ROBERTS BAY AND IDA BAY
ABANDONED MINE SITES
REMEDIATION PLAN

Submitted to:

Public Works and Government Services Canada
Environmental Services, Northern Contaminated Sites
Edmonton, AB

Submitted by:

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WX15131
January 2007

EXECUTIVE SUMMARY

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC) was retained by Public Works and Government Services Canada (PWGSC) on behalf of the Department of Indian and Northern Affairs Canada (INAC) to prepare a site remediation and closure plan for the former Roberts Bay and Ida Bay abandoned silver mine sites in Nunavut. Collectively known as the Roberts Lake property, the sites are situated approximately 115 kilometers southwest of Cambridge Bay, Nunavut, within the ORO claim region. The Roberts Lake property is located in a remote area accessible only by helicopter, float plane, barge or winter ice roads. The mines sites are connected by a rough trail suitable for all-terrain-vehicles.

Site investigation information including geochemical, geotechnical, environmental site assessment and human health risk assessment investigations conducted in August 2005 along with a review of all previously obtained information was used to prepare a recommendation for site remediation and closure for the Roberts Lake property.

The purpose of this document is to collectively examine the information collected during all investigations, summarize the possible site remediation options for waste rock, tailings, impacted soil, mine openings, hazardous waste, non-hazardous waste and debris at the Roberts Lake property and to develop a Remedial Plan. The Remedial Plan presents the options evaluated and discusses in detail the preferred remedial strategy. Based on the findings of the previous assessments, the main issues at the Roberts Bay Mine Site to be addressed by the Remedial Plan are:

- Remaining infrastructure;
- Tailings pond;
- Waste rock;
- Non-hazardous waste;
- Hazardous waste;
- Petroleum and metals impacted soil; and
- Mine openings.

The main issues at the Ida Bay Mine Site to be addressed by the Remedial Plan are:

- Remaining infrastructure, hazardous and non-hazardous waste;
- Waste rock;
- Mine openings; and
- Marine sediments.

For each of the above issues identified, AMEC ranked the potential remedial options based on long-term effectiveness, technical feasibility, impact on human health and safety, impact on ecological health and safety, time to implement, on-going monitoring requirements, capital costs, and potential benefits to local communities in Cambridge Bay based on feedback received during 2006 public consultation process and ongoing discussions with the town on the proposed remediation options. The preferred remedial options for the Roberts Bay and Ida Bay properties are summarized below:

	Issue	Preferred Remedial Option
Roberts Bay Mine Site	Infrastructure	Dismantle, segregate and bury non-hazardous material on-site. Remove hazardous material from site for disposal in the south.
	Tailings	Drain tailings (treat water if necessary); remove any spilled tailings and place into the pond; expand the containment area by expanding and flattening the berms to a minimum of 3H:1V to accommodate and bury non-hazardous waste (as needed); cover with approximately 2 m of compacted waste rock in the winter to establish permafrost and isolate frozen waste from the environment; cover with overburden.
	Waste rock	Utilize where required for cover, erosion control, and backfill with the remainder; re-graded and left in place.
	Non-hazardous waste	Bury within the tailings pond and covered with waste rock to isolate from the environment. Recycle and reduce volumes where possible. Existing domestic landfill will be covered and the berms reinforced to enhance long-term physical stability.
	Hazardous waste	Neutralize acids and incinerate petroleum products where feasible to reduce volumes with the majority of the waste containerized and transported off-site for disposal at an appropriate disposal facility in the south.
	Petroleum and metals impacted soil	Excavate hydrocarbon contaminated soil from fuel storage compound and garage area (~325 m^3) and excavate metal laden soil from mill building area (~65 m^3), place in 1 m^3 supersacs or containers and transport off-site to an appropriate facility for treatment or disposal.
	Mine openings	Infill with waste rock where feasible, blast the roof and then backfill depression with waste rock. Replace cap on the Roberts Bay Mine vent raise with an engineered pre-cast / cast-in-place concrete cap, and then cover with waste rock.

	Issue	Preferred Remedial Option
Ida Bay	Infrastructure/non-hazardous and hazardous debris	Dismantle and segregate. Containerize hazardous debris and transport to an appropriate off-site facility. Reduce and recycle volumes of non-hazardous waste where possible and bury remainder within the adit at the Ida Bay site, then cap with waste rock. Move remaining to Roberts Bay site.
	Waste rock	Remove from above the high tide level, utilize for backfill where needed. Transport remainder to Roberts Bay for use as cover, backfill, etc.
	Mine openings	Infill with waste rock, blast the roof and then backfill depression with waste rock.
	Marine sediments	Remove the waste rock from the shoreline above high tide and manage it with the remaining one.

Of paramount importance for the remedial activities will be the protection and restoration of the natural environment both during and following the remedial activities. The need to minimally disturb the natural environment was a factor in the consideration of the potential remedial options. Further to this a screening level environmental assessment will be required under the Canadian Environmental Assessment Act (CEAA) once the preferred remedial options have been determined.

After implementation of the remedial plan, the long-term monitoring program should be very simple, requiring only simple instrumentation installed at the Roberts Bay Site. No instrumentation should be required at the Ida Bay Site as no landfill or hazardous materials are expected to remain at the site after remediation. Installation of groundwater monitoring equipment should not be necessary because the small water shed and shallow active zone. The chemistry of the local surface water should closely represent the chemistry of the groundwater in the active zone.

AMEC considered three different logistical “scenarios” for implementation of the proposed remediation plan. These “scenarios” are summarized as follows:

1. Option 1: Mobilize equipment to site by sealift barge to the existing Miramar off-loading site on the west shore of Roberts Bay. Move heavy equipment across the ice in the following winter and complete the majority of the earthworks under winter conditions. Demobilize equipment in the following winter and ship equipment back off site by sealift barge. Total implementation time is in the order of 28 months resulting in significant equipment standby costs where the equipment is idle awaiting movement to and from the site.

2. Option 2: Mobilize equipment to site by smaller sealift barge direct to the Ida Bay site. Complete earthworks at Ida Bay mine site during the summer and winter. Move heavy equipment across a winter road to the Roberts Bay site in the following winter and complete the majority of the earthworks under winter conditions. Demobilize equipment in the following winter and ship equipment back off site by sealift barge. Total implementation time is in the order of 28 months resulting in significant equipment standby costs where the equipment is idle awaiting movement to and from the site.

3. Option 3: “Piggy back” remediation of the Roberts Bay and Ida Bay mine sites onto the back of the planned construction of the Doris North Project. A winter road would be constructed across Roberts Bay to connect the Doris North Project to the Roberts and Ida Bay sites. Remediation earthworks would be completed under winter conditions using the contractor personnel and equipment employed by Miramar to construct the Doris North Project, thus significantly reducing equipment mobilization and stand by costs. Under this option all non-hazardous demolition and site clean up debris would be trucked to the Doris North Project landfill site rather than create a non-hazardous landfill within the tailings pond at the Roberts Bay mine site as is proposed under options 1 and 2. Under Option 3, the approximately 390 m^3 of hydrocarbon and metal contaminated soils identified at the Roberts Bay site would be trucked to the Doris North Project to be

placed underground in the permafrost as mine backfill thereby isolating it from the environment. Under Options 1 and 2 these soils will be removed from site to be disposed of at a licensed hazardous landfill site in Alberta.

The estimated cost of implementing the proposed remediation plan at the Roberts and Ida Bay abandoned mine sites under these three different "scenarios" is summarized as follows:

Option 1	**Option 2**	**Option 3**
$4.76 million	$4.73 million	$2.22 million

There is virtually no difference in the estimated remediation cost between Options 1 and 2. This is primarily due to the fact that mobilization, de-mobilization and equipment standby costs for these two options remain essentially the same representing approximately 42% of the estimated direct remediation cost.

While there are some minor reductions in the mobilization/demobilization/standby costs for Option 2 as compared to Option 1, they are insignificant. Under Option 2, the earthworks at the Ida Bay site are completed sooner than under Option 1 and most are done during the summer months. This aspect would give the edge to Option 2 over Option 1, and may prove to be an advantage in terms of quality of work, safety and overall manpower and equipment availability for Roberts Bay mine site. The overall project schedule remains however similar with the equipment being demobilized in the summer of Year 3 as per Option 1.

Should timing of the remediation work and other project requirements allow it, Option 3 would be the preferred alternative. For Option 3, the mobilization/demobilization/standby cost is reduced to approximately $0.6 million by "piggy backing" the remediation work onto the construction of the Doris North Project. Under this case mobilization and demobilization of most of the heavy equipment is born by the Doris North Project and most of the standby costs are eliminated.

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1.0 INTRODUCTION

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC) was retained by Public Works and Government Services Canada (PWGSC) on behalf of the Department of Indian and Northern Affairs Canada (INAC) to undertake a geotechnical and geochemical assessment of potential acid rock drainage and metals leaching concerns from residual waste rock and tailings located at the former Roberts Bay and Ida Bay silver mines in Nunavut, and prepare a remediation plan for the two sites. Collectively known as the 'Roberts Lake property', the site is situated approximately 115 kilometers southwest of Cambridge Bay, Nunavut and is located within the ORO claim region.

During August 2005, a team of engineers, scientists and field technicians from AMEC, Earth Tech Canada Inc. (Earth Tech), EBA Engineering (EBA), and AECOM-UMA Engineering (UMA), together with representatives of PWGSC and INAC, visited the Roberts Bay and Ida Bay Mine Sites to investigate site conditions and obtain samples of waste rock, tailings, soil, water and vegetation for analyses to provide data to support the development of a remediation plan for these two mine sites. The objectives of this project were to complete the additional field and laboratory studies and to prepare a remediation plan. Components of the scope of work are as follows:

- Review all previously obtained information;
- Perform and finalize a detailed assessment of tailings and waste rock geochemistry;
- Assess mobility of arsenic and other metals from the tailings pond;
- Further assess logistical issues;
- Geotechnical investigation of mine openings;
- Complete a site survey;
- Obtain information from the two other consultants performing assessment activities concurrently; and
- Document all information in written reports and prepare a recommendation for site remediation and closure for both Roberts Lake properties.

Work was conducted in cooperation and in concert among the geochemical, geotechnical, environmental site assessment and human health risk assessment investigations for the sites. Data and information was shared with and among the Geotechnical Investigation, Environmental Site Assessment (ESA), and Human Health and Ecological Risk Assessment (HHERA) teams.

The purpose of this document is to collectively examine the information collected during all investigations, summarize the possible site remediation options for waste rock, tailings, mine openings, hazardous and non-hazardous waste and debris at the Roberts Lake property and develop a Remedial Plan. The Remedial Plan presents the options evaluated and discusses in detail the preferred remedial strategy.

2.0 SITE DESCRIPTION

2.1 Site Location

Roberts Bay and Ida Bay abandoned silver mines are located approximately 68° 10' 45" N by 106° 33' 29" W and about 115 kilometers southwest of Cambridge Bay, Nunavut. The location of the mine sites are indicated on Figure 1.

2.2 Background

The Roberts Bay area was first staked by the Roberts Mining Company Ltd. in 1964. Silver was discovered at Roberts Bay in 1965. A silver showing was subsequently discovered and staked at Ida Bay in 1966. Exploration of the Ida Bay and Roberts Bay silver showings was conducted by the Hope Bay Silver Syndicate between 1967 and 1972 where exploration activities included trenching, drilling, mapping, and geophysical surveys. Mining equipment was mobilized to Ida Bay by Hope Bay Mines Ltd. (formerly Hope Bay Mining Co.) in 1973 and subsequent underground mining yielded over 10,000 ounces of high grade silver, shipped from site for metal recovery. The Roberts Bay deposit produced 10 tons of hand sorted ore with grades peaking at 4,863 oz/ton (approximately 15% Ag).

In 1974 Hope Bay Mines Ltd. entered into a joint venture with Van Silver Explorations Ltd. and Reako Explorations to upgrade the Roberts Bay mine. A small 50 to 75 ton/day grinding-flotation mill was constructed at the Roberts Bay site that yielded a total of 74,500 ounces of silver in the form of flotation concentrates until operations ceased in 1975. These concentrates were shipped off-site for metal recovery. Consequently no leaching, smelting or refining are believed to have occurred on site.

Further exploration continued at the leases throughout the 1980's and 1990's. In 1997 the Roberts Mining Lease was surrendered back to INAC and in 1998 the ground was re-staked as the ORO 5 claim.

Rescan Environmental Services Ltd. (Rescan, 2003) performed a preliminary assessment of the sites for PWGSC (acting on behalf of INAC) in 2003. In February 2004, Rescan conducted a combined Phase I/II Environmental Site Assessment for the sites on behalf of Indian and Northern Affairs Canada. In October 2004, Senes Consultants Limited completed Human Health Screening Level Risk Assessments for each of the two sites. AMEC, Earth Tech, EBA, and UMA, together with representatives of PWGSC and INAC, completed field studies for geotechnical, geochemical, ecological site assessment, and human health risk assessment in 2005, which is summarized within this document.

2.2.1 Roberts Bay Mine

The Roberts Bay abandoned silver mine is located approximately 1 km north of Roberts Lake. (see Figure 1). A trail leads from the lakeshore of Roberts Lake to the mine site following the crest of a basaltic ridge. The mine site itself is located on and between two basaltic ridges, which run north-south. The site between the ridges occurs on a subtle crest primarily sloping southward and draining between the ridges into Roberts Lake. The low areas between the basaltic ridges are underlain with a coarse textured glacial till with permafrost found about 0.6 m below surface.

Prominent features remaining at the site are a variety of waste rock piles, two open and flooded adits, infrastructure remains of light framed “temporary” buildings, abandoned equipment, debris, an open surface landfill/dump with a waste rock berm, several surface ponds, drainage ditches and a small tailings pond. Waste rock was used at the mine site to level areas to support infrastructure and to construct berms for the landfill, fuel bladder and tailings pond. The waste rock pads vary in thickness from a thin veneer, typically 0.2 to 0.5 m thick, spread over the surface to piles greater than 2 m high with some piles several meters high. The tailings pond was small (compared to many other facilities) measuring approximately 40 m in diameter and about 3 m deep at the thickest point. The estimated volume of tailings is 1,800 m^3 including the associated berm.

2.2.2 Ida Bay Mine

The Ida Bay mine site is located on the north shore of Ida Bay on the Melville Peninsula adjacent to Melville Sound about 6 km north of the Roberts Bay site (see Figure 1). The area is located on a basaltic outcrop with north/south striking ridges. Adjacent to the outcrop are low-lying marshes underlain by coarse textured glacial till. The site slopes towards the southeast with surface drainage directly to the Arctic Ocean (Melville Sound). The rock is dominated by black fine-grained basalt containing small amounts of pyrite in fractures, small thin veins and stringers of quartz and some pink granite.

The Ida Bay Mine appears to have been operated as an annex to the Roberts Bay Mine with no milling operations performed on-site. Hand picked ore from the Ida Bay Mine was either transported overland to Roberts Bay or shipped off-site for processing. The prominent features remaining at the abandoned mine site are four main piles or areas of waste rock and the open flooded adit.

2.3 Geomorphological Setting

The Roberts Lake project area is coastal lowland with numerous lakes and ponds separated by glacial landforms and parallel running geological intrusions of diabase dykes and sills. The drainage basins are generally long and narrow and predominantly oriented along the north-south axis. Low lying areas at the site are saturated and marshy and underlain by clayey silt with permafrost detected at depths of 0.3 to 0.6 m. The dominant soils are Turbic and Static Cyrosols (Rescan Environmental Services 2004). Elevated areas are typically underlain by a silty gravelly sand till, saturated if poorly drained with permafrost at approximately 0.6 m below grade. Occasional granular deposits are found in the vicinity of the site at surface and are typically well graded sands and gravels with 1 to 2% silt/clay.

The Roberts Bay abandoned silver mine (see Figures 2 and 3) is located approximately 1 km north of Roberts Lake, and approximately 2 km east of Roberts Bay. Roberts Lake is accessible by float plane. The local topography ranges from sea level at Roberts Bay to 8.2 m above mean sea level (amsl) at Roberts Lake to between 65 and 70 m amsl at the main Roberts Bay Mine site, and about 85 m amsl at the entrance to the partially collapsed adit opening (Adit #2) on the ridge about 200 m east of the center of the main site (see Figure 4).

A trail leads from the lakeshore of Roberts Lake north to the mine site following the crest of a basaltic ridge. The mine site itself is located on and between two basaltic ridges, which run north-south. The site between the ridges occurs on a subtle crest primarily sloping southward and draining between the ridges into Roberts Lake. Parts of the mine site are located north of the crest draining to the north and subsequently westward to Roberts Bay. Parts of the mine site including the tailings pond (Figure 5) and the existing dumpsite on the western basalt ridge drain to the west towards Roberts Bay.

The Ida Bay mine site (see Figures 6 and 7) is located on a southeast-facing slope of Ida Bay along the shore of Melville Sound. Many erratic boulders on the order of 0.5 to 1.0 m diameter are scattered on the bedrock surface around the perimeter of the site. The adit opening at Ida Bay is about 20 m from the shoreline with elevation of 3.0 m amsl. Elevation increases gradually to the north and west. An old camp site for the mine located about 150 m from the shoreline has elevation of 11 m amsl. A small creek running from the west through coarse till empties into Melville Sound at the head of Ida Bay about 300 m southwest of the adit (see Figure 7)

2.4 Bedrock Geology

The Roberts Lake property is found within the Hope Bay Volcanic Belt in the north of the Slave geological province; a geological sub-province of the Canadian Shield. The rocks within the region are primarily Archean in age and within the Yellowknife Supergroup. The region is underlain by the late Archean Hope Bay Greenstone Belt. This geological formation ranges from 7 to 20 km in width and over 80 km in length, orientated in a north-south direction. The late Archean Hope Bay Greenstone Belt lies entirely within the faulted Bathurst Block forming the northeast portion of the Slave Structural Province. The rocks in this belt are dominantly mafic to felsic lavas and tuffs, namely basalts and andesites that have undergone metamorphism to greenschist facies. Inclusions of granite, granodiorite and quartz veins are common throughout the volcanic belt. Along the margins, at the contact of the volcanics with granite, there are both structural and metamorphic deformations. Both the Roberts Bay and Ida Bay silver mineralization are found within vein structures. The structures of the deposits are generally controlled along a fault, and economic ore minerals included silver, copper, lead and zinc.

2.5 Climatic Conditions

The closest permanent meteorological station to the mine sites is the Cambridge Bay Airport station, operated by Environment Canada. Precipitation and temperature records for the Cambridge Bay Airport are shown in Tables 2.1 and 2.2 summarized from Canadian Climate Normal information published by Environment Canada. The average annual precipitation is 69.6 mm rainfall, 821 mm snowfall, and 138.8 cm total precipitation. The mean daily high for July is 12.3°C and low of 4.6°C. The January mean daily high is -29.3°C and low of -36.3°C. The fluctuation between highs and lows for daily temperature averages 7.0°C.

Local climate data, in association with the near-by Doris North Project, has been collected at the Windy Lake and Boston mineral exploration camps since 1993. The project area has a low Arctic ecoclimate with a mean annual temperature of –12.1°C with winter (October to May) and summer (June to September) mean daily temperature ranges of -50°C to +11°C and -14°C to +30°C, respectively. The mean annual total precipitation ranges from 94 mm to 207.3 mm. Annual lake evaporation (typically occurring between June and September) is estimated to be 220 mm. Air quality monitoring was initiated in the Doris North Project area in May 2003. Total suspended particulate (TSP) measured in August 2003 indicated that ambient TSP concentrations were consistently low, ranging from 3.9 to 5.5 µg/m^3, which is less than 5% of the federal objective (120 µg/m^3) for TSP. These results are consistent with other particulate monitoring data gathered at remote sites in northern Canada. Concentrations of sulphur dioxide, oxides of nitrogen and fine particulates are low in the Roberts Lake project area.

2.5.1 Climate Change

The Department of Indian and Northern Affairs Canada (INAC) commissioned a technical report on the “Implication of Global Warming and the Precautionary Principle in Northern Mine Design and Closure” (BGC 2003). The Intergovernmental Panel on Climate Change (IPCC) concluded that the temperature trends indicate that some global climate change has already occurred (IPPC 1995). Their predictions for the year 2100 estimate a global mean temperature increase between 1.5°C and 4.5°C, with a “best estimate” of 2.5°C. This translates into a predicted increase of up to 6°C in the winter, 4.2°C in the spring and about 1°C in the summer and fall. These increases would raise the mean ambient temperature by 3.1°C. The predictions advanced by IPCC show that climate change would eventually modify the thermal regime that currently exists in the area of the site. Continuous permafrost in the area will remain, but the surface “active” layer (the surficial layer that thaws annually) may deepen in response to the milder mean annual temperature predicted. Inuit Elders report longer summers and milder winters in recent years.

Table 2.1: Average monthly and annual precipitation, Cambridge Bay Airport

	Rainfall (mm)	Snowfall (cm)	Precipitation (mm)	Average Snow Depth (cm)
January	0	5.6	4.6	21
February	0	6.4	5.1	24
March	0	7.4	6	28
April	0.1	7.5	6.5	31
May	1.6	9.3	9.4	30
June	9.8	2.8	12.5	7
July	21.7	0	21.7	0
August	24.5	2.2	26.7	0
September	11.4	8.9	19.3	1
October	0.4	16.2	14.6	7
November	0	9.3	7.2	14
December	0	6.3	5.3	18
YEAR	69.6	82.1	138.8	15

Source: Environment Canada, Canadian Climate Normals, 1971–2000, Cambridge Bay Airport, Nunavut.

Table 2.2: Summary of air temperatures, Cambridge Bay Airport

	Daily Average (°C)	Standard Deviation	Daily Maximum (°C)	Daily Minimum (°C)
January	-32.8	2.6	-29.3	-36.3
February	-33.0	3.2	-29.3	-36.6
March	-29.7	2.4	-25.7	-33.7
April	-21.4	3.0	-16.7	-26.0
May	-9.2	2.6	-5.3	-13.0
June	2.4	2.3	5.6	-0.8
July	8.4	1.6	12.3	4.6
August	6.4	1.6	9.4	3.4
September	-0.3	1.9	1.9	-2.5
October	-11.5	2.9	-8.1	-14.9
November	-23.0	3.3	-19.3	-26.5
December	-29.6	2.8	-26.1	-33.0
YEAR	-14.4	1.2	-10.9	-18.0

Source: Environment Canada, Canadian Climate Normals, 1971–2000, Cambridge Bay Airport, Nunavut.

2.6 Site Access

The Roberts Lake property is located in an isolated area with no permanent road access. As part of this project, transportation options to move resources in and out of the area were investigated.

2.6.1 Ice Roads

Ice roads have been used in the past to connect the mine sites to Cambridge Bay (approximately 115 km long). Based on previous experience of local contractors, ice roads could be used in late winter and early spring, but not beyond mid-April.

Ice roads are an effective alternative to the use of barges for the transport of equipment and materials. Ice roads are high maintenance, and close monitoring of ice roads is of paramount importance to ensure safety of workers and equipment.

2.6.2 Aerial Access

Currently, there are no air strips present at either of the two mine sites. It is not practical to build an air strip for remediation purposes. Access by air is therefore limited to float plane or helicopter.

Supplies and personnel can be brought to the site by float plane during open water season (June 15 to September 15). Float plane landing points are envisaged at Roberts Lake approximately 1 km south of Roberts Bay mine site, and at the proposed docking location, on the north shore of Ida Bay mine site at Melville Sound. Float plane access from Roberts Lake could be fairly limited. The depth of water in Roberts Lake is sufficient for landing; however, the shoreline presents a morphology that is not suitable for docking boats or floatplanes requiring a large draft under full load. The shoreline at Roberts Lake is fairly shallow, sloping at a gentle angle to the water. Float plan landing on Melville Sound, along the north shore at Ida Bay mine site is feasible (Figure 7) provided float planes land at the preferred barge landing location, where a steep shore and deep waters were identified.

Helicopter pads could be easily prepared at both mine sites. There is limited or no vegetation at the sites, and low laying terrain morphology provides good opportunity and visibility for helicopter landing and take off. The pad would have to be built on a waste rock pad built on solid ground, or directly on a flat area adjacent to the mine site. This could be a very efficient way of accessing the site without any major disturbance to the environment. Helicopter access could be considered for emergency situations, for transport of supplies, personnel, and also removal of material form the site (debris, equipment, etc.).

2.6.3 Water Access

Open water is generally available in the region between June 15 to September 15. Barge access is available in Roberts Bay during open water season approximately 1.5 km from the Roberts Bay mine site. However, careful consideration should be given to the barge draft requirements under a full load.

A single location for barge access from Melville Sound to Ida Bay mine site was located just 100 m or less to the northwest from the mine site. The shoreline at this location presents a steep drop in profile. The shore is mainly bare rock outcrops, so landing and transport on shore would be easier. The landing point is estimated to be around 7 or 8 m wide. The depth of water could not be measured, but is expected to be in excess of 2 m at 2 to 3 m from shoreline. When selecting a barge, careful consideration should be given to the draft requirements under a full load. In addition, tidal water elevations should be monitored and coordinated with the requirements of maximum draft under full load. Barge landing should be avoided at a low tide level. Materials could be stockpiled at the shore during winter for removal by barge in the summer.

It should be noted that Miramar Hope Bay Limited has been re-supplying their exploration camps at Windy Lake and Boston using NTCL supplied barges on an annual basis since the late 1990's. The barges are offloaded at a site on the west shore of Roberts Bay where equipment and material are stored pending winter conditions. In winter the material and equipment are transported over ice roads across Roberts Bay and overland to these two exploration camps. The same routing could be used for remediation of the Roberts Bay and Ida Bay abandoned silver mine sites. The distance between the Miramar barge off-loading site and the Roberts Bay site is approximately 5 km with most of this across Roberts Bay.

2.6.4 Road Access Between the Mine Sites

The Ida Bay mine site is located on the north shore of Ida Bay on the Melville Peninsula adjacent to Melville Sound about 6.2 km north of the Roberts Bay site (Figure 1). Given the amount of average annual snowfall in the area and the site conditions, winter roads are one of the preferred alternatives to access and connect the Roberts Bay and Ida Bay mine sites. Winter roads have the following advantages:

- They use limited or no fill material. Minimal overburden material needs to be used and removed at the end of the project.
- Provide good vehicle support. Vehicles mounted on tracks are the preferred option.
- Usually, their construction takes less time.
- They are less invasive for the environment, and leave a minimal print on a pristine environment.
- A winter road connecting Roberts Bay and Ida Bay mine sites would allow movement of equipment and materials between the two sites along a suitable alignment, with minimal changes in elevation.

The drawback of using winter roads in the arctic environment is working in a very cold, harsh climate, with low temperatures and reduced visibility. Winter roads would need maintenance and proper signage to ensure safety of workers and their equipment.

2.7 Remediation Logistics – Constraints and Opportunities

The Roberts Bay and Ida Bay abandoned silver mine sites are remote. The estimated cost of remediation is high in comparison to more southerly locations, primarily due to the logistical difficulties to be overcome in getting equipment to and from the site and in supporting the personnel needed to complete the work. The remoteness of these sites results in mobilization – demobilization and support costs that are estimated to be higher than the actual cost of doing the remediation work.

Equipment can only be moved to the site by sealift using tugs and barges during the short open water season (June through September) or by winter road across the Melville Strait from Cambridge Bay during the winter months (January through mid April).

There is no developed barge off-loading site at the Roberts Bay or Ida Bay sites. Water depth in the vicinity of Roberts Bay mine site is fairly shallow making it difficult to safely get the current sealift barges used by the active marine shipping companies operating in this area to the site. This means that equipment may have to be off-loaded at the existing barge off-loading site located on the west shore of Roberts Bay that is currently being used by Miramar Hope Bay Limited to supply their exploration camps at Windy Lake and Boston.

Waters along the shoreline at Ida Bay mine site are slightly deeper and a rocky shoreline would provide good landing conditions; however, an off-loading site needs to be developed at Ida Bay. Equipment could be quickly moved between Ida Bay and Roberts Bay during the winter of Year 1, and most of the work could be completed within the same year at Ida Bay mine site.

The carrying or standby costs for the equipment over several winter seasons, along with the mobilization/demobilization costs are thus very significant and are estimated to represent close to half the total project cost.

Bringing the equipment over a winter road from Cambridge Bay does not significantly alter this mobilization/demobilization cost for the same reason. While there is heavy equipment in

Cambridge Bay it is being used to support the needs of the community. Consequently it is likely that additional equipment would have to be moved to and from Cambridge Bay by sea lift for this remediation project. Consequently the logistics become equally difficult, although a more flexible project schedule could be achieved.

Options for addressing these logistical difficulties are addressed in the remediation plan assessment and cost estimates presented in Sections 5 and 6.

Miramar Hope Bay Limited is currently planning to develop the Doris North underground gold mine project. This project is located 5 km south of Roberts Bay, has been undergoing environmental assessment for a number of years and is expected to enter the permitting phase in 2006. Miramar is hoping to initiate construction in the winter of 2007/2008 meaning that construction equipment would be shipped to site with the sealift in the summer open water season in 2007 (assuming that environmental assessment and permitting continue along the timeframe expected and that the Miramar Board give final approval to proceed). This opens an opportunity to “piggy back” remediation of the Roberts Bay and Ida Bay mine sites onto the construction contracts for the Doris North Project. This could result in significant cost reductions for the remediation plan as mobilization/demobilization and standby costs can be apportioned over both projects.

3.0 SITE ASSESSMENT INVESTIGATIONS

A number of site assessments have been completed at the two mine sites. The intent of these investigations was to characterize the soil, surface water, sediment, tailings and waste rock to determine if remedial efforts were required, where effort should be expended and to obtain sufficient data to develop a remedial plan. The following is a summary of the major findings to date at the Roberts Lake property. Each of the following reports was reviewed and the data assimilated with previous reports to: (a) identify the areas at each mine site that require remediation; (b) define the key issues that need to be addressed in the remediation options selected for each area; and (c) to select the potential remedial options carried forward for evaluation.

3.1 Roberts Bay Mine Site

3.1.1 Survey and Inspection - Vista Engineering 1996

Vista Engineering produced an inventory of the abandoned waste materials and chemicals stored at the site as well as the remaining infrastructure. The inventory included drums of ore processing chemicals, flotation chemicals, lime, nitric acid, carbonate, lead acid batteries, lube oil, and detonation cord.

3.1.2 Environmental Site Assessment (ESA) – Rescan 2003

The focus of this assessment was to determine the location of waste rock piles and tailings areas, determine the potential for acid rock drainage and metal leaching and to assess the stability of the mine workings. Rescan concluded that there was no evidence of acid rock drainage, however some of the waste rock tested indicated the potential for acid generation. The potential for arsenic leaching for the tailings pond was also identified. The recommendations presented included: a need to permanently secure all mine openings; a need to collect and secure all waste materials; and a need to conduct additional studies to determine whether there will be any future environmental impacts from the tailings impoundment and waste rock piles.

3.1.3 Environmental Site Assessment – Rescan 2004

This report identified approximately 225 m^3 of hydrocarbon impacted soil in the vicinity of the mill, machine shop, and at the former fuel storage area. Elevated metal concentrations in soil were also identified at concentrations similar to the waste rock piles. An estimated 305 m^3 of non-hazardous waste materials were identified at the property. Hazardous materials included barrels of fuel, oil, grease, compressed gas cylinders, lead acid batteries, a transformer and unlabelled barrels of liquid.

3.1.4 Screening Level Human Health Risk Assessment - Senes 2004

The conclusions make by Senes were based on the ESA reports completed by Rescan in 2003 and 2004 (see above). The risk assessment included receptor characterization, exposure assessment, hazard assessment and risk characterization. The report concluded that on the basis of conservative assumptions, ingestion of arsenic was a concern at the Roberts Bay mine site. Physical hazards, such as the adits, waste rock piles, infrastructure and debris also represented a potential risk.

3.1.5 Environmental Site Assessment Draft Report – Earth Tech 2005

The objective of this assessment was to determine the extent and volumes of contaminated materials in order to support the development of a remedial plan for the site. Concerns related to PCBs (Polychlorinated Biphenyls), PAHs (Poly Aromatic Hydrocarbons) and pesticides were not identified at the site. Impacted areas were limited to hydrocarbon and metal parameters in soil and waste rock fines. Concentrations of arsenic, barium, chromium, copper, lead, nickel, silver and zinc were typically an order of magnitude above measured background concentrations. The waste rock fines were located in all areas where waste rock had been stockpiled or used for construction. Concentrations of metals in the soil at the area of the mill were also elevated above background concentrations. The area of petroleum impacted soil was confined to the areas of the former fuel storage, the machine shop and the mill building. Earth Tech estimated 325 m^3 of petroleum impacted soil was present at the Roberts Bay site.

3.1.6 Waste Assessment Draft Report – Earth Tech 2005

A detailed waste audit was conducted to determine the volumes of non-hazardous and hazardous waste. Approximately 355 m^3 of non-hazardous material was identified. As the non-hazardous waste was not located in close proximity to a water body, it was concluded that the material could be safely recovered without causing additional impacts to the surrounding environment. The recommendations with respect to the hazardous waste were that the material should be recovered and hauled to an approved off-site location for disposal.

Due to the high lead content in the product used to paint the steel mill equipment, the recommendation was that the painted steel components be removed and hauled offsite for disposal or a lead abatement program be completed prior to recycling of the steel materials. The metal debris, such as the tent frame structures, has potential for re-use however the transportation costs may prohibit recycling. Earth Tech recommended the frames and trusses be cut and the material provided to the local community as stock.

3.1.7 Geotechnical and Geophysical Report Draft – Earth Tech 2005

The objectives of the geotechnical assessment were to map surficial geology to provide locations and horizontal delineation of landforms, identify candidate locations for on-site landfill areas and determine the quantities and type of locally available borrow material. The objectives of the geophysical assessment were to identify and map any buried debris; and define the limits of any known landfills.

Soil materials at the sites were typically composed of a surface organic layer (typically 15 to 30 cm deep) covering coarse textured mineral layers of sands and gravels with trace amounts of silt and clay-size materials (see geotechnical logs in appendix of Earth Tech report). A frost layer was typically detected at about 0.6 m depth. Buried subsurface debris was generally not detected on the Roberts Bay site, with the exception of a medium sized buried ferrous object or shallow rock with high ferromagnetic properties in the area of the old camp (as determined by a geophysical survey).

Four new locations and two previously developed areas were identified and evaluated as potential landfill sites:

- Location A: area of 1,370 m^2 northeast of the fuel bladders to a depth of about 1 m. The area was also identified as a borrow area. The water table is approximately 0.7 m below grade.
- Location B: area of 900 m^2 east of the garage within a waste rock pad. The depth varies from 0.3 m at the north end to 2 m at the south edge.
- Location C: area of 1,500 m^2 within the old camp area. The area is well drained located primarily on a bedrock outcrop.
- Location D: area of 3,590 m^2 south of the main waste rock pile to a depth of about 0.7 m. The area was also identified as a borrow area containing about 2,520 m^3 of granular fill. The water table is approximately 0.5 m below grade and bedrock was noted at 0.75 m depth.
- Existing Dumpsite: bounded with a waste rock berm approximately 20 m X 10 m wide and 1.5 to 2 m thick. Surface area of the dumpsite is 300 m^2 suitable for the disposal of inert materials placed within lifts of non-frost-susceptible granular material;
- Existing Tailings Pond: covers an area of about 700 m^2. Encapsulated waste would cover the tailings, but the design must allow for freezeback of the waste and include an erosion resistant cover and stabilization of the sideslopes.

Locations B and C were identified as the preferred locations for a non-hazardous waste landfill.

Six borrow areas were identified at the Roberts Bay Site:

- Borrow Area 1: about 200 m east of the former campsite area contains about 300 m^3 of fine to medium textured sand to a thickness of 0.6 m.
- Borrow Area 2: immediately south of the main waste rock pile contains about 2,520 m^3 of fine to medium textured sand and gravel to a thickness of 0.7 m.
- Borrow Area 3: about 60 m south of the former campsite area contains about 2,250 m^3 of medium to coarse sand with gravel and cobbles to a thickness of 0.6 m.
- Borrow Area 4: northeast of the fuel bladders contains about 1,370 m^3 of well graded sand overlying sandy gravel with trace silt/clay to a thickness of about 1.0 m.
- Borrow Area 5: approximately 100 m north of the former mill building contains about 215 m^3 of silty sand and trace gravel to a thickness of 0.76 m above the frost line.
- Borrow Area 6: about 200 m west of the tailings pond contains at least 2,880 m^3 of well graded sand and gravel with trace silt/clay to a thickness of about 1.1 m.

About 5,000 m^3 of additional sand and gravel material located in a sand and gravel outwash deposit is also located about 500 m to the west of the site, but is considered a less preferable source because of the long hauling distance.

3.1.8 Human Health and Ecological Risk Assessment (HHERA) Draft Report – UMA 2005

The assessment of human health risks concluded that there would be negligible risk associated with periodic exposure to the Roberts Bay mine site. This was based on an annual visit by a local family residing at the site for 30 days and subsisting off the aquatic and terrestrial environments. There were however, two sources of contaminants that represented the highest source of risk: standing bodies of water (flooded adits and tailing pond) and the fine fraction of waste rock/tailings (soil impacted with metals).

The HHERA concluded that localized petroleum hydrocarbon impacts were a potential risk to small herbaceous mammals and could potential hamper re-growth of vegetative if allowed to remain on the surface. The concentrations of arsenic, silver, copper, vanadium and zinc in soil and vegetation are also a potential health concern to small herbaceous mammals. The impacted soil is mainly comprised of the fine fraction of the waste rock and the tailings material.

The recommendation of the HHERA was to mitigate these two sources by either reducing or eliminating the potential for human exposure.

3.1.9 Geochemical Report – AMEC 2005 & 2006

The objectives of the geochemical investigation were to perform and finalize detailed geochemical assessment of the tailings and waste rock and to assess mobility of arsenic and other metals from the tailings pond. Twenty-two waste rock samples, seven tailings samples, four mine water samples and a vegetation sample were collected from the Roberts Bay Site for analyses including static ABA tests, shake flask test, and total metals. In addition, based on results of the static tests and on site assessments, an additional six samples of waste rock from Roberts Bay mine site were selected for humidity cell (three samples) and column leach analyses (three samples) for kinetic testing. The major findings of this work are as follows:

- The majority of the waste rock at the Roberts Bay mine site is net non-acid generating;
- Three waste rock piles/areas identified on the Roberts Bay mine site had NP:AP ratios between 4.0 and 1.0 indicating that the rock has uncertain acid generating potential based on the results of static testing; further kinetic testing, however, confirmed that the waste rock at Roberts Bay mine site is non-acid generating (NAG);
- The tailings at the Roberts Bay mine site are net non-acid generating (NAG);
- All waste rock and tailing samples at the Roberts Bays and Ida Bay mine sites has paste pH values greater than 7.0 indicating that none of the samples are currently generating net acidity even though they have been exposed to weathering for >30 years;
- The concentrations of Ag, Sb, As, Cu, Pb, Se, and Zn in most waste rock at the Roberts Bay mine site were elevated relative to average background concentrations;
- The total concentration of nickel in the Roberts Bay tailings was elevated relative to average crustal abundance, while concentrations in the waste rock at both mine sites was similar to average crustal (background) abundances;

- The concentration of Cd and Hg were elevated in the Ida Bay waste rock, while concentrations were similar to background crustal abundance at the Roberts Bay site;
- Results from leach solutions indicate that generation of ARD or leaching of metals of interest (As, Co, Cu, Pb, Ni, and Zn) does not appear to be of concern for these waste rock materials;
- The concentration of metals of concern (As, Cu, Pb, Ni, and Zn) in mine water at the Roberts Bay and Ida Bay mine sites are much lower than MMER regulatory values and consequently treatment is not required before discharge to the environment;
- The concentration of most elements measured in the mine water samples were very low and similar to guideline values protective for fresh water aquatic life (CCME, 2003);
- The concentration of As in the Roberts Bay tailings pond and a large pond near the north road leading to Ida Bay was much lower than MMER discharge guidelines but slightly elevated compared to CCME guidelines for both fresh water and marine water;
- The concentration of Se in the north pond at Roberts Bay exceeded CCME guideline values for fresh water;
- The concentration of Zn in the tailings sump sample at the Roberts Bay site was below MMER guidelines for discharge but exceeded CCME guideline values for fresh water;
- Although the Ida Bay waste rock contained elevated concentrations of Cd relative to background, it likely occurs as insoluble suspended particulates and is not expected to elevate concentrations in solution; and
- Vegetation (cottongrass, *Eriophorum sp.*) found in a mature growth stage actively growing on the north edge of the tailings pond did not accumulate higher than normal concentrations of As, Cd, Cu, Pb or Zn in plant dry matter.

3.1.10 Geotechnical Report – AMEC 2006

A detailed site plan and topographic survey was prepared for use as a base plan for the remediation program. The main conclusions and recommendations were as follows:

- General terrain topography is characterized by low laying morphological features, with maximum elevation difference of 48 m between the Roberts Bay mine site and Roberts Lake water level;
- During the short open-water season, suitable float plane access was identified along the shorelines of Roberts Lake. Suitable barge access is not available at Roberts Lake, because it is a land locked body of water;
- Use of overland winter roads and ice roads is recommended for undertaking remedial work, to minimize any additional impact to the surrounding environment;
- Use of ice roads is recommended for transport of equipment and materials, provided a strict monitoring program is in place;
- Use of helicopter is recommended for both transport of personnel and materials (including debris and equipment), as well as in emergency situations;
- The mine openings were all partly flooded and no ice formation was identified during the summer months within the openings. Some were partly backfilled. Side walls were found

to be stable however roof collapse could become a potential problem if not properly addressed. Controlled blasting of the roof of the adits, followed by backfilling with non-acid generating materials was the preferred alternative for a safe remediation of the mine openings;

- Recommendations were made for additional kinetic testing of various waste rock piles, to evaluate their suitability as construction material for remediation alternatives. Results of the kinetic testing confirmed that waste rock could be used to cover and reshape the landfill site, reinforce the tailings pond berm, and backfill mine openings.

3.2 Ida Bay Mine Site

3.2.1 Environmental Site Assessment – Rescan 2003

The focus of this assessment was to determine the location of waste rock piles, determine the potential for acid rock drainage and metal leaching and to assess the stability of the mine workings. Rescan analyzed a single waste rock sample which was found to have uncertain potential to generate net acidity. Water leachable arsenic was elevated above CCME freshwater aquatic life guideline. The recommendations included the permanent sealing of all mine openings, the collection and segregation in a secure landfill of all non-hazardous waste materials and additional analysis on waste rock piles for ABA and metals leaching.

3.2.2 Environmental Site Assessment – Rescan 2004

Approximately 8 m^3 of non-hazardous waste was identified however; contaminated soil and surface water were not found to be present at this site.

3.2.3 Screening Level Human Health Risk Assessment – Senes 2004

The conclusions were based on the ESA reports completed by Rescan in 2003 and 2004. The risk assessment included receptor characterization, exposure assessment, hazard assessment and risk characterization. The report concluded that physical hazards, such as the adit, exploration pit and the vent raise, were present at the Ida Bay Site.

3.2.4 Environmental Site Assessment Draft Report – Earth Tech 2005

The objective of this assessment was to determine the extent and volumes of contaminated materials present to support the development of a remedial plan for the site. There were no identified contaminants of concern except for the elevated metal concentrations (Cu and Pb) in the marine sediment samples collected immediately below the waste rock piles in Ida Bay.

3.2.5 Waste Assessment Draft Report – Earth Tech 2005

A detailed waste audit was conducted to determine the volumes of non-hazardous and hazardous waste. Approximately 9 m^3 of non-hazardous material was identified at the Ida Bay site. As the non-hazardous waste was not located in close proximity to a water body, it was concluded that the material could be safely recovered without causing additional impacts to the surrounding environment.

3.2.6 Geotechnical and Geophysical Report Draft – Earth Tech 2005

No contaminated soil or water was identified at the Ida Bay Site. About 9 m^3 of non-hazardous waste was identified at this site. A granular deposit for borrow material of about 1,200 m^3 of sand and gravel material with 1.1% fines to a thickness of 1 m is located about 250 m to the northeast of the site.

3.2.7 Human Health and Ecological Risk Assessment (HHERA) Draft Report – UMA 2005

The assessment of human health risks concluded that there would be negligible risk associated with periodic exposure to the Ida Bay mine site. This was based on an annual visit by a local family residing at the site for 30 days and subsisting off the aquatic and terrestrial environments. Elevated sediment lead concentrations were associated with the waste rock in the shallow shores off Ida Bay. The report recommended that BC MEM shake flask analysis be completed on this waste rock. If the results show little potential for the lead to be bioavailable, then disruptive remedial actions within the ocean may not be warranted.

3.2.8 Geochemical Report – AMEC 2005

The objectives of the geochemical investigation were to perform and finalize detailed geochemical assessment of the waste rock and to assess mobility of arsenic and other metals. Four waste rock samples, and duplicate samples of mine water from the adit were collected from the Ida Bay Site for analyses, including static ABA tests, shake flask test, and total metals. In addition, based on results of the static tests and on site assessments, an additional four representative samples of waste rock from Ida Bay mine site were selected for humidity cell (two samples) and column leach analyses (two samples) for kinetic testing. The major findings of this work are as follows:

- The rock represented by two samples from the Ida Bay mine site rock had NP:AP ratios between 4.0 and 1.0 indicating that they have uncertain acid generating potential based on the results of static testing; further kinetic testing, however, confirmed that the waste rock at Ida Bay mine site is non-acid generating (NAG);
- All waste rock and tailing samples at the Roberts Bays and Ida Bay mine sites has paste pH values greater than 7.0 indicating that none of the samples are currently generating net acidity even though they have been exposed to weathering for greater than 30 years;
- The concentration of Cd and Hg were elevated in the Ida Bay waste rock;
- The concentration of metals of concern (As, Cu, Pb, Ni, and Zn) in mine water in the adit at Ida Bay mine sites are much lower than MMER regulatory values and consequently treatment is not required before discharge to the environment;
- The concentration of most elements measured in the mine water samples were very low and similar to guideline values protective for fresh water aquatic life (CCME, 2003); and
- Although the Ida Bay waste rock contained elevated concentrations of Cd relative to background, it likely occurs as insoluble suspended particulates and is not expected to result in elevated concentrations in the receiving waters adjacent to the site.

3.2.9 Geotechnical Report – AMEC 2006

A detailed site plan and topographic survey was prepared for use as a base plan for the remediation program. The main conclusions and recommendations were as follows:

- The distance between Roberts Bay and Ida Bay mine sites, measured along a proposed winter access road was approximately 6.2 km. An all weather road is not recommended;
- During the short open-waters season, suitable float plane access was identified along the shorelines of Melville Sound;
- Suitable barge access was identified at Ida Bay;
- Use of overland winter roads and ice roads were recommended for undertaking remedial work, to minimize any additional impact to the surrounding environment. A monitoring program will be required for safety;
- Use of a helicopter was recommended for both transport of personnel and materials (including debris and equipment), as well as in emergency situations;
- The mine openings were partly flooded; during the summer months, no ice was observed to be formed within the openings. Depth of water was measured and confirmed for each opening. Side walls were found to be relatively stable however roof collapse could become a potential problem if not properly addressed. Controlled blasting of the roof of the adit, followed by backfilling with non-acid generating materials was the preferred alternative for secure long term remediation;
- Recommendations were made for additional kinetic testing of various waste rock piles, to evaluate their suitability as construction material for remediation alternatives. Subsequent kinetic test results confirmed that the waste rock could be used to backfill mine openings.

4.0 SELECTION CRITERIA FOR REMEDIATION ALTERNATIVES

4.1 Evaluation Criteria and Ranking of Alternatives

The Roberts Bay and Ida Bay mine sites are remote and therefore require special considerations for the logistical challenges in developing a remediation plan that is technically and financially feasible and does no further damage to the environment. Addressing the needs and concerns of the community will be incorporated into the selection of the remedial options following completion of the public consultation process planned by PWGSC.

A number of parameters were selected for the evaluation and ranking of the proposed remedial alternatives so that a preferential remedial option could be determined for each component of the site. The parameters were selected based on the desired outcomes and in consideration of the environment in which the project area is located.

Each remedial option was evaluated with respect to its potential risks, advantages and disadvantages. The remedial options were evaluated based on:

- Long-term effectiveness;
- Technical feasibility;
- Protection of human health and safety;
- Protection of ecological receptors such as caribou and fish through the effects on water quality and to vegetation (dust);
- Overall time frame to implement;
- The need for long-term care and management of the site including post closure monitoring needs;
- Capital costs; and,
- Operation and Maintenance costs.

Each of the above parameters was assigned a numeric score between 1 and 5 based on how suitable the remedial option was with respect to the parameter. A description of the numeric values is summarized below.

Numeric Values Description	
Score	**Numeric Ranking**
1	Poor
2	Less than acceptable
3	Acceptable
4	Good
5	Better

As there are eight evaluation parameters, the maximum possible score assigned to a remedial option would be 40, thus options with the highest score indicate a desirable remedial option. Options that have less desirable attributes achieve lower scores.

Section 5.0 describes the main issues and outlines the remedial alternatives for each of the items. Remediation Option Evaluation matrices for each of the sites have been developed and are included in Appendix A.

A screening level environmental impact assessment report under the Canadian Environmental Assessment Act will need to be prepared prior to the implementation of the final remediation plan.

4.2 Water and Soil Quality Objectives

The following guideline criteria are considered applicable to the comparison of analytical data obtained at the Roberts Bay and Ida Bay Mine sites for both assessment and remediation purposes:

- Canadian Council of Ministers of the Environment (CCME) Environmental Quality Guidelines (EQG) (1999 updated to 2005); and
- CCME Canada-Wide Standard for Petroleum Hydrocarbons in Soil (CWS PHC, 2001).

The above two documents provide guideline values for petroleum hydrocarbon fractions, polycyclic aromatic hydrocarbons, volatile organic compounds, metals, and polychlorinated biphenyls in soil, sediment and surface water (freshwater and marine) media. Both documents are referenced in the document developed by the Government of the Northwest Territories entitled, "*Environmental Guideline for Contaminated Site Remediation*", dated November 2003. Given changes to the CCME EQG for benzene, toluene, ethylbenzene and xylenes invoked in 2004, the CCME EGQ is more conservative than the NWT guideline.

Environmental assessments conducted at the site by Rescan (2003 and 2004) and Earth Tech (2005) utilized the above CCME documents for the comparison of analytical data when determining the degree of impact to the media from the former mining activities.

As part of the scope in 2005, UMA was retained to conduct a HHERA. The HHERA determined site-specific remedial objectives (SSROs) for non-essential trace metals (arsenic, silver, vanadium) and essential trace metals (zinc and copper). The HHERA also established SSROs for fractional petroleum hydrocarbons (F1 to F4) in fine grained soil.

A summary of the relevant assessment guidelines for soil, surface water and sediment are summarized in three tables in Appendix B. The SSROs developed by the HHERA have been identified in the tables.

The above referenced guidelines were used to assess completion of the remedial plan with respect to impacted soil and water.

5.0 REMEDIATION ALTERNATIVES

5.1 Roberts Bay Site

Based on the findings of the previous assessments, the main issues at the Roberts Bay Mine site to be addressed as part of this remediation plan are:

- Remaining infrastructure;
- Tailings pond;
- Waste rock;
- Non-hazardous waste;
- Hazardous waste;
- Petroleum and metals impacted soil; and
- Mine openings.

The above items are discussed in more detail in the following sections.

5.1.1 Site Infrastructure

At the end of mining activities, the supporting infrastructure was abandoned in place. Infrastructure remaining at the Roberts Bay site at the time of the assessment in August 2005 was identified in four areas:

- Former Camp;
  - Platforms and remains of several tent-cabin frames, outhouse and shed;
  - Core racks;
- Mill Area;
  - Metal frames (tent frames) of mill and assay lab;
  - Hazardous material storage shed;
- Machine Shop/Adit;
  - Metal frame of the machine shop;
  - Metal tent frame covering the underground mine adit entrance that was then enclosed within a chain link fence;
- Pump house;
  - Remains of a shed which enclosed the pump.

5.1.1.1 Key Issues

Presently the infrastructure remains are spread across most of the mine site, in various stages of unsightly disrepair. The tent frames, litter, and debris present a clear hazard to visitors to the area. In this isolated area which has no existing transportation infrastructure and difficult climatic conditions, opportunities for reducing waste volumes, such as cost recovery through sale of assets and green demolition practices are limited.

The main issues pertaining to the remaining infrastructure are:

- Physical safety risks to humans and terrestrial wildlife;
- Risk of exposure to hazardous materials within the remains of the former buildings; and
- Aesthetics.

Hazardous materials, associated with the infrastructure, such as PCB containing equipment, asbestos-containing materials, mill process chemicals, waste oil, fuel and batteries have all been identified at the site and are addressed in Section 5.1.5. Concentrations of lead-based paint, greater than 500 ppm, were identified on the steel mill equipment (cone crusher, ball mill tanks and flotation cells, tables, etc.). Therefore this equipment must be treated as hazardous waste under the guideline of the NWT Government (applicable with Nunavut) or the lead must be removed prior to the steel being recycled or disposed of on-site. Removing the lead paint at this remote site without spreading it around will be difficult due to the lack of indoor facilities in which to contain any sandblasting activity.

5.1.1.2 Remedial Options

Two options were identified for remediation of the remaining site infrastructure:

- Leave as is; and
- Dismantle structures and segregate the waste.

Ranking of these two alternatives are described in Appendix A. The first option is not acceptable as it does not address the cleanup of this site in accordance with the objectives set by PWGSC. Dismantling of the existing infrastructure and segregation of the resulting demolition materials into hazardous and non-hazardous waste is the preferred remedial strategy.

The remediation for the infrastructure would entail:

- Removal of hazardous materials from the building remains and equipment. Hazardous materials would then be managed as described in Section 5.1.5. Areas would be cleaned of any chemicals and impacted soils;

- The unpainted metal framed structures and equipment can be cut into manageable sizes for on-site burial in a non-hazardous landfill site to be developed within the tailings pond. Painted surfaces identified as containing lead will either be subjected to lead abatement or taken off-site for disposal at an appropriate facility (the preferred option).

- The wood from the sheds, outhouse, pumphouse, etc. will be collected and broken down such that it can be burned or buried on-site. The ash from burning will be moved to the non-hazardous landfill.

- Debris from around the site would be collected and segregated into stockpiles of non-hazardous waste (i.e. wood, steel, and other inert material) for disposal within the non-hazardous landfill area.

- The adits are addressed in Section 5.1.8 as a separate item.

The majority of the demolition and segregation will be undertaken by hand, although small equipment will be utilized for hauling and stockpiling the material in an on-site burial location. Opportunities to allow some suitable recycle of non-hazardous material such as the cut up steel tent frames will be explored with local communities although the great distance between the site and the local communities will likely be a significant disincentive to interested parties coming to the site to pick up these materials. Once dismantled, the demolition waste will be classified as hazardous and non-hazardous waste and handled according to the remedial plan developed for the respective type of waste material (see Section 5.1.4 and 5.1.5).

5.1.2 Tailings Pond

The majority of ore produced at Roberts Bay was shipped off site for processing in the south. During the last year of operation some ore at the Roberts Bay mine was subjected to flotation processing with the concentrate shipped offsite for further processing. Tailings produced during the process were deposited in the small tailings pond. Reportedly, only flotation tailings were produced with no cyanide or mercury used during processing of the ore on-site.

The tailings pond is a very small (compared to most other facilities), roughly circular impoundment measuring approximately 40 m diameter with a surface elevation of 67.0 m amsl. The surface area of the tailings is about 700 m^2 including the waste rock berm. Although a polyethylene liner was apparently used in the pond the extent and integrity of the liner was questionable at the time of the 2005 site visit. The tailings are retained against the side of a sloping basaltic outcrop near the crest. The outcrop slopes roughly to the south-southwest. The tailings are impounded by a semicircular berm constructed primarily of waste rock on the west, grading to a mixture of waste rock and borrow materials on the south side and mostly borrow material on the southeast side. The berm is approximately 0.5 to 1.0 m higher in elevation (67.5 to 68.0 m amsl) compared to the surface elevation of the tailings and about 3 m at the highest point above the natural grade (approximately 65 m amsl) at the toe. The semicircular berm has a 2:1 (2H:1V) slope and the equivalent volume of material in the structure which includes the tailings and the surrounding waste rock berm is estimated at approximately 1,900 m^3.

All tailings samples collected from the Roberts Bay tailings pond contained less than 0.3% sulphide-S. All samples had paste pH values >7.0 with average net neutralizing potential (NNP) of 60 kg $CaCO_3$/tonne and NP:AP ratios >4.0 indicating that the tailings are net non-acid generating (NAG).

The total concentrations of silver, arsenic, copper, lead, zinc and selenium in the tailings were elevated relative to average crustal abundances. The concentrations of arsenic, copper and lead in the tailings pond water were elevated relative to CCME guidelines for protection of aquatic life, but considerably lower than MMER guidelines typically used to regulate the discharge of mine waters.

5.1.2.1 Key Issues

The main issues pertaining to the tailings pond are as follows:

- The semicircular berm may be too steep to maintain physical stability of the contained tailings in the long term presenting a physical risk;
- Possible ecological and human exposure to metals (arsenic and lead) through direct contact with the tailings; and
- The tailings in their current condition are a potential source of dust and therefore represent a risk to ecological health.

5.1.2.2 Remedial Options

Four strategies were evaluated for remediation of the tailings pond:

1. Do nothing other than stabilize the waste rock berms with clean waste rock;
2. Drain standing water, cover tailings with waste rock;
3. Relocate the tailings to the underground workings; and
4. Remove the tailings from the site and dispose at a suitable landfill facility in Cambridge Bay or in the south.

The four alternative strategies have been discussed and evaluated in Appendix A. Draining of the standing water and covering the tailings in the winter time with a minimum of 2 m of waste rock to provide an isolation barrier and reestablish permafrost was determined to be the preferred solution. The steps in implementing this remedial strategy are:

- The existing berms around the tailings pond will be beefed up and re-graded to 3H:1V slope to provide a stable long-term structure. The estimated volume of clean waste rock required to implement this alternative is approximately 665 m^3. This waste rock will be obtained from the waste rock stockpiles, from the Ida Bay site, and from the rock filled berms around the fuel bladder, fine ore pad and machine shop.
- The water in the tailings pond would be drained prior to the emplacement of clean waste rock. To minimize the impact to the environment and eliminate the use of a sedimentation pond, the water would be pumped into the underground mine adit so that it discharges at least 2 m below the current flooded surface. This will allow more rapid drawdown of the water from the tailings pond without fear of sediment release to the receiving aquatic environment. The water in the tailings pond has been found to have metals concentrations above the freshwater aquatic life guidelines but less than the MMER guidelines.
- Non-hazardous demolition debris from both the Roberts and Ida Bay sites would be buried within the tailings pond and then capped with clean waste rock.
- Tailings and waste rock fines from other areas of the site would be excavated and emplaced above the existing tailings.
- The entire surface of the tailings pond would be covered with no less than 2 m of waste rock to isolate the tailings from contact with people, wildlife and to prevent future wind

and water erosion of the currently exposed tailings. Side slopes will also be reinforced with waste rock and flattened to a 3H:1V slope minimum to ensure long term stability.

Earth moving equipment required to complete this work would include an excavator, dump truck(s) and a loader.

5.1.3 Waste Rock Dumps

Waste rock was abandoned around the Roberts Bay Mine Site without consideration of treatment requirements. Some waste rock was used for construction of roads and infrastructure, usually as a surface veneer less than 1.0 m thickness. Other waste rock was abandoned in small piles around the site. The waste rock areas and piles (excluding the tailings pond) identified at the sites are summarized in Table 5.1.

Table 5.1: Estimated Volumes of Waste Rock at the Roberts Bay and Ida Bay Mine Sites.

Site	Location	Volumes (m^3)			
		Clean WR	ARD WR	In-Use WR	Total WR
Robert's Bay	Ore Pad - West Half	31			
	Ore Pad - East Half	32			
	Explosives Area (including road)	20			
	Fuel Bladder Berm - South Half	76			
	Fuel Bladder Berm - North Half	72			
	Waste Rock Pile - South End	80			
	Waste Rock Pile - North East End	80			
	Waste Rock Pile - North West End	80			
	Waste Rock Plateau - East	488			
	Waste Rock Plateau - North	332			
	Waste Rock Pile 1 (East)	155			
	Waste Rock Pile #2 (North)	27			
	Waste Rock Berm #1 (W of Fine Ore Pad))	59			
	Access Road to Ida Bay	451			
	Fine Ore Pad	134			
	Mill Yard Area (North)	251			
	Waste Rock Berm #2 (N of Tailings Pond)	44			
	Waste Rock Berm #3 (S of Tailings Pond)	321		321	
	Waste Rock Berm around existing Dump	48		48	
	Ramp of Waste Rock (to Adit #2)	64			
	Subtotal Roberts Bay	2473	0	369	2842
Ida Bay	Waste Rock Pile # 1 (East)	1606			
	Waste Rock Pile # 2 (North)	602			
	Waste Rock Pile # 3 (South)	148			
	Waste Rock Pile #4 (West)	156			
	Subtotal Ida Bay	2512	0		2512
Grand Total		4985	0	369	5354

The estimated total volume of waste rock at the Roberts Bay site is 2,842 m^3 based on site survey information and best estimates for average depths of veneers. Based on the geochemical test results, the potential for the waste rock to generate acidity and to release metals in the long term is very limited.

5.1.3.1 Key Issues

The key issues related to waste rock are:

- Aesthetics; and
- Use to infill openings, cover low laying areas and minimize visual impact.

The waste rock was confirmed to be non-acid generating and therefore it constitutes a valuable resource for use as backfill, re-grading, capping and erosion protection, without a need for special disposal conditions.

5.1.3.2 Remedial Options

In order to address the issues related to the waste rock management at the site, the following alternatives are proposed:

1. Leave the waste rock in place; and
2. Non-acid generating rock to be used to cover the tailings pond, construction of berms and covers material for non-hazardous demolition debris.

An evaluation and discussion of these alternatives is included in Appendix A. Waste rock from Roberts Bay and Ida Bay will be used for backfill, re-grading, capping and erosion protection. If there is excess waste rock it will be left in place and re-contoured to improve aesthetics.

Placement of the waste rock within the flooded sections of the underground workings is the preferred remedial strategy however, based on the geometry of the adit, there is not enough capacity within the adits. There is also the added difficulty that the adits are flooded and potentially unstable. The waste rock material could therefore be emplaced either within the adits, or used as backfill following adit roof blasting. The remaining waster rock could be used for backfilling, berm reinforcement, cover, and reshaping of the various site features.

The steps entailed in implementing this solution area as follows:

- The maximum quantity of waste rock (approximately 100 m^3) will be emplaced within the adits. (Note: Some of the waste rock will have been used to infill the adit at Ida Bay prior to the remainder being transferred to Roberts Bay mine site.) The adit backs will then be blasted and additional waste rock will be used to backfill the depressions and level of the area to blend with the surrounding environment.

- The stockpiled overburden will be used to cover the waste rock and contour the landscape, as deemed necessary.

5.1.4 Non-hazardous Waste

The Roberts Bay Site had a flotation mill and maintenance shop that were constructed as wood and steel tent frames that have decayed leaving significant debris (wood, concrete, tires, steel, plastic, cabling, abandoned equipment, etc.). Site infrastructure was generally abandoned and left to decay leaving significant debris across the two sites (estimated at 375 m^3 of non-hazardous debris).

As part of the waste audit conducted by Earth Tech approximately 92 m^3 of wood, 84 m^3 steel/metal products and 178 m^3 miscellaneous inert wastes were identified; for a total quantity of 354 m^3. The waste assessment report (Earth Tech, 2005) should be referenced for a complete summary of the quantities and types of waste present. During the demolition of the site infrastructure, additional non-hazardous wastes are expected to be generated.

An existing surface landfill, containing domestic waste, is present on-site but it has not been closed out. It did not appear that any waste had been buried below grade at this location.

5.1.4.1 Key Issues

The debris currently present at the site is unsightly and unsafe to visitors and terrestrial wildlife.

The existing landfill which was used for the disposal of domestic waste generated at the camp, has not been appropriately covered. As such, the landfill presents a physical hazard which will need to be addressed as part of the remedial plan.

5.1.4.2 Remedial Options

Options evaluated for the remediation of non-hazardous waste included:

1. Leaving all remaining structures and non-hazardous debris in place;
2. Demolish the remaining structures, clean up all non-hazardous debris, and remove all non-hazardous material for disposal/recycling in a suitable off-site landfill;
3. Demolish the remaining structures, clean up all non-hazardous debris, and segregate recyclable wastes where feasible and ship to a suitable recycling facility, bury non-recyclable non-hazardous wastes on-site in a suitably designed landfill capped with clean waste rock;

The alternative strategies have been discussed and evaluated in Appendix A. The preferable remedial option was the emplacement of the non-hazardous waste within the tailings pond footprint and covering this landfill with a minimum thickness of 2 m of non-acid generating waste rock. All of the non-hazardous debris will be segregated into wood, steel and other inert wastes. The wood could be incinerated in a controlled fashion on site with the ash moved to the tailings pond. Authorization will be required from the Nunavut Department of Environment. Steel waste will be placed in the demolition landfill within the tailings pond footprint. This remedial strategy is a long-term solution, requiring little to no monitoring, little potential for re-emergence of the material from freeze-jacking and will isolate the waste from potential human and wildlife exposure.

The options evaluated for the existing landfill containing domestic waste were:

1. Leave the landfill in its current condition;
2. Reinforce the berms and construct a proper landfill cover. Waste rock would be used to stabilize the berms and cover the waste to prevent freeze jacking.
3. Excavate the non-hazardous waste from the landfill and manage the waste along with the remaining non-hazardous materials and re-grade the existing berms.

The preferred remedial option is to leave the waste materials in place and simply provide a waste rock cover to isolate the waste from humans and wildlife and improve the aesthetics (Option 2). This provides a stable, long-term solution, at a low cost, and utilizing available materials.

This would be implemented by using approximately 350 m^3 of NAG waste rock to stabilize and finish the berms plus cover the surface of the landfill to a depth of approximately 1 m. This remedial option would require the use of earth moving equipment.

5.1.5 Hazardous Waste

The waste audit conducted by Earth Tech created an inventory of hazardous wastes at the Roberts Bay site. The following hazardous materials were identified:

- PCB containing equipment (capacitors, light ballasts) - 0.25 m^3;
- Fuel – gasoline and jet fuel - 3200 L;
- Hydrocarbon impacted water from fuel bladders and in barrels - 800 L;
- Waste oils and glycols - 675 L;
- Compressed gas cylinders – 10;
- Mill process chemicals (xanthanate, various acids, calcium, lime, lead shavings);
- Acids;
- Equipment painted with lead amended paints – 11,000 kg;
- Lead acid batteries – 0.25 m^3; and
- Detonation cord.

Asbestos materials on site were limited to a transite panel constructed heating cabinet located within the former mill. Although confirmatory asbestos samples were not submitted it is expected that the transite board would contain in the range of 2 to 10% chrysotile asbestos. A few brake pads were also observed at both the Roberts Bay and Ida Bay mine sites. Hazardous and non-hazardous waste found at the Ida Bay site will be transported to the Roberts Bay site so that waste materials can be managed together under strict handling conditions, and disposed of as appropriate (on site landfill, or off site).

Steel components covered with paint that has a lead concentration greater than 500 ppm is considered a hazardous waste. It should be removed and transported off-site to a facility licensed to receive lead waste. Alternatively the lead-based paint could be removed from the metal prior to recycling or disposal of the steel materials. Steel coated with lead-based paint should not be considered for on-site burial or donation to the community.

5.1.6 Key Issues

The key issue with the presence of hazardous waste at the site is the threat to human and terrestrial wildlife health and safety. Aesthetically the drums and containers are unappealing. If the containers of liquid waste remain at the site, there is a risk of spillage through puncture, corrosion, and/or vandalism, which could impact soil, surface water and/or groundwater.

5.1.6.1 Remedial Options

Only two remedial options for the hazardous waste were considered:

1. Leave in place; and
2. Collect and remove for disposal at an appropriate off-site disposal facility.

The preferred remedial option is to collect and remove the hazardous waste to an appropriate off-site facility. Where feasible, acids would be neutralized on-site. Potentially abandoned petroleum products could be appropriately mixed and incinerated on-site to reduce the volume of hazardous waste requiring transportation.

Remediation of waste lead and lead paint should be consistent with the “Guideline for Waste Lead and Lead Paint” published by the Government of the Northwest Territories in April 2004.

Remediation of waste batteries should be consistent with the “Guideline for the Management of Waste Batteries” published by the Government of the Northwest Territories in September 1998.

Hazardous materials would be placed into drums or overpacks, sealed, and appropriately labeled and manifested. The drums and overpacks will then be transferred via winter road to the barge loading site on Roberts Bay where they will be stored inside seacan shipping containers at the loading dock until open water season. The containers will then be transferred by barge to Hay River and then trucked to an appropriate disposal facility in Alberta. The costs associated with the transportation of the hazardous materials could be significantly reduced were this aspect of the work combined with the resources being utilized at the nearby Doris North project.

5.1.7 Petroleum and Metals Impacted Soil

Both metals and petroleum hydrocarbon impacted soils were identified during the environmental site assessment conducted by Earth Tech (2005). Metals impacted soil, mainly comprised of waste rock fines, was identified in the vicinity of the mill building and other areas of the site where waste rock had been stockpiled. There is approximately 325 m^3 of petroleum contaminated soils located around the fuel storage compound, mill and garage at Roberts Bay and an additional 65 m^3 of metal contaminated soil from around the mill site.

5.1.7.1 Key Issues

The two primary concerns with the presence of the metals and petroleum hydrocarbon impacted soil are:

- Impacted soil represents a safety and toxicity hazard to humans and wildlife through soil contact, ingestion and vapour inhalation;
- The petroleum hydrocarbons and metals may contaminate local surface and shallow groundwater (above the permafrost).

5.1.7.2 Remedial Options

Remedial options evaluation for the impacted soils included:

1. Leave in place;
2. Containerize and remove off-site for appropriate disposal; and
3. Excavate and dispose of hydrocarbon impacted soils in an engineered landfarm.

Option 2 is the preferred remedial option as it will limit human and wildlife exposure (via ingestion, inhalation, or physical contact) to petroleum hydrocarbons and metals impacted soil and will not require future monitoring. Placing the impacted soil in a landfarm does not address the metals impacted soil, requires operation and maintenance and will take an estimated 5 years to naturally attenuate.

A derivation of Option 2 is to place the hydrocarbon impacted soil from the garage and fuel bladder area (estimated to be 325 m^3) into the tailings pond area and then cap it with non-acid generating waste rock (minimum thickness of 2 m). The 65 m^3 of metal contaminated soil will be packaged and removed from the site for disposal at an appropriate disposal facility in Alberta.

The steps in the implementation of Option 2 are as follows:

- Excavate the 390 m^3 (325 + 65) of hydrocarbon impacted soil and place into 1 m^3 capacity super-sack containers;
- Transport the containers to the barge loading dock at Roberts Bay via the next winter road; and
- Transfer the containers by barge to Hay River and then by truck to an appropriate disposal facility in Alberta.

5.1.8 Mine Openings

There were two mine openings identified at the Roberts Bay mine site. One adit, referred to here as Adit #1, was located to the northeast of the tailings pond. At the time of the 2005 site visit Adit #1 had been covered with a wooden framework and plywood against which some waste rock had been emplaced. Standing water was observed at the entrance to the adit indicating the mine working has flooded. A chain-link fence surrounded the adit to provide some protection against access.

A second adit, referred to as Adit #2, was located to the east of Adit #1 on the side of the eastern basaltic ridge. The walls of Adit #2 appear to have partially collapsed and a chain link fence only partially surrounds it. Caving and fractures are evident implying the structural integrity of the opening is not sound.

A vent raise, sealed with concrete, was also identified to the north of the opening of Adit #2. There was no evidence of subsidence around the vent raise however; no details or engineered drawings regarding the manner in which the raise was capped were available.

5.1.8.1 Key Issues

Physical hazards to the safety and health of humans and terrestrial animals who visit the site are posed by access available into the mine workings through the adits. The deteriorating structures and fences surrounding the adits detract from the aesthetic value of the Site.

5.1.8.2 Remediation Alternatives

Potential remedial alternatives considered are as follows:

1. Leave as is;
2. Blast the roof of the mine openings (adits and vent raise) and backfill
3. Backfilling with waste rock, blast the adit and further infill depressions waste rock; and
4. Construction of permanent bulkheads at all openings.

The preferred remedial alternative will be the one in which access to the mine workings are permanently sealed to prevent access and will be stable for the long-term. Ideally, the remedial method will restrict human and wildlife access to mine water with elevated concentrations of metals. Although with the exception of alternative 1, all of the above remedial options meet these objectives. Blasting down the roof of the three adits and in-filling with clean waste rock is the preferred alternative because it utilizes the available on-site materials, reduces the physical hazard of emplacing the waste rock (i.e. the adit does not have to be entered) and would be geotechnically stable.

The steps required to implement this remedial strategy are:

- The adits will be infilled first with waste rock;
- Drilling and blasting will be employed to drop the top of the adit down upon the waste rock; and
- Finally, clean waste rock will be used to infill the depression created and reshape the area to blend in with the surrounding environment.

Equipment required for the implementation of this option includes earth moving and blasting equipment.

An engineered pre-cast concrete cap will be placed over top of the current concrete capped vent raise to ensure that this opening is permanently secured in accordance with prevailing mine safety regulations dealing with minimum cap strengths. The new cap will span the full width and length of the existing concrete cap, and shall be anchored in the surrounding rock at least 0.5 m away from the edges of the existing cap, to ensure that it is well founded on competent bedrock. Should a cast in place reinforced concrete cap be a more economical approach, it would also be an acceptable solution provided the minimum required concrete quality and strength are ensured. The new concrete cap will then be covered with waste rock.

5.2 Ida Bay Site

Based on the findings of the previous assessments, the main issues at the Ida Bay Mine Site to be addressed as part of this remediation plan are:

- Remaining infrastructure including hazardous and non-hazardous waste;
- Waste rock;
- Mine openings; and
- Marine sediments.

The above items are discussed in more detail in the sections below.

5.2.1 Site Infrastructure, Hazardous and Non-Hazardous Waste

An exploration trench was identified in the basaltic ridge west of the adit. Reportedly, the trench was excavated using blast and muck techniques, and measures approximately 1.2 m wide, 8 to 10 m long, and 1.0 m deep. Additional smaller trenches are present in the vicinity. At the time of the 2005 site visit the trench was filled with water. No warning signs had been posted and no oxidation staining was visible.

A considerable amount of mine-related waste materials were scattered around the Ida Bay site. Including the following types of materials:

- Non-hazardous (wood, lumber, steel, rubber hoses, tin cans, auto parts) – approximately 9 m^3; and
- Hazardous (e.g. broken lead acid batteries) – approximately 100 kg and a few asbestos brake pads.

5.2.1.1 Key Issues

The key issues are:

- Aesthetics; and
- Human health and safety and safety of terrestrial wildlife;

5.2.1.2 Remedial Options

Remedial options being considered for the infrastructure, non-hazardous and hazardous waste are:

- Infrastructure and Non-hazardous waste:
  1. Do nothing;
  2. Transport non-hazardous waste to the Roberts Bay site where they will be co-managed (burial in tailings pond); and
  3. Remove non-hazardous waste to an appropriate off-site facility.

- Exploration Trench:
  1. Do nothing; and
  2. Fill in the exploration trench with available clean waste rock or borrow material.

- Hazardous waste:
  1. Do nothing; and
  2. Containerize and remove the hazardous waste off-site for disposal to an appropriate facility (co-managed with Roberts Bay waste).

The preferred remedial strategy is to transport the non-hazardous waste to the Roberts Bay site where they will be co-managed. The preferred remedial option for the management of non-hazardous waste at Roberts Bay is burial within the tailings pond. The remaining infrastructure and debris would be collected and segregated by hand. The non-hazardous waste from Ida Bay would have to be transported to Roberts Bay mine site and then emplaced in a 0.5 m lift above the tailings. The waste would then be covered with a minimum thickness of 2 m of waste rock.

The preferred option for the remediation of the exploration trench is to infill the trench with waste rock and contour with the existing grade. Earth moving equipment would be required to implement this task. Approximately 10 m^3 of the clean waste rock material will be required to backfill the exploration trench.

The preferred option of the management of the hazardous waste is to place the lead batteries and asbestos into appropriate containers and store the containers over the winter months at the barge loading dock. In the summer the packaged hazardous material will be shipped to Hay River by barge for subsequent transport by truck to a suitable recycling and/or disposal facility in Alberta.

5.2.2 Waste Rock

Four waste rock piles were identified in proximity to the adit at the Ida Bay mine site (see Figure 8). During the August 2005 investigation the total volume of waste rock at Ida Bay was determined to be 2,512 m^3. As per the AMEC Geochemical report, the waste rock was determined, based on static and kinetic test results, to be non-acid generating (NAG).

In addition, all waste rock samples had paste pH values greater than 7.0 indicating that none of the samples are currently generating net acidity even though they have been exposed to weathering for greater than thirty years. The concentration of cadmium and mercury were elevated in the Ida Bay waste rock relative to average background concentrations.

5.2.2.1 Key Issues

The waste rock at Ida Bay is not expected to generate net acidic drainage or release deleterious concentrations of metals into the aquatic environment.

The key issues related to waste rock are:

- Aesthetics and visual impact.

The clean or non-acid generating waste rock constitutes a valuable resource for use as backfill, re-grading, capping and erosion protection.

5.2.2.2 Remedial Options

Two remedial options were considered for the NAG waste rock:

1. Leave in place and
2. Utilize as cover materials for the adit, backfill trenches and transport remainder to Roberts Bay.

If the waste rock were not required for backfill, re-grading, capping and erosion protection at either of the mine sites, it would be left in place and re-contoured. It is expected that the bulk of the waste rock present at Ida Bay mine site will be required to implement the remedial plan at the Roberts Bay mine site. Also, the visual impact at Ida Bay mine site will be considerably improved. The required quantity of waste rock would be transported by truck via a winter road from Ida Bay to Roberts Bay mine site, with minimal or no impact to the environment.

The preferred remedial strategy was required to be a long-term, no maintenance solution that will eliminate potential for metal leaching. Although off-site disposal meets these objectives, this alternative has a relatively high cost associated with both the transportation and tipping fee. The preferred option would be to place the waste rock within the flooded sections of the underground workings at Ida Bay and Roberts Bay mine sites, filling in all the trenches and the adit at Ida Bay first.

The steps in implementing this remedial option are:

- Remove the waste rock from above high tide level first, then the remainder using earth moving equipment;
- Emplace waste rock within the adit at Ida Bay. If additional material can be placed in the vent raise this should also be undertaken. After placing the waste rock the adit (and vent raise) the rock would be blasted to drop the roof down on the waste rock. Additional waste rock would then be used to infill the depression created and regrade the area;
- The remaining quantities of waste rock (~600 m3) would be loaded into trucks and transported via winter road to the Roberts Bay mine site where it will be used to cover and reshape the local site features.

5.2.3 Mine Openings

The adit is a prominent feature at the Ida Bay site. The adit is fully open with no physical barrier, to prevent access, or posted warning signs. The adit is located approximately 15 m from the ocean shoreline and at the time of the 2005 site visit, was fully flooded with fresh water. The timbers bracing the back of the adit entrance appear deteriorated and their structural integrity is uncertain.

A vent raise located to the west of the adit that had been covered with loose plywood which has begun to deteriorate. Below the plywood, the vent raise is filled with water.

5.2.3.1 Key Issues

The open adit at Ida Bay is a prominent safety hazard to humans or wildlife. The adit should be permanently sealed to prohibit access by humans or wildlife. The open and partially covered vent raise is also a safety hazard to humans or wildlife. The structural integrity of the timbers supporting the adit and the plywood covering the vent raise are uncertain.

5.2.3.2 Remedial Options

Options considered for the permanent closure of the adit are:

1. Do nothing;
2. Blast the adit roof back and backfill with waste rock;
3. In-fill the adit with waste rock, blast the roof to collapse on the rock then backfill the depression with waste rock; and
4. Construct bulkhead.

Options being considered for the permanent closure of the vent raise are:

1. Do nothing;
2. Seal the vent raise with an appropriately engineered cap.
3. Blast the opening and backfill with clean waste rock.

Placement of the waste rock within the flooded section of the adit and vent raise is the preferred remedial strategy however, based on the geometry of the adit, there would not be enough capacity within the adit and vent raise for all waste rock. There is also the added difficulty that the adit and vent raise are flooded and potentially unstable. Provided the material could be emplaced safely this would be a preferred alternative. However, the majority of the waste rock would be transported to Roberts Bay mine site.

5.2.4 Marine Sediments

The most southern waste rock pile was observed to extend from land into the ocean and is partially covered by seawater at high tide. The volume of waste rock material deposited within the ocean tidal zone is estimated to be less than 20 m^3.

5.2.4.1 Key Issues

Approximately 20 m^3 of sediment impacted with metals (Cu and Pb) were identified below the waste rock pile which extended into the tidal zone which may impact the aquatic environment

5.2.4.2 Remedial Options

Remedial options considered to address the above issues are:

1. Do nothing;
2. Remove the waste rock from the shoreline above high tide and place the waste rock with the remaining stockpiles; and
3. Excavate sediment (20 m^3) and move to Roberts Bay to be treated with other metals impacted soil.

The preferred remedial option is to remove the waste rock from the shoreline above high tide while leaving the impacted sediment in place. This will leave the aquatic environment undisturbed while eliminating a potential source of future impact.

The steps in this remedial plan are:

- Survey and mark the high tide elevation;
- Excavate the waste rock above the high tide; and
- Transport the remaining waste rock to Roberts Bay via a winter road where it will be used for backfilling and reshaping.

The implementation of this remedial option will require the construction of a winter road using earth moving equipment, excavation of waste rock using earth moving equipment and a truck to haul the waste rock over land to Roberts Bay.

5.3 Community Consultations

A plan for community consultation was developed by PWGSC. The community consultations took place late summer of 2006 in Cambridge Bay, NU. As part of the community consultation program, the remedial options and the evaluation of each of the remedial options were discussed with the community to provide weighted values to the evaluation parameters.

Some of the main questions raised related to the following aspects:

- The tardiness in cleaning up Roberts Bay and Ida Bay mine sites. This was explained that INAC has prioritized all contaminated sites that they are in charge of, and these two sites are of moderate priority. Now they are next priority for clean-up.
- The potential removal of all materials from the site. Removal of non-hazardous materials from the site was explained and is not economically feasible to do so. In addition, discussions were carried out with local people and the town engineer in Cambridge Bay for the possibility of constructing a landfill that would receive the non-hazardous materials. This was not accepted by the town and the preference was given to be buried on site.
- Inquiries were made regarding creation of jobs during the clean-up project. It was confirmed by PWGSC that the remediation contractor will be hiring local people for most of the positions that will be available.

PWGSC and AMEC took into account all of the feedback received before deciding on the final remediation plan.

5.4 Instrumentation and Monitoring

After implementation of the remediation plan the long-term monitoring program should be very simple, requiring only simple instrumentation installed at the Roberts Bay Site. No instrumentation should be required at the Ida Bay Site as no landfill or hazardous materials are expected to remain at the site after remediation.

Installation of groundwater monitoring equipment should not be necessary because of the relatively small watershed and shallow active zone. The chemistry of the local surface water should closely represent the chemistry of the groundwater in the active zone. Monitoring sites at the Roberts Bay site should include the following:

1. The stream flowing south to Roberts Lake (main watershed);
2. The stream or streams flowing north and west around the bedrock high (northern site drainage);
3. Any stream flowing west to Roberts Bay located below the tailings and dump sites to detect possible leachate from these features;
4. Roberts Lake (for background and quality control).

The monitoring program should minimally follow the INAC protocols for remediated sites. During the first five years after remediation, monitoring and sample collection should be conducted at least once a year, preferably immediately after the spring melt (June). Monitoring frequency should be reduced to once every five years (for the next 5 years with re-evaluation after 25 years).

Thermistors strings should be installed (in pairs) within the tailings pond location at the Roberts Bay mine site to confirm permafrost re-establishment after capping of the structure. The collection of data from these thermistors should occur on the same schedule as water sample collection to save on travel and labor costs.

5.5 Quality Assurance and Quality Control

All water samples should be analyzed for total concentration of metals, organic compounds and possible daughter products and metabolites at a qualified laboratory. Samples should be collected by a qualified individual. Protocols for Quality Assurance and Quality Control (QA/QC) should include the addition of field blanks at each sample time and collection of duplicate water samples with separate containers specified for the analytical protocol. Sufficient volumes should be collected to allow long term storage for re-analyses (as analytical checks) along with newer samples collected during future sampling times.

6.0 REMEDIATION IMPLEMENTATION & COST ESTIMATE

6.1 Logistics and Schedule

As previously discussed in Section 2.7, the estimated cost of remediation for the Roberts and Ida Bay sites is high in comparison to more southerly locations, primarily due to the logistical difficulties to be overcome in getting equipment to and from the site and in supporting the personnel needed to complete the work. The remoteness of these sites results in mobilization – demobilization and support costs that are estimated to be higher than the actual cost of doing the remediation work.

AMEC considered three different logistical “scenarios” for implementation of the proposed remediation plan. These “scenarios” are described in the following section:

<u>Option 1: Barge Access to the Miramar Off-Loading Site on the West Shore of Roberts Bay</u>

Under Option 1, equipment and material for implementation of the remediation plan would be mobilized to Roberts Bay via barge and tug, contracted from NTCL (Northern Transportation Company Limited) from Hay River in the summer open water season of Year 1. The equipment would arrive at Roberts Bay in mid August and be off-loaded at the existing Miramar barge off-loading site on the west shore of Roberts Bay. The equipment and material would be held in storage until January of Year 2 when an ice road would be constructed across Roberts Bay and the equipment and material moved to the Roberts Bay and Ida Bay abandoned mine sites. The major earthworks required at the Roberts and Ida Bay sites would be completed in the winter of Year 2 (between February 01 and end of March) so that waste rock and hazardous and non-hazardous waste materials that need to be moved from the Ida Bay to the Roberts Bay site is completed using a winter road between the two sites. The objective is prevent heavy equipment moving between these two sites under non-winter conditions to avoid creating further terrestrial impacts.

In preparation for this winter construction program, a tent camp would be flown to site and set up at the Roberts Bay site and one at Ida Bay mine site in the summer of Year 1 (June). Alternatively, winterized trailers could also be used in lieu of tents, brought by barge. The camps would be used as a base of operation for a small crew who would be tasked with collecting and re-packaging hazardous materials, demolishing the structures and assembling the non-hazardous waste materials in piles at the Roberts and Ida Bay sites. This crew would have no heavy equipment, consequently their work would be hand work, labour intensive with movement between the two sites restricted to an all terrain vehicle and trailer brought to site by a floatplane or open boat from Cambridge Bay or by helicopter. The camp would be closed down in late August of Year 1 and winterized.

The camp would be re-opened in mid January to support the winter earthworks program and operated through the end of March. Remediation of the Ida Bay site would essentially be completed during this period with all remaining waste rock that has to be moved from the Ida Bay to the Roberts Bay site moved before the end of March. All hazardous material and non-hazardous demolition and clean up debris would also be moved to the Roberts Bay site by the end of March. The camp would again be closed until the summer of Year 2 (June).

The camp would be re-opened in June of Year 2 and the remainder of the site remediation work completed at the Roberts Bay Site. This work would primarily focus on placing all non-hazardous demolition and clean up debris in the tailings pond and capping the tailings pond with waste rock. The Roberts Bay site would be essentially remediated by the end of August at which time the camp would be decommissioned and dismantled.

The winter road between the Roberts Bay site and the Miramar barge loading site would be re-established in mid-January of Year 3 and all of the equipment, the hazardous material and sacks of contaminated soil would be transported to the barge loading site to be held pending arrival of the barge in mid August. All of this equipment and hazardous material would be shipped by barge to Hay River in the late summer of Year 3. Upon arrival in Hay River, the equipment would be shipped back to Edmonton and the hazardous materials transported to the appropriate disposal facilities in Alberta (such as Swan Hill).

Under this scenario, most of the equipment would be assigned to this project for a total time period approaching 28 months (June of Year 1 through October of Year 3). The actual usage of the equipment (operating time) over this 28 month period would be in the order of 6 months. Consequently the project will incur significant equipment “standby” charges.

The proposed schedule for option 1 is presented in Table 6.1.

Table 6.1: Option 1 Remediation Schedule – Winter Earthworks – Barge to the Miramar Off-Loading Site near Roberts Bay Mine Site

Option 1 - Barge to Roberts Bay - Earth Works Primarily Over Winter Months (Remediation Independent of the Doris North Project)

	Duration	Start	End						Year 1												Year 2												Year 3						
Activity	Weeks	Date	Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mobilization - Summer Year 1																																							
Mobilize equipment & supplies to Hay River	4	01-Jun	30-Jun						■																														
Barge departs Hay River for Roberts Bay	6	01-Jul	15-Aug							■	■																												
Barge off loads at Roberts Bay	1	15-Aug	16-Aug								■																												
Place Equipment & Material in Storage	22	15-Aug	31-Jan								■	■	■	■	■	■																							
Construct Ice Road across Roberts Bay	2	15-Jan	31-Jan													■																							
Move Equipment to Roberts Bay	1	24-Jan	31-Jan													■																							
Set Up Camp in Summer of Year 1																																							
Fly camp, equipment & supplies to Cambridge Bay	2	01-Jun	15-Jun						■																														
Fly camp, equipment & supplies to Roberts Bay Mine site	1	15-Jun	22-Jun						■																														
Set up Construction Camp at Roberts Bay Mine Site	2	15-Jun	30-Jun						■																														
Collect Hazardous Materials & Prepare for shipment offsite	4	01-Jul	31-Jul							■																													
Demolish structures	8	01-Jul	30-Aug							■	■																												
Collect and move non-hazardous debris into piles at Roberts & Ida Bay Mine sites ready for transfer	8	01-Jul	30-Aug							■	■																												
Dewater tailings pond	1	15-Aug	30-Aug								■																												
Winter Earthworks - Year 2																																							
Move waste rock into mine adit openings at both sites	4	01-Feb	28-Feb														■																						
Drill off and blast in adit roof openings (3) at both sites	3	15-Feb	07-Mar														■	■																					
Fill in blasted depressions at all three adits (allow for settling)	2	15-Mar	30-Mar															■																					
Drill off and blast in Ida Bay vent raise opening	2	01-Feb	15-Feb														■																						
Fill in blasted depression over Ida Bay vent raise	2	15-Feb	28-Feb														■																						
Backfill exploration trenches at Ida Bay site	4	01-Feb	28-Feb														■																						
Move excess waste rock from Ida Bay to Roberts Bay	4	15-Feb	15-Mar														■	■																					
Move hazardous and non-hazardous waste to Roberts Bay site	4	01-Feb	01-Mar														■																						
Regrade Ida Bay waste site	2	15-Mar	30-Mar															■																					
Summer Earthworks - Year 2																																							
Re-open Camp	2	01-Jun	15-Jun																		■																		
Construct tailings pond stabilizing berm	2	15-Jun	01-Jul																		■																		
Excavate hole and bury demolition debris in tailings pond	2	15-Jun	30-Jun																		■																		
Cover tailings pond with waste rock cap	2	01-Jul	01-Aug																			■																	
Place pre-cast concrete cap on Roberts Bay Vent raise & cover	2	01-Jul	15-Jul																			■																	
Excavate hydrocarbon & metal contaminated soils & place in sacks/containers for shipment	8	01-Jul	30-Aug																			■	■																
Regrade Roberts Bay site	2	15-Aug	30-Aug																				■																
Decommission and remove camp	2	15-Aug	30-Aug																				■																
Winter Works - Year 3																																							
Construct Ice Road across Roberts Bay	2	15-Jan	31-Jan																									■											
Move sacks of contaminated soil to barge loading site	2	01-Feb	15-Feb																										■										
Move equipment to barge loading site	2	01-Feb	15-Feb																										■										
Ship equipment to Hay River via barge	6	15-Aug	30-Sep																																■	■			
Ship hazardous material by barge to Hay River	6	15-Aug	30-Sep																																■	■			
Transport hazardous material from Hay River to disposal sites in Alberta	2	01-Oct	15-Oct																																		■		
Dispose of hazardous material at licensed sites	2	15-Oct	31-Oct																																		■		
Post Closure Water Quality Monitoring										■												■												■					

Option 2: Barge Access Direct to the Ida Bay Mine Site

Under Option 2, equipment and material for implementation of the remediation plan would be mobilized to the Ida Bay site via a smaller dedicated barge from Hay River in the summer open water season of Year 1. The equipment would arrive at the Ida Bay site in mid August and be off-loaded. The major earthworks required at the Ida Bay site would be completed in the late summer of Year 1 (between mid August and mid September). The ability to off-load a barge at this site still needs to be confirmed in consultation with NTCL

Similar to Option 1, in preparation for this work, a tent camp would be flown to site and set up at the Roberts Bay mine site in the summer of Year 1 (June). The camp would be used as a base of operation for a small crew who would be tasked with collecting and re-packaging hazardous materials, demolishing the structures and assembling the non-hazardous waste materials in piles at both the Roberts and Ida Bay sites. This crew would have no heavy equipment prior to the arrival of the barge in August, consequently their work would be hand work, labour intensive with movement between the two sites restricted to an all terrain vehicle and trailer brought to site by a floatplane or open boat from Cambridge Bay or by helicopter. In mid August once the barge arrived, the heavy equipment would be used to essentially complete the required earthworks at the Ida Bay site. The camp would be closed down for the winter in late September.

The camp would be re-opened in mid January to support the winter earthworks program and operated through the end of March. All remaining waste rock required at Roberts Bay, heavy equipment, hazardous and non-hazardous material would be moved to the Roberts Bay site by the end of March with remediation of the Ida Bay site essentially complete. The camp would again be closed until the summer of Year 2 (June).

The camp would be re-opened in June of Year 2 and the remainder of the site remediation work completed at the Roberts Bay Site. This work would primarily focus on placing all non-hazardous waste in the tailings pond and capping the tailings pond. The Roberts Bay site would be essentially remediated by the end of August at which time the camp would be decommissioned and dismantled.

The winter road between the Roberts Bay site and the Ida Bay barge loading site would be re-established in mid-January of Year 3 and all of the equipment, the hazardous material and sacks of contaminated soil would be transported to the barge loading site to be held pending arrival of the barge in mid August. All of this equipment and hazardous material would be shipped by barge to Hay River in the late summer of Year 3. Upon arrival in Hay River, the equipment would be shipped back to Edmonton and the hazardous materials transported to the appropriate disposal facilities in Alberta (such as Swan Hill).

Similar to Option 1, under this scenario, most of the equipment would be assigned to this project for a total time period approaching 28 months (June of Year 1 through October of Year 3). The actual usage of the equipment (operating time) over his 28 month period would be in the order of 6 months. Consequently the project will still incur significant equipment “standby” charges.

The proposed schedule for Option 2 is presented in Figure 6.2.

Table 6.2: Option 2 Remediation Schedule – Summer and Winter Earthworks – Barge to Ida Bay

Option 2 - Barge to Ida Bay - Earthworks Over Summer & Winter Months (Remediation Independent of the Doris North Project)

Activity	Duration Weeks	Start Date	End Date	Year 1 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mobilization - Summer Year 1															
Mobilize equipment & supplies to Hay River	4	01-Jun	30-Jun						X						
Barge departs Hay River for Ida Bay	6	01-Jul	15-Aug							X	X				
Barge off loads at Ida Bay	1	15-Aug	22-Aug								X				
Place Equipment & Material in Storage	22	01-Oct	31-Jan										X	X	X
Construct Ice Road to Roberts Bay Minesite	2	15-Jan	31-Jan												
Move Equipment to Roberts Bay Minesite	1	24-Jan	31-Jan												
Summer Earthworks - Year 1															
Drill off and blast in adit roof opening at Ida Bay	3	01-Sep	21-Sep									X			
Fill in blasted depressions at Ida Bay adit (allow for settling)	2	15-Sep	30-Sep									X			
Drill off and blast in Ida Bay vent raise opening	2	15-Aug	30-Aug								X				
Fill in blasted depression over Ida Bay vent raise	2	01-Sep	15-Sep									X			
Backfill exploration trenches at Ida Bay site	4	15-Aug	15-Sep								X	X			
Regrade Ida Bay waste site	2	15-Sep	30-Sep									X			
Set Up Camp in Summer of Year 1															
Fly camp, equipment & supplies to Cambridge Bay	2	01-Jun	15-Jun						X						
Fly camp, equipment & supplies to Roberts Bay Mine site	1	15-Jun	22-Jun						X						
Set up Construction Camp at Roberts Bay Mine Site	2	15-Jun	30-Jun						X						
Collect Hazardous Materials & Prepare for shipment offsite	4	01-Jul	31-Jul							X					
Demolish structures	8	01-Jul	30-Aug							X	X				
Collect and move non-hazardous debris into piles at Roberts & Ida Bay Mine sites ready for transfer	8	01-Jul	30-Aug							X	X				
Dewater tailings pond	1	15-Aug	30-Aug								X				
Winter Earthworks - Year 2															
Drill off and blast in adit roof openings (2) at Ida Bay site	3	15-Feb	07-Mar												
Fill in blasted depressions at Roberts Bay adits (allow for settl	2	15-Mar	30-Mar												
Move excess waste rock from Ida Bay to Roberts Bay	4	15-Feb	15-Mar												
Move hazardous and non-hazardous waste to Roberts Bay si	4	01-Feb	01-Mar												
Summer Earthworks - Year 2															
Re-open Camp	2	01-Jun	15-Jun												
Excavate hole and bury demolition debris in tailings pond	2	15-Jun	30-Jun												
Cover tailings pond with waste rock cap	4	01-Jul	01-Aug												
Construct tailings pond stabilizing berm	4	01-Jul	01-Aug												
Place pre-cast concrete cap on Roberts Bay Vent raise	2	01-Jul	15-Jul												
Cover pre-cast shaft cap with clean waste rock	2	15-Jul	31-Jul												
Excavate hydrocarbon & metal contaminated soils & place in sacks/containers for shipment	8	01-Jul	30-Aug												
Regrade Roberts Bay site	2	15-Aug	30-Aug												
Decommission and remove camp	2	15-Aug	30-Aug												
Winter Works - Year 3															
Construct Winter Road to Ida Bay	2	15-Jan	31-Jan												
Move sacks of contaminated soil to barge loading site	2	01-Feb	15-Feb												
Move equipment to barge loading site	2	01-Feb	15-Feb												
Ship equipment to Hay River via barge	6	15-Aug	30-Sep												
Ship hazardous material by barge to Hay River	6	15-Aug	30-Sep												
Transport hazardous material from Hay River to disposal sites in Alberta	2	01-Oct	15-Oct												
Dispose of hazardous material at licensed sites	2	15-Oct	31-Oct												
Post Closure Water Quality Monitoring										X					

Activity	Year 2 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mobilization - Summer Year 1												
Mobilize equipment & supplies to Hay River												
Barge departs Hay River for Ida Bay												
Barge off loads at Ida Bay												
Place Equipment & Material in Storage	X											
Construct Ice Road to Roberts Bay Minesite	X											
Move Equipment to Roberts Bay Minesite	X											
Summer Earthworks - Year 1												
Drill off and blast in adit roof opening at Ida Bay												
Fill in blasted depressions at Ida Bay adit (allow for settling)												
Drill off and blast in Ida Bay vent raise opening												
Fill in blasted depression over Ida Bay vent raise												
Backfill exploration trenches at Ida Bay site												
Regrade Ida Bay waste site												
Set Up Camp in Summer of Year 1												
Fly camp, equipment & supplies to Cambridge Bay												
Fly camp, equipment & supplies to Roberts Bay Mine site												
Set up Construction Camp at Roberts Bay Mine Site												
Collect Hazardous Materials & Prepare for shipment offsite												
Demolish structures												
Collect and move non-hazardous debris into piles at Roberts & Ida Bay Mine sites ready for transfer												
Dewater tailings pond												
Winter Earthworks - Year 2												
Drill off and blast in adit roof openings (2) at Ida Bay site		X	X									
Fill in blasted depressions at Roberts Bay adits (allow for settl			X									
Move excess waste rock from Ida Bay to Roberts Bay		X	X									
Move hazardous and non-hazardous waste to Roberts Bay si		X										
Summer Earthworks - Year 2												
Re-open Camp						X						
Excavate hole and bury demolition debris in tailings pond						X						
Cover tailings pond with waste rock cap							X					
Construct tailings pond stabilizing berm							X					
Place pre-cast concrete cap on Roberts Bay Vent raise							X					
Cover pre-cast shaft cap with clean waste rock							X					
Excavate hydrocarbon & metal contaminated soils & place in sacks/containers for shipment							X	X				
Regrade Roberts Bay site								X				
Decommission and remove camp								X				
Winter Works - Year 3												
Construct Winter Road to Ida Bay												
Move sacks of contaminated soil to barge loading site												
Move equipment to barge loading site												
Ship equipment to Hay River via barge												
Ship hazardous material by barge to Hay River												
Transport hazardous material from Hay River to disposal sites in Alberta												
Dispose of hazardous material at licensed sites												
Post Closure Water Quality Monitoring							X					

Activity	Year 3 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mobilization - Summer Year 1												
Mobilize equipment & supplies to Hay River												
Barge departs Hay River for Ida Bay												
Barge off loads at Ida Bay												
Place Equipment & Material in Storage												
Construct Ice Road to Roberts Bay Minesite												
Move Equipment to Roberts Bay Minesite												
Summer Earthworks - Year 1												
Drill off and blast in adit roof opening at Ida Bay												
Fill in blasted depressions at Ida Bay adit (allow for settling)												
Drill off and blast in Ida Bay vent raise opening												
Fill in blasted depression over Ida Bay vent raise												
Backfill exploration trenches at Ida Bay site												
Regrade Ida Bay waste site												
Set Up Camp in Summer of Year 1												
Fly camp, equipment & supplies to Cambridge Bay												
Fly camp, equipment & supplies to Roberts Bay Mine site												
Set up Construction Camp at Roberts Bay Mine Site												
Collect Hazardous Materials & Prepare for shipment offsite												
Demolish structures												
Collect and move non-hazardous debris into piles at Roberts & Ida Bay Mine sites ready for transfer												
Dewater tailings pond												
Winter Earthworks - Year 2												
Drill off and blast in adit roof openings (2) at Ida Bay site												
Fill in blasted depressions at Roberts Bay adits (allow for settl												
Move excess waste rock from Ida Bay to Roberts Bay												
Move hazardous and non-hazardous waste to Roberts Bay si												
Summer Earthworks - Year 2												
Re-open Camp												
Excavate hole and bury demolition debris in tailings pond												
Cover tailings pond with waste rock cap												
Construct tailings pond stabilizing berm												
Place pre-cast concrete cap on Roberts Bay Vent raise												
Cover pre-cast shaft cap with clean waste rock												
Excavate hydrocarbon & metal contaminated soils & place in sacks/containers for shipment												
Regrade Roberts Bay site												
Decommission and remove camp												
Winter Works - Year 3												
Construct Winter Road to Ida Bay	X											
Move sacks of contaminated soil to barge loading site		X										
Move equipment to barge loading site		X										
Ship equipment to Hay River via barge								X	X			
Ship hazardous material by barge to Hay River								X	X			
Transport hazardous material from Hay River to disposal sites in Alberta										X		
Dispose of hazardous material at licensed sites										X		
Post Closure Water Quality Monitoring							X					

Option 3: Barge Access to Roberts Bay – Piggy Back on Construction of the Doris North Project

Under Option 3, the remediation of the Roberts and Ida Bay abandoned mine sites would be “piggy backed” onto the proposed construction of the Doris North Project. In other words the contracts for remediation of the Roberts Bay and Ida Bay abandoned silver mine sites would be awarded to the same contractor(s) awarded the earthworks construction contract for the Doris North Project by Miramar Hope Bay Limited. The major advantage is that equipment already brought to the project area for construction of the Doris North Project can be used thus eliminating most of the high mobilization, demobilization and standby costs incurred in bringing in dedicated heavy equipment to complete remediation of the Roberts and Ida Bay mine sites.

