# Johnny Mountain Mine

## *Mines Act* Permit M-178 Annual Reclamation Report for 2019

April 2020

Project No.: 0539378-0001

April 2020

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## *Mines Act* Permit M-178 Annual Reclamation Report for 2019

Name of Property: Johnny Mountain Mine

Company Name: SnipGold Corp.

*Prepared for:*

**SnipGold Corp.**

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# EXECUTIVE SUMMARY

The Johnny Mountain Mine is a closed underground gold mine located in the Coast Mountain Range of British Columbia (BC), approximately 100 km northwest of Stewart, BC.

The underground mine has been closed since 1993, and reclamation activities took place sporadically on the site from 1999 to 2015. In 2016 Seabridge Gold Inc. acquired SnipGold Corp. and their associated properties, and commenced annual reclamation activities. SnipGold is a subsidiary of Seabridge Gold Inc. Currently there are three provincial permits associated with the site: *Mines Act* Reclamation Permit M-178, *Environmental Management Act* Permit PE-8415 (amended June 2019), and *Environmental Management Act* Permit PR-7927. *Environmental Management Act* Permit PR-7927 was amended on May 31, 2018 to include upgrades to the main landfill. The Johnny Mountain site, along with surrounding mineral tenures and the Bronson Airstrip, make up the Iskut Project.

Since acquiring the property, SnipGold has been carrying out compliance permit programs and on-going reclamation activities. SnipGold continues to carry out an exploration program on the property under *Mines Act* Permit MX-1-46. New reclamation activities were completed in 2019 as described in this report.

Currently, site activities are staged from the Bronson airstrip (part of Iskut Project) and Bronson camp. The Bronson airstrip and camp are currently only accessible by fixed wing aircraft or by helicopter. Access to the former mine site is via helicopter or by driving 10 km along an access road from the Bronson airstrip. There is a decommissioned airstrip at the Johnny Mountain Mine site.

The overall land use objective of the reclamation plan is to return disturbed lands and new anthropogenic landforms to alpine tundra wildlife habitat. Permit M-178 stipulates that the average land capability to be achieved should not be less than the average that existed pre-mining.

Returning the area to its original land use will be accomplished by meeting the following objectives, as outlined in the *Closure Plan for the Johnny Mountain Gold Mine, Reclamation Permit No. M-178* (Woznow and Yeager 1999):

- develop a closure scenario that prevents potential impacts to surface and groundwater resources;
- restore the natural appearance of the area after mining ceases through the re-contouring and re-vegetation of disturbed lands and anthropogenic landforms;
- ensure that disturbances and re-developed landforms are stable from a long-term geotechnical and geochemical perspective;
- re-vegetate the site through the development of self-sustaining natural succession processes; and
- develop landforms and vegetative cover that provide a stable and productive wildlife habitat for resident and transient species utilizing the area.

<u>2019 Environmental Protection (Environmental and Engineering) Activities</u>

The following Environmental Protection (Environmental and Engineering) activities took place in 2019:

- completion of the compliance surface water quality monitoring program for *Environmental Management Act* Permit PE-8415 which was last amended on June 10, 2019;
- completion of the compliance groundwater and surface water quality monitoring program for *BC Environmental Management Act* Permit PR-7927 which was last amended on April 17, 2019;

- operation and maintenance of the Johnny Mountain meteorological station located ~400 m west of the tailings pond;
- installation and operation of two hydrology stations to monitor tailings pond seepage;
- monitoring groundwater flow from the level 10, level 11, and level 12 portals;
- groundwater well level and water quality sampling; and
- initiation of vegetation trials on the decommissioned airstrip.

2019 Reclamation Program

The following Reclamation Program activities took place in 2019:

- Main Landfill activities. Non-PAG gravel was hauled from Borrow Areas #1 and #3 to the Cell 2 area, placed and compacted for the base levelling course. A total of 3,352 $m^3$ of inert waste was placed at the approved Main Landfill, and covered with a minimum of 300 mm of mineral soil.
- Relocation of material to the upgraded Main Landfill included non-hazardous material from the former warehouse site, portal 11 mechanics shop, the Old Tank Farm, and from the Mill Building.
- Excavation and relocation of five additional un-documented waste sites to the Main Landfill.
- Mill building reclamation continued with further deconstruction of much of the remaining (interior) mine equipment, cyanide tanks, conveyors, pumps, wood timbers and non-load bearing steel structural members.
- In-situ hydrocarbon remediation continued in the In-situ Hydrocarbon Remediation Area. Approximately 6,000 $m^3$ of contaminated soils were treated.
- A trial placement of potentially acid generating (PAG) material excavated from the decommissioned airstrip was mixed with hydrated lime and was placed in two areas in the tailings storage facility (TSF) to assess closure cover constructability. A total of 2,620 $m^3$ of waste rock mixed with 635 kg of hydrated lime was placed in the TSF in 2019.
- A dam safety inspection was conducted on August 13 to 14, 2019 by Engineer of Record (EoR) Neil K. Hemrajani Singh, P.Eng. of KCB and Drew Hegadoren, P.Eng. of KCB with representatives of SnipGold (TSF Qualified Person Elizabeth Miller and Kevin Hidber and Brent Murphy).
- Other opportunistic reclamation activities including:
  - Repairs to onsite equipment;
  - Portal 11 Site Grading;
  - Excavation of ground water diversion trench east of Old Tank Farm;
  - Additional test pits;
  - Onsite testing for ML/ARD waste rock at portal 10, 11 and 12 and decommissioned airstrip;
  - Repairs to Piezometers located on the TSF (DH17-02 and DH17-05);
  - Lower remaining two ore islands inside the TSF below water elevation;
  - Rough and loose technique used on north section of decommissioned airstrip ~ 0.8 ha;
  - Copper Wire salvage and recycling; and
  - Burning of un-treated timbers.

Forward-Looking Summary

Environmental programs and monitoring required through the JMM permits (i.e., *Mines Act* Reclamation Permit M-178, *Environmental Management Act* Permit PE-8415, and *Environmental Management Act* Permit PR-7927) will continue, as necessary. Annual reports documenting associated activities will be provided as required.

SnipGold will continue to implement relevant management and monitoring plans required for the JMM site and associated activities, for example the ML/ARD Monitoring Plan, Closure Management Manual, etc.

Achieving the approved closure and reclamation objectives will remain the priority of SnipGold and SnipGold will continue to develop detailed Project Execution Plans for each year of activity. The key objectives being:

- Removal of infrastructure and cleanup of the JMM site;
- Decompact disturbed lands to enable development of natural habitat for wildlife utilization; and
- Establish long-term stability of restored areas, biologically, geotechnically and geochemically.

Through this time SnipGold will maintain a controlled, safe and secure site, where safety and safe work practices are of paramount importance.

Outstanding Reclamation Liability

The total reclamation expenditures in 2019 were $1,325,448.00. The net outstanding reclamation liability estimate is [redacted] This is based on the 2018 estimate (prepared to an AACE Class 2 Construction Cost Estimate level, with an expected accuracy range of 10%/+20%).

# QUALIFIED PROFESSIONAL SIGN-OFF

I am a qualified professional with the knowledge, skills and experience to provide expert information, advice and/or recommendations in relation to the *Johnny Mountain Mine Mines Act Permit M-178 Annual Reclamation Report for 2019*. I have prepared content for all sections of this report, with the exception of sub-sections 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.9.2, and Section 5.

Prepared by:


Lorraine Muckian, Ph.D., R.P.Bio. #3142

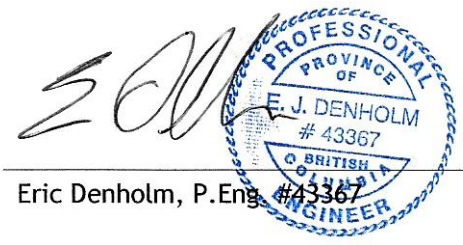
I am a qualified professional with the knowledge, skills and experience to provide expert information, advice and/or recommendations in relation to the *Johnny Mountain Mine Mines Act Permit M-178 Annual Reclamation Report for 2019*. I have prepared and reviewed the following sub-sections of this report: 3.1.2, 3.1.3, 3.1.4, 3.1.5, and 3.1.9.2.

Prepared and reviewed by:


Kelsey Norlund, Ph.D., P.Geo., #44971

I am a qualified professional with the knowledge, skills and experience to provide expert information, advice and/or recommendations in relation to the *Johnny Mountain Mine Mines Act Permit M-178 Annual Reclamation Report for 2019*. I have reviewed all sections of this report with the exception of Section 5: Reclamation Liability Cost Estimates.

Prepared and reviewed by:




Eric Denholm, P.Eng. #43367

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# GLOSSARY AND ABBREVIATIONS

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

| | |
|---|---|
| AEC | Area of Environmental Concern |
| Ag.t | Total silver |
| Al.d | Dissolved aluminum |
| AM | Alpine meadow |
| APEC | Area of Potential Environmental Concern |
| ARR | Annual Reclamation Report |
| As.t | Total arsenic |
| BC | British Columbia |
| BEC | Biogeoclimatic ecosystem classification |
| Be.t | Total beryllium |
| BTEX | Benzene, toluene, ethylbenzene, and xylene |
| Cd.d | Dissolved cadmium |
| CIS LRMP | Cassiar-Iskut Land and Resource Management Plan |
| CMAun | Coastal Mountain-heather Alpine (undifferentiated) |
| COD | Chemical oxygen demand |
| Co.t | Total cobalt |
| Cr.t | Total chromium |
| Cu.d | Dissolved copper |
| DSI | Dam Safety Inspection |
| DSR | Dam safety review |
| EC | Electrical conductivity |
| EMA | *Environmental Management Act* |
| EMPR | British Columbia Ministry of Energy, Mines, and Petroleum Resources |
| ENV | British Columbia Ministry of Environment and Climate Change Strategy |
| EPH | Extractable petroleum hydrocarbons |
| EoR | Engineer of Record |
| ESPC | Erosion prevention and sediment control |
| FAL WQG | British Columbia Freshwater Aquatic Life Water Quality Guidelines |
| Fe.d | Dissolved iron |

| | |
|---|---|
| Fe.t | Total iron |
| ha | Hectares |
| HDPE | High-density polyethylene |
| HEPH | Heavy extractable petroleum hydrocarbons |
| Hg.t | Total mercury |
| ILMB | Integrated Land Management Bureau |
| JMM | Johnny Mountain Mine |
| KCB | Klohn Crippen Berger |
| kg | Kilogram |
| L | Litre |
| LEPH | Light extractable petroleum hydrocarbons |
| m | Metres |
| masl | Metres above sea level |
| mbg | Metres below grade |
| MDL | Method detection limit |
| MEM | British Columbia Ministry of Energy and Mines |
| MEND | Mine Environment Neutral Drainage |
| MH | Mountain Heather Parkland |
| MHmm2p | Mountain Hemlock moist maritime subzone leeward variant |
| MM | Mountain Heather Meadows |
| MN | Non-vegetated Morainal |
| µg | Micrograms |
| mg | Milligrams |
| ML/ARD | Metal Leachate/Acid Rock Drainage |
| Mn.t | Total manganese |
| MR | Mountain Heather – Rhacomitrium Scrub |
| nPAG | Non potentially acid generating |
| NWR | NorthWest Response |
| PAG | Potentially acid generating |
| PAHs | Polycyclic aromatic hydrocarbons |
| Pb.t | Total lead |
| Permit M-178 | *Mines Act* Permit M-178 |

| | |
|---|---|
| Permit PE-8415 | *Environmental Management Act* Permit PE-8451 |
| Permit PR-7927 | *Environmental Management Act* Permit PR-7927 |
| PEP | Project Execution Plan |
| Portal 10 | Level 10 Portal |
| Portal 11 | Level 11 Portal |
| Portal 12 | Level 12 Portal |
| P.Geo | Professional Geologist |
| QA/QC | Quality Assurance/Quality Control |
| RMZ | Resource Management Zone |
| RTEC | A joint venture company between ERM Consultants Canada Ltd. (ERM) and the Tahltan Nation Development Corporation (TNDC). |
| Seabridge | Seabridge Gold Inc. |
| Skyline Gold Corporation | Previous owners of the Johnny Mountain Mine site and SnipGold properties. |
| SnipGold | SnipGold Corp., a subsidiary of Seabridge Gold Inc. Seabridge Gold Inc. acquired SnipGold Corp on June 21, 2016 which includes the Iskut exploration land package and the closed Johnny Mountain Mine Site. |
| SS | Sedge meadows |
| TCG | Tahltan Central Government |
| TDS | Total dissolved solids |
| TEM | Terrestrial Ecosystem Mapping |
| TIC | Total inorganic carbon |
| TNDC | Tahltan Nation Development Corporation |
| TOC | Total organic carbon |
| TSF | Tailings Storage Facility. Referred to as the Tailings Impoundment or Tailings Pond in Permit PE-8415, referred to as the Tailings Storage Facility in Permit M-178. |
| $VH_W$ | Volatile hydrocarbons extractable in water |
| VPH | Volatile petroleum hydrocarbons |
| VOCs | Volatile organic compounds |
| WAD | Weak acid dissociable |
| Zn.t | Total zinc |

# 1. INTRODUCTION

## 1.1 History of the Project

The Johnny Mountain Mine (JMM) is a closed underground gold mine located in the Coast Mountain Range of British Columbia (BC), approximately 100 km northwest of Stewart, BC.

The underground mine has been closed since 1993, and reclamation activities took place sporadically on the site from 1999 to 2015. In 2016 Seabridge Gold Inc. acquired SnipGold Corp. and their associated properties, and commenced annual reclamation activities. SnipGold is a subsidiary of Seabridge Gold Inc. Currently there are three provincial permits associated with the site: *Mines Act* Reclamation Permit M-178, *Environmental Management Act* Permit PE-8415 (Permit PE-8415) (amended June 2019; Appendix A), and *Environmental Management Act* Permit PR-7927 (Permit PR-7927) (Appendix A). Permit PR-7927 was amended on May 31, 2018 to include upgrades to the Main Landfill. The Johnny Mountain Mine site, along with surrounding mineral tenures and the Bronson Airstrip, make up the Iskut Project.

The site began development in 1986 and mining operations were conducted from 1988 to 1990. There was also a three-month operating period in 1993. The milling process was comprised of conventional grinding and gravity separation. A cyanide leach process was initially included in the mill design. Due to inefficiencies, the cyanide leach process was decommissioned early on during active mining operations (prior to the 1990 shutdown).

Since acquiring the property, SnipGold has been carrying out the compliance permit programs and on-going reclamation activities. SnipGold continues to carry out an exploration program on the property. New reclamation activities were completed in 2019 as described in this report.

