APPENDIX D

Resolution Island Remediation
Design Report

BAF-5, Resolution Island Remediation Design Report Revised Project Scope

Public Works and Government Services Canada

Project Number: 60328051 (515)

March 28, 2017

AECOM Signatures

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
Revision 0	March 15, 2017	Draft	Yes		
Revision 1	March 28, 2017	Final	Yes		

Distribution List

# Hard Copies	PDF Required	Association / Company Name
1	Yes	Public Works and Government Services Canada

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1. Introduction

Resolution Island (BAF-5) is located off the southeastern tip of Baffin Island, Nunavut (NU), at 61° 30' north latitude and 65° 00' west longitude, and occupies an area of over three square kilometres (km^2). BAF-5 was constructed in 1954 as part of the Pole Vault system, providing a link between the Distant Early Warning (DEW) Line and military bases in southern Canada and the United States. The site was vacated as a Pole Vault station and a Strategic Air Command Communications (SACC) post by the United States Air Force (USAF) in 1972 and then used by the Canadian Coast Guard as a Long Range Navigation (LORAN) site until 1974. In 1985, a portion of the site was secured for use by the Department of National Defence (DND) as a Short Range Radar (SRR) station, where it still operates. Between 1997 and 2006, environmental remediation works were completed to bring the site into legal compliance with respect to the Canadian Environmental Protection Act (CEPA) and Fisheries Act legislation.

AECOM Canada Ltd. (AECOM) was retained by Public Works and Government Services Canada (PWGSC), on behalf of Indigenous and Northern Affairs Canada (INAC), Nunavut Regional Office Contaminated Sites Program, to complete a Maintenance Assessment, Remedial Action Plan (RAP) and detailed design, including provision of tender drawings, specifications and cost estimate for the BAF-5, Resolution Island site. The results of the assessment activities have been reported previously (AECOM 2016a, AECOM 2015 and AECOM 2014).

Historical reviews and a site visit in 2012 had identified a number of areas where additional sampling, assessment and inspection were recommended to evaluate post remediation conditions. In August 2013, AECOM completed a Maintenance Assessment at BAF-5. The objective of this work was to provide additional information to complete the design and specifications for remedial work at the site. Not all of the 2013 Maintenance Assessment action items could be investigated due to poor weather conditions and limited time on site. In August 2014, AECOM completed an additional assessment at BAF-5 for the purposes of finalizing the design and specifications. This assessment consisted of a limited petroleum hydrocarbon (PHC) investigation at fuel storage areas, confirmatory soil sampling at the Camp Landfill, evaluation of the SRR Construction Landfill, and further assessment and investigation of potential granular borrow areas. Additional tasks included the collection of surface water samples, confirmation of replacement culvert installation details, collection of additional building structural details and topographic survey of specific site areas.

Following submission of the Issued for Tender Specifications and Drawings for maintenance activities at Resolution Island in March 2015, the Indigenous and Northern Affairs Canada (INAC) Project Technical Office (PTO) completed a review of the Resolution Island detailed work plan to assess potential changes to the project scope (INAC 2014). As a result of that review, the scope of the planned remediation at Resolution Island was reduced to only address the high priority liabilities including but not limited to:

- Excavation of contaminated soil associated with Permeable Reactive Barriers (PRBs) and removal and/or replacement of PRBs, as required.
- Collection, containerization and off-site disposal of hazardous materials. (This includes hazardous surface debris, PRB materials and waste fuel but does not include inaccessible hazardous materials within remaining infrastructure.)
- Incineration and/or off-site transport and disposal of waste fuels.
- Excavation and off-site disposal of contaminated soils, as required.

In August 2016, AECOM completed supplementary assessment activities to provide the additional information required to complete the design and specifications for the revised scope of remedial work at the site. Assessment activities consisted of additional delineation of contaminated soil areas, collection of samples downgradient of the SRR Construction Landfill and collection of vegetation samples to support the Problem Formulation with Human Health and Ecological Risk Assessment (AECOM 2016c) for the site.

This design report discusses information sources used for the design, assumed site conditions, execution assumptions for construction, and design decisions made to develop the tender documents for the revised project scope.

2. Site Access

2.1 Off-Site Access

2.1.1 Sea Access

The BAF-5 site is located on Resolution Island on Brewer Bay, facing the Labrador Sea, and sealifts have historically landed at the Beach Area. The ground at the beach is composed of generally well-drained, coarse-grained beach deposits, which are not expected to pose a problem for beaching or using heavy equipment in the area for movement of materials upon landing. AECOM has reviewed a nautical chart for the area outlining “Approaches to Sorry Harbour”, published by the Canadian Hydrographic Service (CHS 2005). The nautical chart indicates the presence of an anchorage area adjacent to the barge landing at the Beach Area. Based on this information and historical landings, sea landing at Resolution Island is not expected to pose a significant challenge.

2.1.2 Air Access

The airstrip at Resolution Island is approximately 450 metres (m) long and 40 m wide and is constructed with granular material borrowed from an area adjacent to the airstrip. The airstrip is generally in fair condition; however, there are areas which will need minor upgrading with the placement and compaction of additional granular fill during future maintenance activities. A specific area of concern is located near the middle of the airstrip, where the access road connecting the upper site and beach area crosses the airstrip. A Twin Otter successfully landed at the site in August 2016. However, it is essential that the airstrip be inspected by aircraft crews familiar with the necessary granular support requirements prior to its use. An alternative to fixed wing aircraft is a helicopter.

It has been assumed that aircraft access for re-supply and personnel transport to the site will not be an issue, especially given the assumption that the primary mobilization of contractor equipment will be via sealift. All landings at the site will be at the discretion of the aircraft pilot.

2.1.3 Summary

It is anticipated that BAF-5 will be accessible by sea transport, air transport or a combination of these. The close proximity to the community of Iqaluit with regular commercial airline flights, will allow for shipping of smaller cargo items, including groceries, to the BAF-5 site. It has been assumed that access to the site for mobilization and demobilization of contractor equipment and major supplies will be via sealift.

2.2 On-Site Access

2.2.1 Site Access Roads

There are a number of gravel roads throughout the site connecting the Upper Site with the airstrip, the Old Fresh Water Lake, existing landfills, and beach areas. A visual inspection was completed in 2013 to evaluate the general condition of gravel roads and to assess the maintenance or upgrading required for movement of construction equipment, haul trucks, and other passenger vehicles likely to occur during the maintenance activities. For reference, the roadway was divided into sections which include Road Section 1 from the Upper Site to the Airstrip; Road Section 2 from the Airstrip to the Old Freshwater Lake; Road Section 3 connecting the Old Freshwater Lake to the Beach; and Road Section 4 providing access to Radio Hill. The road cross-sections are approximately 5 to 6 m wide and were constructed with locally sourced granular material. The condition of the roads varies between very poor and good. Roads within the upper site area tend to be in better condition than the road connecting the Old Freshwater Lake and Beach Area. The worst road sections occur in the vicinity of the Old Freshwater Lake. The 2013 roadway assessment is summarized in Table 1. Significant deviations from the 2013 findings were not identified during the 2016 site visit.

Road Section 1 includes the access road network in the vicinity of the Upper Site and the road that connects the Upper Site with the Airstrip, comprising an overall roadway length of 1.8 kilometres (km). In general, the roads in this area were in good to fair condition, requiring minor repair or upgrade for use during future construction activities. Minor erosion features and localized areas of poor drainage were present, but could be easily addressed. The area adjacent to the Tier II Disposal Facility was not wide enough for two-way traffic and may require widening during maintenance activities. The portion of road within 100 m of the airstrip was in very poor condition with major erosional features, drainage channels and evidence of slope instabilities. Stabilization and upgrade efforts will be required in this area.

Road Section 2 is approximately 1.7 km long and includes the portion of the road network that connects the Airstrip to the Freshwater Lake. The portion of Road Section 2 between the Airstrip and Radio Hill access was generally in good condition with only minor erosion features and localized areas of poor drainage. The portion of Road Section 2 between the Radio Hill access and the Old Fresh Water Lake was generally in poor to very poor condition and one area of this road is considered to be impassable for construction equipment. Deep erosion channels (approximately 15 to 20 centimetres (cm) deep) were present and there was a washout near the bottom of the hill where the ditch has been blocked by sediment. Approximately 30 to 50 cm of fill would be required to repair this 30 m section of road and the drainage ditch would have to be re-established. There were multiple washouts at a low spot near the Freshwater Lake where water crossed the road, so a culvert may be required in this location. The most significant feature in this section of road was a washout at the base of the hill near the Freshwater Lake, where there are two culverts, both of which have collapsed and segmented. During the field investigation, this washout was passable by ATV but not with the Kubota excavator. Repair of this area will require the installation of two new culverts and maintenance of the concrete structure that is currently preventing flow from the Freshwater Lake through the access road.

Road Section 3 is approximately 2.3 km long and includes the portion of the road network that connects the Freshwater Lake to the Beach Area. This section was generally in fair condition, and several erosion gullies and washouts have developed that will require repair. These erosion features can be repaired during construction and improvement of the drainage ditches and the redirecting of surface water will also be required. Portions of the road may need to be widened to accommodate two-way traffic.

Road Section 4, the access road to Radio Hill, is approximately 850 m long. This section of road was in good to fair condition. There was a large drainage channel present in the centre of the road, approximately 70 m upgradient of the access point of the Radio Hill Access Road from the Airstrip to Freshwater Lake road section. The road was on a relatively steep slope and enhanced safety precautions will be required during construction around the tight curves and narrow sections.

Table 1. Summary of Roadway Assessment

Road Section	Condition	Passable (Minimum Width)	Steep and High Side Slopes	Erosion Features	Rough Surface and Exposed Bedrock
Upper Site to Airstrip	Good to Very Poor	Area near Tier II Landfill may require widening to accommodate two-way traffic.	The section of road within 100 m of the airstrip in experiencing slope failure. Fill and compaction required.	Minor erosion features and localized areas of poor drainage are present, which require repair. The section of road within 100 m of the airstrip has major erosion and drainage channels that require attention.	Exposed bedrock near centre of road in few locations.
Airstrip to Freshwater Lake	Good to Very Poor	Currently not passable due to large washout near Freshwater Lake.	N/A	Several erosional features present and require repair: Major washouts and drainage issues make potions of the road impassable. Culverts may be required in some locations.	N/A
Freshwater Lake to Beach	Fair	Portions road may need to be widened if two-way traffic is required during construction.	N/A	Several erosion features have developed that require repair including several erosion gullies and washouts. Adding drainage ditches would protect the road by redirecting surface runoff from the road.	N/A
Radio Hill Access	Good to Fair	Tight bends and narrow sections will require precautions during construction.	Road is on relatively steep slope.	N/A	N/A

2.2.2 Construction Camp and Laydown Areas

The construction camp and laydown areas for construction staging should be located in previously disturbed areas that are a minimum of 30 m from any water body and should not be in conflict with any contract work areas. Potential suitable locations exist at the Beach and Airstrip Areas. The washout at the Freshwater Lake could limit access to the Upper Site until repairs are completed.

3. Execution Assumptions

3.1 Schedule

Remedial activities at Resolution Island include the following:

- Excavation of contaminated soil associated with Permeable Reactive Barriers (PRBs) and removal and/or replacement of PRBs, as required.
- Excavation and off-site disposal of contaminated soils, as required.
- Collection, containerization and off-site disposal of hazardous materials. This includes hazardous surface debris, PRB materials and waste fuel but does not include inaccessible hazardous materials within remaining infrastructure.
- Collection and on-site stockpiling of select non-hazardous materials. This includes creosote treated materials following wrapping in polyethylene sheeting, crushed barrels, old contaminated soil containers and existing culverts.
- Incineration and/or off-site transport and disposal of waste fuels in barrels and fuel storage tanks.
- Upgrading of site access roads, as required, to facilitate construction activities.

It is expected, based on the assumption of sealift access, that the contractor would mobilize to the site in the summer (late June or early July) and initiate the construction with critical work items and complete the remediation activities over two construction seasons, including the mobilization/demobilization. Assuming the first year extends to mid-September, which is typical for other sites in the area, this would allow for approximately six to eight weeks of construction during the mobilization year. During this time, it would be reasonable to assume that the contractor could complete major upgrades to the access roads, set-up the construction camp, investigate borrow areas and begin borrow development. It is anticipated that remedial activities would be well underway at the end of the first year.

Based on the recommended remedial actions outlined previously, construction activities will require two seasons of clean-up activity (with time for efficient mobilization/demobilization and time to accommodate weather-related delays). It is anticipated that the contractor will only require a partial second season.

In order to meet the anticipated schedule, a priority construction activity will include the incineration of waste fuels. For this work item, the onus will be placed on the contractor to supply and operate a waste fuel incinerator capable of incinerating the estimated total volume of fuel by the end of on-site construction activities.

3.2 Culvert Replacement

Repair of the washout at the Old Freshwater Lake is required to maintain access between the Upper Site and Beach Area. The repair will include the installation of two new culverts and maintenance of the concrete structure that is currently preventing flow from the Freshwater Lake through the access road. Construction activities will include the following:

- The supply and installation of two 900 millimetre diameter corrugated steel pipe culverts, including the removal of existing culverts
- Supply and installation of corrugated steel pipe culverts
- Supply of granular fill, supply of couplings
- The grouting of replacement culvert into the existing concrete headwall
- On-site transportation and storage of the old culverts in Building B2

The design of the culvert replacement is based on survey data and measurements collected from the area in 2014.

3.3 Permeable Reactive Barriers (PRBs)

Three PRBs were previously installed at the Furniture Dump, the S1/S4 Valley and the S1/S4 Beach to control Polychlorinated Biphenyl (PCB) migration from areas of inaccessible PCB contaminated soil at the site. The 2012 Remediation Information Review and Risk Evaluation (AECOM, 2013) identified the need for a long term plan for managing residual PCB impacts at the PRB areas. The Analytical Services Unit (ASU) of Queen's University was tasked with delineating contaminated soil at the PRBs and developing a barrier decommissioning plan (ASU 2013). The remedial design of the PRBs is based on the environmental status and correspondingly, the long term protection of the environment. The primary objectives of the PRB remediation design are to:

1. Address the environmental issues identified by ASU during previous investigations
2. Address the identified exposure scenarios and risks
3. Address engineering and constructability constraints
4. Provide a cost-effective solution that balances contractual and environmental risks

3.3.1 Furniture Dump

In 2011, the drainage pathway from the excavated Furniture Dump to the Furniture Dump Barrier was further investigated and delineated. ASU estimated that 5 to 10 cubic metres (m^3) of soil contaminated with PCBs at the Canadian Environmental Protection Act (CEPA) level remained in the drainage pathway. The CEPA-level PCB contaminated soil trapped at the Furniture Dump indicates that there is a significant source area remaining. The inability to effectively capture or contain the source is considered the highest risk remaining at the site, requiring regular monitoring and maintenance of the barriers, and requiring that a PCB storage facility remain at the site. ASU has recommended that the Furniture Dump drainage pathway be excavated and the existing barrier be demolished and a replacement barrier rebuilt in place.

Based on the delineation completed in 2013, ASU estimates that there is 1 m^3 of hazardous contaminated soil contained within the Furniture Dump barrier structure and 10 m^3 of hazardous contaminated soil contained within the Furniture Dump drainage pathway. According to observations made during the 2016 site visit, the volume of contaminated soil in this area appears relatively unchanged since 2013. For a breakdown of the PRB contaminated soil and material quantities, refer to the Design Quantity Summary provided in Appendix B.

3.3.2 S1/S4 Valley Permeable Reactive Barrier

Based on the annual monitoring between 2006 and 2011, it appears that the PCB source at the S1/S4 area is substantially depleted and there is significantly less potential for ongoing migration. As such, the risk associated with this area is low. Given the significant revegetation of the valley and the concentration and volume of sediment in the S1/S4 Valley barrier, ASU has recommended that the gate portion of the barrier be simplified and all liners removed, to minimize monitoring and maintenance requirements in the S1/S4 valley. The soil within the S1/S4 Valley barrier structure is to be removed.

Based on the delineation completed in 2013, ASU estimated that there is 15 m^3 of Tier I contaminated soil contained within the S1/S4 Valley barrier structure. According to observations made during the 2016 site visit, the volume of contaminated soil in this area appears to have increased since 2013. Therefore, a contingency of 15% was added to the contaminated soil volume, resulting in an estimated volume of approximately 17 m^3 in the barrier structure. For a breakdown of the PRB contaminated soil and material quantities, refer to the Design Quantity Summary provided in Appendix B.

3.3.3 S1/S4 Beach Permeable Reactive Barrier

Based on the annual monitoring between 2006 and 2011, similar to the S1/S4 Valley, it appears that the PCB source at the S1/S4 area is substantially depleted and there is significantly less potential for ongoing migration. As such, the risk associated with this area is low. ASU has recommended that the S1/S4 Beach PRB remain in place, following the excavation of contaminated sediments and replacement of used filters.

Based on the delineation completed in 2013, ASU estimated that there is 6 m^3 of Tier I contaminated soil contained within the barrier structure. According to observations made during the 2016 site visit, the volume of contaminated soil in this area appears to have increased since 2013. Therefore, a contingency of 15% was added to the contaminated soil volume, resulting in an estimated volume of approximately 7 m^3 in the S1/S4 Beach barrier structure. For a breakdown of the PRB contaminated soil and material quantities, refer to the Design Quantity Summary provided in Appendix B.

If the barrier is to be decommissioned in the future, the area will require delineation to determine current PCB concentrations of the soils and to assess the movement of the CEPA contaminated soils. According to ASU assessments, results of past soil sampling programs suggest that PCB contaminated soils are migrating towards the beach area reactive barrier via surface runoff following freshet and precipitation events.

3.4 Barrels and Fuel Storage Tanks

Approximately 42 barrels (Monitoring Camp Barrel Cache) were identified within Building S18 at the Station Area during the 2013 assessment. Barrel content samples have not been collected, but previous assessments have indicated that the barrels contain gasoline and lubricating oil. Sampling and analysis of parameters outlined in the Targeted Barrel Testing Approach should be completed prior to remediation to determine disposal requirements. Barrels with hydrocarbon contents meeting the incineration criteria can be incinerated in accordance with Occupational Health and Safety Requirements and the appropriate licenses and permissions. Barrel contents that do not meet incineration criteria will require treatment or off-site disposal.

Ten fuel storage tanks remain on the site including the Camp Tank and Helipad Tank within the Station Area and the eight Beach Tanks at the Beach Area. All tanks have residual contents that will have to be removed. Fuel storage tank contents meeting the incineration criteria can be incinerated in accordance with Occupational Health and Safety Requirements and the appropriate burn permits/ licenses/ permissions.

It is estimated that approximately 76,150 L of waste fuel is contained within the barrels and fuel storage tanks. A list of the tanks and barrels, location and volume is identified in Table 2.

Table 2. BAF-5 Summary of Residual Petroleum Hydrocarbons

Container	Fuel Type	Approximate Volume	Location
Camp Tank	Jet A/Arctic Diesel	20,000 L	Station Area
Helipad Tank	Jet A/Arctic Diesel	20,000 L	Station Area
Beach Tanks	Jet A/Arctic Diesel	30,000 L	Beach Area
Monitoring Camp Barrel Cache	Gasoline and Lube Oil	6,150 L	Station Area

Cleaned and crushed drums, and non-hazardous material removed from fuel tank systems will be stockpiled within Building B2 for future off-site shipment and disposal as non-hazardous waste.

3.5 Contaminated Soils

Contaminated soil designated for removal will be containerized and shipped off-site for disposal at a southern waste disposal facility. Containerized contaminated soil currently stored on site will be re-containerized prior to off-site shipment. When generating design quantities, a 10% design contingency was applied to all contaminated soil volumes. Since the payment for contaminated soil excavation will be measured by volume placed in container, an overall design contingency of 5% and a 25% bulking factor was also applied to determine the design quantities.

For a breakdown of the contaminated soil quantities, refer to the Design Quantity Summary provided in Appendix B.

3.6 Non-Hazardous Waste

Non-hazardous waste designated for removal or generated during remediation activities will be stockpiled within Building B2 for future off-site shipment and disposal. Non-hazardous waste at Resolution Island includes the following:

- Wrapped creosote-treated materials located within the two surface debris areas
- Cleaned and crushed barrels from the Monitoring Camp Barrel Cache
- Cleaned and crushed barrels from Building B2
- Cleaned soil bags from Building B2
- Non-hazardous PRB materials
- Non-hazardous waste generated by the permanent withdrawal of fuel tank systems

The estimated total crushed volume of known non-hazardous waste requiring on-site stockpiling and storage is approximately 21 m^3. For a breakdown of non-hazardous waste quantities at Resolution Island, refer to the Overall Quantities Table in Appendix B.

3.7 Hazardous Waste

Hazardous waste designated for removal will be packaged in accordance with Transportation of Dangerous Goods regulations and shipped off-site for disposal at a licensed hazardous waste disposal facility. Hazardous waste at Resolution Island includes the following:

- Hazardous waste located within the two surface debris areas
- All Geosynthetic Clay Liner (GCL), reinforced geomembrane and High Density Polyethylene (HDPE) geomembrane removed from the Furniture Dump PRB and S1/S4 Valley PRB
- POL products that do not meet incineration criteria (unknown quantity)
- Hazardous soil excavated from the PRBs structures and drainage pathways

The estimated total volume of known hazardous waste (including hazardous contaminated soil) requiring off-site transport and disposal is approximately 26 m^3. For a breakdown of hazardous waste quantities at Resolution Island, refer to the Design Quantity Summary in Appendix B.

4. Design

4.1 Problem Formulation with Human Health and Ecological Risk Assessment

Following supplementary assessment activities in 2016, AECOM completed a Problem Formulation with Human Health and Ecological Risk Assessment (AECOM 2016c) to evaluate the remedial strategy of excavating metals contaminated soil exceeding Tier II DEW Line Clean-up Criteria (DCC) at Resolution Island. The assessment focused exclusively on the environmental risk associated with the residual DCC Tier II metals contaminated soil previously identified at the North Slope Dump, Camp Landfill, SRR Landfill and Airstrip Landfill, and excluded all PCB contaminated soil.

Based on the conclusions of the assessment, approximately 195 m^3 of previously identified metals contaminated soil exceeding Tier II DCC were removed from the scope of remedial activities at Resolution Island.

4.2 Borrow Areas

A total of 14 borrow areas were previously identified at Resolution Island for sourcing granular material during construction. There is a requirement for approximately 25 m^3 of Type 1, 2,600 m^3 of Type 2 and 500 m^3 of Type 3 Granular Fill. This includes the Granular Fill required for the installation of culverts at the Old Freshwater Lake, access road upgrades, backfilling of contaminated soil excavations and a general site allowance for Type 3 Granular Fill. Table 3 summarizes granular material types and the estimated available volume in each area.

Table 3. Summary of Granular Material Quantities

Borrow Area	Location	Type[1]	Estimated Quantity[2] (m^3)	Evaluation of Source
Upper Airstrip Borrow Area 1	South Side of East End of Airstrip	Type 1	1,000	Potential source.
Upper Airstrip Borrow Area 2	South Side of West End of Airstrip	Type 1, 2, 3	9,000	Southwest expansion area is 9,000 m^2. Old depleted area to produce small volume of Type 1 material.
Upper Airstrip Borrow Area 3	North of Airstrip	Type 1, 2, 3	3,000	Northeast ridge is a potential source.
Lower Airstrip Borrow Area 1	West of Airstrip	Type 1, 2, 3	3,000	Potential source. Access to the area would be difficult.
Lower Airstrip Borrow Area 3	West of Airstrip	Type 1, 2, 3	27,000	Potential source. Construction of access may be difficult.
Freshwater Lake Borrow Area 1	Southeast portion of Freshwater Lake, including stockpile	Type 1, 2, 3	12,000	Potential Source. Difficult to access remaining material in borrow area. NE expansion area 5,000 m^2
Freshwater Lake Borrow Area 2	North of Freshwater Lake	Type 1, 2, 3	9,000	Likely insufficient yield due to the volume of granular material required to construct access.
Access Road Borrow Area 2	Beach Area		Minimal	Borrow area appears mostly depleted and saturated.
Freshwater Lake Borrow Area 3	East of South End of Freshwater Lake	Type 2, 3	3,000	Potential source.
Lower Airstrip Borrow Area 4	Near Junction of Main Road and Radio Hill Access Road	Type 1, 2, 3	18,000	Potential source. Water management is required.
Lower Airstrip Borrow Area 5	Southwest of Airstrip	Type 1, 2, 3	13,000	Potential source. Water management is required.
Upper Beach Borrow Area	Northeast of Beach Landfill	Type 1, 2, 3	9,000	Potential source. Good access.
			107,000 m^3	**Total**

Notes:

(1) Processing may be required to obtain required granular material type

(2) Estimated borrow volumes are bulk volumes including all material types and do not consider wasting of poor quality, reject or otherwise unsuitable material.

Refer to the Design Quantity Summary in Appendix B for granular requirement details.

4.3 Disposal of Contaminated Soil, Hazardous and Non-Hazardous Waste

The contractor is to containerize all hazardous waste and contaminated soil for off-site transport and southern disposal.

The contractor is to stockpile all non-hazardous waste in Building B2 for future disposal.

5. References

AECOM Canada Ltd. (AECOM 2016a). BAF-5, Resolution Island, Supplementary Assessment Report.

AECOM Canada Ltd. (AECOM 2016b). BAF-5, Resolution Island, Remedial Action Plan (Revised Project Scope).

AECOM Canada Ltd. (AECOM 2016c). BAF-5, Resolution Island, Nunavut: Problem Formulation with Human Health and Ecological Risk Assessment.

AECOM Canada Ltd. (AECOM 2015). BAF-5, Resolution Island, Supplementary Maintenance Assessment.

AECOM Canada Ltd. (AECOM 2014). BAF-5, Resolution Island, Maintenance Assessment Report.

AECOM Canada Ltd. (AECOM 2013). BAF-5, Resolution Island, Information Review and Risk Evaluation.

Analytical Services Unit (ASU) (ASU, 2013), Queen's University. Resolution Island 2013, Monitoring and Research.

Canadian Hydrographic Service (CHS 2005). Resolution Island, Approaches to Sorry Harbour, Chart #5340.

Indigenous and Northern Affairs Canada (INAC 2014). Resolution Island Project Detailed Work Plan – Review of Project Scope

