



Crown-Indigenous Relations
and Northern Affairs Canada

Relations Couronne-Autochtones
et Affaires du Nord Canada



Government of
Northwest Territories

Gouvernement des
Territoires du Nord-Ouest

GIANT MINE REMEDIATION PROJECT

Contamination Downgradient of Dam 3 Reclamation Research Plan

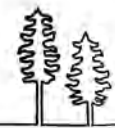
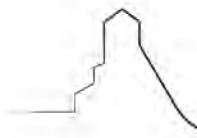


TABLE OF CONTENTS

| | | |
|-----|---|---|
| 1.0 | INTRODUCTION..... | 1 |
| 2.0 | STUDY OBJECTIVES..... | 2 |
| 3.0 | RECLAMATION RESEARCH PLAN TASKS..... | 3 |
| | TASK 1 – ADDITIONAL SOIL QUALITY ASSESSMENT..... | 3 |
| | TASK 2 – CONTAMINANT MOBILITY ASSESSMENT..... | 3 |
| | TASK 3 – SEDIMENT AND SURFACE WATER QUALITY ASSESSMENT..... | 3 |
| | TASK 4 – CONCEPTUAL SITE MODEL..... | 4 |
| | TASK 5 – SELECTION OF CLOSURE OPTION..... | 4 |
| 4.0 | LINKAGES TO OTHER RECLAMATION RESEARCH PLANS..... | 4 |
| 5.0 | SCHEDULE..... | 4 |
| 6.0 | REFERENCES..... | 5 |

LIST OF TABLES

| | | |
|--------------|--|---|
| Table 1.1-1: | Tailings Pond Water Impacted Area Reclamation Research | |
| | - Schedule of Tasks..... | 4 |

1.0 INTRODUCTION

The area downgradient of the North Pond, to the north and northeast of Dam 3, is contaminated with arsenic. Planned and unplanned events occurred during mining activities, are associated with the contamination downgradient of Dam 3:

- *Tailings Pond Water Management in the 1960s.* From 1964 to 1970, the mine operator was allowed by the Federal Department of National Health to discharge/decant tailings pond water over Dam 3, overland towards Yellowknife Bay. The Federal Department of National Health recommended this location as an alternative to the historical discharge/decant location of Baker Creek. The frequency and volume of discharged/decanted tailings pond water is unknown. In 1970, the Federal Department of National Health reversed their recommendation and the discharge/decant of tailings pond water to Baker Creek resumed.
- *Perimeter Tailings Dam Integrity in the 1970s.* During the early to mid-1970s, uncontrolled releases and overtopping of perimeter Dam 3 resulted in the release of tailings solids and tailings pond water. The frequency and volume of the releases of tailings solids and tailings pond water is unknown.

The area downgradient of the North Pond consists of approximately 20 hectares (ha) of bedrock/forest/wetland terrain to the north and northeast of Dam 3 (refer to Figure 5.4B-1). The terrain near Dam 3 is characterized by steep bedrock outcrops, which transition to a gently sloping vegetated plateau towards Yellowknife Bay. Vegetation within this area is dominated by grasses, moss hummocks, wetland plants (i.e., cattails and sedges), and spruce and birch trees. This area is surrounded by well-established forested lands characterized by large trees, shrubs, and low brush cover. The bedrock outcrops within this area typically contain minimal vegetation. Soil conditions generally consist of shallow surficial deposits, with isolated vegetated valleys situated between bedrock outcrops. In some areas, a thin veneer of glacial till is dominant. Lacustrine materials, including peaty organic soils, are dominant within the wetland and low lying areas.

During the Surface Design Engagement (SDE) process, affected party feedback indicated that this area was a concern due to historical tailings spills and tailings pond water releases (SRK 2016; refer to Chapter 1). This resulted in the Giant Mine Remediation Project (GMRP) team initiating further investigation of this area. Based on soil quality data and field observations collected to date, two contaminated areas were identified and will require different closure methods (refer to Figure 5.4B-1):

- 1) **Tailings Pond Water Impacted Areas.** The Tailings Pond Water Impacted Areas are laterally extensive, covering approximately 16 ha, and were historically impacted by tailings pond water released over Dam 3 in the 1960s. These areas have lower contaminant concentrations relative to the Tailings Impacted Areas, as the average arsenic concentration in shallow soil is approximately 700 milligrams per kilogram (mg/kg). The spatial extent of the Tailings Pond Water Impacted Areas is uncertain. It is also uncertain if the historical tailings pond water releases affected groundwater, surface water, and local sediment. This Reclamation Research Plan (RRP) has been prepared to further evaluate the environmental condition of the Tailings Pond Water Impacted Areas and to aid in the selection of the appropriate closure activities in support of the CRP.

- 2) **Tailings Impacted Areas.** An approximate 4 ha area experienced direct surface deposition of tailings solids from the North Pond as a result of perimeter Dam 3 integrity issues in the early to mid-1970s. The Tailings Impacted Areas reflect direct tailings solids deposition and are characterized by elevated contaminant concentrations that have a higher likelihood to act as ongoing contaminant sources. The average arsenic concentration in shallow soil within this area is approximately 2,300 mg/kg. The selected closure activity for the Tailings Solids Impacted Areas includes excavation using conventional equipment (i.e., excavators, haul trucks, bulldozers, and lightweight track-mounted equipment). Contaminated fine-grained soil and tailings removed from the Tailings Impacted Areas will be disposed of in the Tailings Containment Areas (TCAs) prior to the TCAs being capped as part of the Closure and Reclamation Plan (CRP). The Tailings Impacted Areas will be backfilled with 0.5 m of coarse-grained borrow material and 0.3 m of fine-grained borrow material to support re-vegetation to control the potential for erosion; specifics of revegetation will be further discussed with affected parties. The areas will be re-contoured to support surface water management, as required. This is further discussed in the CRP. It is anticipated that the closure criterion for this area is to meet industrial soil quality standards for arsenic; however the criterion will be finalized once the RRP is concluded and the work related to the Tailings Pond Water Impacted Areas is complete and can be integrated with the Tailings Solids Impacted Areas (see Section 5.4 of the CRP).

2.0 STUDY OBJECTIVES

The objective of this RRP is investigate the extent of contamination within the Tailings Pond Water Impacted Areas and, with the engagement of affected parties, make a recommendation on a closure option. This is tied to the closure plan objective CS1: *Contaminated materials (i.e., soil, sediment, granular fill, and tailings) are remediated or risk managed to reduce risk to humans and to aquatic and terrestrial ecosystems.* It is expected a new closure criteria will be developed to address the Dam 3 Tailings Pond Water Impacted Areas, expected to be pending criterion CS1-7 (see Section 5.4 of the CRP).

Specifically, the tasks are to investigate:

- The lateral and vertical extent of soil quality impairment.
- The environmental quality of shallow groundwater and mobility of contaminants to shallow groundwater.
- Sediment and surface water quality within wetlands located downgradient of Dam 3 and along the shoreline of Yellowknife Bay.
- Select an option for closure of the Tailings Pond Water Impacted Areas.

These investigations are proposed to reduce uncertainty about the extent of contamination and to help inform closure options for the Tailings Pond Water Impacted Areas.

3.0 RECLAMATION RESEARCH PLAN TASKS

The following section outlines the specific tasks required to address the objectives related to the Tailings Pond Water Impacted Areas.

Task 1 – Additional Soil Quality Assessment

This task will further assess soil quality within the Tailings Pond Water Impacted Areas. Soil quality was initially characterized in 2016; however, further delineation is required to define the lateral and vertical extent of this area. A desktop review will be completed to determine the location of additional soil sample stations. A field program will be completed with the collection of the additional soil samples. The soil samples will be collected using portable hand tools (i.e., trowels, shovels, and hand augers) and submitted to an accredited laboratory for analysis of total metals. This information will be incorporated into the Conceptual Site Model (CSM) discussed in Task 4.

Task 2 – Contaminant Mobility Assessment

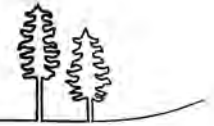
This task will assess contaminant mobility within the shallow groundwater zone. Contaminants in soil are not necessarily readily released into shallow groundwater, particularly when they are not soluble or when the soil has a strong ability to sorb contaminants (i.e., clays or high-organic content soil). It is possible that shallow groundwater chemistry within the Tailings Pond Water Impacted Areas may be reflective of contaminant migration from the Tailings Impacted Areas. As such, drive-point monitoring wells will be installed downgradient of Dam 3. Soil samples will also be collected from each drive-point location and at the depth(s) of the screened interval. Soil samples will be submitted to an accredited laboratory for analysis of total metals, leachable metals, total organic content, grain size, and cation exchange capacity, while shallow groundwater samples collected from the drive-points will be submitted for analysis of dissolved and total metals. Groundwater field parameters, including temperature, pH, and conductivity, will also be collected. In addition, physical information (i.e., topography, and surface water and groundwater elevations) will be collected for the Tailings Pond Water Impacted Areas to inform potential closure options. The information collected as part of this assessment will be used to model potential contaminant migration and will be incorporated into the CSM discussed in Task 4. In addition, the surface water quality data will be incorporated into the water quality model for the Site to validate arsenic loading estimates to Yellowknife Bay within this area.

