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REPORT ON

LANDFARM DESIGN AND MANAGEMENT PLAN
MEADOWBANK GOLD PROJECT

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07-1413-0047 (2000)

November 27, 2007 Doc No. 564 Ver. 0

EXECUTIVE SUMMARY

This Landfarm Design and Management Plan (Plan) outlines the detailed design and operation of a landfarm for contaminated snow and soil, as part of the Agnico-Eagle Mines Limited (AEM) Meadowbank Gold Project in Nunavut. This Plan was developed in support of AEM's application for a Type-A Water Licence from the Nunavut Water Board (NWB) to operate the Meadowbank Gold Project.

The proposed landfarm is required for the treatment of petroleum hydrocarbon-contaminated soil and snow/ice that may be generated by mining activities and operations. The landfarm is to be located immediately east of the plant site fuel storage area. The landfarm will have a maximum holding capacity of 2,100 m^3 for contaminated soil and 500 m^3 for contaminated snow/ice.

The leachate from the landfarm will be captured in sumps and pumped out regularly. The leachate will be treated in the plant site oil-water separator and the effluent will be either be used in the plant circuit or discharged to the Tailings Reclaim Pond. Non-aqueous phase liquids (NAPL) will be skimmed or pumped from the separator and collected in 205 L drums. The drums will be stored within a specified hazardous materials storage area until the contents are incinerated or shipped off-site for recycling or disposal at a licensed facility. At the end of mine life and/or once all the soils have reached an acceptable level of treatment, the soils will be removed from the landfarm and the landfarm area will be reclaimed. The remediated soils would be available for progressive closure activities on site.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

1.1 Project Overview

This Landfarm Design and Management Plan (Plan) outlines the detailed design and operation of an onsite landfarm for the treatment of petroleum hydrocarbon contaminated snow and soil, as part of the Agnico-Eagle Mines Limited (AEM) Meadowbank Gold Project (Project) in Nunavut. The Project is an open pit gold mine located on Inuit-owned land in the Kivalliq Region of Nunavut, approximately 70 km north of the hamlet of Baker Lake.

The proposed landfarm is required for the disposal of petroleum hydrocarbon-contaminated snow and soil that may be generated by mining activities and operations. This Plan was developed in support of MMC's application for a Type-A Water License from the Nunavut Water Board (NWB) to operate the mine.

An assessment of the applicability of landfarming in arctic areas, the landfarm citing options considered for the site, and the corresponding environmental overview approach are described in the technical memorandum entitled "Landfarm Option Analysis, Meadowbank Gold Project, Nunavut," dated August 23, 2007 (Golder, 2007a; Doc. 498).

The overall site plan for the Meadowbank Gold Project is shown in Drawing (DWG) 1. The proposed location for the landfarm is east of the plant site fuel facilities (DWG 2). The Meadowbank mine is designed to minimize the areas of surface disturbance, stabilize disturbed land surfaces against erosion, and return the land to a post-mining use for traditional pursuits and wildlife habitat (MMC, 2007a; Doc. 511).

1.2 Purpose and Scope of the Landfarm Design and Management Plan

The primary purpose of this report is to provide the design details and a management plan for the operation of an on-site landfarm which will treat and/or hold petroleum hydrocarbon-contaminated soil and snow/ice that may be generated during mining and operational activities.

2.0 REMEDIATION GUIDELINES

Federal and Territorial Remediation guidelines are applicable in Nunavut. Based on similar projects, it is anticipated that the Type-A Water License (License) will define acceptable target levels of soil remediation for the Project (Golder, 2007a; Doc. 498). The licensed target levels will likely be based on the Canadian Council of Ministers of the Environment (CCME) *Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil* and the *Technical Supplement* (dated January 2001). Based on the objective of the Project Preliminary Closure and Reclamation Plan (MMC, 2007a; Doc. 511) to return the mine site footprint back to productive use, the soil should be screened against the most stringent criteria, which are Residential/Parkland levels. The Canada Wide Standards (CWS) for petroleum hydrocarbons (PHC) in the range of diesel (F3) for coarse grained soils, such as fill, is 2,500 mg/kg. It is anticipated that this is the level that will be stipulated within the License for on-site disposal of hydrocarbon-impacted soils at the Project. The guideline for total petroleum hydrocarbons presented in the *Environmental Guideline for Site Remediation* (Nunavut Environmental Protection Service, 2002) presents a concentration of 2,500 mg/kg of total petroleum hydrocarbons (Industrial Level).

The *Federal Guidelines for Landfarming Petroleum Hydrocarbon Contaminated Soils*, SAIC (Science Applications International Corporation) Canada, dated December 2005, provide information about the construction and use of landfarms. The *Generic Plans and Operating Procedures of a Remediation Facility for Hydrocarbon Contaminated Materials in the NWT* (Government of NWT, 1995) presents plans and operating procedures for facilities used to treat hydrocarbon contaminated soil and snow. The same report also provides a review of various remediation technologies.

3.0 PHYSICAL CONDITIONS

3.1 Location and Subsurface Conditions

The proposed landfarm location is situated approximately 350 m east of Third Portage Lake (DWG 1). The relief is gentle, with a slight slope towards the northeast (DWG 2). The ground surface elevation at the proposed facility location ranges from 142 m to 148 m above mean sea level (masl) (DWG 3).

Based on borehole data collected in 2003 approximately 450 m northwest of the landfarm location it is expected that the subsurface conditions in the vicinity of the proposed landfarm will consist of a 0.3 to 3 m thick layer of cobble and coarse angular gravel overlying bedrock (Golder, 2007b; Doc. 449 Vol. 2).

3.2 Permafrost

The Project area is located within the zone of continuous permafrost. Permafrost depths are estimated to be between 450 and 550 m, depending on proximity to lakes, slope aspect, and other site-specific conditions. The measured active layer depth ranges from about 1.3 m in areas of shallow surficial material (till) and away from lakes, up to 4.0 m adjacent to lakes, and up to 6.5 m beneath the outlets connecting Third Portage and Second Portage lakes. Results from a geotechnical investigation at the tank farm facility indicate that the ground thaws to a depth of 1.5 m below ground surface (bgs) in this area.

3.2.1 Seismicity

The Meadowbank Project is located in an area of low seismicity (Golder, 2007b; Doc. 449 Vol. 1).

3.3 Climatic Conditions

The Meadowbank Gold Project is situated within an Arctic ecoclimate described as one of the coldest and driest regions of Canada. Arctic winter conditions occur from October through May, with temperatures ranging from +5° C to -40° C. Summer temperatures range from -5° C to +25° C with isolated rainfall increasing through September (MMC, 2007d; Doc. 500).

The long-term mean annual air temperature for the Meadowbank area is estimated to be approximately -11.1°C. The mean annual precipitation totals for rain and snow are respectively 142.5 mm, and 146.8 mm, for a total of 289.2 mm (MMC, 2007d, Doc. 500). Average temperatures for June to September are above freezing, therefore it is anticipated that bioremediation will be feasible during these months.

4.0 ESTIMATED VOLUMES OF MATERIAL TO BE TREATED AT THE LANDFARM FACILITY

The landfarm facility is designed with two cells: a soil remediation cell, and a snow/ice remediation cell (DWG 2). The design volume of each cell is based on allowances for the materials to be treated, potential precipitation inflows corresponding to the average annual snowfall plus the 1 in 100-year 24 hour rainfall event, and freeboard.

It is estimated that the Project may generate approximately 300 m^3 to 400 m^3 of petroleum hydrocarbon contaminated soil per summer season (average 350 m^3). It is further estimated that soils contaminated with light end petroleum hydrocarbons (i.e., diesel) will require three full summer seasons for bioremediation and heavier end petroleum hydrocarbons (i.e., motor oil) will require six full summer seasons (Miramar, 2007). Using a conservative approach and allowing for six seasons for all soil remediation, the annual capacity for contaminated soils will be approximately 2,100 m^3.

The soil remediation portion of the landfarm is proposed to have a useful area (footprint available for remediation) of approximately 98 m by 75 m for a total of 7,350 m^2. At maximum capacity, it is anticipated that it would be possible to store contaminated soil for treatment in an even or continuous layer of up to 30 cm thick. Assuming an allowance for a 25 m pie-shaped area around the sump that will not be filled with soil (DWG 2), the potential storage volume would be approximately 2,100 m^3 within the bermed area of the soil remediation cell (Table 4.1).

