REMEDIAL ACTION PLAN
FOR PELLY LAKE FORMER AIRSTRIP
AND FUEL CACHE SITE
PELLY LAKE, NUNAVUT

Prepared for:

Public Services and Procurement Canada
Western Region
10025 Jasper Avenue
Edmonton, AB T5J 1S6

Prepared by:

BluMetric Environmental Inc.
4916 49th Street, Second Floor
Yellowknife, NT X1A 1P3

Project Number: 220515
14 December 2023

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Prepared by:

BluMetric Environmental Inc.

Postal:
P.O. Box 11086
Yellowknife, NT X1A 3X7

Physical:
4916 49th Street, Second Floor
Yellowknife, NT X1A 1P3

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EXECUTIVE SUMMARY

IMPORTANT: *This executive summary provides an overview of the main findings of the study to which it pertains. This executive summary does not provide a comprehensive report, and its review should not be considered a substitute for reading the report in its entirety.*

BluMetric Environmental Inc. (BluMetric®) was retained by Public Services and Procurement Canada (PSPC) Western Region to conduct a Remedial Action Plan (RAP) for the Pelly Lake Former Airstrip and Fuel Cache Site (the "Site"). The RAP was originally intended to include a Remedial Options Assessment (ROA), but this work was delivered separately from the RAP (June 2023). The RAP builds on the ROA and focuses on detailing the RAP and its implementation.

The Site is located approximately 250 kilometres (km) northwest of Baker Lake, approximately 350 km southwest of Gjoa Haven, and approximately 6 km to the northeast of Pelly Lake. The Site is within the Kivalliq region of Nunavut (7327399 N and 407062 E). The Site was reportedly used as a base and airstrip from 1954 to 1956 by Spartan Air Services, who was contracted by the Federal Government to take aerial photographs of the region. Later, a land use permit was granted to Bathurst Inlet Developments Ltd. In 1993 (unknown end date) to rehabilitate the two airstrips at the Site and operate a fuel cache.

Waste Streams Requiring Remedial/Risk Management

Based on the findings of the Phase III ESA and the HHERA, the areas requiring remedial action are impacted sediment, hazardous waste, and non-hazardous waste.

Remedial Options Analysis

After an analysis of possible remedial options outlined in detail in the ROA (BluMetric, 2023a), BluMetric in consultation with PSPC, CIRNAC, and through local engagement determined the recommended remedial/ risk management approach for each waste stream as follows:

- Sediment Impacts: Excavation and southern off-site disposal
- Hazardous Waste: Removal from Site and southern off-site disposal
- Non-Hazardous Waste: A combination of removal of all moveable non-hazardous waste and southern off-site disposal and consolidation and on-site management of large non-hazardous waste.

Site Access

The Site being in a remote and land locked location does not allow for direct barge access or efficient winter hauling routes. Therefore, site access is limited to small aircraft access via the existing airstrip on Site using skis or wheels or via larger aircraft utilizing an ice landing strip on an adjacent water body and via snow machines in the winter months. The access evaluation information obtained during the 2022 field program did not provide confidence in landing larger aircraft than the Twin Otter on the existing airstrip. A preliminary evaluation of access options suggests that larger aircraft may only be able to access the site by using an ice landing strip.

Remediation Strategy and Rationale

The remediation strategy was informed by previous studies, the Remedial Options Assessment (BluMetric, 2023a) and the community engagement (BluMetric, 2023b).

The HHERA resulted in sediment with lead impacts posing an unacceptable risk to ecological receptors. Sediment impacts that exceeded the HHERA ecological screening guideline for lead were considered for remediation, with a total of 6.1 m^3 of impacted sediment estimated for removal.

Hazardous Materials were identified as requiring remediation and/or risk management based on observations made during supplemental sampling. The following Table E-1 summarizes hazardous wastes and approximate volumes:

Table E-1: Summary of Hazardous Debris to be Removed from Site.

Debris Summary	Hazardous Debris				
	Batteries (m^3)	Vehicle Fluids (m^3)	Lead Paint (m^3)	Liquid and Drum/Tank Residues (m^3)	Total (m^3)
Total Debris Quantity - Hazardous	0.10	0.03	0.52	6.64[1]	7.05

[1]Includes the full barrel of liquid at Site#2 Fuel Cache

Non-hazardous debris was identified as requiring remediation and/or risk management based on observations made during supplemental sampling and from feedback during the community consultation. Table E-2 below summarizes the non-hazardous debris and the assumed management strategy.

Table E-2: Summary of Non-hazardous Debris Quantities Grouped by Management Strategy

Debris Summary	Non-Hazardous				
	Total Debris for Removal			Total Debris Managed on Site	
	Metal (m^3)	Other[1] (m^3)	Tank Water (m^3)	Burnable Wood (m^3)	Items Staying Onsite (m^3)
Debris Quantity – Non-Hazardous	68.3	17.2	0.35	45.6	41.7
Total	**85.9**			**87.3**	

Implementation Strategy

The RAP assumes a schedule that requires approximately 1.5 years, including mobilization and demobilization of materials and equipment, to complete the remedial work. The scope of work for the spring/summer of year 1 will include the following:

- mobilization of the camp, hand tools, and equipment to support material processing and packaging
- demolition of existing structures
- burning of clean, unpainted wood debris
- cleaning and crushing of drums
- cutting and packaging of tanks
- hazardous and non-hazardous waste consolidation and packaging
- impacted sediment excavation and packaging
- cleaning and consolidation of debris to remain on site including the removal of lead-based paint and engine fluids from large debris
- staging of materials for winter demobilization
- demobilization of the camp, sediment, and hazardous wastes (if possible) to Baker Lake

The scope of work year 2 will include the following:

- construction of an ice landing strip
- construction of a winter access trail leading to and from the ice landing strip to the staging area
- demobilization of equipment from site
- transportation of sediment, hazardous waste (if not removed during summer program), and non-hazardous waste from the Site to Baker Lake
- summer site visit to verify that Site status after winter demobilization

It is assumed that the final demobilization of waste from Baker Lake to southern-based hazardous waste landfills, recycling facilities and non-hazardous landfills will occur via sealift in the summer of Year 2.

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1 INTRODUCTION

BluMetric Environmental Inc. (BluMetric®) was retained by Public Services and Procurement Canada (PSPC) Western Region to conduct a Remedial Action Plan (RAP) for the Pelly Lake Former Airstrip and Fuel Cache Site (the "Site"). The RAP was originally intended to include a Remedial Options Assessment, but this work was delivered under a separate cover from the RAP (June 2023). The RAP builds on the ROA and focuses on detailing the RAP and its implementation.

This work was completed in response to the terms of reference (TOR) received February 28, 2023: Terms of Reference (TOR), 2022/2023 and 2023/2024 Consulting Services for Pelly Lake Remediation Project, Nunavut. The work was on behalf of PSPC's client Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC).

The Site is located approximately 250 kilometres (km) northwest of Baker Lake, approximately 350 km southwest of Gjoa Haven, and approximately 6 km to the northeast of Pelly Lake. The Site is within the Kivalliq region of Nunavut (7327399 N and 407062 E). The Site was reportedly used as a base and airstrip from 1954 to 1956 by Spartan Air Services, who was contracted by the Federal Government to take aerial photographs of the region. Later, a land use permit was granted to Bathurst Inlet Developments Ltd. In 1993 (unknown end date) to rehabilitate the two airstrips at the Site and operate a fuel cache.

The main area of the Site is situated on a flat area approximately 200 metres above sea level (masl). The Site is uninhabited and located on Crown land. The location of the Site is presented on Figure 1 in Appendix A.

Throughout the years, various materials and structures were left at the Site, including several dilapidated structures, 49 x 1,000-gallon fuel tanks, an estimated 710 barrels of petroleum products (including oil lubricants, aviation fuel, oil, tar, and soil impacted with tar, and 101 cans of aviation oil), pieces of equipment, and the remains of a "Mosquito" aircraft. Three small lakes are present at the Site and several debris areas are located around these lakes. A limited cleanup was reportedly conducted in 1996 but did not remove everything from the Site. The Site is currently abandoned, but it may be used periodically by the local communities for camping during hunting and trapping activities in the region. A Site Plan is presented on Figure 2 in Appendix A.

This report presents the recommended remedial and/or risk management approach, and supporting rationale, for each waste stream identified on Site. This Remedial Action Plan will then detail and discuss a strategy to implement the recommended remedial and/or risk management approach.

2 PROJECT CONTEXT

2.1 ARCHAEOLOGICAL ASSESSMENT

The Archaeological Impact Assessment (AIA) conducted by BluMetric (BluMetric, 2023c) found that no archaeological sites were found at the Site (BluMetric, 2023c). Recent historical and modern sites were documented for anthropological purposes.

2.2 BORROW SOURCE ASSESSMENT

An evaluation of potential borrow sources which could be used for various remedial approaches was conducted by TREK Geotechnical as part of the Phase III ESA (BluMetric, 2023d). A summary of the borrow material assessment can be found in Table 1.

Table 1: Summary of the Borrow Material Assessment

Material Description	Borrow Source	Available Volume (m^3)
Granular Fill	1	2,600
	2	4,700
	5	600
Common Fill	1	2,600
	2	4,700
	3	1,330
	5	600
	8	900
	10	530
	11	2,000
Bedding Sand	4	5,800
	6	4,500
	7	1,380
Rip Rap	1	230
	2	470
	12	650

It was recommended that any borrow area be kept to as small a footprint as possible given the likelihood of permafrost degradation caused by borrow development. Borrow areas must be regraded to promote drainage and match the existing landscape. Erosion protection may be required in areas where higher over land flows are anticipated. Refer to TREK Geotechnical Figures 4A and 4B in Appendix A for borrow source locations.