Task 3 – Sediment and Surface Water Quality Assessment

This task will assess the sediment and surface water quality in the following two aquatic areas downgradient of Dam 3:

- Characterization of the Shoreline along Yellowknife Bay. Surface water and sediment samples will be collected along the shoreline of Yellowknife Bay in areas where historical discharge tailings solids may have been deposited.
- Characterization of Wetlands Downgradient of Dam 3. Surface water and sediment samples will be collected from various wetlands located downgradient of Dam 3. Surface water samples will be paired with existing surface runoff programs to avoid duplication.

Sediment samples will be submitted to an accredited laboratory for analysis of total metals, total organic carbon, and grain size, while surface water samples will be submitted for analysis of total metals, total suspended solids, and other relevant parameters. Surface water field parameters, including temperature, pH, and conductivity, will also be collected. This information will be incorporated into the CSM discussed in Task 4.



Task 4 – Conceptual Site Model

The data collected as part of Tasks 1, 2, and 3 will be synthesized into a CSM, which will provide information on contaminant sources, contaminant migration pathways, and receptors. The CSM will include a contaminant migration model and will incorporate information regarding the physical and chemical hydrogeology, soil properties, topography, and surface water and groundwater elevations. The CSM will be used to identify potential closure options including ex-situ methods, in-situ methods, and risk management methods for the Tailings Pond Water Impacted Areas. The results of the Quantitative Risk Assessment (QRA; currently ongoing) and the Human Health and Ecological Risk Assessment (HHERA; CanNorth 2018) will also inform the identification of potential closure options.

Task 5 – Selection of Closure Option

The evaluation and selection of the closure options for the Tailings Pond Water Impacted Areas will be completed through an options analysis decision making process. The options analysis process ranks potential options relative to each other using a numerical scoring method. This process involves the identification of evaluation categories/criteria and the confirmation of an appropriate weighting distribution. The categories/criteria typically include a range of technical, economic, environmental, long term management, and social issues, with both the specific criteria definition and the weighting determined through group discussion. Application of this approach is consistent with the decision-making process for other components of the GMRP. Once the closure option is chosen, this RRP will be complete and detailed design will proceed.

4.0 LINKAGES TO OTHER RECLAMATION RESEARCH PLANS

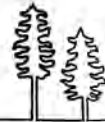
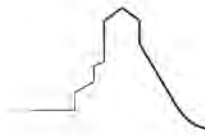
Depending on the results of Tasks 1 through 4 and the *Reclamation Research Plan for Alternative Technologies to Reduce Arsenic Loading to the Aquatic Environment*, the use of constructed wetland treatment or other passive treatment technologies may be considered as part of a potential closure option for the Tailings Pond Water Impacted Areas.

5.0 SCHEDULE

A schedule for execution of the RRP is outlined in Table 1.

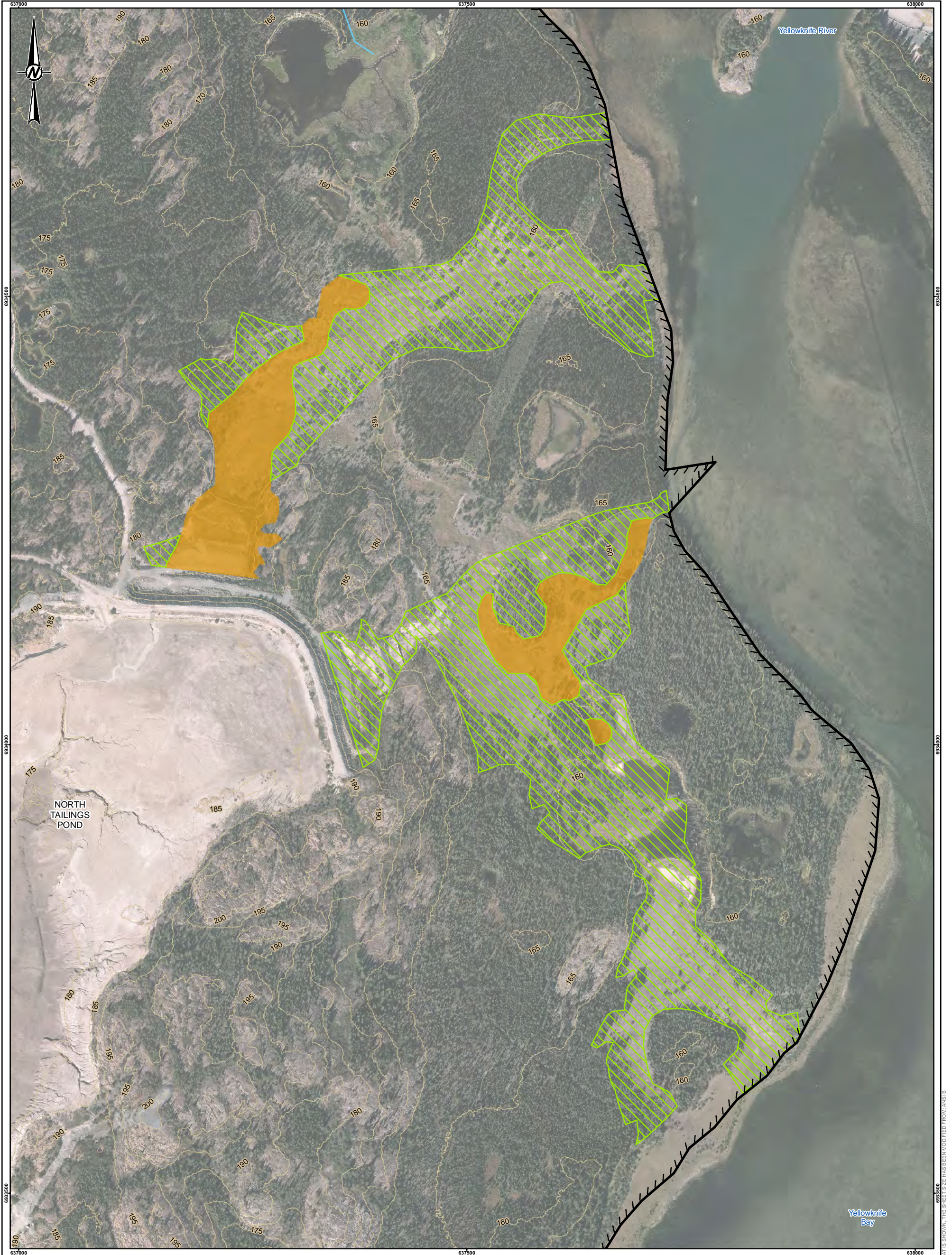
Table 1: Tailings Pond Water Impacted Area Reclamation Research - Schedule of Tasks

| Task | Item | Approximate Schedule | Status (as of January 2019) |
|-------------|---|-----------------------------|------------------------------------|
| 1 | Additional Soil Quality Assessment | 2018 | Complete |
| 2 | Contaminant Mobility Assessment | 2018 | Complete |
| 3 | Sediment and Surface Water Quality Assessment | 2018 | Complete |
| 4 | Conceptual Site Model and Evaluation of Potential Closure Options | 2018/2019 | In Progress |
| 5 | Selection of Closure Option | 2019-2020 | Pending |

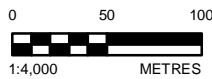


6.0 REFERENCES

- CanNorth (Canada North Environmental Services). 2018. Giant Mine Human Health and Ecological Risk Assessment, Prepared for Public Services and Procurement Canada – Western Region, Environmental Services and Contaminated Sites Management. Edmonton, AB, Canada.
- INAC and GNWT (Indian and Northern Affairs Canada and Government of the Northwest Territories). 2010. Giant Mine Remediation Project Developer's Assessment Report. October 2010.
- SRK (SRK Consulting). 2016. Giant Mine Remediation Project Surface Design Engagement Options Evaluation Workshop. August 2016.



- LEGEND**
- CONTOUR (5 m)
 - GIANT MINE PROJECT BOUNDARY
 - WATERCOURSE
 - POND WATER IMPACTED AREA
 - TAILINGS IMPACTED AREA



REFERENCE(S)

CONTOURS INTERPOLATED FROM LIDAR. HYDROLOGY AND TRANSPORTATION DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. 2015
 DATUM: NAD 83 PROJECTION: UTM ZONE 11

PROONENT

Crown-Indigenous Relations and Northern Affairs Canada
 Relations Couronne-Autochtones et Affaires du Nord Canada



| | |
|------------|------------|
| YYYY-MM-DD | 2018-12-07 |
| DESIGNED | SF |
| PREPARED | AA |
| REVIEWED | AC |
| APPROVED | AC |

PROJECT

Giant Mine Remediation Project

TITLE
DOWNGRADIENT OF DAM 3

| | | | |
|--------------|---------|------|--------|
| PROJECT NO. | CONTROL | REV. | FIGURE |
| 13-1377-0015 | 23000 | 0 | 5.4B-1 |

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SCALE SIZE HAS BEEN MODIFIED FROM ANS/B

25mm