Remedial Action Plan

Former Navigational Aid and Weather Station
Radio Island, Nunavut

Prepared for:

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Iqaluit, Nunavut

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EXECUTIVE SUMMARY

The Treasury Board Secretariat instituted the *Federal Contaminated Sites Assessment Initiative* to address the Federal Government's liability due to contaminated sites. Under this initiative, Indian and Northern Affairs Canada (INAC) has developed a remedial action plan and cost estimate for the former Navigational Aid and Weather Station located at Radio Island, Nunavut.

In support of the remedial action plan, Public Works and Government Services Canada, on behalf of INAC, has prepared this report which characterizes human health concerns and environmental risks at the site and presents a remedial design, preliminary specifications and cost estimate (±15%) (indicative, Class B).

The site remediation protocol used to develop the remedial design is based on an approach which addresses all legal requirements, health and safety issues, INAC's Contaminated Sites Policy requirements and standard environmental management practices. This protocol proposes financially efficient methodologies for addressing the environmental issues at the site, balancing the environmental risk with remedial costs.

A summary of the human health and environmental issues identified at Radio Island and the proposed remedial activities are outlined below.

Environmental Issue	Site Assessment Findings	Proposed Remedial Action
Landfills	• No landfill was identified at the site.	• No engineered landfill will be developed at the site due to a lack of borrow material available for filling and capping.
Physical Debris	• Approximately 200 m^3 of non-hazardous debris have been identified at the site. Debris consists of: cables, scrap metal, barrels, wood and building demolition material.	• Non-hazardous physical debris identified at the site will be disposed of off-site. Approximately ½ of the material is wood wastes that can be burned on site.
Contaminated Soil • Metal Contaminated Soil • PCB Contaminated Soil	• 1290 m^3 of soils with concentrations of As, Co, Cd, Cu, Hg, Pb, Ni and Zn, which exceed the INAC Abandoned Military Site Remediation Protocol criteria. • No soils with concentrations of PCB that exceed the INAC Abandoned Military Site Remediation Protocol criteria.	• Metals impacted soils will be disposed of off-site. 10 m^3 of this soil is hazardous and special handling and disposal will be necessary.

Environmental Issue	Site Assessment Findings	Proposed Remedial Action
• Petroleum Hydrocarbon Contaminated Soil	• 400 m^3 of soils with concentrations of petroleum hydrocarbons, which exceed the CCME Canada Wide Standard - Petroleum Hydrocarbons in Soil for Residential / Parkland land use. Hydrocarbon impacted soil plume overlaps the metal impacted soil plume.	• Petroleum hydrocarbon impacted soils identified at the site are co-contaminated with elevated concentrations of metals. They will be disposed of off-site.
Contaminated Surface Water	• A pond located southeast of the main house revealed dissolved copper and zinc concentrations that exceed the CCME surface water guidelines for the protection of Aquatic Life.	• Surface water with metals concentrations in exceedance of applicable criteria will be pumped and treated on site.
Hazardous Materials	• Approximately 15 m^3 of hazardous materials were identified at the site. These materials consisted of lead acid batteries, lead paint and asbestos.	• Hazardous materials identified at the site will be packaged and shipped off-site for disposal in accordance with the Transportation of Dangerous Goods Act.
Barrels	• There are approximately 135 empty barrels identified at the site	• Empty barrels will be crushed and disposed of off-site.
Buildings and Infrastructure	• The remaining infrastructure at the site consists of: ▪ 2 intact buildings ▪ the remains of 3 buildings ▪ 2 helipads ▪ 1 beacon tower	• All the buildings and infrastructure at the site will be demolished, with the exception of: ▪ Main House which is to remain as an emergency shelter ▪ Beacon Tower which is operational
Borrow Sources	• No potential borrow sources were identified	• Due to the absence of borrow material at the site, no engineered landfill will be developed.

The estimated cost to undertake these remedial activities is $ 5,200,000 (± 15%). Prior to undertaking any remedial activities, an environmental impact assessment, in accordance with the Canadian Environmental Assessment Act and the Nunavut Impact Review Board must be conducted.

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1.0 INTRODUCTION

The Treasury Board Secretariat (TBS) has recently announced the provision of financial resources under the *Federal Contaminated Sites Assessment Initiative (FCSAI*). The first objective of the TBS program is to obtain enhanced data on the total financial liability of the federal government for the management and/or remediation of its contaminated sites. The second objective is to obtain financial and environmental data in support of the ongoing responsibilities of federal government departments associated with the management of their contaminated sites.

As a result of the FCSAI initiative, Indian and Northern Affairs Canada (INAC) is developing a remedial action plan for the former Navigational Aid and Weather Station located at Radio Island, Nunavut. INAC has retained Environmental Services, Public Works and Government Services Canada (PWGSC) to prepare the conceptual remediation design and preliminary specifications for this site.

2.0 OBJECTIVES

The objectives of this project were:

- To document the existing site conditions of the facility and its surroundings with respect to potential contamination and remediation requirements;
- To characterize and quantify any identified site contamination; and
- To develop a remedial action plan for the site, complete with preliminary design specifications, plans and a cost estimate (± 15%) to undertake the remedial work.

3.0 SITE DESCRIPTION

Radio Island is located at the south tip of Resolution Island, which is located at the southeast end of Baffin Island, in the Territory of Nunavut. Refer to Drawing No. 1, Appendix A, for a site location plan. From 1929 to 1961, the Canadian Department of Transport operated a navigational aid and weather station at the site.

The site consists of two standing buildings, the remains of three other buildings, two helipads, and a beacon tower. Hazardous and non-hazardous debris is scattered throughout the site. Figure 2.0 through Figure 2.3, located in Appendix A, provides an overall site plan of the station and its features, including the location of the delineated contaminated soil. The Canadian Coast Guard operates a beacon tower, located at the south end of the island.

4.0 BIOPHYSICAL ENVIRONMENT

4.1 PHYSIOGRAPHIC DESCRIPTION

Radio Island is located south of Resolution Island, which is located at the southeastern tip of Baffin Island, in the Territory of Nunavut. It is situated at Latitude 61° 18' N and Longitude 64° 52' W. The nearest community is the City of Iqaluit, located approximately 340km northwest of the site.

The island, which is composed of Canadian Shield bedrock, is approximately 1 km long and 0.5 km wide. The terrain consists of tilted bedrock with parallel rock ridges, knolls and gullies. The only soils identified at the site are located in the gullies and valleys formed by the bedrock. Surface drainage at the site flows along the gullies to the ocean.

4.2 CLIMATE

The site has a low arctic ecoclimate, marked by short cold summers and long winters. Meteorological data collected at Iqaluit between 1946 and 1990, identify mean daily temperatures ranging from –26.8°C in February to +7.7°C in July. The average mean daily temperature over the year is –9.5°C. An average annual precipitation of 424.1mm falls in this area, 60% of which is in the form of snow.

4.3 FLORA

The flora in this region is limited to the gullies and valleys where there is soil present. Mosses were found throughout the site where soils were present.