Appendix B

Design Quantity Summary

ENVIRONMENTAL REMEDIATION PROJECT

SUMMARY OF QUANTITIES: BAF-5 - Resolution Island, NU

Dwg. Ref.	CLEANUP WORK ITEM	GRANULAR FILL			CONTAMINATED SOIL			DEBRIS AND DEMOLITION				OTHER								
		Type 1 (m^3)	Type 2 (m^3)	Type 3 (m^3)	Tier I (m^3)	Tier II (m^3)	Hazardous (m^3)	Debris Clean-up		Demolition		Re-Construction/Maintenance of PRBs								Incineration of Fuel (L)
								Non-Haz (m^3)	Hazardous (m^3)	Non-Haz. (m^3)	Hazardous (m^3)	GCL (m^2)	Geomembrane (m^2)	Lumber (m)	Rock Bolts (No.)	Silica Gravel (m^3)	GAC (m^3)	Soil Containers for Future Use (m^3)	
C01	**Site Location Plan**																			
C02	**Overall Site Plan**																			
	Debris Areas																			
	Debris Area 1							1	0.3											
	Debris Area 2								0.2											
	Contaminated Soil																			
	Containerized Contaminated Soil				15	4	1													
	Access Road Upgrade and Maintenance		1,545																	
C03	**Station Area Site Plan**																			
	Contaminated Soil																			
	CL-005					1														
	Hazardous Waste Material																			
	Monitoring Camp Barrel Cache																			6,150
C04	**Airstrip Area Site Plan**																			
	Contaminated Soil																			
	AL-236			5		3														
C05	**Freshwater Lake Area Site Plan**																			
	Culvert Installation	25	50																	
C06	**Beach Area Site Plan**																			
C07	**Permeable Reactive Barrier Contaminated Soil Details**																			
	Contaminated Soil																			
	Furniture Dump PRB						11													
	S1/S4 Valley PRB				17															
	S1/S4 Beach PRB				7															
S01	**Fuel Tank Plans and Elevations**																			
	Camp Tank									2	0									20,000
	Helipad Tank									2	0									20,000
	Beach Tanks									12	0									30,000
S02	**Permeable Reactive Barrier Details**																			
	Demolition																			
	Furniture Dump PRB									0.2	2	60	30	19	20	0.2	0.2			
	S1/S4 Valley PRB									3	2					0.5				
	S1/S4 Beach PRB									0	1					0.2	0.4	10		
	Re-Construction/Maintenance																			
	Furniture Dump PRB																			
	S1/S4 Valley PRB																			
	S1/S4 Beach PRB																			

ENVIRONMENTAL REMEDIATION PROJECT

SUMMARY OF QUANTITIES: BAF-5 - Resolution Island, NU

Dwg. Ref.	CLEANUP WORK ITEM	GRANULAR FILL			CONTAMINATED SOIL			DEBRIS AND DEMOLITION				OTHER							
								Debris Clean-up		Demolition		Re-Construction/Maintenance of PRBs							Incineration of Fuel (L)
		Type 1 (m^3)	Type 2 (m^3)	Type 3 (m^3)	Tier I (m^3)	Tier II (m^3)	Hazardous (m^3)	Non-Haz (m^3)	Hazardous (m^3)	Non-Haz. (m^3)	Hazardous (m^3)	GCL (m^2)	Geomembrane (m^2)	Lumber (m)	Rock Bolts (No.)	Silica Gravel (m^3)	GAC (m^3)	Soil Containers for Future Use (m^3)	
TOTAL BAF-5 SITE - DESIGN QUANTITIES		**25**	**1,595**	**500**	**39**	**8**	**12**	**1**	**0**	**20**	**5**	**60**	**30**	**19**	**20**	**0.9**	**0.6**	**10**	**76,150**
Design Contingency		15%	10%	0%	10%	10%	10%	0%	0%	0%	0%	10%	10%	10%	0%	10%	10%	0%	0%
TOTAL BAF-5 DESIGN QUANTITIES (incl. Contingency)		**29**	**1,755**	**500**	**43**	**10**	**15**	**1**	**0.5**	**20**	**5**	**70**	**40**	**20**	**20**	**1.0**	**0.7**	**10**	***76,150***
Bulking Factor		0%	0%	0%	30%	30%	25%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
TOTAL BAF DESIGN QUANTITIES (w/ Bulking Factor)		**30**	**2000**	**500**	**60**	**13**	**19**	**1**	**0.5**	**20**	**5**	**70**	**40**	**25**	**20**	**1.2**	**0.8**	**10**	**76150**

Non-Hazardous Debris and Demolition Waste (m3) = 21

Required Contaminated Soil Container Volume (m3) = 73

Required Hazardous Waste Container Volume (m3) = 25