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FINAL REPORT ON

LANDFILL DESIGN AND MANAGEMENT PLAN
MEADOWBANK GOLD PROJECT

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EXECUTIVE SUMMARY

This proposed Landfill Design and Management Plan (Plan) outlines the conceptual design, operation and closure for two industrial waste landfills as part of the Meadowbank Mining Corp. (MMC) Meadowbank Gold Project in Nunavut. This proposed Plan was developed in support of MMC's application for an A-Type Water Licence from the Nunavut Water Board (NWB) to operate the Meadowbank Gold Project.

The proposed landfills are required for the disposal of non-salvageable, non-hazardous solid wastes from mining activities that cannot be incinerated. They would be built on or near the Portage Rock Storage Facility located on the mine site. The camp is expected to accommodate 344 persons during operations, but to be conservative the total capacity of the proposed landfills has been assumed to be equivalent to that typically required for a community of 500 persons. An 11 year landfill life (an average of 500 m^3 of waste) has been assumed, allowing for two years of pre-mine development, eight years of mine operation and one year for closure activities.

The leachate from the proposed landfills is anticipated to be very weak (dilute) due to the controls on materials placed in the landfill, and thus specific leachate management is not considered to be required.

During operations, the slopes of the proposed landfills would be covered with rockfill, thus protecting them from erosion. Additional surface water and erosion control measures from the Mine Waste and Water Management Plan (MMC, 2007a) (*e.g.*, diversion ditches) would be incorporated into landfill design, as appropriate.

At the end of mine life, the landfill waste would be covered by 0.3 to 1 m thickness of rockfill, with an additional 2 m thickness of coarse acid-buffering ultramafic waste rock material. The final landfill slopes would be up to 50%. Drainage water would be managed under the Mine Waste and Water Management Plan (MMC, 2007a).

To meet NWB guidelines, an environmental overview effects assessment was conducted to characterize environmental resources and determine the anticipated environmental effects of the proposed landfills. The primary potential environmental effects from landfill activities included leachate generation, windblown debris and habitat (vegetation) loss. Given the effective implementation of mitigation plans, no residual environmental effects to valued ecosystem components from construction, operation or closure of the proposed landfills are anticipated.

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1.0 INTRODUCTION

1.1 Project Overview

This proposed Landfill Design and Management Plan (Plan) outlines the conceptual design, operation and closure for two solid waste landfills as part of the Meadowbank Mining Corp. (MMC) [formerly known as Cumberland Resources Ltd. (Cumberland)] Meadowbank Gold Project. The Project is an open pit gold mine located on Inuit-owned land in the Kivalliq Region of Nunavut, approximately 70 km north of Baker Lake.

The proposed landfills are required for the disposal of non-salvageable, non-hazardous industrial wastes from standard mining activities that cannot be incinerated. The proposed Plan was developed in support of MMC's application for an A-Type Water License from the Nunavut Water Board (NWB) to operate the mine.

The camp is expected to accommodate 344 persons during operations, but to be conservative the total capacity of the proposed landfills has been assumed to be the equivalent to that typically required for a community of 500 persons. An 11 year landfill life has also been assumed, allowing for two years of pre-mine development, eight years of mine operation and one year for closure activities.

Hazardous wastes would not be placed in the landfills. Management procedures for hazardous wastes are provided under a separate report – Meadowbank Gold Project Hazardous Materials Management Plan (MMC, 2007c). All other materials considered unsuitable for landfill deposition would be packaged for shipment and disposal off site at a licensed facility.

To meet NWB guidelines, an environmental overview effects assessment was conducted to characterize environmental resources and determine the anticipated environmental effects of the proposed landfills. Other applicable regulatory guidelines and criteria were also incorporated into this proposed Plan, as discussed in Section 2.0.

The overall Meadowbank Gold Project description, landfill siting options and descriptions, and corresponding environmental overview approach are described in the sections below.

1.2 Project Description

The Meadowbank Gold Project facility layout is shown in Figure 1. The mine site will include the following structures and facilities:

- Open pits;
- Dewatering Dikes;
- Tailings Storage Facility (TSF);
- Waste rock storage facilities (RSF);
- Plant site and ancillary facilities;
- Airstrip, roads and storage areas;
- Quarries and granular borrow areas, if present;
- Water management facilities;
- All-weather Private Access Road (AWPAR); and
- Industrial Waste Landfill(s).

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, 2007d).

The criteria evaluated for the siting of the proposed landfills is described in Section 1.3.

1.3 Landfill Siting

The proposed landfills were sited considering the following criteria:

- Drainage – sites that drain into areas where water will be collected and monitored as part of the overall mine plan are preferred.

- Avoid Ice Rich Soil Excavation – sites where bedrock is at relatively shallow depth are preferred.

- Disturbed Areas – sites that will be within or near areas that will be disturbed as part of the overall mine plan are preferred.

- Access – sites that are located close to existing or proposed access roads are preferred.

The first three criteria are recommendations from the Mine Site Reclamation Guidelines for the Northwest Territories (INAC, 2006).

Based on the above criteria, a landfill at each of the following two locations was proposed (Figure 2):

- Landfill #1 would be developed near the west-northwest toe of the Portage RSF; and
- Landfill #2 would be developed at the top of the Portage RSF.

While the preferred landfill location is the top of the Portage RSF (minimizing the disturbed area), such a landfill would hinder waste rock placement during mining activities. Thus Landfill #1 would be developed first and serve as the non-hazardous waste disposal site for the first nine years of the mine development. In the last two years of the mine development, Landfill #2 would serve as the non-hazardous waste disposal site.

1.4 Environmental Overview Assessment Approach

An environmental overview assessment was conducted to assess potential environmental effects resulting from the construction, operation and closure of the two proposed landfill sites identified in Section 1.3. The approach for this assessment is described below.

Background Information

Available environmental assessment information pertaining to the potential landfill sites were reviewed to characterize environmental resources and assess anticipated environmental effects. No fieldwork was undertaken specifically as part of this proposed Plan, due to the availability of the results of previous studies. Available environmental documentation included:

- Final Environmental Impact Statement (FEIS) (Cumberland, 2005a) for the Meadowbank Project;
- Supporting baseline reports;
  - Physical Ecosystem (Cumberland, 2005b);
  - Air Quality (Cumberland, 2005c);
  - Noise (Cumberland, 2005d);
  - Aquatic Ecosystem (Cumberland, 2005e);
  - Fish Habitat (Cumberland, 2005f);
  - Terrestrial Ecosystem (Cumberland, 2005g);
  - Archaeology (Cumberland, 2005h);
  - Traditional Knowledge (Cumberland, 2005i); and

- Monitoring and Management Plans;

  - Mine Waste and Water (MMC, 2007a);
  - Air Quality and Noise (Cumberland, 2005j);
  - Aquatic Effects Management Program (AEMP) (Cumberland, 2005k);
  - No-Net-Loss Plan (NNLP) (Cumberland, 2006);
  - Metal Mining Effluent Regulations (MMER) (Cumberland, 2005l);
  - Terrestrial Ecosystem Management Plan (TEMP) (Cumberland, 2005m);
  - Socioeconomic and Archaeology (Cumberland, 2005n);
  - Hazardous Materials Management (MMC, 2007c)
  - Preliminary Closure and Reclamation Plan (MMC, 2007d); and
  - Water Quality and Flow Monitoring Plan (MMC, 2007b).

Valued Ecosystem Components

To maintain consistency, the same valued ecosystem components (VECs) used for the FEIS were also evaluated for the landfill environmental overview. VECs are components of the ecosystem that were identified by stakeholders to be of greatest value or concern and included:

- Permafrost;
- Groundwater;
- Surface water;
- Water quality;
- Air quality and noise;
- Terrestrial - vegetation cover, ungulates, predatory wildlife, small mammals, raptors, waterfowl, breeding birds;
- Aquatic - fish populations and fish habitat; and
- Cultural – sites of heritage significance and traditional way of life.

The general baseline conditions for these VECs in relation to the overall Meadowbank mine Project area are described in Section 3.0.

Spatial Boundaries

The spatial boundaries for the landfill environmental overview effects assessment varied depending on the VEC as shown in Table 1.

TABLE 1: Spatial Boundaries of Landfill Environmental Overview Effects Assessment

Valued Ecosystem Component	Description of Spatial Boundary
Permafrost, Air Quality and Noise, Terrestrial, Cultural	Immediate local area – proposed landfill footprint(s) or close proximity to the footprint(s).
Groundwater	Area immediately upgradient and downgradient of the proposed landfills.
Surface Water, Water Quality, Aquatic	Water bodies in the vicinity of proposed landfills (Second Portage and Third Portage lakes).

Effects Classification

A landfill is an environmental protection structure (a structure with measures to mitigate environmental impacts) and thus environmental protection measures are incorporated as part of the proposed landfill design. In the context of this report, "effect" refers to environmental changes that result from landfill construction, operation and closure, assuming that the proposed landfill design description is implemented.

The potential for the proposed landfills to cause effects on VECs was analyzed based on:

- background information provided by MMC;
- a review of proposed landfill related activities;
- temporal and/or spatial conflict; and
- professional judgment.

Measures to mitigate any identified potential adverse effects were then recommended. Significance of residual effects, or the effects remaining after the proposed landfill design and/or additional mitigation measures are implemented, were determined and rated as follows:

- N/A = residual effect not applicable;
- None = no potential effect to VEC during proposed landfill activities.
- Insignificant = no detrimental effect to VEC during proposed landfill activities after implementation of additional mitigation measures.
- Significant = effect of proposed landfill activities could threaten sustainability of VEC, even after the application of additional mitigation measures. Further study or follow-up program should be considered.

2.0 REGULATORY SETTING

Waste management in Nunavut is regulated under the *Nunavut Public Health Act*, the *Nunavut Environmental Protection Act* and the federal *Environmental Protection Act*. In addition to mandatory requirements, a number of waste management guidelines are commonly used in the NWT and Nunavut. The most recent of these was developed for municipal solid waste, and is titled "Guidelines for the Planning, Design, Operations and Maintenance of Modified Solid Waste Sites in the NWT" (Ferguson Simek Clark, April 2003, on behalf of the Department of Municipal and Community Affairs, Government of Northwest Territories). While not all of the recommendations provided in this guideline are appropriate for the management of industrial waste such as those generated at a gold mine, those principals that are considered applicable have been adopted in the proposed Plan.

In addition, the NWB guidelines *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2006) were followed in this current document regarding specific landfill design and mitigation for impacts pertaining to waste. The recommendations from *Implications of Global Warming and the Precautionary Principle in Northern Mine Design and Closure* (BGC 2003) were also incorporated into this document, where appropriate.

3.0 BASELINE CONDITIONS

Baseline data collection for the Meadowbank Gold Project started in 1996 and continued through to 2005. Data collection methods and results are summarized in a series of baseline reports that are included as supporting documents in the FEIS (Cumberland, 2005a).

General baseline information for the mine facility that relate to the proposed landfills are summarized in the following sections.

3.1 Physical Environment

Landforms and Soil – Landforms in the Meadowbank Project area are dominated by hummocky boulder glacial till plains and scattered boulder till moraines with bedrock outcrops in isolated exposures, elevated plateaus, and elongated ridges. The dominant soil is locally derived glacial till with an average thickness of 2.75 m (up to 10 m deposits in localized areas).

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 streams connecting Third Portage and Second Portage lakes.

Groundwater - There are two groundwater regimes in the Meadowbank Project area: a deep regime beneath the permafrost that is connected to taliks beneath Second Portage and Third Portage lakes, and a shallow regime in the active permafrost layer below the ground surface. The active layer thaws from late spring to late summer, when temperatures are above 0°C. Groundwater in the active layer flows to local depressions and ponds or directly to Second Portage and Third Portage lakes.

Surface Water - Lakes in the Project area (*e.g.*, Second Portage, Third Portage and Wally lakes) are connected by short, small to medium width channels. Snowmelt runoff in the region begins from late May to mid-June. Third Portage Lake drains to Second Portage Lake from three stream channels that flow across a narrow strip of land.

Water Quality - Lakes in the Project Area have good water quality and clarity. Total metal concentrations including antimony, arsenic, chromium, copper, mercury and nickel are all below laboratory detection limits and well below CCME (2001) water quality guidelines for the protection of aquatic life. Besides common salts (sodium, magnesium) the only metals to exceed detection limits in these lakes are aluminum, lead, and zinc.

Air Quality – Air quality in the area is low in particulates and concentrations of pollutants. The average annual wind speed is 10 km/hr and winds tend to be most frequently from the northwest.

3.2 Biological Environment

Vegetation Cover - No rare or regionally unique vascular plants or plant communities have been found within the Meadowbank Project area. The dominant vegetation communities found in the area of the Portage RSF (*i.e.*, landfill areas) are heath tundra, birch seep and riparian shrub.

The heath tundra community is found in upland areas, and is the most common community on the mine site. Heath tundra is dominated by low growing plants (bog blueberry, lingonberry, white arctic heather, Labrador tea, bearberry and crowberry). The birch seep community is found in seepage areas and the base of slopes, and consists of dwarf birch with an under story of low growing plants such as lingonberry, bog blueberry, white arctic heather. The riparian shrub community is dominated by dwarf birch and is found in the defined drainages between lakes, typically on boulder substrate.

Ungulates - The Meadowbank Project area does not appear to represent critical caribou habitat during the spring migration, calving or summer-post calving. Barren-ground caribou and muskoxen have been observed near the mine site.

