May 2015

MEADOWBANK PROJECT
CONFIDENTIAL

Detailed Design Report for Saddle Dams 3, 4 and 5

Submitted to:
Patrice Gagnon/Thomas Lépine
Agnico-Eagle Mines Limited Meadowbank Division
PO Box 540
Baker Lake, Nunavut X0C 0A0

REPORT

Report Number: Doc 1504-1416081 SD 3, 4 & 5 Design Rev0

Distribution:

1 e-copy and 3 copies: Agnico-Eagle Mines Ltd, Baker Lake, NU

1 copy: Golder Associés Ltée, Montréal, QC

Golder Associés

Table of Contents

TABLES

APPENDICES

APPENDIX A
Drawings

APPENDIX B
Technical Specifications

APPENDIX C
Conditions and Limitations

1.0 INTRODUCTION

Agnico-Eagle Mines Limited (AEM) mandated Golder Associates Ltd. (Golder) to prepare the detailed engineering design of Saddle Dams 3, 4 and 5 for the Meadowbank Gold Project, Nunavut. These dams are the latest structure to be built to allow the completion of the South Cell of the Tailings Storage Facility (TSF).

This report summarizes the assumptions, information and data that form the design basis for the detailed design of Saddle Dams 3, 4 and 5 for the Meadowbank Project. The design presented in this document is an update of the previous designs presented in Golder (2008b) and in the Design Basis Memorandum (Golder 2015b). No additional modelling (e.g. thermal, seepage or stability) was performed but the new drillhole data was integrated to update the stratigraphic model within the dams' footprints.

2.0 DESIGN BASIS

This section presents the design basis of Saddle Dams 3, 4 and 5, including specifications that will need to be respected throughout their operation.

Saddle Dams 3, 4 and 5 are perimeter structures of the South Cell of the TSF. The Saddle Dams are rockfill structures built in compacted lift. Their design includes inverted base filters, upstream graded filters and a geomembrane liner on their upstream slopes.

Saddle Dam 3 is located in the northwestern corner of the South Cell and ties in to Saddle Dam 2. Saddle Dam 4 is located in the southwestern corner of the South Cell and ties in to Saddle Dam 5, which merges with the southern extremity of Central Dike.

Table 1 presents an updated summary of the design parameters of the Saddle Dams, as originally proposed in the TSF Dike Design Report (Golder, 2008b).

Table 1: Summary of Design Criteria

Description	Unit	Value
Final Elevation		
Minimum final dam elevation	m	140
Maximum final dam elevation	m	150
Geometric Parameters		
Width of circulation road at final dam crest elevation	m	15
Upstream slope	-	3H:1V
Downstream slope	-	1.5H:1V
Length of inversed filter	m	10 min.(1)
Tailings Beach		
Minimum beach length from upstream face of dam	m	20
Minimum tailings freeboard (i.e. crest to pond)	m	0.5

Note: The 10 m length for the inverse filter is valid only if the prepared foundation under the upstream slope is on the bedrock surface. The inverse filter length could be reduced where the dam's height is less than 6 m.

2.1 Dam Classification

This section presents the classification of Saddle Dams 3, 4 and 5, as outlined in the Canadian Dam Association's *Dam Safety Guidelines* (CDA, 2007), which provide a guide as to the standard of care expected for their design and operation. The classification is used to determine the consequence of failure. The standard of care for the design and operation of the structures reduces the risk of failure, which is defined as the product of likelihood and consequence of a failure.

The dam classification information is presented in Table 2 below. The following is noted for the Saddle Dams:

- Loss of life: The Saddle Dams are classified as "significant" as there are no permanent workers in the downstream area.
- Environmental and cultural values: The Saddle Dams are classified as "high" due to water licence requirements and environmental permitting considerations. This classification was determined in consultation with AEM.
- Infrastructure and economics (third party): The facility is classified as "high" due to water licence requirements and environmental permitting considerations. This classification was determined in consultation with AEM.

The dam classification is determined by the highest of the three ratings above; therefore, the classification for the Saddle Dams is "**high**."

Table 2: Dam Classification in Terms of Consequences of Failure (After CDA 2007)

Classification	**Population at Risk [Note 1]**	**Incremental Losses**		
		Loss of Life [Note 2]	**Environmental and Cultural Values**	**Infrastructure and Economics**
Low	None	0	▪ Minimal short-term loss ▪ No long-term loss	Low economic losses; area contains limited infrastructure or services
Significant	Temporary only	Unspecified	▪ No significant loss or deterioration of fish or wildlife habitat ▪ Loss of marginal habitat only ▪ Restoration or compensation in kind highly possible	Losses to recreational facilities, seasonal workplaces, and infrequently used transportation routes
High	**Permanent**	**10 or fewer**	▪ **Significant loss or deterioration of *important* fish or wildlife habitat** ▪ **Restoration or compensation in kind highly possible**	**High economic losses affecting infrastructure, public transportation and commercial facilities**
Very High	Permanent	100 or fewer	▪ Significant loss or deterioration of *critical* fish or wildlife habitat ▪ Restoration or compensation in kind possible but impractical	Very high economic losses affecting important infrastructure or services *(e.g. highway, industrial facility, storage facilities for dangerous substances)*

Classification	Population at Risk [Note 1]	Incremental Losses		
		Loss of Life [Note 2]	Environmental and Cultural Values	Infrastructure and Economics
Extreme	Permanent	More than 100	▪ Major loss of *critical* fish or wildlife habitat ▪ Restoration or compensation in kind impossible	Extreme losses affecting critical infrastructure or services *(e.g. hospital, major industrial complex, major storage facilities for dangerous substances)*

Note 1: Definitions for population risk:
None – There is no identifiable population at risk, so there is no possibility of loss of life other than through unforeseeable misadventure.
Temporary – People are only temporarily in the inundation zone *(e.g. seasonal cottage use, passing through on transportation routes, participating in recreational activities)*.
Permanent – The population at risk is ordinarily located in the inundation zone *(e.g. as permanent residents)*; three consequence classes (high, very high, extreme) are proposed to allow for more detailed estimates of potential loss of life (to assist in decision-making if the appropriate analysis is carried out).
Note 2: Implications for loss of life:
Unspecified – The appropriate level of safety required at a facility where people are temporarily at risk depends on the number of people, the exposure time, the nature of their activity, and other conditions. A higher classification could be appropriate depending on the requirements.

2.2 Tailings Deposition Plan

The Saddle Dams construction schedule and raise sequence will be designed on the basis of the tailings deposition plan. According to the latest deposition plan transmitted by AEM, water is not expected to pond against the Saddle Dams for significant periods of time during the operations of the South Cell. Depending on further revision of the deposition plan, where water may pond against the upstream slope, a protection to the geomembrane might need to be placed.

The planned dam elevation during operations, based on the most recent tailings deposition plan, is at crest El. 140 m. However, there is a possibility that the structure of the South Cell will be raised at some point to crest El. 150 m. The different elements of the Saddle Dams are designed based on an assumed final crest elevation of El. 150 m, but the quantity estimate were calculated for a final crest elevation of El. 140 m.

The final crest elevations are considered flexible and may be revised during operations based on tailings deposition activities. The actual crest elevations required at specific times will be dealt with as a construction consideration and determined during the TSF operations.

2.3 Thermal Conditions

The thermal conditions are based on results from the TSF modelling (Golder 2008a, b). Those simulations included:

- Coupled thermal and seepage analyses during operations and post-closure;
- Staged flooding of the Portage Pit during a period of four years;
- Consideration of the rockfill flooding and thawing;
- Consideration of the impact of the Portage Fault on the seepage rates; and

- Contaminant transport analysis based on the flow velocities computed from the coupled seepage/thermal model.

The result of the thermal modelling (Golder, 2008a and 2008b) indicated that the following conditions would prevail through the different phases of the project:

- Operations: Tailings and the Saddle Dams are thawed and the foundations are frozen at the surface and thawed at shallow depth;
- Closure: Tailings are thawed and parts of the foundations are frozen; and
- Post-closure: Tailings are frozen and parts of the Saddle Dams and the foundations are frozen.

The results of the 2008 thermal modelling are based on the 2007 design of Central Dike and indicate that the tailings will freeze within a period of 40 years after closure. The instrumentation indicates that the Saddle Dams and their foundations quickly freeze-back following the end of the construction and remain frozen, which seems to suggest that the thermal analyses were conservative. The detailed design of Saddle Dams 3, 4 and 5 is based on the results of the 2008 thermal modelling. No further thermal analyses were required, as the designed cross-sections were similar and based on the monitored thermal condition at Saddle Dams 1 and 2.

The thermistors data at Saddle Dams 1 and 2 indicate that the foundations and the semi-pervious backfill placed on top of the compacted till dropped quickly below 0ºC after the end of construction and have not increased since then. The rockfill shells of the Saddle Dams and the tailings located upstream are also in permafrost conditions with the exception of a small active layer in the upper part of the rockfill and the tailings. The thermistors data and a more detailed analysis of the thermal conditions at Saddle Dams 1 and 2 can be found in the annual geotechnical inspection report (Golder, 2015a).

2.4 Seepage Conditions

Based on the results of the seepage analysis completed during the TSF's detailed design (Golder, 2008b), a seepage collection and management system, including trenches and sumps on the downstream side, will be required at Saddle Dams 3 and 4 to manage the risks associated with a potential release of tailings solids and supernatant water in the environment. Water will flow laterally within the rockfill and emerge as a function of the topography and ice build up within the rockfill. No seepage collection system is required at Saddle Dam 5 as it is expected that the seepage will drain laterally and report to the Central Dike rockfill. It is considered that no further seepage analyses are required as the cross-section and field conditions are similar to the one analyzed in 2008.

2.5 Tailings Containment

The Saddle Dams 3, 4 and 5 are to provide containment so that tailings do not migrate downstream into the environment. The geomembrane liner and zoned filter system will provide a barrier to tailings migrating through the dam. The filter system will also be extended to 10 meter (inverted filter at the base) under the dam with an upstream slope foundation on the bedrock.

The cut-off design for the Saddle Dams includes an upstream toe liner tie-in area which will be excavated to bedrock. At this location, the impermeable geomembrane liner will be laid down on compacted till bedding

overlying the bedrock. The upstream toe liner tie-in area will be backfilled with till to ensure a complete barrier protection for seepage and tailings migration.

The extent and properties of the in situ till have been confirmed during the construction of the various structures of the TSF and, most recently, the raise of Central Dike.

2.6 Tailings Beach Length and Freeboard Requirements

The design of the TSF and its perimeter structures is based on the mine operations maintaining the tailings pond away from the perimeter structures. A tailings beach is to be provided by operations at all times to protect the geomembrane and to limit seepage through the structures and their foundations.

The tailings beach design parameters are:

- Minimum horizontal tailings beach length of 20 m from the dam upstream's slope; and
- Minimum freeboard (vertical distance between tailings beach and dam crest) of 0.5 m.

The minimum tailings beach length and freeboard are to be provided at all times during operations.

2.7 Stability

The foundation and structural fill of the dam need to be stable under static and pseudo-static cases. General stability analyses for the Saddle Dams were done during the TSF's detailed design (Golder, 2008b) and indicated that the design criteria of the Saddle Dams exceeded the design criteria for both cases. No additional stability analyses were performed, as further knowledge of soil conditions acquired during construction of others structure around the TSF indicate that the soil configuration is similar to the Saddle Dams models analysed in 2008.

2.8 Construction Schedule

The construction schedule is influenced by:

- Timing of the construction of each phase as a function of expected tailings elevation throughout mine operations; and
- Field season for construction, where construction activities may not share the same "construction window."

3.0 STRATIGRAPHY

Borehole locations and the simplified stratigraphy along the Saddle Dams alignment are shown in the Drawings in APPENDIX A. Boreholes were drilled at the planned location of Saddle Dams 3, 4 and 5 during the 2009 and 2010 geotechnical investigation (Golder, 2009 and 2010). Additional boreholes were drilled by AEM in the summer and fall of 2014. Theses boreholes were required to better define the bedrock limit within the footprints of the dams before proceeding to the detailed design of Saddle Dams 3, 4 and 5.

4.0 SADDLE DAMS DESIGN

The Saddle Dams are permanent structures which, along with Central Dike, form the South Cell of the TSF and are used to retain tailings and limit seepage to the environment during operations, closure and post-closure of the mine life.

The Saddle Dams 3, 4 and 5 are categorized as high consequence of failure structures due to the potential for environmental damage and economic loss.

The location and planned alignment of these structures are included in the Drawings in APPENDIX A. The Technical Specifications are provided in Appendix B. References to the Drawings and Technical Specifications are made throughout the subsequent sections.

The Saddle Dams section includes a compacted rockfill embankment with upstream seepage barrier, granular filters, and an upstream toe liner tie-in area (shown in Drawings in APPENDIX A). The Saddle Dam crests may be used to support the tailings pipeline and spigots.

The dam footprints are located between the existing air strip and the South Cell. The crest is not expected to be used as a haul road but rather for light vehicle only. The planned final crest elevation is between El. 140 m and El. 150 m and is a function of the planned tailings deposition (Section 2.2). The width of the road at the final crest elevation is 15 m, excluding safety berms. .

Foundation soils may include lakebed sediments and till overlying bedrock. Soft and ice-rich soils will be removed from the Saddle Dams footprints to limit settlement beneath the entire structure.

Zones of permeable granular materials may exist within the foundation till as layers or as channels. Zones of high hydraulic conductivity materials that can convey large flows can have dimensions that are too small to detect with conventional drilling methods. An engineered cut-and-fill excavation located along the upstream toe is required to limit flow through foundation soils and allow adequate connection of the geomembrane liner with the bedrock. The location of the engineered excavation is named the upstream toe liner tie-in area as described in Section 2.5.

The entire exposed bedrock surface in the upstream toe liner tie-in area will be cleaned by the Contractor and mapped by the QA Engineer. No slush grout is planned as the likelihood of piping of the compacted till placed on the bedrock is considered limited.

Any observed discontinuities or open fractures above 10 mm width on the exposed bedrock in the upstream toe liner area will need to be protected by bentonite enriched granular material.

To provide continuity of the seepage barrier from the upstream LLDPE geomembrane liner to the bedrock in the upstream toe liner tie-in excavation, the LLDPE geomembrane liner will be embedded in compacted till. To reduce the risk associated with liner damage during construction, restrictions on material placement and compaction over LLDPE geomembrane are provided in the Technical Specifications (see APPENDIX B).

The majority of the Saddle Dams will be constructed of rockfill that will be placed and compacted in lifts either on the exposed bedrock surface (upstream portion) or on the dense till overlying bedrock (downstream portion). The compaction of rockfill using a vibratory roller compactor is required to limit settlement of the crest and liner.

Rockfill embankment side slopes for the Saddle Dams are 3H:1V up for the upstream face and 1.5 H: 1 V for the downstream face.

A two-zone granular filter that will limit the movement of tailings through the rockfill will be placed between the liner and the rockfill. Filters on the upstream rockfill act as a bedding for the liner; these zones will required compaction. A minimum of 10 metre long inverse filters will be placed beneath the rockfill from the upstream toe to limit the movement of foundation till into the rockfill. A longer inverse filter may be required if not all the overburden is excavated from beneath the upstream slope.

The requirements for material types, gradations, placement, and compaction are presented in the Technical Specifications in APPENDIX B.

Ice loading against the face of the dam can damage the LLDPE geomembrane. Ponding of water directly against the LLDPE geomembrane increases the likelihood of increased seepage through the structure and its foundation. To prevent damage to the LLDPE geomembrane and to limit the quantity of seepage passing through the structure and its foundation, a tailings beach is to be provided by operations at all times. The minimum tailings beach length and freeboard are to be provided at all times during operations (refer to Section 2.6 for the minimum requirements).

Since there is no cover to be placed over the upstream LLDPE geomembrane, the operations will need to enact extra protection measures to prevent scour due to tailings deposition and puncture holes from spigot installation. The performance of regular visual inspections of the LLDPE geomembrane by operations will be required. Any identified damage to the LLDPE geomembrane is to be repaired promptly.

4.1 Transition between Saddle Dam 4, 5 and Central Dike

The design configuration of Central Dike differs slightly from that of Saddle Dam 5. Since there is a topographic tie-in between the structures, they need to be intimately tied together. Central Dike must connect with Saddle Dam 5 without compromising the flow barrier. Both upstream geomembrane liner and adjacent material must tie-in perfectly with one another and the upstream toe liner tie-in area must be maintained continuously. Similarly, and depending on the final crest elevation, Saddle Dam 4 may eventually merge with Saddle Dam 5 and the connection with one another must maintain the continuity of the flow barrier.

4.2 Construction Sequence

This section presents the general steps for the construction of the Saddle Dams 3, 4 and 5; AEM's detailed construction planning is to consider the information presented herein. The design allows flexibility to change stage elevations. The primary requirement is to properly anchor and connect the LLDPE geomembrane at the end of each construction phase.

The construction of Saddle Dams 3, 4 and 5 is presented in APPENDIX A and includes:

- Foundation preparation. Ice rich soil will be removed from the entire footprint of the Saddle Dams before construction to limit differential settlements that may adversely impact liner performance. The foundation will be excavated to bedrock beneath the upstream slope of the dike. The remaining portions of the Saddle Dams will be constructed on the in situ till. The transition zone between the foundation excavated to bedrock and the in situ till will have a 1H: 1V slope;

- Upstream toe liner tie-in area excavation and bedrock mapping;
- Possible bentonite enriched granular material placement over areas of concern;
- Inverse filter placement beneath the rockfill near the upstream toe to limit the movement of liner tie-in compacted till and foundation till into the rockfill;
- Rockfill placement including compaction by vibratory roller and resloping of the upstream face: rockfill is compacted to reduce settlement that may adversely impact LLDPE geomembrane performance (this is to be performed while resloping the cofferdam);
- Filter placement over the rockfill material along the upstream slope and compaction;
- Initial compacted till placement in the upstream toe liner tie-in area;
- Geotextile and LLDPE geomembrane: liner placement on the upstream toe liner tie-in area and upstream slope (including anchor trench excavation and backfill);
- Upstream toe liner tie-in completion with the final placement of compacted till and protection granular layers; and installation of instrumentation.

4.3 Construction Material

The Saddle Dams will be built on land above the lake surface elevation with non-acid generating (Non-AG) rockfill and granular material.

Coarse filter gradation is designed to prevent movement of fine filter material into the rockfill and is produced by running rockfill through a primary crusher.

The fine filter gradation is designed to prevent tailings and till from moving into the coarse filter. Crushing and screening is required to produce the fine filter.

The liner will be a low linear density polyethylene (LLDPE) geomembrane which allows placement in cold weather conditions.

Verification of the material compatibility was done in the past for construction activities at Meadowbank requiring the same granular material (zoning). The granulometry for each type of material is based on a compilation of the particle size analysis results from past construction activity at Meadowbank. The particle size envelopes were then used to verify the materials' filter compatibility against two criteria for piping and one criterion for hydraulic conductivity. The determined envelope for each material is presented in the Technical Specifications in APPENDIX B.

4.4 Material Quantity Estimate

A summary of the estimated quantities for the construction of dikes to a final crest at El. 140 m is presented in Table 3. The quantity estimation is based on the design presented in APPENDIX A and is an in-place, neat-line estimate. The actual quantities will be influenced by conditions encountered in the field.

Table 3: Saddle Dams Quantity Estimate (Crest El. 140 m)

Material Type	SD 3 Quantity	SD 4 Quantity	SD 5 Quantity	SD 3, 4 & 5 Total Quantity
Foundation stripping	11,100 m^2	16,400 m^2	9,000 m^2	36,500 m^2
Overburden (till) excavation	46,500 m^3	38,000 m^3	5,700 m^3	90,200 m^3
Fine Rockfill (zone 5)	0 m^3	1,200 m^3	900 m^3	2,100 m^3
Non-AG Rockfill (zone 4)	28,400 m^3	26,100 m^3	16,500 m^3	71,000 m^3
Fine filter (zone 2)	2,100 m^3	3,900 m^3	1,100 m^3	7,100 m^3
Coarse filter (zone 3)	1,800 m^3	3,300 m^3	1,000 m^3	6,100 m^3
Compacted till (zone 1)	4,000 m^3	8,000 m^3	800 m^3	12,800 m^3
Low quality till	8,100 m^3	6,800 m^3	0 m^3	14,900 m^3
Geotextile	3,200 m^2	6,700 m^2	1,100 m^2	11,000 m^2
LLDPE	3,600 m^2	7,300 m^2	1,400 m^2	12,300 m^2

4.5 Instrumentation

Instrumentation is required on the Saddle Dams to provide early warning of the development of potentially adverse trends and to compare performance with the predictions made during the design studies. This instrumentation will include:

- Multiple bead thermistor strings;
- Survey control monuments; and
- Prefabricated cabins for housing instrumentation terminals and data acquisition equipment.

All instrumentation will be read manually before and immediately following installation and during construction. An automatic field data acquisition system will allow the collection of data from the piezometers and thermistors during operation.

Instrumentation type, number and location are provided in the Drawings and Specifications in APPENDIX A and APPENDIX B, respectively.

Additional information regarding the instrumentation is provided below.

4.5.1 Thermistor Strings

Thermistors are used to monitor temperatures within the foundation and fill. They are also used to identify potential advective and installed along the slope to final crest elevation. The set of thermistor strings placed through the entire embankment, including the foundation, shall be installed at the end of the dam construction.

Thermistors are shown in the Drawings in APPENDIX A.

4.5.2 Survey Control Monuments

Survey control monuments are installed at locations shown in the Drawings in APPENDIX A to provide control points for surveys. The survey control monuments are to be installed on the final crest.

4.5.3 Monitoring Frequency

Instrumentation data will need to be collected on a regular basis. Monitoring frequency will need to be described in the operation, maintenance and surveillance (OMS) manual.

5.0 FUTURE WORK TO BE PERFORMED

The future work required to complete the detailed design consists in:

- Addressing any design issues that may arise during the phased construction; and
- Reviewing the design, as required, with respect to the mine plan and the storage capacity required for tailings in the South Cell.

6.0 REPORT CLOSURE

This report has been prepared in accordance with the "**General Conditions and Limitations of This Report**," which are presented in APPENDIX C.

We trust that the information presented in this report satisfies your current requirements. Please contact the undersigned should you have any questions.

GOLDER ASSOCIÉS LTÉE

Yves Boulianne, P.Eng.(QC, NU)(NU)
Associate, Geotechnical Engineer

Patrick Gince, Eng.(QC)
Project Engineer

Frédérick L. Bolduc, Eng., M. Sc. A.
Geotechnical Engineer

PG/FB/YB/

\\golder.gds\gal\montreal\actif\2014\1221\1416081 aem - devis sd 3, 4 & 5 - meadowbank\5 preparation of deliverables\sd 3-4-5 design report - doc 1504-1416081\doc 1504 1416081 ra rev0 sd345 design report yb24apr2015_mg.docx

REFERENCES

Canadian Dam Association (CDA) 2007. Dam Safety Guidelines.

Golder 2008a. Coupled Seepage/Thermal and Contaminant Transport Analysis for Tailings Facility, Meadowbank Gold Project. Report, Golder Associates Ltd, No. 07-1413-0074-6000 Doc. 722 Ver. 0, August 1, 2008.

Golder 2008b. Tailings Storage Facility Dike Design, Meadowbank Project. Report, Golder Associates Ltd, No. 08-1428-0029 Doc. No. 784 Ver. 0, December 17, 2008.

Golder 2009. Geotechnical Investigation Tailings Storage Facility. Meadowbank Gold Project, Report, Golder Associates Ltd. December 2009 (Doc 979 Ver 0).

Golder 2010. Central Dike Geotechnical Investigation. Tailings Storage Facility, Meadowbank project. Report, Golder Associates Ltd, No. 09-1428-5007 Doc 1094 Ver. 0, September 20, 2010.

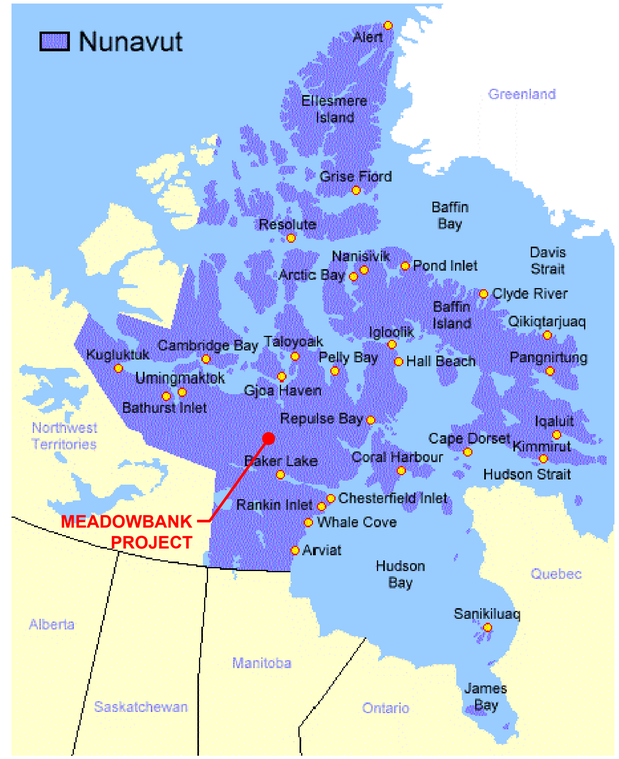
Golder 2015a. 2014 Annual Geotechnical Inspection. Meadowbank Gold Mine Nunavut, Report, Golder Associates Ltd. January 2015 (Doc 1483 Ver 0).

Golder 2015b. Saddle Dams 3, 4 and 5 Design Basis, Meadowbank Project. Technical Memorandum, Golder Associés Ltée, No. 1416081 Doc. No. 1496 Ver. A, February, 2015.

APPENDIX A

Drawings

AGNICO EAGLE MINES, LIMITED
MEADOWBANK GOLD PROJECT
TAILINGS STORAGE FACILITY
SADDLE DAM 3, 4 & 5



DRAWING INDEX				
DWG NO.	DRAWING TITLE	REVISION	REVISION TITLE	DATE
SD 3,4&5-01	LOCATION MAP AND DRAWING INDEX	0	ISSUED FOR CONSTRUCTION	2015-04-30
SD 3,4&5-02	PROJECT SITE PLAN	0	ISSUED FOR CONSTRUCTION	2015-04-30
SD 3,4&5-03	GENERAL ARRANGEMENT PLAN	0	ISSUED FOR CONSTRUCTION	2015-04-30
SD 3,4&5-04	SADDLE DAM 3 PLAN, PROFILE AND QUANTITIES	0	ISSUED FOR CONSTRUCTION	2015-04-30
SD 3,4&5-05	SADDLE DAM 4 PLAN, PROFILE AND QUANTITIES	0	ISSUED FOR CONSTRUCTION	2015-04-30
SD 3,4&5-06	SADDLE DAM 5 PLAN, PROFILE AND QUANTITIES	0	ISSUED FOR CONSTRUCTION	2015-04-30
SD 3,4&5-07	TYPICAL CROSS-SECTION AND DETAILS	0	ISSUED FOR CONSTRUCTION	2015-04-30
SD 3,4&5-08	STAGED CONSTRUCTION SEQUENCE	0	ISSUED FOR CONSTRUCTION	2015-04-30
SD 3,4&5-09	SADDLE DAM 3 CROSS-SECTIONS	0	ISSUED FOR CONSTRUCTION	2015-04-30
SD 3,4&5-10	SADDLE DAM 4 CROSS-SECTIONS	0	ISSUED FOR CONSTRUCTION	2015-04-30
SD 3,4&5-11	SADDLE DAM 5 CROSS-SECTIONS	0	ISSUED FOR CONSTRUCTION	2015-04-30
SD 3,4&5-12	INSTRUMENTATION PLAN AND SECTION - SADDLE DAM 3	0	ISSUED FOR CONSTRUCTION	2015-04-30
SD 3,4&5-13	INSTRUMENTATION PLAN AND SECTION - SADDLE DAM 4	0	ISSUED FOR CONSTRUCTION	2015-04-30
SD 3,4&5-14	INSTRUMENTATION PLAN AND SECTION - SADDLE DAM 5	0	ISSUED FOR CONSTRUCTION	2015-04-30
SD 3,5&5-15	SUMP LOCATIONS AND DETAILS	0	ISSUED FOR CONSTRUCTION	2015-04-30

SECTIONS INDEX				
SECTION NO.	SECTION TITLE	REVISION	REVISION TITLE	DATE
S1	GENERAL	0	ISSUED FOR CONSTUCTION	2015-04-30
S2	SCOPE	0	ISSUED FOR CONSTUCTION	2015-04-30
S3	CARE OF WATER	0	ISSUED FOR CONSTUCTION	2015-04-30
S4	FOUNDATION PREPARATION AND EXCAVATION	0	ISSUED FOR CONSTUCTION	2015-04-30
S5	FILLS	0	ISSUED FOR CONSTUCTION	2015-04-30
S6	LINEAR LOW DENSITY (LLDPE) GEOMEMBRANE	0	ISSUED FOR CONSTUCTION	2015-04-30
S7	GEOTEXTILE	0	ISSUED FOR CONSTUCTION	2015-04-30
S8	INSTRUMENTATION	0	ISSUED FOR CONSTUCTION	2015-04-30
S9	QUALITY CONTROL (QC) AND QUALITY ASSURANCE (QA) PLAN	0	ISSUED FOR CONSTUCTION	2015-04-30

GENERAL NOTES

1. THESE DRAWINGS ARE THE INTELLECTUAL PROPERTY OF GOLDER ASSOCIATES LTD. AND ARE TO BE USED SOLELY FOR THE INTENT FOR WHICH THEY WERE PREPARED. MODIFICATIONS OR DEVIATIONS FROM THESE DRAWINGS SHALL ONLY OCCUR WITH WRITTEN APPROVAL OF GOLDER ASSOCIATES LTD.
2. IT IS THE RESPONSIBILITY OF THE USER OF THESE DRAWINGS TO ENSURE THAT THE MOST RECENT REVISION IS BEING USED.
3. THE INFORMATION PROVIDED ON THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE MOST RECENT REVISION OF THE TECHNICAL SPECIFICATIONS. PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL BE FAMILIAR WITH THE SCOPE OF WORK, THE DRAWINGS, AND THE TECHNICAL SPECIFICATIONS.
4. IN THE EVENT OF DISCREPANCY BETWEEN THE DRAWINGS AND THE TECHNICAL SPECIFICATIONS, CLARIFICATION AND/OR DIRECTION SHALL BE PROVIDED AS OUTLINED IN THE TECHNICAL SPECIFICATIONS.
5. THE CONTRACTOR SHALL VERIFY THE COORDINATES AND ELEVATIONS BEFORE COMMENCING CONSTRUCTION.
6. THE CONTRACTOR SHALL COMPLETE CONSTRUCTED SURFACES TO THE LINES AND GRADES SHOWN ON THE DRAWINGS AND AS DESCRIBED IN THE TECHNICAL SPECIFICATIONS LISTED ON DWG SD 3,4&5-01.
7. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
8. COORDINATE SYSTEM IS NAD83 UTM, ZONE 14.
9. PHASED CONSTRUCTION OF THE SADDLE DAMS 3, 4 & 5 IS PLANNED. AEM WILL PROVIDE THE CONTRACTOR WITH THE PHASE CONFIGURATION TO BE CONSTRUCTED AS WELL AS THE AS-BUILT DOCUMENTATION OF PREVIOUS CONSTRUCTION PHASES, IF ANY.

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED
0	2015-04-30	ISSUED FOR CONSTRUCTION	F. Bolduc	S. Betnesky	P. Gince	Y. Boulianne
A	2015-03-27	ISSUED FOR COMMENTS	F. Bolduc	R. Gravel	P. Gince	Y. Boulianne

SEAL

Original Signed and Sealed by Yves Boulianne on April 30th, 2015

CLIENT

AGNICO EAGLE MINES LIMITED

CONSULTANT

GOLDER ASSOCIATES LTD.
1001, DE MAISONNEUVE W. BLVD
MONTREAL (QUEBEC)
CANADA H3A 3C8
[+1] (514) 383-0990
www.golder.com

PROJECT

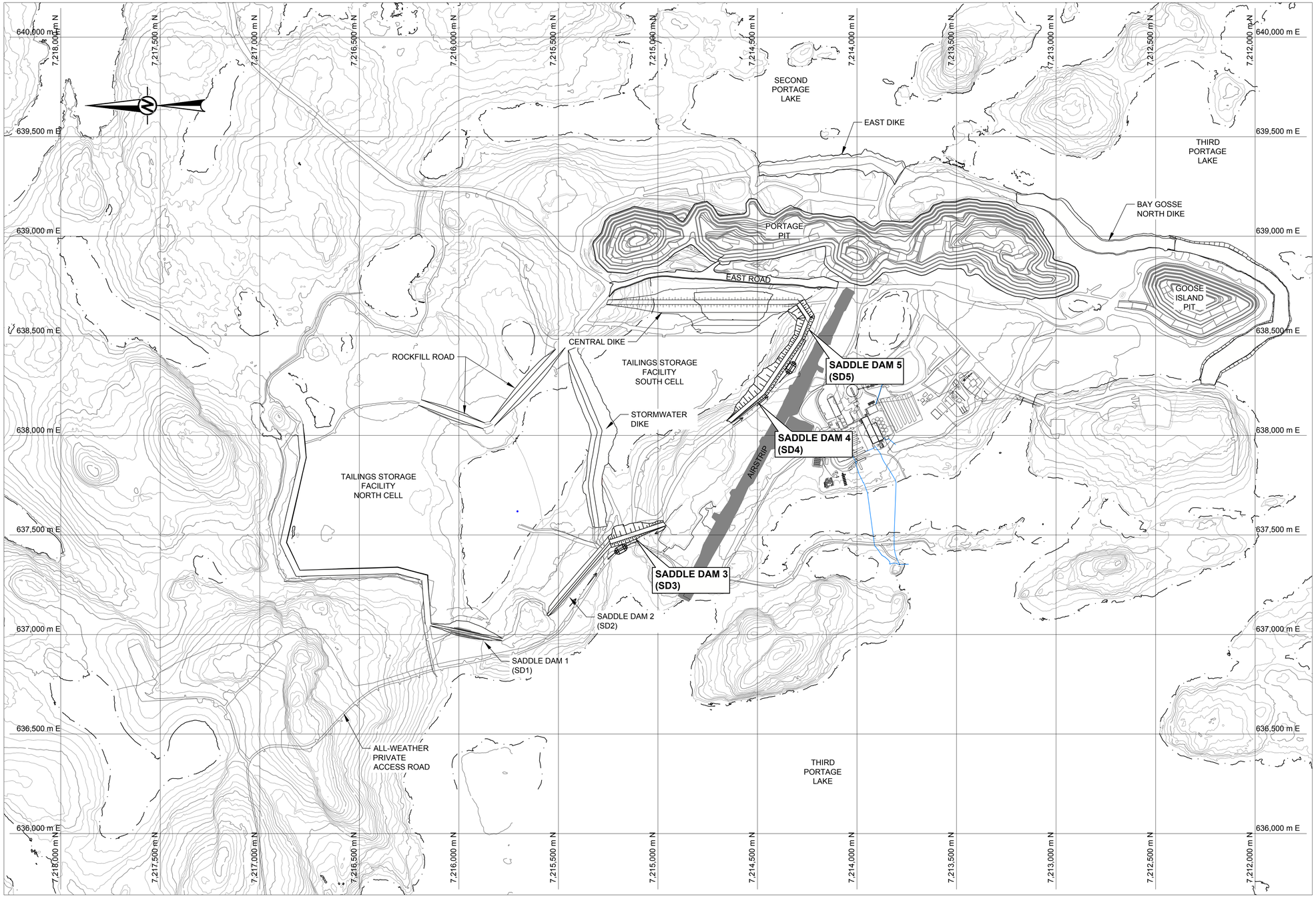
MEADOWBANK GOLD PROJECT
TAILINGS STORAGE FACILITY
SADDLE DAM 3, 4 & 5

TITLE

LOCATION MAP AND DRAWING INDEX

PROJECT No.	PHASE	Rev.	PLAN
1416081	2000	0	SD 3,4&5-01

1 of 15



LEGEND

- 140 — LAND-BASED TOPOGRAPHIC MAJOR CONTOUR INTERVAL 10 m
- LAND-BASED TOPOGRAPHIC MINOR CONTOUR INTERVAL 2 m
- SHORELINE
- ROAD

NOTES

1. REFER TO THE GENERAL NOTES ON THE FRONT PAGE (SD 3,4&5-01).
2. PROJECT SITE INFRASTRUCTURE IS SHOWN FOR INFORMATION PURPOSE ONLY.
3. THE PROPOSED AND COMPLETED CONTAINMENT INFRASTRUCTURE ARE SHOWN.
4. FINAL DAM AND DIKE ROCKFILL FOOTPRINTS ARE SHOWN.

REFERENCES

- DRAWINGS # Meadowbank Geotechnical2014 Drilling Program.dwg AND #Meadowbank SD3,4,5.dwg PROVIDED BY AEM LTD., MEADOWBANK DIVISION, JANUARY 2015
- UPDATED PITS OUTLINE PROVIDED BY AEM.

