

**FINAL REPORT: GORDON LAKE
GROUP REMEDIAL ACTION
PLAN**



Prepared for:
Public Works and Government
Services Canada and Aboriginal
Affairs and Northern
Development Canada

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Plain Language Summary

This Remedial Action Plan (RAP) describes the approach for addressing environmental concerns associated with nine former mine and advanced exploration sites located on or near Gordon Lake, approximately 75 kilometers (km) northeast of Yellowknife, Northwest Territories (NT). The nine Gordon Lake Group (GLG) sites include:

- Burnt Island (mine site)
- Camlaren (mine site)
- Goodrock (mine site)
- Kidney Pond (mine site)
- Murray Lake (advanced exploration site)
- Storm Property (advanced exploration site)
- Treacy (mine site)
- Try Me (advanced exploration site)
- West Bay (mine site)

The purpose of this RAP is to summarize what is currently at each site, identify the regulations that apply to the sites and the hazard components, outline the objectives for the remediation, review potential remedial options, evaluate the advantages and disadvantages of each option, and recommend a remedial option that meets the remedial objectives. The following remedial goals were considered when assessing remedial options:

1. Reduce, and where possible eliminate, the risk to the environment and human health
2. Effectively reduce federal financial liability associated with these sites using cost effective solutions
3. Reduce residual risks with the goal of site closure
4. Promote socio-economic benefits to Aboriginal people and other northerners
5. Balance the consequential impacts of remediation with the benefits of reducing human and environmental risk

The remedial planning team consists of Indigenous and Northern Affairs Canada (INAC, formerly Aboriginal Affairs and Northern Development Canada (AANDC)), Public Works and Government Services Canada (PWGSC), Stantec Consulting Ltd (Stantec), and the Yellowknives Dene First Nations (YKDFN).

INAC, PWGSC, Stantec and the YKDFN met in February 2016 to review the current site conditions and discuss the potential remediation options. The options chosen are the basis for this RAP.

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The remedial guidelines are based on the federal and territorial guidelines, as these are the most applicable based on the land ownership. There are individual guidelines for each hazard component, however the key documents used to guide the process was the Decision-Making Framework (DMF) for Federal Contaminated Sites Action Plan (FCSAP) (FCSAP, 2013), the MVLWB and AANDC document Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories (MVWLB, 2013), and the Site-Specific Remedial Targets (SSRTs) as defined in the human health and ecological risk assessment (HHERA) and risk assessment updates (SLR, 2014; Stantec 2015b).

Hazard components present at each site and their description are in the table below:

Hazard Component	Burnt Island	Camlaren	Goodrock	Kidney Pond	Murray Lake	Storm Property	Treacy	Try Me	West Bay	Description
Co-mingled Impacted Soil	X	X		X					X	Soil containing concentrations of metals and PHCs greater than the SSRTs
Metals Impacted Soil		X	X	X	X	X	X		X	Soil containing concentrations of metals greater than the SSRTs
PHC* Impacted Soil	X	X		X			X		X	Soil containing concentrations of PHCs greater than the SSRTs
Mine Openings	X	X	X	X	X	X		X	X	Portals, shafts, and declines
Underground Workings	X	X		X						Former underground workings
Trenches	X	X	X	X	X	X	X	X		Trenches of varying sizes
Abandoned Infrastructure	X	X	X	X	X			X	X	Former core racks, docks and former machinery
Abandoned Site Buildings	X	X	X	X			X	X	X	Former site buildings, headframes
Waste Rock	X	X	X	X	X	X	X		X	Rock that was removed and crushed to access ore-bearing deposits (potential

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Hazard Component	Burnt Island	Camlaren	Goodrock	Kidney Pond	Murray Lake	Storm Property	Treacy	Try Me	West Bay	Description
										ML or PAG** source).
Tailings	X	X					X		X	Remains of ore-bearing rock
Hazardous Waste	X	X	X	X		X	X	X	X	Material containing asbestos or lead based paint
Non-hazardous Waste	X	X	X	X	X	X	X	X	X	Scattered wood and metal debris
Sediment	X	X	X	X		X	X	X	X	Sediments containing metals greater than the applicable guidelines
Impacted Water		X	X	X	X		X	X	X	Surface water impacted with COPCs*** greater than the applicable guidelines
Unfired Explosives				X						Remains of explosives with unknown state

*PHC = petroleum hydrocarbons **ML = metal leaching; PAG = potentially acid generating *** contaminants of potential concern

A wide variety of potential remediation options were evaluated initially in the Preliminary Remedial Action Plan for Gordon Lake Mine Sites. Remedial options which were carried forward from this initial elimination were further assessed for their ability to meet remedial targets, timeline to closure, how easy they are to implement (considering accessibility, mobilization, heavy equipment and material requirements), regulatory and community acceptability, and cost (completed on a relative high, medium, and low interpretation).

The hazard components identified for the GLG sites were further broken down into those that are common across sites and those that are site specific. Below are the options selected for the common components:

- Co-Mingled Impacted Soil - dispose of the co-mingled impacted soil in a consolidated landfill
- Metals Impacted Soil - dispose of the metals impacted soil in a consolidated landfill
- PHC Impacted Soil – landfarm and disposal of treated soil as cover material; with disposal of any untreated PHC impacted soil in a consolidated landfill



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- Waste Rock – construct a consolidated waste rock containment area
- Tailings – construct a consolidated tailings and soil containment area
- Hazardous Waste – containerize for off-site disposal
- Non-Hazardous Waste – burn and/or crush and place in consolidated landfill
- Unfired Explosives – assessed by an explosives expert and addressed accordingly

The remaining hazard components are site specific options. Generally these include backfilling mine openings, creating exclusion zones around areas of underground workings, preserving heritage items, managing some impacted material (both soil and moderate risk waste rock) in place through monitoring, and covering tailings at Burnt Island with borrow material.

As part of the remediation program, the tailings containment area at Camlaren will be upgraded to a Tailings and Soil Containment Area (TSCA), a Waste Rock and Soil Containment Area (WRSCA) will be constructed at Kidney Pond, and a Portal Water Management System will be constructed at the Kidney Pond portal.

The remediation program will be followed up with a short term monitoring plan (1-5 years after remediation) to include facility monitoring, surface water and sediment monitoring and sampling, and visual monitoring, along with identification of appropriate triggers and threshold values; and a long term monitoring plan (6+ years after remediation).

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Abbreviations

AANDC	Aboriginal Affairs and Northern Development Canada
ACM	Asbestos Containing Material
AEC	Areas of Environmental Concern
ARD	Acid Rock Drainage
BP	Before Present
CCME	Canadian Council of Ministers of Environment
COPC	Contaminants of Potential Concern
DMF	Decision Making Framework
FCSAP	Federal Contaminated Sites Action Plan
FRTR	Federal Remediation Technologies Roundtable
FWL	Freshwater life
GLG	Gordon Lake Group
GNWT	Government of Northwest Territories
HHERA	Human Health and Ecological Risk Assessment
INAC	Indigenous and Northern Affairs Canada
km	kilometre
LBP	Lead Based Paint
m	metre
ML	Metals Leaching
MVLWB	Mackenzie Valley Land and Water Board
NT	Northwest Territories
°C	Degrees Celsius
PAG	Potentially Acid Generating
PCB	Polychlorinated Biphenyl
PHC	Petroleum Hydrocarbons
PWGSC	Public Works and Government Services Canada
R/RM	Remediation / Risk Management
RAP	Remedial Action Plan

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SQG	Soil Quality Guidelines
SSRTs	Site Specific Remedial Targets
SWHA	Site Wide Hazard Assessment
TCA	Tailings Containment Area
TSCA	Tailings and Soil Containment area
WRSCA	Waste Rock and Soil Containment Area
YKDFN	Yellowknives Dene First Nations

1.0 INTRODUCTION

This Remedial Action Plan (RAP) describes the approach for addressing legacy environmental concerns associated with nine former mine and advanced exploration sites located on or near Gordon Lake, approximately 75 kilometers (km) northeast of Yellowknife, Northwest Territories (NT). The hazard components present at each site vary but in general include impacted soil, physical hazards (such as mine openings, underground workings, and trenches), waste rock, tailings, hazardous and non-hazardous waste, sediment, and impacted water. The nine Gordon Lake Group (GLG) sites include:

- Burnt Island (mine site)
- Camlaren (mine site)
- Goodrock (mine site)
- Kidney Pond (mine site)
- Murray Lake (advanced exploration site)
- Storm Property (advanced exploration site)
- Treacy (mine site)
- Try Me (advanced exploration site)
- West Bay (mine site)

Figure 1, Appendix A shows the relative location of each site compared to Gordon Lake.

This report is structured similar to Part 2 of the Mackenzie Valley Land and Water Board (MVLWB) and Aboriginal Affairs and Northern Development Canada (AANDC) guidance document Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories (MVLWB, 2013). For the remedial option assessment, where remedial options could generally be applied to a hazard component across all sites (for example metals impacted soil), the options assessment was compiled in Section 5.1 as common component remedial options, while hazard components that required assessment based on the site specific conditions (for example mine openings), are summarized in Section 5.2.

1.1 PURPOSE

The purpose of this RAP is to summarize the existing conditions at each site, identify the applicable regulatory framework, and the applicable guidelines for each hazard component, outline remedial objectives for the components requiring action, review potential remedial options, evaluate the advantages / disadvantages of each option, and recommend a remedial option that meets the remedial objectives. In addition, the RAP highlights logistical considerations and includes a proposed schedule for the remediation. The RAP also outlines conceptual remedial designs for the engineered structures proposed for the remediation program.

This work is being funded through the Federal Contaminated Sites Action Plan (FCSAP) and must be compliant with FCSAP requirements including reporting structures and submission deadlines (FCSAP, 2013). Where conflict exists between meeting FCSAP requirements and meeting Mine Closure Plan requirements as outlined in the MVLWB and AANDC document Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories (MVLWB, 2013), FCSAP requirements govern.

1.2 SCOPE OF WORK

The scope of work for this RAP included:

- Reviewing the regulatory framework applicable for the sites
- Summarizing previously completed work for each site
- Finalizing the list of hazard components that do not meet regulatory requirements
- Assessing the potential remedial options for each of the individual hazard components
- Reviewing the recommended options for each individual hazard components from an overall remediation program perspective
- Drafting the conceptual design of the remedial program
- Preparing a schedule for the remediation

1.3 REMEDIAL GOALS

The following remedial goals were considered when assessing remedial options:

1. Reduce, and where possible eliminate, the risk to the environment and human health
2. Effectively reduce federal financial liability associated with these sites using cost effective solutions
3. Reduce residual risks with the goal of site closure
4. Promote socio-economic benefits to Aboriginal people and other northerners
5. Balance the consequential impacts of remediation with the benefits of reducing human and environmental risk

1.4 REMEDIAL PLANNING TEAM

The remedial planning team consists of:

- Indigenous and Northern Affairs Canada (INAC, formerly Aboriginal Affairs and Northern Development Canada (AANDC))) – Responsible for the sites, project funding, and overall project execution
- Public Works and Government Services Canada (PWGSC) – Responsible for administration of the contract to complete the assessment, RAP, and remediation programs on behalf of INAC
- Stantec Consulting Ltd (Stantec) – Responsible for the final supplemental site assessment, and preparation of this RAP and design and tender documents



1.5 ENGAGEMENT

Engagement of the Yellowknives Dene First Nations (YKDFN) to date has included an initial desktop study, a tour of the sites for the YKDFN elders to review the site locations and gather information about historic and current uses of the sites, participation in a Traditional Knowledge study, participation in an archaeology assessment, and participation in a RAP workout.

When this document was in draft status, it was the focal point of a presentation to the YKDFN in February 2016 to communicate the proposed remediation program. When this consultation was completed, this RAP was revised and finalized taking into account items addressed during the RAP workout (meeting minutes attached in Appendix B). Upon award, the successful contractor will also be required to complete a consultation program and highlight the benefits they will bring to the community during the remediation program.

In addition, a training program will be part of the bid evaluation process to encourage engagement and jobs for the remediation program.

1.6 REGULATORY FRAMEWORK

The remedial guidelines for these sites are based on the federal and territorial guidelines, as these are the most applicable based on the land ownership. There are individual guidelines for each hazard component, however the key documents used to guide the process was the Decision-Making Framework (DMF) for Federal Contaminated Sites Action Plan (FCSAP) (FCSAP, 2013) and the MVLWB and AANDC document Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories (MVLWB, 2013). Hazard components include:

- Soil (including co-mingled impacted soil, metals impacted soil, petroleum hydrocarbon (PHC) impacted soil)
- Physical Hazards (including mine openings, underground workings, trenches, abandoned infrastructure, and abandoned site buildings)
- Waste Rock
- Tailings
- Hazardous Waste
- Non-Hazardous Waste
- Sediment
- Water

This section outlines the overall framework followed by the applicable guidelines for each hazard component.

1.6.1 Overall Framework

The DMF document outlines the framework for remediation on federally managed sites. The DMF is considered a roadmap that outlines the specific activities and requirements for addressing federal contaminated sites in Canada. The DMF is based on A Federal Approach to Contaminated Sites, a 10-step process guiding federal custodians in the aspects of working with contaminated sites (FCSAP, 1999).

Step 7 of FSCAP outlines the process to develop a Remediation/Risk Management (R/RM) Strategy and requires the selection of either a guideline or risk assessment approach for the remedial program. For this site, a risk assessment approach was chosen and Project specific recommendations in the Human Health and Ecological Risk Assessment (HHERA) outlined the assessed levels of risk from contaminants of potential concern (COPCs). If the conditions change (i.e. land use changes), then the findings of the risk assessment would need to be re-evaluated.

Under the FCSAP process, once a risk assessment is completed, the proponent can decide if the resulting risk is acceptable or not and opt for risk management or mitigation strategies in order to reduce the resulting risk to an acceptable level, as appropriate. Risk management is the systematic process of minimizing, monitoring, and controlling the probability and/or impact of identified risks. These mitigation strategies and approaches form the basis of the risk management strategy. The key to risk management is to identify risks that are intolerable and to either eliminate them or mitigate them to a tolerable level. The benefit of using a risk matrix is that it identifies those elements of risk that drive the resulting risk level that can then be targeted for mitigation. This targeted approach allows for more effective risk mitigation.

1.6.2 Soil

Soil impacted with hydrocarbons and metals is present over the sites in specific areas linked to previous mining or exploration activities. Initially, the contaminant concentrations were compared to the applicable federal and territorial guidelines. The applicable guidelines were then further refined through a risk assessment process which resulted in site specific remedial targets (SSRTs) being developed.

1.6.2.1 Initial Guidelines

The guidelines used to screen soil initially included:

- Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment, 2014 (CCME, 2014)
- Canada-Wide Standard for Petroleum Hydrocarbons (PHC) in Soil. Canadian Council of Ministers of the Environment, 2008 (CCME, 2008a)
- Canada-Wide Standard for Petroleum Hydrocarbons (PHC) in Soil: Scientific Rational Supporting Technical Document. Canadian Council of Ministers of the Environment, 2008 (CCME, 2008b)



- Environmental Guideline for Contaminated Site Remediation, Government of the Northwest Territories, 2003 (GNWT, 2003)
- Guidelines and Standards from other Provincial jurisdictions including Alberta and Ontario, in cases where federal guidelines did not apply

1.6.2.2 SSRTs

The SSRTs were developed based on the risk from specific parameters at specific areas of environmental concerns (AECs) at the GLG sites. The initial list of assessed parameters were based on the known historic uses at each site, and included by-products of extraction and processing where it was applicable, and field observations. The COPCs analyzed in previous assessments were summarized in each of the site specific appendices of the HHERA. The methodology used to screen COPCs considered both residential/parkland and agricultural land use scenarios where applicable. Agricultural guidelines were considered for exposure of ecological receptors for COPC screening purposes. Further evaluation of these COPCs carried forward resulted in the development of the SSRTs.

At the time the SSRTs were developed, the results of the draft Traditional Knowledge (TK) report (YKDFN, 2015) were not yet available. Instead, the SSRTs were developed based on a hypothetical residential toddler receptor to assess exposure to threshold (non-carcinogenic) COPCs and a hypothetical residential adult receptor to assess exposure to non-threshold COPCs (i.e., carcinogens). The exposure scenario assumed direct soil contact 24 hours/day, 7 days/week for 26 weeks/year (based on snow cover). Ingestion of country foods was omitted, based on the following: COPC concentrations in fish in Gordon Lake are similar to concentrations in fish in other areas of the NWT and Northern Canada; the areal extent of the mine sites is too small relative to the feeding territories of large game (e.g., moose, caribou) to contribute significantly to the body burdens of contaminants in these species; population densities of small game (e.g., ptarmigan, snowshoe hare) relative to the areal extent of each of the mine sites is likely too small to present a significant source of hunted game that might be contaminated with mine COPCs; and vegetation at the mine sites is generally sparse, particularly on the contaminated areas of the mines. As a result, country food harvesting and consumption of vegetation from the mine sites was considered unlikely to be significant (Stantec, 2015).

The results of the draft TK report (YKDFN, 2015) and information provided by the operators of Sandy Point Lodge (D. Cooke, personal communication, February and March 2016) confirmed exclusion of the country food ingestion exposure pathway. However, it is recommended that if the status of traditional use/harvesting in the area of the Gordon Lake Group of mine and mineral exploration sites changes in the future, an assessment of the country foods exposure pathway should be undertaken at that time. The SSRTs were derived following guidance provided by the Canadian Council of Ministers of the Environment (CCME, 2006) and are considered protective of both human and ecological health.

The final SSRTs recommended for the GLG sites are shown in Table 1.

Table 1 Final Recommended SSRTs (mg/kg)

COPC	Lowest Calculated SSRT	CCME SGQ _{HH} (Residential)	Background	Final SSRT
Arsenic	69	31	44.4	69
Cobalt	130	n/a	15.6	130
Lead	332	140	17.9	332
Mercury, inorganic	13	6.6	0.085	13
PHC F1	--	700 ^a	--	700
PHC F2	--	1,000 ^a	111	1,000
PHC F3	--	2,500 ^a	2,910	2,910

Notes:

^a Management Limit (CCME, 2008) coarse-grain soil, agricultural and residential land use; not risk-based.

For the purposes of determining the final areas that required remediation, Stantec retained the COPCs identified in the HHERA, and applied the SSRTs developed by Stantec as accepted by PWGSC and INAC. As identified by SLR in the HHERA (SLR, 2014), the COPCs which created an unacceptable risk are summarized in Table 2 below by site, media, and exposure unit (i.e., area of site).

Table 2 COPC Summary

Location	Media Exposure Unit	Metals					PHCs		
		As	Co	Pb	Hg	HS*	F1	F2	F3
Burnt Island	Soil - Old Mill			✓	✓				✓
	Soil - Workings							✓	✓
	Soil - Old Saw Mill								✓
Camlaren	Soil - Main Camp Area	✓		✓			✓	✓	✓
	Soil - North Cabin		✓			✓			
	Soil - Zenith Island	✓	✓						
Goodrock	None					✓			
Kidney Pond	Soil - 1983 Camp					✓		✓	✓
	Soil - Exploration Camp	✓							
	Soil - Kidney Pond Area	✓					✓	✓	✓
Murray Lake	Soil - Camp	✓							
	Soil - Trench Area	✓							
Storm Property	Soil - Shaft Area	✓							
	Soil - Camp Area					✓			
Treacy	Soil - Entire Site	✓						✓	✓
Try Me	None								

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Location	Media Exposure Unit	Metals					PHCs		
		As	Co	Pb	Hg	HS*	F1	F2	F3
West Bay	Soil - Entire Site	✓		✓	✓		✓	✓	✓

Notes:

- As - Arsenic
- Co - Cobalt
- Pb - Lead
- Hg - Mercury, inorganic
- PHCs - Petroleum Hydrocarbon Fractions
- ✓ - SSRT application for specific site, media exposure unit and COPC
- *Metals "hotspot" as identified in the HHERA completed by SLR (SLR, 2014)

The final SSRTs were applied to the COPCs for the areas presented in Table 2 in order to determine areas requiring remediation. Note that no soil COPCs were identified for Try Me, therefore no SSRTs were applicable. The soil criteria discussed in Section 1.6.2.1 were used for comparison purposes and background concentration considerations.

It should be noted that if the risk assessment assumptions are revisited or revised to include consideration for the agricultural land use, cases where the COPCs exceed the agricultural guidelines but not the residential/parkland guidelines should be considered, as these are currently not summarized in the Gap Assessment (Stantec, 2016b) that supports this RAP. Table 3 below summarizes the number of sample locations that exceed agricultural guidelines but not the residential/parkland guidelines at each site.

Table 3 Samples Exceeding Agricultural Guidelines but not Residential/Parkland Guidelines

Site	Quantity of Samples Exceeding Agricultural Guidelines and not Residential/Parkland Guidelines
Burnt Island	9
Camlaren	45
Goodrock	2
Kidney Pond	13
Murray Lake	1
Storm Property	1
Treacy	3
Try Me	0
West Bay	2
TOTAL	76

The areas associated with the samples identified in Table 4 should be reviewed if the risk assessment assumptions are altered.



1.6.3 Mine Openings, Underground Workings, Trenches, Abandoned Infrastructure, and Abandoned Site Buildings

Physical hazards include features such as mine openings (shafts, portals, trenches), underground workings, abandoned infrastructure, and abandoned site buildings. The applicable regulatory guidelines for these items include:

- Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories, AANDC/MVLWB (MVLWB, 2013)
- Mine Health and Safety Act and the Mine Health and Safety Regulations

A site-wide hazard assessment (SWHA) was completed by Stantec under separate cover (Stantec, 2016a), which included a complete regulatory review and evaluation of site hazards including physical hazards. The recommended remedial options for physical hazards as outlined in the SWHA have been formulated to be consistent with the recommended remedial options herein (see Section 5.2).

1.6.4 Waste Rock (Metal Leaching / Acid Rock Drainage)

Hazards associated with waste rock include potential for metal leaching/acid rock drainage (ML/ARD), governed by the following guidelines:

- Mine Environment Neutral Drainage Prediction Manual for Drainage Chemistry from Sulphidic Geological Materials MEND Report 1.20.1 (MEND, 2009).
- The Global Acid Rock Drainage Guide, International Network for Acid Prevention (GARD, 2014).

In addition, the following guidelines are used to evaluate exceedances of waste rock sample results:

- Guideline for Industrial Waste Discharges in the NWT, published by the Department of Environment and Natural Resources, Government of Northwest Territories (GNWT, 2004).
- Metal Mining Effluent Regulations SOR/2002-222, Schedule 4 (MMER, 2015).
- Average Continental Crust Concentration in Shales for evaluation of metals in waste rock (Price, 1997).

1.6.5 Tailings

There are no guidelines specific to tailings. However, based on their composition (a soil type medium), the analytical results for tailings were compared to the SSRTs to determine the level of environmental risk associated with leaving tailings, or requiring action on tailings.

1.6.6 Hazardous Waste

Hazardous waste present at the sites includes asbestos, lead based paint, and batteries. The applicable regulatory guidelines for these items include:

- Guideline for the Management of Waste Asbestos (GNWT, 2004).
- Guideline for the Management of Waste Batteries (GNWT, 1998).
- Guideline for the Management of Waste Lead and Lead Paint (GNWT, 2004).
- Guideline for the General Management of Hazardous Waste in the NWT (GNWT, 1998).
- Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149) (CEPA, 2005).
- Interprovincial Movement of Hazardous Waste Regulations (SOR/2002-301) (CEPA, 1999).

These guidelines and regulations were referenced as appropriate.

1.6.7 Non-Hazardous Waste

Non-hazardous waste present at the sites includes scattered wood and metal debris, which present physical hazards. The applicable regulatory guidelines for these items include:

- Guidelines for Closure and Remediation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories (MVWLB, 2013)
- Waste Reduction and Recovery Act, S.N.W.T. 2003, c.29, as amended by S.N.W.T 2010, c.16. (GNWT, 2010)

These guidelines and regulations were referenced as appropriate.

1.6.8 Sediment

There were no SSRTs for sediment developed for the GLG sites. COPCs for sediment were assessed based on the CCME sediment quality guidelines (SQG) for the protection of freshwater life (FWL). Ecological COPCs included arsenic, cadmium, chromium, copper, mercury, lead, zinc, cobalt, nickel and thallium. The sediment criteria discussed were applied to historical and supplemental site assessment results, used for comparison purposes and background concentration considerations, as outlined in the Gap Assessment Report (Stantec, 2016b).

No other guidelines were applicable for the assessment of sediment quality.

1.6.9 Water

The following guidelines should be referenced for surface water sampling in the future:

- CCME guidelines for the Protection of Aquatic Life (Freshwater)
- Health Canada Guidelines for Canadian Drinking Water Quality

There were no SSRTs for surface water developed for the GLG sites. With respect to groundwater, the Federal Interim Groundwater Quality Guidelines (FIGQGs) for Federal Contaminated Sites (November 2015) should be referenced.

2.0 PROJECT ENVIRONMENT

This section provides the project environment. This information is drawn from the Gordon Lake Gap Assessment Report (Stantec, 2016b).

2.1 ATMOSPHERIC ENVIRONMENT

2.1.1 Climate

Gordon Lake is located in Northern Canada and although it is south of the Arctic Circle, it is subject to extreme weather. According to historical averages provided by the Government of Canada's Climate Normals Station Data (1981-2010) Station ID 2204100 (located in Yellowknife, NT), Gordon Lake's temperatures typically reach subzero daily averages for seven months of the year (October to April). Temperatures in this area have historically reached below -50°C within these winter months. Within the remaining five months of the year, the average daily temperature is above the freezing point. The daily average temperature is below 10°C for the months of May and September, while between June and August the daily average temperature ranges from 13-17°C. The total average annual precipitation is 288.6 millimeters (mm) (Station ID 2204100). While rainfall averages (approximately 170.7 mm) are higher than snowfall averages (156 centimeters (cm) or approximately 117.9 mm precipitation), snowfall can occur during any month of the year but has a very low likelihood within the months of June to August (EC, 2015).

2.1.2 Air Quality

As there are no air monitoring stations at the sites, no information is available on the air quality at the sites.

2.1.3 Precipitation

Table 3 below presents the precipitation and lake evaporation data for Station ID 2204100 (Yellowknife, NT).

Table 4 Precipitation and Evaporation Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Precipitation (mm)	14.3	14.1	13.9	11.3	18.4	28.9	40.8	39.3	36.3	30.3	24.8	16.2
Lake Evaporation (mm)	-	-	-	-	4.6	4.8	4.9	3.5	1.7	-	-	-

Government of Canada's Climate Normals Station Data (1981-2010) Station ID 2204100 (EC, 2015)

2.2 PHYSICAL (TERRESTRIAL) ENVIRONMENT

2.2.1 Hydrology

The watershed surrounding the GLG sites is difficult to define as the area is encompassed by a vast number of smaller water bodies. The Cameron River system, which is located near the West Bay site, has been defined as the location to which the Lake's water outlets. Referring to Section 2.3, seven months of the year are typically seen to have subzero temperatures thus causing the surface water to freeze. This may cause a flux in precipitation infiltration, which results in either surface water runoff or a greater accumulation on the surface (Humphries, 2005).

2.2.2 Surficial Geology and Mineralization

The GLG lies within the Slave Province, an Archean granite-greenstone terrane located in the northwestern Canadian Shield. The supracrustal rocks of this terrane comprise sedimentary and volcanic rocks intruded by granitic bodies that have undergone multiple phased deformation events and date between 2.71 and 2.65 Ga (Mortensen et al., 1988). The GLG occurs within the Burwash Formation, part of the Duncan Lake Group, assigned to the Yellowknife Supergroup (Bleeker and Villeneuve, 1995). The metasedimentary rocks of the Burwash Formation are dominantly low to high grade metamorphosed turbidite (metaturbite) sequences of well-preserved mudstone grading to greywacke. The GLG sites are situated on two members of the Burwash Formation, Atl and Atm, low-grade and medium-grade metaturbites, respectively.

The Slave Province is recognized for its province-wide zoning of three major gold deposit types; gold hosted in 1) quartz veins, 2) shear zones, and 3) iron formations. Most gold deposits formed before the intrusion of the major granitic bodies (Ferguson et al., 2005). The GLG sites included in this study feature mainly gold-sulphide bearing white-smoky quartz veins hosted in metaturbites of the Burwash Formation. Sulphide minerals associated with these deposit types include pyrite, pyrrhotite, marcasite, chalcopyrite, arsenopyrite, galena, and sphalerite.

This region was last covered by the Late Wisconsin glaciation event until about 11,000 before present (BP) and was completely ice-free by 10,000 BP (Dyke and Prest, 1987). Paleo ice flow was generally to the southwest (Kerr, 1990) as apparent by orientation of drumlins and eskers (Othof et. al., 2014).

Retreating ice-sheets deposited fine-grained glaciolacustrine sediments below 320 to 350 metre (m) elevation in the Great Bear and Great Slave basins. In the Gordon Lake area, re-worked glacial and glaciofluvial sediments are the dominant surficial material with till thickness and distribution increasing westerly and northwesterly. Till thickness varies, but generally greater than 2 m occurring as silt to gravel blankets, following bedrock topography, and may include patches of till veneer or drumlinoids.

With respect to permafrost, the Gordon Lake area is located within the extensive discontinuous permafrost zone, where permafrost can be found on 50% to 90% of the land (Heginbottom *et al.* 1995). Within the extensive discontinuous permafrost zone, ground ice content in the upper 10 m of ground is believed to range from low to medium (<10 % to approximately 20% by volume) and consist mainly of frozen pore water (i.e., interstitial ice), ice lenses and ice veins (i.e., segregated ice and reticulated ice). Ice wedges, which are a type of patterned ground resulting from thermal contraction and cracking of the ground surface (ACGR, 1988), might occur locally.

The distribution of the permafrost in the area is related to several interconnected factors such as the local climate, ground surface topography, material types and textures, vegetation coverage and drainage conditions. Similarly, the variation in the amount of ground ice present within the permafrost is found to be directly related to factors such as the nature of the surficial deposits and characteristics of the local terrain.

No data is currently available on the local distribution of the permafrost in the Gordon Lake area; however, our knowledge of northern environments suggests that peat bogs and fine grained deposits (e.g., silty to clayey lacustrine and/or glaciolacustrine sediments) are likely the only terrain units containing permafrost in the area. Bedrock outcrops and well- to rapidly-drained, coarse-grained deposits such as till and glaciofluvial deposits are likely free of permafrost. Where permafrost is present, the active layer (i.e., the portion of soil that thaws each summer and refreezes in the winter) would typically range between 0.5 m and 1.5 m deep and would vary greatly depending on local ground conditions.

2.2.3 Bedrock Geology

Most of the bedrock in the Gordon Lake Area is Archean (over 2.5 billion years old) or Paleoproterozoic (1.6 – 2.5 billion years old) in age (ECG, 2008). The bedrock surface is often highly fractured (frost shattered) and subject to extensive frost heave. The borrow assessment completed at the sites identified discontinuous veneers of till and glaciofluvial deposits. The till veneers generally consist of sandy material with variable amounts of angular to sub-rounded gravel to boulder size fragments. The glaciofluvial material, mainly eskers and/or outwash deposits, are predominately sandy material, with localized gravel. Coarse fragments were generally located at the surface (i.e. 0 to 30 cm in depth) and decrease rapidly with depth. The material is well sorted and contains very low amounts of fines (i.e. silt and clays).

2.3 CHEMICAL ENVIRONMENT

Results of previous work including soil, sediment, surface water, groundwater and ARD and ML assessments are summarized in the reports in Table 4. This includes a background soil quality assessment completed for the HHERA (SLR, 2014) and further assessment completed in the Gordon Lake Gap Assessment Report (Stantec, 2015b).

2.4 BIOLOGICAL ENVIRONMENT

The GLG sites are located northwest of the East Arm of Great Slave Lake, which falls into the Northwestern Boreal Uplands of Canada. When further classifying the area, Gordon Lake and surrounding sites are located in the Taiga Shield- Great Slave Upland Low Subarctic (LS) Ecoregion of the Northwest Territories (ECG, 2008). The total area of this ecoregion in the NWT is approximately 15,431 km² or 13.5% of the Taiga Shield LS Ecoregion (ECG, 2008). This Ecoregion is known for having a bedrock-dominated landscape that is sloped towards the southwest, which supports scattered black spruce woodland growth on the bedrock outcrops. In areas of till veneers and blankets, it is common to have dense black spruce forests occur. In areas of outwash, white spruce woodlands are common and Jack pine can be found in areas of lower elevation (ECG, 2008).

As summarized in the HHERA by SLR, observed wildlife included lake trout and pike, wood frog, moose, muskrat, red squirrel, spruce squirrel, and 25 bird species (SLR, 2014). Caribou and snowshoe hare pellets and bear scat were also recorded. Additional information regarding wildlife and ecological receptors is described in the HHERA (SLR, 2014).

3.0 PROJECT DESCRIPTION

Stantec reviewed the following previous reports to determine current conditions at each of the sites and frame up the project description:

Table 5 Reviewed Previous Reports

Site Name IEMS Site #	Report Title
Burnt Island SM220	<ul style="list-style-type: none"> Burnt Island Mine Phase III Environmental Site Assessment, report completed by SLR for PWGSC, dated March 2013 Phase II Environmental Site Assessment SM220 - Burnt Island, report prepared by WESA for PWGSC, dated March 2010
Camlaren SM205	<ul style="list-style-type: none"> Camlaren Mine Phase III Environmental Site Assessment, report prepared by SLR for PWGSC, dated March 2013 Phase II Environmental Site Assessment SM205 - Camlaren Mine, report prepared by WESA for PWGSC, dated March 2010
Goodrock	<ul style="list-style-type: none"> Goodrock Mine Phase III Environmental Site Assessment, report prepared by

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Site Name IEMS Site #	Report Title
SM466	SLR for PWGSC, dated March 2013 <ul style="list-style-type: none"> Phase II Environmental Site Assessment SM466 - Goodrock Mine, report prepared by WESA for PWGSC, dated March 2010
Kidney Pond / Knights Bay SM474	<ul style="list-style-type: none"> Kidney Pond Mine Phase III Environmental Site Assessment, report prepared by SLR for PWGSC, dated March 2013 Phase II Environmental Site Assessment SM474 - Kidney Pond/Knight Bay, report prepared by WESA for PWGSC, dated March 2010
Murray Lake SM488	<ul style="list-style-type: none"> Phase I/II Environmental Site Assessment Murray Lake Property SM490, report prepared by Columbia Environmental for PWGSC, dated March 2013 Conceptual Assessment Design and Remediation Plan Murray Lake Property (SM490), report prepared by Columbia Environmental for PWGSC, dated March 2013
Storm Property SM471	<ul style="list-style-type: none"> Phase II Environmental Site Assessment SM471 - Storm Property, report prepared by WESA for PWGSC, dated March 2010
Treacy SM475	<ul style="list-style-type: none"> Treacy Mine Phase III Environmental Site Assessment, report prepared by SLR for PWGSC, dated March 2013 Phase II Environmental Site Assessment SM475 - Treacy Mine, report prepared by WESA for PWGSC, dated March 2010
Try Me SM488	<ul style="list-style-type: none"> Phase I/II Environmental Site Assessment, Try Me Property (SM488), report prepared by Columbia Environmental for PWGSC, dated March 2013 Conceptual Assessment Design and Remediation Plan, Try Me Property (SM488), report prepared by Columbia Environmental for PWGSC, dated March, 2013
West Bay/ Blackrock SM302	<ul style="list-style-type: none"> Phase I Environmental Site Assessment West Bay/Black Ridge Gold Mine SM 211 & SM 302, report prepared by Dillon Consulting Limited for PWGSC, dated March 2007 Phase II Environmental Site Assessment For West Bay/Blackridge Mine SM 302, report prepared by EBA for PWGSC, report dated April 2009 Phase III Environmental Site Assessment, West Bay Mine, Gordon Lake, Northwest Territories, report prepared by AECOM for PWGSC, dated March 31, 2010
Overall Gordon Lake Group	<ul style="list-style-type: none"> Human Health and Ecological Risk Assessment (HHERA), Gordon Lake Mine Sites, report prepared by SLR for PWGSC, report dated March 2014 Status Memo, Gordon Lake Mine, report prepared by SLR for PWGSC, dated March 2014 Final Report – Technical Review of HHERA for Nine Former Mine Sites, Gordon Lakes, Northwest Territories, report prepared by Stantec Consulting Ltd., report dated March 7, 2014 Final Report – Review of SSRTs, Summary, and Conclusions of the HHERA for Nine Former Mine Sites, Gordon Lakes, Northwest Territories, report prepared by Stantec Consulting Ltd, report dated March 31, 2014 Basis of Estimate and Cost Estimate – Remediation of Nine Former Mine Sites, Gordon Lake, Northwest Territories, report prepared by Stantec Consulting Ltd., dated March 31, 2014 Remedial Options Analysis Gordon Lake Mines, Northwest Territories, report

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Site Name IEMS Site #	Report Title
	<p>prepared by Stantec Consulting Ltd, dated March 31, 2014</p> <ul style="list-style-type: none"> • Supplemental Assessment of Site-Specific Remedial Targets for Nine Former Mine Sites, Gordon Lake, Northwest Territories, letter report prepared by Stantec Consulting Ltd. for PWGSC, dated December 15, 2014 • Gordon Lake Mine Site Borrow Assessment, report prepared by Stantec Consulting Ltd. for PWGSC, dated January 28, 2015 • Final Report – Gordon Lake Gap Analysis, report prepared by Stantec Consulting Ltd. for PWGSC, dated February 27, 2015 • Addressing Environment Canada Concerns Re: Site-Specific Remedial Targets for the Gordon Lake Mine Sites, Northwest Territories, letter report prepared by Stantec Consulting Ltd. for PWGSC, dated March 31, 2015 • Preliminary Remedial Action Plan for Gordon Lake Mine Sites, Gordon Lake, Northwest Territories, report prepared by Stantec Consulting Ltd. for PWGSC, dated March 31, 2015 • Final Report: Gordon Lake Group- Revised Gap Analysis, report prepared by Stantec Consulting Ltd. for PWGSC, dated July 17, 2015 • Final Report: Gordon Lake Group- Revised Detailed Work Plan, report prepared by Stantec Consulting Ltd. for PWGSC, dated June 24, 2015 • Final Report: Gordon Lake Group Gap Assessment Report, report prepared by Stantec Consulting Ltd. For PWGSC, dated March 14, 2016 • Archaeology Assessment Report, report prepared by Points West for Stantec Consulting, dated March 11, 2016

3.1 LOCATION AND ACCESS

All of the sites are located on Crown land, managed by the federal government and are part of the unsettled Akaitcho land claim.

Site access is limited as there is no all-season access road to any of the nine sites. During previous assessment programs, the area was accessed by float plane or helicopter, and the individual sites accessed by float plane, helicopter or boat from Sandy Point Lodge. For sites that were accessed by float plane, the aircraft was docked along the shoreline. There were no functional docks at any of the Sites, therefore installation of temporary docks would be required at any site where float plan access is required.

Site access options for the remedial program include using the Tibbitt to Contwoyto Joint Venture (JV) winter road, and constructing spur roads to each site. Intended branch road alignments would need to be determined and verified prior to the initiation of any remedial work. Approximately 50 km of spur roads would require construction to access all of the GLG sites (Figure 1, Appendix A).

Temporary haul roads and access routes to the winter road system would likely need to be constructed to access the borrow sources. The existing site roads are in poor condition (generally limited to trails) and several areas do not have road access. Therefore, the existing roads at the sites will also require upgrading prior to conducting remedial activities.



There is a historic winter road connecting Murray Lake to Gordon Lake, which could allow winter access to Murray Lake (and possibly Try Me from Murray Lake) if required. Verification that this route would be open during site activities would be required.

The other sites located off of Gordon Lake (including Storm Property and Goodrock) will require temporary access roads to be constructed. Due to the limited amount of waste present at these sites, it may be feasible to transport the wastes via air (either fixed wing aircraft on floats/skis or by helicopter) or via skidoo trails using a Hagglund or snowcat.

The location of site infrastructure components, including former dock locations, site roads/trails, potential camp locations, and potential staging locations are shown in the site specific figure sets described in Section 3.2, while Figure 1 shows the location of the JV winter road, borrow sources, and possible spur roads.

3.2 SITE HISTORY

All of the sites are currently un-occupied; however, five of the sites have active mineral claims outlined in Table 5 below.

Table 6 Mineral Claim Summary

Site	Claim #	Claim Holder	Expiry Date
Kidney Pond	3248	Silver Pursuit Resources Ltd.	2030
Camlaren	K06900	Lakeland Resources	2018
Murray Lake	K03650	Pasinex Resources Limited	2016
Burnt Island	5058	Pasinex Resources Limited	2029
West Bay	F33025	Walter Humphries	2016

The Gordon Lake area is used by hunters, trappers, and for recreational fishing (Sandy Point Lodge is located towards the northern end of Gordon Lake on the eastern shore). The Tibbitt to Contwoyto Joint Venture winter road is constructed in the winter through the middle of Gordon Lake (running north-south), connecting the Ingraham Trail (Highway 4) to the mines northeast of Yellowknife.

3.2.1 Burnt Island

The history of Burnt Island was summarized in a report prepared by SLR in 2013 (SLR, 2013a) and key points are summarized below. Figures A-1 through A-7 showing the hazard components and site infrastructure are attached in Appendix A.

- Burnt Island is divided into several areas including the shaft area, tailings impoundment, old mill, waste rock area and the Knutsen camp, which are all located on the southern interior of the island.



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- An old saw mill area is present on the southwestern shore of the island. The old saw mill area, the Knutsen camp, and the old mill area are all located along the shoreline of Gordon Lake; however, all the other areas are located inland.
- Initial mineral exploration activities commenced in the late 1930s and continued periodically until 1990 when decommissioning activities started.
- Equipment and structures previously located at the site during its operation were removed during the decommissioning of the site in 1993.
- A large waste rock area, fuel storage pad, tailings, burn pits, wooden structures, scattered wood/metal debris and areas of hydrocarbon staining remain at the site.

Based on the previously completed work, the hazard components are tabulated in Table 1, Appendix C and summarized below:

- 1 Area of Co-Mingled Impacted Soil
- 6 Areas of PHC Impacted Soil
- 2 Openings
- 1 Underground Working
- Trenches
- 5 Abandoned Infrastructure Components
- 3 Abandoned Site Buildings
- 1 Area of Waste Rock
- 1 Area of Tailings
- 1 Hazardous Waste Component
- Non-hazardous Waste
- Impacted Sediment

3.2.2 Camlaren

The history of Camlaren was summarized in a report prepared by SLR in 2013 (SLR, 2013b) and key points are summarized below. Figures B-1 through B-6 showing the hazard components are attached in Appendix A.

- Camlaren is divided into several areas including the abandoned mine site on the south side of Muir Island, and the North Cabin Area on the north side of Muir Island.
- The site also includes a small abandoned mine site located on Zenith Island located 1.5 km southeast of Muir Island.
- Initial mineral exploration activities commenced at Muir and Zenith islands in the late 1930s, after mineral claims on the islands were staked in 1936. Between the late 1930s and the early 1960s, exploration on the islands was intermittent. Activities on the islands continued until 1982, when the site was decommissioned.
- Heavy equipment, structures, and bulk fuel storage tanks previously located at the site during its operation were removed during the decommissioning of the site in 1982.

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- Concrete pads from several former buildings, waste rock and ore piles, tailings, burn pits, scattered wood and metal debris and areas of hydrocarbon staining were identified on the south side of Muir Island.
- In the North Cabin area, an intact building was identified, in addition to a burn pile with metal and wood waste.
- One mine shaft, waste rock/ore pile, and scrap wood debris was identified at Zenith Island.

Based on the previously completed work, the hazard components are tabulated in Table 1, Appendix C and summarized below:

- 1 Area of Co-Mingled Impacted Soil
- 17 Areas of Metals Impacted Soil
- 7 Areas of PHC Impacted Soil
- 5 Openings
- 1 Underground Working
- 1 Trench
- 5 Abandoned Infrastructure Components
- 4 Abandoned Site Buildings
- 5 Areas of Waste Rock
- 1 Area of Tailings
- 1 Hazardous Waste Component
- Non-hazardous Waste
- Impacted Sediment
- Impacted Water
- Non-hazardous Waste
- Impacted Sediment
- Impacted Water

3.2.3 Goodrock

The history of Goodrock was summarized in a report prepared by SLR in 2013 (SLR, 2013c) and key points are summarized below. Figures C-1 through C-4 showing the hazard components are attached in Appendix A.

- Goodrock is divided into several areas including a former camp, mill site and the remains of a wharf. The mill site is located inland; however the former camp area and wharf can be accessed via Gordon Lake.
- Initial mineral exploration activities commenced at Goodrock in the late 1930s and continued into the late 1970s. Between the 1930s and the 1970s exploration activities for gold and tungsten were undertaken at the site.
- Although no recorded mining activities occurred recently, a habitable cabin remains on the site and is part of the Goodrock Recreational Lease. A second habitable cabin is currently used by the lease holder for storage purposes.

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- Fire swept through the area in 1998 and suspected fire retardant was observed in localized areas of the site during a site investigation undertaken by WESA in 2009.
- An old incinerator, former building debris, exploration trenches, two mine shafts, a metal can dump and the remains of an old wharf are still present on-site.

Based on the previously completed work, the hazard components are tabulated in Table 1, Appendix C and summarized below:

- 1 Area of Metals Impacted Soil
- 2 Openings
- Trenches
- 2 Abandoned Infrastructure Components
- 4 Abandoned Site Buildings
- 2 Areas of Waste Rock
- 1 Hazardous Waste Component
- Non-hazardous Waste
- Impacted Sediment
- Impacted Water

3.2.4 Kidney Pond

The history of Kidney Pond was summarized in a report prepared by SLR in 2013 (SLR, 2013d) and key points are summarized below. Figures D-1 through D-8 showing the hazard components are attached in Appendix A.

- The Kidney Pond site is divided into several areas including the 1983 camp, 1939 camp, exploration camp, portal area and the kidney pond area. The 1983 camp, 1939 camp and the exploration camp are located away from the main site and are accessible via Gordon Lake. The kidney pond area and the portal area are located inland.
- Historical mining activities at Kidney Pond commenced in the late 1930s and continued periodically until 2003 when, after being re-staked, work halted.
- No processing of mined ore occurred on site and therefore no tailings were observed.
- Features observed on site during previous investigations include burn pits, scattered debris, surface staining, building pads, tin can dumps, trenches, a core shed and racks, and a waste rock/ore pad.

Based on the previously completed work, the hazard components are tabulated in Table 1, Appendix C and summarized below:

- 3 Areas of Co-Mingled Impacted Soil
- 5 Areas of Metals Impacted Soil
- 6 Areas of PHC Impacted Soil
- 1 Opening
- 1 Underground Working



- Trenches
- 2 Abandoned Infrastructure Components
- 1 Abandoned Site Buildings
- 5 Areas of Waste Rock
- 1 Hazardous Waste Component
- Non-hazardous Waste
- Impacted Sediment
- Impacted Water
- Potentially Unfired Explosives

3.2.5 Murray Lake

The history of Murray Lake was summarized in a report prepared by Columbia Environmental in 2013 (Columbia, 2013a) and key points are summarized below. Figures E-1 through E-4 showing the hazard components are attached in Appendix A.

- The Murray Lake site is divided into several areas including the 1938 camp, the 2008 camp and a series of small areas containing exploration trenches.
- Mineral exploration activities commenced at Murray Lake in the late 1930s, after the initial mineral claims were staked.
- Between the late 1930s and 1940 significant gold exploration activities were undertaken at the site. Exploration activities continued intermittently until 2008 after which time no further mining works were reported.
- Fire reportedly swept through the site area around 1995. As a result, other than burnt metal debris, little remains at the 1938 camp site.

Based on the previously completed work, the hazard components are tabulated in Table 1, Appendix C and summarized below:

- 5 Areas of Metals Impacted Soil
- 2 Openings
- Trenches
- 1 Abandoned Infrastructure Components
- 2 Areas of Waste Rock
- Non-hazardous Waste
- Impacted Water

3.2.6 Storm Property

The history of Storm Property was summarized in a report prepared by WESA in 2010 (WESA, 2010) and key points are summarized below. Figures F-1 through F-4 showing the hazard components are attached in Appendix A.

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- Storm Property is divided into two areas; the shaft area located on a small lake east of Gordon Lake and the former camp area.
- The site consists of two shafts, three trenches, a number of former building footprints, burn pits, ore piles and various scattered debris.
- Initial mineral exploration activities commenced at Storm Property in the early 1940s with further mining activities occurring at the site in the late 1970s into the early 1980s.
- Mining activities at the site discontinued in the early 1980s.

Based on the previously completed work, the hazard components are tabulated in Table 1, Appendix C and summarized below:

- 4 Areas of Metals Impacted Soil
- 2 Openings
- Trenches
- 2 Areas of Waste Rock
- 1 Hazardous Waste Component
- Non-hazardous Waste
- Impacted Sediment

3.2.7 Treacy

The history of Treacy was summarized in a report prepared by SLR in 2013 (SLR, 2013e) and key points are summarized below. Figures G-1 through G-4 showing the hazard components are attached in Appendix A.

- Treacy is divided into two sub areas, including the mill area and an old camp southwest of the mill area; both areas are located on the shore of Gordon Lake.
- Mineral exploration activities commenced at Treacy Mine in the mid-1940s, after the initial mineral claims on the islands were staked in 1945.
- Ore processing occurred at Treacy between 1951 and 1953 after which there was a decline in site activity until the 1980s. Activities on the islands continued until the early 2000s.
- Remains of the mine operations observed on-site include ore/waste rock piles, exploration trenches, burn pits, a concrete pad from a former building and scattered wood and metal debris. Areas of hydrocarbon staining were also identified in the mill area.

Based on the previously completed work, the hazard components are tabulated in Table 1, Appendix C and summarized below:

- 2 Areas of Metals Impacted Soil
- 1 Area of PHC Impacted Soil
- Trenches
- 1 Abandoned Site Building
- 1 Area of Waste Rock
- 1 Area of Tailings

- 1 Hazardous Waste Component
- Non-hazardous Waste
- Impacted Sediment
- Impacted Water

3.2.8 Try Me

The history of Try Me was summarized in a report prepared by Columbia in 2013 (Columbia, 2013b) and key points are summarized below. Figures H-1 through H-4 showing the hazard components are attached in Appendix A.

- Try Me is located on the shore of MacDonald (Mac) Lake and is divided into four main areas including the main camp, western camp, shaft and waste rock area as well as the areas containing exploration trenches.
- Mineral exploration activities commenced at Try Me in the late 1930s, after the initial mineral claims were staked in 1938.
- Between the early 1940s and late 1980s no gold exploration activities were undertaken at the site. Exploration activities continued in 1989 but only for a short time after which no further mining works was conducted.
- Features observed remaining on site during previous investigations consist of scattered debris, wooden structure remains, exploration trenches, a prospect shaft and empty 205 L drums.
- Fire reportedly swept through the site area in the late 1990s.

Based on the previously completed work, the hazard components are tabulated in Table 1, Appendix C and summarized below:

- 1 Opening
- Trenches
- 2 Abandoned Infrastructure Components
- 1 Abandoned Site Building
- 1 Hazardous Waste Component
- Non-hazardous Waste
- Impacted Sediment
- Impacted Water

3.2.9 West Bay

The history of West Bay was summarized in a report prepared by EBA in 2009 (EBA, 2009) and key points are summarized below. Figures I-1 through I-4 showing the hazard components are attached in Appendix A.

- West Bay is located on the southeastern shore of Gordon Lake and is sub divided into two areas including the northern and southern areas.

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- An open pit, former mill area, waste rock piles and various scattered debris were observed remaining on-site.
- Mineral exploration activities were completed at West Bay mine between 1947 and 1948. Site activities ceased until the early 1980s, at which time significant gold exploration activities resumed.
- Further mine activities continued in the early 1990s with no reported activity after 1991.

Based on the previously completed work, the hazard components are tabulated in Table 1, Appendix C and summarized below:

- 1 Area of Co-Mingled Impacted Soil
- 4 Areas of Metals Impacted Soil
- 3 Areas of PHC Impacted Soil
- 1 Opening
- 2 Abandoned Infrastructure Components
- 1 Abandoned Site Building
- 2 Areas of Waste Rock
- 1 Area of Tailings
- 1 Hazardous Waste Component
- Non-hazardous Waste
- Impacted Sediment
- Impacted Water

4.0 REMEDIAL OPTIONS METHODOLOGY

4.1 HAZARD COMPONENTS

Based on the results of previous work the following hazard components are present at one or all of the sites:

- Co-Mingled Impacted Soil – Soil containing concentrations of metals and PHCs greater than the SSRTs.
- Metals Impacted Soil – Soil containing concentrations of metals greater than the SSRTs.
- PHC Impacted Soil – Soil containing concentrations of PHCs greater than the SSRTs.
- Physical Hazards: Mine Openings - Hazards including portals, shafts, and declines that are open or not properly sealed.
- Physical Hazards: Underground Workings - Hazards including stability concerns or where rock geo-mechanical information is limited.
- Physical Hazards: Trenches - Hazards include trenches of varying sizes.
- Physical Hazards: Abandoned Infrastructure - Hazards including former core racks, docks and former machinery.

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- Physical Hazards: Abandoned Site Buildings – Hazards include former site buildings, headframes.
- Waste Rock – Rock that was removed and crushed to access ore-bearing deposits (potential ML or PAG source).
- Tailings – Ore-bearing rock that was milled and often treated with chemicals to extract the ore (ML/PAG source) that contain concentrations of COPCs greater than SSRTs and/or present an aesthetic concern.
- Hazardous Waste – Material containing asbestos in excess of the territorial guidelines or material painted with lead based paint in excess of the territorial guidelines. Also includes batteries.
- Non-Hazardous Waste – Building materials tested to confirm the absence of asbestos, lead and/or PCB paint materials, and scattered wood and metal debris.
- Sediment – Sediments containing metals greater than the applicable guidelines.
- Impacted Water – Surface water impacted with COPCs greater than the applicable guidelines.
- Unfired Explosives – Remains of explosives with unknown state.

The waste and hazard components requiring action during remediation are based on a review of the previous reports in Section 3.3 and observations made during the supplement site assessment conducted in 2015 (Stantec, 2016b). The information provided in the previous reports was relied upon for accuracy and where data gaps exist or delineation not achieved, reasonable assumptions have been made to summarize the extent of the hazard component. Generally, quantities of impacted media were surveyed in the field to calculate volumes. Additional impacted material from areas in close proximity to un-delineated contamination is anticipated.

4.2 REMEDIAL OPTIONS ANALYSIS SUMMARY

A wide variety of potential remediation options were evaluated initially in the Preliminary Remedial Action Plan for Gordon Lake Mine Sites prepared by Stantec in 2015 (Stantec, 2015a). These options were referenced from the Federal Remediation Technologies Roundtable (FRTR) Treatment Technologies Screening Matrix, which lists 59 industry-standard remedial options suitable for sites requiring remediation (FRTR, 2007). Stantec also supplemented this list of 59 remedial options with those that have been used at other northern mining sites. A complete list and brief description of each remedial option is included in the Preliminary Remedial Action Plan (Stantec, 2015a).

Project specific considerations such as remoteness, ability to travel between sites, the northern climate and other conditions (such as proximity to water and size of each site) were used to conduct a preliminary elimination of remedial options that were not practical for the sites. The rationale for the preliminary elimination is summarized in the Preliminary Remedial Action Plan (Stantec, 2015a).

Remedial options which were retained from this preliminary elimination were further assessed for their ability to meet remedial targets, timeline to closure, ease of implementation (considering accessibility, mobilization, heavy equipment and material requirements), regulatory and community acceptability, and cost (completed on a relative high, medium, and low interpretation). The options evaluated following the preliminary elimination are summarized in Section 4.3. A more detailed discussion on the advantages and disadvantages of the remedial options can be found in each applicable area of Section 5.0.

4.3 RETAINED REMEDIAL OPTIONS

The retained remedial options for each hazard component are outlined below each with a unique remedial option (RO) number.

4.3.1 Co-mingled Impacted Soil

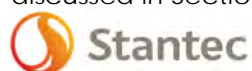
Co-mingled impacted soil is present at Burnt Island, Camlaren, Kidney Pond and West Bay (minimum of 1,520 m³ to maximum of 2,090 m³). The objectives of addressing co-mingled impacted soil are to protect human and ecological health by achieving the SSRTs while using processes that minimize project costs.

The five potential remedial options carried forward from the preliminary elimination include:

Table 7 Co-Mingled Impacted Soil Remedial Options

Option	Description	RO #
Cap and cover	Would include placement of a rock cover over the co-mingled impacted soil areas to reduce the potential for human and ecological contact with the soil.	RO - 1.1
Excavation & on-site landfill	Would include excavation of co-mingled impacted soil and construction of a landfill at that particular site (i.e., landfills at each site)	RO - 1.2
Excavation & consolidated landfill	Would include excavation of co-mingled impacted soil and construction of a landfill at one site, where all co-mingled impacted soil would be placed	RO - 1.3
Excavation & disposal off-site	Would include excavation of co-mingled impacted soil and disposal off-site (likely in Alberta or BC) at a licensed disposal facility	RO - 1.4
Phyto-remediation	Would include strategic planting of species of plants known to uptake metals and aid in PHC degradation	RO - 1.5

These options were further assessed against the secondary screening criteria and the results are discussed in Section 5.0.



4.3.2 Metals Impacted Soil

Metals impacted soil is present at Camlaren, Kidney Pond, Murray Lake, Storm Property, Treacy and West Bay (minimum of 10,880 m³ to maximum of 12,250 m³). The objectives of addressing metals impacted soil are to protect human and ecological health by achieving the SSRTs while using processes that minimize project costs.

The five potential remedial options carried forward from the preliminary elimination include:

Table 8 Metals Impacted Soil Remedial Options

Option	Description	RO #
Excavation & on-site landfill	Would include excavation of metals impacted soil and construction of a landfill at that particular site (i.e., landfills at each site)	RO - 2.
Excavation & consolidated landfill	Would include excavation of metals impacted soil and construction of a landfill at one site, where all metals impacted soil would be placed	RO - 2.2
Excavation & disposal off-site	Would include excavation of metals impacted soil and disposal off-site (likely in Alberta or BC) at a licensed disposal facility	RO - 2.3
Phyto-remediation	Would include strategic planting of species of plants known to uptake metals	RO - 2.4
Cap and Cover	Would include placement of a rock cover over the metals impacted soil areas to reduce the potential for human and ecological contact with the soil.	RO - 2.5

These options were further assessed against the secondary screening criteria and the results are discussed in Section 5.0. Note for this hazard component some areas were considered for site specific screening based on the conditions at that site.

4.3.3 PHC Impacted Soil

PHC impacted soil is present at Burnt Island, Camlaren, Kidney Pond and West Bay (minimum of 1,470 m³ to maximum of 1,610 m³). The objectives of addressing PHC impacted soil are to protect human and ecological health by achieving the SSRTs while using processes that minimize project costs.

The five potential remedial options carried forward from the preliminary elimination include:

Table 9 PHC Impacted Soil Remedial Options

Option	Description	RO #
Cap and cover	Would include placement of a soil cover over the PHC impacted soil areas to reduce the potential for human and ecological contact with the soil.	RO - 3.1
Excavation & on-site landfill	Would include excavation of PHC impacted soil and construction of a landfill at that particular site (i.e., landfills at each site)	RO - 3.2
Excavation & consolidated landfill	Would include excavation of PHC impacted soil and construction of a landfill at one site, where all PHC impacted soil would be placed	RO - 3.3
Excavation & disposal off-site	Would include excavation of PHC impacted soil and disposal off-site (likely in Alberta or BC) at a licensed disposal facility	RO - 3.4
Landfarm	Would include excavation of PHC impacted soil, construction of a landfarm area, and tilling and amending the pile with nutrients until SSRTs are met. Final use as backfill or top cover where required	RO - 3.5

These options were further assessed against the secondary screening criteria and the results are discussed in Section 5.0.

4.3.4 Mine Openings

Mine openings are present at Burnt Island, Camlaren, Goodrock, Kidney Pond, Murray Lake, Storm Property, Try Me and West Bay. The objective of addressing mine openings is to limit access to underground workings from surface openings, for the safety of humans and wildlife.

The five potential remedial options carried forward from the preliminary elimination include:

Table 10 Mine Openings Remedial Options

Option	Description	RO #
Do nothing	No action would be taken to address the opening	RO - 4.1
Backfill	The opening would be backfilled with waste rock/borrow material	RO - 4.2
Engineered cap	The opening would be sealed with an engineered cap	RO - 4.3
Engineered cap with passive treatment system	The opening would be sealed with an engineered cap with a passive water treatment system to address impacted seepage water	RO - 4.4

Option	Description	RO #
Construct barrier	A barrier would be constructed to restrict access, consisting of either boulders locally sources or a berm constructed of borrow material	RO - 4.5

These options were further assessed against the secondary screening criteria and the results are discussed in Section 5.0.

4.3.5 Underground Workings

Underground workings are present at Burnt Island, Camlaren and Kidney Pond. The objective of addressing underground workings is to limit access from surface openings for the safety of humans and wildlife, and reduce the potential for structural collapse as a result of remediation activity.

The four potential remedial options carried forward from the preliminary elimination include:

Table 11 Underground Workings Remedial Options

Option	Description	RO #
Do nothing	No action would be taken for the underground workings	RO - 5.1
Backfill	The underground workings would be backfilled either from the surface or through directionally drilled holes	RO - 5.2
Construct Rock/Berm Barrier	A surface rock/berm barrier would be placed to identify where the underground workings are located and restrict access by heavy machinery	RO - 5.3
Construct Fence Barrier	A fence would be placed to identify where the underground workings are located and restrict access by heavy machinery	RO - 5.4

These options were further assessed against the secondary screening criteria and the results are discussed in Section 5.0.

4.3.6 Trenches

Trenches were observed at all sites with the exception of West Bay and consist of various shapes and sizes. The objective of addressing trenches is to protect human and ecological health and limit any metals leaching.

The three potential remedial options carried forward from the preliminary elimination include:

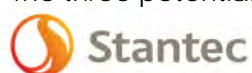


Table 12 Trenches Remedial Options

Option	Description	RO #
Do nothing	No action would be taken for the trench	RO - 6.1
Backfill	The trench would be backfilled with waste rock/borrow material to grade	RO - 6.2
Cap	The trench would be sealed with a cap (in most cases a foam seal)	RO - 6.3

These options were further assessed against the secondary screening criteria and the results are discussed in Section 5.0.

4.3.7 Abandoned Infrastructure

Abandoned infrastructure was observed at Burnt Island, Camlaren, Goodrock, Kidney Pond, Murray Lake, Try Me, and West Bay consisting of various items including docks and core racks. The objective of addressing abandoned infrastructure is to protect human and ecological health and limit long term liability associated with maintenance.

The four potential remedial options carried forward from the preliminary elimination include:

Table 13 Abandoned Infrastructure Remedial Options

Option	Description	RO #
Do nothing	No action would be taken for the abandoned infrastructure, or it would remain as a heritage item	RO - 7.1
Demolition, burn (as appropriate), and on-site landfill	The abandoned infrastructure would be demolished, any wood material would be burned, and the remainder of the material would be placed in an on-site landfill (i.e., landfills at each site)	RO - 7.2
Demolition, burn (as appropriate), and consolidated landfill	The abandoned infrastructure would be demolished, any wood material would be burned, and the remainder of the material would be placed in a landfill constructed at a landfill at one site	RO - 7.3
Demolition, burn (as appropriate), and off-site landfill	The abandoned infrastructure would be demolished, any wood material would be burned, and the remainder of the material would be disposed off-site (likely in Yellowknife) at a licensed disposal facility	RO - 7.4

These options were further assessed against the secondary screening criteria and the results are discussed in Section 5.0.

4.3.8 Abandoned Site Buildings

Abandoned site buildings are present at Burnt Island, Camlaren, Goodrock, Treacy, Try Me and West Bay and consist of items such as headframes, standing cabins and collapsed buildings. The

objectives of addressing abandoned site buildings are to minimize contamination to the environment, reduce the potential for the building to act as a physical hazard to visitors, and retain culturally significant features where possible.

The four potential remedial options carried forward from the preliminary elimination include:

Table 14 Abandoned Site Buildings Remedial Options

Option	Description	RO #
Do nothing	No action would be taken for site building, or it would remain as a heritage item	RO - 8.1
Demolition, burn (as appropriate), and on-site landfill	The abandoned site buildings would be demolished, any wood material would be burned, and the remainder of the material would be placed in an on-site landfill (i.e., landfills at each site)	RO - 8.2
Demolition, burn (as appropriate), and consolidated landfill	The abandoned site buildings would be demolished, any wood material would be burned, and the remainder of the material would be placed in a landfill constructed at a landfill at one site	RO - 8.3
Demolition, burn (as appropriate), and off-site landfill	The abandoned site buildings would be demolished, any wood material would be burned, and the remainder of the material would be disposed off-site (likely in Yellowknife) at a licensed disposal facility	RO - 8.4

These options were further assessed against the secondary screening criteria and the results are discussed in Section 5.0.

4.3.9 Waste Rock

Waste rock is present at all sites. Based on the results of the Gap Assessment (Stantec, 2016a), waste rock was classified based upon risk, with either moderate or high risk material being considered as impacting material (i.e., demonstrated potential to cause downgradient impacts). For each site the approach is dependent on the level of risk. High risk impacting waste rock material is present at Camlaren, Kidney Pond, Treacy, and West Bay with a total volume of 41,214 m³. The objective of addressing high risk impacting waste rock is to minimize generation of poor water quality including ML/ARD and/or impacts to downgradient soils. Moderate risk impacting waste rock material is present at Burnt Island, Goodrock, Kidney Pond, Murray Lake, and Storm Property with a total volume of 1,089 m³. The objective of addressing moderate risk impacting waste rock is to confirm there are no impacts to any proximate water bodies in the long term through monitoring.

The four potential remedial options carried forward from the preliminary elimination include:

Table 15 Waste Rock Remedial Options

Option	Description	RO #
Leave in place and monitor	Waste rock would be left in place and a monitoring program consisting of downgradient surface water and soil sampling would be completed	RO - 9.1
Excavation & consolidated waste rock containment area	Would include excavation of ML/PAG waste rock and construction of a waste rock containment area at one site, where all PAG waste rock would be placed	RO - 9.2
Excavation & disposal off-site	Would include excavation of ML/PAG waste rock and disposal off-site (likely in Alberta or BC) at a licensed disposal facility	RO - 9.3
Excavation & on-site waste rock containment area	Would include excavation of ML/PAG waste rock soil and construction of a waste rock containment area at that particular site (i.e., waste rock containment areas at each site)	RO - 9.4

These options were further assessed against the secondary screening criteria and the results are discussed in Section 5.0.

4.3.10 Tailings

Tailings are present at Burnt Island, Camlaren, Treacy, and West Bay. Note the tailings at Burnt Island did not contain concentrations greater than the SSRTs and will be addressed as a site dependent component. There is approximately 47,420 m³ of tailings to address, however the bulk of this volume (45,040 m³) is present at Camlaren in the current tailings containment area (TCA). The objectives of addressing tailings are to eliminate direct contact, stabilize embankments and surfaces of tailings containment areas, blend piles with local topography where appropriate, and minimize the occurrence of impacted leachate being produced.

The four potential remedial options carried forward from the preliminary elimination include:

Table 16 Tailings Remedial Options

Option	Description	RO #
Excavation & on-site TCA	Tailings would be excavated and placed in an on-site TCA (i.e., TCA at that site)	RO - 10.1

Option	Description	RO #
Excavation & consolidated TCA	Tailings would be excavated and placed in one consolidated TCA (i.e., one TCA, at Camlaren)	RO - 10.2
Excavation & disposal off-site	Tailings would be excavated and disposed of off-site (likely in Alberta or BC) at a licensed disposal facility	RO - 10.3
Phyto-remediation	Would include strategic planting of species of plants known to uptake metals	RO - 10.4

These options were further assessed against the secondary screening criteria and the results are discussed in Section 5.0.

4.3.11 Hazardous Waste

Hazardous waste is present at all sites with the exception of Murray Lake and consists of asbestos containing material (ACMs), lead containing painted wood, batteries, crucibles, and unfired explosives (total volume of 8 m³). The objective of addressing hazardous waste is to meet regulatory requirements for proper management and disposal of this material. The two potential remedial options carried forward from the preliminary elimination include:

Table 17 Hazardous Waste Remedial Options

Option	Description	RO #
Collect and containerize for off-site disposal	Hazardous waste material would be collected, containerized and disposed of off-site in a licensed facility	RO - 11.1
Collect and place in an on-site containment area	Hazardous waste material would be collected and placed in a centralized hazardous waste disposal facility	RO - 11.2

These options were further assessed against the secondary screening criteria and the results are discussed in Section 5.0.

4.3.12 Non-Hazardous Waste

Non-hazardous waste is present at all sites as wood and metal scattered debris (total volume of 90 m³ after burn). The objective of addressing non-hazardous waste is to address their physical hazard and meet aesthetic expectations during the remediation. The four potential remedial options carried forward from the preliminary elimination include:

Table 18 Non-Hazardous Waste Remedial Options

Option	Description	RO #
Do nothing	Debris would be left on-site where it is located	RO - 12.1
Burn (as appropriate), and on-site landfill	The non-hazardous waste would be collected, any wood material would be burned, and the remainder of the material would be placed in an on-site landfill (i.e., landfills at each site)	RO - 12.2
Burn (as appropriate), and consolidated landfill	The non-hazardous waste would be collected, any wood material would be burned, and the remainder of the material would be placed in a landfill constructed at a landfill at one site	RO - 12.3
Burn (as appropriate), and off-site landfill	The non-hazardous waste would be collected, any wood material would be burned, and the remainder of the material would be disposed off-site (likely in Yellowknife) at a licensed disposal facility	RO - 12.4

These options were further assessed against the secondary screening criteria and the results are discussed in Section 5.0.

4.3.13 Sediment

Sediment is present at concentrations that exceed the CCME guidelines at all sites with the exception of Murray Lake. Based on the HHERA (SLR, 2014), unacceptable risk was found to be present at:

- Camlaren – additional sampling was recommended around the Main Camp and was completed as part of the 2015 supplemental site assessment program (Stantec, 2016b)
- Kidney Pond – the wetland area was found to pose a risk, however this area has been considered as soil for the purposes of remediation in this RAP, and therefore, any required remediation has been assessed under the soil hazard component
- Treacy - the HHERA indicated that a hotspot could be removed at Treacy, however it is denoted as a soil location in the document text, and soil removal is expected around the tailings area at Treacy; therefore, remediation will be addressed through soil and source removal

The additional sampling at Camlaren assessed additional lines of evidence through collection and analysis of *Hyalella azteca*, which has demonstrated that both the bioaccessibility and the potential toxicity of metals in the surface water and sediment could be assessed using this approach. The data from the Gap Assessment (Stantec, 2016b) had some important gaps including:

- most of the surface water and sediment samples that were collected contained low concentrations of metals, which provided a good representation of the background or reference conditions
- one surface water sample from the Gap Assessment had elevated concentrations of metals, which was collected from inside the concrete divide area (open to the underground workings) at Camlaren; therefore, characterization of these areas was not well represented and additional data is needed to fill this gap

The one location with elevated concentration of metals in the Gap Assessment was in an area open to the underground workings; similar concentrations do not appear further out into the lake outside this area. Disruption of the aquatic habitat during dredging would likely produce more harm than good to ecological health (this would also be true for Treacy if sediment removal was to occur). It is therefore recommended that remediation of the aquatic environment at the GLG sites not occur in favor of risk management, and that further work be undertaken to reduce the uncertainty associated with this recommendation. Therefore, although sediment was not considered further in this RAP, if additional data indicates remediation is required, the approach will be re-considered at that time.

4.3.14 Impacted Water

Metals impacted surface water and groundwater is present at one or more sites and includes surface water located in the tailings impoundments, the portal openings, trenches and open pits. The localized ponding could pose potential risk to human and ecological health. The discharge of impacted water is regulated by the MVLWB. Based on previous experience remediating northern sites, the MVLWB accepts discharge to the surface of minor amounts of impacted water assuming it is not discharged directly into a water body and it is of a limited quantity. With the exception of Kidney Pond, impacted surface water appears to be localized and will be addressed by discharging overland a minimum of 30 m from surface water bodies. The impacted water at the Kidney Pond portal will be managed as part of the portal closure design. Therefore, remedial options were not assessed for impacted water.

4.4 RETAINED OPTIONS SCORING

The hazard components identified for the GLG sites were further broken down into those that are common across sites and those that are site specific. Primarily, this distinction was made if the applicable remedial options were the same for the hazard across all or most sites, and if the scoring criteria could be applied equally across all or most sites with that particular component. For example, the options for metals impacted soil could mostly be scored across all sites together without site specific considerations. However, mine openings required consideration on an individual basis depending on that site's specific conditions, and that opening's specific conditions. The division of the hazard components is shown below.

Components with Common Remedial Options

- Co-mingled Impacted Soil
- Metals Impacted Soil
- PHC Impacted Soil
- Tailings
- Impacting Waste Rock (high risk only)
- Non-Hazardous Waste
- Hazardous Waste

Components with Site Specific Remedial Options

- Mine Openings
- Underground Workings
- Trenches
- Abandoned Infrastructure
- Abandoned Site Buildings
- Impacting Waste Rock (moderate risk only)

The scoring criteria for each remedial option are broken down in Table 18 below.

Table 19 Remedial Option Scoring Criteria

Ranked Criteria	Ranking	Description	Comments
Cost	1	Highest Cost	Highest cost relative to the other options ranked
Cost	2	Medium Cost	Medium expected cost relative to other options ranked
Cost	3	Lowest Cost	Lowest expected cost relative to other options ranked
Effectiveness	1	Least effective option to meet objectives	Results may or may not meet remediation objectives when completed (lots of uncertainty)
Effectiveness	2	Medium effectiveness to meet objectives or some uncertainty in outcomes	Results are likely to meet remediation objectives when completed
Effectiveness	3	Most effective option to meet objectives, most definitive	Has demonstrated ability to meet remediation objectives
Timeframe	1	Longest timeframe of evaluated options	Longest timeframe in comparison to other options
Timeframe	2	Medium timeframe of evaluated options	Medium timeframe in comparison to other options
Timeframe	3	Shortest timeframe of evaluated options	Shortest timeframe in comparison to other options
Ease	1	Most difficult option to complete, or very difficult	These options would have the most complicated execution
Ease	2	Medium level of effort compared to other options	The execution of these options would be of medium effort and have a proven track record
Ease	3	Most easily completed option compared to other options	Routinely executed options, or those with minimal items to complete



Ranked Criteria	Ranking	Description	Comments
Regulatory	1	Most regulatory pushback	This would include options not commonly used or understood
Regulatory	2	Medium regulatory pushback	This would include options previously used but not widely accepted
Regulatory	3	Most accepted method	This would include options regularly used to complete closures
Community	1	Least amount of community acceptance based on final status	These options are typically not accepted by the community
Community	2	Some community pushback, but limited in scale	These options have been accepted in the past, but are not well understood in most situations
Community	3	Options which are regularly accepted by communities	These options have been accepted in the past with little pushback

4.5 HAZARD COMPONENT LOCATIONS AND QUANTITIES SUMMARY

Table 28 below summarizes the volume of material identified for action in the Gap Assessment (Stantec, 2016b). As part of the work for this RAP, the volumes have been adjusted to account for uncertainty factors; therefore, the volumes below do not necessarily correspond to those reported in Table 1, Appendix C. It is likely that during the detailed design these volumes will be further refined. However, the volumes calculated in the Gap Assessment Report were the starting point for this RAP.