Predatory Wildlife- Grizzly bear, wolverine and wolf have been observed in the vicinity of the Project area.

Small Mammals - Arctic hare, Arctic ground squirrel, collared lemming and northern red-backed vole are relatively common small mammals observed in the Project area.

Raptors – Nesting habitat for raptors in the vicinity of the Meadowbank Project area is considered to be low due to the absence of preferred nesting areas (*i.e.*, cliffs). However, there is good foraging habitat because the large areas of health tundra combined with grassy meadows, bare rocky areas, patches of low shrub, and shallow and deep water habitats, which support prey such as Arctic hares, rodents, passerines, ptarmigan, shorebirds and waterfowl.

Waterfowl - During baseline surveys, 13 waterfowl species were recorded in the vicinity of the Project area. Canada geese were the most common species recorded.

Breeding Birds - Fourteen other bird species breed in the Project area. The most common species are Lapland longspur, horned lark, savannah sparrow and rock ptarmigan. Relatively few shorebirds were recorded in the Meadowbank area during baseline surveys. The most common shorebird species was the semipalmated sandpiper, which was recorded in several extensive sedge meadows, often adjacent to small lakes and ponds.

Fish Populations and Fish Habitat - Lake trout and round whitefish dominate abundance in the lakes within the Project area. Other fish species include Arctic char, ninespine stickleback, slimy sculpin and burbot.

3.3 Cultural Environment

Sites of Heritage Significance – Project design was adjusted so that planned site infrastructure is located away from identified/known heritage resources sites.

Traditional Ways of Life – According to traditional knowledge there has been a lack of human activity in the Meadowbank area. Presently the area is not used by trappers, outfitters, tourist operators, or any other commercial organizations.

4.0 PLAN FOR THE ON-SITE DISPOSAL OF SOLID WASTE

4.1 Approach

The strategy for the disposal of solid waste was to first identify and segregate acceptable disposal items from non-acceptable items. Acceptable items that could be disposed at an on-site facility are those that are non-hazardous, non-putrescible, with a low leachate and heat generation potential. All other materials would either be incinerated or hauled offsite. This strategy for limiting the materials that could be placed in the landfills greatly reduces the concentration of constituents in the leachate.

The second part of the strategy was to concentrate disposal of solid waste at two landfills, Landfill #1 and Landfill #2. Landfill #1 would be located at the proposed west-northwest toe of the Portage RSF and would serve the mine for the first nine years. Landfill #2 would be located near the top of the Portage RSF and would serve the mine for the last two years of the mine operation. Demolition waste from the plant site removal / reclamation would be disposed of in Landfill #2.

The development of two landfills would minimize the area disturbed and the re-handling of waste. Landfills at the selected locations would allow any leachate that may be generated to be collected with seepage and runoff water from the Portage RSF. The leachate from the proposed landfills is anticipated to be very weak due to the controls on materials placed in the landfill and thus site specific landfill leachate management is not considered to be required.

During the first year of mine operations, three samples of incinerator ash should be tested to confirm that it is a non-hazardous waste and to determine sodium chloride (salt) content. Samples would be taken on three different days. Although the quantity of ash that is landfilled would be relatively small, the ash may contain high amounts of salt that could lower the freezing point of water. However, if the ash is spread over an area in the landfill, this freezing point depression effect would be lessened. In addition, the other waste materials would provide cover for the waste thus reducing the potential for wind blown ash.

Based on the above strategy, a liner is not considered to be required for the proposed landfills, nor is any special monitoring recommended. However, the proposed landfills should conform with the operations and closure plan for each landfill site for orderly landfill development and to reduce the potential for wind blown debris.

4.2 Acceptable Waste for Landfilling

The following materials would be acceptable for disposal at the proposed landfills:

- Plastic (except expanded polystyrene);
- Steel, copper, aluminum, iron;
- White goods;
- Wire;
- Incidental pieces of wood (wood that cannot be separated and burned);
- Fiberglass insulation;
- Fiberglass;
- Roofing;
- Asphalt;
- Concrete;
- Carpet;
- Bricks;
- Ceramics;
- Rubber including shredded tires (excluding whole tires) provided it is not concentrated in the overall waste;
- Empty caulking tubes;
- Hardened caulk;
- Clothing;
- Glass including light bulbs;
- Asbestos;
- Small appliances (with batteries removed);
- Gyproc;
- Ash provided it has cooled to 60ºC or less; and
- Vehicles and machinery provided all liquids, grease, batteries, and electronics have been removed.

4.3 Unacceptable Waste for Landfilling

Materials that are not listed above would be unacceptable for placement at the proposed landfills, unless approved in writing by a solid waste engineer. These materials include:

- Organic matter including food, septic tank pumpings or sludge from waste water treatment, dead animals, paper, cardboard;
- Food containers and wrappings, unless cleaned;
- Wood, unless it is not practical to separate from other larger materials;
- Whole tires;

- Hazardous waste including mercury, medical waste, batteries, solvents, glues, ethylene glycol antifreeze, adhesives (except empty caulking tubes);
- Electronics;
- Petroleum products, including materials contaminated with petroleum products; and
- Expanded polystyrene.

4.4 Total Volume of Waste

For the proposed conservative population of 500 persons, it has been assumed that each person will produce 1 tonne of refuse per year, and that 50% by weight of that refuse can be incinerated (*i.e.*, not landfilled except for the ash). Thus 250 tonnes of solid waste would need to be landfilled each year. If it is further assumed that the density of this solid waste is 0.5 tonnes/m^3, then 500 m^3 of waste would need to be landfilled per year for the 11 year life of the mine (including construction and closure).

The quantity of ash from the incinerator is estimated to be 75 tonnes/yr, assuming incineration results in a 70% reduction in mass. Assuming the ash has a total density of 1.2 tonnes/ m^3, then about 63 m^3/yr of ash needs to be disposed. It is assumed that this quantity is part of the 500 m^3 of waste that would need to be landfilled each year.

5.0 PROPOSED LANDFILL LOCATION AND CONSTRUCTION

5.1 Landfill #1

The proposed location of Landfill #1 is shown on Figure 2. It is anticipated that this landfill would serve as the solid waste disposal facility for the first 9 years of mine life. Thus a conservative capacity allowance of 5,000 m^3 should provide sufficient capacity for this period. If the waste is placed in one 2.5 m thick lift, then the required waste storage area is about 2,000 m^2.

The area to receive waste would be bounded on the northwest and southeast sides by a rockfill berm (Figure 3). The purpose of the rockfill berm is to act as a wind shield for the waste. The proposed landfill would be a rectangular shape with the length perpendicular to the prevailing wind direction so that much of the waste could be protected from wind by the rockfill berm. The northwest berm would be 3 m above the final top of waste (or a total of 5.5 m high above existing ground surface). The southeast berm would be lower, 2 m above the final top of waste (or a total of 4.5 m high above existing ground surface), due to the typically lower wind speeds from this direction. Also for wind protection, the width of the waste surface would be limited to less than 10 times the height of the berm relative to the top of the waste.

Provided the materials that go into the incinerator are controlled to exclude all hazardous materials (*i.e.*, even small quantities of hazardous waste such as batteries are not disposed in the landfill), then the incinerator ash should be non-hazardous. As discussed in Section 4.1, during the first year of operations three samples of the incinerator ash should be tested to confirm that it is not hazardous waste.

5.2 Landfill #2

The proposed Landfill #2 would fill a 4 m deep depression in the top of waste rock pile at the Portage RSF. The depression would be constructed by the waste rock trucks discharging their loads in a controlled manner such that the dimensions of the depression would be approximately as shown on Figure 4. The area to receive waste would be bounded on the northwest side by a 2 m high rockfill berm. The rockfill berm would act as a wind shield to reduce the amount of wind-blown debris, while providing material for intermediate cover of the landfill.

Waste would be placed to a maximum thickness of 4 m, after which it would be covered with a minimum of 0.3 m thickness of rock fill. This proposed landfill should be provided with a capacity of 3,600 m^3, which is equivalent to 7 years of waste disposal at 500 m^3/year, plus an allowance for waste from the demolition of the mine plant site. Thus, the base area of the depression is anticipated to measure about 30 m by 30 m.

6.0 LANDFILL OPERATION

6.1 Conceptual Operations Plan

The following is a conceptual plan for operating the proposed landfills:

a) Materials Acceptable for Disposal

See Section 4.2. During the first year of operation of the incinerator, three samples of the ash (obtained on different days) would be tested to confirm that it is not hazardous waste and to determine sodium chloride content.

b) Materials Not Acceptable for Disposal

See Section 4.3.

c) Waste disposal rate

The proposed landfill capacity assumes an average of 500 m^3 of waste would be landfilled per year for the 11 year life of the mine (including construction and closure).

d) Site Development and Landfilling Method

The proposed site for Landfill #1 would be prepared by first excavating soil down to bedrock or to 2.1 m depth, whichever is less. The excavation would then be filled with gravel. This would provide a suitable working surface for the proposed landfill for all seasons. The first half of the two side temporary rockfill berms would then be constructed to a mid-point of the proposed landfill, so that waste placement could commence. The rockfill berms would be extended in length as necessary to accommodate the actual solid waste disposal needs.

The proposed landfills will be filled progressively in an orderly manner. Specifically, waste would be placed at one end of the landfill at full height and then the active waste area would progressively advance. Areas where the waste has been placed to full height and levelled would be progressively covered by placement of a minimum 0.3 m thickness of rock fill on top of the waste. Ash would be placed on the northwest half of Landfill #2 or close to the 5.5 m high temporary berm of Landfill #1, for wind protection. The ash would be spread by a rubber tired machine and then covered with other waste.

e) Staffing and Equipment

The proposed landfills would not require a full-time attendant. Trucks would haul waste to the landfills and a rubber tired machine would be used to spread and level the waste.

f) Leachate Management

The leachate from the proposed landfills is anticipated to be very weak (dilute) due to the controls on materials placed in the proposed landfills. Therefore, specific leachate management is not considered to be required (see Section 4.1).

g) Surface Water and Erosion Control

The slopes of the proposed landfills would be covered with rockfill, thus protecting them from erosion. Additional surface water and erosion control measures from the Mine Waste and Water Management Plan (MMC, 2007a) (*e.g.*, diversion ditches) would be incorporated into the landfill design, as appropriate.

h) Operational Inspections

The Meadowbank General Mine Manager would designate a Landfill Inspector to undertake periodic inspections of the Landfill operations to verify compliance with the permit and operations and closure plan, including the condition of landfill works, evidence of erosion, excessive ponding or unusual landfill settlement, and adequacy of safety measures.

6.2 Conceptual Closure Plan

The following is a conceptual plan for closing the proposed landfills:

a) Estimate of Total Waste Volumes, Tonnage and Life of Landfills

Upon closure, it is estimated that the proposed landfills would have the volumes as described in Sections 5.1 and 5.2. .

b) Final Cover Design

- The waste of the proposed landfills would be covered by 0.3 to 1 m thickness of rockfill, covered with an additional 2 m thickness of coarse acid-buffering ultramafic waste rock material;
- The final landfill slopes would be up to 50%; and
- Drainage water would be routed to the Portage RSF drainage system.

c) End use of Landfill After Closure

There would be no planned end use of the landfills post-closure.

d) Water Management

Contact water from the proposed landfills in closure would continue to be managed under the Mine Waste and Water Management Plan (MMC, 2007a).

7.0 POTENTIAL ENVIRONMENTAL EFFECTS

The proposed landfills would be designed and built as part of the Portage RSF. The access road to the north side of the Central Dike would be used to access Landfill #1. Alternatively, an access road to the north side of the Portage RSF may be constructed. Access to Landfill #2 would be by the access road to the Portage RSF.

Landfill activities that were identified to have potential effects on VECs include site preparation and construction, operations and closure.

Potential effects from the proposed landfills on VECs were assessed as follows:

- Degradation of permafrost;
- Change in surface water and groundwater drainage patterns due to proposed landfill footprint (altered landscape);
- Change in groundwater and surface water quality from leachate percolation, leading to degradation of aquatic habitat;
- Change in air quality from dust and windblown debris;
- Loss of vegetation cover and terrestrial mammal habitat due to proposed landfill footprint;
- Attraction of predatory and small mammals to waste; and
- Loss of sites of heritage significance or traditional ways of life.

A number of mitigative measures, including management and monitoring plans, will be implemented as part of the overall Meadowbank Gold Project and would also be incorporated into landfill construction, operations and closure. The plans that set out detailed site-specific protection measures and procedures that serve to protect the VECs include:

- Mine Waste and Water Management (MMC, 2007a);
- Air Quality and Noise Management (Cumberland, 2005i);
- Terrestrial Ecosystem Management (TEMP) (Cumberland, 2005m);
- Hazardous Materials Management (MMC, 2007c);
- Preliminary Closure and Reclamation Plan (MMC, 2007d); and
- Water Quality and Flow Monitoring Plan (MMC, 2007b).

A summary of the environmental overview effects assessment, including mitigation measures and potential for residual effects is provided in Table 2.

TABLE 2: Environmental Overview Effects Assessment Summary

Valued Ecosystem Component	Description of Potential Project Effect	Mitigation of Effect	Residual Effect
Permafrost	Permafrost Degradation The construction, operations and closure of the proposed landfills may disturb permafrost.	The proposed landfills would be designed and built as part of the Portage RSF to minimize ground disturbance and permafrost degradation, as per the Pre-mining Planning Option objectives outlined in the Mine Site Reclamation Guidelines for the Northwest Territories (INAC, 2006).	None
Surface Water and Groundwater Quantity and Distribution	Change in Drainage Pattern The construction, operations and closure of the proposed landfills may alter surface water and groundwater drainage patterns.	The proposed landfills would be designed and built as part of the Portage RSF. Construction control measures are available for existing facilities to limit impacts to groundwater. During operations and closure, drainage water from the proposed landfills would be directed toward the Portage RSF drainage system. Additional surface water and erosion control measures from the Mine Waste and Water Management Plan (MMC, 2007a) (*e.g.*, diversion ditches) would be incorporated into landfill design, as appropriate.	None

Valued Ecosystem Component	Description of Potential Project Effect	Mitigation of Effect	Residual Effect
Water Quality	Change in Water Quality Leachate generation from landfill waste during operations and closure may have an effect on water quality in the nearby water bodies.	Waste that can result in high toxicity leachate will be incinerated or hauled offsite, and would not be landfilled (see also Hazardous Materials Management Plan (MMC, 2007c)). During the first year of operations, incinerator ash that is landfilled would be tested to confirm that it is not hazardous waste. The leachate from the proposed landfills is anticipated to be very low strength (dilute) due to controls on materials to be placed in the landfills. Contact water from the landfills would be managed under the Water Quality and Flow Monitoring Plan (MMC, 2007b). At the end of mine life, the landfills would be capped with acid buffering ultramafic rock, as part of the mitigation strategy for the Portage RSF.	None
Air Quality	Change in Air Quality (Emissions and Dust) Emissions, dust and windblown debris from landfill operations may affect air quality.	Air quality including emissions and dust control protocols would be managed and monitored as part of the Air Quality & Noise Management Plan (Cumberland, 2005j). Emissions and dust deposition are anticipated to be low due to the small quantity of waste and the covering of ash by other waste. A rockfill berm would be constructed to act as a wind shield to reduce amount of windblown debris.	None

Valued Ecosystem Component	Description of Potential Project Effect	Mitigation of Effect	Residual Effect
Vegetation Cover	Vegetation Loss Landfill construction and operation will reduce vegetation.	The proposed landfills would be designed and built as part of Portage RSF; therefore there would be no additional effects to vegetation cover. Detailed mitigation measures for vegetation are provided in the Terrestrial Ecosystem Management Plan (TEMP) (Cumberland, 2005m), Air Quality & Noise Management Plan (Cumberland, 2005j) and Preliminary Closure and Reclamation Plan (MMC, 2007d). Where appropriate, these mitigation measures would be incorporated into landfill closure. These measures include, but are not limited to: facilitating progressive reclamation and natural revegetation by scarifying and/or recontouring surfaces, stabilizing slopes, restoring natural drainage patterns.	None
Predatory Mammals	Attraction to Landfills Food and camp wastes attract scavengers during landfill operations including grizzly bear, Arctic fox and wolverine. Mortality of animals may occur if they are a threat to human safety.	Putrescible waste will be incinerated and would not be landfilled and thus there should be no food attraction for animals.	None

Valued Ecosystem Component	Description of Potential Project Effect	Mitigation of Effect	Residual Effect
Small Mammals	Attraction to Landfills and Habitat Loss Landfill construction and operation will reduce vegetation cover and habitat for small mammals. Food and camp wastes attract scavengers during landfill operations.	Putrescible waste will be incinerated and would not be landfilled and thus there should be no food attraction for animals. During operations and closure, an attempt will be made to create habitat for microtine rodents on the slopes of the Portage RSF, whenever possible (see TEMP (Cumberland, 2005m)).	None
Raptors	Nesting and Foraging Habitat Loss Construction and operation of the porposed landfills will reduce vegetation cover and habitat for raptor prey (small mammals).	Based on survey information to date, raptor nesting sites will not be impacted by mine construction activities (see FEIS (Cumberland, 2005a) and Baseline Terrestrial Ecosystem Report (Cumberland, 2005g)). The landfills would be designed and built as part of the Portage RSF; therefore there would be no additional effects to vegetation cover. Progressive reclamation of the proposed landfills would restore small mammal habitat after mine closure (see TEMP (Cumberland, 2005m) and Preliminary Closure and Reclamation Plan (MMC, 2007d)).	None

Valued Ecosystem Component	Description of Potential Project Effect	Mitigation of Effect	Residual Effect
Waterfowl	Terrestrial and Aquatic Habitat Loss Construction of the proposed landfills will cause loss and disturbance of terrestrial and habitats (*i.e.*, roosting, foraging and nesting).	The proposed landfills would be designed and built as part of the Portage RSF; therefore there would be no additional effects to aquatic and terrestrial waterfowl habitats. Progressive reclamation of the proposed landfills would restore roosting, foraging and nesting habitat for terrestrial and aquatic waterfowl after mine closure (see TEMP (Cumberland, 2005m) and Preliminary Closure and Reclamation Plan (MMC, 2007d)).	None
Other Breeding Birds	Roosting, Foraging and Nesting Habitat Loss Construction and operation of the proposed landfills will reduce vegetation cover resulting in loss of nesting sites.	The proposed landfills would be designed and built as part of the Portage RSF; therefore there would be no additional effects to vegetation cover (breeding bird habitat). Progressive reclamation of the proposed landfills would restore small breeding bird habitat after mine closure (see TEMP (Cumberland, 2005m) and Preliminary Closure and Reclamation Plan (MMC, 2007d)).	None
Ungulates (caribou and muskoxen)	Habitat Loss (foraging)	The proposed landfills would be designed and built as part of the Portage RSF; therefore there would be no additional effects to vegetation loss (ungulate foraging habitat). Progressive reclamation of the proposed landfills would restore foraging habitat for ungulates after mine closure (see TEMP (Cumberland, 2005m) and Preliminary Closure and Reclamation Plan (MMC, 2007d)).	None

Valued Ecosystem Component	Description of Potential Project Effect	Mitigation of Effect	Residual Effect
Fish Habitat and Fish Populations	Aquatic Habitat Degradation Leachate generation from landfill waste during operations and closure may have an effect on water quality in the nearby water bodies.	Waste that can result in high toxicity leachate will be incinerated or hauled offsite and would not be landfilled (see also Hazardous Materials Management Plan (MMC, 2007c)). During the first year of operations, incinerator ash that is landfilled would be tested to confirm that it is not hazardous waste. The leachate from the proposed landfills is anticipated to be very low strength (dilute) due to controls on materials to be placed in the landfills. Contact water from the proposed landfills would be managed under the Water Quality and Flow Monitoring Plan (MMC, 2007b). At the end of mine life, the proposed landfills would be capped with acid buffering ultramafic rock, as part of the mitigation strategy for the Portage RSF.	None
Sites of Heritage Significance	Loss to Heritage Sites	Project design was adjusted to the extent practicable to ensure that identified/known heritage resources sites are away from planned infrastructure (Cumberland, 2005n).	N/A
Traditional Way of Life	Loss to Traditional Way of Life	According to traditional knowledge, there has been a lack of human activity in the Meadowbank area (Cumberland, 2005i).	N/A

7.1 Effects Summary

The primary potential environmental effects from landfill activities included leachate generation, windblown debris and habitat (vegetation) loss. Given the effective implementation of mitigation plans, no residual environmental effects to VECs from construction, operation or closure of the proposed landfills are anticipated. See summary below:

- The leachate that would be generated by the proposed landfills is anticipated to be of very low strength (dilute) due to restrictions on the materials that would be placed in the landfills. Water drainage from the landfill area would be directed to the Portage RSF drainage collection system and would be managed under the Water Quality and Flow Monitoring Plan (MMC, 2007b) during operations and closure.

- A rockfill berm would be constructed to act as a wind shield to reduce amount of windblown debris.

- Habitat loss would be minimized because the proposed landfills would be designed and built within the footprint of the Portage RSF. With the implementation of terrestrial habitat reclamation strategies, the final surfaces of the proposed landfills would be graded to blend into the existing topography and enhance conditions for wildlife. Terrestrial habitat reclamation strategies will be incorporated as part of the Preliminary Closure and Reclamation Plan (MMC, 2007d), which include encouraging the regrowth of natural vegetation or revegetation to enhance re-establishment of vegetation communities, where warranted.

8.0 PLAN REVIEW AND CONTINUAL IMPROVEMENT

The proposed Landfill Design and Management Plan would be reviewed annually by the Meadowbank General Mine Manager in consultation with the Landfill Inspector, and updated every two years of operation. Improvements suggested through these reviews would 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.

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TD/CW/JAH/drw/cm/lw
O:\Final\2006\1413\06-1413-081\Correspondence\Word Docs\458 0827_07 RPT-Ver 0 Landfill Design and Management Plan.doc

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Cumberland Resources Ltd., 2005a. Meadowbank Gold Project Final Environmental Impact Statement. Final Report October 2005.

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Cumberland Resources Ltd., 2005c. Meadowbank Gold Project Air Quality Impact Assessment. Meadowbank EIS Support Document. Final Report October 2005.

Cumberland Resources Ltd., 2005d. Meadowbank Gold Project Noise Impact Assessment. Meadowbank EIS Support Document. Final Report October 2005.

Cumberland Resources Ltd., 2005e. Meadowbank Gold Project Baseline Aquatic Ecosystem Report. Meadowbank EIS Support Document. Final Report October 2005.

Cumberland Resources Ltd., 2005f. Meadowbank Gold Project Baseline Fish Habitat. Meadowbank EIS Support Document. Final Report October 2005.

Cumberland Resources Ltd., 2005g. Meadowbank Gold Project Baseline Terrestrial Ecosystem. Meadowbank EIS Support Document. Final Report October 2005.

Cumberland Resources Ltd., 2005h. Meadowbank Gold Project Baseline Archaeology Report. Meadowbank EIS Support Document. Final Report October 2005.

Cumberland Resources Ltd., 2005i. Meadowbank Gold Project Baseline Traditional Knowledge Report. Meadowbank EIS Support Document. Final Report October 2005.

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MMC (Meadowbank Mining Corporation), 2007a. Meadowbank Mine Waste and Water Management. Final Report August 2007.

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

MMC (Meadowbank Mining Corporation), 2007c. Meadowbank Gold Project Hazardous Materials Management Plan. Final Report August 2007.

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

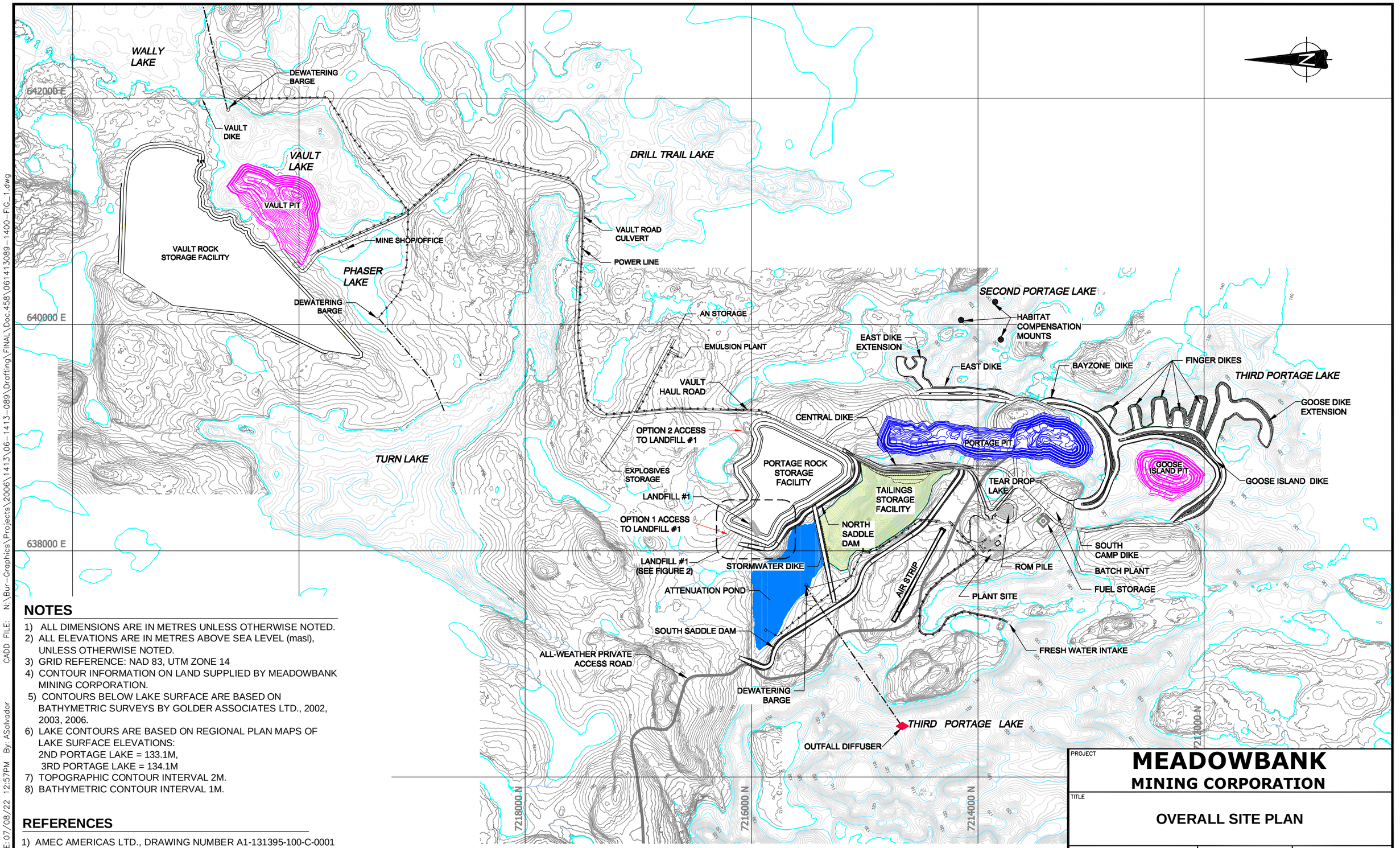
Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater 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.

REFERENCES

1) AMEC AMERICAS LTD., DRAWING NUMBER A1-131395-100-C-0001 (100-C-0001.DWG), MEADOWBANK FEASIBILITY STUDY, APRIL 2005.

NOT FOR CONSTRUCTION

0 300 600 900 1200 1500
Scale in Metres

PROJECT
MEADOWBANK
MINING CORPORATION

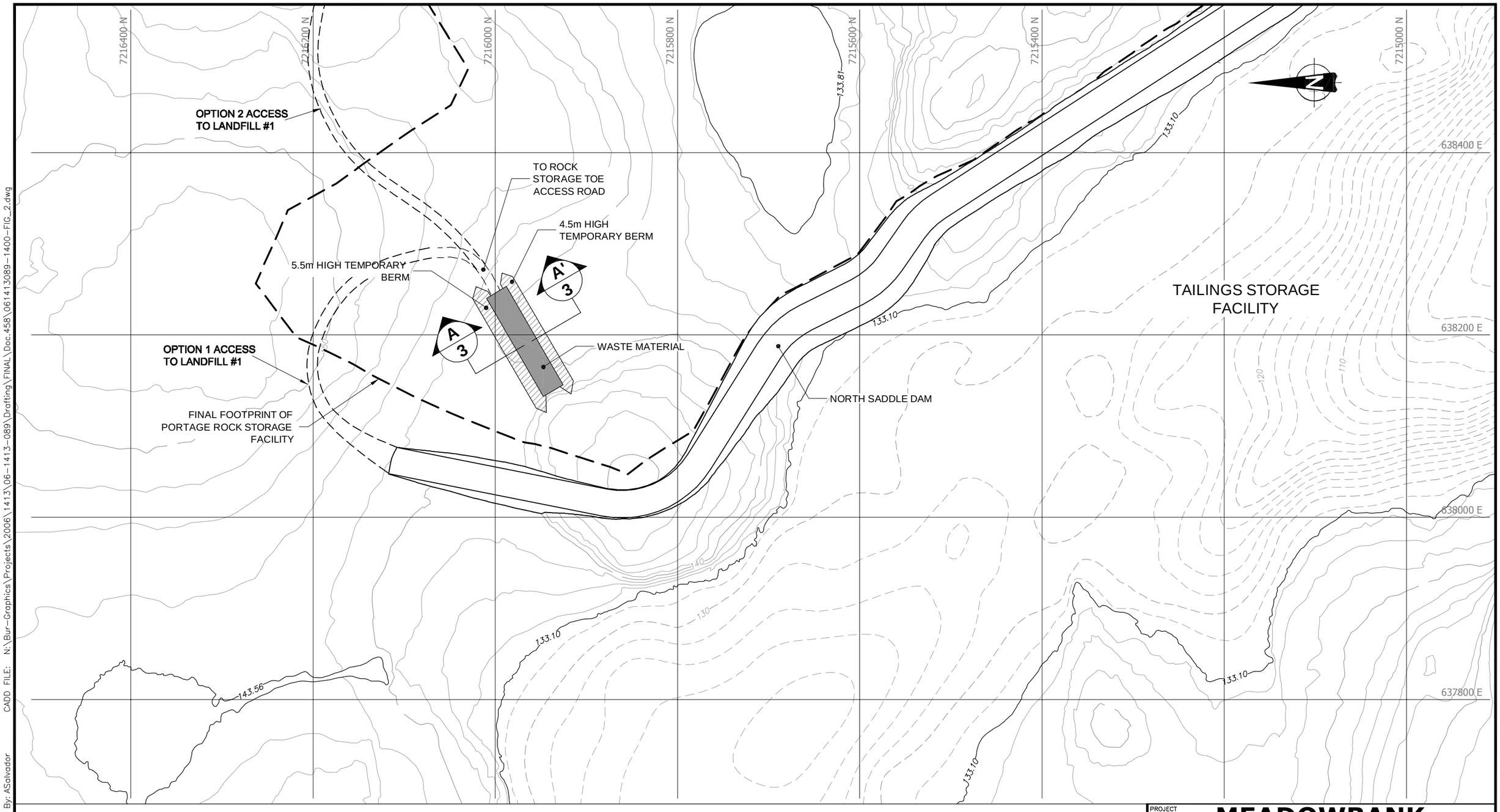
TITLE
OVERALL SITE PLAN

Golder Associates

PROJECT No. 06-1413-089			FILE No. 061413089-1400-FIG_1		
DESIGN	BW	15AUG07	SCALE AS SHOWN	REV.	–
CADD	AS	15AUG07			
CHECK					
REVIEW					

FIGURE 1

REVISION DATE: 07/08/22 12:57PM By: ASalvador CADD FILE: N:\Bur-Graphics\Projects\2006\1413\06-1413-089\Drafting\FINAL\Doc.458\061413089-1400-FIG_1.dwg



LEGEND

- LAND-BASED MAJOR CONTOUR (120)
- LAND-BASED MINOR CONTOUR
- BATHYMETRY MAJOR CONTOUR (120)
- BATHYMETRY MINOR CONTOUR

0 40 80 120 160 200

Scale in Metres

NOT FOR CONSTRUCTION

PROJECT

MEADOWBANK
MINING CORPORATION

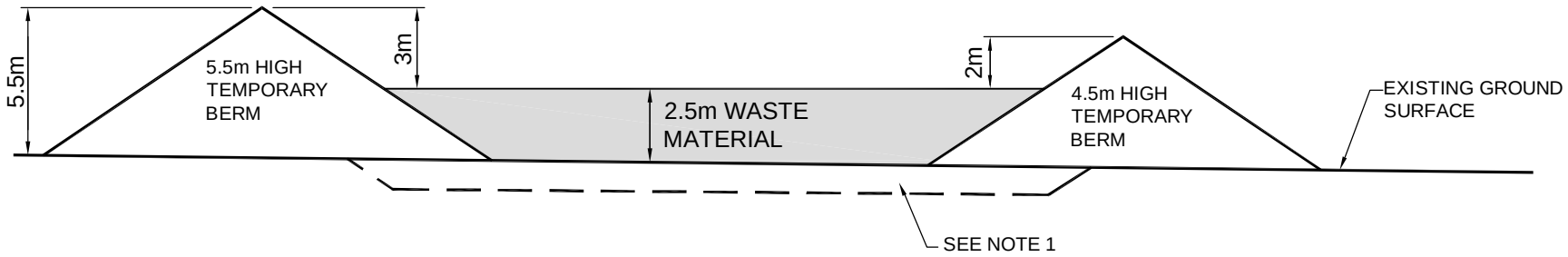
TITLE

CONCEPTUAL LANDFILL #1 LOCATION PLAN

Golder Associates

PROJECT No. 06-1413-089			FILE No.061413089-1400-FIG_2	
DESIGN	JH	05APR07	SCALE AS SHOWN	REV. -
CADD	AS/EA	15AUG07	FIGURE 2	
CHECK				
REVIEW				

REVISION DATE: 07/08/22 03:25PM By: ASalvador CADD FILE: N:\Bur-Graphics\Projects\2006\1413\06-1413-089\Drafting\FINAL\Doc.458\061413089-1400-FIG_2.dwg



SECTION A-A'

0 2 4 6 8 10

Approximate Scale in Metres

NOT FOR CONSTRUCTION

NOTES

1) EXCAVATION SOIL TO BEDROCK OR 2.1m DEPTH, WHICHEVER IS LESS AND REPLACE WITH GRAVEL.
2) TEMPORARY BERM MATERIAL SHALL BE ROCKFILL.

PROJECT

MEADOWBANK
MINING CORPORATION

TITLE

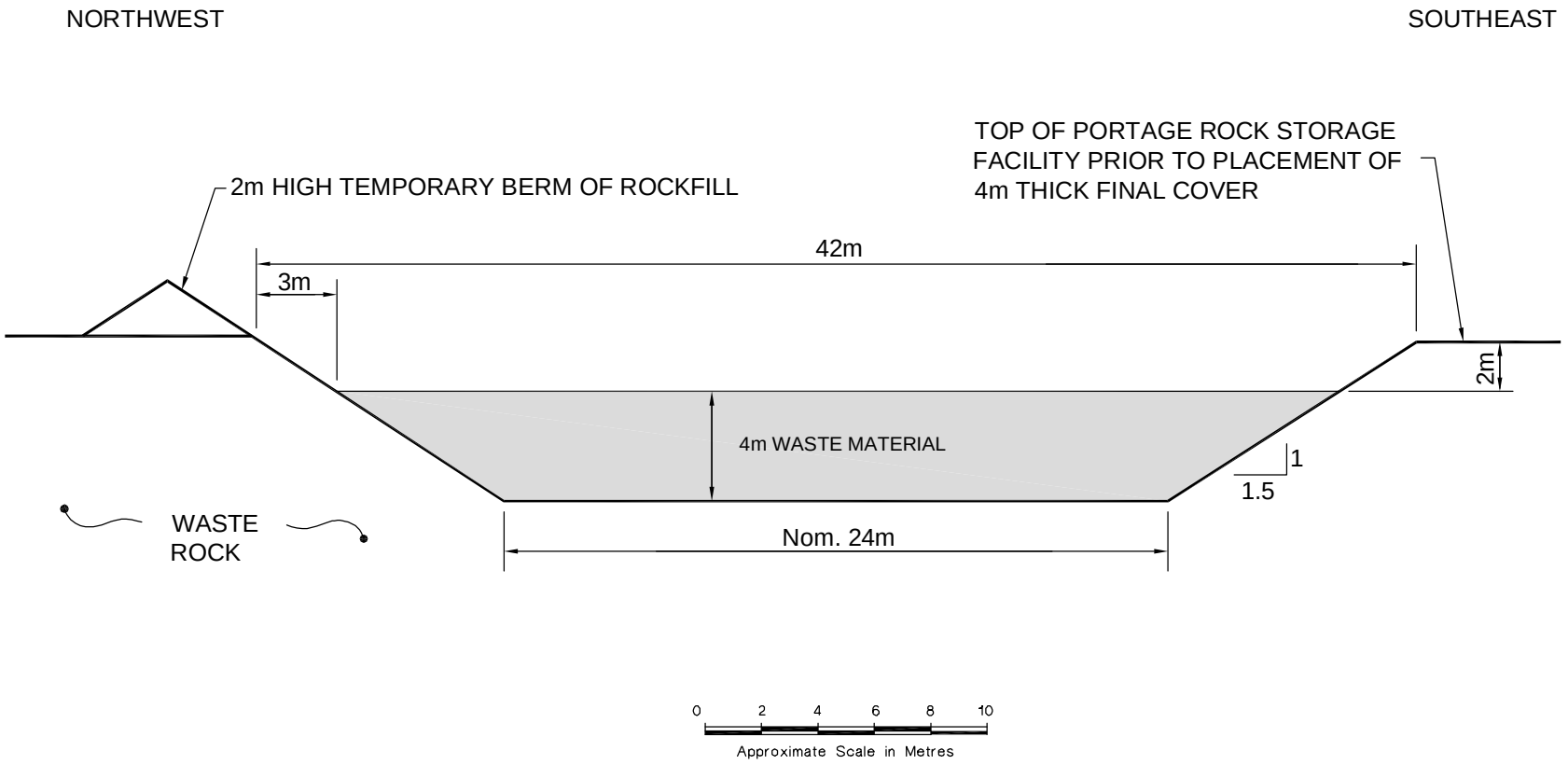
CONCEPTUAL CROSS SECTION A-A' OF LANDFILL #1 PRIOR TO PLACEMENT OF COVER

Golder Associates

PROJECT No. 06-1413-089			FILE No. 061413089-1400-FIG_4	
DESIGN	CW	23MAR07	SCALE AS SHOWN	REV. -
CADD	AS	15AUG07		
CHECK				
REVIEW				

FIGURE 3

REVISION DATE: 07/08/22 03:22PM By: ASalvador CADD FILE: N:\Bur-Graphics\Projects\2006\1413\06-1413-089\Drafting\FINAL\Doc.458\061413089-1400-FIG_4.dwg



NOT FOR CONSTRUCTION

PROJECT

MEADOWBANK
MINING CORPORATION

TITLE

CONCEPTUAL CROSS SECTION OF LANDFILL #2 PRIOR TO PLACEMENT OF COVER

Golder Associates

PROJECT No. 06-1413-089			FILE No. 061413089-1400-FIG_4	
DESIGN	CW	23MAR07	SCALE AS SHOWN	REV. –
CADD	AS	15AUG07	FIGURE 4	
CHECK				
REVIEW				