4.4 FAUNA

Marine mammals, such as walrus, seal, whale and polar bears are common to this region. Shorebirds and waterfowl are also found in this region.

5.0 SITE REMEDIATION PROTOCOL

There are a number of factors, which must be considered when determining the most appropriate approach to site remediation. These include legal and policy requirements, health and safety issues, public perception and a balance between the cost of remedial work and the actual environmental risk. The INAC Abandoned Military Site Remediation Protocol was used to develop the remedial action plan for this site. The protocol is based on an approach, which addresses all legal requirements, health and safety issues, INAC's Contaminated Sites Management Policy requirements and standard environmental management practices. It also proposes financially efficient

methodologies for addressing the environmental issues at the site and balancing the environmental risk against remedial cost. Typical environmental issues and their remedial action addressed by the protocol are outlined below.

5.1 LANDFILLS

5.1.1 LANDFILL CLOSURE

Where landfills exist, their condition will be evaluated to determine the appropriate action.

- If the landfill is located in an unstable, high erosion location, it will be relocated to a properly engineered landfill. During the relocation process, any identified hazardous materials will be segregated for off-site disposal (Class A landfill).
- If the landfill is located in a suitable, stable location, but there is evidence of contaminated leachate, a suitably engineered containment system will be constructed. If this course of action is cost prohibitive, the landfill may be relocated to an engineered landfill capable of handling the contaminated leachate or the waste may be disposed of off-site (Class B Landfill).
- If the landfill is located in a suitable, stable location, with no evidence of contaminated leachate, it will be left in place. If required, additional granular fill will be placed to ensure erosion protection and proper drainage (Class C landfill).

5.1.2 LANDFILL DEVELOPMENT

Where required and possible, new engineered landfills will be developed to address specific contaminants. These landfills will be used for the disposal of non-hazardous materials and non-regulated contaminated soils only. The landfills will be capped with a minimum of 0.6 m of granular fill material or other thickness as determined by site conditions, which will be graded to promote surface run-off and minimize erosion. The cover thickness will promote redevelopment of the permafrost layer to stabilize the landfill contents.

New landfill siting considerations will include proximity to drainage courses, waste material and borrow sources and the overall topography of the site. At sites where no acceptable location can be identified, blasting may be used to create a depression suitable for an engineered landfill or the wastes may be shipped off-site.

Monitoring of any new landfills will be required to ensure that they are operating as intended. Monitoring activities will include inspection of the landfill and cover.

5.2 PHYSICAL DEBRIS

Visible site debris will be collected and segregated into hazardous and non-hazardous waste streams for disposal.

- Non hazardous waste: The volume of the non-hazardous materials will be minimized through crushing, shredding, or burning, prior to their placement in an on-site engineered landfill. If there is no existing landfill on-site, and no suitable location for a new engineered landfill, the non-hazardous materials will be disposed of off-site.
- Hazardous waste: These materials will be disposed of off-site, in accordance with the protocol outlined in Section 5.4.

5.3 CONTAMINATED SOILS

Contaminated soils will be considered in three primary categories; soils that are regulated, soils that are classified as hazardous and soils that are classified as contaminated but not hazardous waste. Contaminated soils that are regulated will be remediated and/or disposed of in compliance with the applicable regulations. Contaminated soils that are not regulated or hazardous will be remediated to meet the DLCU Criteria. Where the historical land use has been for another industry in addition to the military operations, additional parameters will be assessed and remediated to levels established through Site Specific Risk Assessments. Hydrocarbon contaminated soil remediation levels will be established through the application of the CCME Canada Wide Standards – Petroleum Hydrocarbons in Soil (CCME 2001).

Three primary contaminated soil types have been identified; metal contaminated soil, hydrocarbon contaminated soil and PCB contaminated soil. Where multiple contaminants are present in the soils, the most conservative remedial option that addresses both contaminant types will be applied.

- **Metals Contaminated Soils:** All soils with metal concentrations exceeding the DLCU Criteria or criteria derived through Risk Assessment processes will be either disposed of off-site or encapsulated on-site.
- **Petroleum Hydrocarbon Contaminated Soils:** Hydrocarbon contaminated soil remediation levels will be established through the application of the CCME Canada Wide Standards – Petroleum Hydrocarbons in Soil. Tier 2 levels will be routinely applied with Tier 3 levels applied to sites where conditions are significantly different than the norm. Where hydrocarbon contamination is determined to exceed these protective levels, in-situ or ex-situ remediation options will be considered. Where on-site remediation is not cost effective, hydrocarbon contaminated soils may be transported off site for disposal. If they do not pose a significant environmental risk, they may be capped in place or left in place to remediate through natural attenuation.

Where free product is encountered the free phase liquid will be addressed prior to the application of the CCME CWS PHC or risk assessment methods for establishing remediation requirements.

- **PCB Contaminated Soils:** All soils with PCB concentrations exceeding the DLCU Criteria will be either disposed of off-site or encapsulated on-site. If the PCB contaminated soils are considered to be a PCB Waste under the PCB Regulations made under the Canadian Environmental Protection Act (CEPA 1999), soil handling and disposal will be governed by the PCB regulations. PCB impacted soil has not been identified at the site.

Where multiple contaminants are present in the soils, the most conservative remedial option will be applied. For example, where metal contaminants and petroleum hydrocarbon contaminants are present, the remedial option, which addresses the metal contamination, will be selected.

5.4 HAZARDOUS MATERIALS

Hazardous materials referred to in this section are defined as any materials that are designated "hazardous" or "dangerous goods" under Nunavut Territorial or Federal legislation. Generally, all hazardous materials identified at the site, will be collected and transported off site, in accordance with the Transportation of Dangerous Goods Act, to a licensed hazardous waste disposal facility. PCB painted building components, which are regulated under the CEPA, will be collected and transported off site, in accordance with the Transportation of Dangerous Goods Act and CEPA, to a licensed hazardous waste disposal facility. Some exceptions to off-site disposal exist, where an on-site engineered landfill is available. The exceptions are outlined below:

- **Asbestos:** Asbestos waste will be collected, double bagged and disposed of in an on-site engineered landfill. If there is no existing landfill on-site, and no suitable location for a new engineered landfill, the asbestos waste will be disposed of off-site.
- **Petroleum Products:** Petroleum products such as gasoline or diesel, which do not contain other hazardous products (chlorine, PCB, heavy metals, etc.) will be incinerated on-site under appropriate emissions controls. Heavier petroleum products such as lubricating oil will be disposed of off-site or mixed with lighter petroleum products and incinerated.
- **Compressed Gas Cylinders:** Compressed gas cylinders with known contents will be vented. Once empty, the metal cylinder will be disposed on-site in an engineered landfill or removed from site for disposal.
- **Creosote Treated Timbers:** Timbers will be wrapped in polyethylene sheets and disposed on-site in an engineered landfill. If there is no existing landfill on-site, and no suitable location for a new engineered landfill, the asbestos waste will be disposed of off-site.

- **PCB Paint on Building Components:** PCB paint and PCB painted components which are regulated under the CEPA, will be collected and transported off site, in accordance with the Transportation of Dangerous Goods Act and CEPA, to a licensed hazardous waste disposal facility; and
- **Lead-Based Paint on Building Components**: Lead-based painted components which are classified as hazardous material will be collected and transported off site, in accordance with the Transportation of Dangerous Goods Act and CEPA, to a licensed hazardous waste disposal facility. Painted components that exceed the relevant federal or Territorial criteria but are not considered hazardous will be collected and disposed in an on-site engineered landfill.

5.5 BARRELS

Barrels identified at the site will be handled according to the DLCU Barrel Protocol as outlined below:

- Empty Barrels: Empty barrels will be crushed and disposed in an on-site engineered landfill or removed from site.
- Filled or Partially Filled Barrels: Barrel contents will be inspected and tested if necessary and disposed of appropriately (off-site or incinerated). The empty barrels will be rinsed, crushed and disposed on-site in an engineered landfill. If there is no existing landfill on-site, and no suitable location for a new engineered landfill, the asbestos waste will be disposed of off-site. The spent rinse liquid will be treated with absorbent material and disposed as hazardous material, as required; and
- Buried Empty Barrels: Areas containing buried empty barrels will be inspected to determine if any barrels contain material and characterized through a geophysical survey. If the barrels are found to be empty the area will be stabilized through compaction to crush any corroded barrels. A cover of borrow material will be placed over the area and compacted.

5.6 BUILDINGS AND INFRASTRUCTURE

The existing buildings and infrastructure at the site will be demolished to their foundations. All hazardous materials must be segregated prior to demolition. Non-hazardous demolition materials and asbestos will be collected and disposed of in an off-site landfill facility. Hazardous demolition materials will be disposed of off-site at a facility that accepts and/or destroys such wastes.

5.7 BORROW SOURCES

At sites where new landfills are to be constructed or backfill is necessary at excavation areas, granular borrow material will be required for the development of the new landfills and general site grading purposes. Existing sources of borrow material will be used until

exhausted before exploiting new areas. At the completion of the remedial activities, all borrow areas will be recontoured to restore natural drainage and to match the surrounding topography.

5.8 SITE GRADING

Grading operations will consist of the shaping and regrading of disturbed areas to blend in with the natural contours. The disturbed areas may include:

- contaminated soil excavation areas
- debris areas
- areas disturbed during demolition activities
- granular borrow areas
- any area disturbed during the establishment and operation of the remediation camp, equipment storage and maintenance activities

5.9 CONTRACTOR SUPPORT ACTIVITIES

For the implementation of the remedial activities, a Contractor may establish a camp and storage areas on-site or at a nearby location. Where possible, these will be located in previously disturbed areas such as borrow or storage areas, to minimize any new disturbances in accordance with all applicable licenses.

Domestic refuse generated by the camp will be incinerated and ash disposed of on-site in an engineered landfill or shipped off-site. Sewage will be handled by an appropriately sized sewage treatment system, in accordance with applicable legislation and licenses.

Potable water supplies at the site will be tested and used, only if they meet the Canadian Drinking Water Quality Standards (CCME 2002), in accordance with all applicable licenses.

Fuel required for the operation of the camp and equipment will be supplied by the Contractor and be stored on-site in accordance with applicable legislation and licenses.

6.0 ENVIRONMENTAL SITE ASSESSMENT RESULTS

Environmental site assessments have been conducted at this site in 1996 by the Environmental Sciences Group of Royal Military College, Kingston, Ontario and in 2001 by Earth Tech Canada, Edmonton, Alberta. The Environmental Sciences Group conducted additional work in August 2005 to assess the leachable lead content in paint and soil at the site. The results of these assessments have been used to develop this remedial action plan. A summary of their findings is provided in the subsequent sections. Refer to Drawing Sheets 3 to 6, in Appendix A, for the locations of the environmental issues identified.

6.1 LANDFILLS

6.1.1 EXISTING LANDFILLS

Debris was scattered throughout the site, but no consolidated surface debris piles or covered landfill was identified.

6.1.2 LANDFILL DEVELOPMENT

Two potential landfill sites were identified. They were evaluated based on their potential capacity and their location relative to the major sources of landfill material.

- Site 1: A natural depression in the bedrock, southeast of former building foundation. This site is located close to clean-up areas in the southern portion of the site. It has a capacity of 1,500 m^3.
- Site 2: The freshwater pond/reservoir west of the Main House. This site is also close to the clean-up areas. It has a capacity of 2,100 m^3.

6.2 PHYSICAL DEBRIS

A total of 200 m^3 of non-hazardous debris has been identified at the site. The non-hazardous debris consists of cables, scrap metal, barrels, wood and building demolition material. The volumes and locations of these materials are outlined in Table 1.

Table 1: Non – Hazardous Debris

Area	Description	Type of Non – Hazardous Debris	Volume (m^3)
1	Former Helipad and Beacon Tower	Cables, metal structure, wood and domestic debris	45
2	Vicinity of Former Power House on east and west sides and north south along ravine	Steel frame columns, trusses/beams; wooden sill foundation, C channels, metal debris, cable from helipad to tower site, and barrels (70)	35
3	Vicinity of Main House on east and west sides and north south along ravines.	Steel frame columns, trusses/beams, wooden foundation(s), C channels, metal debris, barrels, wire cable, bricks, wooden structures (helipad, hut, and winch shed), winch mechanism and motor, and submerged debris in pond and low areas.	65
4	Beach Hut and coal stockpile	Metal from winch system, scrap metal from hut, wooden ladder/platform, cables, poles, wires, barrels (30), and 26m^3 of coal.	55
		Total Non-Hazardous Waste Volume:	**200 m^3**

Note: It is estimated that 50% of the non-hazardous debris consists of wood waste.

6.3 CONTAMINATED SOILS

6.3.1 METALS CONTAMINATED SOILS

A total of 1,290 m^3 of soils with concentrations of arsenic, cobalt, cadmium, copper, lead, mercury, nickel and zinc, which exceed the DEW Line Cleanup Criteria were identified at the site. Table 2 provides a location and volume of the contaminated soil.

Due to the extremely high concentrations of lead in some of the soil samples, leachate tests were conducted to determine disposal requirements. The results indicated that approximately 8 m^3 of soil had a leachable lead concentration greater than 5.0 mg/L. These soils are classified under the Transportation of Dangerous Goods Act as Class 9.3, Dangerous Waste. They will require disposal in a hazardous waste landfill designed to accept this type of waste.

Table 2: Metals Contaminated Soils

Identification	Location	Contaminant	Volume (m^3)
Metals-1	SE of Generator Building and S of Former Building Foundation	Ni	60
Metals-2	SW of Former Building Foundation	Co, Cu, Ni, Pb, Zn	45
Metals-3	E of Old Helipad Site	Co, Cu, Pb, Ni, Zn	35
Metals-4	NE of Old Helipad, S of Former Generator House, S and W of Former Generator House, N of Former Generator House	Cd, Co, Cu, Hg, Pb, Ni, Zn, Hydrocarbons	482
Metals-5	S of Former Generator Station	Leachable Pb	8
Metals-6	Low Area N of Helipad	Cd, Co, Cu, Pb, Ni, Zn	120
Metals-7	Low Area / Ravine N of Helipad	As, Cu, Pb, Hg, Ni, Zn	50
Metals-8	Low Area / Ravine NEt of Helipad	Ni	25
Metals-9	Ravine Partially Filled with Debris NE of Main House	Cu, Pb, Ni, Zn	70
Metals-10	Ravine East of Debris, NE of Main House	Cu, Pb, Zn	65
Metals-11	Far East Ravine, NE of Main House	Ni, Zn	15
Metals-12	Ravine Adjacent and S of Main House	Pb	10
Metals-13	Ravine Adjacent and W of Freshwater Pond	Cu, Pb, Ni, Zn	25
Metals-14	Former Beach Hut	Cu, Pb, Ni, Zn	20
		Total Metal Impacted Soil:	**1,032 m^3**
		Total Metal Impacted Soil (including 25% contingency):	**1,290 m^3**

6.3.2 PETROLEUM HYDROCARBON CONTAMINATED SOILS

A total of 400 m^3 of soils with concentrations of petroleum hydrocarbons, which exceed the CCME Canada Wide Standard - Petroleum Hydrocarbons in Soil for residential/parkland land use, were identified at the site. The petroleum hydrocarbons identified at the site ranged from C_{10} to $C_{>34}$. These soils also have elevated concentrations of metals therefore this volume will be removed from the site and has been included in Section 6.3.1.

6.3.3 PCB CONTAMINATED SOILS

No soils with concentrations of PCB which exceed the INAC Abandoned Military Sites Remediation Protocol, or CEPA regulations, were identified at the site.

6.4 CONTAMINATED SURFACE WATER

Surface water samples collected by ESG in August, 1996 from the pond located southeast of the Main House revealed dissolved copper and zinc concentrations which exceeded the CCME Canadian Environmental Quality Guidelines for the protection of Aquatic Life (Freshwater). The source of the metals in the water is likely from the Metals-1 and Metals-2 contaminated soil pockets (see Appendix A). The estimated volume of pond water that requires treatment is less then 100,000 L.

6.5 HAZARDOUS MATERIALS

A total of 15 m^3 of hazardous materials has been identified at the site. These materials include lead acid batteries, lead paint and asbestos. Table 3 provides an inventory of the hazardous materials found at the site.

Table 3: Hazardous Waste

Item	Location	Units	Quantity	Volume (m^3)
-Lead Acid Batteries	Former Helipad and Beacon Tower	500 lbs	8	1.5 m^3
-Batteries	Vicinity of Former Power House on	1000 lbs.	16	2.0 m^3
-Asbestos insulation	E and W sides and N-S along ravine	Asbestos	--	3.5 m^3
-Lead Paint on buildings	Vicinity of Main House on east and west sides and north south along	--	--	1.5 m^3
-Lead Acid Batteries	ravines	1000 lbs.	16	2.0 m^3
-Asbestos insulation		--	--	1.5 m^3
-Lead sheathed electrical wire		1000 lbs	100m	3.0 m^3
Total Hazardous Waste Volume:				**15 m^3**

6.6 BARRELS

There are approximately 135 empty barrels located throughout the site. The crushed volume of these barrels has been included in the calculation of the volume of non-hazardous debris.

6.7 BUILDINGS AND INFRASTRUCTURE

The buildings and infrastructure remaining at the site consist of two intact structures, the Main House and the Winch Shed; and the remains of three buildings, the Generator House, a burnt out house and a building foundation. In addition, there are two helipads and a beacon tower at the site. These structures are all in a deteriorated condition, with the exception of the Main House, which appears to be structurally sound. The Beacon Tower is currently operational.

6.8 BORROW SOURCES

No potential borrow source areas were identified at the site:

7.0 REMEDIAL DESIGN

The preliminary remedial design proposed for the Radio Island site is based on the Site Remediation Protocol described in Section 5.0. The detailed design, specifications and tender documents will be completed in January, 2006.

Prior to undertaking any remedial activities, an environmental assessment, in accordance with the Canadian Environmental Assessment Act and the Nunavut Impact Review Board must be conducted.

7.1 LANDFILLS

7.1.1 LANDFILL CLOSURE

No existing landfills were identified.

7.1.2 LANDFILL DEVELOPMENT

Due to the fact that there is no borrow source on the island, neither of the two potential landfill sites identified will be used to develop an engineered landfill.

7.2 PHYSICAL DEBRIS

Of the 200 m^3 of non-hazardous physical debris identified at the site, 100 m^3 will be collected, containerized and disposed of off-site at a facility licensed to accept the waste. The remaining material is estimated to be wood debris that may be burned on site. If any hazardous materials are identified during the collection process they will be handled in accordance with Section 5.4.

7.3 CONTAMINATED SOILS

The contaminated soils identified at the site will be collected and shipped off-site for disposal. The contaminated soils are typically located in the bedrock gullies. The clean-up activities must ensure that all contaminated soils are collected from any bedrock crevices and fissures. The design drawings will provide information to the Contractor with respect to the required collection limits.

Because the soils being containerized are contaminated, appropriate health and safety precautions must be taken to ensure that workers are protected. This will include the use of appropriate protective clothing and equipment.

7.3.1 METALS CONTAMINATED SOILS

The 1,290 m^3 of soil with concentrations of arsenic, cobalt, cadmium, copper, lead, mercury, nickel and zinc, which exceed the INAC Abandoned Military Sites Remediation Protocol will be containerized and labeled, as necessary, in accordance with the Transportation of Dangerous Goods Act for transport to an off-site disposal facility licensed to accept metals contaminated soils.

The 8 m^3 of soil with elevated leachable lead concentrations will be containerized separately. This soil will be classified as dangerous waste, labeled in accordance with the Transportation of Dangerous Goods Act, and shipped off-site to a hazardous waste landfill for disposal.

7.3.2 PETROLEUM HYDROCARBON CONTAMINATED SOIL

The petroleum hydrocarbon contaminated soils identified at the site also had elevated metal concentrations. Therefore, they are considered to be metals contaminated soils and will be disposed of off-site at a disposal facility licensed to accept metals contaminated soils.

7.3.3 PCB CONTAMINATED SOILS

No PCB contaminated soils were identified at the site.

7.4 CONTAMINATED SURFACE WATER

Contaminated surface water from the pond southeast of the Main House will be treated on-site to remove the dissolved metals and discharged on-site. Contaminated water will be pumped out of the pond, filtered through media specifically selected to remove metals, and discharged to a drainage course. Treated water samples will be collected and analyzed to confirm that the copper and zinc concentrations have been reduced to an acceptable level prior to discharge. Temporary containment of the treated water will be necessary prior to discharge while samples are analyzed for metal concentrations.

7.5 HAZARDOUS MATERIALS

The hazardous materials identified at the site will be packaged and shipped off-site in accordance with the Transportation of Dangerous Goods Act. Hazardous materials will require disposal in a hazardous waste landfill designed to accept this type of waste.

7.6 BARRELS

The empty barrels at the site will be crushed and disposed of off-site.

7.7 BUILDINGS AND INFRASTRUCTURE

All the buildings and infrastructure at the site will be demolished, to foundation, with the exception of the Main House and the beacon tower. Prior to demolition, all hazardous materials will be removed from the buildings and disposed of off-site in accordance with the protocol identified in Section 5.4. This includes the removal of building components covered with lead based paint, asbestos, lead acid batteries, etc. The non-hazardous demolition debris will also be disposed of off-site in an engineered landfill.

The Main House appears to be structurally sound and will be left on the site as an emergency shelter. However, the exterior lead based paint will be removed and the contents of the building will be collected and disposed of appropriately.

7.8 BORROW SOURCES

No borrow sources were identified at the site.

7.9 SITE GRADING

As the site is composed of Canadian Shield bedrock, no grading is necessary.

7.10 REMEDIATION LOGISTICS

There is no airstrip at the site however a former helipad still exists. Mob/demob is possible by sealift or helicopter although it is anticipated that mob/demob will take place via sealift, with support and re-supply service provided by helicopter.

The remedial activities are scheduled to occur in a single season. The proposed schedule of activities is outlined below:

- Mobilization to site by sea lift in June/July
- Removal of lead based paints from buildings
- Containerization and shipping of all hazardous materials off-site for disposal
- Demolition of buildings and infrastructure and disposal off site.
- Collection of non-hazardous debris and disposal off-site
- Collection and off-site disposal of metal contaminated soil
- Treatment of metals impacted surface water in pond
- Demobilization from site by sea lift in September/October

It is anticipated that the Contractor will construct a temporary camp for a maximum of 20 people on-site in the location of the original, burned-out, camp. Domestic refuse will either be disposed off-site or incinerated on-site with the ash disposed of off-site. Due to the short field season, it is expected that the Contractor will be providing potable water in the form of bottled water.

7.11 REMEDIAL COSTS

The estimated cost to complete this remedial action plan is $5,200,000 (± 15%). This estimate includes Contractor costs as well as project management costs. For a detailed breakdown, refer to Appendix C.

APPENDIX A:

FIGURES

HUDSON STRAIT

ENTRY ISLANDS

BEACH / COAL
OFF LOADING AREA
(SEE FIGURE 1.3)

COAL PILE

BEACH HUT (BURNT)

MAIN STATION
AREA NORTH
(SEE FIGURE 1.2)

HELIPAD

WINCH SHED

MAIN HOUSE

GENERATOR HOUSE

BUILDING FOUNDATION

BEACON
TOWER

OLD HELIPAD

MAIN STATION
AREA SOUTH
(SEE FIGURE 1.1)

TRIDENT ISLAND

HUDSON STRAIT

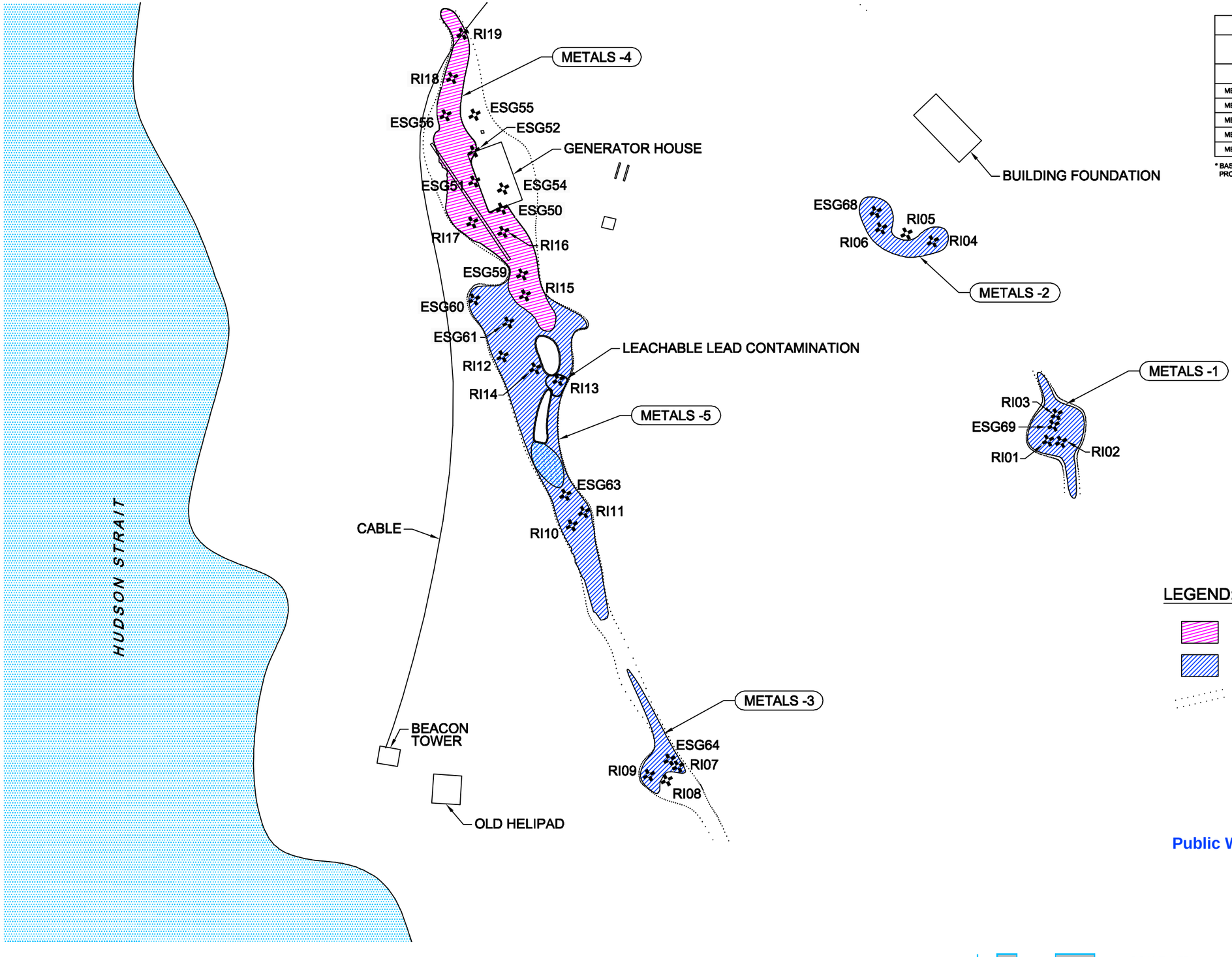
Public Works and Government Services Canada
Environmental Restoration at Radio Island, NU
Contaminated Soils Delineation Update

Project Layout

0 25 50 75 m SCALE 1:2500

UMA | AECOM

Figure - 1.0



CONTAMINATED SOIL TO BE EXCAVATED*		
AREA NAME	APPROX. AREA OF CONTAMINATION (m^2)	ESTIMATED IN PLACE VOLUME (m^3)
METAL CONTAMINATION		
METALS - 1	115	60
METALS - 2	92	45
METALS - 3	69	35
METALS - 4	442	220
METALS - 5	532	270

* BASED ON THE "ABANDONED MILITARY SITE REMEDIATION PROTOCAL" BY INAC DATED MARCH 2005.

LEGEND:

- HEAVY METALS AND HYDROCARBONS EXCEEDANCES
- HEAVY METALS EXCEEDANCES
- BEDROCK DEFINED GULLIES

0 7.5 15 22.5 m SCALE 1:75(

Public Works and Government Services Canada
Environmental Restoration at Radio Island, NU
Contaminated Soils Delineation Update

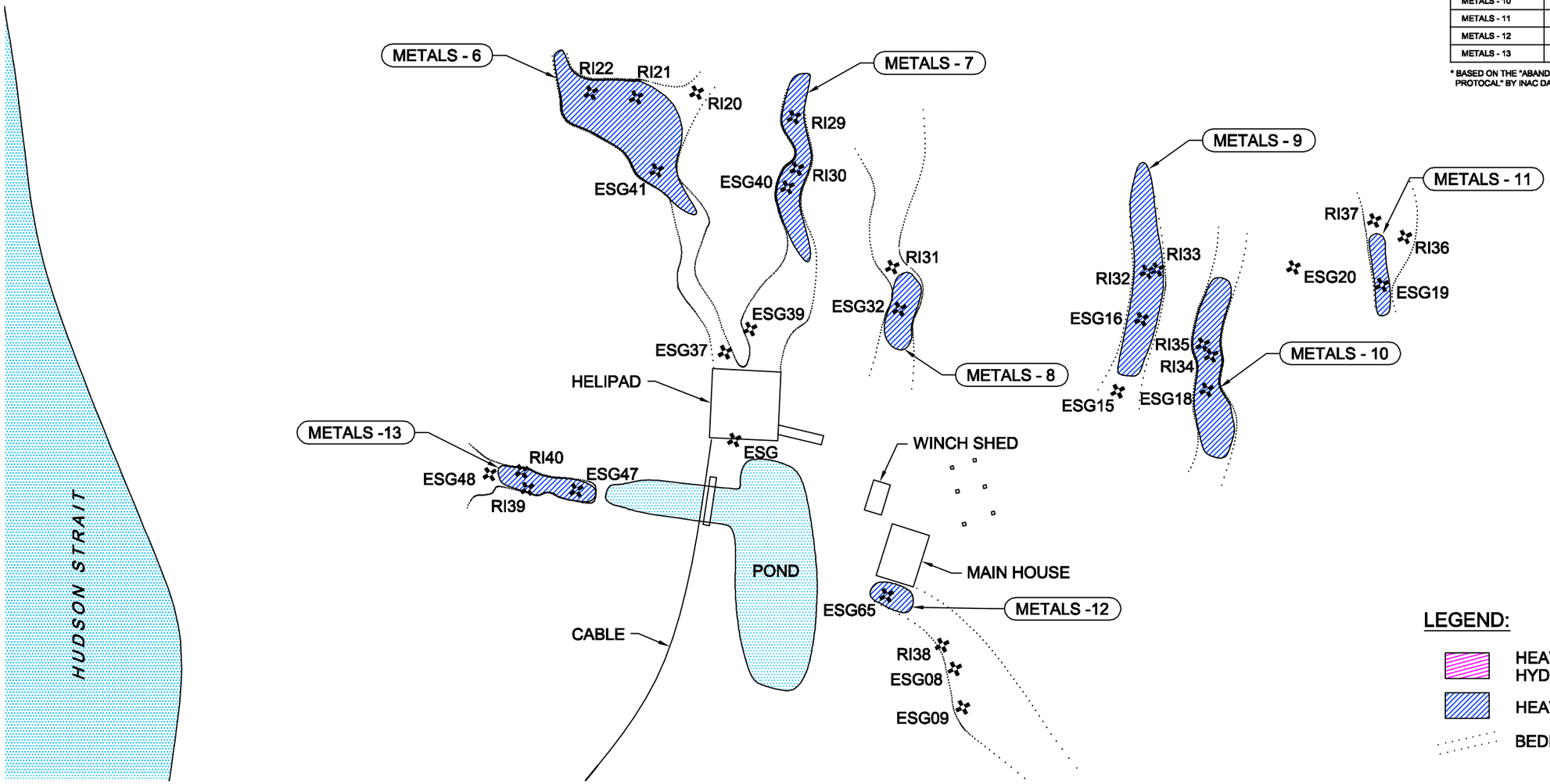
Main Station Area South

Figure - 1.1

UMA | AECOM

CONTAMINATED SOIL TO BE EXCAVATED*		
AREA NAME	APPROX. AREA OF CONTAMINATION (m^2)	ESTIMATED IN PLACE VOLUME (m^3)
METAL CONTAMINATION		
METALS - 6	240	120
METALS - 7	96	50
METALS - 8	49	25
METALS - 9	141	70
METALS - 10	129	65
METALS - 11	30	15
METALS - 12	24	12
METALS - 13	48	25

* BASED ON THE "ABANDONED MILITARY SITE REMEDIATION PROTOCAL" BY INAC DATED MARCH 2005.



LEGEND:

- HEAVY METALS AND HYDROCARBONS EXCEEDANCES
- HEAVY METALS EXCEEDANCES
- BEDROCK DEFINED GULLIES

Public Works and Government Services Canada
Environmental Restoration at Radio Island, NU
Contaminated Soils Delineation Update

Main Station Area North

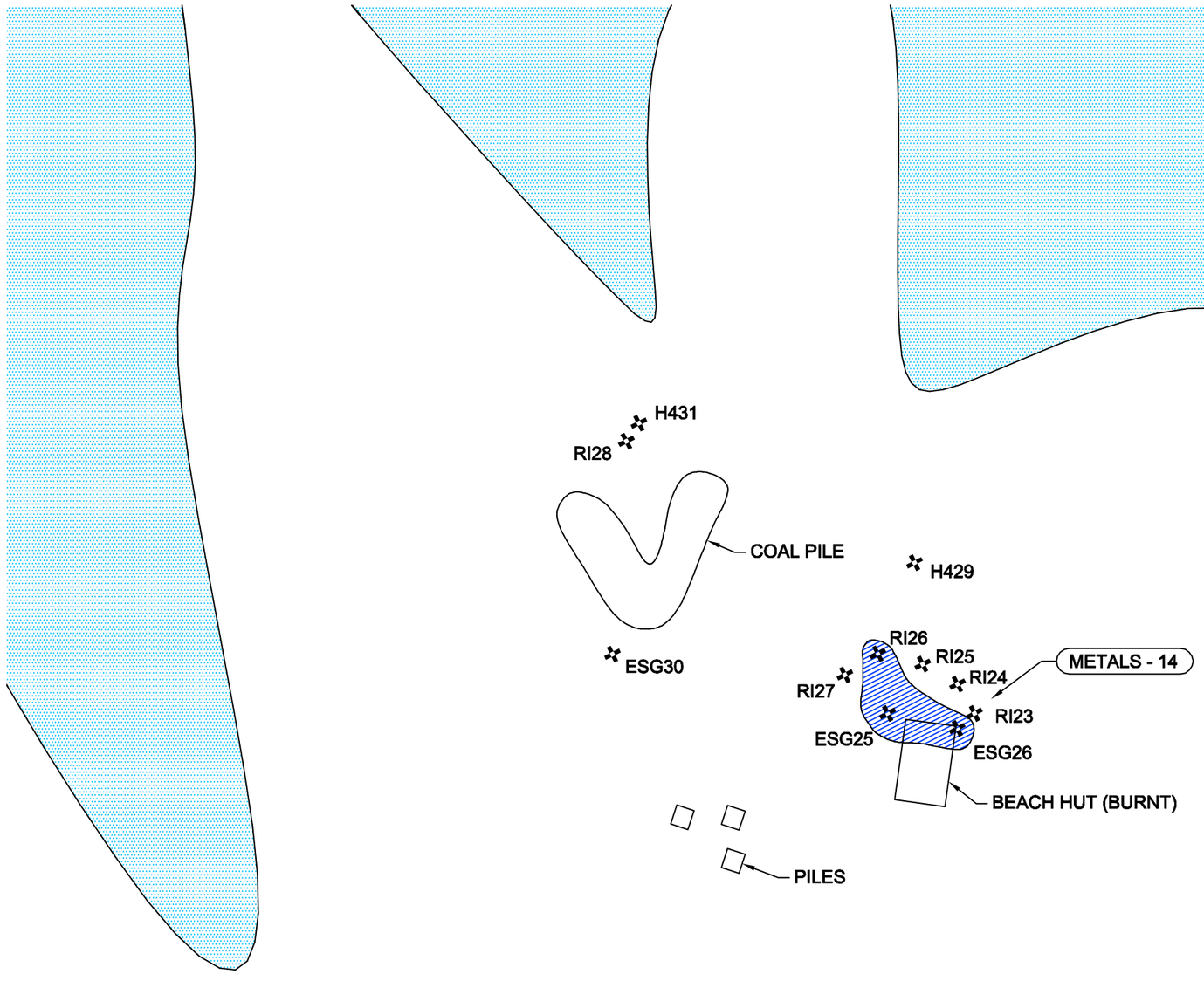
0 7.5 15 22.5 m SCALE 1:750

UMA | AECOM

Figure - 1.2

CONTAMINATED SOIL TO BE EXCAVATED*		
AREA NAME	APPROX. AREA OF CONTAMINATION (m^2)	ESTIMATED IN PLACE VOLUME (m^3)
METAL CONTAMINATION		
METALS - 14	39	20

* BASED ON THE "ABANDONED MILITARY SITE REMEDIATION PROTOCOL" BY INAC DATED MARCH 2005.



LEGEND:

- HEAVY METALS AND HYDROCARBONS EXCEEDANCES
- HEAVY METALS EXCEEDANCES
- BEDROCK DEFINED GULLIES

Public Works and Government Services Canada
Environmental Restoration at Radio Island, NU
Contaminated Soils Delineation Update

Beach / Coal Off Loading Area

0 4 8 12 m SCALE 1:40(

UMA | AECOM

Figure - 1.3

APPENDIX B:

SITE PHOTOS

View of Main House (right) and Winch Shed (left)

View of Helipad, Winch Shed and Main House

Close-up of Lead based pain on Winch Shed

View of Generator Building Foundation and Debris

View of Beach Hut (Burnt)

View of Acadia Cove and probable sea lift access location

View of man-made Pond and Debris west of Main House

APPENDIX C:

DETAILED COST ESTIMATE

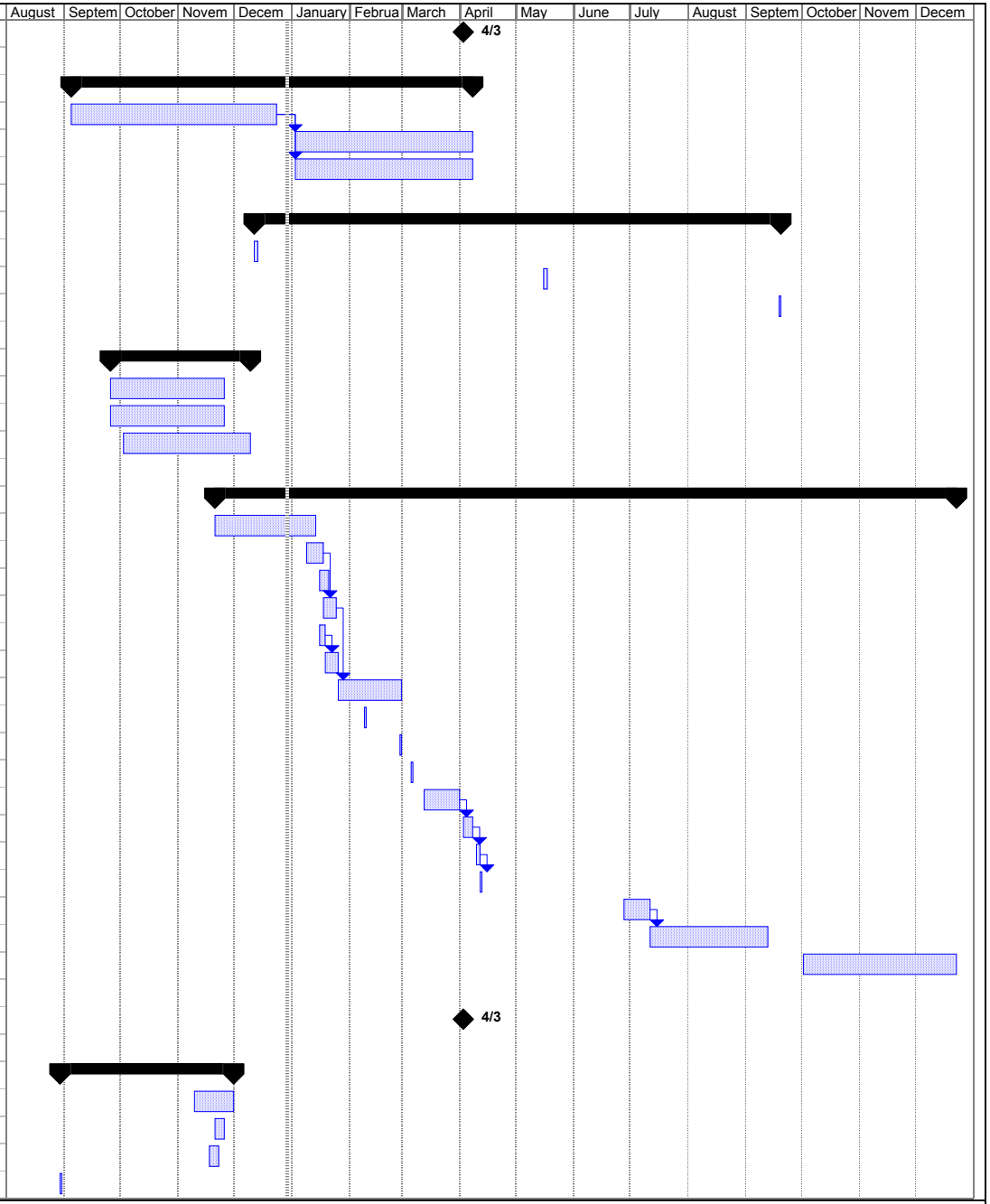
Remediate former Navigational Aid and Weather Station.
RADIO ISLAND, NUNAVUT

No.	Description	Unit	Quantity	Unit Price	Total Price 2006/07
1	Camp Supply	lump sum	1		$ 350,000.00
2	Purchase Enviro Tanks	each	2	$ 50,000.00	$ 100,000.00
3	Equipment allowance	lump sum	1		$ 245,000.00
4	Marine Mobilization	lump sum	1		$ 320,000.00
5	Fuel	liters	100,000	$ 1.50	$ 150,000.00
6	Consumeables (oil, filters etc)	lump sum	1		$ 15,000.00
7	Kitchen appliances	lump sum	1		$ 15,000.00
8	Camp set up	lump sum	1		$ 65,000.00
9	Camp operation	days	42	$ 4,500.00	$ 189,000.00
10	Safety Supplies	lump sum	1		$ 15,000.00
11	Rotary wing aircraft	lump sum	1		$ 564,000.00
12	Surveyor	lump sum	1		$ 12,000.00
13	Engineer/scientific advisor	days	42	$ 800.00	$ 33,600.00
14	Supply containers	lump sum	1		$ 250,000.00
15	Drum collection/crush	each	135	$ 90.00	$ 12,150.00
16	Decontaminate lead based paints	lump sum	1		$ 3,000.00
17	Soils contaminated with metals	cu.m.	1100	$ 300.00	$ 330,000.00
18	Backfill excavations	cu.m.	550	$ 16.00	$ 8,800.00
19	Demolish site, collect debris	cu.m.	415	$ 400.00	$ 166,000.00
20	Clean lumber-burning	Allowance	1		$ 10,000.00
21	Hazardous materials/ collection	lump sum	1		$ 8,600.00
22	Hazardous materials/ disposal	lump sum	1		$ 5,000.00
23	Communications	lump sum			$ 10,000.00
24	Submittals	lump sum	1		$ 25,000.00
25	Load sea cans on barge	lump sum	1		$ 250,000.00
26	Camp breakdown	lump sum	1		$ 65,000.00
27	Marine demobilization	lump sum	1		$ 600,000.00
	Total				**$ 3,817,150.00**
	Contingencies @15%				$ 572,572.50
	Total construction				**$ 4,389,722.50**
	Engineering				
	Design				$ 47,000.00
	Site Inspection				
	Site inspection Disb/travel				$ 50,000.00
	Scientific advisor				
	Confirmation testing				$ 100,000.00
	Consultant Project Management				$ 200,000.00
	PWGSC Project Management				$ 200,000.00
	INAC Project Management				$ 200,000.00
	Total engineering				**$ 797,000.00**
				TOTAL	**$ 5,186,722.50**
	Budget Summary				
	Construction				$ 3,817,150.00
	Construction Contingency				$ 572,572.50
	Engineering				$ 797,000.00
				TOTAL	**$ 5,186,722.50**

APPENDIX D:

WORK PROGRAM SCHEDULE

ID	Task	Task Name	Duration	Start	Finish
1	1	**Care and Maintenance**	0 days	Mon 4/3/06	Mon 4/3/06
2					
3	2	**Regulatory Approvals**	**155 days**	**Mon 9/5/05**	**Fri 4/7/06**
4		Report Preparation	4 mons	Mon 9/5/05	Fri 12/23/05
5		Obtain NWB Permit	3.45 mons	Tue 1/3/06	Fri 4/7/06
6		Obtain Land Use Permit	3.45 mons	Tue 1/3/06	Fri 4/7/06
7					
8	3	**Consultations**	**202 days?**	**Mon 12/12/05**	**Tue 9/19/06**
9		Community Consultations to present RAP	2 days	Mon 12/12/05	Tue 12/13/05
10		Pre-Construction Community Consultation	2 days	Tue 5/16/06	Wed 5/17/06
11		Post Construction Community Consultation	1 day?	Tue 9/19/06	Tue 9/19/06
12					
13	4	**Site Investigation And Assessment**	**55 days**	**Mon 9/26/05**	**Fri 12/9/05**
14		Complete Environmental Screening	45 days	Mon 9/26/05	Fri 11/25/05
15		Complete Site Specific HHERA	45 days	Mon 9/26/05	Fri 11/25/05
16		Finalize Remedial Action Plan	50 days	Mon 10/3/05	Fri 12/9/05
17					
18	5	**Site Remediation**	**285 days**	**Mon 11/21/05**	**Fri 12/22/06**
19		Prepare Tender Documents	40 days	Mon 11/21/05	Fri 1/13/06
20		Prepare Request for Proposal	7 days	Mon 1/9/06	Tue 1/17/06
21		In house cost estimate	5 days	Mon 1/16/06	Fri 1/20/06
22		French Translations	5 days	Wed 1/18/06	Tue 1/24/06
23		RMP and PAAA	3 days	Mon 1/16/06	Wed 1/18/06
24		Procurement Plan Approval	5 days	Thu 1/19/06	Wed 1/25/06
25		Post RFP on MERX	24 days	Thu 1/26/06	Tue 2/28/06
26		Bidder's Conference	1 day	Thu 2/9/06	Thu 2/9/06
27		Tender Closing Date	1 day	Tue 2/28/06	Tue 2/28/06
28		Evaluate Proposals in Ottawa	1 day	Mon 3/6/06	Mon 3/6/06
29		Obtain Contractor Documents	15 days	Mon 3/13/06	Fri 3/31/06
30		Approvals	5 days	Mon 4/3/06	Fri 4/7/06
31		Recommend Award	2 days	Mon 4/10/06	Tue 4/11/06
32		Award Contract	1 day	Wed 4/12/06	Wed 4/12/06
33		Mobilize to site	10 days	Wed 6/28/06	Tue 7/11/06
34		Complete Remediation Activities	45 days	Wed 7/12/06	Tue 9/12/06
35		Remediation Report Preparation	60 days	Mon 10/2/06	Fri 12/22/06
36					
37	6	**Monitoring**	0 days	Mon 4/3/06	Mon 4/3/06
38					
39	7	**Project Management**	**67 days**	**Tue 8/30/05**	**Wed 11/30/05**
40		Complete Detailed Work Plan	15 days	Thu 11/10/05	Wed 11/30/05
41		Complete Detailed Budget	5 days	Mon 11/21/05	Fri 11/25/05
42		Complete Detailed Schedule	3 days	Fri 11/18/05	Tue 11/22/05
43		Site Visit	1 day	Tue 8/30/05	Tue 8/30/05



Project: Radio Island Project Schedule
Date: Thu 12/29/05

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone