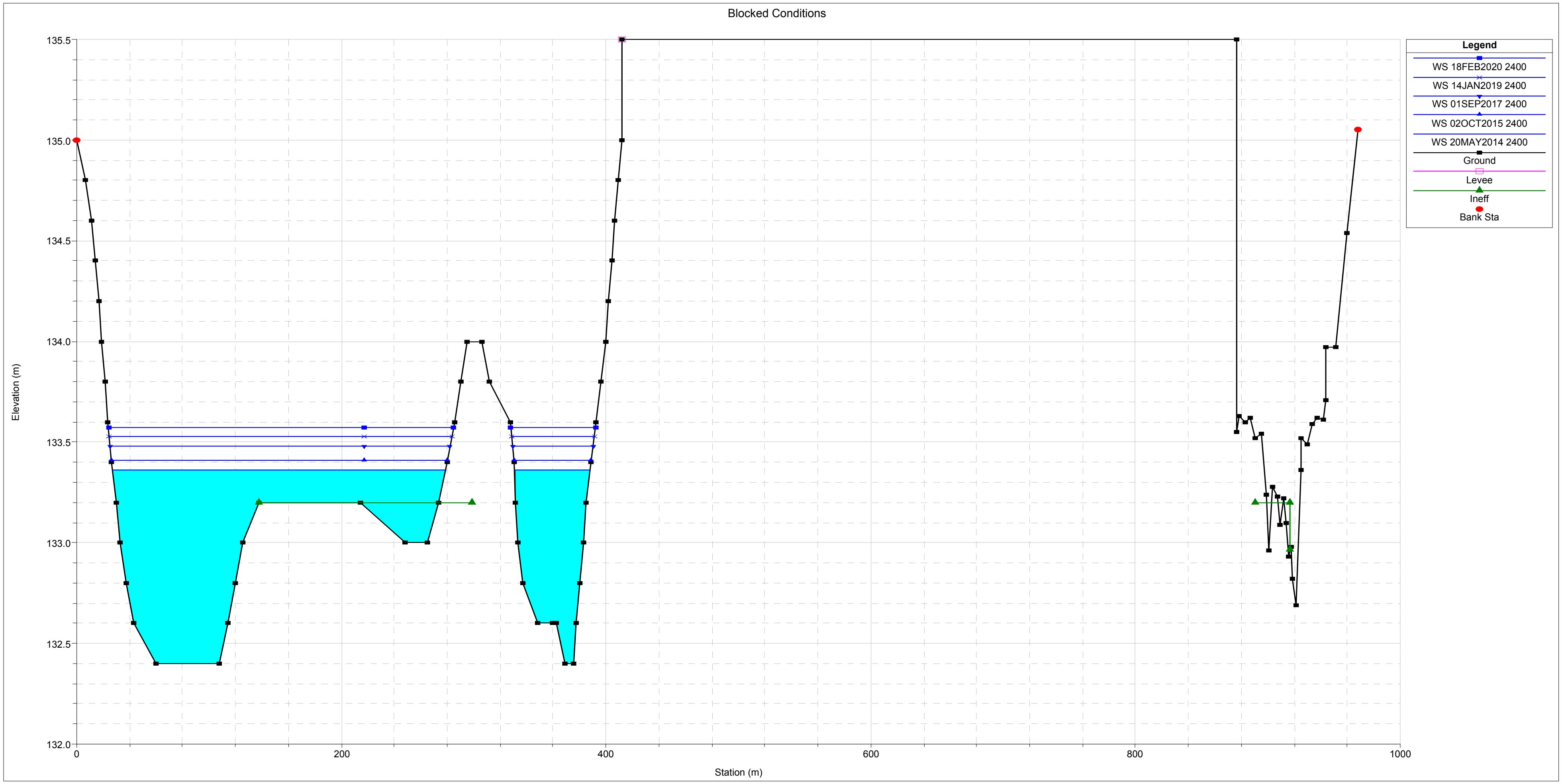
| | | | | |
|---|---|---|---|---|
| PROJECT No. 07-1413-0047 | | | PHASE / TASK No. 5300 | |
| DESIGN | -- | | SCALE NTS | REV. |
| CADD | -- | | **FIGURE IV-8** | |
| CHECK | -- | | | |
| REVIEW | | | | |

REVISION DATE: BY: FILE:

REVISION DATE: BY: FILE:

# Blocked Conditions With Dewatering

Water Elevations: 134.37m, 134.33m, 134.28m, 134.21m, 133.16m




PROJECT **MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE
**Blocked Conditions With Dewatering**
**Cross Section 2 Profile**

Golder Associates

| | | | | |
|---|---|---|---|---|
| PROJECT No. | 07-1413-0047 | | PHASE / TASK No. | 5300 |
| DESIGN | -- | 11DEC07 | SCALE NTS | REV. |
| CADD | -- | | **FIGURE IV-9** | |
| CHECK | -- | | | |
| REVIEW | | | | |

| Runoff Condition | Q Total (m3/s) | Min Ch Elevation (m) | Max Depth (m) | W.S. Elevation (m) | E.G. Elevation (m) | E.G. Slope (m/m) | Velocity Channel (m/s) | Flow Area (m2) | Top Width (m) | Froude # |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1.14 | 132.40 | 0.88 | 133.28 | 133.28 | 0.0213 | 0.01 | 125.13 | 302.87 | 0.00 |
| | 1.20 | 132.40 | 0.89 | 133.29 | 133.29 | 0.0209 | 0.01 | 128.18 | 303.59 | 0.00 |
| | 1.26 | 132.40 | 0.90 | 133.30 | 133.30 | 0.0205 | 0.01 | 131.24 | 304.30 | 0.00 |
| | 1.32 | 132.40 | 0.91 | 133.31 | 133.31 | 0.0201 | 0.01 | 134.30 | 305.01 | 0.00 |
| | 1.39 | 132.40 | 0.92 | 133.32 | 133.32 | 0.0197 | 0.01 | 137.37 | 305.73 | 0.00 |
| | 1.47 | 132.40 | 0.93 | 133.33 | 133.33 | 0.0194 | 0.01 | 140.36 | 306.42 | 0.00 |
| | 1.55 | 132.40 | 0.94 | 133.34 | 133.34 | 0.0189 | 0.01 | 143.44 | 307.14 | 0.01 |
| | 1.66 | 132.40 | 0.95 | 133.35 | 133.35 | 0.0185 | 0.01 | 146.54 | 307.85 | 0.01 |
| 100 yr Dry Blocked Channel | 1.81 | 132.40 | 0.96 | 133.36 | 133.36 | 0.0181 | 0.01 | 149.64 | 308.56 | 0.01 |
| | 2.03 | 132.40 | 0.97 | 133.37 | 133.37 | 0.0177 | 0.01 | 152.74 | 309.28 | 0.01 |
| | 2.12 | 132.40 | 0.98 | 133.38 | 133.38 | 0.0174 | 0.01 | 155.76 | 309.97 | 0.01 |
| | 2.23 | 132.40 | 0.99 | 133.39 | 133.39 | 0.0171 | 0.01 | 158.89 | 310.69 | 0.01 |
| | 2.34 | 132.40 | 1.00 | 133.40 | 133.40 | 0.0167 | 0.01 | 162.01 | 311.40 | 0.01 |
| 10 Yr Dry Blocked Channel | 2.48 | 132.40 | 1.01 | 133.41 | 133.41 | 0.0164 | 0.02 | 165.15 | 312.15 | 0.01 |
| | 2.58 | 132.40 | 1.02 | 133.42 | 133.42 | 0.0162 | 0.02 | 168.29 | 312.91 | 0.01 |
| | 2.69 | 132.40 | 1.03 | 133.43 | 133.43 | 0.0160 | 0.02 | 171.35 | 313.64 | 0.01 |
| | 2.80 | 132.40 | 1.04 | 133.44 | 133.44 | 0.0158 | 0.02 | 174.51 | 314.40 | 0.01 |
| | 2.92 | 132.40 | 1.05 | 133.45 | 133.45 | 0.0155 | 0.02 | 177.67 | 315.15 | 0.01 |
| | 3.55 | 132.40 | 1.06 | 133.46 | 133.46 | 0.0153 | 0.02 | 180.85 | 315.90 | 0.01 |
| | 3.62 | 132.40 | 1.07 | 133.47 | 133.47 | 0.0151 | 0.02 | 184.03 | 316.66 | 0.01 |
| Average Blocked Channel | 3.70 | 132.40 | 1.08 | 133.48 | 133.48 | 0.0150 | 0.02 | 187.12 | 317.39 | 0.01 |
| | 3.78 | 132.40 | 1.09 | 133.49 | 133.49 | 0.0148 | 0.02 | 190.32 | 318.15 | 0.01 |
| | 3.85 | 132.40 | 1.10 | 133.50 | 133.50 | 0.0146 | 0.02 | 193.52 | 318.90 | 0.01 |
| | 3.93 | 132.40 | 1.11 | 133.51 | 133.51 | 0.0144 | 0.02 | 196.73 | 319.65 | 0.01 |
| | 4.04 | 132.40 | 1.12 | 133.52 | 133.52 | 0.0143 | 0.02 | 199.95 | 320.41 | 0.01 |
| 10 Yr Wet Blocked Channel | 5.07 | 132.40 | 1.13 | 133.53 | 133.53 | 0.0141 | 0.02 | 203.18 | 321.16 | 0.01 |
| | 5.25 | 132.40 | 1.14 | 133.54 | 133.54 | 0.0140 | 0.03 | 206.31 | 321.90 | 0.01 |
| | 5.44 | 132.40 | 1.15 | 133.55 | 133.55 | 0.0138 | 0.03 | 209.56 | 322.65 | 0.01 |
| | 6.26 | 132.40 | 1.16 | 133.56 | 133.56 | 0.0136 | 0.03 | 212.80 | 323.40 | 0.01 |
| 100 yr Wet Blocked Channel | 6.37 | 132.40 | 1.17 | 133.57 | 133.57 | 0.0135 | 0.03 | 216.06 | 324.16 | 0.01 |
| | 6.49 | 132.40 | 1.18 | 133.58 | 133.58 | 0.0133 | 0.03 | 219.33 | 324.91 | 0.01 |
| | 6.84 | 132.40 | 1.19 | 133.59 | 133.59 | 0.0132 | 0.03 | 222.50 | 325.65 | 0.01 |

PROJECT
**MEADOWBANK MINING CORPORATION**
**MEADOWBANK GOLD PROJECT**
**THIRD PORTAGE LAKE OUTLETS**

TITLE

# BLOCKED WITH DEWATERING HEC-RAS MODEL RESULTS FOR CROSS SECTION 2

Golder Associates

| | | | |
|---|---|---|---|
| PROJECT No. 07-1413-0047 | | PHASE / TASK No. 5300 | |
| DESIGN | -- | SCALE NTS | REV. |
| CADD | -- | **FIGURE IV-10** | |
| CHECK | -- | | |
| REVIEW | | | |

REVISION DATE: BY: FILE: