2.11 Sewage Treatment Facilities

Sewage treatment will be via a modular packaged biological treatment plant that will be brought to site fully assembled. The camp wastewater will be collected in a grinder pump lift station and discharged to the solids settling tank within the skid-mounted container. The ROTORDISK® sewage treatment plant is a high-efficiency package plant using the process of rotating biological contactors (RBCs) to remove pollutants from wastewater. ROTORDISK® employs disks made from 3/8" grid extruded medium density polyethylene material with U.V. light inhibitors. The grid pattern promotes oxygen transfer into the wastewater and particularly into the core of the media. The assembly is specially designed to prevent anaerobic conditions from developing.

ROTORDISK® is a multi-staged, fixed steel baffle RBC that has been proven to be more efficient for the removal of carbonaceous biological oxygen demand (BOD) and nitrification than a rotating baffle and plug flow media system. This process utilizes a fixed growth bacteria process whereby bacteria are grown on a media surface that is rotated into and out of the wastewater. The treated wastewater flows through four zones each with a progressively higher standard of treatment. Unlike most suspended growth bioreactors, the ROTORDISK® is not prone to upsets and can be operated with very low flows during early years of community development. The system can be operated from zero influent to above design capacity. Treated effluent is collected in a discharge/recycle tank for delivery into the tailings line. Final discharge is into Tail Lake.

2.12 Explosive Storage Facilities

The majority of explosives used during construction and mining at Doris North will consist of ANFO that is batch mixed on site as needed (this batch plant will be located underground once space is available). The ammonium nitrate required will be stored on surface at the Roberts Bay and/or the mill site laydown area until needed. This product is stable and requires no special storage facility.

Pre-packaged explosives will be stored within modular pre-fabricated storage magazines (made from modified sea-cans) shipped to site for this specific purpose. Explosives magazines will be required to store up to 38,000 kg of blasting powder and 39,000 detonators. These storage magazines will meet the appropriate codes for fire and security protection. Explosives and detonators will be stored in separate magazines as required under the prevailing safety codes covering the storage of explosives.

The explosives magazine has to be a minimum distance away from the camp. Information on this minimum setback distance is provided in Section 5.7 in SRK 2003 (b), Supporting Document A4 to the November 2003 FEIS. The proposed explosives magazine site would be approximately 800 m from the camp (straight line distance), but located at the opposite end of a rock outcrop. The explosives magazines will be comprised of a 2.0 m thick pad with surface areas of approximately 600 m^2 and 30 m^2 for the detonator and powder magazines, respectively. Both magazines will be designed to Type 4 magazine standards, as outlined in "storage Standards for Industrial Explosives" (NRCan 1995).

2.13 Power Generation Facilities

Electrical power for the project will be generated on-site by means of diesel electric generator units with a capacity of 4.0 MW (4 x 1.0 MW diesel electric generators). Each of the four generators will arrive installed in a separate 6.1 m x 2.4 m sea-can container. These four containers will be installed side-by-side next to the mill tank farm. They will occupy an area of 70 m^2 (7 m x 10 m).

2.14 Roberts Bay Sealift Landing Site (Jetty, Laydown and Fuel Tank Farm)

The mine site is approximately 4.5 km inland from a navigable portion of the Arctic coastline. Supplies and equipment will be brought to site via annual sealift. The tidal variation in Roberts Bay is in the order of 0.3 m.

2.14.1 Existing Barge Landing Site

Currently, for exploration purposes there is a barge landing site on the western shore of Roberts Bay. This barge landing site has been proven to be a suitable landing site, both with respect to the depth of the bay and the fact that it sits in the lee of the land, which protects it from the prevailing northwest winds. The bay is sufficiently deep that the tugs are able to push the barges onto shore, allowing for easy off-loading. If this site was to be made the barge landing site for the life of the mine it would require an additional 1.5 km of all-weather road as well as a major stream crossing to be constructed. Consequently, an alternate sealift landing site has been identified. The existing site will be rehabilitated and abandoned.

2.14.2 Proposed New Sealift Landing Site (Jetty)

The proposed new permanent sealift-landing site is located on the southeastern shore of Roberts Bay (Figure 2.1). The bay is relatively shallow at this location, necessitating the construction of a 103 m long jetty out into the bay.

The jetty will be constructed from clean quarry rock, end dumped directly onto the bay sediments. The jetty footprint covers 1,794 m^2 of ocean bottom. The final jetty traffic surface will be at least 1.0 m above the high-tide level; this allows the surface to remain 0.5 m above water level during periods of wind-induced increases in water depth of up to 0.5 m. This will require an average jetty thickness of 2.5 to 3.0 m. This thickness allows for 0.5 m of sediment settlement; this assumption is sufficient for preliminary design. In practice, significant displacement of sediment will likely occur as fill is placed, resulting in a mud wave that precedes the fill. The displaced volume of sediment will increase the fill requirements. Final fill volumes will be adjusted in the field to accommodate this potential increase and post construction settlement will be addressed with incremental fill as necessary.

The bottom 2-3 m will be constructed from run-of-mine quarry material (1000 mm maximum size). This will be overlain by 0.2 m of a surfacing grade layer (38 mm maximum size fraction) and 0.3 m of a select grade material (38 mm maximum size fraction) which would act as intermediary between the sub base and the surfacing layer. The side-slopes of the jetty will be at the angle of repose for the quarry rock (approximately 40°).

The overall operational jetty width will be 6 m, which would allow easy and safe off loading of the 20 ft (6.1 m) and 40 ft (12.2 m) long seacan containers with forklifts and trucks. The jetty will end in a widened working area, with a 25 m long mooring face. Bollards and mooring chains will be anchored into the jetty to allow securing of vessels to the jetty structure. Additional information on the proposed jetty can be found in Section 5.1 in SRK 2003 (b), Supporting Document A4 to the November 2003 FEIS.

2.14.3 Permanent Beach Lay-down Area

The land mass immediately inshore from the jetty site is relatively flat tundra, with rock outcrops on either side. Drilling has indicated that these soils are sandy to silty clays of low plasticity containing minor ground ice. This land is well suited for construction of a pad to be used as a lay-down area for annual temporary storage of ammonium nitrate, equipment and supplies offloaded from the sealift vessels. This lay-down area will be a minimum of 100 m from the high tide level, and will be connected to the jetty via an all-weather road.

The lay-down area will have a surface area of 6,000 m^2 (100 m x 60 m), and the pad will be at least 2.5 m thick to preserve the permafrost. The pad has been sized based on the volume of annual freight that is expected to be delivered. The pad will be constructed from clean quarry material placed immediately on undisturbed tundra. A 2 m thick base of sub-grade material (<1,000 mm) will be capped by 0.3 m of select grade (<200 mm) and finished with 0.2 m of surfacing grade (<38 mm) crush. The pad will have an overall surface grade of 0.5% to allow drainage of surface water off the pad. This surface water will be considered uncontaminated and will be allowed to drain freely onto the tundra. The side-slopes of the pad will be at angle of repose for the quarry rock, approximately 40°.

The proposed location of the laydown occurs near the upper catchment boundary. Little to no surface drainage currently occurs within the laydown area footprint, and no design allowances have been made for such drainage.

Following development of the rock quarry northeast of the proposed laydown area, this area will be considered for use as a laydown. If exposed rock is suitable and competent, and sufficient space is available, consideration will be given to using the quarry instead of, or in addition to, the currently proposed laydown area.

2.14.4 Permanent Beach Fuel Tank Farm

Every year approximately eight million litres of fuel will be shipped to Roberts Bay via sealift and pumped to a permanent tank farm on shore. Pumps and floating fuel hoses are supplied by the shipping company for the purpose of fuel transfer. From the tank farm, fuel would be hauled by standard fuel trucks via the all-weather access road to a 0.5 million litre tank farm at the mill as needed. Filling and dispensing connections will be located within a secondary containment berm constructed around the tank farm. These connections consist of a shore manifold for use during offloading from barges situated in Roberts Bay, and a transfer station for supplying fuel haul trucks for conveyance of fuel to the mill site.

The regulations governing the bulk storage of fuel in aboveground storage tanks are in the process of being upgraded. The tank farm at Roberts Bay has been designed in accordance with the principles outlined in two working documents: Environment Canada's 'Proposed

Federal Petroleum Products and Allied Petroleum Products Storage Tank Systems Regulations' (Environment Canada 2003) and the Canadian Council of Ministers of the Environment's (CCME's) 'FINAL DRAFT: Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products' (CCME 2003). While these documents are not yet in the legal standards, it is expected that all new fuel storage facilities will be required to adhere to the standards therein.

The eight million litre capacity fuel tank farm will be constructed on a level precision blasted surface within the area of Quarry #1. Geotechnical concerns over settlement led to the proposed placement of the tank farm within Quarry 1. The tanks will be erected in an engineered containment area (71 m by 71 m) consisting of a HDPE lined pad, with minimum 0.8 m high lined containment berms, having sufficient capacity to retain 100% of the volume of the largest single fuel tank plus 10% of cumulative volume of all additional tanks. The base of the containment area will be graded at 1% to a corner sump location that will be used to pump out storm water and snowmelt directly onto the tundra using a removable pump. Any fuel spills will be pumped to appropriate containers. A minimum pad thickness of 0.5 m will be placed at the base of the sump; pad thickness elsewhere is determined by 1% slope of pad floor.

To ensure containment of any fuel released during transfer from storage tanks to the fuel haul truck, the fuel transfer station will be located inside the secondary containment berm. Ramp access for the fuel truck to the fuelling station will be located at the southwest corner of the secondary containment berm. This ramp will be 6 m wide and will be graded at a 5H:1V slope to allow safe access for the fuel truck.

The pad will be a minimum of 0.5 m thick with a minimum 0.8 m high containment berm surrounding the entire facility, for a total berm thickness of 3.1 m. The HDPE liner will cover the entire inside area of the tank farm, including the inside slopes of the containment berms and the base of the sump. The liner will be installed between two layers of geotextile, which in turn will be placed between two 0.3 m layers of suitable sand and gravel (if suitable fines cannot be sourced on site this specification will be revised to allow greater use of geotextiles). The primary construction material for the tank farm will be clean quarry material crushed to <38 mm.

The tank farm requires a small building to house a generator and for general storage. For these purposes a 6.1 m x 2.4 m x 2.4 m metal sea container (seacan) will be located immediately adjacent to the tank farm at the southwest corner of the secondary containment berm.

Additional information on the proposed Roberts Bay tank farm can be found in Section 5.3 in SRK 2003 (B), Supporting Document A4 to the November 2003 FEIS, complete with typical plan and cross-sectional drawings of the tank farm along with information on foundation conditions.

2.15 Airstrips

The permanent all-weather airstrip must meet the minimum requirements of three design aircraft; Dornier-228, the De Havilland Twin Otter and Dash 7. A winter airstrip on Doris Lake will be sized to accommodate up to a Lockheed C-130/ L-100 Hercules. Both airstrips are to be equipped with lights for night use and with the instrumentation necessary to support IFR night operations.

2.15.1 All-Weather Airstrip

The all-weather airstrip will be constructed by widening 914 m of the all weather road between the barge landing site and the mill to 23 m (Figure 2.1). This will ensure year round air access for small aircraft. This airstrip is not located in an optimum location with respect to the prevailing northwest winds. MHBL has accepted the operational limitations and risk associated with this airstrip location and alignment. While not operationally ideal, this location helps to minimize the overall footprint of the proposed project. An alternative airstrip location on the east side of Tail Lake was considered, however while preferable from an operating standpoint, the Tail Lake site did involve more ground disturbance and access road construction.

A 40 m x 17 m apron for vehicle parking and an emergency power generator, fuel storage and emergency shelter will be constructed at the southern end of the runway. Design details of the proposed permanent all-weather airstrip are provided in Section 6.6.1 in SRK 2003 (B), Supporting Document A4 to the November 2003 FEIS - Surface Infrastructure Preliminary Design report.

2.15.2 Winter Airstrip

Every year, once sufficient ice has developed on Doris Lake, a 1,524 m x 45 m airstrip will be constructed. The winter airstrip will also be instrumented and illuminated for IFR night operations, similar to lighting and instrumentation proposed for the permanent all-weather airstrip.

2.16 All Weather Roads

The all-weather roads will be constructed with a minimum fill thickness of the pad required to cover micro-relief and protect permafrost. Basic thermal modeling using site data suggest that pad thickness to ensure the integrity of the permafrost will be in the order of 2.0 to 2.5 m. For the purposes of this report a constant roadway thickness of 2.0 m has been assumed. Wherever possible, roadways will be constructed in the winter to ensure the integrity of the permafrost. All roadway fill will be from clean quarry material from three different locations (Figure 2.1). If and when inert waste rock from the underground mining becomes available, this may also be used for construction purposes. Fill will be crushed to the required size fraction for construction on site. Typical roadway cross sections are presented in Section 5.4 in SRK 2003 (B), Supporting Document A4 to the November 2003 FEIS - Surface Infrastructure Preliminary Design report.

The road surfaces will be 6 m and 5.1 m wide respectively for the main and secondary roads. Side slopes will be at angle of repose (40o, or 1.2H:1V). Roadway drainage will be via 0.5% surface grading in both directions from the centreline of the roadway for the main road, while secondary roads will be graded 0.5% in the down slope direction only. The pad will consist of a 0.2 m thick surfacing grade layer overlying a 0.3 m thick select grade layer. Both these will overlie a 1.5 m thick sub grade layer.

2.16.1 Main Road from Roberts Bay to Mill/Camp Site

The 4.8 km all weather road between Roberts Bay and the mill area will follow the natural topography, which is well suited towards road construction. There are no natural obstacles, and the grades are low, suggesting few construction difficulties. Between Roberts Bay and where

the road will turn east towards the mill, the road will be constructed towards the windward side of the valley to avoid snowdrifts that occur in the lee side of the western outcrops. Between the turn in the road and the mill the road will follow along the northeastern edge of the valley before turning east into the mill location. There are a number of areas where culverts will have to be installed to allow seasonal runoff to continue flowing along its original routes, but there are no significant stream crossings along this stretch of road. The soil conditions consist of open tundra underlain by thick marine silts and clays with abundant ground ice overlying bedrock. Areas where the surface is marked by large ice-wedge polygons indicate that abundant ground ice encountered during drilling operations is widespread.

At two locations along the route the 6 m wide road will be widened to 10 m for a distance of 30 m to form passing turnouts. These turnouts provide space for passing and turnaround of vehicles traveling along the road.

2.16.2 Tailings Service Road

Tailings will be deposited into Tail Lake, necessitating a 5.9 km, 5.1 m wide all-weather service road. A 150 mm diameter insulated HDPE tailings feed line and a 100 mm diameter, insulated and heat traced return water pipeline will be placed on the shoulder of the road, taking up at least 1.5 m of the roadway space. The pipelines will be placed on the outside edge of the roadway, i.e. closest to the lake shorelines. This will minimize the number of pipe crossings required. Eight passing zones measuring 10 m wide and 30 m long will be constructed along this stretch of road to ensure safe passing of traffic.

The road will start at the mill and pass the portal on the south before following a northeasterly direction towards the northern end of Doris Lake. At this location a bridge will be constructed to cross the Doris Lake outlet. The details of this bridge are described in Section 5.5 in SRK 2003 (b), Supporting Document A4 to the November 2003 FEIS complete with typical plan and cross-sections. The road will then turn southeast and will approximately follow the east shore of Tail Lake, always above the projected full supply elevation in Tail Lake of 33.5 m. There will be a 10 m x 10 m turning platform adjacent to the South Dam where the road ends.

This roadway has been designed to have a minimum longitudinal grade of 1% at any point, as well as minimizing the number of low-points. Since the tailings and return water pipeline follow the roadway grade these aspects will enable the lines to be drained by gravity flow in the event of a stoppage of either pipeline. Contents of the tailings line will be collected at selected emergency dump catch basins.

2.16.3 Explosives Magazine Service Road

Explosives will be permanently stored in separate Type 4 powder and detonator magazines approximately 800 m northwest of the camp, and accessed by the main all-weather road coming from Roberts Bay. The detonator magazine will be 275 m off this road, which will ensure that it is tucked in behind a rock outcrop effectively shielding it from view to the mill and campsite. The powder magazine will be located on the same road 100 m beyond the detonator magazine. This roadway will be 5.1 m wide allowing only one-way traffic to and from the main road. Sufficient turn-around room will be provided in the magazine areas to allow for safe vehicle turn around.

2.16.4 Dock Service Road

The link between the boat and float plane dock will be a 300 m long, 6 m wide all-weather road. The road will join up with the airport access and tailings service road immediately south of the portal. This roadway will also provide the bedding platform for the two 100 mm diameter water pipelines from Doris Lake (fresh, and fire/mill water supply). These pipelines will be heat traced and insulated and will take up at least 1.5 m of the width of the road. At the road junction a series of culverts will be installed to allow crossing of the two fresh water pipelines, the return water pipeline and the tailings pipeline.

2.16.5 Non-Hazardous Solid Waste Disposal Facility Access Road

The permanent non-hazardous solid waste disposal site will be located in the rock quarry immediately west of the campsite. A 150 m long stretch of all-weather road will link the disposal facility with the main access road to the camp. This roadway will be 6 m wide to ensure access by large equipment.

2.16.6 Bridge Crossing over Doris Lake Outflow

The stream crossing at the Doris Lake outflow is substantial, requiring a bridge deck with a span of at least 21 m to minimize impact on the stream banks. The bridge will be a modular 7.32 m wide prefabricated steel deck bridge with a loading capacity of up to 75 tonnes.

There appears to be suitable founding conditions just upstream of the small set of falls in the stream. The roadway will be widened to 10 m on either side of the stream crossing and raised to greater than 2.5 m thick for a bridge approach angle slope of less than 20H:1V. The bridge will be supported at either side of the bridge by I-beam cross members founded on the road embankment. The minimum distance between the bridge abutments on either side will be 10 m and the bridge deck will be at least 2.5 m above the stream centreline.

2.17 Proposed Construction Rock Quarries and ARD/ML Characterization

Geotechnical drilling undertaken during 2003 has provided information on the foundation conditions at all proposed locations of the major surface infrastructure components. The information obtained from exploration and geotechnical drilling and thermistor installations suggests that the active layer over the permafrost is between 1.5 and 2.5 m thick. Thermal modelling suggests that in order to protect permafrost the minimum pad thickness will have to be between 2 and 2.5 m (see SRK 2003 (B), Supporting Document A4 to the November 2003 FEIS).

"Clean" (non acid generating and non-metal leaching) waste rock will be available from development of the underground mine access ramp. The quantity will be insufficient to meet all of the needs for site construction. Additional rock will be obtained from three quarry sites located close to the major infrastructure components:

- Quarry at the south end of Roberts Bay adjacent to the proposed sealift offloading jetty site (Q1);
- Quarry at the Doris North Project site west of the proposed camp (Q2); and
- Quarry on the east side of Tail Lake close to the proposed tailings dam site (Q3).

The quarries will be drilled and blasted in benches, and the rock will be hauled to where it will be required. Table 2.4 provides details with regard to the volume of fill required. The construction rock properties have been assumed to be as follows; specific gravity = 2.50, swell = 40%, LCM density = 1.79, moisture content = 4%, reconsolidation = 50%, and the reconsolidated (excavated cubic metre (ECM)) density = 2.08. Assuming an average powder factor of 0.9kg/BCM, 245 tonnes of ammonium nitrate (ANFO) will be required to complete the surface infrastructure construction.

Table 2-4: Estimated Quarry Rock Volumes (neat) for Surface Infrastructure Components

Infrastructure Component	General Detail	Estimated Quantity	
		BCM (m^3)	Dry Tonnes
Jetty	6 m wide traffic surface; 1.2:1 side slopes; 0.5 m sediment consolidation, 2.5 m to 3.0 m average thickness; 103 m length	5,580	11,606
Beach lay-down area	60m x 100m surface area; 1.2:1 side slopes; 2.5 m average thickness	16,230	33,758
Tank farm (7.5 million litres)	71 m x 71 m surface area; 1.2:1 side slopes; 0.5 m average thickness; 0.8 m high containment berm; 3,300 m^2 HDPE, 6,600 m^2 geotextile	5,183	10,781
All-weather road (jetty site to mill)	6m wide traffic surface; 1.2:1 side slopes; 2.0 m average thickness; 4.8 km length	80,640	167,731
Road turnouts (2) (jetty site to mill)	10 m wide; 30m long; 1.2:1 side slopes; 2.0 m average thickness	1,200	2,496
All-weather road (tailings service road)	5.1 m wide traffic surface; 1.2:1 side slopes; 2.0 m average thickness; 5.9 km length	88,500	184,080
Road turnouts (8) & turnaround (tailings service road)	10m wide; 30m long; 1.2:1 side slopes; 2.0 m average thickness & 10m x 10m turnaround	5,010	10,421
Explosives magazine access road	5.1 m wide traffic surface; 1.2:1 side slopes; 2.0m average thickness; 375 m length	5,625	11,700
Float plane & boat dock service road	6m wide traffic surface; 1.2:1 side slopes; 2.0m average thickness; 300m length	5,040	10,483
Solid Waste Disposal Site access road	6m wide traffic surface; 1.2:1 side slopes; 2.0m average thickness; 150m length	2,520	5,242
Bridge crossing and abutments (2)	10m wide traffic surface; 1.2:1 side slopes; 2.5m average thickness; 27m length	1,830	3,806
Permanent all-weather airstrip	23m wide traffic surface; 2.5:1 side slopes; 2.5m average thickness; 914m length	66,840	139,027
Airstrip apron	17m x 40m surface area; 2.5:1 side slopes; 2.5m average thickness	1,970	4,098
North Tailings Dam	160m crest length; 10 m crest width; 8m maximum height; 3:1 side slopes	22,022	45,806
South Tailings Dam	170m crest length; 3 m crest width; 3m maximum height; 3:1 side slopes	14,322	29,790
Explosives Magazine	2 pads, 30 m^2 and 60 m^2 surface area respectively for detonator and powder magazines; 1.2:1 side slopes; 2.5 m average thickness	1,980	4,118
Mill and Camp Area	Mill, Crusher, Ore Stockpile, Workshop, Fuel Tank Farm, Mill Reagents Storage Area, Lay-down Area, Power Supply Area, Camp/Dry Area, Mine Office Area, Sewage Treatment Plant, Potable Water Treatment Plant => 41,613 m^2	44,850	93,288
Float Plane Dock	Preferred option is for a floating dock; Alternatively a rock fill dock of the following dimensions is possible: 10m x 40m surface area; 1.2:1 side slopes: 3.0 m average thickness	900	1,872
Tailings emergency dump catch basins (4)	25.2m x 25.2 m surface area; 2:1 side slopes; 2.0 m average base thickness; 1m high containment berm; 1,150 m^2 HDPE, 1,150 m^2 geotextile	5,070	10,546
Total		**375,312**	**780,649**

The acid generating and metal leaching potential for the rock at these three quarry sites was characterized by acid base accounting and shake flask extraction testing conducted in 2002/2003. The proposed rock was characterized as having low acid generating and metal leaching potential. The three proposed quarry sites were geologically mapped in the summer of 2003. Representative chip samples were collected under the direction of a geologist from each of the rock types identified at each quarry site. All of the collected samples were subjected to whole rock analysis by XRF, trace metals content analysis, acid base accounting analysis including sulphur speciation and determination of inorganic carbonate content and for soluble metals content using the BC Ministry of Energy and Mines shake flask extraction procedure.

Acid base accounting testing indicated that the rock samples taken from all three proposed quarry sites are not likely to be acid generating (i.e., all three samples had low acid generating potential). Similarly shake flask extraction testing indicated that all three samples are not likely to be a significant source of metal leaching (i.e., the samples tested contained low levels of soluble metals and should not be a source of contaminant release). The results from this testing are presented in AMEC 2003 (b), Supporting Document B2 to the November 2003 FEIS.

On this basis the selected quarry sites will allow for the production of a non-acid generating, chemically stable rock for use in the construction of the site infrastructure such as building pads, access roads and the airstrip. A program of ARD characterization will be conducted during construction to verify this conclusion.

2.18 Construction Workforce

The projected construction work force is presented in Table 2.5. The road and quarry construction workforce (8 month duration) is expected to total 37 persons (36 contractor personnel plus 1 owner representative). During construction of the mill and camp (4 month duration) the workforce will increase by 10 persons (8 contractor personnel plus 2 owner personnel) for a total construction workforce of approximately 47 persons.

Table 2-5: Projected Construction Work Force

Road & Quarry Construction (8 months)	Contractor	Owner	From Nunavut*
Project Superintendent	1		
Site Foreman	1		
Truck Operators	4		3
Loader Operators	2		2
Dozer Operators	4		2
Crusher Operators	1		
Grader Operators	1		1
Mechanics	4		1
Welders	2		
Helpers & Labourers	3		2
Surveyor	2		
Drillers	6		4
Engineer		1	
Catering & Housekeeping	4		4
Health & Safety	1		
Total	36	1	19
Mill & Camp Construction (4 months)	**Contractor**	**Owner**	**From Nunavut***
Site Administrator	1		1
Truck Operators	2		2
Loader Operators	1		1
Helpers & Labourers	3		3
Geologist		2	
Catering & Housekeeping	1		1
Total	8	2	8

Note:
** Staffing levels from Nunavut are estimates only. Actual numbers will depend upon availability of qualified personnel.*

2.19 New Technology

No new processes or technologies are proposed for any aspect of this Project.

2.20 Major Project Interactions with the Environment

2.20.1 Air Quality

Powerhouse and mobile equipment exhaust will contain greenhouse gasses; road traffic and aircraft landing and taking off from the permanent airstrip will produce dust.

2.20.2 Water Quality

Tailings disposal, including the tertiary treated sewage from camp, will alter water quality in Tail Lake and to a lesser extent in Doris Outflow Creek.

Doris Project ore is characterized as ore having an uncertain acid generation potential. Although, there is the potential risk that the ore stockpile may generate acid during the period of storage, it should be noted that the ore material will be on the pad for a relatively short time and the kinetics of acid generation occurring during this time is considered minimal. However, any run off, if acidic, would be neutralized as it percolates through the carbonate rich wall rock of the ore pad. Examination of the wall rock that will be used for building pad and road construction showed that it poses no risk of acid generation on exposure to the atmosphere.

2.20.3 Site development and tundra alteration

Constructing Project support and production infrastructure will cause terrain alteration through the construction of roads, laydown areas and building pads. The estimated amount of land disturbed is estimated at 38.4 hectares. Additional land along the existing shoreline of Tail Lake will be disturbed by flooding caused by the development of the tailings containment area. At full supply level the Tail Lake tailings containment area will flood 53.4 hectares of land. Preliminary estimates of areas required for site development needs are presented in Table 2.6.

Table 2-6: Estimated Area of Disturbance by Infrastructure Component

Infrastructure Component	General Detail	Surface Area (m^2)
Jetty	6 m wide traffic surface; 1.2:1 side slopes; 0.5 m sediment consolidation, 2.5 to 3.0 m average thickness;103 m length	1,794
Beach lay-down area	60 m x 100m surface area; 1.2:1 side slopes; 2.5 m average thickness	6,996
Tank farm (8 million liter)	5,000 sq m surface area; 1.2:1 side slopes; 0.5 m average thickness; 0.8 m high containment berm; 3,300 m^2 HDPE, 6,600 m^2 geotextile, constructed in Quarry 1 footprint	included in Quarry #1 area
All-weather road (jetty site to mill)	6 m wide traffic surface; 1.2:1 side slopes; 2.0 m average thickness; 4.8 km length	51,840
Road turnouts (2) (jetty site to mill)	10 m wide; 30 m long; 1.2:1 side slopes; 2.0 m average thickness	744
All-weather road (tailings service road)	5.1 m wide traffic surface; 1.2:1 side slopes; 2.0 m average thickness; 5.9 km length	58,410
Road turnouts (8) & turnaround (tailings service road)	10 m wide; 30 m long; 1.2:1 side slopes; 2.0 m average thickness & 10m x 10m turnaround	3,057
Explosives magazine access road	5.1 m wide traffic surface; 1.2:1 side slopes; 2.0 m average thickness; 375m length	3,713
Float plane & boat dock service road	6 m wide traffic surface; 1.2:1 side slopes; 2.0 m average thickness; 300m length	3,240