2.3 SITE ACCESS EVALUATION

In 2022, site access was gained using a DHC-6 Twin Otter aircraft. A questionnaire was provided to the pilots by TREK Geotechnical during the field investigation to assess site access by larger aircraft. The findings showed that the existing airstrip is suitable for DHC-6 Twin Otter or a DC-3 aircraft equipped with skis. Site reconnaissance would be required in the winter season to confirm suitable conditions for the DC-3 to land. Additional follow-up discussions with charter companies and contractors supported the possibility of landing on site with an aircraft equipped with skis and identified the possibility of landing aircraft similar in size to the DC-3 on an ice strip on one of the lakes in close proximity to the site. This would require the development of a winter hauling trail for access from the airstrip to the main Pelly Lake Site. The full findings of the assessment are provided in Appendix B of the Phase III ESA (BluMetric, 2023d).

Subsequent to the field program, BLM contacted various contractors to explore access options for the Site. While overland access is possible, the potential for impacts to wildlife and archaeological features, complex permitting requirements, anticipated high cost, and prolonged project timeframe were deemed prohibitive from both a cost and logistics perspective. The overland access was not considered further.

Access is discussed further in Section 6.

3 ENVIRONMENTAL CONDITION OF THE PROPERTY

3.1 ENVIRONMENTAL SITE ASSESSMENTS

Areas of Environmental Concern (AEC) including the impacted media, a list of associated COCs and the estimated quantity of impacted soil and sediment are summarized below in Table 2. The estimated quantities were determined in the Phase III ESA work and includes co-mingled contaminants.

Table 2: Summary of Impacts to Soil and Sediment

Summary of the Phase III ESA Findings			
Impact Group	**Former AEC/APEC**	**Area of Impacts**	**Estimated Quantity of Impacted Media**
AEC 1 – Campsite Area Pond	AEC 1	POND1 (surface water): aluminum, cadmium, copper, iron, lead	Surface Water: Surface Area: 3,298 square metres (m^2) Depth: unknown Volume: N/A
		POND2 (sediment): copper, lead	Sediment: Surface Area: 32.9 m^2 Depth: 0.3 m Volume: 9.9 m^3
		POND3 (sediment): PAH (acenaphthene, acenaphthylene, dibenz[a,h]anthracene)	Surface Area: 17 m^2 Depth 0.3 m Volume: 5.1 m^3
AEC 2 – Campsite Area	APEC 1	CAMP5 (soil): PHC F2 and F3	Surface Area: 82 m^2 Depth: 1.0 m Volume: 82 m^3
		CAMP11 (soil): PHC F2 and F3	Surface Area: 173 m^2 Depth: 0.6 m Volume: 103.8 m^3
AEC 3 – Site #1	APEC 2	S1-1 (soil): PHC F3 and F4	Surface Area: 34.5 m^2 Depth: 0.6 m Volume: 20.7 m^3
		S1-2 (soil): PHC F3 and F4	Surface Area: 35.5 m^2 Depth: 0.6 m Volume: 21.3 m^3
		S1-3 (soil): PHC F3 and F4	Surface Area: 76 m^2 Depth: 0.6 m Volume: 45.6 m^3
		DF-1 (soil): Dioxins and Furans TEQ	Surface Area: 29 m^2 Depth: 0.9 m Volume: 26.1 m^3

Summary of the Phase III ESA Findings			
Impact Group	**Former AEC/APEC**	**Area of Impacts**	**Estimated Quantity of Impacted Media**
AEC 4 – Site #2	APEC 3	S2-1 (soil): PHC F3	Surface Area PS11: 21.4 m^2 Depth PS11: 0.9 m Volume PS11: 19.3 m^3 Surface Area PS12: 42.8 m^2 Depth PS12: 0.6m Volume PS12: 25.7 m^3 Total Volume: 45 m^3
		S2-2 (soil): PHC F1	Surface Area: 212 m^2 Depth: 0.9 m Volume: 190.8 m^3
		GW (groundwater): metals (aluminum, cadmium, copper, iron, lead, manganese, zinc)	Surface Area: unknown Depth: N/A Volume: N/A
Estimated volume of impacted soil		**535.3 m^3**	
Estimated volume of impacted sediment		**15 m^3**	

Note:
The total estimated volume of soil impacted with PHC is 509.2 m^3 and with dioxins and furans is 62.1 m^3.

Soil impacts were partially or wholly delineated through the Phase III ESA sampling program however delineation of sediment was not completed. As part of the Phase III ESA, a limited hazardous and non-hazardous building material assessment (LHBMA) was also completed. Three building material samples were collected from a debris area east of APEC 2. Results confirmed that the material was not asbestos containing. Liquid samples were collected from a tank and two barrels and results indicated that tank sample (T1) and one barrel sample (B1) were significantly diluted with water, but that barrel sample (B2) contained high concentrations of F2 through F4.

During the field program a debris inventory was created for each AEC. Using this inventory and the topographic drone survey, a volume estimate for on-site debris was created. A 25% void space was applied to the debris piles as the survey does not factor it in. Based on this approach, the estimated total volume of on-site debris is approximately 172.77 m^3. From the survey, the estimated total number of barrels on-site is 710 and tanks is 49.

3.2 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

The HHERA was carried out using data collected in 2022, as part of the 2023 Phase III ESA conducted by BluMetric. The Human Health Risk Assessment (HHERA) assessed aluminum, cadmium, copper, iron, lead, PHC F1, F2, F3, and F4, and dioxins and furans in soil for the direct contact pathway (i.e., humans directly touching soil). COCs identified in surface water included aluminum, cadmium, copper, iron, and lead, and in sediment included copper, lead, and PAHs. Exposures routes assessed including inadvertent ingestion, dermal contact and inhalation for soil and ingestion for surface water.

Following COC screening, a qualitative HHRA was conducted for the Site for lead and iron in surface water. As people do not live at the Site, they are not drinking the water every day. Furthermore, the lead and iron exceedances were found in the very shallow drainage ditch that leads to the Campsite Area Pond which is unlikely to be used as a source of drinking water. Based on this, the exceedances in surface water were not considered to be a human health risk. Surface water screening indicated exceedances in lead and iron at the Campsite Area Pond (AEC 1). As there are no federal or provincial sediment quality guidelines for the protection of human health, and human contact with sediments is considered to be minimal at the Site, risk to human health from sediment was not discussed in the HHRA. The screening for soil showed no risk for human health.

The Ecological Risk Assessment (ERA) evaluated the risk to plants, wildlife, the aquatic community, and Species at Risk (SAR) that would forage at the Site. A qualitative evaluation was undertaken for wildlife and SAR as the maximum measured concentrations at the Site were below ecological guidelines and therefore wildlife and SAR were not considered at risk.

Petroleum hydrocarbons (PHCs) were identified in soil for the assessment of vegetation. The results of the ERA showed that there are no risks to vegetation due to the presence of PHCs in soil as they are spatially limited across the Site and there was little to no vegetation observed to be growing in the areas where the guidelines were exceeded. Lead and iron in sediment were considered to be the only COCs for the Campsite Area Pond. While aquatic communities are not expected to be at risk in the Campsite Area Pond, there is the potential for localized effects in aquatic communities and it was recommended that remedial activities at the Site focus on the area in the shallow drainage channel entering Campsite Area Pond.

3.3 SUMMARY OF ITEMS REQUIRING REMEDIAL ACTION

Based on the findings of the Phase III ESA and the HHERA, the areas requiring remedial action are categorized into Impacted Sediment (Table 3), Hazardous Waste (Table 4) and Non-Hazardous Waste (Table 5). The volumes of waste are outlined below.

Table 3: Impacted Sediment

Impacted Sediment	Estimate Volume of Sediment
Total Estimated Volume of Impacted Sediment	6.1 m^3

Table 4: Hazardous Waste

Type of Waste	Estimate Volume of Waste
Total Debris	0.10 m^3
Total Paint	0.52 m^3
Total Liquid and Drum/Tank Residues[1]	6.64 m^3

Note:

[1]Includes the full barrel of liquid at Site#2 Fuel Cache

Table 5: Non-Hazardous Waste

Type of Waste	Estimate Volume of Waste
Wood Debris	45.9 m^3
Metal Debris	70.8 m^3
Construction Debris	15.3 m^3
Household Debris	0.3 m^3
Tanks	27.5 m^3
Barrels	13.2 m^3
Total Liquid	0.35 m^3

4 REMEDIAL OPTIONS EVALUATION RESULTS

4.1 REMEDIAL OPTIONS METHODOLOGY

The review of available remediation and risk management options for the Site were pre-screened for regulatory requirements, community acceptance, material availability, allowance for traditional land use, preservation of areas of historic value and climate resilience and only those passing the pre-screening were subject to the more detailed evaluation using a Remedial and Risk Management evaluation matrix. This allowed the evaluation to focus only on options that met the feasibility requirements specified by the client and project stakeholders.

The options passing the pre-screening moved to the Remedial and Risk Management evaluation matrix. This matrix scored the remedial options against five criteria: effectiveness, ease of implementation, anticipated socio-economic benefit, anticipated cost and anticipated carbon footprint generating a numerical score to identify the preferred approach. The full methodology can be found in the ROA (BluMetric, 2023a).

4.2 SEDIMENT

The HHERA carried out for the COCs identified under the Phase III ESA work resulted in sediment with lead impacts posing an unacceptable risk to ecological receptors. Sediment impacts that exceeded the HHERA ecological screening guideline for lead were considered for remediation, with a total of 6.1 m^3 of impacted sediment estimated for removal. The extent of the sediment impacts is presented on Figure 3 in Appendix A. No other impacts identified in the Phase III ESA posed a risk to human or ecological health as discussed in the HHERA.

Excavation and Southern Off-site Disposal, Excavation and On-Site Disposal, and Signage and Long-term Monitoring options had passed pre-screening and had gone through the Remedial and Risk Management evaluation matrix.