0 500 1,000
1:10,000 METRES

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED
0	2015-04-30	ISSUED FOR CONSTRUCTION	F. Bolduc	S. Betnesky	P. Gince	Y. Boulianne
A	2015-03-27	ISSUED FOR COMMENTS	F. Bolduc	R. Gravel	P. Gince	Y. Boulianne

SEAL

Original Signed and Sealed by Yves Boulianne on April 30th, 2015

CLIENT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED

CONSULTANT

Golder Associés

GOLDER ASSOCIATES LTD.
1001, DE MAISONNEUVE W. BLVD
MONTREAL (QUEBEC)
CANADA H3A 3C8
[+1] (514) 383-0990
www.golder.com

PROJECT

MEADOWBANK GOLD PROJECT
TAILINGS STORAGE FACILITY
SADDLE DAM 3, 4 & 5

TITLE

PROJECT SITE PLAN

PROJECT No.	PHASE	Rev.		
1416081	2000	0	2 of 15	SD 3,4&5-02

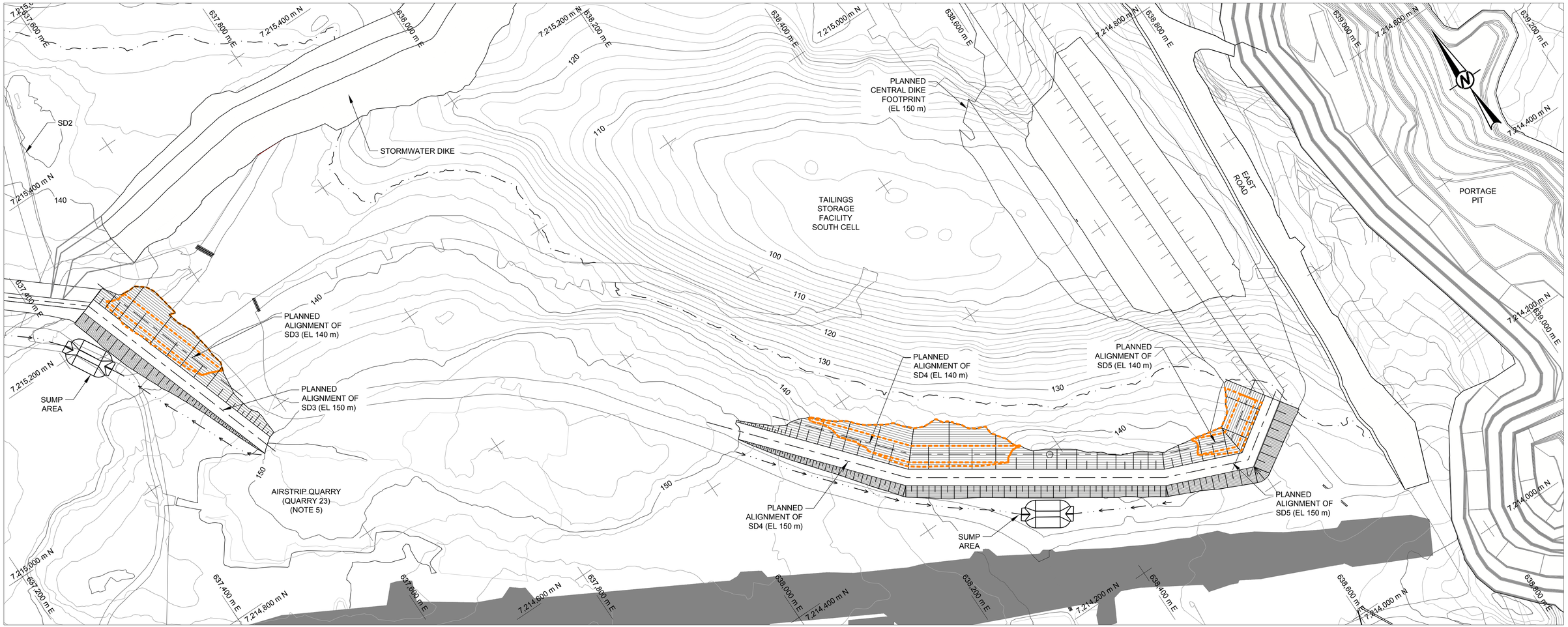
PLAN

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

25 mm

0

Path: \\golder.gds\gal\Montreal\SIG\GCAD\PROJETS\AGNICO-EAGLE\MEADOWBANK\PRODUCTION\1416081\2000\ | File Name: 1416081-2000-001.dwg



LEGEND

- SADDLE DAM ELEVATION 140 m FOOTPRINT
- 140 — LAND-BASED TOPOGRAPHIC MAJOR CONTOUR INTERVAL 10 m
- LAND-BASED TOPOGRAPHIC MINOR CONTOUR INTERVAL 2 m
- SHORELINE
- ROAD
- SADDLE DAM ELEVATION 150 m FOOTPRINT
- PROPOSED DITCH

NOTES

1. REFER TO THE GENERAL NOTES ON THE FRONT PAGE (SD 3,4&5-01).
2. SADDLE DAM 3 TIE-IN TO SADDLE DAM 2, SADDLE DAM 4 TIE-IN TO SADDLE DAM 5 AND SADDLE DAM 5 TIE-IN TO CENTRAL DIKE.
3. FINAL DAM AND DIKE ROCKFILL FOOTPRINTS ARE SHOWN.
4. THE SUMP AREA AND ADJACENT DITCHES ARE TO BE ADAPTED TO FILED CONDITIONS.
5. SD3 ALIGNMENT MAY NEED TO BE ADJUSTED IN ITS SOUTHERN EXTENSION DUE TO THE AIRSTRIP QUARRY LIMIT. A SAFETY BERM ON THE CREST ALONG THE QUARRY WALL IS REQUIRED FOR TRAFFIC PROTECTION.

REFERENCES

- DRAWINGS # Meadowbank Geotechnical2014 Drilling Program.dwg AND #Meadowbank SD3,4,5.dwg PROVIDED BY AEM LTD., MEADOWBANK DIVISION, JANUARY 2015
- UPDATED PITS OUTLINE PROVIDED BY AEM.

0 100 200
1:2,500 METRES

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED
0	2015-04-30	ISSUED FOR CONSTRUCTION	F. Bolduc	S. Betnesky	P. Gince	Y. Boulianne
A	2015-03-27	ISSUED FOR COMMENTS	F. Bolduc	R. Gravel	P. Gince	Y. Boulianne

SEAL

Original Signed and Sealed by Yves Boulianne on April 30th, 2015

CLIENT

AGNICO EAGLE MINES LIMITED

CONSULTANT

GOLDER ASSOCIATES LTD.
1001, DE MAISONNEUVE W. BLVD
MONTREAL (QUEBEC)
CANADA H3A 3C8
[+1] (514) 383-0990
www.golder.com

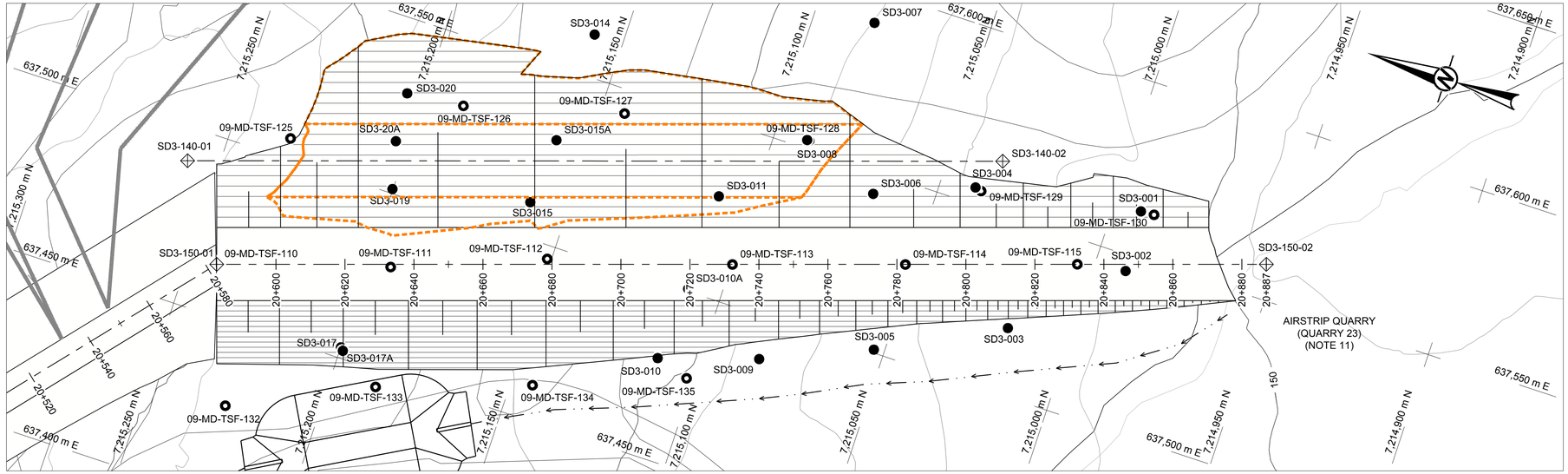
PROJECT

MEADOWBANK GOLD PROJECT
TAILINGS STORAGE FACILITY
SADDLE DAM 3, 4 & 5

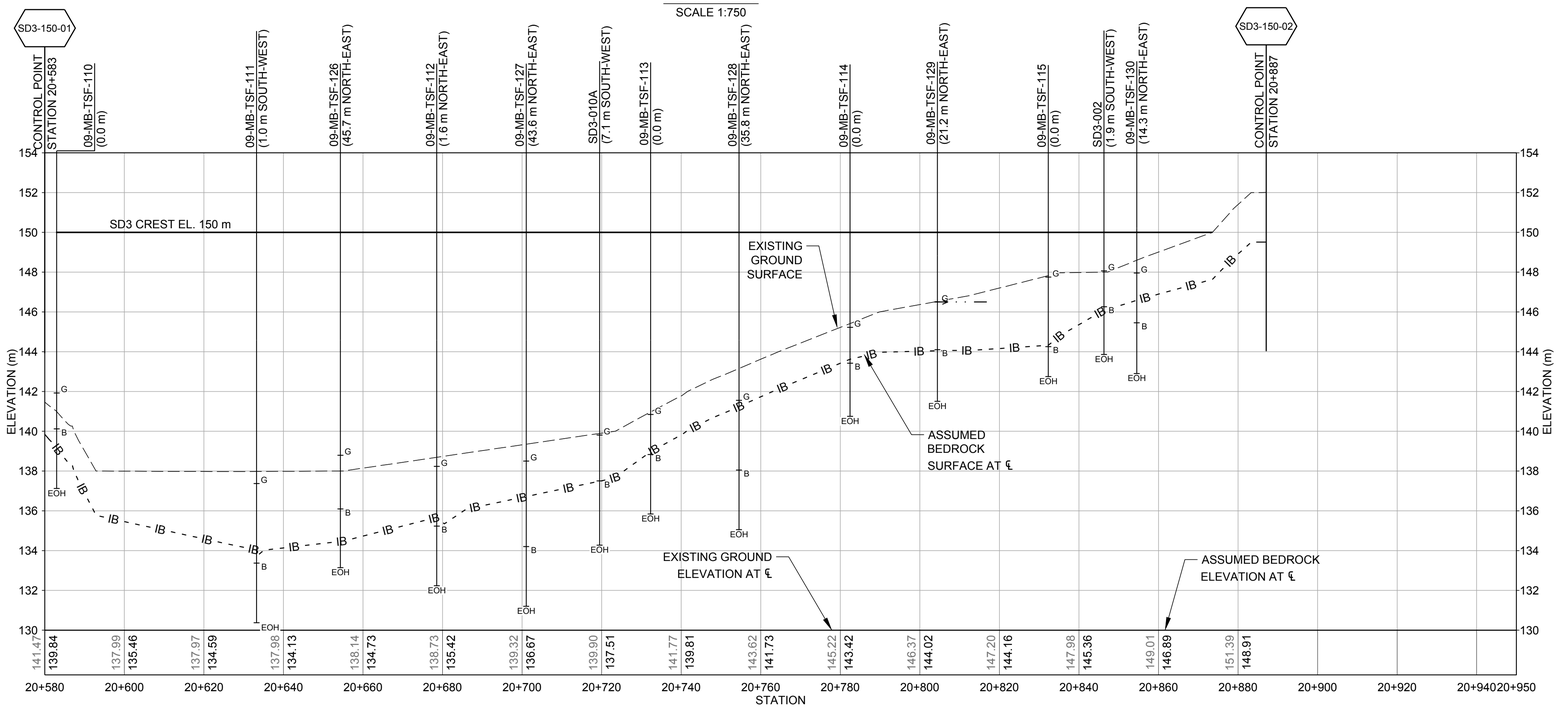
TITLE

GENERAL ARRANGEMENT PLAN

PROJECT No.	PHASE	Rev.		PLAN
1416081	2000	0	3 of 15	SD 3,4&5-03



PLAN VIEW
SCALE 1:750



LONGITUDINAL VIEW
HORIZONTAL SCALE 1:750
VERTICAL VIEW SCALE 1:150

LEGEND

- BOREHOLE (GOLDER, 2009)
- BOREHOLE (GOLDER, 2010)
- BOREHOLE (AEM, 2014)
- SADDLE DAM CONTROL POINT
- STATION AND CENTER LINE (2+580)
- PROPOSED DITCH
- SADDLE DAM ELEVATION 140 m FOOTPRINT
- 140 — LAND-BASED TOPOGRAPHIC MAJOR CONTOUR INTERVAL 10 m
- LAND-BASED TOPOGRAPHIC MINOR CONTOUR INTERVAL 2 m
- 10-MB-TSF-154 (0.0 m) — BOREHOLE NAME (OFFSET PERPENDICULAR TO CENTER LINE)
- G — GROUND SURFACE
- B — BEDROCK
- EOH — END OF HOLE
- ℄ — CENTRELINE

SADDLE DAM 3 QUANTITY ESTIMATE (CREST ELEVATION 140 m)	
Foundation Stripping	11,100 m^2
Overburden (Till) excavation	46,500 m^3
Low Quality Till	8,100 m^3
Compacted Till (Zone 1)	4,000 m^3
Fine Filter (Zone 2)	2,100 m^3
Coarse Filter (Zone 3)	1,800 m^3
Non-AG Coarse Rockfill (Zone 4B)	28,400 m^3
Fine Rockfill (Zone 5)	0 m^3
Géotextile	3,200 m^2
Geomembrane	3,600 m^2

NOTES

1. REFER TO THE GENERAL NOTES ON THE FRONT PAGE (SD 3,4&5-01).
2. GEOTECHNICAL INFORMATION SHOWN ON THE PROFILE, INCLUDING GROUND SURFACE AND BEDROCK ELEVATION, IS APPROXIMATE.
3. ACTUAL LIMIT OF FOUNDATION PREPARATION WILL BE BASED ON CONDITIONS ENCOUNTERED ON THE FIELD.
4. THE FOOTPRINT SHOWN ON PLAN IS FOR ROCKFILL ONLY.
5. ESTIMATED QUANTITIES FOR LINER INCLUDE ALLOWANCE FOR SEAMING OVERLAPS.
6. THE ESTIMATED EXCAVATION QUANTITY IS BASED ON ASSUMED GROUND AND BEDROCK ELEVATIONS.
7. DETAILED BOREHOLE LOGS ARE CONTAINED WITHIN GOLDER'S GEOTECHNICAL REPORT.
8. THE LINER OF SD3 MUST CONNECT WITH THE LINER OF SD2
9. FOR DETAILED DESIGN AND CONSTRUCTION SEQUENCE REFER TO DWG SD 3, 4&5-07-08-09-12-13 INCLUSIVE.
10. THE SUMP AREA AND ADJACENT DITCHES ARE TO BE ADAPTED TO FIELD CONDITIONS
11. SD3 ALIGNMENT MAY NEED TO BE ADJUSTED IN ITS SOUTHERN EXTENSION DUE TO THE AIRSTRIP QUARRY LIMIT. A SAFETY BERM ON THE CREST ALONG THE QUARRY WALL IS REQUIRED FOR TRAFFIC PROTECTION.

SAD3 - CONTROL POINTS		
POINT ID	EASTING (m)	NORTHING (m)
SD3-140-01	637490.42	7215259.12
SD3-140-02	637564.44	7215034.71
SD3-150-01	637464.59	7215241.68
SD3-150-02	637560.11	7214952.77

REFERENCES

- DRAWINGS # Meadowbank Geotechnical2014 Drilling Program.dwg AND #Meadowbank SD3,4,5.dwg PROVIDED BY AEM LTD., MEADOWBANK DIVISION, JANUARY 2015
- GOLDER 2009. 2009 GEOTECHNICAL INVESTIGATION TAILINGS STORAGE FACILITY, MEADOWBANK GOLD PROJECT, REPORT, GOLDER ASSOCIATES LTD. DECEMBER 2009 (DOC 979 VER 0)
- GOLDER 2010. 2010 GEOTECHNICAL INVESTIGATION, TAILINGS STORAGE FACILITY, MEADOWBANK GOLD PROJECT, REPORT, GOLDER ASSOCIATES LTD. SEPTEMBER 2010 (DOC 1094 VER 0)
- AEM 2014, DATA TRANSMITED BY E-MAIL ON DECEMBER 31, 2014

0 5 10
1:150 METRES

0 25 50
1:750 METRES

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED
0	2015-04-30	ISSUED FOR CONSTRUCTION	F. Bolduc	S. Betnesky	P. Gince	Y. Boulianne
A	2015-03-27	ISSUED FOR COMMENTS	F. Bolduc	R. Gravel	P. Gince	Y. Boulianne

SEAL

Original Signed and Sealed by Yves Boulianne on April 30th, 2015

CLIENT

AGNICO EAGLE MINES LIMITED

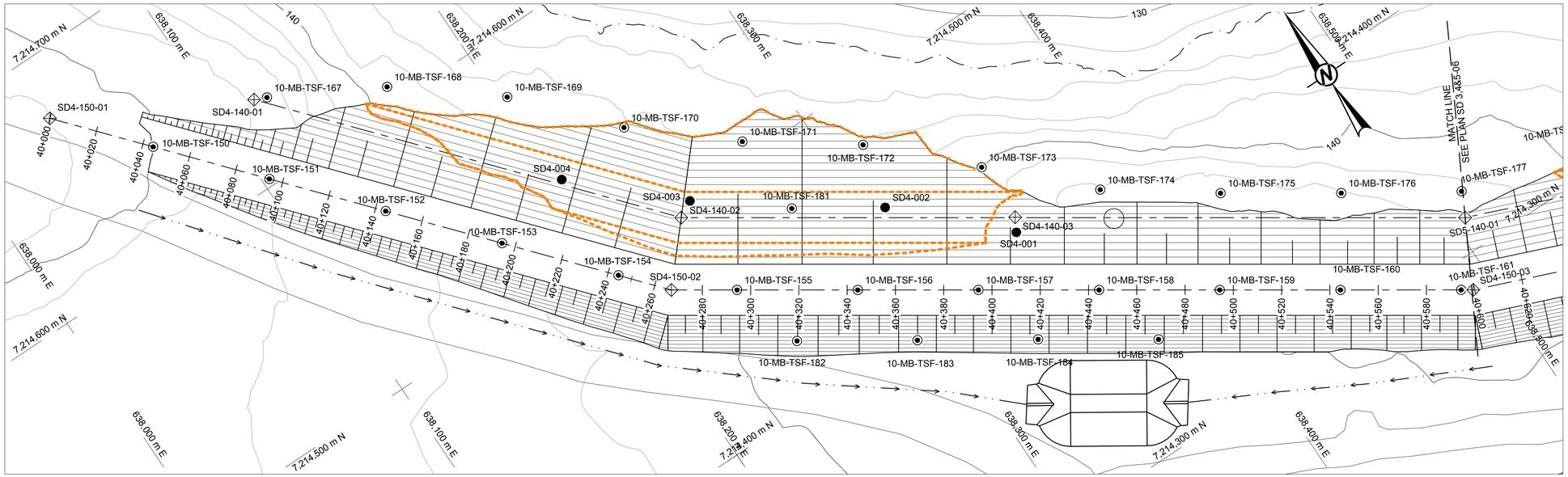
CONSULTANT

GOLDER ASSOCIATES LTD.
1001, DE MAISONNEUVE W. BLVD
MONTREAL (QUEBEC)
CANADA H3A 3C8
[+1] (514) 383-0990
www.golder.com

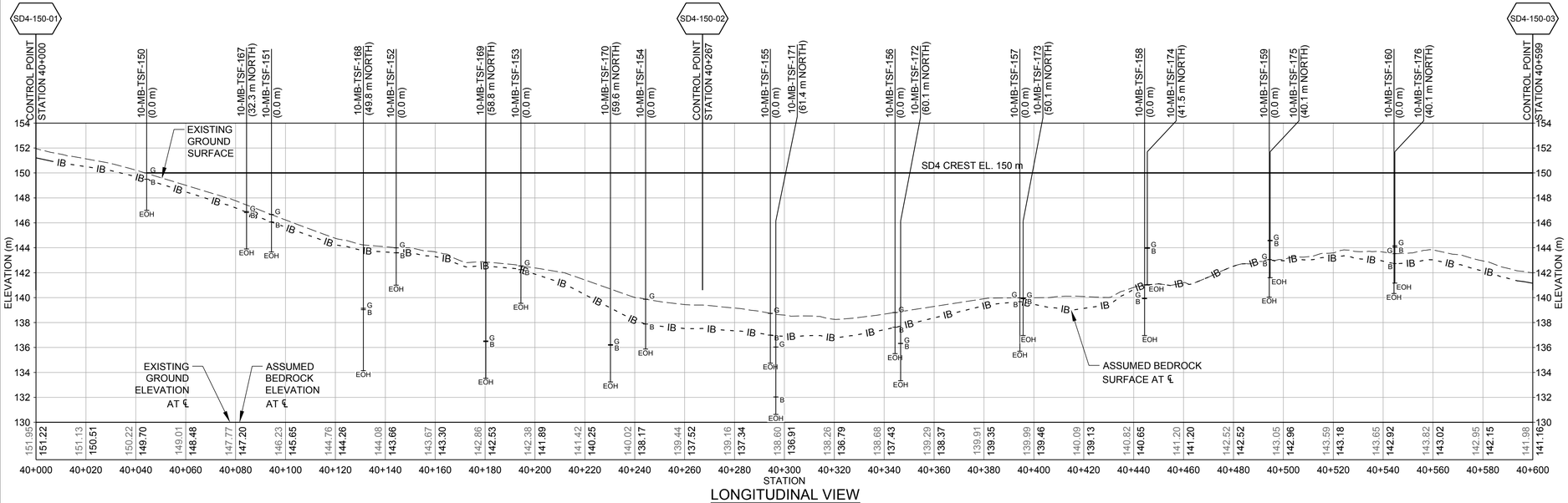
PROJECT
MEADOWBANK GOLD PROJECT
TAILINGS STORAGE FACILITY
SADDLE DAM 3, 4 & 5

TITLE
SADDLE DAM 3 PLAN, PROFILE AND QUANTITIES

PROJECT No.	PHASE	Rev.		PLAN
1416081	2000	0	4 of 15	SD 3,4&5-04



PLAN VIEW
SCALE 1:1,000



LONGITUDINAL VIEW
HORIZONTAL SCALE 1:1,000
VERTICAL VIEW SCALE 1:200

LEGEND

- BOREHOLE (GOLDER, 2009)
- BOREHOLE (GOLDER, 2010)
- BOREHOLE (AEM, 2014)
- SADDLE DAM CONTROL POINT
- STATION AND CENTER LINE (2+580)
- SADDLE DAM ELEVATION 140 m FOOTPRINT
- 140 — LAND-BASED TOPOGRAPHIC MAJOR CONTOUR INTERVAL 10 m
- LAND-BASED TOPOGRAPHIC MINOR CONTOUR INTERVAL 2 m
- PROPOSED DITCH
- 10-MB-TSF-154 (0.0 m) BOREHOLE NAME (OFFSET PERPENDICULAR TO CENTER LINE)
- G GROUND SURFACE
- B BEDROCK
- EOH END OF HOLE
- ℄ CENTRELINE

NOTES

1. REFER TO THE GENERAL NOTES ON THE FRONT PAGE (SD 3,4&5-01).
2. GEOTECHNICAL INFORMATION SHOWN ON THE PROFILE, INCLUDING GROUND SURFACE AND BEDROCK ELEVATION, IS APPROXIMATE.
3. ACTUAL LIMIT OF FOUNDATION PREPARATION WILL BE BASED ON CONDITIONS ENCOUNTERED ON THE FIELD.
4. THE FOOTPRINT SHOWN ON PLAN IS FOR ROCKFILL ONLY.
5. ESTIMATED QUANTITIES FOR LINER INCLUDE ALLOWANCE FOR SEAMING OVERLAPS.
6. THE ESTIMATED EXCAVATION QUANTITY IS BASED ON ASSUMED GROUND AND BEDROCK ELEVATIONS.
7. DETAILED BOREHOLE LOGS ARE CONTAINED WITHIN GOLDER'S GEOTECHNICAL REPORT.
8. THE LINER OF SD4 MUST CONNECT WITH THE LINER OF SD5
9. FOR DETAILED DESIGN AND CONSTRUCTION SEQUENCE REFER TO DWG SD 3,4&5-07-08-10-12-13 INCLUSIVE
10. THE SUMP AREA AND ADJACENT DITCHES ARE TO BE ADAPTED TO FIELD CONDITIONS.

SADDLE DAM 4 QUANTITY ESTIMATE (CREST ELEVATION 140 m)	
Foundation Stripping	16,400 m^2
Overburden (Till) excavation	38,000 m^3
Low Quality Till	6,800 m^3
Compacted Till (Zone 1)	8,000 m^3
Fine Filter (Zone 2)	3,900 m^3
Coarse Filter (Zone 3)	3,300 m^3
Non-AG Coarse Rockfill (Zone 4B)	26,100 m^3
Fine Rockfill (Zone 5)	1,200 m^3
Géotextile	6,700 m^2
Geomembrane	7,300 m^2

SAD4 - CONTROL POINTS

POINT ID	EASTING (m)	NORTHING (m)
SD4-140-01	638116.01	7214633.81
SD4-140-02	638235.67	7214494.53
SD4-140-03	638350.63	7214417.53
SD4-150-01	638041.46	7214674.55
SD4-150-02	638215.57	7214471.89
SD4-150-03	638491.38	7214286.71

REFERENCES

- DRAWINGS # Meadowbank Geotechnical2014 Drilling Program.dwg AND #Meadowbank SD3,4,5.dwg PROVIDED BY AEM LTD., MEADOWBANK DIVISION, JANUARY 2015
- GOLDER 2009. 2009 GEOTECHNICAL INVESTIGATION TAILINGS STORAGE FACILITY. MEADOWBANK GOLD PROJECT, REPORT, GOLDER ASSOCIATES LTD. DECEMBER 2009 (DOC 979 VER 0)
- GOLDER 2010. 2010 GEOTECHNICAL INVESTIGATION, TAILINGS STORAGE FACILITY. MEADOWBANK GOLD PROJECT, REPORT, GOLDER ASSOCIATES LTD. SEPTEMBER 2010 (DOC 1094 VER 0)
- AEM 2014, DATA TRANSMITED BY E-MAIL ON DECEMBER 31, 2014

0 50 100
1:1,000 METRES

0 10 20
1:200 METRES

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED
0	2015-04-30	ISSUED FOR CONSTRUCTION	F. Bolduc	S. Betnesky	P. Gince	Y. Boulianne
A	2015-03-27	ISSUED FOR COMMENTS	F. Bolduc	R. Gravel	P. Gince	Y. Boulianne

SEAL

Original Signed and Sealed by Yves Boulianne on April 30th, 2015

CLIENT
AGNICO EAGLE MINES LIMITED

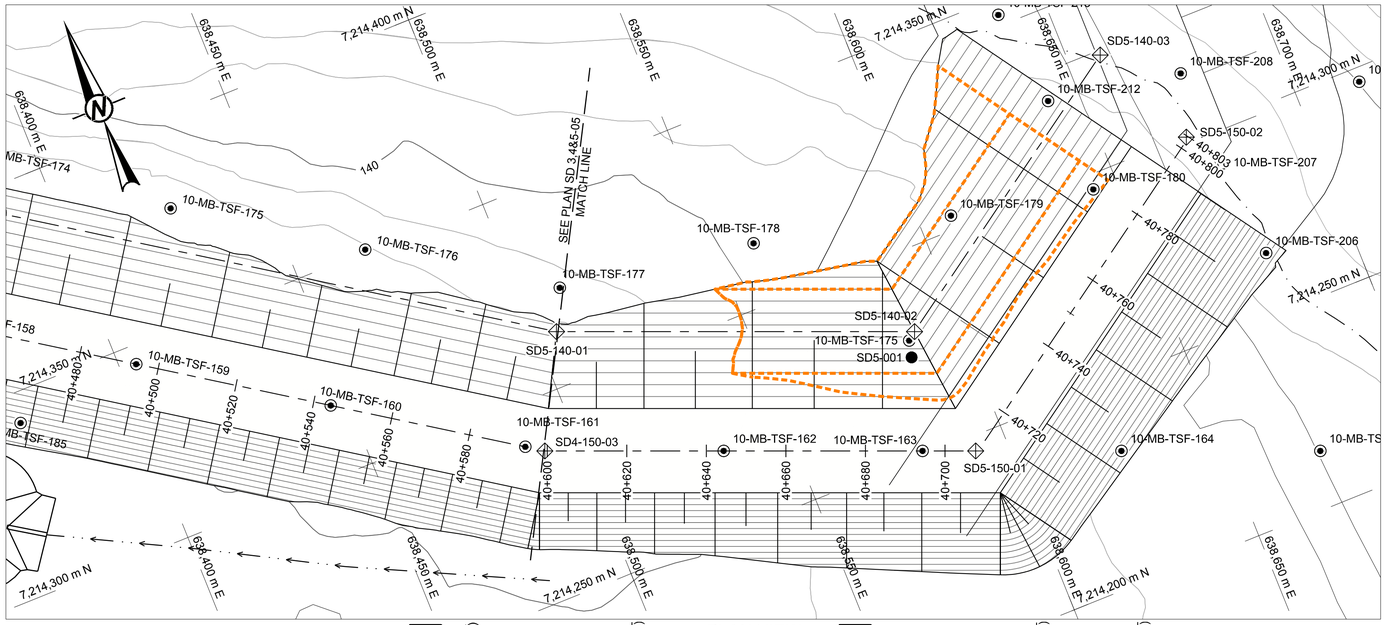
CONSULTANT
GOLDER ASSOCIATES LTD.
1001, DE MAISONNEUVE W. BLVD
MONTREAL (QUEBEC)
CANADA H3A 3C8
[+1] (514) 383-0990
www.golder.com

PROJECT
MEADOWBANK GOLD PROJECT
TAILINGS STORAGE FACILITY
SADDLE DAM 3, 4 & 5

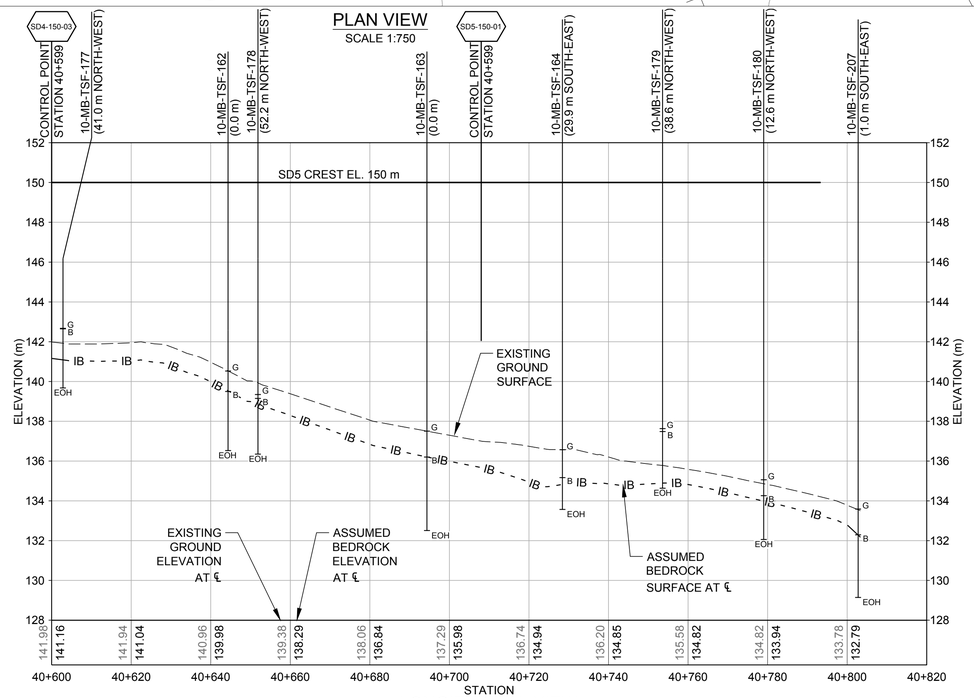
TITLE
SADDLE DAM 4 PLAN, PROFILE AND QUANTITIES

PROJECT No.	PHASE	Rev.	PLAN
1416081	2000	0	SD 3,4&5-05

5 of 15



PLAN VIEW
SCALE 1:750



LONGITUDINAL VIEW
HORIZONTAL SCALE 1:750
VERTICAL VIEW SCALE 1:150

SADDLE DAM 5 QUANTITY ESTIMATE (CREST ELEVATION 140 m)	
Foundation Stripping	9,000 m^2
Overburden (Till) excavation	5,700 m^3
Low Quality Till	0 m^3
Compacted Till (Zone 1)	800 m^3
Fine Filter (Zone 2)	1,100 m^3
Coarse Filter (Zone 3)	1,000 m^3
Non-AG Coarse Rockfill (Zone 4B)	16,500 m^3
Fine Rockfill (Zone 5)	900 m^3
Géotextile	1,100 m^2
Geomembrane	1,400 m^2

SAD5 - CONTROL POINTS		
POINT ID	EASTING (m)	NORTHING (m)
SD5-140-01	638505.29	7214313.45
SD5-140-02	638588.81	7214279.88
SD5-140-03	638658.05	7214326.97
SD5-150-01	638591.89	7214246.32
SD5-150-02	638670.44	7214299.74

LEGEND

- BOREHOLE (GOLDER, 2009)
- BOREHOLE (GOLDER, 2010)
- BOREHOLE (AEM, 2014)
- SADDLE DAM CONTROL POINT
- STATION AND CENTER LINE (2+580)
- SADDLE DAM ELEVATION 140 m FOOTPRINT
- 140 — LAND-BASED TOPOGRAPHIC MAJOR CONTOUR INTERVAL 10 m
- LAND-BASED TOPOGRAPHIC MINOR CONTOUR INTERVAL 2 m
- PROPOSED DITCH
- 10-MB-TSF-154 (0.0 m) BOREHOLE NAME (OFFSET PERPENDICULAR TO CENTER LINE)
  - G GROUND SURFACE
  - B BEDROCK
  - EOH END OF HOLE
- ℄ CENTRELINE

NOTES

1. REFER TO THE GENERAL NOTES ON THE FRONT PAGE (SD 3,4&5-01).
2. GEOTECHNICAL INFORMATION SHOWN ON THE PROFILE, INCLUDING GROUND SURFACE AND BEDROCK ELEVATION, IS APPROXIMATE.
3. ACTUAL LIMIT OF FOUNDATION PREPARATION WILL BE BASED ON CONDITIONS ENCOUNTERED ON THE FIELD.
4. THE FOOTPRINT SHOWN ON PLAN IS FOR ROCKFILL ONLY.
5. ESTIMATED QUANTITIES FOR LINER INCLUDE ALLOWANCE FOR SEAMING OVERLAPS.
6. THE ESTIMATED EXCAVATION QUANTITY IS BASED ON ASSUMED GROUND AND BEDROCK ELEVATIONS.
7. DETAILED BOREHOLE LOGS ARE CONTAINED WITHIN GOLDER'S GEOTECHNICAL REPORT.
8. THE LINER OF SD5 MUST CONNECT WITH THE LINER OF SD4 ON THE WEST END AND THE LINER OF CENTRAL DIKE ON THE EAST END.
9. FOR DETAILED DESIGN AND CONSTRUCTION SEQUENCE REFER TO DWG SD 3,4&5-07-08-11-12-13 INCLUSIVE.