Infrastructure Component	General Detail	Surface Area (m^2)
Solid Waste Disposal Site access road	6 m wide traffic surface; 1.2:1 side slopes; 2.0 m average thickness; 150m length	1,620
Bridge crossing and abutments (2)	10 m wide traffic surface; 1.2:1 side slopes; 2.5 m average thickness; 27m length	864
Permanent all-weather airstrip	23 m wide traffic surface; 2.5:1 side slopes; 2.5 m average thickness; 914m length	32,447
Airstrip apron	17 m x 40m surface area; 2.5:1 side slopes; 2.5 m average thickness	1,549
North Tailings Dam	160 m crest length; 10m crest width; 8.0 m maximum height; 3:1 side slopes	8,014
South Tailings Dam	170 m crest length; 3m crest width; 3m maximum height; 3:1 side slopes	7,782
Explosives magazine	2 pads, 430 and 630 m^2 surface area respectively for detonator and powder magazines; 1.2:1 side slopes; 2.5m average thickness	1,690
Mill and camp area	Mill, Crusher, Ore Stockpile, Workshop, Fuel Tank Farm, Mill Reagents Storage Area, Lay-down Area, Power Supply Area, Camp/Dry Area, Mine Office Area, Sewage Treatment Plant, Potable Water Treatment Plant	41,613
Tailings emergency dump catch basins (4)	25.2 m x 25.2 m surface area; 2:1 side slopes; 2.0 m average base thickness; 1 m high containment berm; 1.150 m^2 HDPE, 1,150 m^2 geotextile	4,409
Roberts Bay Quarry (Q1)	Rock quarry at south end of Roberts Bay, approximately 200 m x 100 m, includes tank farm footprint	20,000
Solid Waste Landfill Quarry Q2	Rock quarry west of the Doris North mill site, approximately 600 m x 120 m	72,000
Tail Lake Quarry (Q3)	Rock quarry east of Tail Lake, approximately 515 m x 121 m	62,315
Sub-Total Terrestrial Disturbances		**384,612**
	Land Flooded by Tailings Containment Area	
Tail Lake Tailings Impoundment	Tail Lake Tailings impoundment: Tail Lake is approximately 2.9 km long x 0.61 km wide with a perimeter of 6,923 m. Pre-development surface area is 76.6 ha. Maximum flooded impoundment area will be 130 ha. Maximum amount of land flooded by the tailings containment area is 53.4 ha.	534,000
Sub-Total Flooded Land		**534,000**
TOTAL - TERRESTRIAL DISTURBANCES + FLOODED LAND		**918,612**

2.20.4 Tailings Disposal and Aquatic Life

Tailings will be sub-aqueously disposed of in Tail Lake at an average rate of 668 tonnes (dry weight) per day. The total proposed mass for disposal during the life of the Project is approximately 467,000 tonnes (dry weight). The tailings impoundment is sized to operate as a zero discharge facility during the two years of operation if necessary. In addition, under the most conservative water balance assumptions Tail Lake would take just over five years to reach the design Full Supply Level (FSL) of 33.5 m. A permanent spillway will constructed at this elevation. Using the most conservative water management strategy, and the associated water quality predictions, the water quality in Tail Lake will return to background water quality within a maximum of 25 years. The North Dam will be breached at this time, allowing the water level in Tail Lake to return to its pre-mining elevation of 28.3 m. The South Dam will not be breached, but considering that it is constructed on a watershed, it will have no detrimental impact on the surrounding environment. The operating intent of both the North and South Dams is therefore to retain water for a maximum period of 25 years, after which the dams will no longer serve any function, and could be breached.

Fish populations studies using gill nets showed that lake trout was the only fish species captured in Tail Lake (ninespine stickleback were found as stomach contents in lake trout caught in Tail Lake. MHBL will compensate for the loss of all fish and fish habitat destroyed by the proposed project by creating or enhancing alternate fish habitat in other areas near the Doris north site under a Fish Habitat Compensation Agreement to be reached with the Federal Department of Fisheries and Oceans.

2.20.5 Project operations and wildlife

A full complement of tundra wildlife has been documented in and adjacent to the Project area has been documented in Project sponsored environmental baseline studies. No critical habitat for any species is at risk. Direct interactions with both large herbivores (caribou and muskox), and carnivores (grizzly bear, wolverine, and wolf) are probable and will be subject to contingency plans. The Project area includes the mainland winter range of the Victoria Island caribou herd, the summer range of the mainland Bathurst herd, and, perhaps, margins of the annual range of the Queen Maude Gulf herd. Raptors are common in the Project area and one known nest site is within 2 km of the Project camp and mill site facilities. Searches for tundra swan and other water fowl have not identified any nests on the north end of Doris Lake or on Tail Lake.

No endangered species have been noted in the course of baseline studies. Also, no wildlife population that ranges over the Project area is at risk due to Project activities and related habitat alteration.

2.21 Abandonment/Decommisioning Plans

A detailed Closure and Reclamation Plan has been prepared for the Doris North Project using the guidance provided in the 2002 "Mine Reclamation Guidelines for the Northwest Territories and Nunavut" issued by Indian and Northern Affairs Canada. This Closure Plan has been appended to AMEC 2003 (b), Supporting Document G1 to the November 2003 FEIS. The following is a brief summary of the closure and reclamation measures proposed for the Doris North Project. Additional detail can be found through reference to the Closure Plan.