After evaluation, the options received the following scores:

- Remedial - Excavation and Southern Off-site Disposal: **34**
- Remedial - Excavation and On-site Disposal: **20**
- Risk Management - Signage and Long Term Monitoring: **17**

Following scoring, Excavation and Southern Off-site Disposal scored the highest and is considered the preferred remedial approach for impacted sediment at the Site. The full results can be found in the ROA (BluMetric, 2023a).

4.3 HAZARDOUS WASTE

Hazardous Waste was identified as requiring remediation and/or risk management based on observations made during supplemental sampling. Appendix B presents a summary of the debris locations proposed for remediation. The following hazardous wastes and approximate volume are listed below:

- Hazardous Debris – 0.10 m^3
- Total Lead Paint – 0.52 m^3
- Liquid (Fuel, Fuel Residues and Vehicle Fluids) – 6.43 m^3

Excavation and On-Site Disposal, Excavation and Southern Off-site Disposal, and Consolidate and Long-term Monitoring options had passed pre-screening and had gone through the Remedial and Risk Management evaluation matrix.

After evaluation, the options were scored as the following:

- Remediation - On-site Disposal: **18**
- Remediation - Southern Off-site Disposal: **34**
- Risk Management - Consolidate and Long Term Monitoring: **15**

Following scoring, Excavation and Southern Off-site Disposal scored the highest and is considered the preferred remedial approach for hazardous waste at the Site. The full results can be found in the ROA (BluMetric, 2023a).

4.4 NON-HAZARDOUS DEBRIS

Non-hazardous debris was identified as requiring remediation and/or risk management based on observations made during supplemental sampling and from feedback during the community consultation. Appendix B presents a summary of the debris locations proposed for remediation.

Excavation and On-Site Disposal, Excavation and Southern Off-site Disposal, and Consolidate and Long-term Monitoring options had passed pre-screening and had gone through the Remedial and Risk Management evaluation matrix.

After evaluation, the options were scored as the following:

- Remediation - On-site Disposal: **19**
- Remediation - Southern Off-site Disposal: **28**
- Risk Management - Consolidate and Long Term Monitoring: **23**

Following scoring, Southern Off-site Disposal scored the highest and is considered the preferred remedial approach for non-hazardous debris at the Site. The full results can be found in the ROA (BluMetric, 2023a).

5 ENGAGEMENT

A community engagement meeting was held in Baker Lake on May 18, 2023. A total of 27 community members signed into the meeting along with young adults and children. The meeting included a presentation which provided an overview of the project, work completed to date, and remediation/risk management options. Discussion was encouraged throughout the presentation and a period of questions and answers was held following the presentation.

The discussion provided local insight pertaining to the remediation of the Site. During the community engagement session, CIRNAC committed to the removal of all hazardous material from the Site for off-site disposal. CIRNAC acknowledged the community's request to remove all non-hazardous debris but clarified that the non-hazardous debris posed a low risk to human health and the environment. CIRNAC committed to removing non-hazardous debris as long as it was logistically feasible to do so. The community members acknowledged that the cost and logistics associated with transporting heavy equipment and debris to complete this remedial option would be high. Community members also brought forth ideas for site access including a winter ice landing strip with a haul trail to the Site. The winter ice strip would allow larger aircraft to access the Site which could cut the number of flights necessary to haul the waste away. A community member also noted the soft conditions of the soil at the site. The soft conditions could pose challenges to the movement of larger equipment at the site.

6 ACCESS

The Site being in a remote and land locked location does not allow for direct barge access or effective winter hauling routes. Therefore, Site access is limited to small aircraft access via the existing airstrip on Site using wheels or skis and to larger aircraft via an ice landing strip in the winter months. The access evaluation information obtained during the 2022 field program did not provide confidence in landing aircraft larger than the Twin Otter on the existing airstrip. Larger aircraft will likely only be able to access the site by an ice landing strip constructed in the winter on a nearby lake.

Access to the Site is assumed to be by fix winged aircraft for this work. It is assumed that the hazardous materials (i.e., batteries, fuel/oils, impacted soils/sediments) are a small volume and will be containerized and shipped to an off-site disposal facility via fixed wing aircraft in either the summer or winter months.

The consolidation and packaging of waste is assumed to be completed in the summer months with access to the Site by fixed wing aircraft using the existing airstrip. Transportation around the site will be via ATVs equipped with trailers during the summer months. Non-hazardous debris will be piled and consolidated in one area for removal in the winter months.

Access to the site in winter/late winter will be first by fixed wing on skis and access to the laydown area will be by snowmachine and small tracked vehicles. A winter ice strip would be built on a nearby lake (approximately 15 km away) that larger aircraft could use on skis (i.e. Basler or Electra). A winter access trail would then be constructed using tracked equipment between the debris laydown area and the ice landing strip. This would facilitate the transportation of waste between the Site and the ice landing strip. It is anticipated that several flights would be required.

7 REMEDIATION STRATEGY AND RATIONALE

The remediation strategy was informed by previous studies, the Remedial Options Assessment (BluMetric, 2023a) and the community engagement (BluMetric, 2023b). The following sections describe the preferred remedial options for each waste stream identified in the ROA (BluMetric, 2023a).

7.1 REMEDIAL GUIDELINES

Remediation activities at the site include excavation of impacted sediments and managing hazardous materials that may be encountered on the Site. The following table summarizes the remedial guidelines that were applied to the RAP:

Table 6: Remedial Guidelines Summary

Metals Impacted Sediment	Canadian Council of Ministers of the Environment (CCME) – Sediment Quality Guidelines for the Protection of Freshwater Aquatic Life (Metals: CCME, 1998a)	Sediment with metals concentrations greater than the following: • Lead 91.3 mg/kg
Lead Based Paint	Nunavut: Environmental Guideline for Waste Lead and Lead Paint (2014)	Paint with lead concentrations greater than the following: - Lead Content 100 mg/kg - Leachable Lead 5.0 mg/L
Asbestos	Government of Nunavut Environmental Guideline for Waste Asbestos (2011)	Materials with asbestos percentages equal or greater than the following: - Asbestos 1%

Barrel Investigation (Contents)	Indian and Northern Affairs Canada (INAC), Abandoned Military Site Remediation Protocol (INAC, 2009)	Contents can be incinerated on-site or shipped south for disposal depending on the following: - Phase (Organic or Aqueous) - % glycols or alcohols (>2% or <2%) - PCB (>2 ppm or <2 ppm) - Chlorine (>1000 ppm or <1000 ppm) - Cadmium (>2 ppm or <2 ppm) - Chromium (>10 ppm or <10 ppm) - Lead (>100 ppm or <100 ppm)

The burning of unpainted wood is proposed for the Site. Best practices for managing this approach are summarized in the AMSRP guidelines (Indian and Northern Affairs Canada, 2009) and the Nunavut Department of Environment – Environmental Guidelines for the Burning and Incineration of Solid Waste (Nunavut Department of Environment, 2012).

7.2 SEDIMENT

As described in the ROA (BluMetric, 2023), impacted sediment will be removed and disposed of off site. This was the preferred outcome in both the ROA (BluMetric, 2023) and the community engagement sessions. Due to the relatively small volume of impacted sediment, the sediment will be removed by hand and placed into suitable containers or drums and removed off site opportunistically during the summer Year 1. Any remaining drums or containers will be removed during the winter/early spring of Year 2 along with the non-hazardous debris. Removing the sediment by hand will decrease the need for heavy machinery, allowing for a simpler logistical approach and a decrease in the carbon footprint of this remediation strategy.

7.3 HAZARDOUS DEBRIS

Hazardous Materials were identified as requiring remediation and/or risk management based on observations made during supplemental sampling. The following hazardous wastes and approximate volume are listed below:

- Hazardous Debris – 0.10 m^3
- Total Lead Paint – 0.52 m^3
- Liquid (Fuel, Fuel Residues and Vehicle Fluids) – 6.64 m^3

The hazardous liquid waste to be removed from site is assumed to be from one drum known to contain PHCs, an estimated volume of fluids that remain in the machinery and vehicles on site and sludge resulting from the cleaning of the fuel drums and tanks. As a detailed inspection of each of the tanks and drums was not feasible, it has been assumed that 100L of sludge would be produced during the cleaning and processing of tanks. Drums were assumed to have 2L of sludge that would

require disposal after cleaning and crushing. On-site treatment and discharge of water produced during tank and drum cleaning was assumed and would need to be permitted through the water license.

The preferred management strategy is to remove all hazardous waste debris from the Site as described in the ROA (BluMetric, 2023a). This was also the preferred approach at the community engagement meetings. Table 7 below summarizes the location of all hazardous debris On-Site. Appendix B provides further details of all debris found on Site.

The hazardous debris will be collected and placed into suitable containers or drums and removed off Site opportunistically during the summer of Year 1. Any remaining containers or drums will be removed during winter/early spring of Year 2 with the non-hazardous debris.

Table 7: Summary of hazardous debris to be removed from Site.

Item #	Area Description	APEC ID	Hazardous Debris				
			Batteries (m^3)	Vehicle Fluids (m^3)	Lead Paint (m^3)	Liquid and Drum/Tank Residues (m^3)	Total (m^3)
1	Campsite Food Cache	1	-	-	-	0.3	0.3
2	Immediately West of the Food Cache	1	-	-	-	-	0
3	Northwest of Food Cache	1	0.1	-	-	-	0.1
4	West of Food Cache	1	-	0.01	0.25	-	0.31
5	North of Food Cache - 1	1	-	-	-	-	0
6	North of Food Cache - 2	1	-	-	-	-	0
7	Southeast of Food Cache	1	-	0.01	-	-	0.01
8	Site #1 Fuel Cache (South Pile)	2	-	-	-	-	0
9	Site #1 Fuel Cache (Middle Pile)	2	-	-	-	0.7	0.7
10	Site #1 Fuel Cache (North Pile)	2	-	-	-	1.2	1.2
11	North of Site #1 Fuel Cache	2	-	-	-	-	0
12	West of Site #1 Fuel Cache	2	-	0.01	0.15	-	0.21
13	Site #1 Drum Pile (S)	2	-	-	-	-	0
14	Site #2 Fuel Cache	3	-	-	-	2.8	2.8
15	East of Site #2 Fuel Cache	3	-	-	-	-	0
16	Southwest of Site #2 Fuel Cache	3	-	-	0.12	-	0.1
17	Drinking Water Lake	4	-	-	-	-	0
18	Landing Lakes	5	-	-	-	0.1	0.1
19	Empty Fuel Drums Throughout the Site	n/a	-	-	-	1.3	1.3
Total Debris			**0.10**	**0.23**	**0.52**	**6.40**	**7.05**

7.4 NON-HAZARDOUS DEBRIS

The remedial objectives for the Site identified that non-hazardous debris would require remediation and/or risk management.

The preferred Non-hazardous waste option will be a combination of Remediation – Southern Off-Site Disposal and Risk Management – Consolidate. This strategy considers the preferred community option of off-site disposal while managing costs, logistical challenges, and impacts to the carbon footprint resulting from off-site disposal of large non-hazardous debris.

Large non-hazardous debris that will remain on-site includes the old D4 bulldozer, and a large steel cart holding an old turbine aircraft engine. These items would demand significant effort and heavy machinery to move the waste and to dispose of it off-site. The heavy machinery would need to access the site via the use of overland transport from Baker Lake to and from the site. This strategy is not preferred as it results in significant cost increases, logistical challenges, and a greater carbon footprint. The large debris that is to remain on site poses a low risk to human health and the environment.

Unpainted wood debris will be burned on-site. All other non-hazardous debris will be removed from Site. Table 8 below summarizes the non-hazardous debris and the assumed management strategy.

Table 8: Summary of Non-hazardous Debris Quantities Grouped by Management Strategy

Item #	Area Description	APEC ID	Non-Hazardous				
			Total Debris for Removal			Total Debris Managed on Site	
			Metal (m^3)	Other[1] (m^3)	Tank Water (m^3)	Burnable Wood (m^3)	Items Staying Onsite (m^3)
1	Campsite Food Cache	1	3.4	1.3	-	4	-
2	Immediately West of the Food Cache	1	0.5	0.25	-	13	-
3	Northwest of Food Cache	1	4.1	-	-	9.9	-
4	West of Food Cache	1	0.6	-	-	-	16.7
5	North of Food Cache - 1	1	0.2	1	-	4	-
6	North of Food Cache - 2	1	6.6	-	-	10	-
7	Southeast of Food Cache	1	2.6	0.66	-	-	-
8	Site #1 Fuel Cache (South Pile)	2	3.2	-	-	-	-
9	Site #1 Fuel Cache (Middle Pile)	2	3.2	-	-	-	-
10	Site #1 Fuel Cache (North Pile)	2	5.5	-	-	-	-
11	North of Site #1 Fuel Cache	2	2	7	-	2.7	-
12	West of Site #1 Fuel Cache	2	-	-	-	-	25
13	Site #1 Drum Pile (S)	2	0.1	-	-	-	-
14	Site #2 Fuel Cache	3	20.4	-	0.3	-	-
15	East of Site #2 Fuel Cache	3	2.7	7	-	2	-
16	Southwest of Site #2 Fuel Cache	3	12	-	-	-	-
17	Drinking Water Lake	4	0.2	-	-	-	-
18	Landing Lakes	5	0.9	-	-	-	-
Total Debris by Material			**68.3**	**17.2**	**0.3**	**45.6**	**41.7**
Total Debris for Removal and/or On Site Management			**85.9**			**87.3**	

7.4.1 Non-Hazardous Wood Waste

Clean wood is generally described as any wood material that is unpainted and/or untreated. All clean wood will be burned on-site according to guidelines in the AMSRP (Indian and Northern Affairs Canada, 2009) and the Nunavut Department of Environment – Environmental Guidelines for the Burning and Incineration of Solid Waste (Nunavut Department of Environment, 2012) which will reduce approximately 46 m^3 of non-hazardous debris. Following incineration, ashes will be collected and shipped off Site for appropriate disposal. This is expected to occur during the summer of Year 1.

7.4.2 Non-Hazardous Debris – Removal

All non-hazardous debris that is scheduled to be removed from site will be packaged and staged during the summer of Year 1 for removal off site in the winter/early spring of Year 2. During the staging period all debris will be packed in mega bags, on skids, or equivalent for removal by aircraft. It is expected that an ice runway will be constructed in the winter/early spring of Year 2 for non-hazardous debris removal. The debris will be unloaded in Baker Lake for barging to the south for final disposal in summer/fall of Year 2.

7.4.3 Non-Hazardous Debris – On-site Management

Two large items will be left on-site, the D4 bulldozer and the old turbine on a steel cart. These items will be inspected for any remaining fuels/liquids within the equipment and the paint will be tested for lead and PCBs. If there are any liquids within the large equipment, they will be drained and removed off-site for hazardous waste disposal. If the paint contains lead or PCBs, it will be removed from the equipment following approved methodology and removed off site for disposal as hazardous waste.

8 IMPLEMENTATION STRATEGY

Following the ROA and the community engagement sessions, the recommended remediation and risk management option is excavation and southern off-site disposal of all sediment, hazardous debris and non-hazardous debris with the exception of large non-hazardous debris.

8.1 Assumptions and Items for Consideration

The following assumptions have been made for the implementation strategy described herein:

- The work will be completed in two stages over two summer seasons and 1 winter season.
- The first stage (summer) will include mobilization of equipment and materials by air, and the consolidation of debris. It may also include the demobilization by air of hazardous wastes, equipment, and other items as feasible based on the aircraft. This program is estimated to take place from July to September.
- The second stage (winter/following summer) will include the demobilization of equipment, materials, hazardous waste, non-hazardous waste, and impacted sediment via a winter access trail to an ice strip. A final inspection and collection of any remaining small debris will be conducted during snow-free conditions. This stage is estimated to take place from March to May.
- Minimum equipment requirements were assumed to include: a drum crusher, drum and tank cleaning equipment, ATVs, trailers, and hand tools.
- All equipment is assumed to be unavailable in Baker Lake and will be shipped by the Contractor to Baker Lake for air transport to the site.
- Contractor personnel will be required to be always accompanied by a wildlife monitor.
- Contractor will be properly certified and trained for the removal, handling, and packaging of all waste materials.
- Sediment disposal is contingent upon approval for acceptance of out-of-province waste by the destination province of either Quebec or Manitoba.
- Excavation of sediment can be accomplished by hand due to the small size and shallow depth of the tributary.
- Borrow material will be required to backfill the area of removed sediment. A bulking factor of 1.3 times the volume of sediment is assumed to be required for backfilling, approximately 7.9 m^3.
- The site is primarily flat and access by ATVs with trailers is assumed to be feasible without the use of additional borrow material. Some grading of areas may be conducted to improve the ease of transportation in areas where materials are loose and more challenging to navigate.
- The remediation personnel will be housed in a temporary camp which will be mobilized by air and established on site. The temporary camp will be removed at the end of the summer program and re-established in the vicinity of the winter ice strip for the winter program.
- The airstrip has been used recently and is expected to be maintained by the Contractor for use by a DHC-6 300 Twin Otter.
- The Contractor will be expected to always maintain a qualified supervisor on-site.

- The Contractor would require a rental vehicle, accommodations, and meals to be provided for mobilization and demobilization in the community of Baker Lake.
- The Contractor will be expected to conduct all work to be protective of ecological receptors including the stopping of work for migrating caribou, avoiding the disturbance of nesting/migrating birds and any other limitations as specified in the applicable permits.
- The Contractor will be expected to preserve any heritage resources which may be discovered during the completion of the work.

The following future considerations are to be considered when developing the Class B cost estimate:

- Consider rental versus purchase prices for equipment.
- Identify all potentially acceptable containers to be considered for the various waste streams to determine the most economical containers for use, taking all aspects of the work into consideration (e.g., aircraft capacity, barging fees, staging requirements, containment requirements for liquids and hazardous materials).
- Movement of equipment and materials to and from the staging area over loose to compact material may require measures such as the use of on-site borrow material for equipment bedding and/or removal rig mats or pads. Options should be considered.
- Consideration for the construction of travel routes connecting areas of the site that require remediation to the existing airstrip, staging area, and camp for waste consolidation during the summer season.
- Disposal costs should include trucking and tipping fees to more than one approved licensed waste facility for the acceptance of sediment impacted with lead, lead based paint, hazardous waste, excess hazardous liquids and sludge, and non-hazardous debris. These locations may be located in Manitoba or Quebec depending on barging routes and facilities accepting the waste.
- Disposal costs should add contingency costing for lead impacted sediments in the event that field screening during delineation results in increased volumes of impacted sediment.
- Permitting fees for use of the required borrow material will need to be further investigated.
- The cost of a temporary camp (including permitting fees) versus daily fly-in from Baker Lake should be evaluated.

8.2 SCHEDULE

The high-level costing for the preferred off-site remediation option assumes a schedule that requires approximately 1.5 years, including mobilization and demobilization of materials and equipment, to complete the remedial work.

A summer program, estimated to be from July to September of Year 1, will include the mobilization of the field camp, hand tools, and small equipment, the demolition of existing structures, burning of wood debris, crushing of drums, cutting and consolidation of tanks, hazardous and non-hazardous waste consolidation, sediment excavation and consolidation, cleaning and consolidation of debris to remain on site, and demobilization of the field camp and hazardous wastes.

A winter program, estimated to be from March to May of Year 2, will include the construction of an ice landing strip and construction of a winter access trail leading to and from the ice landing strip to the consolidated debris staging area. This program will also include demobilization of equipment and the transportation of non-hazardous waste from the Site to Baker Lake. A staging facility will be required in Baker Lake to hold the waste and equipment until final demobilization from Baker Lake to southern landfills can occur in the summer/fall of Year 2 by barge.

A final inspection including representatives from the Community, the Contractor, PSPC, CIRNAC, and PSPC's Construction Representative (PCR) will occur in the summer/fall of Year 2, following the demobilization of all waste and equipment from the Site.

8.3 MOBILIZATION AND DEMOBILIZATION

An initial shipment of equipment and camp supplies to Baker Lake is assumed to take place in the spring/summer of Year 1, prior to commencing the on-Site work. A temporary laydown area is to be established in Baker Lake to store the equipment prior to mobilization to Site for the summer program. The summer mobilization to site will take place in late June or early July of Year 1 using small, fixed wing aircraft such as a Twin Otter DHC-3. The initial mobilization will consist of multiple trips from Baker Lake to the site using the landing strip on Site. During the initial mobilization, it has been assumed that a temporary camp will be established at the Site for the contractor's staff/field assistants/wildlife monitors. The equipment and camp supplies will be mobilized via a small, fixed wing aircraft on the existing landing strip at the Site. All necessary equipment is assumed to fit in a small, fixed wing aircraft. Some improvements to the airstrip may facilitate the landing of larger aircraft during the summer months but the assumption is that only small aircraft will be able to access the site. The equipment and camp will be placed in a laydown area, detailed in Section 8.4.

Demobilization of non-hazardous debris will occur in the winter months of the project. All equipment and material on site will be removed, except for large non-hazardous waste, during final demobilization. An ice landing strip is assumed to be built on a nearby lake (up to 15 km away) to allow for larger aircraft landing. An ice/snow winter access trail would need to be constructed between the Site and an ice landing strip for transportation of non-hazardous debris.

The estimated volume of waste on site is approximately 100 m^3 (132,000 kg). Based on this, it is assumed that more than 30 trips are needed to transport the waste materials off Site using Basler DC3T aircraft or more than 14 loads using a Lockheed Electra L-188 aircraft. Both aircraft have been identified as potential options for landing on an ice landing strip near the site.

All waste (including hazardous waste, impacted sediment, and non-hazardous waste) to be removed from site must be placed in the laydown area and labelled to meet all governing regulations. Hazardous waste may be removed from Site at the end of the summer program assuming that the smaller fixed winged aircraft has the capacity to transport this waste, as confirmed by the pilot at time of shipping. From the Site laydown area, all remaining waste will be transported to the staging area adjacent to the ice landing strip during the winter months. From the winter staging area, the waste will be hand-loaded onto the fixed wing aircraft and shipped to Baker Lake, Nunavut. The waste will be staged in Baker Lake until it is able to be loaded and transported via barge to ports in either Quebec or Manitoba. The hazardous waste, impacted sediment, and non-hazardous waste will then be shipped over land to one or more licensed waste facilities. The transportation of hazardous materials must follow the transportation of dangerous goods regulations.

Once all waste has been removed from the site, all remaining equipment and camp facilities will be demobilized from the site using fixed wing aircraft via the ice strip. The equipment and camp facilities will be staged along with the waste in Baker Lake until it can be transported to the Contractor's facilities in the South via barge and surface transportation. Any equipment that is not necessary during the waste loading operations and winter trail/ice strip maintenance may be demobilized from Site using fixed wing aircraft when available.

8.4 Access Trails and Laydown Areas

All equipment, machinery, camp materials and supplies will be mobilized to site via small, fixed wing aircraft landing on the existing landing strip at the Site. A summer laydown area on Site for waste and equipment will be established adjacent to the landing strip or at an area in proximity of the proposed winter access trail. The temporary camp could be set up in the area adjacent to the equipment laydown area.

All waste to be removed from the site will be collected and consolidated in the laydown area. The on-site waste will be accessed on foot or on All-Terrain Vehicle (ATV). The terrain at the site is composed primarily of sand and gravel and may be loose in areas. ATV tires may need to be equipped with low pressure tires. Additional portable mats or pads may be required to facilitate access to debris areas so that material can be consolidated and transported to the laydown area.

A winter access trail will be constructed from the Site to the proposed ice landing strip location during the winter months. Based on a preliminary review of nearby lakes that could accommodate the ice landing strip, the winter access trail will have a length of approximately 15 kilometres. The access trail will be constructed on snow and ice and granular borrow material will not be required. Sleds, towed by snow machines or other small, tracked vehicles, will be used to transport all waste and other materials from the Site to a winter staging area adjacent to the proposed ice landing strip to facilitate final demobilization.

8.5 SEDIMENT

All sediment designated for removal will be excavated and containerized from the Site using hand tools. The containerized impacted sediment would then be transported to the staging area to await shipment to the south for disposal in a licensed waste facility. The sediment containers will be acceptable containers for air transport. To prevent erosion of the creek bed, the excavated area will be backfilled and graded to match the pre-existing conditions prior to the removal of sediments.

8.6 SURFACE DEBRIS

The surface debris will be separated into non-hazardous waste and hazardous waste (refer to Tables 4 and 5). The non-hazardous waste will be broken down, if needed, and placed into approved acceptable containers (e.g., clean drums, megabags, shipping crates) and then transported to the laydown area in preparation for winter hauling to the ice landing strip. The hazardous materials would be placed into approved acceptable containers (e.g., drums, overpacks, megabags) and then properly labelled and transported to the staging area in preparation for hauling to the ice landing strip. As mentioned in Section 8.3, the hazardous waste may be removed from site at the end of the summer program if sufficient payload is available using the fixed wing aircraft accessing the Site. All material slated for winter transport off site will be hauled to the staging area adjacent to the ice landing strip via winter trail and then taken off site by fixed wing aircraft from the ice landing strip. All surface waste will be shipped and disposed of as per Section 8.3.

8.7 DEMOLITION AND WOOD BURNING

Demolition of the wood structure, lined with sheet metal, and containing tar paper in the roofing will be conducted by trained workers. Barrels and tanks will be cleaned prior to crushing or cutting by trained workers, using appropriate cleaning equipment and managing wash water and residues as hazardous material.

Removal of lead-based paint from the carts and bulldozer on site will be conducted by trained workers certified in lead abatement work. The removal of the lead-based paint should be carried out using methods that reduce the generation of lead dust or the dispersion of lead paint chips. The removed lead-based paint will be stored in acceptable containers for hazardous materials. The Contractor will be required to provide a supervisor who has experience with lead abatement removals and barrel and tank cleaning procedures. All hazardous, lead-based paint, and non-hazardous waste would be separated into acceptable approved containers and clearly labelled within laydown areas with appropriate spill protection where applicable.

All wood debris that is deemed safe to burn will be placed in an accepted burning area. Burning should be carried out by trained personnel in a controlled area such as a burn pad. The Contractor is responsible for providing a supervisor familiar with safe burning operations. All ash material should be collected and packaged in acceptable containers. The ash should be moved to the laydown area for removal off Site.

8.8 Debris to Remain on Site

Non-hazardous materials that are too large to ship off site and that are unable to be cut into smaller pieces will be cleaned of all hazardous materials, drained of all liquids, and left on site. Waste that is too large to ship off site include a D4 bulldozer and a metal cart with an aircraft engine on top. Some of the large waste may contain lead-based paint which will be removed as per Section 8.5.

8.9 Drums and Tanks

Empty drums and tanks on the Site will be classified as non-hazardous once cleaned. Drums and tanks that contain liquid would be separated from the other surface debris and the liquids will be consolidated in new lined drums to minimize the number of drums and tanks containing liquid as well as potential leaks. This procedure should be carried out ensuring containment measures are taken so that no liquid is spilled into the environment. Drums and tanks containing liquid organic wastes are considered hazardous and will need to be stored and consolidated in approved containers with spill containment during their storage in the staging area prior to transport. The drums will be washed and crushed on site and the tanks will be cleaned, cut up using hand tools, and consolidated prior to placement in the staging area. As stated in Section 7.4, it is assumed that the cleaning of drums will result in approximately 2 litres of sludge per drum. A total of 100 litres of wastewater from the washing process of drums and tanks is assumed. It is assumed that on-site treatment and discharge of water produced during tank and drum cleaning is feasible and that this treatment and discharge would need to be permitted through a water license. The crushed drums and consolidated tanks will be transported by air to Baker Lake and shipped south for disposal in a licensed waste facility for recycling and for disposal of liquid organic waste as per Section 8.3.

8.10 BORROW REQUIREMENTS

Granular borrow source material may be required to build pads for the camp and/or laydown areas on Site. Borrow may be required to facilitate access to some areas of the site so that ATVs can more easily traverse the site between the debris and laydown areas. The quantity of required borrow material for executing the remedial scope will likely be minimal as it will generally be contained to localized re-grading of small areas to facilitate access. It is estimated that approximately 6.1 cubic metres of compacted and slightly mounded soil would be needed to fill the excavated sediment area. A bulking factor of 1.3 for the borrow material has been assumed for the backfill area of the sediment. A total of approximately 7.9 cubic metres will be required to backfill the excavated sediment area.

The summer program will take place using small ATVs equipped with trailers and on foot. It is not anticipated that a significant amount of borrow material for regrading purposes will be required. The winter trails and ice landing strip will be constructed using snow and ice. As such, the need for borrow material is required for the summer program only.

9 CLOSING AND LIMITING CONDITIONS STATEMENTS

The Remedial Action Plan has been conducted using industry-standard best methods and practices. All data incorporated in the risk assessment were collected and assembled by BluMetric Environmental Inc. The RAP has been prepared following the scope of work developed by Public Service and Procurement Canada (PSPC) on behalf of Indigenous Northern Affairs Canada and information provided by PSPC and Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) regarding site use and the findings of the Phase III ESA (BluMetric, 2023) and HHERA (BluMetric, 2023). The RAP is valid for the intended site use and practices at the time of writing. The RAP assumptions were based on the findings and conclusions of the Phase III ESA and HHERA and should be validated accordingly with any intended or actual site changes.

The observations and results obtained during the investigation are representative of the conditions encountered at the sampling locations and at the time of the investigation only. No information presented in this report should be interpreted as being indicative of conditions elsewhere on the property. The statements made in this report are based solely on the information obtained to date as part of the above referenced investigations. BluMetric has used its professional judgement in analyzing this information and formulating its conclusions. No other warranty or representation, expressed or implied, as to the accuracy of the information or recommendations is included in this report.

BluMetric Environmental Inc. makes no warranty as to the accuracy or completeness of the information provided by others, or of conclusions and recommendations predicated on the accuracy of that information.

This report has been prepared for PSPC on behalf of CIRNAC. Any use a third party makes of this report, any reliance on the report, or decisions based upon the report, are the responsibility of those third parties unless authorization is received by BluMetric Environmental Inc. in writing.

BluMetric Environmental Inc. accepts no responsibility for any loss or damage suffered by any unauthorized third party as a result of decisions made or actions taken based on this report.

Respectfully submitted,
BluMetric Environmental Inc.

Brett Webster, B.A.Sc., P.Eng. (ON)
Environmental Engineer

Stephen Anderson, M.Sc.
Environmental Scientist

Andrea Jenney, B.Sc., P.Eng. (NT/NU)
Senior Environmental Engineer

10 REFERENCES

BluMetric, 2023a. Remedial Options Assessment for Pelly Lake Former Airstrip and Fuel Cache Site. Pelly Lake, Nunavut.

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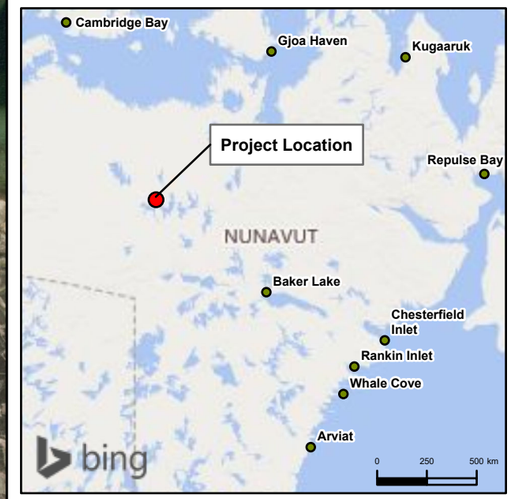
APPENDIX A

Figures

LEGEND

- Approximate Alignment of Airstrip
- Intermediate Contour (0.5 m)
- Major Contour (1 m)



REV.	DESCRIPTION	YY/MM/DD	BY	CHK
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REFERENCES

N W E S

0 250 500 Meters

1:10,000

CLIENT

Public Services and Procurement Canada

PROJECT

Remedial Action Plan Pelly Lake Airstrip and Former Fuel Cache Site, Nunavut

TITLE

Site Location Map

BluMetric™ Environmental

4916 49th Street,
PO Box 11086
Yellowknife, NT, X1A 1P3
TEL: (867) 873-3500
FAX: (867) 873-3499
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
220515	**December 05, 2022**

DRAWN	CHECKED	FIG NO.	REV
PB	**JK**	**01**	**0**

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LEGEND

Area of Potential Concern

- AEC 1 - Campsite Area Pond
- APEC 1 - Campsite Area
- APEC 2 - Site #1
- APEC 3 - Site #2
- APEC 4 - Drinking Water Lake
- Approximate Alignment of Airstrip
- Stream outline
- Direction of Stream Flow
- Historical Soil Sample Location
- Historical Groundwater Sampling Location
- Historical Surface Water Sample

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
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REFERENCES

THIS DRAWING MAY HAVE BEEN REDUCED. ALL SCALE NOTATIONS INDICATED ARE BASED ON 11"x17" FORMAT DRAWINGS.

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CLIENT

Public Services and Procurement Canada

PROJECT

Remedial Action Plan
Pelly Lake Airstrip and Former Fuel Cache Site, Nunavut

TITLE

Hazardous and Non-Hazardous Materials Inventory Results

BluMetric™ Environmental

4916 49th Street,
PO Box 11086
Yellowknife, NT, X1A 1P3
TEL: (867) 873-3500
FAX: (867) 873-3499
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
220515	February 27, 2023

DRAWN	CHECKED	FIG NO.	REV
MB	JK	02	0

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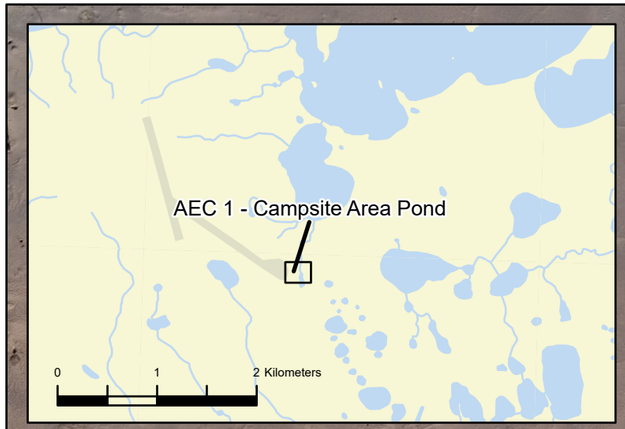

SW/SED-1 North of AEC 1

COC	Unit	PS30	PS30 – STEP 1	PS30 – STEP 2	PS30 – STEP 3	SED5	SED6	PW3	PW5
Lead (Pb)	mg/kg	**4385**	**1740**	**7540**	**2720**	60.2	14.8	0.97	0.95

COC	Unit	SED1	SED 2	SED 3	SED 4
Lead (Pb)	mg/kg	0.84	1.26	3.53	3.62

LEGEND

- Extent of sediment impacts exceeding the Probable Effects Level
- Surface Water Sample Location
- Historic Sediment
- Historical Sediment/Surface Water
- Stepout Sediment
- Sample Below Guidelines
- Sample Above Guidelines

Parameter	Probable Effects Level
Lead	91.3
All units are in mg/kg	
Bold and grey indicates value exceeded guideline value	

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

N W E S

0 15 30 Meters

1:781

CLIENT

Public Services and Procurement Canada

PROJECT

Remedial Action Plan Pelly Lake Airstrip and Former Fuel Cache Site, Nunavut

TITLE

AEC 1 -Campsite Area Pond Sediment Impacts Remedial Extent

BluMetric™ Environmental

4916 49th Street,
PO Box 11086
Yellowknife, NT, X1A 1P3
TEL: (867) 873-3500
FAX: (867) 873-3499
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
220515	**February 15, 2023**

DRAWN	CHECKED	FIG NO.	REV
PB	**KC**	**09**	**1**

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TERRAIN CLASSIFICATION

SURFICIAL SOILS IN THE VICINITY OF THE PROJECT LOCATION HAVE BEEN CLASSIFIED IN GENERAL ACCORDANCE WITH THE TERRAIN CLASSIFICATION SYSTEM FOR BRITISH COLOMBIA[1]. TABLE 1 PROVIDES THE SOIL CLASSIFICATION USING UPPER CASE LETTERS (E.G., F^G) TO DESCRIBE THE DEPOSITIONAL PROCESS (E.G. GLACIAL FLUVIAL), SURFACE EXPRESSION (E.G. F^Gt FOR GLACIAL FLUVIAL TERRACE) AND OTHER GEOMORPHOLOGICAL PROCESSES (E.G. F^Gt-Xwr FOR GLACIAL FLUVIAL TERRACE WITH PERMAFROST FEATURES, PATTERNED GROUND AND ICE WEDGE POLYGONS). FURTHER INDICATION OF SOIL TYPE IS PROVIDED AS LOWER CASE LETTERS IN FRONT OF THE DESCRIPTION (E.G. 's' INDICATES SAND). GEOLOGICAL DEPOSITS ARE VARIABLE AND SOIL TYPES BASED ON PHOTO INTERPRETATION REQUIRED FIELD VERIFICATION TO FULLY DETAIL MATERIAL TYPES AND QUANTITIES (GROUND TRUTHED).

TABLE 1. TERRAIN CLASSIFICATION SUMMARY

Material Name	Material Description and Potential Use
Glaciofluvial F^G	Materials that exhibit clear evidence of having been deposited by glacial meltwater streams either directly in front of, or in contact with glacier ice.
Fluvial F	Materials transported and deposited by streams and rivers. Consists of fine gravel, sand, silt and sometimes trace clay.
Additional Descriptors (surface expression)	
Terrace t	Terrace – area raised above surrounding terrain
Plain p	Plain – a level or very gently sloping surface.
Veneer v	Veneer – A layer of unconsolidated materials too thin to mask the minor irregularities of the surface of the underlying material. It is between about 10 cm and 1 m in thickness, and possesses no constructional form typical of the material genesis.
Permafrost Feature X	Process controlled by the presence of permafrost
Patterned Ground r	Patterned ground – general term for surface features expressed as polygons, stripes, or frost boils characteristic of ground subject to intense freeze-thaw action.
Compound Description	Example – sgkF^Gv-Xwr/sF^Gt – Glacial fluvial veneer with sand trace gravel, trace cobble, ice wedge pattern ground visible throughout overlying a glacial fluvial sand terrace
Additional Descriptors (texture/grain size)	
k	Cobble
g	Gravel
s	Sand
z	Silt
c	Clay

' TERRAIN CLASSIFICATION SYSTEM FOR BRITISH COLUMBIA, FISHERIES BRANCH, MINISTRY OF ENVIRONMENT, SURVEYS AND RESOURCE MAPPING BRANCH. PROVINCE OF BRITISH COLUMBIA. MOE MANUAL 10 (VERSION 2)

TABLE 2. POTENTIAL BORROW SOURCES

Borrow Source	Nearest APEC	Approx. Distance (km)	Approximate Area (hectares)	Common Fill	Granular Material	Low Perm. Material	Riprap	Bedding Sand	Comments
1	APEC 1	0.1	0.53	●	●			●	
2	APEC 2	0.1	0.96	●	●			●	
3	APEC 1 & 2	0.3	1.33	●			◉	●	
4	APEC 4	0.1	0.58					●	
5	APEC 1 & 4	0.55	0.12	●	●				Likely too far from APEC and difficult to access
6	APEC 4	0.1	0.45					●	
7	APEC 4	0.1	0.23					●	
8	APEC 4	0.15	0.06					●	Limited quantity and difficult to access
9	APEC 3	0.15	0.60	◉				●	
10	APEC 3	0.25	0.53	◉				●	
11	APEC 3	0.4	2.00	◉				●	
12	APEC 4	0.1	0.82				●	●	

Notes:

1. *APEC - Area of Potential Environmental Concern*
2. *Underline indicates processing likely required to produce material type*
3. *● – likely suitable*
4. *◉ – may be suitable*

LEGEND

— — — TRANSITION FROM sF^Gt-Xwr TO sgF^G-V

sF^Gt-Xwr - GLACIAL FLUVIAL TERRACE WITH SAND AND POTENTIALLY TRACE GRAVEL, ICE WEDGE POLYGONS OR PATTERNED GROUND VISIBLE THROUGHOUT

sgF^G-V - GLACIAL FLUVIAL SAND AND GRAVEL WITH GULLY EROSION, COBBLES AND BOULDERS LIKELY AT TOE OF SLOPE

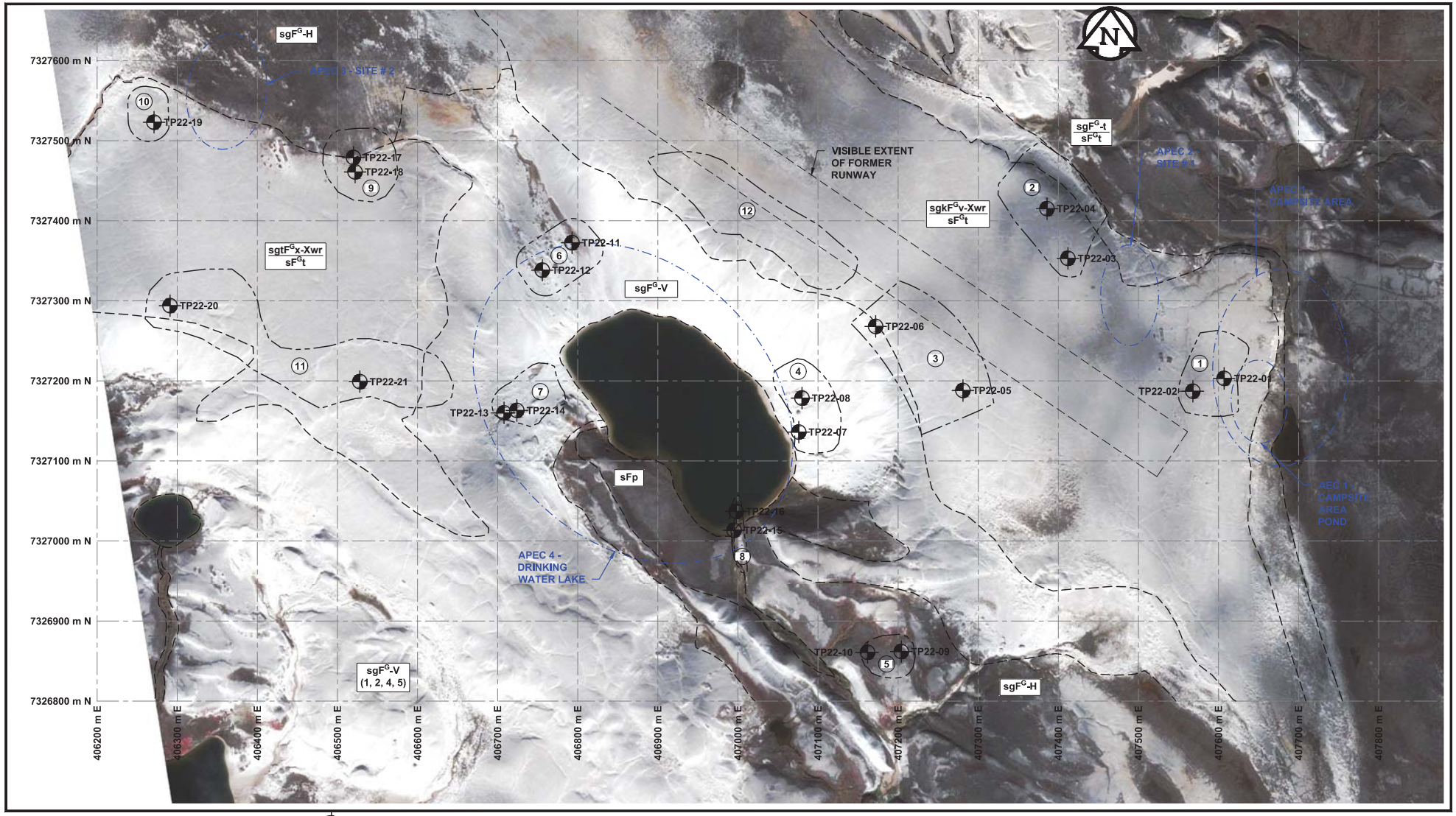
zsFp - FLUVIAL PLAIN WITH SILT AND SAND, POTENTIALLY TRACE AMOUNTS OF CLAY

sgF^G-H - GLACIAL FLUVIAL SAND AND GRAVEL, HUMMOCKY MORAINE WITH NUMEROUS KETTLE DEPRESSIONS AND KAMES TERRACES, PATTERNED GROUND AND THERMOKRAST TERRAIN PRESENT THROUGHOUT

KEY PLAN
SCALE: N.T.S.

LOCATION PLAN
SCALE: N.T.S.

Figure 4A - Geotechnical Borrow Sources - Notes and Tables



0 50 100 150 200 m
SCALE = 1 : 4 500 (279 mm x 432 mm)

LEGEND:

- TEST PIT (TREK, 2022)
- (1) DELINEATED BORROW AREA (SEE TABLE 2 ON FIGURE 01)
- POTENTIAL BORROW SOURCE
- TERRAIN CLASSIFICATION DELINEATION
- APEC DELINEATION

NOTES:

1. AERIAL PHOTO FROM SKYWATCH SATELITE DATASHARE, CAPTURE SEPTEMBER 7, 2015.
2. GRID SHOWN IN UTM ZONE 14 W.
3. SEE FIGURE 02 FOR ADDITIONAL INFORMATION.
4. APECS AND AECS SHOWN FROM BLUMETRIC ENVIRONMENTAL DRAWING (AEC / APEC PLAN DATED AUGUST 5, 2022, REV 0).

Figure 4B - Geotechnical Borrow Sources -Terrain Assessments & Test Pit Locations

APPENDIX B

Limited Building Material Investigation and Debris Inventory

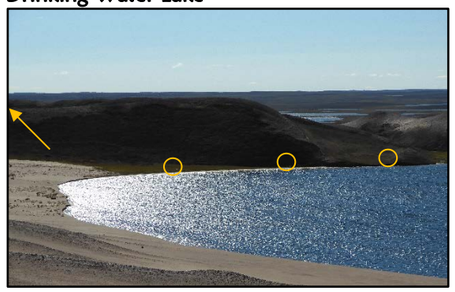
Table B-1: Debris Piles Descriptions and Inventory

ITEM	Surface Debris	APEC	Description	Inventory – Hazardous	Inventory – Non-hazardous
1	Campsite Food Cache 	1	Constructed of wood and metal (walls, ceiling, roof and floors) and built into the mound of soil with the entrance facing west. The walls consist of unpainted boards and are lined with sheet metal. The wood and metal is not painted. The roof appears to have been covered in black tar paper in poor condition (partially buried in the gravel to the side of the structure). There appears to be a sheet of plywood lying in front of the structure that may have been the door. The floor has collapsed exposing bare earth, and the structure itself has partially collapsed). There are three tanks on the roof. **Area: 9 m²** **Volume: 20.9 m³** **Adjusted volume without void space: 8.7 m³**	Liquid and Drum/Tank Residues – 0.3 m³ **Total: 0.3 m³**	Plywood and boards 4 m³ Metal debris 2 m³ Tar paper 1.3 m³ Three tanks, cut up 1.4 m³ **Total: 8.7 m³**
2	Immediately West of the Food Cache 	1	No structure remains. Wooden debris, a metal structure, household items, and empty barrels (approximately 7) remain in this area. **Area: 15 m²** **Volume: 15.1 m³** **Adjusted volume without void space: 13.75 m³**	none	Wood debris 13 m³ Metal Debris 0.39 m³ Household items 0.25 m³ Empty barrels, crushed 0.11 m³ **Total: 13.75 m³**
3	Northwest of the Food Cache 	1	No structure remains. Wooden debris, an old generator, a battery, rubber hose, household items, soda cans, and overturned empty barrels (approximately 6) are present in this area. **Area: 54 m²** **Volume: 41.1 m³** **Adjusted volume without void space: 14.1 m³**	Car batteries (3 units) 0.10 m³ **Total: 0.10 m³**	Cylinders (Two 0.8 m³ tanks, two 0.5 m³ tank, and two 0.002 m³ tank) 2.6 m³ Machine parts and generator 1.4 m³ Wood debris 9.9 m³ Empty barrels, crushed 0.09 m³ **Total: 14 m³**
4	West of the Food Cache 	1	No structure remains. CAT bulldozer and metal debris (including approximately two empty barrels) remain in this area. **Area: 25 m²** **Volume: 26 m³** **Adjusted volume without void space*: 17.58 m³** *void space estimated at 2/3 of volume for equipment	Possible liquids inside bulldozer 10 L Assumed lead-based paint, estimated thickness 0.01 m. **Total Liquids: 0.01 m³** **Total Paint: 0.25 m³**	Empty barrels, crushed 0.031 m³ Steel debris 0.6 m³ CAT bulldozer, dismantled 16.7 m³ **Total: 17.3 m³**