Under Option 3, remediation of the Roberts and Ida Bay sites would primarily be completed under winter conditions in Year 2 in the period between early January and late March. A winter road would be constructed and maintained between the Doris North jetty site at the south end of Roberts Bay and the Roberts and Ida Bay sites to allow the contractors equipment to travel between the two sites during this winter period to complete the major earth moving components of the remediation plan.

Similar to Option 1, a smaller tent camp would be transported by air and set up at the Roberts Bay abandoned silver mine site in the summer of Year 1 (June). The camp would be used as a base of operation for a small crew who would be tasked with collecting and re-packaging hazardous materials, demolishing the structures and assembling the non-hazardous waste materials in piles at both the Roberts and Ida Bay sites. This crew would have no heavy equipment, consequently their work would be hand work, labour intensive with movement between the two sites restricted to an all terrain vehicle and trailer brought to site by a floatplane or open boat from Cambridge Bay or by helicopter. The camp would be closed down for the winter in late August.

The winter earth moving work would be supported out of the construction camp at the Doris North site using the same contractor personnel and equipment used to construct the Doris North Project.

Other cost advantages offered by “piggy backing” this remediation work onto the construction of the Doris North Project includes:

- Under Option 3 the non-hazardous demolition debris derived from clean up of the Roberts and Ida Bay abandoned mine sites (including demolition of the remaining buildings and equipment) will be trucked and buried in the non-hazardous landfill facility to be constructed within Quarry #2 at the Doris North Project. Under this arrangement no demolition debris landfill would have to be created within the tailings pond at the Roberts Bay mine site. The non-hazardous demolition debris would be assembled in piles at both the Roberts and Ida Bay sites in the summer of Year 1 and then trucked to the Doris North landfill site in the winter of Year 2.

- Under Option 3 the hydrocarbon and metal contaminated soil (~ 390 m^3 of mixed waste rock and soil) from the Roberts Bay site would be excavated and trucked to the Doris North Mine to be placed underground as backfill. In this manner this potential contamination source will be permanently sequestered within the permafrost underground at the Doris North Mine. This would save the high cost of transferring this soil into 1 m^3 capacity super sacs and transporting them by barge and truck to an appropriate hazardous landfill site in Alberta.

The Roberts Bay summer camp would be re-opened in July of Year 2 to allow for final site inspection at both sites once the winter snows have melted. This will allow for any additional clean up and grading missed during the winter remediation program using hand tools and the ATV left on site. The two sites would essentially remediated by the end of August at which time the camp would be decommissioned and removed to the Doris North Project site. The hazardous material moved to the Doris North jetty site in the previous winter will be shipped by barge to Hay River in the late summer of Year 2. Upon arrival in Hay River the hazardous materials will transported by truck to the appropriate disposal facilities in Alberta (such as Swan Hill).

Under this option significant cost and time savings are achieved by “piggy backing” onto the construction of the Doris North Project. There are significant savings by eliminating most of the heavy equipment mobilization, demobilization and standby costs associated with Options 1 and 2. The proposed schedule for Option 3 is presented in Figure 6.3.

Table 6.3: Option 3 Remediation Schedule – "Piggy Back" Remediation of Roberts Bay and Ida Bay Mine Sites onto Construction of the Doris North Project

Option 3 - "PIGGY BACK" ON DORIS NORTH CONSTRUCTION

	Duration	Start	End						Year 1													Year 2												Year 3					
Activity	**Weeks**	**Date**	**Date**	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mobilization - Summer Year 1																																							
Mobilize equipment & supplies to Hay River	4	01-Jun	30-Jun																																				
Barge departs Hay River for Roberts Bay (Miramar sealift)	6	01-Jul	15-Aug																																				
Barge off loads at Roberts Bay (Miramar sealift)		15-Aug																																					
Hold Equipment & Material in Storage pending winter conditions	18	15-Aug	01-Jan																																				
Construction Starts at Doris North		01-Jan																																					
Set Up Camp in Summer of Year 1																																							
Fly camp, equipment & supplies to Cambridge Bay	2	01-Jun	15-Jun																																				
Fly camp, equipment & supplies to Roberts Bay Mine site		15-Jun																																					
Set up summer camp at Roberts Bay Mine Site	2	15-Jun	30-Jun																																				
Collect Hazardous Materials & Prepare for shipment offsite	4	01-Jul	31-Jul																																				
Demolish structures	8	01-Jul	30-Aug																																				
Collect and move non-hazardous debris into piles at Roberts & Ida Bay Mine sites ready for transfer	8	01-Jul	30-Aug																																				
Dewater tailings pond	2	15-Aug	30-Aug																																				
Winter Earthworks - Year 2																																							
Construct ice road from Doris North Ice Road to the Roberts Bay and Ida Bay Mine Sites	1	15-Jan	30-Mar																																				
Move PAG rock into mine adit openings at both sites	1	15-Jan	30-Mar																																				
Drill off and blast in adit roof openings (3) at both sites	2	15-Jan	30-Mar																																				
Fill in blasted depressions at all three adits (allow for settling)	1	15-Jan	30-Mar																																				
Drill off and blast in Ida Bay vent raise opening	1	15-Jan	30-Mar																																				
Fill in blasted depression over Ida Bay vent raise	1	15-Jan	30-Mar																																				
Backfill exploration trenches at Ida Bay site with NAG rock	1	15-Jan	30-Mar																																				
Move NAG rock needed for capping from Ida Bay to the Roberts Bay site	1	15-Jan	30-Mar																																				
Cap Roberts Bay tailings pond with NAG waste rock cap	1	15-Jan	30-Mar																																				
Construct Roberts Bay tailings pond stabilizing berm	1	15-Jan	30-Mar																																				
Place pre-cast concrete cap on Roberts Bay Vent raise	1	15-Jan	30-Mar																																				
Cover pre-cast shaft cap with clean waste rock	1	15-Jan	30-Mar																																				
Move excess PAG rock from Ida Bay to Doris North Mine for ultimate placement underground as backfill	1	15-Jan	30-Mar																																				
Excavate hydrocarbon & metal contaminated soils & haul to Doris North site for subsequent placement underground as backfill	1	15-Jan	30-Mar																																				
Move non-hazardous demolition waste from both the Ida Bay & Roberts Bay site to the Doris North landfill	1	15-Jan	30-Mar																																				
Final regrading of the Ida Bay site (waste piles)	1	15-Jan	30-Mar																																				
Final regrading of the Roberts Bay site	1	15-Jan	30-Mar																																				
Remove all remaining equipment & hazardous materials from the Roberts & Ida Bay sites to the Doris North jetty site	1	15-Jan	30-Mar																																				
Leave ATV & Trailer at Roberts Bay site		15-Jan	30-Mar																																				
Summer Earthworks - Year 2																																							
Re-open summer camp at Roberts Bay site	1	01-Jul	07-Jul																																				
Final touch up regrading of Roberts & Ida Bay sites using ATV	2	07-Jul	21-Jul																																				
Remove ATV by air or small boat to Doris North (helicopter)	1	21-Jul	31-Jul																																				
Decommission and remove camp by air to Doris North	1	21-Jul	31-Jul																																				
Place packaged hazardous materials into Seacan containers for shipment off-site by barge	1	21-Jul	31-Jul																																				
Ship hazardous material by barge to Hay River	6	15-Aug	30-Sep																																				
Transport hazardous material from Hay River to disposal sites in Alberta	2	01-Oct	15-Oct																																				
Dispose of hazardous material at licensed sites	2	15-Oct	31-Oct																																				
Post Closure Water Quality Monitoring																																							

6.2 Estimate of Remediation Costs

The estimated cost of implementing the proposed remediation plan at the Roberts and Ida Bay abandoned mine sites under these three different "scenarios" is summarized as follows:

Option 1	Option 2	Option 3
$4.76 million	$4.73 million	$2.22 million

As can be seen there is virtually no difference in the estimated remediation cost between Options 1 and 2. This is primarily due to the fact that mobilization, de-mobilization and equipment standby costs for these two options remain essentially the same representing approximately 42% of the overall estimated remediation cost.

It should be noted that the estimated cost for each of these three 'scenarios" includes:

- Mobilization, demobilization and equipment standby costs;
- Cost of completing the proposed remediation work at both sites;
- All logistical support costs;
- An allowance for site administration and supervision;
- An allowance for project engineering;
- A contingency allowance of 15% to cover unexpected items and changes in quantities and pricing; and
- Post –closure environmental monitoring both during the two year long implementation timeframe and for an additional 25 year period on a diminishing scale (every year for the first 5 years, followed by once every 5 years through 25 years.

The estimated cost for the three remediation options are compared in summary form in Table 6.1.

Table 6.4: Comparison of Estimated Remediation Cost for the Three Closure Scenarios

TABLE 6.1: SUMMARY OF ESTIMATED RECLAMATION COST - ROBERTS BAY & IDA BAY ABANDONED SILVER MINE SITES - COST COMPARISON OF THE THREE OPTIONS

Capital Costs		SUB-TOTAL COSTS		
COMPONENT TYPE		**Option 1**	**Option 2**	**Option 3**
UNDERGROUND MINE - SECURE ADITS & RAISE		$141,510	$ 133,970	$ 140,500
TAILINGS		$67,840	$ 67,840	$ 57,820
BUILDINGS AND EQUIPMENT		$156,630	$ 156,630	$ 147,230
HAZARDOUS MATERIALS AND SOIL CONTAMINATION		$591,055	$ 591,055	$ 158,155
MOBILIZATION/DEMOBILIZATION/STANDBY COSTS		$1,960,698	$ 1,946,298	$ 617,050
SITE ADMINISTRATION AND MAINTENANCE DURING REMEDIATION		$596,017	$ 595,717	$ 159,867
SUBTOTAL		**$3,513,750**	**$ 3,491,510**	**$ 1,280,622**
PROJECT MANAGEMENT & SUPERVISION	5 % of subtotal	$175,687	$174,575	$64,031
ENGINEERING	5 % of subtotal	$175,687	$174,575	$64,031
CONTINGENCY	15 % of subtotal	$527,062	$523,726	$192,093
GRAND TOTAL - CAPITAL COSTS		**$4,392,187**	**$ 4,364,387**	**$ 1,600,777**
POST-CLOSURE MONITORING COST (NPV at 3%)		$316,472	$316,472	$ 316,472
POST-CLOSURE MONITORING CONTINGENCY 15%		$43,750	$43,750	$ 43,750
YEARS OF POST CLOSURE MONITORING	25			
POST CLOSURE MONITORING COST OVER 25 YEARS (NPV at 3%)		$360,222	$360,222	$ 360,222
GRAND TOTAL CAPITAL AND POST-CLOSURE COSTS		**$ 4,752,409**	**$ 4,724,609**	**$ 2,217,123**

The most significant cost item is Mobilization/Demobilization/Standby Costs at ~$1.9 million for Options 1 and 2, which represents 42% of the estimated total direct cost of the proposed remediation work.

While there are some minor reductions in the mobilization/demobilization/standby costs for Option 2 as compared to Option 1, they are insignificant. Under Option 2, the earthworks at the Ida Bay site are completed sooner than under Option 1, most during summer months, but the overall project schedule remains the same with the equipment being demobilized in the summer of Year 3 as per Option 1.

For Option 3 the mobilization/demobilization/standby cost is reduced to $0.6 million by “piggy backing” the remediation work onto the construction of the Doris North Project. Under this case mobilization and demobilization of most of the heavy equipment is born by the Doris North Project and standby costs are eliminated.

The detailed cost estimates for each of the three scenarios is presented in Appendix C, D and E as follows

- Option 1 – Appendix C, Tables C1 through C9;
- Option 2 – Appendix D, Tables D1 through D9;
- Option 3 – Appendix E, Tables E1 through E9.

6.3 Basis for the Cost Estimate

The remediation cost estimates for the three “scenarios” was prepared using the RECLAIM model Version 4.0 (March 2001) spreadsheet. The RECLAIM model was developed to estimate the cost of mine reclamation by the federal Department of Indian and Northern Affairs Canada (DIAND) for use by government agencies, mining companies, and others.

The model includes the major components of a typical mine site. An important feature of the model is a table of unit costs of common reclamation activities, which can be updated or customized to be site specific. The tabulated unit costs contained within the RECLAIM model are based on experience from reclamation work at northern mines.

For the Roberts Bay and Ida Bay remediation plan estimates, unit costs have been obtained from the following sources:

- The RECLAIM model table of unit costs, although most of the unit cost items taken from this source were inflated to recognize inflation into 2006 dollars and to recognize the remote location of the sites and the inherent higher costs associated with doing work in such a remote location;
- Other unit cost estimates were drawn from Miramar Hope Bay Limited’s (MHBL) past experience in doing business at the Doris North Project and Boston sites (e.g.: air transport costs, barging costs) and from cost estimates provided to MHBL by prospective suppliers of goods and services to the Doris North Project. This data was obtained through discussions with MHBL personnel and from contacts made with Kitnuna Inc. of Cambridge Bay;
- Unit cost estimates for other reclamation activities were drawn from AMEC Earth and Environmental Ltd.’s experience in estimating and implementing mine closure and reclamation plans at other northern Canadian mining sites.

The remediation cost estimates were based on the following general criteria, information and assumptions:

- An average labour rate of $50 per hour was applied to all demolition activities. This rate is intended to reflect third party contractor rates and is inclusive of all contractor overheads including WCB, payroll burdens, administration, profit, etc. An average labour rate of $60 per hour was applied for heavy equipment operators and drillers, and $70 per hour for mechanics and electricians;

- All equipment required for remediation of these two sites will be mobilized to site by sealift barge from Hay River (NTCL);

- Earth moving activities requiring travel between the Roberts Bay and Ida Bay sites will primarily occur under winter conditions to minimize the amount of new ground disturbance required. The objective is to avoid constructing a new road between these two sites;

- All hazardous materials will be collected, re-packaged and removed from the site for disposal at a licensed appropriate disposal facility within Alberta;

- The three mine adits will be partially backfilled with waste rock (flooded portions). The roof of the adit entrances will be drilled off and blasted causing them to cave in. Non acid generating waste rock will then be used to backfill the depressions. The backfill will be mounded and shaped with a dozer to allow for future potential settlement. The vent raise at the Ida Bay mine site will be similarly blasted and then backfilled with waste rock. A pre-cast engineered concrete cap will be placed on top of the concrete capped vent raise at the Roberts Bay site. The new cap will span across the old cap to ensure it is founded on competent bedrock. The objective is to ensure that the new concrete cap meets the current regulatory engineering standards for such structures.

- All non-hazardous demolition and clean up debris will be collected and placed within a new non-hazardous disposal site to be constructed on the existing tailings pond at the Roberts Bay site. This debris will then be buried under a minimum 2 m thick layer of non-acid generating waste rock to control frost heaving and to isolate this material from the environment. Under option 3 this material would be trucked to the non-hazardous landfill site to be constructed as part of the Doris North Project;

- Post-closure environmental monitoring and inspection of the Roberts Bay and Ida Bay sites will continue for a period of 25 years following the completion of remediation. For the purposes of the cost estimates it has been assumed a sampling program would continue to be implemented each June/July close after the Spring thaw both during the two-to-three year remediation period, then every year for the next five years followed by once every five years for the next twenty years. It has been assumed that a 25-year post closure monitoring period will be sufficient to verify that the remediation objectives have been achieved and that no ongoing environmental degradation caused by the reclaimed mine sites is occurring. The intent is that this assumption would be assessed at periodic intervals during this 25 year period.

6.4 Opportunities to Reduce Remediation Costs

There are several "opportunities" to lower the estimated overall remediation cost for the Roberts and Ida Bay abandoned silver mines. The following "opportunities" are technically feasible but do result in added "risk" to the owner. These risks are discussed in the following section:

- Site investigations have identified the presence of approximately 390 m^3 of hydrocarbon and metal contaminated soil. These "soils" are a mix of waste rock and native soil that have been contaminated through spillage of fuel, ore and possibly metal concentrate during mine operations. These soils contain contaminant levels that exceed regulatory guidance levels and are identified as potential future sources of contamination to the local aquatic receiving environment. Consequently the preferred remediation option is to excavate these soils and remove them from the site to an area where they can be permanently sequestered. Under Options 1 and 2 it is proposed that these soils be placed in bulk bags and shipped off site to a secure hazardous landfill site in Alberta. Under Option 3, it is proposed that these soils be removed and permanently sequestered by placing them underground as backfill within the Doris North Mine where the soils will be contained within permafrost. Off site removal as proposed in Option 1 and 2 is costly. An alternative would be bury these contaminated soils within the tailings pond at the Roberts Bay site and isolate them from the environment by capping them under a waste rock cover. This would save approximately $400K but does add risk over the preferred remedial option. The increased risk comes from the fact that this contaminant source would still be on site and thus could be released under certain conditions. However this risk can be significantly reduced by appropriate engineering of the method in which the contaminant soils are isolated from the environment.

- Site investigations have identified the fact that approximately 11 tonnes of milling equipment left at the site (grinding mill, crusher) have been painted with a lead based paint and thus exceed the prevailing NWT (Nunavut) standards. This means that these pieces of equipment qualify as potentially hazardous material and should not be landfilled without removing the lead based paint. Consequently the preferred remediation plan is to ship these materials off site to be disposed of at a hazardous waste disposal site in Alberta. This removes this material as a future contaminant source from the remediated site. However the cost of removing and disposing of this equipment off site is in the order of $10K. There is an opportunity to lower overall remediation costs by seeking authorization to cut up this equipment and bury the debris within the planned on-site demolition landfill to be placed on top of the dewatered tailings pond at the Roberts Bay site. The materials would be isolated from the environment by placing a 2 m thick minimum cover of waste rock over this buried material. This action would require special authorization from the Nunavut Department of Environment. The potential savings are relatively small and probably not worth the effort when compared against possible adverse public perception that could taint the overall remediation effort.

6.5 Protection of the Environment during Construction

Of paramount importance for the remedial activities will be the protection and restoration of the natural environment both during and following the remedial activities. The need to minimally disturb the natural environment was a paramount factor in the consideration of the potential remedial options. Elements to be considered when selecting the remedial option to be implemented are:

- Wildlife habitat;
- Minimizing construction of new roads, utilize winter and ice roads where possible; and
- Minimizing disturbance beyond the existing footprint of the mine sites.

By factoring in the above elements at the selection stage and then applying appropriate mitigative measures during the implementation stage the impact to the environment can be minimized.

Further to this a screening level environmental assessment will be required under the Canadian Environmental Assessment Act (CEAA) once the preferred remedial options have been finalized.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Collective assessment of information obtained during all prior and current investigations of the Roberts Lake property to develop this Remedial Plan provided the following conclusions and recommendations.

AMEC ranked the potential remedial options based on long-term effectiveness, technical feasibility, impact on human health and safety, impact on ecological health and safety, time to implement, on-going monitoring requirements, benefits to the community, and capital costs.

A screening level environmental assessment will be required under the Canadian Environmental Assessment Act (CEAA) once the preferred remedial options have been determined. The preferred remedial options currently identified for the Roberts Lake property are summarized in Table 7.1 and 7.2 below:

Table 7.1: Preferred Remedial Options for Roberts Bay Mine Site

	Issue	Preferred Remedial Option
Roberts Bay Mine Site	Infrastructure	Dismantle, segregate and bury non-hazardous material on-site. Remove hazardous material from site for disposal in the south.
	Tailings	Drain tailings (treat water if necessary); remove any spilled tailings and place into the pond; expand the containment area by expanding and flattening the berms to a minimum of 3H:1V to accommodate and bury non-hazardous waste (as needed); cover with approximately 2 m of compacted waste rock in the winter to establish permafrost and isolate frozen waste from the environment; cover with overburden.
	Waste rock	Utilize where required for cover, erosion control, and backfill with the remainder; re-graded and left in place.
	Non-hazardous waste	Bury within the tailings pond and covered with waste rock to isolate from the environment. Recycle and reduce volumes where possible. Existing domestic landfill will be covered and the berms reinforced to enhance long-term physical stability.
	Hazardous waste	Neutralize acids and incinerate petroleum products where feasible to reduce volumes with the majority of the waste containerized and transported off-site for disposal at an appropriate disposal facility in the south.
	Petroleum and metals impacted soil	Excavate hydrocarbon contaminated soil from fuel storage compound and garage area (~325 m^3) and excavate metal laden soil from mill building area (~65 m^3), place in 1 m^3 supersacs or containers and transport off-site to an appropriate facility for treatment or disposal.
	Mine openings	Infill with waste rock where feasible, blast the roof and then backfill depression with waste rock. Replace cap on the Roberts Bay Mine vent raise with an engineered pre-cast / cast-in-place concrete cap, and then cover with waste rock.

Table 7.2: Preferred Remedial Options for Ida Bay Mine Site

	Issue	Preferred Remedial Option
Ida Bay	Infrastructure/non-hazardous and hazardous debris	Dismantle and segregate. Containerize hazardous debris and transport to an appropriate off-site facility. Reduce and recycle volumes of non-hazardous waste where possible and bury remainder within the adit at the Ida Bay site, then cap with waste rock. Move remaining to Roberts Bay site.
	Waste rock	Remove from above the high tide level, utilize for backfill where needed. Transport remainder to Roberts Bay for use as cover, backfill, etc.
	Mine openings	Infill with waste rock, blast the roof and then backfill depression with waste rock.
	Marine sediments	Remove the waste rock from the shoreline above high tide and manage it with the remaining one.

Of paramount importance for the remedial activities will be the protection and restoration of the natural environment both during and following the remedial activities. The need to minimally disturb the natural environment was a factor in the consideration of the potential remedial options. Further to this a screening level environmental assessment will be required under the Canadian Environmental Assessment Act (CEAA) once the preferred remedial options have been determined.

After implementation of the remedial plan, the long-term monitoring program should be very simple, requiring only simple instrumentation installed at the Roberts Bay Site. No instrumentation should be required at the Ida Bay Site as no landfill or hazardous materials are expected to remain at the site after remediation.

Installation of groundwater monitoring equipment should not be necessary because of the relatively small water shed and shallow active zone. The chemistry of the local surface water should closely represent the chemistry of the groundwater in the active zone.

8.0 CLOSURE

This remediation plan report was prepared exclusively for Public Works and Government Services Canada by AMEC Americas Limited Earth & Environmental Division. This report is intended to be used by Public Works and Government Services Canada only, and it's nominated representatives, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this site report by any non-nominated third party is at that party's sole risk.

Soil conditions, by their nature, can be highly variable across a site. The placement or removal of fill material and other prior construction activities on a site can contribute to the variability, especially near surface. A contingency should always be included in any construction budget to allow for the possibility of variation in soil conditions, which may result in modification of the design and construction procedures.

This report was prepared exclusively for Public Works and Government Services Canada and their agents, for the proposed remediation project as described in the report. The quality of information, conclusions and estimates contained herein are consistent with the level of effort involved in AMEC's services. The findings and recommendations presented in this report were based on the results of field and laboratory investigations, combined with an interpretation of test results and information from previous reports and the assumptions, conditions and qualifications set forth in this remediation plan.

The data and recommendations provided herein should not be used for any other purpose, or by any other parties, without review and advice from qualified engineering personnel. The findings and recommendations of this report were prepared in accordance with generally accepted professional engineering principles and practice.

If conditions are encountered that appear to be different from those shown and described in this report, or if the assumptions stated herein are not in keeping with the proposed project, this office should be notified in order that the recommendations can be reviewed and adjusted, if necessary. No other warranty, expressed or implied, is given.

This report was prepared collaboratively by Dr. Jim Warren, P.Ag. P.Geo, Dr. Caius Priscu, P.Eng, and Ms. Allyson Desgroseilliers, P.Eng, CCEP. Senior review was provided by Mr. Larry Connell, P.Eng and Mr. Stu Anderson, P.Eng. If you have any questions or comments regarding this work, please do not hesitate to contact the Project Manager.

Respectfully submitted,

AMEC Earth & Environmental
a division of AMEC Americas Limited

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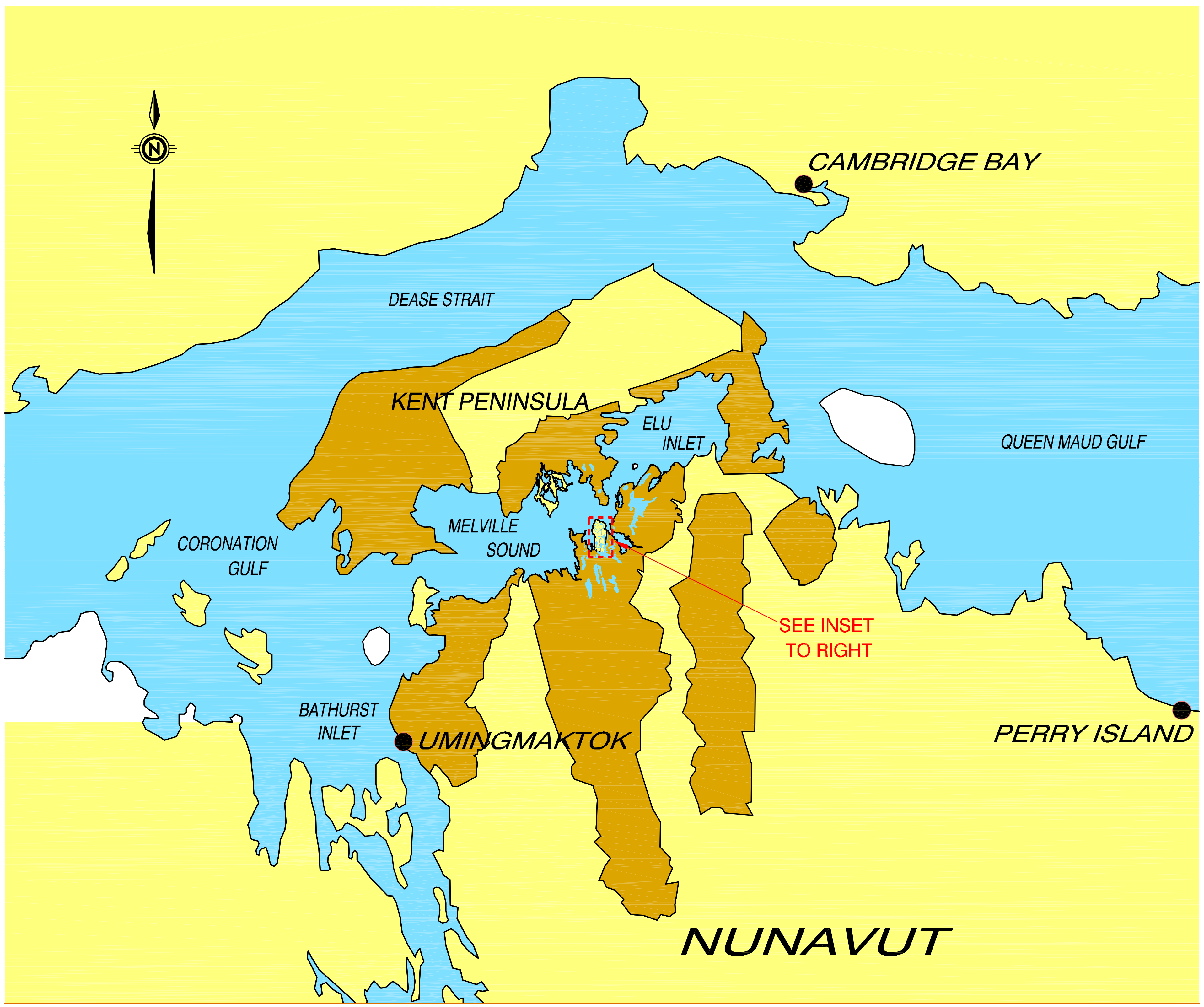
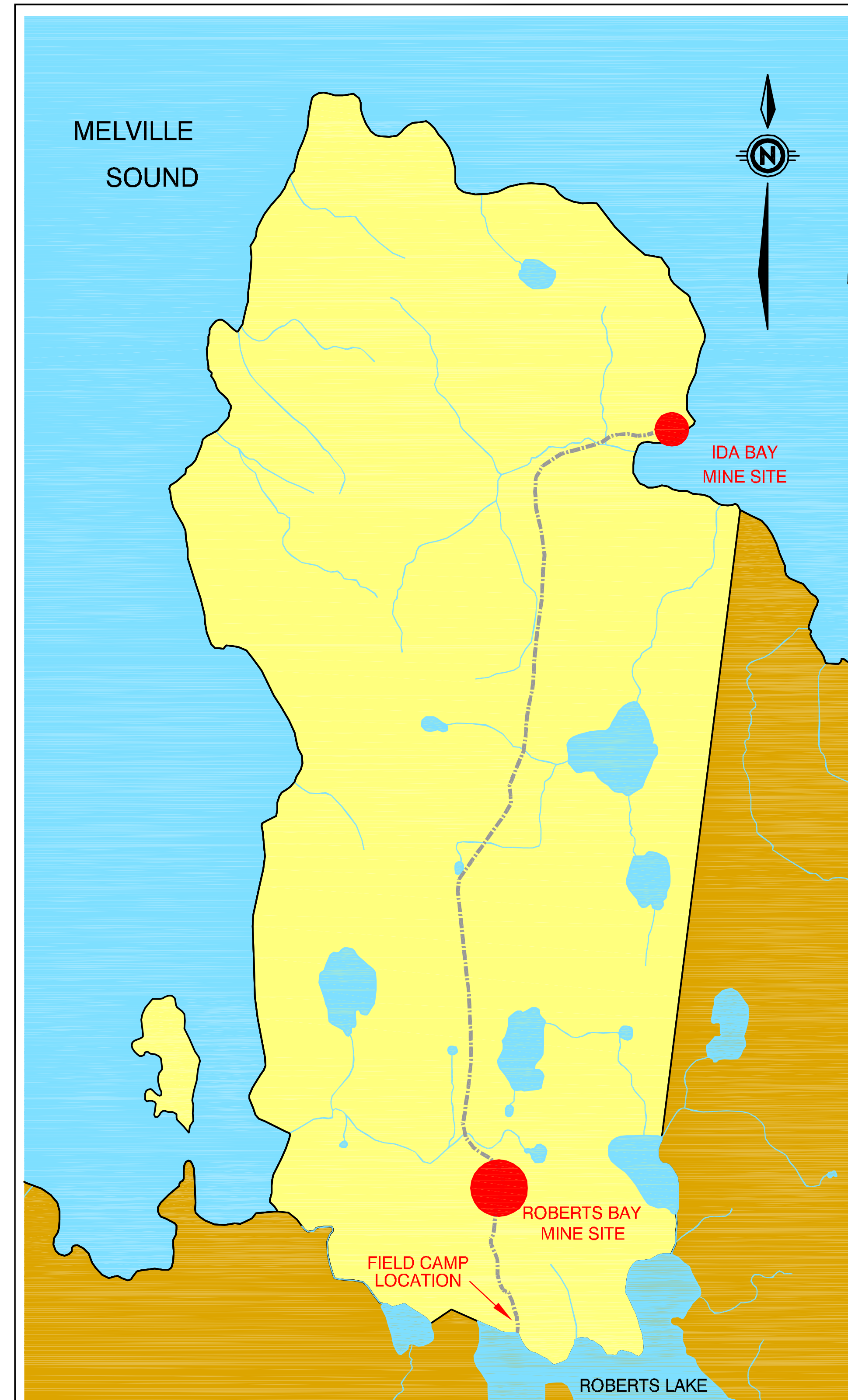
FIGURES



GENERAL AREA OVERVIEW
NOT TO SCALE



ROBERTS BAY & IDA BAY MINE SITE OVERVIEW

GRAPHIC SCALE
500m 0 500m 1000m

NOTES:

1. ALL UNITS ARE IN METERS UNLESS OTHERWISE NOTED.
2. COORDINATE SYSTEM USED IS UTM - ZONE 13 N, NAD83

CONTROL POINT LIST: (ALL CP MONUMENTS ARE 30" REBARS)

CP 10	N 7,563,851.484	E 435,373.394	ELEV. 73.293
CP 11	N 7,563,708.886	E 435,478.696	ELEV. 55.236
CP 12	N 7,563,648.798	E 435,300.224	ELEV. 48.711
CP 13	N 7,564,033.994	E 435,330.586	ELEV. 60.781
CP 14	N 7,563,979.374	E 435,495.807	ELEV. 67.380
CP 15	N 7,566,821.144	E 435,549.572	ELEV. 82.843
CP 16	N 7,569,722.164	E 436,874.448	ELEV. 10.262
CP 17	N 7,569,712.694	E 436,944.793	ELEV. 4.927
CP 18	N 7,569,657.635	E 436,750.048	ELEV. 3.685

	BY	DATE
SURVEYED	AMEC Land Surveys Limited	Aug 2005

LEGEND:

- INUIT OWNED LANDS
- NUNAVUT LAND
- MINE SITE AREA
- EXISTING TRAIL (ROUGH, QUAD ONLY)

NO.	REVISION	DATE	BY	CK'D	APP'D
.	.	.	.	.	.

R.E.T.

SIGNED: ____________
BRENT CAMPBELL

DATED: ____________

SCALE: AS SHOWN	CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
DATE: SEPT 2005	PROJECT NAME: ROBERTS BAY & IDA BAY MINE SITE REMEDIATION
SURVEYED: B.A.C.	DRAWING TITLE: KEY PLAN and SITE LOCATION
DRAWN: B.A.C.	
CHECKED: C.P.	PROJECT NUMBER: ALS050052 — DWG. NO. ALS050052-SITE — FIGURE 1
APPROVED: B.A.C.	AMEC Land Surveys Limited

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Figure 2 Aerial view of the Roberts Bay mine site from the south, with Roberts Lake in the forefront.

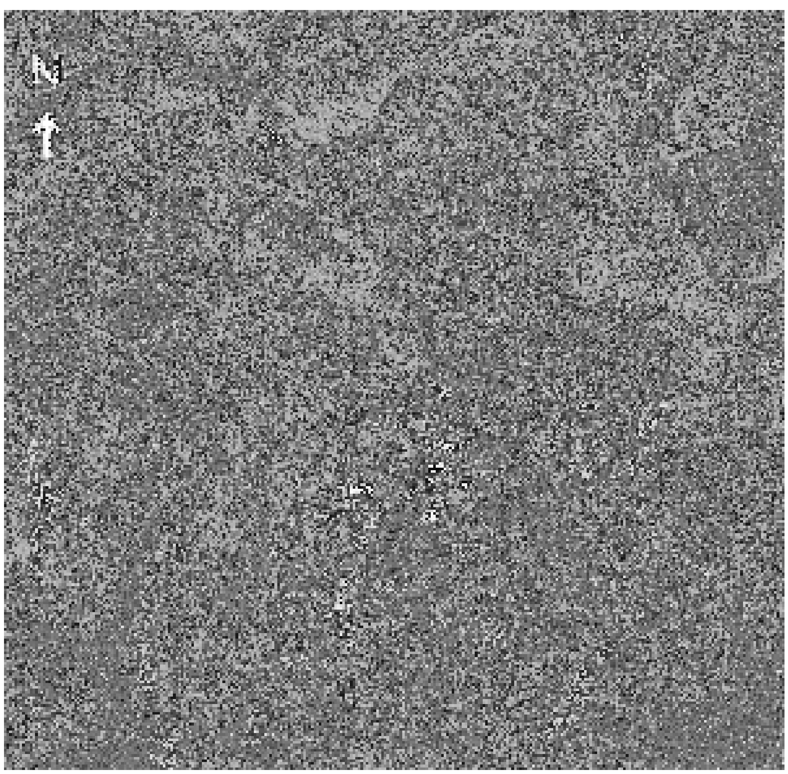
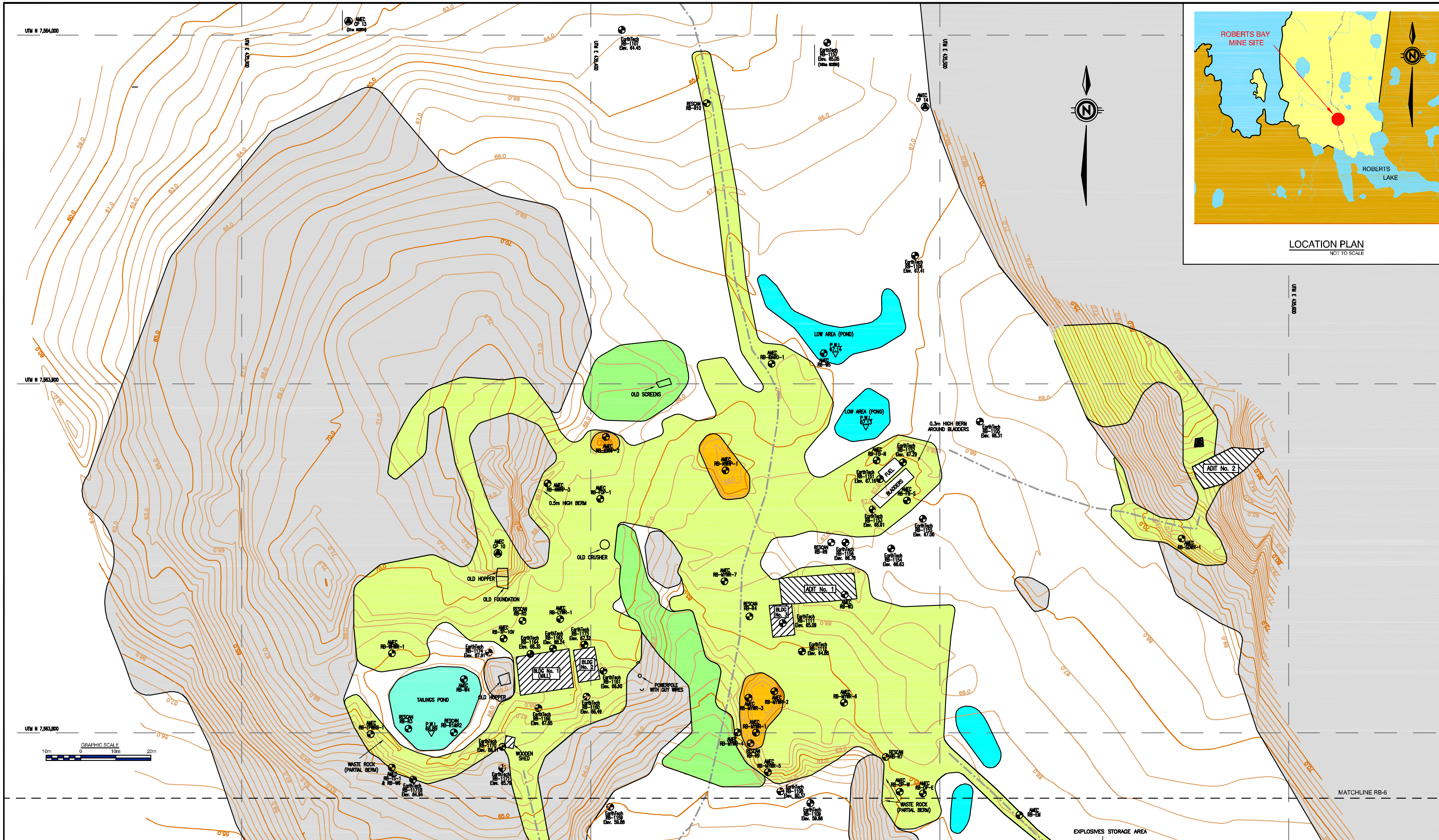


Figure 3 Aerial photo (1982) of the Roberts Bay Mine Site (centre).



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CP 11	N 7,563,708.886	E 435,478.696	ELEV. 55.236
CP 12	N 7,563,648.798	E 435,300.224	ELEV. 48.711
CP 13	N 7,564,033.994	E 435,330.586	ELEV. 60.781
CP 14	N 7,563,979.374	E 435,495.807	ELEV. 67.380
CP 15	N 7,566,821.144	E 435,549.572	ELEV. 82.843
CP 16	N 7,569,722.164	E 436,874.448	ELEV. 10.262
CP 17	N 7,569,712.694	E 436,944.793	ELEV. 4.927
CP 18	N 7,569,657.635	E 436,750.048	ELEV. 3.685

	BY	DATE
SURVEYED	AMEC Land Surveys Limited	Aug 2005

LEGEND:

- WASTE ROCK PILE
- ROCK OUTCROP
- TRAIL (ROUGH, QUAD ONLY)
- P.W.L. PRESENT WATER LEVEL
- WASTE ROCK AREA
- OVERBURDEN AREA
- CONCRETE AREA
- TESTHOLE LOCATION

NO.	REVISION	DATE	BY	CK'D	APP'D
.	.	.	.	.	.

REF.

SIGNED: BRENT CAMPBELL

DATED:

SCALE	AS SHOWN
DATE	SEPT 2005
SURVEYED	B.A.C.
DRAWN	B.A.C.
CHECKED	C.P.
APPROVED	B.A.C.

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

PROJECT NAME: ROBERTS BAY & IDA BAY MINE SITE REMEDIATION

DRAWING TITLE: ROBERTS BAY MINE SITE CONTOUR AND SITE PLAN

PROJECT NUMBER: ALS050052 | DWG. NO. ALS050052-SITE | FIGURE 4

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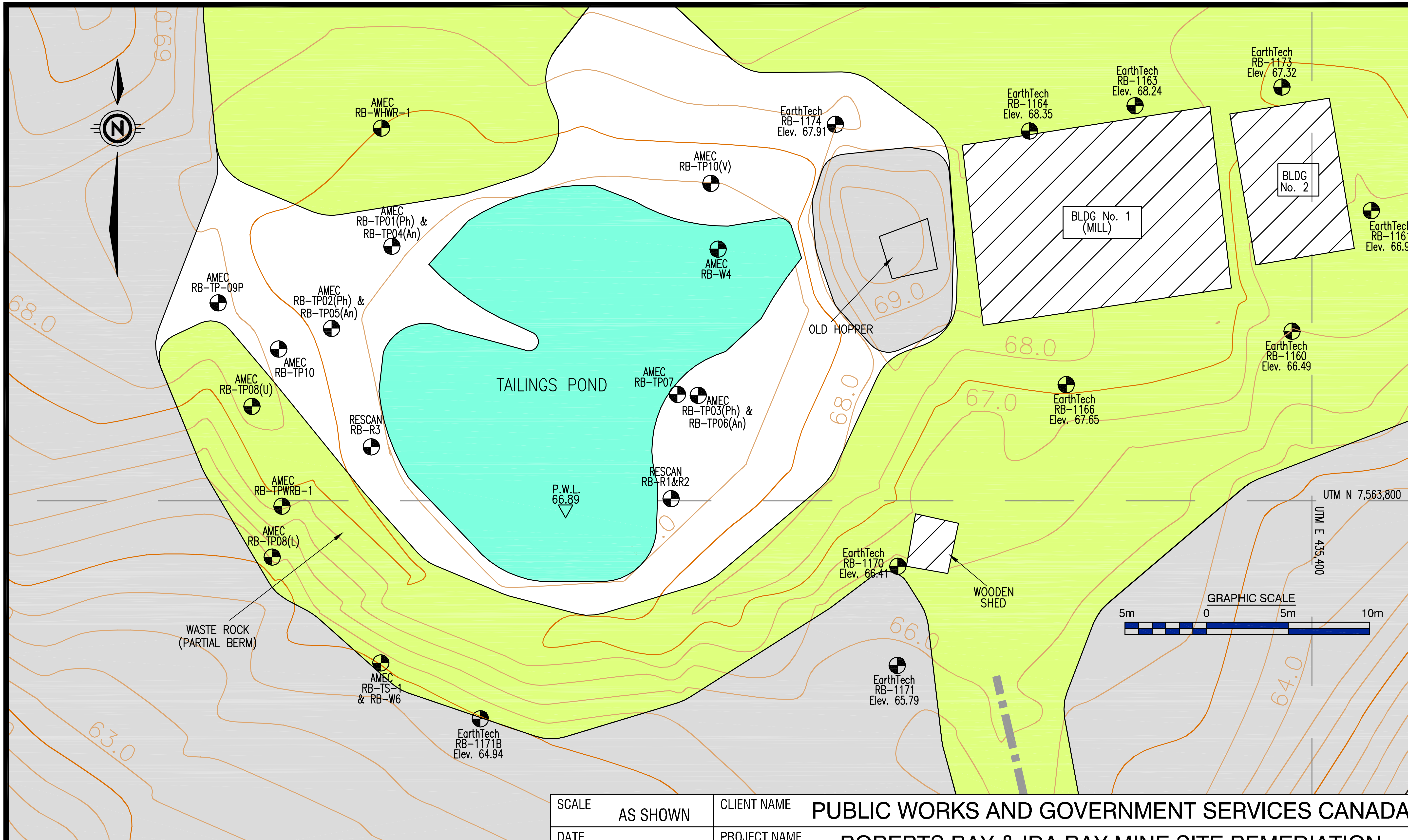


NOTES:

1. ALL UNITS ARE IN METERS UNLESS OTHERWISE NOTED.
2. COORDINATE SYSTEM USED IS UTM - ZONE 13 N, NAD83

WASTE ROCK AREA

ROCK OUTCROP

TESTHOLE / SAMPLE

SCALE	AS SHOWN	CLIENT NAME	PUBLIC WORKS AND GOVERNMENT SERVICES CANADA		
DATE	NOV 2005	PROJECT NAME	ROBERTS BAY & IDA BAY MINE SITE REMEDIATION		
SURVEYED:	BAC	DRAWING TITLE	ROBERTS BAY MINE SITE TAILINGS POND DETAIL		
DRAWN	BAC				
CHECKED		PROJECT NUMBER	ALS050052	DWG. NO. ALS050052-SITE	FIGURE 5
APPROVED		AMEC Land Surveys Limited			

Figure 6: **Aerial view of the Ida Bay Mine Site from the southeast.**

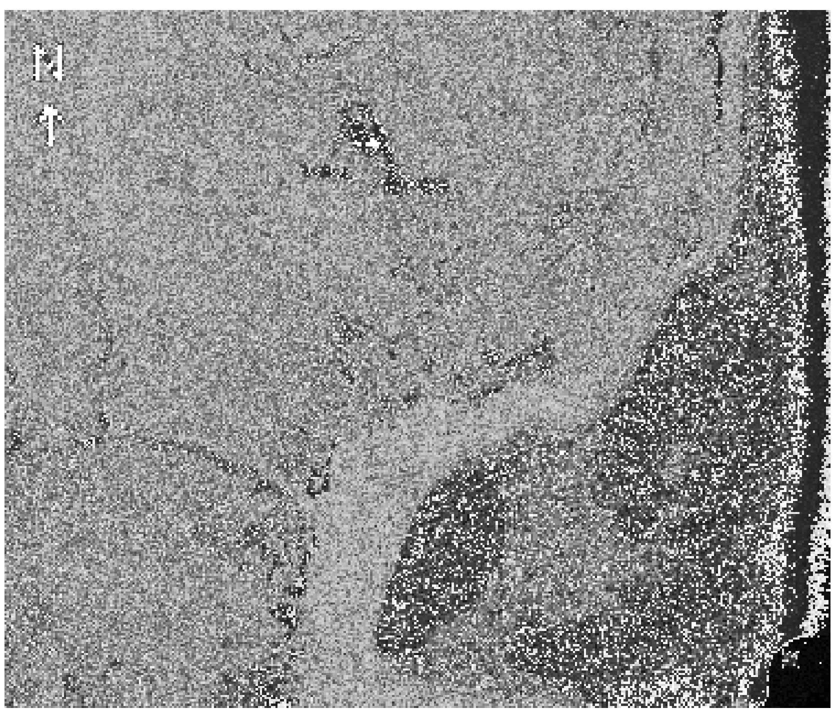
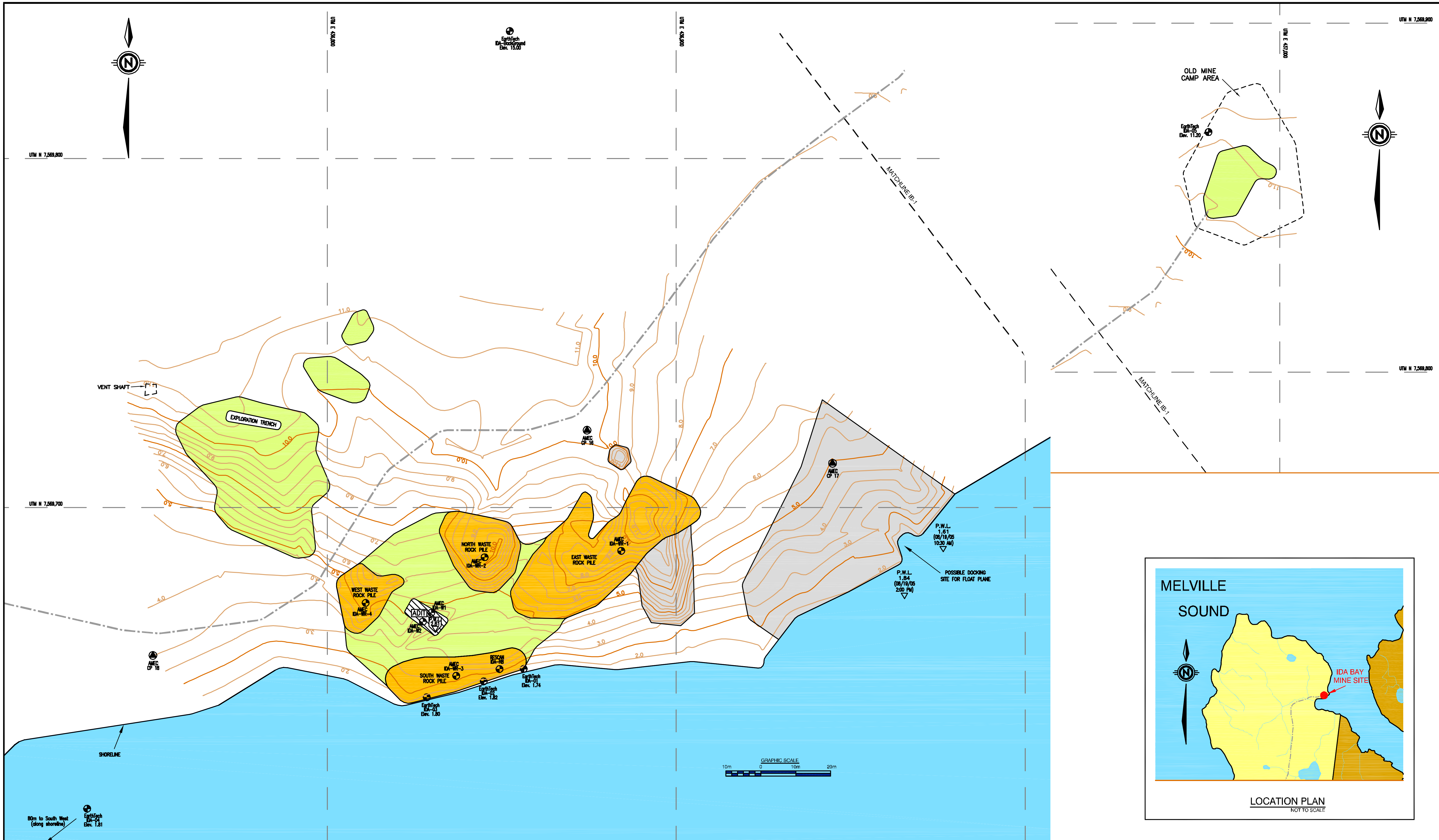


Figure 7: **Aerial photo (1982) of the Ida Bay Mine site (centre).**



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CONTROL POINT LIST: (ALL CP MONUMENTS ARE 30" REBARS)

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CP 11	N 7,563,708.886	E 435,478.696	ELEV. 55.236
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CP 17	N 7,569,712.694	E 436,944.793	ELEV. 4.927
CP 18	N 7,569,657.635	E 436,750.048	ELEV. 3.685

	BY	DATE
SURVEYED	AMEC Land Surveys Limited	Aug 2005

LEGEND:

- WASTE ROCK PILE
- ROCK OUTCROP
- TRAIL (ROUGH, QUAD ONLY)
- P.W.L. PRESENT WATER LEVEL
- WASTE ROCK AREA
- OVERBURDEN AREA
- CONCRETE AREA
- TESTHOLE LOCATION

NO.	REVISION	DATE	BY	CK'D	APP'D
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R.E.T.

SIGNED: BRENT CAMPBELL

DATED:

SCALE	AS SHOWN
DATE	SEPT 2005
SURVEYED	B.A.C.
DRAWN	B.A.C.
CHECKED	C.P.
APPROVED	B.A.C.

CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

PROJECT NAME: ROBERTS BAY & IDA BAY MINE SITE REMEDIATION

DRAWING TITLE: IDA BAY MINE SITE CONTOUR AND SITE PLAN

PROJECT NUMBER: ALS050052 DWG. NO. ALS050052-SITE FIGURE 8

AMEC Land Surveys Limited

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APPENDIX A

Evaluation of remediation Options

APPENDIX A

Evaluation of Remedial Options for Site Remediation at Roberts Bay and Ida Bay Abandoned Mine Sites in Nunavut, Canada

TABLE OF CONTENTS

LIST OF TABLES

1.0 INTRODUCTION

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC) was retained by Public Works and Government Services Canada (PWGSC) on behalf of the Department of Indian and Northern Affairs Canada (INAC) to undertake a geotechnical and geochemical assessment and to formulate a Remediation Plan for the Roberts Bay and Ida Bay abandoned silver mines in Nunavut, collectively known as the Roberts Lake property.

The purpose of this appendix is to describe the alternative approaches considered for remediation of the Roberts Lake property to address all main issues associated with the property and to provide a rationale for the preferred options. A Remediation Option Evaluation Matrix was developed for each of the sites to provide a ranking for the options.

2.0 MAIN ISSUES

The main issues at the Roberts Bay Mine Site to be addressed as part of the remediation plan are:

- Remaining infrastructure;
- The tailings pond;
- Waste rock;
- Non-hazardous waste;
- Hazardous waste;
- Petroleum and metals impacted soil; and
- Mine openings.

The main issues at the Ida Bay Mine Site to be addressed as part of the remediation plan are:

- Remaining infrastructure, hazardous and non-hazardous waste;
- Waste rock;
- Mine openings; and,
- Marine sediments.

3.0 EVALUATION CRITERIA

As described in Section 4.0, a number of parameters were selected for the evaluation and ranking of the proposed remedial alternatives so that potential issues related to each remedial option were considered for each site. The remedial options were evaluated based on:

- Long-term effectiveness;
- Technical feasibility;
- Protection of human health and safety;
- Protection of ecological receptors such as caribou and fish through the effects on water quality and to vegetation (dust);
- Overall time frame to implement;
- Need for long-term management or monitoring;
- Capital costs; and,
- Operation and Maintenance costs.

Each of the above parameters was assigned a numeric score between 1 and 5 based on how suitable the remedial option was with respect to the parameter. A description of the numeric values is summarized below.

Score	Numeric Ranking
1	Poor
2	Less than acceptable
3	Acceptable
4	Good
5	Better

As there are eight evaluation parameters, the maximum possible score assigned to a remedial option would be 40, thus indicating a desirable remedial option. Options that have less desirable attributes will achieve lower scores.

The Remediation Option Evaluation Matrix developed for the Roberts Bay Mine Site is provided in Table A1 and the Remediation Option Evaluation Matrix developed for the Ida Bay Mine Site in provided in Table A2. Discussion of the remedial alternatives is included in the following sections.

4.0 ROBERTS BAY SITE

4.1 Site Infrastructure

Four main areas of infrastructure were identified at the Roberts Bay site at the time of the August 2005 site visit:

- Former Camp;
  - Platforms and remains of several tent-cabin frames, outhouse and shed;
  - Core racks;
- Mill Area;
  - Metal frames of mill and assay lab;
  - Hazardous material storage shed;
- Machine Shop/Adit;
  - Metal frame of the machine shop (also known as the garage);
  - Mill entrance housing the adit enclosed within a fence;
- Pump house;
  - Remains of a shed which enclosed the pump.

4.1.1 Key Issues

Presently the infrastructure remains are spread across most of the mine site, in various stages of unsightly disrepair. The tent frames, litter, and debris present a clear hazard to visitors of the area. In this isolated area which has no existing transportation infrastructure and difficult climatic conditions, opportunities for reducing waste volumes, cost recovery through sale of assets and green demolition practices are limited.

The main issues pertaining to the remaining infrastructure are:

- Physical risks to humans and terrestrial wildlife;
- Risk of exposure to hazardous materials within the remains of the former buildings; and
- Aesthetics.

Hazardous materials, associated with the infrastructure, such as PCB containing equipment, asbestos-containing materials, mill process chemicals, waste oil, fuel and batteries have all been identified at the site and are addressed in Section 5.1.5 of the main report. Concentrations of lead-based paint, greater than 500 ppm, were identified on the steel mill equipment (cone crusher, ball mill tanks and flotation cells, tables, etc.). Therefore this equipment must be treated as hazardous waste under the guideline of the NWT Government or the lead must be removed prior to the steel being recycled or disposed of on-site.

4.1.2 Remedial Options

Two alternatives for remediation of the remaining site infrastructure and their rank summary are as follows:

Option	Rank Summary
1. Leave as is;	21
2. Dismantle structures and segregate the waste into hazardous and non-hazardous materials.	36

Although dismantling and waste segregation are more costly, the costs are outweighed by considerations for human health, safety and protection of the environment. Long-term physical risks to humans and terrestrial wildlife that happen upon the site are the primary concern in the remediation of the remaining infrastructure. Dismantling of the infrastructure reduces the physical risks to humans and wildlife and improves aesthetics.

4.2 Tailings Pond

The tailings pond at the Roberts Bay Mine Site is a small (compared to most other facilities), roughly circular impoundment measuring approximately 40 m diameter. The surface area of the tailings is about 700 m^2 including the waste rock berm. Although a polyethylene liner was apparently used in the pond the extent and integrity of the liner was questionable at the time of the 2005 site visit. The tailings are retained against the side of a sloping basaltic outcrop by a semicircular berm has a 2:1 slope and the equivalent volume of material in the structure which includes the tailings and the surrounding waste rock berm is estimated at approximately 1,900 m^3. Reportedly, only flotation tailings were produced with no cyanide or mercury used during processing of the ore on-site. All tailings samples collected from the Roberts Bay mine site during the 2005 site visit were net non-acid generating.

4.2.1 Key Issues

The key issues pertaining to the tailings pond are as follows:

- The semicircular berm may be too steep to maintain stability in the long term presenting a physical risk ;
- Possible ecological and human exposure to metals (arsenic and lead) through direct contact with the tailings; and
- The tailings in their current condition are a potential source of dust and therefore represent a risk to ecological health.

4.2.2 Remedial Options

Four strategies were evaluated for remediation of the tailings pond and their rankings were:

Option	Rank Summary
1. Do nothing other than stabilize the waste rock berms with clean waste rock	24
2. Drain standing water, cover tailings with clean waste rock;	36
3. Relocate the tailings to the underground workings;	32
4. Remove the tailings from the site and dispose of at a suitable off site landfill facility.	34

Each of the alternatives is discussed in more detail below:

<u>Option 1: Do nothing other than reinforce the tailings pond containment berm</u> with clean waste rock such that there are no preferential pathways for the erosion and migration of the tailings. The advantages of this remedial alternative are that there would be no release of the water present within the tailings impoundment, there is a relatively low cost associated with this strategy, little outside resources would be required and there would not be an increase in the metals concentration in the discharging stream.

The do-nothing approach will require on-going monitoring of the standing water over the tailings to determine if the characteristic of the water is changing over time. There would remain the potential for the generation of dust as well as the potential exposure of humans and animals to the standing water and exposed tailings.

<u>Option 2: Drain the supernatant from the pond and then cover the tailings</u> with approximately 2 m of clean waste rock to provide an isolation barrier. The existing berms would be re-graded to provide a stable long-term slope. The estimated volume of waste rock required to implement this alternative is approximately 665 m^3.

The advantages of this alternative are that the tailings will be emplaced below the waste rock limiting ecological and human exposure to the tailings, the potential for wind erosion and the creation of dust is reduced and this is a long-term solution requiring no additional monitoring. The disadvantage of this remedial strategy is that the water, currently covering the tailings and containing elevated dissolved metals concentrations, would need to be drained prior to the emplacement of clean waste rock. It is expected that the water could be pumped to the nearby vent raise thereby eliminating the need for a sedimentation pond and allowing rapid drawdown of the tailings. Earth moving equipment required to complete this work would include an excavator, dump truck(s) and a loader. Waste rock would be obtained from the waste rock stockpiles, from the Ida Bay site, and from berms around the fuel bladder, fine ore pad and machine shop.

Option 3: The tailings could be relocated into the underground workings. The estimate volume of tailings requiring removal is 1,800 m^3 while the estimated capacity of the accessible underground workings is approximately 100 m^3 indicating that only a small percentage of the tailings could be managed in this manner. This option would have to be used in conjunction with one of the other remedial options. After emplacing the tailings within the adit, clean waste rock would be used to cover the adit opening after emplacement of the tailings. This is a less desirable strategy given the difficulty in dewatering and physically moving the tailings from their current location to the adit, creation of dust and potential for 'tracking' tailings across the site as they are moved, difficulty in emplacing the tailings within the adit in its current flooded condition and that only a small percentage of the tailings could be accommodated.

Option 4: The tailings could be excavated, placed into drums or containers and transported off-site for disposal. Similar to Options 2 and 3, the water covering the tailings would need to be drained prior to excavating. The advantage of this remedial alternative is that the tailings would be removed from the site permanently and therefore additional monitoring and analysis would not be required. There would be no possible future exposure to humans or ecological receptors at the site once the tailings have been removed.

The disadvantage of this alternative is that drums or other disposal containers would have to be transported to Site; the containers would then have to be transported to and held at a barge landing site prior to being shipped to a suitable disposal site. There will be a cost associated with the transportation of the containers and with the disposal of the tailings at the designated landfill. Dust may be generated during the packaging of the tailings into the disposal containers. While local employment will be generated in the packaging of the tailings, the transportation and disposal would be conducted by those outside of the community.

For each of the above remedial strategies, the tailings would be consolidated into a single area. As such, the tailings identified in the barrel storage area would be excavated and combined with the remainder of the tailings. Waste rock fines found in the areas of the waste rock piles could also be consolidated with the tailings. The HHERA recognizes the fine fraction of waste rock/tailings and the standing bodies of water (i.e. the tailings pond) as potential sources of risk to human health. The HHERA recommended limiting or eliminating access to these contaminant sources.

Draining the standing water and covering the tailings with 2 m of clean waste rock was identified as the preferred remedial option. This remedial strategy had the benefits of limiting exposure by humans to standing water in the tailings impoundment and to the tailings, limiting the potential for dust and tailings erosion, no requirement for further monitoring once implemented, no increase the concentration in the discharging stream and no requirement for significant outside material resources.

4.3 Waste Rock

Some waste rock abandoned at the Roberts Bay Mine Site was used for construction of roads and infrastructure, usually as a surface veneer less than 1.0 m thickness. Other waste rock was abandoned in small piles around the site. The estimated total volume of waste rock at the Roberts Bay site is 2,842 m^3 based on site survey information and best estimates for average depths of veneers.

4.3.1 Key Issues

The key issues related to waste rock are:

- Aesthetics; and
- Use to infill openings, cover low laying areas and minimize visual impact.

The clean, non-acid generating waste rock constitutes a valuable resource for use as backfill, re-grading, capping and erosion protection.

4.3.2 Remedial Options

In order to address the issues related to the waste rock management at the site, the following alternatives are proposed:

1. Leave the waste rock in place; and
2. Non-acid generating rock to be used to cover the tailings pond, construction of berms and covers material for non-hazardous demolition debris.

Option	Rank Summary
1. Leave non-acid generating waste rock in place	37
2. Non-acid generating rock to be used to cover the tailings pond and non-hazardous demolition debris	37

Both leaving the waste rock in place and using it for backfilling are deemed acceptable remedial strategies to improve the aesthetics of the overall site. If the clean waste rock were not required for backfill, re-grading, capping and erosion protection, it would be left in place and re-contouring and re-vegetation could be considered. Both strategies will be implemented as required to manage the NAG waste rock. In addition, it is anticipated that the excess waste rock located at Ida Bay will be transported to Roberts Bay as part of the Ida Bay remedial plan.

4.4 Non-hazardous Waste

The Roberts Bay site had a flotation mill and maintenance shop that were constructed as wood and steel tent frames that have decayed leaving significant debris (wood, concrete, tires, steel, plastic, cabling, abandoned equipment, etc.). Site infrastructure was generally abandoned and left to decay leaving significant debris across the two sites (estimated at 375 m^3 of non-hazardous debris).

As part of the waste audit conducted by Earth Tech (2005) approximately 92 m^3 of wood, 84 m^3 steel/metal products and 178 m^3 miscellaneous inert wastes were identified; for a total quantity of 354 m^3. The waste assessment report should be referenced for a complete summary of the quantities and types of waste present. During the demolition of the site infrastructure, additional non-hazardous wastes are expected to be generated.

An existing surface landfill, containing domestic waste, is present on-site but it has not been closed out. It did not appear that any waste had been buried below grade at this location.

4.4.1 Key Issues

The key issues related to non-hazardous waste are:

- Aesthetics; and
- Physical risks to humans and terrestrial wildlife.

As part of the waste audit conducted by Earth Tech approximately 375 m^3 of wood, steel/metal products and miscellaneous inert wastes were identified. During the demolition of the site infrastructure, additional non-hazardous wastes are expected to be generated. The debris currently present at the site is unsightly and unsafe to visitors and terrestrial wildlife.

4.4.2 Remedial Options

Options evaluated for the remediation of non-hazardous waste included:

Option	Rank Summary
1. Leaving all remaining structures and non-hazardous debris in place	17
2. Demolish the remaining structures, clean up all non-hazardous debris, and remove all non-hazardous material for disposal in a suitable off-site landfill	34
3. Demolish the remaining structures, clean up all non-hazardous debris, and segregate recyclable wastes where feasible and ship to a suitable recycling facility, bury non-recyclable non-hazardous wastes on-site in a suitably designed landfill or above the tailings pond capped with NAG waste rock.	34

As leaving the debris and structures in place presents a physical hazard to humans and wildlife, this is not an acceptable remedial alternative and was not evaluated further.

<u>Option 2: Demolish the remaining structures, clean up all non-hazardous debris, and remove all non-hazardous material for disposal in a suitable off-site landfill</u>. This option ranked equally

with Option 3, but has a much higher associated costs. It is recognized that costs could be significantly reduced should the transportation be coordinated with work being undertaken at the nearby Doris North project. The non-hazardous material would be collected and segregated into wood, steel and other inert material. The collection and segregation would be primarily done by hand.

Non-hazardous waste originating from Ida Bay would be combined with that generated at the Roberts Bay site. The material would need to be transported from Roberts Bay to Ida Bay via the proposed winter road. All of the non-hazardous material to be transported would be collected and stockpiled at the loading dock envisioned at Ida Bay. Then during open water the material would be transported to Cambridge Bay or Hay River landfills.

In order to reduce the volume of waste requiring transport, the appropriate approvals to incinerate the wood at the site should be obtained. The steel collected at the site would be sent to a recycling facility. Steel covered with paint amended with lead would be considered hazardous material or subjected to a lead abatement program prior to removal from site.

<u>Option 3: Demolish the remaining structures, clean up all non-hazardous debris, segregate recyclable wastes where feasible and ship to a suitable recycling facility, bury non-recyclable non-hazardous wastes on-site in a suitably designed landfill or above the tailings pond capped with NAG waste rock.</u> Similar to Option 2, all of the non-hazardous waste would be collected by hand and segregated. The wood could be incinerated or simply included with the waste to be buried. It is expected that steel would be managed in one of the following ways:

1. <u>Off-site Recycling</u> is an environmentally sound alternative however, is associated with a high transportation cost. The steel would need to be cut into manageable size pieces, transported to the barge loading dock and then transported south to a recycling facility.

2. <u>On-site Burial</u> the steel would need to be cut into manageable size pieces, transported to the disposal area and covered with clean waste rock and/or overburden materials. The advantage of this option is the lower cost however as the steel was oxidized it is expected that settlement would occur in the disposal area which may present a safety concern.

3. <u>Donation of the Steel</u> is an alternative remedial option, if the local community expresses an interest in acquiring the material.

The non-hazardous waste requiring burial could be emplaced at the preferred landfill location (Area C) identified by Earth Tech (2005). In this scenario, clean waste rock would be used to cover the waste and provide the weight to prevent frost jacking. Overburden material from the adjacent Borrow Areas 2 and/or 3 could then be used to contour the cover material. However, a more preferable option is emplacing the waste material above the existing tailings (after dewatering) which would provide additional isolation of the tailings and utilize available resources without requiring any borrow material. Once the waste is spread over the surface of the tailings in a lift less than 0.5 m in thickness, 2 m of waste rock will be used to cover the entire surface.

Option 3, with the waste being placed within the tailings pond is the preferable remedial option as it utilizes available resources, provides a long-term solution with low maintenance, addresses the potential for frost jacking,

The options evaluated for the existing landfill containing domestic waste were:

Option	Rank Summary
1. Leave the landfill in its current condition	19
2. The on-site landfill containing domestic waste requires reinforcement of the berms and a proper landfill cover. Waste rock would be used to stabilize the berms and cover the waste to prevent freeze jacking.	35
1. Excavate the non-hazardous waste from the landfill and manage along with the remaining non-hazardous materials and re-grade the existing berms.	35

As leaving the landfill in its current condition did not address the issues of aesthetics and physical safety to humans and wildlife, this option was not considered further.

<u>Option 2: Re-enforcement of berms and provide cover materials</u>. The materials currently residing in the landfill consist of mostly incinerated domestic waste such as tin cans and glass. It did not appear that the wastes were buried below grade, instead they were contained within a 10 m wide berm that was 20 m long and about 2 m in height. There was no cover provided for the landfill and the berm did not fully enclose the sides of the landfill. Completing the berms around the landfill and providing a waste rock cover would be sufficient to improve the aesthetics and isolate the wastes from contact with humans and wildlife. Approximately 350 m^3 of waste rock would be required to implement this option.

This has the advantage of using available waste rock and minimal disturbance to the environment. The disadvantage is the potential for freeze-jacking however, a sufficiently thick cover of waste rock (1 m) would provide enough weight to counteract the effect.

<u>Option 3: Excavate the non-hazardous waste from the landfill and manage along with the remaining non-hazardous materials and re-grade the existing berms</u>. Option 3 considered excavating waste deposited in the existing landfill and transferring it to the disposal area for the remaining non-hazardous waste (i.e. the tailing pond). The existing waste rock berm would then be excavated and used as cover material on the tailings pond.

The advantage is that all of the non-hazardous waste (approximately 400 m^3 including the berm materials and infill with the waste) would then be located in a single area; the disadvantage is cost required to excavate and move the waste.

The preferred remedial option is to leave the waste materials in place and simply provide a waste rock cover to isolate the waste from humans and wildlife and improve the aesthetics (Option 2).

4.5 Hazardous Waste

The waste audit conducted by Earth Tech created an inventory of hazardous wastes at the Roberts Bay site. Small quantities of ore and assay processing chemicals (xanthanate, various acids, calcium, lime, lead shavings) are stored onsite in overpack drums;

Non-mining hazardous materials at the Roberts Bay site included PCB containing capacitors and light ballasts, barrels of Jet Fuel, motor oil, glycol, heating oil, hydrocarbon impacted water, acids, detonation cord, grease, lead acid batteries as well as minor amounts of asbestos;

Asbestos materials on site were limited to a transite panel constructed heating cabinet located within the former mill. Although a confirmatory asbestos samples was not submitted it is expected that the transite board would contain 2 to 10% chrysotile asbestos. A few brake pads were also observed at both the Roberts Bay and Ida Bay mine sites.

Steel components covered with paint that has a lead concentration greater than 500 ppm are considered hazardous waste. The steel should be removed and transported off-site to a facility licensed to receive lead waste. Alternatively the lead-based paint could be removed from the metal prior to recycling or disposal of the steel materials. Steel coated with lead-based paint should not be considered for on-site burial or donation to the community.

Hazardous and non-hazardous waste found at the Ida Bay site should be transported via winter road to the Roberts Bay site so that waste materials can be managed together.

4.5.1 Key Issues

The key issues with respect to hazardous wastes are:

- Aesthetics;
- Risk to human and terrestrial wildlife health and safety; and
- Risk of impacts to soil, surface and ground water.

4.5.2 Remediation

The remedial options considered for the management of hazardous waste are:

Option	Rank Summary
1. Leave in place	17
2. Remove for off-site disposal; neutralize and incinerate where possible.	35

As leaving the hazardous wastes in the present condition does not address the issues of aesthetics, health and safety to humans and wildlife or the potential for future impacts to soil, groundwater and surface water, this option was not considered further.

Option 2: Collect hazardous waste for off-site disposal. The remediation of hazardous waste by this method would have the waste materials placed into containers which would then be transported by winter road to Ida Bay. At Ida Bay the containers would be stockpiled at the loading dock to await open water. In the summer months the containers would transported by barge to an appropriate disposal facility in Alberta. The advantage of this remedial option is that the waste is permanently removed from the site and therefore requires no further monitoring and no longer presents a risk to visitors of the site. The disadvantage is the high cost associated with transportation and tipping fees. The transportation costs could be reduced by coordinating this project with the nearby Doris North project.

Where feasible the volumes of waste requiring disposal will be reduced through neutralizing acids and by blending and incinerating abandoned petroleum products,

If a lead abatement program is undertaken the lead impacted paint must be treated as hazardous waste. Remediation of waste lead and lead paint should be consistent with the "Guideline for Waste Lead and Lead Paint" published by the Government of the Northwest Territories in April 2004. The lead paint would be placed into containers and transported, as desbribed above, to an approved facility.

Waste batteries should be segregated in the containers such that the materials can be recycled where possible. Remediation of waste batteries should be consistent with the "Guideline for the Management of Waste Batteries" published by the Government of the Northwest Territories in September 1998.

The preferred remedial option is to collect and remove the hazardous waste to an appropriate off-site facility. Where feasible, acids would be neutralized on-site. Potentially abandoned petroleum products could be appropriately mixed and incinerated on-site to reduce the volume of hazardous waste requiring transportation.

4.6 Petroleum and Metals Impacted Soil

Both metals and petroleum hydrocarbon impacted soils were identified during the environmental site assessment conducted by Earth Tech in 2005. Metals impacted soil, mainly comprised of waste rock fines, was identified in the vicinity of the mill building and other areas of the site where waste rock had been stockpiled. There is approximately 325 m^3 of petroleum contaminated soils located around the fuel storage compound, mill and garage at Roberts Bay.

4.6.1 Key Issues

The two primary concerns with the presence of the metals and petroleum hydrocarbon impacted soil are:

- Impacted soil represent a safety and toxicity hazard to humans and wildlife through soil contact, ingestion and vapour inhalation;
- The petroleum hydrocarbons and metals may contaminate local surface and groundwater.

4.6.2 Remediation

The following three remedial options were evaluate:

Option	Rank Summary
1. Leave in place	17
2. Remove for off-site disposal.	36
3. Place in on-site engineered landfarm for bio-remediation	27

As leaving the metals and petroleum impacted soil does not address the safety and toxicity hazards to humans and wildlife and does not prevent further contamination to surface and groundwater, this option was not evaluated further.

Option 2: Remove for off-site disposal. The remediation of impacted soils by this method would have the impacted soils placed into containers which would then be transported by winter road to Ida Bay. At Ida Bay the containers would be stockpiled at the loading dock to await open water. In the summer months the containers would transported by barge to an appropriate disposal facility in Alberta. The advantage of this remedial option is that the soil is permanently removed from the site and therefore requires no further monitoring and no longer presents a risk to visitors of the site. The disadvantage is the high cost associated with transportation and tipping fees. The transportation costs could be reduced by coordinating this project with the nearby Doris North project.

Option 3: Place petroleum impacted soils in on-site engineered landfarm. The remediation of petroleum impacted soils using an engineered cell would entail a fully lined and bermed land-farming area where excavated materials could be placed and allowed to bio-remediate. The bermed area would be lined with an impermeable geomembrane and covered with a secondary non-woven liner. The non-woven liner will protect the geomembrane during construction operation and maintenance. The length of time for remediation would be increased due to the cold climate. It is estimated that the bioremediation of the impacted soil, especially given the heavier petroleum hydrocarbon fractions identified. This method will not reduce the metals concentrations in the soil but will contain the metals impacted soil within the engineered cell. The cell would also require tilling and nutrient amendment during the period where active remediation is occurring at the site. After this time, the soil would be allowed to naturally attenuate within the cell. A protective cover would be used to prevent the infiltration of precipitation. The landfarm would be monitored in conjunction with the overall long-term monitoring program as per INAC standard policy. At the end of the remedial program the landfarm could be covered with waste rock and allowed to remain.

The preferred remedial option is off-site disposal. This remedial option limits human and wildlife exposure (via ingestion, inhalation, or physical contact) to petroleum hydrocarbons and metals impacted soil and will not require future monitoring. The higher costs associated with this option can be offset through coordination with the Doris North Project.

4.7 Mine Openings

There were two mine openings identified at the Roberts Bay mine site. One adit, referred to here as Adit #1, was located to the northeast of the tailings pond. At the time of the site visit Adit #1 had been covered with a wooden framework and plywood against which some waste rock had been emplaced. Standing water was observed at the entrance to the adit indicating the mine working has flooded. A chain-link fence surrounded the adit and provided some protection against access.

A second adit, referred to as Adit #2, was located to the east of Adit #1 on the side of eastern basaltic ridge. The walls of Adit #2 appear to have partially collapsed and a chain link fence only partially surrounds it. Caving and fractures are evident implying the structural integrity of the opening is not sound.

A vent raise, sealed with concrete, was also identified to the north of the opening of Adit #2. There was no evidence of subsidence around the vent raise however; no details regarding the manner in which the raise was capped are available.

4.7.1 Key Issues

Access into the mine workings through the adits poses a physical hazard to the safety and health of humans and to terrestrial animals who visit the Site. The deteriorating structures and fences surrounding the adits detract from the aesthetic value of the Site.

4.7.2 Remedial Options

Permanently seal access to the underground workings by:

Option	Rank Summary
1. Leave as is	17
2. Blast adit back, backfill with NAG waste rock	39
3. Infill with waste rock, blast roof of adit and backfill depression with more waste rock	37
4. Place/replace concrete caps over mine openings	35

As leaving the mine openings in their current condition was deemed an unreasonable safety risk, this option was not evaluated further.

Option 2: Blast adit back, backfill with NAG waste rock. This remedial option involves mobilizing blasting equipment to site such that the first 10 to 15 m of the adit back can be imploded into the adit opening. The depression created by this will be infilled with NAG waste rock. It is expected that a depressed area of 80 m^2 will be created at Adit #1 and requiring infill with NAG waste rock. As Adit #2 is significantly smaller and the opening nearly vertical, the volume of waste rock required to infill the depression was not determined. The advantages of this remedial option are that it is long-term, requires no future monitoring and utilizes readily available waste rock. The high cost of mobilizing blasting equipment is the main disadvantage to this alternative.

Option 3: Infill with NAG waste rock, blast roof of adit, and backfill depression with NAG waste rock. This remedial option involves emplacing NAG waste rock into Adits #1 and #2 prior to blasting the roof upon the rock. Once the rock is in place, the adit backs would be imploded. The depression remaining would be infilled with NAG waste rock. The volume of the depressions created and requiring infilling is not known, but is expected to be less than the interior of the adit which was estimated at 100 m^3.

Option 4: Place/replace concrete caps over mine openings. This remedial option requires suitable pre-cast concrete caps to be mobilized to the site. The concrete caps would then be emplaced and anchored over the mine openings. This is mid-term solution which would require periodic inspection of the condition of the concrete caps. The disadvantage to this alternative is the transportation costs associated with mobilizing the caps to site. While this may not be the ideal alternative for the remediation of the adits, this may be a good alternative to retrofit the existing cap over the vent raise.

The preferred remedial alternative will be the one in which access to the mine workings are permanently sealed to prevent access and will be stable for the long-term. Ideally, the remedial method will also restrict access by humans or wildlife to mine water which may be impacted with elevated metals concentrations. Although all of the above remedial options meet these objectives, blasting the adit back and in-filling with clean waste rock is the preferred alternative because it utilizes the available on-site materials, presents less of a physical hazard in emplacing the waste rock (ie. the adit does not have to be entered) and would be geotechnically stable.

5.0 IDA BAY SITE

5.1 Site Infrastructure, Hazardous and Non-Hazardous Waste

An exploration trench was identified within the basaltic ridge south of the adit. Reportedly, the trench was excavated using blast and muck techniques. The trench was observed to be about 1.2 m wide, 8 to 10 m long and 1.0 m deep. Additional smaller trenches are present in the vicinity. At the time of the 2005 site visit the trench was filled with water. No warning signs had been posted and no oxidation staining was visible.

A considerable amount of mine-related waste materials were scattered around the Ida Bay site. Including the following types of materials:

- Non-hazardous (wood, lumber, steel, rubber hoses, tine cans, auto parts) – approximately 9 m^3; and
- Hazardous (broken lead acid batteries) – approximately 100 kg and a few asbestos brake pads.

5.1.1 Key Issues

The main issue with the existing site infrastructure is the potential risk to human health and safety as well as the safety of terrestrial wildlife. In addition to being a safety hazard the debris which remains at the site is also aesthetically unappealing.

5.1.2 Remedial Options

Option	Rank Summary
Infrastructure	
1. Leave as is	21
2. Dismantle, segregate and co-manage at Roberts Bay	36
3. Transport for off-site disposal	34
Exploration Trench	
1. Do nothing	22
2. In-fill with clean waste rock	35
Hazardous waste	
1. Do nothing	22
2. Transport for off-site disposal	34

The physical hazards associated with the remaining infrastructure and hazardous waste were not addressed by the ‘do nothing’ alternatives and therefore not evaluated further.

Infrastructure/Non-hazardous waste
Option 2: Dismantle, segregate and co-manage at Roberts Bay. This option would see the infrastructure dismantled mainly by hand and then segregated into wood, steel and other inert materials. The waste would then be transported overland by truck or ATV with trailer via a winter road to the Roberts Bay site. At Roberts Bay the non-hazardous waste would be co-managed and emplaced above the tailings pond for disposal. The waste would then be covered with a minimum of 2 m of waste rock which would reduce the potential for freeze jacking. Combination of the waste into one area increases efficiency. The disadvantage is the need and expense to transport the waste to Roberts Bay mine site.

Option 3: Transport for off-site disposal. In this option, the waste would be placed into containers or loaded as stockpiles onto a barge for disposal at an appropriate facility in Cambridge Bay or Hay River. The material would have to be stockpiled at the loading dock at Ida Bay until the summer months when the barge could access the site.

The preferred remedial strategy is to transport the non-hazardous waste to the Roberts Bay site where it will be co-managed. The preferred remedial option for the management of non-hazardous waste at Roberts Bay is burial above the tailings pond.

Exploration Trench

Option 2: In-fill with clean waste rock. This is the preferred remedial strategy. The existing trench and the smaller trenches in the vicinity would be in-filled with NAG waste rock. This option would use readily available waste rock and the equipment being utilized for other site activities.

Hazardous Waste

Option 2: Transport for off-site disposal. This approach is the preferred remedial strategy and would involve placing the lead-acid batteries and asbestos materials into appropriate containers. The containers would then be stockpiled at the Ida Bay loading dock for transport to a suitable recycling/disposal facility in Alberta.

5.2 Waste Rock

Four waste rock piles were identified in proximity to the adit at the Ida Bay mine site. During the August 2005 investigation the total volume of waste rock at Ida Bay was determined to be 2,512 m^3. As reported in the AMEC Geochemical report, the waste rock at Ida Bay mine site is non-acid generating. Furthermore, all waste rock and tailing samples had paste pH values greater than 7.0 indicating that none of the samples are currently generating net acidity even though they have been exposed to weathering for greater than thirty years. The concentration of cadmium and mercury were elevated in the Ida Bay waste rock.

5.2.1 Key Issues

The waste rock at Ida Bay is not expected to generate net acidic drainage or release deleterious concentrations of metals into the aquatic environment.

The key issues related to waste rock are:

- Aesthetics (non-vegetated surfaces) and visual impact.

The non-acid generating waste rock constitutes a valuable resource for use as backfill, re-grading, capping and erosion protection.

5.2.2 Remediation

The remedial options considered for the NAG waste rock were:

Option	Rank Summary
1. Leave in place	33
2. Utilize as cover materials for the adit, backfill trenches and transport remainder to Roberts Bay (if required)	38

Options 1 and 2: Utilize NAG waste rock as cover materials and backfill, transport required quantity to Roberts Bay mine site for reclamation activities and leave remainder in place. If the clean waste rock were not required for backfill, re-grading, capping and erosion protection, it would be left in place and re-contoured. Waste rock located near the shore, above high tide level, should be removed and therefore this material would be utilized first to backfill the adit, vent raise and exploration trench. Approximately 10 m^3 of the clean waste rock material will be required to backfill the exploration trenches. The adit has a capacity of approximately 120 m^3 for waste rock. The amount of waste rock that would be required to infill the vent raise was not determined but is expected to be less than 100 m^3.

The preferred remedial strategy was required to be a long-term, no maintenance solution that will eliminate potential for metal leaching. Although off-site disposal meets these objectives, this alternative has a relatively high cost associated with both the transportation and tipping fee. The preferred option would be to place the waste rock within the flooded sections of the underground workings at Ida Bay and Roberts Bay mine sites, filling in all the trenches and the adit at Ida Bay first.

5.3 Mine Openings

The adit is a prominent feature at the Ida Bay site. The adit is fully open with no physical barrier, to prevent access, or posted warning signs. The adit is located approximately 15 m from the ocean shoreline and at the time of the 2005 site visit, was fully flooded with fresh water. The timbers bracing the back of the adit entrance appear deteriorated and their structural integrity is uncertain. A vent raise located to the west of the adit that had been covered with loose plywood which has begun to deteriorate. Below the plywood, the vent raise is filled with water.

5.3.1 Key Issues

The key issue is:

- Physical hazards to the safety of humans and terrestrial wildlife due to the open adit and vent raise.

5.3.2 Remediation

Options being considered for the permanent closure of the adit and vent raise are:

Option	Rank Summary
1. Do nothing	21
2. Blast the roof and vent raise to collapse then backfill the depression with NAG waste rock	35
3. In-fill the adit and vent raise with potentially acid generating waste rock, to the water line, blast the roof to collapse on the rock then backfill the depression with clean waste rock	37
4. Construct bulkhead over mine openings	28

In consideration of the unacceptable physical risk associated with the open adit and vent raise, the do nothing option was not further evaluated.

Option 2: Controlled blast of the roof and vent raise to collapse, then backfill the depression with NAG waste rock. This remedial option involves mobilizing blasting equipment to site such that the first 10 to 15 m of the adit back can be imploded into the adit opening, creating a depression that will be infilled with less than 120 m^3 of waste rock. The advantages of this remedial option are that it is long-term, requires no future monitoring and utilizes readily available waste rock. The high cost of mobilizing blasting equipment is the main disadvantage to this alternative.

Option 3: In-fill the adit and vent raise with waste rock, blast the roof to collapse on the rock then backfill the depression further with waste rock. This remedial option involves emplacing waste rock into the adit prior to blasting the roof upon the rock. Once the NAG was in place, the adit back would be imploded. The depression remaining would be infilled with more waste rock. The volume of the depressions created and requiring infilling is not known, but is expected to be less than the interior of the adit which was estimated at 120 m^3.

Option 4: Place/replace concrete caps over mine openings. This remedial option requires suitable pre-cast concrete caps to be mobilized to the site. The concrete caps would then be emplaced and anchored over the mine opening into the surrounding rock. This is mid-term solution which would require periodic inspection of the condition of the concrete caps. The disadvantage to this alternative is the transportation costs associated with mobilizing the caps to site.

The preferred remedial alternative will be the one in which access to the mine workings are permanently sealed to prevent access and will be stable for the long-term. Ideally, the remedial method will also restrict access by humans or wildlife to mine water which may be impacted with elevated metals concentrations. Although all of the above remedial options meet these objectives, blasting the adit back and in-filling with clean waste rock is the preferred alternative because it utilizes the available on-site materials, presents less of a physical hazard in emplacing the waste rock (ie. the adit does not have to be entered) and would be geotechnically stable.

5.4 Marine Sediments

The most southern waste rock pile was observed to extend from land into the ocean and is partially covered by seawater at high tide. The volume of waste rock material deposited within the ocean tidal zone is estimated to be less than 20 m^3.

5.4.1 Key Issues

Approximately 20 m^3 of sediment impacted with metals (Cu and Pb) were identified below the waste rock pile which extended into the tidal zone which may impact the aquatic environment.

5.4.2 Remediation

Options being considered for the remediation of the marine sediments are:

Option	Rank Summary
1. Do nothing	27
2. Remove the waste rock from the shoreline above high tide and place the waste rock with the remaining stockpiles	37
3. Excavate sediment (20 m^3) and move to Roberts Bay to be treated with other metals impacted soil	34

Option 1: Do nothing. The presence of waste rock in proximity to the marine environment could present an ecological risk. As such, the do nothing option was not evaluated further.

Option 2: Remove waste rock from the shoreline above high tide and place the waste rock with the remaining stockpiles. This option would see the high tide level being surveyed and marked such that all waste rock above this zone could be excavated and then managed as discussed in Section 5.1.2.

Option 3: Excavate sediment (20 m^3) and move to Roberts Bay to be treated with other metals impacted soil. With this remedial option, it is proposed that the sediment which was found to be impacted also be removed. This would be conducted using earth moving equipment and would require special considerations for limiting the impact to the existing coastal environment which has now been established on this sediment. To implement this option would require significant input from the Department of Fisheries and Oceans as this work would fall under the Federal Fisheries Act.

The preferred remedial option is to leave the sediment in place such that the coastal environment is not altered, but remove the waste rock from above high tide such that there is no further potential source of contaminants to this environment. This would require survey equipment to mark the high tide and earth moving equipment to excavate the rock.

TABLE A1: Reclamation Options Assessment Matrix for the Roberts Bay Mine Site

Assessment Component	Sub-component	Remedial Options	Pros	Cons	Long-term Effectiveness	Technically Feasible	Human Health and Safety	Ecological Health and Safety	Time to Implement	Monitoring Requirement	Capital Cost	O&M Cost	Rank Summary
Remaining Infrastructure		Leave as is	lowest cost	does not address safety, aesthetic and health concerns	2	5	1	1	5	1	5	1	21
		dismantle and segregate waste	waste is removed and risk permanently managed	higher cost	5	5	5	5	3	5	3	5	36
Tailings pond		Stabilize berms, leave as is	Lowest cost	Doesn't address exposure risk or erosion/dust, monitoring required	3	5	2	2	5	1	4	2	24
		Drain water cover with WR	Limits exposure by humans and wildlife; utilizes waste rock; erosion reduced	Supernatant would need to be drained	5	5	5	5	5	5	2	4	36
		Relocate tailings to UG workings	Eliminates exposure risk	Not enough capacity for all tailings; would have to be used in conjunction with other strategy	5	1	5	5	5	5	2	4	32
		Remove to off-site landfill	Eliminates exposure risk; no further monitoring required	Highest cost alternative; transportation issues	5	5	5	5	3	5	1	5	34
Waste Rock	NAG WR	Leave in place	lowest cost	doesn't utilize available resources to manage other issues	5	5	4	4	5	5	5	4	37
		Use to isolate tailings and construct non-hazardous landfill	Uses available resources; eliminates exposure risk of tailings; can help control freeze jacking	Heavy equipment required to move	5	5	5	5	4	5	4	4	37
Non-hazardous waste	Infrastructure and debris	Leave in place	Lowest cost	Does not address safety and aesthetic concerns	1	2	1	1	5	1	5	1	17
		Off-site disposal	Address safety and aesthetic concerns	Highest cost	5	5	5	5	3	5	1	5	34
		Construct on-site non-hazardous landfill or place in tailings pond, reduce volume through burning, recycling	Addresses safety and aesthetic concerns; uses on-site resources, long-term, low maintenance	increase cost; freeze jacking to be addressed; recycling may not be feasible	5	5	5	4	4	3	4	4	34
	existing landfill	Leave as is	Lowest cost	Does not address safety and aesthetic concerns	1	2	1	1	5	2	5	2	19
		Excavate and dispose in tailings pond	Addresses safety and aesthetic concerns; uses on-site resources, long-term, low maintenance	Highest cost; requires excavation	5	5	5	5	4	5	1	5	35
		Cover and close existing on-site landfill	Addresses safety and aesthetic concerns; uses on-site resources, long-term, low maintenance	Frost jacking to be addressed and monitored.	5	5	5	5	4	4	4	3	35

TABLE A1: Reclamation Options Assessment Matrix for the Roberts Bay Mine Site

Assessment Component	Sub-component	Remedial Options	Pros	Cons	Long-term Effectiveness	Technically Feasible	Human Health and Safety	Ecological Health and Safety	Time to Implement	Monitoring Requirement	Capital Cost	O&M Cost	Rank Summary
Hazardous waste		Do nothing	Low cost	Continued risk; short-term	1	2	1	1	5	1	5	1	17
		Remove for off-site disposal, recycle, neutralize, treat and incinerate to reduce volumes	Addresses human and ecological risks; reduces volumes where possible	Higher cost; approvals required, on-site work required	5	5	5	5	4	5	1	5	35
Impacted Soil	Petroleum/metal Impacted	Leave in place	Low cost	continued potential exposure to humans and wildlife	1	2	1	1	5	1	5	1	17
		Containerize and remove for off-site disposal	Removes issue, no monitoring or management required; opportunities to coordinate to reduce costs	High cost of tipping and transportation	5	5	5	5	4	5	2	5	36
		On-site engineered landfill	Reduces potential exposure hazards	On-going monitoring required; risk to gw; does not treat metals	5	4	4	4	3	2	3	2	27
Mine Openings	Adit #1 and #2	Do nothing	Lowest cost	Safety and health concerns will remain, temporary solution	1	2	1	1	5	1	5	1	17
		Blast adit back, backfill with WR	Long-term, uses on-site materials	High cost of mobilizing drilling and blasting equipment	5	5	5	5	4	5	5	5	39
		Infill with WR, blast then infill with more WR	Low cost, Use on-site materials	Not enough capacity for all WR; long-term settlement	5	4	5	5	4	5	4	5	37
		Construct bulkhead	medium to long-term solution	Logistics; monitoring of condition req'd; cost	5	5	5	5	4	4	3	4	35
	Vent raise	do nothing	Lowest cost, vent raise is already capped	Details on construction of the cap are not known	1	2	1	1	5	1	5	1	17
		retrofit new concrete cap	medium to long-term solution	Logistics; monitoring of condition req'd; cost	5	5	5	5	4	4	3	4	35

Ranking
1 Poor
2 Less than acceptable
3 Acceptable
4 Good
5 Better

Definitions:
WR - waste rock
NAG - non-acid generating
UG - underground
GW - groundwater
O&M - operation and maintenance

TABLE A2: Reclamation Options Assessment Matrix for the Ida Bay Mine Site

Assessment Component	Sub-component	Remedial Options	Pros	Cons	Long-term Effectiveness	Technically Feasible	Human Health and Safety	Ecological Health and Safety	Time to Implement	Monitoring Requirement	Capital Cost	O&M Cost	Rank Summary
Remaining Infrastructure, Hazardous and Non-Hazardous Material	Infrastructure/ non-hazardous waste	Leave as is	lowest cost	does not address safety, aesthetic and health concerns	2	5	1	1	5	1	5	1	21
		dismantle and segregate waste, tranport to Roberts Bay	waste is removed and risk permanently managed	higher cost; need winter road for transport	5	5	5	5	3	5	3	5	36
		Off-site disposal	Address safety and aesthetic concerns	Highest cost	5	5	5	5	3	5	1	5	34
	Exploration Trenches	Do nothing	lowest cost	does not address safety, aesthetic and health concerns	1	5	1	1	5	1	5	3	22
		In-fill with clean WR	long-term solution; utilizes available materials	Equipment required to move WR	5	5	5	5	4	5	3	3	35
	Hazardous waste	Do nothing	Low cost	Continued risk; short-term	1	5	1	1	5	1	5	3	22
		Remove for off-site disposal	Addresses human and ecological risks; reduces volumes where possible	Higher cost; approvals required, on-site work required	5	5	5	5	3	5	1	5	34
Waste Rock	NAG WR	Leave in place	lowest cost	doesn't utilize available resources to manage other issues; aesthetic value	3	5	4	4	5	3	5	4	33
		Tranport to Roberts Bay for mgmt	Long-term solution; utilizes WR where it is needed	tranportation costs; need for winter road	5	5	5	5	4	5	4	5	38

TABLE A2: Reclamation Options Assessment Matrix for the Ida Bay Mine Site

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Assessment Component	Sub-component	Remedial Options	Pros	Cons	Long-term Effectiveness	Technically Feasible	Human Health and Safety	Ecological Health and Safety	Time to Implement	Monitoring Requirement	Capital Cost	O&M Cost	Rank Summary
Mine Openings	Adit & vent raise	Do nothing	Lowest cost	Safety and health concerns will remain, temporary solution	1	5	1	1	5	1	5	2	21
		Blast adit back, backfill with WR	Long-term, uses on-site materials	High cost of mobilizing drilling and blasting equipment	5	4	5	5	4	5	2	5	35
		Infill with NAG WR	Low cost, Use on-site materials	Not enough capacity for all WR; long-term settlement	5	4	5	5	4	5	4	5	37
		Construct bulkhead	Medium to long-term solution	Logistics; monitoring of condition req'd; cost	3	4	4	4	4	4	2	3	28
Marine Sediments		Do nothing	Lowest cost	Potential for continued leaching; short-term solution	1	5	4	1	5	3	5	3	27
		Remove waste rock from above high tide level	Addresses metal leaching; doesn't disturb marine sediment	Leaves some impacted sediment to naturally attenuate	5	5	5	4	4	5	4	5	37
		Excavate metals impacted sediments, take to RB	Addresses metal leaching	Disturbs marine environment	5	4	5	3	4	5	3	5	34

Ranking

1 Poor
2 Less than acceptable
3 Acceptable
4 Good
5 Better

Definitions:

WR - waste rock
NAG - non-acid generating
UG - underground
GW - groundwater
O&M - operation and maintenance

Appendix B
Relevant Assessment Guidelines

Table B.1: Assessment Guidelines for Fine and Coarse Grained Soil, Residential/Parkland Land Use

Analytical Parameters	Surface soil[1] (mg/kg)	
	Fine Grained	Coarse Grained
Benzene[2]	0.0068	0.0095
Toluene	0.08	0.37
Ethylbenzene	0.018	0.082
Xylenes	2.4	11
PHC-F1	245[3]	130
PHC-F2	700[4]	150
PHC-F3	1135[5]	400
PHC-F4	647[5]	2800
Naphthalene	0.6	
Quinoline	NG	
Phenanthrene	5	
Pyrene	10	
Benzo(a)anthracene	1	
Benzo(b)fluoranthene	1	
Benzo(k)fluoranthene	1	
Benzo(a)pyrene	0.7	
Indeno(1,2,3-cd)pyrene	1	
Dibenzo(a,h)anthracene	1	
Antimony	20	
Arsenic	105[1]	
Barium	500	
Beryllium	4	
Cadmium	10	
Chromium	64	
Cobalt	50	
Copper	176[1]	
Lead	140	
Mercury	6.6	
Molybdenum	10	
Nickel	50	
Selenium	1	
Silver	39[1]	
Thallium	1	
Tin	50	
Uranium	NG	
Vanadium	130	
Zinc	>2000[1]	

Notes:

[1] Site Specific Remedial Objective (SSRO) developed by the human health and ecological risk assessment (HHERA)
[2] Benzene – 10^{-6} incremental risk of cancer guideline
[3] PHC – Petroleum Hydrocarbon F1: fractional C_6-C_{10}; corrected for BTEX
[4] PHC – Petroleum Hydrocarbon F2: fractional C_{10}-C_{16}
[5] PHC – Petroleum Hydrocarbon F3: fractional C_{16}-C_{34}
[6] PHC – Petroleum Hydrocarbon F4: fractional C_{34}-C_{50+}

Table B.2: Assessment Surface Water Guidelines for Protection of Freshwater and Marine Life

Analytical Parameters	Surface Water Freshwater (mg/L)	Surface Water Marine (mg/L)
Benzene	0.370	0.110
Toluene	0.002	0.215
Ethylbenzene	0.090	0.025
Xylenes	0.18[1]	NG
PHC-F1	NG	NG
PHC-F2	NG	NG
PHC-F3	NG	NG
PHC-F4	NG	NG
Aluminum	0.005 – 0.1	NG
Antimony	NG	NG
Arsenic	0.005	0.0125
Barium	NG	NG
Beryllium	NG	NG
Bismuth	NG	NG
Cadmium	0.000017	0.00012
Calcium	NG	NG
Chromium	0.0089	0.056
Cobalt	NG	NG
Copper	0.002 – 0.004	NG
Iron	0.3	NG
Lead	0.001 – 0.007	NG
Magnesium	NG	NG
Manganese	NG	NG
Mercury	0.000026	0.000016
Molybdenum	0.073	NG
Nickel	0.025 – 0.150	NG
Phosphorus	NG	NG
Potassium	NG	NG
Selenium	0.001	NG
Silver	0.0001	NG
Sodium	NG	NG
Strontium	NG	NG
Thallium	0.0008	NG
Tin	NG	NG
Titanium	NG	NG
Vanadium	NG	NG
Zinc	0.03	NG

Notes:

[1]Alberta Environment, 2001. Risk Management Guidelines for Petroleum Storage Tank Sites. Used in absence of available CCME guidelines.

Table B.3: Assessment Guidelines for Protection of Freshwater and Marine Aquatic Life

Analytical Parameters	Freshwater Sediment Guidelines (mg/kg)	Marine Sediment Guidelines (mg/kg)
Benzene	NG	NG
Toluene	NG	NG
Ethylbenzene	NG	NG
Xylenes	NG	NG
PHC-F1	NG	NG
PHC-F2	NG	NG
PHC-F3	NG	NG
PHC-F4	NG	NG
Aluminum	NG	NG
Antimony	NG	NG
Arsenic	5.9	7.24
Barium	NG	NG
Beryllium	NG	NG
Bismuth	NG	NG
Cadmium	0.6	0.7
Calcium	NG	NG
Chromium	37.3	52.3
Cobalt	NG	NG
Copper	35.7	18.7
Iron	NG	NG
Lead	35.0	30.2
Magnesium	NG	NG
Manganese	NG	NG
Mercury	0.17	0.13
Molybdenum	NG	NG
Nickel	NG	NG
Phosphorus	NG	NG
Potassium	NG	NG
Selenium	NG	NG
Silver	NG	NG
Sodium	NG	NG
Strontium	NG	NG
Thallium	NG	NG
Tin	NG	NG
Titanium	NG	NG
Vanadium	NG	NG
Zinc	123	124

APPENDIX C

Summary of Estimated Reclamation Costs – Option 1

TABLE C1: SUMMARY OF ESTIMATED RECLAMATION COST - ROBERTS BAY & IDA BAY ABANDONED SILVER MINE
OPTION 1 - PRIMARILY WINTER EARTHWORKS

Capital Costs		
COMPONENT TYPE		**TOTAL COST**
UNDERGROUND MINE - SECURE ADITS & RAISE		$141,510
TAILINGS		$67,840
BUILDINGS AND EQUIPMENT		$156,630
HAZARDOUS MATERIALS AND SOIL CONTAMINATION		$591,055
MOBILIZATION/DEMOBILIZATION/STANDBY COSTS		$1,960,698
SITE ADMINISTRATION AND MAINTENANCE DURING REMEDIATION		$596,017
SUBTOTAL		**$3,513,750**
PROJECT MANAGEMENT & SUPERVISION	5 % of subtotal	$175,687
ENGINEERING	5 % of subtotal	$175,687
CONTINGENCY	15 % of subtotal	$527,062
GRAND TOTAL - CAPITAL COSTS		**$4,392,187**
POST-CLOSURE MONITORING COST (NPV at 3%)		$316,472
POST-CLOSURE MONITORING CONTINGENCY 15%		$43,750
YEARS OF POST CLOSURE MONITORING	25	
POST CLOSURE MONITORING COST OVER 25 YEARS (NPV at 3%)		$360,222
GRAND TOTAL CAPITAL AND POST-CLOSURE COSTS		**$4,752,409**

1 Table C2: Underground Mine Adits and Raises *1*

	ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
	ROBERTS BAY MINE SITE				
A1	BACKFILL 2 ADITS WITH NAG + BLAST BROW + FILL DEPRESSION				
.	Front End Loader	operating hours	72	160	$11,520
	Haul Truck	operating hours	72	160	$11,520
	Air Trac Drill	operating hours	72	135	$9,720
	Air Compressor	operating hours	72	75	$5,400
	Drill bits & steel	allowance	1	3500	$3,500
	Explosives	allowance	1	2500	$2,500
	Dozer	operating hours	24	210	$5,040
	Miscellaneous Labour	person-hours	72	50	$3,600
A2	SEAL VENTILATION RAISE				
	Purchase of Precast concrete cap	each	1	10000	$10,000
	Freight to ship pre-cast cap				
	Road Freight Edmonton to Hay River	ton	10	125	$1,250
	Barging Cost to Roberts Bay	ton	10	648	$6,480
	Place concrete cap				
	Front End Loader	operating hours	24	160	$3,840
	Labour	person-hours	24	50	$1,200
	Bury concrete cap under waste rock				
	Front End Loader	operating hours	12	160	$1,920
	Haul Truck	operating hours	12	160	$1,920
	Dozer	operating hours	2	210	$420
	IDA BAY SITE				
B1	BACKFILL ADIT + VENT RAISE + BLAST BROW+ FILL DEPRESSION				
	Front End Loader	operating hours	24	160	$3,840
	Haul Truck	operating hours	24	160	$3,840
	Air Trac Drill	operating hours	48	135	$6,480
	Air Compressor	operating hours	48	75	$3,600
	Drill bits & steel	allowance	1	3500	$3,500
	Explosives	allowance	1	2500	$2,500
	Dozer	operating hours	4	210	$840
	Miscellaneous Labour	person-hours	48	50	$2,400
B2	BACKFILL NAG ROCK				
	Excavator	operating hours	12	160	$1,920
	Front End Loader	operating hours	12	160	$1,920
	Haul Truck	operating hours	12	160	$1,920
B3	BACKFILL EXPLORATION TRENCHES				
	Front End Loader	operating hours	24	160	$3,840
	Haul Truck	operating hours	24	160	$3,840
	Dozer	operating hours	4	210	$840
B4	MOVE REMAINING NAG WASTE ROCK TO ROBERTS BAY				
	Front End Loader	operating hours	48	160	$7,680
.	Haul Truck	operating hours	48	160	$7,680
B5	REGRADE IDA BAY SITE				
	Dozer	operating hours	24	210	$5,040

1 Table C2: Underground Mine Adits and Raises *1*

ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
Subtotal				$141,510

COMMENTS:

Total Labour Input **person-hours**

	Year 1	Year 2	Year 3
HE Operator		670	
General Labour		144	
Total Labour		814	

1 Table C3: Roberts Bay Site Tailings Impoundment *1*

	ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
A	REMOVE SUPERNATANT POND				
A1	Drain the Tailings Pond Supernatant				
A1A	Install pump and hose to transfer supernatant into the Adit				
	Rental of pump and hose	month	2	500	$1,000
	Rental of Diesel generator & Fuel Tank	month	2	1000	$2,000
	Air Freight for pump to and from site	allowance	1	5000	
	Labour to set up & dismantle pumping system	person-hours	24	70	$1,680
A1B	Pump supernatant into the vent raise				
	Labour to operate pump	person-hours	28	70	$1,960
A2	Haul and place 2 m thick rockfill cover over tailings surface	m^3	650		
	Front end loader	operating-hours	120	160	$19,200
	Haul Truck	operating-hours	120	160	$19,200
	Dozer	operating-hours	48	210	$10,080
A3	Stabilize Tailings Pond Berm by Placing Additional Waste Rock	m^3	150		
	Front end loader	operating-hours	24	160	$3,840
	Haul Truck	operating-hours	24	160	$3,840
	Dozer	operating-hours	24	210	$5,040
	Subtotal				$67,840

COMMENTS:

Total Labour Input **person-hours**

	Year 1	Year 2	Year 3
HE Operator		360	
General Labour	24		
Total Labour	24	360	

1 **Table C4: Building / Equipment** ***1***

	ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
A	DEMOLISH STRUCTURES - ROBERTS BAY SITE				
A1	Demolish Adit Cover Building				
	Labour	person-hours	48	50	$2,400
	Materials (cutting torches, compressed gas, etc.)	allowance	1	500	$500
	Truck	operating hours	12	160	$1,920
	Loader	operating hours	12	160	$1,920
	Dozer	operating hours	4	210	$840
A2	Demolish Mill Building & Fresh Water Pumphouse				
	Labour	person-hours	672	50	$33,600
	Materials (cutting torches, compressed gas, etc.)	allowance	1	2500	$2,500
	Truck	operating hours	24	160	$3,840
	Loader	operating hours	24	160	$3,840
	Dozer	operating hours	6	210	$1,260
A3	Demolish Coarse Ore Hopper Structure				
	Labour	person-hours	48	50	$2,400
	Materials (cutting torches, compressed gas, etc.)	allowance	1	500	$500
	Truck	operating hours	6	160	$960
	Loader	operating hours	6	160	$960
	Dozer	operating hours	6	210	$1,260
A6	Demolish Assay Building				
	Labour	person-hours	96	50	$4,800
	Materials (cutting torches, compressed gas, etc.)	allowance	1	500	$500
	Truck	operating hours	6	160	$960
	Loader	operating hours	6	160	$960
	Dozer	operating hours	2	210	$420
A7	Demolish Reagent Storage Building				
	Labour	person-hours	96	50	$4,800
	Materials (cutting torches, compressed gas, etc.)	allowance	1	500	$500
	Truck	operating hours	6	160	$960
	Loader	operating hours	6	160	$960
	Dozer	operating hours	2	210	$420
B	SITE CLEAN UP - ROBERTS BAY SITE				
B1	Clean up old camp area including capping of landfill				
	Labour	person-hours	96	50	$4,800
	Materials (cutting torches, compressed gas, etc.)	allowance	1	500	$500
	Truck	operating hours	24	160	$3,840
	Loader	operating hours	24	160	$3,840
	Dozer	operating hours	12	210	$2,520
B2	Clean up Adit, Garage, Fuel Bladder area				
	Labour	person-hours	48	50	$2,400
	Materials (cutting torches, compressed gas, etc.)	allowance	1	250	$250
	Truck	operating hours	6	160	$960
	Loader	operating hours	6	160	$960
	Dozer	operating hours	6	210	$1,260
B3	Clean up of Mill, Assay Lab area				

1 **Table C4: Building / Equipment** *1*

	ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
	Labour	person-hours	48	50	$2,400
	Materials (cutting torches, compressed gas, etc.)	allowance	1	250	$250
	Truck	operating hours	6	160	$960
	Loader	operating hours	6	160	$960
	Dozer	operating hours	6	210	$1,260
C	SITE CLEANUP - IDA BAY SITE				
	Labour	person-hours	48	0	$0
	Materials (cutting torches, compressed gas, etc.)	allowance	1	250	$250
	Truck	operating hours	6	160	$960
	Loader	operating hours	6	160	$960
	Dozer	operating hours	6	210	$1,260
D	DRAIN AND REMOVE FUEL BLADDERS				
.	Labour	person-hours	72	50	$3,600
.	Materials (Drums, pumps, hoses, etc.)	allowance	1	2500	$2,500
.	Support Equipment	allowance	1	1500	$1,500
.					
E	BURY DEMOLITION WASTE IN TAILINGS POND				
E1	Bury Debris in Tailings Pond				
	Excavator/backhoe	operating hours	24	160	$3,840
	Dozer	operating hours	6	210	$1,260
E2	Place rockfill cover (min 2 m thick - thicker over demolition debris)				
	Loader	operating hours	48	160	$7,680
	Truck	operating hours	48	160	$7,680
	Dozer	operating hours	12	210	$2,520
E3	Grade landfill cover				
	Dozer	operating hours	12	210	$2,520
F	GRADE AND CONTOUR SITE				
.	Dozer	operating hours	24	210	$5,040
G	RECLAIM ROADS				
	Loader	operating hours	12	160	$1,920
.	Truck	operating hours	12	160	$1,920
.	Dozer	operating hours	48	210	$10,080
	Subtotal				$156,630

COMMENTS:

1 **Table C4: Building / Equipment** ***1***

ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST

Total Labour Input **person-hours**

	Year 1	Year 2	Year 3
HE Operator		0	464
General Labour		960	312
Total Labour		960	776

1 TABLE C5: Hazardous Materials and Soil Contamination: *1*

	ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
A	COLLECTION & PACKAGING OF HAZARDOUS MATERIALS FOR SHIPMENT				
.	Labour to collect hazardous waste and re-package	person-days	480	50	$24,000
	Purchase of Hazardous Waste Drums and Overpacks	each	50	75	$3,750
	Road Freight Edmonton to Yellowknife	allowance	1	2500	$2,500
	Air Freight to Site	allowance	1	40000	$40,000
B	TRANSPORTATION OF HAZARDOUS MATERIAL OFF-SITE				
	Purchase of Six shipping containers	each	6	1000	$6,000
	Barge Freight to Hay River	ton	20	648	$12,960
	Truck Freight to Disposal Site	ton	20	500	$10,000
	Hazardous Material - liquids	litre	4755		
	Hazardous Material - solids	Kg	4083		
	Lead painted steel equipment	Kg	11000		
B	DISPOSAL OF HAZARDOUS WASTE				
.	PCB, disposal (3 electrical capacitors labelled as PCB Containing) - Swan Hills Alberta	Kg	30		$750
	PCB containing transformer ballasts (7 units) - Swan Hills	Kg	28		$750
	Lead Batteries Swan Hills Alberta (1 drum + 3 vehicle batteries	Kg	375		$500
	Asbestos insulated cabinet (1)	Kg	250		
	Asbestos Brake Pad	Kg	5		$500
	Waste Oil	litre	1060	1	$1,060
	Liquid remaining in fuel bladder	litre	300	1	$300
	Used Oil Filters	Kg	15		$250
	Glycol	litre	205	1	$205
	Waste Gasoline	litre	80	1	$80
	Propane and compressed gas cylinders	each	9		$100
.	Turbo Jet Fuel - Type B (dated 1998) - 14 drums	litre	3100	1	$3,100
	Unknown liquids in drums	litre	3065	2	$6,130
	Lead contaminated Steel	tons	12.1	200	$2,420
.					
G	CONTAMINATED SOILS				
.	Petroleum & Metal Contaminated Soil	m3	390		
G1	Excavate & Place in Sacks				
	Purchase of supersacks	each	400	25	$10,000
	Excavator	operating hours	400	160	$64,000
	Labour	person-hours	500	50	$25,000
	Barge Freight Roberts Bay to Hay River	ton	400	648	$259,200
	Road Freight Yellowknife to Edmonton	ton	400	150	$60,000
	Disposal Cost at Swan Hills, Alberta	ton	400	125	$50,000
H	Haz. Mat. testing & assessment				
.	Allowance for ID Lab Testing prior to disposal	allowance	1	7500	$7,500
.					
	Subtotal				$591,055

1 TABLE C5: Hazardous Materials and Soil Contamination: *1*

ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST

COMMENTS:

Total Labour Input	person-hours		
	Year 1	Year 2	Year 3
HE Operator			400
General Labour		480	500
Total Labour		480	900

1 TABLE C6: Mobilization/DeMobilization/Standby Costs *1*

	ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
A	MOBILIZE HEAVY EQUIPMENT TO HAY RIVER				
	Tracked Excavator	ton	6	125	$811
	Rubber Tired Backhoe/Loader	ton	10	125	$1,294
	5 Ton Dump Truck	ton	7	125	$844
	Small Tracked Dozer - Cat D4	ton	7	125	$923
	ATV with trailer (Two)	ton	2	125	$250
	Rotary Air-Trac Drill	ton	7	125	$875
	Portable Air Compressor for Drill	ton	10	125	$1,250
	Diesel Gensets	ton	10	125	$1,250
	Pumps and hoses	ton	1	125	$125
	Contractor Overheads & Preparation Labour	allowance	1	10000	$10,000
B	BARGE FREIGHT TO ROBERTS BAY				
	Tracked Excavator	ton	6	648	$4,205
	Rubber Tired Backhoe/Loader	ton	10	648	$6,707
	5 Ton Dump Truck	ton	7	648	$4,374
	Small Tracked Dozer - Cat D4	ton	7	648	$4,782
	ATV with trailer (Two)	ton	2	648	$1,296
	Rotary Air-Trac Drill	ton	7	648	$4,536
	Portable Air Compressor for Drill	ton	10	648	$6,480
	Diesel Gensets	ton	10	648	$6,480
	Pumps and hoses	ton	1	648	$648
C	CONSTRUCT WINTER ROAD & MOVE EQUIPMENT				
	Construct winter road to site	person-hours	168	60	$10,080
	Move equipment to Site from barge loading area	person-hours	168	60	$10,080
	Helicopter Support during activity	operating hours	70	1500	$105,000
	Miscellanous cost	allowance	1	7500	$7,500
D	PURCHASE & MOBILIZE CAMP				
	Small Diesel Power Generator	rental -month	18	1000	$18,000
	Self bermed Diesel Fuel Tank	rental-month	18	250	$4,500
	Weatherhaven Tent for Sleeping Accommodation	each	6	2500	$15,000
	Kitchen Tent	each	1	5000	$5,000
	Washroom Tent	each	1	3000	$3,000
	Other Camp equipment	allowance	1	15000	$15,000
	Lumber, Piping, Electrics for camp set up	allowance	1	20000	$20,000
	Labour to set up camp	person-hours	672	60	$40,320
	Labour to dismantle camp	person-hours	336	50	$16,800
E	MOBILIZE WORKERS				
.	Allowance for air charters from Cambridge Bay	trips	48	7500	$360,000
	Allowance for Air Travel between the south and Cambridge Bay by commercial carrier	trips	60	1000	$60,000
	Hotel and meals in Cambridge Bay	nights	60	200	$12,000
F	EQUIPMENT STANDBY COSTS				
	Tracked Excavator	month	22	7500	$165,000
	Rubber Tired Backhoe/Loader	month	22	7500	$165,000
	5 Ton Dump Truck	month	22	7500	$165,000
	Small Tracked Dozer - Cat D4	month	22	10000	$220,000
	ATV with trailer (Two)	month	22	750	$16,500

1 TABLE C6: Mobilization/DeMobilization/Standby Costs *1*

	ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
	Rotary Air-Trac Drill	month	22	5000	$110,000
	Portable Air Compressor for Drill	month	22	5000	$110,000
G	MOBILIZE MISC. SUPPLIES				
.	Fuel & lubricants	litres	20000	7730	$10,000
.	Minor tools and equipment	allowance	1	10000	$50,000
H	CONSTRUCT WINTER ROAD & MOVE EQUIPMENT				
	Construct winter road to barge site	person-hours	168	60	$10,080
	Move equipment to Barge Site loading area	person-hours	168	60	$10,080
	Helicopter Support during activity	operating hours	70	1500	$105,000
	Miscellanous cost	allowance	1	7500	$7,500
I	BARGING COST TO MOVE EQUIPMENT TO HAY RIVER				
	Tracked Excavator	ton	6	648	$4,205
	Rubber Tired Backhoe/Loader	ton	10	648	$6,707
	5 Ton Dump Truck	ton	7	648	$4,374
	Small Tracked Dozer - Cat D4	ton	7	648	$4,782
	ATV with trailer (Two)	ton	2	648	$1,296
	Rotary Air-Trac Drill	ton	7	648	$4,536
	Portable Air Compressor for Drill	ton	10	648	$6,480
	Diesel Gensets	ton	10	648	$6,480
	Pumps and hoses	ton	1	648	$648
J	FREIGHT TO DEMOBILIZE EQUIPMENT TO EDMONTON				
	Tracked Excavator	ton	6	125	$811
	Rubber Tired Backhoe/Loader	ton	10	125	$1,294
	5 Ton Dump Truck	ton	7	125	$844
	Small Tracked Dozer - Cat D4	ton	7	125	$923
	ATV with trailer (Two)	ton	2	125	$250
	Rotary Air-Trac Drill	ton	7	125	$875
	Portable Air Compressor for Drill	ton	10	125	$1,250
	Diesel Gensets	ton	10	125	$1,250
	Pumps and hoses	ton	1	125	$125
	Contractor Overheads & Administration	allowance	1	10000	$10,000
	Subtotal				$1,960,698

COMMENTS:
Due to High Standby Cost for Equipment it may be more economic to purchase equipment and then resell it at end of project. Total project spans over 28 months, of which 22 months are stand-by time (including mob/demob time to Hay River, NWT).

Total Labour Input **person-hours**

Year 1 **Year 2** **Year 3**

1 TABLE C6: Mobilization/DeMobilization/Standby Costs *1*

ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
HE Operator				
General Labour	1008			
Total Labour	1008			

1 **TABLE C7: SITE ADMINISTRATION AND OPERATING & MAINTENANCE COST DURING REMEDIATION**

Mon / Mtce # *1*

	ACTIVITY/MATERIAL	UNITS	QUANTITY IN YEAR 1	QUANTITY IN YEAR 2	QUANTITY IN YEAR 3	UNIT COST	COST
A	SITE ADMINISTRATION & OPERATING COST						
	Camp Cost - Food and Accommodation	person-day	299	308	3	$100	$61,017
	Communications to and from site	per month	3	4	1	$2,500	$20,000
	Camp Generator Cost - fuel & lubes	litres		20000		$1	$20,000
	Helicopter Support between Roberts and Ida Bay	operating hours	252	50	28	$1,500	$495,000
B	SITE MAINTENANCE COST						
	Maintenance Labour	person- hours	160	840	$40	70	$72,800
	Maintenance Supplies	allowance	2000	10000	$2,000		$14,000
	Subtotal						$596,017

COMMENTS:

1 **TABLE C8: POST-CLOSURE MONITORING** **Mon / Mtce #** *1*

Post Closure Monitoring & Maintenance	NPV at 3%	Reclamation Period		Post Closure																									
		Year 1	Year 2	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Sum
# of Site Visits		2	2	1	1	1	1	1					1					1					1					1	
Monitoring Labour	$33,498	$6,000	$6,000	$3,000	$3,000	$3,000	$3,000	$3,000					$3,000					$3,000					$3,000					$3,000	$39,000
Monitoring Supplies & Equipment	$2,122	$380	$380	$190	$190	$190	$190	$190					$190					$190					$190					$190	$2,470
Transportation to and from Site	$73,392	$0	$0	$10,000	$10,000	$10,000	$10,000	$10,000					$10,000					$10,000					$10,000					$10,000	$90,000
Analytical Costs	$21,216	$3,800	$3,800	$1,900	$1,900	$1,900	$1,900	$1,900					$1,900					$1,900					$1,900					$1,900	$24,700
Transportation of Samples to Lab	$2,792	$500	$500	$250	$250	$250	$250	$250					$250					$250					$250					$250	$3,250
Geotechnical Inspections/Other Studies	$138,789	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000					$15,000					$15,000					$15,000					$15,000	$165,000
Annual Reporting	$44,664	$8,000	$8,000	$4,000	$4,000	$4,000	$4,000	$4,000					$4,000					$4,000					$4,000					$4,000	$52,000
Sub-Total	**$316,472**	**$33,680**	**$33,680**	**$34,340**	**$34,340**	**$34,340**	**$34,340**	**$34,340**					**$34,340**					**$34,340**					**$34,340**					**$34,340**	**$376,420**
Contingency Allowance (15%)	$43,750	$5,052	$5,052	$5,151	$5,151	$5,151	$5,151	$5,151					$5,151					$5,151					$5,151					$5,151	$51,312
Total	**$360,222**	**$38,732**	**$38,732**	**$39,491**	**$39,491**	**$39,491**	**$39,491**	**$39,491**					**$39,491**					**$39,491**					**$39,491**					**$39,491**	**$393,392**

Analytical Costs	Cost per Sample#
Assay Set Ref #4	$190

Appendix D
Summary of Estimated Reclamation Costs – Option 2

TABLE D1: SUMMARY OF ESTIMATED RECLAMATION COST - ROBERTS BAY & IDA BAY ABANDONED SILVER MINE SITES
OPTION 2 - BOTH SUMMER AND WINTER EARTHWORKS

Capital Costs		
COMPONENT TYPE		**TOTAL COST**
UNDERGROUND MINE - SECURE ADITS & RAISE		$133,970
TAILINGS		$67,840
BUILDINGS AND EQUIPMENT		$156,630
HAZARDOUS MATERIALS AND SOIL CONTAMINATION		$591,055
MOBILIZATION/DEMOBILIZATION/STANDBY COSTS		$1,946,298
SITE ADMINISTRATION AND MAINTENANCE DURING REMEDIATION		$595,717
SUBTOTAL		**$3,491,510**
PROJECT MANAGEMENT & SUPERVISION	5 % of subtotal	$174,575
ENGINEERING	5 % of subtotal	$174,575
CONTINGENCY	15 % of subtotal	$523,726
GRAND TOTAL - CAPITAL COSTS		**$4,364,387**
POST-CLOSURE MONITORING COST (NPV at 3%)		$316,472
POST-CLOSURE MONITORING CONTINGENCY 15%		$43,750
YEARS OF POST CLOSURE MONITORING	25	
POST CLOSURE MONITORING COST OVER 25 YEARS (NPV at 3%)		$360,222
GRAND TOTAL CAPITAL AND POST-CLOSURE COSTS		**$4,724,609**

1 Table D2: Underground Mine Adits and Raises 1

	ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
	ROBERTS BAY SITE				
A1	BACKFILL 2 ADITS WITH WR + BLAST BROW + FILL DEPRESSION				
.	Front End Loader	operating hours	72	160	$11,520
	Haul Truck	operating hours	72	160	$11,520
	Air Trac Drill	operating hours	72	135	$9,720
	Air Compressor	operating hours	72	75	$5,400
	Drill bits & steel	allowance	1	3500	$3,500
	Explosives	allowance	1	2500	$2,500
	Dozer	operating hours	24	210	$5,040
	Miscellaneous Labour	person-hours	72	50	$3,600
A2	SEAL VENTILATION RAISE				
	Purchase of Precast concrete cap	each	1	7500	$7,500
	Freight to ship pre-cast cap				
	Road Freight Edmonton to Hay River	ton	10	125	$1,250
	Barging Cost to Roberts Bay	ton	10	648	$6,480
	Place concrete cap				
	Front End Loader	operating hours	24	160	$3,840
	Labour	person-hours	24	50	$1,200
	Bury concrete cap under waste rock				
	Front End Loader	operating hours	12	160	$1,920
	Haul Truck	operating hours	12	160	$1,920
	Dozer	operating hours	2	210	$420
	IDA BAY SITE				
B1	BACKFILL ADIT + VENT RAISE + BLAST BROW+ FILL DEPRESSION				
	Front End Loader	operating hours	24	160	$3,840
	Haul Truck	operating hours	24	160	$3,840
	Air Trac Drill	operating hours	48	135	$6,480
	Air Compressor	operating hours	48	75	$3,600
	Drill bits & steel	allowance	1	3500	$3,500
	Explosives	allowance	1	2500	$2,500
	Dozer	operating hours	4	210	$840
	Miscellaneous Labour	person-hours	48	50	$2,400
B2	BACKFILL NAG ROCK				
	Excavator	operating hours	12	160	$1,920
	Front End Loader	operating hours	12	160	$1,920
	Haul Truck	operating hours	12	160	$1,920
B3	BACKFILL EXPLORATION TRENCHES				
	Front End Loader	operating hours	24	160	$3,840
	Haul Truck	operating hours	24	160	$3,840
	Dozer	operating hours	4	210	$840
B4	MOVE REMAINING NAG ROCK TO ROBERTS BAY				
	Front End Loader	operating hours	48	160	$7,680
.	Haul Truck	operating hours	48	160	$7,680
B5	REGRADE IDA BAY SITE				
	Dozer	operating hours	12	210	$2,520
	Subtotal				$133,970

1 Table D2: Underground Mine Adits and Raises *1*

ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST

COMMENTS:

Total Labour Input **person-hours**

	Year 1	Year 2	Year 3
HE Operator	296	290	
General Labour	48	96	
Total Labour	344	386	

1 Table D3: Roberts Bay Site Tailings Impoundment *1*

	ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
A	REMOVE SUPERNATANT POND				
A1	Drain the Tailings Pond Supernatant				
A1A	Install pump and hose to transfer supernatant into the Adit				
	Rental of pump and hose	month	2	500	$1,000
	Rental of Diesel generator & Fuel Tank	month	2	1000	$2,000
	Air Freight for pump to and from site	allowance	1	5000	
	Labour to set up & dismantle pumping system	person-hours	24	70	$1,680
A1B	Pump supernatant into the vent raise				
	Labour to operate pump	person-hours	28	70	$1,960
A2	Haul and place 2 m thick rockfill cover over tailings surface	m^3	650		
	Front end loader	operating-hours	120	160	$19,200
	Haul Truck	operating-hours	120	160	$19,200
	Dozer	operating-hours	48	210	$10,080
A3	Stabilize Tailings Pond Berm by Placing additional Rockfill	m^3	150		
	Front end loader	operating-hours	24	160	$3,840
	Haul Truck	operating-hours	24	160	$3,840
	Dozer	operating-hours	24	210	$5,040
	Subtotal				$67,840

COMMENTS:

Total Labour Input **person-hours**

	Year 1	Year 2	Year 3
HE Operator		360	
General Labour	24		
Total Labour	24	360	

1 **Table D4: Building / Equipment** *1*

	ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
A	DEMOLISH STRUCTURES - ROBERTS BAY SITE				
A1	Demolish Adit Cover Building				
	Labour	person-hours	48	50	$2,400
	Materials (cutting torches, compressed gas, etc.)	allowance	1	500	$500
	Truck	operating hours	12	160	$1,920
	Loader	operating hours	12	160	$1,920
	Dozer	operating hours	4	210	$840
A2	Demolish Mill Building & Fresh Water Pumphouse				
	Labour	person-hours	672	50	$33,600
	Materials (cutting torches, compressed gas, etc.)	allowance	1	2500	$2,500
	Truck	operating hours	24	160	$3,840
	Loader	operating hours	24	160	$3,840
	Dozer	operating hours	6	210	$1,260
A3	Demolish Coarse Ore Hopper Structure				
	Labour	person-hours	48	50	$2,400
	Materials (cutting torches, compressed gas, etc.)	allowance	1	500	$500
	Truck	operating hours	6	160	$960
	Loader	operating hours	6	160	$960
	Dozer	operating hours	6	210	$1,260
A6	Demolish Assay Building				
	Labour	person-hours	96	50	$4,800
	Materials (cutting torches, compressed gas, etc.)	allowance	1	500	$500
	Truck	operating hours	6	160	$960
	Loader	operating hours	6	160	$960
	Dozer	operating hours	2	210	$420
A7	Demolish Reagent Storage Building				
	Labour	person-hours	96	50	$4,800
	Materials (cutting torches, compressed gas, etc.)	allowance	1	500	$500
	Truck	operating hours	6	160	$960
	Loader	operating hours	6	160	$960
	Dozer	operating hours	2	210	$420
B	SITE CLEAN UP - ROBERTS BAY SITE				
B1	Clean up old camp area including capping of landfill				
	Labour	person-hours	96	50	$4,800
	Materials (cutting torches, compressed gas, etc.)	allowance	1	500	$500
	Truck	operating hours	24	160	$3,840
	Loader	operating hours	24	160	$3,840
	Dozer	operating hours	12	210	$2,520
B2	Clean up Adit, Garage, Fuel Bladder area				
	Labour	person-hours	48	50	$2,400
	Materials (cutting torches, compressed gas, etc.)	allowance	1	250	$250
	Truck	operating hours	6	160	$960
	Loader	operating hours	6	160	$960
	Dozer	operating hours	6	210	$1,260
B3	Clean up of Mill, Assay Lab area				

1 **Table D4: Building / Equipment** *1*

	ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
	Labour	person-hours	48	50	$2,400
	Materials (cutting torches, compressed gas, etc.)	allowance	1	250	$250
	Truck	operating hours	6	160	$960
	Loader	operating hours	6	160	$960
	Dozer	operating hours	6	210	$1,260
C	SITE CLEANUP - IDA BAY SITE				
	Labour	person-hours	48	0	$0
	Materials (cutting torches, compressed gas, etc.)	allowance	1	250	$250
	Truck	operating hours	6	160	$960
	Loader	operating hours	6	160	$960
	Dozer	operating hours	6	210	$1,260
D	DRAIN AND REMOVE FUEL BLADDERS				
.	Labour	person-hours	72	50	$3,600
.	Materials (Drums, pumps, hoses, etc.)	allowance	1	2500	$2,500
.	Support Equipment	allowance	1	1500	$1,500
.					
E	BURY DEMOLITION WASTE IN TAILINGS POND				
E1	Bury Debris in Tailings Pond				
	Excavator/backhoe	operating hours	24	160	$3,840
	Dozer	operating hours	6	210	$1,260
E2	Place rockfill cover (min 2 m thick - thicker over demolition debris)				
	Loader	operating hours	48	160	$7,680
	Truck	operating hours	48	160	$7,680
	Dozer	operating hours	12	210	$2,520
E3	Grade landfill cover				
	Dozer	operating hours	12	210	$2,520
F	GRADE AND CONTOUR SITE				
.	Dozer	operating hours	24	210	$5,040
G	RECLAIM ROADS				
	Loader	operating hours	12	160	$1,920
.	Truck	operating hours	12	160	$1,920
.	Dozer	operating hours	48	210	$10,080
	Subtotal				$156,630

COMMENTS:

1 **Table D4: Building / Equipment** *1*

ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST

Total Labour Input **person-hours**

	Year 1	Year 2	Year 3
HE Operator		0	464
General Labour		1008	264
Total Labour		1008	728

1 TABLE D5: Hazardous Materials and Soil Contamination: *1*

	ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
A	COLLECTION & PACKAGING OF HAZARDOUS MATERIALS FOR SHIPMENT				
.	Labour to collect hazardous waste and re-package	person-days	480	50	$24,000
	Purchase of Hazardous Waste Drums and Overpacks	each	50	75	$3,750
	Road Freight Edmonton to Yellowknife	allowance	1	2500	$2,500
	Air Freight to Site	allowance	1	40000	$40,000
B	TRANSPORTATION OF HAZARDOUS MATERIAL OFF-SITE				
	Purchase of Six shipping containers	each	6	1000	$6,000
	Barge Freight to Hay River	ton	20	648	$12,960
	Truck Freight to Disposal Site	ton	20	500	$10,000
	Hazardous Material - liquids	litre	4755		
	Hazardous Material - solids	Kg	4083		
	Lead painted steel equipment	Kg	11000		
B	DISPOSAL OF HAZARDOUS WASTE				
.	PCB, disposal (3 electrical capacitors labelled as PCB Containing) - Swan Hills Alberta	Kg	30		$750
	PCB containing transformer ballasts (7 units) - Swan Hills	Kg	28		$750
	Lead Batteries Swan Hills Alberta (1 drum + 3 vehicle batteries	Kg	375		$500
	Asbestos insulated cabinet (1)	Kg	250		
	Asbestos Brake Pad	Kg	5		$500
	Waste Oil	litre	1060	1	$1,060
	Liquid remaining in fuel bladder	litre	300	1	$300
	Used Oil Filters	Kg	15		$250
	Glycol	litre	205	1	$205
	Waste Gasoline	litre	80	1	$80
	Propane and compressed gas cylinders	each	9		$100
.	Turbo Jet Fuel - Type B (dated 1998) - 14 drums	litre	3100	1	$3,100
	Unknown liquids in drums	litre	3065	2	$6,130
	Lead contaminated Steel	tons	12.1	200	$2,420
.					
G	CONTAMINATED SOILS				
.	Petroleum & Metal Contaminated Soil	m3	390		
G1	Excavate & Place in Sacks				
	Purchase of supersacks	each	400	25	$10,000
	Excavator	operating hours	400	160	$64,000
	Labour	person-hours	500	50	$25,000
	Barge Freight Roberts Bay to Hay River	ton	400	648	$259,200
	Road Freight Yellowknife to Edmonton	ton	400	150	$60,000
	Disposal Cost at Swan Hills, Alberta	ton	400	125	$50,000
H	Haz. Mat. testing & assessment				
.	Allowance for ID Lab Testing prior to disposal	allowance	1	7500	$7,500
.					
	Subtotal				$591,055

1 TABLE D5: Hazardous Materials and Soil Contamination: *1*

ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST

COMMENTS:

Total Labour Input **person-hours**

	Year 1	Year 2	Year 3
HE Operator			400
General Labour		480	500
Total Labour		480	900

1 TABLE D6: Mobilization/DeMobilization/Standby Costs *1*

	ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
A	MOBILIZE HEAVY EQUIPMENT TO HAY RIVER				
	Tracked Excavator	ton	6	125	$811
	Rubber Tired Backhoe/Loader	ton	10	125	$1,294
	5 Ton Dump Truck	ton	7	125	$844
	Small Tracked Dozer - Cat D4	ton	7	125	$923
	ATV with trailer (Two)	ton	2	125	$250
	Rotary Air-Trac Drill	ton	7	125	$875
	Portable Air Compressor for Drill	ton	10	125	$1,250
	Diesel Gensets	ton	10	125	$1,250
	Pumps and hoses	ton	1	125	$125
	Contractor Overheads & Preparation Labour	allowance	1	10000	$10,000
B	BARGE FREIGHT TO Ida BAY				
	Tracked Excavator	ton	6	648	$4,205
	Rubber Tired Backhoe/Loader	ton	10	648	$6,707
	5 Ton Dump Truck	ton	7	648	$4,374
	Small Tracked Dozer - Cat D4	ton	7	648	$4,782
	ATV with trailer (Two)	ton	2	648	$1,296
	Rotary Air-Trac Drill	ton	7	648	$4,536
	Portable Air Compressor for Drill	ton	10	648	$6,480
	Diesel Gensets	ton	10	648	$6,480
	Pumps and hoses	ton	1	648	$648
C	CONSTRUCT WINTER ROAD & MOVE EQUIPMENT				
	Construct winter road to site	person-hours	48	60	$2,880
	Move equipment to Site from barge loading are	person-hours	168	60	$10,080
	Helicopter Support during activity	operating hours	70	1500	$105,000
	Miscellanous cost	allowance	1	7500	$7,500
D	PURCHASE & MOBILIZE CAMP				
	Small Diesel Power Generator	rental -month	18	1000	$18,000
	Self bermed Diesel Fuel Tank	rental-month	18	250	$4,500
	Weatherhaven Tent for Sleeping Accommodati	each	6	2500	$15,000
	Kitchen Tent	each	1	5000	$5,000
	Washroom Tent	each	1	3000	$3,000
	Other Camp equipment	allowance	1	15000	$15,000
	Lumber, Piping, Electrics for camp set up	allowance	1	20000	$20,000
	Labour to set up camp	person-hours	672	60	$40,320
	Labour to dismantle camp	person-hours	336	50	$16,800
E	MOBILIZE WORKERS				
.	Allowance for air charters from Cambridge Bay	trips	48	7500	$360,000
	Allowance for Air Travel between the south and Cambridge Bay by commercial carrier	trips	60	1000	$60,000
	Hotel and meals in Cambridge Bay	nights	60	200	$12,000
F	EQUIPMENT STANDBY COSTS				
	Tracked Excavator	month	22	7500	$165,000
	Rubber Tired Backhoe/Loader	month	22	7500	$165,000
	5 Ton Dump Truck	month	22	7500	$165,000
	Small Tracked Dozer - Cat D4	month	22	10000	$220,000
	ATV with trailer (Two)	month	22	750	$16,500

1 TABLE D6: Mobilization/DeMobilization/Standby Costs *1*

	ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
	Rotary Air-Trac Drill	month	22	5000	$110,000
	Portable Air Compressor for Drill	month	22	5000	$110,000
G	MOBILIZE MISC. SUPPLIES				
.	Fuel & lubricants	litres	20000	7730	$10,000
.	Minor tools and equipment	allowance	1	10000	$50,000
H	CONSTRUCT WINTER ROAD & MOVE EQUIPMENT				
	Construct winter road to barge site	person-hours	48	60	$2,880
	Move equipment to Barge Site loading area	person-hours	168	60	$10,080
	Helicopter Support during activity	operating hours	70	1500	$105,000
	Miscellanous cost	allowance	1	7500	$7,500
I	BARGING COST TO MOVE EQUIPMENT TO HAY RIVER				
	Tracked Excavator	ton	6	648	$4,205
	Rubber Tired Backhoe/Loader	ton	10	648	$6,707
	5 Ton Dump Truck	ton	7	648	$4,374
	Small Tracked Dozer - Cat D4	ton	7	648	$4,782
	ATV with trailer (Two)	ton	2	648	$1,296
	Rotary Air-Trac Drill	ton	7	648	$4,536
	Portable Air Compressor for Drill	ton	10	648	$6,480
	Diesel Gensets	ton	10	648	$6,480
	Pumps and hoses	ton	1	648	$648
J	FREIGHT TO DEMOBILIZE EQUIPMENT TO EDMONTON				
	Tracked Excavator	ton	6	125	$811
	Rubber Tired Backhoe/Loader	ton	10	125	$1,294
	5 Ton Dump Truck	ton	7	125	$844
	Small Tracked Dozer - Cat D4	ton	7	125	$923
	ATV with trailer (Two)	ton	2	125	$250
	Rotary Air-Trac Drill	ton	7	125	$875
	Portable Air Compressor for Drill	ton	10	125	$1,250
	Diesel Gensets	ton	10	125	$1,250
	Pumps and hoses	ton	1	125	$125
	Contractor Overheads & Administration	allowance	1	10000	$10,000
	Subtotal				$1,946,298

COMMENTS:
Due to High Standby Cost for Equipment it may be more economic to purchase equipment and then resell it at end of project

Total Labour Input		**person-hours**	
	Year 1	**Year 2**	**Year 3**

1 **TABLE D6: Mobilization/DeMobilization/Standby Costs *1***

ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
HE Operator				
General Labour	1008			
Total Labour	1008			

1 TABLE D7: SITE ADMINISTRATION AND OPERATING & MAINTENANCE COST DURING REMEDIATION

Mon / Mtce # *1*

	ACTIVITY/MATERIAL	UNITS	QUANTITY IN YEAR 1	QUANTITY IN YEAR 2	QUANTITY IN YEAR 3	UNIT COST	COST
A	SITE ADMINISTRATION & OPERATING COST						
	Camp Cost - Food and Accommodation	person-day	336	268	3	$100	$60,717
	Communications to and from site	per month	3	4	1	$2,500	$20,000
	Camp Generator Cost - fuel & lubes	litres		20000		$1	$20,000
	Helicopter Support between Roberts and Ida Bay	operating hours	252	50	28	$1,500	$495,000
B	SITE MAINTENANCE COST						
	Maintenance Labour	person- hours	160	840	$40	70	$72,800
	Maintenance Supplies	allowance	2000	10000	$2,000		$14,000
	Subtotal					$595,717	

COMMENTS:

1 **TABLE D8: POST-CLOSURE MONITORING** **Mon / Mtce # *1***

Post Closure Monitoring & Maintenance	NPV at 3%	Reclamation Period		Post Closure																									
		Year 1	Year 2	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Sum
# of Site Visits		2	2	1	1	1	1	1					1					1					1					1	
Monitoring Labour	$33,498	$6,000	$6,000	$3,000	$3,000	$3,000	$3,000	$3,000					$3,000					$3,000					$3,000					$3,000	$39,000
Monitoring Supplies & Equipment	$2,122	$380	$380	$190	$190	$190	$190	$190					$190					$190					$190					$190	$2,470
Transportation to and from Site	$73,392	$0	$0	$10,000	$10,000	$10,000	$10,000	$10,000					$10,000					$10,000					$10,000					$10,000	$90,000
Analytical Costs	$21,216	$3,800	$3,800	$1,900	$1,900	$1,900	$1,900	$1,900					$1,900					$1,900					$1,900					$1,900	$24,700
Transportation of Samples to Lab	$2,792	$500	$500	$250	$250	$250	$250	$250					$250					$250					$250					$250	$3,250
Geotechnical Inspections/Other Studies	$138,789	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000					$15,000					$15,000					$15,000					$15,000	$165,000
Annual Reporting	$44,664	$8,000	$8,000	$4,000	$4,000	$4,000	$4,000	$4,000					$4,000					$4,000					$4,000					$4,000	$52,000
Sub-Total	**$316,472**	**$33,680**	**$33,680**	**$34,340**	**$34,340**	**$34,340**	**$34,340**	**$34,340**					**$34,340**					**$34,340**					**$34,340**					**$34,340**	**$376,420**
Contingency Allowance (15%)	$43,750	$5,052	$5,052	$5,151	$5,151	$5,151	$5,151	$5,151					$5,151					$5,151					$5,151					$5,151	$51,312
Total	**$360,222**	**$38,732**	**$38,732**	**$39,491**	**$39,491**	**$39,491**	**$39,491**	**$39,491**					**$39,491**					**$39,491**					**$39,491**					**$39,491**	**$393,392**

Analytical Costs	Cost per Sample#
Assay Set Ref #4	$190

APPENDIX E

Summary of Estimated Reclamation Costs – Option 3

TABLE E1: SUMMARY OF ESTIMATED RECLAMATION COST - ROBERTS BAY & IDA BAY ABANDONED SILVER MINE SITES
OPTION 3 - "PIGGY BACK" ON DORIS NORTH CONSTRUCTION

Capital Costs		
COMPONENT TYPE		**TOTAL COST**
UNDERGROUND MINE - SECURE ADITS & RAISE		$140,500
TAILINGS		$57,820
BUILDINGS AND EQUIPMENT		$147,230
HAZARDOUS MATERIALS AND SOIL CONTAMINATION		$158,155
MOBILIZATION/DEMOBILIZATION/STANDBY COSTS		$617,050
SITE ADMINISTRATION AND MAINTENANCE DURING REMEDIATION		$159,867
SUBTOTAL		**$1,280,622**
PROJECT MANAGEMENT & SUPERVISION	15 % of subtotal	$192,093
ENGINEERING	15 % of subtotal	$192,093
CONTINGENCY	15 % of subtotal	$192,093
GRAND TOTAL - CAPITAL COSTS		**$1,856,901**
POST-CLOSURE MONITORING COST (NPV at 3%)		$316,472
POST-CLOSURE MONITORING CONTINGENCY 15%		$43,750
YEARS OF POST CLOSURE MONITORING	25	
POST CLOSURE MONITORING COST OVER 25 YEARS (NPV at 3%)		$360,222
GRAND TOTAL CAPITAL AND POST-CLOSURE COSTS		**$2,217,123**

Table E2: Underground Mine Adits and Raises and Waste 1 Rock Piles

	ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
				1	
	ROBERTS BAY SITE				
A1	BACKFILL 2 ADITS WITH NAG + BLAST BROW + FILL DEPRESSION				
.	Front End Loader	operating hours	40	210	$8,400
	Haul Truck	operating hours	40	185	$7,400
	Air Trac Drill	operating hours	72	135	$9,720
	Air Compressor	operating hours	72	75	$5,400
	Drill bits & steel	allowance	1	3500	$3,500
	Explosives	allowance	1	2500	$2,500
	Dozer	operating hours	24	210	$5,040
	Miscellaneous Labour	person-hours	72	50	$3,600
A2	SEAL VENTILATION RAISE				
	Purchase of Precast concrete cap	each	1	7500	$7,500
	Freight to ship pre-cast cap				
	Road Freight Edmonton to Hay River	ton	10	125	$1,250
	Barging Cost to Roberts Bay	ton	10	648	$6,480
	Place concrete cap				
	Front End Loader	operating hours	12	210	$2,520
	Labour	person-hours	24	50	$1,200
	Bury concrete cap under waste rock				
	Front End Loader	operating hours	10	160	$1,600
	Haul Truck	operating hours	10	185	$1,850
	Dozer	operating hours	2	210	$420
	IDA BAY SITE				
B1	BACKFILL ADIT + VENT RAISE + BLAST BROW+ FILL DEPRESSION				
	Front End Loader	operating hours	24	210	$5,040
	Haul Truck	operating hours	24	185	$4,440
	Air Trac Drill	operating hours	48	135	$6,480
	Air Compressor	operating hours	48	75	$3,600
	Drill bits & steel	allowance	1	3500	$3,500
	Explosives	allowance	1	2500	$2,500
	Dozer	operating hours	4	210	$840
	Miscellaneous Labour	person-hours	48	50	$2,400
B2	MOVE EXCESS PAG ROCK TO DORIS NORTH MINE SITE FOR PLACEMENT UG				
	Front End Loader	operating hours	36	210	$7,560
	Haul Trucks	operating hours	72	185	$13,320
	Dozer	operating hours	10	210	$2,100
B3	BACKFILL EXPLORATION TRENCHES				
	Front End Loader	operating hours	20	210	$4,200
	Haul Truck	operating hours	20	185	$3,700
	Dozer	operating hours	4	210	$840
B4	MOVE NAG ROCK TO ROBERTS BAY				
	Front End Loader	operating hours	20	210	$4,200
.	Haul Trucks	operating hours	40	185	$7,400
B5	REGRADE IDA BAY SITE				
	Dozer	operating hours	10	210	$2,100

1 Table E2: Underground Mine Adits and Raises and Waste Rock Piles

ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST *1*	COST
Subtotal				$140,500

COMMENTS:

Total Labour Input — **person-hours**

	Year 1	Year 2	Year 3
HE Operator		542	
General Labour		144	
Total Labour		686	

1 Table E3: Roberts Bay Site Tailings Impoundment 1

	ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
A	REMOVE SUPERNATANT POND				
A1	Drain the Tailings Pond Supernatant				
A1A	Install pump and hose to transfer supernatant into the Adit				
	Rental of pump and hose	month	2	500	$1,000
	Rental of Diesel generator & Fuel Tank	month	2	1000	$2,000
	Air Freight for pump to and from site	allowance	1	5000	
	Labour to set up & dismantle pumping system	person-hours	24	70	$1,680
A1B	Pump supernatant into the vent raise				
	Labour to operate pump	person-hours	28	70	$1,960
A2	Haul and place 2 m thick rockfill cover over tailings surface	m^3	650		
	Front end loader	operating-hours	50	210	$10,500
	Haul Truck	operating-hours	100	185	$18,500
	Dozer	operating-hours	48	210	$10,080
A3	Stabilize Tailings Pond Berm by Placing additional Rockfill	m^3	150		
	Front end loader	operating-hours	20	210	$4,200
	Haul Truck	operating-hours	20	185	$3,700
	Dozer	operating-hours	20	210	$4,200
	Subtotal				$57,820

COMMENTS:

Total Labour Input — **person-hours**

	Year 1	Year 2	Year 3
HE Operator		258	
General Labour	24		
Total Labour	24	258	

1 **Table E4: Building / Equipment** ***1***

	ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
A	DEMOLISH STRUCTURES - ROBERTS BAY SITE				
A1	Demolish Adit Cover Building				
	Labour	person-hours	48	50	$2,400
	Materials (cutting torches, compressed gas, etc.)	allowance	1	500	$500
A2	Demolish Mill Building & Fresh Water Pumphouse				
	Labour	person-hours	672	50	$33,600
	Materials (cutting torches, compressed gas, etc.)	allowance	1	2500	$2,500
A3	Demolish Coarse Ore Hopper Structure				
	Labour	person-hours	48	50	$2,400
	Materials (cutting torches, compressed gas, etc.)	allowance	1	500	$500
A6	Demolish Assay Building				
	Labour	person-hours	96	50	$4,800
	Materials (cutting torches, compressed gas, etc.)	allowance	1	500	$500
A7	Demolish Reagent Storage Building				
	Labour	person-hours	96	50	$4,800
	Materials (cutting torches, compressed gas, etc.)	allowance	1	500	$500
A8	Pick Up Demolition Debris from Ida & Roberts Bay Sites and Transport to Non-Hazardous Landfill at Doris North Site				
	Front End Loader	operating hours	40	210	$8,400
	Haukt Trucks	operating hours	80	185	$14,800
B	SITE CLEAN UP - ROBERTS BAY SITE				
B1	Clean up old camp area including capping of old landfill area				
	Labour	person-hours	96	50	$4,800
	Materials (cutting torches, compressed gas, etc.)	allowance	1	500	$500
	Truck	operating hours	20	185	$3,700
	Loader	operating hours	10	210	$2,100
	Dozer	operating hours	4	210	$840
B2	Clean up Adit, Garage, Fuel Bladder area				
	Labour	person-hours	48	50	$2,400
	Materials	allowance	1	250	$250
	Truck	operating hours	6	185	$1,110
	Loader	operating hours	6	210	$1,260
	Dozer	operating hours	4	210	$840
B3	Clean up of Mill, Assay Lab area				
	Labour	person-hours	48	50	$2,400
	Materials	allowance	1	250	$250
	Truck	operating hours	6	185	$1,110
	Loader	operating hours	6	210	$1,260
	Dozer	operating hours	6	210	$1,260
C	SITE CLEANUP - IDA BAY SITE				
	Labour	person-hours	48	0	$0
	Materials	allowance	1	250	$250
	Truck	operating hours	6	185	$1,110
	Loader	operating hours	6	210	$1,260

1	**Table E4: Building / Equipment**			**1**	
	ACTIVITY/MATERIAL	**UNITS**	**QUANTITY**	**UNIT COST**	**COST**
	Dozer	operating hours	6	210	$1,260
D	DRAIN AND REMOVE FUEL BLADDERS				
.	Labour	person-hours	72	50	$3,600
.	Materials (Drums, pumps, hoses, etc.)	allowance	1	2500	$2,500
.	Support Equipment	allowance	1	1500	$1,500
.					
E	TRUCK NON-HAZARDOUS DEMOLITION WASTE TO DORIS NORTH LANDFILL SITE				
	Front end loader	operating hours	30	210	$6,300
	Haul Trucks	operating hours	60	185	$11,100
	Dozer	operating hours	4	210	$840
F	GRADE AND CONTOUR SITE				
.	Dozer	operating hours	20	210	$4,200
G	RECLAIM ROADS				
	Excavator	operating hours	10	160	$1,600
.	Truck	operating hours	10	185	$1,850
.	Dozer	operating hours	48	210	$10,080
	Subtotal				$147,230

COMMENTS:

Total Labour Input	**person-hours**		
	Year 1	**Year 2**	**Year 3**
HE Operator		384	
General Labour	960	312	
Total Labour	960	696	

1 TABLE E5: Hazardous Materials and Soil Contamination: *1*

	ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
A	COLLECTION & PACKAGING OF HAZARDOUS MATERIALS FOR SHIPMENT				
.	Labour to collect hazardous waste and re-package	person-days	480	50	$24,000
	Purchase of Hazardous Waste Drums and Overpacks	each	50	75	$3,750
	Road Freight Edmonton to Yellowknife	allowance	1	2500	$2,500
	Air Freight to Site	allowance	1	40000	$40,000
	Load and Truck Hazardous Materials to Doris North Jetty Site				
	Front End Loader	operating hours	20	210	$4,200
	Haul Truck	operating hours	20	185	$3,700
B	TRANSPORTATION OF HAZARDOUS MATERIAL OFF-SITE				
	Purchase of 6 shipping containers	each	6	1000	$6,000
	Barge Freight to Hay River	ton	20	648	$12,960
	Truck Freight to Disposal Site	ton	20	500	$10,000
	Hazardous Material - liquids	litre	4755		
	Hazardous Material - solids	Kg	4083		
	Lead painted steel equipment	Kg	11000		
B	DISPOSAL OF HAZARDOUS WASTE				
.	PCB, disposal (3 electrical capacitors labelled as PCB Containing) - Swan Hills Alberta	Kg	30		$750
	PCB containing transformer ballasts (7 units) - Swan Hills	Kg	28		$750
	Lead Batteries Swan Hills Alberta (1 drum + 3 vehicle batteries	Kg	375		$500
	Asbestos insulated cabinet (1)	Kg	250		
	Asbestos Brake Pad	Kg	5		$500
	Waste Oil	litre	1060	1	$1,060
	Liquid remaining in fuel bladder	litre	300	1	$300
	Used Oil Filters	Kg	15		$250
	Glycol	litre	205	1	$205
	Waste Gasoline	litre	80	1	$80
	Propane and compressed gas cylinders	each	9		$100
.	Turbo Jet Fuel - Type B (dated 1998) - 14 drums	litre	3100	1	$3,100
	Unknown liquids in drums	litre	3065	2	$6,130
	Lead contaminated Steel	tons	12.1	200	$2,420
.					
G	CONTAMINATED SOILS - EXCAVATE & PLACE UNDERGROUND AT DORIS NORTH AS BACKFILL				
.	Petroleum & Metal Contaminated Soil	m3	390		
G1	Excavate & Truck to Doris North Mine				
	Excavator	operating hours	40	210	$8,400
	Haul Truck	operating hours	80	185	$14,800
	Dozer	operating hours	20	210	$4,200
H	Haz. Mat. testing & assessment				
.	Allowance for ID Lab Testing prior to disposal	allowance	1	7500	$7,500
.					
	Subtotal				$158,155

1 TABLE E5: Hazardous Materials and Soil Contamination: *1*

ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST

COMMENTS:

Total Labour Input **person-hours**

	Year 1	Year 2	Year 3
HE Operator			180
General Labour		480	
Total Labour		480	180

1 TABLE E6: Mobilization/DeMobilization/Standby Costs *1*

	ACTIVITY/MATERIAL	UNITS	QUANTITY	UNIT COST	COST
A	CONSTRUCT & MAINTAIN WINTER ROAD FROM DORIS NORTH TO ROBERTS & IDA BAY SITES				
	Snow Plow	operating hours	60	200	$12,000
	Labour	person-hours	20	50	$1,000
B	PURCHASE & MOBILIZE SUMMER CAMP AT ROBERTS BAY SITE				
	Small Diesel Power Generator	each	1	1000	$1,000
	Self bermed Diesel Fuel Tank	each	1	250	$250
	Weatherhaven Tent for Sleeping Accommodati	each	2	2500	$5,000
	Kitchen Tent	each	1	2500	$2,500
	Washroom Tent	each	1	2500	$2,500
	Other Camp equipment	allowance	1	10000	$10,000
	Lumber, Piping, Electrics for camp set up	allowance	1	10000	$10,000
	Labour to set up camp	person-hours	480	60	$28,800
	Labour to dismantle camp	person-hours	240	50	$12,000
	Purchase ATV + Trailer	each	1	10000	$10,000
	Air Freight to move Equipment to Site	allowance	1	30000	$30,000
E	MOBILIZE WORKERS				
.	Allowance for air charters from Cambridge Bay	trips	48	7500	$360,000
	Allowance for Air Travel between the south and Cambridge Bay by commercial carrier	trips	60	1000	$60,000
	Hotel and meals in Cambridge Bay	nights	60	200	$12,000
G	MOBILIZE MISC. SUPPLIES				
.	Fuel & lubricants	litres	20000	7730	$10,000
.	Minor tools and equipment	allowance	1	10000	$50,000
	Subtotal				$617,050

COMMENTS:

Total Labour Input — **person-hours**

	Year 1	**Year 2**	**Year 3**
HE Operator			
General Labour	480	240	
Total Labour	480	240	

1 **TABLE E7: SITE ADMINISTRATION AND OPERATING & MAINTENANCE COST DURING REMEDIATION** **Mon / Mtce # *1***

	ACTIVITY/MATERIAL	UNITS	QUANTITY IN YEAR 1	QUANTITY IN YEAR 2	QUANTITY IN YEAR 3	UNIT COST	COST
A	SITE ADMINISTRATION & OPERATING COST						
	Camp Cost - Food and Accommodation	person-day	249	175		$100	$42,367
	Communications to and from site	per month	2	1		$2,500	$7,500
	Camp Generator Cost - fuel & lubes	litres		20000		$1	$20,000
	Helicopter Support - contingent	operating hours	40	20		$1,500	$90,000
B	SITE MAINTENANCE COST						
	Maintenance Labour	person- hours	80	40		70	$8,400
	Maintenance Supplies	allowance	2000	10000			$12,000
	Subtotal						$159,867

COMMENTS:

1 **TABLE E8: POST-CLOSURE MONITORING** **Mon / Mtce # *1***

Post Closure Monitoring & Maintenance	NPV at 3%	Reclamation Period		Post Closure																									
		Year 1	Year 2	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Sum
# of Site Visits		2	2	1	1	1	1	1					1					1					1					1	
Monitoring Labour	$33,498	$6,000	$6,000	$3,000	$3,000	$3,000	$3,000	$3,000					$3,000					$3,000					$3,000					$3,000	$39,000
Monitoring Supplies & Equipment	$2,122	$380	$380	$190	$190	$190	$190	$190					$190					$190					$190					$190	$2,470
Transportation to and from Site	$73,392	$0	$0	$10,000	$10,000	$10,000	$10,000	$10,000					$10,000					$10,000					$10,000					$10,000	$90,000
Analytical Costs	$21,216	$3,800	$3,800	$1,900	$1,900	$1,900	$1,900	$1,900					$1,900					$1,900					$1,900					$1,900	$24,700
Transportation of Samples to Lab	$2,792	$500	$500	$250	$250	$250	$250	$250					$250					$250					$250					$250	$3,250
Geotechnical Inspections/Other Studies	$138,789	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000					$15,000					$15,000					$15,000					$15,000	$165,000
Annual Reporting	$44,664	$8,000	$8,000	$4,000	$4,000	$4,000	$4,000	$4,000					$4,000					$4,000					$4,000					$4,000	$52,000
Sub-Total	**$316,472**	**$33,680**	**$33,680**	**$34,340**	**$34,340**	**$34,340**	**$34,340**	**$34,340**					**$34,340**					**$34,340**					**$34,340**					**$34,340**	**$376,420**
Contingency Allowance (15%)	$43,750	$5,052	$5,052	$5,151	$5,151	$5,151	$5,151	$5,151					$5,151					$5,151					$5,151					$5,151	$51,312
Total	**$360,222**	**$38,732**	**$38,732**	**$39,491**	**$39,491**	**$39,491**	**$39,491**	**$39,491**					**$39,491**					**$39,491**					**$39,491**					**$39,491**	**$393,392**

Analytical Costs	Cost per Sample#
Assay Set Ref #4	$190