The average annual snow precipitation is approximately 147 mm (water equivalent) and the precipitation from a 100 year 24 hour rainfall event is approximately 59 mm. The anticipated design volume for precipitation inflows to a soil remediation cell with a catchment area of 9,480 m^2 (the useful area plus the berm area) gives a volume of approximately 1,950 m^3.

The snow/ice remediation portion of the proposed landfarm will have a useful area of approximately 68 m by 12 m for a total area of 816 m^2. A 0.50 m ± 0.2 m thick layer of contaminated snow/ice in the useable area would give a volume of approximately 500 m^3. The catchment area for the snow/ice cell is 2,500 m^2, which would correspond to some 500 m^3 of precipitation inflow for the design condition (Table 4.1).

An allowance of 25 cm of freeboard was included throughout the internal perimeter of the landfarm facility. The freeboard allowance, contaminated soil (or snow/ice) allowance and precipitation inflow allowances were used determine the height and therefore elevation for the lower and upper berm in each cell.

Table 4.1: Calculated Volumetric Capacity Requirements for the Soil and Snow/Ice Cells

Remediation Cell	Volume (m³)	Capacity Description
Soil	1,950	Precipitation Capacity(1)
	2,100	Remediation Capacity
	4,050	Net Capacity
Snow /Ice	500	Precipitation Capacity(1)
	500	Remediation Capacity
	1,000	Net Capacity

(1) Considering 147 mm of snow precipitation and 59 mm from 1:100 year 24 hour rainfall

In the event of a large spill in the summer, contaminated soils can be temporarily stored in the snow/ice cell. If the soil and snow/ice cells do not have sufficient capacity to accommodate a large spill, a temporary stockpile area could be set up adjacent to the landfarm. The soil would then be placed in the landfarm as soon as practical. Further, if the on-going operation requires more capacity to manage contaminated soils, a second landfarm cell could be constructed adjacent or beside this landfarm.

5.0 WATER MANAGEMENT

The landfarm facility is separated from the remainder of the site by lined perimeter berms. Surface runoff will drain to a sump within both the soil and snow/ice cells. These sumps would be pumped out on an as-needed basis, once a trigger level of 75 cm of water in the sump is noted.

Considering the collection area for each cell, as presented in Section 4.0, the storage requirement volumes of precipitation runoff expected to be collected within the landfarm facility based on a 100 year 24-hour rainfall event runoff of 59 mm is provided in Table 5.1.

Table 5.1 Storage Requirements of Landfarm Cells Based on 1:100 Year Storm Event

Remediation Cell	Catchment Area (m^2)	Storm Event (years)	Volume (m^3)
Snow/Ice	2,500	1:100	148
Soil	9,480	1:100	560

It is proposed that the required pumping capacity for the landfarm be dictated by the average year snow melt volume pumped over a three week snow melt period. Any additional precipitation falling on the landfarm catchment area during this period would be stored within the cells up to the 100-year 24-hour rainfall event, and the pumping period would be extended as required. Monitoring of the landfarm will be conducted to monitor sump volumes to prevent overtopping of containment by water (see Section 8.2.3). Provisions for an emergency overflow from the landfarm, if required, will be included in the construction drawings for the facility based on the site contact water management system. The spillway would be designed to direct overflow to downstream contact water collection to prevent the potential release of PHC to the environment.

The pumping volume requirements for melting snow within the landfarm area are noted on Table 5.2. As noted above, the volumes presented consider an average year spring runoff of 147 mm (water equivalent) and assumes that the water is pumped over a three week period (anticipated snow melt period).

Table 5.2 Pumping Requirements of Landfarm Cells

Remediation Cell	Collection Area (m^2)	Melt (m^3)	Total/day (m^3/day)
Snow/Ice Cell	2,500	368	17.5
Soil Cell	9,480	1,394	66.4

The operation for the landfarm will employ a vacuum truck to remove the water for treatment. The vacuum truck would require adequate capacity to manage the noted volumes of water. The above pumping rates are intended to keep sump levels low so that the soil undergoing remediation does not become saturated within the landfarm (remediation is not effective when the soil is saturated since aeration is prevented). It is noted that the rate of the snow melt will control the required pumping from the landfarm (Table 4.3).

6.0 PROPOSED LANDFARM CONSTRUCTION

The proposed location of the Landfarm is shown on DWG 2. The landfarm will be comprised of two cells separated by a lined rock berm (DWG 3). The estimated capacity for contaminated snow/ice is 500 m^3, while the estimated capacity for contaminated soil is 2,100 m^3.

6.1 Design Criteria

The base of the landfarm would be developed with a 100 to 600 mm minus well graded gravel or processed pit-run sand and gravel material, where fills more than 1 m thick are required. This material would be overlain by a 0.5 m thick layer of 100 mm minus well graded sand and gravel (Type B fill - Appendix I). A 0.3 m thick layer of 25 mm minus sand and gravel (Type A fill) will be placed over top of the Type B fill. A low permeable liner system, consisting of HDPE or LLDPE geomembrane sandwiched between a non-woven geotextile will be placed over top of the Type A fill. The liner system would be covered by 0.3 m of Type A material. A marker layer such as a geotextile or geosynthetic snow fence would be placed over the Type A material. A 0.3 m thick layer of the Type B material would be placed over the marker layer. The contaminated material will be placed on this layer. When the remediated material is removed the marker layer will serve to 'protect' the liner. Refer to DWGs 3 to 5 for the detailed design drawings and refer to Appendix I for the material specifications.

The base of the cells will be sloped at 5% towards the north, to allow the leachate/surface runoff water to drain to a collection sump (two sumps total, one per cell) (DWG 3). The water will be pumped or vacuumed into a tank truck, and transported to the mine site oil-water separator for treatment as required.

Based on the topography and the berm slope, a 1.8 m to 3.5 m high perimeter berm will form the external boundaries of the landfarm structure. Another 1.5 m to 2.5 m high internal berm will partition the structure into the two cells (DWG 4). The side slope for both the perimeter berm and the internal berm will be 2:1 (H:V).

7.0 PROPOSED LANDFARM OPERATION

The following presents the proposed Operation Plan for the Landfarm. It is understood that AEM will be responsible for managing and implementing the Operation Plan.

7.1 Operations Plan

The proposed landfarm will treat PHC contaminated soils generated through mine-related activities at the Meadowbank Gold Project. Material from other sites will not be accepted without approval from the Nunavut Water Board (NWB).

PHC contaminated snow and ice will be stored in a separate cell within the landfarm facility. The snow and ice will not be treated per se, but rather, once melted, the contaminated water will be collected and transported in a vacuum truck to the plant site oil-water separator for treatment as required.

The following products will be used on-site that, if spilled may be treated in the landfarm:

- Diesel fuel;
- Aviation fuel (Jet B);
- Hydraulic oils; and
- Gasoline.

Metals, solvents, glycol and heavy oils will not bioremediate in a landfarm, and soil or snow/ice containing these contaminants should not be introduced into the landfarm.

7.2 Procedures Following a Spill

As set out in the Spill Contingency Plan (MMC, 2007b; Doc. 483), all PHC product spills associated with the mine operation and closure activities will require a written report documenting the release, and an investigation to assess the nature and extent of the impacted area resulting from the spill. Remediation of the spilled material will be subject to the investigation results.

Initial actions for spills include ensuring personnel and site safety, identifying and containing spill materials, reporting the spills to the On-site Coordinator, notifying government agencies, and recording the incident (MMC, 2007b; Doc. 483). The Spill Contingency Plan documents the action plan for all spills.

7.3 Landfarm Operational Procedures

PHC contaminated soil or snow/ice will be excavated from the source and transported to the landfarm facility in dump trucks. Care will be exercised to ensure that none of the contaminated material is lost during transport. If the soil has not been characterized, it would be placed in the temporary cell or snow/ice remediation cell (used to store contaminated soil and ice in the winter months) for temporary storage until the chemical quality of the soil is determined. Once that quality is known, the soil should be uniformly spread in layers within the soil remediation cell, starting at the opposite (south) end away from the sump, to minimize unnecessary compaction of treated soil. Depending on the quality of the new soil, it would either be segregated from, or partially blended with existing remediating soil.

7.3.1 Aeration and Moisture

To ensure proper aeration, soils will be tilled monthly from June through to September using a roto-tiller or a rubber-tire backhoe. Moisture levels will be monitored and maintained within the optimal range for bio-remediation at approximately 12% to 30% moisture by weight (AMEC, 2006).

7.3.2 Nutrient Addition

Nutrients will be blended into the soil in the early summer months to promote bioremediation. The nutrients applied will have an approximate nutrient ratio of carbon: nitrogen: phosphorous (C: N: P) ratio of 100: 7.5: 0.5 (Golder, 2007a, Doc. 498). The quantity and frequency of adding nutrients will be assessed by the Environmental Coordinator, based on the performance of the bioremediation cell.

7.3.3 Leachate

Leachate and/or melted snow from both cells in the landfarm will be collected in sumps. Sumps will be periodically pumped using a sump pump or vacuum truck and the fluid would be transported to the plant site oil-water separator for treatment. The discharge from the oil-water separator will include 1) non-aqueous phase and 2) aqueous phase liquids. Non-aqueous phase liquids (NAPL) will be skimmed or pumped from the separator and collected in drums. The drums will be stored within a specified hazardous materials storage area until the contents are incinerated or shipped off-site for recycling or disposal at a licensed disposal facility. Aqueous phase liquids will be either used in the plant circuit to help satisty process water makeup requirements, or will be discharged to the Reclaim Pond.

Given the low annual precipitation amounts typical of the site, it is not anticipated that the landfarm will need to be covered with a tarp. To minimize leachate generation, uncontaminated snow may be removed from the landfarm using small equipment such as a bobcat.

7.3.4 Remediated Soils

Soils that have reached accepted levels for on-site disposal will be stockpiled and used for progressive reclamation.

7.3.5 Landfarm Inspections and Control Measures

Inspections will be performed by the Environmental Coordinator on a weekly basis to verify compliance with the permit and the conceptual closure plan for the facility (Section 8). During periods of high melt and freshet runoff (approximately from mid-May through June) sump volumes will be measured daily (refer to Section 8.2.3). During the inspections, the Environmental Coordinator will note the condition of the landfarm including any areas in need of repair. Repairs will be carried out promptly. The Environmental Coordinator will assess if dust control measures need to be taken, such as adding moisture or if required, covering the soil with tarping.

During the inspection, the Environmental Coordinator will ensure that no contaminated soils have spilled on to the surrounding land. If a spill has occurred remedial action will be taken promptly to move the spilled soils into the landfarm facility.

The Environmental Coordinator will also note if significant levels of hydrocarbon vapours are observed during the inspection, and will also document any wildlife activities that are occurring in or close to the Landfarm facility. Remedial measures may be necessary if wildlife is entering the facility.

7.3.6 Staffing and Equipment

The landfarm will require dump trucks for hauling contaminated soil and/or snow and ice. A rubber tired machine will be used to spread and level the materials. A roto-till or rubber tire back hoe will be employed to aerate the soil. Nutrient addition and soil sampling tasks will be facilitated with the use of a rubber tire back hoe. A vacuum truck will be used to drain leachate and melted snow from the sumps. As all of these activities are periodic, the proposed landfarm will not require a full-time attendant.

8.0 PERFORMANCE AND ENVIRONMENTAL MONITORING PROGRAM

The following presents the proposed Performance and Environmental Monitoring Program for the Landfarm. It is understood that AEM will be responsible for managing and implementing the Program.

8.1.1 Performance Monitoring

It is proposed that representative soil samples from the remediating soil materials within the landfarm facility will be analyzed for the contaminants of concern (COC), including total petroleum hydrocarbons (TPH); benzene, toluene, ethylbenzene and xylene (BTEX); and volatile petroleum hydrocarbons (VPH). Soils will be tested regularly to assess the effectiveness of the remediation system and until soils reach an acceptable quality, as per the applicable remediation guidelines (presented in Section 2). It is proposed to test the soils once at the beginning of the summer and once in the early fall on a yearly basis for the COCs. If soils are nearing target remediation levels, analysis will be required to confirm the concentrations of COCs.

As discussed in Section 4.0, the soil biocell will have inner dimensions of approximately 98 m length, 75 m width and a useable height of 0.3 m, for a total volume of 2,100 m^3. For soil sampling purposes, it is proposed to create a grid with cells of approximately 230 m^3 (on grid lines 33 m by 25 m). The grid cell will be divided into five sub-cells and a composite sample consisting of a representative aliquot from each of the five sub-cells would be homogenized to represent the 230 m^3 grid cell.

Temporary soil vapour probes will be installed to monitor organic vapours, and carbon dioxide and oxygen concentrations using a multi-gas portable monitoring device. Monitoring oxygen levels regularly will provide guidance for the frequency of tilling required. Bioremediation becomes less efficient when oxygen levels are low. It is proposed to install the soil vapour monitoring probes during the summer months. The monitoring probes will need to be removed prior to soil tilling, and then re-installed.

8.2 Environmental Monitoring

8.2.1 Soil

Once annually, in addition to the COCs presented in Section 8.1.1, it is proposed that soil analysis will also be performed for total metals, oil and grease, and, if applicable, volatile organic compounds (VOCs).

8.2.2 Vapour

Vapours within the soil remediation cell will be monitored to ensure compliance with relevant regulations and to ensure there is no risk to employees working within the landfarm facility. Vapour samples will be collected using an air sampling device with an active carbon tube, situated at the approximate height for human air intake (1.5 m above the soil), at up to four locations within the soil remediation cell. Soil vapour samples will be taken when a new load of soil arrives for remediation.

8.2.3 Water Quality and Quantity Monitoring

All water derived from melting of snow or ice in the snow/ice remediation cell and from runoff and seepage in the soil remediation cell will be monitored in the sumps (refer to DWG 3) prior to transport to the plant for treatment in the oil-water separator (refer to Section 7.3.3). The discharge from the oil-water separator will include 1) a non-aqueous phase liquid for incineration or offsite recycle or disposal at a licensed disposal facility and 2) an aqueous phase liquid that will be either used in the plant circuit or discharged to the Reclaim Pond. Water discharged to the Reclaim Pond is included in the Internal Monitoring Program (IM) for the Meadowbank Project (MMC, 2007c, Doc. 450) for water quality characterization. Table 8.1 presents the proposed monitoring frequencies, monitoring method, constituents of potential interest, and action plan outlining contingencies in case of non-compliance.

Water derived from the melting of snow and ice contained in the snow/ice remediation cell will be monitored at the sump located within the cell prior to transport to the oil-water separator for treatment. The melt water in the snow/ice remediation containment area will be monitored 1) for water quality and 2) for sump volume.

Water from the soil remediation cell will be collected in the sump located within the cell. The sump is designed to capture surface runoff and water that seeps through the soil and collects at the base of the cell. Surface runoff and seepage water will be monitored in the sump for 1) water quality and 2) sump volume.

Table 8.1: Summary of Proposed Monitoring Storage Pond Water Quality Monitoring Plan and Flow Monitoring Plan

Component	Parameters	Monitoring locations	Monitoring frequency	Monitoring methods	Potential Exceedance	Mitigation
Cell volume	Water elevation in the sump	Snow/ice and soil remedation cell sumps	Monitoring during ice-free seasons: daily mid-May through June, weekly July through October	Graduated staff showing pond elevation either on the pond wall or within the sump	Allowable free board (refer to Section 4.0)	Transport to oil-water separator in plant
Water quality	Arsenic, copper, lead, nickel, zinc, turbidity, TDS, benzene, toluene, ethyl benzene, oil & grease and pH	Snow/ice and soil remedation cell sumps	Monthly or as necessary prior to transport to oil-water separator at plant	Unfiltered surface grab sample collected below the non-aqueous phase surface layer if present	Fuel, oil/grease, volatile organic compounds, metals	Review delivery schedule of material to the Landfarm Containment Area

Monitoring location

The current landfarm design calls for two separate cells with a sump located in the northwest corner of each cell (refer to DWG 3). The design of the sumps is shown in DWG 5.

The sump in the snow/ice remediation cell is designed to monitor water derived from melting of contaminated snow and ice within the cell. The base of the sump and cell is sloped to promote flow of water to the sump area within the cell. A staff gauge will be installed to allow for the monitorng of water levels in the cell. Table 8.2 lists the proposed monitoring locations and provides a brief description of the sample collection points.

The sump in the soil remediation cell is designed to 1) capture runoff from the surface of the soil remediation cell and seepage water from the soils in the cell and 2) allow settlement of particulates prior to pumping and transport of the water to the plant. The surface of the sump will be maintained to promote surface runoff from the contained soils to flow toward the sump. The base of the sump and cell is sloped toward the low point in the sump to promote the flow of water in the saturated soils above the impermeable liner toward the sump.

Table 8.2: Monitoring Program Station Locations

Monitoring Program Station Number	Description
Snow/ice remediation cell	Sump in northwest corner of the snow/ice remediation cell
Soil remediation cell	Sump in northwest corner of the soil remediation cell

Monitoring Frequency

The remediation cells and sumps are sized to accommodate expected contaminated snow and ice volumes and soil volumes as well as preciititation and runoff from the 100 year storm in addition to the maximum storage volume for the average year climate conditions. To accommodate the potential of unanticipated storm events and in order to maintain capacity in the ponds and sumps, water will be periodically pumped from the sumps and transported to the oil-water separator at the plant for processing. In addition, the sumps will be drained at the end of each ice-free season to provide maximum storage volume for 1) contaminated snow and ice during the winter months and 2) melting and runoff during the spring freshet. The monitoring program is designed to provide systematic monitoring during the ice-free season following the proposed schedule.

Sump volumes will be measured daily during periods of high melting and runoff during the freshet (approximately from mid-May through June) and weekly during the remainder of the ice-free season. Water quality monitoring will be conducted 1) monthly during the ice-free season or 2) prior to pumping and transport to the plant for treatment. Table 8.3 summarizes the proposed monitoring schedule during ice free periods.

Table 8.3: Proposed Regular and Event Based Monitoring Schedule

Monitoring Schedule during the ice-free season	
Sump volume	Water quality
Daily mid-May though June	Monthly
Weekly July through October	Prior to pumping and tranport

Monitoring Parameters

Parameters for monitoring include cell pond water volume and water quality parameters of potential interest as determined by the material contained within the landfarm facility and conditions defined in the License. The parameters of potential interest for the landfarm monitoring program include arsenic, copper, lead, nickel, zinc, turbidity, total dissolved solids (TDS), benzene, toluene, ethyl benzene, oil & grease and pH. The inclusion of arsenic, copper, lead, nickel, zinc, turbidity, TDS and pH is to comply with the Schedule 2 list of analytes from the IM program for the Meadowbank Project (MCC, 2007b). The inclusion of benzene, toluene, ethyl benzene, and oil & grease are designed to monitor the volatile organic compounds and petroleum products in the sump waters.

Monitoring Methods

Water volumes in the cells and sumps will be measured by use of a calibrated staff installed within in the cell or sump area, a painted scale on the sump wall, or an automated water level monitoring device at each cell based upon the monitoring schedule outlined in Table 8.3.

Unfiltered surface water grab samples for the water quality monitoring program will be collected from the aquaeous phase (i.e. below the non-aqueous phase surface layer if present) from each of the monitoring locations. Table 8.4 summarizes the volume, container type, preservation method, and holding time for each analyte.

Table 8.4: Summary of Analytes for the Regular Monitoring Program [(1)]

Analyte	Minimum volume	Container	Preservation	Holding Time
Arsenic	250 mL	Plastic	Unfiltered, HNO_3 – pH below 2	6 months
Copper	250 mL	Plastic	Unfiltered, HNO_3 – pH below 2	6 months
Lead	250 mL	Plastic	Unfiltered, HNO_3 – pH below 2	6 months
Nickel	250 mL	Plastic	Unfiltered, HNO_3 – pH below 2	6 months
Zinc	250 mL	Plastic	Unfiltered, HNO_3 – pH below 2	6 months
Turbidity	100 mL	Plastic	Unfiltered, Cool, 4 ºC	48 hours
TDS	200 mL	Plastic	Unfiltered, Cool, 4 ºC	7 days
Benzene (µg/L) (2)	2 x 40 mL	Glass/teflon cap	$NaHS0_4$	14 day
Toluene(µg/L) (2)	2 x 40 mL	Glass/teflon cap	$NaHS0_4$	14 day
Ethyl benzene(µg/L)	2 x 40 mL	Glass/teflon cap	$NaHSO_4$	14 day
Oil & Grease	1000 mL	Glass	Cool, 4 ºC, H_2SO_4 – pH below 2	28 days
pH	25 mL	Plastic	none	Analyze immediately

(1) USEPA Methods for Chemical Analysis of Water and Waste Water, EPA-600/4-79-020.
(2)Environmental Sampling Guide, 2004, ALS Environmental, 1988 Triumph Street, Vancouver BC, V5L 1K5.

Action Plan Outline

The objectives of the landfarm monitoring program are two fold: 1) to monitor sump volumes to prevent overtopping of containment by water in the snow/ice remediation cell or from the sump in the soil remediation cell of the Landfarm Containment Area and 2) to characterize the water quality of the aqueous phase that will be discharged from the oil-water separator at the plant.

Potential exceedences in sump volume will be addressed by pumping the ponded sump water into a vacuum truck for transport to the oil-water separator for processing. Pumping of the sump will be initiated when sump levels exceed a trigger point that allows 1) sufficient time for the results of the water quality analyses to be available prior to transport and 2) maintains the water level in the cell below a 0.25 m freeboard.

Water quality guidelines for discharge of the aqueous phase from the oil-water separator to the Reclaim Pond are shown in Table 8.5 In the unlikely event that parameters of potential interest in the aqueous phase exceed the guidelines, the source of recent deliveries and sources of material stored in the facility will be reviewed for compliance with the schedule of material designated for storage within the facility (refer to Section 7.1), and appropriate remedial actions will be initiated.

Table 8.5: Water Quality Guidelines for the Parameters of Potential Interest

Parameter	Max. Average Concentration (MAC) (mg/L)	Maximum Concentration of any single grab sample (mg/L)
Arsenic	0.5	1.00
Copper	0.3	0.6
Lead	0.05	0.2
Nickel	0.5	1.0
Zinc	0.5	1.0
Turbidity		
TDS		
Benzene (μg/L)	370	
Toluene(μg/L)	2	
Ethyl benzene(μg/L)	90	
Oil & Grease	5 and no visible sheen	
pH	pH between 6 and 9.5	

9.0 LANDFARM MANAGEMENT

The landfarm will be managed to ensure safety and environmental responsibility. This will be achieved by having the facility security overseen by the Meadowbank security team and under the direction of the Environmental Co-ordinator. Only trained personnel will be permitted access to the landfarm facility.

9.1 Health and Safety

The health and safety planning for the works carried out at the landfarm facility will be consistent with the Meadowbank Gold Project's standard procedures. This landfarm design and management plan describes the landfarm facility and covers a description of the works. In addition, a hazard identification for the landfarm is required.

Key hazards associated with working with chemical substances, including PHC, and around heavy equipment, such as haulage trucks and excavators are:

- Inhalation chemical substances;
- Ingestion chemical substances;
- Contact with or absorption of chemical substances; and
- Limited vision of equipment operators.

The use of appropriate personal protective equipment (PPE) will minimize or eliminate the exposure pathways for the chemical substances. It is recommended that the Material Safety Data Sheets (MSDS) for the PHC used at the mine site be provided for all personnel who will be working at the landfarm facility. In addition, personnel working in the landfarm around heavy equipment should take precautionary measures to ensure their safely. These include, but are not limited to:

- Approaching the equipment only once the operator is aware of your presence, eye contact is made and your desire to approach is conveyed (through signals or by radio);
- Standing at a location outside the maximum reach of the equipment; and
- Ensuring the operator is aware of the tasks involved and departing the work areas once your task is complete.

Suggested PPE for working in the landfarm facility are:

- Steel toe and chemically resistant safety boots;
- Hard Hat;
- High visibility safety vest when working around heavy equipment;

- Hearing protection when working around heavy equipment;
- Eye protection – safety glasses or goggles;
- Chemically resistant gloves (i.e., nitrile);
- Air purifying respirators; and
- Air monitoring equipment, such as a photo ionization detector (PID), and associated action levels to stop work to preserve personal health and safety.

9.2 Conceptual Closure Plan

At the end of mine life and/or once all the contaminated soils have reached an acceptable level of treatment, the remediated soils will be removed from the landfarm and the landfarm area will be reclaimed. Remediated soils will be stockpiled and used for reclamation purposes. Any residually contaminated soils and the underlying fill material (Fill A) in the cells will be buried within the Tailings Storage Facility (TSF), which will be covered with 2 m of ultramafic rock (MMC, 2007a, Doc. 511; MMC, 2007d, Doc. 500). It is anticipated that materials buried within the TSF will become encapsulated within permafrost (MMC, 2007d, Doc. 500). The HDPE liner will be disposed of in the closure or final landfill (Landfill #2; Golder, 2007c, Doc. 458). The Type B fill (coarse rockfill) and berm walls will be sampled for the contaminants of concern on closure and removal of the geomembrane. If the soil quality meets the applicable standards, the rockfill will be stockpiled and used for reclamation purposes; otherwise it will be buried within the TSF.

The landfarm site will be reclaimed with the aim of returning the land back to productive use. The Meadowbank mine including the landfarm facility is designed to minimize the areas of surface disturbance, stabilize disturbed land surfaces against erosion, and return the land to a post-mining use for traditional pursuits and wildlife habitat (MMC, 2007a, Doc. 511).

10.0 PLAN REVIEW AND CONTINUAL IMPROVEMENT

The proposed Landfarm Design and Management Plan should be reviewed annually by the Meadowbank Environmental Co-ordinator in consultation with the Mine General Manager, and updated at least every two years of operation. Improvements suggested through these reviews should be implemented in consultation with the Nunavut Water Board.

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

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED BY

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

EOB/JV/DRW/JAH/lw
O:\Final\2007\1413\07-1413-0047\564 27Nov_07 RPT - Landfarm Design and Management Plan Ver.0.doc

REFERENCES

AMEC Americas Limited, 2006. "*Snap Lake Project, Landfarm for Hydrocarbon Contaminated Soils," Project No. 142222, Revision 01*, submitted to Mackenzie Valley Land and Water Board on behalf of DeBeers Canada Inc., dated August 3, 2006.

Environmental Protection Service, 2002. Environmental Guideline for Site Remediation, Department of Sustainable Development, Government of the Nunavut, dated January, 2002.

Golder (Golder Associates Ltd.), 2007a. Landfarm Option Analysis, Meadowbank Gold Project, Nunavut, *Project 07-1413-0047-2000, Revision 0*, submitted to Agnico-Eagle Mines Limited, dated August 23, 2007.

Golder (Golder Associates Ltd.), 2007b. Final Report On Pit Slope Design Criteria for Portage and Goose Island Deposits, Meadowbank Gold Project Nunavut, *Project 06-1413-089/5000, Doc. No. 449, Revision 0,,* submitted to Meadowbank Mining Corporation, dated April 5, 2007.

Golder (Golder Associates Ltd.), 2007c. Final Report On Landfill Design and Management Plan, Meadowbank Gold Project Nunavut, *Project 06-1413-089/9000, Doc. No. 458, Revision 0,,* submitted to Meadowbank Mining Corporation, dated August 27, 2007.

Government of NWT, Environmental Protection Division, Department of Renewable Resources, 1995. The Generic Plans and Operating Procedures of a Remediation Facility for Hydrocarbon Contaminated Materials in the NWT, dated August 1995.

Miramar Hope Bay Ltd., 2007. Landfarm Management Plan, dated April, 2007.

MMC (Meadowbank Mining Corporation), 2007a. Meadowbank Gold Project Preliminary Closure & Reclamation Plan. August 2007.

MMC (Meadowbank Mining Corporation), 2007b. Meadowbank Gold Project Spill Contingency Plan. August 2007.

MMC (Meadowbank Mining Corporation), 2007c. Water Quality and Flow Monitoring Plan. Final Report August 2007.

MMC (Meadowbank Mining Corporation), 2007d. Meadowbank Gold Project Mine Waste and Water Management. August 2007.

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

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

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

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

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

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

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

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

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

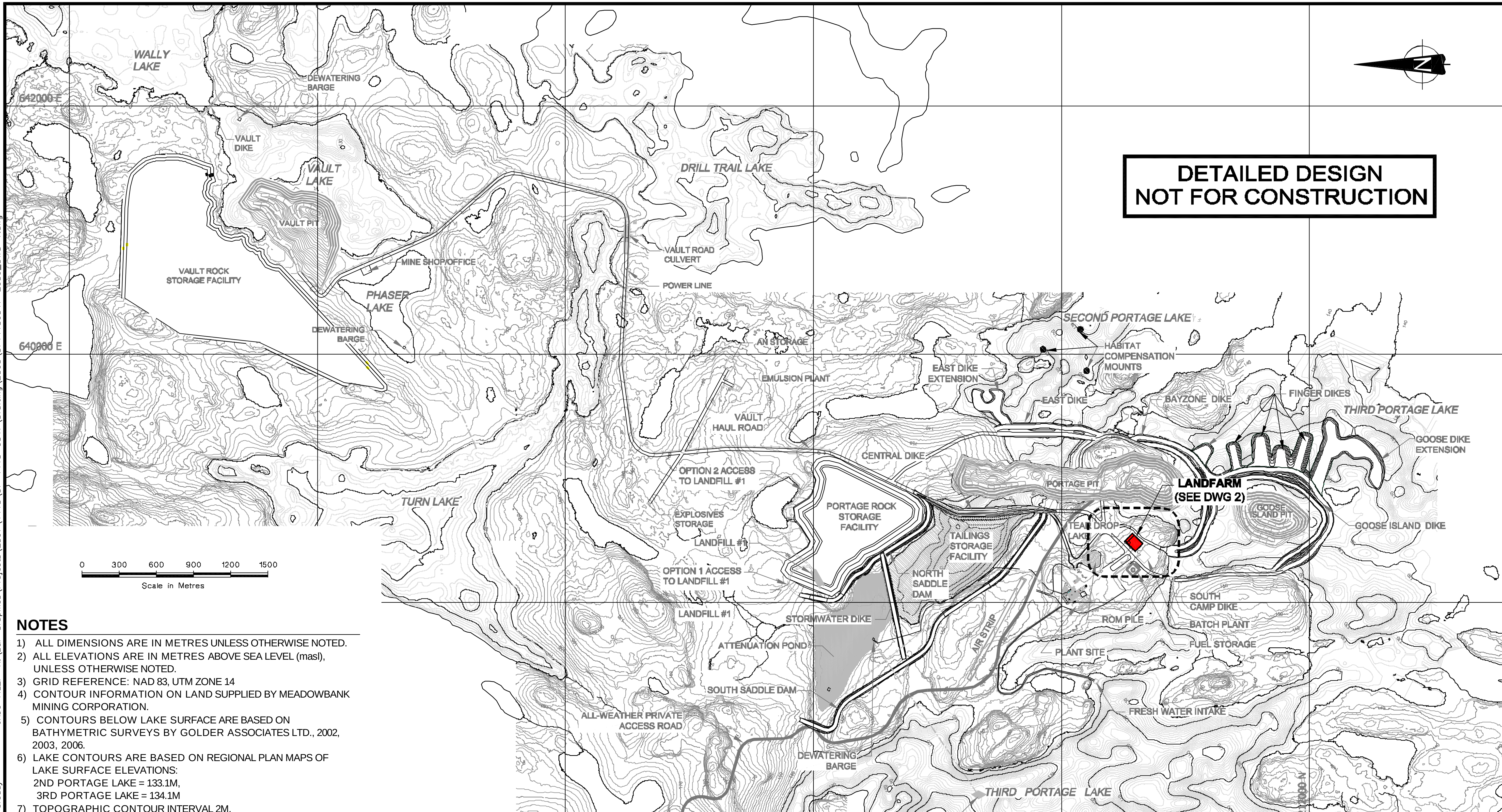
Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater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

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

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

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

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



NOTES

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

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AEM AGNICO-EAGLE MINES LIMITED
MEADOWBANK DIVISION

TITLE
LANDFARM DETAILED DESIGN
OVERALL SITE PLAN

DRAWING NO.	REFERENCES
A1-131395-100-C-0001	AMEC AMERICAS LTD. MEADOWBANK FEASIBILITY STUDY, APRIL 2005.

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
A	27NOV07	JV	DETAILED DESIGN	SRR		

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Golder Associates

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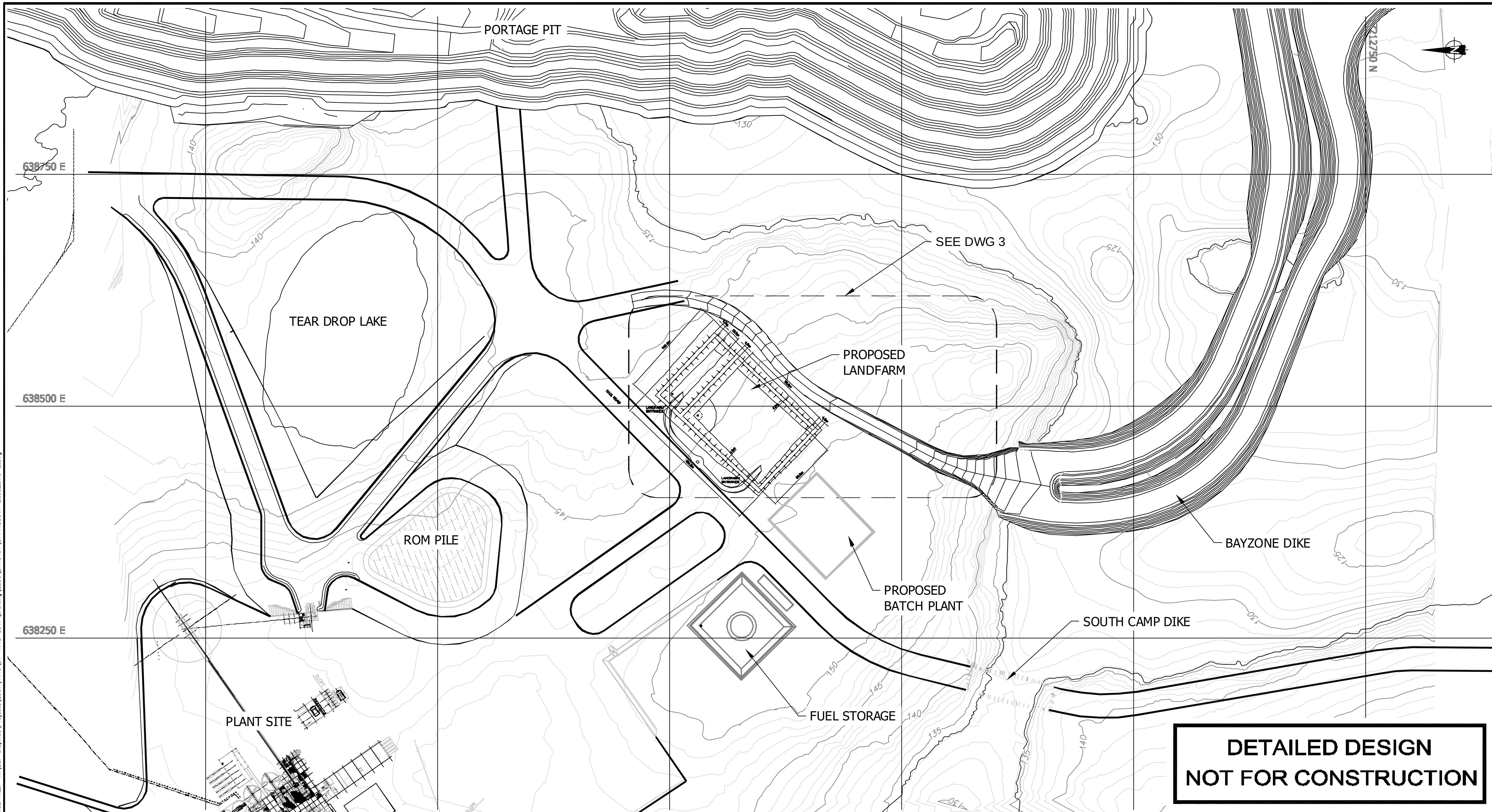

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Scale in Metres

PROJECT

AEM AGNICO-EAGLE MINES LIMITED
MEADOWBANK DIVISION

TITLE

MEADOWBANK GOLD PROJECT
LANDFARM
LOCATION PLAN

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
A	27NOV07	JV	DETAILED DESIGN	MJH		

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Golder Associates

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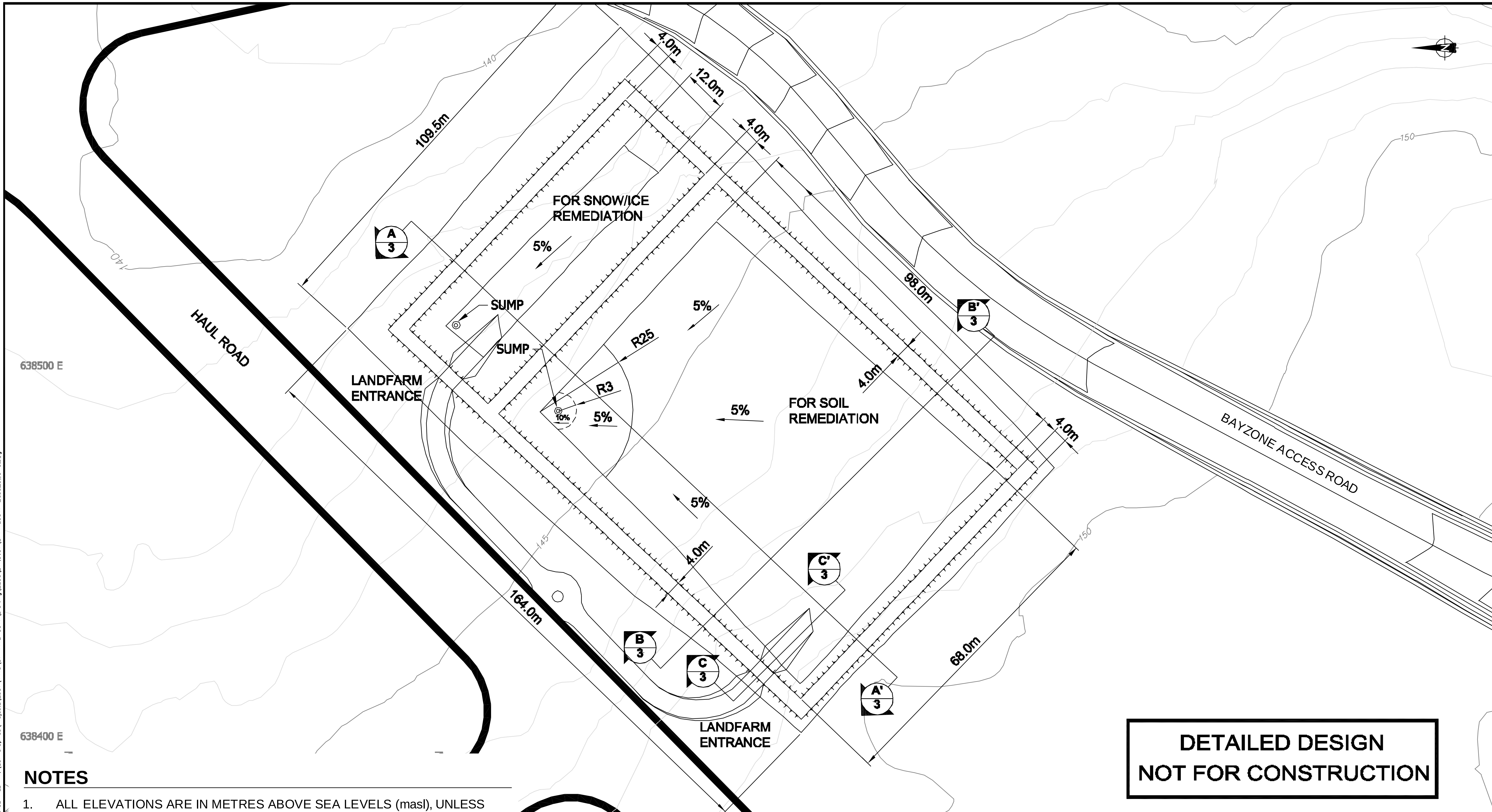

NOTES

1. ALL ELEVATIONS ARE IN METRES ABOVE SEA LEVELS (masl), UNLESS OTHERWISE NOTED.
2. GRID REFERENCE: NAD 83, UTM ZONE 14.

Scale in Metres: 0 10 20 30 40 50

DRAWING NO.	REFERENCES

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A	27NOV07	JV	DETAILED DESIGN	MJH		

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PROJECT: AGNICO-EAGLE MINES LIMITED
MEADOWBANK DIVISION

TITLE: MEADOWBANK GOLD PROJECT
LANDFARM
PLAN VIEW

Golder Associates

PROJECT No.		07-1413-0047
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CADD	EA/MJH	27NOV07
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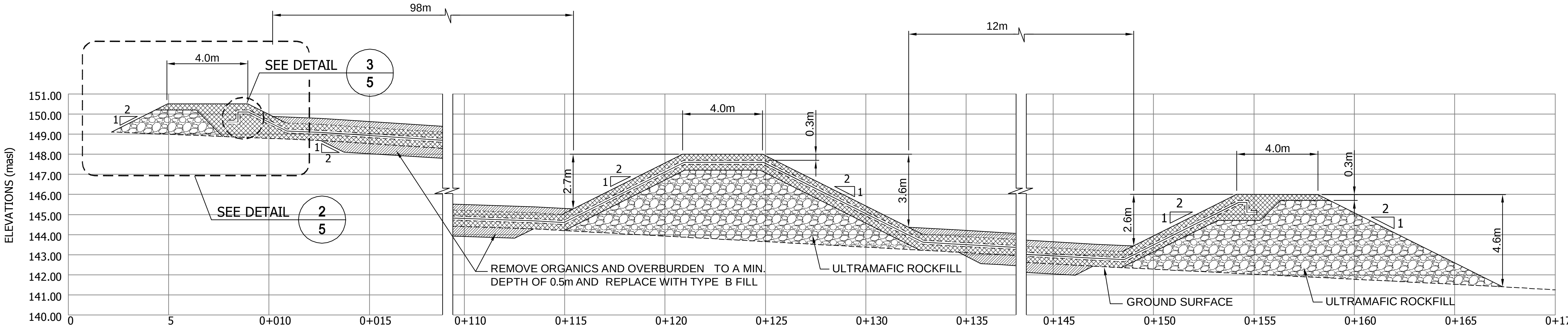

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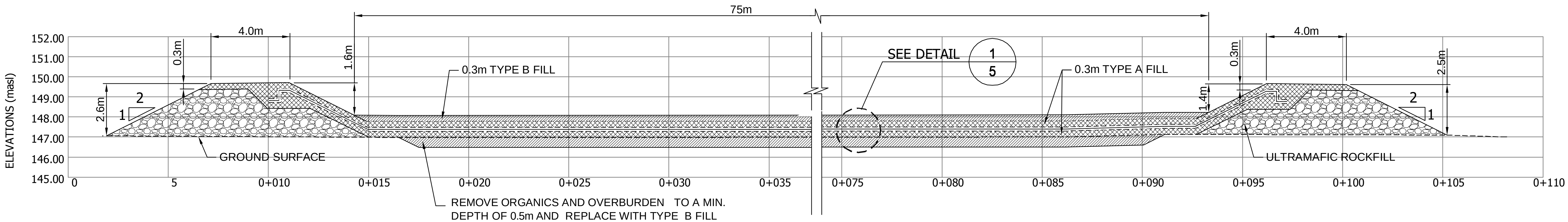

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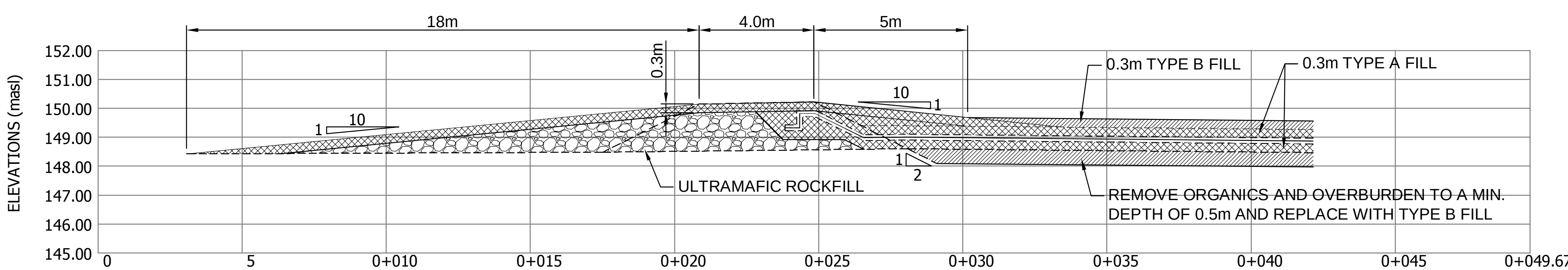

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TITLE	MEADOWBANK GOLD PROJECT LANDFARM DETAILED DESIGN SECTIONS

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Golder Associates

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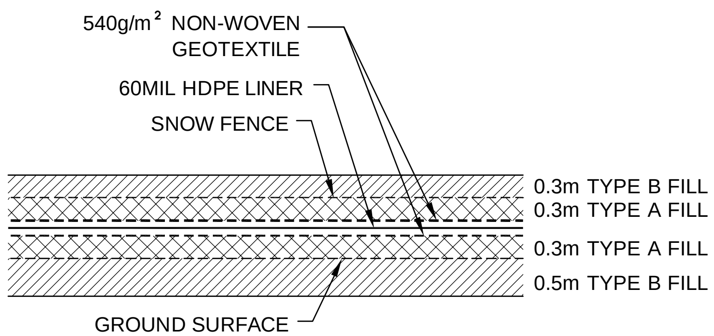

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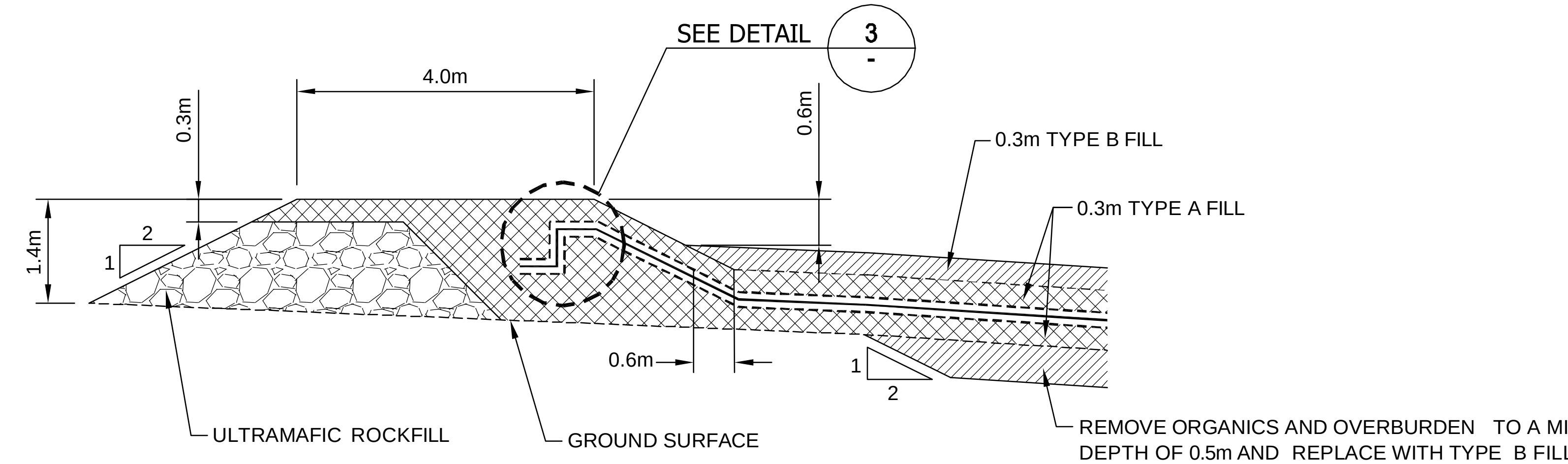

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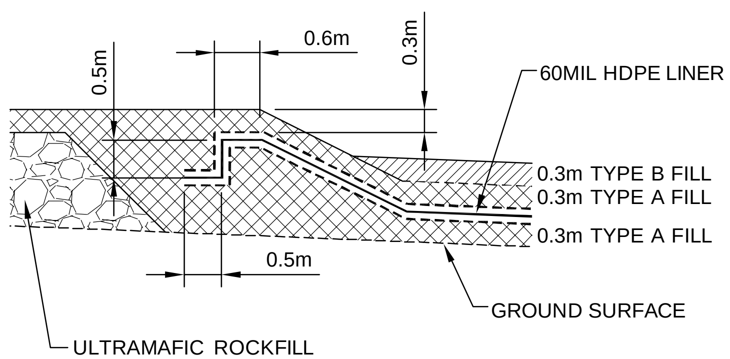

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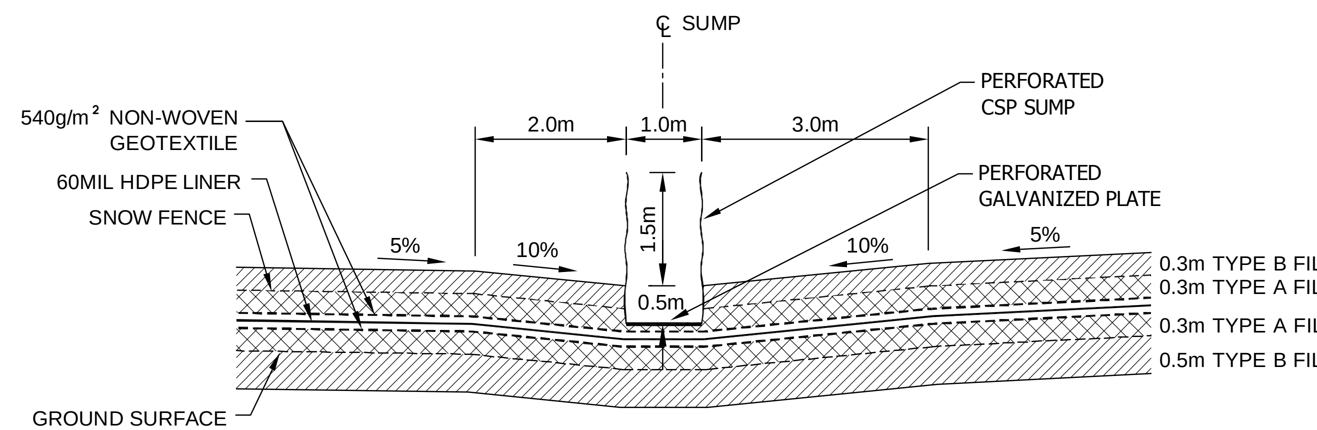

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DRAWING NO.	REFERENCES

STAMP

PROJECT
AEM AGNICO-EAGLE MINES LIMITED
MEADOWBANK DIVISION

TITLE
MEADOWBANK GOLD PROJECT
LANDFARM DETAILED DESIGN DETAILS

Golder Associates

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APPENDIX I

MATERIAL SPECIFICATIONS

Materials

Materials in general will be developed from non-acid generating and non-metal leaching quarry bedrock sources to be located on-site. In addition, the rockfill sources for this project will include run-of-mine material, blasted bedrock and quarried bedrock.

The Landfarm will be constructed with four types of materials; described in the following sections.

Where appropriate, a sieve analysis should be completed to confirm gradations prior to supply.

Type A Fill

Type A fill shall be free from undesirable quantities of soft or flaky particles, loam, organic or deleterious material. The gradation limits for Type A are shown in Table I.

Table I: Gradation Limits for Type A Fill

U.S. Standard Sieve	Metric Size, mm	% Passing
1"	25	100
1/2"	12.5	75 - 100
3/8"	9.5	60 - 90
# 4	4.75	40 - 70
# 8	2.36	27 - 55
# 20	0.850	10 - 35
# 48	0.300	5 - 20
# 200	0.075	0 - 5

Type B Fill

Type B fill shall be free from undesirable quantities of soft or flaky particles, loam, organic or deleterious material. The gradation limits for Type B are shown in Table II.

Table II: Gradation Limits for Type B Fill

U.S. Standard Sieve	Metric Size, mm	% Passing
4"	100	100
2"	50	70 - 100
1"	25	50 - 100
# 4	4.75	25 - 100
# 10	2.0	10 - 80
# 200	0.075	0 - 5

Ultramafic Rockfill

Ultramafic (UM) Rockfill shall consist of fragments of hard, durable rock, screened to remove all particles in excess of the maximum particle size and meeting the following gradation specifications presented in Table III.

Table III: Gradation Limits for UM Rockfill

Metric Size, mm	% Passing
600	100
300	85 - 100
100	60 -100
25	45 - 90
4.75	25 - 70
0.850	10 - 30
0.425	5 -20
0.180	0 - 10
0.075	0 - 5

Construction Specifications

HDPE or LLDPE Geomembrane Liner

The liner base shall be maintained in dry condition. Liner panels to be placed in maximum widths and lengths to minimize seams. Panels shall be oriented parallel to the line of maximum slope. Seams across the slope are to be avoided and approval must be obtained from the Site Engineer. Seams are not permitted in corners and base seams shall not be closer than two meters from toe of slope.

Panels shall be placed incorporating sufficient slack to allow for thermal movement. The amount of slack shall be determined by the contractor. The panels shall be placed straight with the least amount of curls or waves.

The liner panels shall be temporarily held in place with sandbags to prevent movement.

The liner edge shall be anchored as indicated on the drawings. The anchor trench shall be backfilled as indicated on the drawings and as per specifications.

A 540g/m^2 (16oz/yd^2) non-woven geotextile shall be used for the landfarm as specified on the design drawings (DWG 4 and 5).

Liner Base

The area to be lined including side slopes and dike top shall be compacted to 95% of Standard Proctor Density (ASTM D-698). Locations subject to static loading from equipment or stockpiles shall be compacted to 95% Standard Proctor Density (SPD).

The contractor shall maintain the liner base in the specified condition immediately prior to placement of the liner and any damage by surface erosion shall be filled and compacted to specifications.

Liner Anchorage

The HDPE liner, sandwiched between two layers of geotextile, shall be anchored as per supplier recommendations.

The anchor trench as shown on the drawings shall be free of sharp stones and debris. The trench shall be backfilled in lifts of 100 mm maximum and compacted to 95% of Standard Proctor Density (ASTM D-698).

Special care shall be taken when compacting backfill in trenches to ensure that the liner is not damaged.

Liner Cover

Prior to placement of the Type A fill material for the liner cover, a 540g/m^2 (16oz/yd^2) non-woven geotextile shall be placed on top of the HDPE geomembrane liner.

A minimum 300 mm thick, Type A fill cover material shall be placed over the low permeability liner system by dumping rather than blading so that no tensile shear forces are transmitted to the liner. Piles of dumped material shall be no more than 0.8 m high and should be levelled to the specified thickness using low ground pressure equipment. Equipment shall not be permitted on the liner without sufficient cover to protect it from damage. Activity on the liner and protective base course shall be kept to a minimum.

Compaction of material shall be as indicated on the drawings and accomplished utilizing low ground pressure equipment.

All granular fill materials including the rockfill should be placed in loose lifts not exceeding 0.3 m in thickness, unless otherwise noted and all granular fills should be moisture conditioned, if required, prior to compaction. Ultramafic Rockfill shall be placed in loose lifts not exceeding 600 mm thickness. Water should be added to adjust the in-situ moisture content within 2 per cent of the optimum moisture content, as determined by the Proctor density – moisture relationship. All lifts shall be uniformly compacted using a smooth drum 10 tonne vibratory roller to the following in-situ density:

- Type A Fill: Granular base shall be compacted to 95% of the Standard Proctor maximum dry density, as determined by ASTM Test Method D698-70.
- Type B Fill: Select granular sub-base shall be compacted to 95% of the Standard Proctor maximum dry density and to 100% within 0.3 m of finished sub-grade, as determined by ASTM Test Method D698-70.
- Ultramafic Rockfill: Rockfill shall be compacted by a minimum of 6 complete passes of a smooth drum 10 to 15 tonne vibratory roller, or equivalent.