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Item number: N° de l'article : LT 536 634 658 CA
Date Year Année M M D J 2010 06 22
From Expéditeur
Customer No. N° du client HOPE BAY MINING LTD.
Telephone No. N° de téléphone 604 904 5585
Name Nom LÉA-MARIE BOWES-LYON
Address Adresse 300 - 889 HARBOURSIDE DR.
City / Prov. / Postal Code Ville / Prov. / Code postal NORTH VANCOUVER, BC V7P 3S1
To Destinataire
Customer No. N° du client —
Telephone No. N° de téléphone 867 982 3310
Name Nom STANLEY ANABLAK
Address Adresse KITIKMEOT INUIT ASSOCIATION
P.O. BOX 360
City / Prov. Ville / Prov. KUGLUKTUK, NU
Postal Code Code postal X0B 0E0

June 22, 2010

Geoff Clark
Director of Lands, Environment and Resources
KIA Lands Division
Kitikmeot Inuit Association
P.O. Box 360
Kugluktuk, NU
X0B 0E0
(867) 982-3310

Re: KTCL308D003 – Landfill Management Plan, Construction Drawings, and Specifications Package

Dear Mr. Clark,

Please find attached to this letter Hope Bay Mining Ltd.'s (HBML) landfill management plan, construction drawings, and design specifications package. These are being submitted to the KIA for review prior to submission to the Nunavut Water Board. Water licence 2AM-DOH0713 allows HBML to operate a landfill, but as you are aware this facility has not been built because the KIA Board was not in favor of the design previously submitted to them by Miramar. The Miramar design was for a facility in Quarry 2. As that quarry is still active, HBML is now proposing to site the facility in Quarry D adjacent to the Windy Road. Moving the land fill location will after KIA review, require a change to the terms of Water Licence 2AM-DOH0713.

Since the purchase of Miramar, HBML has not sought to operate a landfill and instead has been backhauling waste from site by plane and barge to licenced facilities in southern Canada. With the construction of Doris North now underway, a land fill is now required for clean construction waste from Doris North and subsequently the decommissioning of the Windy camp following the approval of a Closure and Reclamation Plan by the NWB for that facility. Coming to agreement with KIA on this facility is important to the orderly development of the Hope Bay Belt.

Thank you for your attention to this request. Please do not hesitate to contact me at chris.hanks@newmont.com to discuss this further.

Sincerely,

Christopher C. Hanks

Digitally signed by Christopher C. Hanks
DN: cn=Christopher C. Hanks, o=Hope Bay Mining Company, ou=Environment and Social Responsiblity, email=chris.hanks@newmont.com, c=US
Date: 2010.06.21 16:49:48 -07'00'

Chris Hanks
Director, Environmental and Social Responsibility
Hope Bay Mining Ltd.

June 3, 2010 EBA File: E14101082.001

Hope Bay Mining Ltd.
300 – 889 Harbourside Drive
North Vancouver, BC V7P 3S1

Via Email: Bill.Patterson@Newmont.com

Attention: Bill Patterson
Environmental Affairs Manager

Subject: Quarry A Landfill Management Plan, Construction Drawings, and Specifications Package – Issued for Use
Doris North, Hope Bay Project, Nunavut

As requested by Hope Bay Mining Ltd. (HBML), EBA Engineering Ltd. (EBA) has prepared a Landfill Management Plan (LMP) complete with Design Drawings and Specifications for construction of the Quarry A Landfill, Doris North property, Hope Bay Project, Nunavut. These documents are submitted herein to meet the requirements of the conditions associated with landfilling materials on site as defined in the water licence. HBML are required under the Type A Water Licence No. 2AMDOH071 to submit an LMP to the Nunavut Water Board. The Quarry A LMP provides information for the operation and management of the non-hazardous, solid waste landfill facility planned for Quarry A at the Doris North Property, and the attached Design Drawings and Specifications are issued for construction of the landfill.

We trust this information meets your present requirements for submission to the Nunavut Water Board. Should you have any questions or comments, please contact the undersigned at your convenience.

EBA Engineering Consultants Ltd.

Ed M. Grozic, P.Eng.
Senior Project Engineer
Direct Line: 403.723.6858
egrozic@eba.ca

Bill Horne, P.Eng.
Principal Consultant
Direct Line: 780.451.2130 x276
bhorne@eba.ca

/jnc

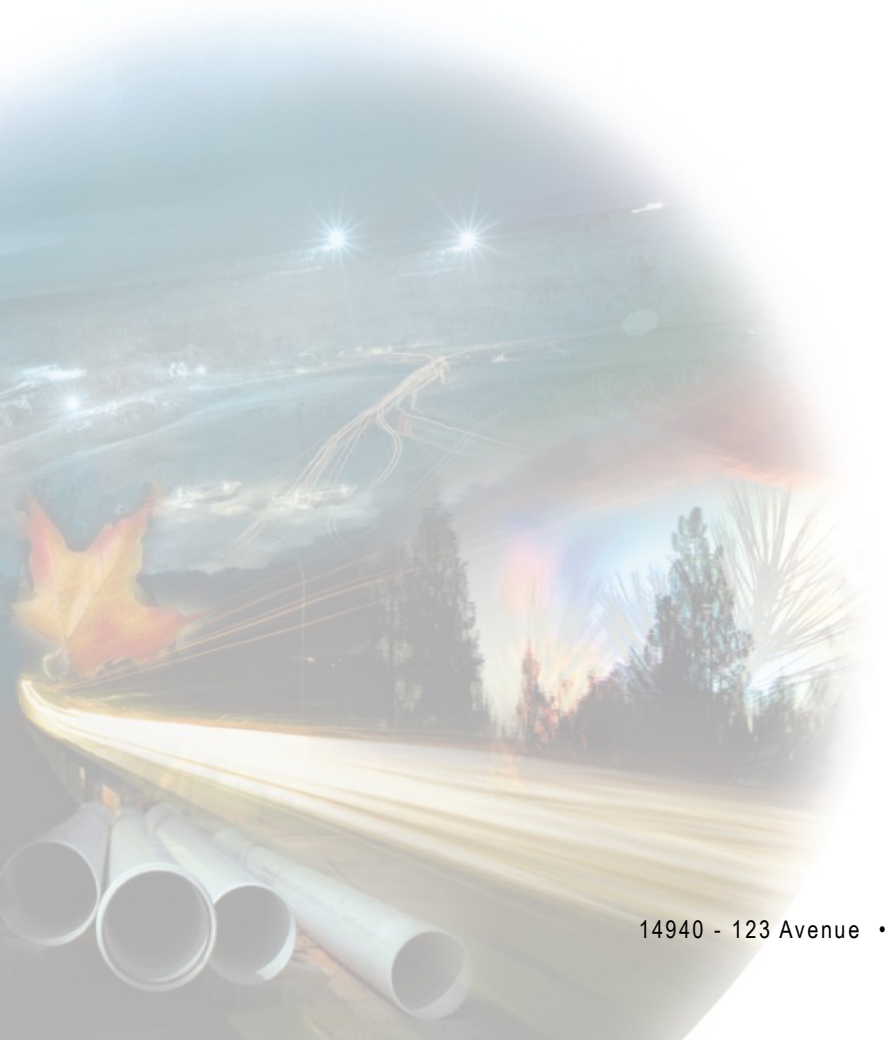
Enclosed: Quarry A Landfill Management Plan, Doris North Property, NU.
Engineering Design Drawings for Quarry A Landfill, Doris North Hope Bay Project, NU, Canada.
Quarry A Landfill Construction Specifications, Doris North Property, Nunavut.

EBA Engineering Consultants Ltd.
p. 780.451.2121 • f. 780.454.5688
14940 - 123 Avenue • Edmonton, Alberta T5V 1B4 • CANADA

Hope Bay Mining Ltd.

ISSUED FOR USE

QUARRY A LANDFILL MANAGEMENT PLAN
DORIS NORTH PROPERTY, NU



E14101082.001

June 2010

EBA Engineering Consultants Ltd.
p. 780.451.2121 • f. 780.454.5688
14940 - 123 Avenue • Edmonton, Alberta T5V 1B4 • CANADA

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1.0 INTRODUCTION

This report presents a Landfill Management Plan (LMP) for an inert, non-hazardous, solid waste landfill facility to be located in Quarry A at the Doris North Property, Hope Bay Project. The Licensee is authorized to dispose of and contain all non-hazardous solid wastes at the Landfill or as otherwise approved by the Board. The LMP is pursuant to the requirements of Nunavut Water Board Type A Water Licence No. 2AMDOH0713, issued to Hope Bay Mining Ltd. (HBML) by the Nunavut Water Board (NWB).

A "Landfill" is defined in the water licence as a facility designed to permanently contain solid, non-combustible, non-hazardous waste materials. "Inert" waste is waste that is neither chemically nor biologically reactive and will not decompose (e.g., concrete, drywall, steel, tires). The inert landfill described herein is designed to be operated as an industrial dry waste landfill, not as a municipal solid waste landfill. Food waste and food contaminated materials are separated and incinerated from inert solid waste destined for the landfill. An Incinerator Management Plan is presented under separate cover providing information on the appropriate incineration of wastes on site (SRK 2009). No hazardous wastes will be placed in the industrial landfill. A Hazardous Materials Management Plan is presented under separate cover providing information on the safe and environmentally responsible storage and handling of the hazardous products used at the site (HBML 2006).

This LMP provides information on how inert industrial wastes will be handled on site. This plan will be implemented during the construction phase of the Doris North property and Hope Pay Project and adjustments will be made as required to accommodate the changing nature and volume of wastes generated. As a minimum, the LMP will be reviewed on an annual basis and revised accordingly. The Licensee shall visually monitor and record observations and ensure that a geotechnical inspection is carried out annually. Separate from this LMP, the Licensee shall operate a landfarm, a sewage treatment plant, a fuel storage facility, and sedimentation and pollution control ponds as described in the water licence.

1.1 BACKGROUND

Hope Bay Mining Ltd. (HBML), Newmont Mining Corporation's (Newmont's) operating company for the Hope Bay Project, retained EBA Engineering Consultants Ltd. (EBA) to site and design an on-site inert waste landfill within Quarry A at the Doris North Property, which includes preparation of this Landfill Management Plan specific to the Quarry A Landfill. The Engineering Design Drawings for the Quarry A Landfill are presented herein.

The Doris North Property is located on the mainland in the West Kitikmeot region of Nunavut, about 75 km northeast of Umingmaktok, and 5 km south of Roberts Bay (Drawing C01). The Doris North site is currently planned to operate as an underground mine, and the site is in the initial phases of construction. The mine will generate a variety of construction and demolition wastes. A landfill is required to handle storage of

non-hazardous wastes that cannot be recycled and is the subject of this management plan. The Inert Waste Landfill will be located about 2 km south of Doris North in Quarry A, which is currently being developed to source rockfill materials for construction of an all-weather road from Doris North to Windy Lake camp.

Authorization to proceed with this project was given by Mr. Bill Patterson, Project Manager for the Hope Bay Project, Newmont Mining Corporation, in Professional Services Agreement PSA-HB-10-KE001, dated March 8, 2010.

1.2 NEWMONT'S ENVIRONMENTAL POLICY

Newmont's environmental policy applies to all activities undertaken on the Hope Bay Project. It is Newmont's policy to achieve the highest standard of environmental care in conducting its business as a resource company contributing to society's material needs. Newmont's approach to environmental management seeks continuous improvement in performance by taking account of evolving knowledge and community expectations.

HBML is committed to sustainable development and will ensure that the handling, storage, transportation, and disposal of all wastes on site will be completed in a safe, efficient, and environmentally compliant manner.

2.0 REGULATORY SETTING

On September 15, 2006, the Nunavut Impact Review Board (NIRB) issued Project Certificate #003 to Miramar Hope Bay Ltd. (MHBL). In December 2007, Newmont purchased controlling interest of MHBL, the parent company of HBML. The transit of the various licences and permits from MHBL to HBML was completed in early 2008. In March 2008, Newmont completed the acquisition of Miramar and its subsidiaries, thereby becoming the new owner of the Doris North project.

Newmont has been reviewing the previous owner's project schedule and development plans, and re-evaluating in light of both their global mining experience and their plans for development of the overall Hope Bay district. Initially, HBML had deferred the Doris North Project as a stand-alone project in order to study a broader belt-wide strategy that included the Doris North deposit. Subsequently, HBML decided to proceed with development and construction of the Doris North project while it continued to evaluate future alternative expansion scenarios, and supported advanced exploration needed for an overall belt-wide strategy. The stand-alone Doris North Project was originally proposed by MHBL and is authorized by NIRB in the current Project Certificate.

Waste management 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 Northwest Territories and Nunavut. The most applicable of these guidelines are:

- "Guidelines for Industrial Waste Discharge in the NWT" (Environmental Protection Service Department of Resources, Wildlife and Economic Development Government of the Northwest Territories, April 2004.)
- "Guidelines for the Planning, Design, Operations and Maintenance of Modified Solid Waste Sites in the NWT" (Ferguson Simek Clark, on behalf of the Department of Municipal and Community Affairs, Government of Northwest Territories, April 2003).
- "Environmental Guideline for Industrial Waste Discharges" (Environmental Protection Service, Department of Sustainable Development Government of the Nunavut, January 2002).

While not all the recommendations provided in these guidelines are necessarily appropriate for the management of industrial wastes generated at the Hope Bay Project, the principles have been adopted in the design and operation of the Quarry A Landfill.

3.0 LANDFILL DESIGN

The landfill design is based on the premise that it will contain generally dry, non-leachate generating materials. Therefore, it is not considered necessary to completely eliminate moisture migration into and out of the landfill. The landfill is located in a region of low annual precipitation that experiences long, cold winters and brief, cool summers. Temperatures in January are often below –30°C, and the mean annual precipitation is less than 150 mm (MHBL 2005).

The landfill is deliberately sited on a topographic high within the development footprint of Quarry A, in an area that does not interfere with natural drainage and where there is no surface runoff through the area. In addition, a High Density Polyethylene (HDPE) geomembrane liner will be installed within the landfill cover to eliminate the ingress of moisture through the cover from precipitation, and any drainage potentially originating from the landfill is designed to be contained within Quarry A. HDPE is the most common field fabricated geomembrane material used throughout the north. Liner material details are presented in the Quarry A Landfill Construction Drawings and Specifications.

Since this landfill contains only inert waste, the risk of generating contaminated leachate is anticipated to be low. This assumption will be verified during the operating life of the landfill by the ongoing monitoring of the water quality and reporting of any water that accumulates in the low point (sump) of the landfill and any accumulation in the low point of Quarry A. Water quality reporting to the control sump will continue to be monitored and managed until it can be demonstrated that this water can be released without causing environmental impairment to the receiving waters.

3.1 LOCATION

The landfill will be located in Quarry A, as shown on Drawing C01. Quarry A is presently being developed to provide blast rockfill materials to construct an all-weather road from

Doris North to Windy Camp. A Quarry Management Plan for Quarry A and two additional sources along the route are described in a report prepared by SRK Consulting Engineers and Scientists (SRK), dated April 2010 (SRK 2010).

The planned landfill is relatively small, consistent with the mine size and operations mode, but could be expanded as Quarry A is developed to accommodate additional inert industrial waste anticipated to be generated during the life of mine. The overall quarry location is large enough to accommodate industrial waste from an expanded mine, if additional reserves are proven and the Doris North site and operations continue beyond the current projection.

3.2 GEOMETRY

The landfill footprint is graded to the southwest as shown on Drawing C01. The configuration of the foundation base consists of a sloped surface, graded at 1.5% to 2.5%, adjoining a steep, angled rock surface in Quarry A. The landfill location consists of a near-vertical rock-cut face along its west side and perimeter containment berms along the north, east, and south sides. The landfill will be accessed from the south using a ramp over the south berm.

The base of the landfill is designed to slope from north to south and east to west, so any discharge from the landfill would concentrate in the southwest corner and be contained in Quarry A, if required. The landfill is entirely contained within the development footprint of Quarry A. EBA prepared a foundation base grading plan for the landfill in advance of the detailed landfill design to assist the on-site contactor (NUNA/Kitnuna) with development of Quarry A as a material source and construction of a suitable foundation base for the landfill (EBA 2010). The grading plan for Quarry A is such that that surface runoff would be permitted to flow from west to east and south to north as described in the Quarry Management Plan (SRK 2010).

The landfill is located on competent bedrock within a region of continuous permafrost. Permafrost below the landfill provides an impermeable barrier to water leaching deep into the subsurface. The landfill is hydrogeologically isolated due to the presence of permafrost, and the host rock is of good quality such that cracks or fractures created by blasting are expected to be surficial and should not propagate any leachate.

Capping material will be used to cover the landfill debris and to move the active thaw layer away from the stored waste. Based on the local geological conditions, it is expected that over time permafrost will partially aggrade into the landfilled waste. The cold, freezing temperatures should bond any moisture originating from precipitation that migrates into the landfill from its sideslopes to the base of the landfill. A liner system will be installed within the landfill cover (an HDPE liner protected on either side by a nonwoven geotextile) to eliminate the ingress of precipitation from the surface of the landfill. The synthetic liner will be placed between two 0.3 m layers of crushed bedding material, and the top 0.3 m thick bedding layer will be covered with a 0.4 m layer of 32 mm crushed rock. Moisture

that contacts the liner will travel along the surface of the liner and exit from the downslope side of the landfill. Free water is not expected to migrate from the landfill.

Crushed rock 20 mm and 32 mm (¾ inch and 1¼ inch) minus material from Quarry 2 will be used to construct the landfill berms and final cap, and to supply the layers of intermediate fill, as shown on the attached Drawings. The perimeter containment berms will be about 3.4 m in height and have maximum inside and outside sideslopes of 2.0H:1V and 2.5H:1V, respectively, as presented. The shallow outside sideslopes are provided for long-term stability and to minimize surface erosion. A layer of 150 mm (6 inch) crushed rock will be placed on the outside berm slopes for added armouring and erosion protection.

The total thickness of landfilled debris will be equal to the height of the berms, about 3.4 m, and the landfill will be capped with a 1.0 m thick rockfill cover. The surface of the landfill will be graded, similar to the foundation base grades, to mitigate water ponding/infiltration. If some additional landfill capacity is required in later years, then it is feasible to place additional layers of waste along the rock face on the west side of the landfill and have the landfill cover slope from northwest to southeast. Melt water from the surface of the landfill would still be contained within Quarry A.

3.3 GENERAL STRATEGIES

Generation of wastes will be minimized whenever possible by applying the principles of Reduce, Reuse, and Recycle (the three R's). As a waste generator, HBML will always be held responsible for how it manages its waste; therefore, the following strategies for minimizing and disposing of wastes will be employed:

- Proactive procurement policy: HBML will implement a procurement policy that would require potential suppliers to provide information to assess the environmental friendliness of their products and packaging.
- Pollution prevention: Pollution prevention methods to eliminate the generation of wastes will be evaluated and feasible methods implemented. This will be achieved by adopting reduction, substitution, segregation, reuse, recycle, and recovery methods wherever feasible.
- Strategic material substitution: At the purchasing stage, the possibility of substituting materials that are hazardous to handle, generate hazardous wastes, or create environmental problems with less pollutant varieties will be examined.
- Waste segregation: Segregating the various waste streams will make it easier to reuse, recycle, recover, and dispose of the various wastes generated. As part of the planning process, all waste categories will be analyzed and the principles of the three R's will be applied.
- Reduction initiatives: Reducing raw material consumption is the first step to reduce waste generation. To practice this principle, all processes and materials used will be evaluated on the basis of possible reduction in disposable material usage.

- Reuse initiatives: Reusing material in other applications and/or by other parties will be encouraged and examined by using the waste materials exchange.
- Recycling initiatives: Recycling is the next option considered for the successful management of the waste streams. Wherever feasible, recyclable containers will be back shipped to recycling depots or directly to original suppliers.
- Disposal: Disposal becomes the final option when the three R's are no longer applicable or practical. However, hazardous wastes will be stored temporarily on-site and ultimately transported to a licensed hazardous waste handling facility for possible recovery, treatment, and disposal.

4.0 LANDFILL OPERATION

4.1 TYPES AND QUANTITIES OF WASTE

Table 4-1 provides a summary of the anticipated types of waste to be generated at the Doris North property during construction.

TABLE 4-1: PROJECTED ANNUAL LANDFILL WASTE TYPES

Waste Type	Examples
Scrap metal	Structural steel, equipment guards, plate steel, steel pilings, tanks (decommissioned), bins, cladding, doors, rebar, filing cabinets, cable tray, metal furniture, wheels
Rubble	Broken concrete, masonry
Wood products	Timber dunnage, plywood, and lumber from formwork and camp modules
Rubber products	Tires, conveyor belting, floor mats
Construction	Construction and demolition debris
Glass	Cleaned bottles, jars, plate glass, and mirrors
Piping	Steel and plastic piping (fuel and glycol piping clean), including insulation, heat trace cable, and support brackets
Fabrics and liners	Synthetic liners, woven geotextile, insulation (liners cut into strips for burial to prevent water containment)
Electrical	Cabling, cable support systems, electrical panels, switchgear, transformers (except oil-filled units)
Equipment (non-recyclable)	Non-hydrocarbon-contaminated and cleaned equipment: electric motors, boilers, fans, heaters, bearings, gearboxes, pumps, screens, truck parts, conveyor idlers and pulleys, truck shop equipment, appliances
Incinerator ash	Ash from the kitchen incinerator

4.2 RECYCLING OPPORTUNITIES

Recycling opportunities for non-hazardous wastes are somewhat limited at the Doris North Property because of the remoteness of the site; however, the mine site has been taking advantage of practical recycling opportunities that come available. This will be largely determined by what is practical to back ship (barge) to a receiving centre.

There is also limited opportunity for use of previously used materials on site; however, re-use opportunities will be evaluated on an ongoing basis to find ways to minimize waste.

4.2.1 Hazardous Wastes

Hazardous wastes will not be landfilled. They will be separated, packaged, and temporarily stored at the hazardous materials compound away from the landfill area until they can be shipped off-site. All hazardous wastes will be back shipped off site, except for contaminated soil, snow, and ice, which will be treated on site as discussed in the Landfarm Management Plan (SRK 2009). Temporary storage of hazardous wastes is discussed in the Hazardous Materials Management Plan.

Hazardous wastes and chemicals temporarily remaining on site will be collected and stored in appropriately sealed containers and/or empty drums. This includes any remaining fuel, hydraulic oil, antifreeze, batteries, and other lubricating fluids and/or chemicals. Re-useable items will be stored at the Doris North property, and unusable items will be transported to the Roberts Bay jetty, where it will be loaded into specially marked shipping containers (Seacans) to await removal from site on the next sealift. Materials shipped off site will be disposed off in a licensed facility in Alberta or Northwest Territories, such as Hay River, NT (or another designated location), in accordance with appropriate Federal, Territorial, Provincial, or Municipal hazardous waste regulations.

4.2.2 Recyclables Stored On Site

The Doris North mine site will establish a 'bone yard' adjacent to one of the laydown areas where equipment will be stored pending possible reuse on site. The bone yard location will be sited well away from water bodies and within a controlled drainage area.

Large tires (e.g., those for ore trucks) when no longer useable on trucks and, if not recyclable through truck tire dealers, could be used as roadside barriers which are typical of mine use for these items.

4.2.3 Burning

The water licence allows for incineration of certain wastes. Scrap, clean wood, and paper are proposed for burning to reduce the quantity of material that requires burying. Burning will be controlled as an authorized activity on site. Discussions of materials authorized to be incinerated are presented in an Incinerator Management Plan (SRK 2009).

The burn pit is located adjacent to Quarry 2 in a position that is sheltered from the prevailing winds. Suitable materials may be burned daily to prevent an accumulation of waste and minimize the volume of materials that are landfilled or shipped off site — commonly, clean wood and paper products will be burned. Care will be exercised to prevent the fires from spreading, and fire is to be supervised at all times until it self-extinguishes. The embers must be extinguished before being left unattended. Ash from the burn pit may be landfilled when cool provided that the ash is not deemed a hazardous waste

and satisfies water licence requirements to allow for disposal in an inert waste landfill. Presently, incinerator ash is containerized and shipped south for disposal.

4.3 OPERATING AREA

The landfill is constrained by a rock cut to the west, an access road to the east, low-lying tundra terrain to the north, and Quarry A to the south. A site plan for the landfill is presented on the attached Drawings. The total airspace within in the designed landfill is 12,200 m^3. The landfill is intended to be progressively filled over time beginning at the north end of the landfill and working south. The estimated fill rate will vary over time and will include construction material debris from the construction of Doris Camp. Additional quantities of incinerator ash may be placed in the landfill if it is shown that the ash is not deemed a hazardous waste and satisfies water licence requirements to allow for disposal in an inert waste landfill.

4.4 WASTE PLACEMENT

Landfill debris will be placed and compacted in lifts (0.7 m thick), with intermediate fill (0.15 m thick) graded over the debris to fill the voids in order to reduce settlement and final cover subsidence. The waste will be compacted under the weight of heavy equipment. The waste will be placed in a manner that reduces water contact with the waste during operations. The waste will be placed in the upper (north) portion of the landfill first so that water can drain to the lower (south) portion of the landfill. Cover will be placed on the waste as soon as the layer thickness is achieved. Cover will also be placed over the waste during the winter periods or extended periods when no landfilling activity is anticipated. Snow and ice will be removed from the facility before it thaws to minimize ponded water in the facility.

4.4.1 Compaction

Proper compaction of solid waste that has been landfilled provides several important benefits including conserving landfill space, reducing cover efforts and cost, reducing total and differential settlement of the waste and associated closure and post-closure costs, and creating a more aesthetic operation. All landfill waste will be placed in lifts 0.7 m thick or less and compacted with specific compaction equipment or with large heavy equipment trafficking back and forth. This typically requires four to six passes with a compactor or piece of heavy equipment.

4.4.2 Levelling, Grading and Cover Materials

The waste materials will be levelled and compacted weekly using a dozer when actively landfilling. A 1% grade will be maintained towards the collection corner of the landfill to facilitate surface runoff collection. Intermediate layers of cover material will be stored near the landfill site for frequent and efficient covering of waste.

4.5 DISCHARGE WATER

The landfill has been sited on a topographic high such that most surface water is directed away from the landfill, thereby minimizing water accumulation in the facility. If ponded water accumulates in the facility, the water will be removed prior to landfilling debris over it. The water will be tested before removal to confirm it meets the water discharge criteria for the mine.

Rainwater/precipitation that contacts waste on the site will be collected in the base of the landfill cell and sampled prior to discharge to the environment. If required, runoff waters may be treated to satisfy water licence requirements.

5.0 LANDFILL MANAGEMENT

5.1 GENERAL

Operation of the landfill will be under the direction of the mine site manager and operating superintendents. Ultimate responsibility will rest with the senior HBML employees on site. A waste control program will be implemented to avoid the disposal of inappropriate materials. Access to the landfill will be limited by means of a gated entrance (or similar structure) so that dumping will only be permitted by authorized personnel.

An area method of dumping will be used such that materials will be dumped in cells and covered as required by processed crushed rock materials produced from Quarry 2. Wastes will be disposed directly on the ground and compacted with heavy equipment against the berm or existing filled cell. As much as practical, dumped materials will be segregated in strips so that each major type occupies a subsection of the operating cell.

5.2 KITCHEN WASTES AND INCINERATOR ASH

All kitchen wastes will be incinerated to prevent attraction of wildlife particularly foxes, wolverines, and grizzly bears. Operation of the incinerator will be the responsibility of NUNA (contractor) and HBML, who will report incinerator operation and maintenance issues to the environmental coordinator or designate. The existing incinerator is sized to accept anticipated food wastes from the present camp. The incinerator operated at Hope Bay, Doris Camp, is a Westland Incinerator, Model CY 100 CA-D-O two-stage incinerator. It utilizes a primary combustion chamber and secondary afterburner section, and is equipped with a six-metre (nominal) refractory lined stack. The incinerator is located at the Robert's Bay Laydown area and is the only one on site. A by-product of combustion from this facility is ash. If the ash material is considered non-hazardous, then it may be permitted to be disposed of in the solid waste landfill. Presently, all incinerator ash is containerized and shipped south for disposal. This practice is expected to continue.

If incinerator ash is permitted and authorized to be disposed of in the landfill, then it will need to be covered with waste rock material immediately after being dumped to prevent it from being subject to wind erosion. The management and appropriate incineration of waste is

presented in the Incinerator Management Plan prepared by SRK, July 2009, which addresses the requirements specified in Part G, Section 5 of the Water Licence No. 2AMDOH0713.

5.3 EQUIPMENT

Only clean equipment that cannot be recycled or reused would be considered for disposal in the landfill. Large equipment, such as unrepairable trucks, will not be placed in the landfill but may be stored for burial, perhaps in the underground mine or in waste rock dumps on mine closure. On-site burial of equipment that is drained of hydrocarbons is common practice at mining operations. If regulations change before Doris Mine closure, provisions will be made to back ship such equipment via barge.

Equipment containing petroleum hydrocarbons would be drained prior to landfilling, if permitted. The waste petroleum products will be disposed of in waste oil cubes for back shipping via barge to a licensed hazardous materials disposal contractor. If required, petroleum reservoirs in the equipment will be cleaned with solvent or steam prior to landfilling.

5.4 CLEAN WOOD AND PAPER

Clean wood and paper will be burned in the designated "burn pit" area located adjacent to Quarry 2 where the fire can be controlled to minimize the volume of materials that are landfilled or shipped off site. Burning of materials that the senior site management or the environmental coordinator has approved for open burning will only be done by authorized personnel. No petroleum-stained wood or paper will be burned at the landfill. Burning will only be conducted at times when winds are low or calm. The required regulatory permit to open burn will be obtained before beginning this activity. The mine environmental coordinator will be responsible for keeping the permit current.

5.5 WATER TREATMENT PLANT SLUDGE

There is no sludge pit on site. All water treatment plant sludge is incinerated as per the Incinerator Management Plan (SRK 2009).

5.6 INSPECTION

Inspection of landfill operation will be the responsibility of the mine environmental coordinator. The environmental coordinator will monitor landfill operation and report issues to senior management personnel who will have the authority to ensure issues are addressed. Ongoing issues that need general coordination at the mine to be resolved will be subject to discussion at health, safety, and environment committee meetings.

Inspection by the environmental coordinator will include:

- Berm integrity;
- Security integrity;

- Housekeeping;
- Evidence of unauthorized use of the landfill;
- Evidence of ponding of water on berms, mounds, or unused areas; and
- Any other items that may indicate difficulties with safe operation of the landfill.

Problems will be reported to the appropriate senior site management personnel (and if required to the health, safety, and environment committee) for action. Issues will be addressed on a priority basis.

Annual volumes of waste will be estimated and recorded by the environmental coordinator. Records will be retained for management and government inspection purposes.

5.6.1 Waste Acceptance

Only wastes generated by HBML will be disposed of in the landfill. These wastes include items such as those presented in Section 4.1 that are deemed as inert, non-hazardous, and non-leachate generating. Wastes that are prohibited from entering the landfill include:

- Oily waste,
- Batteries (except alkaline),
- Liquids,
- Paints (unless dried),
- Chemical waste,
- Animal carcasses,
- Used oil,
- Hazardous waste,
- Grease,
- Contaminated soil,
- Asbestos,
- Uncombusted household/food wastes, and
- Concentrate-contaminated materials.

A sign will be placed in a visible location near the landfill stating:

- No Hazardous Wastes
- No Liquid Wastes
- No Food or Animal Wastes

5.7 RECORDS AND REPORTING

The Site will maintain the following records:

- The certificate of operation;
- The Landfill Management Plan and revisions;
- Load records;
- Inspection records for inspections conducted by staff and regulatory agencies;
- Training procedures;
- Contingency plan and notification procedures;
- Closure and post-closure care plans; and
- Copies of annual reports.

An annual report will be prepared under the direction of the site manager and will include the following:

- Total volume and/or tonnage of waste discharged into the landfill for the year;
- Approved design volume;
- Remaining site life and capacity;
- Operational plan for next 12 months;
- Operation and maintenance expenditures;
- Leachate and groundwater quality data and interpretation;
- Any changes from approved reports, plans, and specifications;
- An up-to-date contingency plan, noting any amendments made; and
- A review of the closure plan and associated estimated costs.

Records will need to be kept on file for the operational life of the landfill or mine, whichever is greater, and should be reviewed by senior managers regularly to ensure that records are being filed and that the information is consistent with observations. The documentation will also be used to address tipping fees to the landowner.

Any out of specification situations need to be raised immediately and addressed prior to continuing with landfill operation. An incident report should be completed if any out of specification conditions are associated with waste disposal or landfill performance.

5.7.1 Inclement Weather Operations

The landfill will not be operated (no debris materials placed in the landfill) during severe climatic conditions such as severe wind or snow, in accordance with safe worksite operations and practices.

5.8 CONTINGENCY PLANNING

A contingency plan will be developed for the operation of the landfill that will include, but not be limited to, procedures for responding to the following scenarios:

- Leachate release;
- Surface water or ground water contamination;
- Injuries, accidents, or other emergencies; and
- Storms and inclement weather.

5.8.1 Improper Disposal

Should unacceptable wastes be placed for disposal, they are to be removed to the correct disposal/ storage point in the case of minor infractions. Should larger quantities of unacceptable waste be noted, these are to be reported to HBML Environmental staff for corrective action.

5.8.2 Fire

The risk of fire is best managed by prevention. However, if fire breaks out or spreads to areas of waste, the following actions can be taken. The first action is to report the incident to the safety staff on site and the acting mine manager.

Location	Possible Actions
Landfill – prior to disposal	Separate burning wastes, if safe to do so, using equipment. Smother with soil/fine rocks using equipment. Smother with snow.
Burn pit – fire spreads	Separate burning wastes, if safe to do so, using equipment. Smother with soil/fine rocks using equipment. Smother with snow.

5.9 LANDFILL CLOSURE

The landfill will be capped and closed progressively as final elevations are achieved. Final elevations will be field fit so that stability of the landfill is maintained and exposure to natural elements is minimized. Graded/sloped tops will be established on all completed portions of the landfill so that water does not accumulate on tops and percolate through the landfilled debris. In addition, an HDPE geomembrane liner will be placed in the cap of the landfill cover to eliminate the long-term ingress of precipitation from the surface of the landfill (refer to Construction Drawings and Specifications for liner details). With increase in the perimeter berm height, additional lifts of waste may be stored.

Final closure of the landfill will be undertaken once the site can no longer be used, which will be dictated by site conditions (not anticipated) or when the mine closes as part of mine closure activities. Final closure will consist of placing waste rock over the landfill to a depth to allow partial freeze-back and encapsulation of the landfilled materials in permafrost. Pursuant to regulations in force at the time of closure of the landfill, notification will be provided to the Nunavut Water Board, Department of Sustainable Development, Department of Indian and Northern Affairs (DIAND), and Kitikmeot Inuit Association (KIA) in advance of closure. Current requirements are for six months pre-notification for municipal solid waste landfills.

6.0 PLAN REVIEW AND CONTINUAL IMPROVEMENT

When the landfill is constructed, as-built drawings will be substituted for the design drawings presented in this plan. The plan will be reviewed annually by the mine management personnel. Suggestions for improvements will be solicited on an ongoing basis from employees through the health, safety, and environment practices established from the site and other committees that may be created. Improvements suggested through these reviews will be implemented in consultation with Nunavut Water Board, the Department of Sustainable Development, DIAND, and Environment Canada inspectors. The landfill operations plan will be updated as necessary to reflect significant facility expansions or changes in site operations and equipment. KIA will be provided a copy of any and all amended plans.

7.0 LIMITATIONS

This Landfill Management Plan and its contents are intended for the sole use of Hope Bay Mining Ltd. and their agents. EBA does not accept any responsibility for the accuracy of any of the data or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Hope Bay Mining Ltd., or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user.

8.0 CLOSURE

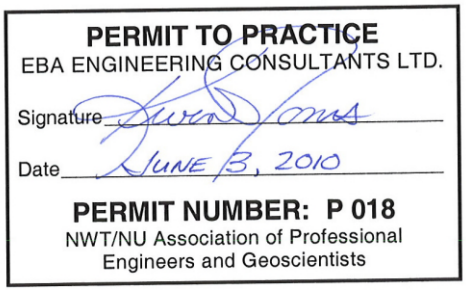
We trust this report meets your present requirements. Should you have any questions or comments, please contact the undersigned at your convenience.

EBA Engineering Consultants Ltd.

Ed M. Grozic, P.Eng.
Senior Project Engineer
Direct Line: 403.723.6858
egrozic@eba.ca

Reviewed by
Bill Horne, P.Eng.
Principal Consultant, Arctic Region
Direct Line: 780.451.2130 x276
bhorne@eba.ca

/jnc



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DRAWINGS

ENGINEERING DESIGN DRAWINGS FOR QUARRY A LANDFILL DORIS NORTH HOPE BAY PROJECT

JUNE 2010

ENGINEERING DESIGN DRAWINGS FOR QUARRY 'A' LANDFILL, DORIS NORTH HOPE BAY PROJECT, NUNAVUT, CANADA

D R A W I N G I N D E X

DRAWING NO.	DRAWING TITLE
C01	LOCATION MAP
C02	EXISTING SITE TOPOGRAPHY AND GENERAL LAYOUT
C03	FOUNDATION BASE AND LANDFILL PLAN
C04	CROSS-SECTIONS
C05	DETAILS AND GENERAL NOTES

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HOPE BAY PROJECT nunavut HOPE BAY MINING LTD.

EBA Engineering Consultants Ltd.

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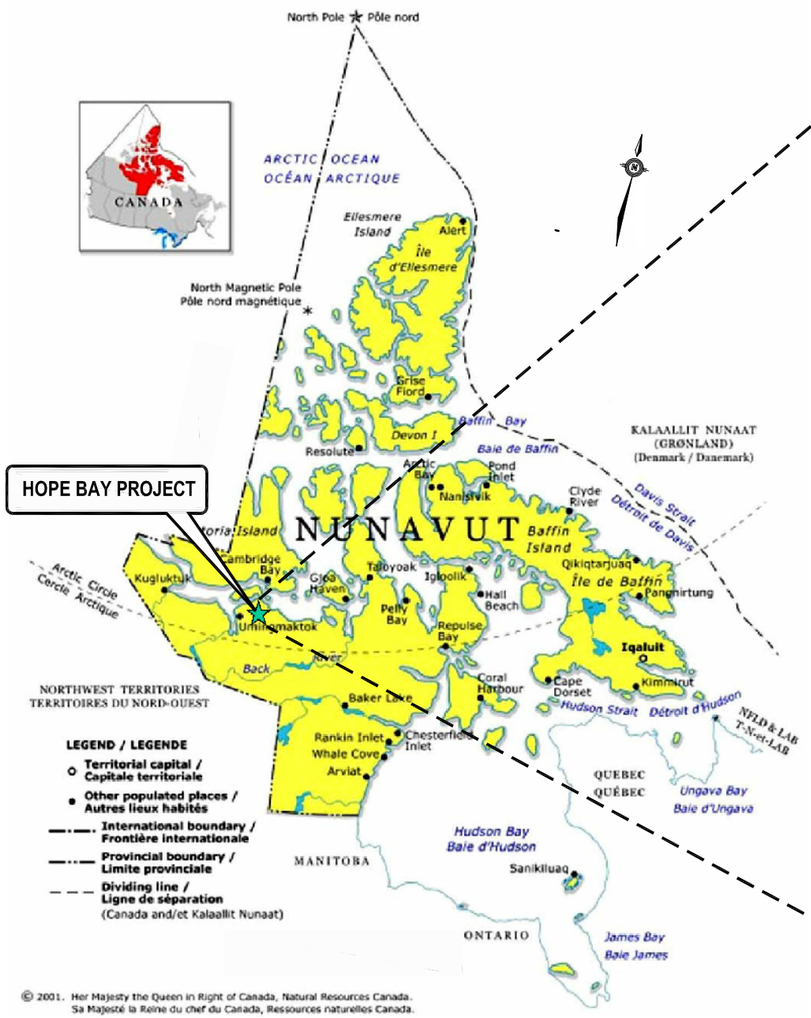

IMAGE PROVIDED COURTESY OF SRK. JOB NUMBER 1CH008.026.800. DRAWING NUMBER 1: LOCATION MAP.

TERRITORIAL MAP

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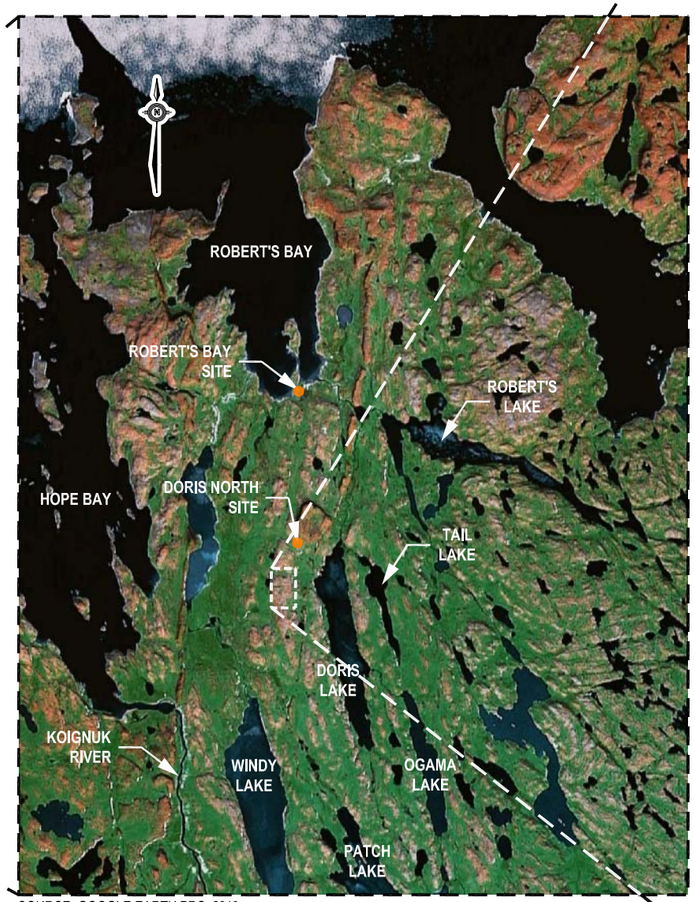
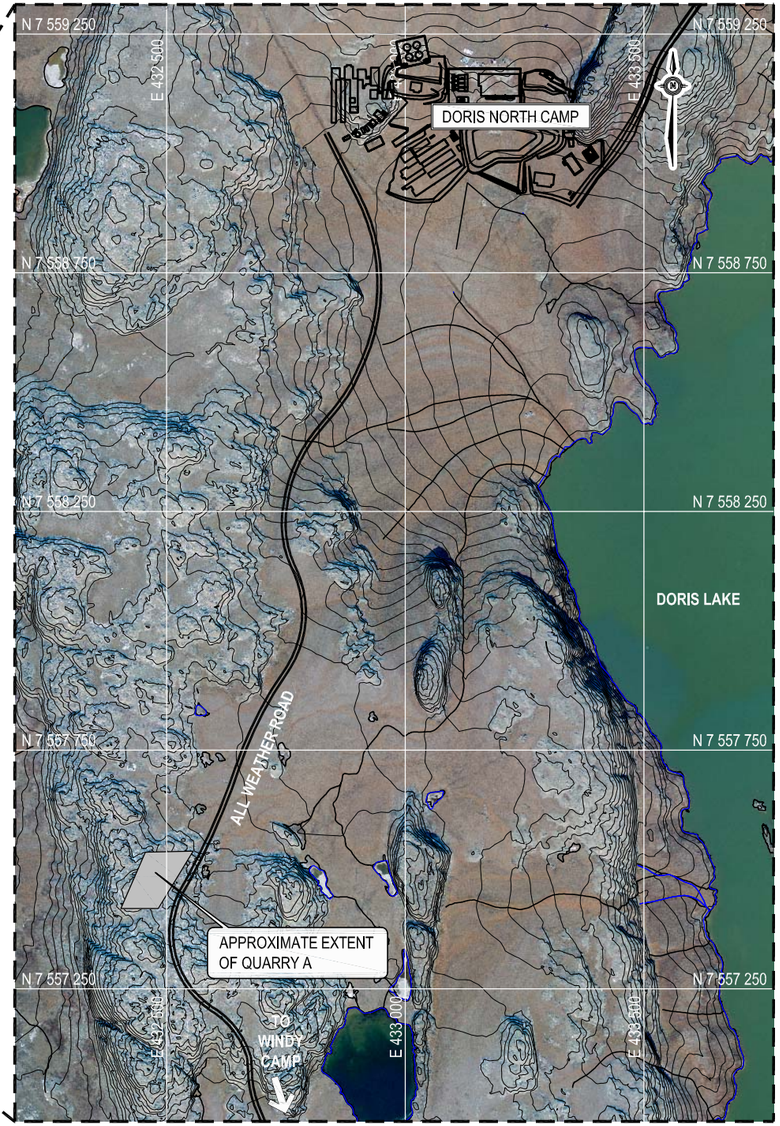
Scale: 1: 125 000



SOURCE: GOOGLE EARTH PRO. 2010.

REGIONAL MAP

NTS



ORTHOPHOTO PROVIDED COURTESY OF SRK. DATED APRIL 2008.

SITE LOCATION

0 500 m

Scale: 1: 12 500

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NOTES

1. COORDINATE SYSTEM IS UTM NAD 83, ZONE 13.
2. ALL DRAWINGS ARE SCALED APPROPRIATELY FOR B-SIZE CONSTRUCTION DRAWINGS. SCALES MAY NOT BE CORRECT IF THESE DRAWINGS ARE REPRODUCED AND PRESENTED IN ANY OTHER SIZE FORMAT.
3. NOTES AND SPECIFICATIONS ON ANY DRAWINGS IN THIS SET APPLY EQUALLY TO ALL DRAWINGS IN THE SET.
4. SHOULD THERE BE ANY DIFFERENCE BETWEEN THE COORDINATES PROVIDED AND THE FIELD LOCATION, THE ENGINEER IS TO BE INFORMED IMMEDIATELY.
5. ALL DIMENSIONS ARE IN METRIC UNITS.

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HOPE BAY PROJECT, NUNAVUT, CANADA

LOCATION MAP

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C01

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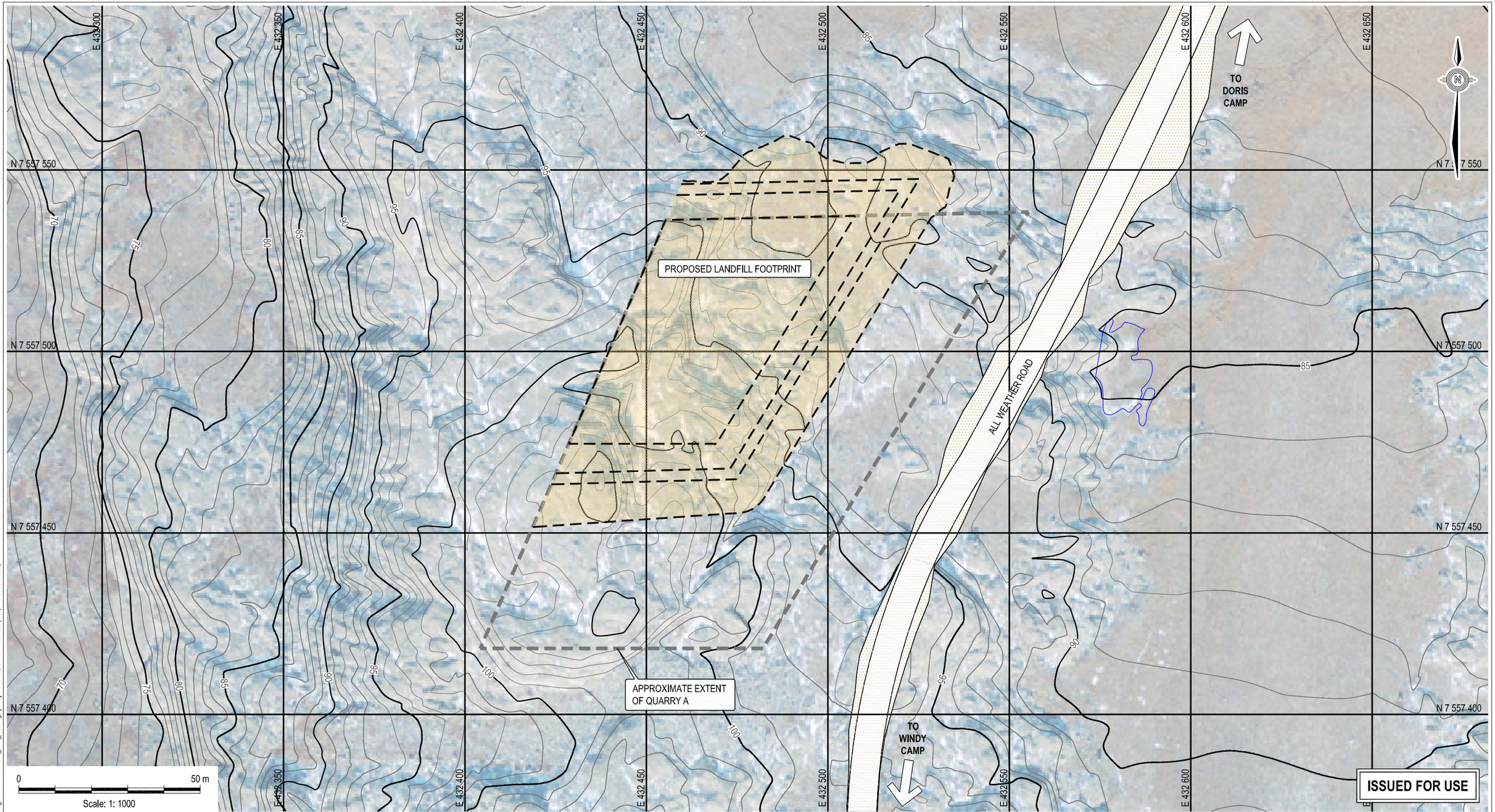

NOTES

1. TOPOGRAPHIC CONTOUR DATA FOR THE TERRAIN MODEL PROVIDED BY SRK.
2. ORTHOPHOTO PROVIDED COURTESY OF SRK. DATED APRIL 2008.
3. COORDINATE SYSTEM IS UTM NAD 83, ZONE 13.
4. SHOULD THERE BE ANY DIFFERENCE BETWEEN THE COORDINATES PROVIDED AND THE FIELD LOCATION, THE ENGINEER IS TO BE INFORMED IMMEDIATELY.
5. ALL DIMENSIONS ARE IN METRIC UNITS.

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EXISTING SITE TOPOGRAPHY AND GENERAL LAYOUT

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C02

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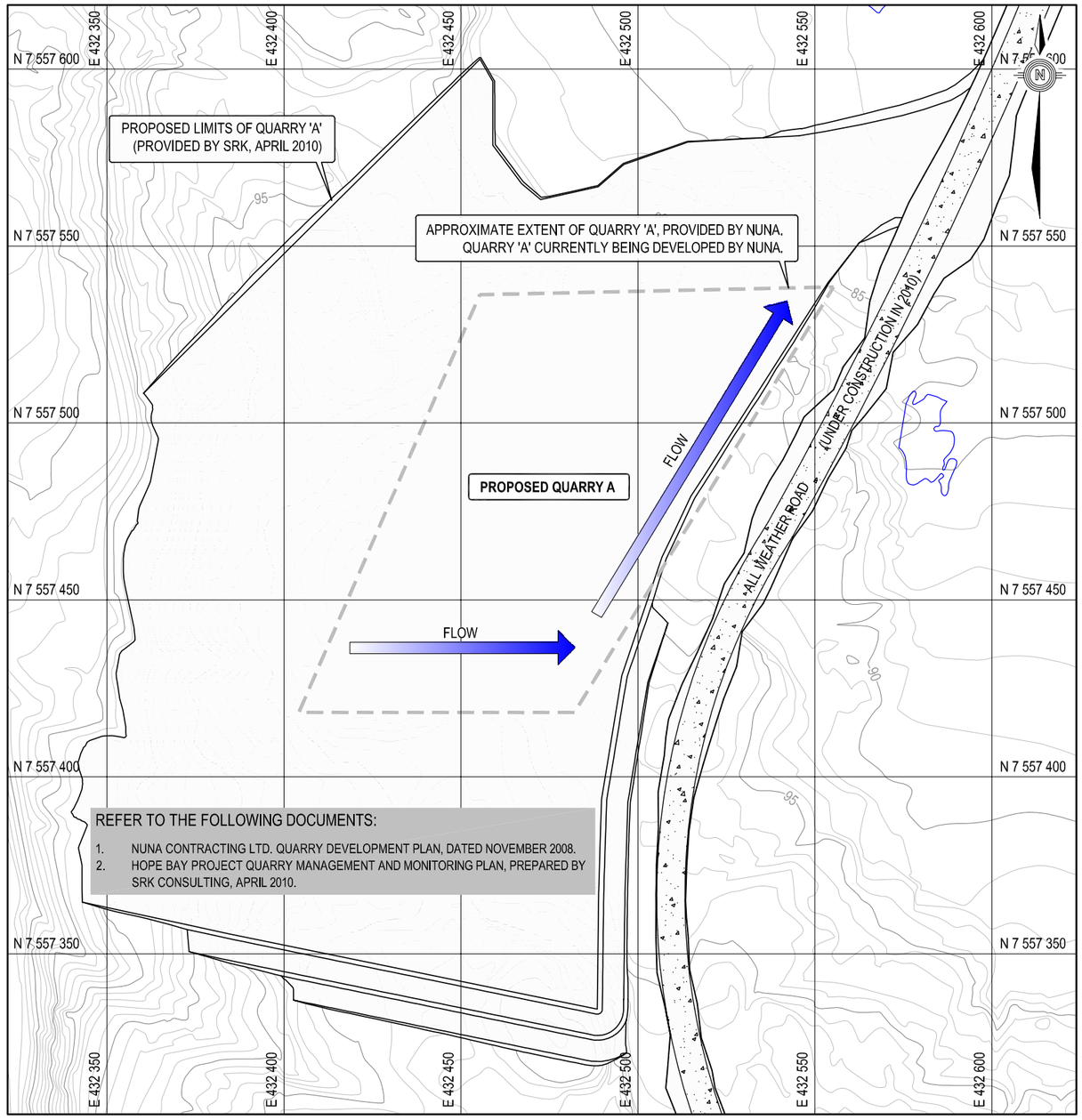


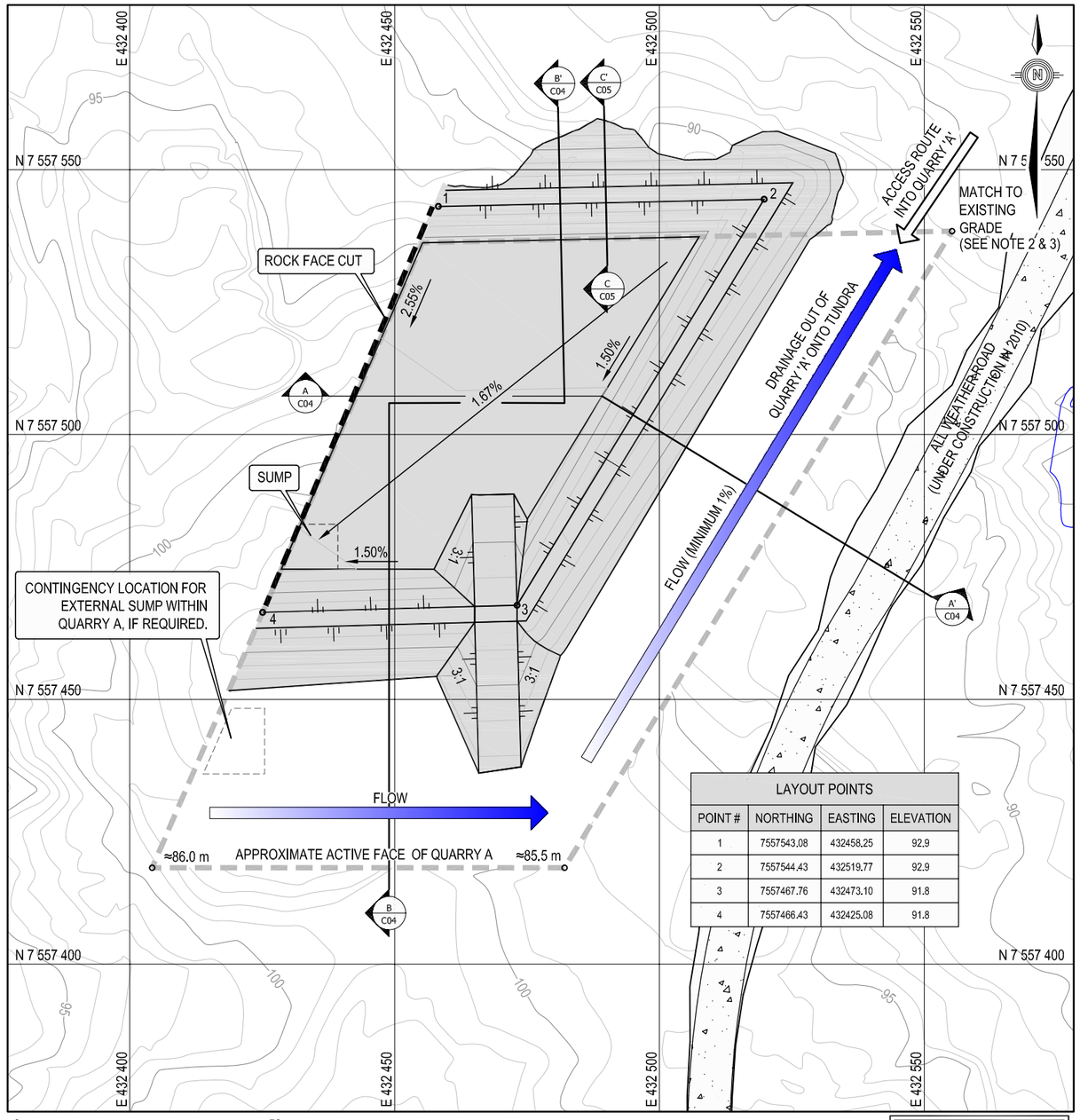
REFER TO THE FOLLOWING DOCUMENTS:

1. NUNA CONTRACTING LTD. QUARRY DEVELOPMENT PLAN, DATED NOVEMBER 2008.
2. HOPE BAY PROJECT QUARRY MANAGEMENT AND MONITORING PLAN, PREPARED BY SRK CONSULTING, APRIL 2010.

0 50 m

Scale: 1: 1 500

PROPOSED QUARRY 'A' DEVELOPMENT AND GRADING PLAN



LAYOUT POINTS			
POINT #	NORTHING	EASTING	ELEVATION
1	7557543.08	432458.25	92.9
2	7557544.43	432519.77	92.9
3	7557467.76	432473.10	91.8
4	7557466.43	432425.08	91.8

0 50 m

Scale: 1: 1000

PROPOSED QUARRY 'A' LANDFILL PLAN

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NOTES

1. NO WATER WILL BE PERMITTED TO POND ALONGSIDE THE LANDFILL.
2. ELEVATIONS AT THE NORTH END OF QUARRY 'A' MUST BE LOWER THAN AT THE SOUTH END OF THE QUARRY.
3. QUARRY 'A' PIT FLOOR WILL GRADE FROM WEST TO EAST AND SOUTH TO NORTH.
4. QUARRY 'A' MUST BE FREE DRAINING.
5. COORDINATE SYSTEM IS UTM NAD 83, ZONE 13.
6. SHOULD THERE BE ANY DIFFERENCE BETWEEN THE COORDINATES PROVIDED AND THE FIELD LOCATION, THE ENGINEER IS TO BE INFORMED IMMEDIATELY.
7. ALL DIMENSIONS ARE IN METRIC UNITS.
8. REFER TO THE CONSTRUCTION SPECIFICATIONS ISSUED WITH THESE DRAWINGS.

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DORIS NORTH QUARRY 'A' LANDFILL DESIGN
HOPE BAY PROJECT, NUNAVUT, CANADA

FOUNDATION BASE AND LANDFILL PLAN

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C03

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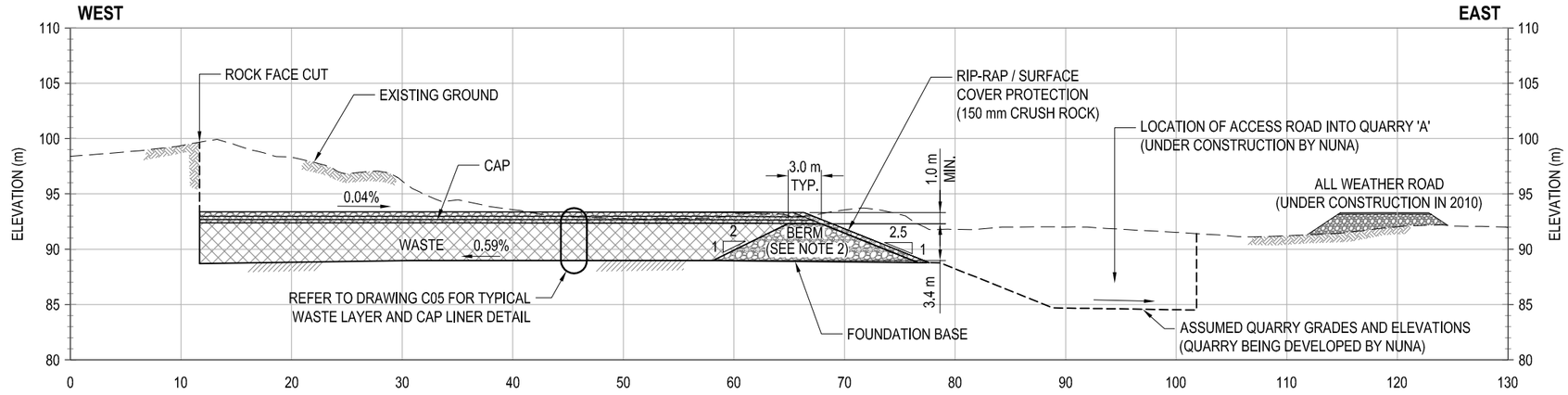

A / C03 CROSS-SECTION A-A'

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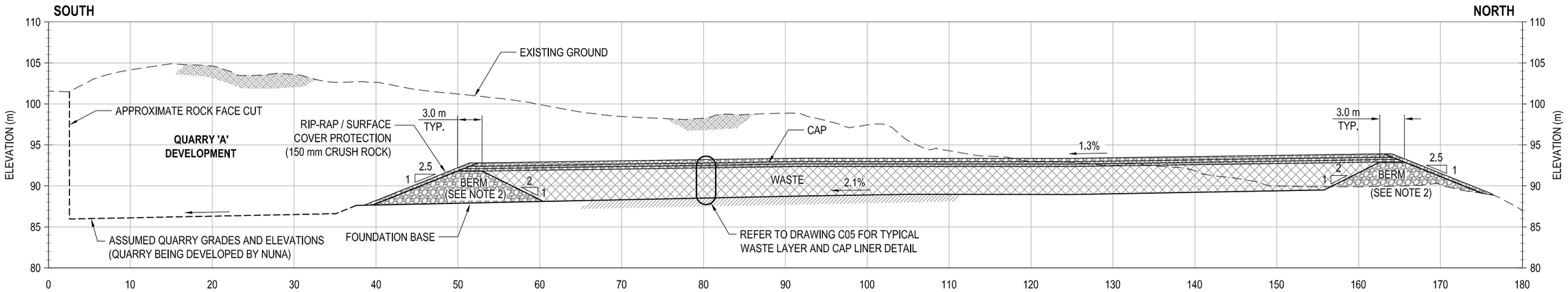

B / C03 CROSS-SECTION B-B'

0 25 m

Scale: 1: 500

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CONSTRUCTION NOTES

1. RUNOFF AND DRAINAGE WILL BE DIRECTED AWAY FROM LANDFILL.
2. LANDFILL BERMS AND CAP TO BE CONSTRUCTED WITH 20 mm CRUSH (PROCESSED QUARRY ROCK). REFER TO CONSTRUCTION SPECIFICATIONS.
3. ALL DIMENSIONS ARE IN METRIC UNITS.
4. REFER TO CONSTRUCTION SPECIFICATIONS ISSUED WITH THESE DRAWINGS.

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HOPE BAY PROJECT, NUNAVUT, CANADA

CROSS-SECTIONS

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E14101082.001	EL	EMG	0
OFFICE: EBA-RIV	DATE: June 2010		

C04

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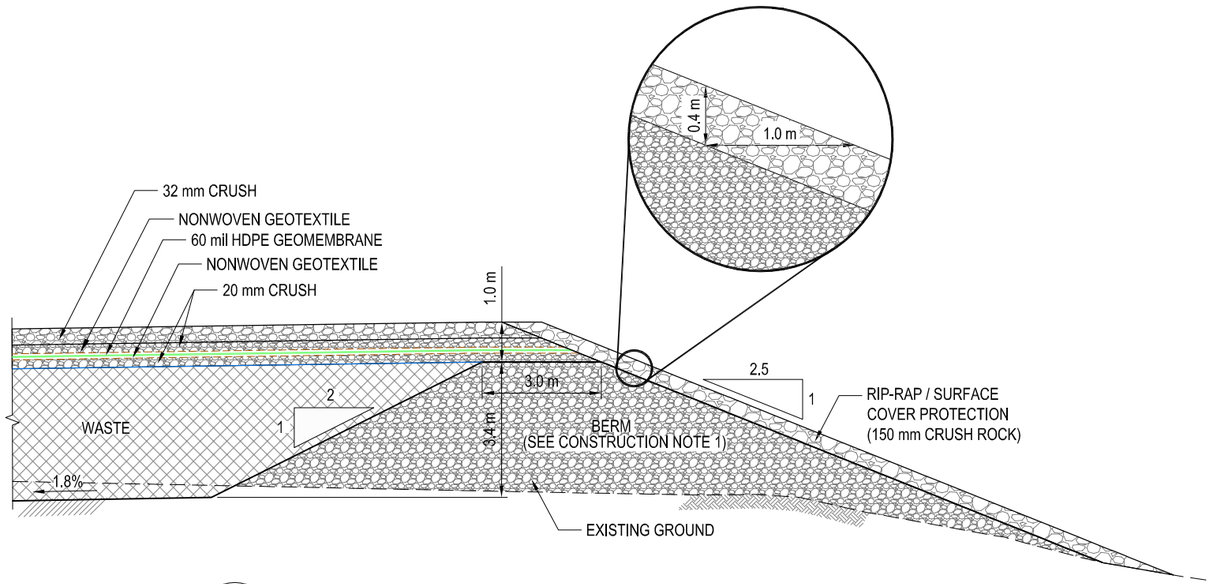
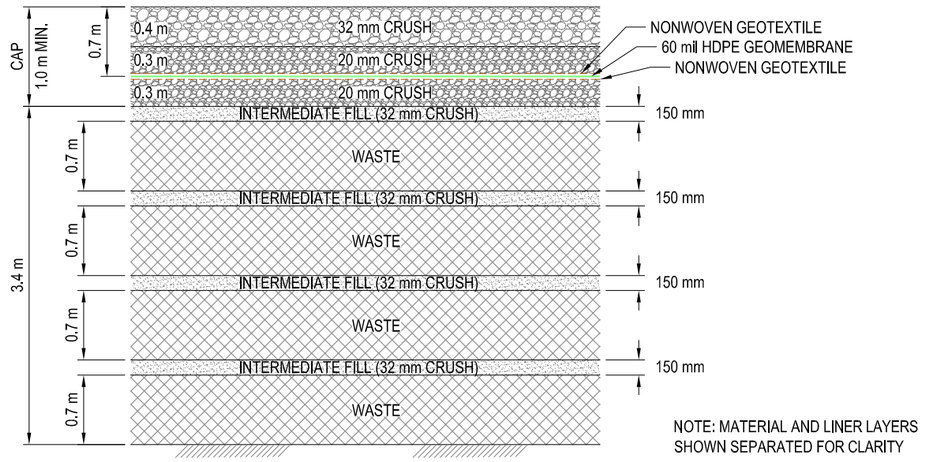


C / **C03** **CROSS-SECTION C-C'**

0 5 m

Scale: 1: 150

NOTE: MATERIAL AND LINER LAYERS SHOWN SEPARATED FOR CLARITY



NOTE: MATERIAL AND LINER LAYERS SHOWN SEPARATED FOR CLARITY

TYPICAL WASTE LAYER AND CAP LINER DETAIL

NTS

GENERAL NOTES

1. REFER TO THE CONSTRUCTION SPECIFICATIONS AS ISSUED FOR PRODUCT AND INSTALLATION SPECIFICATIONS FOR THE NONWOVEN GEOTEXTILE AND HDPE GEOMEMBRANE.
2. REFER TO CONSTRUCTION SPECIFICATIONS AS ISSUED FOR FILL MATERIALS AND PLACEMENT SPECIFICATIONS.
3. AN AS-BUILT SURVEY OF THE FOUNDATION PAD MUST BE UNDERTAKEN AND PRESENTED TO THE ENGINEER PRIOR TO THE START OF BERM CONSTRUCTION TO CONFIRM THE SUITABILITY OF THE DESIGN.
4. THE CONTRACTOR WILL AT ALL TIMES MAKE HIS SURVEYOR AVAILABLE TO THE ENGINEER AT A MUTUALLY AGREED UPON TIME, SHOULD THE ENGINEER NEED SURVEYING SERVICES TO COMPLETE QUALITY CONTROL OF THE WORKS.

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CONSTRUCTION NOTES

1. LANDFILL BERMS AND PROTECTIVE BEDDING FOR LINER TO BE CONSTRUCTED WITH 20 mm CRUSH (PROCESSED QUARRY MATERIAL).
2. LAYERS OF INTERMEDIATE FILL AND LANDFILL CAP TO BE CONSTRUCTED WITH 32 mm CRUSH (PROCESSED QUARRY MATERIAL).
3. TYPICAL DETAILS ARE NOT TO SCALE (NTS) UNLESS SPECIFICALLY MENTIONED.
4. ALL DIMENSIONS ARE IN METRIC UNITS.

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DETAILS AND GENERAL NOTES

EBA Engineering Consultants Ltd.

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OFFICE: EBA-RIV	DATE: June 2010		

C05

PHOTOGRAPHS

Photo 1
Proposed location of landfill in Quarry A. March 19, 2010, development of Quarry A had just commenced. View looking north-northeast.

Photo 2
Quarry A in development April 2010. Aerial photo taken by HBML.
Photo provided by Nuna Logistics, April 17, 2010. View looking north-northeast.

Hope Bay Mining Ltd.

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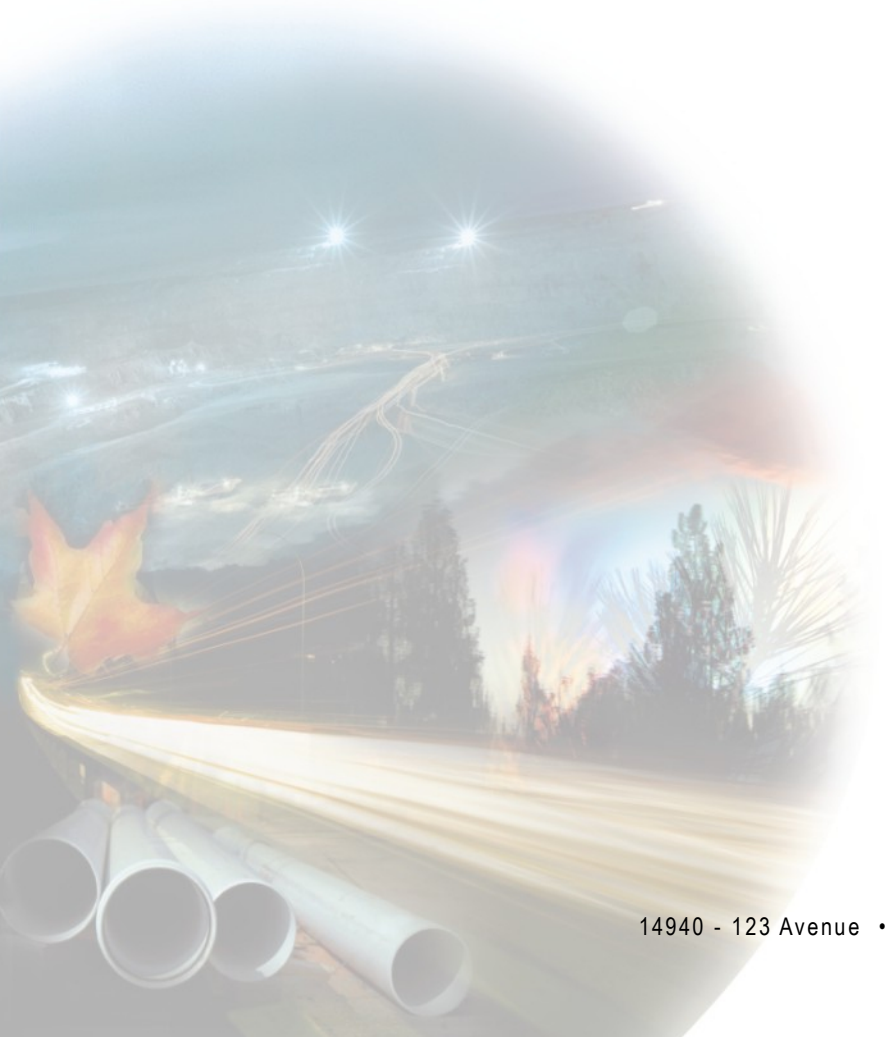
CONSTRUCTION SPECIFICATIONS AND DRAWINGS
QUARRY A INERT SOLID WASTE LANDFILL
DORIS NORTH PROPERTY, NU



E14101082.001

June 2010

EBA Engineering Consultants Ltd.
p. 780.451.2121 • f. 780.454.5688
14940 - 123 Avenue • Edmonton, Alberta T5V 1B4 • CANADA

TABLE OF CONTENTS

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3	Foundation Preparation	1
4	Fill Materials	3
5	Fill Placement	3
6	Liner System – HDPE Geomembrane and Nonwoven Geotextile	13

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Drawing	**Drawing Number**
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Existing Site Topography and General Layout	C02
Foundation Base and Landfill Plan	C03
Cross-sections	C04
Details and General Notes	C05

DEFINITIONS

1.0 GENERAL

.1 Definitions of terms used throughout the Construction Specifications are presented in this Section.

2.0 DEFINITIONS OF TERMS USED

Construction Drawings	The design drawings as issued for construction of the inert solid waste landfill in Quarry A.
Construction Specifications	This document.
Contract	The legal and binding agreement between the Contractor and Hope Bay Mining Ltd. (HBML) regarding construction of the landfill in Quarry A.
Contractor	The general contractor responsible for constructing the landfill.
Engineer	The EBA Engineering Consultants Ltd. (EBA) representative or Owner Representative on site during landfill construction or related activities.
Inert waste	Waste that is neither chemically nor biologically reactive and will not decompose (e.g. concrete, drywall, tires).
Landfill	Defined as a facility designed to permanently contain solid, non-combustible, non-hazardous waste materials.
Owner	Hope Bay Mining Ltd. (HBML), Newmont Mining Corporation's operating company for the Hope Bay Project.
Site	The area (Quarry A) in which landfill construction or related activity is occurring.
Unsuitable	Not meeting the requirements stated herein or not receiving the Engineer's approval.

END OF SECTION

1.0 GENERAL

Hope Bay Mining Ltd. (HBML), Newmont Mining Corporation's operating company for the Hope Bay Project, retained EBA Engineering Consultants Ltd. (EBA) to site and design an on-site inert solid waste landfill within Quarry A at the Doris North Property, Hope Bay Project, NU, Canada. The Engineering Design Drawings and Specifications for the construction of the Landfill are presented herein.

The landfill is entirely contained within the development footprint of Quarry A. The base of the landfill is designed to slope gradually from north to south and east to west, so in the event of discharge from the landfill, leachate would concentrate in the southwest corner of Quarry A and be contained in Quarry A, if required. Quarry A is presently being developed to provide blast rockfill materials to construct an all-weather road from Doris North to Windy Camp. The approximate extent of Quarry A is presented on the Construction Drawings. On September 8, 2008, HBML made an application to access Inuit Owned Lands (IOL) to quarry 1,000,000 cubic metres (m^3) from Quarry A. Authority was granted on October 2, 2008, in the form of Quarry Permit Agreement KT308Q010.

The landfill design is based on the premise that it will contain generally dry, non-leachate-generating materials. Therefore, it is considered unnecessary to completely eliminate moisture migration into and out of the landfill; however, several design elements have been implemented to mitigate moisture migration.

The landfill is located on competent bedrock within a region of continuous permafrost. The landfill is hydrogeologically isolated due to the presence of permafrost, and the host rock is of good quality such that cracks or fractures created by blasting are expected to be surficial and should not propagate any leachate.

Crushed rock 20 mm (¾ inch) and 32 mm (1¼ inch) material from Quarry 2 will be used to construct the landfill berms and cap and provide intermediate layers of fill. The perimeter containment berms will be about 3.4 metres in height and have maximum inside and outside sideslopes of 2.0H:1V and 2.5H:1V, respectively. The shallow outside sideslopes are provided for long-term stability and to minimize surface erosion. An additional layer of 150 mm (6 inch) crushed rock will be placed on the outside slopes of the exposed berms for long-term erosion protection.

Capping material will be used to cover the landfill debris and to move the active thaw layer away from the stored waste. Over time, permafrost is expected to partially aggrade into the landfilled waste. The freezing temperatures should bond any moisture originating from precipitation that migrates into the landfill from its sideslopes to the base of the landfill. A liner system will be installed within the landfill cover (HDPE liner protected on either side by a nonwoven geotextile) to eliminate the ingress of moisture from the surface of the landfill. Moisture that comes in contact with the liner will travel along the surface of the liner and exit from the downslope (south) side of the landfill.

GENERAL

Landfill debris will be placed and compacted in lifts (0.7 metres thick), with intermediate fill (150 mm thick) graded over the debris to fill the voids in order to reduce settlement and final cover subsidence. The waste will be compacted under the weight of heavy equipment.

2.0 MATERIALS

.1 The various materials referenced in the Construction Specifications are designated on the Construction Drawings. Estimated "in-place" material quantities are presented in Table 1.1 for the landfill.

TABLE 1.1 QUARRY A LANDFILL CONSTRUCTION MATERIAL QUANTITIES (ESTIMATE)	
Total Fill (m^3)	15,650
Total 20 mm Landfill Berms and Cover Materials (m^3)	10,600
Total 32 mm Intermediate Fill and Cover Materials (m^3)	4,050
Total 150 mm Erosion Protection Material (m^3)	1,000
Total Nonwoven Geotextile (m^2)	8,290
Total Geomembrane – HDPE (m^2)	4,150
Total Storage Capacity of Landfill, including intermediate fill (m^3)	~12,150

Notes:

(a) Material quantities have been estimated based on lines, grades, and elevations shown on the Construction Drawings.

(b) Material quantities should be increased by a minimum of 10% to account for waste and/or overbuild that may occur during construction.

(c) Liner material quantities should be increased by a minimum of 15% to account for overlap, damaged sections, and/or waste that may occur during construction.

(d) Material quantity for Access Ramp not included in Table 1.1 (general fill, approximately 1,160 m^3).

3.0 SITE CLEANUP

.1 The Contractor shall remove all temporary structures and shall clean up the construction area, borrow areas, and stockpile areas after completion of the Contract work.

END OF SECTION

FOUNDATION PREPARATION

1.0 GENERAL

.1 Foundation preparations for the landfill site are presented in this Section.

2.0 DRILLING AND BLASTING

.1 The Contractor is responsible for ensuring that blasting procedures used are within guidelines set by all regulatory bodies and authorities having jurisdiction on site.

.2 The Contractor shall use excavation methods that minimize fracturing beyond excavation limits.

.3 Care shall be taken in locating the drill holes, and while drilling, orienting the drills so that accurate positioning and alignment of the drill holes is achieved.

.4 The method of excavation shall produce a foundation base that is free of abrupt changes in elevation.

.5 Controlled blasting techniques shall be used to satisfy the excavation requirements stated herein. The initial explosive type and quantity, blasting sequence, and delay pattern shall be modified where required to achieve the requirements specified herein.

.6 The Contractor shall submit complete details of any proposed blast to the Owner's representative twenty-four (24) hours prior to commencement of drilling for each blast.

.7 If, in a specific area, a plan that was previously adopted does not produce conditions in accordance with the requirements stated herein, the Contractor shall submit a revised blasting plan to the Engineer before continuing with drilling and blasting in adjacent areas.

3.0 FOUNDATION APPROVAL

.1 The foundation shall be inspected and approved by the Engineer or the Owner's representative before any fill material is placed. The Contractor shall give not less than twenty-four (24) hours notice to the Engineer regarding required approval of the foundation base.

END OF SECTION

FILL MATERIALS

1.0 GENERAL

.1 This Section describes the material specifications for the fill materials for the landfill.

.2 Material quantities are presented in Table 1.1.

2.0 MATERIAL SOURCES

.1 No material of any type shall be borrowed or excavated without the Owner's prior approval.

.2 Pits and quarries shall be maintained and managed in accordance with the requirements set out in the Owner's Land Use and Quarry Permits.

.3 All Crushed Rock materials specified herein will be processed materials from operations in Quarry 2.

.4 Processed materials will be subject to continual sampling by the Engineer during production.

.5 20 mm Crushed Rock material shall be processed from material obtained from Quarry 2, or from other sources approved by the Owner, provided the final product meets the requirements specified herein. Processing will be required to achieve the specified gradation.

.6 32 mm Crushed Rock material shall be obtained from Quarry 2, or from other sources approved by the Owner, provided the final product meets the specified requirements herein. Processing will be required to achieve the specified gradation.

.7 150 mm Crushed Rock material shall be obtained from Quarry 2, or from other sources approved by the Owner, provided the final product meets the specified requirements herein. Processing will be required to achieve the specified gradation.

.8 The parent rock from which all fill materials are derived shall consist of sound, hard, durable material free from soft particles and unsuitable substances. The potential quarry source shall be approved by the Engineer. The Engineer may require trial crushing and durability testing prior to approving a quarry site.

3.0 PROCESSING

.1 Process aggregate uniformly using methods that prevent contamination, segregation, and degradation.

.2 Moisture condition aggregate as required to achieve the specified density and/or degree of saturation.

FILL MATERIALS

4.0 MATERIAL SPECIFICATIONS

.1 20 mm Material

The 20 mm material shall consist of hard, durable particles; shall be free of roots, topsoil, and deleterious material; and shall have a particle size distribution as presented in Table 3.1.

TABLE 3.1: 20 MM MATERIAL PARTICLE SIZE DISTRIBUTION LIMITS

Particle Size (mm)	% Passing
20.0	100
12.5	65 – 100
5.0	45 – 70
0.63	15 – 35
0.08	4 – 8

.2 32 mm Material

The 32 mm material shall consist of hard, durable particles; shall be free of roots, topsoil, and deleterious material; and shall have a particle size distribution as presented in Table 3.2.

TABLE 3.2: 32 MM MATERIAL PARTICLE SIZE DISTRIBUTION LIMITS

Particle Size (mm)	% Passing
32.0	100
20.5	65 – 100
12.5	60 –90
5.0	45 – 70
0.63	10 – 35
0.08	0 – 10

.3 150 mm Material

The 150 mm material shall be free of roots, topsoil, and other deleterious material, and shall have a particle size distribution within the limits presented in Table 3.3.

FILL MATERIALS

TABLE 3.3: 150 MM MATERIAL PARTICLE SIZE DISTRIBUTION LIMITS	
Particle Size (mm)	**% Passing**
150	100
100	25 – 100
50	15 – 75
20	0 – 35
5	0 – 10

END OF SECTION

FILL PLACEMENT

1.0 GENERAL

.1 The placement methods to be used during construction of the landfill are described in this Section.

.2 Construction shall be performed in accordance with the best modern practice and with equipment best adapted to the work being performed. Berm (embankment) materials shall be placed so that each zone is homogeneous and free of stratifications, ice chunks, lenses or pockets, and layers of material with different texture grading not conforming to the requirements stated herein.

.3 No embankment fill material shall be placed on any part of the foundation until it has been prepared as specified herein and approved by the Engineer or Owner's representative. Placement of fill material shall conform to the lines, grades, and elevations shown on the Construction Drawings, as specified herein. Fill placement shall be conducted in such a manner that mixing of fill materials in adjacent zones is avoided.

.4 Embankment construction shall not proceed when the work cannot be performed in accordance with the requirements of the Construction Specifications. Any part of the embankment that has been damaged by the action of rain, snow, or any other cause shall be removed and replaced with the appropriate material conforming to the requirements stated herein before succeeding layers are placed.

.5 Stockpiling, loading, transporting, placing, and spreading of all materials shall be carried out in such a manner to avoid segregation. Segregated materials shall be removed and replaced with the materials meeting the requirements stated herein as required by the Engineer.

.6 The Contractor shall remove all debris, vegetation, or other material not conforming to the requirements stated herein. The Contractor shall dispose of these materials in an area approved by the Owner.

.7 Suspend operations whenever weather conditions would prevent grading from conforming with this Specification.

2.0 REFERENCE STANDARDS

.1 American Society for Testing Materials

.a ASTM D698-91 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))

FILL PLACEMENT

3.0 20 mm MATERIAL

.1 The 20 mm material shall be placed in lifts not exceeding 250 mm. The placement method used shall ensure that segregation and nesting of coarse particles is avoided.

.2 The placed 20 mm material shall be compacted to a minimum of 95% of the maximum dry density as determined by test method ASTM D698-91. Moisture conditioning may be required to achieve the specified compaction.

.3 The foundation shall be cleared of all deleterious material. The foundation area shall be inspected and approved by the Engineer before fill placement proceeds.

.4 The 20 mm material placed shall be compacted with a smooth drum vibratory compactor. The 20 mm material shall be compacted to achieve the maximum density possible at the placed moisture content. The number of passes may be adjusted at the Engineer's discretion to suit varying conditions.

4.0 32 mm MATERIAL

.1 The 32 mm material shall be placed in lifts not exceeding 300 mm. The placement method used shall ensure that segregation and nesting of coarse particles is avoided.

.2 The placed 32 mm material shall be compacted to a minimum of 95% of the maximum dry density as determined by test method ASTM D698-91. Moisture conditioning may be required to achieve the specified compaction.

.3 The foundation shall be cleared of all deleterious material. The foundation area shall be inspected and approved by the Engineer before fill placement proceeds.

.4 The 32 mm material placed shall be compacted with a smooth drum vibratory compactor. The 20 mm material shall be compacted to achieve the maximum density possible at the placed moisture content. The number of passes may be adjusted at the Engineer's discretion to suit varying conditions.

5.0 150 mm MATERIAL

.1 The 150 mm material shall be placed in one (1) thin lift, not exceeding 400 mm, along the outside landfill slopes for erosion protection. The placement method used shall ensure that segregation and nesting of coarse particles is avoided.

.2 The 150 mm material (jaw crush rockfill) shall be compacted where possible with heavy earthmoving equipment.

.3 Material will only be used as erosion protection on the downslope face of the berms.

6.0 QUALITY ASSURANCE

.1 General

This section describes the required quality assurance testing that shall be carried out for fill materials.

The testing will be carried out by the Engineer or an independent testing firm engaged by the Owner.

.a 20 mm and 32 mm Material

Quality assurance testing shall be performed when the 20 mm and 32 mm material is being processed and placed. The tests and testing frequency required while processing and placing the 20 mm and 32 mm material are presented in Table 5.1. Additional testing may be required at the discretion of the Engineer.

TABLE 5.1 TESTS AND TESTING FREQUENCY

Test	Frequency
Particle size	one per 1,000 m^3 placed
Standard Proctor	one per 2,000 m^3 placed
In Situ Density	one per 100 m^3 placed

.2 Testing Requirements

.a Crushed Rock – Samples of the rockfill material shall be evaluated by the Engineer from time to time to determine if in his judgement it meets the gradation criteria of this specification.

END OF SECTION

LINER SYSTEM – HDPE GEOMEMBRANE AND NONWOVEN GEOTEXTILE

1.0 GENERAL

.1 The product and installation specifications for the nonwoven geotextile and HDPE geomembrane liner system to be used in the landfill cover is presented in this Section.

.2 The liner system will be provided by the Owner [to be confirmed] and installed by the Contractor.

2.0 NONWOVEN GEOTEXTILE

.1 General

.a This section describes the specific requirements for supply and installation of nonwoven geotextile. The geotextile cushion is to form both a base and a cover to the HDPE geomembrane liner.

.2 Materials

.a Nonwoven Geotextile: The geotextile shall be a nonwoven fabric consisting only of continuous chain polymeric filaments or yarns of polyester, formed into a stable network by needlepunching. The fabric shall be inert to commonly encountered chemicals and hydrocarbons, resistant to mildew and rot, resistant to ultraviolet light exposure, resistant to insects and rodents, and conform to the properties in Table 6.1.

.b Alternatives will be considered upon submission of material datasheets. Alternatives will be evaluated for compliance with the following properties, based on minimum average roll values.

TABLE 6.1: TEST REQUIREMENTS: NONWOVEN GEOTEXTILE

Physical Properties		Minimum Average Roll Value (Weakest Principal Direction)
Thickness – Typical (mm)	ASTM D5199	2.9
Grab Tensile Strength (N)	ASTM D4632	1,110
Elongation at Failure (%)	ASTM D4632	50
Tear Strength (N)	ASTM D4533	444
Apparent Opening Size (microns)	ASTM D4751	150
Puncture (N)	ASTM D4833	771
Weight – Typical (g/m^2)	ASTM D5261	339
Roll Size (m)	—	4.57 x 91.4
Roll Weight (kg)	—	140

LINER SYSTEM – HDPE GEOMEMBRANE AND NONWOVEN GEOTEXTILE

.3 Shipping, Handling and Storage

.a Provide the geotextile in rolls wrapped with protective covering to protect the fabric from mud, dirt, dust, and debris. The fabric shall be free of defects or flaws that significantly affect its physical properties. Label each roll of fabric in the shipment with a number or symbol to identify that production run.

.b During delivery and storage, protect geotextiles from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris, rodents, and water.

.4 Conformance Testing

.a Conformance testing of the geotextile is not required; verification of the manufacturing quality control documentation for the production run will be sufficient for determining material conformance.

.5 Installation

.a Place geotextile directly on top of and below geomembrane as shown on the drawings. The surface must be smooth and free of sharp objects.

.b Where located below a geomembrane, maintain intimate contact between geotextile and soil so that no void spaces occur. Avoid laps and folds in the geotextile.

.c Place fill material or geomembrane immediately after laying geotextile.

.d Place fill material so as to avoid damage to the geotextile.

.i Maximum drop height for fill directly onto geotextile is 1 metre.

.ii Minimum lift thickness prior to starting compaction is 300 mm.

.6 Quality Assurance

.a All materials, procedures, operations, and methods shall be in conformance with the Drawings and Specifications and shall be subjected to quality assurance monitoring as detailed herein. The installed systems shall conform to the Drawings and Specifications, except as otherwise authorized in writing by the Engineer.

.7 Underlying Surface Preparation

.a Ensure that the surface underlying the geotextile is graded smooth and is free from angular rocks, debris, and protrusions. Remove all particles greater than 20 mm in diameter.

.8 Deployment

.a Do not begin installation of the nonwoven geotextile until the base has been approved by the Engineer.

.b Deploy the geotextile by unrolling onto the prepared surface in orientation, manner, and locations indicated. No securing pins are permitted to secure nonwoven geotextiles.

.c Place geotextile material smooth and free of tension stress, folds, wrinkles, and creases.

.d Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.

.e Overlap each successive strip of geotextile a minimum of 600 mm over previously laid strip.

.f Employ sufficient temporary anchorage to hold geotextile in place during placement of other elements of the liner system or during backfilling.

.g Heat track or glue geotextile overlaps prior to placing granular fill cover to prevent lifting or separation of overlap.

.h Protect installed geotextile material from displacement and damage until, during, and after placement of additional material layers.

.i Repair rips or tears with a patch that covers a minimum of 1 metre on each side of the rip or tear.

.9 Protection

.a Do not permit passage of any vehicle directly on the geotextile at any time.

3.0 HDPE GEOMEMBRANE

.1 Description

.a This section specifies the requirements for the supply and installation of the High Density Polyethylene (HDPE) Geomembrane Liner to be installed in the cap/cover of the landfill.

.2 References

.a Where materials properties are specified the following standards are applicable:

.i ASTM D413 – Rubber Property - Adhesion to Flexible Substrate (Seam Peel Strength)

.ii ASTM D746 –Brittleness Temperature of Plastics and Elastomers by Impact

.iii ASTM D792 –Specific Gravity and Density of Plastics by Displacement

.iv ASTM D882 –Tensile Properties of Thin Plastic Sheeting (Sheet and Seam Shear Strength)

.v ASTM D1004 –Initial Tear Resistance of Plastic Film and Sheeting

LINER SYSTEM – HDPE GEOMEMBRANE AND NONWOVEN GEOTEXTILE

.vi ASTM D1603 – Carbon Black of Olefin Plastics

.vii ASTM D3767 Standard Practice for Rubber Measurement of Dimensions

.viii ASTM D4437-84 Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes.

.3 Manufacturer's Certification and Warranty

.a The geomembrane manufacturer shall have at least two years of continuous experience in the manufacture of HDPE geomembrane rolls and/or experience totalling 4,000,000 square metres of manufactured HDPE geomembrane.

.b Provide to the Engineer, prior to shipment of materials to the site, the following:

.i Name of the manufacturer and information on the manufacturer's factory size, equipment, personnel, number of shifts per day, and capacity per shift.

.ii Manufacturer's quality control program and manual, or descriptive documentation.

.iii List of material properties and liner samples.

.iv A signed manufacturing certification that the materials to be shipped to the site have test values for each property listed that meet or exceed the property values specified for that material. These certificates shall be signed by the Product Manager or Quality Control Manager of the geomembrane manufacturer.

.v Resume of the qualifications of the Installation Supervisor and Master Seamer to be assigned to the project.

.c Provide a written 20 year warranty against defects or deficiencies in the quality of the geomembrane liner material supplied.

.4 Geomembrane Installer

.a The geomembrane shall be installed by an approved geomembrane installer trained and licensed by the geomembrane manufacturer to install the manufacturer's geomembrane. Installation shall be performed under the constant direction of the Contractor's field Installation Supervisor who shall remain on site and be responsible, throughout the liner installation, for liner activities by the Installer. This Installation Supervisor shall have installed or supervised the installation and seaming of a minimum of 3,000,000 square metres of HDPE geomembrane. The Installation Supervisor shall remain on site until all cover material has been placed over the entire geomembrane.

.b Actual seaming shall be performed under the direction of a Master Seamer who has seamed a minimum of 3,000,000 square metres of HDPE geomembrane. The

Master Seamer, who may also be the Installation Supervisor, shall be present whenever seaming is performed.

.c Provide the following information regarding the Geomembrane Installer:

.i Brief historical background.

.ii Insurance coverage.

.iii Welding procedures.

.iv Information on equipment and personnel.

.d Provide adequate proof of qualification of the Installation Supervisor, including a list of at least five completed facilities, totalling a minimum of 200,000 square metres for which the Supervisor has installed or supervised the installation of HDPE geomembrane. For each installation, the following information shall be provided:

.i Name and purpose of facility, its location, and date of installation.

.ii Name of Owner and Design Engineer.

.iii Thickness of geomembrane and surface area of the installed geomembrane.

.iv Type of seaming, patching, and tacking equipment.

.e Provide prior to liner installation:

.i Proposed installation panel layout identifying seams and details. The drawings shall indicate roll number, sizes, and position of rolls and shall be subject to the approval of the Engineer.

.ii Any proposed variance or deviation from the specified guidelines. Submit changes in writing to the Engineer a minimum of seven working days prior to the scheduled start of geomembrane installation. Acceptance or rejection by the Engineer shall be provided prior to the start of installation activities.

.f Geomembrane Acceptance

.i Retain ownership and responsibility for the geomembrane until acceptance by the Engineer.

.ii The geomembrane liner shall be accepted by the Engineer when all of the following conditions are met:

- Installation of the entire liner is finished.
- Verification of the adequacy of all field seams and repairs, including associated testing, is complete.
- Certification, as described in this Section and including record drawings, is provided by the Contractor to the Engineer.