Table 20 Gap Assessment Summary Table of Hazard Component Quantities

Site	Soil (m ³) ¹			Tailings (m ³) ²	Waste Rock (m ³) ³		Non-Hazardous Material (m ³) ⁴		Hazardous Material (m ³) ⁵		Water ⁶	Physical Hazards ⁷
	Metals	PHC	Metals + PHC	Metals	High Risk	Moderate Risk	Type	Volume (m ³)	Type	Volume (m ³)	Metals (m ³)	
Burnt Island	-	237	32	-	-	48	81.75 m ³ of wooden debris 11.25 m ³ of metal debris	100	Asbestos in brake pads	<1	-	Surficial openings (Shaft and portal), sharp debris and infrastructure remains
Camlaren- Main Site	10,320	832	255	45,035	12,988	-	<ul style="list-style-type: none"> ~19 m³ of wood debris ~12 m³ of metal debris ~120 m³ of concrete/stone/mortar debris ~26 m³ of miscellaneous debris 	177	-	-	500	Surficial openings (Zenith Island shaft and stope breakthrough at Main Site), old head frame, wooden utility culvert
Camlaren- North Cabin	27*	-	-	-	-	-	<ul style="list-style-type: none"> ~5 m³ of wood debris ~0.5 m³ of metal debris ~2 m³ of concrete/stone/mortar debris ~2 m³ of discarded crucibles ~2 m³ of miscellaneous debris 	12	Battery remains	<1		
Camlaren- Zenith Island	417	-	-	-	323	-	<ul style="list-style-type: none"> ~5 m³ of wood debris ~1 m³ of metal debris 	6	-	-		
Goodrock	27*	-	-	-	-	284	<ul style="list-style-type: none"> ~56 m³ of wood debris at camp and mill ~10 m³ of metal debris at camp and mill ~1 m³ of discarded Crucibles at mill ~4 m³ of miscellaneous debris at camp area 	75	Batteries remains	<1	150	Surficial openings (shafts)
Kidney Pond	92*	371	1,506	-	12,771	50	<ul style="list-style-type: none"> ~65 m³ of wood debris ~15 m³ of metal debris ~5 m³ of discarded Crucibles ~22 m³ of miscellaneous debris ~0.01 m³ of blasting caps ~1 m³ of concrete 	100	Battery remains	<1	2,600	Surficial openings (portal), and sharp debris
Murray Lake	269	-	-	-	-	597	Wood waste and metal debris (including three empty drums)	5 (+ 3 drums)	None present	0	1,900	Surficial openings (shaft)
Storm Property	60*	-	-	-	-	110	Unpainted wood (12 m ³) Metals, miscellaneous debris (6 m ³)	20 (+45 drums)	None present	0	60	Surficial openings (2 shafts)
Treacy	180	19	-	11	116	-	Wood (Unpainted) = 36 m ³ Metal = 15 m ³ Concrete = 1 m ³ Misc. Debris = 2 m ³	55	Paint on wood	0.12	120	Sharp debris
Try Me	-	-	-	-	-	-	Scrap Metal (including 11 empty 205 L drums)	20 (+11 drums)	Battery remains	<1	40	Surficial openings (including one prospect shaft) and infrastructure remains.
West Bay	529	97	14	255	15,016	-	10 m ³ of metal debris (including one empty 205 L drum) and 5 m ³ of wooden debris	15	-	<1	2,200	Surficial openings (large open pit)
Approximate Waste Volume Present	11,926	1,556	1,806	45,301	41,214	1,089		590		6.2	7,570	

Notes:

- Volumes of impacted soil presented are total volumes calculated of impacted soil that exceed the SSRT values outlined in *Supplemental Assessment of Site-Specific Remedial Targets* (Stantec, 2014)
 - Volumes of tailings presented are from assessment programs completed by previous consultants that exceed the SSRTs developed by Stantec and have been updated based on the survey completed by Stantec during the 2015 supplemental site assessment
 - Volumes of waste rock presented include trench rock, ore and waste rock present at the site. Metal leaching/potentially acid generating rock presented includes the impacting material, and may include volumes that are co-mingled with contaminated soil. Waste rock volumes have been updated based on the 2015 supplemental site assessment and the assumed quantities co-mingled with impacted soil.
 - Volumes of non-hazardous material are based on previous assessment programs
 - Volumes of hazardous material are based on previous assessment programs and have been updated based on additional hazardous material assessment completed during the 2015 supplemental site assessment
 - Volumes of water presented above include impacted surface water. Volume of water present in underground workings has not been determined during the previous assessment programs and is therefore not presented
 - Additional detail regarding physical hazards can be found in the Site Wide Hazard Assessment report completed by Stantec in 2015
- * Volumes include soil metals "hotspots" identified in the HHERA completed by SLR in 2014

5.0 REMEDIAL OPTIONS ANALYSIS RESULTS

5.1 COMMON COMPONENT REMEDIAL OPTIONS

5.1.1 Co-mingled Impacted Soil

Five options for co-mingled impacted soil were numerically ranked and based on the results, the recommended approach is to construct consolidated landfills and dispose of the co-mingled impacted soil in those facilities. The numerical ranking is presented in Table 2, Appendix C, and below is a summary of the analysis:

Table 21 Co-Mingled Impacted Soil Remedial Option Assessment

Remedial Option	Ability to Meet Remedial Targets	Timeline to Closure	Ease of Implementation	Regulatory and Community Acceptability	Cost	Score
Cap and cover	Addresses direct exposure pathways to contaminated material but does not eliminate it from the site, and the potential for migration is still present	Monitoring required which will extend the overall time to closure	Requires significant volumes of borrow material, geomembrane material, in-field welding, etc.. Requires access by earth moving equipment	Historically a regulatory-accepted remediation strategy in isolated areas, however not often accepted by the local community	Low	12
Excavation & on-site landfill	Effective for removal of PHC and metals-impacted media	Option requires monitoring at each landfill site which lengthens time to closure	Major factor affecting implementation is the construction of an on-site landfill. Requires access by earth moving equipment	Historically a regulatory-accepted remediation strategy and often accepted by the local community	Medium	13
Excavation & consolidated landfill	Effective for removal of PHC and metals-impacted media	Option requires monitoring at consolidated landfills which lengthens time to closure	Major factor affecting implementation is the construction of a consolidated landfill. Requires access by earth moving equipment	Historically a regulatory-accepted remediation strategy and often accepted by the local community	Medium	15

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Remedial Option	Ability to Meet Remedial Targets	Timeline to Closure	Ease of Implementation	Regulatory and Community Acceptability	Cost	Score
Excavation & disposal off-site	Effective for removal of PHC and metals-impacted media	Option has minimal time to closure	Major factor affecting implementation is the transport of the material and its logistical complexity. Requires access by earth moving equipment	Historically a regulatory-accepted remediation strategy, allows a walk away solution from each site and accepted by local communities	High	12
Phyto-remediation	Effective for metals impacted soils, less effective for PHC impacted soils. Demonstrated application at northern sites limited	Option has medial time to closure, as it requires short term monitoring	Difficult to implement due to sourcing of plant species and logistical challenges	Limited history of regulatory-acceptance as a remediation strategy, may not be understood by the local community	Low	9

The alternatives of constructing landfills at each site, or trucking the soil off-site are either more costly, or would garner less acceptance as there would be multiple sites to monitor and potential legacy issues at multiple sites rather than one site. Capping leaves the impacts in place and would require follow up monitoring to assess the integrity of the cap.

The following points should be considered when applying this recommended remedial option:

- Co-Mingled Impacted Soil at Burnt Island (BUR_SO_07 in the Old Mill Area) will be a difficult area to access as compared to the remainder of the site due to the slope from the bedrock outcrop and the limited area to work in. Therefore, access from the water may be required in summer conditions.
- Co-Mingled Impacted Soil at Camlaren (specifically CAM_SO_09) is located near the water line; guidance from Department of Fisheries and Oceans should be obtained to determine how close to the water line the remediation can be extend.

The co-mingled impacted soil would be excavated from where it is located currently, and placed in a Tailings and Soil Containment Area (TSCA) constructed at the former TCA at Camlaren and/or be combined in the proposed Waste Rock and Soil Containment Area (WRSCA) at Kidney Pond. The final disposal locations for each hazard component are summarized in Table 1, Appendix C. This option was recommended as it is a medium cost that is effective, has received regulatory acceptance in the past, and is generally accepted by the community.

5.1.2 Metals Impacted Soil

Five options for metals impacted soil were numerically ranked and based on the results, the recommended approach is to construct consolidated landfills and dispose of the metals impacted soil in those facilities. The numerical ranking is presented in Table 2, Appendix C, and below is a summary of the analysis:

Table 22 Metals Impacted Soil Remedial Option Assessment

Remedial Option	Ability to Meet Remedial Targets	Timeline to Closure	Ease of Implementation	Regulatory and Community Acceptability	Cost	Score
Cap and cover	Addresses direct exposure pathways to contaminated material but does not eliminate it from the site, and the potential for migration is still present	Monitoring required which will extend the overall time to closure	Requires significant volumes of borrow material, geomembrane material, in-field welding, etc. Requires access by earth moving equipment	Historically a regulatory-accepted remediation strategy in isolated areas, however not often accepted by the local community	Low	12
Excavation & on-site landfill	Effective for removal of PHC and metals-impacted media	Option requires monitoring at each landfill site which lengthens time to closure	Major factor affecting implementation is the construction of an on-site landfill. Requires access by earth moving equipment	Historically a regulatory-accepted remediation strategy and often accepted by the local community	Medium	13
Excavation & consolidated landfill	Effective for removal of PHC and metals-impacted media	Option requires monitoring at consolidated landfills which lengthens time to closure	Major factor affecting implementation is the transport of the material and its logistical complexity. Requires access by earth moving equipment	Historically a regulatory-accepted remediation strategy, allows a walk away solution from each site and accepted by local communities	Medium	15
Excavation & disposal off-site	Effective for removal of PHC and metals-impacted media	Option has minimal time to closure	Major factor affecting implementation is the transport of the material and its logistical complexity. Requires access	Historically a regulatory-accepted remediation strategy, allows a walk away solution from each site and	High	12

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Remedial Option	Ability to Meet Remedial Targets	Timeline to Closure	Ease of Implementation	Regulatory and Community Acceptability	Cost	Score
			by earth moving equipment	accepted by local communities		
Phyto-remediation	Effective for metals impacted soils, less effective for PHC impacted soils. Demonstrated application at northern sites limited	Option has medial time to closure, as it requires short term monitoring	Difficult to implement due to sourcing of plant species and logistical challenges	Limited history of regulatory-acceptance as a remediation strategy, may not be understood by the local community	Low	9

The alternatives of constructing landfills at each site, or trucking the soil off-site are either more costly, or would garner less acceptance as there would be multiple sites to monitor and potential legacy issues at multiple sites rather than one site. Capping leaves the impacts in place and would require follow up monitoring to assess the integrity of the cap.

The following points should be considered when applying this recommended remedial option:

- Camlaren Metals Impacted Soil (CAM_SO_02, CAM_SO_04, CAM_SO_06, CAM_SO_07, CAM_SO_08, CAM_SO_10, CAM_SO_11, CAM_SO_12): total volume has been adjusted for an assumed rock component which would be screened out.
- Camlaren Metals Impacted Soil (CAM_SO_21, CAM_SO_22): area of cobalt exceedance at North Cabin - already vegetated and minor exceedances, recommended that it be left in place (discussed further in Section 5.2.2.1).
- Murray Lake Metals Impacted Soil (MUR_SO_02, MUR_SO_03, MUR_SO_04): total volume adjusted for assumed amount of waste rock and bedrock outcrops and additional risk screening was conducted on this material as discussed in Section 5.2.5.1.
- Storm Property Metals Impacted Soil (STM_SO_01, STM_SO_02, STM_SO_03): additional risk screening was conducted on this material as discussed in Section 5.2.6.1.
- Treacy Metals Impacted Soil (TRC_SO_01): total volume adjusted to 50% of area/depth calculation to adjust for assumed amount of waste rock and bedrock outcrops.

The metals impacted soil would be excavated from where it is located currently, and placed in a TSCA constructed at the former TCA at Camlaren and/or be combined in the proposed WRSCA at Kidney Pond. The final disposal locations for each hazard component are summarized in Table 1, Appendix C. This option was recommended as it is a medium cost that is effective, has received regulatory acceptance in the past, and is generally accepted by the community.

5.1.3 PHC Impacted Soil

Five options for PHC impacted soil were numerically ranked and based on the results, the recommended approach is to landfarm the soil, and/or construct consolidated landfills and dispose of the PHC impacted soil in those facilities. The numerical ranking is presented in Table 2, Appendix C, and below is a summary of the analysis:

Table 23 PHC Impacted Soil Remedial Option Assessment

Remedial Option	Ability to Meet Remedial Targets	Timeline to Closure	Ease of Implementation	Regulatory and Community Acceptability	Cost	Score
Cap and cover	Addresses direct exposure pathways to contaminated material but does not eliminate it from the site, and the potential for migration is still present	Monitoring required which will extend the overall time to closure	Requires significant volumes of borrow material, geomembrane material, in-field welding, etc. Requires access by earth moving equipment	Historically a regulatory-accepted remediation strategy in isolated areas, however not often accepted by the local community	Low	12
Excavation & on-site landfill	Effective for removal of PHC and metals-impacted media	Option requires monitoring at each landfill site which lengthens time to closure	Major factor affecting implementation is the construction of an on-site landfill. Requires access by earth moving equipment	Historically a regulatory-accepted remediation strategy and often accepted by the local community	Medium	13
Excavation & consolidated landfill	Effective for removal of PHC and metals-impacted media	Option requires monitoring at consolidated landfills which lengthens time to closure	Major factor affecting implementation is the transport of the material and its logistical complexity. Requires access by earth moving equipment	Historically a regulatory-accepted remediation strategy, allows a walk away solution from each site and accepted by local communities	Medium	15
Excavation & disposal off-site	Effective for removal of PHC and metals-impacted media	Option has minimal time to closure	Major factor affecting implementation is the transport of the material and its logistical complexity. Requires access by earth moving equipment	Historically a regulatory-accepted remediation strategy, allows a walk away solution from each site and accepted by local communities	High	13

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Remedial Option	Ability to Meet Remedial Targets	Timeline to Closure	Ease of Implementation	Regulatory and Community Acceptability	Cost	Score
Landfarm	Effective for PHC impacted soils	Option has medial time to closure, as it requires short term monitoring	Major factor affecting implementation is the construction of the treatment area	Historically a regulatory-accepted remediation strategy and accepted by the local community	Low	15

The alternatives of constructing landfills at each site, or trucking the soil off-site are either more costly, or would garner less acceptance as there would be multiple sites to monitor and potential legacy issues at multiple sites rather than one site. Landfarming is attractive as the treated soil can be used as top cover for the WRSCA at Kidney Pond, which would need to be mobilized from another source, which helps to reduce the overall cost. Capping leaves the impacts in place and would require follow up monitoring to assess the integrity of the cap. This option was recommended as it is a low cost compared to the other options, is effective, has received regulatory acceptance in the past, and is generally accepted by the community.

- The PHC impacted soil would be excavated from where it is located currently, and placed in a Landfarm (LF) constructed at Camlaren. When the soil reaches the SSRTs, it will be used as cover material on the TSCA. The LF would be a temporary facility, with the following design elements: Graded surface free of rocks or cobble of greater size, sloped at 1-2% towards one corner, with baseline soil samples collected before construction
- Under-liner bedding sand minimum 200 mm with non-woven geotextile
- Minimum 20 mil LDPE geomembrane, keyed into perimeter berms minimum 450 mm in an "L" configuration
- Over-liner bedding sand minimum 200 mm, sloped to match prepared surface
- Perimeter sand/gravel berms sloped at 2H:1V (interior)/2.5H:1V (exterior) with minimum 1.0 m crest with a sand/gravel access ramp on top of berm and liner with 10H:1V slope
- Sump well in lowest elevation corner (300 mm diameter PVC with slotted bottom section extending 500 mm, with total height 1.0 m)
- Target PHC soil lift thickness 300 mm (criteria for landfarm treatment surface area, based upon PHC soil volume)

It is likely that some of the soil will not meet the SSRTs within the project timeframe. An intensive sampling program will be conducted on the landfarm soil to delineate soils not meeting the SSRTs, and that soil will be placed within the TSCA prior to capping.

5.1.4 Waste Rock

Four options for high risk impacting waste rock were numerically ranked and based on the results, the recommended approach is to construct a consolidated WRSCA and consolidate the waste rock in this facility. Note that although there is high risk waste rock material at West Bay, it has been considered on a site specific basis in Section 5.2.9.6. The numerical ranking is presented in Table 2, Appendix C, and below is a summary of the analysis:



Table 24 Waste Rock Remedial Option Assessment

Remedial Option	Ability to Meet Remedial Targets	Timeline to Closure	Ease of Implementation	Regulatory and Community Acceptability	Cost	Score
Leave in place and monitor	Does not eliminate risk, allows some level of management and quantification	Monitoring may be required for a long period which will extend the overall time to closure	Easy to implement but requires regular monitoring	Not likely accepted as the waste rock in place is creating unacceptable risks in some cases and not likely acceptable to local community	Low	12
Excavation & consolidated waste rock containment area	Effective for reducing potential of runoff from waste rock	Option requires monitoring at one site which lengthens time to closure	Major factor affecting implementation is the construction of an on-site containment area	Historically a regulatory-accepted remediation strategy, and generally accepted by the local community	Medium	13
Excavation & disposal off-site	Effectively removes remaining risks	Option has minimal time to closure	Major factor affecting implementation is the transport of the material and its logistical complexity. Requires access by earth moving equipment	Historically a regulatory-accepted remediation strategy, allows a walk away solution from each site and accepted by local communities	High	12
Excavation & on-site waste rock containment area	Effective for reducing potential of runoff from waste rock	Option requires monitoring at each landfill site which lengthens time to closure	Major factor affecting implementation is the construction of multiple containment facilities	Historically a regulatory-accepted remediation strategy, and generally accepted by local community	High	11

The alternatives of constructing containment areas at each site, or trucking the high risk waste rock off-site are either more costly, or would garner less acceptance as there would be multiple sites to monitor and potential legacy issues at multiple sites rather than one site. Leaving in place is not effective at addressing the impacts and would require follow up monitoring to assess the integrity of the cap.



The following points should be considered when applying this recommended remedial option:

- Where possible, ARD material will be sorted from non-ARD material.
- Where possible, higher potential ARD material will be placed at the centre of the landfill.
- At sites where backfill is required below the water table, waste rock will be used preferentially (including Goodrock, Murray Lake, and Treacy).

Based on the current location of the majority of high risk waste rock (Camlaren and Kidney Pond), waste rock will be amalgamated into either the TSCA or the WRSCA. This option was recommended as it is a medium cost that is effective, has received regulatory acceptance in the past, and is generally accepted by the community.

5.1.5 Tailings

Four options for tailings were numerically ranked and based on the results, the recommended approach is to construct a consolidated tailings and soil containment area (TSCA) and consolidate the tailings in this facility. The numerical ranking is presented in Table 2, Appendix C, and below is a summary of the analysis:

Table 25 Tailings Remedial Option Assessment

Remedial Option	Ability to Meet Remedial Targets	Timeline to Closure	Ease of Implementation	Regulatory and Community Acceptability	Cost	Score
Excavation & on-site TSCA	Effective for reducing potential of runoff from tailings	Option requires monitoring at each landfill site which lengthens time to closure	Major factor affecting implementation is the construction of multiple containment facilities	Historically a regulatory-accepted remediation strategy and accepted by local community	High	11
Excavation & consolidated TSCA	Effective for removal of tailings material	Option requires monitoring at consolidated landfill which lengthens time to closure	Major factor affecting implementation is the transport of the material and its logistical complexity. Requires access by earth moving equipment	Historically a regulatory-accepted remediation strategy, allows a walk away solution from each site and accepted by local communities	Medium	15
Excavation & disposal off-site	Effectively removes remaining risks	Option has minimal time to closure	Major factor affecting implementation is the transport	Historically a regulatory-accepted remediation	High	12

Remedial Option	Ability to Meet Remedial Targets	Timeline to Closure	Ease of Implementation	Regulatory and Community Acceptability	Cost	Score
			of the material and its logistical complexity. Requires access by earth moving equipment	strategy, allows a walk away solution from each site and accepted by local communities		
Phyto-remediation	Effective for metals impacted soils. Demonstrated application at northern sites limited	Option has medial time to closure, as it requires short term monitoring	Difficult to implement due to sourcing of plant species and logistical challenges	Limited history of regulatory-acceptance as a remediation strategy, may not be understood by the local community	Low	11

The alternatives of constructing containment areas at each site, or trucking the tailings off-site are either more costly, or would garner less acceptance as there would be multiple sites to monitor and potential legacy issues at multiple sites rather than one site. Leaving in place is not effective at addressing the impacts, and is only acceptable in the case of Burnt Island tailings, which do not exceed SSRTs.

Based on the current location of the majority of tailings at Camlaren, tailings would be amalgamated into one TSCA constructed at Camlaren in the current location of the TCA. This option was recommended as it is a medium cost that is effective, has received regulatory acceptance in the past, and is generally accepted by the community. Camlaren was chosen to reduce movement of the majority of volume (and will act as a soil disposal area as well).

Based on the RAP workout conducted with the YKDFN, although the Burnt Island tailings do not exceed the SSRTs, it is preferable to have them covered to restrict the ability of wildlife to interact with them. Therefore, the tailings at Burnt Island will be covered with borrow material developed from a borrow source on Burnt Island.

5.1.6 Hazardous Waste

Two options for hazardous waste were numerically ranked and based on the results, the recommended approach is to collected and containerize for off-site disposal. The numerical ranking is presented in Table 2, Appendix C, and below is a summary of the analysis:

Table 26 Hazardous Waste Remedial Option Assessment

Remedial Option	Ability to Meet Remedial Targets	Timeline to Closure	Ease of Implementation	Regulatory and Community Acceptability	Cost	Score
Collect and containerize for off-site disposal	Meets targets and materials are removed from the sites	Quick timeline to closure	Relatively easy due to the limited amount of material requiring off-site disposal	Historically a regulatory-accepted remediation strategy, allows a walk away solution and accepted by the local community	Medium	17
Collect and place in an on-site containment area	Effective if placed in a properly lined landfill	Option requires long term performance monitoring	Major factor affecting implementation is the construction of an on-site lined landfill	Historically a regulatory-accepted remediation strategy, however not generally accepted by the community	High	7

The alternatives of constructing an on-site consolidated landfill would have a significantly higher cost and would require long term monitoring. Therefore, the material will be collected and consolidated, and subsequently transported to a licensed facility for disposal.

Specifically for each hazardous waste stream:

- Less than 1 m³ of asbestos containing material at Burnt Island - ACM material would be double bagged in accordance with the Guideline for the Management of Waste Asbestos (GNWT, 2004). The ACMs would be containerized in accordance with the *Transportation of Dangerous Goods Act*. The containerized waste would be stored at the on-site storage area until such time that the waste could be transported off-site to the disposal facility via the winter road.
- Approximately 1.5 m³ of material with lead based paint at Treacy - The LBP materials would be separated from the other non-hazardous waste and containerized in accordance with the *Transportation of Dangerous Goods Act*. The containerized waste would be stored at the on-site storage area until such time that the waste could be transported off-site to the disposal facility via the winter road.
- Batteries at Burnt Island, Camlaren, Goodrock, Kidney Pond, Try Me, Storm Property, and West Bay - The batteries would be separated from the other non-hazardous waste and containerized in accordance with the *Transportation of Dangerous Goods Act* (TDG, 1992). The waste would be transported off-site to the disposal facility via the winter road.

5.1.7 Non-Hazardous Waste

Four options for non-hazardous waste were numerically ranked and based on the results, the recommended approach is to burn as appropriate, and place in a consolidated landfill. The numerical ranking is presented in Table 2, Appendix C, and below is a summary of the analysis:

Table 27 Non-Hazardous Waste Remedial Option Assessment

Remedial Option	Ability to Meet Remedial Targets	Timeline to Closure	Ease of Implementation	Regulatory and Community Acceptability	Cost	Score
Do nothing	No specific remedial targets, however remaining aesthetic concerns that impacts traditional use	Quick timeline to closure	Easy implementation	Historically not accepted by regulatory-bodies or community	Low	12
Burn (as appropriate), and on-site disposal	Effective for containing the non-hazardous waste material	Option requires monitoring at each landfill site which lengthens time to closure	Major factor affecting implementation is the construction of each on-site landfill	Historically a regulatory-accepted remediation strategy, and generally accepted by the local community	Medium	10
Burn (as appropriate), and consolidated landfill	Effective for containing the non-hazardous waste material	Option requires monitoring at one consolidated landfill site which lengthens time to closure, but reduces overall monitoring costs	Major factor affecting implementation is the construction of the landfill	Historically a regulatory-accepted remediation strategy and generally accepted by the local community	Medium	15
Burn (as appropriate), and off-site disposal	Effective for removal of non-hazardous waste and aesthetics	Option has minimal time to closure	Major factor affecting implementation is the transport of the material and its logistical complexity	Historically a regulatory-accepted remediation strategy, allows a walk away solution	High	14

Remedial Option	Ability to Meet Remedial Targets	Timeline to Closure	Ease of Implementation	Regulatory and Community Acceptability	Cost	Score
				from each site, and accepted by the local community		

The alternatives of constructing an on-site landfill at each site or trucking the material for off-site disposal would have a higher cost and would require additional locations to conduct long term monitoring. Therefore, the material will be collected and consolidated in landfill (most likely within the TSCA constructed at Camlaren).

5.1.8 Unfired Explosives

Unfired explosives and/or remnants of fired explosives were observed at Kidney Pond and could be present at other sites. These should be assessed by an explosives expert during remediation and addressed based on their recommendations. This may include detonation on-site. No other options were considered for this hazard component. In addition, the site specific health and safety plan developed for the remediation program will need to include safeguards and precautionary measures associated with excavation and other earthworks in areas where unfired explosives may be present.

5.2 SITE SPECIFIC REMEDIAL OPTIONS

As part of the Gap Assessment conducted by Stantec (Stantec, 2016b), a site wide hazard assessment was completed (Stantec, 2016a). As part of that work, INAC visited the sites with the Worker's Safety & Compensation Commission (WSCC) to review the physical hazards and agree on a remedial approach. This information was compiled in the Site Wide Hazard Report prepared by Stantec (Stantec, 2016a) and was used along with site observations to prepare the remedial options for physical hazards.

5.2.1 Burnt Island

5.2.1.1 Mine Openings

Mine openings at Burnt Island consist of the portal opening and the shaft opening. Waste rock at Burnt Island near the portal was assessed and determined to be low risk. Therefore, this material would be suitable to backfill the portal (850 m³) and shaft (475 m³).

5.2.1.1.1 Portal

The portal at Burnt Island is currently sealed with a wood structure over the opening. This hazard component was visited by INAC and WSCC in August, 2015. As approved by the WSCC, the recommended remedial approach for the portal is to backfill. The dimensions are approximately

5m by 5 m by an assumed backfill depth of 15 m (requires 850 m³ of backfill, assuming a 25% adjustment for settling).

5.2.1.1.2 Shaft

The shaft opening at Burnt Island was visited by WSCC in August 2015. The WSCC approved the backfilling of the opening and closure with an engineered cap. The mine shaft is 4 m by 4 m with a measured depth of approximately 36 m (requires 475 m³ of backfill). During backfilling it is possible that there could be potential hangups and/or ice plugs. Therefore, the shaft would be filled as best possible and an engineered cap (could include concrete or foam) would be constructed over the opening.

5.2.1.2 Underground Workings

Based on field observations, it does not appear that the underground workings are affecting the surface. However, the decline is unsupported and with time the risk of collapse to surface may occur. The valid options to address this component are to either backfill the decline, or place a barrier (using boulders or berms) to restrict access. Stantec completed an assessment of the underground workings (Stantec, 2016c) and recommended a 3 m exclusion zone be established around the first 15 m of the decline from the portal opening to reduce the potential for equipment to cause a collapse. The entrance of the portal can then be backfilled as described in Section 5.2.1.1.1.

5.2.1.3 Trenches

The trenches at Burnt Island are all relatively shallow and therefore, no action is required.

5.2.1.4 Abandoned Infrastructure

Abandoned infrastructure items at Burnt Island include a core rack, a drill rig, and a dock.

5.2.1.4.1 Core Rack

The core rack was observed to be in a deteriorated state and as such poses a safety risk. Therefore the recommend approach is to demolish the core rack, burn the wood racks, and dispose of the cores as non-hazardous waste. The approximate remaining volume after burning is less than 1 m³.

5.2.1.4.2 Drill Rig

The drill rig is located near the shaft on Burnt Island. The drill rig will be demolished and disposed of as non-hazardous waste. The approximate remaining volume after crushing is 9 m³. It should be noted that the brakepad on the drill rig was confirmed to contain asbestos. Therefore, the asbestos should be removed prior to dismantling the drill rig and handled according to applicable NT guidelines.

5.2.1.4.3 Dock

The dock is located near the old cabin area and would require a rebuild to be used. Therefore, the dock will be demolished, the wood burned, and any remaining debris will be disposed of as non-hazardous waste. The approximate remaining volume after burning is less than 2 m³.

5.2.1.4.4 Camp Comfort Barrel Stove

As requested by the Mine Heritage society, the camp comfort barrel stove will be removed and donated to the museum.

5.2.1.5 Abandoned Site Buildings

Abandoned site buildings at Burnt Island consist of the former mill, the headframe, and the former cabins.

5.2.1.5.1 Former Mill

The former mill is in a deteriorated state and poses a physical hazard for visitors. The recommended approach is to demolish the former mill, burn the wood, and dispose of the remaining debris as non-hazardous waste. The approximate remaining volume after burning is 3 m³.

5.2.1.5.2 Headframe

The headframe is located near the shaft and poses a physical hazard for visitors. The recommended approach is to demolish the headframe, burn the wood, and dispose of the remaining debris as non-hazardous waste. The approximate remaining volume after burning is less than 1 m³.

5.2.1.5.3 Former Cabins

The former cabins are in a deteriorated state and pose a potential hazard for visitors. The recommended approach is to demolish the former cabins, burn the wood, and dispose of the remaining debris as non-hazardous waste. The approximate remaining volume after burning is less than 2 m³.

5.2.1.6 Waste Rock

Moderate risk waste rock was found in the area of the Old Mill Trenches. As there is a moderate risk of this material causing a dowgradient impact, a short term monitoring program is recommended. This would include sampling surface water directly dowgradient of these features for a period of 5 years post remediation to determine if impacts are migrating. This would be incorporated as part of the short term monitoring (STM) plan (see Section 7.3.4.1).

5.2.1.7 Tailings

Although the tailings at Burnt Island do not exceed the SSRTs, the YKDFN preferred to have them covered to restrict the ability of wildlife to interact with them. Therefore, the tailings at Burnt Island will be covered with borrow material developed from a borrow source on Burnt Island.

5.2.2 Camlaren

5.2.2.1 Metals Impacted Soil

Two areas of metals impacted soil are present at the north cabin area which only exceed the SSRT for cobalt marginally (CAM_SO_21 and CAM_SO_22). As the exceedance is minor, and the area is already revegetated, the soil will be left in place and no action will be taken.

5.2.2.2 Mine Openings

Mine openings at Camlaren consist of the shaft, vent, and stope / crown pillar opening on Muir Island and the shaft at Zenith Island.

5.2.2.2.1 Stope / Crown Pillar Opening

The stope and crown pillar on Muir Island are reported to be open and were observed to be flooded to the lake water surface. This opening was observed by the WSCC in August 2015 and it was agreed that a barrier should be constructed prior to remediation to keep equipment away from the rock edge. The geo-mechanical conditions were also reviewed by Stantec and it is not clear if the crown pillar was backfilled (Stantec, 2016c). Therefore, machinery should be restricted from this area and a barrier constructed back from the cliff edge to keep visitors away.

5.2.2.2.2 Shaft and Vent

The shaft and vent were sealed and capped with concrete during the closure of the site. These openings were visited by WSCC in August 2015. The WSCC agreed that no action was required for these hazard components. However, these features should be marked during remediation so heavy equipment does not move over the openings, and their condition should be monitored (as no engineering drawings of the caps are available).

5.2.2.2.3 Shaft (Zenith Island)

The shaft on Zenith Island was observed to be filled in and it was difficult to evaluate the entire opening. As the status of the opening is unknown, remedial works should be conducted to confirm the status. The opening was measured to be approximately 3m by 3m. It will need to be uncovered prior to closure. The assumed approach will be to backfill as much as possible and complete with an engineered cap. However, if possible additional work should be conducted in 2016/2017 to confirm the extent of the opening.

5.2.2.2.4 Potential Hollow Area

An area that sounded hollow was observed during the 2015 Supplemental Site Assessment (Stantec, 2016b). The area was scanned with an electromagnetic scanner and an anomaly was not observed. This feature requires further assessment with heavy machinery to determine the extent and nature of the void space. Likely action will be to backfill and/or seal.

5.2.2.3 Underground Workings

Field observations do not indicate that the underground workings are affecting the surface. However, the stope is unsupported and with time there is risk of collapse to surface. The valid options to address this component are to either backfill the stope, or place a barrier (using boulders or berms) to restrict access. Stantec completed an assessment of the underground workings (Stantec, 2016c) and recommended a 3 m exclusion zone be established around the stope to reduce the potential for equipment to cause a collapse.

5.2.2.4 Trenches

The trenches at Camlaren are all relatively shallow and therefore, no action is required.

5.2.2.5 Abandoned Infrastructure

5.2.2.5.1 Wooden utility culvert

A wooden utility culvert is present on south Muir Island and during remediation removal is recommended. After removal the area should be contoured to return drainage to natural channels.

5.2.2.5.2 Concrete Divide

A concrete divide is present near the opening to the stope and to the east of the vent and former shaft area. At one time this acted as a coffer dam when the mine was reopened and water was pumped from the underground workings. However, it does not currently have a purpose, and it is not posing a physical hazard. Therefore, the recommended approach is to leave the concrete divide as is. The structure provides a residual benefit of reducing the flux of sediments out of the area facing the mine opening.

5.2.2.5.3 Docks

The docks are located on the west of Muir Island, near the former tank farm and the north mine area, and would require a rebuild to be used. Therefore, the dock will be demolished, the wood burned, and any remaining debris will be disposed of as non-hazardous waste. The approximate remaining volume after burning is less than 1 m³.

5.2.2.5.4 Hoist Pad and Mill Pad

The hoist pad and mill pad are located in AEC 1 and both consist of a remaining concrete slab. The preferred option would be to leave the slabs in place. However, the soil in the area surrounding the slabs will be removed and more than likely the slabs will require removal as they will pose a physical hazard. Therefore, it is assumed the slabs will be removed and be disposed of as non-hazardous waste. The approximate volume is 85 m³.

5.2.2.5.5 Old Chimney, Rock Structures, and Stone Oven

The old chimney, rock structures, and stone oven are present on the south of Muir Island. These items currently do not have a function. However, these structures have heritage value and will be left in place. The Mining Heritage Society agreed that preserving would be preferred.

5.2.2.6 Abandoned Site Buildings

Abandoned site buildings at Camlaren are present at the North Cabin Area and are partially collapsed resulting in a physical hazard for visitors. Therefore, the cabin and associated structures will be demolished, the wood burned, and any remaining debris will be disposed of as non-hazardous waste. The approximate remaining volume after burning is 3 m³.

5.2.3 Goodrock

5.2.3.1 Mine Openings

5.2.3.1.1 North Shaft

The north shaft at Goodrock consists of an opening that is approximately 3 m by 4 m in size. There is water present and the current configuration poses a physical hazard to visitors and wildlife. Therefore, the recommended approach is to backfill the shaft with waste rock to the water table and as this is a shaft, cap with an engineered cap. Approximately 45 m³ of waste rock will be required to fill in the shaft. Any impacted water that is removed will be managed as described in Section 4.3.14.

5.2.3.1.2 South Pit

The south pit at Goodrock consists of an opening that is approximately 3 m by 6 m in size with steep slopes and is water filled. The current configuration poses a physical hazard to visitors and wildlife. Therefore, the recommended approach is to backfill the pit with waste rock to the water table. Approximately 65 m³ of waste rock will be required to fill in the pit. Any impacted water that is removed will be managed as described in Section 4.3.14.

5.2.3.2 Trenches

The trenches at Goodrock are all relatively shallow and therefore, no action is required.

5.2.3.3 Abandoned Infrastructure

5.2.3.3.1 Dock

The dock is located on Gordon Lake and currently consists of submerged timber. As the material remains of the dock are under water, no action will be taken for this item. There is also a private dock that is part of the Goodrock Recreational Lease that will not be disturbed.

5.2.3.3.2 Ore Cart

As requested by the Mine Heritage society, the ore cart will not be disturbed on-site as a heritage item.

5.2.3.4 Abandoned Site Buildings

5.2.3.4.1 Mill Slab

The mill slab remains are located in the mill area and consist of a concrete structure that is the remains of the crusher foundation. The structure does not currently serve a purpose and does not pose a physical hazard. Therefore, no action is recommended.

5.2.3.4.2 Former Cabins

The cabins consist of one collapsed cabin, one modern standing cabin that is being used by the current leaseholder, and one derelict cabin being used by the current leaseholder for storage. The collapsed cabin is in a deteriorated state and poses a potential hazard for visitors. The recommended approach is to complete the demolition of the collapsed cabin, burn the wood, and dispose of the remaining debris as non-hazardous waste. The remaining cabins are part of the Goodrock Recreational Lease and will not be disturbed. The approximate remaining volume after burning is 3 m³.

5.2.3.5 Waste Rock

Moderate risk impacting waste rock was found in the Camp Area and the Mill Area Trenches. As there is a moderate risk of this material causing downgradient impacts, a short term monitoring program is recommended and/or, the material can be used for backfilling mine openings below grade. Monitoring would include sampling surface water directly downgradient of these features for a period of 5 years post remediation to determine if impacts are migrating. This would be incorporated as part of the STM plan (see Section 7.3.4.1).

5.2.4 Kidney Pond

5.2.4.1 Mine Openings (Portal and Seep)

Field observations and analytical results at Kidney Pond indicate that the portal is acting as a source of contamination via the portal seep. There are two components to addressing this hazard component – a physical hazard of the open portal and the source of contamination from the water seep. The recommended approach addresses both items as the portal will be capped with an engineered cove and a passive water treatment system constructed at the portal opening. Additional data is required to determine the conceptual design for this component. This data will be collected during the summer of 2016 and the design will be finalized at that time.

5.2.4.2 Underground workings

Field observations indicate that underground workings are not affecting surface. Nevertheless, the rock mass has three distinct joint sets forming wedges and with time and the presence of water, the risk of collapse to surface may occur. The valid options to address this component are to either backfill the decline, or place a barrier (using boulders or berms) to restrict access. Stantec completed an assessment of the underground workings (Stantec, 2016c) and

recommended a 3 m exclusion zone be established around the first 32 m of the decline from the portal opening to reduce the potential for equipment to cause a collapse. The design of the final closure will also take into account the seep closure system (Section 5.2.4.1).

5.2.4.3 Trenches

The trenches at Kidney Pond are all relatively shallow and therefore, no action is required.

5.2.4.4 Abandoned Infrastructure

5.2.4.4.1 Core Racks

The core racks are in various states of deterioration and some pose a safety risk. Therefore the recommend approach is to demolish the core racks, burn the wood racks, and dispose of the cores as non-hazardous waste. The approximate remaining volume after burning is less than 1 m³.

5.2.4.4.2 Dock

The dock is located near the 1983 camp and would require a rebuild to be used. Therefore, the dock will be demolished, the wood burned, and any remaining debris will be disposed of as non-hazardous waste. The approximate remaining volume after burning is less than 1 m³.

5.2.4.5 Waste Rock

Moderate risk impacting waste rock was found in the area of the Exploration Camp and the Portal Area Trenches. As there is a moderate risk of this material causing downgradient impacts, a short term monitoring program is recommended and/or, the material can be used for backfilling mine openings below grade. Monitoring would include sampling surface water directly downgradient of these features for a period of 5 years post remediation to determine if impacts are migrating. This would be incorporated as part of the STM plan (see Section 7.3.4.1).

5.2.5 Murray Lake

5.2.5.1 Metals Impacted Soil

Metals impacted soil is present at five locations at Murray Lake with an approximate volume of 300 m³. The metal impacted soil volume at the 1938/2008 Camp area (MUR_SO_01) is relatively small (approximately 5 m³) and the recommended option is consistent with the metals impacted soil elsewhere, disposal at a consolidated landfill.

For the metals impacted soil at MUR_SO_02 through MUR_SO_04, a risk review was conducted to determine the potential risk of leaving this material on-site. This risk review was conducted for a number of reasons including:

- Information gathered from the Yellowknives Dene First Nations (YKDFN) who indicated they were not familiar with Murray Lake for traditional or current land uses. Therefore, the risk level

could be re-assessed based on the known site uses and not on assumptions made in the risk assessment.

- The limited area affected by impacted soil (total area of < 3,000m²).
- The cost of constructing access roads into these areas.

According to the 2014 HHERA (SLR, 2014), a human health risk was identified for Murray Lake, but no ecological risk was identified. Based on the new scenario (updated with knowledge from the YKDFN) the metals impacted soils do not pose a significant human health risk, therefore, removal of the soil at MUR_SO_02 through MUR_SO_05 is not required. The risk review is attached in Appendix D.

5.2.5.2 Mine Openings

The shaft and deep trench at Murray Lake consists of openings that are approximately 2 m by 3 m in size. There is water present and the current configuration poses a physical hazard to visitors and wildlife. Therefore, the recommended approach is to fill in the shaft with waste rock to the water table to allow safe exit. Approximately 275 m³ of waste rock will be required to fill in the shaft. Any impacted water that is removed will be managed as described in Section 4.3.14.

5.2.5.3 Trenches

The trenches at Murray Lake are all relatively shallow and therefore, no action is required.

5.2.5.4 Waste Rock

Moderate risk impacting waste rock was found in the Trench area. As there is a moderate risk of this material causing downgradient impacts, a short term monitoring program is recommended and/or, the material can be used for backfilling mine openings below grade. Monitoring would include sampling surface water directly downgradient of these features for a period of 5 years post remediation to determine if impacts are migrating. This would be incorporated as part of the STM plan (see Section 7.3.4.1).

5.2.6 Storm Property

5.2.6.1 Metals Impacted Soil

Metals impacted soil is present at three locations at Storm Property with an approximate volume of 300 m³. A risk review was conducted to determine the potential risk of leaving this material on-site. This risk review was conducted for a number of reasons including:

- Information gathered from the YKDFN who indicated they were not familiar with Storm Property for traditional or current land uses. Therefore, the risk level can be re-assessed based on the known site uses and not on assumptions made in the risk assessment.
- The limited area affected by impacted soil (total area of < 1,200 m²).
- The cost of constructing access roads into these areas.



According to the 2014 HHERA (SLR, 2014), both a potential human health and ecological health risk were identified for Storm Property. Based on the new scenario (updated with knowledge from the YKDFN) no significant human health risk exists, therefore, removal of the soil at STO_SO_01 through STO_SO_03 is not required. The risk review is attached in Appendix D.

5.2.6.2 Mine Openings

There are two shafts at Storm Property. The North Shaft consists of an opening that is approximately 6 m by 8 m in size while the South Shaft is approximately 3 m by 3 m. There is water present in both shafts and the current configuration poses a physical hazard to visitors and wildlife. Therefore, the recommended approach is to fill in the shafts with waste rock to the water table to allow safe exit. Approximately 285 m³ of the moderate risk waste rock will be used to fill in the shafts. Any impacted water that is removed will be managed as described in Section 4.3.14.

5.2.6.3 Trenches

The trenches at Storm Property are all relatively shallow and therefore, no action is required.

5.2.6.4 Waste Rock

Moderate risk impacting waste rock was found in the Shaft Area. As there is a moderate risk of this material causing downgradient impacts, a short term monitoring program is recommended and/or, the material can be used for backfilling mine openings below grade. Monitoring would include sampling surface water directly downgradient of these features for a period of 5 years post remediation to determine if impacts are migrating. This would be incorporated as part of the STM plan (see Section 7.3.4.1).

5.2.7 Treacy

5.2.7.1 Trenches

The east trench at Treacy is relatively deep and filled with water. As it is currently configured it poses a physical hazard to humans and wildlife. Therefore, the recommended approach is to backfill the east trench with waste rock to the water line. The west trench is filled with tailings and removal of these tailings is recommended. Upon removal the west trench will be backfilled with on-site waste rock to the water line. Any impacted water that is removed will be managed as described in Section 4.3.14.

5.2.7.2 Abandoned Site Buildings

The mill building remains are located in the mill area and consist of wood and metal debris. As little of the structure remains and does not serve a purpose it will be fully demolished. The wood will be burned and remaining debris will be disposed of as non-hazardous waste, and the metal

debris will be crushed as applicable and placed in the NHL. The concrete foundation will be left in place and graded to surface to reduce the potential to act as a physical hazard.

5.2.8 Try Me

5.2.8.1 Mine Openings

The shaft at Try Me consists of an opening that is approximately 2 m by 2 m in size. The current configuration poses a physical hazard to visitors and wildlife. Therefore, the recommended approach is to cap the shaft opening with an engineered cap.

5.2.8.2 Trenches

The trenches at Try Me are all relatively shallow and therefore, no action is required.

5.2.8.3 Abandoned Infrastructure

5.2.8.3.1 Core Racks

The core rack was observed to be previously destroyed. The recommended approach is to collect any remaining debris, burn any remaining wood, and dispose of the cores as non-hazardous waste. The approximate remaining volume after burning is less than 1 m³.

5.2.8.3.2 Dock

The dock is located near the main camp, and the current state is essentially destroyed (submerged). As the material remains of the dock are under water, no action will be taken for this item.

5.2.8.4 Abandoned Site Buildings

The remains of former cabins and other buildings are located in the main camp area and consist of wood and metal debris. As the structure barely remains and doesn't currently serve a purpose it will be fully demolished. The wood will be burned and the remaining debris will be disposed of as non-hazardous waste.

5.2.9 West Bay

5.2.9.1 PHC Impacted Soil

An area of PHC impacted soil is present at the north area and exceeds the SSRT for the F3 fraction (WES_SO_01). However, the elevated concentrations of PHCs are reportedly attributed to background conditions at the site as the samples were not collected from areas associated with historical mining activities. As such, and because the area is already revegetated, the soil will be left in place and no action will be taken.

5.2.9.2 Mine Openings

An open pit is present at West Bay and in its current configuration does not pose an environmental risk. However, as the pit is deep and steep-walled, there is potential for visitors, workers, or wildlife to be harmed. Therefore, a physical barrier (such as a boulder fence or chain link fence) will be constructed prior to remediation to restrict access to the edge of the pit.

5.2.9.3 Abandoned Infrastructure

5.2.9.3.1 Core Rack

The core rack was observed to be in a partially deteriorated state and as such could pose a safety risk in time. Therefore the recommend approach is to demolish the core rack, burn the wood racks, and dispose of the cores as non-hazardous waste. The approximate remaining volume after burning is less than 1 m³.

5.2.9.3.2 Dock

The dock is located near the south area on Gordon Lake and would require a rebuild to be used. Therefore, the dock will be demolished, the wood burned, and any remaining debris will be disposed of as non-hazardous waste.

5.2.9.4 Abandoned Site Buildings

The remains of former cabins and other buildings are located in the south camp area and consist of wood and metal debris. As the structure barely remains and does not currently serve a purpose it will be fully demolished. The wood will be burned and the remaining debris will be disposed of as non-hazardous waste.

5.2.9.5 Waste Rock

High risk waste rock material is present in two large piles at West Bay, adjacent to the pit. Additional analysis was completed on the risk associated with this material, and concentrations found in downgradient water bodies were compared to those observed at Camlaren. Surface water quality results in proximity to the West Bay waste rock piles were used to define expected case and worst case ARD conditions, and together with estimates of runoff, mass loadings of COCs have been estimated. These estimates, under a worst case scenario, do show potential for exceedances of freshwater aquatic life (FAL) criteria within the wetland area south of the waste rock piles and subsequently into Gordon Lake. These exceedances are significantly lower than those observed at Camlaren, where the recent risk assessment toxicity evaluation suggests non-toxic conditions for aquatic invertebrates. Multiple areas of uncertainty hamper consideration of these estimates for West Bay as conclusive and future work to reduce uncertainty is recommended.

At this point, further work is required to make a final decision on the remedial option, however it is not expected to result in a requirement to remove the piles. This analysis is attached in Appendix E.



6.0 CONCEPTUAL REMEDIAL DESIGN

6.1 TAILINGS AND SOIL CONTAINMENT AREA (TSCA)

As discussed previously, Stantec is recommending that a TSCA be constructed using the existing TCA at Camlaren. The current TCA spans approximately 3 ha in area. The original topography and geology is dominated by bedrock outcrops covered by a thin (0.1-0.3m) layer of organics, and/or sand/gravel colluvium deposit in depressions.

The objective of the TSCA is to protect human and ecological health by containing tailings and impacted soil such that the direct contact pathway is removed, leachate high in metals is contained/eliminated, and physical hazards are removed through proper sloping.

The existing TCA was created by construction of a perimeter dam about 3 to-5 m in height. The design and as-built records of the dam are not available, however based on the surficial observations, including the failure zone; it is likely that starter dams were constructed of the coarse tailings. The starter dams were then likely covered by an erosion protection layer of fine rock-fill, which may have been placed also for stabilization. The actual thickness of the rock-fill layer is not known. The final slope of dam varies between 3 H:1V (3 Horizontal to 1 Vertical) and 2H:1V. The highest dam section up to 5 m in height was observed at the east perimeter. In this area the dam slope was the steepest of about 2H:1V, raising from the toe at elevation 293.0 m to the dam crest of about 298.0 m. Overall, the perimeter dam crest elevation undulates between 297.5 to 298.0 m depending on the location. The crest of the dam was constructed as a small rock-fill berm. There is approximately 0.5 to 2 m of freeboard between the tailings and the dam crest depending on the location along the perimeter. The highest freeboard is located in the north-east dam area, where the tailings surface is the lowest.

Currently, surface runoff is contained within the TCA; however an opening in the berm to the northwest will allow water to drain during periods of high precipitation. During periods of intense precipitation, the surface runoff may accumulate forming a shallow pond near the north-east perimeter. The runoff slowly percolates through the tailings recharging deeper groundwater. It is believed that most of groundwater reports to the nearby lake by seepage. During the site visit, dam toe seepage was not observed, however, it is possible that occasionally during the wet season and intense precipitation events, the groundwater may get perched above the bedrock causing seepage at the dam toe, mostly at the north and east perimeter.

The tailings were deposited into the impoundment by discharging from the west and south perimeter forming a tailing beach sloping towards the north-east. The overall thickness of the tailings deposit varies between 1.5 and 3.5 m and is composed mostly of fine sand and silt. Based on the available field investigation results, the tailings were deposited over the existing natural ground mostly bedrock or thin overburden (organics and colluvium).

6.1.1 Design Criteria

The following design criteria were developed for the purpose of rehabilitating the TCA into the TSCA:

- The embankment, foundation and abutments of the dam must be stable under static, hydraulic and dynamic loading conditions;
- Seepage through the foundation and embankment must be controlled and properly drained to prevent excessive uplift pressures and piping of materials.
- The tailings basin will accommodate additional waste to develop a final cone like surface with a minimum slope of 1% draining the surface runoff away from the TSCA. The surface should not have any depressions that would cause water ponding or channeling.
- The tailings and waste material will be covered with a composite cover system including a light low-density polyethylene (LDPE) or linear low-density polyethylene (LLDPE) geomembrane liner. The cover will be impermeable to prevent any percolation into the underlying tailings and other waste. The LDPE/LLDPE should have enough flexibility to accommodate minor settlements. The LDPE/LLDPE should have sufficient puncture resistance to prevent punctures by smaller sub-angular edge stones. A soil cover will overly the LDPE/LLDPE.
- The soil cover over the LDPE/LLDPE should be of sufficient thickness to prevent action of burrow animals. The top surface of the cover should be designed to prevent surface erosion by surface runoff.
- A surface runoff ditch will be developed around the perimeter of the TSCA. The ditch will carry all the TSCA runoff water towards the lake downstream east of the TSCA. The ditch shall be designed to channel the 1 in 100 year's runoff event, as determined through a climate-change adjusted Intensity-Duration-Frequency (IDF) curve from the nearest Environment Canada weather station.

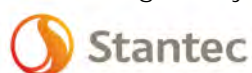
In accordance with 2013 Canadian Dam Association Guidelines, the minimum Factors of Safety (FS) for all embankment slopes against sliding shall be as follows:

Table 28 TSCA Factors of Safety

Loading Conditions	Factor of Safety
End of Construction, Static Conditions	1.3
Pseudo-Static (earthquake)	1.5
Post-Earthquake (liquefaction)	1.3
	1.2- 1.3

6.1.2 Conceptual Design

As described above, the TSCA will accommodate additional waste from the adjacent areas and other GLG sites. Depending on the final volume, the waste will fill up all the depressions in the existing facility and form a cone like shape with a minimum slope of 1% draining the surface



runoff away from the TSCA. The conceptual design is shown on Figure J-1 and J-2, Appendix A. In accordance with the Canadian Dam Safety Association (CDA) Mining Dams Technical Bulletin 2014, the TSCA will no longer be classified as a dam but rather as a Landform. This is due to the following:

- The former dam will be upgraded and stabilized by toe berms to contain waste material and no longer act as initially constructed;
- The existing dam crests will be regraded (lowered) by about 1 m, and the TSCA will be cone shaped draining any runoff water;
- There will be no pond and the phreatic surface will be permanently lowered;
- The existing waste will consolidate over time, therefore will result in improved stability;
- The added waste will be compacted;
- The overall stability will be improved significantly to reduce the risk of failure to the minimum.

Nevertheless, the seismic hazard return period must be selected for the TSCA slope stability.

The tailings and waste material will be covered with a composite cover system. The cover system will be a composite layer including an LDPE/LLDPE liner placed over the prepared foundation, 0.2 m thick sand layer on the top of the LDPE/LLDPE, and additional 0.2 m erosion control layer i.e. fine rock-fill or gravel. The foundation preparation will involve smoothing of the underlying material, compaction and filling voids to ensure positive drainage in accordance with the final TSCA design slope. The final surface shall be of fine material and free of any sharp stones, if required additional sand bedding material will be used to prepare foundations. The cover will be impermeable and will prevent any percolation into the underlying tailings and other added waste. The surface runoff occasionally will be perched over the liner, however the composite system will act as a surface drainage layer directing all surface runoff outside of the TSCA.

The surface runoff will be collected by the perimeter ditch system directing all the runoff downstream of the TSCA towards the lake to the east or west. The ditch will be excavated through the overburden to bedrock, or sand/rock-fill with liner will be used to fill some depression in bedrock and create positive drainage into the lake. Minor excavation in bedrock may be also required in areas where bedrock is undulating. The ditch shall have a minimum gradient of 1% from the west to the east. The ditch shall be deep enough to provide flow capacity of 1 in 100 year's storm event and to prevent groundwater backflow under the tailings facility. The ditch shall be armored with erosion-resistant material (rip-rap).

The slopes will be upgraded with fine rock-fill to create final slopes minimum 3H:1V. This will provide additional required stabilization to the areas where the slope is steeper than 3:1. In other areas where the slope is already close to 3:1, an additional 2 m wide stabilization rock-fill buttress

should be provided. The embankment will be covered with the LDPE/LLDPE liner extended into the dam area from the TSCA area. The liner will be extended covering the final fill from the top to the toe. This will prevent percolation of the water into the embankment and possible internal erosion in the toe areas. In the higher ground areas, the liner will be sealed to bedrock to prevent any surface water backflow into the TSCA. In the lower bedrock areas, there will be a gap left between the liner and the bedrock to allow free drainage of any groundwater accumulated within the TSCA. In the long term, it is expected that groundwater levels within the TSCA and below the dams will be lowered significantly as a result of cutting off any infiltration from the top of the TSCA. Instrumentation should be installed as per Section 6.1.4 to monitor these items.

Permafrost is assumed to be present in the area however the construction of this landfill is not based on using permafrost as a means of containment. It is possible that freeze-back into the TSCA may occur. Instrumentation (see Section 6.1.4) will be used to monitor this. Careful construction sequencing will need to be considered and accurately completed by the contractor to avoid the potential for permafrost heaving and/or settling which could compromise the liner.

6.1.3 Construction Material Requirements

The construction materials for the TSCA cover and dam fill will include four types of material:

- Class 1A – coarse rockfill: this material will be used as armor stone to line the perimeter ditches. If quantities are limited, this material will be preferentially be used in ditch sections with grades steeper than 3%. Type 1A material should be composed of rockfill with a D50 of 100 mm and D100 of 150-200 mm.
- Class 1– gravel or fine rockfill: this material will be a coarse material for the top erosion control layer or dam stabilization buttress. This material should be composed of fine rock-fill less than 80 mm size or gravel with sand material with the minimum 50% of gravel. The material should be well graded to prevent any internal erosion.
- Class 3 – sand (1/2" minus material) used for bedding and sand cover of the geomembrane: this material will be a well graded sand material with minor gravel content and less than 5% of fines.
- Class 4 – RipRap, minus 100 mm mainly cobbles and gravel, used for ditch lining and erosion protection.

Details of all materials and compaction requirements are provided in the project specifications. Field investigation for the borrow material was conducted in the summer of 2015 and the results were summarized in the Gap Assessment Report (Stantec, 2015b). Based on the results, it is expected that sufficient material exists for the required types. For example borrow areas GD18 and GD37 have significant deposits of sand. Selective excavation and/or minor processing may be required to meet the material design criteria.

6.1.4 Waste Volumes

The table below summarizes the volume of waste material identified for disposal in the TSCA.

Table 29 TSCA Waste Volume Summary

Waste Type	Minimum Volume (m ³)	Maximum Volume (m ³)
Co-Mingled Impacted Soil	287	315
Metals Impacted Soil	10,182	11,853
Waste Rock (added to facility)	4,417	4,858
Waste Rock (currently in place as part of berms, not being moved)	8,895	8,895
Tailings (currently in place)	45,035	45,035
Non-Hazardous Waste (includes remains of abandoned infrastructure and abandoned site buildings as well as ash from wood burning and metal debris)	177	177
Total	68,992	71,113

6.1.5 Performance Monitoring

Performance monitoring of the TSCA will be conducted at scheduled intervals. Site performance monitoring will include Dam Safety Inspections, visual observations of the TSCA and surrounding area, monitoring of installed instrumentation and collection of samples from the installed instrumentation.

It is proposed that the site monitoring will be incorporated into the overall monitoring program described in Section 7.3.4.

Monitoring events will be scheduled in the summer to allow inspections during snow free conditions. The frequency of site monitoring visits will be re-evaluated after completion of remediation activities and again after year five. Monitoring will continue until steady state is achieved based on monitoring results and observations. This monitoring frequency approach assumes that most of physical stability and environmental issues at the site are mitigated upon completion of the rehabilitation measures.

This monitoring will assess whether the remedial objectives are being met. The site monitoring and Dam Safety Inspection will be completed to assess geotechnical performance of slopes and geomorphic performance and condition of the TSCA cover. Dam Safety Inspections should follow the Canadian Dam Association Guidelines (CDA, 2013). To meet the objectives, the inspection and overall performance monitoring shall focus on the following:

- Differential settlement (Dam Crest and TSCA)
- Cracking on the dam crest and slopes
- Slopes slumping
- Slopes or cover erosion
- Groundwater monitoring

- Seepage at the dam face, or toe areas
- Permafrost degradation or re-establishment
- Tailings boils/piping
- Liner exposure
- Frost heave effects
- Extent, type and rate of vegetation establishment
- Animal activities such as burrowing
- Exposed tailings
- Monitoring instrumentation will include the following instrumentation:
 - Ground thermistors - 2 locations,
 - Vibrating wire piezometers – 2 locations
 - Water quality monitoring standpipes - 2 locations

The instrumentation will be installed through the cover materials and tailings and will be distributed at locations to provide reasonable and adequate spatial and depth variability of conditions within the TSCA. The monitoring instrumentation locations and depths will be optimized during the detail design stage. The instrumentation specifications and design details will be also provided during the detailed design. If monitoring reveals that the TSCA objectives are not being met (such as stability issues, liner issues, generation of leachate greater than expected quantities, etc.) then additional work may be required which could include additional monitoring (increased frequency or additional locations added), further assessment, design modifications, or construction repair.

6.2 WASTE ROCK AND SOIL CONTAINMENT AREA (WRSCA)

As discussed previously, Stantec is recommending that a WRSCA be constructed at Kidney Pond. The waste rock at Kidney Pond currently spreads over an approximately 2 ha area on the hill side overlooking Middle Pond to the East and Sentinel Lake to the northeast. The original topography and geology of the general area was likely dominated by bedrock outcrops, in some areas bedrock is covered by a thin layer of organics, and/or sand/gravel colluvium deposit in depressions. The area of the WRSCA is currently dotted by a number of small waste rock piles about 2- 3 m high and about 5 to 10 m in diameter. The waste rock piles were not engineered, are not physically stable and were found to be acid generating.

The objective of the WRSCA is to protect human and ecological health by containing waste rock and impacted soil such that the direct contact exposure pathway is removed, leachate high in metals and acidic is contained / eliminated, and physical hazards are removed through proper sloping.

The new engineered WRSCA is required for storage of waste rock and other contaminated debris from the surrounding area. The location of the WRSCA is proposed at the same general area, on the side of the natural slope. The construction would involve moving waste rock into one controlled area and rehabilitation of the exposed surface area after moving. Some of the current waste rock piles located within the WRSCA would remain in place.



6.2.1 Design Criteria

The WRCA should meet the following design criteria.

- The WRSCA should be located not to obstruct the seepage flow from the Portal, and provides the area required to implement the portal seep remedial measures.
- The WRCA should contain 20,000 m³ of waste rock and other metal contaminated debris.
- The WRCA will be designed to prevent ARD and ML from the waste – zones of higher PAG-potential should be located closer to the centroid. The WRCA should not include domestic waste, or toxic substances such as oils, paints and/or hydrocarbon contaminated soils.
- The embankment slope of the WRCA must be stable under static, hydraulic and dynamic loading conditions.
- The waste rock within the WRCA will be placed to develop a final surface with a minimum slope of 4% draining the surface runoff away from the WRCA. The surface should not have any depressions that would cause water ponding or channeling.
- The waste material will be covered with a composite cover system including an LDPE/LLDPE liner. The cover will be impermeable to prevent any percolation into the underlying waste rock. The LDPE/LLDPE should have enough flexibility to accommodate minor settlements. LDPE/LLDPE should have sufficient puncture resistance to prevent punctures by smaller sub-angular edge stones.
- The cover over the LDPE/LLDPE should be of sufficient thickness to prevent action of burrow animals. The top surface of the cover should be designed to prevent surface erosion by surface runoff.
- If required, a surface diversion ditch will be developed upstream and alongside the perimeter of the WRCA. The ditch will route all the upstream runoff water towards the lake downstream. The ditch shall be designed to have a minimum capacity of 1 in 100 years runoff event.
- The minimum FS for embankment slopes against sliding shall be as follows:

Table 30 WRSCA Factors of Safety

Loading Conditions	Factor of Safety
End of Construction,	1.3
Static Conditions	1.5
Pseudo-Static (earthquake)	1.1
Post-Earthquake (liquefaction)	1.2- 1.3

6.2.2 Conceptual Design

The WRSCA will be constructed on the existing natural slope in the area of existing scattered waste rock stockpiles. The new WRSCA will be blended to the existing hill, such that the WRSCA will be an extension of the natural slope. The final elevation of the WRSCA should not exceed the elevations of the surrounding hills, therefore, it will blend into the surrounding topography. The conceptual design is shown on Figure J-3 and J-4, Appendix A. Note the location will be revisited

as part of the detailed design upon confirmation of the Kidney Pond Portal Water Management System components.

The WRSCA will accommodate waste rock from the existing stockpiles and other waste from the surround areas. Depending on the final volume, the WRSCA will have an approximate area of 100 m by 100 m and the height of 7 m. The stability will be controlled by safe slopes constructed not to exceed 3H:1V.

The waste material will be covered with a composite cover system of an LDPE/LLDPE liner placed over a prepared foundation, and a 0.2 m thick sand layer on the top of the LDPE/LLDPE, followed by an additional 0.2 m of erosion control material (i.e. fine rock-fill or gravel). The foundation preparation will involve smoothing of the underlying material, compaction and filling voids to encourage positive drainage in accordance with the final WRSCA design slope. The final surface shall be of the fine material and free of any sharp stones. If required, additional sand bedding material will be used to prepare foundations. The final cover will be impermeable and will prevent percolation into the underlying waste rock.

The surface runoff will be directed away from the WRSCA. Depending on the topography, an upstream and perimeter diversion ditch system may be required, or the liner may be keyed into the bedrock. This diversion ditch system would direct runoff downstream of the WRSCA towards Middle Pond. The ditch would be excavated through the overburden to bedrock, or sand/rock-fill with liner will be used to fill depressions in bedrock and create positive drainage toward the lake. Minor excavation in bedrock may be also required in areas where bedrock is undulating. The ditch shall be deep enough to provide flow capacity of 1 in 100 year's storm event and to prevent groundwater backflow under the WRSCA facility. The ditch shall be lined with erosion-resistant rock (rip-rap). Refer to Section 6.3 for the Kidney Pond Portal Management System design.

6.2.3 Construction Material Requirements

The construction materials for the WRSCA cover will include two types of material:

- Class 1– gravel or fine rockfill: this material will be a coarse material for the top erosion control layer or dam stabilization buttress. This material should be composed of fine rock-fill less than 80 mm size or gravel with sand material with the minimum 50% of gravel. The material should be well graded to prevent any internal erosion.
- Class 3 – sand (1/2" minus material) used for bedding and sand cover of the geomembrane: this material will be a well graded sand material with minor gravel content and less than 5% of fines.
- Class 4 – RipRap, 100 mm minus mainly cobbles and gravel, used for ditch lining and erosion protection.
- Class 5 – Rockfill, 200 mm minus material, coarse rockfill manually selected from existing waste rock after visual inspection for ARD signs. Used for portal seepage bed.

Field investigation for the borrow material was conducted in the summer of 2015 and the results were summarized in the Gap Assessment Report (Stantec, 2015b). Based on the results, it is expected that sufficient material exists for the required types. For example borrow areas GD18 and GD37 have significant deposits of sand. Selective excavation and/or minor processing may be required to meet the material design criteria.

6.2.4 Waste Volumes

The table below summarizes the volume of waste material identified for disposal in the WRSCA.

Table 31 WRSCA Waste Volume Summary

Waste Type	Minimum Volume (m ³)	Maximum Volume (m ³)
Co-Mingled Impacted Soil	1240	1670
Metals Impacted Soil	690	850
Waste Rock (added to facility)	340	380
Waste Rock (currently in place or requires minimal movement)	12,600	15,120
Tailings	260	330
Non-Hazardous Waste (includes remains of abandoned infrastructure and abandoned site buildings as well as ash from wood burning and metal debris)	50	50
Total	15,180	18,400

6.2.5 Performance Monitoring

Performance monitoring of the WRSCA will be conducted at scheduled intervals. Site performance monitoring will include visual observations of the WRSCA and surrounding area, monitoring of installed instrumentation and collection of samples from the installed instrumentation.

It is proposed that the site monitoring will be incorporated into the overall monitoring program described in Section 7.3.4. Monitoring events will be scheduled in the summer to allow inspections during snow free conditions. The frequency of site monitoring visits will be re-evaluated after remediation is completed and again after the third year. Monitoring should continue until steady state is achieved based on monitoring results and observations. This monitoring frequency approach assumes that most of physical stability and environmental issues at the site are mitigated upon completion of the construction.

This monitoring will assess whether the remedial objectives are being met. The site monitoring will be completed to assess geotechnical performance of slopes and condition of the cover and will focus on the following:

- Differential settlement
- Slopes slumping
- Slopes or cover erosion
- Groundwater Monitoring
- Seepage at the toe areas
- Permafrost degradation or re-establishment
- Liner exposure
- Frost heave effects
- Extent, type and rate of vegetation establishment
- Animal activities such as burrowing
- Exposed waste rock
- Monitoring instrumentation will include the following instrumentation:
 - Ground thermistors - 2 location,
 - Water quality monitoring standpipes - 2 location

The instrumentation described above will be installed at a location which would be representative of the entire WRSCA. The instrumentation specifications and design details will be provided during the detail design. If the WRSCA objectives are not being met (such as stability issues, liner issues, generation of leachate greater than expected quantities, etc.) then additional work may be required which could include additional monitoring (increased frequency or additional locations added), further assessment, design modifications, or construction repair.

6.3 KIDNEY POND PORTAL WATER MANAGEMENT SYSTEM

Based on the information known about the Kidney Pond portal, additional data is required prior to designing the water management and portal closure system. Currently impacted water is discharging from the portal and pooling adjacent to the portal opening. At this time impacts in downgradient water bodies have not been observed. Therefore, the water management system will be designed to mimic this system, but remove the direct contact pathway to impacted water. At this time there are data gaps including the volumes of water discharging from the portal, quality of discharge water throughout the year, and an understanding of infiltration rate outside the immediate portal area. The Portal Water Management System is expected to have the following design features:

- Minimum 1.0 metre low-PAG waste rock placed as drain rock (rockfill) within the area of maximum predicted seasonal ponding of portal discharge;
- Geotextile and burlap or equivalent as rock cover and demarcation between rock and soil cover, to minimize vertical migration of soil into rock matrix;
- Soil cover consisting of 0.3 m pit-run borrow (class 1) and native vegetation. This material should be composed of fine rock-fill less than 100 mm size or gravel with sand material

with the minimum 50% of gravel. The material shall be well graded to prevent any internal erosion.

- Instrumentation for monitoring consisting of triangular v-notch weir facility at portal opening, along with 3-4 monitoring wells for water level and quality monitoring, and 1-2 thermistor strings (could be co-located with monitoring wells). Weir facility to include steel bar grating and locking access door attached to portal opening walls to prevent entry into the portal (refer to drawings).

These features should be adjusted after assessment of the additional data collected.

6.4 BORROW MATERIAL REQUIREMENTS

Borrow source materials are required for the remedial program, specifically for the construction of the containment areas, staging areas/camp(s), upgrades to/construction of site access, and as backfill material.

6.4.1 Required Borrow Material

Borrow material will be required to backfill excavations, backfill mine openings, and as part of the construction of the TSCA and the WRSCA. In some cases there is low or moderate risk waste rock present at sites where mine openings require backfilling. The table below details the backfill requirements for each site and the type of hazard component it is addressing:

Table 32 Summary of Backfill Requirements

Site	Co-mingled Impacted Soil Areas	Metals Impacted Soil Areas	PHC Impacted Soil Areas	Mine Openings	Trenches	Waste Rock Areas	Tailings Areas	Facilities	Total
Burnt Island	32		248	1,061			751		2,093
Camlaren	191	7,401	848	210		542			9,192
Goodrock				124					124
Kidney Pond	1,786	130	399	270					2,584
Murray Lake				275					275
Storm Property				135					135
Treacy		154	14		220		13		402
Try Me				30					30
West Bay	17	578	202				159		955
TSCA*								20,000	20,000

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Site	Co-mingled Impacted Soil Areas	Metals Impacted Soil Areas	PHC Impacted Soil Areas	Mine Openings	Trenches	Waste Rock Areas	Tailings Areas	Facilities	Total
WRSCA*								25,000	25,000
Camps**								5,000	5,000
Staging Areas**								2,500	2,500

Notes - * estimate of material based on preliminary design, will be refined in project specifications

** camps and staging area quantities have been roughly estimated to determine material requirements by type, and will be refined in project specifications

The approximate requirement for borrow material is 73,500 m³.

6.4.2 Borrow Material Sources

In 2014, Stantec completed an assessment of borrow sources within the Gordon Lake area and in 2015 additional work was conducted to better define these deposits (test pit / borehole logs and sieve analyses are appended in Appendix F). In total, the program evaluated 67 sites that varied in size and composition. The following section provides a review of the potential borrow sources that would be of sufficient size to accommodate the remediation requirements (see Stantec, 2016b for the full evaluation). During the evaluation of these sites, Stantec has included options that:

- Are previously disturbed
- Are in close proximity to the sites
- Have suitable type and quantity of borrow material
- Require minimal logistics (i.e., access roads)
- Minimize environmental concerns

Additional details on the borrow source assessment and findings can be found in the Gap Assessment Report prepared by Stantec (Stantec, 2016b). Upon site selection, the design of the borrow source will be required to adhere to the conditions of the land use permit, quarry permit and other regulatory requirements. The borrow sources discussed below are shown on Figure 1, Appendix A.

6.4.2.1 Potential Borrow Source GD-18 (West Bay Quarry)

This borrow source is located on a very large esker on the west side of Gordon Lake south of Murray Lake. The site is accessible from an existing access trail and is currently operated as a gravel pit. Based on grain size analysis, approximately 53,000 m³ of good material is available and over 100,000 m³ of fair material is present. This material would be suitable for constructing and cover for the TSCA and the WRSCA.

6.4.2.2 Borrow Source GD-45 (Burnt Island)

This borrow source, a glaciofluvial esker deposit, covers approximately a third of Burnt Island and is located 200 m south of the Burnt Island mine site. The deposit showed highly variable material textures ranging from medium to coarse sand with gravel, clean fine gravel and some sandy gravel and cobble. The deposit is estimated to contain approximately one million cubic meters of granular material. A small borrow pit (<25 m²) was observed near the old dock area on the southeast side of the island. However, a grave site was recorded during the archaeology assessment which will limit the use of this borrow source. However, during the assessment, approximately 3,000 m³ was assessed. Based on the results of the RAP workout with the YKDFN, the use of this borrow source would be allowed after a representative had indicated ‘no go’ areas at and around the source.

6.4.2.3 Borrow Source GD-37

This borrow source, a glaciofluvial esker deposit, is located 250 m east of Gordon Lake and 100 m east of the West Bay mine site’s waste rock piles. The esker consists of three separate deposits 2.5 km, 600 m and 200 m long, respectively; all within 30 to 160 m wide. The thickness of the deposit ranges from 2 m to 3 m and a series of trails lead to an existing borrow pit located on the eastern portion of the esker (GD-37). The existing borrow pit is used by the Joint Venture Management Committee during the maintenance of the JV winter road (permit number MV2009X0047).

6.4.2.4 On-site Low and Moderate Risk Impacting Waste Rock Sources

In addition to the off-site borrow sources, there are areas of low and moderate risk impacting waste rock which would be suitable for placement in below grade mine openings and/or below the water table. These include:

Table 33 On-site Low and Moderate Risk Impacting Waste Rock

Site	On-Site Material
Burnt Island	5,000
Goodrock	284
Murray Lake	600
Storm Property	110
Try Me	151

6.4.3 Borrow Material Reconciliation

Based on the quantities available on-site, and those from off-site borrow sources, the volumes were reconciled to confirm sufficient quantities are available from near site sources. The table below summarizes borrow material quantities:



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Site	Total required	On-Site Material	GD-45	GD-18	GD-37	Reconciliation
Burnt Island	2,093	1,061*	1,032			0
Camlaren	9,192	0		9,192		0
Goodrock	124	124				0
Kidney Pond	2,584	0			2,584	0
Murray Lake	275	275				0
Storm Property	135	110		25		0
Treacy	402	0			402	0
Try Me	30	30				0
West Bay	955	0			955	0
TSCA	20,000	0		20,000		0
WRSCA	25,000	0			25,000	0
Camp**	5,000	0		2,500	2,500	0
Staging Area**	2,500	0		1,250	1,250	0
	Total	1,600	1,032	32,967	32,691	
	Total Capacity		3,000	250,000	90,000	
	Remaining		1,968	217,033	57,309	

Notes - * this quantity will be placed below grade in the shaft, the remainder of borrow material is required to cover tailings at the surface as low and moderate risk impacting waste rock is not appropriate for this use

** camps and staging area requirements are not known at this time, estimates used for reconciliation

This borrow material analysis was based on the preliminary design and will be further refined in project specifications. Based on the results, there should be sufficient quantities of borrow material to meet the requirements of remediation.

7.0 CONCEPTUAL REMEDIAL PROGRAM

The process of remediating the site can be broken down into the following components:

- Regulatory Approvals Required
- Remedial Considerations
 - Site Access
 - Camp Facilities
 - Equipment Requirements



- Fuel Requirements
 - Borrow Source Materials (discussed in Section 6.4)
- Remedial Sequencing
 - Constructing Site Infrastructure
 - Remedial Sequencing
 - Confirmatory Activities
- Post Remedial Activities

These items are further discussed below.

7.1 REGULATORY APPROVALS

Based on the proposed remediation program, the following permits and licenses will be required:

- Land Use Permit under the Mackenzie Valley Resource Management Act – For use and occupation of land
- Water License – Use of water or deposition of waste (applicability to be determined)
- Quarry Permit

7.2 REMEDIAL CONSIDERATIONS

7.2.1 Site Access

As described in Section 3.1, access to the sites is limited to float plane/helicopter in the summer, and helicopter and winter road in the winter. Access for specific time periods is described in Section 7.3.2. Based on the components requiring remediation, spur roads from the Tibbitt to Contwoyto Joint Venture (herein referred to as the JV winter road) will be required to Burnt Island, Camlaren, Goodrock, Camlaren, Kidney Pond, and West Bay. As the remediation would involve significant use of this road during the winter of 2017, 2018 and 2019, a royalty cost sharing agreement would need to be setup with the operators of the JV winter road.

Note that spur roads are not anticipated to be required to the following sites:

- Treacy – Excavated soil can be moved via barge to Kidney Pond for disposal in the WRSCA. The east trench requires backfilling, however there should be sufficient volume of waste rock to fill this in below the water table. Any remaining waste rock can be move via barge to Kidney Pond. Areas of soil excavation are limited and it is expected that the area can be roughly re-contoured without requiring borrow material.
- Murray Lake – The main volume of material requiring movement at Murray Lake is waste rock used to fill in the shaft and deep trench.
- Try Me – No significant volumes of material require movement from Try Me, therefore, no winter road spur is required. It is assumed that heli-portable equipment can be used to fill in the shaft.

- Storm Property – The most significant volume of material is required to fill in the shafts. As the shafts can also be capped with an engineered cap, a spur road is potentially not warranted, however earth moving equipment would need to be air mobilized to the site.

Goodrock may or may not require the construction of a spur road at this point as the contractor may decide to fly into this site. It is expected that a helicopter will be contracted for the summer as not all sites are fixed wing accessible.

7.2.2 Camp Facilities

During the remediation a temporary camp (or camps) will be constructed to maintain the remediation teams within easy access of the sites. The final location of the camp will be determined based upon contractor plans, however several potential have been evaluated. Those include constructing a camp(s) at Camlaren, Kidney Pond and/or West Bay.

Where possible, camps will be constructed in previously disturbed areas to minimize additional disturbances. Camps will be constructed in areas free of impacted material. Fuel required for camps will be stored in accordance with applicable legislation.

One camp is expected to be constructed at Kidney Pond due to the accessibility of the site (via aircraft, winter road, and watercraft) and the amount of remedial activity occurring at this site. Other locations, such as Camlaren, also feature relatively good access and significant remedial activity; however, the island is smaller in size and therefore Kidney Pond is preferable for a large camp. The successful contractor may decide that operating two main camps (one at Kidney Pond and Camlaren) is beneficial. In addition, satellite camps may be considered for locations where the expected duration of work would favour overnighting workers over a daily commute from a main camp location. West Bay may also be a strategic location for a camp to support developing the borrow source at that site.

Camps are expected to have a capacity for a minimum of 50 on-site workers and associated camp staff, in total. Water samples collected from Gordon Lake in the area of Camlaren, Burnt Island, and Kidney Pond were analyzed for drinking water quality, however all samples exceeded Health Canada guidelines for bacteria content. Therefore, water treatment may be required for the camp – water quality will be re-evaluated in summer 2016.

Based on the maximum number of personnel required during the remediation program, the camps would be expected to include sleeper units (sufficient for all workers plus departmental representatives), an office trailer, and a kitchen or combined kitchen/wet facility (showers, washer/dryer, etc.). In addition a medical facility will be included at the main camp for a full time medic to reside during construction.

Camps will be constructed with suitable infrastructure to meet territorial guidelines for this type and size of camp (such as sewage collection) and will be constructed and prepared for weather and/or emergency situations. Domestic waste generated from the camp will be either

incinerated or disposed off-site at an approved disposal facility. Upon completion of the remediation program, the camp infrastructure will be removed from the site.

7.2.3 Equipment Requirements

Heavy equipment including trucks, excavators, loaders and dozers will be required to consolidate, transport, and dispose of the wastes present at the sites.

To facilitate the completion of multiple sites concurrently, use of a commercial barge to transport equipment / personnel between the sites (where possible) may be cost effective. Due to limited availability and requirements for barge landings, the barge would need to be fabricated considering shore access and cargo requirements. If a barge were to be used during the remediation activities, docks would be required to facilitate the transfer of equipment / wastes.

For sites that are not located on Gordon Lake, air portable heavy equipment (e.g. Kubota excavator) could be mobilized to the sites via fixed winged aircraft on floats or via helicopter.

The following equipment is expected to be mobilized:

- excavators
- loaders
- rock and/or dump trucks
- dozers
- packers
- skid steers
- flat decks/water trucks
- ATVs
- runner boats
- barge(s) including tugs
- screeners
- grizzly
- skidoo
- Hagglund

7.2.4 Fuel Requirements

Diesel fuel and gasoline will be required during the remediation program to support heavy equipment and camp operations. Fuel could be staged at a central location, for example at the Camlaren site, via the winter road. Fuel would also be stored at the proposed camp(s). Proper fuel storage and handling measures would be required.

7.3 REMEDIAL SEQUENCING

7.3.1 Constructing Site Infrastructure

There are many infrastructure components that will be required during the remediation including, but not limited to:

- Ice spur roads – will be constructed from the JV winter road to MWVLB guidelines for ice road construction (possible routes are shown on Figure 1, Appendix A).
- Camps – Described in Section 7.2.2
- Borrow Source staging areas – Borrow sources will be developed in the summer period and will require staging for winter moves. This will include screening and sorting prior to staging as screening will not be possible in the winter.
- Waste staging areas – Impacted soil, waste rock and tailings that require removal and disposal will be excavated in the summer and staged at a location that will be easily accessible in the winter from the spur road. This will require placing a liner to limit impacting other areas.

7.3.2 Construction Execution Program

This section provides a description of the work to be completed during the remediation program and is laid out based on a conceptual schedule. Note that this remediation scenario is one of a large number of possible scenarios, and should not be considered prescriptive – it is provided to illustrate the necessary steps required to complete the proposed remediation program.

7.3.2.1 January 2016 to August 2016

Work completed during this timeframe would include finalizing the RAP (presented herein), presenting the RAP to stakeholders in community meetings, completing the detailed design, tendering (including the preparation of tender specifications and awarding the tender) and the preparation of regulatory applications (i.e. permits and licenses). Award is assumed to occur prior to September 2016.

7.3.2.2 June 2016 to October 2016

Work during this period would be conducted concurrently with tendering and would include collecting data to support closing data gaps at the Kidney Pond portal, around the West Bay waste rock piles, collecting additional drinking water samples, and completing a second round of Hyalella sampling.

7.3.2.3 September 2016 to October 2016

Work during this period would primarily involve site preparation and staging material. The activities would not require a camp due to the limited amount of time on-site and limited number of personnel required. The primary activities would include:

- Winter road track survey - This task will include assessing proposed ice road spur and winter road routes for suitability and identifying those requiring improvements. Preliminary review was completed by NOR-Ex Ice Engineering through contract to Stantec. The results are attached in Appendix G.
- Site access preparation – This task will include preparatory work such as brush clearing to make site areas more accessible via helicopter and ATV.

7.3.2.4 February 2017 to March 2017

Activities during this period will primarily consist of staging camps and heavy equipment as described in Section 7.2.3 at Burnt Island, Camlaren, Kidney Pond, West Bay, and borrow source GD-18. The sites will be accessed via ice road spurs constructed from the JV winter road, which is generally open between late January and March 31. During the 2017 winter activities, a camp may be required to house personnel as equipment will be mobilized and dropped off to the appropriate sites. It may be possible to stage a camp at the same location as the JV winter road camp to minimize site disruptions and this should be investigated by the contractor.

7.3.2.5 Summer 2017 (May 2017 to September 2017)

The following activities are expected to be completed during the summer of 2017:

- Quarry Development – Quarry development will commence at the West Bay Quarry and GD-18. The material will be screened, sorted and staged in anticipation of transportation during the winter season.
- Construct Floating Docks / Barge Landing Areas – Floating docks will be constructed to allow float plane and watercraft access at Kidney Pond, West Bay, Treacy, and Camlaren.
- Excavate, Stockpile and Consolidate Material – The equipment mobilized during the winter of 2017 will be used to excavate, stockpile and consolidate materials on-site in preparation to be transported during the winter season.
 - At Burnt Island, this will consist of excavating impacted soil and consolidation in anticipation of winter transportation to Camlaren.
 - At Camlaren this will consist of excavating impacted soil, screening as required, and consolidating in the current TCA.
 - At Kidney Pond, this will consist of excavating impacted soil and consolidating waste rock into the WRSCA area.
 - At West Bay this will consist of excavating borrow material and excavating impacted soil. This material will be staged for transportation over the winter.

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- At GD-18 this will consist of excavating borrow material, sorting, and staging for winter transportation. The intention will be to fully develop this source so after the winter of 2018 access will not be required again.
- At Treacy, either helicopter portable, or barge portable equipment will be moved from Kidney Pond to complete the necessary remedial activities and move the material to Kidney Pond via barge.
- At Murray Lake and Try Me, a helicopter portable excavator will be mobilized to complete mine opening backfilling and hazardous and non-hazardous waste will be collected for transportation via helicopter.
- Hazardous waste including batteries, asbestos containing material, and wood painted with lead based paint would be collected from all applicable sites either via helicopter or boat and amalgamated at Kidney Pond for off-site disposal in the winter of 2018.
- Wood Burning Activities – untreated wood would be burned using a controlled burn in an appropriate container in accordance with the terms and conditions outlined in the land use permit at all sites individually.

At the end of the summer of 2017, work at Murray Lake, Treacy and Try Me is expected to be completed, and excavation of impacted material will be completed at Burnt Island, Camlaren, and West Bay.

Access from Yellowknife and the Kidney Pond during this period will be via aircraft (Twin Otter and helicopter). Access between the camp and sites will be via helicopter (when ice is on the lake) and watercraft once the ice breaks. The camp is expected to be operated from May 15 to September 30, 2017.

7.3.2.6 Winter 2018 (February 2018 to March 2018)

Similar to the winter of 2017, Burnt Island, Camlaren, Kidney Pond, West Bay, and borrow source GD-18 will be accessed via the JV winter road and spur roads during the winter of 2018.

Remediation tasks that will be completed during this timeframe are outlined below:

- Transport Borrow Material to Sites and Stockpile – Borrow material originating from the two borrow sources will be transported and stockpiled in cleared areas at each site. Camlaren will be used as a staging area where possible for borrow material.
- Transport of excavated materials – Material being removed from each site will be hauled to its respective containment area. When possible, the trucks used to transport borrow material to each site will be used to transport non-hazardous materials back to the staging area at West Bay. The PAG material at Kidney Pond and tailings at Camlaren will be left in place (and addressed during summer of 2018); however, the soil at Camlaren will need to be transported within the site. The transport of material will generally be done on a site-by-site basis (i.e. one site at a time).
- Transport Hazardous Material Off-Site – Hazardous material will be transported from the staging area at West Bay to Yellowknife.

7.3.2.7 Summer 2018 (May 2018 to September 2018)

The following activities are expected to be completed during the summer of 2018:

- TCSA and WRSCA Construction – Work would focus on the construction of the TCSA and the WSCA at Camlaren and Kidney Pond, including capping with the liner and cover material upon completion of filling.
- Excavate and Dispose of on-site – The contaminated soil at Camlaren will be excavated, transported and disposed of on-site in the TCSA.
- Shaft and Portal Capping – Foam will be used to cap mine shafts and portals. This option has been used as opposed to a concrete cap to facilitate the application of the cap and eliminate the necessity of concrete mixing trucks. Activities involving mine shaft/vent/trench remediation will require the presence of a Level 2 mine site supervisor on the part of the contractor.
- Trench Backfill and Grading – Trenches will be backfilled and/or graded. It is anticipated that small trenches will only require grading whereas larger trenches (i.e. deep trenches with shear walls) will need to be backfilled and graded.
- At Goodrock and Storm Property, a helicopter portable excavator will be mobilized to complete mine opening backfilling and hazardous and non-hazardous waste will be collected for transportation via helicopter.
- Wood Burning Activities – untreated wood would be burned using a controlled burn in an appropriate container in accordance with the terms and conditions outlined in the land use permit at all sites individually.

At the end of the summer of 2018, work at all sites is expected to be completed.

Access from Yellowknife and the Kidney Pond/Camlaren camp during this period will be via aircraft (Twin Otter and helicopter). Access between the camp and sites will be via helicopter (when ice is on the lake) and watercraft once the ice breaks. The camp is expected to be operated from May 15 to September 30, 2017.

7.3.2.8 March 2019

The winter of 2019 will be designated to equipment demobilization activities to clear all of the GLG sites and prepare for monitoring activities. Equipment will be demobilized via JW winter road/spur roads.

Over the winter of 2019, the sites will be accessed via the winter ice road and spur roads. The camp may be required to house personnel as equipment will be demobilized from the sites.

7.3.3 Confirmatory Sampling Program

During remediation, confirmatory soil samples will be collected after impacted soil/tailings are removed to assess if residual concentrations are less than the applicable criteria. Samples will

also be collected of impacted soils/tailings to characterize COC concentrations prior to placement in the landfills. It is expected that areas where impacted soil is excavated that some soil will remain in crevices etc. The effort required to remove the residual soil will be quite extensive when compared to the risk posed. Therefore, removal of 95% of the impacted soil will be considered the threshold where remediation will no longer continue.

In addition to confirming soil concentrations, quality testing will be conducted to confirm earthworks such as testing for fill quality prior to construction of the landfills. The testing will be conducted to determine if the construction is in accordance with the specifications for the remediation. Baseline sampling of temporary construction works (staging areas, laydown areas, camps, landfarm, etc.) areas will also be required.

Residual contamination may be present at temporary construction works following the completion of the remedial activities. These areas will be visually assessed for contamination indicators such as staining, debris, or paint chips and sampled if required. Any deviations from baseline conditions will require rectification on the part of the contractor.

Finally, during remediation, testing will be required as per the conditions of the Land Use Permit and Water License.

7.3.4 Post Construction Activities

7.3.4.1 Short Term Monitoring

The short-term post-remedial monitoring program (years 1-5 after remediation) will include:

- Facility Monitoring:
 - Performance monitoring of the TSCA, WRSCA, and Kidney Pond Portal Water Management System as described in Sections 6.1.4, 6.2.4, and 6.3
 - Performance monitoring of the backfilled/capped shafts
- Surface Water and Sediment Monitoring and Sampling:
 - Downgradient from areas with significant remedial excavations:
 - Burnt Island
 - Camlaren (Muir Island and Zenith Island)
 - Goodrock
 - Kidney Pond
 - Treacy
 - West Bay
 - Downgradient from facilities (TSCA, WRSCA and Kidney Pond Portal Water Management System)
- Visual Monitoring:
 - All sites where backfilling of mine openings occurred
 - All sites where excavations were backfilled
 - Decommissioned borrow areas

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- Risk Reviewed Areas:
 - Visual monitoring of impact areas left in place at Murray Lake, Storm Property, and Try Me based on the additional risk review
 - Visual monitoring of the area of cobalt impacted soil at Camlaren to confirm vegetation is still present
- Moderate Risk Impacting Waste Rock Areas:
 - Visual monitoring of areas left in place at Burnt Island, Goodrock, Kidney Pond, Murray Lake, Storm Property, and West Bay based on the additional risk assessment
 - Collection and analysis of water and/or soil samples if signs of ARD are encountered

The STM plan will be further developed during the remediation program and will depend on the specific conditions observed during remediation. At the end of five years, a Performance Assessment report will be prepared that will outline recommended monitoring from year six onwards. This monitoring will be outlined in the Long Term Monitoring (LTM) Plan.

7.3.4.2 Long Term Monitoring

The LTM Plan will be based on the findings in the Performance Assessment report and will include numeric triggers and threshold values that initiate actions to:

- a) collect samples (i.e., move from visual to media monitoring),
- b) update trends (i.e., add sample results to update trends),
- c) update assessments of risk significance (i.e., recalculate exposure concentrations for comparison to risk thresholds, and in cases where thresholds are exceeded, take remedial action).
- d) Define timelines for the decommissioning of monitoring wells

The current threshold values for the GLG sites are as follows:

- Threshold for aquatic habitat significant risk: *Hyalella azteca* LBC₅₀ for aquatic COPCs (arsenic, copper, and zinc).
- Threshold for aquatic habitat increased monitoring: *Hyalella azteca* LBC₂₅ for aquatic COPCs (arsenic, copper, and zinc).
- Threshold for impacting waste rock significant risk: trends in established COPCs in downgradient surface water increasing above the following CCME FAL criteria ratios – arsenic 30x, cadmium 3.4x, copper 21x, lead 8.4x, zinc 4.7x.
- Threshold for impacting waste rock increased monitoring: new COPCs in downgradient surface water, increasing trends in established COPCs in downgradient surface water.

The SSTLs defined for the project are the thresholds for terrestrial (i.e., soil) impact areas.

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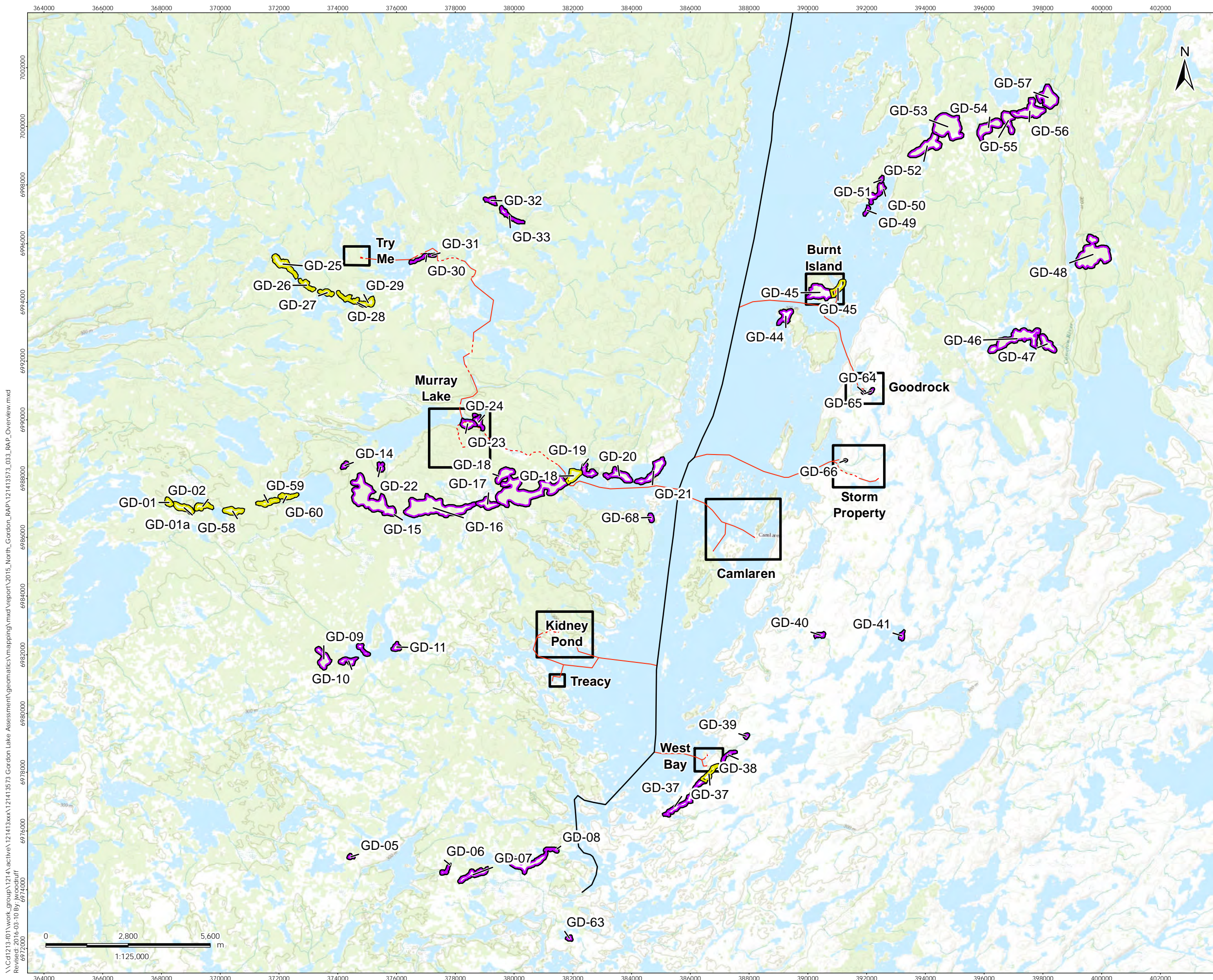
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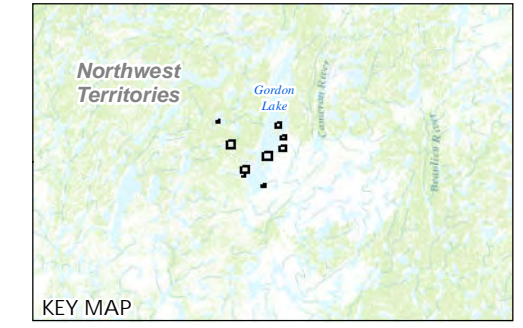
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APPENDIX A Figures



- Legend**
- - - Over Land Road Section
 - Over Water Road Section
 - Tibbitt to Contwoyto Winter Road
 - Potential Borrow Sources
 - Potential Borrow Areas Assessed
 - Mine Site Location



- Notes**
1. Coordinate System: NAD 1983 UTM Zone 12N
 2. Basemapping: CANVEC © Department of Natural Resources Canada. All rights reserved.
 3. Geonames from GeoBase®, Downloaded March 2013.
 4. Orthoimagery © MapMart, 2011.
 5. Not all features included in the legend are visible within the map extent

March 2016
121413573-033

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Figure No.
1
Title

**Gordon Lake Group
Site Locations**

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 Revised: 2016-03-10 By: jwoodruff

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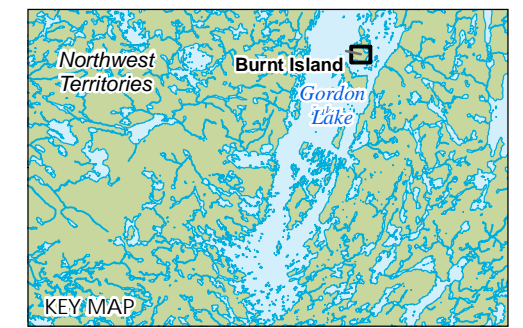
390500

391000



Legend

- Background Sample
- Watercourse
- Water body
- Map Extent



NAD 1983 UTM Zone 12N February 2016 121413573

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Figure No.
A-1

Title
**Burnt Island
 Site Overview**

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Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

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Legend

Features Observed

- Other (as labeled)
- Trail
- Debris
- Other (as labeled)
- Structure Remains
- Areas of Environmental Concern (AEC)
- Watercourse
- Water body
- Map Extent



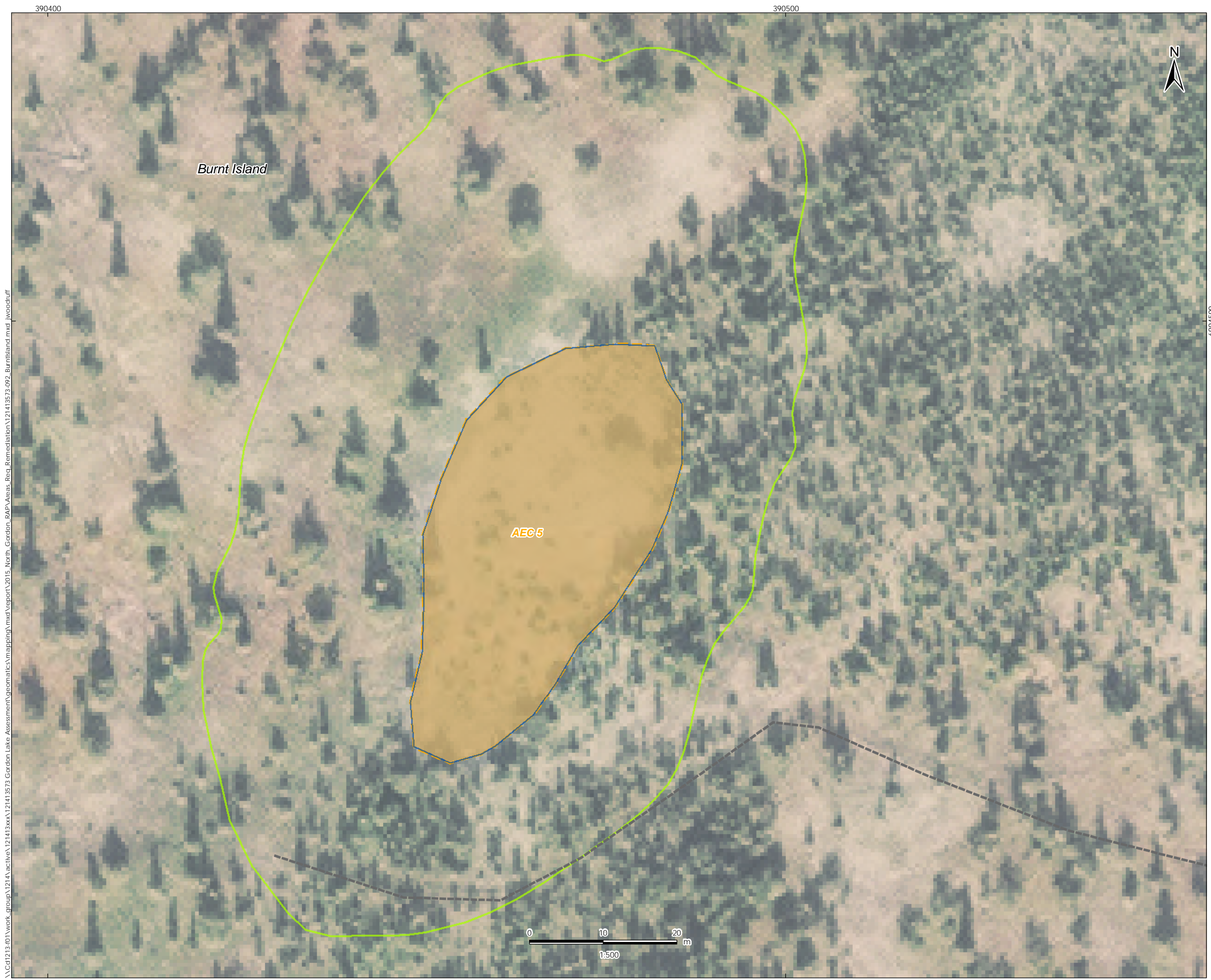
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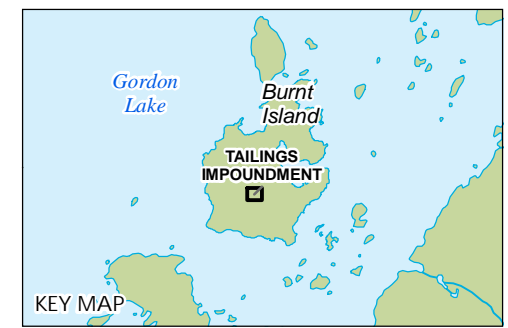
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Government Services Canada
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Figure No.
A-2

Title
Burnt Island - Knutsen Camp
Summary of Hazard Components



- Legend**
- Features Observed**
- Trail
 - Other (as labeled)
 - Tailings
 - Areas of Environmental Concern (AEC)
 - Watercourse
 - Water body
 - Map Extent



NAD 1983 UTM Zone 12N March 2016
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Figure No.
A-3

Title
**Burnt Island - Tailings Impoundment
Summary of Hazard Components**

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Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

390600

390700



Legend

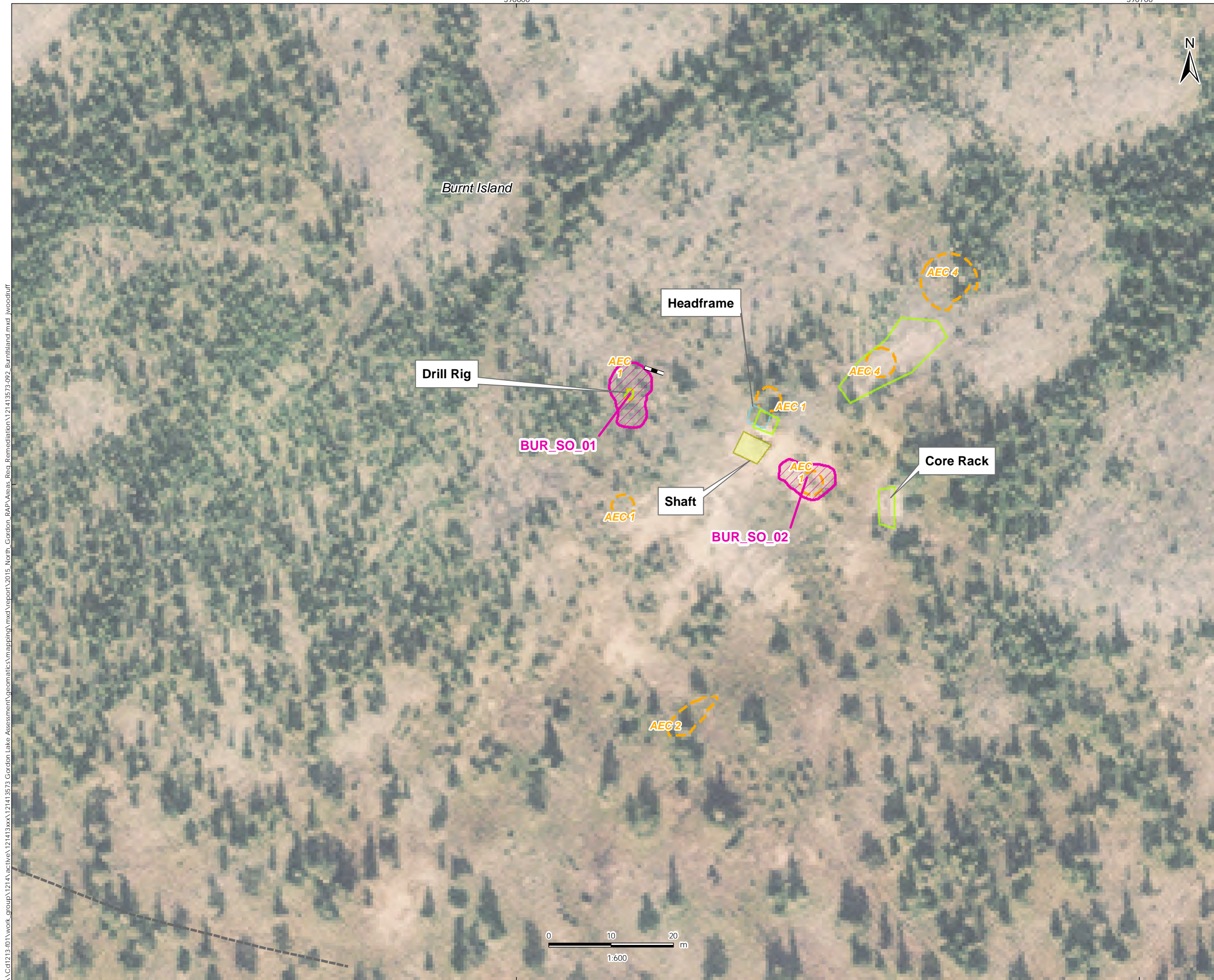
Impact Type

- Petroleum Hydrocarbon (PHC)

Features Observed

- Pipe Rack
- Trail
- Other (as labeled)
- Structure Remains
- Trench/Shaft
- Areas of Environmental Concern (AEC)
- Watercourse
- Water body
- Map Extent

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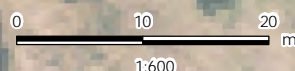
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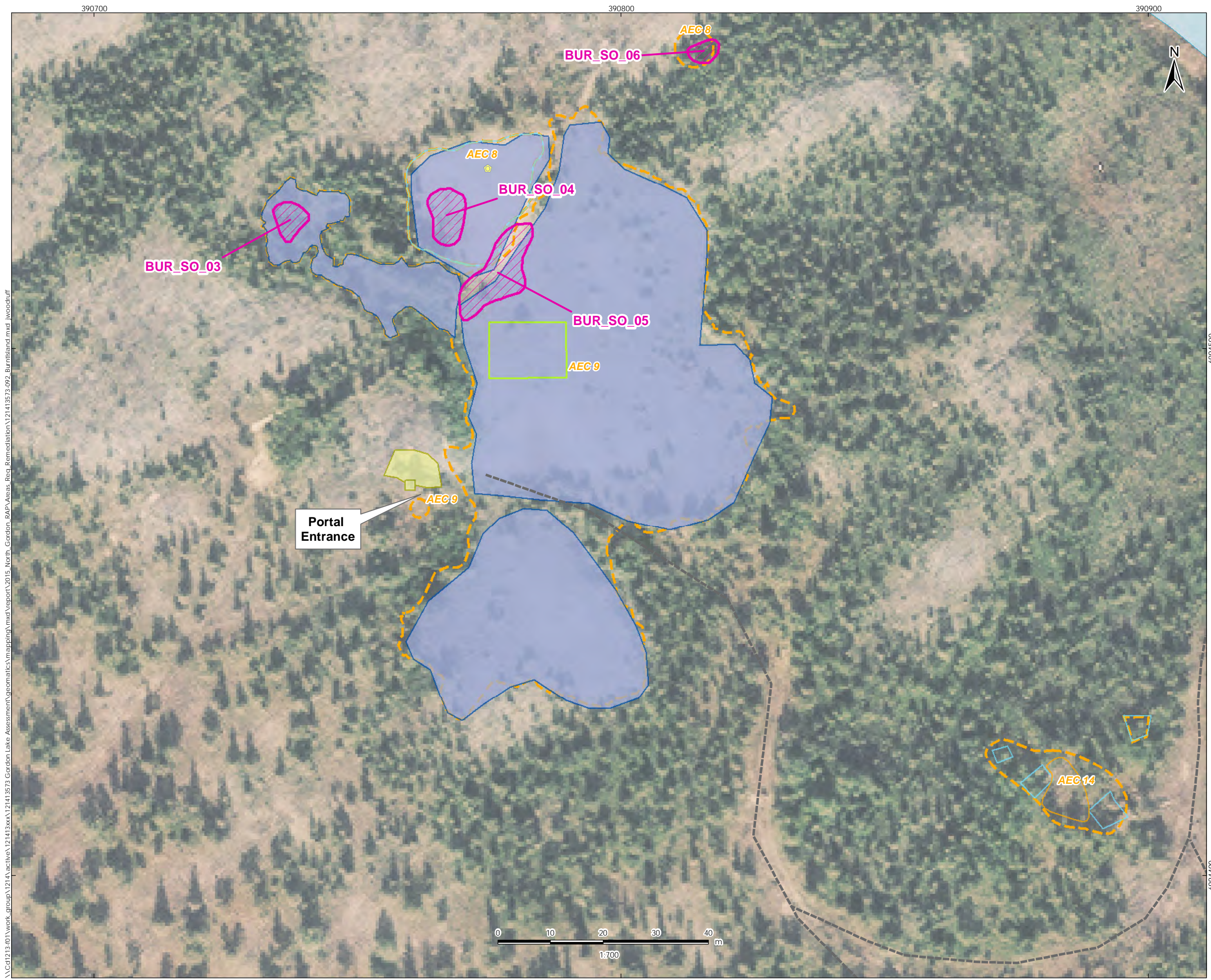
Figure No.

A-4

Title

Burnt Island - Shaft Area
Summary of Hazard Components





Impact Type	Features Observed
Petroleum Hydrocarbon (PHC)	Other (as labeled)
	Trail
	Debris
	Other (as labeled)
	Structure Remains
	Trench/Shaft
	Waste Rock/Ore
	Areas of Environmental Concern (AEC)
	Watercourse
	Water body
	Map Extent



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 Figure No.
A-5
 Title
**Burnt Island - Waste Rock Area
 Summary of Hazard Components**

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Sources: MapMirt Orthomagey (2011), GeoBase, CANVEC



Legend

Features Observed

- Debris
- Areas of Environmental Concern (AEC)
- Watercourse
- Water body
- Map Extent

Burnt Island

AEG 15

AEG 15

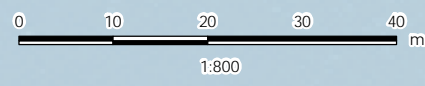


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Figure No.
A-6

Title
**Burnt Island - Old Saw Mill
Summary of Hazard Components**



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Legend

Impact Type

- Petroleum Hydrocarbon (PHC)
- Co-mingled
- Moderate Risk Impacting Material

Features Observed

- Burn Pit
- Structure Remains
- Trail
- Structure Remains
- Trench/Shaft
- Areas of Environmental Concern (AEC)
- Watercourse
- Water body
- Map Extent

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121413573

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Gordon Lake Group Remedial Action Plan

Figure No.
A-7

Title
**Burnt Island - Old Mill Area
Summary of Hazard Components**

Sources: MapMirt Orthomagey (2011), GeoBase, CANVEC

390000

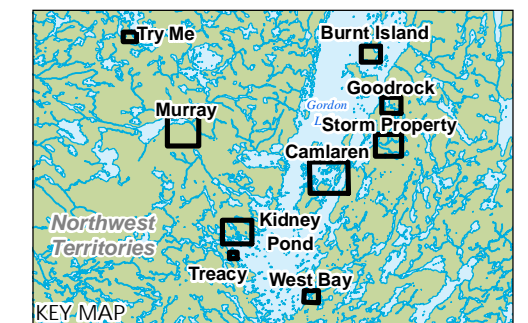
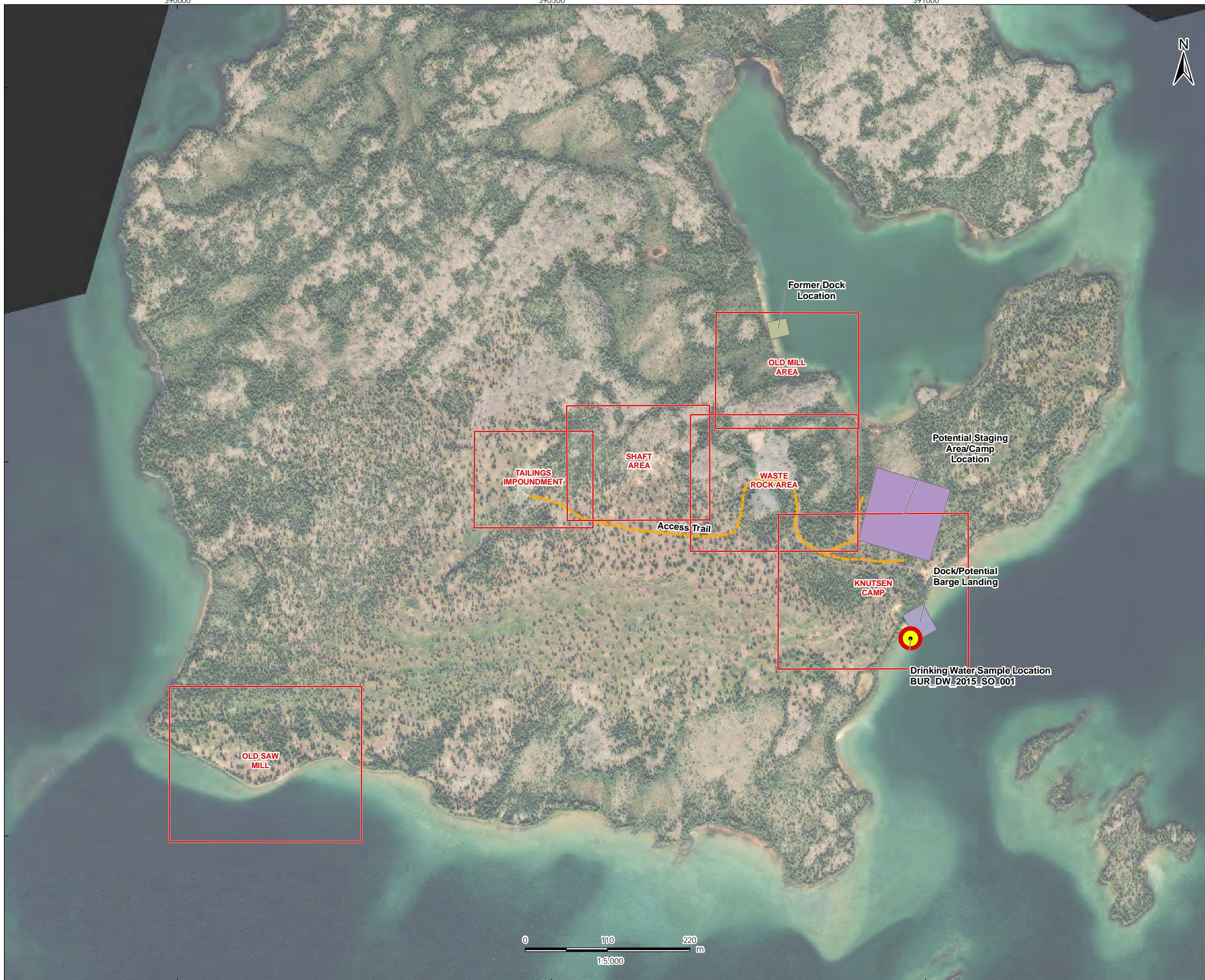
390500

391000



Legend

- Exceedance of Applicable Guidelines
- Drinking Water Sample Location
- Access Trail
- Infrastructure Type
 - Dock/Potential Barge Landing
 - Former Dock Location
 - Potential Staging Area/Camp Location



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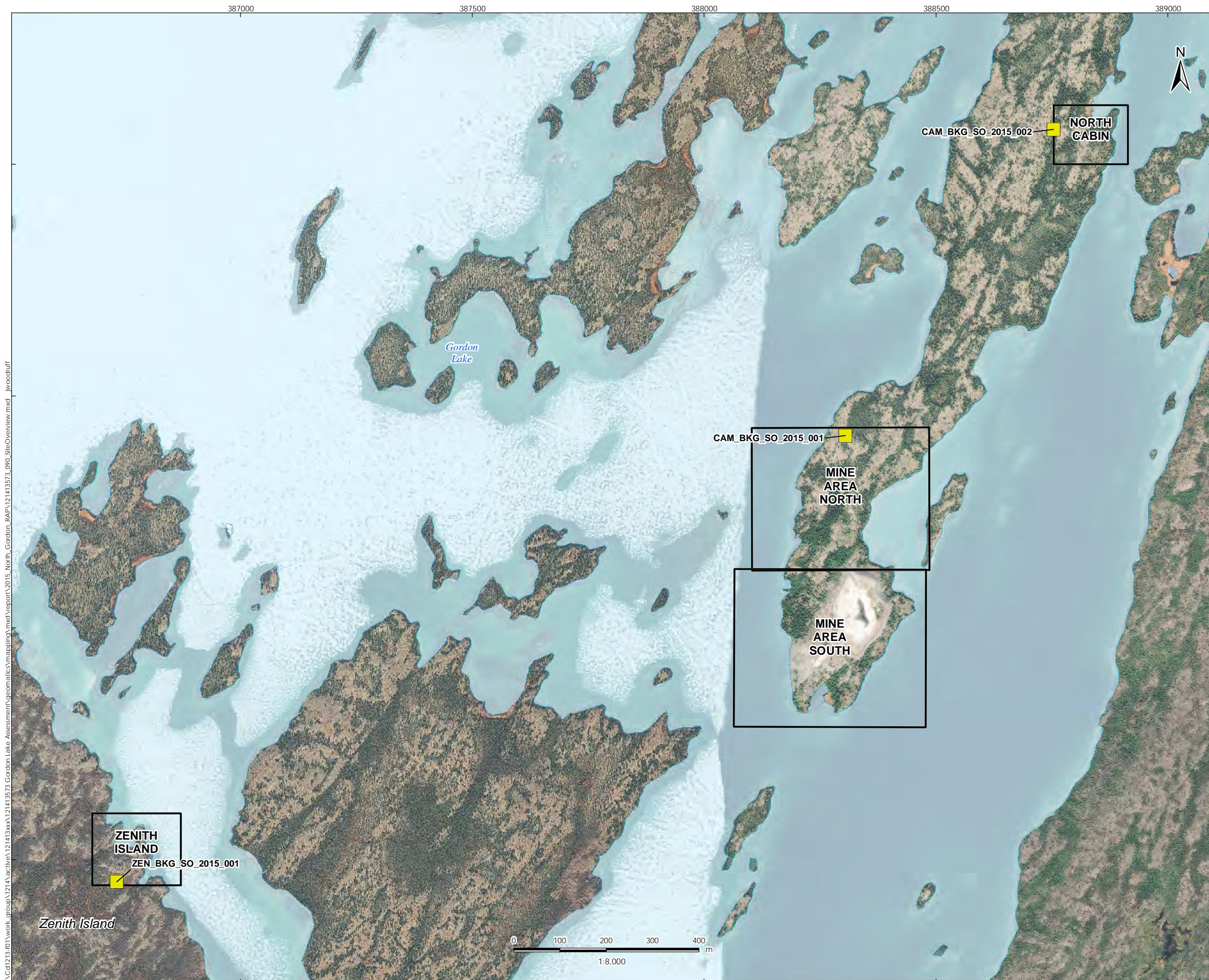
Client/Project
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 Government Services Canada
 Gordon Lake Group Remedial Action Plan

Figure No.
 A-8

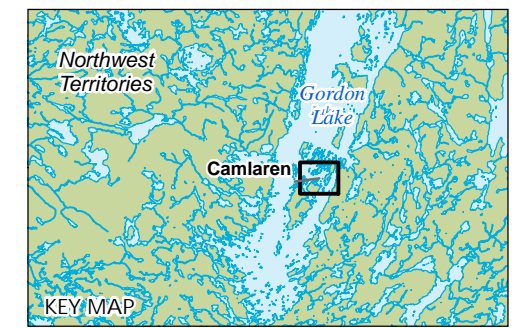
Title
 Burnt Island
 Infrastructure Overview

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 Revised: 2016-03-11 By: jwoodruff

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC



- Legend
- Background Sample
 - Watercourse
 - Water body
 - Map Extent



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 February 2016
 121413573

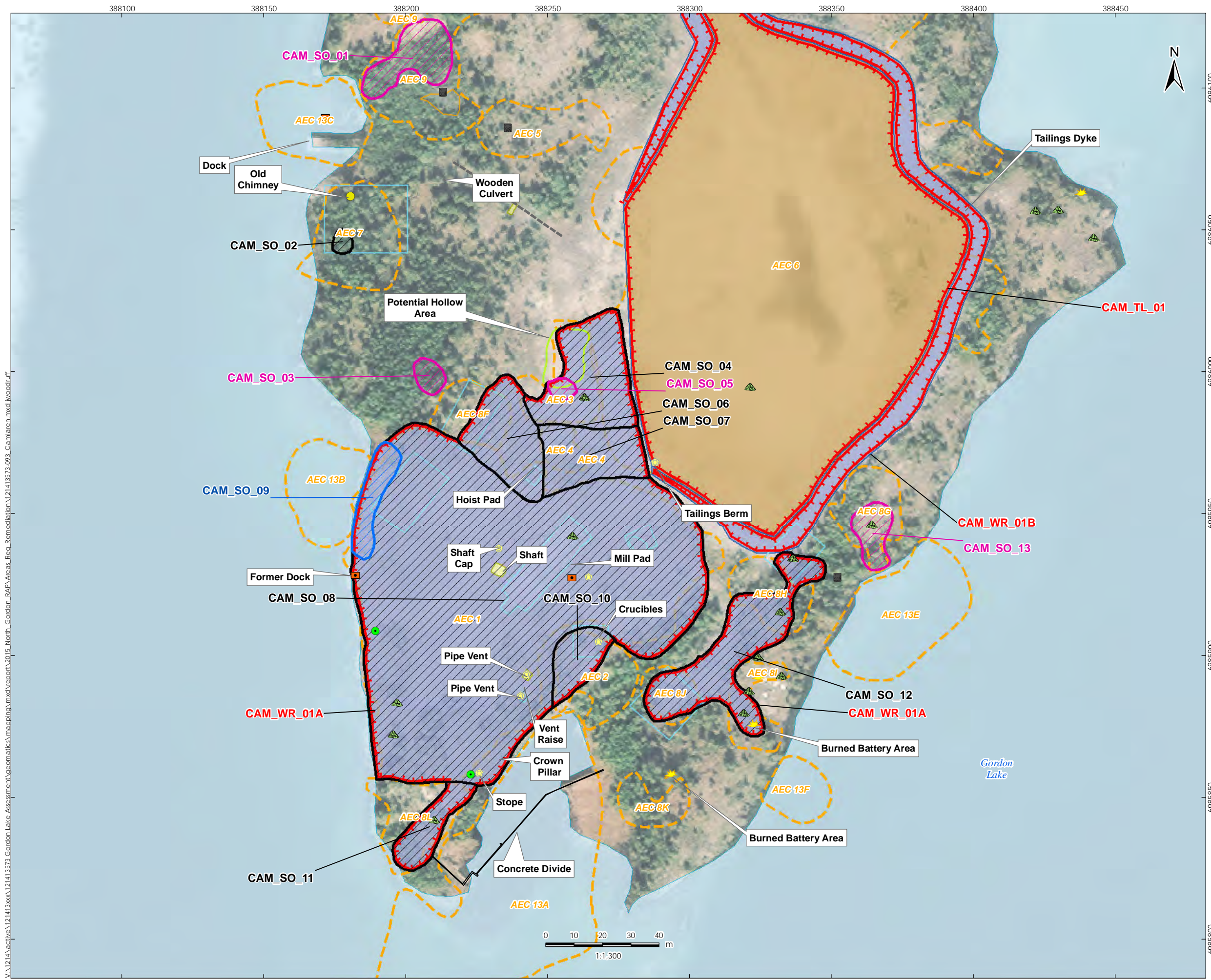
Client/Project
 Public Works and
 Government Services Canada
 Gordon Lake Group Remedial Action Plan

Figure No.
 B-1

Title
 Camlaren
 Site Overview

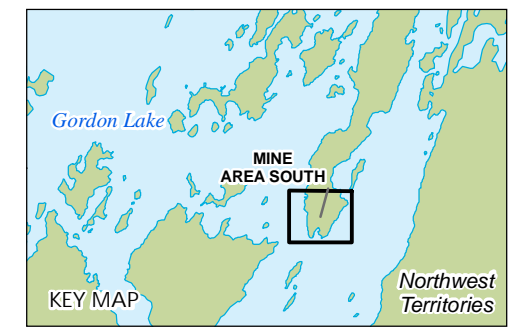
\\C:\1213-107\work_group\1214\active\121413573\121413573\Gordon Lake Assessment\geomates\mapping\mxd\report\2015_North_Gordon_RAP\121413573_090_SiteOverview.mxd | woodruff

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC



Legend

Impact Type	Features Observed
Petroleum Hydrocarbon (PHC)	Burn Pit
Co-mingled	Debris
Metals	Drum
High Risk Impacting Material	Mine Sign
	Other (as labeled)
	Structure Remains
	Structure Edge
	Trail
	Debris
	Other (as labeled)
	Structure Remains
	Tailings
	Trench/Shaft
	Waste Rock/Ore
	Areas of Environmental Concern (AEC)
	Watercourse
	Water body
	Map Extent



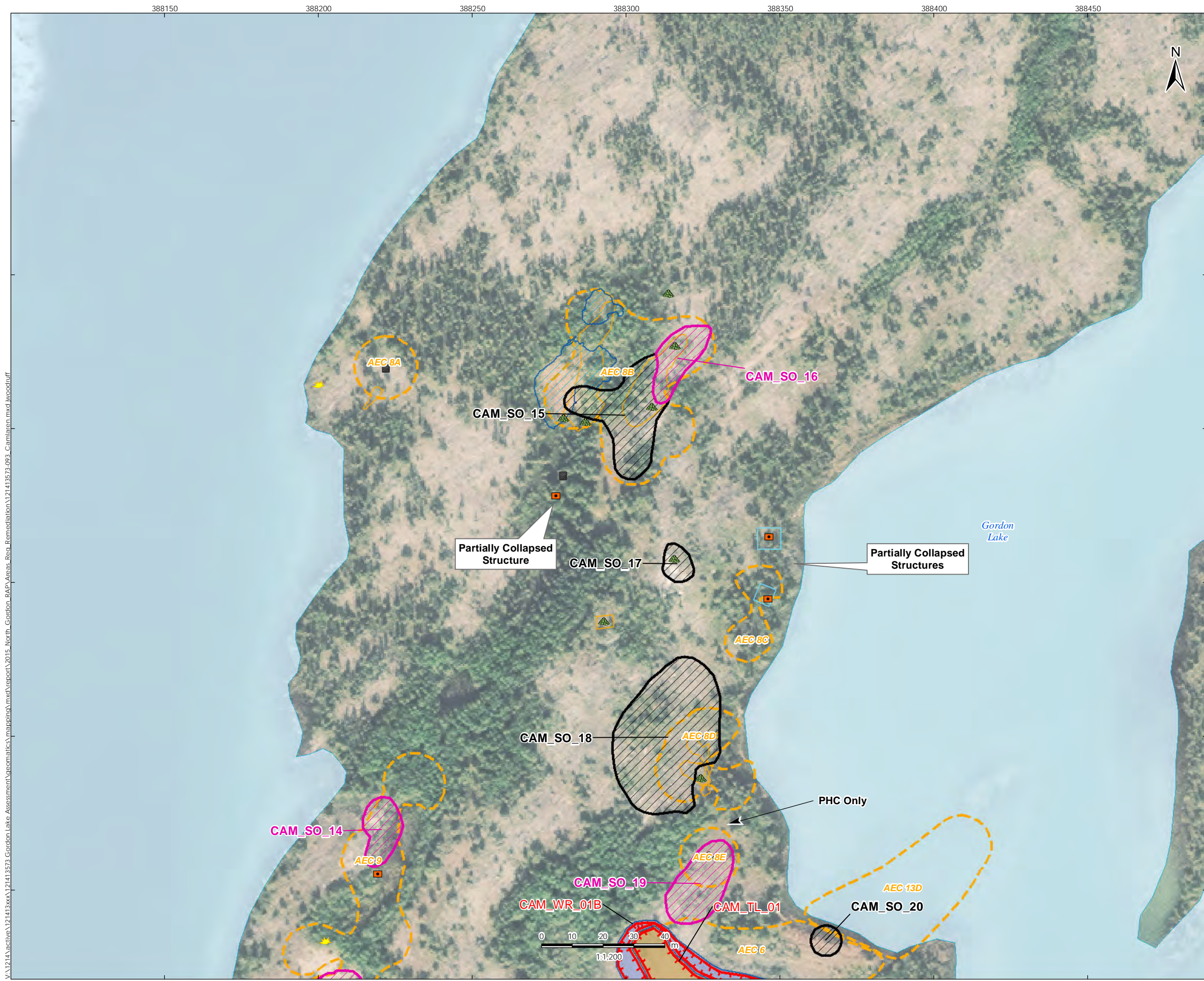
NAD 1983 UTM Zone 12N
 March 2016
 121413573

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 Gordon Lake Group Remedial Action Plan

Figure No.
 B-2

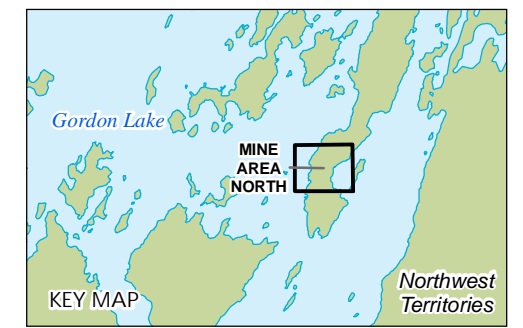
Title
 Camlaren - Mine Area South
 Summary of Hazard Components

V:\1214\active\121413573 Gordon Lake Assessment\geomatics\mapping\2015_North_Gordon_RAP_Areas_Req_Remediation\121413573_093_Camlaren.mxd Woodruff
 Sources: MapMart Orthomagey (2011), GeoBase, CANVEC



Legend

Impact Type	Features Observed
Petroleum Hydrocarbon (PHC)	Burn Pit
Metals	Debris
High Risk Impacting Material	Drum
	Structure Remains
	Debris
	Wet Area
	Structure Remains
	Tailings
	Waste Rock/Ore
	Areas of Environmental Concern (AEC)
	Watercourse
	Water body
	Map Extent



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 Figure No.
 B-3
 Title
 Camlaren - Mine Area North
 Summary of Hazard Components

Sources: MapMint Orthomage (2011), GeoBase, CANVEC

388800 388850 388900

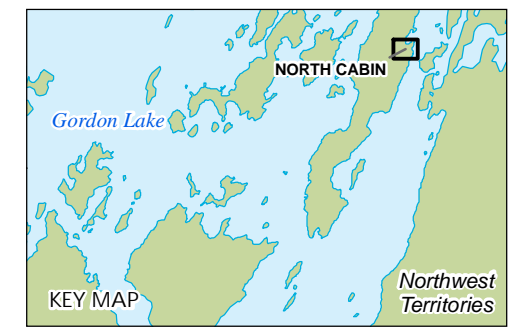


Legend

Impact Type	Features Observed
Metals	Burn Pit
Previously Identified Metals Hot Spot	Debris
	Drum
	Other (as labeled)
	Structure Remains
	Debris
	Structure Remains
	Areas of Environmental Concern (AEC)
	Watercourse
	Water body
	Map Extent



6987100 6987050 6987000



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Gordon Lake Group Remedial Action Plan

Figure No.
B-4

Title
Camlaren - North Cabin
Summary of Hazard Components

V:\1214\active\121413xxx\121413573 Gordon Lake Assessment\geomatics\mapping\mxd\Report\2015_North_Gordon_RAP_Areas_Req_Remediation\121413573-093_Camlaren.mxd\woodruff

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

386700

386750

386800

386850

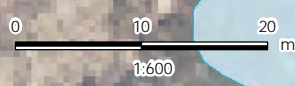
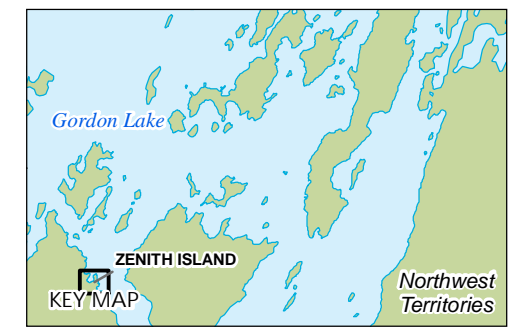
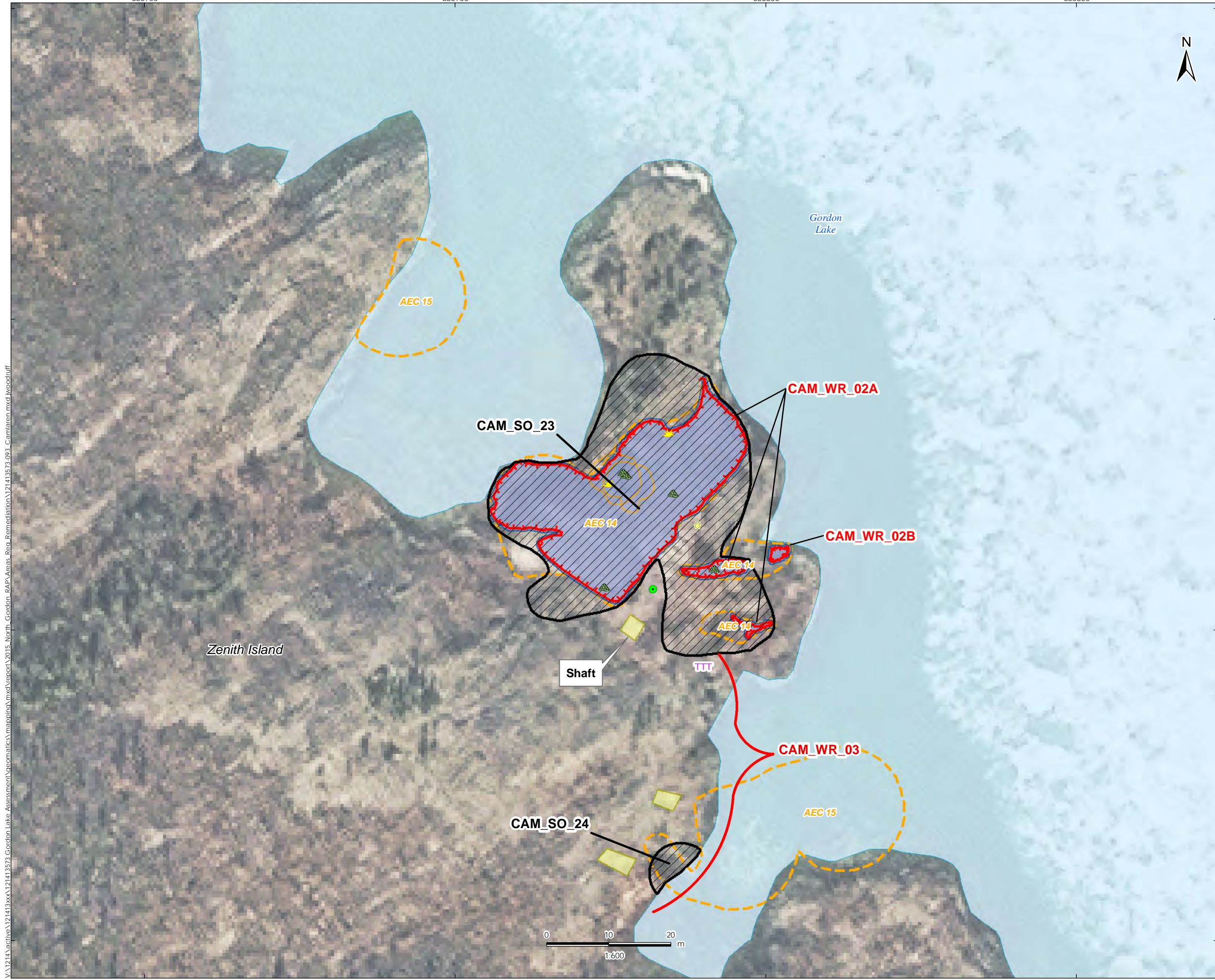
6985600



Legend

Impact Type	Features Observed
Metals	Burn Pit
High Risk Impacting Material	Debris
High Risk Impacting Material	Mine Sign
	Other (as labeled)
	Trench
	Debris
	Trench/Shaft
	Waste Rock/Ore
	Areas of Environmental Concern (AEC)
	Watercourse
	Water body
	Map Extent

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121413573

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Figure No.
B-5

Title
Camlaren - Zenith Island
Summary of Hazard Components

Sources: MapMart Orthomagey (2011), GeoBase, CANVEC

386500 387000 387500 388000 388500 389000



Legend

- Exceedance of Applicable Guidelines
 - Drinking Water Sample Location
 - ▲ Wooden Culvert
 - Access Trail
- Infrastructure Type
- Concrete Retaining Wall
 - Dock Location
 - Former Dock Location/ Potential Barge Landing
 - Potential Camp Location
 - Potential Staging Area
 - Tailing Containment Area



NORTH CABIN

Drinking Water Sample Location
CAM_DW_2015_SO_001

ZENITH ISLAND

MINE AREA NORTH

Potential Camp Location

Potential Staging Area

Tailing Containment Area

Access Trail

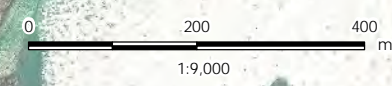
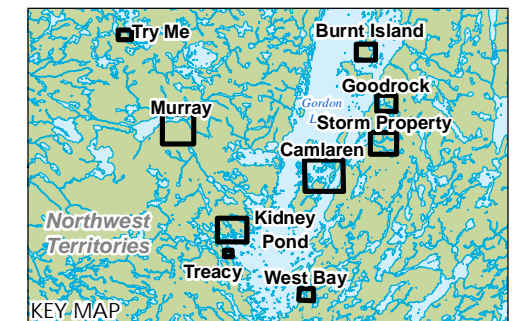
Dock Location

Wooden Culvert

MINE AREA SOUTH

Former Dock Location/ Potential Barge Landing

Concrete Divide



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Revised: 2016-03-04 By: jwoodruff

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

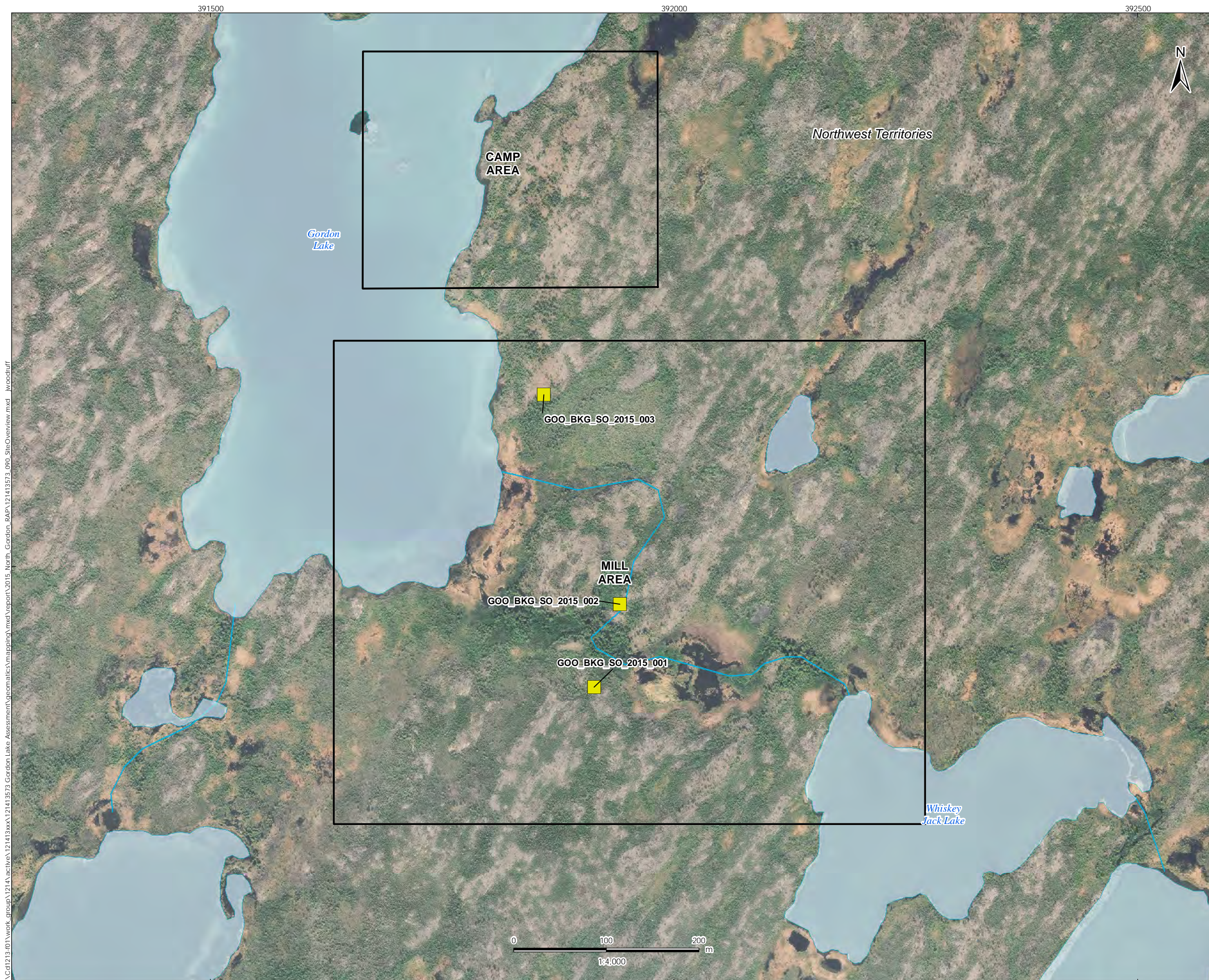
6987000
6986500
6986000
6985500

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Gordon Lake Group Remedial Action Plan

Figure No.
B-6

Title
**Camlaren
Infrastructure Overview**



- Legend
- Background Sample
 - Watercourse
 - Water body
 - Map Extent



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Figure No.
 C-1

Title
 Goodrock
 Site Overview

\\C:\1213-101\work_group\1214\active\121413xxx\121413573 Gordon Lake Assessment\geomates\mapping\mxd\report\2015_North_Gordon_RAP\121413573_090_SiteOverview.mxd | woodruff

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

391700

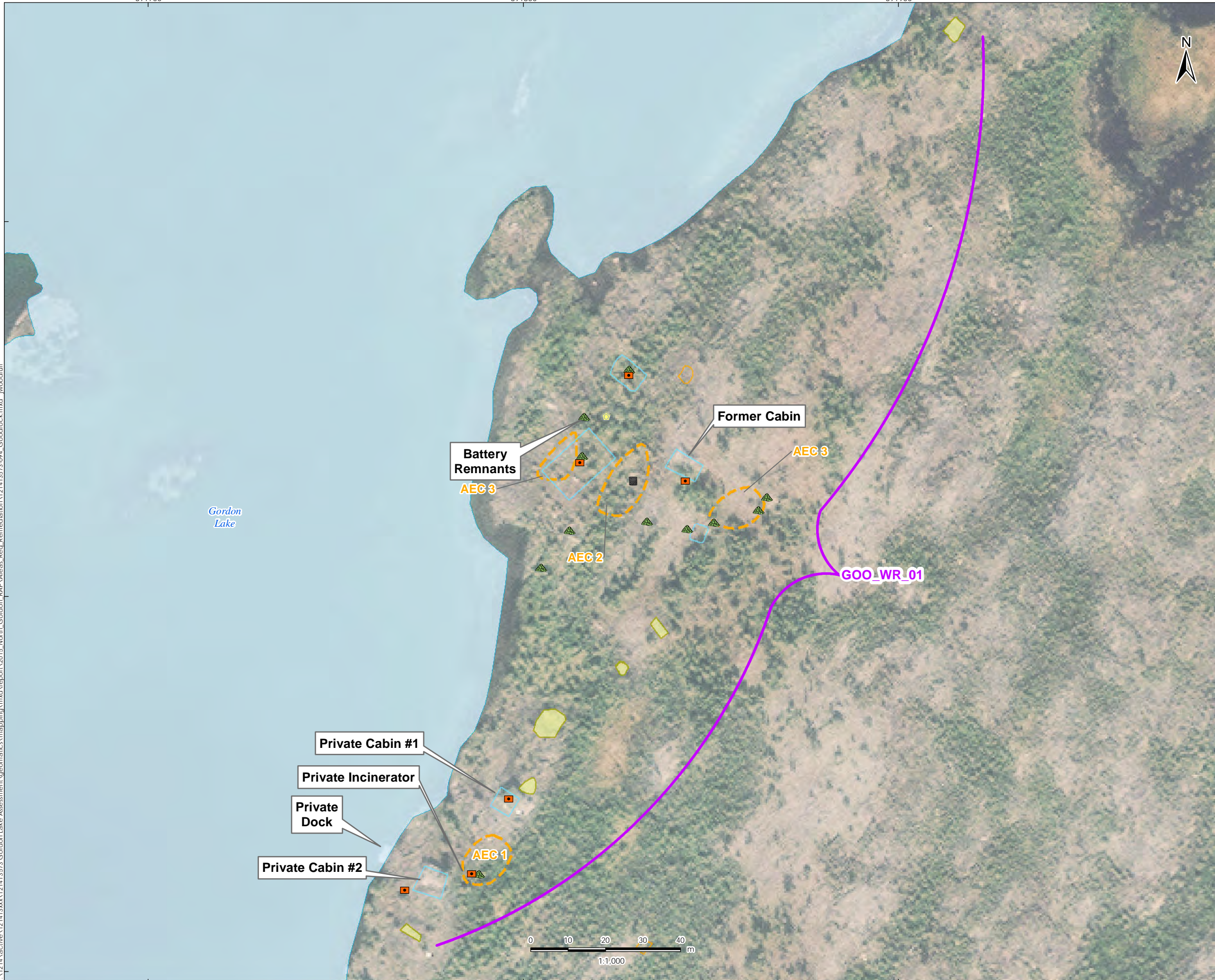
391800

391900

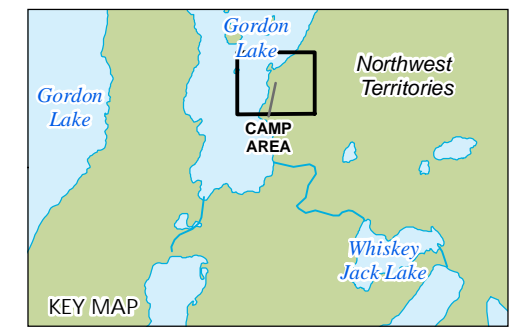
Legend

- Moderate Risk Impacting Material
- Features Observed
 - Debris
 - Drum
 - Other (as labeled)
 - Structure Remains
- Debris
- Structure Remains
- Trench/Shaft
- Areas of Environmental Concern (AEC)
- Watercourse
- Water body
- Map Extent

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6991500
6991400
6991300



NAD 1983 UTM Zone 12N March 2016 121413573

Client/Project
Public Works and
Government Services Canada
Gordon Lake Group Remedial Action Plan

Figure No.
C-2

Title
Goodrock Mine - Camp Area
Summary of Hazard Components

Sources: MapMirt Orthomagey (2011), GeoBase, CANVEC

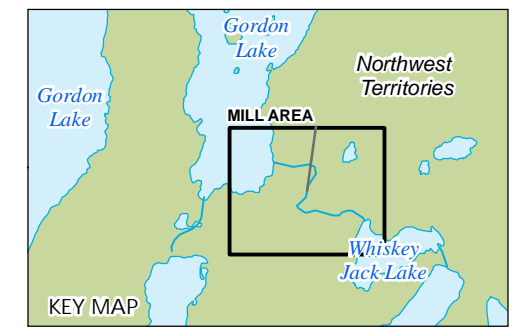
391700 391800 391900 392000 392100 392200



Legend	
Impact Type	Features Observed
Previously Identified Metals Hot Spot	Burn Pit
Moderate Risk Impacting Material	Debris
	Other (as labeled)
	Debris
	Wet Area
	Structure Remains
	Trench/Shaft
	Waste Rock/Ore
	Areas of Environmental Concern (AEC)
	Watercourse
	Water body
	Map Extent

6991200
6991100
6991000
6990900
6990800

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NAD 1983 UTM Zone 12N March 2016 121413573

Client/Project
Public Works and
Government Services Canada
Gordon Lake Group Remedial Action Plan

Figure No.
C-3

Title
Goodrock Mine - Mill Area
Summary of Hazard Components

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

391500

392000

392500



Legend

Infrastructure Type

Dock Location

Former Dock Location

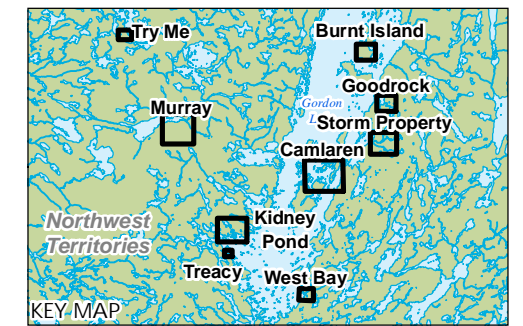
Potential Staging Area



6991500

6991000

6990500



NAD 1983 UTM Zone 12N

March 2016
121413458

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Government Services Canada
Gordon Lake Group Gap Assessment

Figure No.

C-4

Title

**Goodrock
Infrastructure Overview**

381000





381500

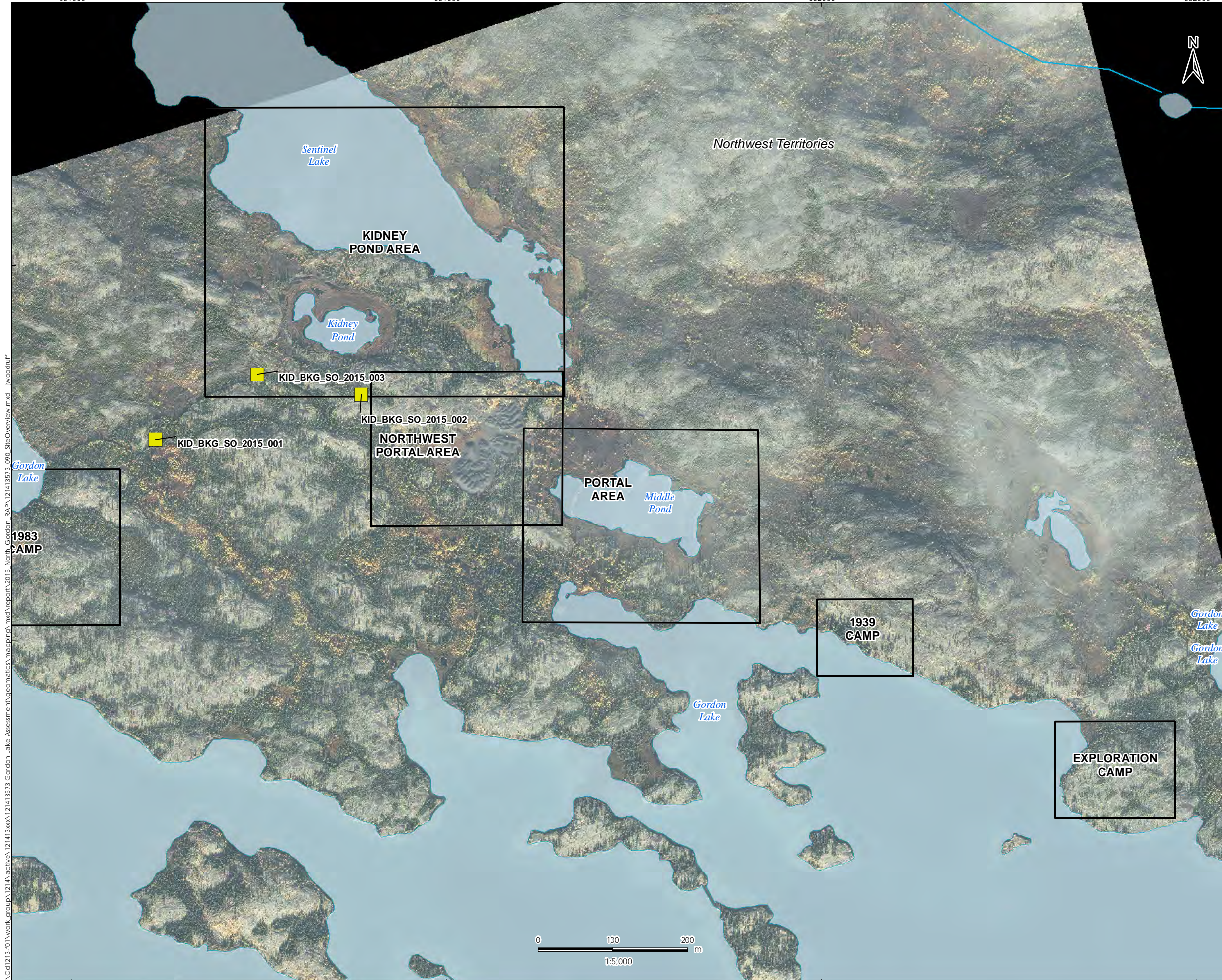
382000

382500



Legend

-  Background Sample
-  Watercourse
-  Water body
-  Map Extent



6983000
6982500



NAD 1983 UTM Zone 12N February 2016
121413573

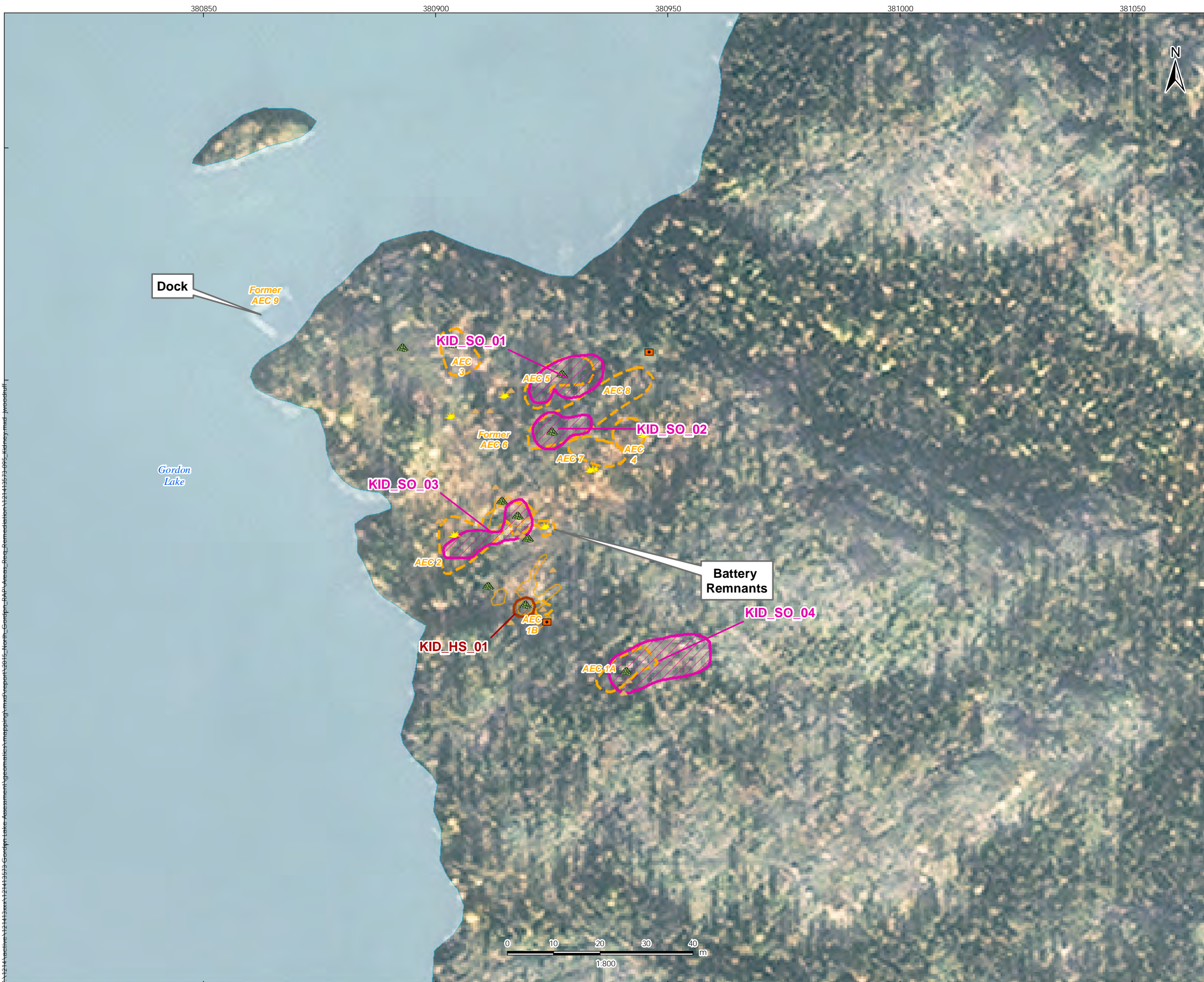
Client/Project
Public Works and
Government Services Canada
Gordon Lake Group Remedial Action Plan

Figure No.
D-1

Title
**Kidney Pond
Site Overview**

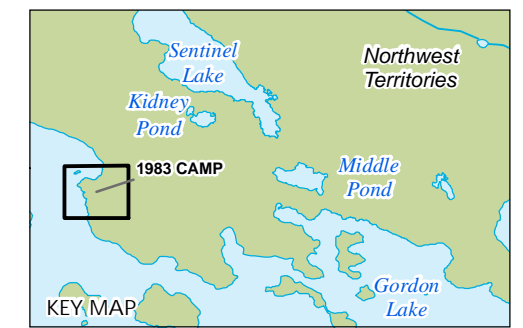
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Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC



Legend

Impact Type	Features Observed
Petroleum Hydrocarbon (PHC)	Burn Pit
Previously Identified Metals Hot Spot	Debris
	Outcrop
	Structure Remains
	Debris
	Areas of Environmental Concern (AEC)
	Watercourse
	Water body
	Map Extent

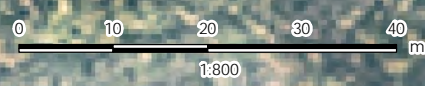


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121413573

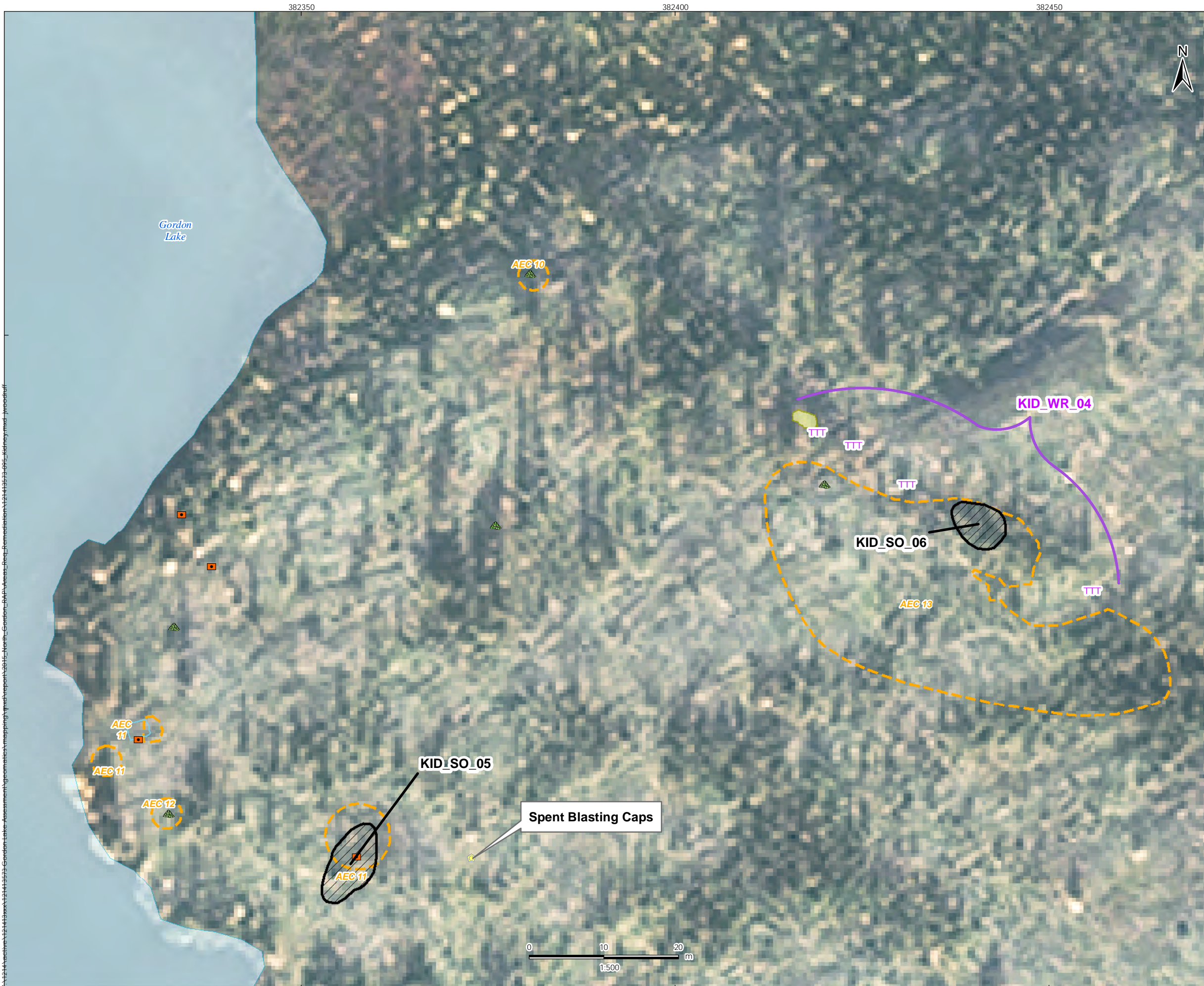
Client/Project
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Government Services Canada
Gordon Lake Group Remedial Action Plan

Figure No.
D-2

Title
**Kidney Pond - 1983 Camp
Summary of Hazard Components**



Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC



Legend

Impact Type	Features Observed
Metals	Debris
Moderate Risk Impacting Material	Other (as labeled)
	Structure Remains
	Trench
	Structure Remains
	Trench/Shaft
	Areas of Environmental Concern (AEC)
	Watercourse
	Water body
	Map Extent



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Figure No.
D-3

Title
**Kidney Pond - Exploration Camp
Summary of Hazard Components**

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

381600 381650 381700 381750 381800 381850 381900



Legend

- Impacting Material Requiring Remediation
- Moderate Risk Impacting Material
- Overland Drainage
- Wet Area
- Trench/Shaft
- Waste Rock/Ore
- Areas of Environmental Concern (AEC)
- Watercourse
- Water body
- Map Extent

6982750

6982700

6982650

6982600

6982550

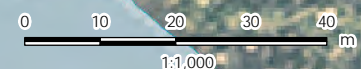


NAD 1983 UTM Zone 12N March 2016 121413573

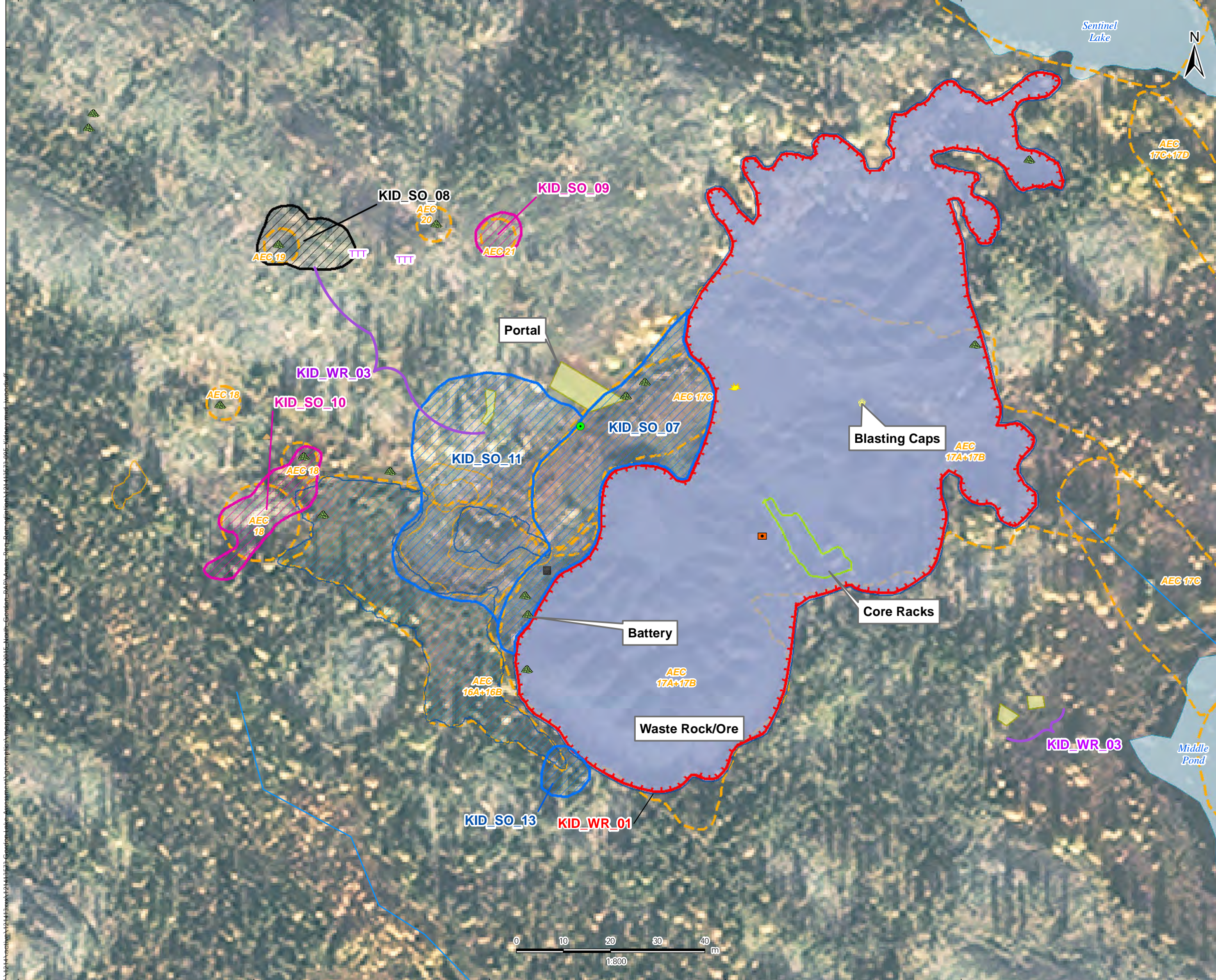
Client/Project
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Government Services Canada
Gordon Lake Group Remedial Action Plan

Figure No.
D-5

Title
Kidney Pond - Southeast Portal Area
Summary of Hazard Components

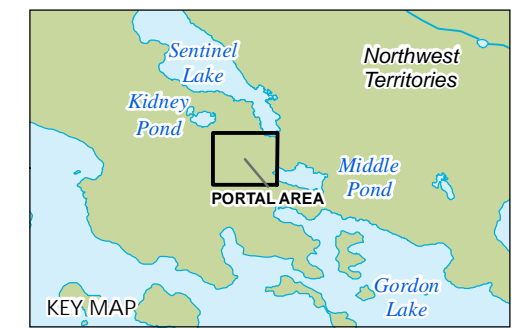


Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC



Legend

Impact Type	Features Observed
Petroleum Hydrocarbon (PHC)	Burn Pit
Co-mingled	Debris
Metals	Drum
Impacting Material Requiring Remediation	Mine Sign
Moderate Risk Impacting Material	Other (as labeled)
	Outcrop
	Structure Remains
	Trench
	Overland Drainage
	Debris
	Other (as labeled)
	Portal
	Wet Area
	Trench/Shaft
	Waste Rock/Ore
	Areas of Environmental Concern (AEC)
	Watercourse
	Water body
	Map Extent



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Figure No.
D-6

Title
Kidney Pond - Portal Area
Summary of Hazard Components



Legend

Impact Type	Features Observed
Metals	Burn Pit
Impacting Material Requiring Remediation	Debris
High Risk Impacting Material	Structure Remains
	Other (as labeled)
	Trench/Shaft
	Waste Rock/Ore
	Areas of Environmental Concern (AEC)
	Watercourse
	Water body
	Map Extent



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121413573

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Gordon Lake Group Remedial Action Plan

Figure No.
D-7

Title
**Kidney Pond - Kidney Pond Area
Summary of Hazard Components**

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

381000

381500

382000

382500



6983500

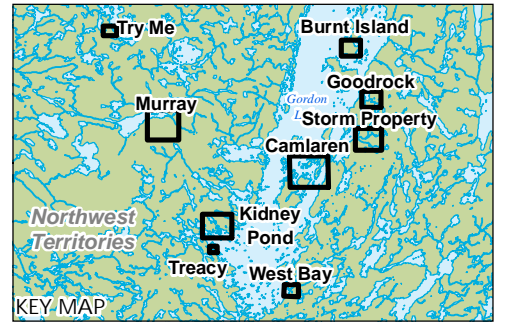
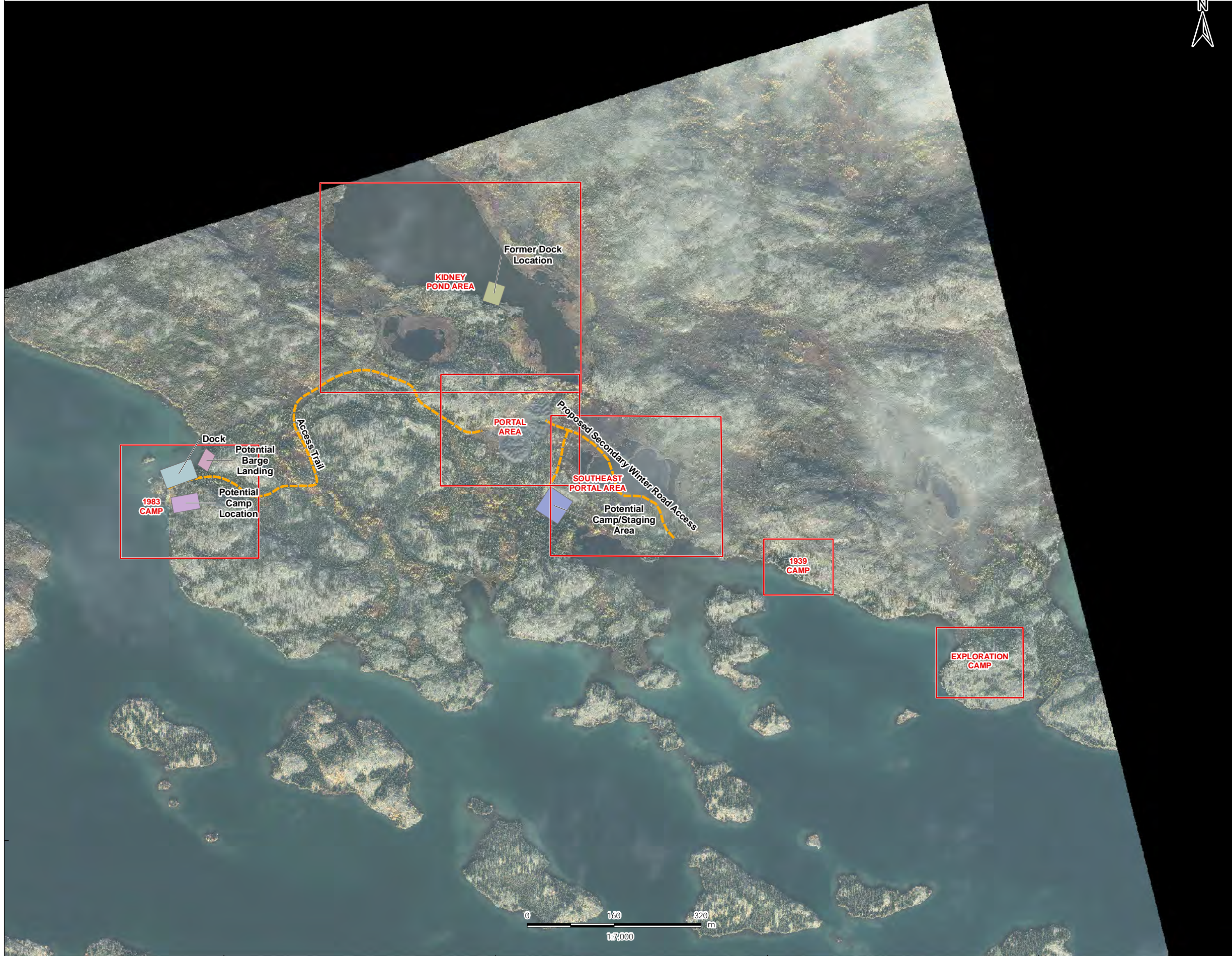
6983000

6982500

6982000

Legend

- Access Trail
 - Proposed Secondary Winter Road Access
- Infrastructure Type
- Dock Location
 - Former Dock Location
 - Potential Barge Landing
 - Potential Camp Location
 - Potential Staging Area







NAD 1983 UTM Zone 12N March 2016 121413458

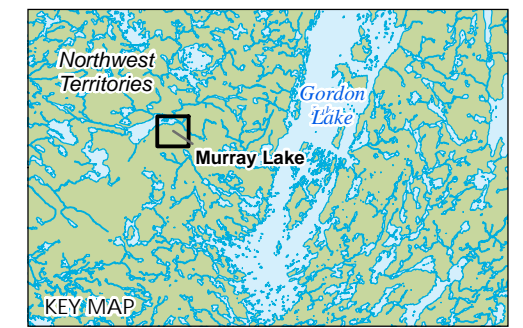
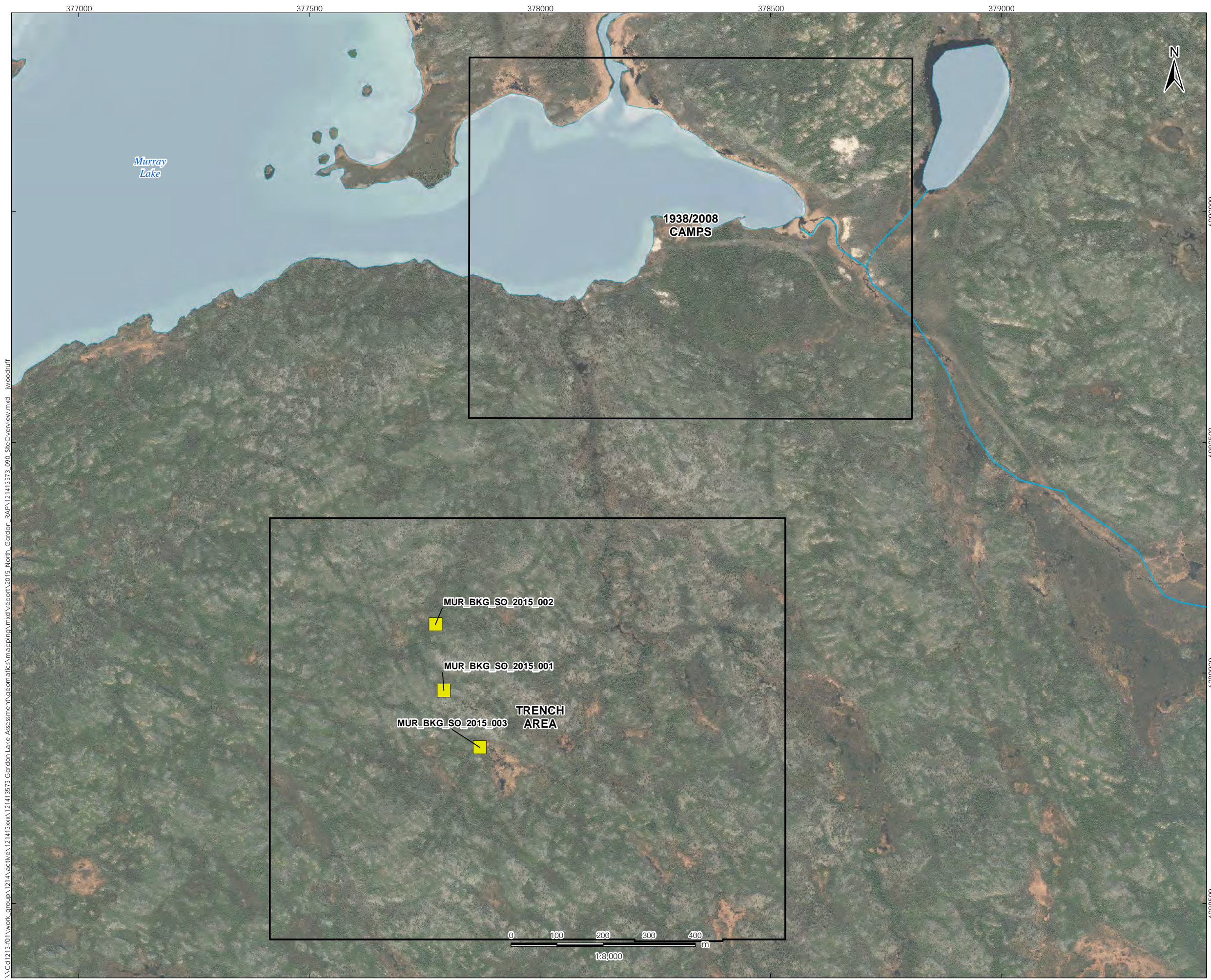
Client/Project
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Figure No.
 D-8

Title
 Kidney Pond
 Infrastructure Overview

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 Revised: 2016-03-04 By: jwoodruff
 Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

- Legend
-  Background Sample
 -  Watercourse
 -  Water body
 -  Map Extent



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Figure No.
 E-1

Title
 Murray Lake
 Site Overview

\\C011213-101\work_group\1214\active\121413xxx\121413573 Gordon Lake Assessment\geomates\mapping\mxd\report\2015_North_Gordon_RAP\121413573_090_SiteOverview.mxd | Woodruff

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

378000

378250

378500

378750

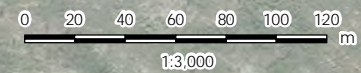
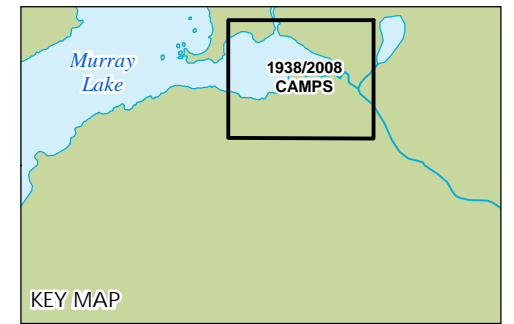


Legend

- | | |
|-------------|--------------------------------------|
| Impact Type | Features Observed |
| Metals | Debris |
| | Structure Remains |
| | Areas of Environmental Concern (AEC) |
| | Watercourse |
| | Water body |
| | Map Extent |



6990250
6990000
6989750



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 Gordon Lake Group Remedial Action Plan

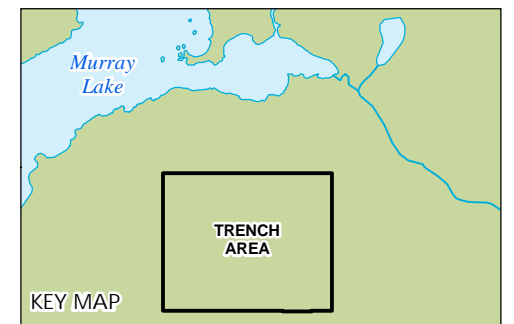
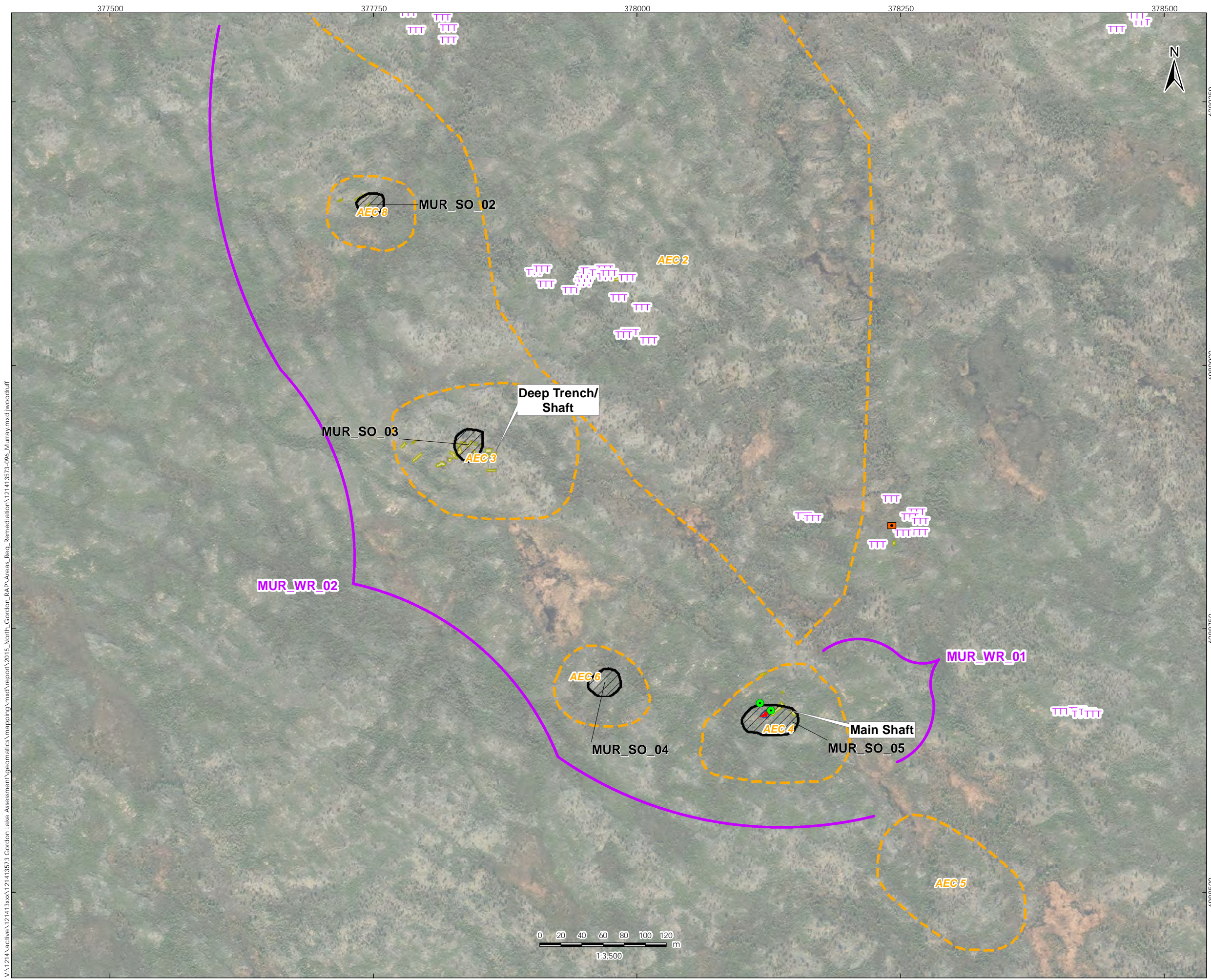
Figure No.
 E-2

Title
 Murray Lake - 1938/2008 Camp
 Summary of Hazard Components

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Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

Impact Type	Features Observed
Metals	Mine Sign
Moderate Risk Impacting Material	Structure Remains
	Trench
	Trench/Shaft
	Waste Rock/Ore
	Areas of Environmental Concern (AEC)
	Watercourse
	Water body
	Map Extent



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Government Services Canada
Gordon Lake Group Remedial Action Plan

Figure No.
E-3

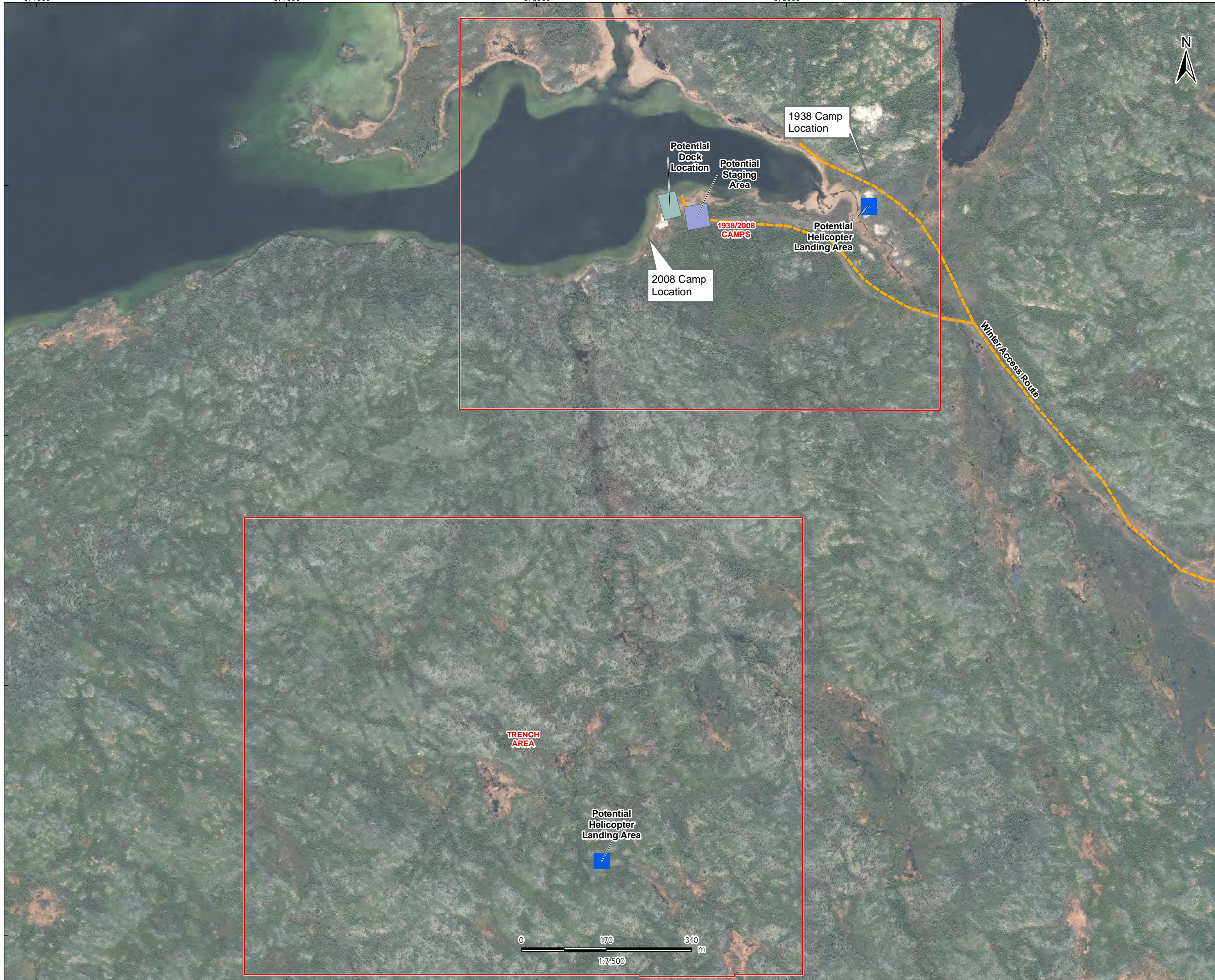
Title
Murray Lake - Trench Area
Summary of Hazard Components

377000 377500 378000 378500 379000

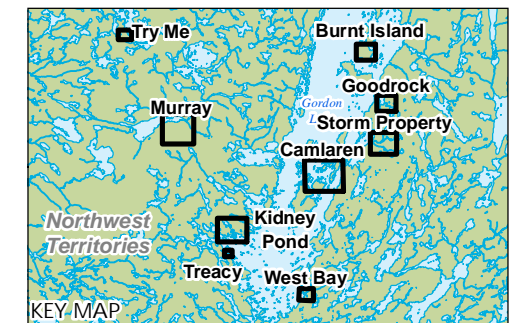


Legend

- Potential Helicopter Landing Area
- Winter Access Route
- Infrastructure Type**
- Potential Staging Area
- Potential Dock Location



6990000
6989500
6989000
6988500



NAD 1983 UTM Zone 12N March 2016 121413458

Client/Project
Public Works and
Government Services Canada
Gordon Lake Group Remedial Action Plan

Figure No.
E-4

Title
Murray Lake
Infrastructure Overview

V:\1214\active\121413xxx\121413573 Gordon Lake Assessment\geomatics\mapping\mxd\report\2015_North_Gordon_RAP\121413573_034_Infrastructure_Overview_Mapbook.mxd
Revised: 2016-03-04 By: jwoodruff

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

391000 391500 392000 392500



- Legend
- Background Sample
 - Watercourse
 - Water body
 - Map Extent



NAD 1983 UTM Zone 12N February 2016 121413573

Client/Project
 Public Works and
 Government Services Canada
 Gordon Lake Group Remedial Action Plan

Figure No.
 F-1

Title
 Storm Property
 Site Overview

\\C:\1213-101\work_group\1214\active\121413573\Gordon Lake Assessment\geomates\mapping\mxd\report\2015_North_Gordon_RAP\121413573_090_SiteOverview.mxd | woodruff

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

392300

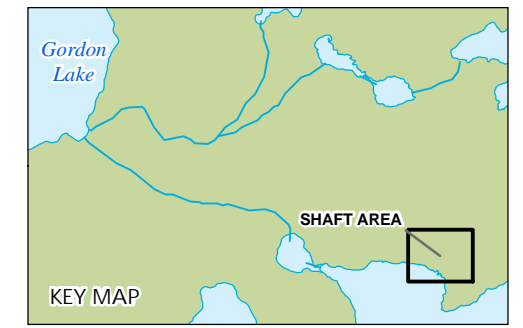
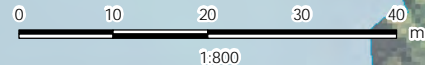
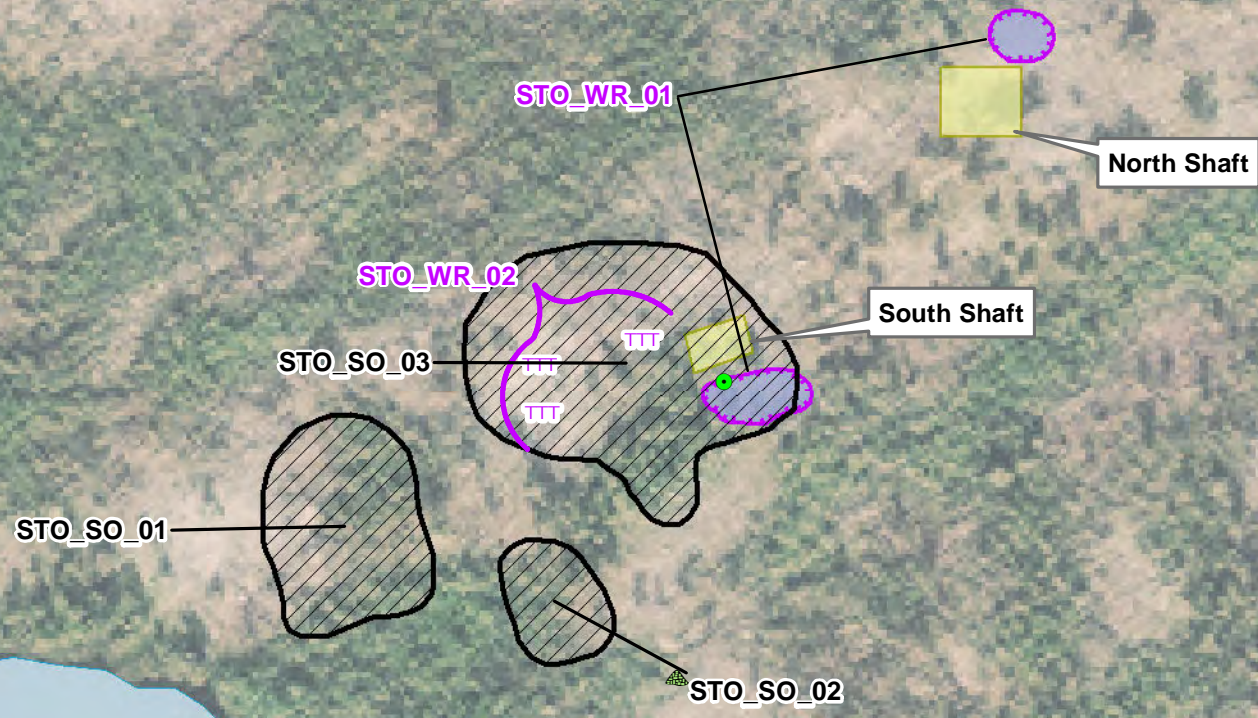
392400

392500



Legend	
Impact Type	Features
Metals	Debris
Moderate Risk Impacting Material	Mine Sign
Moderate Risk Impacting Material	Trench
	Trench/Shaft
	Waste Rock/Ore
	Watercourse
	Water body
	Map Extent

V:\1214\active\121413573 Gordon Lake Assessment\geomatics\mapping\mxd\Report\2015_North_Gordon_RAP_Areas_Req_Remediation\121413573-097_Storm.mxd | woodruff



NAD 1983 UTM Zone 12N March 2016 121413573

Client/Project
 Public Works and
 Government Services Canada
 Gordon Lake Group Remedial Action Plan

Figure No.
 F-2

Title
 Storm Property - Shaft Area
 Summary of Hazard Components

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

391000 391100 391200



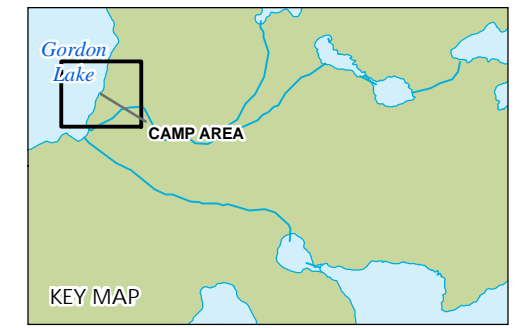
- Legend**
- | | |
|---------------------------------------|-------------------|
| Impact Type | Features |
| Previously Identified Metals Hot Spot | Burn Pit |
| | Debris |
| | Drum |
| | Structure Remains |
| | Structure Remains |
| | Watercourse |
| | Water body |
| | Map Extent |



Gordon Lake

Battery Remnants

STO_HS_01



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Client/Project
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Government Services Canada
Gordon Lake Group Remedial Action Plan

Figure No.
F-3

Title
Storm Property - Camp Area
Summary of Hazard Components

V:\1214\active\121413573 Gordon Lake Assessment\geomatics\mapping\mxd\report\2015_North_Gordon_RAF_Areas_Req_Remediation\121413573-097_Storm.mxd |woodruff

Sources: MapMirt Orthomagey (2011), GeoBase, CANVEC

391000 391500 392000 392500



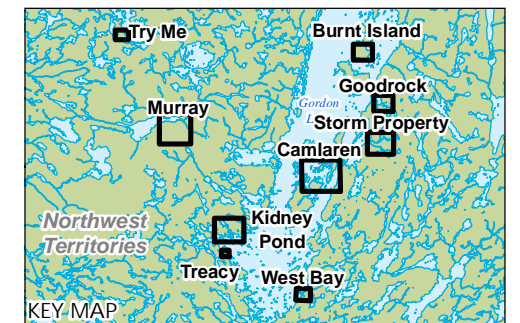
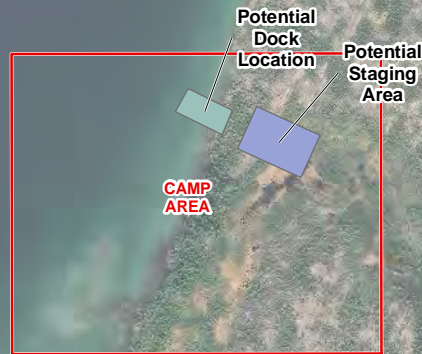
Legend

Infrastructure Type

- Potential Staging Area
- Potential Dock Location



6989000
6988500
6988000



NAD 1983 UTM Zone 12N March 2016 121413458

Client/Project
Public Works and
Government Services Canada
Gordon Lake Group Remedial Action Plan





Figure No.
F-4

Title
Storm Property
Infrastructure Overview

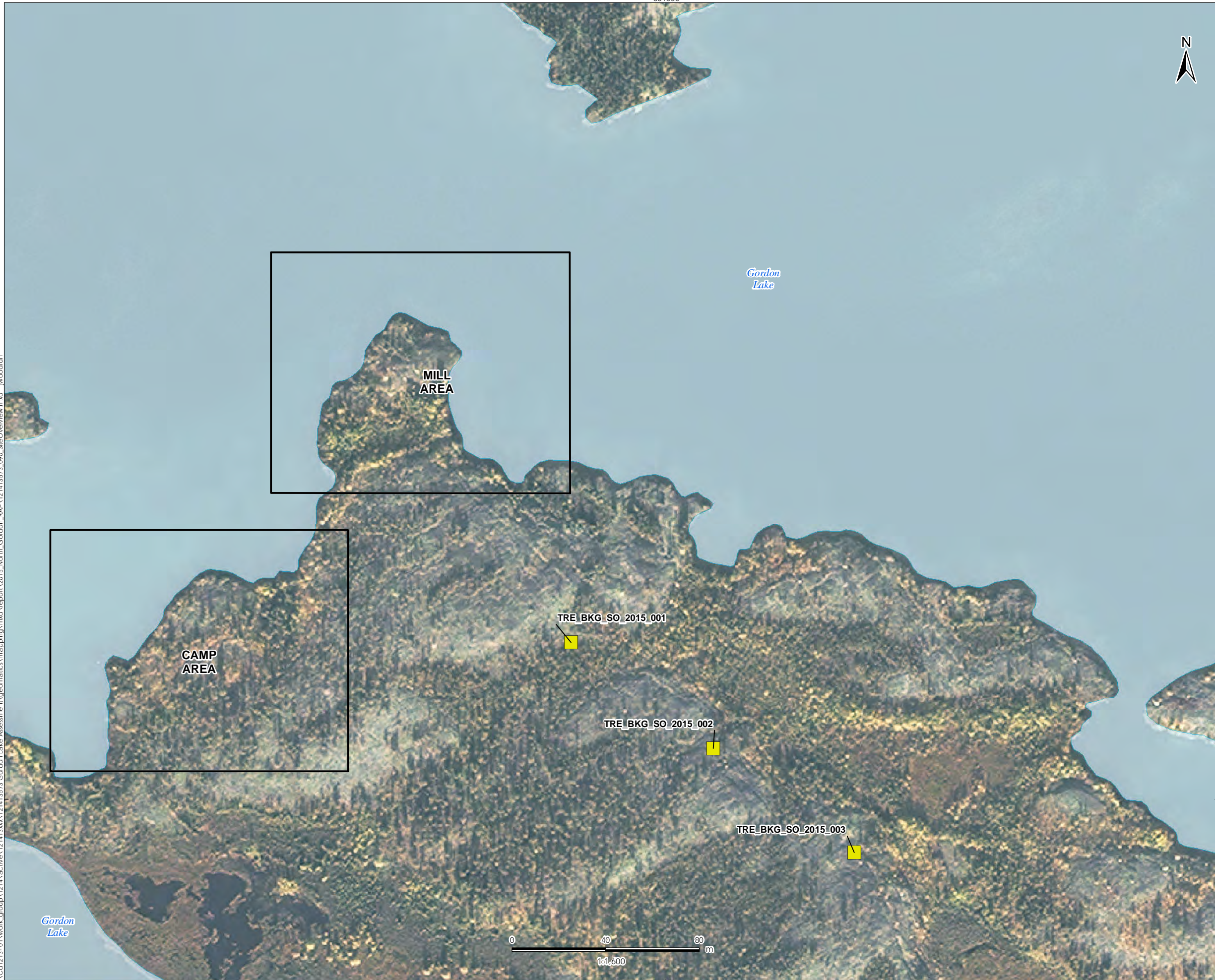
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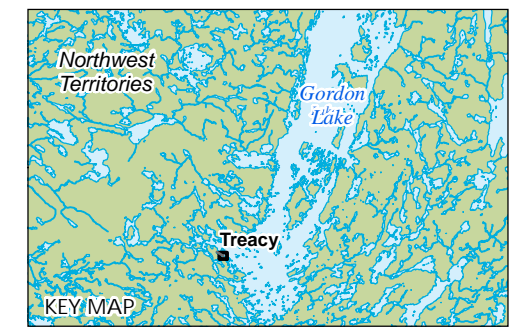
Legend

-  Background Sample
-  Watercourse
-  Water body
-  Map Extent

\\C:\1213-101\work_group\1214\active\121413xxx\121413573 Gordon Lake Assessment\geomates\mapping\mxd\report\2015_North_Gordon_RAP\121413573_090_SiteOverview.mxd |woodruff



6981000



NAD 1983 UTM Zone 12N February 2016
121413573

Client/Project
Public Works and
Government Services Canada
Gordon Lake Group Remedial Action Plan

Figure No.
G-1

Title
Treacy
Site Overview

381350

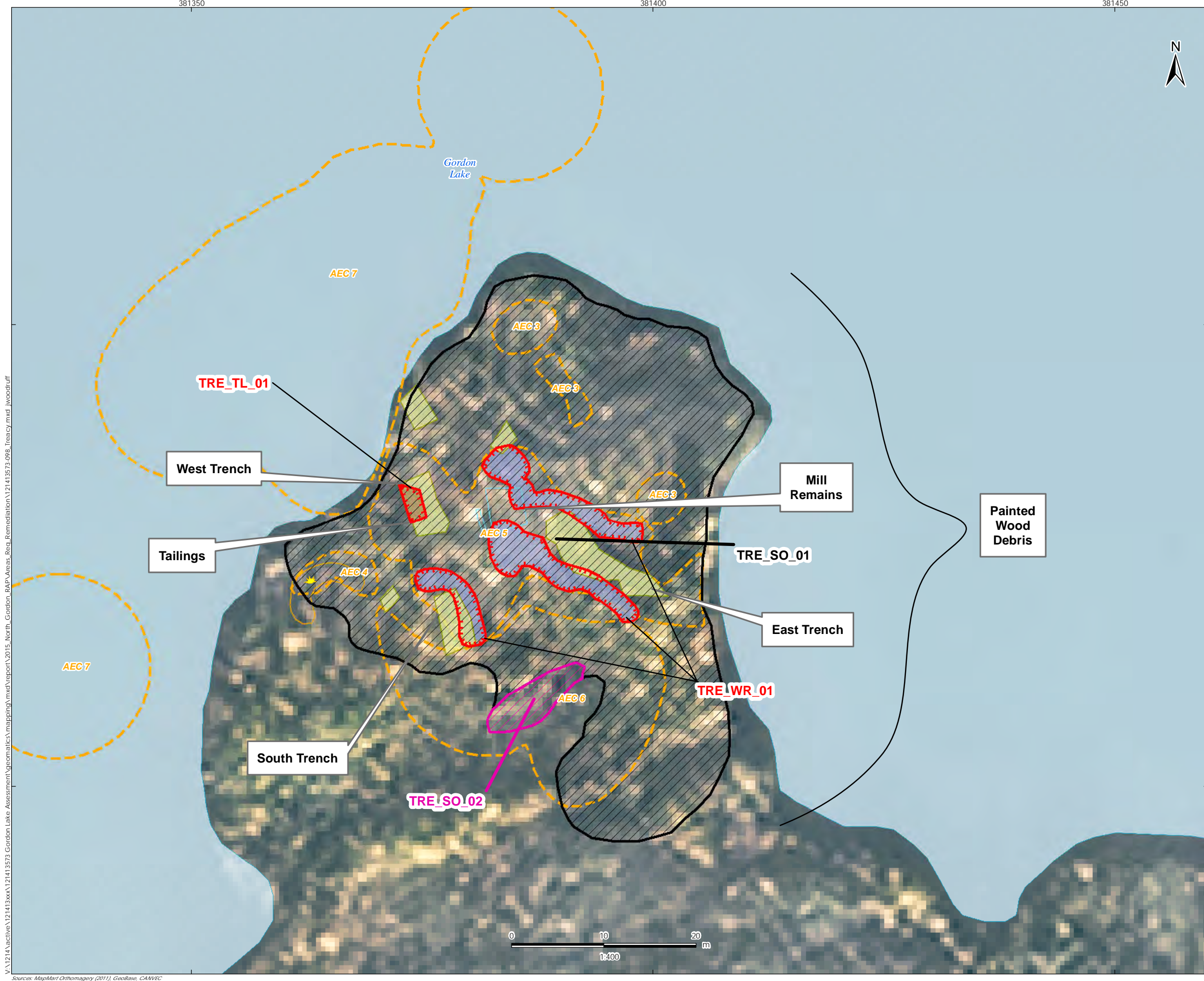
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381450

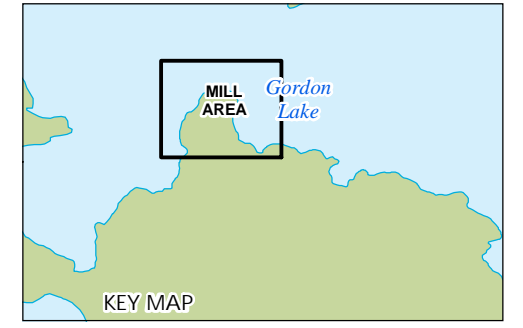


Legend	
Impact Type	Features Observed
Petroleum Hydrocarbon (PHC)	Burn Pit
Metals	Debris
High Risk Impacting Material	Structure Remains
	Tailings
	Trench/Shaft
	Waste Rock/Ore
	Areas of Environmental Concern (AEC)
	Watercourse
	Water body
	Map Extent

V:\1214\active\121413xxx\121413573 Gordon Lake Assessment\geomatics\mapping\mxd\report\2015_North_Gordon_RAP_Areas_Req_Remediation\121413573-098_Treacy.mxd | woodruff



6981200
6981150



NAD 1983 UTM Zone 12N March 2016 121413573

Client/Project
Public Works and
Government Services Canada
Gordon Lake Group Remedial Action Plan

Figure No.
G-2

Title
Treacy - Mill Area
Summary of Hazard Components



Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

381250

381300

381350



Legend

Impact Type	Features Observed
	Metals
	Debris
	Drum
	Structure Remains
	Structure Remains
	Areas of Environmental Concern (AEC)
	Watercourse
	Water body
	Map Extent

6981100

6981050

Gordon Lake

Building Pad

TRE_SO_03

AEC2

AEC1

AEC2



NAD 1983 UTM Zone 12N

March 2016
121413573

Client/Project

Public Works and
Government Services Canada
Gordon Lake Group Remedial Action Plan

Figure No.
G-3

Title

Treacy - Camp Area
Summary of Hazard Components





V:\1214\active\121413xxx\121413573 Gordon Lake Assessment\geomatics\mapping\mxd\report\2015_North_Gordon_RAF_Areas_Req_Remediation\121413573-098_Treacy.mxd | woodruff



Legend

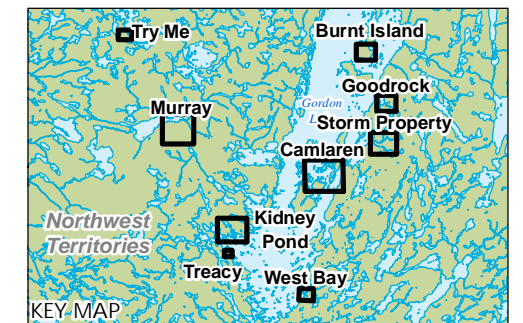
Infrastructure Type

-  Potential Staging Area
-  Potential Dock Location



V:\1214\active\121413xxx\121413573 Gordon Lake Assessment\geomatics\mapping\mxd\report\2015_North_Gordon_RAP\121413573_034_Infrastructure_Overview_Mapbook.mxd
Revised: 2016-03-04 By: jwoodruff

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC



NAD 1983 UTM Zone 12N March 2016
121413458

Client/Project
Public Works and
Government Services Canada
Gordon Lake Group Remedial Action Plan

Figure No.
G-4





Title
Treacy
Infrastructure Overview

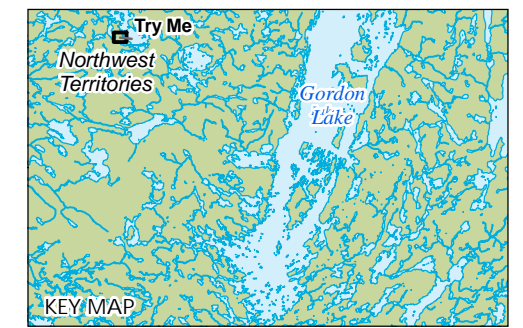
374500

375000



Legend

-  Background Sample
-  Watercourse
-  Water body
-  Map Extent



NAD 1983 UTM Zone 12N February 2016 121413573

Client/Project
 Public Works and
 Government Services Canada
 Gordon Lake Group Remedial Action Plan

Figure No.
 H-1

Title
 Try Me
 Site Overview

\\C:\1213-101\work_group\1214\active\121413xxx\121413573 Gordon Lake Assessment\geomates\mapping\mxd\report\2015_North_Gordon_RAP\121413573_090_SiteOverview.mxd |woodruff

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

374250

374300

374350

374400



Legend

Features Observed

- Debris
- Drum
- Structure Remains
- Watercourse
- Water body
- Map Extent

Batteries

Mac Lake

6995750

6995700

6995650



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March 2016
121413573

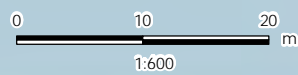
Client/Project

Public Works and
Government Services Canada
Gordon Lake Group Remedial Action Plan

Figure No.
H-2

Title

Try Me - Western Camp
Summary of Hazard Components



V:\1214\active\121413xxx\121413573 Gordon Lake Assessment\geomatics\mapping\mxd\veport\2015_North_Gordon_RAF_Areas_Req_Remediation\121413573-099_TryMe.mxd |woodruff

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

374550 374600 374650 374700 374750 374800 374850 374900 374950 375000

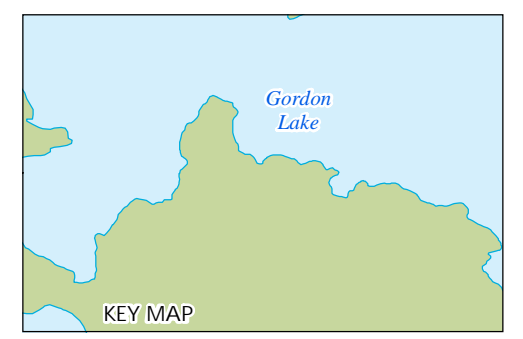
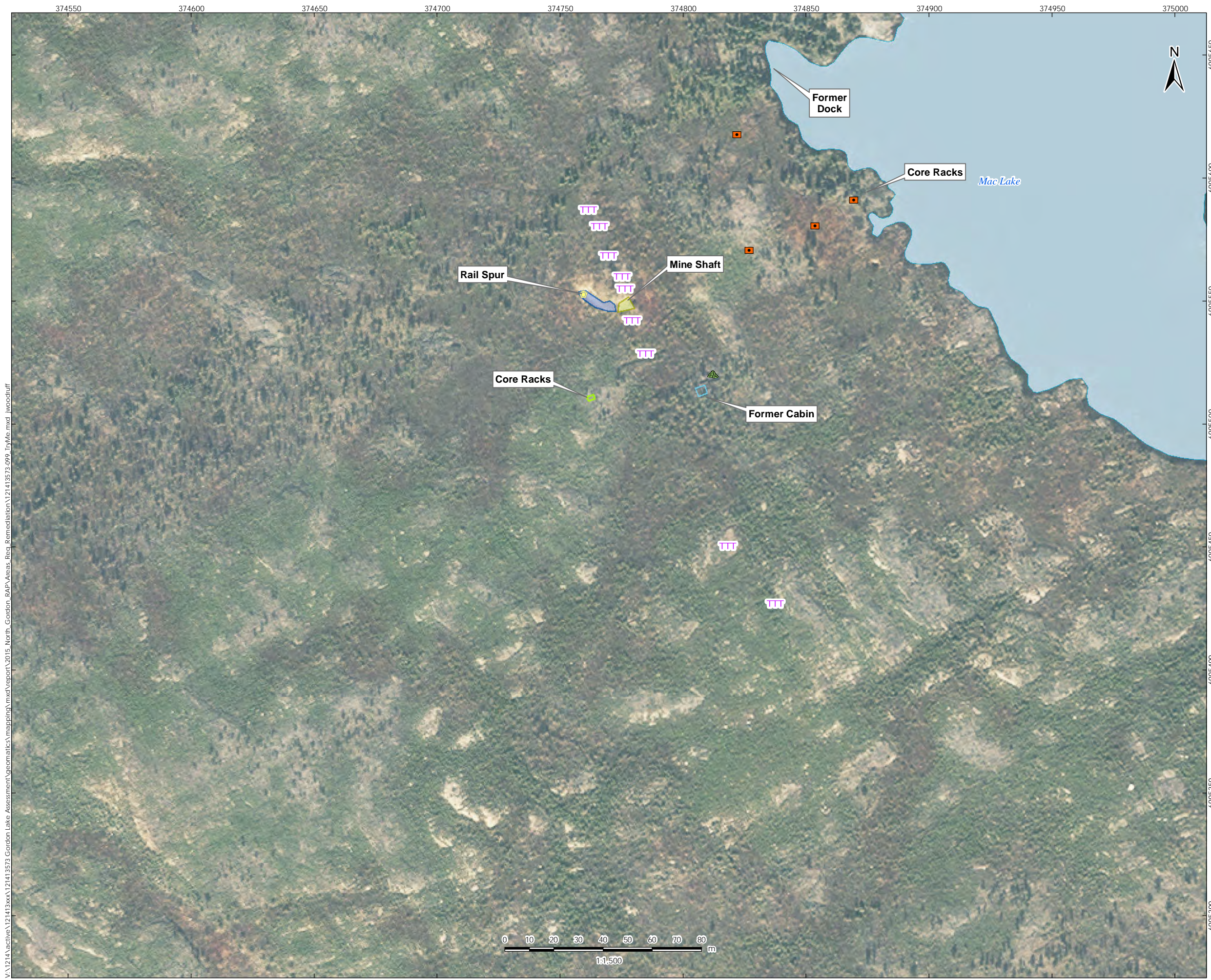


Legend

Features Observed

- Debris
- Other (as labeled)
- Structure Remains
- Trench
- Other (as labeled)
- Structure Remains
- Trench/Shaft
- Waste Rock/Ore
- Watercourse
- Water body
- Map Extent

V:\1214\active\121413xxx\121413573 Gordon Lake Assessment\geomatics\mapping\mxd\veport\2015_North_Gordon_RAP_Areas_Req_Remediation\121413573_099_TryMe.mxd |woodruff



NAD 1983 UTM Zone 12N

March 2016
121413573

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Gordon Lake Group Remedial Action Plan

Figure No.
H-3

Title

Try Me - Main Camp
Summary of Hazard Components



Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

374500

375000

6996000

6995500

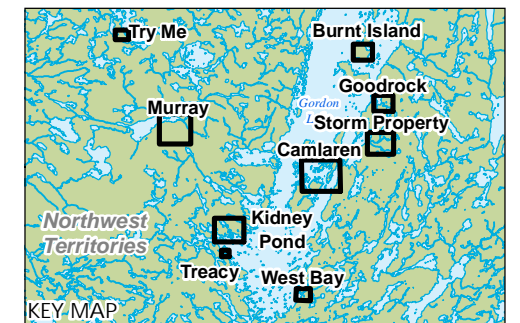


Legend

Infrastructure Type

Former Dock Location

Potential Staging Area



V:\1214\active\121413xxx\121413573 Gordon Lake Assessment\geomatics\mapping\mxd\report\2015_North_Gordon_RAP\121413573_034_Infrastructure_Overview_Mapbook.mxd
Revised: 2016-03-04 By: jwoodruff



Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

NAD 1983 UTM Zone 12N

March 2016
121413458

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Figure No.

H-4

Title





Try Me
Infrastructure Overview

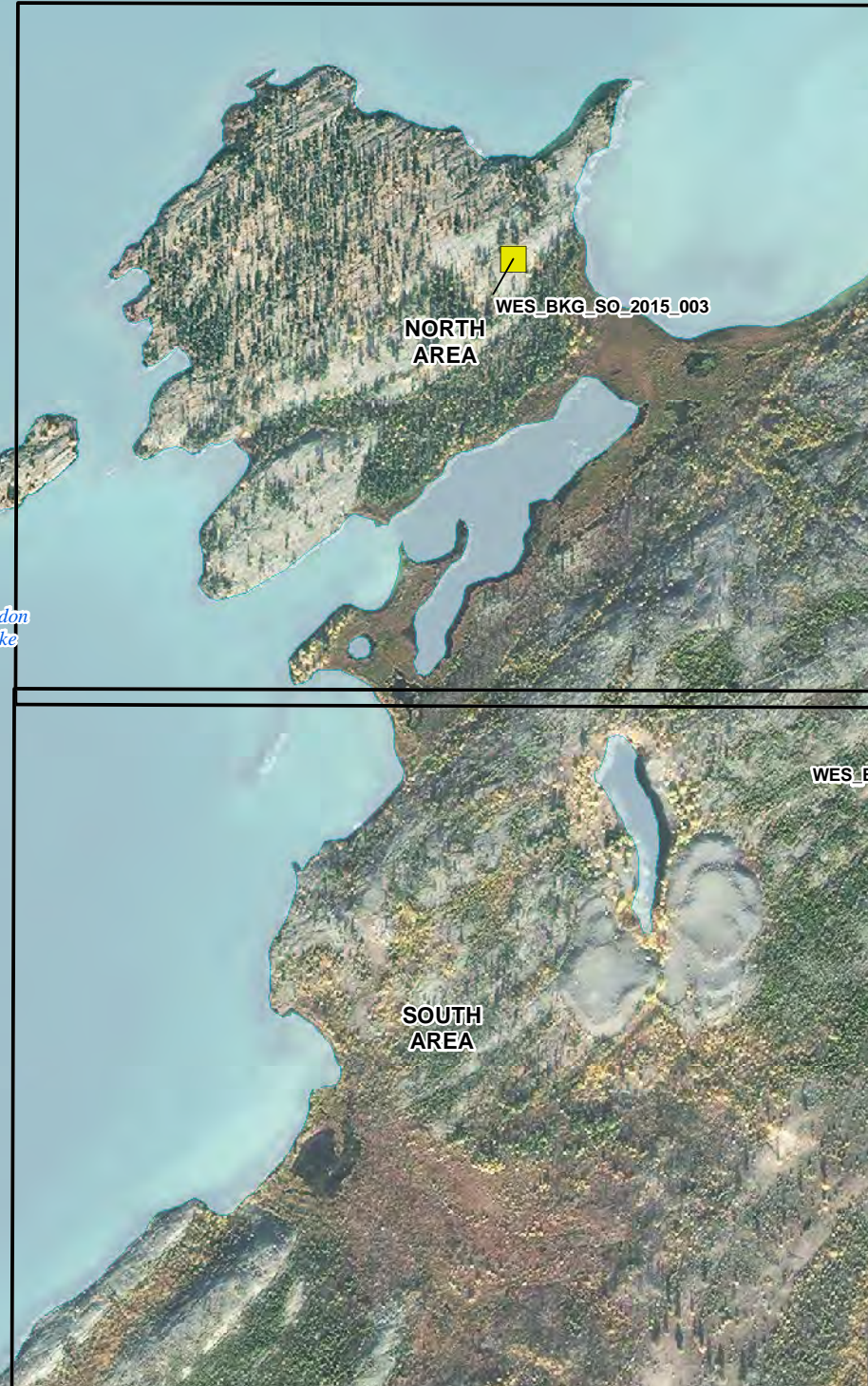
386000

386500

387000

Legend

-  Background Sample
-  Watercourse
-  Water body
-  Map Extent



NAD 1983 UTM Zone 12N February 2016 121413573

Client/Project
Public Works and
Government Services Canada
Gordon Lake Group Remedial Action Plan

Figure No.
I-1

Title
West Bay
Site Overview

\\C:\1213-101\work_group\1214\active\121413573\Gordon Lake Assessment\geomates\mapping\mxd\report\2015_North_Gordon_RAP\121413573_090_SiteOverview.mxd |woodruff

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

386400

386500

386600

386700

386800

6978800

6978700

6978600

6978500



Legend

Impact Type

- Petroleum Hydrocarbon (PHC)

Features Observed

- Trench/Shaft
- Watercourse
- Water body
- Map Extent



WES_SO_01

AEC 1A*

Gordon Lake

*As labelled by Stantec



NAD 1983 UTM Zone 12N

March 2016
121413573

Client/Project

Public Works and
Government Services Canada
Gordon Lake Group Remedial Action Plan

Figure No.

1-2

Title

West Bay - North Area
Summary of Hazard Components



V:\1214\active\121413xxx\121413573 Gordon Lake Assessment\geomatics\mapping\mxd\veport\2015_North_Gordon_RAP_Areas_Req_Remediation\121413573-100_WestBay.mxd | woodruff

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

386400 386500 386600 386700 386800



Legend

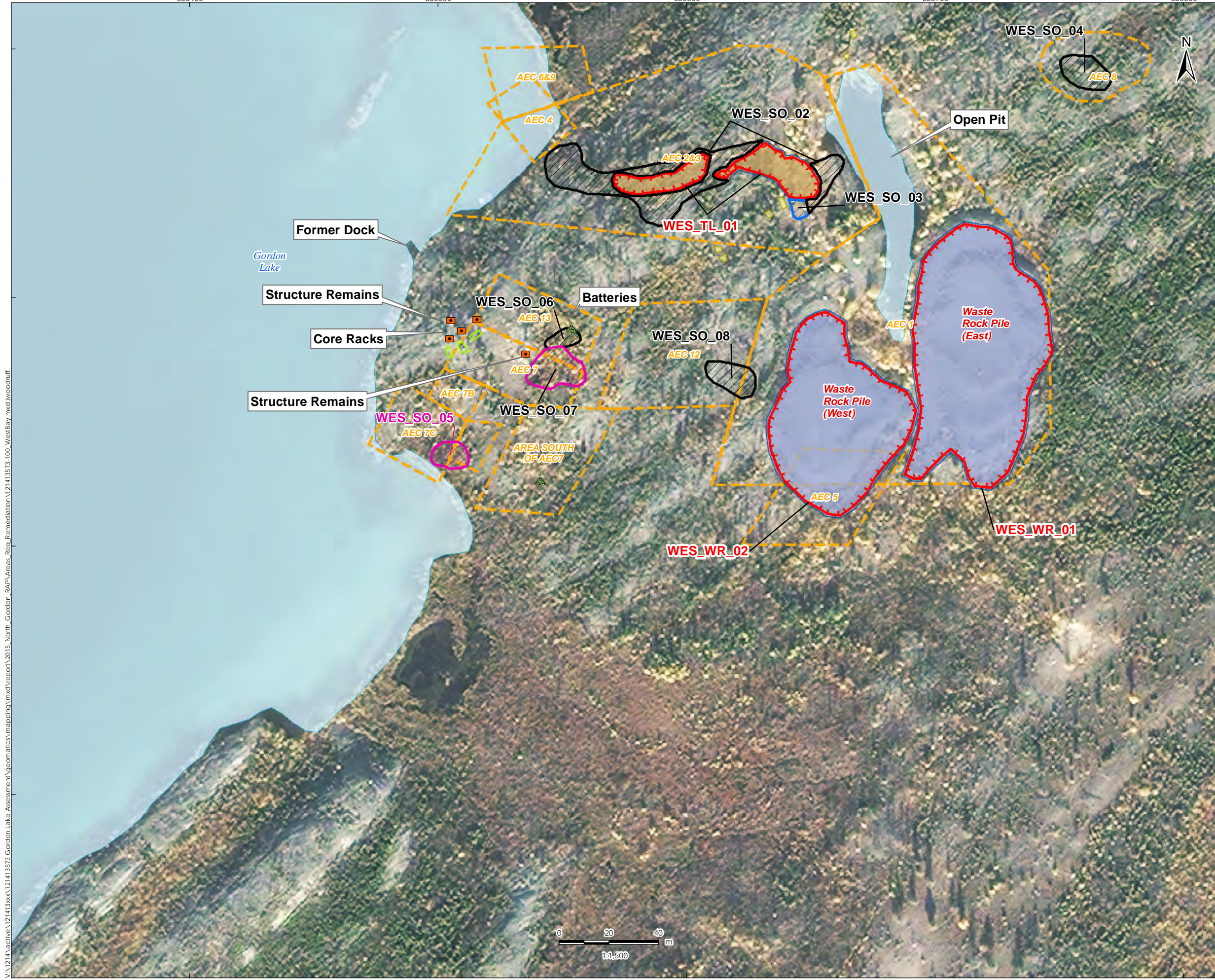
Impact Type

- Petroleum
- Hydrocarbon (PHC)
- Co-mingled
- Metals
- High Risk Impacting Material

Features Observed

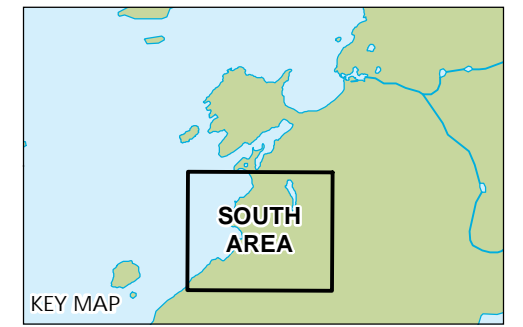
- Debris
- Structure Remains
- Other (as labeled)
- Tailings
- Trench/Shaft
- Waste Rock/Ore
- Areas of Environmental Concern (AEC)
- Watercourse
- Water body
- Map Extent

V:\1214\active\121413573 Gordon Lake Assessment\geomatrics\mapping\mxd\report\2015_North_Gordon_RAP_Areas_Req_Remediation\121413573-100_WestBay.mxd | woodruff



6978400
6978300
6978200
6978100

*As labelled by Stantec



NAD 1983 UTM Zone 12N March 2016 121413573

Client/Project
Public Works and
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Figure No.
I-3

Title
West Bay - South Area
Summary of Hazard Components



Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

386000

386500

387000



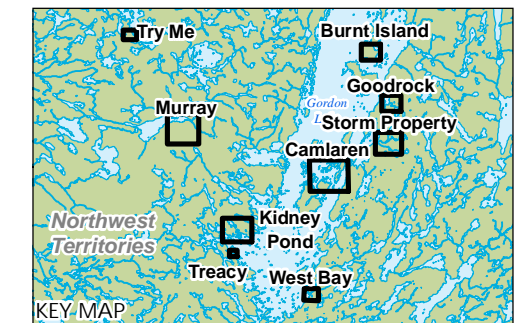
Legend

- Exceedance of Applicable Guidelines
- Drinking Water Sample Location
- Access Trail
- Infrastructure Type
 - Former Dock Location
 - Potential Dock/Barge Landing Location
 - Potential Staging Area/Camp Location



6978500

6978000



NAD 1983 UTM Zone 12N March 2016 121413458

Client/Project
 Public Works and
 Government Services Canada
 Gordon Lake Group Remedial Action Plan

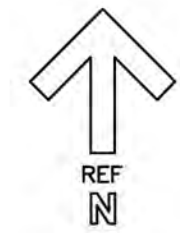
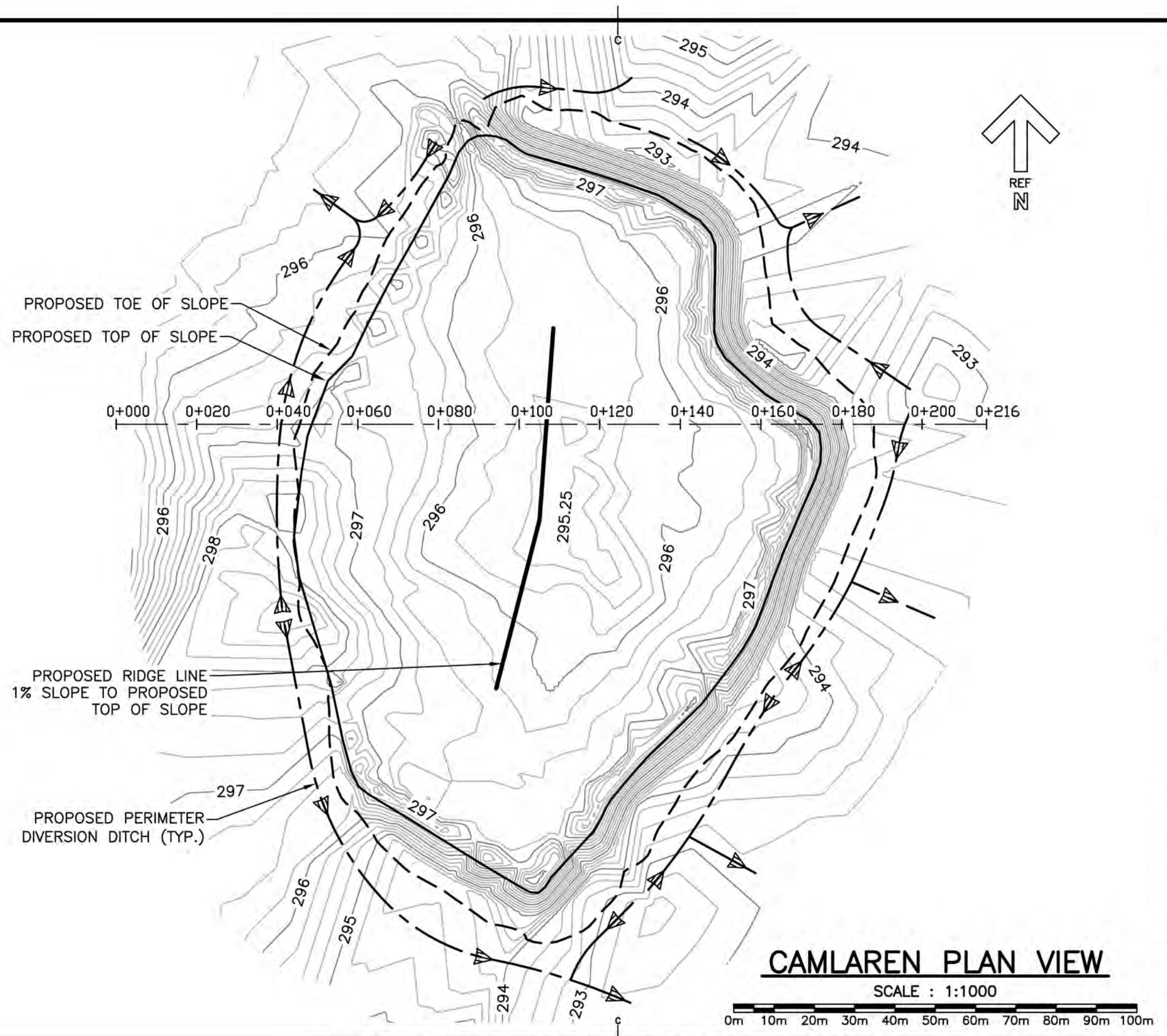
Figure No.
 I-4

Title
 West Bay
 Infrastructure Overview

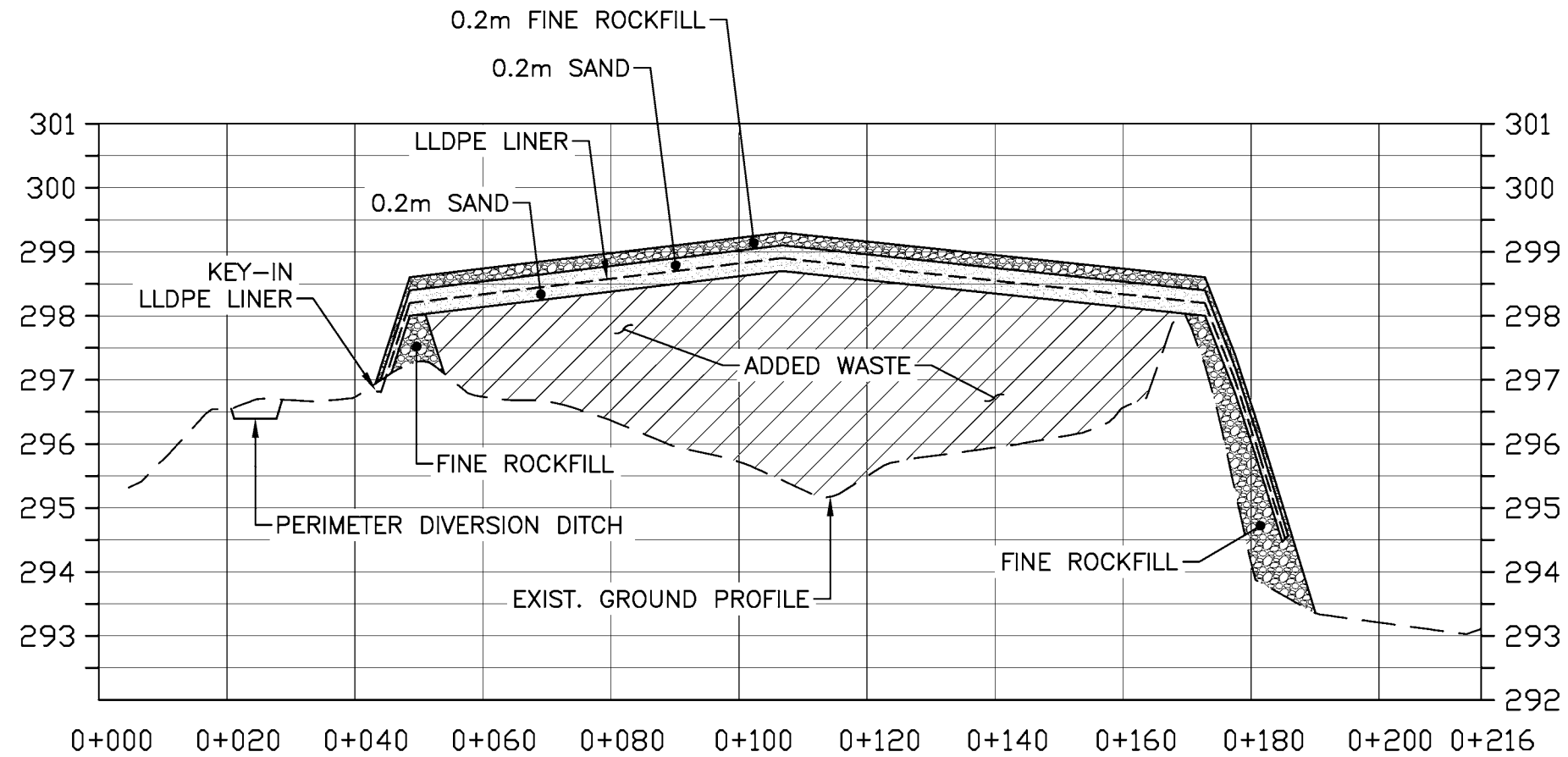
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 Revised: 2016-03-04 By: jwoodruff

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

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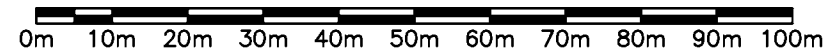


revisions		date	
project		projet	
drawing		dessin	
CAMLAREN PLAN VIEW			
designed	K. Hojka	conçu	
date	2015 DEC 17		
drawn	R. Cornish	dessiné	
date	2015 DEC 17		
approved		approuvé	
date			
Tender		Soumission	
PCA Project Manager		Administrateur de projets PCA	
project number		no. du projet	
drawing no.		no. du dessin	
J-1			

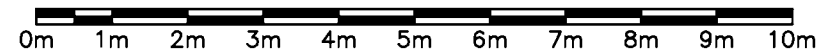


CAMLAREN PROFILE VIEW

SCALE : 1:1000 HORIZ.



SCALE : 1:100 VERT.



revisions	date
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project	projet
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drawing	dessin
---------	--------

CAMLAREN PROFILE VIEW

designed K. Hojka	conçu
-------------------	-------

date 2015 DEC 17	
------------------	--

drawn R. Cornish	dessiné
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date 2015 DEC 17	
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approved	approuvé
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date	
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Tender	Soumission
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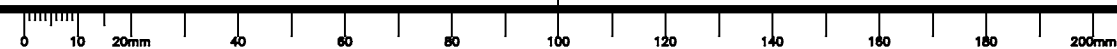
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project number	no. du projet
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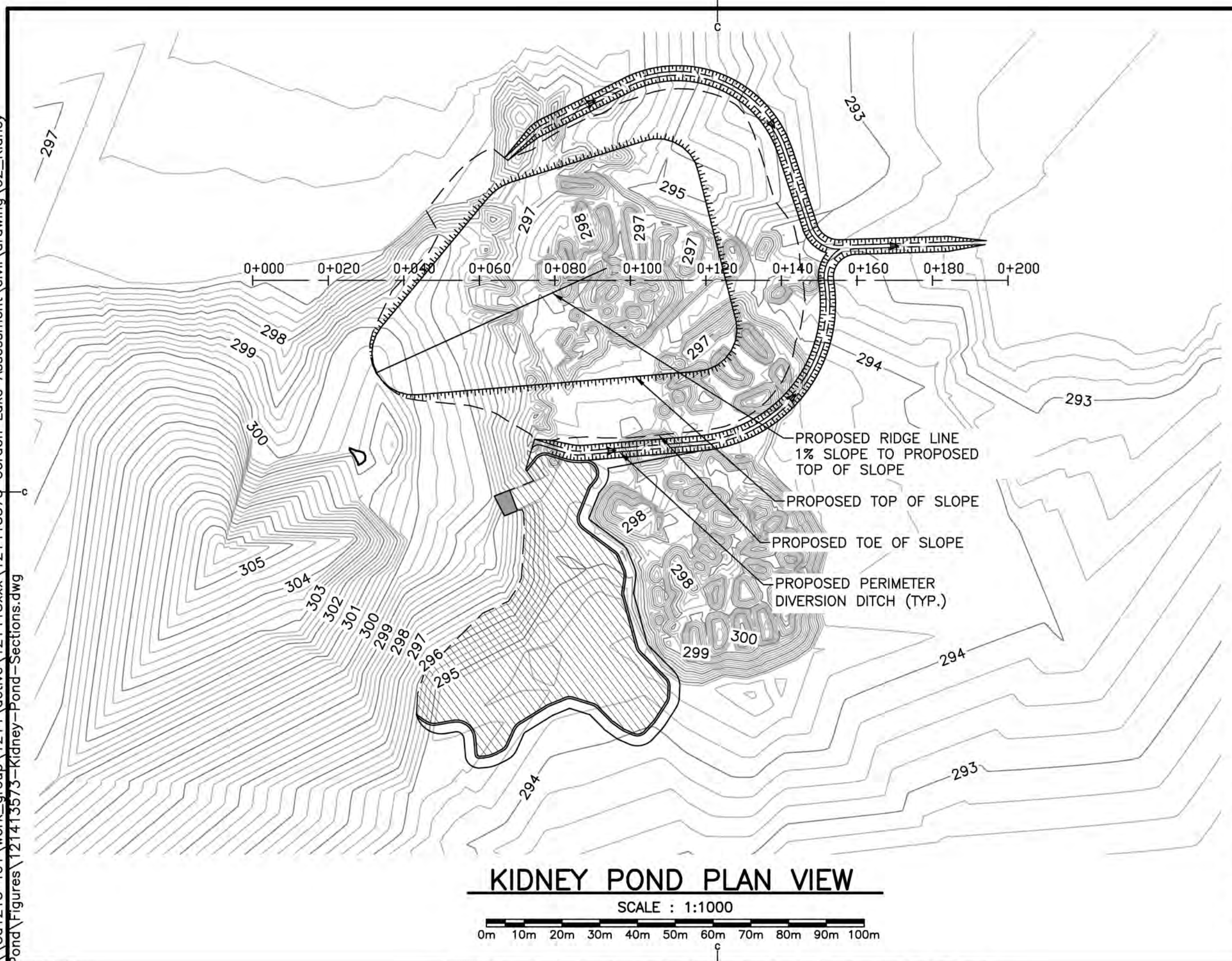
drawing no.	no. du dessin
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J-2

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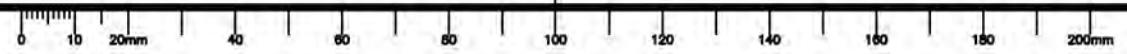
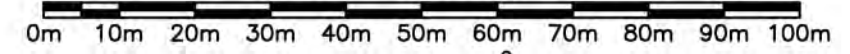


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 Pond\Figures\121413573-Kidney-Pond-Sections.dwg



KIDNEY POND PLAN VIEW

SCALE : 1:1000



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A	CONCEPT REPORT	DEC 23 2015
revisions		date
project		projet

drawing / dessin

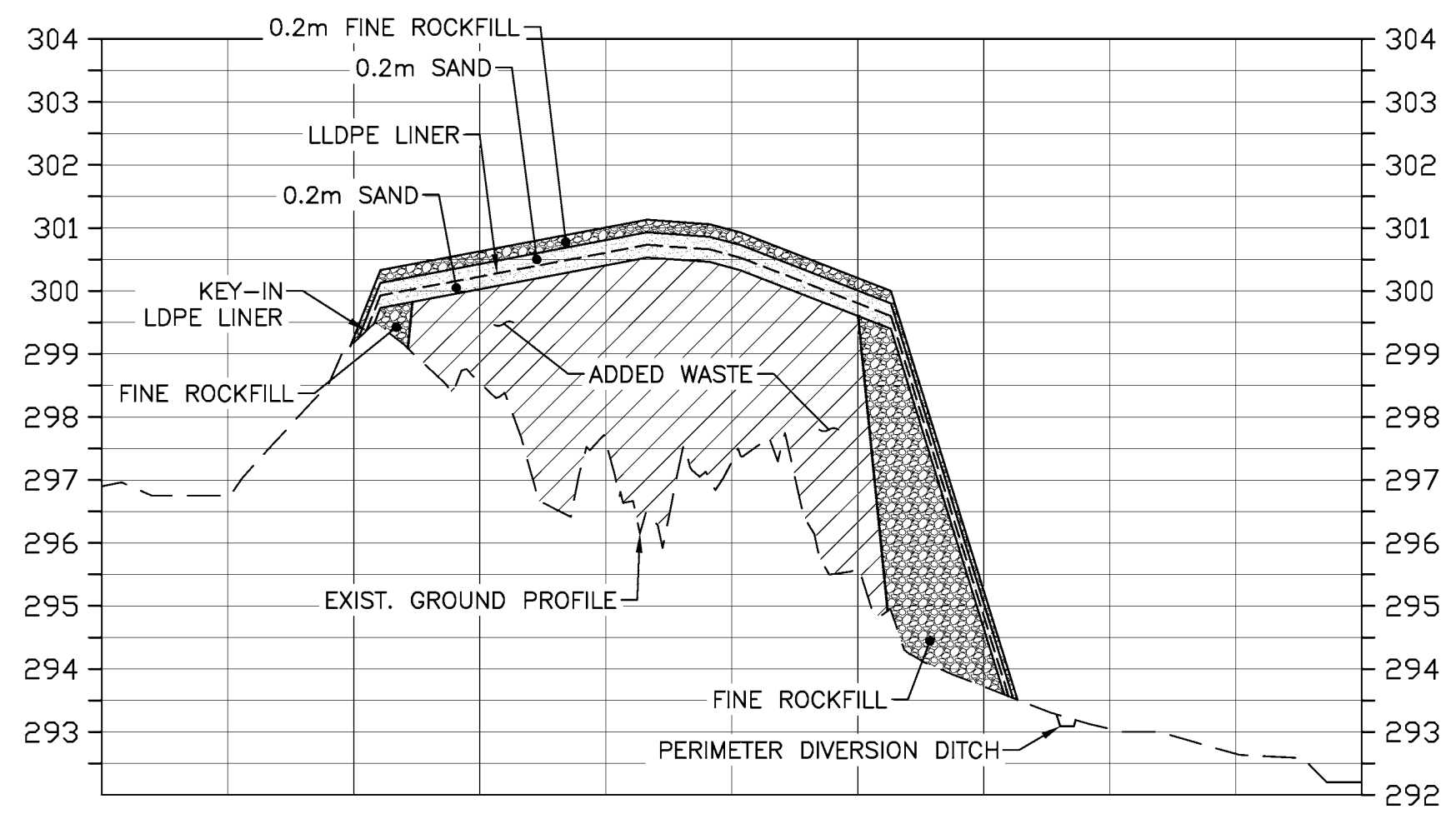
KIDNEY POND PLAN VIEW

designed	K. Hojka	conçu
date	2015 DEC 17	
drawn	R. Cornish	dessiné
date	2015 DEC 17	
approved		approuvé
date		
Tender		Soumission

PCA Project Manager / Administrateur de projets PCA
 project number / no. du projet

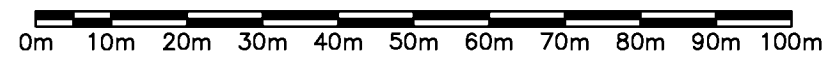
drawing no. / no. du dessin
J-3

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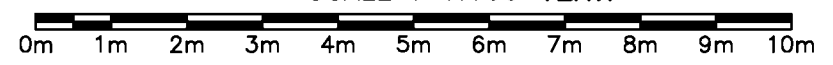


KIDNEY POND PROFILE VIEW

SCALE : 1:1000 HORIZ.



SCALE : 1:100 VERT.



B	CONCEPT REPORT	MAR 21 2016
A	CONCEPT REPORT	DEC 23 2015
revisions		date

project	projet
---------	--------

drawing dessin

KIDNEY POND PROFILE VIEW

designed K. Hojka conçu

date 2015 DEC 17

drawn R. Cornish dessiné

date 2015 DEC 17

approved approuvé

date

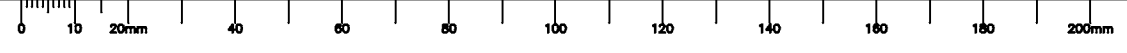
Tender Soumission

PCA Project Manager Administrateur de projets PCA

project number no. du projet

drawing no. no. du dessin

J-4



APPENDIX B
Rap Workout Meeting Minutes



Gordon Lake Group Project Remedial Options Workshop February 2nd and 3rd, 2016

In support of the development of the development of a Remedial Action Plan (RAP) for the Gordon Lake Group of Sites (GLGS), a remedial options workout was undertaken February 2nd 3rd, 2016 at the Tree of Peace in Yellowknife, NT with representatives from the Yellowknives Dene First Nation (YKDFN), Indigenous and Northern Affairs Canada (INAC), Public Works and Government Services Canada (PWGSC) and Stantec Ltd..

The GLGS consist of Burnt Island, Camlaren, Goodrock, Kidney Pond, Murray Lake, Storm Property, Treacy, Try Me and West Bay. These sites are old mine or mineral exploration sites, of various sizes (small to large). Many of the YKDFN participants were already familiar with these sites as a result of being on the land or from visiting these sites in the summer of 2015 as part of a traditional knowledge investigation undertaken by the YKDNF on behalf of INAC.

Workshop objectives were to:

- Review site history, status and environmental / health risks for each site
- Discuss proposed technical remedial options for each environmental / health risk
- Select consensus remedial options for each site
- Use the results for remediation planning and permit applications

The decisions / consensus options resulting from the remedial options workout are listed below for the record.

Attendance List:

Randy Freeman YKDFN
George Tatsiechele YKDFN
Eddie Sikyea YKDFN
Peter Sangris YKDFN
Alfred Baillargeon YKDFN
Lucy Staples YKDFN
Therese Sangris YKDFN
Modeste Sangris YKDFN
Fred Sangris YKDFN
Samuel Kennedy INAC CARD
Kaitlyn Vician INAC CARD
Matthew McElwaine PWGSC - NCS
Mike Doucet Stantec
David Wilson Stantec



Burnt Island – Summary of Proposed Remedial Options

Waste	Type/ Vol.s	Option 1	Option 2	Option 3	Option 4	Comments
Underground mine openings:						
Shaft	Approx. 576 m ³ to fill	Do nothing	Engineered cap	Backfill and engineered cap	Backfill	Potential hang-ups for backfilling, ice plugs
Portal	Assumed 10 m depth, 220 m ³ of fill required	Do nothing	Engineered cap	Backfill	-	As approved by WSCC, backfill, dimensions are 4.7 x 4.7,
Open pit mine workings:						
Trenches		Do nothing	Backfill	Cap	-	Relatively shallow, no action recommended
Buildings and debris:						
Site Buildings	Headframe, Mill Building, Former Cabin	Do nothing	Demolition and On-site Burn	Demolition & on-site or off-site landfill	Demolition & consolidated landfill	Combination, demolish and burn wood, remove other equipment and landfill in consolidated landfill
Infrastructure	Core rack, drill rig, dock	Do nothing	Demolition and On-site Burn	Demolition & on-site or off-site landfill	Demolition & consolidated landfill	Combination, demolish and burn wood, remove other equipment and landfill in consolidated landfill (core rack is deteriorated)
Wood	82 m ³	Do nothing	On-site burn	On-site landfill	Consolidated landfill	Total of 82 m ³ , assume 5% remaining after burn
Other	Metal, misc. debris – 12 m ³	Do nothing	Landfill on-site	Consolidated landfill	Off-site disposal	Total of 12 m ³ , assume 25% remaining after crushing

Waste	Type/ Vol.s	Option 1	Option 2	Option 3	Option 4	Comments
Hazardous wastes:						
Batteries		Off-site disposal	-	-	-	Containerize and dispose of off-site
Asbestos containing material		Off-site disposal	-	-	-	Containerize and dispose of off-site
Soils/Tailings/Waste Rock:						
Soils – Co-impacted	BUR_SO_07 – 35 m ³	Cap and cover	Excavation & on-site landfill	Excavation & consolidated landfill	Excavation & disposal off-site	Phytoremediation option also considered. Excavate and move to Camlaren
Soils - PHCs	BUR_SO_01 - 06 - 261 m ³	Cover in-situ and monitor	Excavation & disposal on-site	Excavation & disposal off-site	Landfarm	At Kidney Pond
Tailings	2049 m ³	Do nothing	Cap	Excavation & consolidated landfill	-	No SSRT exceedances – does not pose significant risk
Waste rock	6060 m ³	Do nothing	Cap	Excavation & consolidated landfill	-	88% of samples non-PAG – does not pose significant risk

Preferred Options

Shaft - backfill with foam and an engineering cap over top.

Portal - backfill with waste rock.

Trenches - leave as is.

Site building, headframe, mill, former cabin-demolish and wood is to be burned on site. Other material will be consolidated in the Camlaren landfill.

Infrastructure Core rack, drill rig, Dock will be demolished. The wood will be burned on site and the other material will be placed in the landfill.

Wood - burn on site.

All other **waste** material will be consolidated in a landfill.

Batteries will be disposed of off-site.

Asbestos containing material will be disposed of off-site.

Co-impacted soils will be consolidated in the Camlaren landfill.

PHCs soils will be land farmed.

Tailings will be covered with borrow source.

Waste Rock will be used as backfill or left in place.



Camlaren Mine – Proposed Remedial Options

Waste	Type/ Vols	Option 1	Option 2	Option 3	Option 4	Comments
Underground mine openings:						
Shaft and Vent	Muir Island	Do nothing	Engineered cap	Backfill and engineered cap	Backfill	Already capped
Slope / Crown Pillar Opening	Muir Island	Do nothing	Backfill	Engineered cap	Barrier	As approved by WSCC, backfill and/or create a barrier
Shaft	Zenith Island	Do nothing	Backfill	Engineered cap	-	Need to uncover/evaluate further before final closure option confirmed.
Open pit mine workings:						
Trenches		Do nothing	Backfill	Cap	-	As approved by WSCC, no action required
Buildings and debris:						
Site Buildings	Old Chimney and Rock Structures	Do nothing	Demolition and Burn	Demolition & on-site or off-site landfill	Demolition & consolidated landfill	Leave in place, will be further considered as a possible heritage item
	Cabins	Do nothing	Demolition and Burn	Demolition & on-site or off-site landfill	Demolition & consolidated landfill	Combination, demolish and burn wood, remove other equipment and landfill in consolidated landfill
Infrastructure	Hoist Pad	Do nothing	Demolition & On-site landfill	Demolition & on-site or off-site landfill	Demolition & consolidated landfill	Assuming removal is required during remediation, if not, leave in place and merge with grade
Wood	Docks and Wood – 30 m3	Do nothing	On-site burn	On-site landfill	Consolidated landfill	Total of 30 m3, assume 5% remaining after burn
Other	Metal, misc. debris – 170 m3	Do nothing	Landfill on-site	Consolidated landfill	Off-site disposal	Total of 170 m3, assume 25% remaining after crushing

Waste	Type/ Vols	Option 1	Option 2	Option 3	Option 4	Comments
Buildings and debris cont'd:						
Infrastructure	Concrete wall	Do nothing	Demolition & On-site landfill	Demolition & on-site or off-site landfill	Demolition & consolidated landfill	Serving to limit flushing, not posing a significant risk
Soils/Tailings/Waste Rock:						
Soils – Co-impacted	CAM_SO_09 – 280 m3	Cap and cover	Excavation & on-site landfill	Excavation & consolidated landfill	Excavation & disposal off-site	Excavate and place in TCA
Soils – Metals	CAM_SO_02/4/6/7/8/10-12 – 10213 m3	Cap and cover	Excavation & on-site landfill	Excavation & consolidated landfill	Excavation & disposal off-site	Phyto option also considered. Place in TCA, total volume adjusted for assumed 30% rock component which will be screened out
	CAM_SO_01 5/17/18/20 – 1197 m3	Cap and cover	Excavation & on-site landfill	Excavation & consolidated landfill	Excavation & disposal off-site	Metals impacted soil on north Muir Island, to be placed in the TCA
	CAM_SO_03 – 380 m3	Cap and cover	Excavation & on-site landfill	Excavation & consolidated landfill	Excavation & disposal off-site	Metals impacted soil on Zenith Island, to be placed in the TCA
	CAM_SO_02 1/22 – 30 m3	Do nothing	Excavation & on-site landfill	Excavation & consolidated landfill	Excavation & disposal off-site	Area of cobalt exceedance at North Cabin - already vegetated and minor exceedance only
Soils - PHCs	CAM_SO_01/03/05/13/14/16/19 – 915 m3	Cap and cover	Excavation & on-site or off-site landfill	Excavation & consolidated landfill	Landfarm	Recycle soil - use as capping material once remediated
Tailings	CAM_TL_01 – 49538 m3	Cap and cover	Excavation & disposal on-site in TCA	Excavation & consolidated TCA	Excavation & disposal off-site	Use existing tailings area

Preferred Options:

Shaft and vent - leave as is and to continue monitoring the existing caps.

Slope/Crown Pillar - place a barrier around the opening.

Shaft - remove existing debris in the shaft and backfill with waste rock.

Trenches - leave as is.

Site Building, Chimney and Rock structure - leave as is. It does not pose a hazard and has potential historical value.

Cabins - demolish and wood will be burned on site.

Infrastructure Hoist pad - demolish and consolidated in the landfill.

Wood - burn on site.

Other material - consolidate in the landfill

Infrastructure, Concrete wall - leave in place.

Co-impacted soils - excavate and place in the landfill.

Soils with metals - excavate and consolidate in the landfill.

PHCs soils - land farm

Tailings - repair tailing containment facility and place a cap and new soil over the facility.



Waste	Type/Vols	Option 1	Option 2	Option 3	Option 4	Comments
Soils/Tailings/Waste Rock:						
Waste rock	CAM_WR_02 - 4377 m3	Leave in place and monitor	Excavation & onsite construction material	Excavation & consolidated waste rock containment	Engineered cover	Waste rock fraction of metals impacted soil on south Muir Island is 3978 m3, to be used as construction material as non-PAG
	CAM_WR_01a/01b/03 - 404 m3	Leave in place and monitor	Excavation & onsite waste rock containment	Excavation & consolidated waste rock containment	Engineered cover	Zenith Island Waste Rock, move to Kidney Pond
Impacted Water:						
		Do nothing	Ex-Situ Treatment	In-Situ Chemical Adjustment	-	

Waste Rock - excavate and place in the tailings containment facility.

Impacted Water - leave as is but continue to monitor.

Goodrock – Proposed Remedial Options

Waste	Type/Vols	Option 1	Option 2	Option 3	Option 4	Comments
Underground mine openings:						
North Shaft		Do nothing	Backfill	Engineered cap	-	Depending on material availability, backfill or engineered cap (foam plug)
Open pit mine workings:						
South Pit		Do nothing	Backfill	Engineered cap	-	Site visit indicated insufficient water to provide safe exit, therefore, backfill
Trenches		Do nothing	Backfill	Cap	-	Relatively shallow
Buildings and debris:						
Site Buildings	Former Cabins and Mill Slab	Do nothing	Demolition and On-site Burn	Demolition & on-site or off-site landfill	Demolition & consolidated landfill	Combination, demolish and burn wood, remove other equipment and landfill in consolidated landfill
Infrastructure	Dock	Do nothing	Demolition and On-site Burn	Demolition & on-site or off-site landfill	Demolition & consolidated landfill	
Wood	56 m3	Do nothing	On-site burn	On-site landfill	Consolidated landfill	Total of 56 m3, assume 5% remaining after burn
Other	Metal, misc. debris - 20 m3	Do nothing	Landfill on-site	Consolidated landfill	Off-site disposal	Total of 20 m3, assume 25% remaining after crushing

Preferred Options

North Shaft - backfill and place an engineering cap over the shaft.

South pit - backfill with waste rock

Trenches - leave as is.

Site Buildings, Former Cabins and Mill Slab - demolish and burn wood on site. The remaining material will be consolidated in the landfill at Camlaren.

Infrastructure, Dock - demolish and burn on site.

Wood - burn on site.

Other material - consolidate in the landfill.



Waste	Type/ Vol.s	Option 1	Option 2	Option 3	Option 4	Comments
Hazardous wastes:						
Batteries		Off-site disposal	-	-	-	Containerize and dispose of off-site
Soils/Tailings/Waste Rock:						
Soils – Metals	GOO_HS_01 – 30 m3	Cap and cover	Excavation & on-site landfill	Excavation & consolidated landfill	Excavation & disposal off-site	Phyto option also considered. Place in TCA
Waste rock	GOO_WR_01/02 – 312 m3	Leave in place and monitor	Excavation & onsite waste rock containment	Use as Backfill, and remainder to consolidated waste rock containment	Engineered cover	Move residual to Kidney Pond after filling south pit and north shaft
Impacted Water:						
	AEC 10 (North Shaft and South Pit)	Do nothing	Ex-Situ Treatment	In-Situ Chemical Adjustment	-	Water in shaft and pit contains metals concentrations greater than CCME FWAL

Batteries - dispose of off-site.

Co-impacted soils - excavate and consolidate in the landfill at Camelaren.

Waste Rock - use as backfill and the remainder consolidate in the landfill.

Impacted water -leave as is, small volume

Kidney Pond - Proposed Remedial Options

Waste	Type/ Vol.s	Option 1	Option 2	Option 3	Option 4	Comments
Underground mine openings:						
Portal	Portal and seep (AEC 17)	Do nothing	Backfill	Engineered cover with passive seep control	-	Additional water balance assessment required
Open pit mine workings:						
Trenches		Do nothing	Backfill	Cap	-	Relatively shallow, no action recommended
Buildings and debris:						
Infrastructure	Core rack, dock	Do nothing	Demolition and On-site Burn	Demolition & on-site or off-site landfill	Demolition & consolidated landfill	Combination, demolish and burn wood, remove other equipment and landfill in consolidated landfill (core racks are deteriorated)
Wood	65 m3	Do nothing	On-site burn	On-site landfill	Consolidated landfill	Total of 65 m3, assume 5% remaining after burn
Other	Other (metal, misc debris, incl. protruding drill rods) – 35 m3	Do nothing	Landfill on-site	Consolidated landfill	Off-site disposal	Total of 35 m3, assume 25% remaining after crushing
Hazardous wastes:						
Batteries		Off-site disposal	-	-	-	Containerize and dispose of off-site
Unfired explosives		Off-site disposal	-	-	-	Should any be found

Preferred Options

Portal - place an engineering cover and passive seep control. It was also identified that this area needs to be monitored.

Trenches –leave as is.

Infrastructure, Core racks and dock – demolish and burn wood

Other material - place in a landfill.

Wood - burn on site.

Other material - consolidate in a landfill.

Batteries - dispose of off-site.

Unfired explosives - disposed of off-site.



Waste	Type/ Vol.s	Option 1	Option 2	Option 3	Option 4	Comments
Soils/Tailings/Waste Rock:						
Soils – Co-impacted	KID_SO_07/11 – 10800 m3	Cap and cover	Excavation & on-site landfill	Excavation & consolidated landfill	Excavation & disposal off-site	Consider disposal at Kidney Pond in concert with waste rock
Soils - metals	KID_HS_01/KID_SO_05/06/08/12 – 101 m3	Cover in-situ and monitor	Excavation & on-site landfill	Excavation & consolidated landfill	Excavation & disposal off-site	Consider disposal at Kidney Pond in concert with waste rock
Soils - PHCs	KID_SO_01/02/03/04/09/10 - 408 m3	Cap & cover	Excavation & on-site or off-site landfill	Excavation & consolidated landfill	Landfarm	Recycle - use as waste rock cover once remediated
Waste rock	KID_WR_01 - 42615 m3	Leave in place and monitor	Excavation & onsite or off-site waste rock containment	Excavation & consolidated waste rock containment	Engineered cover	Main waste rock disposal location
	KID_WR_02 – 24 m3	Leave in place	Excavation & onsite or off-site waste rock containment	Excavation & consolidated waste rock containment	Engineered cover	Trench Area at Exploration Camp Area – samples show low risk from PAG

Murray Lake - Proposed Remedial Options

Waste	Type/ Vol.s	Option 1	Option 2	Option 3	Option 4	Comments
Underground mine openings:						
Shaft		Do nothing	Backfill	Engineered cap	-	As approved by WSCC, backfill with waste rock placed below water table
Open pit mine workings:						
Trenches		Do nothing	Backfill	Cap	-	As approved by WSCC, no action required
Buildings and debris:						
Wood	4 m3	Do nothing	On-site burn	On-site landfill	Consolidated landfill	Total of 4 m3, assume 5% remaining after burn
Other	Metal, misc debris – 3 m3	Do nothing	Landfill on-site	Consolidated landfill	Off-site disposal	Total of 3 m3, assume 25% remaining after crushing
Soils/Tailings/Waste Rock:						
Soils – metals	MUR_SO_01 - 5 m3	Cap and cover	Excavation & on-site landfill	Excavation & consolidated landfill	Excavation & disposal off-site	Metals impacted soil at the 1938 camp area, within tent ring
Soils - metals	MUR_SO_02/03/04/05 – 1060 m3	Additional risk screening, leave in place	Excavation & on-site landfill	Excavation & consolidated landfill	Excavation & disposal off-site	Risk of exposure to human visitors low given location; risk to ecological receptors low given area

Co-impacted soils - excavate and consolidate in the landfill.

Soils with metal - excavate and consolidate in the landfill

PHCs Soils - land farm

Waste Rock - create a containment area for waste rock on site. Place an engineered cap over the containment site.

Non-Acid generating waste rock - use as backfill or leave on site.

Preferred Options:

Shaft - backfill.

Trenches -leave as is.

Wood - burn on site

Other material - consolidate in the landfill.

Soils with metals - excavate and consolidate in the landfill.

Soils with low metal levels -leave as is but need to be monitored.



Waste	Type/ Vol.s	Option 1	Option 2	Option 3	Option 4	Comments
Soils/Tailings/Waste Rock:						
Waste rock	MUR_WR_01/02 – 657 m3	Leave in place	Excavation & onsite or off-site waste rock containment	Excavation & consolidated waste rock containment	Engineered cover	Trench Area and Main Shaft Area – risk to human and ecological receptors low given location/area
Impacted Water:						
	Trench Area	Do nothing	Ex-Situ Treatment	In-Situ Chemical Adjustment	-	

Waste Rock - leave in place
Impacted water in the trench - leave in place but monitor

Storm Property – Proposed Remedial Options

Waste	Type/ Vol.s	Option 1	Option 2	Option 3	Option 4	Comments
Underground mine openings:						
Shaft		Do nothing	Backfill	Backfill and engineered cap	-	As approved by WSCC
Open pit mine workings:						
Trenches		Do nothing	Backfill	Cap	-	As approved by WSCC, no action required
Buildings and debris:						
Wood	10 m3	Do nothing	On-site burn	On-site landfill	Consolidated landfill	Total of 10 m3, assume 5% remaining after burn
Other	Metal, misc. debris – 12 m3	Do nothing	Landfill on-site	Consolidated landfill	Off-site disposal	Total of 12 m3, assume 25% remaining after crushing
Hazardous wastes:						
Batteries		Off-site disposal	-	-	-	Containerize and dispose of off-site
Soils/Tailings/Waste Rock:						
Soils – metals	STM_HS_01/STM_SO_SO_01/02/03 – 364 m3	Additional risk screening, leave in place	Excavation & on-site landfill	Excavation & consolidated landfill	Excavation & disposal off-site	Risk of exposure to human visitors low given location; risk to ecological receptors low given area
Waste rock	STM_WR_SO_01/02 – 105 m3	Leave in place	Excavation & backfill openings	Excavation & consolidated waste rock containment	Engineered cover	Remainder after use as backfill - risk to human and ecological receptors low given location/area

Preferred Options

Shaft - backfill
Trenches - leave as is.
Wood - burn on site.
Other material - consolidate in a landfill.
Batteries - dispose of off-site.
Soils with metals - excavate and consolidate in landfill.
Waste rock - leave in place but monitor



Tracy – Proposed Remedial Options

Waste	Type/ Vol.s	Option 1	Option 2	Option 3	Option 4	Comments
Open pit mine workings:						
Trenches	East Trench	Do nothing	Backfill	Cap	-	Use local waste rock up to water table (PAG)
Buildings and debris:						
Site Buildings	Mill Building	Do nothing	Demolition and On-site Burn	Demolition & on-site or off-site landfill	Demolition & consolidated landfill	Combination, demolish and burn wood, remove other equipment and landfill in consolidated landfill
Wood	36 m3	Do nothing	On-site burn	On-site landfill	Consolidated landfill	Total of 36 m3, assume 5% remaining after burn
Other	Metal, misc. debris – 19 m3	Do nothing	Landfill on-site	Consolidated landfill	Off-site disposal	Total of 19 m3, assume 25% remaining after crushing
Hazardous wastes:						
Leach. lead paint		Do nothing	Collect and place in an on-site containment area	Collect and containerize for off-site disposal	-	

Waste	Type/ Vol.s	Option 1	Option 2	Option 3	Option 4	Comments
Soils/Tailings/Waste Rock:						
Soils – Co-impacted	TRC_SO_01/03- 771 m3	Cap and cover	Excavation & on-site landfill	Excavation & consolidated landfill	Excavation & disposal off-site	Mill Area and Camp Area
Soils - PHCs	TRC_SO_02 – 21 m3	Cap and cover	Excavation & on-site landfill	Excavation & consolidated landfill	Excavation & disposal off-site	Move to Kidney Pond
Tailings	TRC_TL_01 (tailings filled trench) – 13 m3	Cap and cover	Excavation & disposal on-site in TCA	Excavation & consolidated TCA or landfill	Excavation & disposal off-site	Move to Kidney Pond
Waste rock	TRE_WR_01 - 172 m3	Leave in place and monitor	Excavation & on-site or off-site waste rock containment	Excavation & consolidated waste rock containment	Engineered cover	Move to Kidney Pond
Impacted Water:						
	AEC 5	Do nothing	Ex-Situ Treatment	In-Situ Chemical Adjustment	-	Water in shaft and pit contains metals concentrations greater than CCME FWAL

Preferred Options

Trenches - backfill

Mill building - demolish. Burn wood on site, consolidate other material in landfill.

Wood - burn

Other material - consolidate in landfill.

Lead paint - remove off site.

Co-impacted soils - excavate and consolidate in landfill.

PHCs soils – excavate and landfarm.

Tailings - excavate and consolidate landfill.

Waste rock - excavate and consolidate in the waste rock containment area.

Impacted water – leave as is.



Try Me – Proposed Remedial Options

Waste	Type/ Vol.s	Option 1	Option 2	Option 3	Option 4	Comments
Underground mine openings:						
Decline Shaft		Do nothing	Engineered cap	Backfill	-	As discussed with WSCC. Could be foam
Open pit mine workings:						
Trenches		Do nothing	Backfill	Cap	-	As approved by WSCC, no action required
Buildings and debris:						
Site Buildings	Cabin and wooden structures	Do nothing	Demolition and On-site Burn	Demolition & on-site or off-site landfill	Demolition & consolidated landfill	Combination, demolish and burn wood, remove other equipment and landfill in consolidated landfill
Infrastructure	Core racks, dock	Do nothing	Demolition and On-site Burn	Demolition & on-site or off-site landfill	Demolition & consolidated landfill	Dock already destroyed, core racks are already destroyed
Other	Metal, misc. debris	Do nothing	Landfill on-site	Consolidated landfill	Off-site disposal	-
Hazardous wastes:						
Batteries		Off-site disposal	-	-	-	Containerize and dispose of off-site

Waste	Type/ Vol.s	Option 1	Option 2	Option 3	Option 4	Comments
Soils/Tailings/Waste Rock:						
Waste rock	TRY_WR_01/02 - 151 m3	Leave in place	Excavation & backfill openings	Excavation & consolidated waste rock containment	Engineered cover	Remainder after use as backfill - risk to human and ecological receptors low given location/area
Impacted Water:						
		Do nothing	Ex-Situ Treatment	In-Situ Chemical Adjustment	-	

Preferred Options:

- Decline Shaft** - foam plug/cap.
- Trenches** – leave as is.
- Structures and Cabin** - demolish, burn on site and consolidate into a landfill.
- Infrastructure** - demolish, Burn on site and consolidate into a landfill.
- Batteries** - dispose of off-site.
- Waste Rock** - leave in place
- Impacted water** - leave in place.



West Bay – Proposed Remedial Options

Waste	Type/ Vol.s	Option 1	Option 2	Option 3	Option 4	Comments
Open pit mine workings:						
Open Pit		Do nothing	Backfill	Barrier	-	As approved by WSCC, construct physical barrier for construction workers
Buildings and debris:						
Former Buildings	Headframe, Mill Building, Former Cabin	Do nothing	Demolition and On-site Burn	Demolition & on-site or off-site landfill	Demolition & consolidated landfill	Combination, demolish and burn wood, remove other equipment and landfill in consolidated landfill
Infrastructure	Core rack, dock	Do nothing	Demolition and On-site Burn	Demolition & on-site or off-site landfill	Demolition & consolidated landfill	As above
Wood	5 m3	Do nothing	On-site burn	On-site landfill	Consolidated landfill	Total of 5 m3, assume 5% remaining after burn
Other	Metal, misc. debris – 10 m3	Do nothing	Landfill on-site	Consolidated landfill	Off-site disposal	Total of 10 m3, assume 25% remaining after crushing
Hazardous wastes:						
Battery		Off-site disposal	-	-	-	Containerize and dispose of off-site

Preferred Options:

Open pit - place a barrier around the pit but not a boulder barrier. The YKDFN want a chain link fence around the pit.

Former Buildings - demolish. Burn wood on site and consolidate other material in the landfill.

Infrastructure - demolish. Burn wood on site and consolidate other material in the landfill.

Other material - consolidate in landfill.

Battery - dispose off-site.

Co-impacted soils - excavate and consolidate in landfill.

Soils with metals - excavate and consolidate in landfill

PHCs soils -land farm.

Tailings - excavate and consolidate in the tailing containment area.

Waste rock - control by placing rock that is neutralizing. It neutralizes the acid and down from the rock we will monitor the water to make sure it is clean.

Impacted water - leave as is and monitor



Waste	Type/ Vol.s	Option 1	Option 2	Option 3	Option 4	Comments
Soils/Tailings/Waste Rock:						
Soils - Co-impacted	WES_SO_o 3 - 28 m ³	Cap and cover	Excavation & on-site landfill	Excavation & consolidated landfill	Excavation & disposal off-site	Move to Kidney Pond
Soils - metals	WES_SO_o 2/04/06/08 - 957 m ³	Cap and cover	Excavation & on-site landfill	Excavation & consolidated landfill	Excavation & disposal off-site	As above
Soils - PHCs	WES_SO_o 1/05/07 - 199 m ³	Cap and cover	Excavation & on-site or off-site landfill	Excavation & consolidated landfill	Landfarm	Recycle - move to Kidney Pond, use as waste rock cover material
Tailings	WES_TL_o 1 - 107 m ³	Cap and cover	Excavation & disposal on-site in TCA	Excavation & consolidated TCA	Excavation & disposal off-site	No SSRT exceedances. Risk communication for leaving in place
Waste rock	WES_WR_o 01/02 - 44594 m ³	Do nothing	Local containment of acid generation	Excavation & consolidated waste rock containment	Engineered cover	Large WR piles determined to have significant potential for acid-generation impacts - remediate impacts in place
Impacted Water:						
		Do nothing	Ex-Situ Treatment	In-Situ Chemical Adjustment	-	

APPENDIX C Tables

Table 1 - Hazard Component Summary
 Draft Report: Gordon Lake Group Remedial Action Plan
 Stantec Project 121413573

ID #	Site Name	Hazard Category	Hazard Name	Hazard Location	Remediation Area (m ²)	Remediation Depth (m)	Remediation Volume (m ³)	Impacted Soil Polygon Perimeter (m)	Inferred Boundary (m)	Percent of polygon not bound (%)	Remediation Volume with Uncertainty - Min (m ³)	Remediation Volume with Uncertainty - Max (m ³)	Remediation Volume Adjustment Factor	Remediation Volume Adjustment Comment	Adjusted Remediation Volume with Uncertainty - Min (m ³)	Adjusted Remediation Volume with Uncertainty - Max (m ³)	Backfill Area (m ²)	Backfill Depth (m)	Backfill Volume (m ³)	Uncertainty (%)	Backfill Volume with Uncertainty - Max, based on remediation volume (m ³)	Backfill Volume Adjustment Factor (%)	Backfill Volume Adjustment Comment	Adjusted Backfill Volume (m ³)	Remedial Option	Disposal Location	Remedial Option Type		
1.1.1	Burnt Island	Co-Mingled Impacted Soil	BUR_SO_07	Old Mill Area	129	0.3	32	47	0	0%	32.2	32.2	100%		32.2	32.2						100%		32.2	Excavation and consolidated landfill	TSCA	Site Independent		
1.3.2	Burnt Island	PHC Impacted Soil	BUR_SO_01	Shaft Area	53	0.6	29	29	7	24%	22.3	36.1	100%		22.3	36.1						100%		36.1	Excavation and landfill	LF	Site Independent		
1.3.3	Burnt Island	PHC Impacted Soil	BUR_SO_02	Shaft Area	40	0.4	16	25	7	28%	11.6	20.5	100%		11.6	20.5						100%		20.5	Excavation and landfill	LF	Site Independent		
1.3.4	Burnt Island	PHC Impacted Soil	BUR_SO_03	Waste Rock Area	33	0.6	20	22	0	0%	19.7	19.7	100%		19.7	19.7						100%		19.7	Excavation and landfill	LF	Site Independent		
1.3.5	Burnt Island	PHC Impacted Soil	BUR_SO_04	Waste Rock Area	59	0.6	36	30	0	0%	35.7	35.7	100%		35.7	35.7						100%		35.7	Excavation and landfill	LF	Site Independent		
1.3.6	Burnt Island	PHC Impacted Soil	BUR_SO_05	Waste Rock Area	124	1.1	130	52	0	0%	130.5	130.5	100%		130.5	130.5						100%		130.5	Excavation and landfill	LF	Site Independent		
1.3.7	Burnt Island	PHC Impacted Soil	BUR_SO_06	Waste Rock Area	19	0.3	6	16	0	0%	5.8	5.8	100%		5.8	5.8						100%		5.8	Excavation and landfill	LF	Site Independent		
1.4.8	Burnt Island	Mine Openings	Portal	Portal Area							0.0	0.0			0.0	0.0	25.0	15.0	375.0	25%	468.8	125%	Adjusted to account for 25% uncertainty in	585.9	Backfill	n/a	Site Dependent		
1.4.9	Burnt Island	Mine Openings	Mine Shaft	Shaft Area							0.0	0.0			0.0	0.0	12.0	36.0	432.0	10%	475.2	100%		475.2	Backfill and engineered cap	n/a	Site Dependent		
1.5.10	Burnt Island	Underground Workings	Underground Workings	Shaft Area							0.0	0.0			0.0	0.0									Addressed as part of portal and shaft options	n/a	Site Dependent		
1.6.11	Burnt Island	Trenches	Trenches	Old Mill Area							0.0	0.0			0.0	0.0								0.0	Do nothing	n/a	Site Dependent		
1.7.12	Burnt Island	Abandoned Infrastructure	Core Rack	Shaft Area	1	1.0	1				1.0	1.0	25%	Adjusted to reflect 25% remaining after burn	0.3	0.3										Dismantle, burn and landfill remainder	TSCA	Site Dependent	
1.7.13	Burnt Island	Abandoned Infrastructure	Dock	Old Cabin Area	120	0.2	24				24.0	24.0	5%	Adjusted to reflect 5% remaining after burn	1.2	1.2											Dismantle, burn and landfill remainder	TSCA	Site Dependent
1.7.14	Burnt Island	Abandoned Infrastructure	Dill Rig	Shaft Area	3	12.0	36				36.0	36.0	25%	Adjusted to reflect 25% remaining after crushing	9.0	9.0											Dismantle, burn and landfill remainder	TSCA	Site Dependent
1.7.15	Burnt Island	Abandoned Infrastructure	South Sump	Old Cabin Area	1	1.0	1				1.0	1.0	100%		1.0	1.0										Collect material in sumps, burn(as appropriate) and landfill. Regrade.	TSCA	Site Dependent	
1.7.16	Burnt Island	Abandoned Infrastructure	Camp Comfort Stove	Old Sawmill	1	1.0	1				1.0	1.0	0%		0.0	0.0										Do nothing	n/a	Site Dependent	
1.8.17	Burnt Island	Abandoned Site Buildings	Former Cabins	Kruseen Camp Area			12				12.0	12.0	10%	Adjusted to reflect 10% remaining after burn	1.2	1.2											Dismantle, burn and landfill remainder	TSCA	Site Dependent
1.8.18	Burnt Island	Abandoned Site Buildings	Headframe	Shaft Area	60	0.2	12				12.0	12.0	5%	Adjusted to reflect 5% remaining after burn	0.6	0.6											Dismantle, burn and landfill remainder	TSCA	Site Dependent
1.8.19	Burnt Island	Abandoned Site Buildings	Old Mill Building	Old Mill Area	140	0.2	28				28.0	28.0	10%	Adjusted to reflect 10% remaining after burn	2.8	2.8											Dismantle, burn and landfill remainder	TSCA	Site Dependent
1.9.20	Burnt Island	Waste Rock	BUR_WR_01	Old Mill Area	95	0.5	48				47.5	47.5	0%	Moderate risk impacting waste rock - will be monitored	0.0	0.0											Moderate risk impacting waste rock - monitoring program will be implemented	n/a	Site Dependent
1.10.21	Burnt Island	Tailings	Tailings	Tailings Area	1366	1.5	2049			0%	2049.0	2049.0	0%	Tailings to be covered in place	0.0	0.0	1366.0	0.5	683.0	110%	751.3	100%	Assumed backfill depth to 0.5 m	751.3	Cover in place	n/a	Site Dependent		
1.11.22	Burnt Island	Hazardous Waste	Asbestos	Brake pad on drill rig (Shaft Area)	1	1.0	1				1.0	1.0	100%		1.0	1.0										Package for off-site disposal	Off site	Site Independent	
1.12.23	Burnt Island	Non-Hazardous Waste	Other (Metal, Misc. Pans)	Throughout (Old Cabin Area, Tin Can Dump, Collapsed Tent Frame, etc.)			12				12.0	12.0	25%	Adjusted to reflect 25% remaining after crushing	3.0	3.0											Burn (as appropriate) and landfill	TSCA	Site Independent
1.12.24	Burnt Island	Non-Hazardous Waste	Wood	Throughout (Old Cabin Area, Portal/Wood Barrier, etc.)			82				82.0	82.0	5%	Adjusted to reflect 5% remaining after burn	4.1	4.1											Burn (as appropriate) and landfill	TSCA	Site Independent
1.13.25	Burnt Island	Sediment	Impacted Sediment	Kruseen Camp Area							0.0	0.0			0.0	0.0										Do nothing	n/a	Site Independent	
2.1.1	Camlaren	Co-Mingled Impacted Soil	CAM_SO_09	Mine Area (South)	316	1.2	364	95	0	0%	363.7	363.7	70%	Adjusted to assume 30% rock component which will be screened out	254.6	254.6						75%	Adjusted to assume 75% less backfill and contouring	191.0	Excavation and consolidated landfill	TSCA	Site Independent		
2.2.2	Camlaren	Metals Impacted Soil	CAM_HS_01	North Cabin (Near Potential Burned Battery Area)	9	0.5	5	12	12	99%	9.0	9.0	100%		9.0	9.0						100%		9.0	Excavation and consolidated landfill	TSCA	Site Independent		
2.2.3	Camlaren	Metals Impacted Soil	CAM_SO_02	Mine Area (South)	49	0.7	32	26	0	0%	32.0	32.0	100%		32.0	32.0						100%		32.0	Excavation and consolidated landfill	TSCA	Site Independent		
2.2.4	Camlaren	Metals Impacted Soil	CAM_SO_04	Mine Area (South)	1024	0.2	205	169	87	51%	99.9	309.7	70%	Adjusted to assume 30% rock component which will be screened out	70.0	216.8						110%	Adjusted to assume 10% additional material for backfilling	238.4	Excavation and consolidated landfill	TSCA	Site Independent		
2.2.5	Camlaren	Metals Impacted Soil	CAM_SO_06	Mine Area (South)	800	0.5	360	117	0	0%	359.9	359.9	70%	Adjusted to assume 30% rock component which will be screened out	251.9	251.9						75%	Adjusted to assume 75% backfill and contouring	188.9	Excavation and consolidated landfill	TSCA	Site Independent		
2.2.6	Camlaren	Metals Impacted Soil	CAM_SO_07	Mine Area (South)	713	1.2	820	120	0	0%	820.3	820.3	70%	Adjusted to assume 30% rock component which will be screened out	574.2	574.2						110%	Adjusted to assume 10% additional material for backfilling	631.6	Excavation and consolidated landfill	TSCA	Site Independent		
2.2.7	Camlaren	Metals Impacted Soil	CAM_SO_08	Mine Area (South)	9922	1.1	10617	462	0	0%	10616.7	10616.7	70%	Adjusted to assume 30% rock component which will be screened out	7431.7	7431.7						80%	Adjusted to assume 50% backfill and contouring	3715.9	Excavation and consolidated landfill	TSCA	Site Independent		
2.2.8	Camlaren	Metals Impacted Soil	CAM_SO_10	Mine Area (South)	362	0.5	163	81	0	0%	163.0	163.0	70%	Adjusted to assume 30% rock component which will be screened out	114.1	114.1						75%	Adjusted to assume 75% backfill and contouring	85.6	Excavation and consolidated landfill	TSCA	Site Independent		
2.2.9	Camlaren	Metals Impacted Soil	CAM_SO_11	Mine Area (South)	371	0.3	111	93	0	0%	111.3	111.3	70%	Adjusted to assume 30% rock component which will be screened out	77.9	77.9						75%	Adjusted to assume 75% backfill and contouring	58.4	Excavation and consolidated landfill	TSCA	Site Independent		
2.2.10	Camlaren	Metals Impacted Soil	CAM_SO_12	Mine Area (South)	1323	0.8	992	240	0	0%	992.4	992.4	70%	Adjusted to assume 30% rock component which will be screened out	694.7	694.7						90%	Adjusted to assume 90% backfill and contouring	625.2	Excavation and consolidated landfill	TSCA	Site Independent		
2.2.11	Camlaren	Metals Impacted Soil	CAM_SO_15	Mine Area (North)	621	0.6	373	128	0	0%	372.6	372.6	100%		372.6	372.6						100%		372.6	Excavation and consolidated landfill	TSCA	Site Independent		
2.2.12	Camlaren	Metals Impacted Soil	CAM_SO_17	Mine Area (North)	94	0.2	14	36	17	48%	7.4	20.9	100%		7.4	20.9						100%		20.9	Excavation and consolidated landfill	TSCA	Site Independent		
2.2.13	Camlaren	Metals Impacted Soil	CAM_SO_18	Mine Area (North)	1311	0.5	599	141	108	77%	137.7	1041.9	100%	Adjusted to assume 30% rock component which will be screened out	1041.9	1041.9						100%		1041.9	Excavation and consolidated landfill	TSCA	Site Independent		
2.2.14	Camlaren	Metals Impacted Soil	CAM_SO_20	Mine Area (North)	79	0.3	24	31	31	75%	5.9	41.5	100%		5.9	41.5						110%		45.6	Excavation and consolidated landfill	TSCA	Site Independent		
2.2.15	Camlaren	Metals Impacted Soil	CAM_SO_21	North Cabin	46	0.4	19	25	7	28%	13.3	23.9	0%	Cobalt impacts therefore adjusted to zero	0.0	0.0										Do nothing	n/a	Site Dependent	
2.2.16	Camlaren	Metals Impacted Soil	CAM_SO_22	North Cabin	29	0.3	9	20	0	0%	8.6	8.6	0%	Cobalt impacts therefore adjusted to zero	0.0	0.0										Do nothing	n/a	Site Dependent	
2.2.17	Camlaren	Metals Impacted Soil	CAM_SO_23	Zenith Island	1332	0.5	666	182	0	0%	666.0	666.0	60%	Adjusted to assume 40% rock component which will be addressed under CAM_WR_02	399.6	399.6						75%	Adjusted to assume 75% backfill and contouring	299.7	Excavation and consolidated landfill	TSCA	Site Independent		
2.2.18	Camlaren	Metals Impacted Soil	CAM_SO_24	Zenith Island	36	0.5	18	25	25	100%	0.0	35.5	100%		0.0	35.5						100%		35.5	Excavation and consolidated landfill	TSCA	Site Independent		
2.3.19	Camlaren	PHC Impacted Soil	CAM_SO_01	Mine Area (South)	473	0.8	378	102	0	0%	378.1	378.1	100%		378.1	378.1						100%		378.1	Excavation and landfill	LF	Site Independent		
2.3.20	Camlaren	PHC Impacted Soil	CAM_SO_03	Mine Area (South)	103	0.4	41	37	0	0%	41.0	41.0	100%		41.0	41.0						75%	Adjusted to assume 75% backfill and contouring	30.8	Excavation and landfill	LF	Site Independent		
2.3.21	Camlaren	PHC Impacted Soil	CAM_SO_05	Mine Area (South)	59	0.2	12	29	0	0%	11.7	11.7	70%	Adjusted to assume 30% rock component which will be screened out	8.2	8.2						110%	Adjusted to assume 10% additional material for backfilling	12.9	Excavation and landfill	LF	Site Independent		
2.3.22	Camlaren	PHC Impacted Soil	CAM_SO_13	Mine Area (South)	240	0.2	48	65	0	0%	48.0	48.0	100%		48.0	48.0						110%	Adjusted to assume 10% additional material for backfilling	52.8	Excavation and landfill	LF	Site Independent		
2.3.23	Camlaren	PHC Impacted Soil	CAM_SO_14	Mine Area (North)	208	0.8	175	58	0	0%	174.9	174.9	100%		174.9	174.9						100%		174.9	Excavation and landfill	LF	Site Independent		
2.3.24	Camlaren	PHC Impacted Soil	CAM_SO_16	Mine Area (North)	256	0.5	120	70	0	0%	120.3	120.3	100%		120.3	120.3													

Table 1 - Hazard Component Summary
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 Stantec Project 121413573

ID #	Site Name	Hazard Category	Hazard Name	Hazard Location	Remediation Area (m ²)	Remediation Depth (m)	Remediation Volume (m ³)	Impacted Soil Polygon Perimeter (m)	Inferred Boundary (m)	Percent of polygon not bound (%)	Remediation Volume with Uncertainty - Min (m ³)	Remediation Volume with Uncertainty - Max (m ³)	Remediation Volume Adjustment Factor	Remediation Volume Adjustment Comment	Adjusted Remediation Volume with Uncertainty - Min (m ³)	Adjusted Remediation Volume with Uncertainty - Max (m ³)	Backfill Area (m ²)	Backfill Depth (m)	Backfill Volume (m ³)	Uncertainty (%)	Backfill Volume with Uncertainty - Max, based on remediation volume (m ³)	Backfill Volume Adjustment Factor (%)	Backfill Volume Adjustment Comment	Adjusted Backfill Volume (m ³)	Remedial Option	Disposal Location	Remedial Option Type	
2.8.41	Camlaren	Abandoned Site Buildings	Old Chimney	Mine Area (South)	2	5.0	10				10.0	10.0	0%	No remedial action required	0.0	0.0									Do nothing	n/a	Site Dependent	
2.9.39	Camlaren	Waste Rock	CAM_WR_02B	Zenith Island- Waste Rock (associated with shaft area)	9	1.0	9				9.0	9.0	100%	Area of CAM_WR_03 outside of metals impacted soil	9.0	9.0					789.8	50%	Assumed 50% backfill and contouring	394.9	Excavation and consolidated landfill	TSCA	Site Independent	
2.9.43	Camlaren	Waste Rock	CAM_WR_02A	Zenith Island- Waste Rock (associated with shaft area)	736	1.0	736				736.0	736.0	40%	Adjusted to account for 60% soil component in CAM_SO_23	294.4	294.4					294.4	50%	Assumed 50% backfill and contouring	147.2	Excavation and consolidated landfill	TSCA	Site Independent	
2.9.44	Camlaren	Waste Rock	CAM_WR_01A	South Muir Island			13644				13644.0	13644.0	30%	Adjusted to assume 70% soil component which will be screened out	4093.2	4093.2									Excavation and consolidated landfill	TSCA	Site Independent	
2.9.45	Camlaren	Waste Rock	CAM_WR_03	Zenith Island- Waste Rock (associated with trenches to the south)	40	0.5	20				20.0	20.0	100%		20.0	20.0									Excavation and consolidated landfill	TSCA	Site Independent	
2.9.46	Camlaren	Waste Rock	CAM_WR_01B	South Muir Island			8895				8895.0	8895.0	0%	Berms surrounding tailings	0.0	0.0									Incorporate into the TSCA	TSCA	Site Dependent	
2.10.47	Camlaren	Tailings	CAM_IL_01	South Muir Island. Within tailings dyke.	15012	3.0	45035			0%	45034.8	45034.8	0%	Material already in place at the TCA	0.0	0.0									Upgrade tailings containment area (TCA) to tailings and soil containment area (TSCA) through consolidation of material in the area	TSCA	Site Dependent	
2.11.48	Camlaren	Hazardous Waste	Burned Battery Area	South Muir Island and North Cabin	2	1.0	2				2.0	2.0	100%		2.0	2.0								Collect and containerize for off-site disposal	Off-site	Site Independent		
2.12.49	Camlaren	Non-Hazardous Waste	Other (Metal, Misc. Debris)	Throughout the Site (Zenith Island and Muir Island)			170				170.0	170.0	25%	Adjusted to reflect 25% remaining after crushing	42.5	42.5									Burn (as appropriate) and landfill	TSCA	Site Independent	
2.12.50	Camlaren	Non-Hazardous Waste	Wood	Throughout the Site (Zenith Island and Muir Island)			30				30.0	30.0	5%	Adjusted to reflect 5% remaining after burn	1.5	1.5									Burn (as appropriate) and landfill	TSCA	Site Independent	
2.13.51	Camlaren	Sediment	Impacted Sediment	Muir Island			0.0				0.0	0.0			0.0	0.0								Do nothing	n/a	Site Independent		
2.14.52	Camlaren	Impacted Water	Impacted Water	Main Camp			0.0				0.0	0.0			0.0	0.0								Do nothing	n/a	Site Independent		
3.2.1	Goodrock	Metals Impacted Soil	GOO_HS_01	Mill Area	54	0.5	27	27	0	0%	27.0	27.0	50%	Volume expected to be reduced by debris and not consistent depth	13.5	13.5					27.0	0%	Assumed no backfilling to be completed	0.0	Excavation and consolidated landfill	TSCA	Site Independent	
3.4.2	Goodrock	Mine Openings	North Mine Shaft	Mill Area							0.0	0.0			0.0	0.0	12.0	3.0	36.0	50%	54.0	80%	Assumed to fill 80% and cap	43.2	Backfill and engineered cap	n/a	Site Dependent	
3.4.3	Goodrock	Mine Openings	South Pit	Mill Area							0.0	0.0			0.0	0.0	18.0	3.0	54.0	50%	81.0	100%		81.0	Backfill	n/a	Site Dependent	
3.4.4	Goodrock	Trenches	Trenches	Camp Area							0.0	0.0			0.0	0.0								Do nothing	n/a	Site Independent		
3.6.5	Goodrock	Trenches	Large Trench Area	Mill Area							0.0	0.0			0.0	0.0								Do nothing	n/a	Site Dependent		
3.7.6	Goodrock	Abandoned Infrastructure	Private Dock	Camp Area	10	0.2	2				2.0	2.0	0%	No remedial action required	0.0	0.0									Do nothing	n/a	Site Dependent	
3.7.7	Goodrock	Abandoned Infrastructure	Dock	450 m northwest of the mill and 450 m south of the camp	30	0.2	6				6.0	6.0	5%	Adjusted to reflect 5% remaining after burn	0.3	0.3									Dismantle, burn and landfill remainder	TSCA	Site Dependent	
3.8.8	Goodrock	Abandoned Site Buildings	Private Cabin #1 and #2	Camp Area	200	0.2	40				40.0	40.0	0%	No remedial action required	0.0	0.0									Do nothing	n/a	Site Dependent	
3.8.9	Goodrock	Abandoned Site Buildings	Private Incinerator	Camp Area	1	2.0	2				2.0	2.0	0%	No remedial action required	0.0	0.0									Do nothing	n/a	Site Dependent	
3.8.10	Goodrock	Abandoned Site Buildings	Former Cabin	Camp Area	133	0.2	27				26.6	26.6	10%	Adjusted to reflect 10% remaining after burn	2.7	2.7									Dismantle, burn and landfill remainder	TSCA	Site Dependent	
3.8.11	Goodrock	Abandoned Site Buildings	Mill Slab	Mill Area	1	1.0	1				1.0	1.0	100%		1.0	1.0								Do nothing (however may be affected during soil removal)	n/a	Site Dependent		
3.9.10	Goodrock	Waste Rock	GOO_WR_02	Mill Area (waste rock associated with trenches)			221				221.0	221.0	0%	Moderate risk impacting waste rock - will be monitored	0.0	0.0									Moderate risk impacting waste rock - monitoring program will be implemented	n/a	Site Dependent	
3.9.11	Goodrock	Waste Rock	GOO_WR_01	Camp Area (waste rock associated with trenches)	70	0.9	63				63.0	63.0	0%	Moderate risk impacting waste rock - will be monitored	0.0	0.0									Moderate risk impacting waste rock - monitoring program will be implemented	n/a	Site Dependent	
3.11.14	Goodrock	Hazardous Waste	Battery Remnants	Camp Area	1	1.0	1				1.0	1.0	100%		1.0	1.0								Collect and containerize for off-site disposal	Off-site	Site Independent		
3.12.15	Goodrock	Non-Hazardous Waste	Other (Metal, Misc. Debris)	Camp Area/Mill Area			20				20.0	20.0	25%	Adjusted to reflect 25% remaining after crushing	5.0	5.0									Burn (as appropriate) and landfill	TSCA	Site Independent	
3.12.16	Goodrock	Non-Hazardous Waste	Wood	Camp Area/Mill Area			56				56.0	56.0	5%	Adjusted to reflect 5% remaining after burn	2.8	2.8									Burn (as appropriate) and landfill	TSCA	Site Independent	
3.13.17	Goodrock	Sediment	Impacted Sediment	Welland			0.0				0.0	0.0			0.0	0.0								Do nothing	n/a	Site Independent		
3.14.18	Goodrock	Impacted Water	Metal Impacted Water	North Shaft and South Pit			0.0				0.0	0.0			0.0	0.0								Do nothing	n/a	Site Independent		
4.1.1	Kidney Pond	Co-Mingled Impacted Soil	KID_SO_07	Portal Area	988	1.1	1087	196	0	0%	1086.8	1086.8	100%		1086.8	1086.8									Excavation and consolidated landfill	WRSCA	Site Independent	
4.1.2	Kidney Pond	Co-Mingled Impacted Soil	KID_SO_11	Portal Area	1301	0.3	390	155	111	72%	110.7	669.7	100%		110.7	669.7									Excavation and consolidated landfill	WRSCA	Site Independent	
4.1.3	Kidney Pond	Co-Mingled Impacted Soil	KID_SO_13	Portal Area	83	0.4	29	33	0	0%	29.1	29.1	100%		29.1	29.1									Excavation and consolidated landfill	WRSCA	Site Independent	
4.2.4	Kidney Pond	Metals Impacted Soil	KID_SO_05	Exploration Camp	51	0.2	10	28	12	42%	5.7	13.9	100%		5.7	13.9									Excavation and consolidated landfill	WRSCA	Site Independent	
4.2.5	Kidney Pond	Metals Impacted Soil	KID_SO_06	Exploration Camp	34	0.2	5	22	6	30%	3.6	6.6	100%		3.6	6.6									Excavation and consolidated landfill	WRSCA	Site Independent	
4.2.6	Kidney Pond	Metals Impacted Soil	KID_SO_08	Portal Area	209	0.2	36	57	40	70%	10.7	60.4	100%		10.7	60.4									Excavation and consolidated landfill	WRSCA	Site Independent	
4.2.7	Kidney Pond	Metals Impacted Soil	KID_SO_12	Kidney Pond Area	171	0.2	34	47	0	0%	34.1	34.1	100%		34.1	34.1									Excavation and consolidated landfill	WRSCA	Site Independent	
4.2.8	Kidney Pond	Metals Impacted Soil	KID_HS_01	1983 Camp Area	15	0.5	8	14	14	100%	0.0	15.0	100%		0.0	15.0									Excavation and consolidated landfill	WRSCA	Site Independent	
4.3.9	Kidney Pond	PHC Impacted Soil	KID_SO_01	1983 Camp	112	0.3	34	45	0	0%	33.7	33.7	100%		33.7	33.7									Excavation and landfarm	LF	Site Independent	
4.3.10	Kidney Pond	PHC Impacted Soil	KID_SO_02	1983 Camp	67	0.3	19	34	0	0%	18.9	18.9	100%		18.9	18.9									Excavation and landfarm	LF	Site Independent	
4.3.11	Kidney Pond	PHC Impacted Soil	KID_SO_03	1983 Camp	94	0.3	31	53	0	0%	31.1	31.1	100%		31.1	31.1									Excavation and landfarm	LF	Site Independent	
4.3.12	Kidney Pond	PHC Impacted Soil	KID_SO_04	1983 Camp	183	0.4	66	96	23	42%	38.2	93.5	100%		38.2	93.5									Excavation and landfarm	LF	Site Independent	
4.3.13	Kidney Pond	PHC Impacted Soil	KID_SO_09	Portal Area	70	0.2	14	30	0	0%	14.1	14.1	100%		14.1	14.1									Excavation and landfarm	LF	Site Independent	
4.3.14	Kidney Pond	PHC Impacted Soil	KID_SO_10	Portal Area	266	0.8	207	87	0	0%	207.3	207.3	100%		207.3	207.3									Excavation and landfarm	LF	Site Independent	
4.4.15	Kidney Pond	Mine Openings	Portal	AEC 17							0.0	0.0			0.0	0.0	18.0	10.0	180.0	50%	270.0	100%	Backfill quantity to be determined based on passive treatment system	270.0	Backfilled, engineered cover and passive treatment system	n/a	Site Dependent	
4.5.16	Kidney Pond	Underground Workings	Underground Workings	Shaft Area							0.0	0.0			0.0	0.0								Addressed as part of portal options	n/a	Site Dependent		
4.6.17	Kidney Pond	Trenches	Trenches	Exploration Camp (AEC 13), Portal Area (northwest and southeast), Kidney Pond Area (AEC 22)							0.0	0.0			0.0	0.0								Do nothing	n/a	Site Dependent		
4.7.18	Kidney Pond	Abandoned Infrastructure	Core Racks	Portal Area/Kidney Pond Area	1	1.0	1				1.0	1.0	25%	Adjusted to reflect 25% remaining after burn	0.3	0.3									Dismantle, burn and landfill remainder	WRSCA	Site Dependent	
4.7.19	Kidney Pond	Abandoned Infrastructure	Docks	1983 Camp and Kidney Pond Area (Sentinel Lake- northeast of Kidney Pond)	30	0.2	6				6.0	6.0	5%	Adjusted to reflect 5% remaining after burn	0.3	0.3									Dismantle, burn and landfill remainder	WRSCA	Site Dependent	
4.8.20	Kidney Pond	Abandoned Site Buildings	Former Buildings (cabin, back remnants)	1939 Camp	50	0.4	20				20.0	20.0	10%	Adjusted to reflect 10% remaining after burn	2.0	2.0									Dismantle, burn and landfill remainder	WRSCA	Site Dependent	
4.9.21	Kidney Pond	Waste Rock	KID_WR_03	Portal Area Trenches	25	1.0	25				25.0	25.0	0%	Moderate risk impacting waste rock - will be monitored	0.0	0.0									No backfilling required	Moderate risk impacting waste rock - monitoring program will be implemented	n/a	Site Dependent
4.9.22	Kidney Pond	Waste Rock	KID_WR_04	Exploration Camp Trenches	25	1.0	25				25.0	25.0	0%	Moderate risk impacting waste rock - will be monitored	0.0	0.0									No backfilling required	Moderate risk impacting waste rock - monitoring program will be implemented	n/a	Site Dependent
4.9.23	Kidney Pond	Waste Rock	KID_WR_01	Waste Rock Area			12596																					