ITEM	Surface Debris	APEC	Description	Inventory – Hazardous	Inventory – Non-hazardous
5	North of the Food Cache – 1 	1	No structure remains. Wooden debris, household items, glass bottles, and overturned empty barrels (approximately 13) are present in this area. **Area: 54 m²** **Volume: 7.6 m³** **Adjusted volume without void space: 5.2 m³**	none	Wooden debris, household items, glass bottles = 5 m³ Empty barrels, crushed 0.2 m³ **Total: 5.2 m³**
6	North of the Food Cache – 2 	1	No structure remains. Wooden debris, household items, glass bottles, and overturned empty barrels (approximately 2) are present in this area. **Area: 54 m²** **Volume: 17 m³** **Adjusted volume without void space: 16.63 m³**	none	Cylinders (Two 0.8 m³ tanks, two 0.5 m³ tank, and two 0.002 m³ tank) 2.6 m³ Metal debris 4 m³ Wood debris 10 m³ Empty barrels, crushed 0.03 m³ **Total: 16.63 m³**
7	Southeast of the Food Cache 	1	Debris from overturned Jeep remain in this area. **Area: 10 m²** **Volume: 4.9 m³** **Adjusted volume without void space: 3.3 m³** *void space estimated at 2/3 of volume for equipment	Possible liquids inside Jeep 10 L **Total: 0.01 m³**	Jeep debris 3.3 m³ **Total: 3.3 m³**
8	Site#1 Fuel Cache (South Pile) 	2	111 barrels (unlabeled and empty) in the large cache, and approximately 44 more barrels scattered in surrounding areas to the south, southeast and southwest. **Area: 60 m² (for the cache), plus 22 m² for the scattered barrels** **Volume: 22.8 m³ (for the cache), plus 9 m³ for the scattered barrels** **Adjusted volume without void space: 2.3 m³ and 0.9 m³**	none	155 empty fuel barrels, crushed 3.2 m³ **Total: 3.2 m³**

ITEM	Surface Debris	APEC	Description	Inventory – Hazardous	Inventory – Non-hazardous
9	**Site#1 Fuel Cache (Middle Pile)** 	2	7 x 1,000 gallon tanks (empty, unlabeled) **Area: 57 m²** **Volume: 31.8 m³** **Adjusted volume without void space: 3.2 m³**	Liquid and drum/tank residues – 0.7 m³ **Total: 0.7 m³**	7 x 1,000 fuel tanks (empty, unlabeled), cut up 3.2 m³ **Total: 3.2 m³**
10	**Site#1 Fuel Cache (North Pile)** 	2	12 x 1,000 gallon tanks (empty, unlabeled), plus 7 barrels (empty, unlabeled) blown onto runway west of this area **Area: 80 m² (tanks) plus 3.5 m² for barrels** **Volume: 54.6 m³ (tanks) plus 1.4 m³ for barrels.** **Adjusted volume without void space: 5.46 m³ (tanks) plus 0.14 m³ for barrels**	Liquid and drum/tank residues – 1.2 m³ **Total: 1.2 m³**	12 x 1,000 gallon fuel tanks (empty), cut up 5.4 m³ 7 fuel barrels (Contents: empty) 0.14 m³ **Total: 5.5 m³**
11	**North of Site#1 Fuel Cache** 	2	No structure remains. Metal debris, household items, glass bottles, and overturned empty barrels (approximately 2) are present in this area. **Area: 30 m²** **Volume: 12.1 m³** **Adjusted volume without void space: 11.7 m³**	none	2 empty barrels 0.03 m³ Steel framing 2 m³ Metal Debris 0.7 m³ Wood debris 2 m³ Tubing 7 m³ **Total: 11.7 m³**
12	**West of Site#1 Fuel Cache** 	2	Metal cart with engine. **Area: 15 m²** **Volume: 45 m³** **Adjusted volume without void space: 25 m³**	Possible liquids inside engine 10 L Assumed lead-based paint, estimated 0.01 m thick. **Total Liquids: 0.01 m³** **Total Paint: 0.15 m³**	Steel cart 12 m³ Engine 13 m³ **Total: 25 m³**

ITEM	Surface Debris	APEC	Description	Inventory – Hazardous	Inventory – Non-hazardous
13	**Site#1 Drum Pile (S)** 	2	6 barrels (unlabeled and empty) in a small cache. **Area: 3 m²** **Volume: 1.2 m³** **Adjusted volume without void space: 0.09 m³**	None	6 empty fuel barrels, crushed 0.09 m³ **Total: 0.09 m³**
14	**Site#2 Fuel Cache** 	3	352 barrels, 26 tanks, plus another 9 barrels scattered to the south, and 23 scattered to the north, 32 toward the airstrip to the northeast and 1 to the east. One tank sample (approximately 15 cm liquid present, sample T1) and two barrel samples (samples B1 and B2) were collected in this area. Sample B2 had a very high concentration of F2 and is assumed to be fuel (location presented on **Figure 7**). B1 and T1 did not contain fuel and are assumed to be mostly water. Total tanks: 26 Total barrels: 417 **Area: 156 m² (tanks) plus 208.5 m² (barrels)** **Volume: 118.2 m³ (tanks) plus 85.5 m² (barrels)** **Adjusted volume without void space: 11.8 m³ (tanks) plus 8.6 m³ barrels**	205 L of fuel present in 1 barrel (B2). Liquid and drum/tank residues – 2.8 m³ **Total Liquid and drum/tank residues: 3.0 m³**	417 empty barrels, crushed 8.6 m³ metal 1 full barrel (Contents: diluted fuel/water) 205 L liquid 26 empty tanks: 11.8 m³ (metal) 1 tank (Contents: diluted fuel/water) 140 L liquid **Total Liquid: 0.345 m³** **Total Debris: 20.4 m³**
15	**East of Site#2 Fuel Cache** 	3	No structure remains. Wooden and metal debris, household items, and broken glass are present in this area. Three samples were collected for analysis of Asbestos Containing Materials (ACM) from the surfaces of the collapsed building and were negative for ACM (samples A01a, A01b, and A01c). **Area: 54 m²** **Volume: 12.1 m³** **Adjusted volume without void space: 11.7 m³**	none	Two empty barrels 0.03 m³ Steel framing 2 m³ Metal Debris 0.7 m³ Wood debris 2 m³ Tubing 7 m³ **Total: 11.7 m³**
16	**Southwest of Site#2 Fuel Cache** 	3	Metal cart. **Area: 12 m²** **Volume: 18 m³** **Adjusted volume without void space: 12.12 m³**	Assumed lead-based paint, estimated 0.01 m thick. **Total Paint: 0.12 m³**	Steel cart 12 m³ **Total: 12 m³**

ITEM	Surface Debris	APEC	Description	Inventory – Hazardous	Inventory – Non-hazardous
17	**Drinking Water Lake** 	4	15 barrels (unlabeled and empty) scattered around the shoreline and above the banks of Drinking Water Lake **Area: 7.5 m²** **Volume: 3.1 m³** **Adjusted volume without void space: 0.23 m³**	none	15 empty fuel barrels 0.23 m³ **Total: 0.23 m³**
18	**Landing Lakes** 	5	27 barrels and 1 x 1,000 L tank (unlabeled and empty) scattered around the shoreline and to the southwest of the Landing Lakes Area **Area: 18 m²** **Volume: 5.5 m³ (barrels) plus 4.5 m³ (tank)** **Adjusted volume without void space: 0.87 m³**	Liquid and drum/tank residues – 0.1 m³ **Total: 0.1 m³**	27 emptybarrels 0.42 m³ 1 empty tank 0.45 m³ **Total: 0.87 m³**
19	**Empty Fuel Drums throughout the site**	N/A	Empty fuel drums throughout the site	Liquid and drum/tank residues – 1.3 m³ **Total: 1.3 m³**	N/A
			Total Volume Estimates	**Total Debris: 0.10 m³** **Total Paint: 0.52 m³** **Total Liquids and Drum/Tank Residues: 6.64 m³**	**Total (debris): 172.77 m³** **Total (liquid): 0.345 m³**

Notes: Tank volume (1000 gallon/4546 L) assumed to be 4.546 m3 whole and 0.4546 m3 crushed (90% volume reduction)
Barrel volume (205 L) assumed to be 0.205 m3 whole and 0.0155 m3 crushed (90% volume reduction)

BluMetric Environmental Inc.

1682 Woodward Drive
Ottawa, Ontario
Canada K2C 3R8
Tel: 877.487.8436
Fax: 877.487.8436
Ottawa@blumetric.ca

4 Cataraqui Street
The Tower, The Woolen Mill
Kingston, Ontario
Canada K7K 1Z7
Tel: 877.487.8436
Kingston@blumetric.ca

3B, 209 Frederick Street
Kitchener, Ontario
Canada N2H 2M7
Tel: 877.487.8436
Kitchener@blumetric.ca

825 Milner Avenue
Toronto, Ontario
Canada M1B 3C3
Tel: 877.487.8436
Toronto@blumetric.ca

6-410 Falconbridge
Sudbury, Ontario
Canada P3A 4S4
Tel: 877.487.8436
Sudbury@blumetric.ca

260-15 Taschereau Street
Gatineau, Quebec
Canada J8Y 2V6
Tel: 877.487.8436
Gatineau@blumetric.ca

200-1500 Du College Street
Saint-Laurent, Quebec
Canada H4L 5G6
Tel: 877.487.8436
Montreal@blumetric.ca

4916 – 49th Street
Yellowknife, NT
Canada X1A 1P3
Tel: 877.487.8436
Yellowknife@blumetric.ca

Whitehorse, Yukon
Canada Y1A 2J8
Tel: 877.487.8436
Whitehorse@blumetric.ca

www.blumetric.ca