REFERENCES

- DRAWINGS # Meadowbank Geotechnical2014 Drilling Program.dwg AND #Meadowbank SD3,4,5.dwg PROVIDED BY AEM LTD., MEADOWBANK DIVISION, JANUARY 2015
- GOLDER 2009. 2009 GEOTECHNICAL INVESTIGATION TAILINGS STORAGE FACILITY. MEADOWBANK GOLD PROJECT, REPORT, GOLDER ASSOCIATES LTD. DECEMBER 2009 (DOC 979 VER 0)
- GOLDER 2010. 2010 GEOTECHNICAL INVESTIGATION, TAILINGS STORAGE FACILITY. MEADOWBANK GOLD PROJECT, REPORT, GOLDER ASSOCIATES LTD. SEPTEMBER 2010 (DOC 1094 VER 0)
- AEM 2014, DATA TRANSMITED BY E-MAIL ON DECEMBER 31, 2014

0 5 10
1:150 METRES

0 25 50
1:750 METRES

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED
0	2015-04-30	ISSUED FOR CONSTRUCTION	F. Bolduc	S. Betnesky	P. Gince	Y. Boulianne
A	2015-03-27	ISSUED FOR COMMENTS	F. Bolduc	R. Gravel	P. Gince	Y. Boulianne

SEAL

Original Signed and Sealed by Yves Boulianne on April 30th, 2015

CLIENT
AGNICO EAGLE MINES LIMITED

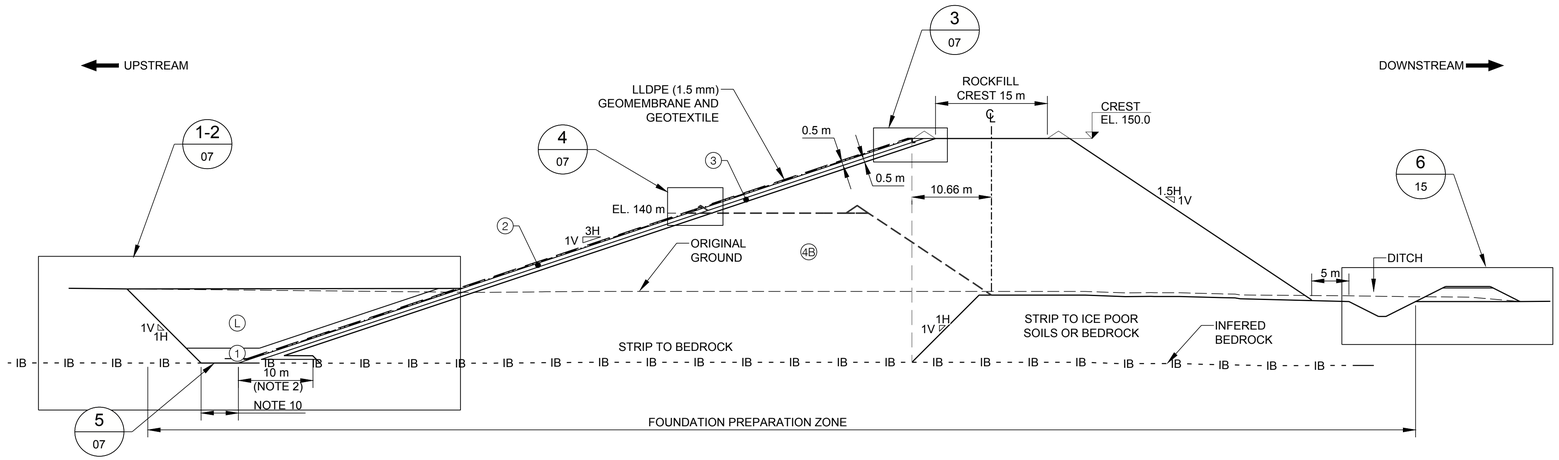
CONSULTANT

GOLDER ASSOCIATES LTD.
1001, DE MAISONNEUVE W. BLVD
MONTREAL (QUEBEC)
CANADA H3A 3C8
[+1] (514) 383-0990
www.golder.com

PROJECT
MEADOWBANK GOLD PROJECT
TAILINGS STORAGE FACILITY
SADDLE DAM 3, 4 & 5

TITLE
SADDLE DAM 5 PLAN, PROFILE AND QUANTITIES

PROJECT No.	PHASE	Rev.	PLAN
1416081	2000	0	6 of 15 SD 3,4&5-06

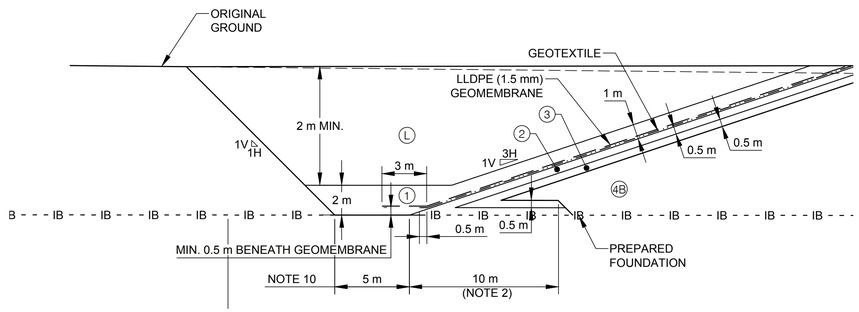


TYPICAL CROSS-SECTION

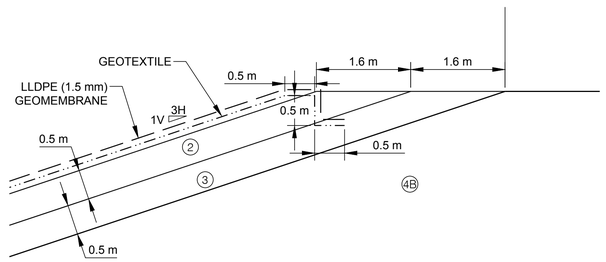
SCALE 1:400

NOTES

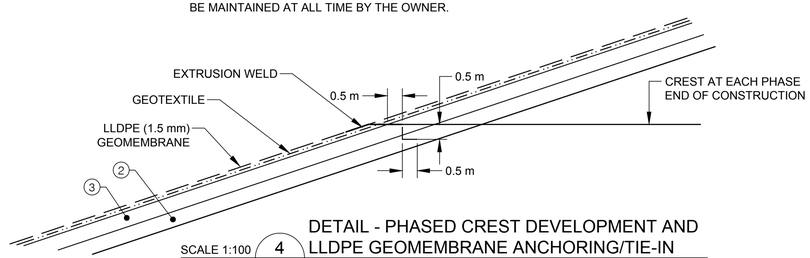
1. REFER TO THE GENERAL NOTES ON THE FRONT PAGE (SD 3,4&5-01).
2. THE INVERSE FILTER LENGTH CAN BE DECREASED ACCORDING TO FIELD CONDITIONS. APPROVAL TO PROCEED IS THE RESPONSIBILITY OF THE OWNER REPRESENTATIVE AND THE QA ENGINEER.
3. UPSTREAM TOE LINER TIE-IN AND UPSTREAM ROCKFILL TO BE FOUNDED ON BEDROCK TO THE SATISFACTION OF THE OWNER REPRESENTATIVE AND THE QA ENGINEER.
4. ALL SOFT AND ICE-RICH MATERIAL SHALL BE REMOVED FROM THE DAM FOOTPRINT.
5. EXCAVATION TO EXPOSE THE GEOMEMBRANE SHALL BE DONE BY HAND.
6. THE PREPARED FOUNDATION SURFACE SHALL BE INSPECTED AND APPROVED BY THE OWNER'S REPRESENTATIVE AND THE QA ENGINEER PRIOR TO PLACEMENT OF FILL MATERIALS.
7. THE CONTRACTOR IS RESPONSIBLE FOR THE STABILITY OF ALL TEMPORARY EXCAVATIONS, INCLUDING DEWATERING.
8. THE EXPOSED BEDROCK SURFACE SHALL BE PREPARED TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE. DETAILED STRUCTURAL MAPPING OF THE BEDROCK SHALL BE PERFORMED BY THE QA ENGINEER PRIOR TO PLACEMENT OF FILL MATERIAL.
9. UPSTREAM TOE LINER TIE-IN BACKFILL MATERIAL SUBJECT TO APPROVAL BY THE QA ENGINEER.
10. EXPOSED BEDROCK DISCONTINUITIES ≥ 10 mm AND OTHERS AREAS OF CONCERN IDENTIFIED BY THE QA ENGINEER ARE TO BE PROTECTED BY BENTONITE ENRICHED (10% BY MASS) GRANULAR FINE FILTER, AS SHOWN IN DETAIL 5. THE USE OF 20 mm PROCESSED ROCKFILL MIXED WITH BENTONITE IS CONSIDERED APPROPRIATE FOR USE AS GRANULAR FILTER MATERIAL ON BEDROCK DISCONTINUITY.
11. THE CONFIGURATION OF THE UPSTREAM TOE LINER TIE-IN DEPENDS ON THE ENCOUNTERED DEPTH OF THE BEDROCK. REFER TO DETAILS 1 AND 2.
12. LINER BEDDING MUST BE PLACED ON APPROVED FOUNDATION SURFACE IN THE EXCAVATION. MATERIAL PLACED BETWEEN FOUNDATION AND LINER SUBJECT TO APPROVAL BY THE QA ENGINEER.
13. A TAILINGS BEACH HAVING A MINIMUM HORIZONTAL LENGTH OF 20 m AND STANDING AGAINST THE DAM SHALL BE MAINTAINED AT ALL TIMES BY THE OWNER. A MINIMUM FREEBOARD OF 0.5 m SHALL BE MAINTAINED AT ALL TIME BY THE OWNER.



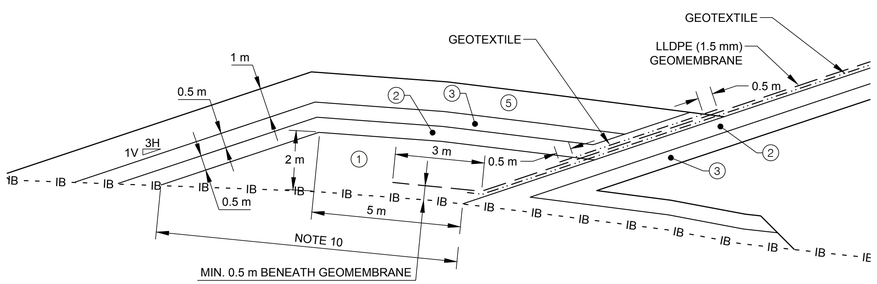
SCALE 1:200 — 1 / 07 — DETAIL - UPSTREAM TOE LINER TIE-IN



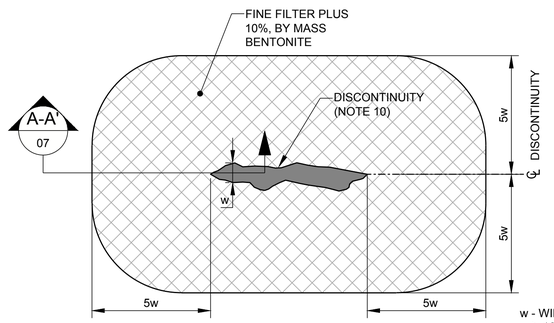
SCALE 1:50 — 3 / 07 — DETAIL - LLDPE GEOMEMBRANE ANCHOR AT CREST



SCALE 1:100 — 4 / 07 — DETAIL - PHASED CREST DEVELOPMENT AND LLDPE GEOMEMBRANE ANCHORING/TIE-IN

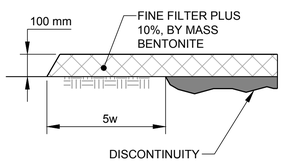


SCALE 1:100 — 2 / 07 — DETAIL - UPSTREAM TOE LINER TIE-IN IN BACKFILL



NTS — 5 / 07 — DETAIL - BEDROCK DISCONTINUITY TREATMENT

w - WIDTH OF DISCONTINUITY
w ≥ 10mm



NTS — A-A' / 07 — CROSS-SECTION A-A'

LEGEND

- IB - - IB — ASSUMED BEDROCK
- EXISTING GROUND
- (L) LOW QUALITY TILL
- (1) COMPACTED TILL
- (2) FINE FILTER
- (3) COARSE FILTER
- (4B) NON-AG COARSE ROCKFILL
- (5) FINE ROCKFILL
- GEOTEXTILE
- LLDPE (1.5 mm)
- ℄ CENTRELINE

0 2 4 — 1:50 METRES

0 5 10 — 1:100 METRES

0 10 20 — 1:200 METRES

0 20 40 — 1:400 METRES

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED
0	2015-04-30	ISSUED FOR CONSTRUCTION	F. Bolduc	S. Betnesky	P. Gince	Y. Boulianne
A	2015-03-27	ISSUED FOR COMMENTS	F. Bolduc	R. Gravel	P. Gince	Y. Boulianne

SEAL

Original Signed and Sealed by Yves Boulianne on April 30th, 2015

CLIENT

AGNICO EAGLE MINES LIMITED

CONSULTANT

GOLDER ASSOCIATES LTD.
1001, BLVD DE MAISONNEUVE W.
MONTREAL (QUEBEC)
CANADA H3A 3C8
[+1] (514) 383-0990
www.golder.com

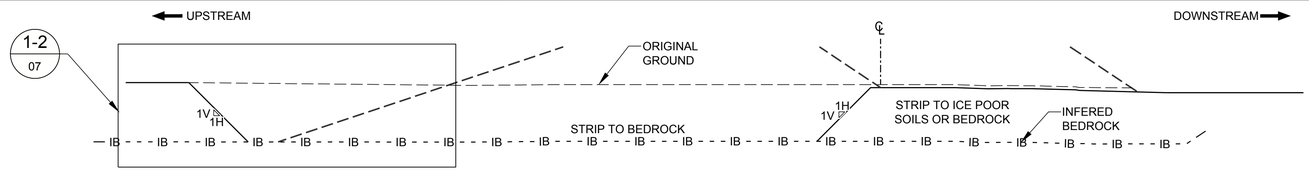
PROJECT

MEADOWBANK GOLD PROJECT
TAILINGS STORAGE FACILITY
SADDLE DAM 3, 4 & 5

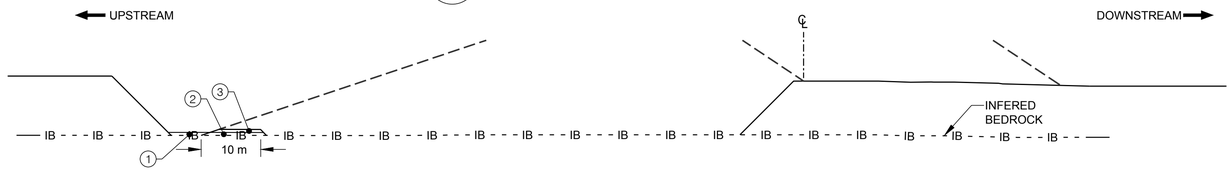
TITLE

TYPICAL CROSS-SECTION AND DETAILS

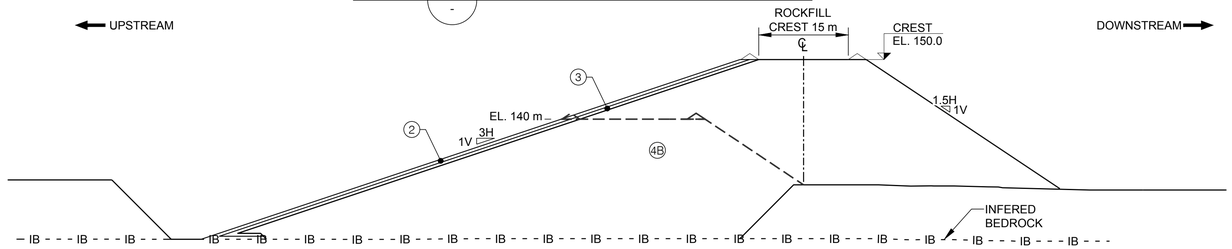
PROJECT No.	PHASE	Rev.	PLAN
1416081	2000	0	SD 3,4&5-07



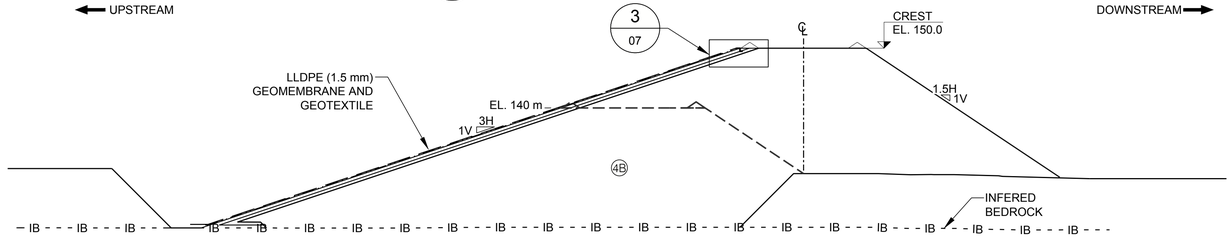
SCALE 1:500 1 - EXCAVATION AND FOUNDATION PREPARATION OF THE UPSTREAM TOE LINER TIE-IN AREA



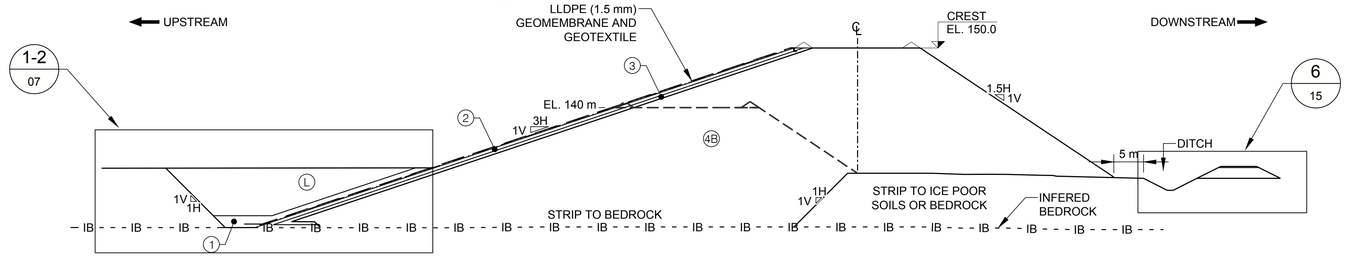
SCALE 1:500 2 - INITIAL INVERSE FILTER PLACEMENT



SCALE 1:500 3 - ROCKFILL AND FILTER PLACEMENT



SCALE 1:500 4 - LINER PLACEMENT



SCALE 1:500 5 - LINER PLUG AT UPSTREAM - FINAL GENERAL ARRANGEMENT

LEGEND

— IB - - —	ASSUMED BEDROCK
- - - - - -	EXISTING GROUND
(L)	LOW QUALITY TILL
(1)	COMPACTED TILL
(2)	FINE FILTER
(3)	COARSE FILTER
(4B)	NON-AG COARSE ROCKFILL
(5)	FINE ROCKFILL
—·—·—	GEOTEXTILE
— — —	LLDPE (1.5 mm)
℄	CENTRELINE

NOTES

1. REFER TO THE GENERAL NOTES ON THE FRONT PAGE (SD 3,4&5-01)
2. SEQUENCE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY.
3. FOR DETAILED DESIGN AND CONSTRUCTION DETAILS REFER TO DWG SD 3,4&5-04-05-06-07-13 INCLUSIVE.

0 20 40
1:500 METRES

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED
0	2015-04-30	ISSUED FOR CONSTRUCTION	F. Bolduc	S. Betnesky	P. Gince	Y. Boulianne
A	2015-03-27	ISSUED FOR COMMENTS	F. Bolduc	R. Gravel	P. Gince	Y. Boulianne

SEAL

Original Signed and Sealed by Yves Boulianne on April 30th, 2015

CLIENT

AGNICO EAGLE MINES LIMITED

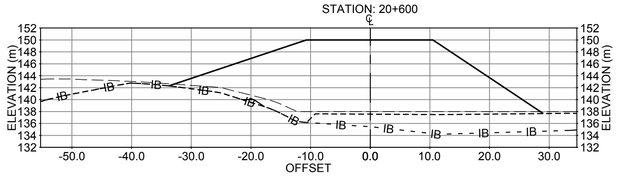
CONSULTANT

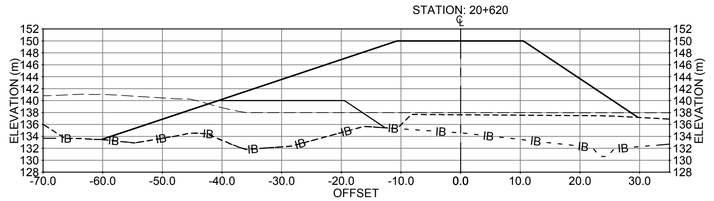
GOLDER ASSOCIATES LTD.
1001, BLVD DE MAISONNEUVE W.
MONTREAL (QUEBEC)
CANADA H3A 3C8
[+1] (514) 383-0990
www.golder.com

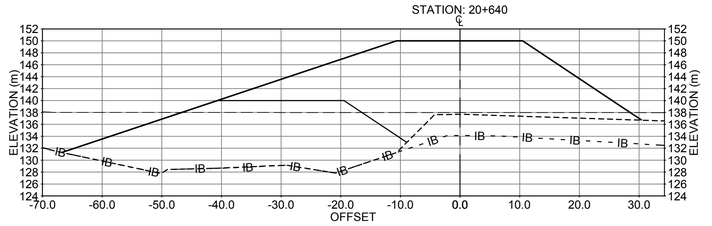
PROJECT
MEADOWBANK GOLD PROJECT
TAILINGS STORAGE FACILITY
SADDLE DAM 3, 4 & 5

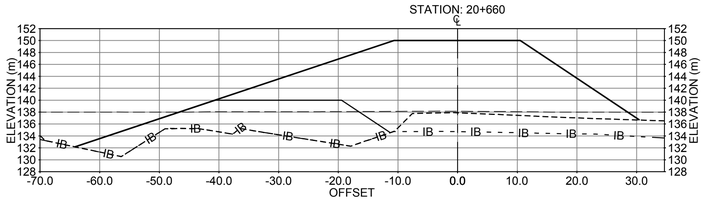
TITLE
STAGED CONSTRUCTION SEQUENCE

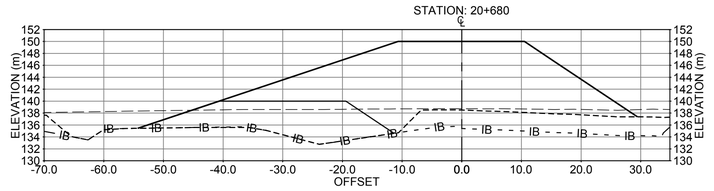
PROJECT No.	PHASE	Rev.		
1416081	2000	0	8 of 15	SD 3,4&5-08

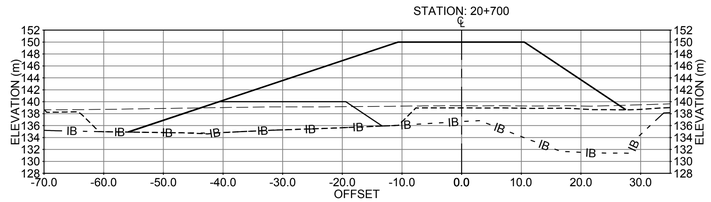


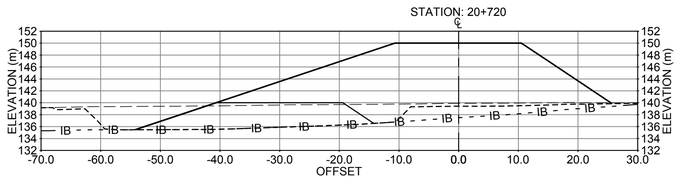


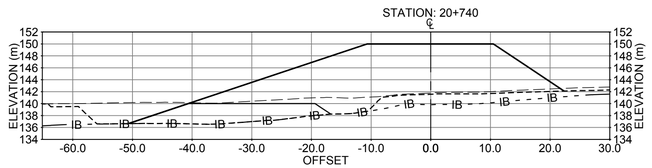


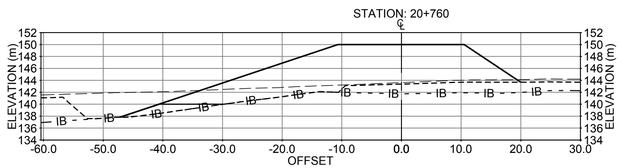


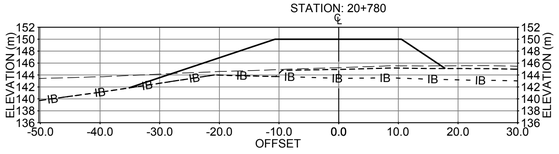


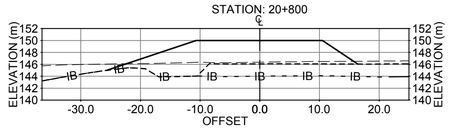


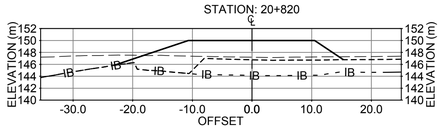


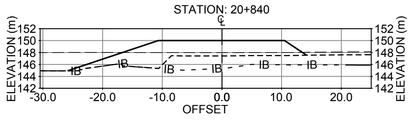


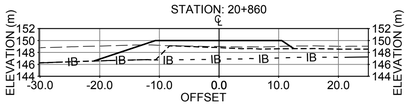












LEGEND

- EXISTING GROUND SURFACE
- IB - - - ASSUMED BEDROCK SURFACE
- WORKING SURFACE
- ℄ CENTRELINE

0 20 40
1:500 METRES

NOTES

1. REFER TO THE GENERAL NOTES ON THE FRONT PAGE (SD 3,4&5-01).
2. SOIL THICKNESS AND BEDROCK DEPTH ARE BASED ON INTERPRETATION OF FIELD INVESTIGATIONS.
3. THE CROSS SECTIONS ARE FOR ILLUSTRATIVE PURPOSE AND DOES NOT INCLUDE THE DETAILS OF THE FILTER, GEOTEXTILE AND UPSTREAM TOE LINER TIE-IN
4. THE CROSS SECTIONS ONLY INCLUDE THE AREA OF THE UPSTREAM TOE LINER TIE-IN IN EXCAVATION. THE BACKFILL PART OF THE USPTREAM TOE LINER TIE-IN TO BE ADJUSTED BASED ON ENCOUNTERED FIELD CONDITIONS

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED
0	2015-04-30	ISSUED FOR CONSTRUCTION	F. Bolduc	S. Betnesky	P. Gince	Y. Boulianne
A	2015-03-27	ISSUED FOR COMMENTS	F. Bolduc	R. Gravel	P. Gince	Y. Boulianne

SEAL

Original Signed and Sealed by Yves Boulianne on April 30th, 2015

CLIENT

AGNICO EAGLE MINES LIMITED

CONSULTANT

GOLDER ASSOCIATES LTD.
1001, BLVD DE MAISONNEUVE W.
MONTREAL (QUEBEC)
CANADA H3A 3C8
[+1] (514) 383-0990
www.golder.com

PROJECT

MEADOWBANK GOLD PROJECT
TAILINGS STORAGE FACILITY
SADDLE DAM 3, 4 & 5

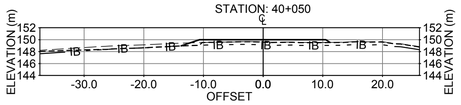
TITLE

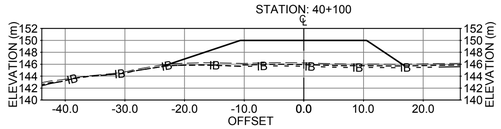
SADDLE DAM 3 CROSS-SECTIONS

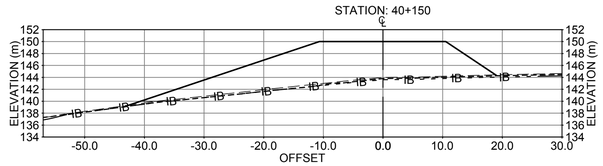
PROJECT No.	PHASE	Rev.		PLAN
1416081	2000	0	9 of 15	SD 3,4&5-09

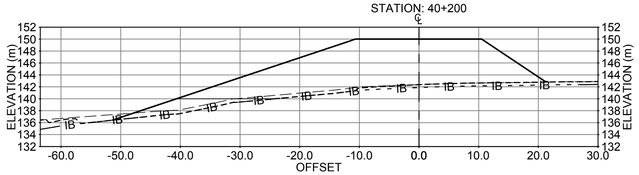
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

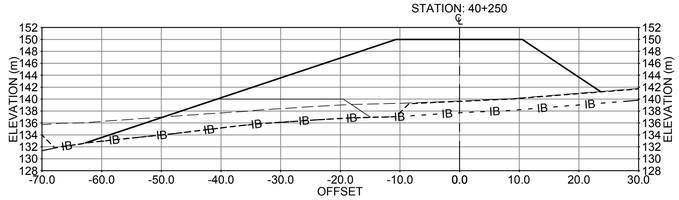
0 25 mm

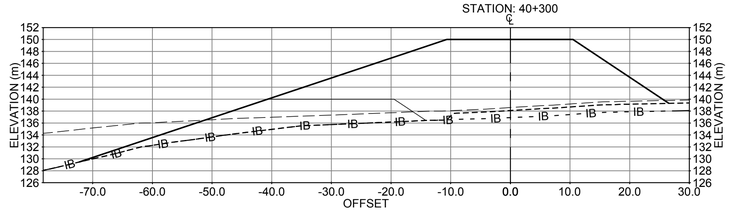


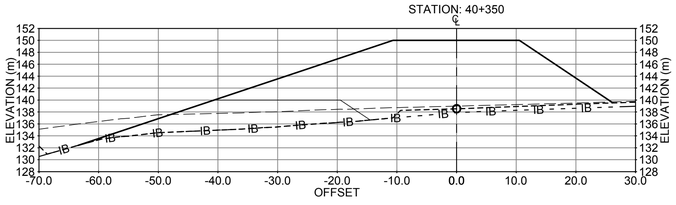


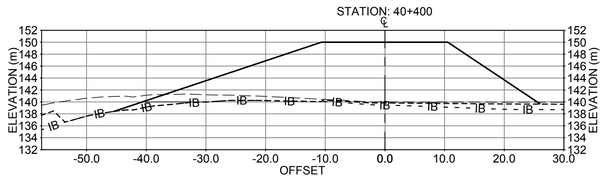


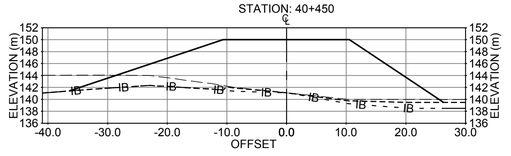


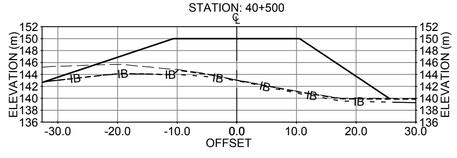


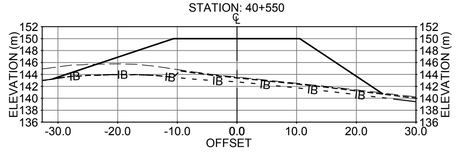












LEGEND

- EXISTING GROUND SURFACE
- IB — ASSUMED BEDROCK SURFACE
- WORKING SURFACE
- ℄ CENTRELINE

0 20 40
1:500 METRES

NOTES

1. REFER TO THE GENERAL NOTES ON THE FRONT PAGE (SD 3,4&5-01).
2. SOIL THICKNESS AND BEDROCK DEPTH ARE BASED ON INTERPRETATION OF FIELD INVESTIGATIONS.
3. THE CROSS SECTIONS ARE FOR ILLUSTRATIVE PURPOSE AND DOES NOT INCLUDE THE DETAILS OF THE FILTER, GEOTEXTILE AND UPSTREAM TOE LINER TIE-IN
4. THE CROSS SECTIONS ONLY INCLUDE THE AREA OF THE UPSTREAM TOE LINER TIE-IN IN EXCAVATION. THE BACKFILL PART OF THE USPTREAM TOE LINER TIE-IN TO BE ADJUSTED BASED ON ENCOUNTERED FIELD CONDITIONS

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED
0	2015-04-30	ISSUED FOR CONSTRUCTION	F. Bolduc	S. Betnesky	P. Gince	Y. Boulianne
A	2015-03-27	ISSUED FOR COMMENTS	F. Bolduc	R. Gravel	P. Gince	Y. Boulianne

SEAL

Original Signed and Sealed by Yves Boulianne on April 30th, 2015

CLIENT

AGNICO EAGLE MINES LIMITED

CONSULTANT

GOLDER ASSOCIATES LTD.
1001, BLVD DE MAISONNEUVE W.
MONTREAL (QUEBEC)
CANADA H3A 3C8
[+1] (514) 383-0990
www.golder.com

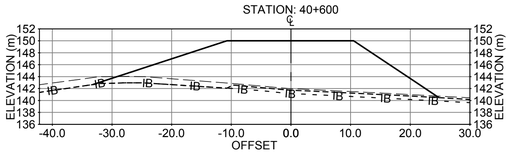
PROJECT

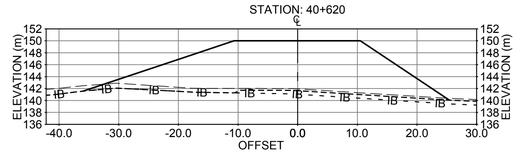
MEADOWBANK GOLD PROJECT
TAILINGS STORAGE FACILITY
SADDLE DAM 3, 4 & 5

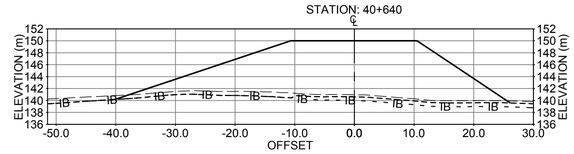
TITLE

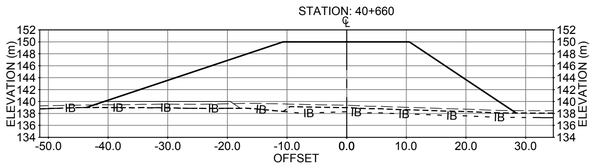
SADDLE DAM 4 CROSS-SECTIONS

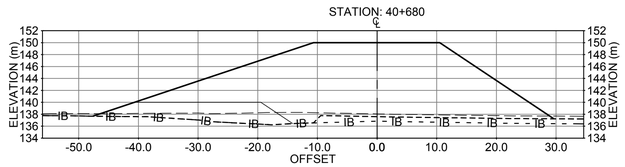
PROJECT No.	PHASE	Rev.		
1416081	2000	0	10 of 15	SD 3,4&5-10

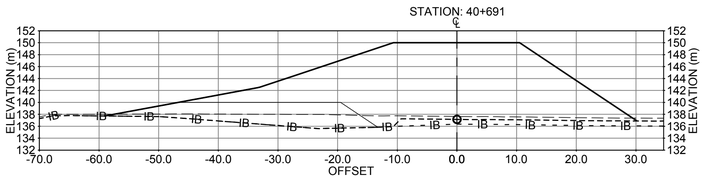


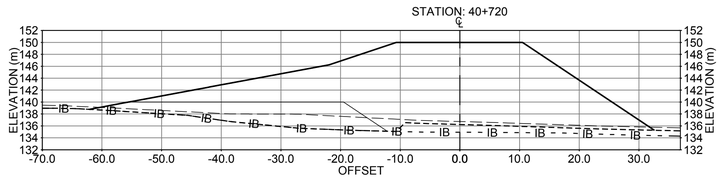


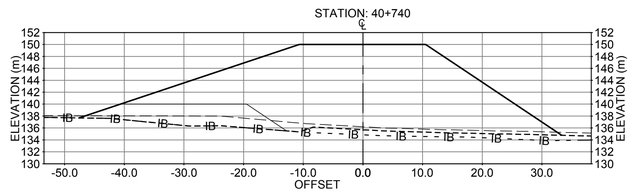


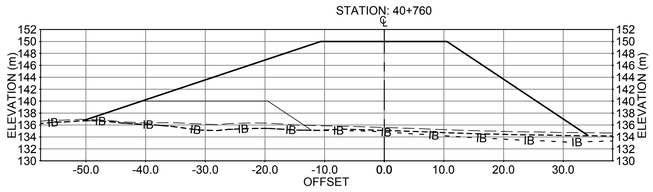


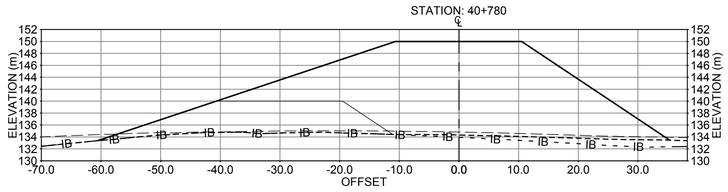












NOTES

1. REFER TO THE GENERAL NOTES ON THE FRONT PAGE (SD 3,4&5-01).
2. SOIL THICKNESS AND BEDROCK DEPTH ARE BASED ON INTERPRETATION OF FIELD INVESTIGATIONS.
3. THE CROSS SECTIONS ARE FOR ILLUSTRATIVE PURPOSE AND DOES NOT INCLUDE THE DETAILS OF THE FILTER, GEOTEXTILE AND UPSTREAM TOE LINER TIE-IN
4. THE CROSS SECTIONS ONLY INCLUDE THE AREA OF THE UPSTREAM TOE LINER TIE-IN IN EXCAVATION. THE BACKFILL PART OF THE USPTREAM TOE LINER TIE-IN TO BE ADJUSTED BASED ON ENCOUNTERED FIELD CONDITIONS

LEGEND

- EXISTING GROUND SURFACE
- IB — ASSUMED BEDROCK SURFACE
- WORKING SURFACE
- ℄ CENTRELINE

0 20 40
1:500 METRES

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED
0	2015-04-30	ISSUED FOR CONSTRUCTION	F. Bolduc	S. Betnesky	P. Gince	Y. Boulianne
A	2015-03-27	ISSUED FOR COMMENTS	F. Bolduc	R. Gravel	P. Gince	Y. Boulianne

SEAL

Original Signed and Sealed by Yves Boulianne on April 30th, 2015

CLIENT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED

CONSULTANT

GOLDER ASSOCIATES LTD.
1001, BLVD DE MAISONNEUVE W.
MONTREAL (QUEBEC)
CANADA H3A 3C8
[+1] (514) 383-0990
www.golder.com

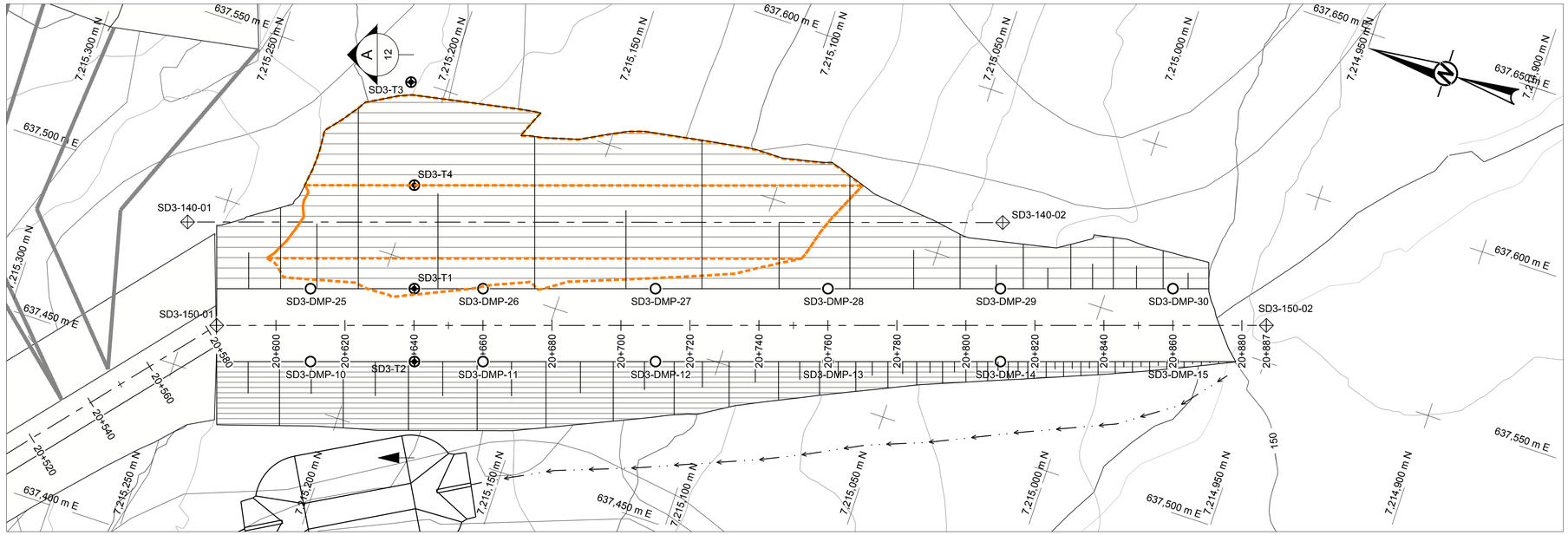
PROJECT

MEADOWBANK GOLD PROJECT
TAILINGS STORAGE FACILITY
SADDLE DAM 3, 4 & 5

TITLE

SADDLE DAM 5 CROSS-SECTIONS

PROJECT No.	PHASE	Rev.	11 of 15	PLAN
1416081	2000	0		SD 3,4&5-11



PLAN VIEW
SCALE 1:750

LEGEND

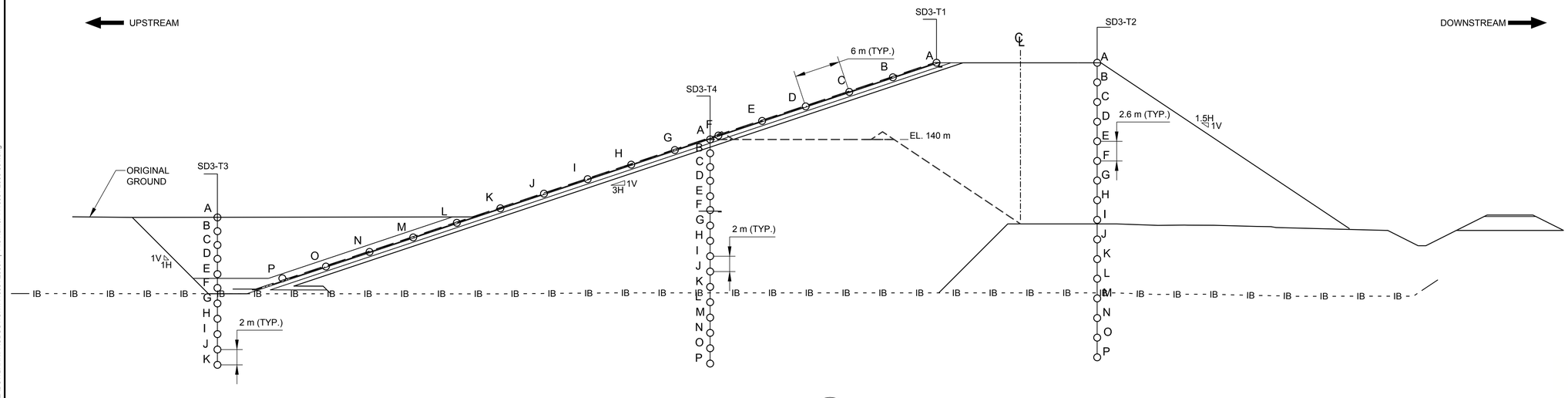
- SD3-T1 — THERMISTOR
- SD3-DMP-14 — DISPLACEMENT MONITORING POINT
- 2+580 — STATION AND CENTER LINE
- SADDLE DAM ELEVATION 140 m FOOTPRINT
- 140 — LAND-BASED TOPOGRAPHIC MAJOR CONTOUR INTERVAL 10 m
- LAND-BASED TOPOGRAPHIC MINOR CONTOUR INTERVAL 2 m
- ℄ — CENTRELINE

NOTES

1. REFER TO THE GENERAL NOTES ON THE FRONT PAGE (SD 3,4&5-01)
2. THE OWNER IS IN CHARGE OF INSTALLING THE INSTRUMENTATION.
3. INSTRUMENTATION INSTALLATIONS SHALL BE IN ACCORDANCE WITH INSTRUMENTATION SPECIFICATION LISTED ON DRAWING SD 3,4&5-01
4. THE CONFIGURATION OF THE UPSTREAM TOE LINER TIE-IN WILL DEPEND ON THE ENCOUNTERED DEPTH OF THE BEDROCK. REFER TO DETAIL 1-07 AND 2-07
5. DISPLACEMENT MONITORING POINTS SHALL BE INSTALLED PREFERENTIALLY ON THE UPSTREAM CREST. DOWNSTREAM INSTALLATIONS TO BE LOCATED FOR PROTECTION FROM THE VEHICULE DAMAGE.

SADDLE DAM 3 - DISPLACEMENT MONITORING POINTS			
POINT ID	STATION	EASTING	NORTHING
SD3-DMP-10	20+610	637463.157	7215212.571
SD3-DMP-11	20+660	637478.852	7215165.098
SD3-DMP-12	20+710	637494.547	7215117.625
SD3-DMP-13	20+760	637510.242	7215070.153
SD3-DMP-14	20+810	637525.937	7215022.68
SD3-DMP-15	20+860	637541.632	7214975.207
SD3-DMP-25	20+610	637483.249	7215219.214
SD3-DMP-26	20+660	637498.945	7215171.741
SD3-DMP-27	20+710	637514.64	7215124.268
SD3-DMP-28	20+760	637530.335	7215076.796
SD3-DMP-29	20+810	637546.03	7215029.323
SD3-DMP-30	20+860	637561.725	7214981.85

SADDLE DAM 3 - THERMISTORS			
POINT ID	STATION	EASTING	NORTHING
SD3-T1	20+640	637492.692	7215190.652
SD3-T2	20+640	637472.609	7215183.988
SD3-T3	20+640	637549.247	7215210.337
SD3-T4	20+640	637521.176	7215200.069



SCALE 1:300 — A — TYPICAL CROSS-SECTION - THERMISTOR LOCATIONS

0 10 20
1:300 METRES

0 25 50
1:750 METRES

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED
0	2015-04-30	ISSUED FOR CONSTRUCTION	F. Bolduc	S. Betnesky	P. Gince	Y. Boulianne
A	2015-03-27	ISSUED FOR COMMENTS	F. Bolduc	R. Gravel	P. Gince	Y. Boulianne

SEAL

Original Signed and Sealed by Yves Boulianne on April 30th, 2015

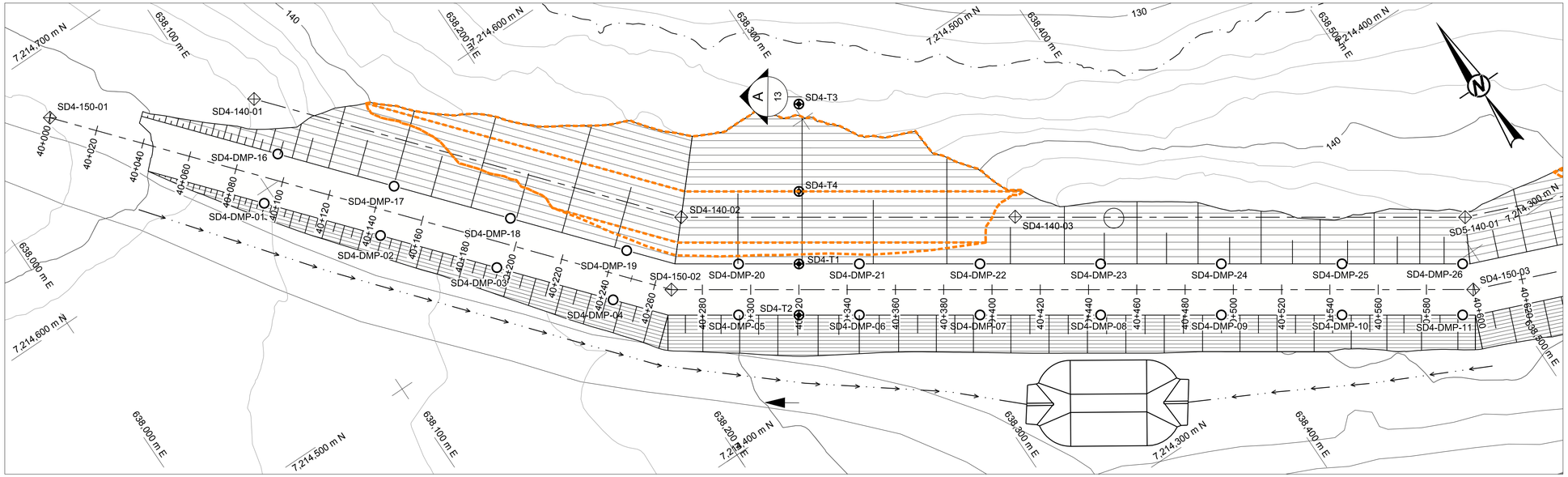
CLIENT
AGNICO EAGLE MINES LIMITED

CONSULTANT
GOLDER ASSOCIATES LTD.
1001, BLVD DE MAISONNEUVE W.
MONTREAL (QUEBEC)
CANADA H3A 3C8
[+1] (514) 383-0990
www.golder.com

PROJECT
MEADOWBANK GOLD PROJECT
TAILINGS STORAGE FACILITY
SADDLE DAM 3, 4 & 5

TITLE
INSTRUMENTATION PLAN AND SECTION - SADDLE DAM 3

PROJECT No.	PHASE	Rev.		PLAN
1416081	2000	0	12 of 15	SD 3,4&5-12



PLAN VIEW
SCALE 1:1,000

LEGEND

- SD4-T1 — THERMISTOR
- SD4-DMP-14 — DISPLACEMENT MONITORING POINT
- STATION AND CENTER LINE (e.g. 2+580)
- SADDLE DAM ELEVATION 140 m FOOTPRINT
- 140 — LAND-BASED TOPOGRAPHIC MAJOR CONTOUR INTERVAL 10 m
- LAND-BASED TOPOGRAPHIC MINOR CONTOUR INTERVAL 2 m
- ℄ — CENTRELINE

NOTES

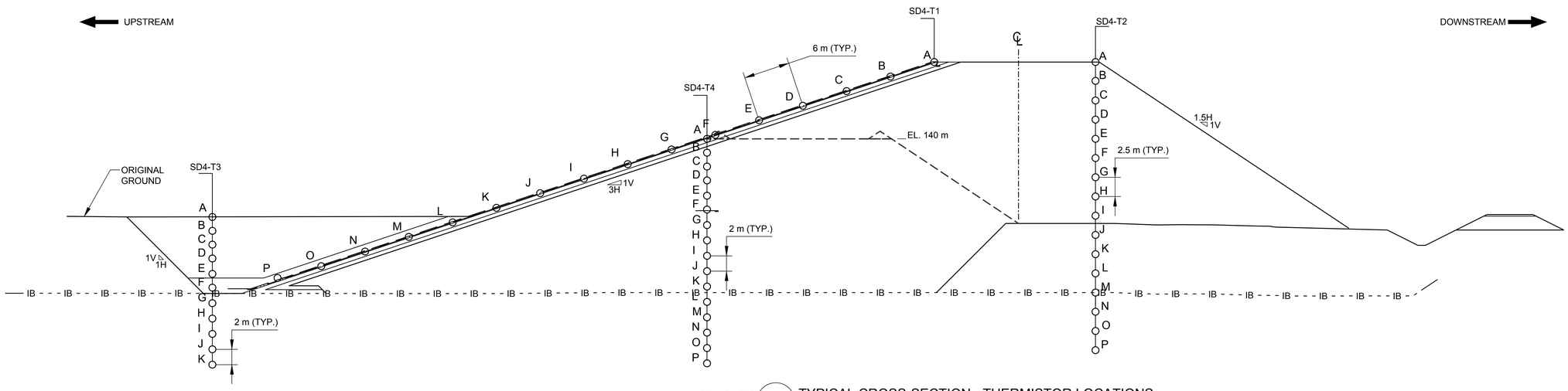
1. REFER TO THE GENERAL NOTES ON THE FRONT PAGE (SD 3,4&5-01)
2. THE OWNER IS IN CHARGE OF INSTALLING THE INSTRUMENTATION.
3. INSTRUMENTATION INSTALLATIONS SHALL BE IN ACCORDANCE WITH INSTRUMENTATION SPECIFICATION LISTED ON DRAWING SD 3,4&5-01
4. THE CONFIGURATION OF THE UPSTREAM TOE LINER TIE-IN WILL DEPEND ON THE ENCOUNTERED DEPTH OF THE BEDROCK. REFER TO DETAIL 1-07 AND 2-07
5. DISPLACEMENT MONITORING POINTS SHALL BE INSTALLED PREFERENTIALLY ON THE UPSTREAM CREST. DOWNSTREAM INSTALLATIONS TO BE LOCATED FOR PROTECTION FROM THE VEHICULE DAMAGE.

SADDLE DAM 4 - DISPLACEMENT MONITORING POINTS

POINT ID	STATION	EASTING	NORTHING
SD4-DMP-01	40+095	638095.403	7214595.648
SD4-DMP-02	40+145	638127.987	7214557.724
SD4-DMP-03	40+195	638160.571	7214519.799
SD4-DMP-04	40+245	638193.155	7214481.874
SD4-DMP-05	40+295	638232.816	7214447.668
SD4-DMP-06	40+345	638274.327	7214419.796
SD4-DMP-07	40+395	638315.837	7214391.924
SD4-DMP-08	40+445	638357.348	7214364.052
SD4-DMP-09	40+495	638398.859	7214336.18
SD4-DMP-10	40+545	638440.37	7214308.309
SD4-DMP-11	40+595	638481.881	7214280.437
SD4-DMP-16	40+095	638111.454	7214609.439
SD4-DMP-17	40+145	638144.038	7214571.514
SD4-DMP-18	40+195	638176.622	7214533.59
SD4-DMP-19	40+245	638209.206	7214495.665
SD4-DMP-20	40+295	638244.609	7214465.228
SD4-DMP-21	40+345	638286.12	7214437.356
SD4-DMP-22	40+395	638327.627	7214409.479
SD4-DMP-23	40+445	638369.138	7214381.607
SD4-DMP-24	40+495	638410.649	7214353.735
SD4-DMP-25	40+545	638452.149	7214325.847
SD4-DMP-26	40+595	638493.66	7214297.975

SADDLE DAM 4 - THERMISTORS

POINT ID	STATION	EASTING	NORTHING
SD4-T1	40+320	638265.367	7214451.294
SD4-T2	40+320	638253.569	7214433.727
SD4-T3	40+320	638302.215	7214506.227
SD4-T4	40+320	638282.09	7214476.201



SCALE 1:300 — A — TYPICAL CROSS-SECTION - THERMISTOR LOCATIONS

0 10 20
1:300 METRES

0 50 100
1:1,000 METRES

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED
0	2015-04-30	ISSUED FOR CONSTRUCTION	F. Bolduc	S. Betnesky	P. Gince	Y. Boulianne
A	2015-03-27	ISSUED FOR COMMENTS	F. Bolduc	R. Gravel	P. Gince	Y. Boulianne

SEAL

Original Signed and Sealed by Yves Boulianne on April 30th, 2015

CLIENT
AGNICO EAGLE MINES LIMITED

CONSULTANT
GOLDER ASSOCIATES LTD.
1001, BLVD DE MAISONNEUVE W.
MONTREAL (QUEBEC)
CANADA H3A 3C8
[+1] (514) 383-0990
www.golder.com

PROJECT
MEADOWBANK GOLD PROJECT
TAILINGS STORAGE FACILITY
SADDLE DAM 3, 4 & 5

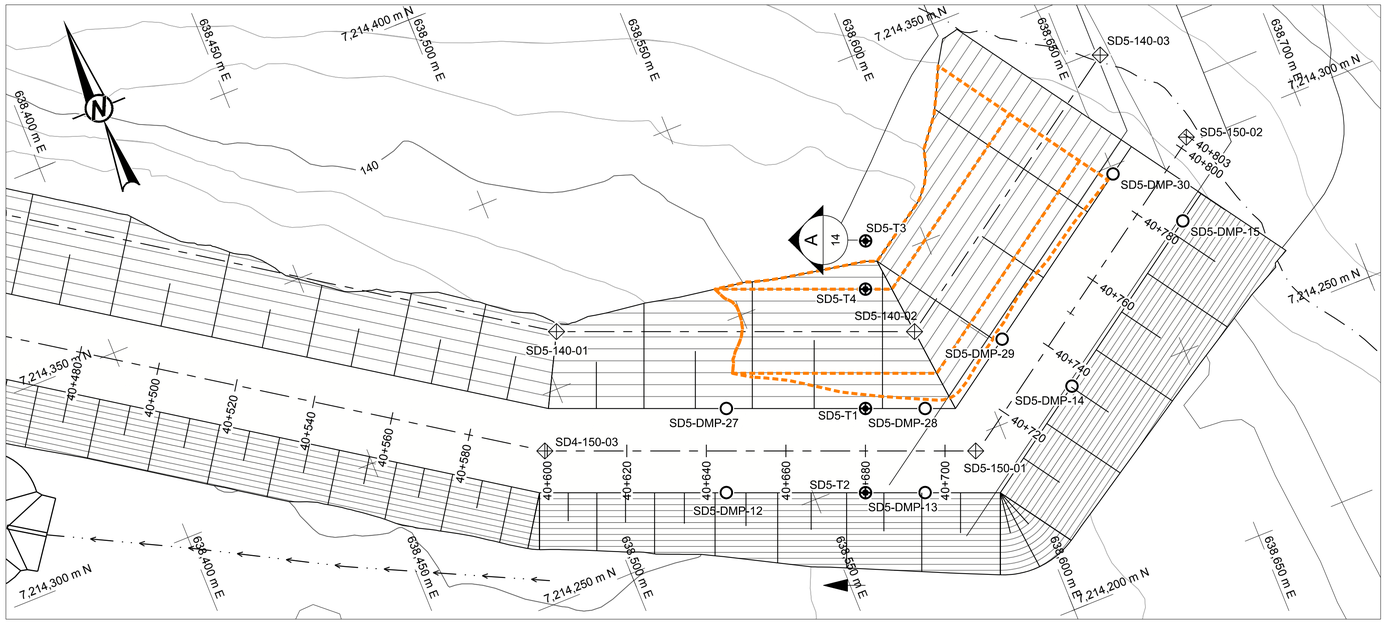
TITLE
INSTRUMENTATION PLAN AND SECTION - SADDLE DAM 4

PROJECT No.	PHASE	Rev.	13 of 15	PLAN
1416081	2000	0		SD 3,4&5-13

Path: \\golder.gds\gal\Montreal\ISIS\CAD\PROJETS\AGNICO-EAGLE\MEADOWBANK\PRODUCTION\1416081/2000\ | File Name: 1416081-2000-001.dwg

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

0 25 mm



PLAN VIEW
SCALE 1:750

SADDLE DAM 5 - DISPLACEMENT MONITORING POINTS			
POINT ID	STATION	EASTING	NORTHING
SD5-DMP-12	40+645	638529.79	7214259.96
SD5-DMP-13	40+695	638576.18	7214241.31
SD5-DMP-14	40+745	638620.42	7214252.40
SD5-DMP-15	40+795	638661.77	7214280.52
SD5-DMP-27	40+645	638537.68	7214279.59
SD5-DMP-28	40+695	638584.07	7214260.95
SD5-DMP-29	40+745	638608.52	7214269.90
SD5-DMP-30	40+795	638649.87	7214298.02

SADDLE DAM 5 - THERMISTORS			
POINT ID	STATION	EASTING	NORTHING
SD5-T1	40+680	638570.154	7214266.54
SD5-T2	40+680	638562.263	7214246.907
SD5-T3	40+680	638585.875	7214305.614
SD5-T4	40+680	638581.341	7214294.376

LEGEND

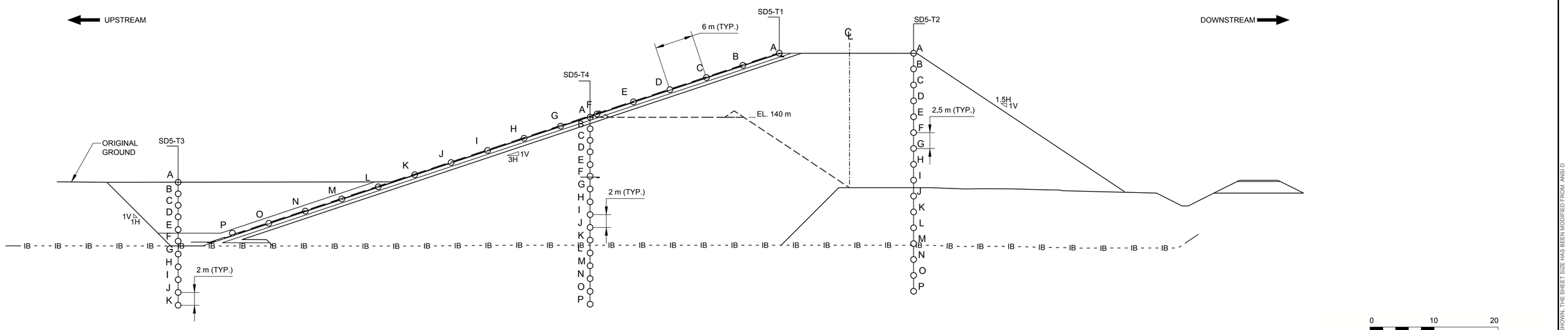
- SD5-T1 — THERMISTOR
- SD5-DMP-14 — DISPLACEMENT MONITORING POINT
- 2+580 — STATION AND CENTER LINE
- SADDLE DAM ELEVATION 140 m FOOTPRINT
- 140 — LAND-BASED TOPOGRAPHIC MAJOR CONTOUR INTERVAL 10 m
- LAND-BASED TOPOGRAPHIC MINOR CONTOUR INTERVAL 2 m
- ℄ — CENTRELINE

REFERENCES

- DRAWINGS # Meadowbank Geotechnical2014 Drilling Program.dwg AND #Meadowbank SD3,4,5.dwg PROVIDED BY AEM LTD., MEADOWBANK DIVISION, JANUARY 2015
- GOLDER 2009. 2009 GEOTECHNICAL INVESTIGATION TAILINGS STORAGE FACILITY. MEADOWBANK GOLD PROJECT, REPORT, GOLDER ASSOCIATES LTD. DECEMBER 2009 (DOC 979 VER 0)
- GOLDER 2010. 2010 GEOTECHNICAL INVESTIGATION, TAILINGS STORAGE FACILITY. MEADOWBANK GOLD PROJECT, REPORT, GOLDER ASSOCIATES LTD. SEPTEMBER 2010 (DOC 1094 VER 0)
- AEM 2014, DATA TRANSMITED BY E-MAIL ON DECEMBER 31, 2014

NOTES

1. REFER TO THE GENERAL NOTES ON THE FRONT PAGE (SD 3,4&5-01)
2. THE OWNER IS IN CHARGE OF INSTALLING THE INSTRUMENTATION.
3. INSTRUMENTATION INSTALLATIONS SHALL BE IN ACCORDANCE WITH INSTRUMENTATION SPECIFICATION LISTED ON DRAWING SD 3,4&5-01
4. THE CONFIGURATION OF THE UPSTREAM TOE LINER TIE-IN WILL DEPEND ON THE ENCOUNTERED DEPTH OF THE BEDROCK. REFER TO DETAIL 1-07 AND 2-07
5. DISPLACEMENT MONITORING POINTS SHALL BE INSTALLED PREFERENTIALLY ON THE UPSTREAM CREST. DOWNSTREAM INSTALLATIONS TO BE LOCATED FOR PROTECTION FROM THE VEHICULE DAMAGE.



SCALE 1:300 — A — TYPICAL CROSS-SECTION - THERMISTOR LOCATIONS

0 10 20
1:300 METRES

0 25 50
1:750 METRES

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED
0	2015-04-30	ISSUED FOR CONSTRUCTION	F. Bolduc	S. Betnesky	P. Gince	Y. Boulianne
A	2015-03-27	ISSUED FOR COMMENTS	F. Bolduc	R. Gravel	P. Gince	Y. Boulianne

SEAL

Original Signed and Sealed by Yves Boulianne on April 30th, 2015

CLIENT

AGNICO EAGLE MINES LIMITED

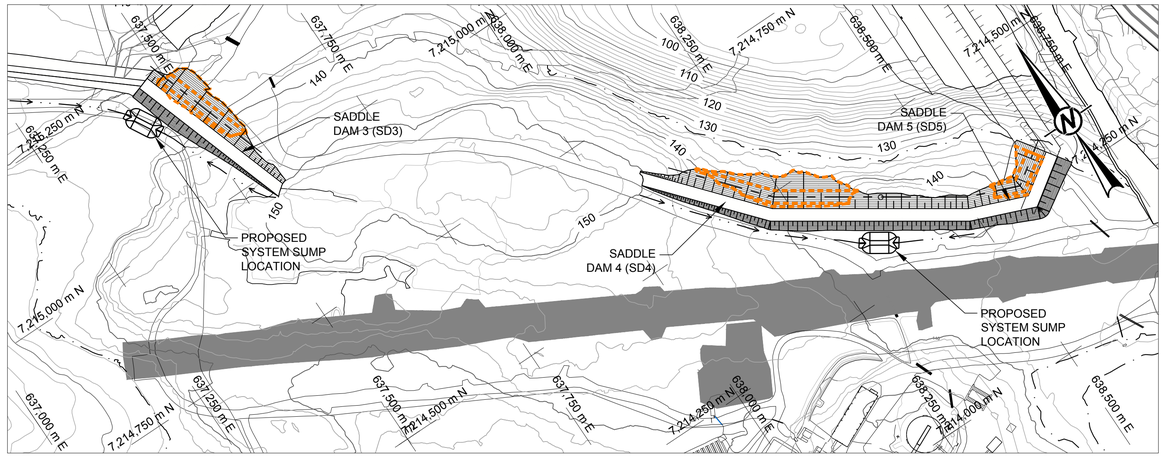
CONSULTANT

GOLDER ASSOCIATES LTD.
1001, BLVD DE MAISONNEUVE W.
MONTREAL (QUEBEC)
CANADA H3A 3C8
[+1] (514) 383-0990
www.golder.com

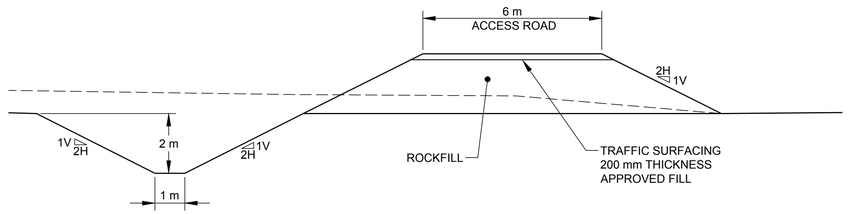
PROJECT
MEADOWBANK GOLD PROJECT
TAILINGS STORAGE FACILITY
SADDLE DAM 3, 4 & 5

TITLE
INSTRUMENTATION PLAN AND SECTION - SADDLE DAM 5

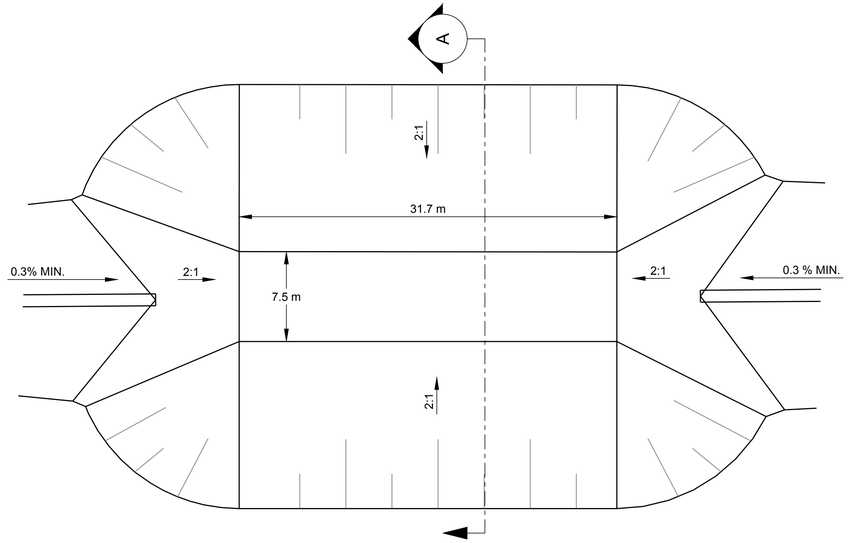
PROJECT No.	PHASE	Rev.		PLAN
1416081	2000	0	14 of 15	SD 3,4&5-14



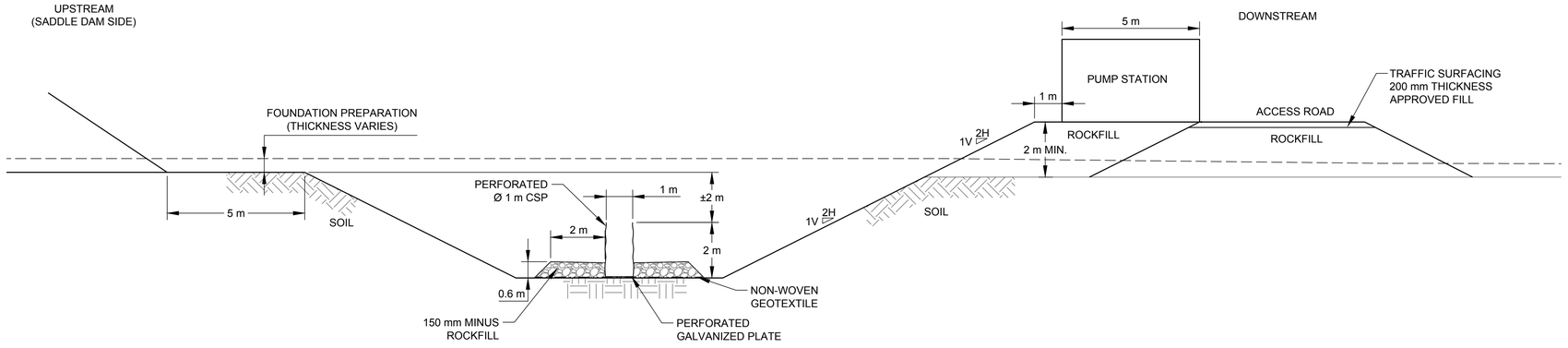
LOCATION PLAN
SCALE 1:5,000



SCALE 1:100 6/07 DETAIL - DITCH AND ACCESS ROAD



PLAN VIEW - TYPICAL SUMP
SCALE 1:250



SCALE 1:100 A TYPICAL SUMP SECTION

LEGEND

- STATION AND CENTER LINE (2+580)
- SADDLE DAM ELEVATION 140 m FOOTPRINT
- 140 — LAND-BASED TOPOGRAPHIC MAJOR CONTOUR INTERVAL 10 m
- LAND-BASED TOPOGRAPHIC MINOR CONTOUR INTERVAL 2 m
- PROPOSED DITCH

NOTES

1. ACTUAL SUMP LOCATION TO BE CONFIRMED BY THE ENGINEER BASED ON GROUND CONDITIONS.

0 5 10
1:100 METRES

0 10 20
1:250 METRES

0 200 400
1:5 000 METRES

Rev.	YYYY-MM-DD	DESCRIPTION	PREPARED	DESIGN	REVIEW	APPROVED
0	2015-04-30	ISSUED FOR CONSTRUCTION	F. Bolduc	S. Betnesky	P. Gince	Y. Boulianne
A	2015-03-27	ISSUED FOR COMMENTS	F. Bolduc	R. Gravel	P. Gince	Y. Boulianne

SEAL

Original Signed and Sealed by Yves Boulianne on April 30th, 2015

CLIENT
AGNICO EAGLE MINES LIMITED

CONSULTANT
GOLDER ASSOCIATES LTD.
1001, BLVD DE MAISONNEUVE W.
MONTREAL (QUEBEC)
CANADA H3A 3C8
[+1] (514) 383-0990
www.golder.com

PROJECT
MEADOWBANK GOLD PROJECT
TAILINGS STORAGE FACILITY
SADDLE DAM 3, 4 & 5

TITLE
SUMP LOCATIONS AND DETAILS

PROJECT No.	PHASE	Rev.		PLAN
1416081	2000	0	15 of 15	SD 3,5&5-15

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D
0 25 mm

Path: \\golder.gds\gal\Montreal\SIG\CAD\PROJETS\AGNICO-EAGLE\MEADOWBANK\PRODUCTION\1416081\2000\ | File Name: 1416081-2000-001.dwg

APPENDIX B

Technical Specifications

PREPARED FOR:
AGNICO-EAGLE MINES LIMITED
MEADOWBANK DIVISION

PREPARED BY:

0	01/05/2015	ISSUED FOR CONSTRUCTION	FLB/PG	YB
A	13/03/2015	ISSUED FOR CLIENT REVIEW	FLB/PG	YB
REV.	DATE	REASON FOR REVISION	BY	APP.

TABLE OF CONTENTS

LIST OF TABLES (in text)

Checklists (at the end of the document):

- Foundation Preparation and Excavation
- Fill Placement
- Geotextile Installation
- LLDPE Geomembrane Installation
- Instrumentation

S1 GENERAL

This section of the construction Technical Specifications (Specifications) provides general administrative requirements for construction of Saddle Dams 3, 4 and 5 at the Meadowbank Gold Mine, Nunavut.

These Specifications and the Drawings reference herein are the intellectual property of Golder Associés Ltée (Golder) and are to be used solely for the intent which they were prepared. Modifications or deviations from the Specifications or Drawings shall only occur with written approval of Golder.

Tailings produced at the Meadowbank Gold Mine are being stored within the Tailings Storage Facility (TSF). The northwest arm of Second Portage Lake was dewatered and a series of containment structures are being progressively constructed to provide containment of the tailings within the TSF. Dike construction is staged relative to tailings deposition and water management requirements. The TSF is subdivided into two components: the North Cell and the South Cell.

These specifications are for the construction of Saddle Dams 3, 4 and 5. These permanent perimeter structures, along with Central Dike will form the South Cell of the TSF. The Saddle Dams are rockfill structures built in compacted lift. Their design includes inverted base filters, upstream graded filters, a geomembrane liner on their upstream slopes and a upstream toe liner tie-in on the bedrock. Saddle Dam 3 is located in the northwest corner of the South Cell and tie-in to Saddle Dam 2. Saddle Dam 4 is located at the southwest corner of the South Cell and tie-in to Saddle Dam 5 which merge with the southern extremity of Central Dike.

The construction of Saddle Dams 3, 4 and 5 will be phased. The configuration to be constructed for each phase will be provided by AEM. As-built information for previous phases will be maintained and made available by AEM.

These Specifications are not for piping, barges, electrical, mechanical, structural, or other works associated with tailings transport or water reclaim.

S1.1 Definitions and Standards

S1.1.1 Definitions

The definitions used in the Specifications are given in Table 1-1.

Table 1-1: Definitions

Accuracy	Degree of approximation of a measurement to the true value of the quantity measured.
AEM	Agnico-Eagle Mines Limited, Owner.
Approval	A written engineering or geotechnical opinion concerning the Work.