LINER SYSTEM – HDPE GEOMEMBRANE AND NONWOVEN GEOTEXTILE

.g Workmanship Warranty

.i Warranty the liner installation to be free of defects in materials and workmanship for a period of 2 years following the date of acceptance by the Owner or its representative.

.ii Make any repairs or replacements made necessary by defects in materials or workmanship in the work that became evident within said warranty period. No additional reimbursement will be made for these repairs.

.iii Make repairs and replacements promptly upon receipt of written order from the Engineer. If the Contractor fails to make repairs and replacements promptly, the Engineer may do so and the Contractor shall be liable for the cost of such repairs and replacements.

.5 Materials

.a Geomombrane shall be 60 mil smooth High Density Polyethylene (HDPE).

.b The HDPE geomembrane shall be formulated from resin incorporating a flexible modifier, and consisting of approximately 98% polyethylene, 2% carbon black, and trace amounts of antioxidants and heat stabilizers.

.c Alternatives will be considered upon submission of material data sheets. Alternatives will be evaluated for compliance with the following properties, based on minimum average roll values.

.d Resin

.i Resin shall be polyethylene copolymer suitable for extrusion into sheets.

.ii The compounding ingredients used in producing sheet stock for geomembranes shall be first quality, prime material.

.iii Reclaimed polymer material, otherwise known as rework or regrind material, die-spill, etc., shall not be used in any form for the manufacture of sheet or extrudate material.

.iv Resin General Properties shall conform to Table 6.2.

TABLE 6.2: RESIN PROPERTIES

Property	Test Method	Value
Density	ASTM D792 Method A	0.93 – 0.95 g/cm
Melt Index	ASTM D1223 Condition E	0.20 – 1.1 g/10 min

.e Geomembrane

.i The sheet cross-section shall be uniform in colour and appearance, without inclusions, bubbles, foreign matter, or evidence of possible laminations when examining microtome specimens under 100x magnification.

.ii The sheet surface shall be free from striations, roughness, pinholes, bubbles and factory patches, and shall not contain blisters, undispersed raw material, nor be contaminated by foreign matter.

.iii The liner sheet shall be manufactured in North America.

.iv Geomembrane Index Characteristics shall conform to Table 6.3.

TABLE 6.3: HDPE GEOMEMBRANE INDEX CHARACTERISTICS

Characteristics	Test Method	Value
Nominal Thickness	ASTM D5199	(60 mil) 1.5 mm ±10%
Carbon Black Content	ASTM D1603	2% to 3%, maximum total additives 3%
ESCR	ASTM D5397	300 hours
Brittleness Temperature	ASTM D746, Procedure B	< -70°C
Tear Resistance	ASTM D1004	>187 N (42 lbs)
Puncture Resistance	ASTM D4833	> 480 N (108 lbs)
Tensile Strength Modified Type IV Die	ASTM D638	
Stress at Yield		22 kN/m (126 ppi)
Stress at Break		40 kN/m (228 ppi)
Strain at Yield (33 mm Gauge)		12%
Strain at Break (50 mm Gauge)		700%

.f Geomembrane Defects

.i The following conditions shall be considered defects:

- Roughness or striations, in either the machine or transverse direction, which could induce a notch effect when placed in tension.
- Bubbles, blisters, or any local variation in sheet thickness which exceeds 20% of the specified sheet thickness, or which exceeds 150 mm in any dimension.
- Undispersed raw material or foreign matter present in either the surface or the cross-section of the sheet.
- Pinholes, tears, gouges, or any other through-thickness defect.

.ii Sheets that contain 10 or more defects per 1,000 square metres shall be rejected. At the discretion of the Engineer's Representative, the extent of rejection may be limited to the affected area only.

.iii Sheets with fewer than 10 defects per 1,000 square metres may be repaired or replaced at the Contractor's option. Repairs shall be made in accordance with this specification.

.6 Identification

.a Identify each roll by means of a label which is permanently affixed to the inside of the roll. As a minimum, the label shall indicate the following information:

.i Name of the manufacturer.

.ii Date of manufacture.

.iii Thickness of the material.

.iv Roll number.

.b If the manufactured rolls are assembled into panels prior to shipping to the job site, the label shall also include the following information:

.i Panel number.

.ii Roll numbers which comprise the manufactured panel.

.7 Transportation

.a Place a sacrificial strip of membrane between the geomembrane and each strap.

.b Cut off the free ends of metal strapping prior to shipping.

.c Install protective caps to cover and protect the edge of the geomembrane during transportation.

.8 Site Handling and Storage

.a Ensure that the sheet is not folded at any time during the manufacturing, fabrication, shipping, or installation processes.

.b Material is to be stored on sacrificial sheet at site.

.c Any damage to the sheet shall be immediately pointed out to the Engineer's Representative.

.i The Engineer's Representative shall determine the feasibility of repair or replacement.

.ii If the material cannot be repaired, it shall be replaced.

.iii If the damage is due to faults in any of manufacturing, shipping, or handling, then the repair or replacement shall be at the Contractor's expense.

4.0 QUALITY ASSURANCE

.1 Contractor Construction Quality Control

.a Carry out a visual inspection of the liner panels and joints as the installation progresses and again upon completion of the liner. Clearly mark and repair

defective and questionable areas. Repair all areas identified to the satisfaction of the Engineer.

.b Test all joints and repairs in the HDPE liner by vacuum testing or pressurized dual seams testing (for double hot wedge welds only). Carry out all testing in the presence of or with knowledge of the Engineer. Repair all defective areas detected to the satisfaction of the Engineer.

.c Perform a vacuum test on all extrusion welded seams and repairs, in the following manner:

.i The area to be tested shall be cleaned of all dirt, debris, and other foreign matter and then a soap and water solution shall be applied.

.ii A gasket vacuum box (American Parts and Service Company, Alhambra, California, Series #A100 or approved equivalent) assembly consisting of a rigid housing, a clean transparent viewing window, and a vacuum gauge shall be immediately placed, in a manner to ensure a seal over the area of the liner to be tested.

.iii A vacuum of 3 to 6 psi shall be induced and held for a minimum of 5 seconds or long enough for the area to be thoroughly examined.

.iv Examine the geomembrane through the viewing window for the presence of soap bubbling; all areas where leaks are identified shall be marked and repaired.

.v Any portion of an extrusion seam or repair that cannot be vacuum tested must be pick tested.

.d Perform pressurized testing of all double wedge weld seams, regardless of length, in the following manner:

.i A needle with pressure gauge, or other approved pressure feed device equipped with a pressure gauge, shall be inserted into the channel produced in the middle of the double wedge weld.

.ii The channel shall be pressurized to 45 psi to allow the seam to stretch and stabilize. The pressure shall then be dropped to 35 psi and sustained for five minutes.

.iii If the loss of pressure exceeds 2 psi or does not stabilize, then the seam will either be repaired entirely or the faulty area will be located and marked for repair.

.iv If blockage is present, locate and test seam on both sides of blockage.

.v Remove needle or other approved pressure feed device and seal all penetration holes by extrusion welding.

LINER SYSTEM – HDPE GEOMEMBRANE AND NONWOVEN GEOTEXTILE

.2 Destructive Testing

.a Qualification Welds:

.i Conduct destructive tests in accordance with ASTM D4437-84 on qualification welds to verify that seaming conditions and equipment are satisfactory.

.ii Test seams at the beginning of each seaming period, if welding has ceased for a period of 2 hours or more for each seaming apparatus used that day when climatic conditions cause wide changes in geomembrane temperature (±5°C in 1 hour) or other conditions that could affect seam quality.

.iii Make all qualification welds at a location selected by the Engineer in the area of the seaming and in contact with the base material. The qualification welds shall be a minimum of 1 metre long with the seam centred lengthwise. Cut specimens from each end of the test seam and test for shear and peel. If a test seam fails to meet field seam specifications, the seaming apparatus and/or seam shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive, successful, full test seams are achieved. A seam pass is achieved when the seam exhibits the following properties:

- Completed seams shall have a minimum strength in shear of at least 90% of the specified parent material tensile strength at yield when tested in accordance with ASTM D4437-84, or approved equivalent.
- Completed seams shall have a minimum strength in peal of at least 80% of the specified parent material tensile strength at yield, and break as a film tear bond or a minimum of 10% adhesion break when tested in accordance with ASTM D4437-84, or approved equivalent.

.b Field Seams:

.i Destructive testing of field seams is not required. Verification of the integrity of field seams by destructive testing of test strips and the non-destructive testing of field seams will be sufficient for determination of conformance.

.c Factory Fabrication Seams:

.i Use heat welding techniques for shop fabrication such that all shop welds will provide a "Full Tear Bond" as outlined in ANSI/NSF 54 Annex A, Part 5, Peel Adhesion, to the requirements listed in Table 02499-1.

.ii Test factory fabrication welding for bonded seam strength and peel adhesion at a rate of 3 samples for every 900 metres of welded seam.

.3 Recording of Results

.a Provide daily documentation of all testing to the Engineer. This documentation shall identify all seams that initially failed the test and include evidence that these seams were repaired and successively retested.

5.0 DEFECTS AND REPAIRS

.1 Inspect all seams and non-seam areas of the installed geomembrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Brush, blow, or wash the geomembrane surface, if required for inspection. The Engineer shall decide if cleaning of the geomembrane is needed to facilitate inspection. This inspection shall be done immediately after placement of the liner.

.2 Non-destructively test each suspect location in seam and non-seam areas, as appropriate, in the presence of the Engineer. Mark each location that fails the non-destructive testing, and repair accordingly.

.3 Make a vacuum box available on site in the event that non-destructive testing of non-seam areas is required.

.4 Adhere to the following procedures in completion of geomembrane repairs:

.a Re-start/re-seam defective seams as described in these Specifications.

.b Repair holes and/or tears by patching. Where the tear is on a slope or an area of stress and has a sharp end, it must be rounded prior to patching.

.c Repair blisters, large holes, undispersed raw materials, and contamination by foreign matter by patching.

.d Ensure patches are round or oval in shape, made of the same geomembrane, and extend a minimum of 150 mm beyond the edge of defects. All patches shall be of the same compound and thickness as the geomembrane specified. Patches shall be applied using approved methods only.

.e Non-destructively test each repair, except when the Engineer requires a destructive seam sample obtained from a repaired seam. Repairs that pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be repeated and re-tested until a passing test result is achieved.

.f Carry out field patching operations at temperatures below 10°C by heat welding only.

6.0 WEATHER CONDITIONS

.1 Do NOT proceed with seaming when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. The Installer shall

demonstrate that acceptable seaming can be performed by completing trial welds acceptable to the Engineer. Do NOT carry out geomembrane seaming during any precipitation, in the presence of excessive moisture (e.g., fog, rain, dew), or in the presence of excessive winds as determined by the Engineer.

7.0 BASE PREPARATION

.1 Prepare a 300 mm thick Granular Fill base layer by levelling and compacting the layer to 95% of Maximum Dry Density in accordance with ASTM D698. Do NOT begin installation of the geomembrane until the base layer has been approved by the Engineer.

8.0 DEPLOYMENT

.1 Ensure that:

.a No equipment or tools damage the geomembrane by handling, trafficking, or other means.

.b No personnel working on the geomembrane wear damaging shoes or engage in other activities that could damage the geomembrane.

.c The method used to unroll the panels does not cause scratches or crimps in the geomembrane and does not damage the supporting soil or underlying geotextile.

.d The method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels).

.e Slack for thermal contraction is well distributed, and in accordance with the manufacturer's recommendations.

.f All defects are marked and documented for repairs. Defects are defined as any abnormalities that affect the physical properties of the geomembrane material. If greater than 10 defects per 1,000 square metres exist, then replace or repair damaged geomembrane areas at the discretion of the Engineer.

.g Use sandbags or other appropriate measures to prevent movement of the geomembrane panels.

9.0 FIELD SEAMING

.a Perform field seaming only when weather conditions are favourable, or where seaming operations can be protected from unfavourable weather conditions.

.b Make field seams between sheets of liner material using approved welding systems, equipment, and techniques. Acceptable welding systems include extrusion fillet welding and hot wedge welding using a double wedge welder. All wedge welders shall be specifically designed for compatibility with the liner material and

recommended by the manufacturer. Only repairs and detail welds shall be extrusion welded.

.c Clean the contact surfaces of the materials of dirt, dust, moisture, or other foreign materials.

.d Lay the materials to be field seamed flat against one another. Align the materials with sufficient overlap, and bond in accordance with the manufacturer's recommended procedures. Prior to seaming, match wrinkles to avoid fishmouths.

.e Make seams so there are no loose edges.

.f Where possible, orient seams on the slopes perpendicular to the toe of the slope; i.e., oriented down, not across the slope.

.g Seams which parallel the toe of the slope shall have the top sheet overlap the bottom sheet.

.h Cross and toe seams shall be staggered a minimum of one metre.

.i An overlap line a minimum of 150 mm from the edge of the underlying sheet will be clearly identified on every fusion seam.

.j The overlap shall be sufficient to leave a loose flap of geomembrane at least 25 mm wide adjacent to both sides of the seam.

10.0 COVER MATERIAL

.1 Install geotextile cover in accordance with Section 2.0 – Nonwoven Geotextile.

.2 A minimum of 300 mm of cover between low ground pressure equipment and the liner is required at all times.

.3 Avoid undue stress on the liner at all times. Push cover material up sideslopes, not down.

.4 Remove all rocks, stones, roots, or other debris that could cause damage to the geomembrane liner.

.5 Avoid sharp turns or quick stops with equipment that could pinch and tear the liner.

.6 Place material ahead of the leading edge of the fill in such a fashion as to prevent stressing the geomembrane. Do not slide cover material over the liner.

.7 Report any damage to the Engineer immediately and perform repairs without needless delay.

.8 Place and maintain cover in a uniform thickness, free of ruts and irregularities.

.9 Do not work wet cover material that cannot support equipment.

END OF SECTION