Table 1 - Hazard Component Summary
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ID #	Site Name	Hazard Category	Hazard Name	Hazard Location	Remediation Area (m ²)	Remediation Depth (m)	Remediation Volume (m ³)	Impacted Soil Polygon Perimeter (m)	Inferred Boundary (m)	Percent of polygon not bound (%)	Remediation Volume with Uncertainty - Min (m ³)	Remediation Volume with Uncertainty - Max (m ³)	Remediation Volume Adjustment Factor	Remediation Volume Adjustment Comment	Adjusted Remediation Volume with Uncertainty - Min (m ³)	Adjusted Remediation Volume with Uncertainty - Max (m ³)	Backfill Area (m ²)	Backfill Depth (m)	Backfill Volume (m ³)	Uncertainty (%)	Backfill Volume with Uncertainty - Max, based on remediation volume (m ³)	Backfill Volume Adjustment Factor (%)	Backfill Volume Adjustment Comment	Adjusted Backfill Volume (m ³)	Remedial Option	Disposal Location	Remedial Option Type					
5.2.3	Murray Lake	Metals Impacted Soil	MUR_SO_03	Trench Area	664	0.3	199	96	0	0%	199.3	199.3	0%	Adjusted to zero as no remediation is proposed in this area from risk screening	0.0	0.0									Do nothing	n/a	Site Dependent					
5.2.4	Murray Lake	Metals Impacted Soil	MUR_SO_04	Trench Area	625	0.3	187	91	0	0%	187.4	187.4	0%	Adjusted to zero as no remediation is proposed in this area from risk screening	0.0	0.0										Do nothing	n/a	Site Dependent				
5.2.5	Murray Lake	Metals Impacted Soil	MUR_SO_05	Trench Area	1250	0.4	500	136	0	0%	499.9	499.9	0%	Adjusted to zero as no remediation is proposed in this area from risk screening	0.0	0.0										Do nothing	n/a	Site Dependent				
5.4.6	Murray Lake	Mine Openings	Main Shaft	Trench Area							0.0	0.0			0.0	0.0	10.0	1.5	15.0	50%	22.5	100%		22.5	Backfill	n/a	Site Dependent					
5.4.7	Murray Lake	Mine Openings	Deep Trench/Shaft	Trench Area							0.0	0.0			0.0	0.0	6.0	28.0	168.0	50%	252.0	100%		252.0	Backfill	n/a	Site Dependent					
5.6.8	Murray Lake	Trenches	Trenches	Trench Area							0.0	0.0			0.0	0.0									Do nothing	n/a	Site Dependent					
5.7.9	Murray Lake	Abandoned Infrastructure	1938/2008 Camp		1	1.0	1				1.0	1.0	100%		1.0	1.0								0.0	0.0	Collect material in sumps, burn(as appropriate) and landfill.	TSCA	Site Dependent				
5.9.9	Murray Lake	Waste Rock	MUR_WR_01	Trench Area -Main Shaft Area	2970	0.1	297				297.0	297.0	0%	Moderate risk impacting waste rock - will be monitored	0.0	0.0										Moderate risk impacting waste rock - monitoring program will be implemented	n/a	Site Dependent				
5.9.10	Murray Lake	Waste Rock	MUR_WR_02	Throughout Trench Area (waste rock associated with trenches)	600	0.6	300				300.0	300.0	0%	Moderate risk impacting waste rock - will be monitored	0.0	0.0										Moderate risk impacting waste rock - monitoring program will be implemented	n/a	Site Dependent				
5.12.12	Murray Lake	Non-Hazardous Waste	Other (Metal, Misc. Debris)	Throughout			3				3.0	3.0	25%	Adjusted to reflect 25% remaining after crushing	0.8	0.8										Burn (as appropriate) and landfill	TSCA	Site Independent				
5.12.13	Murray Lake	Non-Hazardous Waste	Wood	Throughout			4				4.0	4.0	5%	Adjusted to reflect 5% remaining after burn	0.2	0.2										Burn (as appropriate) and landfill	TSCA	Site Independent				
5.14.14	Murray Lake	Impacted Water	Metal Impacted Water	Trench Area							0.0	0.0			0.0	0.0									Do nothing	n/a	Site Independent					
6.2.1	Storm Property	Metals Impacted Soil	STO_HS_01	Camp Area	4	0.5	2	8	8	100%	0.0	4.0	100%		0.0	4.0					4.0	0%	No backfilling required	0.0	0.0	Excavation and consolidated landfill	TSCA	Site Independent				
6.2.2	Storm Property	Metals Impacted Soil	STO_SO_01	Shaft Area	331	0.2	50	68	46	67%	16.3	83.1	0%	Adjusted to zero as no remediation is proposed in this area from risk screening	0.0	0.0										Do nothing	n/a	Site Dependent				
6.2.3	Storm Property	Metals Impacted Soil	STO_SO_02	Shaft Area	117	0.4	42	40	0	0%	42.2	42.2	0%	Adjusted to zero as no remediation is proposed in this area from risk screening	0.0	0.0										Do nothing	n/a	Site Dependent				
6.2.4	Storm Property	Metals Impacted Soil	STO_SO_03	Shaft Area	703	0.2	141	104	81	77%	31.9	249.4	0%	Adjusted to zero as no remediation is proposed in this area from risk screening	0.0	0.0										Do nothing	n/a	Site Dependent				
6.4.5	Storm Property	Mine Openings	South Mine Shaft	Shaft Area							0.0	0.0			0.0	0.0	9.0	5.0	45.0	50%	67.5	100%		67.5	Backfill	n/a	Site Dependent					
6.4.6	Storm Property	Mine Openings	North Mine Shaft	Shaft Area							0.0	0.0			0.0	0.0	15.0	3.0	45.0	50%	67.5	100%		67.5	Backfill	n/a	Site Dependent					
6.6.7	Storm Property	Trenches	Trench	Camp Area and Shaft Area							0.0	0.0			0.0	0.0									Do nothing	n/a	Site Dependent					
6.9.8	Storm Property	Waste Rock	STO_WR_01	Shaft Area	80	1.0	80				80.0	80.0	0%	Moderate risk impacting waste rock - will be monitored	0.0	0.0										Moderate risk impacting waste rock - monitoring program will be implemented	n/a	Site Dependent				
6.9.9	Storm Property	Waste Rock	STO_WR_02	Shaft Area (waste rock associated with trenches)	30	1.0	30				30.0	30.0	0%	Moderate risk impacting waste rock - will be monitored	0.0	0.0										Moderate risk impacting waste rock - monitoring program will be implemented	n/a	Site Dependent				
6.11.10	Storm Property	Hazardous Waste	Battery Remnants	Camp Area	1	1.0	1				1.0	1.0	100%		1.0	1.0										Collect and containerize for off-site disposal	Off-site	Site Independent				
6.12.11	Storm Property	Non-Hazardous Waste	Other (Metal, Misc. Debris)	Throughout			10				10.0	10.0	25%	Adjusted to reflect 25% remaining after crushing	2.5	2.5										Burn (as appropriate) and landfill	TSCA	Site Independent				
6.12.12	Storm Property	Non-Hazardous Waste	Wood	Throughout			12				12.0	12.0	5%	Adjusted to reflect 5% remaining after burn	0.6	0.6										Burn (as appropriate) and landfill	TSCA	Site Independent				
6.13.13	Storm Property	Sediment	Impacted Sediment	Camp Area							0.0	0.0			0.0	0.0									Do nothing	n/a	Site Independent					
7.2.1	Treacy	Metals Impacted Soil	TRE_SO_01	Mill Area	1738	0.4	695	201	30	15%	591.6	798.7	25%	Adjusted to assume 75% rock component and bedrock outcropping	147.9	199.7							199.7	75%	Assumed backfill 75% and contour	149.7	Excavation and consolidated landfill	WRSCA	Site Independent			
7.2.2	Treacy	Metals Impacted Soil	TRE_SO_03	Camp Area	31	0.2	6	21	0	0%	6.1	6.1	100%		6.1	6.1									6.1	75%	Assumed backfill 75% and contour	4.6	Excavation and consolidated landfill	WRSCA	Site Independent	
7.3.3	Treacy	PHC Impacted Soil	TRE_SO_02	Mill Area	37	0.5	19	28	0	0%	18.7	18.7	100%		18.7	18.7									18.7	75%	Assumed backfill 75% and contour	14.0	Excavation and landfarm	LF	Site Independent	
7.4.4	Treacy	Trenches	East Trench	Mill Area							0.0	0.0			0.0	0.0	40.0	3.0	120.0	50%	180.0	110%	Adjusted to account for uncertainty	198.0	Backfill	n/a	Site Dependent					
7.4.5	Treacy	Trenches	Other Trenches	Mill Area							0.0	0.0			0.0	0.0										Do nothing	n/a	Site Dependent				
7.4.6	Treacy	Trenches	West Trench	Mill Area							0.0	0.0			0.0	0.0	10.0	2.0	20.0	9%	20.0	110%	Adjusted to account for uncertainty	22.0	Backfill	n/a	Site Dependent					
7.8.7	Treacy	Abandoned Site Buildings	Mill Remains	Mill Area	25	0.5	13				12.5	12.5	10%	Adjusted to reflect 10% remaining after burn	1.3	1.3										Dismantle, burn and landfill remainder	WRSCA	Site Dependent				
7.9.8	Treacy	Waste Rock	TRE_WR_01	Mill Area	127	1.3	165				165.1	165.1	70%	Adjusted to assume 70% soil component which will be screened out	115.6	115.6										115.6	0%	Assumed no backfilling to be completed	0.0	Excavation and consolidated landfill	WRSCA	Site Independent
7.10.9	Treacy	Tailings	TRE_IL_01	Mill Area	7	1.5	11			25%	7.9	13.1	100%		7.9	13.1									13.1	100%	Excavation and consolidated landfill	WRSCA	Site Dependent			
7.11.10	Treacy	Hazardous Waste	Painted Wood Debris	Mill Area			0				0.1	0.1	100%		0.1	0.1										Package for off-site disposal	Off-site	Site Independent				
7.12.11	Treacy	Non-Hazardous Waste	Other (Metal, Misc. Debris)	Mill Area / Camp Area			19				19.0	19.0	25%	Adjusted to reflect 25% remaining after crushing	4.8	4.8											Burn (as appropriate) and landfill	WRSCA	Site Independent			
7.12.12	Treacy	Non-Hazardous Waste	Wood	Mill Area / Camp Area			36				36.0	36.0	5%	Adjusted to reflect 5% remaining after burn	1.8	1.8											Burn (as appropriate) and landfill	WRSCA	Site Independent			
7.13.13	Treacy	Sediment	Impacted Sediment	Treacy							0.0	0.0			0.0	0.0										Do nothing	n/a	Site Independent				
7.14.14	Treacy	Impacted Water	Metal Impacted Water	Camp Area							0.0	0.0			0.0	0.0										Do nothing	n/a	Site Independent				
8.4.1	Iry Me	Mine Openings	Shaft	Main Camp							0.0	0.0			0.0	0.0	4.0	5.0	20.0	50%	30.0	100%		30.0	Backfill and engineered cap	n/a	Site Dependent					
8.4.2	Iry Me	Trenches	Trenches	Main Camp							0.0	0.0			0.0	0.0										Do nothing	n/a	Site Dependent				
8.7.3	Iry Me	Abandoned Infrastructure	Core Racks	Main Camp	1	1.0	1				1.0	1.0	25%	Adjusted to reflect 25% remaining after burn	0.3	0.3											Dismantle, burn and landfill remainder	TSCA	Site Dependent			
8.7.4	Iry Me	Abandoned Infrastructure	Dock	Main Camp	30	0.2	6				6.0	6.0	5%	Adjusted to reflect 5% remaining after burn	0.3	0.3											Dismantle, burn and landfill remainder	TSCA	Site Dependent			
8.8.5	Iry Me	Abandoned Site Buildings	Cabin and Other Wooden Structures	Main Camp	85	0.1	9				8.5	8.5	10%	Adjusted to reflect 10% remaining after burn	0.9	0.9											Dismantle, burn and landfill remainder	TSCA	Site Dependent			
8.11.6	Iry Me	Hazardous Waste	Battery	Western Camp	1	1.0	1				1.0	1.0	100%		1.0	1.0										Collect and containerize for off-site disposal	Off-site	Site Independent				
8.12.7	Iry Me	Non-Hazardous Waste	Other (Metal, Misc. Debris)	Western Camp and Main Camp (including Rail Spur)			22				22.0	22.0	25%	Adjusted to reflect 25% remaining after crushing	5.5	5.5											Burn (as appropriate) and landfill	TSCA	Site Independent			
8.12.8	Iry Me	Non-Hazardous Waste	Wood	Western Camp and Main Camp			15				15.0	15.0	5%	Adjusted to reflect 5% remaining after burn	0.8	0.8											Burn (as appropriate) and landfill	TSCA	Site Independent			
8.13.9	Iry Me	Sediment	Impacted Sediment	Main Camp							0.0	0.0			0.0	0.0										Do nothing	n/a	Site Independent				
8.14.10	Iry Me	Impacted Water	Metal Impacted Water	Main Camp							0.0	0.0			0.0	0.0										Do nothing	n/a	Site Independent				
9.1.1	West Bay	Co-Mingled Impacted Soil	WES_SO_03	South Area	45	0.3	14	27	7	26%	10.0	17.1	100%		10.0	17.1										17.1	100%	Excavation and consolidated landfill	WRSCA	Site Independent		
9.2.2	West Bay	Metals Impacted Soil	WES_SO_06	South Area	76	0.4	30	36	0	0%	30.4	30.4	50%	Adjusted to assume 50% actual volume based on bedrock outcropping	15.2	15.2											15.2	100%	Excavation and consolidated landfill	WRSCA	Site Independent	
9.2.3	West Bay	Metals Impacted Soil	WES_SO_02	South Area	984	0.4	394	392	38	10%	355.4	431.7	100%		355.4	431.7																

Table 1 - Hazard Component Summary
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ID #	Site Name	Hazard Category	Hazard Name	Hazard Location	Remediation Area (m ²)	Remediation Depth (m)	Remediation Volume (m ³)	Impacted Soil Polygon Perimeter (m)	Inferred Boundary (m)	Percent of polygon not bound (%)	Remediation Volume with Uncertainty - Min (m ³)	Remediation Volume with Uncertainty - Max (m ³)	Remediation Volume Adjustment Factor	Remediation Volume Adjustment Comment	Adjusted Remediation Volume with Uncertainty - Min (m ³)	Adjusted Remediation Volume with Uncertainty - Max (m ³)	Backfill Area (m ²)	Backfill Depth (m)	Backfill Volume (m ³)	Uncertainty (%)	Backfill Volume with Uncertainty - Max, based on remediation volume (m ³)	Backfill Volume Adjustment Factor (%)	Backfill Volume Adjustment Comment	Adjusted Backfill Volume (m ³)	Remedial Option	Disposal Location	Remedial Option Type	
9.9	West Bay	Mine Openings	Open Pit	South Area							0.0	0.0			0.0	0.0	2000.0	12.0	24000.0	50%	36000.0	0%	No backfilling required	0.0	Perimeter barricade	n/a	Site Dependent	
9.7.10	West Bay	Abandoned Infrastructure	Cone Racks	South Area	1	1.0	1				1.0	1.0	25%	Adjusted to reflect 25% remaining after burn	0.3	0.3									Dismantle, burn and landfill remainder	WRSCA	Site Dependent	
9.7.11	West Bay	Abandoned Infrastructure	Docks	South Area	30	0.2	6				6.0	6.0	5%	Adjusted to reflect 5% remaining after burn	0.3	0.3										Dismantle, burn and landfill remainder	WRSCA	Site Dependent
9.8.12	West Bay	Abandoned Site Buildings	Structure Remains	South Area - Camp Area	70	0.3	21				21.0	21.0	10%	Adjusted to reflect 10% remaining after burn	2.1	2.1										Dismantle, burn and landfill remainder	WRSCA	Site Dependent
9.9.13	West Bay	Waste Rock	WES_WR_01	South Area (East Waste Rock Pile)			5679				5679.0	5679.0	0%	Material to be managed in place	0.0	0.0					0.0	0%	No backfilling required		Do nothing	n/a	Site Independent	
9.9.14	West Bay	Waste Rock	WES_WR_02	South Area (West Waste Rock Pile)			9337				9337.0	9337.0	0%	Material to be managed in place	0.0	0.0					0.0	0%	No backfilling required		Do nothing	n/a	Site Independent	
9.10.15	West Bay	Tailings	WES_TL_01	South Area	949	0.3	255			25%	191.1	318.4	100%		191.1	318.4					318.4	50%	Assumed backfilling to 50% of removed volume to allow for contouring	159.2	Excavation and consolidated landfill	WRSCA	Site Independent	
9.11.16	West Bay	Hazardous Waste	Battery	South Area	1	1.0	1				1.0	1.0	100%		1.0	1.0									Collect and containerize for off-site disposal	Off-site	Site Independent	
9.12.17	West Bay	Non-Hazardous Waste	Other (Metal, Misc. Bags)	South Area			10				10.0	10.0	25%	Adjusted to reflect 25% remaining after crushing	2.5	2.5										Burn (as appropriate) and landfill	WRSCA	Site Independent
9.12.18	West Bay	Non-Hazardous Waste	Wood	South Area			5				5.0	5.0	5%	Adjusted to reflect 5% remaining after burn	0.3	0.3										Burn (as appropriate) and landfill	WRSCA	Site Independent
9.13.19	West Bay	Sediment	Impacted Sediment	Main Site							0.0	0.0			0.0	0.0									Do nothing	n/a	Site Independent	
9.14.20	West Bay	Impacted Water	Metal Impacted Water	South Area							0.0	0.0			0.0	0.0									Do nothing	n/a	Site Independent	

Table 2 - Remedial Option Ranking Summary
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Waste Category	Option	Description	RO #	Score	Cost	Effectiveness	Timeframe	Ease	Regulatory	Community	Comment
Co-mingled Impacted Soil	Cap and cover	Would include placement of a rock cover over the co-mingled impacted soil areas to reduce the potential for human and ecological contact with the soil.	RO - 1.1	12	3	2	1	3	2	1	
Co-mingled Impacted Soil	Excavation & on-site landfill	Would include excavation of co-mingled impacted soil and construction of a landfill at that particular mine site (ie landfills at each site)	RO - 1.2	13	2	3	2	2	2	2	
Co-mingled Impacted Soil	Excavation & consolidated landfill	Would include excavation of co-mingled impacted soil and construction of a landfill at one mine site, where all co-mingled impacted soil would be placed	RO - 1.3	15	2	3	3	3	2	2	
Co-mingled Impacted Soil	Excavation & disposal off-site	Would include excavation of co-mingled impacted soil and disposal off-site (likely in Alberta or BC) at a licensed disposal facility	RO - 1.4	12	1	3	1	1	3	3	
Co-mingled Impacted Soil	Phyto-remediation	Would include strategic planting of species of plants known to degrade PHC and update metals	RO - 1.5	9	3	1	1	2	1	1	
Metals Impacted Soil	Cap and Cover	Would include placement of a rock cover over the metals impacted soil areas to reduce the potential for human and ecological contact with the soil.	RO - 2.1	12	3	2	1	3	2	1	
Metals Impacted Soil	Excavation & on-site landfill	Would include excavation of metals impacted soil and construction of a landfill at that particular mine site (ie landfills at each site)	RO - 2.2	13	2	3	2	2	2	2	
Metals Impacted Soil	Excavation & consolidated landfill	Would include excavation of metals impacted soil and construction of a landfill at one mine site, where all metals impacted soil would be placed	RO - 2.3	15	2	3	3	3	2	2	
Metals Impacted Soil	Excavation & disposal off-site	Would include excavation of metals impacted soil and disposal off-site (likely in Alberta or BC) at a licensed disposal facility	RO - 2.4	12	1	3	1	1	3	3	
Metals Impacted Soil	Phyto-remediation	Would include strategic planting of species of plants known to uptake metals	RO - 2.5	9	3	1	1	2	1	1	
PHC Impacted Soil	Cap and cover	Would include placement of a rock cover over the PHC impacted soil areas to reduce the potential for human and ecological contact with the soil.	RO - 3.1	12	3	2	1	3	2	1	
PHC Impacted Soil	Excavation & on-site landfill	Would include excavation of PHC impacted soil and construction of a landfill at that particular mine site (ie landfills at each site)	RO - 3.2	13	2	3	2	2	2	2	
PHC Impacted Soil	Excavation & consolidated landfill	Would include excavation of PHC impacted soil and construction of a landfill at one mine site, where all PHC impacted soil would be placed	RO - 3.3	15	2	3	3	3	2	2	
PHC Impacted Soil	Excavation & disposal off-site	Would include excavation of PHC impacted soil and disposal off-site (likely in Alberta or BC) at a licensed disposal facility	RO - 3.4	13	1	3	2	1	3	3	
PHC Impacted Soil	Landfarm	Would include excavation of PHC impacted soil, construction of a landfarm area, filling and amending the pile with nutrients, and final use as top cover of Waste Rock and Tailings Containment Areas	RO - 3.5	15	2	3	3	1	3	3	
Mine Openings	Do nothing	No action would be taken to address the mine opening	RO - 4.1	0							Site Dependent Hazard Component
Mine Openings	Backfill	The mine opening would be backfilled with waste rock/borrow material	RO - 4.2	0							Site Dependent Hazard Component
Mine Openings	Engineered cap	The mine opening would be sealed with an engineered cap (an engineered foam seal)	RO - 4.3	0							Site Dependent Hazard Component
Mine Openings	Engineered cap with passive treatment system	The mine opening would be sealed with an engineered cap with a passive water treatment system to address seeping surface or groundwater	RO - 4.4	0							Site Dependent Hazard Component
Mine Openings	Construct Barrier	A barrier will be constructed to restrict access to consist of either boulders locally sources or a berm constructed of borrow material	RO - 4.5	0							Site Dependent Hazard Component
Underground Workings	Do nothing	No action would be taken for the underground workings	RO - 5.1	0							Site Dependent Hazard Component
Underground Workings	Backfill	The underground workings would be filled in either from the surface or through directionally drilled holes	RO - 5.2	0							Site Dependent Hazard Component
Underground Workings	Construct Rock/Berm Barrier	A surface rock/berm barrier would be placed to identify where the underground workings are located and restrict access for heavy machinery	RO - 5.3	0							Site Dependent Hazard Component
Underground Workings	Construct Fence Barrier	A fence would be placed to identify where the underground workings are located and restrict access for heavy machinery	RO - 5.4	0							Site Dependent Hazard Component
Trenches	Do nothing	No action would be taken for the trench	RO - 6.1	0							Site Dependent Hazard Component
Trenches	Backfill	The trench would be backfilled with waste rock/borrow material to grade	RO - 6.2	0							Site Dependent Hazard Component
Trenches	Cap	The trench would be sealed with a cap (in most cases a foam seal)	RO - 6.3	0							Site Dependent Hazard Component
Abandoned Infrastructure	Do nothing	No action would be taken for the abandoned infrastructure, or it will remain as a heritage item	RO - 7.1	0							Site Dependent Hazard Component
Abandoned Infrastructure	Demolition, burn (as appropriate), and on-site landfill	The abandoned infrastructure would be demolished, any wood material would be burned, and the remainder of the material would be placed in an on-site landfill (ie landfills at each site)	RO - 7.2	0							Site Dependent Hazard Component
Abandoned Infrastructure	Demolition, burn (as appropriate), and consolidated landfill	The abandoned infrastructure would be demolished, any wood material would be burned, and the remainder of the material would be placed in a landfill constructed at a landfill at one mine site	RO - 7.3	0							Site Dependent Hazard Component
Abandoned Infrastructure	Demolition, burn (as appropriate), and off-site landfill	The abandoned infrastructure would be demolished, any wood material would be burned, and the remainder of the material would be disposal off-site (likely in Yellowknife) at a licensed disposal facility	RO - 7.4	0							Site Dependent Hazard Component
Abandoned Site Buildings	Do nothing	No action would be taken for site buildings	RO - 8.1	0							Site Dependent Hazard Component
Abandoned Site Buildings	Demolition, burn (as appropriate), and on-site landfill	The abandoned site buildings would be demolished, any wood material would be burned, and the remainder of the material would be placed in an on-site landfill (ie landfills at each site)	RO - 8.2	0							Site Dependent Hazard Component
Abandoned Site Buildings	Demolition, burn (as appropriate), and consolidated landfill	The abandoned site buildings would be demolished, any wood material would be burned, and the remainder of the material would be placed in a landfill constructed at a landfill at one mine site	RO - 8.3	0							Site Dependent Hazard Component
Abandoned Site Buildings	Demolition, burn (as appropriate), and off-site landfill	The abandoned site buildings would be demolished, any wood material would be burned, and the remainder of the material would be disposal off-site (likely in Yellowknife) at a licensed disposal facility	RO - 8.4	0							Site Dependent Hazard Component
Waste Rock	Leave in place and monitor	Waste rock would be left in place and a monitoring program consisting of downgradient surface water and soil sampling would be completed	RO - 9.1	12	3	1	3	3	1	1	
Waste Rock	Excavation & consolidated waste rock containment area	Would include excavation of PAG waste rock and construction of a waste rock containment area at one mine site, where all PAG waste rock would be placed	RO - 9.2	13	2	3	2	2	2	2	
Waste Rock	Excavation & disposal off-site	Would include excavation of PAG waste rock and disposal off-site (likely in Alberta or BC) at a licensed disposal facility	RO - 9.3	12	1	3	1	1	3	3	
Waste Rock	Excavation & on-site waste rock containment area	Would include excavation of PAG waste rock soil and construction of a waste rock containment area at that particular mine site (ie waste rock containment areas at each site)	RO - 9.4	11	2	3	1	1	2	2	
Tailings	Excavation & on-site TCA	Tailings would be excavated and placed in an on-site TCA (ie TCA at that mine site)	RO - 10.1	11	1	3	1	2	2	2	
Tailings	Excavation & consolidated TCA	Tailings would be excavated and placed in one consolidated TCA (ie one TCA, at Camlaren)	RO - 10.2	15	2	3	3	3	2	2	
Tailings	Excavation & disposal off-site	Tailings would be excavated and disposed of off-site (likely in Alberta or BC) at a licensed disposal facility	RO - 10.3	12	1	3	1	1	3	3	
Tailings	Phyto-remediation	Would include strategic planting of species of plants known to uptake metals	RO - 10.4	11	2	2	1	2	2	2	
Hazardous Waste	Collect and containerize for off-site disposal	Hazardous waste material would be collected, containerized and disposed of off-site in a licensed facility	RO - 11.1	17	2	3	3	3	3	3	
Hazardous Waste	Collect and place in an on-site containment area	Hazardous waste material would be collected and placed in a centralized hazardous waste disposal facility	RO - 11.2	7	1	1	1	1	2	1	
Non-hazardous Waste	Do nothing	Debris would be left on-site where it is located	RO - 12.1	12	3	1	3	3	1	1	
Non-hazardous Waste	Burn (as appropriate), and on-site landfill	The non-hazardous waste would be collected, any wood material would be burned, and the remainder of the material would be placed in an on-site landfill (ie landfills at each site)	RO - 12.2	9	1	2	1	1	2	2	
Non-hazardous Waste	Burn (as appropriate), and consolidated landfill	The non-hazardous waste would be collected, any wood material would be burned, and the remainder of the material would be placed in a landfill constructed at a landfill at one mine site	RO - 12.3	12	2	2	2	2	2	2	
Non-hazardous Waste	Burn (as appropriate), and off-site landfill	The non-hazardous waste would be collected, any wood material would be burned, and the remainder of the material would be disposal off-site (likely in Yellowknife) at a licensed disposal facility	RO - 12.4	15	1	3	2	3	3	3	
Impacted Water	Do nothing	Contaminated water would remain where it is located and no action would be taken	RO - 14.1	12	3	1	3	3	1	1	
Impacted Water	Ex-Situ Treatment	Contaminated water would be pumped through a treatment system	RO - 14.2	12	1	3	1	1	3	3	
Impacted Water	In-Situ Chemical Adjustment	Chemicals would be added to water in-situ to adjust chemistry and precipitate metals	RO - 14.3	10	2	2	2	1	2	1	

BOLD Indicates recommended option

APPENDIX D Risk Review



Stantec Consulting Ltd.
10160 112 Street, Edmonton AB T5K 2L6

January 15, 2016
File: 121413573

Attention: Matthew McElwaine
Public Works and Government Services Canada
5th Floor, Telus Tower, 10025 Jasper Avenue
Edmonton, AB T5J 1S6

Dear Mr. McElwaine,

Reference: Risk Review of Contaminated Soils/Waste Rock at the Storm Property Shaft Area, Murray Lake Trench Area and Try Me Main Camp Area, Gordon Lake Group of Mine and Mineral Exploration Sites, Northwest Territories

INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by Public Works and Government Services Canada – Northern Contaminated Sites Group (PWGSC-NCSSG) on behalf of Aboriginal Affairs and Northern Development Canada (AANDC) to prepare this risk review of contaminated soils/waste rock at Storm Property (Shaft Area), Murray Lake (Trench Area) and Try Me (Main Camp Area) within the Gordon Lake Group of mine and mineral exploration sites as part of the Gordon Lake Group (GLG) project. The purpose of the risk review was to assess the potential human and ecological health risks if contaminated soils/waste rock were left onsite in their current condition.

Note that the assessment of potential risks from soil and waste rock uses the same approach for human health; therefore, they are presented together in the Risk Review for Human Health section. However, owing to the potential for acid rock drainage from waste rock and the resulting effects on ecological receptors, the assessment of waste rock and soil has been presented separately within the Risk Review for Ecological Health section.

BACKGROUND

The site-specific remedial target (SSRT) for arsenic (69 mg/kg) was adopted to guide soil remediation activities at the Gordon Lake Group of mine and mineral exploration sites. This SSRT was developed by Stantec from the initial SSRT proposed in the Human Health and Ecological Risk Assessment (HHERA) conducted by SLR in 2014 (SLR, 2014). Modifications to SLR's method were introduced by Stantec in the letter report dated December 15, 2014, "*Supplemental Assessment of Site-Specific Remedial Targets for Nine Former Mine Sites, Gordon Lake, Northwest Territories*" to correct for unrealistic levels of conservatism.

Stantec's revised SSRT was developed following guidance from the Canadian Council of Ministers of the Environment (CCME, 2006) and was based on a modified Health Canada exposure scenario for a hypothetical toddler residential receptor with direct soil contact that accounted for



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the regional snow-free period of the year when direct soil contact would be feasible (i.e., 24 hours/day, 7 days/week for 26 weeks/year).

Based on the screening of available soil samples against the arsenic SSRT (69 mg/kg), Table 1 summarizes the areas identified for potential remediation at the Shaft Area at Storm Property and the Trench Area at Murray Lake. Table 1 also shows the area of waste rock proposed for excavation at Try Me (Main Camp Area). It should be noted that the overall impacted area for all three sites represents less than 0.5 hectares (ha).

Table 1 - Summary of Areas Identified for Potential Remediation

Remedial Area	Area (m ²)
Storm Property (Shaft Area)	
STO_SO_01	331
STO_SO_02	117
STO_SO_03	703
Total	1151
Murray Lake (Trench Area)	
MUR_SO_02	433
MUR_SO_03	664
MUR_SO_04	625
MUR_SO_05	1250
Total	2972
Try Me (Main Camp Area)	
TRY_WR_01	53

RISK REVIEW FOR HUMAN HEALTH

Since the arsenic SSRT was developed, the Homiiti (Gordon Lake) Traditional Knowledge Report by the Yellowknives Dene First Nation (YKDFN, 2015) has become available, which provides information on current and past traditional uses at each of the Gordon Lake Mine Sites. The following information was summarized from the Traditional Knowledge Report for each of the areas assessed in this risk review:



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- **Storm Property (Shaft Area)** - The elders, hunter/trappers and YKDFN's Traditional Knowledge Specialist that visited each of the Gordon Lake Mine sites did not know anything about Storm Property, suggesting that the site was not historically or currently used for traditional purposes. Storm Property is not located on or near a traditional trail.
- **Murray Lake (Trench Area)** - A major trail from Gordon Lake to the Yellowknife River passes through Murray Lake and runs just south of the Camp Area. Before burning down, there was an old trappers cabin on the north shore of Murray Lake, located approximately 500 m - 1000 m from the former mine workings. The Elders were not concerned that clean-up of the Trench Area would impact any past or current use of the area.
- **Try Me (Main Camp Area)** - Elders had no knowledge of past use of the lake, nor any trails that passed through or near this mine site which is located adjacent to Mac Lake.

Given the lack of historical or current traditional use of the areas assessed in this risk review, and the fact that intended future use does not include residential development, the arsenic SSRT of 69 mg/kg, which is based on the protection of a residential receptor, is considered overly conservative in these instances.

Therefore, an alternate arsenic SSRT, which was proposed by Stantec (2014) based on an exposure scenario for a Site Visitor/Camper receptor (one month exposure duration), is considered more realistic while still being protective given that the rough, undulating nature of these sites are not likely attractive to campers. Given that the purpose of the risk review is to assess potential risk assuming no remedial activities, the SSRT proposed by Stantec (2014) for a remediation worker receptor was not considered applicable.

As detailed in Stantec's letter report (Stantec, 2014), the arsenic SSRT for a First Nations Site Visitor/Camper assuming exposure of 24 hours/day, 7 days/week for 4 weeks/year is 245 mg/kg for non-carcinogenic effects. Given the sub-chronic duration of exposure (i.e., less than 90 days), a sub-chronic toxicity reference value (TRV) for arsenic (0.005 mg/kg-day) was originally identified from the United States Environmental Protection Agency's Provisional Peer Reviewed Toxicity Value (PPRTV) archive and used to calculate the sub-chronic arsenic SSRT. Although the PPRTV archive no longer lists arsenic, the same sub-chronic TRV value (0.005 mg/kg-day) was recommended to Health Canada by Haber and Meek (2014), based on the assessment of short-term toxicity conducted by the United States Agency for Toxic Substances and Disease Registry (ATSDR, 2007). Consistent with Health Canada guidance, the sub-chronic exposure was not amortized beyond the assumed 4 week exposure duration in calculation of the SSRT.

Given the non-residential, short-term (4 weeks) duration of the most probable activity at these sites (i.e., camping), a non-carcinogenic short-term TRV is the most relevant TRV for assessing potential



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human health risks at these sites. As a result, the non-carcinogenic SSRT of 245 mg/kg is considered protective of human receptors that are likely to access or occupy the areas assessed in this review.

The proposed SSRT based on human health assumes no practical difference between soils and waste rock. Both are particulate in nature, both will adhere to skin surfaces for dermal absorption and, both can be inadvertently ingested via hand-to-mouth transfer (rock dust in the case of waste rock). However, given the much larger particulate size in waste rock, application of the arsenic SSRT to waste rock is conservative with respect to health protection.

To assess potential risks to human receptors if impacted soils/waste rock were to remain *in situ*, arsenic concentrations in soils/waste rock were screened against the revised SSRT considering a First Nations Site Visitor/Camper. To accurately represent the average concentration of arsenic in soil/waste rock to which a mobile human receptor may be exposed across each site, the 95% upper confidence limit of the mean (95% UCLM) was calculated using ProUCL ver. 5.0 where adequate sample sizes were available (i.e., $n \geq 10$). The 95% UCLM is the most reliable estimate of the exposure point concentration to which a receptor would be exposed, on average across the site and throughout a 4 week site visit. When the 95% UCLM is less than or equal to the SSRT, the arsenic exposures that would be calculated for this receptor will be less than the target hazard quotient for assessment of risks posed by short-term onsite exposures.

The results are summarized in Table 2, which show that the 95% UCLM at the Storm Property Shaft Area is less than the revised arsenic SSRT, as are the maximum and 95% UCLM concentrations at the Murray Lake Trench Area, and the maximum concentration in waste rock at the Try Me Main Camp Area. These results suggest that there will be no human health risks if contaminated soils/waste rock are left *in situ* in these areas.

Table 2 - Screening of Arsenic Soil Concentrations at each Mine Site

Mine Site	Number of Samples	Maximum Concentration (mg/kg)	95% UCLM (mg/kg)	Revised SSRT (mg/kg)	Potential Human Health Risk?
Storm Property (Shaft Area)	21	580 ^a	214	245	No
Murray Lake (Trench Area)	42	230	73	245	No
Try Me (Main Camp Area)	4 ^b	17.5	NA ^c	245	No

Note:

- ^a Three samples exceed the revised arsenic SSRT of 245 mg/kg.
- ^b Four waste rock samples collected and analyzed for trace metals.
- ^c Less than 10 samples; therefore, the 95% UCLM could not be calculated.



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RISK REVIEW FOR ECOLOGICAL HEALTH

According to the 2014 HHERA conducted by SLR (SLR, 2014), no ecological risks were identified in soil at the Murray Lake Trench Area. Therefore, contaminated soils left *in situ* are not anticipated to result in adverse ecological effects.

However, potential risks were identified for plants and soil invertebrates at the Storm Property Shaft Area. No species at risk have been identified at the Storm Property Shaft Area; therefore, plants and soil invertebrates were considered at the community level (as opposed to the individual level). As a result, the 95% UCLM was used to represent the concentration of arsenic to which the greater community of plants and soil invertebrates are assumed to be exposed within and around the Storm Property Shaft Area. Compared to the maximum value, the 95% UCLM is a better measure of the exposure a community of sessile organisms may experience.

Dividing the arsenic 95% UCLM calculated from all available data at the Storm Property Shaft Area (214 mg/kg) by the arsenic TRV identified by SLR for the protection of terrestrial plants and soil invertebrates (62 mg/kg) results in a hazard quotient (HQ) of 3.5, which suggests there is a potential for effects on the more sensitive species of terrestrial plants and soil invertebrates.

Although a potential risk is indicated, vegetation within the Storm Property Shaft Area did not appear to be impacted during fieldwork performed in support of the 2014 HHERA (SLR, 2014). That is, there did not appear to be a difference between the abundance, density or diversity of plants between the Storm Property Shaft Area and the surrounding areas. Given the northern location and climatic conditions, both would be characterized as low density, low productivity habitats dominated by bare or lichen-covered bedrock outcrops and rocky, sparsely vegetated soils (see Figure 1).

Although there are poorly vegetated areas at the site that are likely the product of soil contamination and/or lingering physical disruption of the thin surface soil (see Figure 2), these areas are relatively small and do not pose a significant risk to the larger ecosystem, including species higher up in the food web such as birds and mammals (SLR, 2014).



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Figure 1 – Habitat at the Storm Property Shaft Area



Figure 2 – Mine Shaft at the Storm Property



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Although improvements made to the soil quality (i.e., excavation of contaminated soils) would be expected to provide enhanced opportunity for recovery, excavation and establishing access routes to these areas would also result in immediate (albeit temporary) destruction of the terrestrial habitat, including terrestrial plants and soil invertebrates. As a result, the plant community (and associated wildlife habitat) would regress to its earliest stages of succession and would further delay recovery, thus providing limited benefit.

Therefore, given the limited spatial distribution of contaminated soils (1151 m²) and the fact that vegetation appears to be recovering naturally, the limited impact that arsenic is having on terrestrial plants and soil invertebrates does not appear to be extended to the community level at the Storm Property Shaft Area. As a result, there is little benefit in excavating contaminated soils, and maintaining conditions in their current state represents a reasonable alternative.

Potentially Acid Generating Waste Rock

Waste rock at the Try Me Main Camp Area (approximately 53 m²) has been characterized as likely potentially acid generating (PAG). As a result, runoff from the waste rock has the potential to be acidic and elevated in dissolved metal content, relative to that associated with the more neutral pH of precipitation runoff. This poses potential risks to the terrestrial environment (i.e., terrestrial plants and soil invertebrates) over which the runoff flows, and to any receiving aquatic waterbody.

Where the runoff enters surface water, it can have adverse impacts on the health of aquatic receptors (e.g., fish, benthic invertebrates, aquatic plants); however, the nearest waterbody with aquatic life at the Try Me Main Camp is Mac Lake, which is located approximately 100 m east of the waste rock at the site. Surface water samples collected from Mac Lake show that pH ranges from 6-8, which is within acceptable limits for the protection of freshwater aquatic life. Additionally, no ecological risks were identified in surface water from dissolved metals at the Try Me Main Camp Area in the 2014 HHERA (SLR, 2014). Therefore, it is not anticipated that waste rock at the site is having adverse effects on the aquatic environment.

Localized effects on the terrestrial environment (i.e., barren rock that is recovering at a slow pace) are evident in the vicinity of the waste rock at the site (see Figure 3). However, given the limited spatial distribution of the contaminated waste rock (53 m²) and the fact that remediation would require the construction of a new winter road spur into the site (which would necessitate extensive brush clearing and associated impacts, including potential permafrost degradation), maintaining conditions in their current state represents a reasonable alternative.



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Figure 3 – Waste Rock at the Try Me Main Camp Area

CONCLUSIONS

It is not anticipated that arsenic will result in significant impacts to human health or ecological receptors if contaminated soils are left *in situ* at the Storm Property Shaft Area or Murray Lake Trench Area. However, if residential development of these areas is planned in the future, it is recommended that these results be reexamined to ensure the protection of human receptors.

At the Try Me Main Camp Area, it is not anticipated that waste rock left *in situ* will result in significant impacts to human health or the aquatic environment; however, both the physical and chemical characteristics of the waste rock produce localized effects on the terrestrial environment, and recovery appears to be progressing at a slow pace. Within the surrounding area, these localized effects are not significant, but unlike the areas of soil contamination at Storm Property and Murray Lake, recovery will take much longer if the waste rock is left *in situ*.



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CLOSURE

This letter report documents work that was completed in accordance with generally accepted professional standards at the time the services were provided. No other representations, warranties or guarantees are made concerning the accuracy or completeness of the data or conclusions contained within this report, including no assurance that this work has uncovered all potential liabilities associated with the identified property.

This work was undertaken exclusively for the purpose outlined herein and was limited to those contaminants, exposure pathways, receptors, and related uncertainties specifically referenced in this report. This work was specific to the site conditions and land use considerations described herein. All information received from the client or third parties in the preparation of this report has been assumed by Stantec to be correct. Stantec assumes no responsibility for any deficiency or inaccuracy in information received from others.

The opinions in this report can only be relied upon as they relate to the condition of the portions of the identified properties that were assessed at the time the work was conducted. Activities at the properties subsequent to Stantec's assessment may have significantly altered the properties' condition. Stantec cannot comment on other areas of the properties that were not assessed.

Conclusions made within this report consist of Stantec's professional opinion as of the time of the writing of this report, and are based solely on the scope of work described in the report and the limited data available. They are not a certification of the properties' environmental condition. This report should not be construed as legal advice.

This report has been prepared for the client identified herein and any reliance by any third party is strictly prohibited. Stantec assumes no responsibility for losses, damages, liabilities or claims, howsoever arising, from third party use of this report.

The conclusions are based on the site conditions encountered at the time the field work was performed at the specific testing and/or sampling locations, and conditions may vary among sampling locations. In addition, analysis was carried out for only a limited number of chemical parameters, and it should not be inferred that other chemical species are not present. This document describes only the applicable risks associated with the identified environmental hazards, and is not intended to imply a risk-free site. The identification of non-environmental risks to structures or people on the site is beyond the scope of this assessment.

Should additional information become available which differs significantly from our understanding of conditions presented in this report, Stantec specifically disclaims any responsibility to update the conclusions in this report.



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This report was prepared by Alexis Fast, M.E.Des. and reviewed by G. Mark Richardson, Ph.D., Ulysses Klee, Ph.D. and David Wilson, CD, M.A.Sc., P.Eng.

Respectfully Submitted,

STANTEC CONSULTING LTD.

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APPENDIX E West Bay Review

To: Matthew McElwaine
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From: David Wilson, Nikolay Sidenko, Xéna
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Bouchard
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File: 121413573 Task 500.100

Date: March 22, 2016

**Reference: Gordon Lakes Group Mine Sites Remediation – Evaluation of West Bay Waste Rock
Acid Rock Drainage**

INTRODUCTION

West Bay is located on the south portion of Gordon Lake, towards the east side of the Lake. West Bay staked its first claim in the mid-1940s and began mining for gold in an open pit from 1947 to 1948. During this time, trenching and diamond milling occurred concurrently. It was recorded that ore was being processed on-site in a small mill operation using mercury amalgamation, until work ceased in September of 1948. Work resumed with exploration drilling occurring from 1982 to 1984 which identified additional resources of gold around the open pit. The second round of open pit mining occurred in 1990. In 1991, the ore material was transported to Yellowknife for processing. There has been no further mining activities reported since then (EBA, 2009). Two large waste rock piles, excavated from the pit, are the focus of this acid rock drainage (ARD) evaluation. Their locations, and proximity to the pit and to Gordon Lake, are shown on Figure I-7 in the Revised Draft Gap Assessment (Stantec, 2016), and are attached as Figure A.3 for reference.

SCOPE OF WORK

The goal of this examination is to determine the risk that drainage from the waste rock piles pose to the receiving environment and to define the level of uncertainty associated with the determination, such that subsequent work to reduce the uncertainty could be defined.

The tasks undertaken to satisfy this scope were as follows:

- Compile previous waste rock and surface water quality data
- Evaluate the data to select results and locations for use in estimating contaminant of concern (CoC) mass loadings
- Complete a sub-watershed runoff analysis
- Pair selected CoC concentrations with runoff estimates to generate worst case and expected case CoC mass loadings
- Evaluate results with respect to risk posed to the aquatic environment, and uncertainties

Reference: Gordon Lakes Group Mine Sites Remediation – Evaluation of West Bay Waste Rock Acid Rock Drainage

BACKGROUND

GEOMORPHOLOGY

The West Bay mine site is located in the Great Slave Uplands of the Taiga Shield - Low Subarctic Ecoregion which is characterized by interconnected lakes, low-relief, glacially polished bedrock plateaus with thin silt to gravel till cover, black-spruce-lichen woodlands, peat bogs and large forest fire burnt areas (Ecosystem Classification Group, 2008; Olthof et. al., 2014). This region is within the tree-line to tundra transition and features discontinuous permafrost as well as prominent examples of frost-jacking throughout most of the sites. The streams and interconnected lakes transport and deposit fine lacustrine deposits as well as glaciofluvial sediments.

The property-scale topography features northeast-trending linear ridges of exposed bedrock and associated depressions, with unknown thickness of overburden. The average slope dips gently to the southwest.

ACID ROCK DRAINAGE

As reported in the Phase III Environmental Site Assessment (AECOM, 2010), ARD and metal leaching (ML) potential were observed in a surface water sample from a pond that collects leachate draining from the west waste rock pile. Stantec undertook additional assessment in 2015/2016 of the waste rock data collected in earlier investigations, and has summarized that information in the following paragraphs.

In 2010, AECOM collected a total of 10 samples: four from the east waste rock pile, four from the west waste rock pile, and two from the tailings area. Eight of the ten samples were categorized as potentially acid generating (PAG). Although acid-base accounting (ABA) analysis was performed on all samples, rinse pH and carbonate neutralization potential (NP) analyses were not. Metal leaching was conducted by toxicity characteristics leaching potential (TCLP) leachate analysis on one of the tailing samples. Parkland Geo, commissioned by SLR (2013), collected a total of six samples from tailings, bedrock and waste rock. Lithology descriptions were not included in Parkland's report. One of the six samples (tailings) was characterized as PAG, and the remaining as non-PAG. Stantec concluded that the discrepancies between the sampling events were likely due to variation in sampling protocols and the heterogeneous nature of the narrow-zoned deposits (Stantec, 2016).

Stantec assessed the heterogeneity of the waste rock relating to PAG and non-PAG rock (Stantec, 2016). AECOM (2010) determined the waste rock composition to consist of 80% greywacke and 20% quartzite. Quartzite is known to occur in the region, but was not identified in the 1958 or 1985 mapping efforts. Although quartzite and quartz veining have the same chemical composition, the texture and the physical and chemical processes that form these rock types differ substantially. It is possible that the white quartz 'blowout' vein was misidentified as quartzite as described in the 2010 report. Based upon the review of previous work, including mining assessment and environmental assessment reports, Stantec concludes that the West Bay mine site waste rock piles comprise acid generating and metal leaching material. The majority (~80% as per AECOM, 2010) of this material includes PAG slate and greywacke with lesser amounts of non-PAG white quartz veins. For remediation purposes, the waste rock piles should be conservatively considered as homogeneous.

Reference: Gordon Lakes Group Mine Sites Remediation – Evaluation of West Bay Waste Rock Acid Rock Drainage

METAL LEACHING AND WATER QUALITY

Metal Leaching potential was estimated from samples of surface water (attached as Table A.1 for reference). Surface water sampled (sample ID 'West Rock Pile Pond') from ponding water down-gradient from the west waste rock pile featured concentrations exceeding background by two to three orders of magnitude for total and dissolved aluminum, cadmium, copper, iron, nickel, selenium and zinc, as per CCME Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (FAL) criteria (AECOM, 2010). This sample exceeded Metal Mining Effluent Guidelines (MMER) for nickel (4 times) and zinc (4.4 times); it also exceeded Guidelines for Industrial Waste Discharges in the NWT for zinc (4 times). This water body was acidic with a pH of 3.94, indicating acid generation. Surface water sampled (sample ID 'WB-Surface 3') down-gradient of the east waste rock pile exceeded CCME FAL guidelines for total aluminum and lead, dissolved and total copper, nickel and zinc, with a pH of 6.6.

Surface water sampled from the pit during the Phase I (Dillon, 2007), Phase II (EBA, 2009), and Phase III (AECOM, 2010) ESAs indicated exceedances of metals including copper in six of the nine samples (up to 9 times CCME FAL) and zinc in two of the nine samples (up to 1.5 times CCME FAL), while pH ranged from 7.0 to 8.5. The concentration of aluminum, iron, nickel and manganese are elevated when compared with samples from Gordon Lake, although they are below applicable guidelines. When compared to the pit lake, the highest metal concentrations of the west waste rock pile runoff are 78 times greater for aluminum, 72 times greater for zinc, 200 times greater for nickel, 3.7 times greater for copper, 88 times greater for cadmium and 8.4 times greater for iron.

A surface water sample from a swampy area south of the pit lake had a pH of 6.92 and exceeded CCME FAL criteria in total aluminum, copper and iron (Dillon, 2007). Two groundwater monitors installed south of the waste rock piles showed exceedances of total aluminum and copper, with a total copper concentration approximately equal to the concentration of dissolved copper at sample ID 'WB-Surface 3'. Table 1 below summarizes the maximum CoC concentrations found during previous sampling in proximity to the waste rock piles (see Figures I-7 and 3.9 in Stantec, 2016 for sample locations – attached as Figure A.3 for reference):

Table 1: Maximum CoC Concentrations Found During Previous Sampling in Proximity to the Waste Rock Piles

Parameter	FAL µg/L	Max. µg/L	Ratio ⁶	pH or Hardness	Location (ID) & Date
Aluminum ¹	5	7800	1560	3.94 pH	WEST ROCK PILE POND 28-Aug-09
Cadmium ²	0.37 _{LTG}	8.8	23.8	330.4 mg/L CaCO ₃	
Copper ³	4	67	16.8	330.4 mg/L CaCO ₃	
Iron	300	2300	7.7	-	
Manganese	- ⁵	62.7	1.3 ⁵	-	WB 9 Pit Water South Potential Drainage
Nickel ⁴	150	3000	20	330.4 mg/L CaCO ₃	WEST ROCK PILE POND 28-Aug-09
Zinc	30	3300	110	330.4 mg/L CaCO ₃	

1. pH dependent (5 for pH < 6.5, 100 for pH > 6.5).
 2. Hardness-dependent: the CWQG for cadmium (i.e. long-term guideline - LTG) of 0.09 µg·L⁻¹ is for waters of 50 mg CaCO₃·L⁻¹ hardness. The CWQG for cadmium is related to water hardness (as CaCO₃): at hardness ≥ 17 to ≤ 280 mg/L, the CWQG is calculated using this equation (CWQG (µg/L) = 10{0.83(log[hardness]) - 2.46 }); At hardness > 280 mg/L, the CWQG is 0.37 µg/L.

Reference: Gordon Lakes Group Mine Sites Remediation – Evaluation of West Bay Waste Rock Acid Rock Drainage

3. Hardness-dependent: the CWQG for copper is related to water hardness. When the water hardness is 0 to < 82 mg/L, the CWQG is 2 µg/L. At hardness ≥82 to ≤180 mg/L the CWQG is calculated using this equation: $CWQG (\mu\text{g/L}) = 0.2 * e^{(0.8545[\ln(\text{hardness})]-1.465)}$. At hardness >180 mg/L, the CWQG is 4 µg/L. If the hardness is unknown, the CWQG is 2 µg/L.
4. The CWQG for nickel is related to water hardness. When the water hardness is 0 to ≤ 60 mg/L, the CWQG is 25 µg/L. At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG (\mu\text{g/L}) = e^{(0.76[\ln(\text{hardness})]+1.06)}$. At hardness >180 mg/L, the CWQG is 150 µg/L. If the hardness is unknown, the CWQG is 25 µg/L.
5. No FAL criteria: GCDWQ value of 50 µg/L used to calculate ratio (aesthetic/operational guideline).
6. Times greater than FAL guidelines

The maximum exceedances to CCME FAL criteria found in previous sampling in Gordon Lake are shown in Table 2 (see Figures I-6, I-7 and 3.9 in Stantec, 2016 for sample locations – attached as Figure A.3 for reference):

Table 2: Maximum CoC Concentrations Found during Previous Sampling in Gordon Lake in Proximity to West Bay

Parameter	FAL µg/L	Max. µg/L	Ratio ⁶	pH or Hardness	Location (ID)
Aluminum ¹	100	15	0.15	7.57-7.65 pH	WB5/WB6 1-Aug-04
Cadmium ²	0.19 _{LTG}	0.05	0.26	37.67/37.92 mg/L CaCO ₃	
Copper ³	2	6.3	3.15	37.92 mg/L CaCO ₃	WB5 1-Aug-04
Iron	300	30	0.1	-	SM302-SW13 5-Oct-13/WB 6 1-Aug-04
Manganese	- ⁵	2	0.04 ⁵	-	
Nickel ⁴	25	1.8	0.07	37.76 mg/L CaCO ₃	SM302-SW13 5-Oct-13
Zinc	30	5	0.17	37.67/37.92 mg/L CaCO ₃	WB5/WB6 1-Aug-04

1. to 6. See Table 1.

Background samples from the vicinity of West Bay and from reference locations at Sandy Point and Green Island (total of three) were compared to CCME FAL guidelines and are shown in Table 3. Background samples from other sites were not included in this comparison.

Table 3: Maximum CoC Concentrations Found during Background Assessment

Parameter	FAL µg/L	Max. µg/L	Ratio ⁶	pH or Hardness	Location (ID)
Aluminum ¹	100	84	0.84	8.0 pH	BGSW 09-01
Cadmium ²	0.11 _{LTG}	0.011	0.10	7.128 mg/L CaCO ₃	
Copper ³	2	1.2	0.60	7.128 mg/L CaCO ₃	
Iron	300	60	0.20	7.128 mg/L CaCO ₃	
Manganese	- ⁵	9	0.18 ⁵	7.128 mg/L CaCO ₃	
Nickel ⁴	25	0.6	0.02	7.128 mg/L CaCO ₃	
Zinc	30	15	0.50	41.00 mg/L CaCO ₃	SPT_BKGD_2015_001

1. to 6. See Table 1.

While the CoC are below CCME FAL guidelines for the background samples, aluminum, copper, and zinc are approaching FAL guidelines (≥ 0.50 times greater than FAL). These elevated metal concentrations are likely due to the normal influence of the naturally occurring undisturbed mineral deposits around Gordon Lake.

Reference: **Gordon Lakes Group Mine Sites Remediation – Evaluation of West Bay Waste Rock Acid Rock Drainage**

METHODOLOGY

SUB-WATERSHED ANALYSIS

The water balance for the West Bay mine site was simulated for this analysis. Two sub-watersheds were modelled in two separate scenarios. Portions of both the pit lake and the wetland sub-watersheds include waste rock piles. The surface runoff from the east waste rock pile is assumed to drain roughly equally into the two sub-watersheds in both scenarios. The majority of the west waste rock pile flows north into the pit lake in Scenario 1, while the entire pile flows south and west in Scenario 2. The attached Figure A.1 and Figure A.2 show the sub-watershed discretization produced for this evaluation. This evaluation includes this wetland as the most likely point where ARD from the waste rock piles mixes with significant surface water runoff from the remainder of the sub-watershed.

The GoldSim™ Monte Carlo simulation software was used to calculate the water balance for the West Bay mine site. As climate and hydrologic data is unavailable for the site, nearby data sources and assumptions were made to simulate the water balance. The Environment and Climate Change Canada (ECCC) Yellowknife Airport (Climate ID 2204100) meteorological station is located approximately 80 km southeast of the site. Mean monthly snowfall and rainfall data from this station's 60-year dataset (1953-2012) were used as inputs to this model. Runoff coefficients (the fraction of precipitation which runs off on land surface) used for the waste rock piles, and the other remaining watersheds, were 0.3 and 0.4, respectively. Sublimation from snow to water vapor was set to 35 mm annually, 1/8th of which occurs in each month from October to May. Melting of the remaining snowpack was set to occur during June and July, with 2.2% and 3.2% of snowpack melting per day in these two months, respectively. The combined runoff and snowmelt constitute total inflow to either the pit lake or wetland. Results from this model are shown in Table 4.

Table 4: Sub-Watershed Scenarios

Month	Scenario 1				Scenario 2			
	Total inflow to Pit Lake (m ³ /mon)	Waste Rock inflow to Wetland (m ³ /mon)	Undisturbed Inflow to Wetland (m ³ /mon)	Total Wetland Inflow (m ³ /mon)	Total inflow to Pit Lake (m ³ /mon)	Waste Rock inflow to Wetland (m ³ /mon)	Undisturbed Inflow to Wetland (m ³ /mon)	Total Wetland Inflow (m ³ /mon)
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0
Apr	13	2	194	196	9	3	196	199
May	70	9	1043	1052	50	16	1053	1069
Jun	599	78	8956	9034	429	141	9039	9179
Jul	559	73	8360	8432	401	131	8437	8568
Aug	382	50	5720	5770	274	90	5773	5863
Sep	177	23	2653	2676	127	42	2677	2719

Reference: Gordon Lakes Group Mine Sites Remediation – Evaluation of West Bay Waste Rock Acid Rock Drainage

Month	Scenario 1				Scenario 2			
	Total inflow to Pit Lake (m ³ /mon)	Waste Rock inflow to Wetland (m ³ /mon)	Undisturbed Inflow to Wetland (m ³ /mon)	Total Wetland Inflow (m ³ /mon)	Total inflow to Pit Lake (m ³ /mon)	Waste Rock inflow to Wetland (m ³ /mon)	Undisturbed Inflow to Wetland (m ³ /mon)	Total Wetland Inflow (m ³ /mon)
Oct	25	3	372	376	18	6	376	382
Nov	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0
Annual m ³	1824.3	237.8	27298.2	27535.2	1307.9	428.2	27550.5	27978.5
W.shed m ²	17252.0	2863.0	246443.0	249306.0	12668.0	5155.0	248735.0	253890.0
Runoff mm	105.7	83.1	110.8	110.4	103.2	83.1	110.8	110.2

WATER QUALITY ESTIMATES

For the purpose of this assessment, the sub-watershed around the pit is assumed to flow into the pit lake. The pit lake is assumed to not have an apparent overflow into the environment and is permanently stratified. The upper-layer of such stratified lakes have seasonal turnover with some, although limited, mixing occurring. The lower-layer is permanently stratified and likely has sulfate reducing conditions that result in precipitation of metal sulfides. The current assumption is that the drainage from the waste rock piles is denser and sinks to the lower-layer. Because of this assumption, we currently consider the pit lake as a sink of metals disconnected from Gordon Lake. This assumption should be confirmed with further work.

The primary focus of this analysis is the estimated runoff concentrations at the wetland southwest of the waste rock piles. Concentrations of elements in waste rock runoff are represented by two cases:

1. Expected case – drainage from east waste rock pile pond ('WB-Surface 3', Table 5)
2. Worst case – drainage from west waste rock pile pond (('West Bay Pile Pond', Table 5)

Table 5: Source and Predicted Concentrations of Potential CoC

Source concentrations for potential CoC, µg/L										
Sample	Assumed to represent	pH	Alkalinity	Al	Cd	Cu	Fe	Mn	Ni	Zn
CCME FAL	Guideline	6.5-9.0	n/v	100 ¹	1 ²	2 ³	300	n/v	25 ⁴	30
MMER	Limit	n/v	n/v	n/v	n/v	450	n/v	n/v	750	750
WB-Surface 3	Expected runoff from waste rock	6.6	n/v	190	0.1	10	310	24	43	85
West Rock Pile Pond	Worst case runoff from waste rock	3.94	n/v	7800	8.8	67	2300	39000	3000	3300
BGSW 09-01	Runoff from rest of watershed	8	n/d ~35	84	0.011	1.2	60	9	0.6	6

Reference: Gordon Lakes Group Mine Sites Remediation – Evaluation of West Bay Waste Rock Acid Rock Drainage

1. to 6. See Table 1.

Clean runoff from up-gradient is represented by background sample (BGSW 09-01, per Table 3 and Table 4). The concentration in runoff from the “Wetland” watershed (C_{WR}) was calculated as follows:

$$C_{WT} = (C_{WR} \times Q_{WR} + C_C \times (Q_{WT} - Q_{WR})) / Q_{WT}$$

Where:

- C_{WR} - element concentration in waste rock for expected or worst case inputs (Table 1)
- Q_{WR} - annual flow from waste rock area located in wetland watershed for expected or worst case (Table 5 and Table 1-6)
- C_C - element concentration in clean runoff (Table 4)
- Q_{WT} - annual flow from wetland watershed for expected or worst case (Table 5, Table 6 and Table 7)

The worst case inputs are:

- C_{WR} is water quality from west waste rock pile pond
- Q_{WR} is higher annual flow from waste rock piles to the Wetland watershed (Scenario 2 Table 4).

The results of calculations are presented in Table 6, Table 7 and Table 8.

RESULTS

EXPECTED AND WORST CASE MASS LOADING ESTIMATES

The sub-watershed runoff and mass loading estimates by month are tabulated below as expected and worst case scenarios:

Table 6: Expected Case Monthly and Annual Runoff and Mass Loadings

Drainage (m ³ /mo.)			Expected Case Mass Loading into Wetland (gram)							
Waste Rock	Rest of Watershed	Total Wetland Inflow	Month	Al	Cd	Cu	Fe	Mn	Ni	Zn
0	0	0	Jan	0	0	0	0	0	0	0
0	0	0	Feb	0	0	0	0	0	0	0
0	0	0	Mar	0	0	0	0	0	0	0
2	196	198	Apr	16	0.00	0.24	12	8	0.1	1
9	1055	1064	May	88	0.01	1.3	63	35	0.7	7
78	9064	9142	June	757	0.11	11.1	540	307	6.4	57
73	8460	8533	July	707	0.10	10.3	504	287	6.0	53
50	5786	5836	Aug	483	0.07	7.1	345	196	4.1	36
23	2684	2707	Sept	224	0.03	3.3	160	91	1.9	17

Reference: Gordon Lakes Group Mine Sites Remediation – Evaluation of West Bay Waste Rock Acid Rock Drainage

3	377	380	Oct	31	0.00	0.46	22	12	0.3	2
0	0	0	Nov	0	0	0	0	0	0	0
0	0	0	Dec	0	0	0	0	0	0	0
237.9	27621.9	27859.8	Annual	2307	0.32	33.69	1645	935	19.5	173

Table 7: Worst Case Monthly and Annual Runoff and Mass Loadings

Drainage (m ³ /mo.)			Worst Case Mass Loading into Wetland (gram)							
Waste Rock	Rest of Water-shed	Total Wetland Inflow	Month	Al	Cd	Cu	Fe	Mn	Ni	Zn
0	0	0	Jan	0	0	0	0	0	0	0
0	0	0	Feb	0	0	0	0	0	0	0
0	0	0	Mar	0	0	0	0	0	0	0
3	200	203	Apr	40	0.03	0.44	19	119	9	11
16	1074	1091	May	213	0.15	2.3	100	633	49	59
141	9231	9371	June	1859	1.3	20.3	867	5580	428	520
131	8616	8747	July	1731	1.2	18.9	808	5185	398	483
90	5893	5983	Aug	1187	0.9	13.0	553	3562	273	332
42	2733	2775	Sept	552	0.4	6.0	257	1662	128	155
6	384	390	Oct	78	0.06	0.9	36	237	18	22
0	0	0	Nov	0	0	0	0	0	0	0
0	0	0	Dec	0	0	0	0	0	0	0
428.4	28130.4	28559.2	Annual	5660.5	4.1	61.8	2639.8	16979.0	1303.5	1581.0

Under a simple mixing scenario, with no losses within the wetland, the expected and worst case CoC concentrations in the wetland discharge are given in the following table:

Table 8: Annualized Wetland Discharge Concentration with Simple Mixing

Annualized Wetland Discharge Concentration with Simple Mixing (µg/L)							
Scenario	Aluminum	Cadmium	Copper	Iron	Manganese	Nickel	Zinc
CCME FAL	100 ¹	1 ²	2 ³	300	n/v	25 ⁴	30
Expected Case	83.8	0.0	1.3	62.2	9.1	1.0	6.7
Worst Case	199.7	0.1	2.2	93.6	593.9	45.6	55.4
Ratios							

Reference: Gordon Lakes Group Mine Sites Remediation – Evaluation of West Bay Waste Rock Acid Rock Drainage

Worst Case/FAL	2.0	0.14	1.1	0.31	11.88	1.8	1.8
Worst Case/ Expected Case	2.4	12.1	1.8	1.6	17.5	64.5	8.8
Expected Case/FAL	0.84	0.0	0.65	0.21	0.18	0.04	0.22

1. to 6. See Table 1.

The drainage analysis shows the waste rock piles rest on a hydraulic divide with flows splitting north towards the pit and south then west to Gordon Lake. Overland flow (sheet flow) is likely a minor component and flows, in general, are likely low given significant summer and winter evaporative/sublimation losses – estimates of surface flows have assumed maximum flow conditions (no subsurface infiltration) and have assumed that the majority of the west pile flows will be to the south. CoCs have been identified (Al, Cd, Cu, Fe, Mn, Ni, Zn) and concentrations in runoff were estimated for expected case and worst case scenarios (corresponding to results shown by samples ‘WB-Surface 3’ and ‘West Rock Pile Pond,’ respectively) with associated metal loadings for use as an upper bound in evaluating the risk posed by this runoff. Modeled metals concentrations based on the West Rock Pile Pond analytical results, under the expected case scenario wetland discharge, exceed FAL by 8 to 156 times. For copper specifically that exceedance ratio is 16.8 times. This reduces to 0.14 to 11.9 times (1.8 times for copper) under the worst case scenario wetland discharge.

The receptor of primary concern is Gordon Lake; at present, aquatic habitat is unknown in the wetland area between the waste rock piles and the Lake. Gordon Lake water quality shows no exceedances of FAL for any of the CoCs except copper (worst exceedance at 3.2 times FAL).

The likelihood of the estimated expected and worst case loadings being representative of actual conditions is difficult to predict given the areas of uncertainty (uncertainties are discussed below). Notwithstanding, there is some indication that the CoC loadings to Gordon Lake are not high: the sediment results closest to the wetland (WB-Sed-07 and WB-Sed-08; EBA, 2009) show no exceedances of Sediment Quality Guidelines for parameters evaluated (which included cadmium, copper, nickel, and zinc but not aluminum or manganese) and the surface water results in Gordon Lake show results with only one CoC (Cu) exceeding FAL criteria.

SIGNIFICANCE OF RISK TO THE AQUATIC ENVIRONMENT

At another of the Gordon Lake sites, Camlaren, where extensive surface water and sediment analysis has been completed along with benthic invertebrate analysis and risk assessment, surface water exceedances of copper up to 21.3 times FAL have been shown in the Lake – risk assessment at Camlaren suggests that the only CoC for surface water with potential for aquatic toxicity is arsenic (which is not a surface water CoC at West Bay), and even at a worst case of 30 times FAL it has not been found to present an aquatic toxicity risk, based upon benthic invertebrate tissue concentrations. The surface water results for Camlaren, showing maximum concentrations measured compared to West Bay, are shown in Table 9 below:

Reference: **Gordon Lakes Group Mine Sites Remediation – Evaluation of West Bay Waste Rock Acid Rock Drainage**

Table 9: Comparison of Modeled Impact Ratios with Surface Water Impacts Measured at Camlaren with West Bay

Parameter	Site	FAL µg/L	Max. µg/L	Ratio ⁶	pH or Hardness	Location (ID)
Aluminum ¹	Camlaren	100	1100	11	6.72 pH	AEC 9 Mine Area South SM205-SW-04-a 18-Sep-12
	West Bay	5	7800	1560	3.94 pH	AEC 1 Waste Rock Area WEST ROCK PILE POND 28-Aug-09
Arsenic	Camlaren	5	150	30	-	AEC 9 Mine Area South SM205-SW-04-a 18-Sep-12
	West Bay	5	5	1	7.36 pH	AEC 1 Waste Rock Area WB 1A 1-Aug-04
Cadmium ²	Camlaren	0.37 _{LIG}	1.24	3.4	942 mg/L CaCO ₃	AEC 6 Mine Area South SM205-SW-040 26-Jun-09
	West Bay	0.37 _{LIG}	8.8	23.8	330.4 mg/L CaCO ₃	AEC 1 Waste Rock Area WEST ROCK PILE POND 28-Aug-09
Copper ³	Camlaren	3	64	21.3	134 mg/L CaCO ₃	AEC 8B Mine Area North SM205-SW-02-a 18-Sep-12
	West Bay	4	67	16.8	330.4 mg/L CaCO ₃	AEC 1 Waste Rock Area WEST ROCK PILE POND 28-Aug-09
Iron	Camlaren	300	11000	36.7	-	AEC 8B Mine Area North SM205-SW-02-a 18-Sep-12
	West Bay	300	2300	7.7	330.4 mg/L CaCO ₃	AEC 1 Waste Rock Area WEST ROCK PILE POND 28-Aug-09
Lead ⁴	Camlaren	7	59	8.4	317 mg/L CaCO ₃	AEC 9 Mine Area South SM205-SW-04-a 18-Sep-12
	West Bay	1	0.5	0.5	33.2 mg/L CaCO ₃	AEC 1 North Area Gordon Lake SM466-SW-045 4-Jul-09
Manganese	Camlaren	- ⁵	960	19 ⁵	-	AEC 8B Mine Area North SM205-SW-02-a 18-Sep-12
	West Bay	- ⁵	485	9.7 ⁵	6.92 pH	AEC 1 Waste Rock Area WB 9 1-Aug-04
Selenium	Camlaren	1	4	4	-	AEC 6 Mine Area South SM205-SW-041 26-Jun-09
	West Bay	1	0.7	0.7	3.94 pH	AEC 1 Waste Rock Area WEST ROCK PILE POND 28-Aug-09
Zinc	Camlaren	30	140	4.7	-	AEC 8B Mine Area North SM205-SW-02-a 18-Sep-12
	West Bay	30	3300	110	3.94 pH	AEC 1 Waste Rock Area WEST ROCK PILE POND 28-Aug-09

1, -3, and 5, 6. See Table 1.

4. The CWQG for lead is related to water hardness. When the hardness is 0 to ≤ 60 mg/L, the CWQG is 1 µg/L. At hardness >60 to ≤ 180 mg/L the CWQG is calculated using this equation: CWQG (µg/L) = e{1.273[ln(hardness)]-4.705}. At hardness >180 mg/L, the CWQG is 7 µg/L. If the hardness is unknown, the CWQG is 1 µg/L.

UNCERTAINTIES

Several areas of uncertainty exist, and require additional investigation, as outlined in Table 9:

Design with community in mind

Reference: Gordon Lakes Group Mine Sites Remediation – Evaluation of West Bay Waste Rock Acid Rock Drainage

Table 10: Areas of Uncertainty and Recommended Response

Area of Uncertainty	Applies To	Recommended Response
Location of hydraulic divide beneath waste rock piles (particularly the west pile)	Estimated flows from waste rock piles northwards or southwards	Ground truthing of assumptions (indications of drainage direction).
Nature of pit lake (degree of mixing; potentially meromictic)	Interpretation of pit lake water quality results and trends	Sampling of the water column and sediment for field parameters (TDS, DO, temperature, ORP, EC, pH) and CoCs. Monitor pit lake elevations.
Drainage and water quality (surface and groundwater) between waste rock piles and wetland to the southwest	Area southwards/downgradient of waste rock piles, including wetland	Investigation of drainage (surface and sub-surface flows) in late freshet with measurement of flow volumes where possible; collection of samples for CoC analysis
Impact of spring freshet on drainage	Drainage from waste rock piles	Investigation of snow pack before spring melt ¹
Variability in waste rock drainage water quality	Locations in proximity to waste rock previously sampled	Collection of samples for analysis of CoCs at all previously sampled locations in proximity to waste rock piles
Depth to bedrock	Water collection/diversion design	Investigation including outcrop mapping and field survey

1. Being undertaken in March 2016

It is recommended that the uncertainty reduction investigations be undertaken during the summer of 2016, with the exception of the snow pack investigation currently to be completed in March 2016. There is little data and no surface water data between the waste rock piles and the wetland. The fate and transport of metals mobilized from the piles and draining southward is not known beyond the proximate groundwater sample points. The critical questions are:

1. Whether there is a metals ‘plume’ that could be migrating southwards that hasn’t yet reached the Lake; and
2. Whether the pit presents a risk to lake water quality.

The resolution of these questions should be the primary focus of additional data collection and monitoring efforts.

CONCLUSION

Through use of surface water quality results in proximity to the West Bay waste rock piles to define expected case and worst case ARD conditions, coupled with estimates of runoff, mass loadings of CoCs have been estimated. These estimates, under a worst case scenario, do show potential for exceedances of FAL criteria within the wetland area south of the waste rock piles and subsequently into Gordon Lake. These exceedances are significantly lower than those observed at Camlaren,

Reference: Gordon Lakes Group Mine Sites Remediation – Evaluation of West Bay Waste Rock Acid Rock Drainage

where the recent risk assessment toxicity evaluation suggests non-toxic conditions for aquatic invertebrates. Multiple areas of uncertainty hamper consideration of these estimates for West Bay as being conclusive, and future work to reduce uncertainty is recommended.

CLOSURE

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This report was prepared by David Wilson, M.A.Sc., P.Eng., Xéna Montague, B.Sc. (Hons.), GIT and Michael Trudell, P.Eng. Stantec internal review was provided by Nikolay Sidenko, Ph.D., P.Geo., and Marc Bouchard, P.Eng.

Respectfully submitted,

STANTEC CONSULTING LTD.

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david.wilson@stantec.com

Attachment: Figures A.1-A.2. Sub-watershed Discretization
Table A.1 Surface Water Quality Table
Figure A.3 Surface Water Sample Locations

c. C.C.

Reference: Gordon Lakes Group Mine Sites Remediation – Evaluation of West Bay Waste Rock Acid Rock Drainage

REFERENCES

AECOM, 2010. Phase III Environmental Site Assessment, West Bay Mine, Gordon Lake, Northwest Territories, report prepared by AECOM for PWGSC, dated March 31, 2010.

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EBA Engineering Consultants Ltd (EBA), 2009. Phase II Environmental Site Assessment for West Bay/Blackridge Mine SM 302, report dated April 2009.

Ecosystem Classification Group. 2008. Ecological Regions of the Northwest Territories – Taiga Shield. Department of Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT, Canada. viii + 146 pp.

Olthof, I., Kerr, D.E., Wolfe, S.A., and Eagles, S., 2014. Predictive Surficial Materials and Surficial Geology from LANDSAT-7, Upper Carp Lake, NTS 85-P, Northwest Territories; Geological Survey of Canada, Open File 7601. doi:10.4095/293970

Parkland Geo-Environmental Ltd. (Parkland), 2014. Summarization Report for Camlaren, Treacy, Kidney Pond, and West Bay mine sites for SLR Consulting for Aboriginal Affairs and Northern Development Canada.

Stantec Consulting Ltd. (Stantec), 2016. Revised Draft Report: Gordon Lake Group Gap Assessment Report, report dated February 26, 2016.

March 22, 2016
Matthew McElwaine
Attachments

Reference: Gordon Lakes Group Mine Sites Remediation – Evaluation of West Bay Waste Rock Acid Rock Drainage

Attachments – Figures and Tables



March 22, 2016
Matthew McElwaine
Attachments

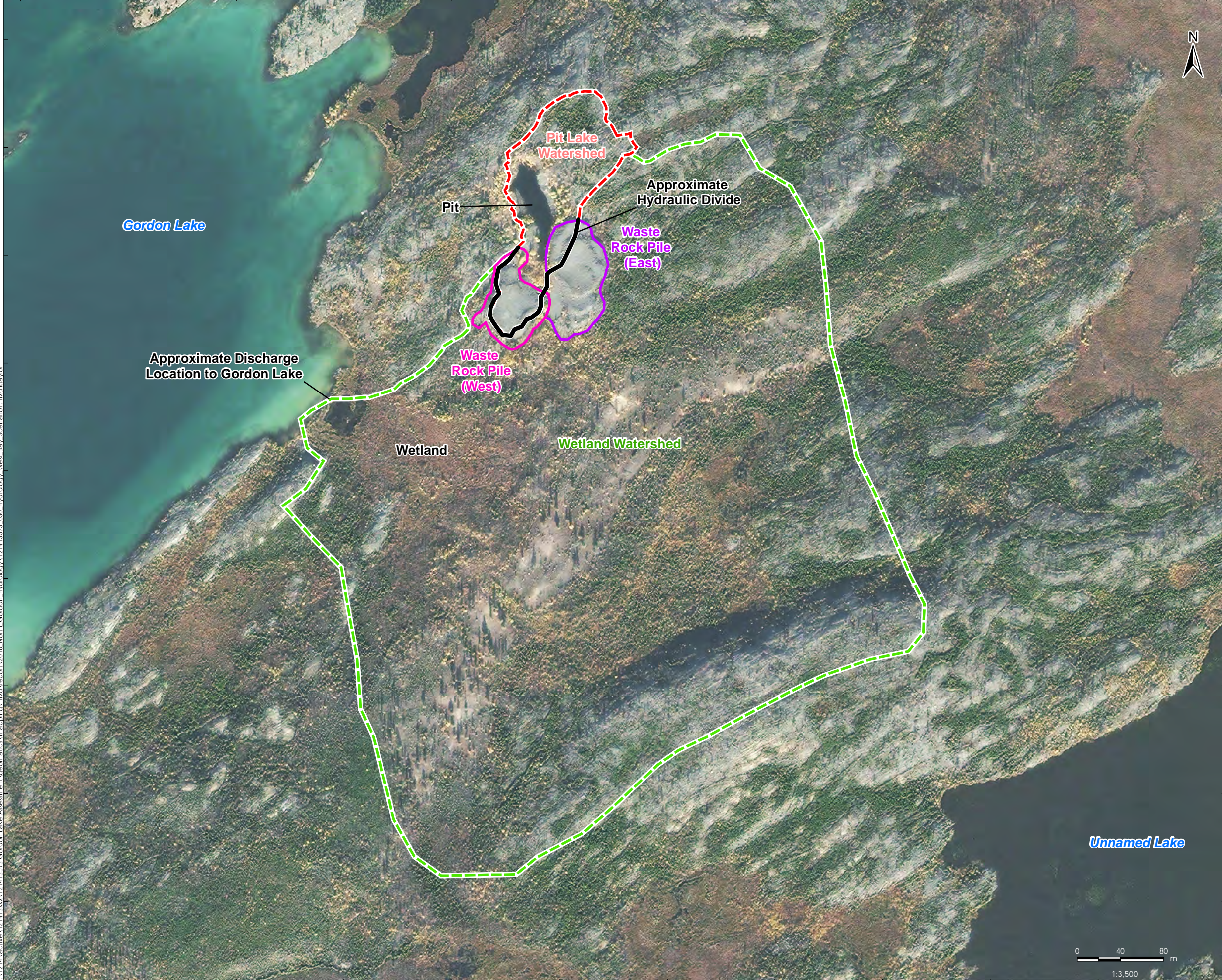
Reference: **Gordon Lakes Group Mine Sites Remediation – Evaluation of West Bay Waste Rock Acid Rock Drainage**

Figures A.1.and A.2 Sub-watershed Delineation at West Bay

386200 386300 386400 386500 386600 386700 386800 386900 387000 387100 387200 387300



- Legend
- Approximate Hydraulic Divide
 - East Waste Rock Pile
 - West Waste Rock Pile
 - Pit Lake Watershed (Scenario 1)
 - Wetland Watershed (Scenario 1)



Gordon Lake

Pit Lake Watershed

Approximate Hydraulic Divide

Waste Rock Pile (East)

Waste Rock Pile (West)

Approximate Discharge Location to Gordon Lake

Wetland

Wetland Watershed

Unnamed Lake

6978500
6978400
6978300
6978200
6978100
6978000
6977900
6977800
6977700

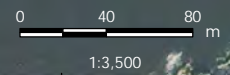


NAD 1983 UTM Zone 12N March 2016 121413573-030

Client/Project
Public Works and Government Services Canada
Gordon Lake Group Hydrology

Figure No.
A.1

Title
West Bay Hydrology - Scenario 1



V:\1214\active\121413xxx\121413573 Gordon Lake Assessment\geomatics\mapping\mxd\report\2016_North_Gordon_Hydrology\121413573_030_Hydrology_West_Bay_Scenario1.mxd kraylor

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC

386200 386300 386400 386500 386600 386700 386800 386900 387000 387100 387200 387300



- Legend
- Approximate Hydraulic Divide
 - East Waste Rock Pile
 - West Waste Rock Pile
 - Pit Lake Watershed (Scenario 2)
 - Wetland Watershed (Scenario 2)

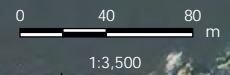


6978500
6978400
6978300
6978200
6978100
6978000
6977900
6977800
6977700



V:\1214\active\121413xxx\121413573 Gordon Lake Assessment\geomatics\mapping\121413573_031_Hydrology_West_Bay_Scenario2.mxd ktaylor

Sources: MapMiri Orthomagey (2011), GeoBase, CANVEC



NAD 1983 UTM Zone 12N
March 2016
121413573-031

Client/Project
Public Works and
Government Services Canada
Gordon Lake Group Hydrology

Figure No.
A.2

Title
West Bay
Hydrology - Scenario 2



March 22, 2016
Matthew McElwaine
Attachments

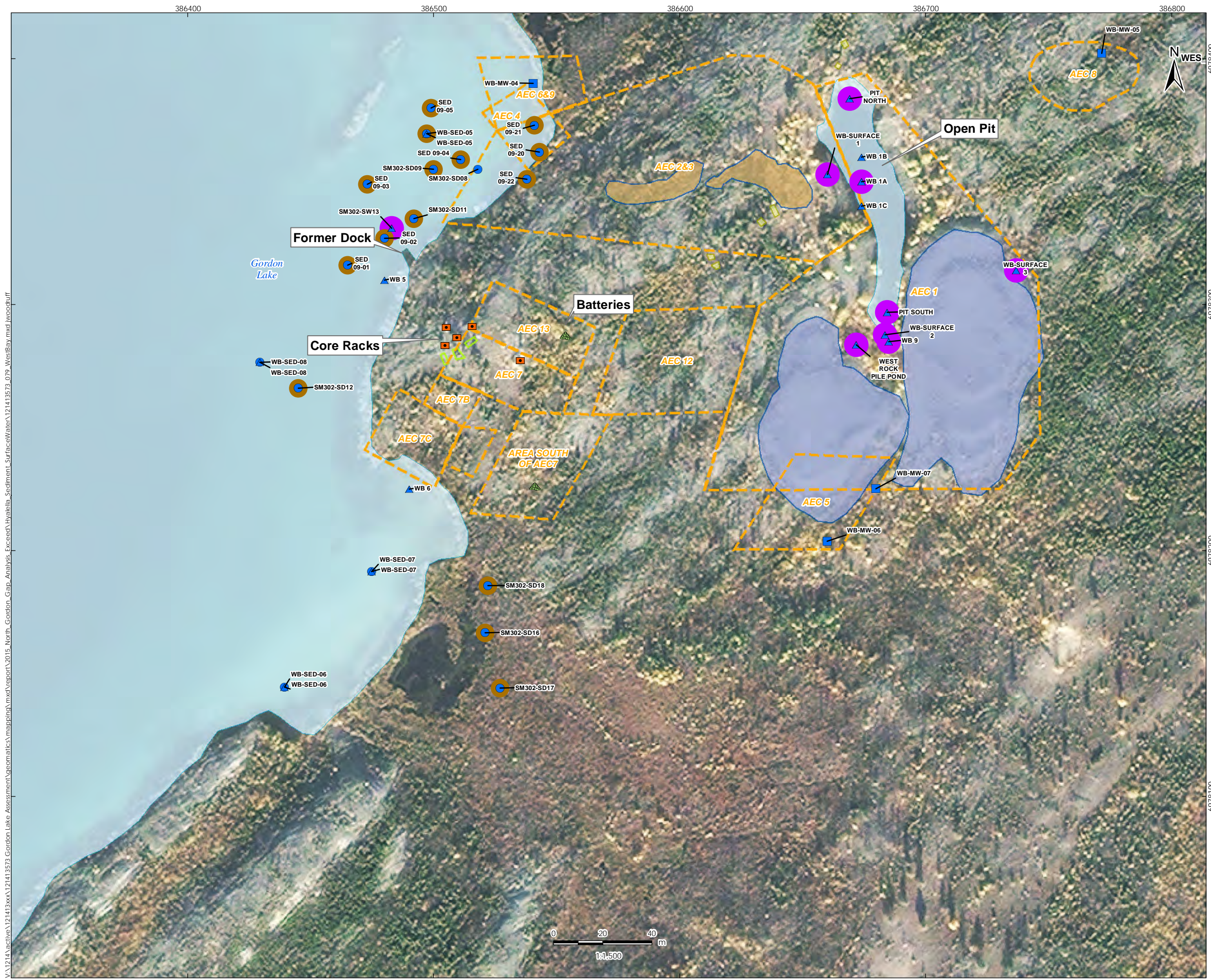
Reference: Gordon Lakes Group Mine Sites Remediation – Evaluation of West Bay Waste Rock Acid Rock Drainage

Table A.1 and Figure A.3 – Surface Water Quality Table and Figure – South Area of West Bay

Table A.1
Summary of Surface Water and Groundwater Analytical Results - West Bay
Gordon Lakes Mine Sites, NWT
PWSGC

Location Description		Area 2 - South Area																		
Sample Location		Pit Water	Pit Water	Pit Water	Pit Water South Potential Drainage	Pit Water	Waste Rock Pond East	Pit Water	Pit Water	Pit water	Waste Rock Pond West	Pit water	Gordon Lake	Gordon Lake	Gordon Lake	Pit Water	Gordon Lake	East of pit lake	South of waste rock piles	South of waste rock piles
Sample Date		1-Aug-04	1-Aug-04	1-Aug-04	1-Aug-04	1-Jul-08	1-Jul-08	28-Aug-09	28-Aug-09	28-Aug-09	28-Aug-09	1-Jul-08	5-Oct-13	1-Aug-04	1-Aug-04	1992	1-Jul-08	1-Jul-08	1-Jul-08	1-Jul-08
Sample ID		WB 1A	WB 1B	WB 1C	WB 9	WB-SURFACE 2	WB-SURFACE 3	PIT NORTH	PIT SOUTH	SW OA/OC1#1	West Rock Pile Pond	WB-SURFACE 1	SM302-SW13	WB 6	WB 5	L4	WB-MW 04	WB-MW 05	WB-MW 06	WB-MW 07
Sampling Company		Various	Various	Various	Various	Various	Various	Various	Various	Various	Various	Various	Various	Various	Various	Various	Various	Various	Various	Various
Sample Type	Units	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Field Duplicate	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Ground-water	Ground-water	Ground-water	Ground-water
General Chemistry																				
Alkalinity, Bicarbonate	mg/L	-	-	-	-	-	-	-	-	-	-	-	39	-	-	-	-	-	-	-
Alkalinity, Carbonate	mg/L	-	-	-	-	-	-	-	-	-	-	-	0.2500	-	-	-	-	-	-	-
Alkalinity, Total	mg/L	-	-	-	-	-	-	-	-	-	-	-	32	-	-	-	-	-	-	-
Sulphate	µg/L	-	-	-	-	-	-	-	-	-	-	-	7600	-	-	-	-	-	-	-
pH Final	S.U.	7.36	7.33	7.37	6.92	7.1	6.6	8.5	7.9	-	3.94	7	7.47	7.57	7.65	8.04	-	-	-	-
pH, Field	S.U.	-	-	-	-	-	-	-	-	-	-	-	7.59	-	-	-	-	-	-	-
Metals, Total																				
Aluminum	µg/L	85	15	87	171	60	190	19	27	18	7800	100	13	15	15	-	-	-	-	-
Antimony	µg/L	0.1	0.1	0.05	0.05	0.1	0.1	0.1	0.1	0.1	0.15	0.1	0.3	0.1	0.1	-	-	-	-	-
Arsenic	µg/L	5	4	4.5	0.5	0.5	2	0.9	0.8	0.8	2.2	0.5	0.28	1	0.5	0.0019	-	-	-	-
Barium	µg/L	5.3	4.4	4.9	9.7	5	5	5	5	5	30	5	5	4.9	4.6	-	-	-	-	-
Beryllium	µg/L	0.05	0.05	0.05	0.05	0.5	0.5	0.5	0.5	0.5	1	0.5	0.5	0.05	0.05	-	-	-	-	-
Boron	µg/L	-	-	-	-	10	10	10	10	10	20	10	10	-	-	-	-	-	-	-
Cadmium	µg/L	0.05	0.05	0.05	0.05	0.1	0.1	0.069	0.06	0.061	8.8	0.1	0.0025	0.05	0.05	0.005	-	-	-	-
Calcium	µg/L	17900	18300	17900	13800	7800	7100	12000	12000	12000	68000	8700	11000	10800	10900	-	-	-	-	-
Chromium	µg/L	0.25	0.15	0.15	0.35	5	5	0.5	0.5	0.5	0.5	5	0.5	0.15	0.15	-	-	-	-	-
Cobalt	µg/L	0.8	0.3	0.65	0.3	0.4	1.8	0.3	0.15	0.15	750	0.8	0.15	0.05	0.05	0.0075	-	-	-	-
Copper	µg/L	6.9	2.8	4.3	2.7	3.9	10	4.7	4	4	67	18	4.3	0.9	6.3	0.021	-	-	-	-
Iron	µg/L	217	83	274	485	30	310	30	30	30	2300	130	30	30	25	0.046	-	-	-	-
Lead	µg/L	0.3	0.15	0.45	0.05	0.1	0.35	0.1	0.1	0.1	0.35	0.1	0.1	0.05	0.05	0.025	-	-	-	-
Lithium	µg/L	2	1.7	1.8	1.4	10	10	10	10	10	70	10	10	1.6	1.5	-	-	-	-	-
Magnesium	µg/L	6400	6600	6400	3400	2900	2800	4300	4400	4500	39000	3100	2500	2600	2600	8.67	-	-	-	-
Manganese	µg/L	28.5	13.4	49.3	62.7	9	24	8	8	8	4.7	11	2	2	1.8	0.267	-	-	-	-
Mercury	µg/L	0.01	0.01	0.01	0.01	0.025	0.025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.01	0.01	0.000025	0.44	0.19	-	0.025
Molybdenum	µg/L	0.15	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.8	0.1	0.1	0.05	0.05	-	-	-	-	-
Nickel	µg/L	11.6	9.8	12.6	1.9	13	43	14	12	12	3000	15	1.8	0.4	0.4	0.054	-	-	-	-
Phosphorus	µg/L	-	-	-	-	-	-	-	-	-	-	-	50	-	-	-	-	-	-	-
Potassium	µg/L	-	-	-	-	-	-	-	-	-	-	-	1100	-	-	-	-	-	-	-
Selenium	µg/L	0.5	0.5	0.5	0.5	0.5	0.5	0.1	0.1	0.1	0.7	0.5	0.5	0.5	0.5	-	-	-	-	-
Silicon	µg/L	-	-	-	-	-	-	-	-	-	-	-	130	-	-	-	-	-	-	-
Silver	µg/L	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-	-	-	-	-
Sodium	mg/L	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
Strontium	µg/L	-	-	-	-	-	-	-	-	-	-	-	38	-	-	-	-	-	-	-
Thallium	µg/L	0.05	0.05	0.05	0.05	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.05	0.05	-	-	-	-	-
Tin	µg/L	-	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-	-	-	-	-	-	-
Titanium	µg/L	0.8	0.15	1.1	6.9	0.5	1	0.5	0.5	0.5	0.5	2	0.5	0.3	0.2	-	-	-	-	-
Uranium	µg/L	0.05	0.05	0.05	0.2	0.05	0.2	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	-	-	-	-	-
Vanadium	µg/L	0.05	0.05	0.05	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05	0.05	-	-	-	-	-
Zinc	µg/L	16	5	16	5	38	85	13	10	10	3300	46	3.5	5	5	-	-	-	-	-

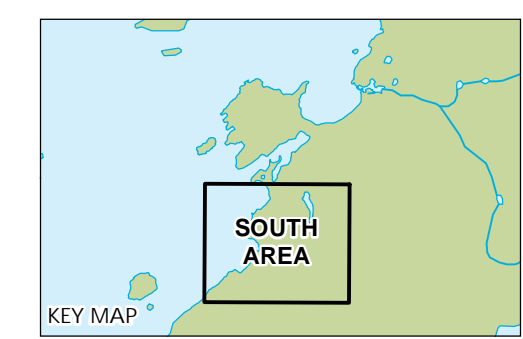
Notes:
 CCME Canadian Council of Ministers of the Environment
 MMER Metal Mining Effluent Guidelines
 6.5 Concentration exceeds Canadian Environmental Quality Guidelines, Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater Aquatics Short Term
 6.5 Exceeds both MMER guideline and CCME Guideline
 15.2 Measured concentration was less than the applicable standard.
 0.25 Laboratory reporting limit was greater than the applicable standard.
 0.015 Analyte was not detected at a concentration greater than the laboratory reporting limit.
 n/v No standard/guideline value.
 - Parameter not analyzed / not available.
 Results reported below the reporting limit were modified to half that value (i.e., <2 changed to 1)



Legend

Historical Exceedance of Applicable Guideline		Features Observed	
	Sediment Sample		Debris
	Surface Water Sample		Structure Remains
			Other (as labeled)
			Tailings
			Trench/Shaft
			Waste Rock/Ore
			Areas of Environmental Concern (AEC)
			Watercourse
			Water body
			Map Extent

*As labelled by Stantec



NAD 1983 UTM Zone 12N
March 2016
121413573

Client/Project
Public Works and
Government Services Canada
Gordon Lake Group Gap Assessment

Figure No.
A.3

Title
West Bay - South Area
Sediment and Surface Water
Sampling Locations



Sources: MapMiri Orthomogery (2011), GeoBase, CANVEC

APPENDIX F Borehole Logs



Grain Size Analysis
ASTM C136, ASTM C117

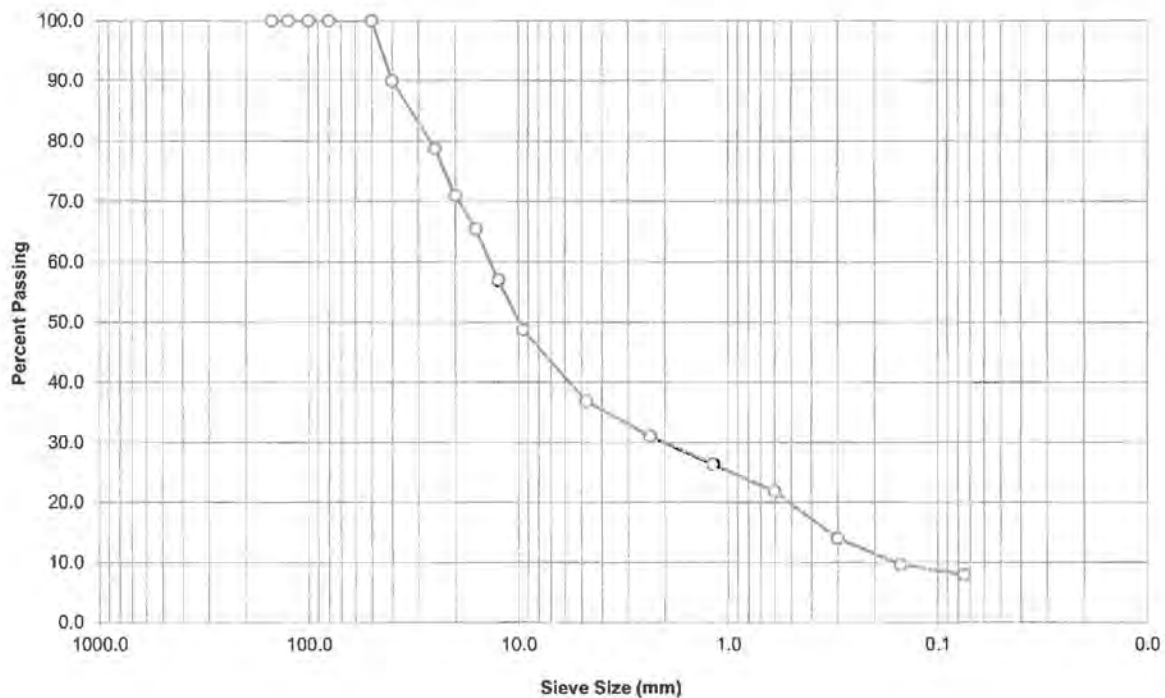
Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

OFFICE **LABORATORY**
10160 - 112 ST 10575 106 ST
Edmonton, Alberta Edmonton, Alberta
Canada T5K 2L6 Canada T5H 2X5

Tel: (780) 917-7000 Tel: (780) 917-7463

SAMPLE #: **BS-2015-002A**
SOURCE: **GD65**
TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Well graded gravel with silt and/or clay and sand**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	89.9	-	-
25.0	78.7	-	-
20.0	70.9	-	-
16.0	65.4	-	-
12.5	57.0	-	-
9.5	48.7	-	-
4.75	36.8	-	-
2.36	31.0	-	-
1.18	26.4	-	-
0.600	21.8	-	-
0.300	14.0	-	-
0.150	9.6	-	-
0.075	7.9	-	-

Comments:

Reviewed by: *[Signature]*



—○— % Passing —◇— Upper Limit —▲— Lower Limit

Reporting of these test results constitutes a testing service only. Engineering interpretation or evaluation of the test results is provided only on written request. The data presented above is for the sole use of the client stipulated above. Stantec is not responsible, nor can be held liable, for the use of this report by any other party, with or without the knowledge of Stantec.



Grain Size Analysis
ASTM C136, ASTM C117

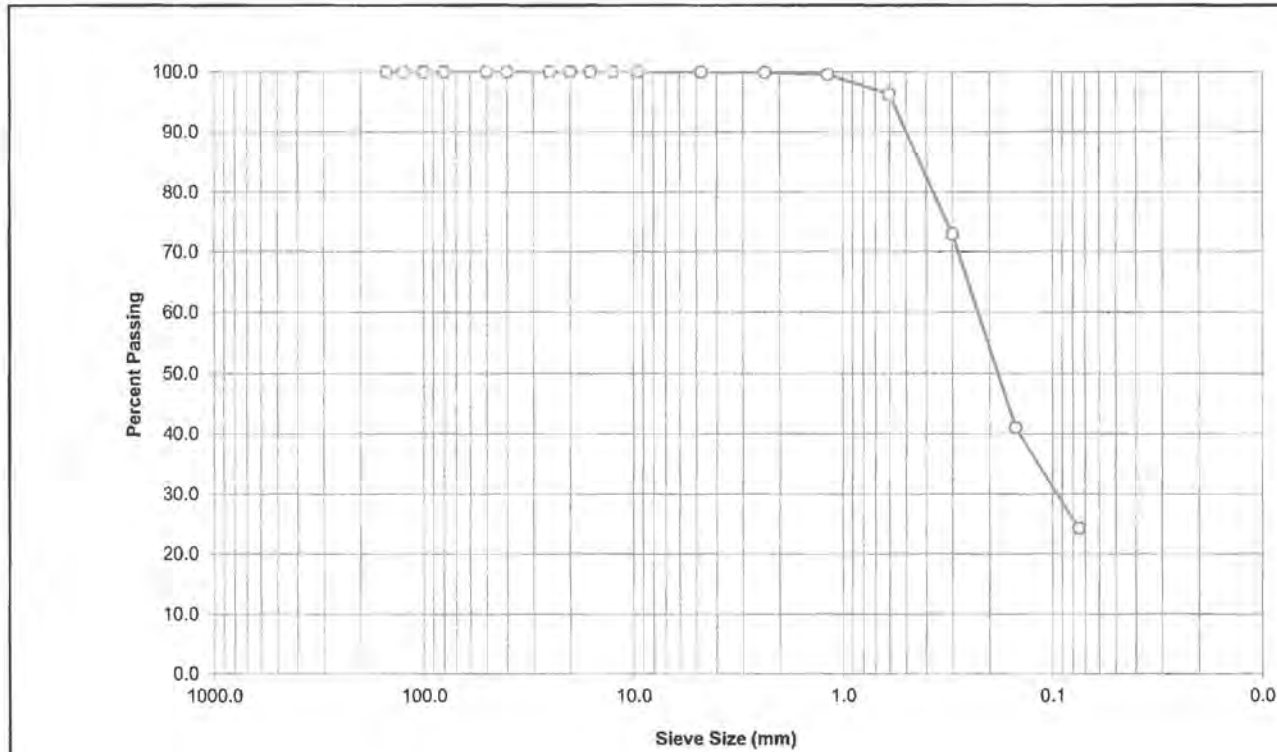
Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

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10160 - 112 ST 10575 106 ST
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Canada T5K 2L6 Canada T5H 2X5

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SAMPLE #: **BS-2015-002B**
SOURCE: **GD18**
TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Silty and/or clayey sand**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	100.0	-	-
25.0	100.0	-	-
20.0	100.0	-	-
16.0	100.0	-	-
12.5	100.0	-	-
9.5	100.0	-	-
4.75	99.9	-	-
2.36	99.9	-	-
1.18	99.5	-	-
0.600	96.2	-	-
0.300	72.9	-	-
0.150	41.0	-	-
0.075	24.3	-	-

Comments:

Reviewed by: *[Signature]*



—○— % Passing —◇— Upper Limit —▲— Lower Limit

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Grain Size Analysis
ASTM C136, ASTM C117

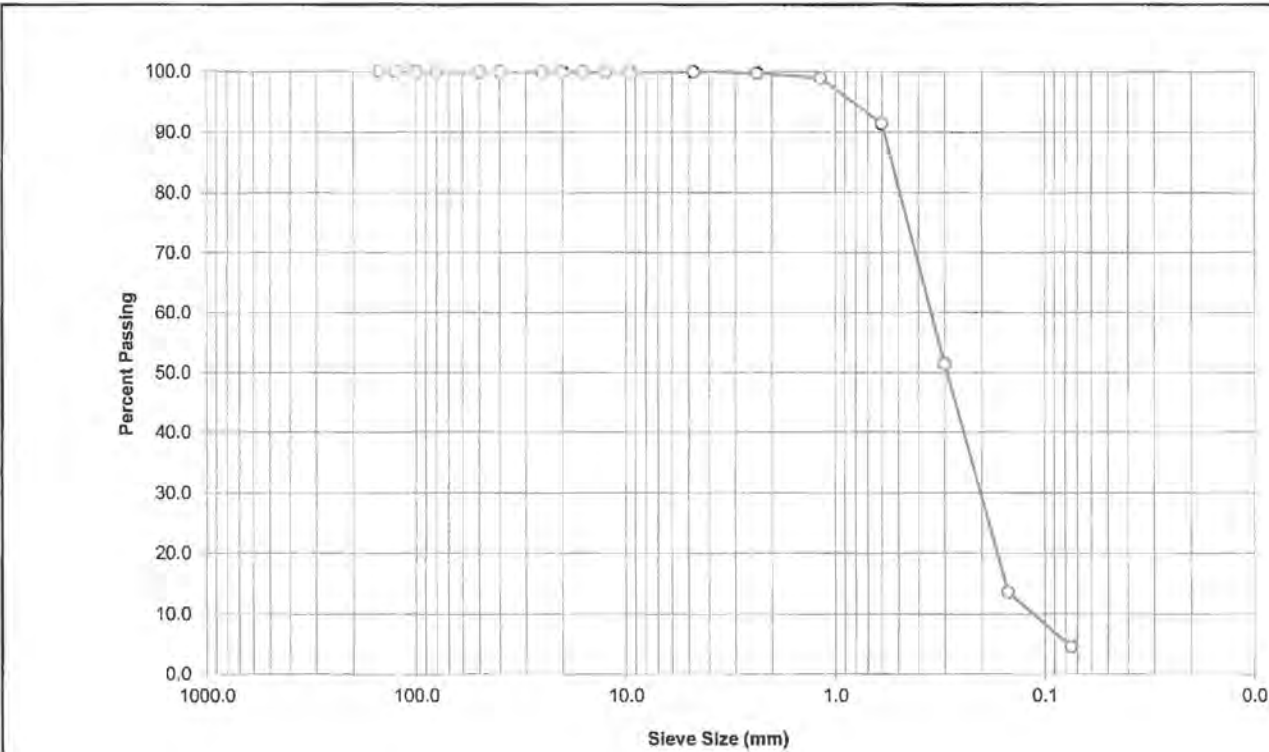
Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

OFFICE **LABORATORY**
10160 - 112 ST 10575 106 ST
Edmonton, Alberta Edmonton, Alberta
Canada T5K 2L6 Canada T5H 2X5

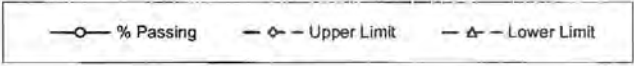
Tel: (780) 917-7000 Tel: (780) 917-7463

SAMPLE #: **BS-2015-001C**
SOURCE: **GD18**
TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Poorly graded sand**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	100.0	-	-
25.0	100.0	-	-
20.0	100.0	-	-
16.0	100.0	-	-
12.5	100.0	-	-
9.5	100.0	-	-
4.75	100.0	-	-
2.36	99.8	-	-
1.18	98.9	-	-
0.600	91.4	-	-
0.300	51.3	-	-
0.150	13.7	-	-
0.075	4.6	-	-



Comments:

Reviewed by:

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Grain Size Analysis
ASTM C136, ASTM C117

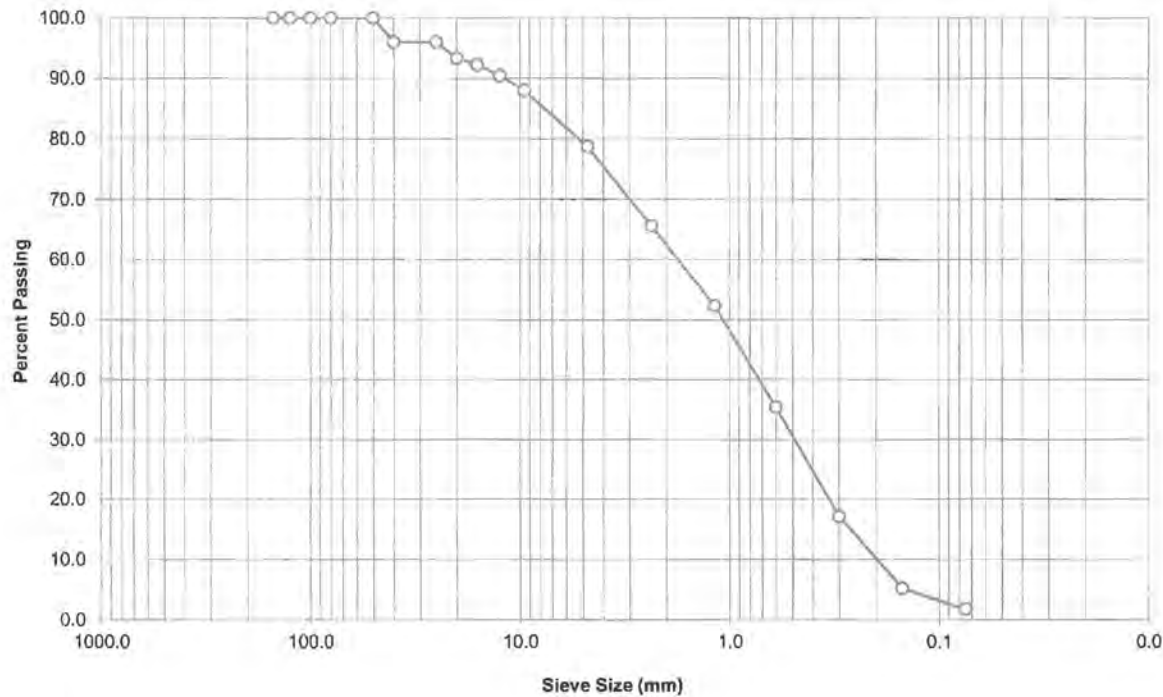
Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

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10160 - 112 ST 10575 106 ST
Edmonton, Alberta Edmonton, Alberta
Canada T5K 2L6 Canada T5H 2X5

Tel: (780) 917-7000 Tel: (780) 917-7463

SAMPLE #: **BS-2015-001**
SOURCE: **GD45**
TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Poorly graded sand with gravel**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	96.0	-	-
25.0	96.0	-	-
20.0	93.3	-	-
16.0	92.2	-	-
12.5	90.4	-	-
9.5	88.0	-	-
4.75	78.7	-	-
2.36	65.6	-	-
1.18	52.3	-	-
0.600	35.4	-	-
0.300	17.1	-	-
0.150	5.2	-	-
0.075	1.8	-	-

Comments:

Reviewed by: *[Signature]*



—○— % Passing -○- Upper Limit -▲- Lower Limit

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Grain Size Analysis
ASTM C136, ASTM C117

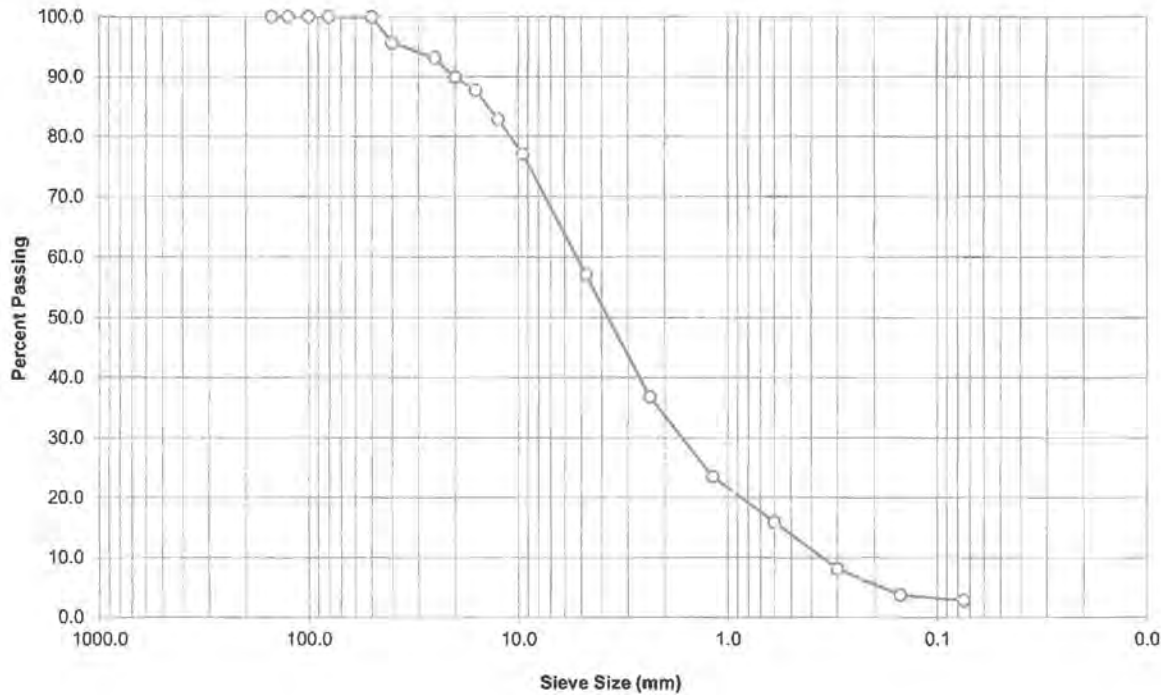
Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

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10160 - 112 ST 10575 106 ST
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Tel: (780) 917-7000 Tel: (780) 917-7463

SAMPLE #: **BS-2015-002**
SOURCE: **GD45**
TESTED BY: **ST**

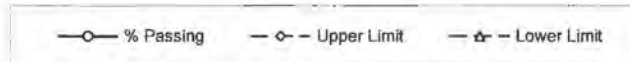
DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Well graded sand with gravel**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	95.6	-	-
25.0	93.1	-	-
20.0	89.9	-	-
16.0	87.7	-	-
12.5	82.9	-	-
9.5	77.0	-	-
4.75	57.0	-	-
2.36	36.8	-	-
1.18	23.5	-	-
0.600	16.0	-	-
0.300	8.1	-	-
0.150	3.7	-	-
0.075	2.8	-	-

Comments:

Reviewed by: *[Signature]*



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Grain Size Analysis
ASTM C136, ASTM C117

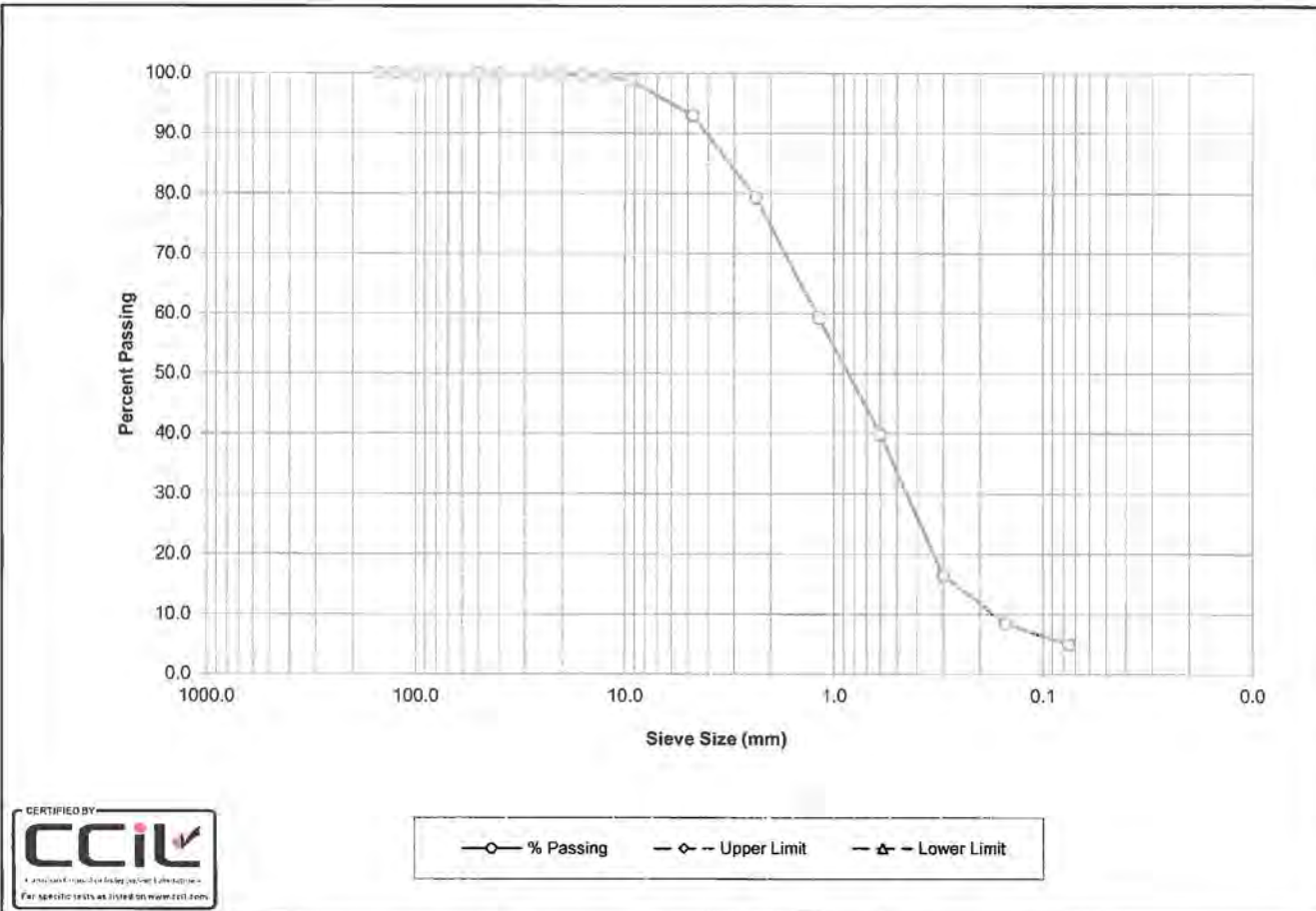
Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

OFFICE **LABORATORY**
10160 - 112 ST 10575 106 ST
Edmonton, Alberta Edmonton, Alberta
Canada T5K 2L6 Canada T5H 2X5

Tel: (780) 917-7000 Tel: (780) 917-7463

SAMPLE #: **BS-2015-001A**
SOURCE: **GD37**
TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Poorly graded sand**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	100.0	-	-
25.0	100.0	-	-
20.0	100.0	-	-
16.0	99.6	-	-
12.5	99.4	-	-
9.5	98.8	-	-
4.75	93.0	-	-
2.36	79.3	-	-
1.18	59.2	-	-
0.600	39.8	-	-
0.300	16.5	-	-
0.150	8.5	-	-
0.075	4.9	-	-

Comments:

Reviewed by: *[Signature]*



—○— % Passing -◇- Upper Limit -▲- Lower Limit

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Grain Size Analysis
ASTM C136, ASTM C117

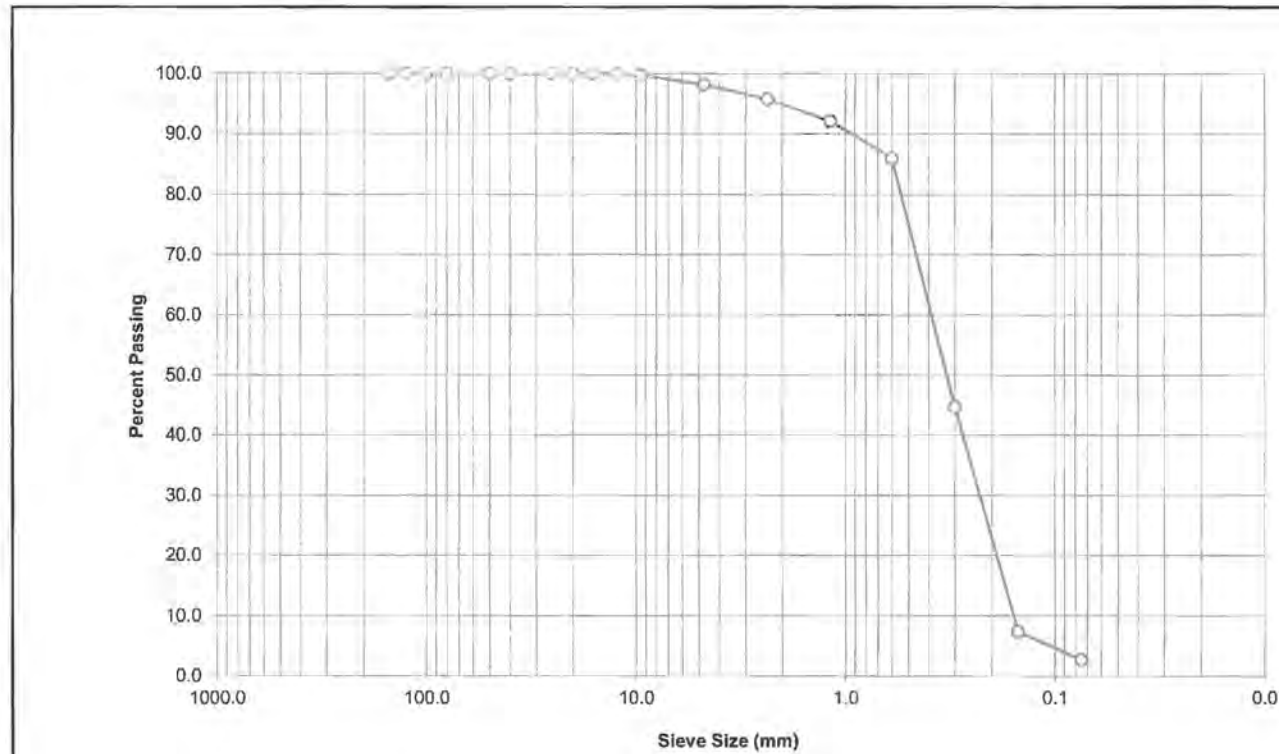
Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

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10160 - 112 ST 10575 106 ST
Edmonton, Alberta Edmonton, Alberta
Canada T5K 2L6 Canada T5H 2X5

Tel: (780) 917-7000 Tel: (780) 917-7463

SAMPLE #: **BS-2015-001B**
SOURCE: **GD37**
TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Poorly graded sand**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	100.0	-	-
25.0	100.0	-	-
20.0	100.0	-	-
16.0	100.0	-	-
12.5	100.0	-	-
9.5	99.7	-	-
4.75	98.2	-	-
2.36	95.7	-	-
1.18	92.1	-	-
0.600	85.9	-	-
0.300	44.7	-	-
0.150	7.4	-	-
0.075	2.7	-	-

Comments:

Reviewed by: *[Signature]*



—○— % Passing —◇— Upper Limit —△— Lower Limit

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Grain Size Analysis
ASTM C136, ASTM C117

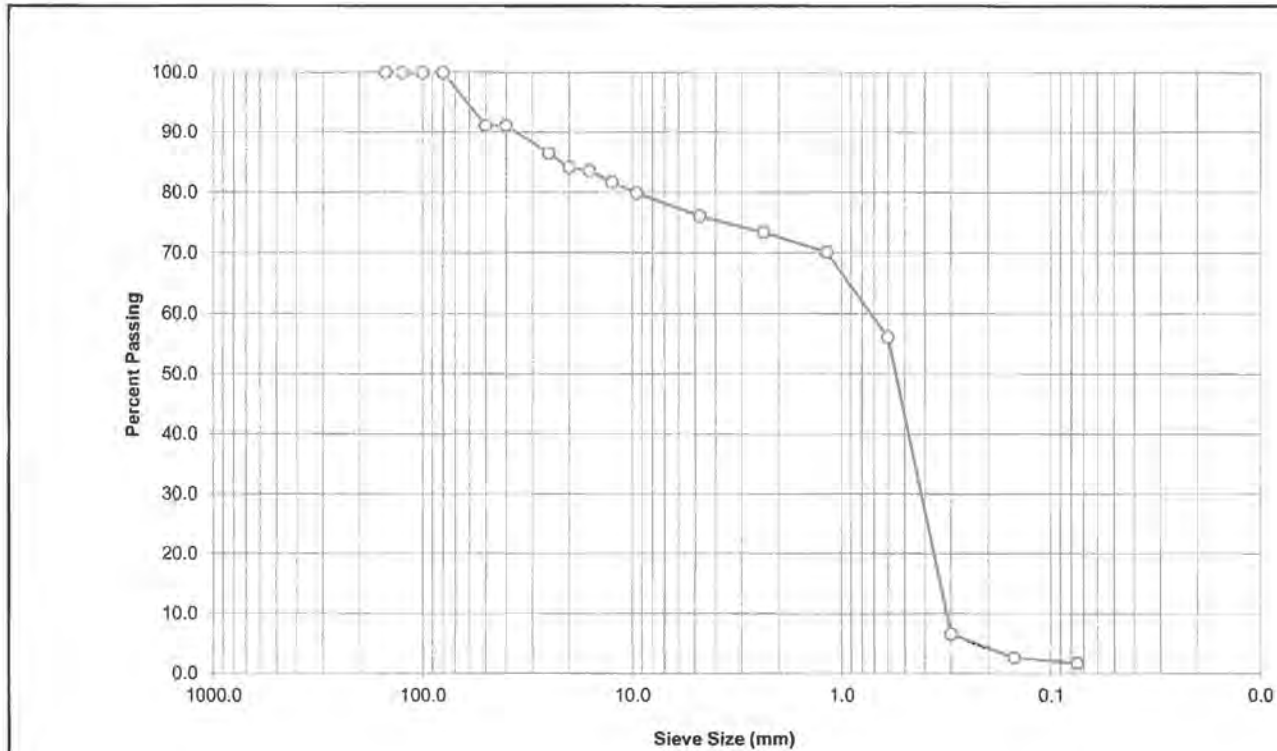
Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

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SAMPLE #: **BS-2015-002B**
SOURCE: **GD37**
TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Poorly graded sand with gravel**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	91.1	-	-
40.0	91.1	-	-
25.0	86.5	-	-
20.0	84.1	-	-
16.0	83.6	-	-
12.5	81.7	-	-
9.5	79.9	-	-
4.75	76.1	-	-
2.36	73.4	-	-
1.18	70.1	-	-
0.600	56.1	-	-
0.300	6.5	-	-
0.150	2.6	-	-
0.075	1.7	-	-

Comments:

Reviewed by: *[Signature]*



—○— % Passing -◇- Upper Limit -△- Lower Limit

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Grain Size Analysis
ASTM C136, ASTM C117

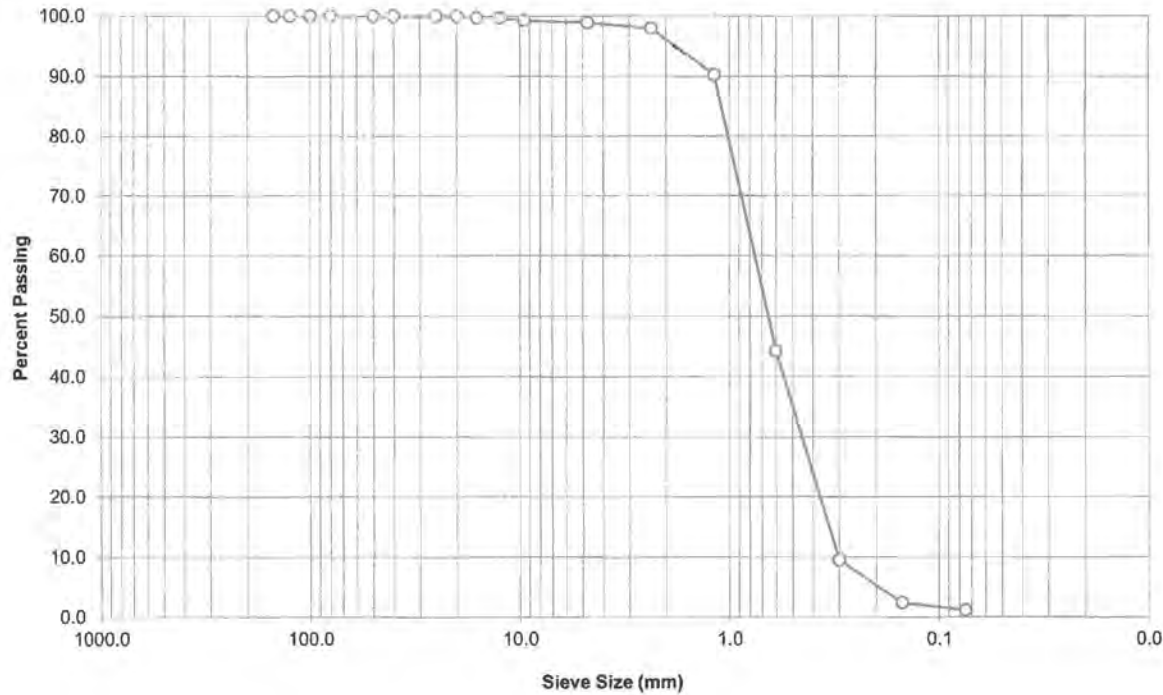
Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

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Edmonton, Alberta Edmonton, Alberta
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SAMPLE #: **BS-2015-003B**
SOURCE: **GD37**
TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Poorly graded sand**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	100.0	-	-
25.0	100.0	-	-
20.0	100.0	-	-
16.0	99.6	-	-
12.5	99.6	-	-
9.5	99.3	-	-
4.75	98.9	-	-
2.36	97.9	-	-
1.18	90.3	-	-
0.600	44.2	-	-
0.300	9.5	-	-
0.150	2.4	-	-
0.075	1.2	-	-

Comments:

Reviewed by: *[Signature]*



—○— % Passing -◇- Upper Limit -△- Lower Limit

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Grain Size Analysis
ASTM C136, ASTM C117

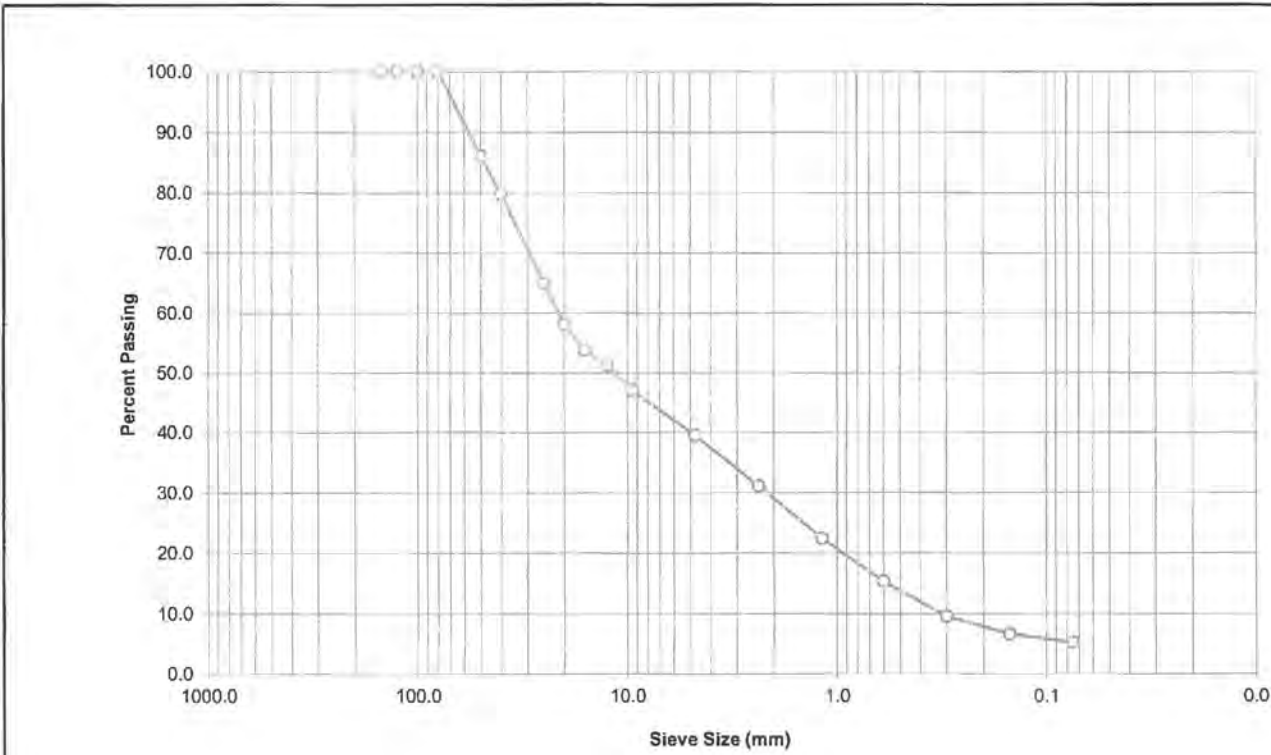
Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

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Edmonton, Alberta Edmonton, Alberta
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SAMPLE #: **BS-2015-001A**
SOURCE: **GD18**
TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Poorly graded gravel with silt and/or clay and sand**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	86.1	-	-
40.0	79.8	-	-
25.0	65.0	-	-
20.0	58.1	-	-
16.0	53.8	-	-
12.5	51.3	-	-
9.5	47.1	-	-
4.75	39.5	-	-
2.36	31.1	-	-
1.18	22.4	-	-
0.600	15.3	-	-
0.300	9.6	-	-
0.150	6.6	-	-
0.075	5.2	-	-

Comments:

Reviewed by:



—○— % Passing —◇— Upper Limit —△— Lower Limit

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Grain Size Analysis
ASTM C136, ASTM C117

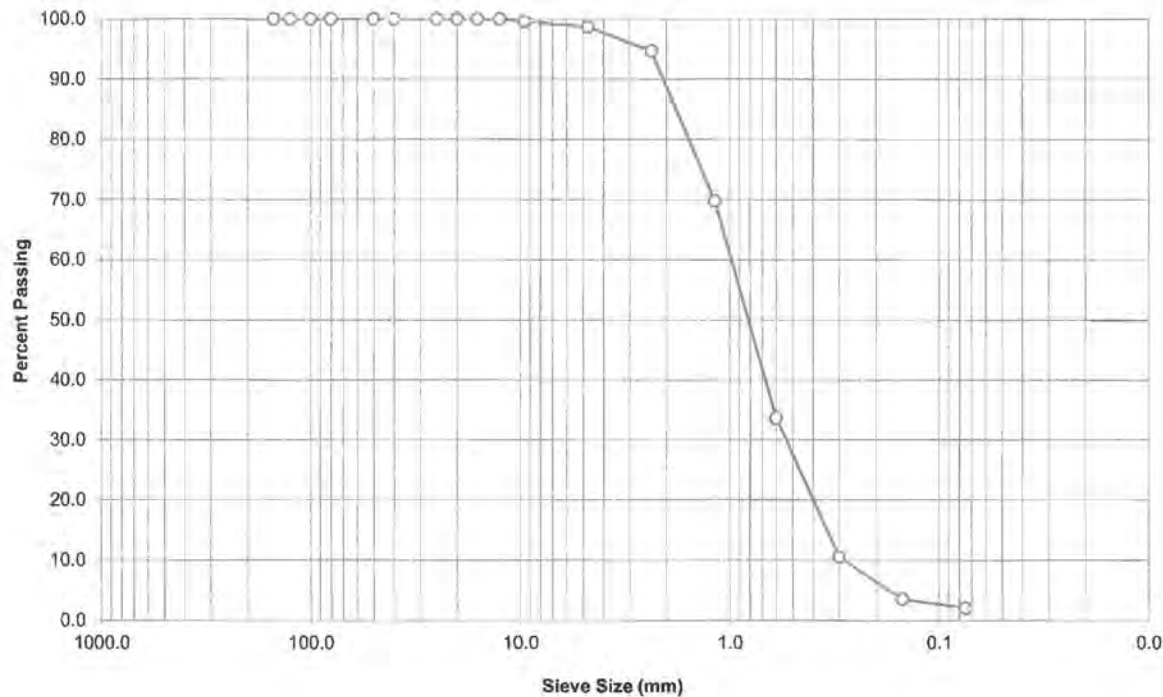
Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

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SAMPLE #: **BS-2015-001B**
SOURCE: **GD18**
TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Poorly graded sand**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	100.0	-	-
25.0	100.0	-	-
20.0	100.0	-	-
16.0	100.0	-	-
12.5	100.0	-	-
9.5	99.6	-	-
4.75	98.6	-	-
2.36	94.7	-	-
1.18	69.8	-	-
0.600	33.6	-	-
0.300	10.5	-	-
0.150	3.5	-	-
0.075	2.1	-	-

Comments:

Reviewed by: *[Signature]*



—○— % Passing —◇— Upper Limit —△— Lower Limit

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Grain Size Analysis
 ASTM C136, ASTM C117

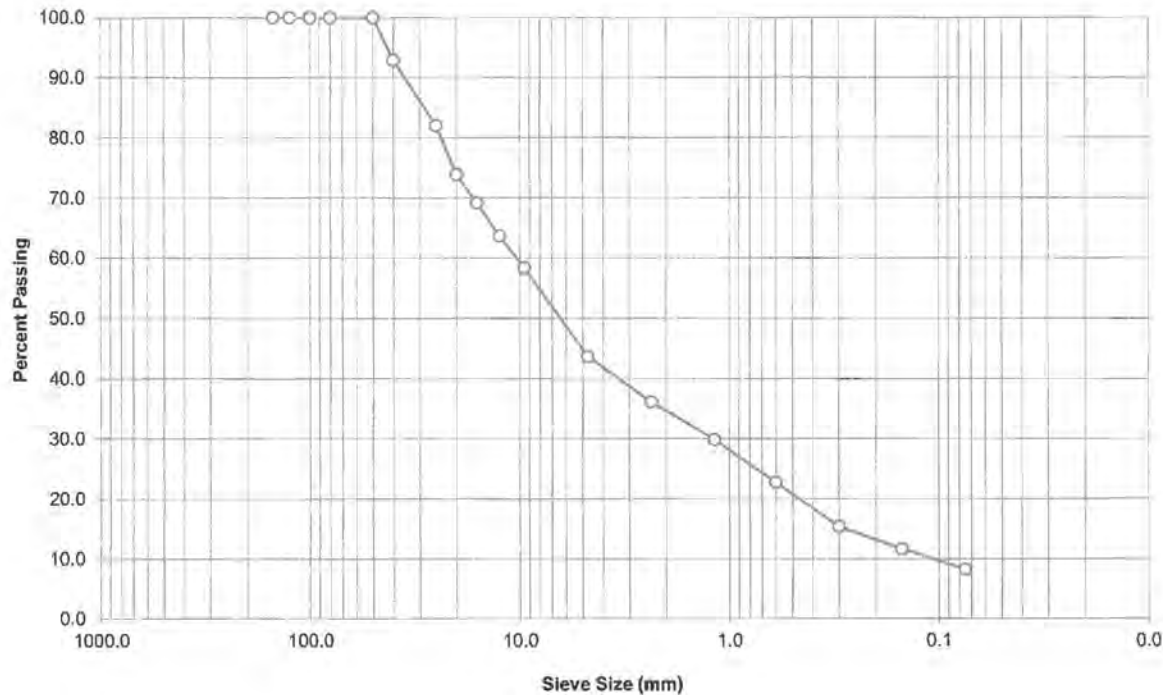
Client: Public Works & Government
 Project Name: Gordon Lake Group Mine Si
 Project No: 121413573

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SAMPLE #: **BS-2015-002C**
 SOURCE: **GD18**
 TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
 DATE TESTED: **September 15, 2015**
 SAMPLE DESCRIPTION: **Well graded gravel with silt and/or clay and sand**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	92.9	-	-
25.0	82.0	-	-
20.0	73.9	-	-
16.0	69.2	-	-
12.5	63.7	-	-
9.5	58.4	-	-
4.75	43.7	-	-
2.36	36.1	-	-
1.18	29.8	-	-
0.600	22.7	-	-
0.300	15.4	-	-
0.150	11.6	-	-
0.075	8.2	-	-

Comments:

Reviewed by: *[Signature]*



—○— % Passing —◇— Upper Limit —△— Lower Limit

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Grain Size Analysis
ASTM C136, ASTM C117

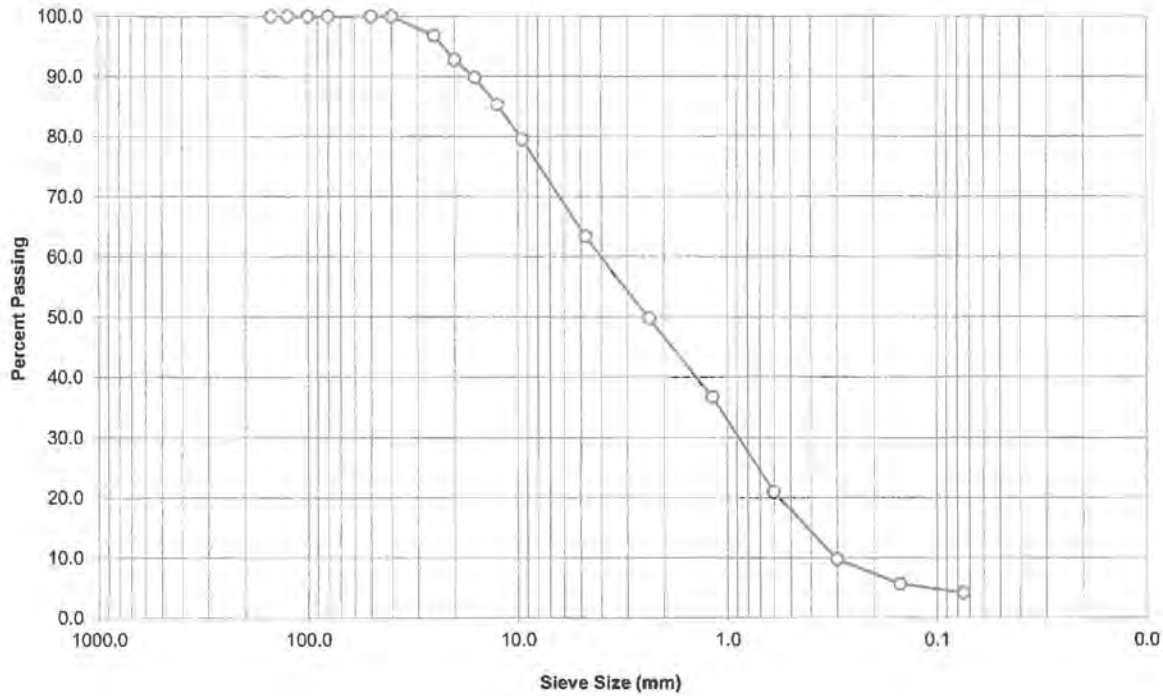
Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

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Edmonton, Alberta Edmonton, Alberta
Canada T5K 2L6 Canada T5H 2X5

Tel: (780) 917-7000 Tel: (780) 917-7463

SAMPLE #: **BS-2015-003**
SOURCE: **GD18**
TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Poorly graded sand with gravel**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	100.0	-	-
25.0	96.8	-	-
20.0	92.8	-	-
16.0	89.8	-	-
12.5	85.3	-	-
9.5	79.5	-	-
4.75	63.3	-	-
2.36	49.7	-	-
1.18	36.7	-	-
0.600	20.9	-	-
0.300	9.7	-	-
0.150	5.6	-	-
0.075	4.1	-	-

Comments:

Reviewed by: *[Signature]*



—○— % Passing —◇— Upper Limit —△— Lower Limit

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Grain Size Analysis
ASTM C136, ASTM C117

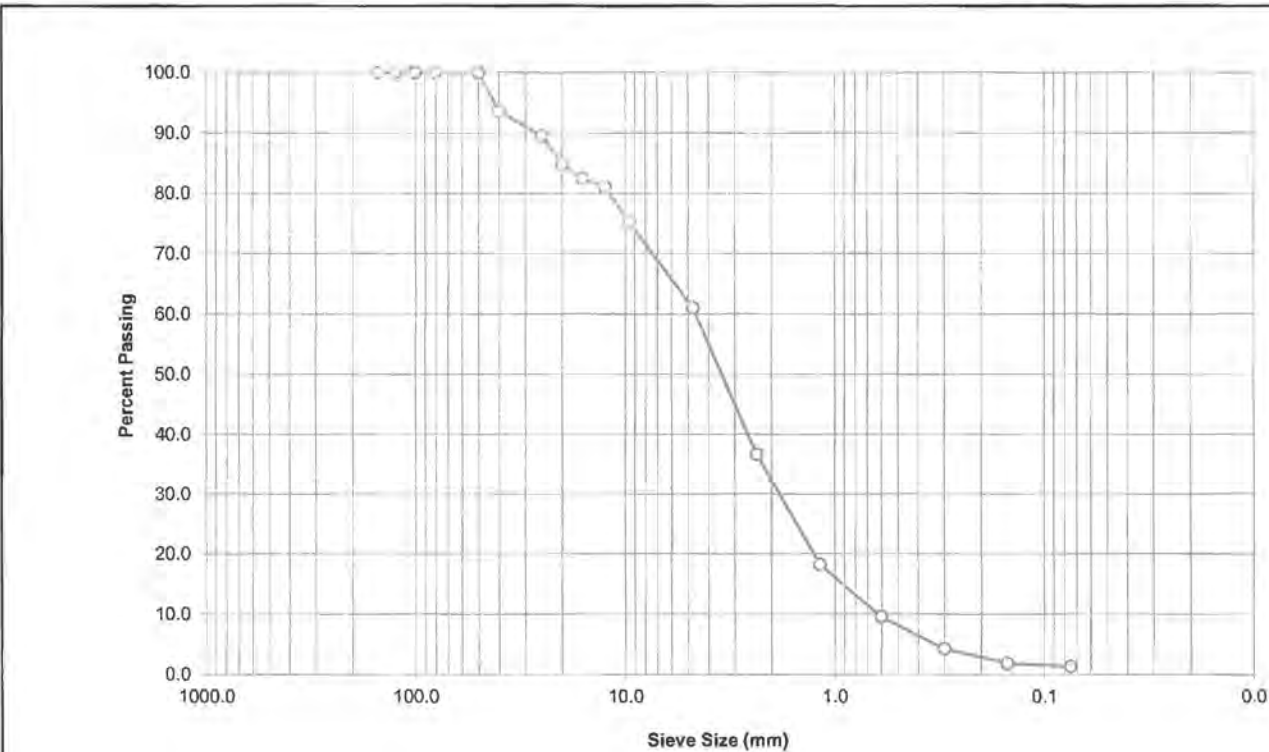
Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

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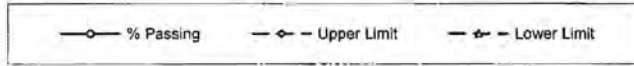
Tel: (780) 917-7000 Tel: (780) 917-7463

SAMPLE #: **BS-2015-001**
SOURCE: **GD11**
TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Poorly graded sand with gravel**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	93.6	-	-
25.0	89.5	-	-
20.0	84.9	-	-
16.0	82.4	-	-
12.5	81.0	-	-
9.5	75.0	-	-
4.75	61.0	-	-
2.36	36.6	-	-
1.18	18.2	-	-
0.600	9.5	-	-
0.300	4.3	-	-
0.150	1.9	-	-
0.075	1.4	-	-



Comments:

Reviewed by: *[Signature]*

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Grain Size Analysis
ASTM C136, ASTM C117

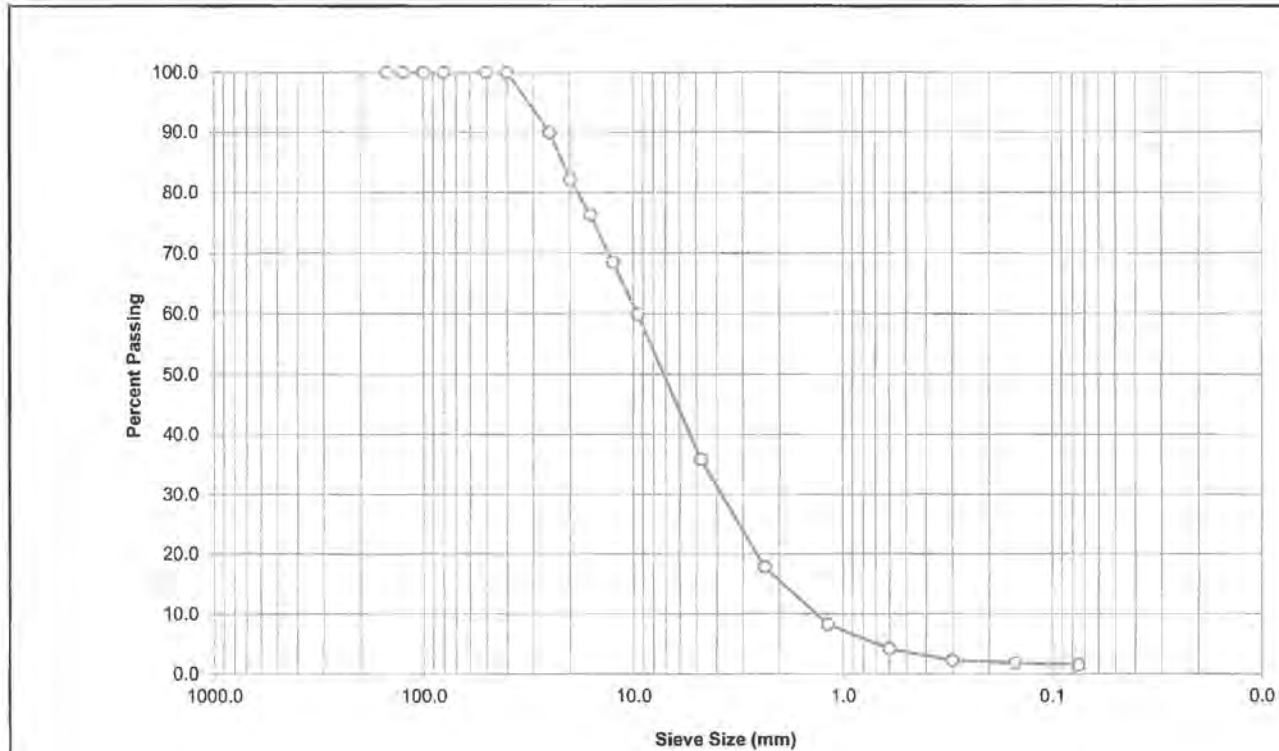
Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

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Tel: (780) 917-7000 Tel: (780) 917-7463

SAMPLE #: **BS-2015-002**
SOURCE: **GD11**
TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Well graded gravel with sand**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	100.0	-	-
25.0	89.9	-	-
20.0	82.2	-	-
16.0	76.3	-	-
12.5	68.5	-	-
9.5	59.9	-	-
4.75	35.8	-	-
2.36	17.8	-	-
1.18	8.2	-	-
0.600	4.2	-	-
0.300	2.3	-	-
0.150	1.8	-	-
0.075	1.5	-	-

Comments:

Reviewed by: *[Signature]*



—○— % Passing -◇- Upper Limit -△- Lower Limit

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Grain Size Analysis
ASTM C136, ASTM C117

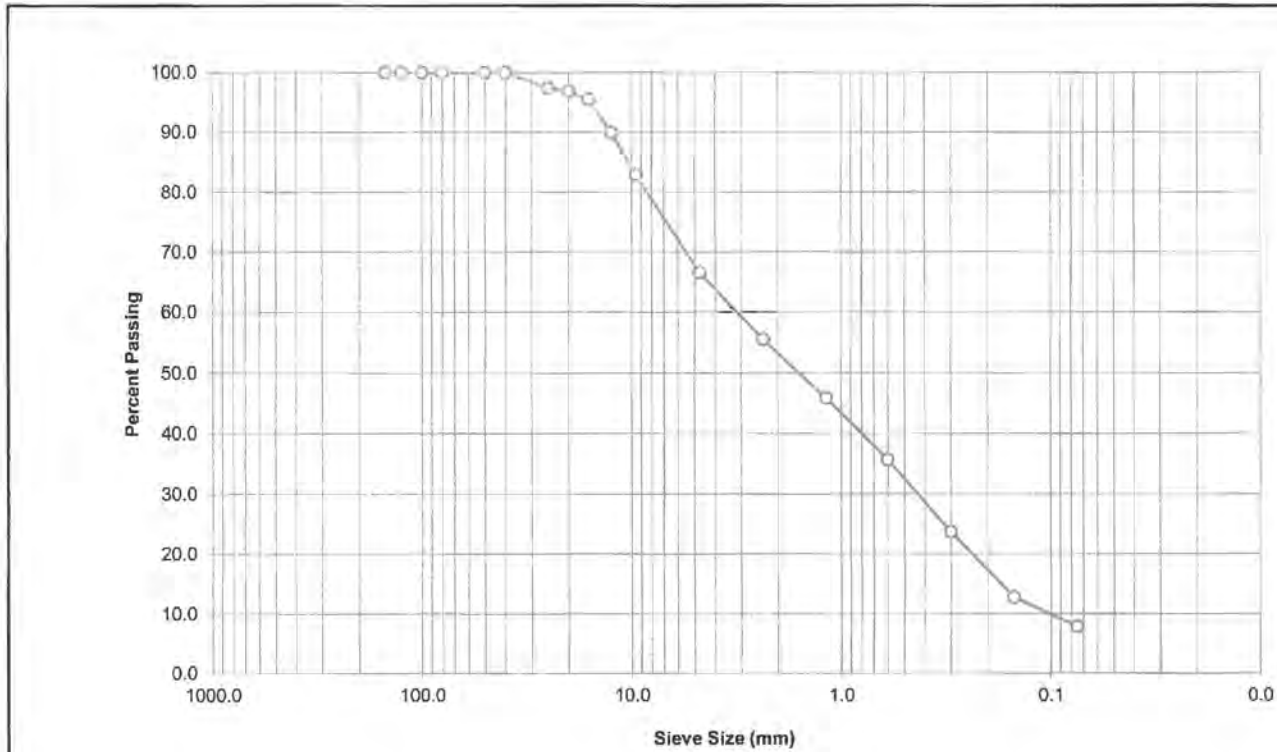
Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

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SAMPLE #: **BS-2015-003**
SOURCE: **GD11**
TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Poorly graded sand with silt and/or clay and gravel**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	100.0	-	-
25.0	97.3	-	-
20.0	96.9	-	-
16.0	95.5	-	-
12.5	89.9	-	-
9.5	82.9	-	-
4.75	66.5	-	-
2.36	55.5	-	-
1.18	45.8	-	-
0.600	35.7	-	-
0.300	23.6	-	-
0.150	12.7	-	-
0.075	7.8	-	-

Comments:

Reviewed by: *[Signature]*



—○— % Passing -◇- Upper Limit -△- Lower Limit

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Grain Size Analysis
ASTM C136, ASTM C117

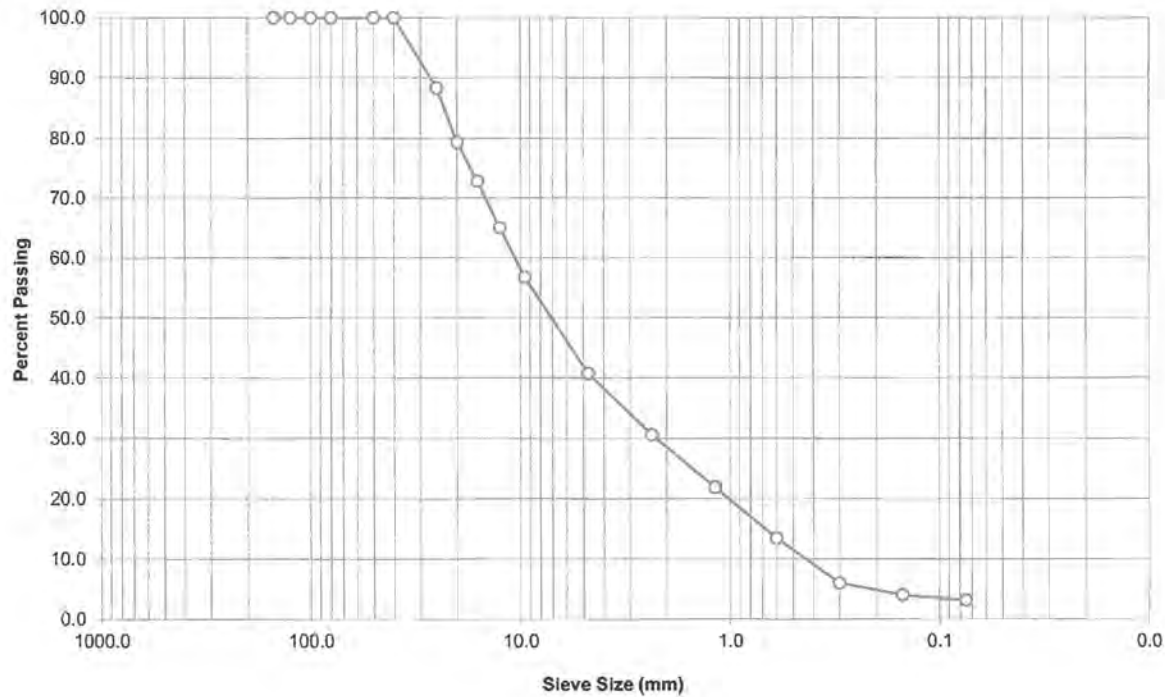
Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

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Tel: (780) 917-7000 Tel: (780) 917-7463

SAMPLE #: **BS-2015-001A**
SOURCE: **GD28**
TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Well graded gravel with sand**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	100.0	-	-
25.0	88.3	-	-
20.0	79.3	-	-
16.0	72.8	-	-
12.5	65.0	-	-
9.5	56.7	-	-
4.75	40.7	-	-
2.36	30.6	-	-
1.18	21.9	-	-
0.600	13.4	-	-
0.300	6.0	-	-
0.150	4.0	-	-
0.075	3.2	-	-

Comments:

Reviewed by:



—○— % Passing -◇- Upper Limit -△- Lower Limit

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Grain Size Analysis
ASTM C136, ASTM C117

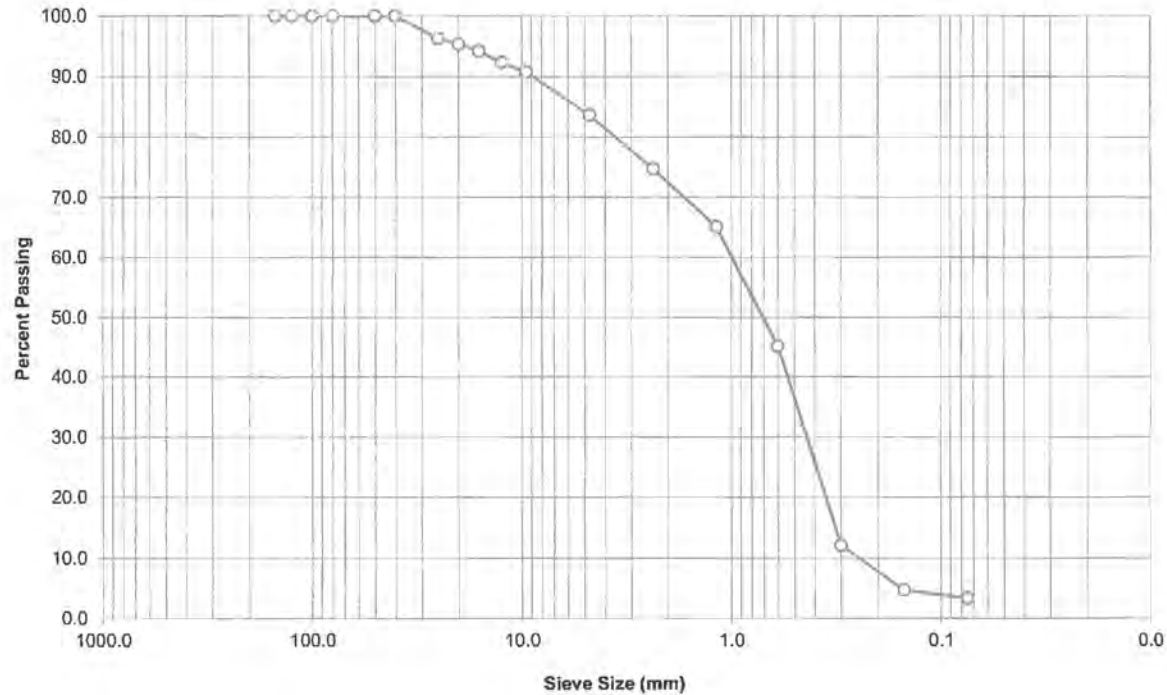
Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

OFFICE **LABORATORY**
10160 - 112 ST 10575 106 ST
Edmonton, Alberta Edmonton, Alberta
Canada T5K 2L6 Canada T5H 2X5

Tel: (780) 917-7000 Tel: (780) 917-7463

SAMPLE #: **BS-2015-001B**
SOURCE: **GD28**
TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Poorly graded sand with gravel**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	100.0	-	-
25.0	96.3	-	-
20.0	95.3	-	-
16.0	94.2	-	-
12.5	92.3	-	-
9.5	90.7	-	-
4.75	83.7	-	-
2.36	74.7	-	-
1.18	65.1	-	-
0.600	45.2	-	-
0.300	12.1	-	-
0.150	4.7	-	-
0.075	3.4	-	-

Comments:

Reviewed by: *[Signature]*



—○— % Passing —◇— Upper Limit —△— Lower Limit

Reporting of these test results constitutes a testing service only. Engineering interpretation or evaluation of the test results is provided only on written request. The data presented above is for the sole use of the client stipulated above. Stantec is not responsible, nor can be held liable, for the use of this report by any other party, with or without the knowledge of Stantec.



Grain Size Analysis
ASTM C136, ASTM C117

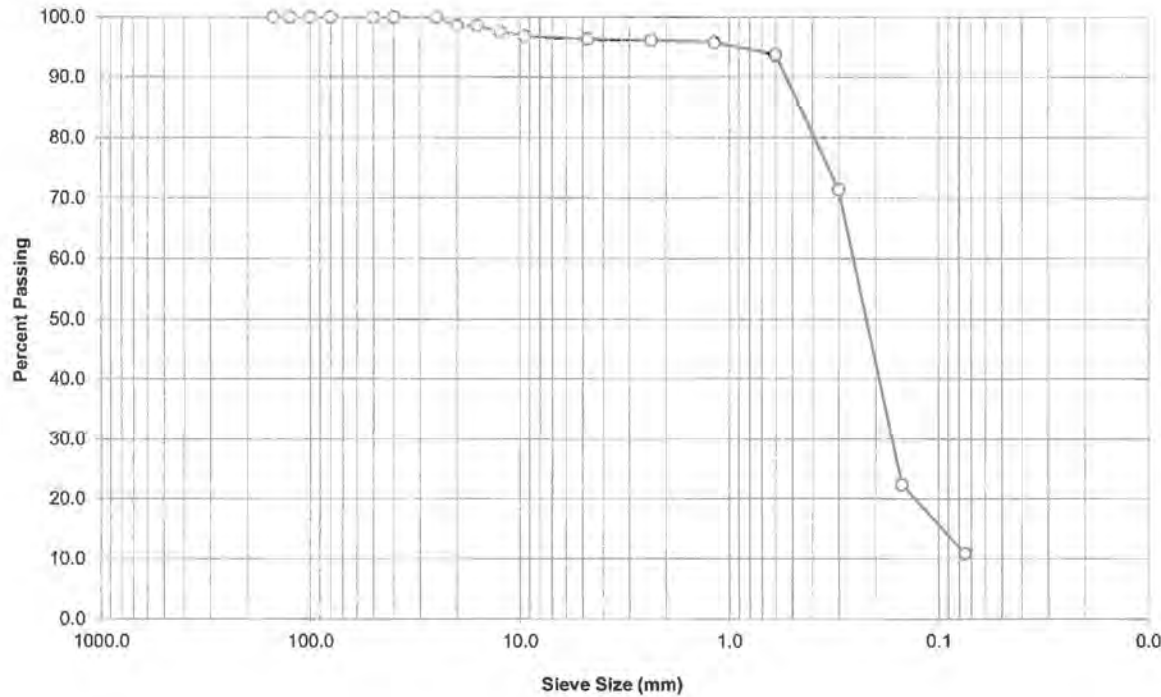
Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

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SAMPLE #: **BS-2015-002**
SOURCE: **GD28**
TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Poorly graded sand with silt and/or clay**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	100.0	-	-
25.0	100.0	-	-
20.0	98.5	-	-
16.0	98.5	-	-
12.5	97.6	-	-
9.5	96.8	-	-
4.75	96.3	-	-
2.36	96.1	-	-
1.18	95.8	-	-
0.600	93.7	-	-
0.300	71.4	-	-
0.150	22.3	-	-
0.075	10.8	-	-

Comments:

Reviewed by: *[Signature]*



—○— % Passing —◇— Upper Limit —△— Lower Limit

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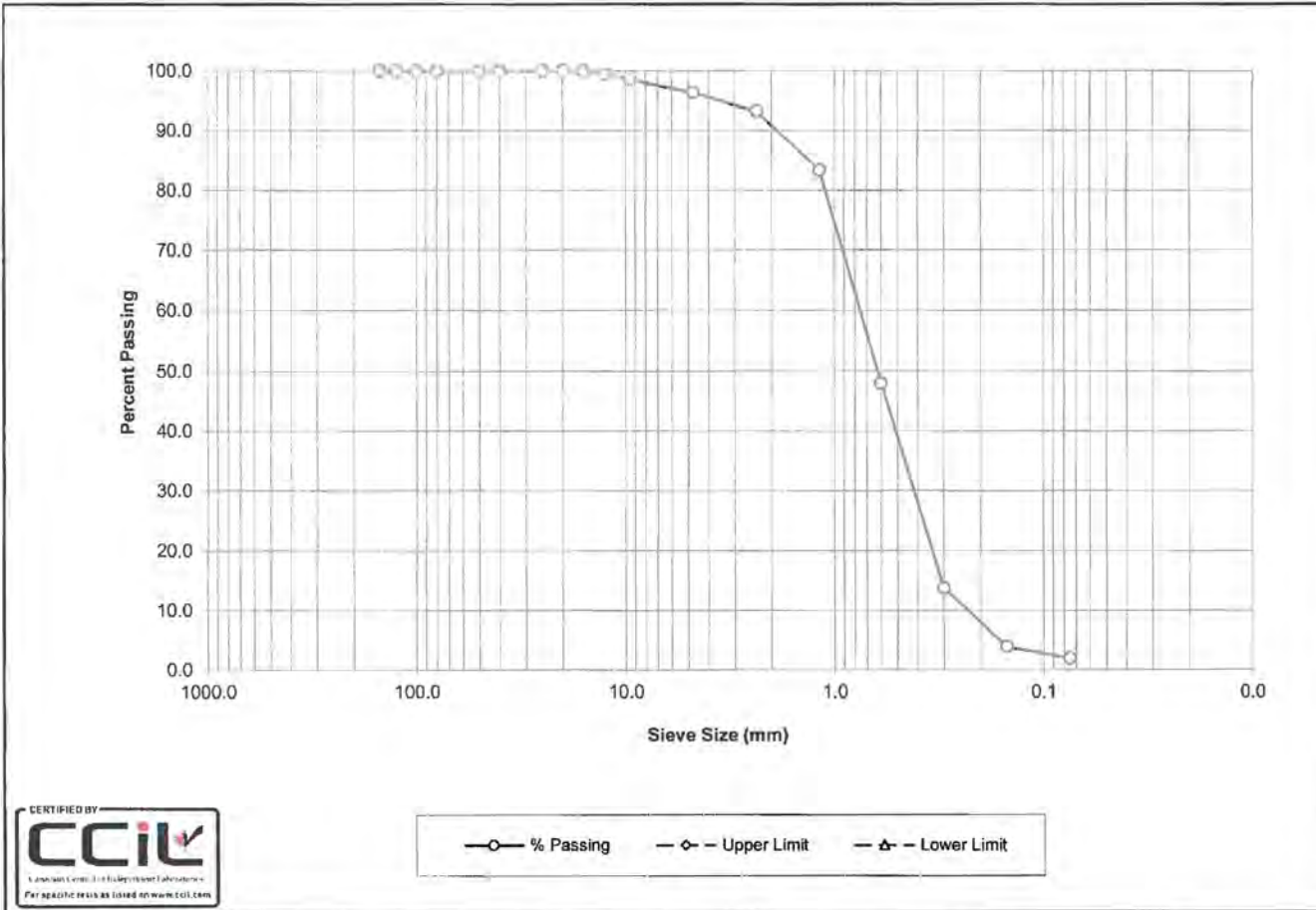
Grain Size Analysis
 ASTM C136, ASTM C117

Client: Public Works & Government
 Project Name: Gordon Lake Group Mine Si
 Project No: 121413573

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SAMPLE #: **BS-2015-003** DATE RECEIVED: **September 4, 2015**
 SOURCE: **GD28** DATE TESTED: **September 15, 2015**
 TESTED BY: **ST** SAMPLE DESCRIPTION: **Poorly graded sand**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	100.0	-	-
25.0	100.0	-	-
20.0	100.0	-	-
16.0	100.0	-	-
12.5	99.3	-	-
9.5	98.5	-	-
4.75	96.3	-	-
2.36	93.2	-	-
1.18	83.3	-	-
0.600	48.0	-	-
0.300	13.7	-	-
0.150	3.8	-	-
0.075	1.9	-	-

Comments:

Reviewed by: *[Signature]*



—○— % Passing —◇— Upper Limit —△— Lower Limit

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Grain Size Analysis
ASTM C136, ASTM C117

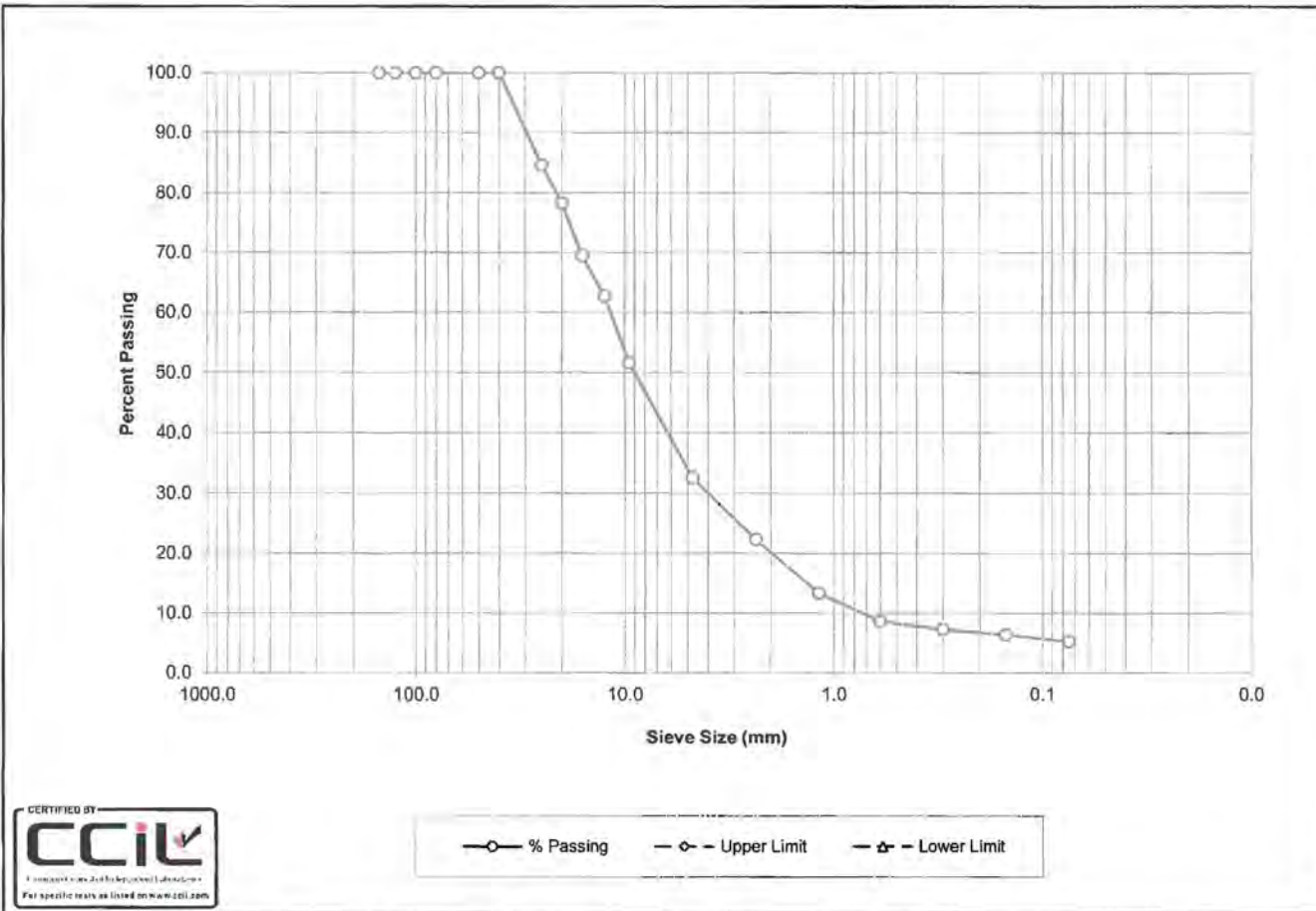
Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

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SAMPLE #: **BS-2015-001**
SOURCE: **GD65**
TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Well graded gravel with silt and/or clay and sand**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	100.0	-	-
25.0	84.6	-	-
20.0	78.2	-	-
16.0	69.5	-	-
12.5	62.7	-	-
9.5	51.6	-	-
4.75	32.6	-	-
2.36	22.3	-	-
1.18	13.3	-	-
0.600	8.6	-	-
0.300	7.3	-	-
0.150	6.4	-	-
0.075	5.2	-	-

Comments:

Reviewed by: *[Signature]*



—○— % Passing —◇— Upper Limit —△— Lower Limit

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Grain Size Analysis
 ASTM C136, ASTM C117

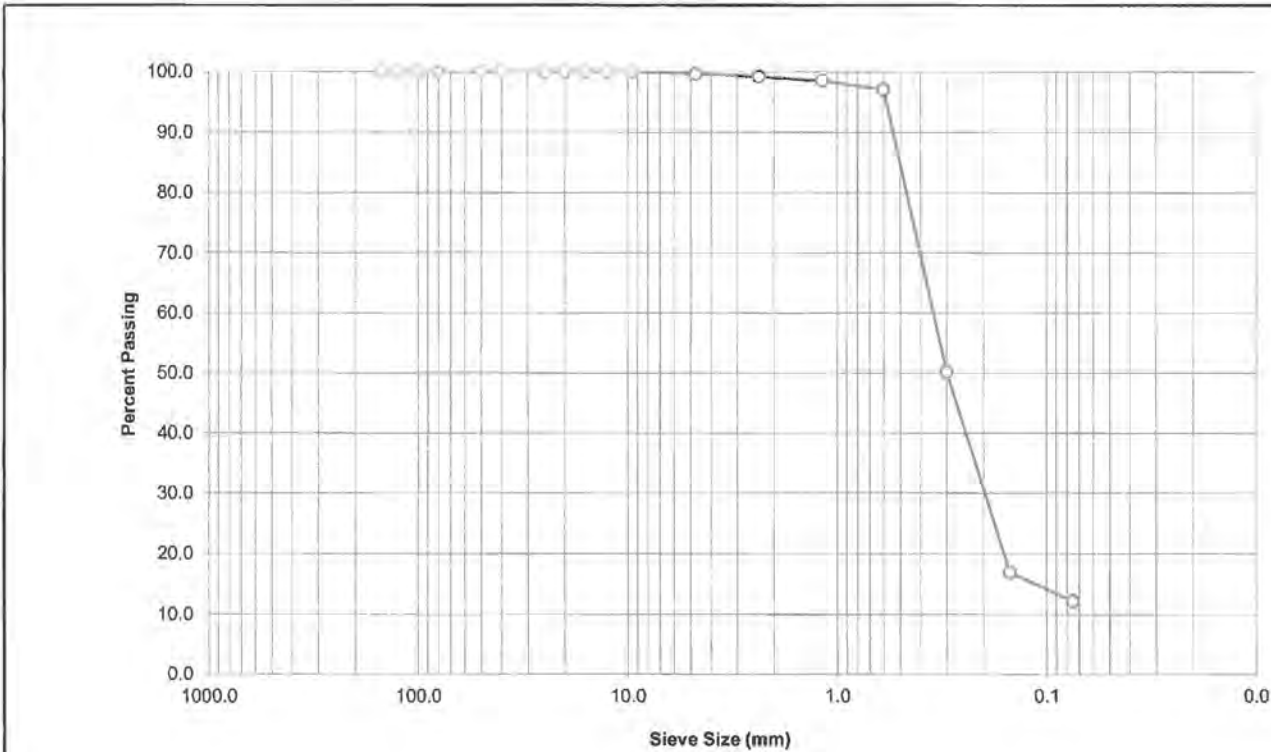
Client: Public Works & Government
 Project Name: Gordon Lake Group Mine Si
 Project No: 121413573

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SAMPLE #: **BS-2015-002B**
 SOURCE: **GD65**
 TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
 DATE TESTED: **September 15, 2015**
 SAMPLE DESCRIPTION: **Silty and/or clayey sand**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	100.0	-	-
25.0	100.0	-	-
20.0	100.0	-	-
16.0	100.0	-	-
12.5	100.0	-	-
9.5	100.0	-	-
4.75	99.6	-	-
2.36	99.2	-	-
1.18	98.5	-	-
0.600	97.1	-	-
0.300	50.1	-	-
0.150	16.9	-	-
0.075	12.2	-	-

Comments:

Reviewed by: *[Signature]*



—○— % Passing —◇— Upper Limit —△— Lower Limit

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Grain Size Analysis
ASTM C136, ASTM C117

Client: Public Works & Government
Project Name: Gordon Lake Group Mine Si
Project No: 121413573

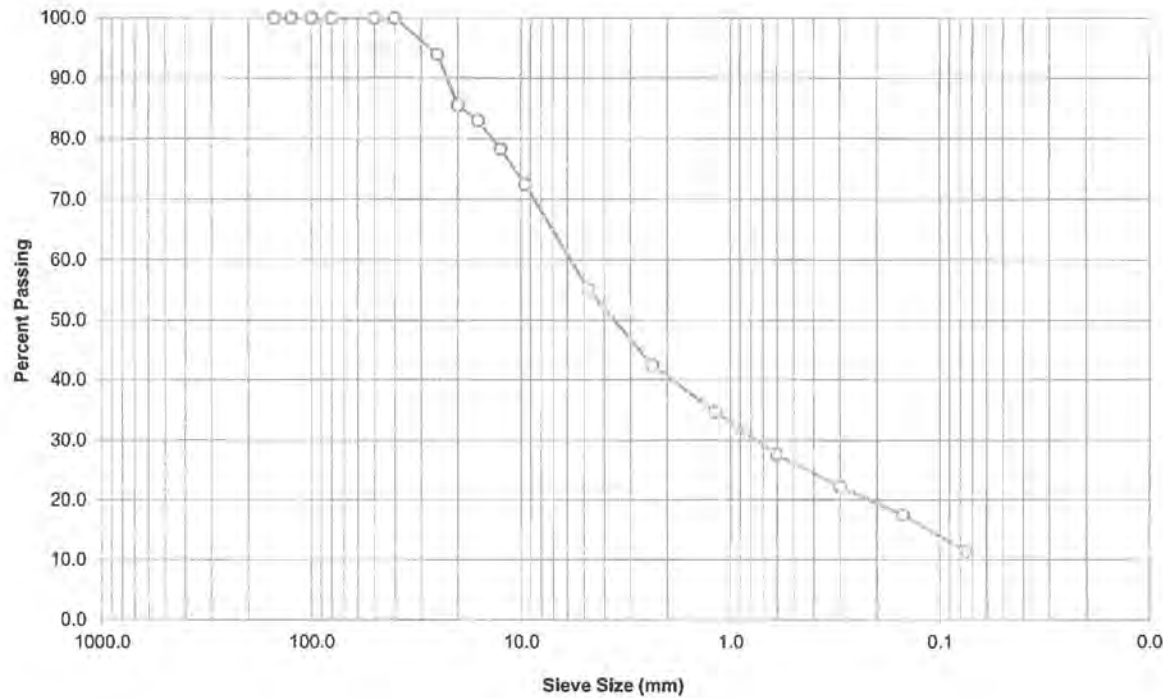
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LABORATORY
10575 106 ST
Edmonton, Alberta
Canada T5H 2X5

Tel: (780) 917-7000 Tel: (780) 917-7463

SAMPLE #: **BS-2015-003**
SOURCE: **GD65**
TESTED BY: **ST**

DATE RECEIVED: **September 4, 2015**
DATE TESTED: **September 15, 2015**
SAMPLE DESCRIPTION: **Well graded gravel with silt and/or clay and sand**



Sieve (mm)	Sample % Passing	Specifications	
		Lower	Upper
150.0	100.0	-	-
125.0	100.0	-	-
100.0	100.0	-	-
80.0	100.0	-	-
50.0	100.0	-	-
40.0	100.0	-	-
25.0	93.9	-	-
20.0	85.6	-	-
16.0	83.0	-	-
12.5	78.3	-	-
9.5	72.4	-	-
4.75	55.1	-	-
2.36	42.5	-	-
1.18	34.7	-	-
0.600	27.6	-	-
0.300	22.2	-	-
0.150	17.5	-	-
0.075	11.4	-	-

Comments:

Reviewed by: *[Signature]*



—○— % Passing —◇— Upper Limit —△— Lower Limit

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TEST PIT RECORD

TP15-001

CLIENT Public Works & Government Services PROJECT No. 121413573
 PROJECT Gordon Lake Group Mine Site DATUM N/A
 LOCATION Gordon Lake, Northwest Territories ELEVATION N/A
 EXCAVATION DATE Aug. 12, 2015 CONTRACTOR N/A EXCAVATION METHOD Hand/Shovel

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLES			Moisture Content & Atterberg Limits				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP	●	ORGANICS								0
	SP	○	SAND - with gravel, poorly graded								
	SP	○	SAND - bedded - alternating beds of coarse and medium sand								2
	SP	○	SAND - poorly graded, coarse, some cobbles								
1	SP	○	SAND - Poorly graded, with gravel - Grain size test at 1.30 m: gravel=21.3%, sand=76.9%, fines=1.8% - End of test pit TP15-001 at 1.30 m -UTM Zone 12: (N: 6994303; E 390950)								4
2											6
											8
3											10

Sample Type: GS - Grab Sample SS - Split Spoon
 ST - Shelby Tube PT - Piston Tube CC - Continuous Core
 Piezometer Backfill Type: Bentonite Sloughed Drill Cuttings Sand

Logged by: E.R.
 Reviewed by: O.P.
 Date: Oct. 20, 2015



TEST PIT RECORD

TP15-003

CLIENT Public Works & Government Services PROJECT No. 121413573
 PROJECT Gordon Lake Group Mine Site DATUM N/A
 LOCATION Gordon Lake, Northwest Territories ELEVATION N/A
 EXCAVATION DATE Aug. 14, 2015 CONTRACTOR N/A EXCAVATION METHOD Hand/Shovel

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLES			<input type="checkbox"/> Insitu Shear Vane (kPa) <input type="checkbox"/> Remoulded Shear Vane (kPa) <input type="checkbox"/> Pocket Penetrometer (kPa) <input type="checkbox"/> Disturbed Torvane (kPa)				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	SW		SAND - with organics								0
	SW		SAND - trace gravel								
	SP		SAND - poorly graded, medium to coarse, some gravel - Grain size test at 0.45 m: gravel=7.0%, sand=88.1%, fines=4.9%	GS	1						
	SP		SAND - poorly graded								2
1			- Grain size test at 1.05 m: gravel=1.8%, sand=95.5%, fines=2.7%	GS	2						
			- End of test pit TP15-003 at 1.06 m								4
			-UTM Zone 12: (N: 6977857; E: 386508)								6
2											8
3											10

Sample Type: GS - Grab Sample SS - Split Spoon
 ST - Shelby Tube PT - Piston Tube CC - Continuous Core
 Piezometer Backfill Type: Bentonite Sloughed Drill Cuttings Sand

Logged by: E.R.
 Reviewed by: O.P.
 Date: Oct. 20, 2015



TEST PIT RECORD

TP15-004

CLIENT Public Works & Government Services PROJECT No. 121413573
 PROJECT Gordon Lake Group Mine Site DATUM N/A
 LOCATION Gordon Lake, Northwest Territories ELEVATION N/A
 EXCAVATION DATE Aug. 14, 2015 CONTRACTOR N/A EXCAVATION METHOD Hand/Shovel

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLES			<input type="checkbox"/> Insitu Shear Vane (kPa) <input type="checkbox"/> Remoulded Shear Vane (kPa) <input type="checkbox"/> Pocket Penetrometer (kPa) <input type="checkbox"/> Disturbed Torvane (kPa)				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP		ORGANICS - with sand								0
	SP		SAND - some organics, loose, poorly graded								
	SP		SAND - poorly graded, loose								2
	SP		SAND - poorly graded with gravel								
1	SP		- Grain size test at 1.10 m: gravel=23.9%, sand=74.4%, fines=1.7% - End of test pit TP15-004 at 1.10 m -UTM Zone 12: (N: 6977959; E: 386620)	GS	1						4
2											6
3											8
											10

Sample Type: GS - Grab Sample SS - Split Spoon
 ST - Shelby Tube PT - Piston Tube CC - Continuous Core
 Piezometer Backfill Type: Bentonite Sloughed Drill Cuttings Sand

Logged by: E.R.
 Reviewed by: O.P.
 Date: Oct. 20, 2015



TEST PIT RECORD

TP15-005

CLIENT Public Works & Government Services PROJECT No. 121413573
 PROJECT Gordon Lake Group Mine Site DATUM N/A
 LOCATION Gordon Lake, Northwest Territories ELEVATION N/A
 EXCAVATION DATE Aug. 14, 2015 CONTRACTOR N/A EXCAVATION METHOD Hand/Shovel

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLES			<input type="checkbox"/> Insitu Shear Vane (kPa) <input type="checkbox"/> Remoulded Shear Vane (kPa) <input type="checkbox"/> Pocket Penetrometer (kPa) <input type="checkbox"/> Disturbed Torvane (kPa)				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP		ORGANICS - with sand								0
	SP		SAND - poorly graded								
	SP		SAND - poorly graded with gravel								
	SP		SAND - poorly graded								2
1			- Grain size test at 1.00 m: gravel=1.1%, sand=97.7%, fines=1.2%	GS	1						
			- End of test pit TP15-005 at 1.20 m -UTM Zone 12: (N: 6978041; E: 386699)								4
2											
											6
											8
3											10

Sample Type: GS - Grab Sample SS - Split Spoon
 ST - Shelby Tube PT - Piston Tube CC - Continuous Core
 Piezometer Backfill Type: Bentonite Sloughed Drill Cuttings Sand

Logged by: E.R.
 Reviewed by: O.P.
 Date: Oct. 20, 2015



TEST PIT RECORD

TP15-006

CLIENT Public Works & Government Services PROJECT No. 121413573
 PROJECT Gordon Lake Group Mine Site DATUM N/A
 LOCATION Gordon Lake, Northwest Territories ELEVATION N/A
 EXCAVATION DATE Aug. 14, 2015 CONTRACTOR N/A EXCAVATION METHOD Hand/Shovel

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLES			<input type="checkbox"/> Insitu Shear Vane (kPa) <input type="checkbox"/> Remoulded Shear Vane (kPa) <input type="checkbox"/> Pocket Penetrometer (kPa) <input type="checkbox"/> Disturbed Torvane (kPa)				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP		ORGANICS - with sand								0
	GP		GRAVEL - poorly graded with sand and fines - Grain size test at 0.20 m: gravel=60.5%, sand=34.3%, fines=5.2%	GS	1						
	SP		SAND - poorly graded, some gravel - Grain size test at 0.45 m: gravel=1.4%, sand=96.5%, fines=2.1%	GS	2						
	SP		SAND - poorly graded								2
1			- Grain size test at 1.00 m: gravel=0.0%, sand=95.4%, fines=4.6%	GS	3						
			- End of test pit TP15-006 at 1.20 m -UTM Zone 12: (N: 6987966; E: 381907)								4
2											6
3											8
											10

Sample Type: GS - Grab Sample SS - Split Spoon
 ST - Shelby Tube PT - Piston Tube CC - Continuous Core
 Piezometer Backfill Type: Bentonite Sloughed Drill Cuttings Sand

Logged by: E.R.
 Reviewed by: O.P.
 Date: Oct. 20, 2015



TEST PIT RECORD

TP15-007

CLIENT Public Works & Government Services PROJECT No. 121413573
 PROJECT Gordon Lake Group Mine Site DATUM N/A
 LOCATION Gordon Lake, Northwest Territories ELEVATION N/A
 EXCAVATION DATE Aug. 14, 2015 CONTRACTOR N/A EXCAVATION METHOD Hand/Shovel

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLES			<input type="checkbox"/> Insitu Shear Vane (kPa) <input type="checkbox"/> Remoulded Shear Vane (kPa) <input type="checkbox"/> Pocket Penetrometer (kPa) <input type="checkbox"/> Disturbed Torvane (kPa)				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP	☼	ORGANICS - with sand, some gravel								0
	GW	⊙	GRAVEL - well graded with fines and sand - Grain size test at 0.20 m: gravel=56.3%, sand=35.5%, fines=8.2%	GS	1						
	SM	⋯	SAND- silty, poorly graded								
			SAND - silty and/or clayey								2
1	SM	⋯									
			- Grain size test at 1.40 m: gravel=0.1%, sand=75.6%, fines=24.3%	GS	2						4
			- End of test pit TP15-007 at 1.40 m								
			-UTM Zone 12: (N: 6987997; E: 381988)								
2											
3											10

Sample Type: GS - Grab Sample SS - Split Spoon
 ST - Shelby Tube PT - Piston Tube CC - Continuous Core
 Piezometer Backfill Type: Bentonite Sloughed Drill Cuttings Sand

Logged by: E.R.
 Reviewed by: O.P.
 Date: Oct. 20, 2015



TEST PIT RECORD

TP15-008

CLIENT Public Works & Government Services PROJECT No. 121413573
 PROJECT Gordon Lake Group Mine Site DATUM N/A
 LOCATION Gordon Lake, Northwest Territories ELEVATION N/A
 EXCAVATION DATE Aug. 14, 2015 CONTRACTOR N/A EXCAVATION METHOD Hand/Shovel

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLES			TEST METHODS				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP		ORGANICS - with sand and silt, trace gravel								0
	SM		SAND - silty, trace gravel								
	SW		SAND AND GRAVEL								
	SP		SAND - poorly graded with gravel								2
1			- Grain size test at 1.00 m: gravel=36.7%, sand=59.2%, fines=4.1% - End of test pit TP15-008 at 1.00 m - UTM Zone 12: (N: 6988167; E: 382119)	GS	1						4
2											6
											8
3											10

Sample Type: GS - Grab Sample SS - Split Spoon
 ST - Shelby Tube PT - Piston Tube CC - Continuous Core
 Piezometer Backfill Type: Bentonite Sloughed Drill Cuttings Sand

Logged by: E.R.
 Reviewed by: O.P.
 Date: Oct. 20, 2015



TEST PIT RECORD

TP15-009

CLIENT Public Works & Government Services PROJECT No. 121413573
 PROJECT Gordon Lake Group Mine Site DATUM N/A
 LOCATION Gordon Lake, Northwest Territories ELEVATION N/A
 EXCAVATION DATE Aug. 15, 2015 CONTRACTOR N/A EXCAVATION METHOD Hand/Shovel

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLES			<input type="checkbox"/> Insitu Shear Vane (kPa) <input type="checkbox"/> Remoulded Shear Vane (kPa) <input type="checkbox"/> Pocket Penetrometer (kPa) <input type="checkbox"/> Disturbed Torvane (kPa)				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP		ORGANICS - with sand								0
	SP		SAND - coarse, trace gravel								
	GW		GRAVEL - with sand								
	GW		GRAVEL AND SAND - some cobbles								2
1	SP		SAND - poorly graded with gravel - Grain size test at 1.00 m: gravel=39.0%, sand=59.6%, fines=1.4% - End of test pit TP15-009 at 1.00 m -UTM Zone 12: (N: 6982377; E: 376012)	GS	1						4
2											6
											8
3											10

Sample Type: GS - Grab Sample SS - Split Spoon
 ST - Shelby Tube PT - Piston Tube CC - Continuous Core
 Piezometer Backfill Type: Bentonite Sloughed Drill Cuttings Sand

Logged by: E.R.
 Reviewed by: O.P.
 Date: Oct. 20, 2015



TEST PIT RECORD

TP15-010

CLIENT Public Works & Government Services PROJECT No. 121413573
 PROJECT Gordon Lake Group Mine Site DATUM N/A
 LOCATION Gordon Lake, Northwest Territories ELEVATION N/A
 EXCAVATION DATE Aug. 15, 2015 CONTRACTOR N/A EXCAVATION METHOD Hand/Shovel

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLES			<input type="checkbox"/> Insitu Shear Vane (kPa) <input type="checkbox"/> Remoulded Shear Vane (kPa) <input type="checkbox"/> Pocket Penetrometer (kPa) <input type="checkbox"/> Disturbed Torvane (kPa)				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP		ORGANICS - with sand								0
	SW		SAND - well graded, some gravel - mostly cobbles								
	GW		GRAVEL AND SAND - coarse sand								
	SW		GRAVEL - well graded with sand (coarse)								
1			- Grain size test at 1.00 m: gravel=64.2%, sand=34.3%, fines=1.5%	GS	1						
			- end of test pit TP15-010 at 1.00 m								
			-UTM Zone 12: (N: 6982259; E: 376003)								
2											
3											

Sample Type: GS - Grab Sample SS - Split Spoon
 ST - Shelby Tube PT - Piston Tube CC - Continuous Core
 Piezometer Backfill Type: Bentonite Sloughed Drill Cuttings Sand

Logged by: E.R.
 Reviewed by: O.P.
 Date: Oct. 20, 2015



TEST PIT RECORD

TP15-011

CLIENT Public Works & Government Services PROJECT No. 121413573
 PROJECT Gordon Lake Group Mine Site DATUM N/A
 LOCATION Gordon Lake, Northwest Territories ELEVATION N/A
 EXCAVATION DATE Aug. 15, 2015 CONTRACTOR N/A EXCAVATION METHOD Hand/Shovel

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLES			<input type="checkbox"/> Insitu Shear Vane (kPa) <input type="checkbox"/> Remoulded Shear Vane (kPa) <input type="checkbox"/> Pocket Penetrometer (kPa) <input type="checkbox"/> Disturbed Torvane (kPa)				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP		ORGANICS - with sand								0
	SW		SAND - and fines, some gravel								
	SW		SAND - well graded, with gravel								
	SW		SAND AND GRAVEL								2
1	SP		SAND - poorly graded with fines and gravel - Grain size test at 1.00 m: gravel=33.5%, sand=58.7%, fines=7.8% - End of test pit TP15-011 at 1.00 m - UTM Zone 12: (N: 6982191; E: 376009)	GS	1						4
2											6
3											8
											10

Sample Type: GS - Grab Sample SS - Split Spoon
 ST - Shelby Tube PT - Piston Tube CC - Continuous Core
 Piezometer Backfill Type: Bentonite Sloughed Drill Cuttings Sand

Logged by: E.R.
 Reviewed by: O.P.
 Date: Oct. 20, 2015



TEST PIT RECORD

TP15-012

CLIENT Public Works & Government Services PROJECT No. 121413573
 PROJECT Gordon Lake Group Mine Site DATUM N/A
 LOCATION Gordon Lake, Northwest Territories ELEVATION N/A
 EXCAVATION DATE Aug. 15, 2015 CONTRACTOR N/A EXCAVATION METHOD Hand/Shovel

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLES			<input type="checkbox"/> Insitu Shear Vane (kPa) <input type="checkbox"/> Remoulded Shear Vane (kPa) <input type="checkbox"/> Pocket Penetrometer (kPa) <input type="checkbox"/> Disturbed Torvane (kPa)				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	SP	[Symbol]	SAND - no rootmat; surface disturbed								0
	SW	[Symbol]	SAND - well graded with gravel - Grain size test at 0.40 m: gravel=59.3%, sand=37.5%, fines=3.2%	X	GS 1						
	SP	[Symbol]	SAND - poorly graded with gravel (some cobbles)								2
1			- Grain size test at 1.10 m: gravel=16.3%, sand=80.3%, fines=3.4%	X	GS 2						
			- End of test pit TP15-012 at 1.10 m								4
			-UTM Zone 12: (N: 6994100; E: 374311)								6
2											8
3											10

Sample Type: GS - Grab Sample SS - Split Spoon
 ST - Shelby Tube PT - Piston Tube CC - Continuous Core
 Piezometer Backfill Type: Bentonite Sloughed Drill Cuttings Sand

Logged by: E.R.
 Reviewed by: O.P.
 Date: Oct. 20, 2015



TEST PIT RECORD

TP15-013

CLIENT Public Works & Government Services PROJECT No. 121413573
 PROJECT Gordon Lake Group Mine Site DATUM N/A
 LOCATION Gordon Lake, Northwest Territories ELEVATION N/A
 EXCAVATION DATE Aug. 15, 2015 CONTRACTOR N/A EXCAVATION METHOD Hand/Shovel

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLES			Moisture Content & Atterberg Limits				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP		ORGANICS - with sand								0
	SW		SAND - some gravel								
			SAND - poorly graded with fines								
1	SP										2
				GS	1						4
			- Grain size test at 1.30 m: gravel=3.7%, sand=85.5%, fines=10.8%								
			- End of test pit TP15-013 at 1.30 m								
			-UTM Zone 12: (N: 6994211; E: 374119)								
2											6
											8
3											10

Sample Type: GS - Grab Sample SS - Split Spoon
 ST - Shelby Tube PT - Piston Tube CC - Continuous Core
 Piezometer Backfill Type: Bentonite Sloughed Drill Cuttings Sand

Logged by: E.R.
 Reviewed by: O.P.
 Date: Oct. 20, 2015



TEST PIT RECORD

TP15-015

CLIENT Public Works & Government Services PROJECT No. 121413573
 PROJECT Gordon Lake Group Mine Site DATUM N/A
 LOCATION Gordon Lake, Northwest Territories ELEVATION N/A
 EXCAVATION DATE Aug. 15, 2015 CONTRACTOR N/A EXCAVATION METHOD Hand/Shovel

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLES			Moisture Content & Atterberg Limits				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP		ORGANICS with sand								0
	SW		SAND and fines with gravel - mostly cobbles								
	GW		GRAVEL and SAND - poorly graded								
	GW		GRAVEL - well graded with fines and sand								2
1			- Grain size test at 1.10 m: gravel=67.4%, sand=27.4%, fines=5.2%	GS	1						
			- End of test pit TP15-015 at 1.10 m								4
			-UTM Zone 12: (N: 6990934; E: 392134)								6
2											8
3											10

Sample Type: GS - Grab Sample SS - Split Spoon
 ST - Shelby Tube PT - Piston Tube CC - Continuous Core
 Piezometer Backfill Type: Bentonite Sloughed Drill Cuttings Sand

Logged by: E.R.
 Reviewed by: O.P.
 Date: Oct. 20, 2015



TEST PIT RECORD

TP15-016

CLIENT Public Works & Government Services PROJECT No. 121413573
 PROJECT Gordon Lake Group Mine Site DATUM N/A
 LOCATION Gordon Lake, Northwest Territories ELEVATION N/A
 EXCAVATION DATE Aug. 15, 2015 CONTRACTOR N/A EXCAVATION METHOD Hand/Shovel

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLES			TEST METHODS				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP		ORGANICS - with sand								0
	SW		SAND and fines with gravel - some cobbles								
	SM		SAND - silty and/or clayey								2
1			- Grain size test at 1.10 m: gravel=0.4%, sand=87.4%, fines=12.2%	GS	1						4
			- End of test pit TP15-016 at 1.10 m								
			-UTM Zone 12: (N: 6990972; E: 392170)								6
2											8
3											10

Insitu Shear Vane (kPa) Remoulded Shear Vane (kPa)
 Pocket Penetrometer (kPa) Disturbed Torvane (kPa)

50kPa 100kPa 150kPa 200kPa

W_p W W_L
 |-----|-----|
 Moisture Content & Atterberg Limits
 ● Standard Penetration Test, blows/0.3m

Sample Type: GS - Grab Sample SS - Split Spoon
 ST - Shelby Tube PT - Piston Tube CC - Continuous Core
 Piezometer Backfill Type: Bentonite Sloughed Drill Cuttings Sand

Logged by: E.R.
 Reviewed by: O.P.
 Date: Oct. 20, 2015



TEST PIT RECORD

TP15-017

CLIENT Public Works & Government Services PROJECT No. 121413573
 PROJECT Gordon Lake Group Mine Site DATUM N/A
 LOCATION Gordon Lake, Northwest Territories ELEVATION N/A
 EXCAVATION DATE Aug. 15, 2015 CONTRACTOR N/A EXCAVATION METHOD Hand/Shovel

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLES			<input type="checkbox"/> Insitu Shear Vane (kPa) <input type="checkbox"/> Remoulded Shear Vane (kPa) <input type="checkbox"/> Pocket Penetrometer (kPa) <input type="checkbox"/> Disturbed Torvane (kPa)				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP		ORGANICS - with sand								0
	SW		SAND - well graded with gravel								
	GW		GRAVEL - and sand (coarse)								
	ML		SILT and fine sand								2
	ML		SILT and fine sand some gravel - some boulders								
1	GW		GRAVEL - well graded with fines and sand - Grain size test at 1.00 m: gravel=44.9%, sand=43.7%, fines=11.4% - End of test pit TP15-017 at 1.00 m - UTM Zone 12: (N: 6991019; E: 392205)	GS	1						
											4
											6
											8
											10

Sample Type: GS - Grab Sample SS - Split Spoon
 ST - Shelby Tube PT - Piston Tube CC - Continuous Core
 Piezometer Backfill Type: Bentonite Sloughed Drill Cuttings Sand

Logged by: E.R.
 Reviewed by: O.P.
 Date: Oct. 20, 2015



APPENDIX G Ice Spur Routing

ROUTING STUDY
GORDON LAKE GROUP REMEDIATION
PROJECT – MINE SITES ACCESS

NOR-EX PROJECT NUMBER 2420



Prepared For

Stantec Consulting Ltd
102 – 40 Highland Park Drive
Dartmouth, NS, B3A 0A3

Respectfully Submitted By

NOR-EX Ice Engineering Inc.
1308 Copperhead Drive
Kamloops, BC, V2E 2T4

April 7, 2016

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Background

On behalf of INAC/Public Works, Stantec has contracted NOR-EX Ice Engineering Inc. to provide winter road alignment recommendations to access a number of remediation sites in the Gordon Lake region, North-East of Yellowknife.

Purpose

The purpose of this review is to study the topography in the area of Gordon Lake for creating over-land and over-ice access routes to the following nine historic mining sites:

- Try Me
- Murray Lake
- Kidney
- Treacy
- West Bay
- Camlaren
- Storm
- Burnt Island
- Goodrock

These nine historic mine sites are planned for remediation. Stantec is assessing the feasibility of access to these sites during the winter months via ice roads, to haul equipment to the sites and to enable continued reclamation of these sites.

Methodology

The routing study has been completed as a desk-based review of the topographic information and aerial imagery available in the Gordon Lake region, to visually determine routing of roads that would be the least resource-intensive. This approach has been combined with the experience and familiarity the NOR-EX team has with the Gordon Lake region and sites. Additionally, a helicopter reconnaissance visit, as recommended in previous reports, allowed for the optimization of overland routing to each of the sites through the use of video footage, GPS tracking, and visual confirmation.

Routing was selected to maximize the use of current winter road infrastructure provided by the Tibbitt to Contwoyto Winter Road (TCWR), which provides access from the city of Yellowknife to the Gordon Lake area annually from late January through to early April. The spur roads off of the TCWR road were combined, where feasible, to reduce construction and maintenance costs. Spur roads make maximum use of ice cover and minimal use of over-land routing. This approach was used as the construction of ice roads is generally easiest and most cost effective over water bodies such as frozen lakes versus over land. The other primary objective in determining the routes was to result in the least overall length of constructed road – whether over land or ice.

The following is the methodology used to determine the recommended routes:

- Data of the precise geo-referenced locations of Gordon Lake reclamation mine sites was obtained from Stantec to assist in determining the access routes.
- A series of topographic maps were sourced from Natural Resources Canada's Toporama database as the optimal imagery for a background to the 2-dimensional routing plans.
- Sites were plotted and route selection was made using terrain analysis tools to map the routes to each site considering the following criteria:
 - Shallow water sections were avoided to the extent possible.
 - Rocks, outcrops, land, and other geological features were avoided to the extent possible.
 - Topographic information was used to minimize elevation change/grade to the extent possible.
 - Aerial imagery supplied by Stantec assisted in placing access routes over previously scorn earth, assumed to be previous transport routes, or over other suitable terrain features.
 - For example, in the case of the Murray Lake and Try Me sites, the route was optimized by visually replicating as closely as possible the historic access road to the Discovery Mine (Discovery Yellowknife Mines Ltd.; Consol Discovery YK Mines), via the gravel pit at the West shore of Gordon Lake, to the extent of Murray Lake. Beyond Murray Lake, the route was optimized over small lakes and over land of minimal grade change to Mac Lake and the Try Me Camp site.
 - The Tibbitt to Contwoyto Winter Road (TCWR) currently constructs a large winter road to Gordon Lake and also constructs a spur road to the West shore of Gordon Lake towards the Murray Lake / Try Me sites. This road extends only to the shoreline.
 - The remainder of the sites are located off of the TCWR, and local ice conditions have been inferred from the main road, as well as a review of available imagery and digital information.
- Lengths of over-land sections of road and lengths of over-water sections of road were determined by measuring kilometer distances in geo-referenced 3-dimensional CAD / Terrain software. These details are summarized in Table 1 and on each of the map sheets in the Appendices.
- Output map sheets were created with attention to scale – showing overall route layouts and individual or paired route layouts. See Figure 1 for an overview of the

routing; see the Appendices for output map sheets focused to the localized Gordon Lake reclamation mine sites, and their access routing.

- Google Earth import files (KMZ files) were created for the routes to allow for GPS routing in future. Shape files were created to assist with GIS integration.
- Each of the above processes were repeated and outputs from the desk-based study were revised and updated to reflect visual knowledge obtained from a reconnaissance visit completed March 24th, 2016 per previous report recommendations. Aerial reconnaissance, and the video footage, GPS tracking, and field notes obtained during the visit, assisted in confirmation of the best overland access routes to each of the Gordon Lake sites. These routes were aligned with lowest ground slope and trafficable land features, pre-existing snowmobile or other tracked routes, ground markers of site locations, and visual observance of least-resistant path.

Route Details

The following table summarizes the recommended Gordon Lake sites' route distances over-ice and over-land, revised to reflect reconnaissance visit from March 24th, 2016:

Table 1 – Lengths of Gordon Lake roads routed over-ice and over-land

Road Name	Length (km)	Length over Water (km)	Length over Land (km)
West Bay Spur to North and South Areas	2.7	2.31	0.44
Kidney - Treacy Spur Road	2.1	2.09	0
Kidney 1939 Camp Spur	1.1	1.06	0.03
Treacy Spur to Camp	2.0	1.99	0.02
Kidney 1983 Camp - off Treacy Spur	1.7	1.64	0.05
Kidney Pond Portal - off Treacy Spur	1.4	0.95	0.40
Murray Lake Spur Road - Camp and Trench Area E	9.7	4.80	4.91
Try Me Spur Road via Murray Lake - Camp and Shaft	9.5	4.07	5.42
Storm Spur to Camp	5.2	5.21	0
Storm Shaft Area - off Storm Spur to Camp	1.9	0.83	1.09
Camlaren Spur Road - to Mine Area South	3.2	3.03	0.15
Camlaren Zenith Island - off Camlaren Spur	1.1	1.07	0.02
Burnt Island / Goodrock Spur Road	2.8	2.78	0
Burnt Island - Knutsen Camp and Waste Rock Area	2.7	2.24	0.49
Goodrock - Camp and Mine Mill Area	4.2	3.64	0.55
Totals	51.3	37.7	13.6

The following figure displays the recommended routing to sites across the Gordon Lake region in plan view:

Figure 1 – Overall Plan of Gordon Lake Sites and Routes (next page)

Stantec

Gordon Lake Group Remediation Project - Routing Study

All Proposed Gordon Lake Routes
Plan View

Drawn / Technical:

M. Pollock

Reviewer:

A. Fitzgerald

Project:

2420

Figure No.:

1

Date:

April 2016

Revision No.:

3

Road Name	Length (km)	Length over Water (km)	Length over Land (km)
West Bay Spur to North and South Areas	2.7	2.31	0.44
Kidney - Treacy Spur Road	2.1	2.09	0
Kidney 1939 Camp Spur	1.1	1.06	0.03
Treacy Spur to Camp	2.0	1.99	0.02
Kidney 1983 Camp - off Treacy Spur	1.7	1.64	0.05
Kidney Pond Portal - off Treacy Spur	1.4	0.95	0.40
Murray Lake Spur Road - Camp and Trench Area E	9.7	4.80	4.91
Try Me Spur Road via Murray Lake - Camp and Shaft	9.5	4.07	5.42
Storm Spur to Camp	5.2	5.21	0
Storm Shaft Area - off Storm Spur to Camp	1.9	0.83	1.09
Camlaren Spur Road - to Mine Area South	3.2	3.03	0.15
Camlaren Zenith Island - off Camlaren Spur	1.1	1.07	0.02
Burnt Island / Goodrock Spur Road	2.8	2.78	0
Burnt Island - Knutsen Camp and Waste Rock Area	2.7	2.24	0.49
Goodrock - Camp and Mine Mill Area	4.2	3.64	0.55
Totals	51.3	37.7	13.6

Legend

- Gordon Lake Site Locations
- Over Water Road Sections
- Over Land Road Sections
- Tibbitt to Contwoyto Winter Road

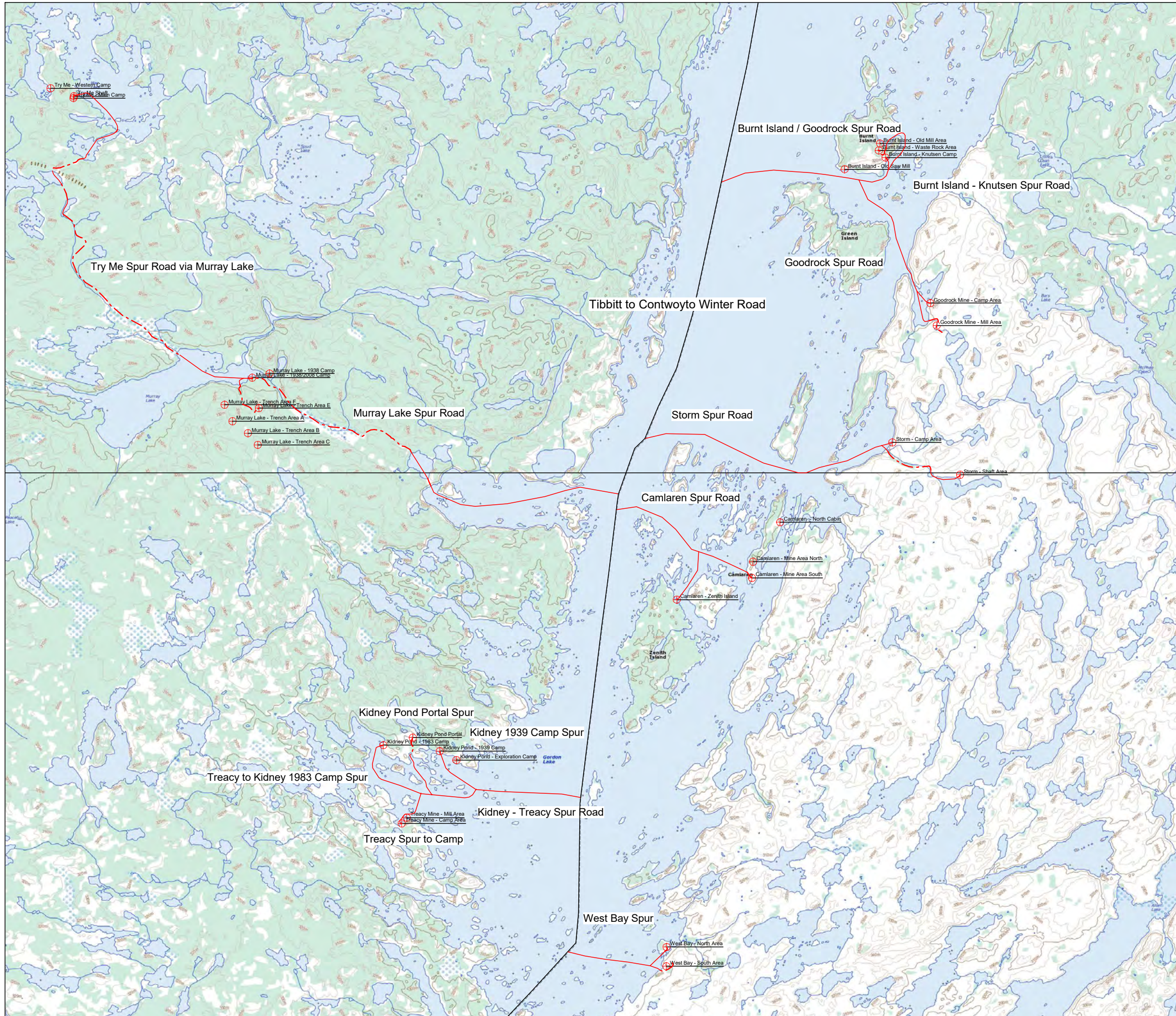
Reference base maps from Natural Resources Canada:
Toporama - 085P03 - GORDON LAKE, Northwest Territories
Toporama - 085I14 - ZENITH ISLAND, Northwest Territories
Map Projection: UTM NAD '83 Zone 12N, Metric (metres)

Plan Scale 1:75,000



0

5000 metres



Construction Considerations

The ice road season in the north is relatively short despite the length of winters. The TCWR – the trunk road accessing all Gordon Lake reclamation mine sites – is generally open for a timeframe of 2 months from February 1st to March 31st, however this can be variable from year to year. A primary consideration for constructing the over-land and over-water ice roads outlined in Appendix A is the shortened window of opportunity to complete construction, mobilize to the sites to complete the intended reclamation work, and demobilize from the sites prior to TCWR closure.

INAC/Public Works will be required to apply and register as a “Third Party User” with the TCWR JV in order to use the TCWR. This is a straight forward process, and would require partial payment in advance for use of the road. The fees for use of the road are based on a “loaded tonne x kilometer” basis, and applications for Third Party User status are generally required by November/December annually.

Broadly speaking, there would be two options available for the transportation of goods and materials to the sites in question. An ice road can be constructed and maintained throughout the season in order to permit wheeled vehicles to travel to sites. The second option would be to skid equipment over the ice and snow, without constructing/clearing a route down to bare ice.

The detailed cost/benefit analysis of each approach is beyond the scope of this report, however, some key considerations on a site by site basis would normally include:

- The number of trips planned in and out for each site.
- The nature of equipment needed to access each site.
- The operating weights of equipment and supplies being used at each site.
- The operating window required at each site.

The following are recommendations to enable early road construction for the Gordon Lake reclamation mine access routes:

- Mobilize construction equipment north on the TCWR at its earliest opening date.
- Consider construction schedule impacts of overland construction. Land Use Permits will often require a minimum 10cm of ice and snow on overland routes prior to opening these routes to traffic. Construction times for the over land sections of all roads, specifically the lengthier sections of the Murray Lake and Try Me routes should be considered in the overall construction and remediation schedule.

-
- Construction of the over ice sections of the roads could begin simultaneously to the TCWR construction in early to mid January. This synchronization could enable early access to priority sites, perhaps as early as mid-late January.
 - Utilization of the existing TCWR spurs will reduce amount of redundant roads being built.
 - Specifically, the TCWR normally constructs a spur road into their West Bay gravel pit, which could be used to access the Murray Lake route. This would reduce construction costs and could enable an early start to the overland construction of the Murray Lake/Try Me route.
 - Complete all work required for mine reclamation activities and demobilize from sites prior to TCWR shutdown, generally at the end of March.

Recommendations

The recommended routing for each site, as illustrated in Figure 1 and the Appendices, has been determined by a desk-based review of imagery and topographical information, and by the experience and knowledge of construction practices and northern challenges associated with the Gordon Lake region of the Northwest Territories.

It is recommended that a reconnaissance visit to each of the sites occur prior to finalizing the access routes for construction. This could be achieved by a helicopter reconnaissance or winter land access using a low ground bearing pressure vehicle. This reconnaissance would be useful to determine final routing based on potential land features and/or obstacles that may not be obvious from a map study.

Update: This reconnaissance visit was completed on March 24th, 2016. A helicopter flight with Stantec personnel allowed for a reconnaissance by foot of the existing West Bay overland access road, as well as an aerial reconnaissance of the remaining Gordon Lake Group Reclamation sites (see Figure 1) and access routes. This visit resulted in the updating of access routes to all sites, with a desk-based revision (no. 3) of all figures using geo-referenced 3-dimensional CAD / Terrain software, and revised outputs created of Shape files suitable for GIS software and KMZ files suitable for Google Earth or other GPS software.

Revisions were made to optimally align the overland access routes with ground features that appeared to have a low-profile or insignificant change in gradient during flight. Attention for the overland routing was also given to visually-identifiable snowmobile routes, animal tracks or minimally-vegetated land. Videos produced from the helicopter flight assisted in confirming the routing during the desk-based revisions.

Report Clarifications

This report has been prepared by NOR-EX for the use of Stantec and its partners. Its' contents should not be relied upon by any other party.

Signatures

Respectfully submitted
NOR-EX ICE ENGINEERING INC.
per:



Meghan Pollock, E.I.T.
Project Engineer-in-Training

Reviewed by,



Al Fitzgerald, P.Eng.
President

Appendices

Appendix A – Figure No. 2 – Routes Accessing Burnt Island and Goodrock Sites – Plan View

Appendix B – Figure No. 3 – Routes Accessing Storm and Camlaren Sites – Plan View

Appendix C – Figure No. 4 – West Bay Site Access Routes – Plan View

Appendix D – Figure No. 5 – Routes Accessing Treacy and Kidney Sites – Plan View

Appendix E – Figure No. 6 – Murray Lake Site Access Routes – Plan View

Appendix F – Figure No. 7 – Try Me Site Access Routes via Murray Lake – Plan View

Appendix G – Google Earth .kmz file of Gordon Lake Routes – *attached

Appendix H – Shape Files of Gordon Lake Routes – *attached

Appendix I – Video Files of Gordon Lake Routes filmed during helicopter flight on March 24th, 2016 – *attached

Stantec

Gordon Lake Group Remediation Project - Routing Study

Routes Accessing Burnt Island and Goodrock Sites Plan View

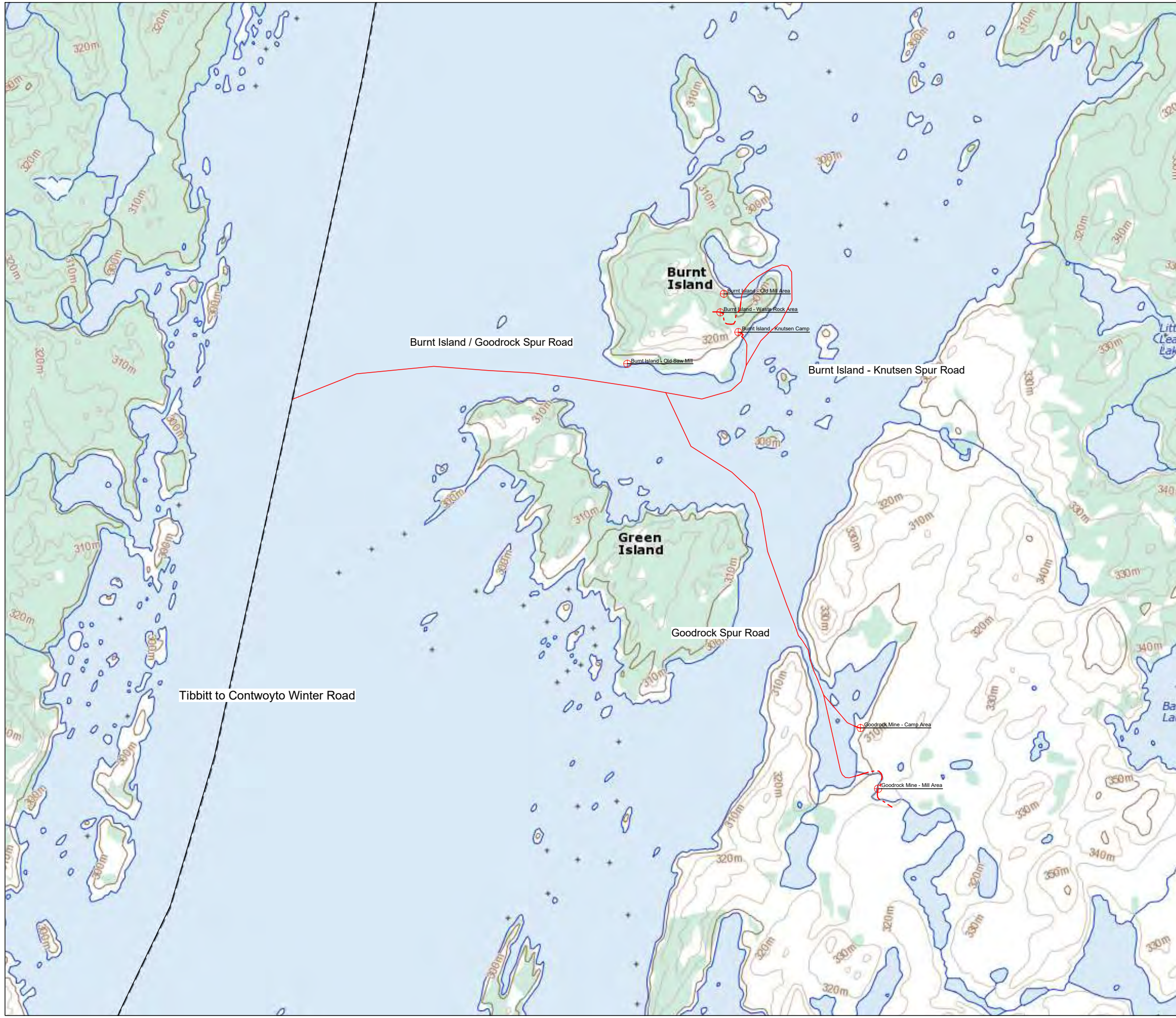
Drawn / Technical: M. Pollock	Reviewer: A. Fitzgerald
Project: 2420	Figure No.: 2
Date: April 2016	Revision No.: 3

Road Name	Length (km)	Length over Water (km)	Length over Land (km)
Burnt Island / Goodrock Spur Road	2.8	2.78	0
Burnt Island - Knutsen Camp and Waste Rock Area	2.7	2.24	0.49
Goodrock - Camp and Mine Mill Area	4.2	3.64	0.55
Total	9.7	8.7	1.0

Legend	
	Gordon Lake Site Locations
	Over Water Road Sections
	Over Land Road Sections
	Tibbitt to Contwoyto Winter Road

Reference base maps from Natural Resources Canada:
Toporama - 085P03 - GORDON LAKE, Northwest Territories
Map Projection: UTM NAD '83 Zone 12N, Metric (metres)

Plan Scale 1:25,000



Stantec

Gordon Lake Group Remediation Project - Routing Study

Routes Accessing Storm and Camlaren Sites Plan View

Drawn / Technical:

M. Pollock

Reviewer:

A. Fitzgerald

Project:

2420

Figure No.:

3

Date:

April 2016

Revision No.:

3

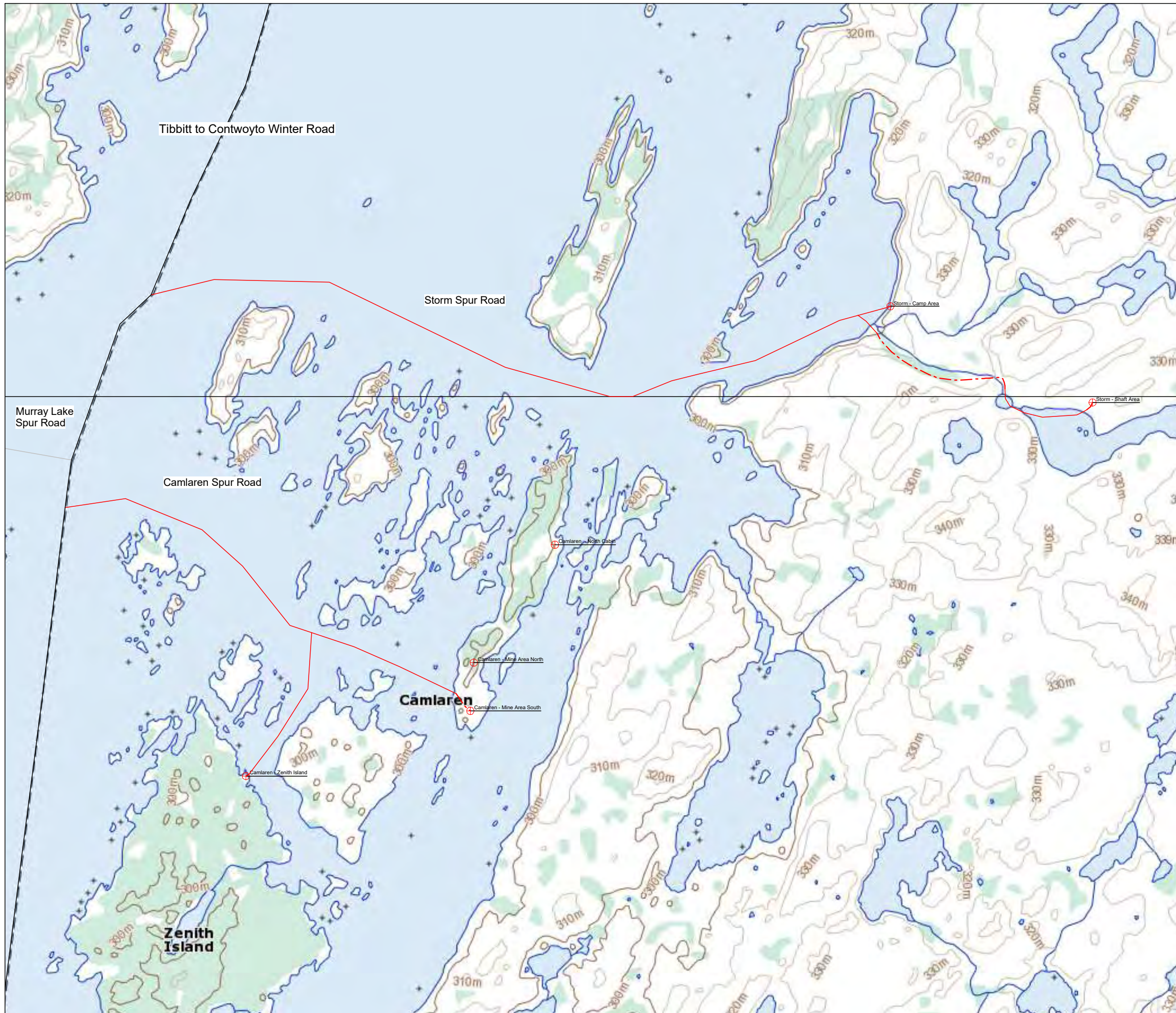
Road Name	Length (km)	Length over Water (km)	Length over Land (km)
Storm Spur to Camp	5.2	5.21	0
Storm Shaft Area - off Storm Spur to Camp	1.9	0.83	1.09
Camlaren Spur Road - to Mine Area South	3.2	3.03	0.15
Camlaren Zenith Island - off Camlaren Spur	1.1	1.07	0.02
Total	11.4	10.1	1.3

Legend

- Gordon Lake Site Locations
- Over Water Road Sections
- Over Land Road Sections
- Tibbitt to Contwoyto Winter Road
- Other Site Access Road

Reference base maps from Natural Resources Canada:
Toporama - 085P03 - GORDON LAKE, Northwest Territories
Toporama - 085I14 - ZENITH ISLAND, Northwest Territories
Map Projection: UTM NAD '83 Zone 12N, Metric (metres)

Plan Scale 1:25,000



Stantec

Gordon Lake Group Remediation Project - Routing Study

West Bay Site Access Routes Plan View

Drawn / Technical:

M. Pollock

Reviewer:

A. Fitzgerald

Project:

2420

Figure No.:

4

Date:




April 2016

Revision No.:

4

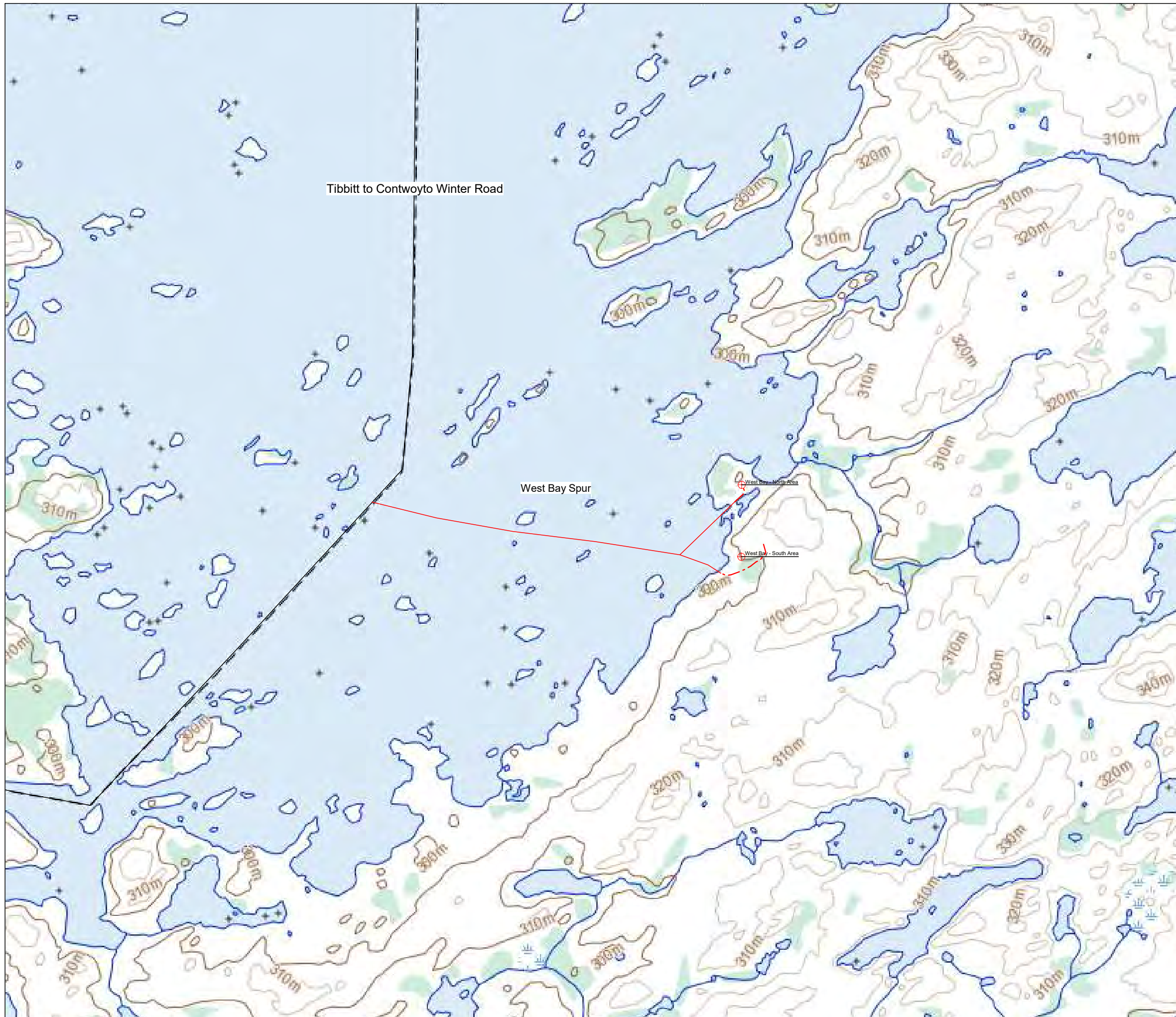
Road Name	Length (km)	Length over Water (km)	Length over Land (km)
West Bay Spur to North and South Areas	2.7	2.31	0.44

Legend

-  Gordon Lake Site Locations
-  Over Water Road Sections
-  Over Land Road Sections
-  Tibbitt to Contwoyto Winter Road

Reference base maps from Natural Resources Canada:
Toporama - 085114 - ZENITH ISLAND, Northwest Territories
Map Projection: UTM NAD '83 Zone 12N, Metric (metres)

Plan Scale 1:20,000



Stantec

Gordon Lake Group Remediation Project - Routing Study

Routes Accessing Treacy and Kidney Sites Plan View

Drawn / Technical:

M. Pollock

Reviewer:

A. Fitzgerald

Project:

2420

Figure No.:

5

Date:

April 2016

Revision No.:

3

Road Name	Length (km)	Length over Water (km)	Length over Land (km)
Kidney - Treacy Spur Road	2.1	2.09	0
Kidney 1939 Camp Spur	1.1	1.06	0.03
Treacy Spur to Camp	2.0	1.99	0.02
Kidney 1983 Camp - off Treacy Spur	1.7	1.64	0.05
Kidney Pond Portal - off Treacy Spur	1.4	0.95	0.40
Total	8.2	7.7	0.5

Legend

- Gordon Lake Site Locations
- Over Water Road Sections
- Over Land Road Sections
- Tibbitt to Contwoyto Winter Road

Reference base maps from Natural Resources Canada:
Toporama - 085114 - ZENITH ISLAND, Northwest Territories
Map Projection: UTM NAD '83 Zone 12N, Metric (metres)

Plan Scale 1:20,000



Stantec

Gordon Lake Group Remediation Project - Routing Study

Murray Lake Site Access Routes Plan View

Drawn / Technical:

M. Pollock

Reviewer:

A. Fitzgerald

Project:

2420

Figure No.:

6

Date:

April 2016

Revision No.:

3

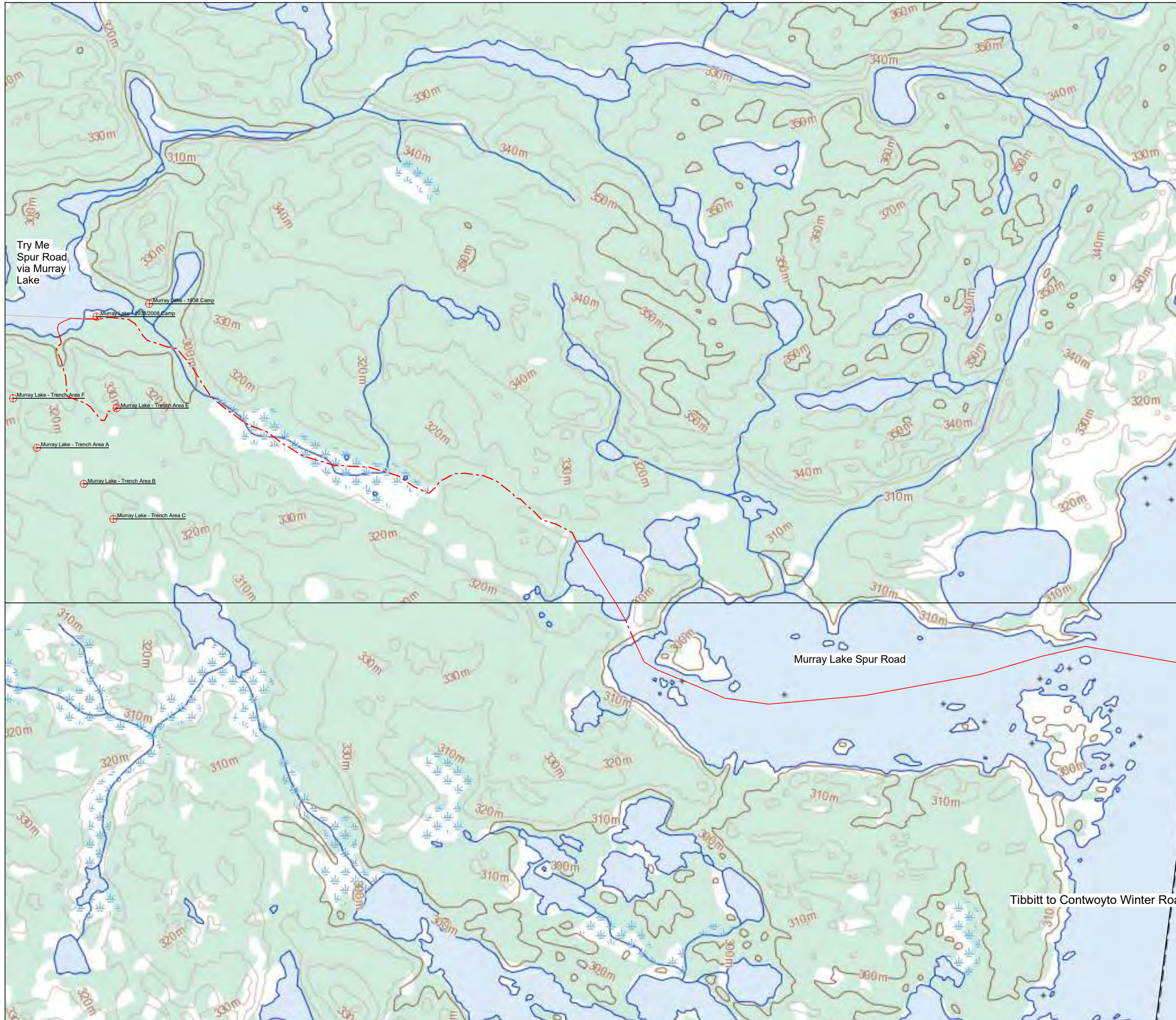
Road Name	Length (km)	Length over Water (km)	Length over Land (km)
Murray Lake Spur Road - Camp and Trench Area E	9.7	4.80	4.91

Legend

	Gordon Lake Site Locations
	Over Water Road Sections
	Over Land Road Sections
	Tibbitt to Contwoyto Winter Road
	Other Site Access Road (Over Water)
	Other Site Access Road (Over Land)

Reference base maps from Natural Resources Canada:
Toporama - 085P03 - GORDON LAKE, Northwest Territories
Toporama - 085I14 - ZENITH ISLAND, Northwest Territories
Map Projection: UTM NAD '83 Zone 12N, Metric (metres)

Plan Scale 1:25,000



Stantec

Gordon Lake Group Remediation Project - Routing Study

Try Me Site Access Routes
via Murray Lake
Plan View

Drawn / Technical: M. Pollock	Reviewer: A. Fitzgerald
Project: 2420	Figure No.: 7
Date: April 2016	Revision No.: 3

Road Name	Length (km)	Length over Water (km)	Length over Land (km)
Try Me Spur Road via Murray Lake - Camp and Shaft	9.5	4.07	5.42

Legend

- Gordon Lake Site Locations
- Over Water Road Sections
- Over Land Road Sections
- Other Site Access Road (Over Water)
- Other Site Access Road (Over Land)

Reference base maps from Natural Resources Canada:
Toporama - 085P03 - GORDON LAKE, Northwest Territories
Map Projection: UTM NAD '83 Zone 12N, Metric (metres)

Plan Scale 1:25,000