AutoCAD	AutoDesk CAD program. Drawings should be saved using the .dxf exchange file format.
Coarse Filter (150 mm minus processed granular fill)—Zone 3	Material produced from processing of non-AG and PAG rockfill and meeting the Specifications.
Coarse Rockfill (1.3 m minus rockfill)—Zone 4A	Non-AG and PAG rockfill, expected to be run-of-mine requiring little to no processing and satisfying the Specifications.
Coarse Rockfill (1.3 m minus rockfill)—Zone 4B	Non-AG rockfill, expected to be run-of-mine requiring little to no processing and satisfying the Specifications.
Compacted Till—Zone 1	Reworked till satisfying the Specifications.
Low Quality Till	Till-like material having relative low permeability.
Contractor	The onsite representative of the construction company contracted by the Owner to successfully carry out the scope of work described herein. For Work performed by mine employees, the Mine Superintendent, an employee of AEM, assumes responsibility for duties and obligations of the Contractor described in the Specifications and in the Drawings.
Contractor's Work Plan	Proposed construction equipment, procedures, schedules, QC plan, environmental management plan, and health and safety plan for all components of work to be completed by the Contractor and any Subcontractor the Contractor may employ to complete the Work.
CSA	Canadian Standard Association.
EMP	Environmental Management Plan.
Designer	Golder Associés Ltée (Golder), Design Engineer.
QA Engineer	Responsible for the QA activities
Field Laboratory	The area and facilities provided for QC and QA testing at the Meadowbank Gold Project Site.
Fine Filter (19 mm minus processed granular fill)—Zone 2	Material produced from processing of non-AG or PAG rockfill and satisfying the Specifications.
Fine Rockfill (300 mm minus rockfill)—Zone 5	Processed rockfill satisfying the Specifications.
Geotextile	Non-woven geotextile, minimum 500 g/m^2, GSE NW16 or equivalent.
Health and Safety (H&S)	A planned set of activities and approaches to provide protection for the health and safety of all persons involved in or potentially affected by construction activities.

Ice-Poor Soil	Frozen soils that contain less than 10% visible ice and having a water content less than 20% (by mass). No visible ice lenses.
Ice-Rich Soil	Frozen soils that contain more than 10% visible ice and/or having a water content greater than 20%. Ice lenses may be present.
Liner Installer	Subcontractor under the responsibility of the Contractor, responsible for the installation of geotextile and LLDPE geomembrane liners.
LLDPE geomembrane	Linear low density polytethylene geomembrane satisfying the Specifications.
Geomembrane Manufacturer	Manufacturer of LLDPE geomembrane.
Meadowbank	The Meadowbank Gold Project site.
ML	Metal leaching.
Non-AG	Non-acid generating.
Owner	Agnico-Eagle Mines Limited, Meadowbank Division (AEM). For Saddle Dams 3, 4 and 5 construction, the Owner is the Operations Manager.
Owner's Representative	The engineer of record for Saddle Dams 3, 4 and 5. It is a person(s) employed or retained by the Owner to oversee the project works and the Owner's interests. This role is the primary point of contact for the Designer, the QA Engineer, the QC Representative, the Contractor and the Liner Installer. For Work performed by mine employees, the Owner's Representative is to represent the Owner and not act as a representative for the Contractor.
PAG	Potentially acid generating.

Quality Assurance (QA)	A planned system of inspection and testing that documents, to the satisfaction of the Owner, the Owner's Representative, the Designer, other stakeholders and regulators, that the work complies with the design, drawings and Specifications. Quality assurance forms a subset of the quality assurance program. Quality assurance comprises inspections carried out during quality control and includes verifications, evaluations of materials and workmanship necessary to determine and document the quality of the constructed facility. Quality assurance refers to measures taken by the quality assurance organization, the QA Engineer, to assess if the work is in compliance with the drawings and Specifications. The QA Engineer is responsible for performing the QA activities.
Quality Control (QC)	A planned system of inspection, testing and documentation carried out during construction to ensure that the work is being performed and completed in a manner that complies with the drawings and Specifications. Notwithstanding his contractual QC obligations, the Contractor is responsible for collaborating with the QC Representative to ensure the QC of his work. The Contractor is responsible for the QC activities for the work performed by its Subcontractor.
Quality Control (QC) Representative	Person or company hired by the Owner and under the supervision of the Owner's Representative to collaborate with the Contractor to ensure QC testing and inspection of all work done by the Contractor.
Reproducibility	Degree of approximation to the arithmetic average of each one of a series of similar measurements.
Sensitivity	Minimum unit to be detected by a system of measurement.
Subcontractor	The onsite representative of the construction company contracted by the Contractor to complete a portion of the work.
Till	Naturally-occurring well-graded soils consisting of sizes ranging from clay to boulders.
TSF	Tailings Storage Facility
TSF Dikes	The embankment structures of the TSF.
Work	All activities associated with the construction of Saddle Dams 3, 4 and 5 and instrumentation.
Work Completion Report (WCR)	Summary report prepared by the Contractor with the content described in the Specification.
Working Platform	The working platform is the surface of fill and/or excavated surface from which the work is conducted.

S1.1.2 Standards

The work shall conform to, but not necessarily be limited to, the requirements of the standards, acts and regulations listed in Table 1-2. The work included in these Specifications shall conform to the applicable provisions of these publications, except as modified by the requirements specified herein or as indicated in the Drawings. Each publication shall be the most recent revision, including applicable addenda in effect at the date of issue of the Specification.

It is important to note that additional standards may be referenced by those listed in Table 1-2; it is the responsibility of the user of this document to be familiar with all the applicable standards.

Table 1-2: Standards

AEM	Safety Handbook 2008
ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3))
ASTM D792	Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D1004	Test Method for Initial Tear Resistance of Plastic Film Sheeting
ASTM D1238	Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D3895	Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
ASTM D4218	Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D4354	Standard Practice for Sampling of Geosynthetics for Testing
ASTM D4355	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
ASTM D4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D4833	Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
ASTM D5261	Standard Test Method for Measuring Mass per Unit Area of Geotextiles
ASTM D5323	Standard Practice for Determination of 2 % Secant Modulus for Polyethylene Geomembranes
ASTM D5596	Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
ASTM D5617	Standard Test Method for Multi-Axial Tension Test for Geosynthetics

ASTM D5721	Standard Practice for Air-Oven Aging of Polyolefin Geomembranes
ASTM D5885	Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry
ASTM D5994	Standard Test Method for Measuring Core Thickness of Textured Geomembrane.
ASTM D6392	Standard Test Method for Determining the Integrity of Non-reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
ASTM D6693	Standard Test Method for Determining Tensile Properties of Non-Reinforced Polyethylene and Non-Reinforced Flexible Polypropylene Geomembranes
Mine Health and Safety Act, S.N.W.T. 1994, c25	
Mine Health and Safety Regulations, N.W.T. Reg. 125-95	
GRI GM 9	Cold Weather Seaming of Geomembranes.
GRI GM 11	Accelerated Weathering of Geomembranes using a Fluorescent UVA-Condensation Exposure Device
GRI GM19	Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes

AEM: Agnico-Eagle Mines Limited; ASTM: ASTM International; originally known as American Society for Testing and Materials; CEBTP: *Centre Expérimental de Recherches et D'Études du Bâtiment et des Travaux Public;* DGS: European Commission Research Directorate-General; EN: European Standard (European Committee for Standardization); NFP : *Norme française (French Standard); GRI:* Geosynthetic Research Institute.

S1.1.3 Alternative Standards and Products

If the Contractor offers materials which conform to a standard other than that specified in the Specifications, then the standard offered shall be equal, or superior, to the specified standard. The Contractor shall provide the Owner's Representative with complete and written details of the differences between the standard offered and the specified standard. The Owner's Representative shall review and comment on the acceptability of the standard offered. Only upon written approval by the Owner's Representative shall the standard offered by the Contractor be used and only within the approved limits.

If the Contractor identifies a product which satisfies the requirements of the Specifications, the Contractor shall provide the Owner's Representative with complete and written details of the product and demonstrate its satisfaction of the Specifications. The Owner's Representative shall review and comment on the acceptability of the product offered. Only upon written approval by the Owner's Representative shall the product offered by the Contractor be used and only within the approved limits.

S1.2 Meetings

The Owner's Representative has the responsibility to organize communications through various meetings described in this Specification. Other meetings may be called as required by the Owner's Representative.

All official communications shall be in writing, in English, with records of communications kept by the Owner's Representative, the QA Engineer, and the Contractor. Radio communications will be on the same channels as the mine in the mining area and on a specific channel in the Work area and will be in English as per the requirements of the Owner.

Official communications between the Designer, the QA Engineer, the QC Representative, the Contractor and the Liner Installer will be through the Owner's Representative.

S1.2.1 Pre-Construction Meeting

Prior to the start of construction, the Owner's Representative, the Designer, the QA Engineer, the QC Representative, and the Contractor shall meet to discuss:

- Designation of a party responsible for recording and distribution of minutes for the Pre-Construction Meeting and Construction Meetings.
- The design, the Specifications, and the Drawings.
- Responsibilities, authorities and submittal requirements of all parties as defined in the Specifications.
- Construction schedule and Contractor's work plan.
- Each task of the work with respect to overall construction schedule.
- Construction quantities.
- Surveying procedures.
- Supply of materials, water, and waste disposal areas.
- QC and QA procedures and responsibilities, including QC tasks documented in the Contractor's work plan, testing frequencies, testing methods, acceptance/rejection criteria and procedures, reporting and documentation.
- Procedures for deficiency resolution, documentation and reporting.
- Stockpile areas and areas to be used for temporary storage/stockpiling, where applicable.

- Health and safety, including the Owner's site health and safety plan and the Contractor's health and safety plan as included in the Contractor's work plan, including, but not limited to: procedures for QC activities, and procedures related to blasting, medical emergency, fire, mine equipment, driving protocols, and hours of work.
- The EMP.
- The site conditions.
- To conduct site walk-over to discuss proposed construction sequence, start-up, and inspect borrow areas, where applicable.
- Any other concerns raised by each party.

S1.2.2 Daily Advance Meetings (including a H&S component)

Daily advance meetings will be held every morning. The Owner's Representative will relay any relevant information to on-site representatives of the QA Engineer, the QC Representative,the Contractor, and the Liner Installer. The Owner's Representative will be responsible for preparing and distributing meeting minutes.

S1.2.3 Construction Meetings

Construction progress meetings shall occur monthly, or more frequently, as required. The meetings shall be chaired by the Owner's Representative. Meetings shall be attended by the Designer, the QA Engineer, the QC Representative, the Contractor, and the Liner Installer. Health and safety concerns will be reviewed along with schedule and construction progress. The Owner's Representative will be responsible for preparing and distributing the meeting minutes.

S1.2.4 Deficiency Resolution Meetings

If a construction issue or deficiency occurs, a deficiency resolution meeting shall be organized by the Owner's Representative. The relevant construction work shall be suspended until a resolution is attained. A deficiency resolution document shall be filled out by the party that identified the deficiency and shall be provided to the various other parties (Owner's Representative, QA Engineer, the QC Representative, Designer, Contractor and the Liner Installer) prior to the deficiency resolution meeting.

The purpose of the meeting shall be to identify, isolate and resolve the problem or deficiency to achieve compliance with the Specifications, the Drawings, and the intent of the design to the

satisfaction of all parties to the extent possible. The deficiency resolution document will include method of resolution. Documentation requirements for deficiencies are described in Section S9.

The deficiency resolution meeting shall be attended by the Owner's Representative, the QA Engineer, the QC Representative, and the Contractor. If the conditions or circumstances require modification(s) to the design, then the Designer will make changes to the design after consultation with the Owner.

The Owner's Representative is responsible for preparing and distributing the meeting minutes for Deficiency Resolution Meetings.

S1.3 Equivalent Materials

When the Drawings and/or Specifications specify a product with a trademark, one must understand that an equivalent product may be used, but must first be approved by the Owner's Representative and authorized by the Owner. The Contractor has the responsibility to demonstrate to the satisfaction of the Owner's Representative that the substitute product is equivalent.

S1.4 Limited Geotechnical and Geophysical Data

The current understanding of subsurface conditions is based on a limited number of boreholes and on interpretation of geophysical data. The presentation of subsurface conditions in the Specifications and Drawings are, therefore, subject to uncertainty and based on interpretation. The Contractor is to make his/her own interpretation of geologic conditions and expect conditions to vary.

S1.5 Limited Capacity to Produce Granular Material

The work site has limited capacity to produce and store granular material. This production must also be shared between the Work described in these Specifications and other works that will be underway at the same time. The sharing of this production capacity between the various works at the site will be discussed at the Pre-Construction Meeting. Material requirements are to be coordinated with the Owner's Representative.

S1.6 Cooperation

The Owner's Representative, the QC Representative and the QA Engineer will be present on-site full-time during construction and will carry out inspections as each deems necessary and to satisfy the requirements of the Specifications.

The Contractor and his Subcontractors shall cooperate with other parties to allow time and to provide safe work conditions to carry out any site visit required to check environmental or H&S concerns and to perform surveys or QA/QC activities. The Contractor and his Subcontractors (e.g. Liner Installer) shall provide labour and equipment as required to contain and/or clean up any environmental spills.

S1.7 Conflict

If there is a conflict between the Drawings and the Specifications, the Specifications shall take precedence. All conflicts between the Drawings and Specifications shall be brought to the attention of the Owner's Representative, the Designer, the QA Engineer, the QC Representative, and the Contractor, in writing, by the party identifying the said conflict.

S1.8 Health and Safety

The site is under regulation by the Mines Act and follows Mine Health and Safety Regulations of Nunavut.

The Owner is responsible for the H&S at the site, including the all weather private access road to Baker Lake. The Owner will provide a site orientation including regulations, H&S, driving on the site and any procedures related to blasting, fire, medical emergency, and white-out including radio procedures and incident reporting. The site orientation shall be completed by every person prior to the start of any work at the site. The Contractor and the Owner's Representative should allow the required time for each employee new to Meadowbank to complete the site orientation and courses on Standard Operating Procedures (SOP's) developed by the Owner. The Owner shall provide the required time for the site orientation prior to the start of the work.

The Contractor is responsible for the H&S of all personnel under his supervision and his employees and those of any Subcontractors under his control. The Contractor must provide a dedicated H&S Specialist at the work site when the Contractor has more than 10 employees at Meadowbank or whenever the activities being performed require specialized supervision.

The Contractor and his Subcontractors shall incorporate H&S considerations while developing and implementing their own work procedures.

The Contractor shall observe the regulations, procedures, and restriction for ingress to the construction area.

The Contractor must submit, as part of the Contractor's Work Plan, a H&S plan covering all work activities to be conducted for approval by the Owner. The plan must comply with the Owner's regulations and any additional Health and Safety requirements specifically related to the Contractor's work, and shall comply with the Mine Health and Safety Act and Regulations in effect in Nunavut. The Contractors H&S plan shall be prepared to the satisfaction of the Owner's Representative. Following approval of the Health and Safety plan, the Contractor shall implement and maintain the plan such that it remains current throughout the execution of the works.

Any dangerous occurrence or reportable incident or H&S concern shall be reported immediately to the Owner's Representative.

S1.9 Environment

A mine site Environmental Management Plan (EMP) shall be provided by the Owner to the Contractor and the Owner's Representative prior to the start of construction. The Contractor shall prepare a work area specific EMP for his work and provide it to the Owner's Representative as part of the Contractor's Work Plan.

The Contractor shall incorporate environmental considerations while developing and while implementing the Contractor's Work Plan. The EMP may discuss, but is not limited to the following:

- Spill Management;
- Animal protection;
- Water Management;
- Dust Management; and
- Refuse Management.

An up-to-date EMP must be maintained by the Contractor to cover all work activities being conducted throughout the duration of the Work.

The Contractor will comply with the Meadowbank and work specific EMP's and all standard procedures related to environmental issues.

Any spill or environmental concern shall be reported immediately to the Owner's Representative and the Environmental Department.

S1.10 Access

The Contractor is responsible to send all his equipment and supplies to Bécancour, Québec, where they will be shipped by barge to Baker Lake. The Owner will be responsible for loading and unloading the barges.

The Owner will be responsible for transporting all the equipment and supplies to the site from Bécancour and Baker Lake.

The Contractor must make sure that all spare parts and regular maintenance supplies and equipment that might be needed to complete construction are sent on the barges. While it is possible to later send spare parts by air, the Contractor will have to pay the entire costs of shipping spare parts by air, unless agreed with AEM. It is also important to note that space availability on the regular flights to the work site is very limited.

The Contractor will be responsible for moving his mobile equipment between Baker Lake and the work site.

The Owner will be responsible for moving all supplies, materials, and containers between Baker Lake and the work site.

S1.10.1 Access to Site and Accommodations

The Owner will provide charter flights to site from Val-d'Or or Montréal. The Owner shall also provide room and board for the Owner's Representative, the Contractor, Subcontractors, the QA Engineer and the QC Representative during the duration of the Works.

S1.10.2 Access to Works

Access to the Works will be provided by the Owner. The Contractor will not have sole or unrestricted access to the Work area and must be prepared to share and coordinate activities and access with others through the Owner's Representative. The Owner will provide staging areas, temporary facilities, haul roads, and access roads.

S1.11 Construction Facilities and Temporary Controls

S1.11.1 Power Supply

The Contractor is responsible for supply of any temporary power required for the Work by diesel powered generators. The Owner will supply diesel fuel at no charge to the Contractor.

S1.11.2 Water Supply for Construction

Water for dust control, water conditioning of fill materials and installation of instrumentation and maintaining in-place fill materials shall be obtained by the Contractor. The Contractor must supply all the pumps, lines and tanks necessary. Water will be available at a location identified by the Owner's Representative.

S1.11.3 Dust Control

During performance of the Work defined by the Specifications or any related operations, the Contractor shall control dust emissions to the satisfaction of the Owner's Representative.

S1.11.4 Surface Water Control

The Contractor is responsible for controlling surface water and protecting Work from damage caused by this water, as set out in Section S3.

S1.11.5 Groundwater Control

The Contractor is responsible for controlling groundwater or any other water that inflows into excavations or working area and protecting Work from damage caused by this water as set out in Section S3.

S1.11.6 Work Area

The Contractor shall:

- Store and dispense of fuel, lubricating oils, and chemicals in such a manner to prevent or contain spills and prevent materials from entering local streams, lakes, or groundwater according to applicable regulatory and site requirements.
- Maintain copies of material safety data sheets (MSDS) sheets on file at the site for all hazardous materials under the control of the Contractor and his Subcontractors. Copies of the MSDS sheets shall be provided to the Owner's Representative. The Owner's Representative is responsible for the delivery and storage of goods on site. The Owner's Representative shall make the MSDS sheets available to all workers.
- Avoid damaging instrumentation or instrumentation cables, such as for piezometers and thermistors, used at the site.

S1.11.7 Traffic Control

The Owner is responsible for traffic control at Meadowbank. The Contractor is responsible for traffic control within areas of the work site that are not routinely accessed by mine traffic.

The Owner's mine heavy equipment and haulage traffic has the right of way at all times with the exception of wild life and emergency vehicles. The Contractor shall be familiar with and follow the appropriate site traffic policies.

S2 SCOPE

S2.1 Execution

The Saddle Dams 3,4 and 5 construction includes Work to be completed by the Contractor.

S2.1.1 Scope of Work

The scope of work of these Specifications includes the construction of the Saddle Dams only as shown on the Drawings.

The construction of Saddle Dams 3, 4 and 5 will be phased as required by tailings deposition operations. The Owner shall provide a schedule of the phased construction requirements to the Contractor, QA Engineer, QC Representative, the Designer, and Owner's Representative prior to the start of the work. Table 2-1 includes a general description of construction tasks for the construction of Saddle Dams 3, 4 and 5. The tasks are not necessarily listed in order of construction sequence. A construction sequence for the current phase of construction shall be developed by the Contractor and provided to the Owner's Representative.

Table 2-1: Scope of Work and Responsibilities

Construction Task	By
Overall control of water.	Owner
Control of water (surface and groundwater) at the work sites.	Contractor
Access to sites and traffic control.	Owner
Foundation preparation including stripping and excavation.	Contractor
Preparation of the bedrock surface in the upstream toe liner tie-in	Contractor
Bedrock mapping of the upstream toe liner tie-in area	QA Engineer
Blasting (if required).	Contractor
Providing rockfill.	Owner
Loading and haulage of rockfill.	Owner and/or Contractor
Placement, compaction, and grading of rockfill.	Contractor
Producing processed granular fill meeting the Specifications and conducting the required QC.	Owner
Provision of bentonite and cement products.	Owner
Loading and haulage of processed granular fill materials.	Owner and/or Contractor
Placement and compaction of processed granular fill materials.	Contractor
Supply of borrow locations for till.	Owner
Development of till borrow area.	Contractor
Excavation, loading, and hauling of till.	Contractor
Placement and compaction of till.	Contractor

Control and management of stockpile areas.	Contractor
Supply of geotextile to site and temporary storage.	Owner
Supply of LLDPE geomembrane to site and temporary storage.	Owner
Handling, placement, and installation of geotextile.	Liner Installer
Handling, placement, and installation of LLDPE geomembrane.	Liner Installer
Supply of instrumentation and temporary storage.	Owner
Installation of instrumentation.	Owner

S2.2 Responsibilities and Authorities

The responsibility and authority of each party involved in the Work shall follow the lines set forth in the following sections and the applicable regulations and/or permit conditions for the following management structure.

S2.2.1 Owner

The Owner is Agnico-Eagle Mines Limited (AEM), Meadowbank Division. All references to the Owner in this document shall implicitly include the Owner's Representative, who is specifically designated for the project by the Owner.

The Owner is responsible for:

- Operating Saddle Dams 3, 4 and 5.
- Retention of the Owner's Representative, the Designer, the QA Engineer, the QC Representative and the Contractor.
- Provision of travel to and from site, accommodations, and site orientation for the Owner's Representative, the Designer, the QA Engineer, the QC Representative, the Contractor, and the Liner Installer.
- Provision of the mine site Environmental Management Plan and Health & Safety Plan to the Owner's Representative, the Designer, the QA Engineer, QC Representative, the Contractor, and the Liner Installer.
- Obtaining all relevant permits.
- Providing traffic control at the site.
- Providing and storing processed granular materials and geosynthetic materials for pick-up by the Contractor and the Liner Installer.
- Supplying rockfill and processed granular fill materials. These materials will be stockpiled for mixing and pickup by the Contractor.

- Supplying site and storage of geosynthetic materials and pre-processed construction materials.
- Supplying borrow location(s) for Till.
- Supplying diesel, waste disposal area(s) for excavated and/or wasted materials and water and source(s) of water.
- Managing waste material placed in the Portage Rock Storage Facility, or other approved disposal area.
- Submittals as described in Section S2.4

S2.2.2 Owner's Representative

The Owner's Representative is a person(s) or a Company retained by the Owner to act on the Owner's behalf.

The Owner's Representative is responsible for:

- Acting as the engineer of record for the works.
- Reviewing and approving all health, safety, and environmental plans prepared by the QA Engineer, the Contractor and the Liner Installer.
- Co-ordination of communications on the site as related to the Work.
- Coordination of communication between the QA Engineer and the Designer.
- Ensuring all Work is performed in accordance with the Mine Health Safety Act and Regulations of Nunavut.
- Confirming all design changes with the Designer.
- Reviewing and accepting the Work in discussion with the Designer and QA Engineer, as required.
- Overseeing the Work.
- Coordinating the activities of the Contractor.
- Supervising the activities of the QC Representative.
- Acting as the point of contact for the Owner, the Designer, the QA Engineer, the QC Representative, the Contractor, and the Liner Installer.
- Having the ability to stop the Work.
- Reviewing and approving all Subcontractors proposed by the Contractor with input from the Designer and the QA Engineer.

- Reviewing and approving all submittals from the Contractor and the Liner Installer with input from the Designer and the QA Engineer.
- Organizing and coordinating all meetings as per the Specifications.
- Submittals as described in Section S2.4.
- Performing responsibilities and tasks listed in the QC and QA requirements in Section S9.
- Inspecting and maintaining of site (e.g. sumps and foundation preparation) before any portion of the site is handed to the Contractor for the commencement of Works.
- Providing items as required in the Specifications and all incidentals needed to bring the Work to final completion, not including those to be supplied by the Contractor.
- Providing reasonable access to the general open areas surrounding the work site for the Contractor and Subcontractors.
- Providing survey for: layout of the work, QA purposes, monitoring progress, and performance.
- Preparing the as-built report with input from the QA Engineer, the QC Representative, the Contractor, and the Liner Installer.

S2.2.3 Designer

The Designer is responsible for:

- Preparing the design for the Work, including: design report, Drawings, and Specifications.
- Production and approval of all changes or modifications to the design as outlined in the Technical Specifications, Drawings and/or design report including revisions and/or clarifications that may occur prior to and/or during construction.
- Responding to requests received from the Owner's Representative regarding design-related issues and conditions encountered in the field.

S2.2.4 QA Engineer

The QA Engineer is responsible for:

- Performing QA activities as per the Technical Specifications to determine and document the quality of the constructed facility.
- Preparing, maintaining, implementing, and taking responsibility for the health and safety, and environmental plan for the QA activities.
- Confirming, in cooperation with the Owner's Representative and the Designer, that the Work is in compliance with the Drawings and the Specifications and that the design intent is satisfied.

- Performing the QA tasks outlined in Section S9, including: observing, inspecting, documenting, reviewing of QC testing and survey results and reporting of the relevant construction activities.
- Implementation of changes, as appropriate, in QC and QA aspects of the Work including frequency of testing, or additional testing and/or survey, to confirm compliance with the Drawings, the Specifications and the intent of the design.
- Preparing QA Daily and Weekly Reports outlining the progress of the Work and the result of testing carried out during the period.
- Preparation of QA inspection report at the completion of the construction.
- Providing approval of the Work if it is determined to be compliant with the intent of the design, the Drawings, and the Specifications.
- Providing as-built reporting input to the Owner's Representative.
- Submittals as described in Section S2.4

S2.2.5 QC Representative

The QC Representative is hired by the Owner and is responsible for:

- Coordinating with the Contractor to perform the QC testing and inspection of all Work undertaken by the Contractor
- Performing tasks outlined in the QC and QA Requirements section, including obtaining samples, field testing of materials, provision and reviewing of documentation, inspecting, and monitoring.
- Implementation of changes in QC aspects of the work including frequency of testing, monitoring, or additional testing to confirm conformance to the Specifications.
- Performs and submits QC records for the Work as required by the Specifications.
- Preparation and submission of Daily Summary Reports documenting the Work carried out each day, including QC testing results.

S2.2.6 Contractor

The Contractor is responsible for:

- Performing the Work, excepting the installation of the LLDPE geomembrane and geotextile done by its Subcontractor, the Liner Installer, to satisfy the requirements of the Drawings and Specifications.

- Ensuring all Work is in accordance with the Mine Health Safety Act and Regulations of Nunavut.
- Taking responsibility for all Work performed by Subcontactor(s).
- Preparing, maintaining, implementing, and taking responsibility for the health, safety, and environmental plan for the Work.
- Environmental management including prevention of pollution and other environmental problems related to the construction activities for Saddle Dams 3, 4 and 5.
- Complying with AEM's procedures and policies.
- Providing traffic control within the Work site that is not routinely accessed by mine traffic.
- Submittals as described in Section S2.4.
- Successful completion of the Work in compliance with the Drawings and Specifications, including any work performed by Subcontractors.
- Thoroughly examining other activities upon which their Work is dependent and report any deficiencies discovered to the Owner's Representative;
- Maintaining the Construction Schedule, including coordination and direction of the Work.
- Supplying and servicing equipment to complete the Work.
- Supplying all materials, spare parts, small tools and consumables required to complete the Works except those supplied by the Owner.
- Performing and meeting the applicable requirements of: Care of Water; Foundation Preparation and Excavation Upstream toe liner tie-in, Fill Placement; LLDPE Geomembrane installation; Geotextile installation.
- Employing appropriate methods and precautions to avoid damage or disturbance of the banks of any excavation. Any damage caused as a result of negligence by the Contractor shall be repaired at his expense and to the satisfaction of the Owner's Representative.
- Avoiding damage or disturbance of tailings deposition infrastructure and operations. Any damage caused as a result of the Contractor shall be immediately brought to the attention of the Owner's Representative. The Contractor shall work with the Owner's Representative to repair any damage to the satisfaction of the Owner's Representative. Repair work will be at the expense of the Contractor.
- Ensuring and maintaining the stability of the excavation during foundation preparation work and backfill activities.

- Controlling surcharges from all excavation and backfilling equipment, waste, berm construction, backfill stockpiles, and any other loading situations that may affect the stability of the excavation.
- Protecting materials before and after placement.
- Protecting materials to minimize loss of materials provided by Owner (e.g.bentonite, crushed aggregate)
- Inspection and maintenance of the site (e.g. sumps) before any portion of the site is handed over to the Owner after the completion of works, or a Subcontractor before their work is due to commence.
- Surveying for performance of the works, QC purposes, placed material quantities, as-built record purposes (including LLDPE geomembrane and geotextile panel locations, seams, and limits).
- Collaborating with the QC Representative to ensure the QC and the inspection of all work.
- Performing tasks outlined in the QC and QA Requirements section.
- Provision of equipment to perform quality control of the work.
- Performance of QC of all Work undertaken by its Subcontractors
- Preparation and submission of Daily Summary Reports documenting the Work carried out each day, including QC testing results.
- Protection of the environment during construction.
- Prepares all submittals, including as-built survey records, as required by the Specifications.

S2.2.7 Subcontractors

The Contractor is responsible for completion and QC of the Work undertaken by any Subcontractors under his control. The work must be completed in accordance with the intent of the design, the Drawings, and the Specifications.

One of the main subcontractors is the Liner Installer. The Liner Installer is retained by the Contractor and is subject to approval by the Owner.

The Liner Installer is responsible for:

- Installation of the LLDPE geomembrane and geotextile to satisfy the requirements of the Drawings and Specifications.

- Ensuring all Work is in accordance with the Mine Health Safety Act and Regulations of Nunavut.
- Preparing, maintaining, implementing, and taking responsibility for the health, safety, and environmental plan for the Work.
- Preparation all submittals, including as-built survey records, as required by the Specifications.
- Performance of QC, including reporting, for the Work as required by the Specifications.
- Performs others responsibilities as per Sections S2.4, S6 and S7.

S2.3 Drawings

The Specifications define the requirements for performing the work as outlined on the most recent revision of the Drawings presented in Table 2-2. Should a discrepancy or omission be identified, a written request for clarification shall be submitted to the Owner's Representative. The Owner's Representative shall provide written clarification following communication with the Designer.

Table 2-2: List of Drawings

Number	Title	Revision	Issued for
SD3,4&5-01	LOCATION MAP AND DRAWINGS	A	REVIEW
SD3,4&5-02	PROJECT SITE PLAN	A	REVIEW
SD3,4&5-03	GENERAL ARRANGEMENT PLAN	A	REVIEW
SD3,4&5-04	SADDLE 3 DAM PLAN, PROFILE AND QUANTITIES	A	REVIEW
SD3,4&5-05	SADDLE DAM 4 PLAN, PROFILE AND QUANTITIES	A	REVIEW
SD3,4&5-06	SADDLE DAM 5 PLAN, PROFILE AND QUANTITIES	A	REVIEW
SD3,4&5-07	TYPICAL CROSS-SECTION AND DETAILS	A	REVIEW
SD3,4&5-08	STAGED CONSTRUCTION SEQUENCE	A	REVIEW
SD3,4&5-09	SADDLE DAM 3 CROSS-SECTIONS	A	REVIEW
SD3,4&5-10	SADDLE DAM 4 CROSS-SECTIONS	A	REVIEW
SD3,4&5-11	SADDLE DAM 5 CROSS-SECTIONS	A	REVIEW
SD3,4&5-12	INSTRUMENTATION SECTIONS	A	REVIEW

S2.4 Submittals

Table 2-3 summarizes the submittals required prior to construction, during construction and post- construction. These documents are in addition to those presented by the Contractor to the Owner at the tender stage.

Table 2-3: Submittals

Item	Submitted by	Submitted to	Required
Construction Schedule	Contractor	Owner's Representative, QA Engineer	• 30 days prior to mobilization • Updated every week during construction
Personal Rotation Schedule	Contractor	Owner, Owner's Representative	• 30 days prior to mobilization • Updated every week during construction
Site Health and Safety Plan	Owner	Owner's Representative, Contractor	90 days prior to start of construction and maintained during construction
EMP	Owner	Owner's Representative, Contractor	90 days prior to start of construction and maintained during construction
Contractor's Health and Safety Plan	Contractor	Owner, Owner's Representative	30 days prior to the start of construction and maintained during construction
Contractor's Work Plan	Contractor	Owner, Owner's Representative	30 days prior to mobilization and maintained during construction
Daily Summary Report	Contractor	Owner's Representative	Within 24 hours of end of reporting period
Monthly Cost Report	Contractor	Owner, Owner's Representative	Within 7 days of end of reporting period
Instrumentation Cabin Design	Owner	Owner's Representative	14 days prior to start of instrumentation installation
Work Completion Report (one for each Stage)	Contractor	Owner, Owner's Representative	Within 30 days following completion of work
QA Daily Report	QA Engineer	Owner's	Within 24 hours of end of reporting

Item	Submitted by	Submitted to	Required
		Representative	period
QA Weekly Report	QA Engineer	Owner's Representative	Weekly
QA Inspection Report	QA Engineer	Owner's Representative	Within 45 days following the completion of construction
QC Daily Summary Report	QC Representative	Owner's Representative, QA Engineer	Within 24 hours of end of reporting period
As-built Report	Owner's Representative with input from QA Engineer, Contractor, and Liner Installer	Regulatory Agencies and Owner	Within 45 days following the completion of construction

The required submittals for LLDPE geomembrane and geotextile are presented in Sections S6 and S7, respectively; reference to these sections shall be made.

S2.4.1 Contractor's Work Plan

The Contractor's Work Plan shall include, but not be limited to:

- Proposed construction procedures, methodologies, products, and schedules.
- Procedures for coordinating construction, maintenance and removal of working platforms, and temporary access roads.
- Equipment set-up and site use layout including storage areas, haul roads, and work platform dimensions.
- Equipment list including specifications and service records for all equipment.
- Material properties, sources, and (manufacturer's) certificates of quality.
- QC procedures, standards, and testing frequencies.
- A detailed H&S plan for each activity to be undertaken, including MSDS for all materials.
- An EMP including procedures and measures for control of surface water, drainage, spills, wastes, etc.

- Procedures for clean-up of spills.

Any updates to the Contractor's Work Plan will be submitted to the Owner's Representative for review prior to introduction of any changes during the execution of the Work.

S2.4.2 Personnel Rotation Schedule

The Personnel Rotation Schedule submitted by the Contractor shall include the following but not be limited to:

- Number of people associated with each task;
- Duration of stay; and
- Date in and date out.

S2.4.3 Daily Summary Report

The Daily Summary Report submitted by the Contractor shall include the following but not be limited to:

- Safety incident;
- Environmental incident;
- Description of progress (e.g. quantities placed, equipment usage, etc.);
- Notes on progress;
- Concerns, issues and delays; and
- Standby time for approval.

S2.4.4 Work Completion Report

Immediately upon completion of the Work, the Contractor shall finalize the Work Completion Report (WCR) that shall provide, but not necessarily be limited to, the following:

- Descriptive report of the Works performed.
- Original Construction Record.

- Copies of meeting minutes, Field Change Notices (FCN), Site Instructions (SI), Request for Information (RFI), and any other documentation of communication that has been part of the Work.
- Original protocols of field or lab tests duly signed by Contractor and QC testing personnel/Company, if applicable.
- Any as-built survey information collected for foundation preparation and excavation, placement for each construction material, and instrumentation installation layout in electronic AutoCAD and hard copy format.
- Calculation sheets for actual quantities of work executed, duly signed by Contractor.
- Liquidation of the Work.
- Final H&S Report.

The Work Completion Report for LLDPE geomembrane and geotextile installation shall also include, but not necessarily be limited to, the following:

- As-built panel layout drawings, in AutoCAD and hardcopy formats.
- Roll deployment record.
- Seaming records, where applicable.
- Repair record.
- QC testing summary.

S2.5 Change Order Procedure

Before initiating any work not included in the initial scope of work, the Contractor must promptly implement the change order procedure and provide full written data required to evaluate changes to the Owner's Representative by submitting a Scope Change Authorization including, but not necessarily be limited to, the following:

- Description of the proposed changes;
- Statement of the reason for making the changes;
- Statement of the effect on the Contract Sum (cost estimate and basis) and the Schedule;
- Statement of the effect on the Work of Subcontractors; and
- Documentation supporting any change in Contract Sum or Schedule as appropriate.

If in agreement, the Owner's Representative will sign and date the Scope Change Authorization as authorization for the Contractor to proceed with the changes and the Contractor will sign and date the Construction Change Authorization to indicate agreement with the terms therein.

If the Contractor initiates or carries out any work not included in the initial scope of work without a signed and dated Scope Change Authorization by the Owner's Representative, the Owner reserves itself the right not to pay or compensate the Contractor for the work.

S3 CARE OF WATER

S3.1 Scope

Care of water consists of all work required to control water from any sources, including groundwater, surface water and precipitation, in order to complete the Work in accordance with the Drawings and the Specifications, and in accordance with the EMP, the site H&S plan, and all other environmental and Health and Safety controls established by the Owner to the satisfaction of the Owner's Representative.

Care of water shall include the following:

- Managing water before, during, and after: excavating; preparing, and constructing foundation and abutments; placing fill materials; designated waste areas, use and construction of access roads, and stockpiles; constructing seepage collection works; and undertaking any other part of the Work.
- Dewatering foundations and associated working areas. The Contractor shall provide, operate and maintain any channels, flumes, drains, culverts, sumps, pumps, and other drainage facilities and equipment necessary to divert water away from or to remove water from areas required to be used for construction of the Work and/or as required to meet environmental or safety requirements.
- Constructing and maintaining any embankments, silt curtain, and other protective works required to divert water away from areas required for the Work, and where applicable, removing such structures upon completion of the Work.
- Diverting and controlling surface runoff occurring along the abutments at the edge of the crest and toe.

S3.2 General

Surface water shall be temporarily diverted and managed during construction of the Work. Any channel, ditch, dike, or other facility required to divert surface water from any area required to complete the Work shall be constructed. All pumps, hoses, culverts, and other equipment required to dewater and maintain all parts of the construction site free from water shall be furnished, installed, maintained and operated.

The Contractor shall adequately operate and maintain temporary diversion and protective works and pumping stations. These shall also be readily accessible at all times.

The Contractor shall remove dikes and other temporary works promptly, when they are no longer required, at the direction of the Owner's Representative. Materials from such removal shall be hauled to disposal areas designated by the Owner's Representative as described in Section S4.5.

S3.3 Execution

The Work shall not commence until appropriate Care of Water measures have been designed and submitted by the Contractor for review and approval by the Owner's Representative, and implemented.

Care of Water systems shall include, but not necessarily be limited to: embankments, trenches, ditches, and lined channels to divert or collect surface water runoff; pipes, drains and sumps to manage groundwater; and pumping systems.

Excavations on land shall be dewatered in advance so that the Work is carried out in safe and dry conditions. If required, proposed methods for preventing and controlling seepage shall be submitted to the Owner's Representative for review and approval as part of the Contractor's Work Plan.

S4 EXCAVATION AND FOUNDATION PREPARATION

S4.1 Scope

The technical requirements for foundation preparation for the construction of Saddle Dams 3, 4 and 5 includes:

- Stripping of Saddle Dams footprints to provide suitable surface for rockfill and granular fill placement, including removal of boulders, organic soils, soft soils and ice-rich soils, including blasting;
- Excavation of upstream toe liner tie-in, possibly including use of a hydraulic hammer and blasting; and
- Preparation of foundation surfaces for LLDPE geomembrane installation, where applicable.

S4.2 Work Sequence

The Work will only start upon the completion of inspection by the Owner's Representative and receipt of approval to proceed from the Owner's Representative and following inspection, as-built survey, and approval of pre-work conditions.

S4.3 Examination

Prior to commencing construction, the Contractor shall thoroughly examine other Work upon which his Work is dependent and report any deficiencies discovered to the Owner's Representative.

S4.4 General

Stripping and excavation shall be carried out in accordance with the Drawings and the Specifications, using water control measures required for safe and effective operation.

Temporary drainage and pumping systems shall be provided, operated and maintained as required to direct water away from the surface excavation areas as specified in Section S3.

Foundation preparation is subject to inspection and approval by the Owner's Representative.

S4.4.1 Access

Access to the Work will be coordinated by the Owner's Representative as described in Section S1.10.

S4.4.2 Temporary Slopes and Work Areas

Temporary slopes are defined as slopes which are not shown in the Drawings. Temporary slopes shall be stable. The Contractor is responsible for slope stability. Monitoring the slopes shall be performed by the Contractor to the satisfaction of the Owner's Representative. Actions shall be taken by the Contractor if unstable ground conditions are observed or as directed by the Owner's Representative.

The Contractor shall inspect the work area with the Owner's Representative prior to the trafficking of any heavy equipment.

Whenever working close to open excavations, the Contractor shall use appropriate methods and take necessary precautions to avoid damage or disturbance of the banks of the excavation. The Contractor shall take the necessary precautions to obtain regular and stable excavation surfaces. Any damage caused as a result of negligence by the Contractor shall be repaired at his expense and to the satisfaction of the Owner's Representative.

Depending on field conditions, actual slopes may need to be flatter than shown in the Drawings and/or stabilized with appropriate techniques for the conditions encountered.

The slope angle and/or stabilization techniques to be used are presented in a separate document prepared for the Owner - direction regarding the implementation of such measures will be provided by the Owner's Representative. The Owner's Representative will approve the slope angles and/or stabilization techniques following discussions with the different parties involved in the construction.

S4.5 Waste Soil and Rock

Waste soil and rock includes soft soils, frozen material, organic materials, boulders, and other rejected materials removed from the dikes footprints.

Waste soil and rock shall be disposed of within the TSF but outside the footprint of the Saddle Dams, or in areas designated by the Owner's Representative.

Disposal materials shall not be piled higher than the final crest elevation of the structures of the TSF.

Disposal materials shall not be spoiled as to adversely affect tailings deposition in the impoundment.

Waste materials shall not be deposited into any riverbed, lake, or other water channel and shall not be burned.

Till or till-like materials excavated during the foundation preparation and for the upstream toe liner tie-in may be stockpiled separately and could be used as backfill material for the upstream toe liner tie-in. The use of excavated materials shall be at the approval of the Owner's Representative.

S4.5.1 Waste Disposal Sites

Waste disposal areas will be designated by the Owner's Representative. All waste materials generated during the construction of Saddle Dams 3, 4 and 5 shall be disposed in the designated areas unless otherwise approved by the Owner's Representative.

S4.5.2 Haulage and Disposal of Waste Materials

Haulage and final disposal of waste materials removed from the dike footprint will be the responsibility of the Contractor.

S4.6 Execution

The Contractor shall lay out each excavation subject to inspection and approval by the Owner's Representative prior to commencing any excavation. The Contractor shall not initiate excavation of any part of the Work until the proposed methodology and construction sequence has been reviewed and approved by the Owner's Representative.

Surface excavation work may begin only after the necessary infiltration and runoff control measures have been completed in accordance with Section S3, and the necessary equipment, elements and materials for protection of surface excavations are available at that site.

The Contractor shall be responsible for surveying of foundation preparation limits and stockpiles.

S4.6.1 Limits

The limits shall meet the minimum dimensions shown on the Drawings and as directed by the Owner's Representative. Method of excavation and stability of the excavation shall be the responsibility of the Contractor, with method reviewed and approved by the Owner's Representative. The upstream toe liner tie-in and the foundation preparation may require an open

cut excavation through frozen foundation soils using drilling and blasting methods. Blasting will be performed by the Owner.

The slopes of the excavations shall be no steeper than those shown on the Drawings, unless otherwise specify by the Owner's Representative. Conditions encountered in the field may require the use of stabilization technique or flattening the slopes during or following excavation. Slope stabilization mitigation measures may be necessary (e.g., placement of granular cover to preserve frozen conditions); these will be determined in the field and will be at the direction of the Owner's Representative.

Temporary slopes during construction that are not be specified in the Drawings shall follow the specifications presented in Section S4.4.2.

All necessary precautions shall be taken by the Contractor to obtain regular and stable excavation surfaces that follow the boundary lines and grades shown on the Drawings.

Alternative methods such as mechanical cutting of rock surfaces and frozen ground may be performed, subject to approval by the Owner's Representative.

The foundation preparation and the excavations of the upstream toe liner tie-in shall be carried out as indicated on the Drawings, and include, but not necessarily be limited to:

- Removal of boulders protruding more than 300 mm above the ground;
- Removal of boulders which will negatively impact the LLDPE geomembrane;
- Removal of ice-rich soils;
- Removal of ice lenses;
- Removal of soft soils;
- Removal of all organic material;
- Removal of soils to expose the bedrock in the upstream toe liner tie-in area and for the required foundation preparation.
- Removal of other materials to meet the excavation lines shown on the Drawings; and
- Removal of other materials deemed unsuitable by the Owner's Representative.

S4.6.2 Preparation of Bedrock Surface

The bedrock surface exposed within the upstream toe liner tie-in shall be cleaned using mechanical means with pressurized water and air to the satisfaction of the Owner's Representative. All soft materials and ponded water shall be removed by the Contractor to the satisfaction of the Owner's Representative.

Bedrock Mapping and Examination

Mapping and examination of the bedrock within the upstream toe liner tie-in area shall be performed by the QA Engineer. The Contractor shall assist the QA Engineer through the provision of pumping and "spot cleaning" as required by the QA Engineer.

Open joints, cracks, cavities, faults, and areas of weathered or unacceptable rock shall be identified during examination. Exposed bedrock discontinuities identified by the QA Engineer and authorized by the Owner's Representative shall be treated with 20 mm process rockfill mixed with bentonite.

S4.6.3 Blasting

All blasting will be performed by the Owner.

All operations in connection with transporting, storage and the use of explosives shall be subject to the rules and regulations of governing authorities. Blasting shall be performed by experienced and licensed personnel.

Control of Vibrations

Vibrations induced by blasting must not alter the natural state of rock beyond the excavation limits nor previously grouted rock, fills or already-placed concrete of any permanent structure. Therefore, the maximum instantaneous explosive charge, as deduced from the following equation, shall be permanently monitored and not surpassed:

$$SD = D/(W)^{1/2}$$

Where:

SD = Scaled distance;
D = Blasting distance, in feet, to the nearest structure requiring protection; and
W = Maximum instantaneous charge, in pounds.

The SD relation will equal 50 when the blasting distance to the structure requiring protection is less than 50 m; when greater, the SD relation to deduce the maximum instantaneous charge will be 65.

S4.6.4 Care of Water

Control of surface and groundwater during foundation preparation and excavation shall meet the requirements of Section S3.

S4.6.5 Grading of Foundation Surfaces

Surfaces for Fill Placement

Foundation surfaces shall be rough graded to form a smooth surface before any fill material is placed. This includes scalping tops of hummocks.

LLDPE Geomembrane Bedding Surfaces

Soils that will serve as liner bedding shall be incompressible and provide a dense, unyielding foundation with no sharp changes or abrupt breaks in grade. Weak or compressible areas which cannot be satisfactorily compacted to provide a smooth surface for LLDPE geomembrane placement shall be removed and replaced with properly compacted fill meeting the requirements of Section S5.

Standing water or excessive moisture shall not be allowed before LLDPE geomembrane placement.

At the direction of the Owner's Representative and/or the Liner Installer, if the soil surface is not suitable for liner placement, the Contractor shall prepare the surface for approval by the Owner's Representative and acceptance by the Liner Installer. This may include, but not necessarily be limited to, grading or the addition of fill material.

S4.7 Dimensional Tolerances

All excavations and blasting shall be completed to be within 300 mm horizontally and vertically of specified lines and grades unless otherwise specified by the Owner's Representative.

S4.8 Completion of the Work

Work will be completed when all unsuitable materials have been removed from the foundation, excavations have met the lines and dimensions shown in the Drawings and rough grading has been performed to provide a smooth foundation surface.

After completion of the Work, the Contractor shall conduct a survey to determine and record the "as-built" conditions of the foundation.

S5 FILLS

S5.1 Scope

This Specification describes requirements for the fills, fill placement, and fill compaction for construction of Saddle Dams 3, 4 and 5.

S5.2 Work Sequence

The Work will only start following the completion of foundation preparation (Sections S4) and upon receipt of approval to proceed from the Owner's Representative.

Fill placement in the upstream toe liner tie-in area will only start following the completion of the foundation preparation. Fill placement over the LLDPE geomembrane will only proceed once it has been seamed tested (by the Liner Installer) and approved (by the Owner's Representative and QA Engineer) (Refers to Section S6).

S5.3 Examination

Prior to commencing construction, the Contractor shall thoroughly examine other Work upon which his Work is dependent and report any identified deficiencies to the Owner's Representative.

S5.4 Survey and Initiation

Survey of the surface work areas shall be carried out by the Owner and the Contractor before the Work starts to establish the base plans for layout, as-built configuration, and quantity for payment.

The Owner is responsible for the layout. The Contractor is responsible for correctness and exactness of the Work.

S5.5 General

Fill placement shall be to the lines, grades, and cross-sections shown on the Drawings and in accordance with the Specifications.

Water control measures such as temporary drainage and pumping systems shall be operated and maintained to satisfy the requirements of Section S3.

Access to the Work will be coordinated by the Owner's Representative.

S5.6 Materials

S5.6.1 Compacted Till (Zone 1)

Recommended gradation limits are provided in Table 5-1. Compacted till shall be unfrozen silty sand and gravel with a maximum particle size of 150 mm. Compacted till placed within 0.5 m of the LLDPE geomembrane shall have a maximum particle size of 50 mm. Compacted till shall be well-graded, plastic, and contain a minimum of 20-35% fines (percent of material by mass passing No. 200 sieve).

Compacted Till placed within 0.5 m of the LLDPE geomembrane shall have a maximum particle size of 50 mm or as directed by the Owner's Representative.

Till shall be free of organic material, debris, cinders, ash, refuse, snow, ice, and other deleterious materials subject to approval of the Owner's Representative.

Table 5-1: Gradation Limits for Till

Grain Size (mm)	Percent Passing by Mass (%)
152.4	100
76.2	91-100
25.4	75-91
12.7	65-84
4.76	53-73
0.425	33-48
0.075	20-35

S5.6.2 Low Quality Till

The till-like fill material shall be unfrozen silty sand and gravel. The material shall be well-graded and have a gradation ranging between 0 and 500 mm. The till-like material shall be free of boulder, organic material, debris, cinders, ash, refuse, snow, ice, and other deleterious materials subject to approval by the Owner's Representative.

S5.6.3 Fine Filter (Zone 2)

Fine filter shall comprise crushed non-AG or PAG rockfill processed to satisfy the gradation limits shown in Table 5-2. Fine filter shall be free of organic material, debris, cinders, ash, refuse, snow, ice, and other deleterious material subject to the satisfaction of the Owner's Representative.

Table 5-2: Fine Filter (Zone 2) Gradation Limits

Grain Size (mm)	Percent Passing by Mass (%)
20	100
12.7	50-100
4.76	23-68
0.425	0-20
0.075	0-15

S5.6.4 Coarse Filter (Zone 3)

Coarse filter shall comprise crushed non-AG or PAG rockfill processed to satisfy the gradation limits in Table 5-3. Coarse Filter material shall be free of clay, organic matter, debris, cinders, ash, refuse, snow, ice and other deleterious material, subject to the satisfaction of the Owner's Representative.

Table 5-3: Coarse Filter (Zone 3) Gradation Limits

Size (mm)	Percent Passing (%)
200	100
152.4	86-100
76.2	35-100
25.4	5-40
12.7	0-18
4.76	0-9
2	0-5

S5.6.5 Coarse Rockfill (Zones 4A and 4B)

Coarse rockfill shall comprise sound, hard, durable, well-graded rock fragments free from ice, frozen chunks, organic matter, debris and other deleterious materials. Coarse rockfill shall have a maximum particle size of 1.3 m. All rockfill shall be geochemically classified by the Owner prior to placement.

Coarse rockfill classified Zone 4A shall comprise non-AG or PAG rockfill material. Coarse rockfill classified Zone 4B shall comprise Non-AG rockfill material only and shall be placed in the zones

shown on the drawings, and areas prioritized by the Owner's Representative. Non-AG rockfill may be placed in lieu of PAG rockfill but only at the direction of the Owner's Representative.

S5.6.6 Fine Rockfill (Zone 5)

Fine rockfill shall comprise sound, hard, durable, well-graded rock fragments free from ice, frozen chunks, organic matter, debris, and other deleterious materials. Fine rockfill shall be well-graded and have a gradation ranging between 0 and 300 mm. Non-AG and PAG rockfill may be used for fine rockfill—the placement limits for each non-AG and PAG type will be at the direction of the Owner's Representative.

S5.7 Placement and Compaction

General

The placement of fill materials includes loading, transporting, unloading, storing, and additional handling when necessary.

Prior to fill placement, water, ice, snow, or other deleterious materials shall be removed from the foundation surface, to the satisfaction of the Owner's Representative.

During placement and spreading, unsuitable waste materials such as, but not limited to, debris, organics, vegetation, over sized particles, or any other unsuitable material shall be removed.

Fill materials shall not be placed until the foundation has been inspected and approved in writing by both the Owner's Representative.

Fills shall be constructed to the lines, grades and cross-sections shown on the Drawings using only suitable materials as defined within the Technical Specifications and/or approved by the Owner's Representative.

Equipment suitability, methods of working, rate of progress, and quality of work shall be demonstrated during the initial stages of the work or at such time as requested by the Owner's Representative. In the event that the work performance is unsatisfactory for either quality or schedule requirements, the Contractor shall immediately implement such changes as required to ensure the required quality and scheduled completion of the work.

Materials shall be loaded, transported, dumped and spread to limit segregation to the extent possible, so that each zone is homogeneous, free of stratification, nesting of larger particles, lenses, pockets, ruts, or layers of material of different texture or grading not conforming to the requirements specified for the material of each zone.

Backfill activities in the upstream toe liner tie-in area shall commence only after the bedrock surface has been approved by the Owner's Representative. No fill shall be placed in the upstream toe liner tie-in area prior to the completion of bedrock mapping (by the QA Engineer) and as-built surveying (by the Contractor).

Accumulations of oversized materials, particularly between different material zones, shall be removed and replaced with suitable materials as required in the Specifications and to the satisfaction of the Owner's Representative.

Accumulation of water, snow, ice or other deleterious material(s) shall be prevented on the surface of the fill or foundations. The Contractor shall crown and seal the surface of all fill surfaces.

Material placement shall cease when satisfactory work cannot be carried out due to rain, snow, or any other unsatisfactory conditions and as directed by the Owner's Representative.

Fill materials shall not be placed on frozen materials unless directed by the Owner's Representative.

Care and attention during fill placement and compaction shall be exercised by the Contractor such that disturbance, movement, and damage to underlying fills and materials (i.e. geotextile and LLDPE geomembrane) are avoided.

Under **NO** circumstances is geotextile or LLDPE geomembrane to be trafficked upon by **ANY** equipment (light, heavy or haulage). Placement and compaction of fills over LLDPE geomembrane shall be performed to the satisfaction of the Owner's Representative and Liner Installer. Placement, compaction, and trafficking restrictions are outlined in S5.7.1, S5.7.2 and S5.7.3 for fills placed over the LLDPE geomembrane.

Haulage and heavy equipment shall be excluded from directly trafficking on the surfaces of the following fill materials:

- Compacted till (Zone 1);
- Fine filter (Zone 2); and
- Coarse filter (Zone 3).

The operation of placement and compaction equipment trafficking and working on the surfaces of the above-listed fill materials shall be such that no damage to the underlying material(s) results. This work shall be performed to the satisfaction of the Owner's Representative. The Contractor shall cooperate with the Owner's Representative to confirm the integrity of underlying material(s) (e.g. excavations).

Haulage and heavy equipment shall only traffic on coarse rockfill materials having a minimum thickness of 2 m over the underlying finer fill materials. Haulage equipment shall only traffic on surfaces following approval by the Owner's Representative. The Contractor shall cooperate with the Owner's Representative to confirm the integrity of underlying material(s) (e.g. excavations).

Each fill material lift shall be compacted before placement of the subsequent lift. Lifts shall be placed horizontally.

Compaction shall be carried out over large surfaces and by executing turns carefully to obtain uniform compaction. One passage of the compactor over the entire area being compacted will constitute a pass and successive passes shall overlap the previous pass by at least 600 mm.

If the compaction of a lift or a portion of lift is insufficient due to either lack of overlapping or rolling, or to excessive lift thickness, or to excess or deficient water content, the Contractor shall improve the condition of the fill in accordance with the requirements specified herein and re-compact the lift. If the additional work cannot provide satisfactory results, remove and waste such lift, or its portion, and provide new material so that the requirements of the Specifications are met. All fills shall be placed and compacted to the satisfaction of the Owner's Representative.

Compaction shall be suspended when weather conditions result in freezing or an increase in water content of the materials above the limits as directed by the Owner's Representative.

Any fill material that has become saturated, softened, loosened, or has undergone a reduction in density by precipitation, ponded water, construction traffic, or frost action is to be treated or excavated and replaced with suitable material. The Owner's Representative shall identify areas from which material shall be removed. This work shall be performed to the satisfaction of the Owner's Representative.

The compaction methodology and degree of compaction achieved in the field will be monitored by the QA Engineer. The Contractor, QA Engineer and the Owner's Representative will conduct field trials and develop methodologies to achieve satisfactory degree of compaction for the fill materials.

Material in pockets and depressions in the foundation shall be compacted with jumping jacks and heavy plate tampers, or similar small size compaction equipment approved by the Owner's Representative.

Fill materials shall be compacted prior to freezing.

S5.7.1 Compacted Till (Zone 1)

General

The maximum loose horizontal lift thickness of the till materials shall be 0.5 m. The placement water content shall be at 0% to 3% above its optimum water content (refer to ASTM D698) or as approved by the Owner's Representative.

Compaction shall be carried out using a 10 tonne pegfoot compactor. The use, or non-use, of vibration during compaction will be at the direction of the Owner's Representative based on the results of field trials. Placement and compaction of the till materials shall result in a homogeneous,

low hydraulic conductivity zone. The density of the compacted till material is expected to be about 95% of standard Proctor maximum dry density (refer to ASTM D698).

Over the LLDPE Geomembrane

Compacted Till placed over and within 0.5 m of the LLDPE geomembrane shall:

- Be placed in loose lifts having a thickness of 0.5 m using an excavator having a maximum mass of 20 t. Direct dumping of Compacted Till onto the LLDPE geomembrane shall **NOT** be allowed. Down-slope placement of material is prohibited.
- **NOT** be compacted with the compactor; compaction shall comprise a single pass of an excavator with a maximum mass of 20 t.
- **NOT** be trafficked by any light, heavy, or haulage equipment other than that above.
- Be to the satisfaction of the Owner's Representative.

S5.7.2 Fine Filter (Zone 2)

The maximum loose lift thickness of fine filter shall be 0.5 m.

Compaction of fine filter shall be carried out using a 10 tonne smooth drum vibratory roller compactor with a minimum of 4 passes parallel to the longitudinal axis of the Saddle Dams and to the satisfaction of the Owner's Representative.

Over the LLDPE Geomembrane

Fine Filter placed over the LLDPE geomembrane shall:

- Be placed in loose lifts having a thickness of 0.5 m and using an excavator or loader having a maximum mass of 20 tonnes equipped with wide tracks. Controlled placement of Fine Filter shall be performed to avoid damaging the LLDPE geomembrane. Speed, braking, and turning radius restrictions shall be to the satisfaction of the Owner's Representative. .
- **NOT** be compacted with a compactor; compaction shall comprise two passes of an excavator with a maximum mass of 20 tonnes. **NOT** be trafficked by any light, heavy, or haulage equipment other than that above. Down-slope placement of material is prohibited.
- Be to the satisfaction of the Owner's Representative.
- *Alternatively, a CAT 307 excavator, a CAT D6 LGP dozer or approved equivalent can be used to place, grade and compact the fine filter layer on the LLDPE geomembrane. If this option is used, the following additional condition must be respected:*

- *One metre of fine filter (or other fill material accepted as equivalent) is the minimum considered to be acceptable to support this equipment.*
- *The placement of material on the LLDPE geomembrane with this equipment must be supervised at all times by the QC Representative or the QA Engineer. The equipment shall place the material in a manner to avoid forming wrinkles/folds/fish mouths in the geosynthetics.The excavator bucket must not come into contact with the geosynthetics and the tracks of the excavator shall not spin freely.*

S5.7.3 Coarse Filter (Zone 3)

The maximum loose lift thickness of Coarse Filter shall be 0.5 m. Coarse filter shall be placed and compacted to avoid disturbing the underlying materials.

Compaction of the coarse filter shall be carried out using a 10 tonne smooth drum vibratory roller compactor with a minimum of 4 passes parallel to the axis of the Saddle Dams and to the satisfaction of the Owner's Representative.

Over the LLDPE Geomembrane

Coarse Filter placed over the LLDPE geomembrane shall:

- Be placed in loose lifts having a thickness of 0.5 m and using an excavator or loader having a maximum mass of 20 tonnes equipped with wide tracks. Controlled placement of Coarse Filter shall be performed to avoid damaging the underlying materials. Speed, braking, and turning radius restrictions shall be to the satisfaction of the Owner's Representative. Down-slope placement of material is prohibited.
- Be placed to provide a minimum 2 m offset from the placement limit of the Fine Filter.
- Be compacted using a 10 tonne smooth drum vibratory roller compactor with a minimum of 4 passes parallel to the axis of the Saddle Dams.
- Be to the satisfaction of the Owner's Representative.

S5.7.4 Coarse Rockfill (Zones 4A and 4B)

The maximum loose lift thickness for coarse rockfill shall be 2 m. Placement equipment shall traffic the material uniformly parallel and perpendicular to the lift front advancement to aid in compaction. Coarse Rockfill shall be placed and compacted to avoid disturbance of the underlying materials.

Compaction of coarse rockfill shall be carried out using a fully-loaded haul truck with a minimum of 4 passes parallel to the axis of the Saddle Dams. Alternatively, in areas which are difficult to

circulate with haul truck, a 10 tonne smooth drum roller vibratory compactor with a minimum of 6 passes parallel to the axis of the Saddle Dams will be used. Compaction shall be to the satisfaction of the Owner's Representative.

S5.7.5 Fine Rockfill (Zone 5)

The maximum loose lift thickness for fine rockfill shall be 0.5 m. Placement equipment shall traffic the material uniformly parallel and perpendicular to the lift front advancement to aid in compaction.

Compaction of fine rockfill shall be carried out using a 10 tonne smooth drum roller vibratory compactor with a minimum of 4 passes parallel to the axis of Saddle Dams 3, 4 and 5 and to the satisfaction of the Owner's Representative.

S5.7.6 Low Quality Till

The maximum loose lift thickness for Low Quality Till shall be 1.0 m. Placement equipment shall traffic the material uniformly parallel and perpendicular to the lift front advancement to aid in compaction.

Compaction of Low Quality Till shall be carried out using a 10-tonne smooth drum roller vibratory compactor with a minimum of 4 passes parallel to the axis of Saddle Dams 3, 4 and 5 and to the satisfaction of the Owner's Representative.

S5.8 Borrow and Stockpile Sources

S5.8.1 Compacted Till (Zone 1) / Low Quality Till

The Owner shall provide borrow sources for Compacted Till and Low Quality Till. The Contractor will be responsible of developing the borrow sources, loading, and hauling the material to the Works and ensuring performance of the QC of the material as-placed.

S5.8.2 Fine Filter (Zone 2)

Fine filter material will be produced and stockpiled by the Owner.

QC of the stockpiled material will be by the Owner. Loading and hauling to the Works and ensuring performance of the QC of material as-placed will be the Contractor's responsibility.

S5.8.3 Coarse Filter (Zone 3)

Coarse Filter material will be produced and stockpiled by the Owner.

QC of the stockpiled material will be by the Owner. Loading and hauling to the Works and ensuring performance of the QC of material as-placed will be the Contractor's responsibility.

S5.8.4 Coarse Rockfill (Zone 4A and 4B)

Coarse rockfill will be provided and geochemically classified by the Owner. Loading and hauling to the Works will be by the Contractor and/or the Owner. The QC of material as-placed will be performed by the QC Representative in collaboration with the Contractor.

S5.8.5 Fine Rockfill (Zone 5)

Fine rockfill will be provided and geochemically classified by the Owner. Loading and hauling to the Works and QC of material as-placed will be performed by the QC Representative in collaboration with the Contractor.

S5.9 Dimensional Tolerances

Slopes shall be within 0.2±H:1V of those shown on the Drawings unless approved by the Owner's Representative.

All compacted till shall be completed to be within 0.1 m horizontally and vertically of lines and grades shown on the Drawings, unless otherwise approved by the Owner's Representative.

The Low Quality Till is used to backfill upper portion of the upstream toe liner tie-in excavation, if required. As indicated on the drawings precaution must be taken to ensure that the elevation of the Low Quality Till is higher than the maximum elevation of the competent soil left under the footprint of the dikes (within 0.1 m). If this is not the case, additional Low Quality Till must be placed in lifts and fit the field condition until this elevation is reached. .

All processed rockfill materials shall be completed to be within 0.1 m horizontally and vertically of the lines and grades shown on the Drawings, unless otherwise approved by the Owner's Representative.

All rockfill placements shall be completed to be within 0.5 m horizontally and vertically of the lines and grades shown on the Drawings, unless otherwise approved by the Owner's Representative.

S5.10 QC and QA

The Work shall satisfy the requirements of Section S9.

The Contractor is responsible for coordinating the construction effort with the QC Representative such that the requirements of the Specifications and Drawings are satisfied. The Contractor shall perform continuous as-built surveying during the placement of fills. The Contractor shall, on a weekly basis, submit hardcopies and electronic data of the as-built surveys to the QA Engineer and the Owner's representative for comment and review during fill placement activities.

QA inspection shall be carried out by the QA Engineer to confirm the QC results including whether the specified fill placement, construction grades and limits, LLDPE geomembrane bedding surfaces, number of passes by the compactor, and densities, are being achieved and construction materials are satisfying the requirements of the Specifications and Drawings and the design intent.

S6 LINEAR LOW DENSITY POLYETHYLENE (LLDPE) GEOMEMBRANE

S6.1 Scope

LLDPE geomembrane placed on the upstream face and within the upstream toe liner tie-in of the Saddle Dams shall be Micro Spike Geomembrane Liner (1.5 mm, textured on both sides), or approved equivalent, as indicated in the Drawings.

The Work covered by this Specification includes, but is not limited to:

By Owner:

- Ordering the LLDPE geomembrane;
- Handling and transport of the LLDPE geomembrane to the mine site;
- Receiving and unloading rolls of the LLDPE geomembrane at the mine site;
- Preparing a suitable temporary storage area for the rolls of the LLDPE geomembrane, and protecting the rolls from damage or environmental degradation while in temporary storage.

By Liner Installer:

- Transporting the rolls of the LLDPE geomembrane from the temporary storage area to the installation sites.
- Placing the LLDPE geomembrane in accordance with the Manufacturer's instructions and the Specifications, to the lines, grades and dimensions shown on the Drawings, or as directed by the Owner's Representative ;
- Providing all materials, equipment and labour required to position and install the LLDPE geomembrane, as shown on the Drawings;
- Carrying out all the non-destructive and destructive tests required in the Specifications, employing industry standard techniques and equipment;
- Clean up of the site; and
- Preparation of pre-installation and as-built panel layout Drawings, in digital AutoCAD drawing format, as described in detail within the Specifications.
- Preparation of the liner installation report.

S6.2 Work Sequence

The Work will only start upon receipt of approval to proceed from the Owner's Representative and following inspection, as-built survey, and approval of pre-work conditions by the Owner's Representative.

S6.3 General

S6.3.1 Manufacturer's Qualifications

The manufacturer shall have at least five (5) years continuous experience in the manufacture of LLDPE geomembrane and/or experience totalling ten million (10,000,000) square meters of manufactured LLDPE geomembrane.

S6.3.2 Liner Installer's Qualifications

The Liner Installer shall employ qualified personnel, experienced in deploying, welding, testing and patching LLDPE geomembrane. The Liner Installer shall be experienced in installing LLDPE geomembrane in cold climates. Qualified personnel shall be certified annually by the liner Manufacturer with a non-transferable letter.

The Liner Installer shall submit a list of proposed personnel to the Owner's Representative for approval at least two weeks prior to the liner deployment, and specifically identify the experience of the personnel that will install the LLDPE geomembrane.

The Liner Installer shall provide the following:

- Resumes of supervisors and master seamers that will work on this project.
- Proposed installation schedule.
- Information on equipment and personnel.
- Samples of field welds of the same type of LLDPE geomembrane specified for this project from each type of weld proposed to be seamed at this project.
- A list of at least ten (10) completed facilities, totalling a minimum of two million (2,000,000) square metres for which the Contractor has installed the same type(s) of LLDPE geomembrane specified for this project. For each installation listed, the following information shall be provided as a minimum: name and purpose of the facility, the location of the facility, the date of the installation, the name of the Owner, the name of the LLDPE geomembrane Manufacturer, the type, thickness and total surface area of LLDPE geomembrane installed, type of seaming, patching, and QC testing used during the installation.

- The master seamer(s) must have seamed a minimum of one million (1,000,000) square-metres of LLDPE geomembrane, using the same type of seaming equipment and techniques approved for the Works.

S6.3.3 Sampling, Testing and Reporting

The Liner Installer shall cooperate with the Owner's Representative and the QA Engineer in providing the liner samples for QA testing, allowing access for QA review of the QC testing, and providing results of QC testing in a prompt manner.

The Contractor must provide laboratory equipment and facilities that are sufficient for the QC testing required within the Specifications.

S6.3.4 Supply

Ordering the Liner

The LLDPE geomembrane shall be ordered by the Owner.

Requirements for Supply

The Manufacturer shall provide QC certificates for each batch, or rail car, of resin used to manufacture the LLDPE geomembrane for this project. The certificates shall state the production date or dates for the resin.

The Manufacturer shall provide labels on each roll of the liner which will include the following information, as stated in the QC and QA Requirements Specification:

- Name of Manufacturer;
- Type of LLDPE geomembrane;
- Thickness, length and width;
- Roll identification number; and
- Manufacturer's lot number.

LLDPE geomembrane labels must be durable to be able to withstand shipping, unloading and temporary storage.

The Manufacturer shall provide a summary document of all the information listed above, including Manufacturer QC certificates, to the Owner's Representative. The QC certificates shall include results from all QC tests listed in Table 6-1. The QA Engineer shall, upon receipt from the Owner's Representative, review the QC certificates.

Table 6-1: Required QC Testing of LLDPE Geomembrane in Manufacturer's Factory

Type of Test	Testing Standard	1.5 mm LLDPE Geomembrane	
		Value	Min. Frequency
Thickness – mm • minimum average • lowest individual for 8 out of 10 values • lowest individual of any of the 10 values	D5994	1.43 1.35 1.28	per roll
Asperity Height – mm (min. average)	GM12	0.41	alternate top and bottom of rolls
Density - g/cc (maximum)	D792, Method B	0.939	per resin lot
Tensile Properties (avg. both directions) • strength at break (min. avg.) (N/mm) • elongation at break (min. avg.) (%)	D6693, Type IV 2 in/min. 5 specimens/direction	29.4 N/mm 400 %	20,000 lb
Tear Resistance (min. average)	D1004	160 N	45,000 lb
Puncture Resistance (min. average)	D4833	310 N	45,000 lb
Carbon Black Content - %	D4218	2 - 3 %	20,000 lb
Carbon Black Dispersion (category)	D5596	note *(1)*	45,000 lb
Oxidative Induction Time (min.)	D3895 200 °C, 1 atm O2	≥100 min.	per resin lot
Melt Flow Index (g/10 minutes)	D1238 190 °C, 2.16 kg	≤1.0	per resin lot
Oven Aging with HP OIT (% retained after 90 days)	D5721 D5885, 150 °C, 500 psi O_2	60	per resin formulation
UV Resistance with HP OIT, note (2) (% retained after 1600 hours)	GRI GM11 D5885, 150 °C, 500 psi O_2	35	per resin formulation
2% Secant Modulus (max.) (N/mm)	D5323	630	per resin formulation
Axi-Symmetric Break Resistance Strain, (%, min.)	D5617	30	per resin formulation

(1) Carbon black dispersion (only near spherical agglomerates) for 10 views: 9 views in Cat. 1 or 2, and 1 view in Cat. 3.

(2) UV resistance is based on 20hr. cycle at 75°C/4 hour dark condensation at 60°C.

LLDPE geomembrane rolls delivered with defects such as holes, blisters, undispersed raw materials, or any signs of contamination by foreign matters, shall be rejected. Edge flaws will only be accepted if they do not interfere with the seaming process.

The Manufacturer shall warrant the liner material meets the requirements covered by these Specifications. The warranty shall provide for the total and complete replacement of any defective materials that may be identified at any time, upon written notification and demonstration by the Owner of the non-conformance of the LLDPE geomembrane material with the Specifications. The Manufacturer shall replace the defective liner within one month of notification of defect.

S6.3.5 Transportation and Handling

Transportation of the LLDPE geomembrane to site is the responsibility of the Owner.

The Liner Installer shall take possession and responsibility of the liner at the time of off-loading at the temporary storage site. When the LLDPE geomembrane arrives at site, the Owner shall unload all the rolls at a temporary storage location where only one handling step is required to take each roll to its position for storage.

The rolls must be handled in such a way to prevent damage to the liner. Slings shall be provided by the Manufacturer on each roll of liner, for loading and off-loading of the liner rolls. After off-loading on site, slings are to be left on each roll. ***Inappropriate use of forklifts or other inappropriate means is forbidden.***

At any time during delivery and/or upon arrival at site, the Owner must allow the Owner's Representative, or designated representative, to be present when the LLDPE geomembrane is handled outside of the sea containers or off loaded from a transport vehicle. This requirement includes any off-site handling of the LLDPE geomembrane required for its transport to site.

S6.3.6 Temporary Storage and Protection

Upon the arrival of the liner rolls on site the Owner shall:

- Prepare a suitable temporary storage area for the sea containers or the LLDPE geomembrane rolls in a secure location; and
- Prepare an 'As-Received' inventory of the rolls of the liner and materials, a copy of which must promptly be provided to the Owner's Representative and the Contractor.

The Owner shall be responsible for protection of the rolls and materials on site prior to the Contractor's retrieval of the rolls and materials.

The Liner Installer shall assume responsibility for the protection and handling of the rolls and materials following retrieval from the temporary storage area.

While in temporary storage, rolls shall be strapped so that no damage occurs to the outer wraps on each roll, and that straps do not damage adjacent rolls. Rolls shall be supported so that no penetrating stresses are induced in the LLDPE geomembrane, and the rolls cannot move.

The rolls shall be stored on a prepared surface. Storage on wooden pallets or other surfaces that may damage the LLDPE geomembrane shall not be permitted. The rolls shall not be stacked more than three (3) high and shall be stacked in such a manner that the roll number of each roll is easily visible. The LLDPE geomembrane shall be stored such that it is protected from puncture, dirt, grease, gasoline, diesel, fuel, water, moisture, mud, mechanical abrasion, excessive heat and other causes of damage to the liner material. Manufacturer's labels shall be maintained intact. Labels shall be clearly visible and legible after rolls have been stored on site.

S6.4 Products

The LLDPE geomembrane to be installed on the upstream face of the Saddle Dams shall be Micro Spike (1.5 mm, textured on both sides) and shall satisfy the requirements of Section S6.3.4.

S6.4.1 Field Seams

The field seam properties of the LLDPE geomembrane for this project shall meet or exceed the minimum values shown in Table 6-2.

Table 6-2: LLDPE Geomembrane Field Seam Properties

Property	Test Method	Minimum Value
		1.5 mm LLDPE Geomembrane
Hot Wedge (Fusion) Seams [1] • shear strength [2], N/25 mm. • shear elongation at break [3], % • peel strength [2], N/25 mm • peel separation, %	ASTM D6392 GRI-GM19	 394 50 328 25
Extrusion Fillet Seams • shear strength [2], N/25 mm • shear elongation [3], % • peel strength [2], N/25 mm • peel separation, %	ASTM D6392 GRI-GM19	 394 50 290 25

Notes:
1. Also for hot air and ultrasonic seaming methods.
2. Values listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values.
3. Elongation should be observed but measurements should be omitted for field testing.

S6.4.2 Extrudate

Compound shall be new, first-quality resin, produced in the United States of America or approved alternative conforming to the same properties as the resin used in the manufacture of the liner sheet and obtained from the same manufacturer.

On an extrusion weld, all the grinded area must be covered by extrudate.

S6.5 Execution

S6.5.1 Bedding Surface

The bedding surface upon which the LLDPE geomembrane is to be installed shall be to the lines and grades as shown on the Drawings and shall satisfy the requirements of Sections S4 and S5. No LLDPE geomembrane shall be placed until the bedding surface has been approved by the Owner's Representative and accepted by the Liner Installer.

Before beginning installation of the LLDPE geomembrane, a surface acceptance form, as prepared by the Contractor, must be signed by the Liner Installer first and then by the Owner's Reprensentative. This acceptance may be segmented in order to cover only localized areas of the

liner placement at any one time. No LLDPE geomembrane shall be installed before the Owner's Representative has signed the surface preparation acceptance form.

It is the responsibility of the Liner Installer to inform the Owner's Representative and the Contractor of any change, due to natural or other causes, to an area of subgrade that has been accepted that may require repair work. Any damage to the subgrade that was caused by the Liner Installer shall be repaired by the Liner Installer at no charge to the Owner.

S6.5.2 Survey and Layout

The Liner Installer shall provide the Owner's Representative with a proposed panel layout drawing, in digital AutoCAD drawing and hardcopy formats, at least one week prior to placing any LLDPE geomembrane. The panel layout drawing shall be based on the actual as-built surface on which the liner is to be placed and shall consider panel placement locations along the dam alignments.

The panel layout should minimize the number and length of required seams. In general, horizontal seams will not be allowed on the proposed panel layout for the sloping face portions of the LLDPE geomembrane installation. The Liner Installer shall not place any liner until the Owner's Representative has given written approval that the proposed panel layout is acceptable.

Survey on site shall be the responsibility of the Contractor.

It shall be the responsibility of the Contractor to secure proper horizontal and vertical control such that the locations of the LLDPE geomembrane conform to the dimensions shown on the Drawings.

Upon completion of LLDPE geomembrane installation, the Liner Installer shall supply drawings depicting the surveyed locations of panels, seams, patches and destructive sample locations, including numbering associated with these locations. This plan, once completed, will be submitted to the Owner's Representative for review and approval.

Completed as-built information shall be submitted within six (6) weeks following acceptance of the installation.

S6.5.3 Deployment and Installation

The Liner Installer is responsible for installation of the LLDPE geomembrane, QC testing and document preparation. The Contractor shall install the liner in accordance with the Manufacturer's instructions, and these Specifications.

No more LLDPE geomembrane shall be deployed than can be seamed during that day's shift. No liner shall be deployed during periods of precipitation, high winds, in the presence of excessive moisture, or in areas of excessive moisture in the subgrade. With the adapted installation technique, the LLDPE geomembrane may be installed in ambient air temperatures as low as -20 °C

(or -30 °C including wind chill factor). The Liner Installer shall not install LLDPE geomembrane when the ambient air temperature is lower than 0°C without proper field method and prior written approval of the Owner's Representative.

The surface of the bedding surface must be smoothed, free of protruding stones, clean, and dry. When deploying the rolls the Contractor shall ensure that the liner panels are properly aligned, with a minimum overlap of 100 mm. Chalk marks 100 mm from the panel edges shall be used to lay out the panels. Dragging the LLDPE geomembrane across the ground will not be permitted.

The LLDPE geomembrane shall be installed in a relaxed condition and shall be free of tension and stress upon completion of the installation. Stretching of the LLDPE geomembrane to fit will **not** be allowed. Excess material shall be limited such that folds are not present in the liner; any fold, in cross-section, having a height greater than half its width shall be cut out and repaired. The LLDPE geomembrane shall be installed to the satisfaction of the Owner's Representative.

The Contractor shall ensure that sufficient ballast is placed to hold the LLDPE geomembrane in place, in the event of high winds. The ballast shall comprise sand-filled burlap sacks, or other means which will not cause damage to the liner. Sand bags shall not be thrown on top of, or allowed to slide down, slopes on top of the LLDPE geomembrane.

Following the installation, each in-place LLDPE geomembrane panel shall be visually inspected by the Liner Installer in order to identify any damaged surfaces or abnormal appearance. Any defect must be repaired promptly by the Liner Installer. Additionally, the Liner Installer shall carry out required QC testing and sampling as specified in the QC/QA Specification.

The Owner's Representative will inspect and approve the LLDPE geomembrane installation only upon receiving all required QC documentation.

No covering or backfilling over the LLDPE geomembrane shall be carried out until the Owner's Representative has approved the LLDPE geomembrane installation in writing. The acceptance may be issued for completion of localized areas of the LLDPE geomembrane, prior to completing the entire installation, at the direction of the Owner's Representative.

S6.5.4 General Workmanship

The Liner Installer shall perform all Work to conform to the best recognized practice to achieve a neat and functional installation.

The Liner Installer is responsible to prevent any damage that may be caused due to the LLDPE geomembrane cover placement or other construction activities. Reference to Section S5 shall be made In order to minimize damage to the LLDPE geomembrane during installation:

- The equipment used shall not damage the liner. At least one week prior to placing any LLDPE geomembrane, the Liner Installer shall provide the Owner's Representative with an equipment

list stating quantity, types and which pieces of equipment are proposed to come into contact with the LLDPE geomembrane.

- Splash pads shall be placed beneath any type of equipment that may leak or splash gasoline, diesel, fuel, oil, or grease upon the LLDPE geomembrane. The splash pad shall be large enough to contain any splash or leak. Prior to placing the splash pad, the LLDPE geomembrane shall be swept clean of any material that may puncture or abrade the LLDPE geomembrane.
- All hoses or cords that are used upon the liner shall be handled such that they will not damage the LLDPE geomembrane. Hoses and cords shall not be dragged across material that may abrade the LLDPE geomembrane.
- There shall be no smoking on the LLDPE geomembrane.
- Personnel working on or near the liner shall wear boots that will not damage the LLDPE geomembrane.
- There shall be no hard objects allowed to come into contact with the LLDPE geomembrane without the use of a rub sheet.
- Any damage to the LLDPE geomembrane as a result of ATV traffic shall be repaired by the Contractor, at no cost to the Owner, and to the satisfaction of the Owner's Representative.

Methods that are found to consistently damage the LLDPE geomembrane or the subgrade, as determined by the Owner's Representative will be terminated immediately upon written notice to the Contractor and the Liner Installer.

Workmanship and all permanent materials furnished by the Liner Installer under this Technical Specifications shall be guaranteed by the Liner Installer against failure due to improper installation.

Upon written notice that the material fails to meet the original intent of the design or of failure of guaranteed materials or workmanship, the Liner Installer shall install new materials and/or furnish the workmanship necessary to correct the failure at the expense of the Liner Installer. The Liner Installer shall bear all costs for labour and materials associated with repair of guaranteed work.

S6.5.5 Seaming

Seaming must be performed according to these Specifications and the instructions of the Manufacturer.

To the extent possible, welding of seams should be done from the bottom to the top of the slope. No horizontal welds shall be allowed on slopes of greater than 5% incline, except on small, localized patches required to repair defects. All seams shall be completed by a welding reviewer,

who has not been a part of the welding team for that seam, completing visual checking of the entire seam length. No base or T-seams shall be placed within 1.5 m from the toe of the slope.

Only welding equipment that is on the equipment list and has been approved shall be used to seam the LLDPE geomembrane. As a minimum, the welding and related equipment shall meet the following requirements:

- The welding equipment shall be equipped with a means of measuring and displaying the temperature within the apparatus: at the nozzle for extrusion welders and at the wedge(s) for fusion welders.
- The power source shall be capable of providing a constant voltage under varying line loads.
- The welding rod shall be free from dirt, dust, moisture, and tangles at all times.
- The machine shall be purged for approximately 30 seconds prior to actual extrudate welding.

Panels shall have a finished minimum overlap of 100 mm unless otherwise approved in writing by the Owner's Representative. The overlap shall be measured and marked on the underlying panel. If trimming of the liner is required to maintain the overlap, the underlying panel shall be trimmed and remarked.

The welder shall write upon the liner, in permanent marker, the following information at the beginning and end of each seam:

- Welder number.
- Welder's name.
- Temperature of the wedge(s) for fusion welders or temperatures of the inside of the welder and at the tip for extrusion welders.
- The date and time.

A copy of this information shall be provided to the Owner's Representative for approval.

Welding shall only be performed when the LLDPE geomembrane is clean of dust, dirt, grease, oil, other foreign substances, and dry. Solvents or adhesives shall not be used unless the specific product is approved in writing by the Owner's Representative.

The following procedures shall be used for extrusion welding:

- Surface of LLDPE geomembrane to be extrusion welded shall be ground.
- Grind surface no more than thirty (30) minutes prior to seaming.

- Grind such that surface oxidation is removed, no more than 5% of the liner thickness is removed, and the ground area shall be covered by the extruded bead.
- Extruded bead shall be placed over excess grinder marks.
- Grinder marks shall be perpendicular to the seam.
- The edge of the overlying panel shall be bevelled.
- The two (2) pieces to be seamed together shall be tack bonded together such that they will be held in place during seaming, so there is no damage to the liner and, seaming operations can be effectively performed, and QC and/or QA testing can be effectively performed.
- Extrudate shall be extruded from the welder to expose fresh extrudate prior to welding.
- The welder die shall be kept "on centre centre" at all times, ensuring that an equal amount of extrudate bead is applied to both portions of liner overlap (top and bottom).
- A consistent forward welding speed shall be maintained, to ensure a smooth and uniform extrudate bead.
- All patches shall have a minimum 25 mm radius at corners, and be securely tacked to the liner.

The following procedures shall be followed when restarting seams:

- Overlap existing weld a minimum of 50 mm.
- Grind existing weld prior to initiating welding.
- Resume welding where the grinding starts.
- Resuming seaming operations on any weld that is over five (5) minutes old shall be considered a restart.

The following procedures shall be followed when re-seaming:

- Bevelling shall be performed during grinding.
- No seam shall be re-seamed without grinding prior to initiating re-seaming operations.

LLDPE geomembrane shall be seamed in ambient temperatures greater than zero (0) Celsius and less than forty (40) degrees Celsius, measured 150 mm above geomembrane surface, except as noted below for cold weather seaming and unless authorized by the Owner’s Representative.

When the ambient temperature is greater than or equal to minus twenty (-20) degrees Celsius but less than or equal to zero (0) degrees Celsius, follow guidelines for cold weather seaming in accordance with GRI Test Method GM 9.

T-Welds shall be patched as determined by the Owner's Representative. Fish-mouths and excessive wrinkles shall be cut and overlapped a minimum of 125 mm and seamed. Where the 125 mm overlap cannot be achieved, a patch shall be seamed in place extending a minimum of 150 mm beyond the cut.

S6.5.6 Repairs

The completed LLDPE geomembrane shall be free of defects including sharp creases, cuts, nicks, holes, tears or deep scratches. Defective areas of liner or seams identified during the QC testing and inspections shall be repaired, and the areas re-inspected and re-tested until approved by the Owner's Representative. Locations of repairs shall be surveyed by the Contractor for as-built purposes.

Areas of the liner installation that cannot be effectively repaired, as determined by the Owner's Representative, shall be capped or the damaged liner removed and replaced, as determined by the Owner's Representative.

Repairs made due to damage resulting from the Contractor's activities shall be at the expense of the Liner Installer.

S6.6 Site Clean-up

The Contractor shall ensure that all excess or waste materials, debris, sand bags or any other extraneous materials are removed from the site whenever they are no longer required. Upon completion of work in any given area, the Liner Installer and the Owner's Representative shall examine that area to determine whether all waste and extraneous materials have been removed and that the area has been left in a satisfactory clean condition to allow placement of materials on top of the LLDPE geomembrane.

S6.7 Completion of Work

The installation of the LLDPE geomembrane shall be considered as totally complete when: all required deployment, field seaming, testing and repairs, and site clean-up have been completed by the Liner Installer; the Liner Installer has submitted all the required quality control documentation to the Owner's Representative, is satisfied that the liner has been installed in accordance with the above Specifications. A Work Completion Report is required, as described in Section S2.4.4.

S6.7.1 Liner Installation Report

A final liner installation report shall be prepared by the Contractor and submitted to the Owner's Representative within six (6) weeks following the end of the installation of the liner. This document shall include:

- As-built panel layout drawings showing panel and seam numbers, in hardcopy formats;
- Roll deployment record;
- Seaming record;
- Repair record; and
- QC testing summary.

S6.8 QC and QA

The Work shall be completed in conformance with the QC and QA Requirements Specifications. All Work performed by the Contractor shall comply with the Specifications and Drawings.

The Liner Installer shall provide on-site supervision, equipment and QC testing during the installation period, for inspection of the completed LLDPE geomembrane and seaming of the LLDPE geomembrane, as required to warrant the entire LLDPE geomembrane assembly. The Contractor shall maintain and clean all equipment on a regular basis to ensure that it is in good working order.

It shall be the Liner Installer's responsibility to monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship to produce Work of the specified quality.

Test equipment shall be calibrated and current inspection records verifying the calibration shall be submitted.

The Liner Installer shall cooperate with the QA Engineer, and extract QA field samples as requested by the QA Engineer. The Contractor shall allow the QA Engineer to oversee QC testing and inform the QA Engineer of planned QC testing. The Contractor shall also give a minimum of four (4) hours notice to the QA Engineer when liner seams are ready for inspection when QC testing is complete. The liner shall not be covered before the QA Engineer has performed tests and given written approval of material and seams.

The Liner Installer shall comply fully with the manufacturers' instructions. Should the manufacturers' instructions conflict with the Contract Documents, the Liner Installer shall request clarification from the Owner's Representative before proceeding.

The manufacturer shall sample and perform quality control testing in accordance with its own quality standards.

S7 GEOTEXTILE

S7.1 Scope

This Specification defines the technical requirements for installation of the non-woven geotextile (minimum mass per unit area of 500 g/m^2) for construction of the Saddle Dams.

The work includes the purchase, fabrication (if needed), supply, transport, storage and testing of the geotextile.

S7.2 Work Sequence

The Work will only start upon receipt of approval to proceed from the Owner's Representative and following inspection, as-built survey and approval of pre-work conditions by the Owner's Representative.

S7.3 General

S7.3.1 Manufacturing Quality Control

Quality control testing shall be carried out by the Manufacturer to demonstrate that the product meets this Specification. Additional testing may be requested by the Owner's Representative to be carried out for purposes of conformance by the QA Engineer and will be paid for by the Owner. If the results of the Manufacturer's and the Owner's Representative testing differ, the testing shall be repeated by the Owner's Representative, and the Manufacturer shall be allowed to monitor this testing. The results of this latter series of tests will prevail provided that the applicable test methods have been followed.

Prior to shipment, the Liner Installer shall provide the Owner's Representative with a Quality Control Mill Certificate for each roll of geotextile provided. The Quality Control Certificate shall be signed by a responsible party employed by the Manufacturer, such as the production manager. The Quality Control Certificate shall include:

- Roll numbers and identification.
- Sampling procedures and results of Quality Control tests; as a minimum, results shall be given for thickness, tensile strength, and tear resistance, evaluated in accordance with the methods indicated in the Specification or equivalent methods acceptable to the Owner's Representative.

S7.3.2 Transportation, Handling and Storage

Transportation of the geotextile is the responsibility of the Manufacturer and Owner. All handling on-site is the responsibility of the Liner Installer.

The Liner Installer shall ensure the handling equipment used on the site is adequate and does not pose any risk of damage to the geotextile.

Upon delivery at the site, the Owner's Representative shall conduct a surface observation of all rolls or factory panels for defects and for damage. This inspection shall be conducted without unrolling rolls or unfolding factory panels unless defects or damages are found or suspected.

The Owner's Representative may:

- Identify rolls, factory panels, or portions thereof, which should be rejected and removed from the site because they have severe flaws.
- Identify rolls or factory panels which include minor repairable flaws.

The Liner Installer shall be responsible for the storage of the geotextile on site. The Owner shall provide storage space in a location (or several locations) such that on-site transportation and handling are optimized if possible. Storage space shall be protected by the Liner Installer from theft, vandalism, passage of vehicles, and the like.

The Liner Installer shall ensure that storage of the geotextile provides adequate protection against UV exposure, dirt, shock, and other sources of damage in accordance with the Manufacturer's recommendations.

S7.4 Submittals

The Owner's Representative shall have available a complete set of Manufacturer's written instructions for storage, handling, installation and seaming of the geotextile and conditions of warranty at least two (2) weeks prior to material delivery to the mine site.

In addition, the Owner's Representative shall have available the Manufacturer's Technical Specifications and properties including the test methods used to determine the material properties at least two (2) weeks prior to material delivery to the mine site. For each roll of geotextile, this shall include:

- A properties sheet including, at a minimum, all specified properties measured using test methods indicated in the Specifications or equivalents.
- The sampling procedure and results of testing.

- A certification that the property values given in the properties sheet are guaranteed by the Geotextile Manufacturer.

S7.5 Products

S7.5.1 Geotextile

The Owner shall supply a geotextile whose material properties meet or exceed the requirements of this Specification.

The specific geotextile properties shall be met for non-woven Geotextile GSE (GSE Lining Technology, Inc.) NW16 or its equivalent as listed in Table 7-1 below. The Owner shall provide Manufacturer's test results for these properties as well as certifications that the materials meet this Specification.

Table 7-1: Property Specifications for Geotextile

Material Property	Unit	Frequency	Minimum Value	Test Method
Mass / Unit Area	g/m^2	8,500 m^2	500	ASTM D5261
Grab Tensile Strength	N	8,500 m^2	1,735	ASTM D4632
Grab Elongation	%	8,500 m^2	50	ASTM D4632
Trapezoidal Tear Strength	N	8,500 m^2	665	ASTM D4533
Puncture Strength	N	8,500 m^2	1,055	ASTM D4833
Apparent Opening Size, Sieve No.	Mm	50,000 m^2	0.150	ASTM D4632
Permittivity	sec^{-1}	50,000 m^2	0.60	ASTM D4833
Water Flow Rate	$L/min/m^2$	50,000 m^2	1,830	ASTM D4833
UV Resistance	(note 1)	per formulation	70	ASTM D4355

Notes: 1) % retained after 500 hours

S7.6 Execution

S7.6.1 Bedding Surface

The bedding surface for geotextile shall be prepared to satisfy the requirements of Section S6.5.1, to the satisfaction of the Owner's Representative, and to the acceptance of the Liner Installer.

The prepared surface for geotextile installation shall be smooth, as recommended by the Manufacturer.

S7.6.2 Placement

The layout of the geotextile should be parallel to the LLDPE geomembrane installation. Alignment, lengths, and areas for geotextile placement are shown on the Drawings. Exact locations and lengths may be varied to suit conditions encountered in the field, as approved by the Owner's Representative.

Seams shall be sewn or spot-welded with a heat gun with a minimum overlap of 450 mm.

S7.7 QC and QA

The Work shall be completed to satisfy the requirements of Section S9.

S8 INSTRUMENTATION

S8.1 Scope

The requirements include equipment and application software for the data acquisition, transmission, and processing system.

All instrumentation will be supplied by the Owner. The main items include installation of:

- Multiple bead thermistor strings;
- Survey control monuments; and
- Prefabricated cabins for housing instrumentation terminals and data acquisition equipment.

The Owner has the option of supplying alternate readout instruments, subject to approval by the Designer prior to mobilization of equipment to site.

The work shall include the installation and testing of instrumentation, including all labour, materials and equipment to complete the design as shown on the Drawings. The Owner shall be responsible for protection of all instruments, leads, and connectors from damage and displacement during progress of the work, and shall provide markers and barricades as necessary. The Contractor shall give the necessary support to the Owner for the instrumentation installation (e.g. drilling, grouting and excavation).

S8.2 Work Sequence

The Work will only start upon receipt of approval to proceed from the Owner's Representative and following inspection, as-built survey and approval of pre-work conditions by the Owner's Representative.

S8.3 General

S8.3.1 Location and Installation Procedures

The instrumentation locations are shown on the Drawings. Installation procedures are provided in the Specifications. The location of all instruments and installation will be subject to approval by the Owner's Representative. Installation of the instruments shall be carried out in accordance with the Drawings, Technical Specifications and the instructions of the Manufacturer. The Owner shall be

responsible for proper installation, calibration, testing, protection, and maintenance of instrumentation during construction.

Readings of each instrument shall be taken to verify correct functioning, and an initial set of readings shall be taken immediately after installation. Fill shall not be placed over the instruments or leads until the instruments have been tested and initial readings have been taken. Instrumentation functionality shall be subject to the review of the Owner's Representative.

All cable conduits shall be marked with identification tags at intervals of 15 m, or closer if required. In addition, each instrument shall be marked with the identification given to it on the Drawings. Cable conduits shall be installed in maximum practicable lengths to minimize joints. Any necessary cutting, splicing and coupling shall be performed in accordance with the recommendations of the manufacturer.

Open ends of all incomplete lines of tubing, conduits and casing shall be sealed to keep the inside of tubes, conduits, and casings free from foreign matter.

No traffic or equipment shall pass over any part of any instrument, leads or connections until at least 600 mm thickness of compacted material cover has been installed. The Owner shall be responsible for protection of all instruments, leads and connections from damage and displacement during the progress of the Work, and shall provide markers and barricades as necessary.

The Owner shall repair or replace any damaged or non-functioning instrumentation to the satisfaction of the Owner's Representative.

S8.3.2 Electrical Protection and Safety

New and existing instrumentation shall be connected to the data acquisition system and it shall be confirmed that the system provides the following minimum protection for all electrical equipment:

- Over-voltage peak suppressor;
- Alternating current filter to eliminate interference; and
- Grounding system for lightning protection.

S8.3.3 Cabins and Accessories

All cabins, supports and accessories necessary for installation and protection of instruments shall be supplied by the Owner.

All cabin and support structures shall be protected from corrosion and shall be finished and painted.

S8.3.4 Voltage and Electrical Frequency

Facilities requiring permanent electrical power, including battery chargers, shall be configured to operate at 110 V alternating current at 60 Hz.

S8.4 Equipment and Installation

All equipment shall be provided by the Owner to install, operate, and maintain the instrumentation. The instrumentation shall be protected with end caps and protective casing.

Method of installation will be submitted with the Owner's Work Plan for review and approval by the Owner's Representative.

S8.4.1 Themistor Strings

General

Thermistor strings shall include all equipment, leads, connector boxes, conduits and accessories necessary for installation and operation. Data collection shall be carried out manually during construction of the Work and automatically thereafter. Each thermistor string shall have the following:

- Length as shown on Drawings;
- Nodes located on each thermistor string as shown on Drawings;
- Heavy duty, direct burial rated 22 gauge, water-blocked instrumentation cable;
- Rated for a temperature range of at least -50°C to 50°C; and
- Accurate to within 0.2°C.

The connector boxes shall have capacity for simultaneous installation of all thermistor leads shown on the Drawings.

Installation

Themistor strings shall be installed according to the manufacturer's instructions, within the fills and foundation at locations and elevations shown on the Drawings.

Leads from the instruments to the connector boxes shall be routed through PVC conduits installed into trenches, as shown on the Drawings. The PVC conduit shall be protected from impact during construction by hand-tamped sand backfill.

The installation of the thermistor string shall be completed by connecting the lead to the connector boxes within the instrumentation cabin.

S8.5 QC and QA

The Work shall be completed to satisfy the requirements of Section S9.

Copies of instrument calibration test sheets provided by the Manufacturer will be provided to the Owner's Representative prior to installation.

Testing of each instrument will be undertaken by the Owner immediately prior to and following installation. Readings will be recorded and submitted in the Daily Summary Report.

QA inspection shall be carried out by the QA Engineer as required to confirm the QC results including whether the specified location and construction materials meet the Specifications and Drawings.

The Owner shall provide facilities and labour as required to assist in conducting tests and sampling for QC and QA.

The Owner shall provide the Owner's Representative with hardcopy and electronic data for the as-built survey information for the instrumentation.

S9 QUALITY CONTROL (QC) AND QUALITY ASSURANCE (QA) PLAN

S9.1 Scope

This Specification defines the requirements for the Quality Control and Quality Assurance for construction of Saddle Dams 3, 4 and 5.

The Specification includes:

- Equipment list for the field laboratory;
- Minimum QC site inspections and testing requirements;
- Minimum QA site inspections and testing requirements;
- Documentation requirements for QC and QA activities;
- Checklists for QC/QA of the major construction activities; and
- Corrective action procedures for non-conforming materials.

S9.2 Site Inspection and Testing

The tasks of the Owner's Representative, the QA Engineer, the QC Representative the Contractor and the Liner Installer for QA and QC construction activities are listed in Table 9-1.

Table 9-1: Construction Activities and QC/QA Responsibilities

Activities	Tasks			
	Contractor (incl. Liner Installer)	**QC Representative**	**QA Engineer**	**Owner's Representative**
Survey	• Survey (control and as-built) as required for QC of the Work; and • Provide protection of the survey stakes. • Provide qualified surveyor and modern equipment in good working condition.		• Review survey lines, chainage and layout; • Review survey data provided by Owner and Contractor; • Determine need for adjustments in field; • As-built reporting (with Owner's Representative).	• Survey for pre-construction condition; initial layout of the Work; as-built reporting (with QA Engineer); and quantities for payment; • Approve quantities; and • Approve layout for fill placement.

Activities	Tasks			
	Contractor (incl. Liner Installer)	**QC Representative**	**QA Engineer**	**Owner's Representative**
Borrow Materials, Sources, and Storage	• Documentation; • Surface water management; and • Prevent material segregation; • Provide assistance to QC/QA during material sampling.	• Perform QC testing including gradations and water content; • Perform visual inspection of materials; • Documentation including photographic records.	• Perform QA testing including gradations, water content and density; • Perform visual inspection of materials; and • Documentation including photographic records.	• Perform QC testing during crushing operations; and • Classify PAG and non-PAG materials. • Approve suitability of borrow material and storage area for construction; • Approve quantities.
Foundation Prepara-tion and Excava-tions	• Propose removal methods for unsuitable materials; • Surface water management; • Prepare sumps, pumps, and lines for dewatering; • Care of water; • Report unusual conditions; • Survey lines conform with Drawings; • Plan excavation and waste material disposal; • Provide excavation records; • All in situ material loosened from excavation removed from trench; • Excavation stability; • Clean bedrock surface with air and water; • Provide safe access to bedrock area; and • Prepare foundation material for direct placement of LLDPE geomembrane, as indicated in the drawings.	• Report unusual conditions; • Inspection of foundation preparation and excavation of material • Inspection of foundation area prior to fill placement.	• Observe foundation preparation; • Documentation including photographic records; • Review survey lines and locations; • Review proposed excavation methods and blasting methods/pattern; • Observe foundation excavation; • Inspect excavation and prepared foundation area prior to fill placement; • Map bedrock and exposed surfaces for geologic features and to determine ground ice conditions; • Inspect and approve bedrock surface; • Report non-conformities; and • Review as-built survey report.	• Identify storage areas for waste materials. • Approve water source for cleaning bedrock.

Activities	Tasks			
	Contractor (incl. Liner Installer)	**QC Representative**	**QA Engineer**	**Owner's Representative**
Fill Placement	• Ensure placement and extent as per Drawings; • Confirm topography; • Plan material storage and waste material disposal; • Report any unusual conditions; • Survey extent of any unusual conditions; • Surface water management; • QC survey during the Work.	• QC testing of placed material gradations, water content, and density • Report any unusual conditions; • Inspect fill surfaces prior to subsequent fill placement; • Ensure fill materials conform to Specifications; • Ensure placement and extent as per Drawings.	• Review survey lines and locations; • Inspection of liner bedding surfaces; • Inspect fill surfaces prior to subsequent fill placement; • Perform QA testing of placed material including gradations, water content, and density; • Confirm the QC results, including whether the specified fill placement, construction grades and limits are being attained and construction materials are meeting the required Technical Specifications; • Observe fill placement; • Inspect fill quality and extents; • Approval of suitability of fill materials prior to placement; • Report non-conformities; and • Documentation including photographic records.	• QC of fill gradations at crusher and as-placed; and • Review as-built survey report and approve quantities.

Activities	Tasks			
	Contractor (incl. Liner Installer)	**QC Representative**	**QA Engineer**	**Owner's Representative**
LLDPE Geomem-brane Installation	• Ensure placement and extent as per Drawings; • Perform QC testing on the Liner and provide results; • Report any unusual conditions or problems and provide resolutions; • Provide liner panel layout plan; • Inspect liner bedding material conforms to Specification and suitable for liner placement; • Provide liner panel as-built drawings.	•	• Perform QA testing; • Select samples for destructive testing; • Observe QC testing; • Inspect excavation and prepared foundation area prior to Liner placement; • Report non-conformities; • Documentation including photographic records; and • Inspect all seams and liner material prior to covering.	• Receive liner at Meadowbank, storage and inventory. • Review as-built survey report and approve quantities.
Geotextile Installation	• Ensure placement and extent as per Drawings; • Perform QC testing and provide results; • Report any unusual conditions or problems and provide resolutions; • Inspect bedding material conforms to Specification and suitable for geotextile placement.		• Review of required documentation; • Review QC testing results; • Report problems; • Approval of geotextile rolls for deployment; • Observation of unrolled material for damage; • Observation of seaming procedure, overlaps, and completed seams; and • Documentation including photographic records.	• Receive geotextile at Meadowbank, storage and inventory. • Review as-built survey report and approve quantities.

Activities	Tasks			
	Contractor (incl. Liner Installer)	**QC Representative**	**QA Engineer**	**Owner's Representative**
Instrumen-tation Installation	• Provide necessary support to the Owner for instrumentation installation (e.g. drilling, grouting, excavation).			• Provide instrumentation, supporting equipment, software, operating manuals, and demonstration to mine staff; • Provide copies of instrument calibration test sheets provided by the manufacturer; • Provide instrumentation casings; • Provide energy sources for applicable instrumentation; • Report any unusual conditions; • Perform testing of each instrument immediately prior to and following installation. Readings will be recorded and submitted in the Daily Summary Report, • Perform as-built survey; and • Perform QC testing. • Review survey lines and locations; • Review QC testing results; • Perform QA testing; • Inspect instrumentation, supporting equipment and software; • Report non-conformities; • Review as-built survey report; and • Documentation including photographic records.

Activities	Tasks			
	Contractor (incl. Liner Installer)	**QC Representative**	**QA Engineer**	**Owner's Representative**
Final Site Clean Up	• Perform site clean up			• Inspection.

S9.2.1 Field Laboratory

The Owner shall provide a proper facility/location for performing the required testing in addition to suitable testing equipment, maintained in good repair, properly calibrated at all times.

The following should be provided in the field laboratory as a minimum:

- Heating, lighting, and power;
- ASTM Gradation Sieves and shaker;
- Hydrometer and appurtenant equipment;
- Oven suitable for soils testing;
- Running water;
- Aluminum moisture boxes- 4;
- Stainless steel mixing bowls – 3 large round and 3 large rectangular;
- Scale for density and water content;
- Sample splitter – 1 large and 1 standard;
- Split standard Proctor mould with hammer and straight edge;
- Tool set including screwdrivers, chisels, hammers, etc.;
- Brush, soft bristle;
- Wash bottle;
- Mortars and pestles – 2;
- Round bottom scoops – 1 large and 1 small;
- Timers – 2 – 1s resolution to 24 hours, electronic;
- Mechanical analysis stirrer for hydrometer testing;
- 10 L Sample buckets and lids;

- Crates for shipping samples;
- pH tape – 1 set;
- Sand Cone and/or nuclear densometer; and
- Rigid walled compaction mould permeameter.

In addition, the Owner shall provide calibration certificates to the Contractor and QA Engineer.

S9.2.2 Minimum Field Testing and Frequency for QA/QC

The quality assurance and quality control minimum testing requirements and frequency are listed in Table 9-2. At a minimum, all the required testing to document the construction quality shall be performed.

Characterization of different rock types with respect to geochemistry is the responsibility of the Owner as described in Section S5.6

Table 9-2: QC/QA Activity with Testing and Frequency

Work	Quality Control (QC)				Quality Assurance (QA)		
	Responsible	**Type of Test or Monitoring**	**Test Frequency**	**Requirement**	**Responsible**	**Type of Testing or Monitoring**	**Test Frequency**
Care of Water	Contractor / QC Representative	Visual Observation	Continuously		Owner's Representative	Visual Observation	Periodically
Borrow Material Storage	Contractor / QC Representative	Visual Observation	Continuously		Owner's Representative	Visual Observation	Periodically
Foundation preparation and upstream toe liner tie-in							
On-land location and extents	Contractor	Survey for QC	Before and after foundation preparation, excavation.		Owner's Representative	Survey for QA and as-built following the work.	Before and after foundation preparation, excavation.
Foundation Preparation Inspection	QC Representative	Visual Observation	Continuously		QA Engineer	Visual observation and photographs	Periodically during work; fully over area prior to fill placement
Foundation Preparation Water Content	QC Representative	Moisture content of foundation materials	1 every 25 m of prepared dam foundation and 1 every 25 m of upstream toe liner tie-in excavation relative to reference line		QA Engineer	Review test data and test procedure	1 in every 5 QC tests
Inspection Placement Surface for Geotextile and/or LLDPE Geomembrane	Liner Installer	Visual Observation	Continuously		QA Engineer	Visual Observation	Periodically during work; fully over area prior to geotextile and/or LLDPE geomembrane installation
On-land location and extents	QC Representative	Survey for QC	Before and after excavation.		Owner's Representative	Survey for QA and as-built following the work.	Before and after excavation.
Bedrock Cleaning	QC Representative	Visual Observation	Continuously		QA Engineer	Visual Observation and photographs	Periodically during work; fully during mapping and prior to fill placement
Bedrock Examination and Mapping	QC Representative	Visual Observation	Before placement of any fill material on top of bedrock foundation material	Exposed bedrock open discontinuities shall be treated with 20 mm processed rockfill mixed with bentonite	QA Engineer / **Owner's Representative**	Inspect, map, and approve bedrock surface	Before placement of any fill material on top of bedrock foundation material
Fills							
Fine Rockfill (Zone 5)	Contractor	Visual Gradation	Continuously	See Section S5.6	QA Engineer	Visual Gradation	Periodically
	Owner	Geochemical Classification of Rockfill	As Required				
	Contractor	Placement - Visual Inspection	Continuously	Max. 500 mm loose lift thickness; See Section S5.6	QA Engineer	Visual Inspection	Periodically
		Compaction - Visual Inspection	Continuously	4 passes w/ 10 t smooth drum vibratory roller; See Section S5.6	QA Engineer	Visual Inspection, count compaction passes.	Periodically
Coarse Rockfill (Zone 4A or 4B)	Contractor/QC Representative	Visual Gradation	Continuously	See Section S5.6	QA Engineer	Visual Gradation	Periodically
	Owner	Geochemical Classification of Rockfill	As Required				
	QC Representative	Placement - Visual	Continuously	Max. 2.0 m loose lift	QA Engineer	Visual Inspection	Periodically

Work	Quality Control (QC)				Quality Assurance (QA)		
	Responsible	Type of Test or Monitoring	Test Frequency	Requirement	Responsible	Type of Testing or Monitoring	Test Frequency
		Inspection		thickness; See Section S5.6			
		Compaction - Visual Inspection	Continuously	6 passes w/ 10 t smooth drum vibratory roller; See Section S5.6	QA Engineer	Visual Inspection, count compaction passes.	Periodically
Coarse Filter (Zone 3)	Owner	Gradation (in stockpile)	1 every 5,000 m^3	See Section S5.6	QA Engineer	Gradation	1 in every 5 QC tests
	QC Representative	Gradation (as placed)	1 every 5,000 m^3	See Section S5.6	QA Engineer	Gradation as placed	1 in every 5 QC tests
		Compaction - Visual Inspection	Continuously	See Section S5.6	QA Engineer	Visual Inspection	Periodically
		Compaction – Visual Inspection	Continuously	4 passes w/ 10 t smooth drum vibratory roller; See Section S5.6	QA Engineer	Visual Inspection, count compaction passes.	Periodically
Fine Filter (Zone 2)	Owner	Gradation (in stockpile)	1 every 1,000 m^3	See Section S5.6	QA Engineer	Gradation	1 every 5 QC tests
	QC Representative	Gradation (as placed)	1 every 1,000 m^3	See Section S5.6	QA Engineer	Gradation as placed	1 every 5 QC tests
		Placement - Visual Inspection	Continuously	Max. 0.5 m loose lift thickness; See Section S5.6	QA Engineer	Visual Inspection	Periodically
		Compaction - Visual Inspection	Continuously	4 passes w/ 10 t smooth drum vibratory roller; See Section S5.6	QA Engineer	Visual Inspection, count compaction passes.	Periodically
Compacted Till (Zone 1)	QC Representative	Gradation (in stockpile)	1 every 1,000 m^3	See Section S5.6	QA Engineer	Gradation (in stockpile)	1 every 5 QC tests
		Gradation (as placed)	1 every 1,000 m^3	See Section S5.6		Gradation (as placed)	1 every 5 QC tests
		Water Content	1 every 1,000 m^3	+/- 3 % of Optimum water Content;		Water Content	1 every 5 QC tests
		Placement – Visual Inspection	Continuously	Max 0.5 loose lift thickness; See Section S5.6		Visual Inspection	Periodically
		Compaction – In Situ Density	Continuously	See Section S5.6		Visual Inspection	Periodically
Low Quality Till	QC Representative	Placement – Visual Inspection	Continuously	Max 1.0 m loose lift thickness; See Section S5.6	QA Engineer	Visual Inspection	Periodically
		Compaction – In Situ Density	Continuously	See Section S5.6		Visual Inspection	Periodically
Geotextile							
Sample Collection for Conformance Testing	Contractor	Collect sample of Geotextile	At the request of the Engineer	1 m wide sample, cut across width of roll, not within 1 m of roll end. Label roll number, machine direction, date and name of sampler.	QA Engineer	Visual Inspection of sampling	As requested
Placement	Contractor	Visual Observation of Seams and Panels	Continuously	Visually inspecting seams. Ensuring they are properly sewn or that a minimum overlap of 450 mm is achieved.	QA Engineer	Visual Observation	Periodically
LLDPE Liner Installation							

Work	Quality Control (QC)				Quality Assurance (QA)		
	Responsible	Type of Test or Monitoring	Test Frequency	Requirement	Responsible	Type of Testing or Monitoring	Test Frequency
Sample Collection for Conformance Testing	Liner Installer	Collect sample of LLDPE liner	At the request of the QA Engineer	1 m wide sample, cut across width of roll, not within 1 m of roll end. Label roll number, machine direction, date and name of sampler.	QA Engineer	Visual Inspection of sampling, Determination of Conformance Testing to be Performed	As requested
Rolls	Liner Installer	Visual inspection of the unrolled panels for holes, blisters, undispersed raw materials and marking for repair or rejection.	Each Roll		QA Engineer	Visual Inspection	Each Roll
Test Welding Equipment	Liner Installer	Calibration Test Seams	Each welder and piece of equipment that will be seaming, at the beginning of each day, and a minimum of once during the middle of the shift.	Load at failure for all samples meets or exceeds values in Table 6-2 (Field Seam Properties) for peel and shear, and all samples receive a FTB (Film Tearing Bond).	QA Engineer	Visual Inspection, Oversee Testing	1 every 5 QC tests
Testing	Liner Installer	Destructive Testing	1 per 150m seam length or 1 per crew per day (whichever is greater). May be reduced to 1 per 300 m seam if there are no failed seams for the first 100,000 m^2 of installed liner.	Minimum sample size 30 cm by 90 cm with seam centrally located. Min. strength properties, as per Table 6-2 Peel and shear testing performed as per ASTM D6392	QA Engineer	Determine Location of Samples, Oversee Testing	1 every 5 QC tests
		Non-Destructive Testing - Vacuum Box	All extrusion welds and patches	Min vaccum of 35 kPa for 10 sec.	QA Engineer	Oversee Testing	1 of every 5 QC tests
Placement Extent	Liner Installer	Non-Destructive Testing – Air Channel	All seams	Air pressure between 200 kPa and 240 kPa, held for 5 mins, not dropping more than 10%.	QA Engineer	Oversee Testing	All QC tests
		Visual Inspection of seams and panels, general workmanship	Continuously		QA Engineer	Visual Inspection	Periodically
Instrumentation							
	Owner	Pre- And Post-Installation Testing	Every Instrument		Owner	Visual Observation during Installation	Every Installation

Increased testing frequencies shall be instituted by the Owner's Representative if observations of normal testing frequencies result indicate potential problems. Additional testing may be warranted when:

- The material repeatedly fails to meet Specifications;
- The degree of compaction is doubtful;
- The materials appear to differ from those specified;
- Less than the required number of compaction equipment passes are made;
- The material water contents differ from those specified;
- The lift thicknesses differ from those specified; or
- Adverse weather conditions occur.

S9.2.3 LLDPE Geomembrane

Quality Control During Manufacture

The LLDPE geomembrane supplied for this project shall meet or exceed the minimum (unless otherwise noted) roll values shown in Table 6-1.

Extrudate used for extrusion welding shall be compounded, new, first-quality resin conforming to the same properties as the resin used in the manufacture of the liner sheet.

The results of the tests performed shall be reported in such a manner that each test performed can be easily traced to the time in the production run that it was performed and which specific rolls that the particular test is intended to represent. Samples of the liner taken for testing and tested samples shall be archived, for a minimum of five (5) years after production. Maintain a production log recording roll number, total rolls manufactured for this project, total square metres manufactured for this project, and the test results of the required quality control tests. A current production log shall be submitted with each set of liner quality control /assurance certificates submitted.

Indelible markings or labels on each roll shall identify the type of material, thickness, length, width, manufacturer lot number, and roll number. Each roll shall be identified by a unique roll number. The rolls shall be marked such that the roll number is easily read while the roll is rolled up in storage prior to deployment and after the roll has been unrolled and deployed. With each roll number the Owner's Representative shall be able to easily determine which resin tests are representative of the resin used to manufacture that particular roll and which quality control tests performed by the manufacturer are representative of that particular roll. If the Manufacturer uses a product and roll labelling system, proper documentation should be provided to facilitate the identification of the material on site.

All rolls of LLDPE geomembrane shall be accompanied by a quality control certificate supplied by the manufacturer. A copy of the quality control certificate shall be sent to the Owner's Representative for approval. The one (1) roll with the poorest physical qualities reported on the quality control certificate shall have a one (1) metre wide sample cut from it to be shipped to an independent laboratory for conformance testing. No rolls shall be delivered to the site for use until the results from the independent laboratory have been reviewed by the Owner's Representative.

No roll shall be shipped to the site unless it conforms to the quality control specifications in Table 6-1.

Conformance Testing

At the option of the Owner's Representative, conformance testing may be performed at any time prior to, during, or after the installation. The cost of the conformance testing shall be negotiated between the Owner and Contractor.

The tests performed during conformance testing shall be determined by the Owner's Representative. Conformance testing shall not include any tests that are not listed in these Specifications as a basis for evaluating conformance of the liner to these Specifications.

Sampling for Conformance Testing:

- Samples shall be obtained by the Liner Installer under direct supervision of the QA Engineer.
- The sample for a roll shall be one (1) metre wide and cut across the entire width of the roll.
- Taken as close to the middle of the roll as practical but shall, as a minimum, be sampled no closer than one (1) metre to the end of a roll.

The sample shall be labelled by the QA Engineer, in permanent marker, with the following information:

- Roll number.
- Machine direction.
- Date sampled.
- Name of individual that sampled the material.

Calibration Test Seams

Each welder and piece of welding equipment that will be seaming liner shall perform Calibration Test Seams at the beginning of each day prior to beginning seaming of permanent materials. No welder or piece of welding equipment shall perform production seaming until the Calibration Test

Seam have been performed, tested, and approved by the Owner's Representative. Test seam must be performed a minimum of once during the middle of the shift. More frequent test seams shall be performed at the request of the Owner's Representative at times as is deemed necessary, such as during change of weather conditions or if the seams are observed to be of questionable quality.

The criteria for a passing test seam will be the same as the criteria for a passing Calibration Test Seam.

The procedure for performing Calibration Test Seams shall be as follows:

- Calibration Test Seams shall be performed in an area designated by the Owner's Representative.
- Perform Calibration Test Seams in contact with the same subgrade conditions and under the same environmental conditions that production seaming will be performed under.
- Performing Calibration Test Seams upon rub sheets will not be permitted unless approved by the Owner's Representative, and rub sheets are used during all production seaming.
- Each Calibration Test Seams shall consist of seaming two pieces of liner together of the same type and thickness that the welding equipment and welder will be seaming during production.
- Calibration Test Seams shall be a minimum of ninety (90) centimetres long and thirty (30) centimetres wide with the seam centred lengthwise.

The testing procedures for Calibration Test Seams shall be as follows:

- Five (5) twenty five (25) millimetre wide strips shall be cut, three (3) from one end and two (2) from the other end of the trial seam.
- Two (2) of the strips shall be tested in shear and three (3) shall be tested in peel in accordance with ASTM D6392.
- A tensiometerwith a calibrated load measuring device and means to apply the required loading rate shall be used to test the start up and test seams at the project site.
- The width of each of the strips shall be measured to within one (1) millimetre and recorded.
- The temperature at the time of the test shall be recorded.
- Results of the Calibration Test Seams shall include the load at failure, the load at failure determined in Newtons or pounds per unit width by dividing the total load at failure by the measured width of the strip, and the locus-of-break code as shown in Figures 3 or 4 of ASTM D6392, as applicable.

A Calibration Test Seam will be considered as passing only if the load at failure meets or exceeds the minimum values specified in Table 6-2 of these Specifications for all samples in peel and shear, and all samples achieve a FTB at failure.

In the event that a particular piece of welding equipment or welder fails a Calibration Test Seam, the entire procedure shall be repeated. If the particular piece of welding equipment or welder fails the Calibration Test Seam the second time, that particular welder or piece of welding equipment shall not be used until the cause of the failure has been identified, corrected and a passing Calibration Test Seam achieved.

Non-Destructive Testing

The Liner Installer shall perform Non-destructive testing on one hundred (100) percent of all seams for this project.

Non-destructive testing shall consist of air channel testing for double-wedge fusion welds or vacuum box testing on extrusion welds. Other types of non-destructive testing will be performed only upon written approval of the Owner's Representative.

No areas of the liner installation will be approved and finalized that have not been non-destructively tested under the observation of the QA Engineer with passing results, or that have not been repaired as determined by the QA Engineer and retested under the observation of the QA Engineer.

All penetrations into the liner during destructive sampling shall be repaired by the Liner Installer by patching as specified in these Specifications and non-destructively tested as specified in these Specifications.

Non-Destructive Testing – Air Channel Testing

Air channel testing consists of sealing both ends of the seam, pressurizing the channel, and monitoring the pressure with time.

The QA Engineer shall observe one hundred (100) percent of all air channel testing. Testing performed without the observation of the QA Engineer will be required to be retested at the sole expense of the Contractor.

Tests that are terminated prior to the specified time interval shall be retested. Propane torches will not be allowed to fuse the ends of the seam closed. Equipment that is used to fuse the ends of the seam closed shall be used with extreme care to avoid damaging the liner. Areas that are damaged shall be marked for repair.

The QA Engineer shall affirm that the entire air channel under test is clear by observing air flowing out of the end of the channel opposite the end with the pressure gauge, prior to the test being performed. All penetrations into the liner, including that made by the device used to apply the air pressure, shall be repaired by patching. Modifications to the specifications for air channel testing shall not be made without the prior written approval of the Owner's Representative.

The Air Channel Testing Procedure shall be as follows:

- One end of the air channel shall be fused shut.
- A device capable of applying air pressure to the channel without leaking shall be installed.
- The device used to apply the air pressure shall also have a four hundred (400) kPa capacity pressure gauge, capable of being read to five (5) kPa, attached to it with a leak free connection.
- Pressurized air shall be applied to the channel to verify an open channel. If the channel is determined to be blocked, the obstruction shall be located and the test performed to that location. If an open channel is verified, the other end of the channel under test shall be fused shut.
- A pressure ranging between two hundred (200) to two hundred forty (240) kPa (gauge) shall be applied to the channel and held for five (5) minutes.
- A drop in pressure of ten (10) percent or less of the applied pressure within a five (5) minute test period will constitute a passing test.
- If the pressure drops more than ten (10) percent of the applied pressure within the five (5) minute test interval, the seam under test will be considered as failing.

Seams that fail the air channel test shall be repaired or remediated in one or more of the following manners:

- Determine the cause of the leak, repair, and retest.
- Extrusion weld the entire seam under test .
- Cap the extremities and vacuum box test the entire seam.
- If the seam is to be extrusion welded, the unattached portion of the overlying liner shall be tack bonded to the underlying liner prior to extrusion welding.
- The extrusion weld shall be performed in accordance with these Specifications.

Non-Destructive Testing – Vacuum Box Testing

Vacuum box testing shall be performed on one hundred (100) percent of all extrusion welded seams and patches.

The QA Engineer shall observe twenty percent (20%) of all vacuum box testing. Testing performed without the observation of the QA Engineer could be required to be retested at the sole expense of

the Liner Installer if requested by the QA Engineer. The QA Engineer shall be the final authority on determining the presence of a leak as indicated by the vacuum box method.

If the QA Engineer considers that the vacuum box is moved too quickly, not sufficiently depressurized and sealed, or if the site glass is too dirty to allow effective testing, the seam or patch shall be retested.

The Vacuum Box Testing Procedures shall be as follow:

- Apply a soapy solution to the section of seam to be tested.
- Excess liner shall be trimmed prior to vacuum testing. A rub sheet and extreme care shall be used while trimming excess liner for vacuum box testing. Nicks made in the installed liner while trimming shall be repaired as determined by the QA Engineer.
- The vacuum box shall be placed over the seam and adjusted so that an effective seal against the liner is achieved.
- A minimum vacuum of thirty five (35) kPa (gauge) shall be applied and held for a minimum of ten (10) seconds.
- Observe seam through the site glass for the presence of bubbles indicating a leak.
- Mark sections of the seam that indicate a leak for repair.

Areas failing vacuum box testing shall be ground and re-welded or re-patched as determined by the QA Engineer and retested until a passing result is achieved.

If the seam is accessible for testing prior to final installation such as with prefabricated appurtenances, the seam shall be tested prior to final installation. If the seam cannot be tested prior to final installation, it shall be seamed under the constant observation of the QA Engineer.

Destructive Testing

Destructive samples shall be taken a minimum of every one hundred fifty (150) linear metres of seam or one (1) sample per seaming crew per day, whichever is greater. The testing frequency of destructive samples may be reduced to one (1) per three hundred (300) metres if there are no failed seams for the first one hundred thousand (100,000) square metres of installed liner, per liner type. More frequent samples may be taken as determined by the QA Engineer.

Destructive sample locations shall be determined by the QA Engineer, and shall not be revealed to the Liner Installer prior to actual sampling. In addition, sampling times will be determined by the QA Engineer. The Contractor shall collect all destructive samples and the QA Engineer shall observe the collection of all destructive samples.

Destructive sample testing shall consist of peel and shear testing per ASTM D6392. Peel testing shall be performed on both seams of double-wedge welds unless otherwise approved in writing by the Owner's Representative. Failing seams shall be welded by extrusion on its entire length.

All penetrations into the liner during destructive sampling shall be repaired by the Liner Installer by patching as specified in the Specifications and non-destructively tested as specified in these Specifications.

Samples shall be collected and tested as the installation proceeds. No areas of the liner installation shall be approved and finalized that:

- Incorporate failing destructive sample results that have not been repaired and retested as required;
- Incorporate a set of destructive samples that have not been randomly tested by the QA Engineer with passing results; or
- Have not been patched as required in these Technical Specifications and non-destructively tested as required in these technical Specifications, with passing results.

No areas of the liner installation shall be approved and finalized prior to the results of all destructive samples being reviewed by the Owner's Representative.

The collection of the destructive samples shall be as follow:

- The destructive samples shall be a minimum of thirty (30) centimetres wide by ninety (90) centimetres long with the seam centrally located.
- The destructive sample shall be distributed as follow:
    - A thirty (30) centimetres by thirty (30) centimetres sample to the Contractor.
    - A thirty (60) centimetres by thirty (30) centimetres sample to the Owner's Representative.
- If the Liner Installer requires more sample to perform the specified testing, he shall inform the Owner's Representative of his requirements and sample accordingly.
- Each sample shall be legibly marked by the Contractor, in permanent marker, with the following:
    - Destructive sample number.
    - Date sampled.
    - Name of individual who obtained the sample.
    - Seam number.

The Liner Installer shall test in peel and shear one hundred (100) percent of the destructive samples collected in accordance with the procedures specified in the Specifications. Results shall be submitted in writing to the Owner's Representative.

The Destructive Sample Test Procedures shall be as follows:

- Destructive samples shall be tested in accordance with ASTM D6392.
- Five (5) specimens from each coupon shall be tested in both shear and peel. The specimens used as peel and shear test specimens shall alternate as the specimens are cut from the sample.
- A tensiometer with a calibrated load measuring device and means to apply the required loading rate shall be used to test the specimens.
- The width of each of the specimens shall be measured to within one (1) millimetre and recorded.
- The temperature at the time of the test shall be recorded.
- Results of the destructive test seams shall include the load at failure, in pounds per inch determined by dividing the total load at failure by the measured width of the strip, and the locus-of-break code as shown in Figures 3 and 4 of ASTM D6392, as applicable.

A Destructive sample will be considered as passing only if the minimum strength specified on Table 6-2 are met or exceeded in at least four (4) of the specimens tested in peel and shear and these same four (4) specimens achieve a film tearing bond (FTB). The fifth specimen can be as low as 80% of the listed values.

In the event that a destructive sample fails the Liner Installer shall either:

- Reconstruct the seam between any two (2) passing test locations; or
- Obtain small samples a minimum of fifteen (15) metres on either side of the failing sample for field testing by the Liner Installer. When the Liner Installer determines that a passing result has been achieved on both sides of the failing test location, the Liner Installer shall then sample according to these Technical Specifications. The Liner Installer shall then test both samples. If both tested samples pass, the seam shall be reconstructed in between the two (2) passing test locations. If one or both of the samples fail, additional samples shall be obtained until passing results are achieved and the seam shall be capped between the passing test locations.

Consideration shall be given to the particular piece of welding equipment and welder that welded any failing seam. Additional destructive samples may be collected as determined by the Owner's Representative or QA Engineer.

Reconstruction of the seam shall include cutting out the failed seam, repositioning the panels, and re-seaming or capping the entire failed seam, or in the case of fusion welds, extrusion welding the entire seam as specified in these Specifications. The method of reconstruction shall be determined by the Owner's Representative.

After reconstruction, destructive samples of the reconstructed seam shall be obtained at locations determined by the Owner's Representative. These samples will be tested and evaluated as described in Technical Specifications.

Patches shall be non-destructively tested. Caps may require destructive testing at the option of the Owner's Representative.

S9.2.4 Deficient Work or Materials

The extent and nature of deficient work or materials shall be determined through additional tests, observations, review of records and test results or other means that are deemed appropriate. The identifier of the deficient work and materials shall fill out a deficiency resolution document. The Owner's Representative shall hold a deficiency resolution meeting. After the extent and nature of the deficiency has been ascertained, the Owner's Representative shall implement corrective actions required to meet the Specifications and Drawings. Areas that have been reworked shall be further retested. All retests must verify that the entire defective area has been corrected prior to additional work being performed in that area.

S9.3 Documentation

The Owner's Representative shall document all testing and ensure that all QA requirements have been addressed and satisfied. Further, the Contractor shall provide field reports, data sheets, and checklists to substantiate that requisite monitoring tasks have been performed. The Liner Installer and QA Engineer shall maintain a job site file of plans, Specifications, checklists, test procedures, daily and weekly reports, logs, and other project relevant documents.

S9.3.1 Daily Summary Report

Daily record keeping by the Contractor shall at a minimum include:

- Date, project name and location;
- Parties on-site participating in meetings and discussions;
- Daily summary, reporting meetings and/or discussions with the Owner's Representative summarizing QC daily activities;
- Daily Construction activities;
- Daily weather observations including precipitation and temperature;
- Compaction equipment (type and weight) and typical number of passes;
- Equipment used to place and spread materials;
- Daily field test results data sheets;
- Laboratory test results data sheets;
- Equipment calibration or recalibration forms as applicable; and
- Design and Specification modification/clarification documentation.
- Instrument readings prior and following installation.

For LLDPE geomembrane installation, the Contractor shall prepare and submit the following liner QC documentation, in electronic and hardcopy formats in the Daily Summary Report:

- Summary of work completed;
- List of equipment working on project;
- Number of personnel in each trade;
- Results of QC field and laboratory testing and test data sheets;
- Repair records (including documenting the location of all repairs on layout plan);
- Description of incidents and problems, and steps to solve them and prevent re-occurrence; and
- Additional information for cold weather seaming (defined as temperatures below 0°C, including wind chill), which includes:
    - Ambient air temperature measured 1 m above the liner;

- Method of removing frost from area to be seamed, as well as drying and cleaning of surface;
- Condition of subgrade beneath seamed area;
- Identification of seaming system used, including preheat, seaming rate and use of enclosure; and
- Unusual conditions with respect to personnel, equipment, sampling and testing attributes to weather conditions.

S9.3.2 QA Daily and Weekly Summary Report

The QA Daily and Weekly Reports shall be prepared by the QA Engineer and summarize the activities for the day/week and, where applicable, will include:

- Date, project name and location;
- Parties on-site participating in meetings and discussions;
- Summary of meetings and discussions attended;
- Identification of borrow source and the associated optimum moisture content/maximum dry density;
- Documentation of all observations of construction and QC/QA activities/test results with diagrams showing locations of field tests and locations of sampling for laboratory testing;
- Methods used to correct construction deficiencies;
- Summary of construction progress and work completed;
- Summary of QC/QA activities and test results, including an indication of passing and failing tests; and
- Summary of problems and their resolutions.

S9.3.3 Construction Deficiency Resolution Forms

Construction problem and resolution documents shall reference specific observations and test result data forms. These documents shall include the following information:

- A detailed description of the problem, non-conformance, or deficiency;
- A location identified by co-ordinates and probable cause for the problem;

- Detailed description of how and when the problem was identified;
- Detailed description of how the problem, non-conformance, or deficiency was resolved or corrected;
- Reference to results of any retests performed; and
- Detailed description of measures implemented to prevent recurrence of the problem.

These documents shall be incorporated as part of the Daily Summary Report. Any modifications or to the Drawings or Specifications shall be by the Designer. Any resulting modification or clarification to procedures used to complete the Work shall be approved by the Owner's Representative.

S9.3.4 Site Checklists

QC checklist forms shall be used for documenting the construction activities. The QC checklist shall be signed by the Contractor, QC Representative, the Liner Installer and the Owner's Representative. The checklists shall include the following information:

- Date;
- Shift inspected;
- Tests performed;
- Location inspected with station;
- Fill material;
- As-built survey conducted;
- Dewatering measures provided;
- Remarks; and
- Deviations and rectifications.

The following examples are attached:

- Saddle Dams construction checklist – Foundation Preparation and Excavation
- Saddle Dams construction checklist – Fill Placement

- Saddle Dams construction checklist – LLDPE Geomembrane Installation
- Saddle Dams construction checklist – Instrumentation

Excavation and Foundation Preparation

SADDLE DAM____-TSF DIKE CONSTRUCTION CHECKLIST - FOUNDATION PREPARATION and EXCAVATION

From Sta. Offset	SHIFT: NIGHT :☐ DAY ☐	DATE :	SHEET OF
To Sta. Offset	LOCATION: :		
EQUIPMENT:			

DESCRIPTION

NO.	ITEMS TO BE INSPECTED	INSPECTED BY CONTRACTOR/ OWNER'S REPRESENTATIVE	INSPECTED BY QA ENGINEER
1.	Survey lines and layout checked to ensure the locations conform with the Drawings		
2.	Storage areas planned for disposal of removed materials		
3.	Occurrence of snow and ice removal method in place		
4.	Occurrence of boulders and removal method in place		
5.	Occurrence of hummocks and scalping method in place		
6.	Occurrence of surface and ground water and its impact mitigation in place		
7.	Presence of other unsuitable materials and removal method in place		
8.	Soil frozen or thawed and measures taken		
9.	Blasting requirement to remove unsuitable material and safety measure checked		
	Preparation of surface for LLDPE geomembrane placement		
10.	Adjustment made to suit design in field		
11.	Final walkover inspection before re-sloping or fill placement		
	Rough grading of foundation		
12.	"As-excavated" survey conducted		
	Bedrock cleaning		
13.	Bedrock Mapping		

REMARKS :

DEVIATIONS : (Attach list if necessary)

DATE OF RECTIFICATION :

SURVEY VERIFICATION	ACCEPTED BY QA ENGINEER :	ACCEPTED BY OWNER'S REPRESENTATIVE:
NAME: _____	NAME: _____	NAME: _____
SIGNATURE: _____	SIGNATURE: _____	SIGNATURE: _____
DATE: _____	DATE: _____	DATE: _____

Fill Placement

SADDLE DAM____- TSF DIKE CONSTRUCTION CHECKLIST- FILL PLACEMENT					
From Sta.	Offset	SHIFT: NIGHT :☐ DAY :☐		DATE :	SHEET OF
To Sta.	Offset	LOCATION:			
EQUIPMENT :					
DESCRIPTION :					
NO.	ITEMS TO BE INSPECTED			INSPECTED BY CONTRACTOR/ OWNER'S REPRESENTATIVE	INSPECTED BY QA ENGINEER
1.	Survey lines and layout conform with the Drawings				
2.	Fill materials stockpiled meet the Specification requirements				
3.	Dewatering measure provided				
4.	Required soil tests performed				
	Required control of quantities for fill material amendment				
5.	Required visual inspection of stockpiled materials performed				
6.	Required visual inspection of placed materials performed				
7.	Snow and loose materials removed from the surface				
8.	Weather condition meets the requirements during fill placement and compaction				
9.	Fill materials contain no frozen chunks				
10.	Adequate control of segregation of fill materials				
11.	No snow or ice trapped during placement				
12	Compaction completed as per Specifications				
	Required soil tests of "As-placed" density and water content of fill materials				
13.	Final trench inspection performed before backfill				
14.	As-built survey conducted				
REMARKS :					
DEVIATIONS : (Attach list if necessary) DATE OF RECTIFICATION :					
SURVEY VERIFICATION NAME: _____ SIGNATURE: _____ DATE: _____		ACCEPTED BY QA ENGINEER : NAME: _____ SIGNATURE: _____ DATE: _____		ACCEPTED BY OWNER'S REPRESENTATIVE: NAME: _____ SIGNATURE: _____ DATE: _____	

Geotextile Installation

SADDLE DAM___- TSF DIKE CONSTRUCTION CHECKLIST – GEOTEXTILE INSTALLATION				
From Sta. Offset		SHIFT: NIGHT :☐ DAY :☐	DATE :	SHEET OF
To Sta. Offset		LOCATION:		
EQUIPMENT :				
DESCRIPTION :				
NO.	ITEMS TO BE INSPECTED		INSPECTED BY LINER INSTALLER/OWNER'S REPRESENTATIVE	INSPECTED BY QA QA ENGINEER
1	Geotextile material received has Manufacturer's certification and meets the Specifications			
2	Visual inspection of geotextile rolls or factory panels to determine physical damage and defects			
3	Deficiencies reported before installation			
4	Inspection of geotextile storage facilities performed			
5	Final bedding surface condition meets the Specification and Approved by Liner Installer			
6	Visual inspection during geotextile installation performed			
7	Damages during installation repaired in accordance with Specifications			
REMARKS :				
DEVIATIONS : (Attach list if necessary) DATE OF RECTIFICATION :				
SURVEY VERIFICATION NAME: _____ SIGNATURE: _____ DATE: _____		ACCEPTED BY QA ENGINEER : NAME: _____ SIGNATURE: _____ DATE: _____		ACCEPTED BY OWNER'S REPRESENTATIVE: NAME: _____ SIGNATURE: _____ DATE: _____

LLDPE Geomembrane Installation

SADDLE DAM_____- TSF DIKE CONSTRUCTION CHECKLIST – geotextile and liner INSTALLATION

From Sta. Offset	SHIFT: NIGHT :☐ DAY :☐	DATE :	SHEET OF
To Sta. Offset	LOCATION:		
EQUIPMENT :			

DESCRIPTION :

NO.	ITEMS TO BE INSPECTED	INSPECTED BY LINER INSTALLER	INSPECTED BY QA ENGINEER
1.	Liner material received has Manufacturer's certification and meets the specification		
2.	Visual inspection of liner performed to determine physical damages during handling		
3	Deficiencies reported before installation		
4	Inspection of LINER storage facilities		
5	Final bedding surface condition meets the Specification and Approved by Liner Installer		
6	Visual inspection during liner installation performed		
7	Weather conditions meet the requirements during installation		
8	Welding carried out in accordance with manufacturer's specification		
9	Liner (routine destructive and non-destructive) testing and sampling performed as required		
10	Floor and upstream wall surfaces of anchor trench are smooth		
11	Damages during installation repaired in accordance with Specification		
12	Site cleaned up		
13	As-built survey conducted and approved		
14	Check for overheating of seams and holes, punctures, folding, wrinkling, visible lumps or protrusions		

REMARKS :

DEVIATIONS : (Attach list if necessary)

DATE OF RECTIFICATION :

SURVEY VERIFICATION	ACCEPTED BY QA ENGINEER :	ACCEPTED BY OWNER'S REPRESENTATIVE:
NAME: _____	NAME: _____	NAME: _____
SIGNATURE: _____	SIGNATURE: _____	SIGNATURE: _____
DATE: _____	DATE: _____	DATE: _____

Instrumentation

SADDLE DAM____- TSF DIKE CONSTRUCTION CHECKLIST- INSTRUMENTATION				
From Sta. Offset		SHIFT: NIGHT :☐ DAY :☐	DATE :	SHEET OF
To Sta. Offset		LOCATION:		
EQUIPMENT:				
DESCRIPTION:				
NO.	ITEMS TO BE INSPECTED		INSPECTED BY OWNER'S REPRESENTATIVE	INSPECTED BY
1.	Survey lines and layout conform with the Drawings			
2	Instrument testing and calibration before placement performed			
3	Instrumentation equipment and methods acceptable			
4	Instrumentation details provided in as built			
5	As-built survey conducted			
REMARKS :				
DEVIATIONS : (Attach list if necessary) DATE OF RECTIFICATION :				
SURVEY VERIFICATION NAME: _____ SIGNATURE: _____ DATE: _____		ACCEPTED BY: NAME: _____ SIGNATURE: _____ DATE: _____		ACCEPTED BY OWNER : NAME: _____ SIGNATURE: _____ DATE: _____

APPENDIX C

Conditions and Limitations

USE OF THE REPORT AND ITS CONTENTS

This report has been prepared for the exclusive use of the Client or his agents. The factual information, interpretations, comments and recommendations contained herein are specific to the project described in this report and do not apply to any other project or site. This report must be read in its entirety as some sections could be falsely interpreted when taken individually or out-of-context. As well, the text of the final version of this report supersedes any other text, opinion or preliminary version produced by Golder. If the design, location or elevation of the project must be modified, and/or if the project is not undertaken within a period of 18 months following the submission of this report, Golder should be consulted to confirm whether its recommendations are still valid.

The comments, interpretations and recommendations expressed in this report are based on a limited assessment of underground conditions as described below and are formulated for the sole purpose of orienting the design of the project. Unless otherwise specified, the interpretations, comments and recommendations presented in this report have been formulated on the basis of our knowledge of the site conditions, the current and/or planned use of the site, the applicable regulations, standards and criteria, as well as the professional rules and practices recognized and accepted at the time of the study, taking into account, in all cases, the location of the site. References to acts and regulations contained in this report are informally provided on a technical basis. Since acts and regulations are subject to interpretation, Golder recommends its Client to consult with legal counsel to obtain suitable advice.

Certain details of the proposed project may not be known by Golder at the time of submitting this report. It is therefore recommended that Golder be consulted at the final design phase, during the preparation of the drawings and specifications associated with geotechnical aspects, in order to ensure their conformity with the intent and recommendations of this report.

It is also recommended that the services of Golder be retained during the construction phase to confirm that the underground conditions of the entire site are not significantly different from those described in this report, and that the construction work has no negative impact on the geotechnical aspects of the design. Regarding this aspect, it is important to note that the control of surface and/or groundwater is often required as a temporary or permanent measure during construction. An inadequate design of the drainage and/or dewatering can have negative consequences. Furthermore, the underground conditions can be substantially modified by construction activities (circulation of heavy equipment, excavation, lowering of the water table, pile driving, blasting, etc.) carried out on the site or on adjacent land as well as by soil exposure to weather conditions (freezing, drought, rain, etc.).

Golder shall not be held responsible for unpredictable underground conditions or their impacts on construction costs and scheduling. Golder shall not be held responsible for damages resulting from unknown conditions, from erroneous information provided by other sources than Golder, and from ulterior changes in the site conditions. Golder will accept no responsibility for the effects of drainage and/or dewatering measures if they have not been specifically consulted and involved in the design and monitoring of the drainage and/or dewatering system. Golder shall not be held responsible for damages resulting from any future modification to the applicable regulations, standards and criteria, nor for any use of this report by a third party, nor for its use for other purposes than those intended. Finally, Golder shall not be held responsible for any decrease, real or perceived, of the property/site's value or any failure to complete a transaction, as a consequence of reporting factual information.

The Client, as well as any contractor performing construction work based on or susceptible to affect the geotechnical considerations mentioned in this report, must inform Golder and/or the design engineer of any event, activity, information, discovery, either past, present or future, susceptible of modifying the underground conditions described in this report and offer them the opportunity to revise their recommendations and/or construction plans. This obligation is also applicable to cases where the actual conditions encountered on the site differ significantly from those anticipated in this report, either as an

effect of the natural variability of underground conditions or as a result of construction activities. It is also understood that the recognition of a change in the soil and rock conditions requires an investigation carried out on the site by a qualified and experienced professional geotechnical engineer.

ASSESSMENT OF UNDERGROUND CONDITIONS

The underground investigation work conducted by Golder and described in this report has been performed in compliance with the professional rules and practices recognized and accepted at that time. Unless otherwise specified, the results of previous or simultaneous work provided by sources other than Golder and quoted and/or used in this report were considered as having been obtained according to recognized and accepted professional rules and practices, and are deemed valid.

Since the composition and geometry of soil and bedrock horizons are always highly variable, the borehole and test pit descriptions can only provide an approximate estimation of their actual characteristics and profiles. The contacts between different soil and/or bedrock horizons are often gradual, and their location in borehole and test pit logs is to some extent the result of interpretation. Furthermore, the classification and identification of soil and rocks rely on an element of judgement. The descriptions of soil and bedrock given in this report are based on classification and identification methods that are widely accepted in professional geotechnic practice. Furthermore, the accuracy of the collected data and their interpretation depend on different factors, including the investigation method, spacing between soundings, depth of investigation, sampling method and frequency, as well as the uniformity of the underground conditions. Some of those factors, such as the investigation method, spacing between soundings, depth of investigation, sampling method and frequency can themselves be subordinated to the physical, financial or time constraints stipulated by the Client.

In all cases, the results obtained and presented in this report should be considered as applying only to the locations of the boreholes and test pits, at the indicated sampling depths and at the time of the investigation. The interpreted underground conditions, physical as well as quantitative or qualitative, can vary significantly between and beyond the drilled boreholes and test pits and the indicated sampling depths.

The groundwater measurements and characteristics given in this report are valid only for the specified locations and dates. These conditions can vary from one season or one year to another, or because of activities or occurrences on the investigated site or adjacent land.

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associés Ltée
1001 Blvd. de Maisonneuve West, suite 700
Montreal (Québec) H3A 3C8
Canada
T: +1 (514) 383-0990

Golder Associés