## 1.2 General Location and Access

The Johnny Mountain Mine site is located approximately 100 km northwest of Stewart, BC, and 85 km due west of Highway 37 (Figure 1.2-1). The site is situated on a sub-alpine plateau surrounded by steep valleys, and is located near the confluence of the Craig and Iskut Rivers. The northwest face of Johnny Mountain is covered by an alpine glacier. The Johnny Mountain Mine site dimensions are approximately 700 m by 1,000 m. The site is legally described as District Lots 7031 and 7032, Cassiar District.

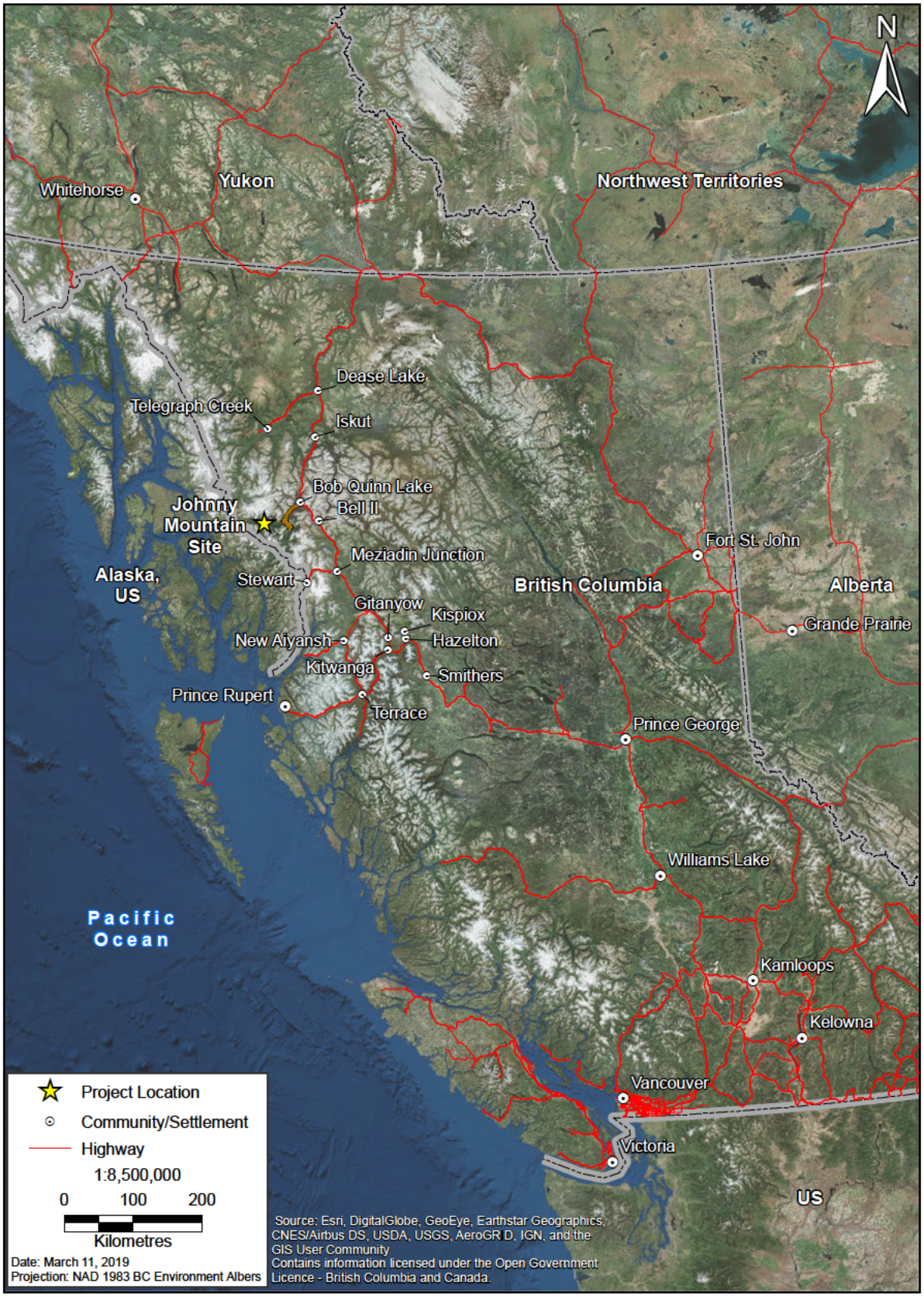
Currently, exploration and reclamation activities are staged from the Bronson airstrip. The Bronson airstrip and camp are currently only accessible by fixed wing aircraft or by helicopter. Access to the former mine site is via helicopter or by driving 10 km along an access road from the Bronson airstrip. There is a decommissioned airstrip at the Johnny Mountain Mine site.

## 1.3 General Setting

The former mine site is situated on a sub-alpine plateau at approximately 1,100 m elevation. Above the plateau are glaciers on Johnny Mountain, which feed streams that run through and around the mine site. Much of the site above the decommissioned airstrip is located on morainal till deposits exposed by the receding glacier. The deglaciated areas typically have limited, if any, soil development; where present, soils are derived from glacial till and colluvium. Terrain falls off steeply around the plateau, with glacier-fed streams falling in cascades surrounding the plateau. The site is surrounded by treed, steep valleys.

**Figure 1.2-1**
**Project Location**

SNIPGOLD CORPORATION
A SUBSIDIARY OF SEABRIDGE GOLD INC.



The climate at the site is typical of an alpine tundra site located near the Pacific Coast. Winters include heavy snowfall and cold temperatures, and rain is common during the rest of the year. A meteorology station was installed on the plateau in September 2016, and this station is collecting local information for wind speed, direction, temperature, humidity, solar radiation, snow depth, and precipitation (RTEC 2020a; Appendix B).

Three main streams originate and drain from the plateau: Johnny Creek (drains to the north-northeast, and enters Bronson Creek); Stonehouse Creek (drains to the southwest, and enters the Craig River); and Sky Creek (drains to the northwest, and enters the Craig River). Below the plateau Bronson Creek drains to the Iskut River. Stonehouse Creek and Sky Creek drain into the Craig River, then into the Iskut River, which eventually drains into the Stikine River, which flows west to the Pacific Ocean. There are fish barriers on Johnny Creek (at the confluence with Bronson Creek), Stonehouse Creek (3 km downstream of the mine), and Sky Creek (4 km downstream of the mine), which prevent fish from accessing the site (RTEC 2017a, 2017b).

Downstream of the fish barriers below the plateau, fish species known to inhabit the regional watersheds of the area include Dolly Varden (*Salvelinus malma*), Cutthroat Trout (*Oncorhynchus clarkii*), Rainbow Trout/steelhead (*O. mykiss*), Coho Salmon (*O. kisutch*), Chinook Salmon (*O. tshawytscha*), Sockeye Salmon (*O. nerka*), Pink Salmon (*O. gorbuscha*), Chum Salmon (*O. keta*), Coastrange Sculpin (*Cottus aleuticus*), Prickly Sculpin (*C. asper*), and Mountain Whitefish (*Prosopium williamsoni*) (BC MOE 2009). Fish captured in Bronson Creek, lower Stonehouse Creek, lower Sky Creek, and surrounding reference stations in 2016 included Dolly Varden, Bull Trout, Mountain Whitefish, Coastrange Sculpin, Coho Salmon, Cutthroat Trout, and Chinook Salmon (RTEC 2017b).

The Biogeoclimatic (BGC) units include the Coastal Western Hemlock Wet Submaritime Subzone Montane Variant (CWHws2) that occurs from 600 to 1,000 m elevation, Moist Maritime Subzone Leeward Variant (MHmm2) that extends from 800 m to 1,800 m in elevation, MHmm2 parkland that is comprised of open subalpine meadows and tree clumps, and Coastal Mountain-heather Alpine (CMA) above the treeline. These BGC units support mature forests, wetlands, alpine areas, and riparian forests that provide habitat to a diverse wildlife community. Common species or groups that occur regionally include ungulates (e.g., moose, mountain goat), omnivores/carnivores (e.g., grizzly bear, black bear, wolves), furbearers (e.g., beaver, fisher, marten, wolverine), hoary marmots, bats, birds (forest and alpine birds, raptors, waterfowl), and amphibians (e.g., Columbia spotted frog, western toad).

For the JMM site specifically, the wildlife habitat is high elevation parkland and CMA. Wildlife on the site is limited in its number of resident species due to the relatively exposed conditions that prevail on the Johnny Mountain plateau. Hoary marmots were the most prevalent species observed in the baseline studies in the 1980s (Woznow and Yeager 1999). Marten, weasel, pack rat, deer mouse and northern red-backed voles were other species observed or expected to be present at the JMM site prior to operations. Pre-existing hoary marmot colonies remained intact during operations despite extremely close proximity to heavy vehicular traffic (Woznow and Yeager 1999). Marten inhabited the unused buildings in 1999, probably feeding on small rodents (Woznow and Yeager 1999). In 2018 a marmot den survey was conducted on site and marmots were found to be abundant in the general area (RTEC 2018a).

Large mammals comprising of mountain goat, wolf, grizzly bear and black bear have historically been observed directly or indirectly at the JMM site. These are all considered transient, however, as no sign of residency has been observed. Mountain goats were observed on the side slopes of Johnny Mountain for several days during pre-production observations (Woznow and Yeager 1999). SnipGold prepared and implemented a Goat Management Plan upon acquiring the property in 2016 (SnipGold 2016; RTEC 2016).

## 1.4 Regional Management Plans

The site is located within the provincial Cassiar-Iskut Land and Resource Management Plan (CIS LRMP), and within the Lower Iskut Resource Management Zone (RMZ). The CIS LRMP, which encompasses approximately 5.2 million ha, was completed in October 2000 with the support of the Tahltan joint councils, representing the Tahltan and Iskut bands (BC ILMB 2000). Land management within the CIS LRMP includes objectives intended to preserve the physical, aesthetic, and cultural characteristics of the region. The CIS LRMP acknowledges and confirms the importance of the economic potential of the area's mineral and energy resources. Under the plan, exploration and development of mineral deposits, as well as construction of access roads, are allowable activities, except within protected areas.

Some of the goals/desired future state for this land use region includes the establishment of a world class mining and energy industry, and economically and environmentally sound mining industry that provides long term benefits to the local community, and certainty of access to support a viable exploration industry. The continued operation of the Bronson airstrip and exploration activities for the Iskut Project are in line with the existing CIS LRMP goals and growth strategies.

## 1.5 Goals and Objectives

The overall land use objective and five supporting closure objectives as established in the 1999 closure plan update (Woznow and Yeager 1999) are:

The overall land use objective of the reclamation plan is to return disturbed lands and new anthropogenic landforms to their original land use and capability of alpine tundra wildlife habitat.

Returning the area to its original land use will be accomplished by striving to meet the objectives outlined below (as described in the 1999 Closure Plan):

1. Develop a closure scenario that prevents potential impacts to surface and groundwater resources.
2. Restore the natural appearance of the area after mining ceases through the re- contouring and re-vegetation of disturbed lands and anthropogenic landforms.
3. Ensure that disturbances and re-developed landforms are stable from a long-term geotechnical and geochemical perspective.
4. Re-vegetate the site through the development of self sustaining natural successional processes.
5. Develop landforms and vegetative cover that provide a stable and productive wildlife habitat for resident and transient species utilizing the area.

*Mines Act* Permit M-178 (Permit M-178) stipulates that the average land capability to be achieved should not be less than the average that existed pre-mining, excepting the tailings pond area which is exempt from this requirement.

In addition to these general reclamation objectives, component-specific Performance Objectives are provided in the Updated Closure Plan (March 2020) that have been developed to guide individual reclamation activities.

The Reclamation Program is described in Chapter 4, including activities over the past year and projected activities for the next five years.

This report focuses on the reclamation and associated activities conducted under Permit M-178. However, there are related project components and activities that are summarized in this report and reported on in

associated JMM compliance reports. For example, work conducted at the Main Landfill is conducted in accordance with the amended *Environmental* Management *Act* Permit PR-7927 (Appendix A) and required updates are provided in detail within the relevant annual compliance report (RTEC 2020b).

## 1.6 Summary of Historical Reclamation Activities

### *1.6.1 Overview*

Reclamation activities at the site began in 1995 and occurred intermittently until 2015. Seabridge acquired SnipGold and their associated properties in 2016, and they have been actively reclaiming the site on an annual basis from 2016 to present.

A formal closure plan under Permit M-178 was developed and accepted by the British Columbia Ministry of Energy Mines and Petroleum Resources in 1999; *Closure Plan for the Johnny Mountain Gold Mine* (Woznow and Yeager 1999). The Closure Plan is being reviewed and updated, where necessary, in 2020 to reflect activities conducted by SnipGold and to document the current status of the site.

Prior to the acquisition of the site by SnipGold, mine reclamation activities were being conducted on a campaign basis beginning in 2000 (Yeager 2001). Annual reclamation reports were submitted each year from 1988 to 2001 and from 2008 to 2015.

Since acquiring the property, SnipGold has prepared and submitted annual reclamation reports on an annual basis from 2016 to present.

Detailed annual reclamation report histories are included in the 2017 report (RTEC 2018b). A brief history of the reclamation activities carried out over the last five years (since 2014) is provide below.

### *1.6.2 2014*

The following reclamation work was conducted during 2014:

- Annual water quality monitoring (to meet the requirements of Permit PE-8415) on August 13, 2014;
- A dam inspection was conducted on August 13, 2014 by J. Zbeetnoff (P.Geo.) and J. Burgess (P.Geo.). Photos of the TSF Dam were taken in the exact locations as detailed in 2011, 2012 and 2013; and
- A Dam Safety Inspection was conducted on September 11, 2014 by JRT GeoEngineering.

### *1.6.3 2015*

The following reclamation work was conducted in 2015:

- Annual water quality monitoring (to meet the requirements of Permit PE-8415) on July 24, 2015;
- A dam inspection was conducted on July 19, 2015 by J. Burgess (P.Geo.). Photos of the TSF Dam were taken in the exact locations as detailed in 2011 through 2014;
- A Closure Management Manual was submitted to the Ministry of Energy and Mines;
- Groundwater wells in the TSF area were located and surveyed and measurements were conducted;
- Weirs were inspected and installed; and
- The mine access road was inspected and maintenance activities were performed.

### *1.6.4 2016*

Seabridge Gold Inc. acquired SnipGold Corp. and their associated properties on June 21, 2016. In 2016, SnipGold carried out the compliance permit programs as well as a voluntary Aquatic Characterization Program. New reclamation activities were completed in 2016, along with reclamation planning for the next five years. Details of the 2016 activities can be found in the *Iskut Project: Annual Reclamation Report for 2017: Mines Act Permit M-178* (RTEC 2018b).

The following Environmental Protection (Environmental and Engineering) activities took place in 2016:

- Completion of the compliance surface water quality program, which included *Environmental Management Act* Permit PE-8415 permit stations including additional locations identified in the 2000 permit amendment;
- Completion of a voluntary comprehensive 2016 Johnny Mountain Mine Aquatic Characterization Program, which included water quality, sediment quality, benthic invertebrates, and fisheries sampling and included a regional geographical area;
- Installation of two hydrology stations to monitor water quantity exiting the tailings pond via the spillway and tailings pond seepage;
- Inspection of existing groundwater wells around the tailings pond;
- Installation of a meteorological station ~400 m west of the tailings pond;
- A dam safety review (DSR) of the tailings impoundment dam was conducted in August 2016. The engineer of record was transferred to Mr. Neil Singh of Klohn Crippen Berger;
- Conduct an Archeological Impact Assessment in exploration area; and
- Development of an Iskut Project Goat Management Plan.

The following Reclamation Program activities took place in 2016:

- A dam safety review (DSR) conducted in August 2016. The engineer of record was transferred to Mr. Neil Singh of Klohn Crippen Berger;
- An inspection of the Bronson Creek dyke;
- Cleanup of the Bronson airstrip area: a five-person crew from the Tahltan Nation was employed for 27 days working at clearing brush and collecting discarded mining equipment scattered around the Bronson airstrip. Old equipment and garbage was collected, sorted, amalgamated and stored in discrete areas adjacent to the airstrip in anticipation of transportation off site in 2017;
- An engineering evaluation of the road connecting the Bronson airstrip with the Johnny Mountain site; and
- The development of a five-year Johnny Mountain Mine Project Execution Plan that meets the objectives of the approved Closure and Reclamation Plan.

### *1.6.5 2017*

In 2017, SnipGold carried out the compliance permit programs as well as voluntary environmental programs. New reclamation activities were completed in 2017, along with reclamation planning for the next five years. Details of the 2017 activities can be found in the *Iskut Project: Annual Reclamation Report for 2017: Mines Act Permit M-178* (RTEC 2018b).

The following Environmental Protection (Environmental and Engineering) activities took place in 2017:

- Completion of the compliance surface water quality monitoring program, which included *Environmental Management Act* Permit PE-8415 permit station locations;
- Completion of a voluntary comprehensive 2017 Johnny Mountain Mine Aquatic Characterization Program, which included water quality, sediment quality, and hydrology;
- Conduct a bathymetric survey of the tailings pond;
- Collected tailings samples from within the tailings pond for geochemical characterization;
- Installation of two hydrology stations to monitor tailings pond seepage;
- Installation of hydrology stations to monitor water exiting the portals;
- Inspection of existing groundwater wells around the tailings pond;
- Installation of new groundwater wells and test pits around the local site area;
- Installation of new vibrating wire level loggers in groundwater wells around the tailings management facility (TSF) to address outstanding non-compliance;
- Operated a meteorological station ~400 m west of the tailings pond;
- Completion of archeological overview assessments of the Quartz Rise Exploration Track;
- Removed and replaced the Sky Creek Bridge which is located along the access road;
- Repaired the Bronson Dyke, which protects the Bronson airstrip from flooding;
- Hauled out inert waste collected in 2016 from Bronson airstrip to a permitted landfill at Meziadin for off-site disposal; and
- Constructed the Quartz Rise Exploration Track.

The following Reclamation Program activities took place in 2017:

<u>Tailings Storage Facility (TSF), Tailings Pond</u>

- A Dam Safety Inspection was conducted by Neil Singh of KCB (TSF Engineers of Record are KCB) on August 23, 2017;
- Repairs to the tailings dam were made both before and after the Dam Safety Inspection;
- Completion of an updated dam classification and breach analysis study;
- Completion of a TSF Closure Design Report;
- General maintenance of the TSF including additional fill placement and grading of the TSF;
- Removal of crane and SeaCan from the TSF berm;
- General cleanup around the TSF including removal of wood and vegetation from the spillway; and
- Construction of test pad within the TSF to give an indication of the stability of the existing tailings when placing additional future fill.

<u>Mill Building</u>

- Assessed the structural integrity of the Mill Building;
- Installation of monitoring wells around the Mill Building to collect geotechnical information;

- Site grading and ditching around the Mill Building;
- Removal and off-site shipment of hazardous waste from the Mill Building;
- Avalanche sensitivity assessment of Mill Building and TSF-site visit by BGC Engineering;
- Installation of cross -bracing on Mill Building;
- Removal of lights from inside of Mill Building-mercury vapor bulbs; and
- Obtained mill demobilization estimate.

Fuel Tanks

- Certification of fuel tanks;
- Demolition of Old Tank Farm and general area cleanup;
- Cut up cleaned metal and stockpile for future removal from site;
- Cleaned up of 300 L spill; and
- In-situ remediation of hydrocarbon contaminated soils.

Other Johnny Mountain Site Activities

- Test pitting for Main Landfill expansion;
- Sourcing TSF cover material and sampling;
- Decommissioning of Johnny Mountain Mine airstrip;
- Closure plan of portals and vents-site visit by Golder Associates;
- Temporary closure of portal 11 and 12 by earth type barricade;
- Temporary closure of vent raise to portal 11 using beams and plywood to cover surface opening;
- Maintenance activities including cover materials added to the Main Landfill;
- Grass seeding of 2017 disturbed areas on Johnny Mountain site due to groundwater well drilling operations; and
- Upgrades to access road from Bronson airstrip to Johnny Mountain site.

### *1.6.6 2018*

In 2018, SnipGold carried out the compliance permit programs. New reclamation activities were completed in 2018, along with reclamation planning for the next five years. Details of the 2018 activities can be found in the *Iskut Project: Annual Reclamation Report for 2018: Mines Act Permit M-178* (RTEC 2019).

The following Environmental Protection (Environmental and Engineering) activities took place in 2018:

- Completion of the compliance surface water quality monitoring program for *Environmental Management Act* Permit PE-8415;
- Completion of the compliance groundwater and surface water quality monitoring program for *BC Environmental Management Act* Permit PR-7927 which was amended on May 31, 2018;
- Operation and maintenance of the Johnny Mountain meteorological station located ~400 m west of the tailings pond;

- Installation and operation of two hydrology stations to monitor tailings pond seepage;
- Monitoring groundwater flow from the level 10, level 11, and level 12 portals;
- Groundwater well level and water quality sampling; and
- Marmot den survey in area of upgraded Main Landfill and borrow areas.

The following Reclamation Program activities took place in 2018:

- Landfill Upgrades – Cells 1 and 2 of the Main Landfill were constructed, filled, and covered with a temporary landfill cover, and runoff was directed to the tailings pond.
- Relocation of material to the upgraded Main Landfill including Disposal Site #1 and #2 material, old septic tanks, and material from general site cleanup.
- Ore concentrate was removed from the Mill Building and placed below water cover in the tailings storage facility.
- Five vent raises were permanently closed, including re-contouring and seeding.
- The Portal 10 as demolished and the area re-contoured and seeded.
- Demolition waste from Portal 12 (generated in 2017) was removed to the upgraded Main Landfill.
- In-situ hydrocarbon remediation was carried out near the Old Tank Farm area (now In-situ Hydrocarbon Remediation Area).
- A dam safety inspection was conducted by Klohn Crippen Berger Engineer of Record David Wilmms, P.Eng. (KCB), under the direction of Neil Singh, P.Eng. (KCB), on August 20-22, 2018.
- Other opportunistic reclamation activities including:
  - Repairs to onsite equipment;
  - Additional test pits;
  - Septic Tank and Riser removal;
  - Demolition of Old Exploration Cabin;
  - Waste Disposal Site #3 relocation, cleanup, re-contoured;
  - Grading around piezometers located on the TSF;
  - Drainage Improvements around Old Tank Farm and Mill Building;
  - Island removal within Tailings Storage Facility (TSF);
  - General Site cleanup; and
  - Re-vegetate disturbed areas.

## 1.7 Progressive and Ongoing Reclamation

SnipGold's focus at the JMM Site is reclamation and closure of the site. SnipGold have developed a JMM Project Execution Plan that guides the sequencing of these reclamation activities annually. The 2020 Project Execution Plan can be found in Appendix C. SnipGold also have an active exploration program ongoing in the general area; these activities and associated reclamation activities are authorized under *Mines Act* Permit MX-1-46.

# 2. HISTORICAL MINING ACTIVITY

## 2.1 Surface Development to Date

The remaining surface development on site is described in Section 2.5 below (including Standard Table 1 from the Ministry of Energy, Mines and Petroleum Resources [EMPR] guidelines; EMPR 2019). Reclamation efforts continue to remove remaining surface infrastructure and reclaim areas where historical infrastructure was located.

In order to provide a safe and appropriate disposal location for non-hazardous waste on site, two cells of the Main Landfill were upgraded in 2018. These two cells of the Main Landfill continued to be used in 2019 to support ongoing reclamation activities on site. Details of the current status of the site including locations and surface areas are provided in Section 2.5 below.

## 2.2 Current Life of Mine

The Johnny Mountain mine has been closed since 1993. While SnipGold has an active annual exploration season, there are currently no plans to reopen the former mine.

## 2.3 Surface Development in the Past Year

No new surface infrastructure developments occurred in 2019. The Main Landfill that was upgraded in 2018 continued to be used in 2019. Temporary disturbances such as the use of Borrow Areas #1 and #3 to support the upgrading and use of the Main Landfill and closure of the TSF in 2020, and the excavation and relocation of inert waste from five undocumented waste sites occurred in 2019. Details of the locations and surface areas are provided in Section 2.5 below.

## 2.4 Surface Development Projected over the Next Five Years

SnipGold is focused on reclaiming and closing the site as outlined in the Closure Plan. Phase 2 development of the Main Landfill upgrade is proposed, if required. Capacity in the Phase 1 cells is sufficient currently. Temporary borrow areas will continue to be used for reclamation and closure activities (i.e., TSF closure and Main Landfill). No surface infrastructure development is projected from 2020 to 2024.

## 2.5 Areas Disturbed (Location, Aspect, and Size in Hectares)

Table 2.5-1 presents the required summary of the areas disturbed and reclaimed to end 2019 (Standard Table 1 in the EMPR's guidelines). The 2019 ARR general information and format requirements guidance specifies the following: *Ensure that the exempt area reported is not double-counted under the different classifications. In the body of the report, the exempt areas must be specified, rational provided for the exemption, and maps included depicting the exempt areas.*

For the Johnny Mountain site, the TSF (i.e., tailings pond area) is excluded as specified in Section 3 of Permit M-178: "excluding the tailings pond area, the average land capability to be achieved in the remaining lands shall not be less than the average that existed prior to mining". Based on this condition in Permit M-178, the TSF is not required to achieve average pre-disturbance land capability. The tailings pond is 9.02 ha, and the embankment is 3.23 ha, for a total area of 12.25 ha that is excluded from the land capability permit requirement. As of the end of 2019, the area left to be re-contoured and seeded/planted at JMM Site is 40.56 ha.

**Table 2.5-1: Summary of Areas Disturbed and Reclaimed to December 31, 2019 (Standard Table 1)**

| Disturbance | Mining | | Reclamation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Area Disturbed (ha) | | Area Contoured (ha) | | Area Seeded/Planted (ha) | | Area Fertilized (ha) | | Area Re-vegetated (ha) | | Land Use Objective |
| | 2019 | Total | 2019 | Total | 2019 | Total | 2019 | Total | 2019 | Total | |
| Tailings Storage Facility | 0 | 12.25 | 0 | exempt | 0 | exempt | exempt | exempt | exempt | exempt | exempt |
| Waste Rock Storage Areas (Level 10, 11, 12 portal pads) | 0 | 1.11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | alpine tundra wildlife habitat |
| Decommissioned Airstrip[d] | 0 | 5.26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | alpine tundra wildlife habitat |
| Five Vent Raises | 0 | 0 | 0 | 1.25 | 0 | 1.25 | 0 | 0 | 0 | 0 | alpine tundra wildlife habitat |
| Three Portals (Level 10, 11, 12), not including areas of pads containing waste rock[a] | 0.28 | 0.16 | 0.28 | 0.88 | 0.28 | 0.88 | 0 | 0 | 0 | 0 | alpine tundra wildlife habitat |
| Mill Building | 0 | 0.82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | alpine tundra wildlife habitat |
| Septic Field Area | 0 | 0 | 0 | 0.56 | 0 | 0.56 | 0 | 0 | 0 | 0 | alpine tundra wildlife habitat |
| General Laydown Area south of airstrip | 0 | 1.99 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | alpine tundra wildlife habitat |
| Main Landfill Area (includes cells 1 and 2 and Borrow Area #3) | 0 | 2.64 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | alpine tundra wildlife habitat |
| Local Site Roads | 0 | 4.71 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | alpine tundra wildlife habitat |
| Access Road from Bronson Airstrip to JMM | 0 | 2.82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | alpine tundra wildlife habitat |
| Core Storage Area | 0 | 0.11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | alpine tundra wildlife habitat |

| Disturbance | Mining | | Reclamation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Area Disturbed (ha) | | Area Contoured (ha) | | Area Seeded/Planted (ha) | | Area Fertilized (ha) | | Area Re-vegetated (ha) | | Land Use Objective |
| | 2019 | Total | 2019 | Total | 2019 | Total | 2019 | Total | 2019 | Total | |
| Disposal Sites #1, #2 and #3 (waste relocated to Main Landfill in 2018)[a] | 0.1 | 0.1 | 0 | 1.95 | 0 | 1.95 | 0 | 0 | 0 | 0 | alpine tundra wildlife habitat |
| Borrow Area #1 (New: Required for 2020 TSF closure activities) | 5.42 | 5.42 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | alpine tundra wildlife habitat |
| Old Exploration Cabin | 0 | 0 | 0 | 0.3 | 0 | 0.3 | 0 | 0 | 0 | 0 | alpine tundra wildlife habitat |
| In-situ Hydrocarbon Remediation Area[b] | 1.04 | 1.04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | alpine tundra wildlife habitat |
| General Mine Site[a,c] | 0.49 | 2.13 | 0 | 4.03 | 0 | 0 | 0 | 0 | 0 | 0 | alpine tundra wildlife habitat |
| **Total** | **7.33** | **40.56** | **0.28** | **8.97** | **0.28** | **4.94** | **0** | **0** | **0** | **0** | |

*[a] The five previously undocumented waste disposal sites located in 2019 are located within these JMM Site area. In an effort to avoid double counting, additional information in each area is provided in Table 2.5-2 below. The 2019 disturbance associated with waste removal activities is recorded, but the overall total disturbance of the area remains unchanged.*

*[b] 'In-situ Hydrocarbon Remediation Area' has replaced the Old Tank Farm area. Old Tank Farm structures were removed in 2017 from the area and on site hydrocarbon contaminated soil remediation treatment has been conducted in the area since 2018. The area used for in-situ hydrocarbon remediation extends beyond the original 0.39 ha of the Old Tank Farm. Related disturbance areas have been adjusted accordingly.*

*[c] 'General Mine Site' has been introduced as an area in order to better capture areas of JMM Site that are not directly associated with existing on-site infrastructure or on-going activities.*

*[d] 0.8 ha of the Decommissioned Airstrip is being utilized as part of a revegetation trial. This has not been registered in the contoured and seeded/planted columns. See Section 4.1.4 for details of the trial.*

**Table 2.5-2: Disturbance Associated with Undocumented Waste Disposal Sites Discovered in 2019**

| Undocumented Waste Disposal Site 2019 | Location (NAD 83 UTM 9V) | Surface Area (ha) | JMM Area Where the Disposal Site Is Located |
|---|---|---|---|
| Main Warehouse Disposal Site | E372722 N6278001 | 0.2 | General Mine Site |
| East-Secondary Warehouse Site | E372837 N6277907 | 0.19 | General Mine Site |
| Portal 11 – Mechanics shop | E372975.7 N6277804 | 0.28 | Portal 11 Area |
| South of Old Tank Farm | E372847 N6278023 | 0.1 | General Mine Site |
| North of Old Tank Farm | E372953 N6278144 | 0.1 | Disposal Site #1, 2 and 3 |

*Note:*
*With the exception of the Portal 11 Area, none of these sites were recontoured or seeded in 2019 as they will be re-disturbed in future years.*

In 2019 (as in 2018), the areas disturbed and reclaimed were updated based on measurements made by site personnel. The areas of disturbed, reclaimed, or seeded/re-vegetated areas were measured and recorded by SnipGold, and are presented and summarized in Table 2.5-1 and Figure 2.5-1.

Most of the buildings and infrastructure at the site have been emptied, demolished, and burned. The following structures remain at the site:

- the Mill Building; and
- a shipping container.

Mobile equipment remaining at the site includes: CAT D8L Dozer, Kenworth DumpTruck, CAT 235 Excavator, CAT 312 Excavator, and CAT D8K Dozer.

## 2.6 Disposal/Storage Locations and Volumes of Tailings and Waste Rock

The information on disposal/storage locations and volumes of tailings, waste rock and overburden is provided in Table 2.6-1 (Standard Table 2).

Volumes and ML/ARD classification of waste rock and tailings for the Johnny Mountain Mine site are also summarized in Table 2.6-1.

## 2.7 Mining and Milling Production

The JMM has not been operational since 1993, hence no Table 3 (Monthly Milling and Milling Production) is provided.

## 2.8 Custom Milling Production

The JMM has not been operational since 1993, hence no Table 4 (Monthly Custom Milling Production) is provided.

## 2.9 Stockpiling of Surface Soil Materials

There is not a stockpile of surface soil materials for reclamation use available on the JMM site, so no Table 5 (Quantities of Soil and Overburden Salvaged and Stockpiled for Reclamation Use) is provided.

**Figure 2.5-1**
**Site Layout**

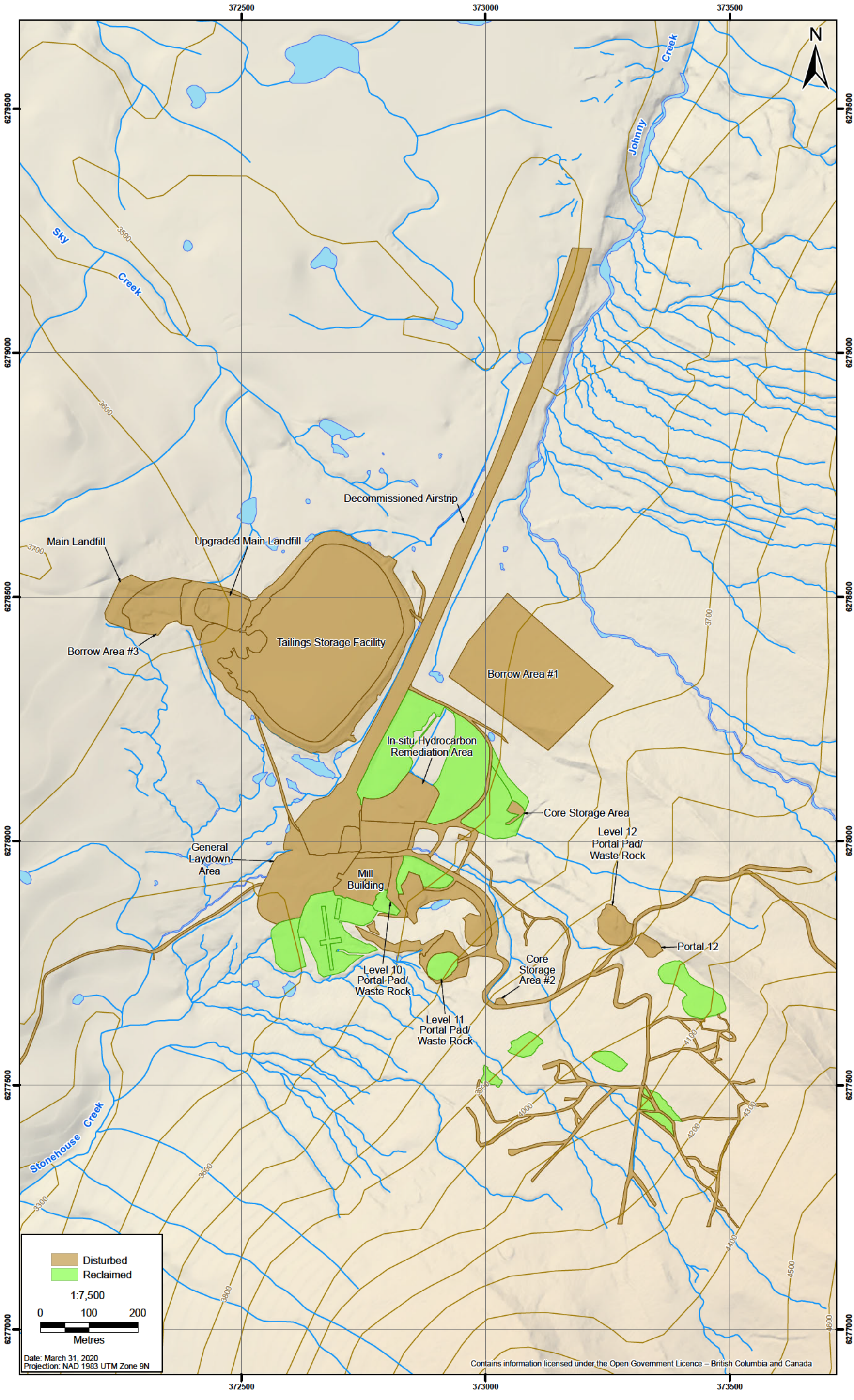


**Table 2.6-1: Quantities Of Waste Rock, Tailings, Low Grade Ore, Coarse Reject and Other Mine Waste as of December 31, 2019 (Standard Table 2)**

| Name of Waste Pile or Pond | Acid Generating Waste | | Potentially Acid Generating Waste** | | | Non-Acid Generating Waste** | |
|---|---|---|---|---|---|---|---|
| | 2019 | Total | 2018 Total | Amount Relocated to the TSF in 2019[b] | Updated Amount as of End of 2019 | 2019 | Total |
| **Waste Dumps*** | | | | | | | |
| 1. Portal 10 Pad | 0 | 0 | 75,000 t | 40 $m^3$/57 t*** | 74,943 t | 0 | 0 |
| 2. Portal 11 Pad | 0 | 0 | 53,000 t | 0 | 53,000 t | 0 | 0 |
| 3. Portal 12 Pad | 0 | 0 | 25,000 t | 0 | 25,000 t | 0 | 0 |
| 4. Decommissioned airstrip | 0 | 0 | 8,000 t[a] | 2,580 $m^3$/3,686 t*** | 4,314 t | 0 | 0 |
| 5. Secondary access road | 0 | 0 | 10,000 t[a] | 0 | 10,000 t | 0 | 0 |
| *Total* | *0* | *0* | *171,000 t* | *3,743 t* | *167,257 t* | *0* | *0* |
| **Tailings Ponds** | | | | | | | |
| 1. Johnny Mountain | 0 | 0 | 204,000 t | 3,743 t | 207,743 t | 0 | 0 |
| *Total* | *0* | *0* | *204,000 t* | *3,743 t* | *207,743 t* | *0* | *0* |
| **Low Grade Ore / Coarse Reject / Other Mine Waste** | | | | | | | |
| 1. None | 0 | 0 | 45 $m^3$ of ore concentrate was removed from the Mill Building in 2018 and relocated to the tailings pond | O | Unknown | 0 | 0 |
| *Total* | *0* | *0* | *45 $m^3$* | *0* | *Unknown* | *0* | *0* |

*[a] Estimates provided in BQE's AMD Mitigation at the Johnny Mountain Mine by Amending Waste Rock with Lime – Final Report (2020; Appendix D).*

*[b] Relocated waste rock was part of a trial placement of potentially acid generating (PAG) material excavated from the decommissioned airstrip was mixed with hydrated lime and placed in two areas in the TSF to assess closure cover constructability.*

** There are no designated waste dumps at the site; the portal pad areas contain waste rock. Original waste rock tonnages are from Price and Yeager 2004.*

*** 2017 testing indicates that some material in each portal pad is nPAG; however, the material cannot be segregated.*

**** Estimated volumes of relocated waste rock (reported as volume hauled) were converted to tonnages using an estimated bulking factor of 40% and applying an assumed bulk density of 2 t/$m^3$ as per Price and Yeager 2004.*

# 3. ENVIRONMENTAL AND ENGINEERING ACTIVITIES

The most recent version of the *Mines Act* Permit *General Information and Format Requirements for Annual Reclamation Reports* (updated January 2019) was used for the preparation of this chapter. The guidelines list many potential components for an Environmental Protection Program described here as the Environmental and Engineering Activities. The following sections provide information on the requested components from the guidelines for the past year, including projections for next year.

## 3.1 Past Year: 2019 Activities

### *3.1.1 Environmental Management Systems/Plans/Audit*

Efforts in 2019 were focused on reclamation activities, complying with existing permits, and conducting an exploration program in a safe and cost-effective manner.

SnipGold prepared an updated Closure Plan, including an updated Closure Management Manual for JMM, which was submitted to EMPR March 31, 2020 for review and approval.

Additional management plans in place and implemented for activities carried out at JMM include:

- JMM Reclamation Project Execution Plan;
- Health, Safety and Environmental Plan;
- Erosion and Sediment Control Plan for the 2018 Main Landfill Upgrades; and
- Iskut Goat Management Plan.

In July 2019, Wood conducted an inspection of the two cells of the upgraded Main Landfill that had been completed as of that time. As part of their due diligence check, Wood also conducted a confirmatory test pit near the centre of the Main Landfill Cell 2 footprint to confirm that there was no groundwater within 1.22 m below the as-built grade of the levelling course (Appendix E). An erosion and sediment control inspection was also carried out at the time by Wood (Appendix E). Wood concluded that the 2019 Main Landfill upgrades and the Erosion Protection and Sediment Control measures complied with the Wood design guidelines and Ministry of Environment and Climate Change Strategy (ENV) Permit PR-7927 requirements (Appendix E).

### *3.1.2 ML/ARD Characterization and Mine Waste Management*

Table 2.6-1 (Standard Table 2 in the guidelines) presents the requested quantities of waste rock and tailings at the Johnny Mountain Mine site.

After the acquisition of SnipGold by Seabridge, additional geochemical characterization studies of tailings, waste rock, the decommissioned airstrip, and Portal 10 cribbing waste material were completed to inform reclamation activities and were reported in the 2017 and 2018 Annual Reclamation Reports (RTEC 2018b, 2019). Waste ore concentrate was relocated to the TSF in 2018 (RTEC 2019).

In consideration of the requirements of Permit M-178, in 2019, SnipGold continued planning for the relocation of PAG waste rock at the portal pads and at locations within the decommissioned airstrip and laydown area to the TSF. PAG material from two locations at the decommissioned airstrip and from the Portal 10 pad was relocated to the TSF. A total of 2,620 $m^3$ of waste rock was disposed in the TSF.

Additional testing was conducted in 2019 to refine the process of relocating this material, and to determine potential treatment requirements for the material. SnipGold commissioned BQE Water to

conduct the test work and trials for treating and relocating waste rock to the TSF (BQE 2020; Appendix D). BQE recommended that waste rock be amended with lime before it is deposited into the TSF to add neutralization potential and prevent the release of dissolved metals. Lime addition with acidic waste rock deposited in the TSF is a requirement of Permit M-178.

The 2019 program involved on-site assessment and sampling of waste rock used in different mine features followed by bench scale trials to evaluate the efficacy of lime amendment at preventing metal release from waste rock. The key findings from this program were as follows (BQE 2020):

- Bench scale results indicated that waste rock on site has potential for metal release when it is placed in the TSF. Highly weathered waste rock with visible gossan formation and/or paste pH below 5 has the highest potential for metal release. Material from the Portal 10 and 11 pads and the airstrip showed the highest potential for metal release. Sample from the Portal 12 pad exhibited minimal metal release potential even without lime amendment.
- BQE Water estimated that the total mass of waste rock requiring management is approximately 171,000 t (85,500 $m^3$), in line with previous estimates by Bill Price (MEND 2004) and Klohn Crippen Berger (KCB; 2018a). The TSF can hold 88,000 $m^3$ of waste rock.
- The amendment of lime to waste rock prevented more than 99% of the release of metal from waste rock. The amount of lime amendment required was found to be 0.01-0.12% w/w as hydrated lime, or approximately 0.02% w/w weighted average across all mine features.
- The total mass of lime required for all waste rock was estimated to be 35 t. Delivery of this amount of lime to site is estimated to cost [redacted] CAD including reagent purchase and delivery to McLymont via truck and then to the JMM site via helicopter. BQE Water recommends having half of the total lime requirement on site for the first season of waste rock deposition in the TSF.
- Once the large scale disposal of waste rock with lime amendment begins, the water quality of the TSF should be monitored with a handheld pH probe and water quality sampling during the work season. If pH in the TSF decreases or if metal content increases then lime dosage should be increased, while if pH is above 9.5 then lime dosage should be reduced.
- Other activities that will reduce the risk of exceeding EMA permit limits are use of a sediment curtain at the pond outlet or other mitigation measures and preventing water discharge during the placement of waste rock.
- BQE estimates that the waste rock disposal program will take multiple seasons with the current equipment on site. The capacity of the equipment currently on site is a bottleneck of the earth movement process.

### *3.1.3 Surface Water Quality and Quantity Monitoring*

#### *3.1.3.1 Surface Water Quality Monitoring*

Surface water quality monitoring in 2019 was carried out in accordance with permits PE-8415 and PR-7927 (Appendices F and G).

Permit PE-8415 Surface Water Quality Monitoring

Permit PE-8415 was amended on June 10, 2019. Conditions of Permit PE-8415 require annual surface water quality sampling of seven stations within the JMM local area (JM1 to JM7), and one field duplicate sample and one travel blank. Authorized discharge characteristics are provided in Table 3.1-1. Table 1 of Permit PE-8415 designates the required parameter list: pH, hardness, sulphate, dissolved copper, dissolved iron, and dissolved zinc.

**Table 3.1-1: Surface Water Quality Station Descriptions and Conditions Outlined in Permit PE-8415**

| Station | Description (exact text from amended permit) | Authorized Discharge Characteristics |
|---|---|---|
| JM5 | Tailings pond discharge | 0.05 mg/L dissolved copper maximum<br>0.2 mg/L dissolved zinc maximum |
| JM4 | Mine Water Discharge at 10 (represents minewater from all levels) | The characteristics of the discharge must be typical of groundwater seepages coming from Portal 10 |
| JM3 | 10-Level Waste Rock Seepage | The characteristics of the discharge must be typical of leachate, which has passed through inert waste rock |
| JM2 | 11-Level Waste Rock Seepage | The characteristics of the discharge must be typical of leachate, which has passed through inert waste rock |
| JM1 | 12-Level Waste Rock Seepage | The characteristics of the discharge must be typical of leachate, which has passed through inert waste rock |
| JM6 | Johnny Creek at end of Johnny Flats | None |
| JM7 | Stonehouse Creek | None |
| JM8 | Duplicate sample from any one of the sampling stations | None |
| JM9 | Travel blank | None |

Water quality samples were collected on August 23, 2019. Table 3.1-2 provides a summary of the locations of sampling stations, and Figure 3.1-1 illustrates the sampling locations.

The 2019 annual report for Permit PE-8415 is included as Appendix F. No non-compliance events occurred in 2019.

Permit PR-7927 Surface Water Quality Monitoring

Permit PR-7927 was most recently amended on May 31, 2018, and includes conditions for groundwater and surface water monitoring down-gradient of the Main Landfill. Monitoring is required for a period of five years commencing in 2018. Hence 2019 reflects the second year of monitoring.

Table 3.1-2 provides the sites, descriptions, and required surface water sampling outlined in EMA Permit PR-7927. Figure 3.1-2 presents the groundwater and surface water sampling stations required under Permit PR-7927.

**Table 3.1-2: Surface Water Monitoring Requirements under Permit PR-7927**

| Monitoring Site | Location Description | Coordinates | Water Quality Sampling |
|---|---|---|---|
| JM10-2018[1] | Surface water station on a tributary to Sky Creek, downslope from the Main Landfill and upstream from MW17-22. | 372498, 6278574 | Annually[2] (during summer) |

[1] *Sky 1.0 in the most recent amendment; however, the label JM10-2018 has been retained by SnipGold for consistency with previous years' monitoring.*

[2] *Field Parameters: specific conductivity, temperature and pH. Analytical parameters: BTEX, EPH, PAH, total metals, pH, alkalinity, bicarbonate, carbonate, chloride, conductivity (EC), fluoride, hardness, nitrate, nitrite, ammonia, sulphate, TDS, TIC, TOC, COD and turbidity, acidity (hot peroxide titration) and cyanides (weak acid dissociable (WAD), free, total, cyanate and thiocyanate).*

Required permit parameters were collected from the surface water station in 2019. The 2019 annual report for Permit PR-7927 is included as Appendix G.

### *3.1.3.2 Surface Water Quantity*

Flow monitoring is required as per ML/ARD condition 4(b) of Permit M-178. Surface water quantity has been monitored on site since 2016.

The objective of the 2019 program was to continue monitoring the water discharging/seeping from the TSF (two locations) and three portal discharge locations (level 10, level 11, and level 12 portals). Both automated and manual monitoring methods were used. Automated hydrometric monitoring stations were installed at the two TSF locations and at the Portal 10. The level 11 and level 12 portal locations are not amenable to installing hydrometric stations due to minimal discharge volumes, and discharge at these locations was measured using manual measurements. Stage-discharge rating measurements were completed at each station and rating curves were developed. The rating curves were applied to the stage data and hydrographs for the monitoring period generated for the three stations (Appendix H; RTEC 2020c).

Figure 3.1-3 shows the locations of the monitoring stations and Table 3.1-3 provides station details. Details of the field methods, data analyses, and QA/QC procedures can be found in Appendix H of this report (RTEC 2020c).

**Table 3.1-3: 2019 Tailings Storage Facility and Portal Hydrometric Monitoring Stations**

| Station | Location | Easting | Northing | Period of Operation |
|---|---|---|---|---|
| JTS-H1 | Downstream of seepage. Small stream ~100 m southwest of the tailing pond. Discharges into Stonehouse Creek. | 372,609 | 6,278,081 | Jun 27 – Oct 31 (2019) |
| JTN-H1 | Downstream of passive spillway. Small stream ~230 m northeast of the tailings pond. Discharges into Johnny Creek. | 372,973 | 6,278,720 | Jun 27 – Oct 31 (2019) |
| P10-A | Portal 10 discharge around the northeast side of the old Mill Building. Relocated in 2019 due to reclamation work to ~40 m downstream of portal discharge culvert. | 372,802 | 6,277,921 | Jun 27 – Oct 31 (2019) |
| P11 | Portal 11 discharge upslope of the old Mill Building. | 372,955 | 6,277,725 | June 27, July 24 and Aug 19, 2019[a] |
| P12 | Portal 12 discharge upslope of the old Mill Building. | 373,324 | 6,277,787 | June 27,July 24, Aug 19, Sept 25, Oct 31, 2019[a] |

*Note:*
*UTM NAD 83, Zone 9V*
*[a] Manual discharge measurements only*

The relationships between stage and discharge were established for the three monitoring stations with available data. Between four and twelve rating points from the 2016, 2017, 2018, and 2019 monitoring programs were used to develop each curve. The rating equations are summarized in Table 3.1-4 and 2019 rating curves along with previous rating curves are presented in Appendix H (RTEC 2020c).

**Figure 3.1-1**
**Permit PE-8415 Water Quality Sampling Stations**

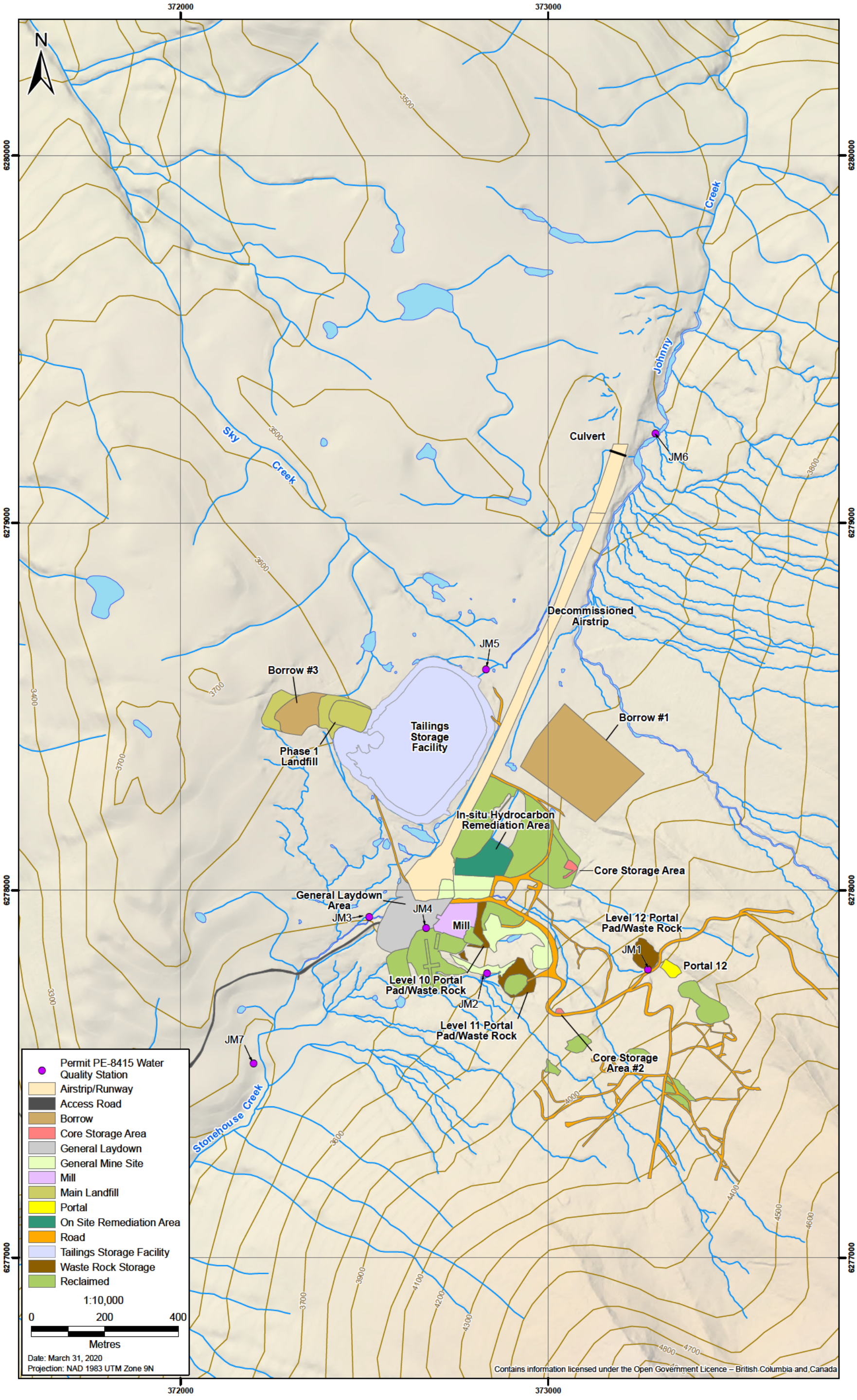


**Figure 3.1-2**
**Permit PR-7927 Groundwater and Surface Water Sampling Stations**

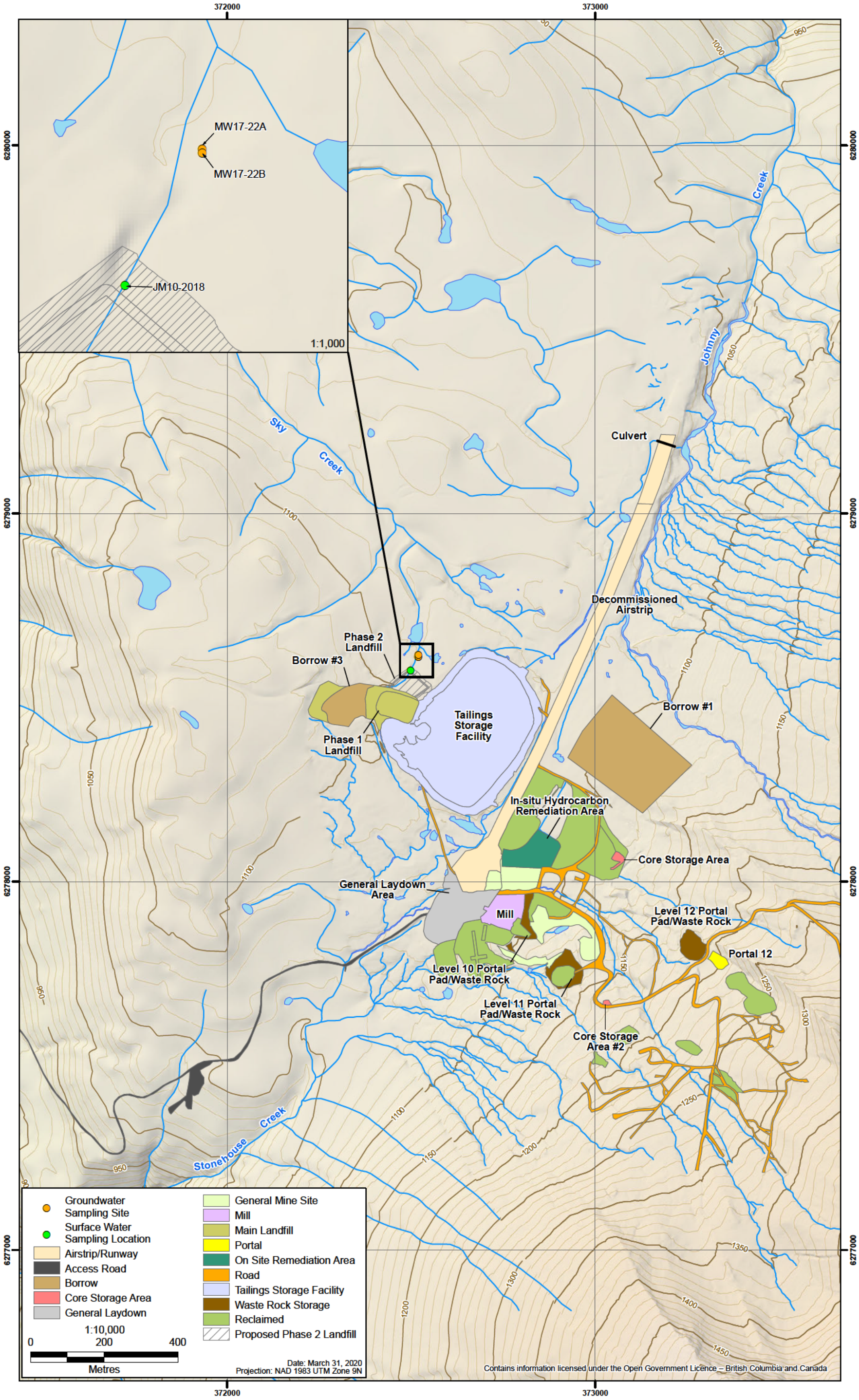


**Figure 3.1-3**
**Hydrometric Monitoring Locations**

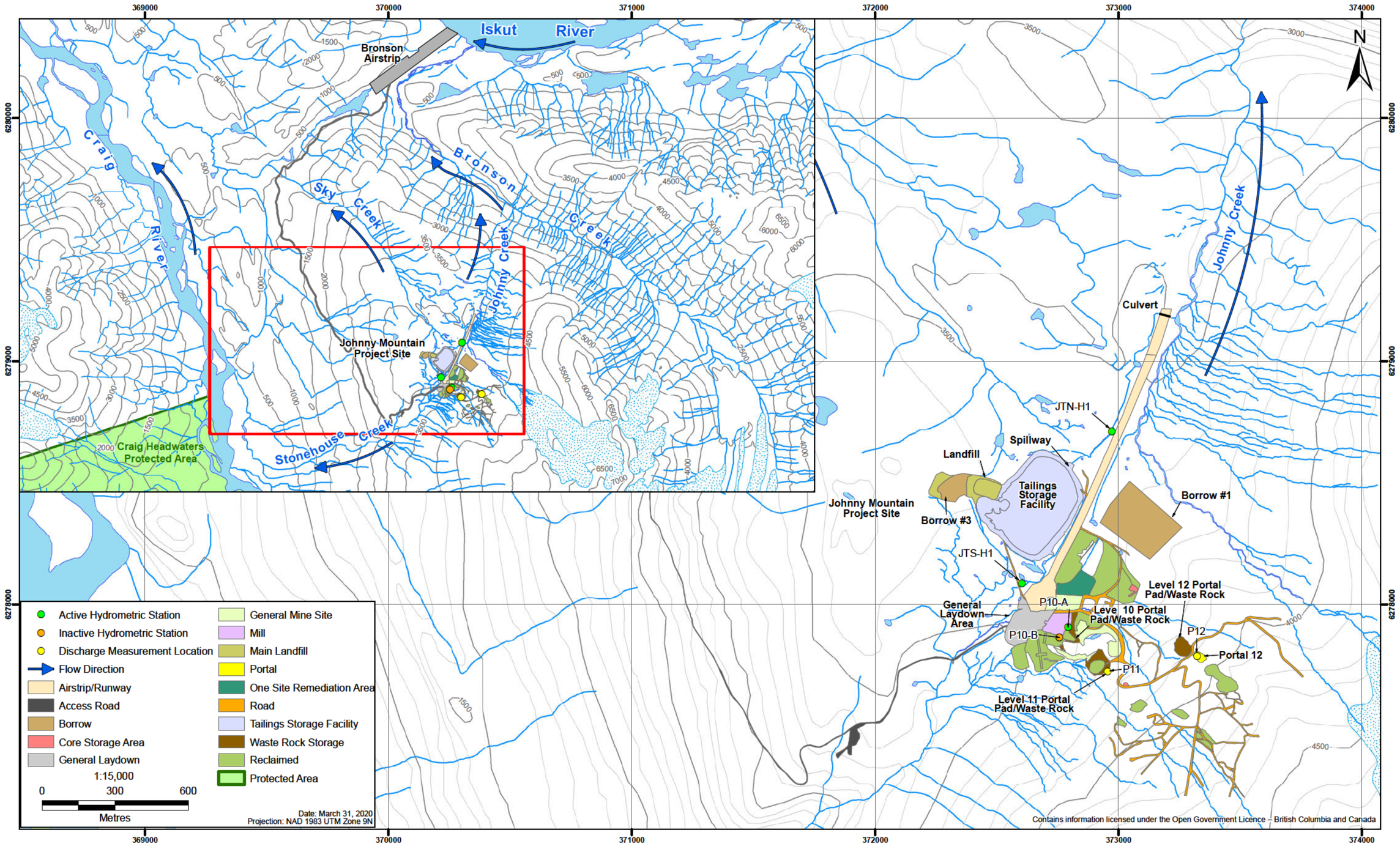


**Table 3.1-4: Stage-Discharge Rating Equations**

| Station | Rating Equation[1] | Number of Rating Points Used in 2019 Curve | RMS Error[2] | Rating Period |
|---|---|---|---|---|
| JTS-H1 | $Q = 3.493(h - 98.852)^{2.332}$ | 10 | 7.9 | 2016 – 2019 |
| JTN-H1 | $Q = 1.694(h - 99.492)^{1.957}$ | 12 | 8.1 | 2016 – 2019 |
| P10-A | $Q = 2.506(h - 98.891)^{2.157}$ | 4 | 12.5 | 2019 |

*[1] Equation $Q = C(h - a)^b$ : Q is the discharge ($m^3/s$), C and b are dimensionless coefficients, h is the stage (m), and a is the stage at zero flow (m).*

*[2] RMS error is a statistical parameter that describes how well the values predicted by the stage-discharge relationship fit or represent the observed data, it is an indicator of uncertainty.*

Daily discharge was generated for the operational periods using the corrected stage records and rating curves for each station. These are presented in Appendix H (see Figures 3.3-1 to 3.3-3 of Appendix H), and include daily precipitation data collected at the Johnny Mountain meteorological station (UTM 371,942 E; 6,278,283 N; Zone 9V; NAD 83).

Observed and calculated discharge values provide a measure of the quantity and timing of discharge at the monitoring locations over the observed period. The 2019 monitoring period was the open water period from late June to late October for the discharge from the tailings pond stations (JTS-H1 and JTN-H1) and for the discharge from the Portal 10 (P10-A). Daily discharge from the tailings pond stations ranged from 4.198 l/s to 154.695 l/s at JTS-H1 and 1.376 l/s to 47.152 l/s at JTN-H1. Discharge fluctuations at these monitoring locations are expected to be largely tied to snowmelt and local precipitation.

The level 10 portal daily discharge at P10-A ranged from 4.73 l/s to 17.64 l/s; the monitoring location would have local inputs of snowmelt and precipitation due to its location several metres downstream of the portal outflow, as well as the groundwater from the portal itself. Table 3.1-5 provides the minimum, mean and maximum daily discharge at each of the monitoring locations over the observed period of record.

**Table 3.1-5: Summary of Observed Minimum, Mean and Maximum Daily Discharge in 2019**

| Station | Minimum Daily Discharge (l/s) | Mean Daily Discharge (l/s) | Maximum Daily Discharge (l/s) | Observed Period |
|---|---|---|---|---|
| JTS-H1 | 4.20 (Aug 17) | 20.56 | 154.69 (9 Oct) | Jun 27 – Oct 31 |
| JTN-H1 | 1.38 (Jul 9) | 9.66 | 47.15 (21 Aug) | Jun 27 – Oct 31 |
| P10-A | 4.73 (Oct 31) | 8.94 | 17.64 (June 6) | Jun 27 – Oct 31 |

### *3.1.4 Groundwater Quality and Quantity*

#### *3.1.4.1 Groundwater Quantity*

As part of the TSF groundwater monitoring program groundwater levels were measured in 11 standpipe piezometers located around the TSF on August 23, 2019 (Figure 3.1-4). A Solinst® Model 101B electric water level meter was used (Appendix I; RTEC 2020d).

Groundwater level measurements are presented in Table 3.1-6. Five (5) of the wells had artesian water levels (water level in pipe was above grade), three (3) wells were flowing artesian, four (4) wells were not artesian and had water levels below grade, and two (2) wells were plugged to the top and assumed decommissioned.

**Figure 3.1-4**

**2019 Groundwater Levels Measurements for Standpipe Piezometers at the Johnny Mountain Tailings Storage Facility**

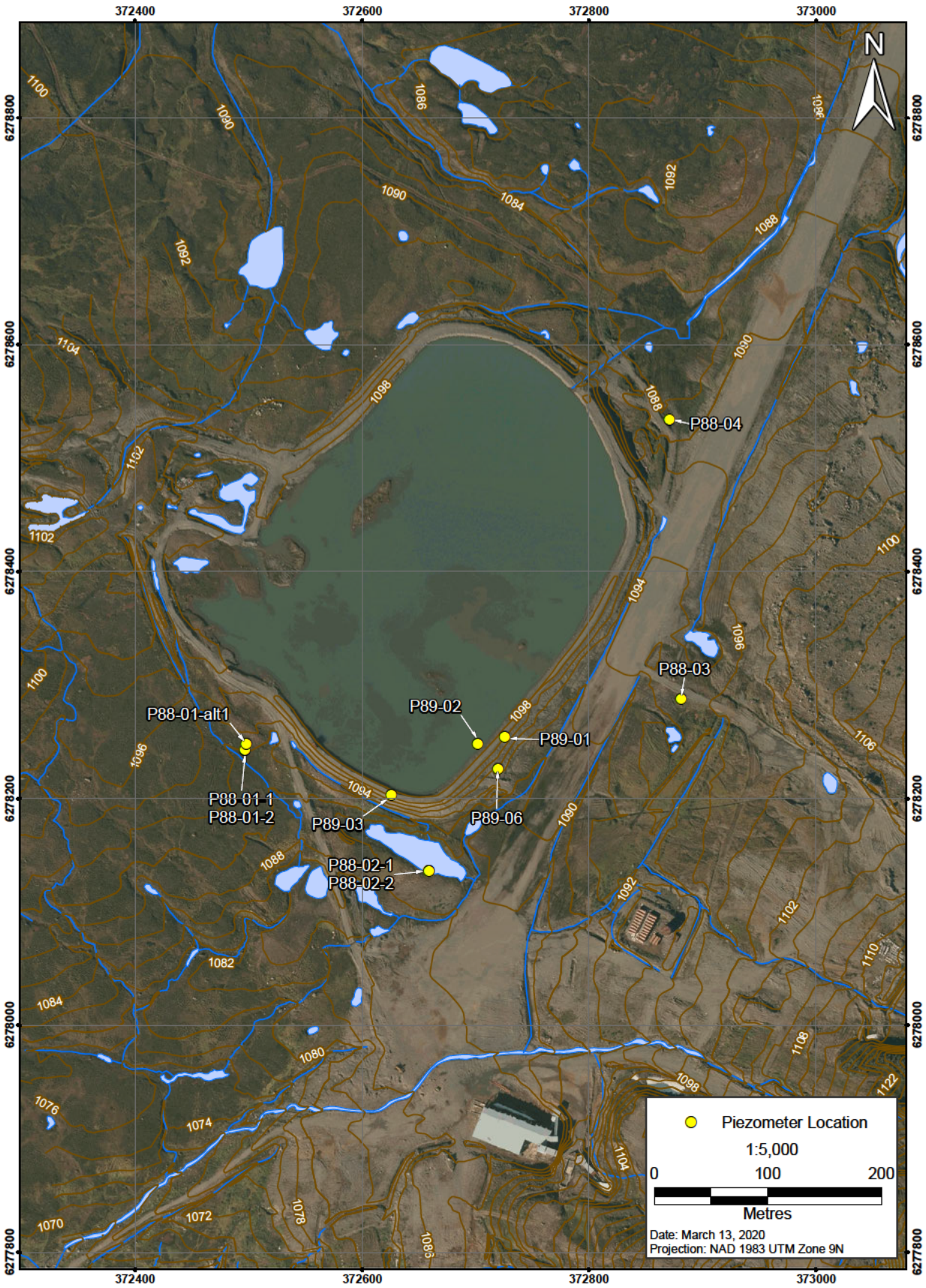


**Table 3.1-6: August 2019 Johnny Mountain Tailings Management Facility Groundwater Level Measurements**

| Piezometer ID | Easting [A] | Northing [A] | Stickup | Groundwater Level | |
|---|---|---|---|---|---|
| | (m) | (m) | (m) | m toc | mbg [B] |
| P88-01-1 | 372,497 | 6,278,243 | 0.34 | 0.000 | -0.340 |
| P88-01-2 | 372,497 | 6,278,243 | 0.37 | 0.020 | -0.350 |
| P88-01-alt1 | 372,498 | 6,278,248 | 0.50 | 0.180 | -0.320 |
| P88-02-1 | 372,659 | 6,278,136 | 0.21 | 0.190 | -0.02 |
| P88-02-2 | 372,659 | 6,278,136 | 0.23 | 0.580 | 0.350 |
| P88-03 | 372,870 [D] | 6,278,308 [D] | 0.26 | 1.670 | 1.410 |
| P88-04 | 372,871 | 6,278,534 | 0.54 | 0.000 | -0.540 |
| P89-01 | 372,710 [D] | 6,278,244 [D] | 0.56 | 7.510 | 6.950 |
| P89-02 | 372,702 | 6,278,248 | 0.16 | Note C | |
| P89-03 | 372,626 | 6,278,203 | 0.26 | Note C | |
| P89-06 | 372,720 | 6,278,226 | 0.10 | 1.390 | 1.290 |

*Notes:*
*Measurements taken August 23, 2019*
*m toc = metres below top of PVC casing; mbg = metres below grade*
*[A] UTM Zone 9V, NAD83*
*[B] Stickup above ground surface subtracted from measurement*
*[C] Pipe damage prevented water level measurement*
*[D] Coordinates revised from July 2016 measurements*

### *3.1.4.2 Permit PR-7927 Groundwater Monitoring*

Permit PR-7927 was amended on May 31, 2018, and includes conditions for groundwater and surface water monitoring in the vicinity of the Main Landfill. Monitoring is required for a period of five years commencing in 2018. Hence 2019 reflects the second year of monitoring.

In addition to the surface water monitoring outlined in Section 3.1.3.1, the permit requires annual sampling at groundwater stations MW17-22A and MW17-22B. Table 3.1-7 summarizes the required groundwater monitoring sites, descriptions, locations, parameters and frequencies outlined in the permit.

Required samples were collected in 2019, including the groundwater quality samples, groundwater well levels, and surface water quality sample. Results of the Permit PR-7927 sampling can be found in Appendix G (RTEC 2020d) and are summarized below.

Groundwater samples and groundwater levels were collected during two field events: July 17 and August 23-24, 2019. Table 3.1-7 provides a summary of the locations of sampling stations, and Figure 3.1-2 illustrates the sampling locations.

Water levels (Table 3.1-8) and required permit parameters were measured in groundwater samples obtained from the two nested groundwater wells, MW17-22A and MW17-22B. Groundwater quality results are presented in Appendix G.

**Table 3.1-7: Permit PR-7927 Groundwater Sampling Requirements**

| Monitoring Sites | Location Description | Coordinates | Monitoring Period, Parameters, and Frequencies | |
|---|---|---|---|---|
| | | | Water Quality | Water Level |
| MW17-22A (existing site) | Deep monitoring well downgradient from the Main Landfill. | 372519, 6278611 | A[1] | A |
| MW17-22B (existing site) | Shallow monitoring well downgradient from the Main Landfill. | 372519, 6278610 | A[1] | A |

*Note:*

*A = Annually (during summer)*

*[1] Field Parameters: specific conductivity, temperature, ORP, and pH. Analytical parameters: BTEX, EPH, PAH, dissolved metals, pH, alkalinity, bicarbonate, carbonate, chloride, conductivity (EC), fluoride, hardness, hydroxide, total iron, total magnesium, total manganese, nitrate, nitrite, ammonia, total potassium, total sodium, sulphate, TDS, TIC, TOC, COD and turbidity, acidity (hot peroxide titration) and cyanides (WAD, free, total, cyanate and thiocyanate).*

**Table 3.1-8: 2019 Groundwater Well Water Levels Specified in Permit PR-7927**

| Well ID | Date Sampled | Groundwater Level (m btoc) | Bottom of Well Depth (m) | Stickup (m) |
|---|---|---|---|---|
| MW17-22A | 17-Jul-19 | 1.240 | | |
| | 24-Aug-19 | 1.150 | 11.8 | 0.79 |
| | 4-Sep-19 | 2.780 | | |
| MW17-22B | 17-Jul-19 | 1.682 | | |
| | 23-Aug-19 | 1.250 | 3.26 | 0.88 |
| | 4-Sep-19 | 1.840 | | |

*Notes:*

*btoc = below top of the well's casing*

*Stickup = vertical distance between the well's casing and ground surface*

### *3.1.5 Water Quality Prediction, Mitigation, and Treatment*

Water quality prediction activities which involved geochemical testwork are described in Section 3.1.2. Monitoring results under Permit PE-8415 at JM5, the sampling site location downstream of the TSF spillway, indicated that water quality did not exceed the authorized discharge characteristics.

Relocating the ore concentrate from the Mill Building to the TSF in 2018 was a mitigation measure to reduce the potential for contact with surface water and to achieve long term storage of this material. Testwork for relocation of the waste rock located at the portal pads and the decommissioned airstrip in 2019 was the first phase of relocating the PAG material on site to the TSF. The main mitigation measure for the waste rock is to relocate it to the TSF, as outlined in Permit M-178. A trial placement of PAG material excavated from the decommissioned airstrip was mixed with hydrated lime and was placed in two areas in the TSF to assess closure cover constructability. A total of 2,620 $m^3$ of waste rock mixed with 635 kg of hydrated lime was placed in the TSF in 2019. Additional relocation of waste rock to the TSF is planned in 2020.

### *3.1.6 Water Management*

The local and regional drainages can be seen on the local site map in Figure 3.1-3.

The tailings impoundment is the primary site water management infrastructure. Surface water drainage does not enter the tailings impoundment and only precipitation that falls directly on the pond contributes to its volume. The water leaves the tailings impoundment via a spillway located on the northeast side. This water is then directed to Johnny Creek. The system is passive and was functioning as designed in 2019 (Appendix J).

Small volumes of water seep through the tailings impoundment and are collected in surrounding ditches. Two hydrometric monitoring stations are in place to monitor this seepage. See Section 3.1.3.2 'Surface Water Quantity' above for details.

A dam safety inspection was conducted on August 13 to 14, 2019 by Neil K. Hemrajani Singh, P.Eng. of KCB and Drew Hegadoren, P.Eng. of KCB with representatives of SnipGold (TSF Qualified Person Elizabeth Miller, Kevin Hidber and Brent Murphy). Neil K. Hemrajani Singh, P.Eng. of KCB is the Engineer of Record (EoR) for reporting to the Ministry of Energy, Mines and Petroleum Resources, British Columbia (EMPR). There were no significant changes to the TSF in 2019, and there were no significant changes to stability or surface water control (Appendix J; KCB 2020). The full dam safety inspection report can be found in Appendix J (KCB 2020).

A requirement of the closure plan is to improve site drainage, directing runoff water away from areas such as the Mill Building and Old Tank Farm and toward one of the three creeks leading away from site. These drainage improvements were made in 2018 and described in the 2018 ARR (RTEC 2019).

For 2019, drainage improvements were made by diverting water from infiltrating the in-situ Hydrocarbon Remediation Area. To alleviate infiltration of groundwater into the area, a diversion ditch was excavated on the east (higher elevation) side of the Old Tank Farm (Photo 3.1-1). The purpose of the diversion ditch was to divert ground water north around the area. This diversion helped de-water the In-situ Hydrocarbon Remediation Area and reduce the amount of groundwater infiltration through the site and into the interceptor ditch west (lower elevation) of the area. The diversion ditch will remain in place until the area is no longer required as an in-situ remediation area for hydrocarbon contaminated soils.

### *3.1.7 Erosion and Sediment Control*

Erosion and sediment control measures were carried out for major reclamation activities in 2019. Measures were specific for each reclamation activity. For example, Wood developed an Erosion and Sediment Control Plan for the Main Landfill upgrades, which was updated in 2019 to reflect the expected activities in 2019 (see Appendix E; Wood 2020b). SnipGold retained overall responsibility for implementation and maintenance of the erosion prevention and sediment control measures while Wood provided training, ongoing support, inspections, and assessment of the effectiveness of the controls. A design change was implemented following the initial 2018 Engineering Field Review that included a reversal of drainage flow direction for Phase 1 into the TSF. As such, the requirements for erosion prevention and sediment control (EPSC) measures for the 2018 and 2019 Main Landfill upgrades were greatly reduced. The EPSC measures were observed to be effective during the 2019 site inspection (Appendix E; Wood 2020b).

Water quality monitoring ultimately assesses the effectiveness of erosion and sediment controls. Results from the 2019 compliance water quality program indicated expected levels of suspended solids based on reference station data from glacier-fed streams.

*Photo 3.1-1: Diversion ditch excavated on east (higher elevation) side of Old Tank Farm in 2019.*

### *3.1.8 Soil Salvage and Stockpiling*

There are no stockpiles of surface soil materials available for reclamation on site.

### *3.1.9 Hydrocarbon Remediation Management*

The information in this subsection has been extracted from the 2019 Wood Supplementary Site Investigation report (Appendix K).Additional information on the 2017 and 2018 Site Investigation work can be found in previous ARRs (RTEC 2019, 2018b) and the 2019 Wood Johnny Mountain Mine Supplementary Site Investigation report (Wood 2019).

#### *3.1.9.1 Johnny Mountain Mine Environmental Site Investigations*

In 2019 Wood continued the environmental site investigation on specific areas of potential environmental concern (APECs) and areas of environmental concern (AECs) to delineate previously identified hydrocarbon impacts or to assess areas for potential hydrocarbon contamination.

Areas of Environmental Concern (AECs)

During the period of July 10 to 14, 2019, Wood supervised the excavation of 18 test pits to assist in the delineation of hydrocarbon impacted soil in the following areas of environmental concern: Mill Building (AEC1), Old Tank Farm and Fuel Lines (AEC 2), Fuel Pump Station (AEC 3), Mechanical Shop/Portal 11 area (AEC 4) and Warehouse Area East (AEC 7). Test pits at each of these sites were excavated.

Findings indicated that the estimated volumes of hydrocarbon impacted soils in the following areas are:

- Mill Building – 949 $m^3$
- Old Tank Farm and fuel line area – 14,250 $m^3$
- Fuel Pump Station – between 1,834 $m^3$ to 3,668 $m^3$

Note that approximately 9,000 $m^3$ of soils from the Old Tank Farm and fuel line area have been treated already.

One test-pit was excavated at the Warehouse Area East site in 2019. Delineation was not achieved as the area is located on a bench built into a steep slope. Wood recommended additional soil sampling for hydrocarbons in the Warehouse East area (Appendix K).

As part of the 2019 site investigations, Wood completed excavations to delineate the hydrocarbon contamination at the Mechanical Shop/Portal 11 site. No additional remediation activity occurred at the site in 2019.

All data, results, analysis and mapping for AECs are presented in detail within Appendix K.

Areas of Potential Environmental Concern (APECs)

*Portal 12 (APEC 8)*

Additional information became available during the 2017 Site investigation, which identified that several small storage and maintenance buildings were historically located at Portal 12. To assess for the presence of hydrocarbons at the Portal 12, test pits TP19-18 to TP19-21 were excavated and soil samples were submitted for laboratory analysis of hydrocarbons. Based on the results of the 2019 sampling data, hydrocarbon contaminated soil was not identified at the Portal 12.

*Disposal Site #2 (APEC 12)*

Elevated concentrations of HEPH were observed in soil within Disposal Site #2 during the 2017 Supplemental Investigation. Excavation of the source waste material was completed in 2018 by a third party contractor, including the area represented by the investigation soil samples. Test pits TP19-36 to TP19-40 were excavated in the vicinity of Disposal Site #2 in 2019 to determine if residual hydrocarbon impacted soil remained subsequent to the excavation completed in 2018. The results of the 2019 soil sampling program did not identify hydrocarbon impacts in soil. It is likely that the source waste material excavation completed in 2018 removed hydrocarbon impacted soil from this area.

All data, results, analysis and mapping for APECs are presented in detail within Appendix K.

### *3.1.9.2 Background Groundwater Assessment*

In 2017, 2018, and 2019, SnipGold contracted Wood to conduct site investigations and supplementary site investigations that included groundwater sampling (AMECFW 2018; Wood 2019, 2020b).
The groundwater sampling was intended to capture potential trends in groundwater quality in the areas around the two disposal sites, Mill Building, Old Tank Farm, and Main Landfill. Results of the groundwater sampling, maps and information on other aspects of the site investigation can be found in the appended Wood *2019 Supplementary Environmental Site Investigation Report* (Wood 2020b; Appendix K). The following results summary was provided by Wood (2020b), and the full report with the analytical results is available in Appendix K.

2017 and 2018 Activities

During the 2017 site investigation, 28 monitoring wells were drilled in nested pairs such that the well designated as A had screen set within the competent bedrock, while the well designated as B had screen either within the weathered shallow bedrock or straddling the bedrock-quaternary sediment interface. Generally, nested well pairs were completed within 3 m of each other and were never completed within the same borehole.

The site investigation work completed by Wood during the 2017 and 2018 field seasons identified elevated concentrations of dissolved metals: antimony, cobalt, manganese, cadmium, copper, lithium and arsenic in groundwater. Additional information regarding groundwater levels and groundwater quality during these years can be found in previous site investigation reports (AMECFW 2018; Wood 2019).

2019 Activities

In 2019, groundwater samples were collected from 23 boreholes in July and September 2019 (additional information in Appendix K, Table 4). On July 17 2019, Wood collected groundwater samples from monitoring wells MW17-22A and MW17-22B, located downgradient from the Main Landfill, to satisfy the requirements for Permit PR-7927, which authorizes the discharge of waste to the Main Landfill. Groundwater samples collected from monitoring wells MW17-22A and MW17-22B were submitted for analysis of BTEX, $EPHw_{10-19}$, PAHs, ion and nutrients, total and dissolved metals, chemical oxygen demand (COD), cyanide, cyanate and thiocyanate, total inorganic carbon (TIC) and total organic carbon (TOC). Further information on monitoring, sampling, and QAQC of these groundwater samples is provided in Appendix K (Wood 2020b).

2019 Results

The following provides a summary of the 2019 groundwater quality results as presented in Wood 2020b. Please refer to Appendix K for additional maps, figures and details.

*Petroleum Hydrocarbons Results*

Groundwater samples collected from MW17-4B, MW17-22A, MW17-22B and MW17-23A were submitted for analysis of BTEX, VHw, volatile VPHw, $EPHw_{10-19}$ and LEPHw. Groundwater samples MW17-22A and MW17-22B were also submitted for analysis of PAHs. A synopsis of the analytical results is as follows:

- Groundwater sample MW17-4B located within APEC 1 (Mill and Portal 10) contained an elevated concentration of LEPHw (1,030 µg/L) and $EPH_{19-32}$ (1,450 mg/kg); and
- Groundwater samples collected from monitoring well MW17-22A contained detectable concentrations of BTEX, VHw, volatile VPHw, $EPHw_{10-19}$, LEPHw, 1-methylnaphthalene, 2-methylnaphthalene and naphthalene; however, the reported results are less than five times the method detection limit (MDL) or are marginal and not considered significant. All remaining groundwater samples submitted for analysis of BTEX, VHw, volatile VPHw, $EPHw_{10-19}$ and LEPHw reported concentrations that are less than the detection limit.

*Dissolved Metals Results – July 2019*

During the period of July 15 to 17 2019, Wood collected groundwater samples from monitoring wells MW17-04B, MW17-05B, MW17-06B, MW17-09A, MW17-09B, MW17-10A, MW17-11A, MW17-11B, MW17-14A,

MW17-24A, MW17-22A, MW17-22B, MW17-26A, MW17-27A and MW17-27B. Groundwater samples were submitted for laboratory analysis of dissolved metals. A synopsis of the analytical results is as follows:

- Groundwater sample MW17-4B, located within APEC 1 (Mill and Portal 10), contained an elevated concentration of manganese (3,070 µg/L);
- Groundwater sample MW17-5B, located within APEC 1 (Mill and Portal 10), contained elevated concentrations of cobalt (3.99 µg/L) and manganese (11,000 µg/L). Its blind duplicate groundwater sample MW7-55B contained elevated concentrations of cobalt (4.1 µg/L) and manganese (11,800 µg/L);
- Groundwater sample MW17-6B, located within APEC 1 (Mill and Portal 10), contained an elevated concentration of manganese (3,620 µg/L);
- Groundwater sample MW17-9A, located within APEC 10 (Disposal Site #1), contained an elevated concentration of uranium (39.1 µg/L);
- Groundwater sample MW17-9B, located within APEC 10 (Disposal Site #1), contained elevated concentrations of cobalt (13.8 µg/L) and manganese (8,710 µg/L); and
- Groundwater sample MW17-27B, located within APEC 11 (Airstrip), contained an elevated concentration of cobalt (1.27 µg/L).

All remaining groundwater samples analyzed for dissolved metals reported concentrations that are below the detection limits, less than five times the MDL and/or marginal and not considered significant.

*Alkalinity, Ions and Nutrients – July 2019*

During the period of July 15 to 17 2019, Wood collected groundwater samples from monitoring wells MW17-04B, MW17-05B, MW17-06B, MW17-09A, MW17-09B, MW17-10A, MW17-11A, MW17-11B, MW17-14A, MW17-24A, MW17-22A, MW17-22B, MW17-26A, MW17-27A and MW17-27B. Groundwater samples were submitted for laboratory analysis of alkalinity, ions and nutrients. All groundwater samples analyzed for alkalinity, ions and nutrients reported concentrations that are below the detection limits, less than five times the MDL and/or marginal and not considered significant.

*Quality Assurance and Quality Control*

To ensure quality of data, a field duplicate was taken to measure possible field sampling error or local environmental variance. Duplicate samples are taken at a frequency of 1 out of 10 for groundwater and soil samples. Relative percent differences values are calculated for each duplicate that has a concentration at or greater than five times the reported detection limit (RDL). A summary of RPDs for duplicate samples collected is provided in Appendix K.

The BC Field Sampling Manual identifies RPD values >20% as an indication that a possible problem exists, and >50% indicates that a definite problem exists, most likely either through contamination or lack of sample representativeness (ENV 2013). During the 2017 to 2019 investigations, a total of eight soil duplicate samples and eight groundwater duplicate samples were analyzed for concentrations of hydrocarbons, metals, PAHs, VOCs and major ions. The RPD values for total of 743 groundwater parameters were calculated. Out of 743 groundwater RDPs, a total of 10 metal parameters had a calculated RPD value greater than 50% and one (1) hardness parameter had a calculated RPD value greater than 20%. The remaining groundwater RPDs were either below the target RPD of 20% or not calculable to due to concentrations reported as less than detection limits. The RPD values for total of 574 soil parameters were calculated. Out of 574 soil RDPs, a total of six metal parameters had a calculated RPD value greater than 20% and four (4) metal parameters had a calculated RPD value greater than 50%. One (1) $EPH_{10\text{-}19}$ parameter had a calculated RPD value greater than 50%.

The remaining soil RPDs were either below the target RPD of 20% or not calculable to due to concentrations that are less than detection limits. Out of 743 duplicate groundwater parameters, less than 1.5% exceeded the target RPD and out of 574 duplicate soil parameters, less than 2% exceeded the target RPD. Some errors in sampling are anticipated during a large site investigation and this can be further compounded by the heterogeneity of concentrations in soil; however, overall the field QA/QC project has met Wood's data quality objectives (Appendix K; Wood 2020b).

#### *3.1.9.3 In-situ Hydrocarbon Remediation*

The 2019 season was a continuation of the NWR in-situ hydrocarbon remediation program started in 2018. The 2019 season also included support from Wood, involving the addition of high nitrogen fertilizer along with the bioremediation product - Oil Gator (i.e., biocatalyst product).

The bioremediation stockpiles are located within the In-situ Hydrocarbon Remediation Area (includes footprint of the Old Tank Farm). The first activities in 2019 (June) involved turning of the 2018 stockpiled materials (approximately 3,000 $m^3$) that had been treated with Oil Gator in 2018. No additional product was added to these stockpiles; the material was lifted, mixed and aeriated for the fourth time in total.

A high nitrogen content fertiliser, N-P-K ratio of 42-6-0, was added to the treatment protocol for 2019 to augment the Oil Gator treatment. Approximately 9,000 kg of fertilizer was brought to the site in 2019 and 480 bags of Oil Gator.

Approximately 6,000 $m^3$ of additional contaminated soil was treated in 2019, using 6,000 kg of fertilizer and 420 bags of Oil Gator. Due to the volume of material treated in 2019 and unsuitable (wetter) weather later in the 2019 season, the treated soils within the remediation area were mixed only once during the 2019 season.

Upgrades were made to the drainage system around the In-situ Hydrocarbon Remediation Area in 2019. In order to alleviate infiltration of ground water into the area, a diversion ditch was excavated on the east (higher elevation) side of the Old Tank Farm location. The purpose of the diversion ditch was to divert ground water north around the area. The ditch will be retained until the remediation area is decommissioned and reclaimed. This diversion helped de-water and reduce the amount of groundwater infiltration through the site and into the interceptor ditch west (lower elevation) of the area (Photo 3.1-2).

### *3.1.10 Vegetation Management*

At the non-operational JMM Site 2019 vegetation-related activities were focused on a vegetation trial being conducted on 0.8 ha of the northern end of the decommissioned airstrip where rock was deemed to be non-PAG. The trials initiated in 2019 will be monitored in future years and reported in the ARRs. These efforts are detailed in sub-section 4.1.4 below.

### *3.1.11 Wildlife Protection*

The Goat Management Plan that was prepared in 2016 continues to be implemented. The Plan aims to protect goats from potential negative effects of helicopter overflights. A PowerPoint slide presentation was developed in 2016 (RTEC 2016) and continues to be used for pilots and other personnel doing work in the area.


*Photo 3.1-2: Aerial View of the In-situ Hydrocarbon Remediation Area - Hydrocarbon Contaminated Soil Treatment.*

Following the recommendations from the JMM marmot den survey conducted in the area of the Main Landfill and borrow areas in 2018 (RTEC 2018a), required excavation activities are carried out at a slower than normal pace around the previously observed den areas, in order to give potential transient marmots an opportunity to escape. It was also a recommendation of the survey findings that the field crew appoint a spotter when working close to know marmot dens. Large boulders could also be moved to undisturbed areas of site, where they may act as attractants to marmots. These recommendations have been followed for activities conducted on site in 2019 also.

Best management practices are used to avoid or minimize wildlife-human interactions, such as management of garbage and waste, and regular communication check-ins for field staff.

### *3.1.12 Archeological Resources*

In 2019 an Archeological Impact Assessment (AIA) report was prepared that summarized archaeological assessments that have taken place from 2016 to 2019 (Appendix L; RTEC 2020e). The AIAs were carried out under *Heritage Conservation Act* Heritage Inspection Permit 2016-0229.

Based on the AIAs the following general management recommendations were provided:

- On the steep north facing slope down to Bronson Creek within Exploration Focus Area A no further archaeological assessment is required, however, if impacts are anticipated at the top of the slope additional assessment will be required.
- No further archaeological assessment is recommended within Exploration Focus Area B, which encompasses the majority of the historical mine area.
- The area around the Meteorological Station was assessed (20 metre radius), no archaeological concerns were identified, and no further work is required.

SnipGold is advised that even the most thorough study may not identify all archaeological resources that may be present and SnipGold's Archaeological Chance Find Procedure should continue to be implemented prior to the commencement of ground altering activities. All staff on site should be familiarized with the procedure and protocols for managing known archaeological sites and any chance finds that may occur during construction.

The management recommendations presented above are offered by RTEC and are subject to review and acceptance by the Archaeology Branch.

### *3.1.13 Meteorological Station*

A meteorology station was installed on the plateau in September 2016 and continued to operate throughout 2017, 2018, and 2019. The station is collecting local information for wind speed, direction, temperature, humidity, solar radiation, snow depth, and precipitation. The station includes a network camera and satellite telemetry connection, and hosts an online website to display up-to-date and historical data. A detailed description of the station and information collected to date can be found in Appendix B (RTEC 2020a).

During the monitoring period of August 2016 to October 2019, air temperature ranged between 24.5°C (June 19, 2018) and -26.8°C (February 2, 2019). The mean relative humidity records indicate that fog and low clouds were present at the Johnny Mountain plateau approximately 34% of the time during the reporting period. The total 39 month precipitation unadjusted for wind undercatch was 4,657 mm, with a maximum daily precipitation of 47.5 mm on October 11, 2018. The snow pack reached its maximum depth of 179 cm on April 29, 2019, and the ground at the meteorological station became snow free each year in mid to late May.

Winds were predominantly from the southwest quadrant with a secondary predominant direction from the northeast. The highest wind speeds generally blew from the northeast during wintertime. The most frequent wind speeds were light to moderate breezes between 1.5 and 5 m/s (50% of the time). Strong winds at or above 11 m/s occurred 4.3% of the time. The maximum hourly average wind speed was 26.1 m/s (94 km/h; January 8, 2017), and the maximum wind gust speed was 42.3 m/s (152 km/h; January 9, 2017). The hourly average solar radiation ranged from 0 to 990 W/m$^2$, peaking during the summer.

### *3.1.14 Tahltan Engagement*

The following engagement activities were conducted in 2019:

- A meeting was held with SnipGold and the Tahltan Central Government (TCG) on **January 30, 2019** to present an Iskut Project Summary including the reclamation activities at JMM.

- **February 18, 2019**- Presented 2019 JMM Reclamation work summary to the Ministry of Mines in Victoria, with THREAT (Nalaine Morin) in attendance at SnipGold's request.
- A JMM Reclamation presentation was given to the TCG, Tahltan and Iskut Bands on **April 6, 2019**.
- A site tour was conducted at JMM on **August 28, 2019**. Chad Day, Ken Edzerza, Kody Penner and Norman Day visited JMM via helicopter for a site tour.

## 3.2 Next Year: 2020 Planned Activities

### *3.2.1 Environmental Management Systems/Plans/Audit*

No new environmental management systems, plans or audits are planned for 2020. SnipGold have developed a Project Execution Plan for 2020 which aligns with the objectives of the overall JMM PEP and JMM Closure Plan.

### *3.2.2 ML/ARD Characterization and Mine Waste Management*

For 2020 it is planned to relocate PAG material from the portal pads and from select areas of the decommissioned airstrip to the TSF, following the treatment procedures outlined in Permit M-178. It will likely take more than one snow-free season to complete the relocation (Appendix C).

### *3.2.3 Surface Water Quality and Quantity Monitoring*

#### *3.2.3.1 Surface Water Quality*

Surface water quality monitoring will be carried out in 2020 in accordance with requirements of permits PE 8415 and PR-7927.

#### *3.2.3.2 Surface Water Quantity*

Surface water quantity monitoring will be carried out in 2020.

### *3.2.4 Groundwater Quality and Quantity*

For 2020, historic groundwater wells may be inspected, water levels recorded, and some of the non-functioning wells may be closed.

The compliance groundwater sampling for Permit PR-7927 will be carried out as required during the snow-free period in 2020.

### *3.2.5 Water Quality Prediction, Mitigation, and Treatment*

There are no plans for a water quality prediction program in 2020. Water quality sampling will be carried out for Permit PE-8415 and Permit PR-7927. The main mitigation and treatment measure for water quality on site is to relocate PAG waste rock from the portal pads and select areas of the decommissioned airstrip to the TSF, following the treatment procedures outlined in Permit M-178. The relocation of this material is planned for 2020, and will likely continue into 2021.

### *3.2.6 Water Management*

The TSF will continue to be inspected on an annual basis. Permit M-178 requires the permittee to prepare a Dam Safety Inspection Report for the TSF every two years (or annually should a yearly field inspection of the TSF not be undertaken), and Dam Safety Reviews every 10 years. The two hydrometric stations collecting seepage from the TSF will be installed again in 2020, and hydrometric monitoring at the three portals will continue. There may be active management of water within the TSF during the relocation of waste rock in an effort to control the quality of surface water existing in the TSF during the activities planned for 2020.

### *3.2.7 Erosion and Sediment Control*

The site is subject to approximately 2,000 mm of precipitation as well as added and concentrated flows from the local melting glaciers. Spring/summer flows can also be significant with melting of the accumulated snow pack in the area. Many ditches and swales have been installed since 2017 to manage surface flows and direct runoff water toward historic channels. The 2020 season will be a continuation of the overall water management plan, including re-establishing effective surface water diversions around the Mill Building area, re-establishment of collection channels to effectively maintain drainage across the site and control sedimentation, and mitigate erosion (Appendix C; Project Execution Plan [PEP]; SnipGold 2020).

Current best practices and/or guidelines from agencies will be followed if any earthmoving works occur in 2020. Water quality monitoring will take place in 2020 as described above, which ultimately assesses the effectiveness of erosion and sediment controls.

### *3.2.8 Soil Salvage and Stockpiling*

There are no plans to stockpile soils in 2020.

### *3.2.9 Hydrocarbon Remediation Management*

An estimated soil volume of 9,000 $m^3$ of hydrocarbon contaminated soil was treated within the In-situ Hydrocarbon Remediation Area during the 2018 and 2019 seasons. 2020 will continue with treatment of contaminated soils within the designated remediation area. Fertilizer and a natural biocatalyst (oil Gator) will be added to the soils and turned several times during the 2020 season to speed aeration and the treatment process. The treatment process and material testing will be overseen by Wood and Northwest Response Ltd (Appendix C).

Based on 2019 results, Wood recommended sampling of 2018 stockpiled contaminated soils in early 2020 and continue on site treatment of 2019 stockpiled material throughout 2020 (Appendix K). In regard to the groundwater site investigation sampling program, Wood recommended that select groundwater wells are sampled and analyzed to supplement the existing groundwater data set (Appendix K). Wood also provided recommendations on which APECs/AECs should be carried forward for additional assessment and/or remediation work in 2020 (Appendix K). Table 3.2-1 provides a summary of information extracted from Appendix K and provides a synopsis of the areas of environmental concern and the Wood recommendations for additional activities.

### *3.2.10 Vegetation Management*

The 2019 vegetation trial established on 0.8 ha of the northern end of the decommissioned airstrip will be observed through the course of 2020.

**Table 3.2-1: Site Investigation Recommendations for 2020**

| Initial APEC | Description | 2019 Classification | Summary of 2020 Recommendations |
|---|---|---|---|
| APEC 1 | Mill / Portal 10 | AEC 1 | Groundwater sampling<br>HC remediation of soil |
| APEC 2 / APEC 14 | Old Tank Farm Area / Fuel Lines | AEC 2 | Groundwater sampling<br>HC remediation of soil |
| APEC 4 | Fuel Pump Shed | AEC 3 | HC remediation of soil |
| APEC 5 | Mechanical Shop / Portal 11 | AEC 4 | HC remediation of soil |
| APEC 9 | Main Landfill | AEC 5 | Undetermined |
| APEC 10 | Disposal Site #1 | APEC 10 | Groundwater sampling |
| APEC 11 | Airstrip | AEC 6 | Groundwater sampling |
| APEC 12 | Disposal Site #2 | APEC 12 | Groundwater sampling |
| APEC 13 | Warehouse East Area | AEC 7 | Groundwater sampling<br>Additional soil sampling |

### *3.2.11 Wildlife Protection*

The Goat Management Plan will continue to be implemented in 2020. Best management practices will continue to be used to avoid or minimize wildlife-human interactions, such as management of garbage and waste, around the Bronson camp (not owned by SnipGold), and regular communication check-ins for field staff.

### *3.2.12 Archaeological Resources*

Archeological baseline work may be conducted if any new exploration areas are identified, or if any activities are anticipated to take place outside of the areas already assessed.

### *3.2.13 Meteorological Station*

For 2020, it is anticipated that the meteorological station will be maintained, winterized, and kept in good working condition so that remote access to data is maintained.

### *3.2.14 Tahltan Engagement*

SnipGold will continue to engage with Tahltan Nation representatives in 2020, where appropriate, in order to keep all parties well informed on the on-going efforts by SnipGold to reclaim and remediate the JMM site.

## 3.3 Next Five Years: Summary 2020-2024

Environmental programs and monitoring required through the JMM permits (i.e., *Mines Act* Reclamation Permit M-178, *Environmental Management Act* Permit PE-8415, and *Environmental Management Act* Permit PR-7927) will continue, as necessary. Annual reports documenting associated activities will be provided as required.

SnipGold will continue to implement relevant management and monitoring plans required for the JMM site and associated activities, for example the ML/ARD Monitoring Plan, Closure Management Manual, etc.

Achieving the approved closure and reclamation objectives will remain the priority of SnipGold and SnipGold will continue to develop detailed Project Execution Plans for each year of activity. The key objectives being:

- Removal of infrastructure and cleanup of the JMM site;
- Decompact disturbed lands to enable development of natural habitat for wildlife utilization; and
- Establish long-term stability of restored areas, biologically, geotechnically and geochemically.

Through this time SnipGold will maintain a controlled, safe and secure site, where safety and safe work practices are of paramount importance.

# 4. RECLAMATION PROGRAM

## 4.1 Past Year: 2019 Activities

### *4.1.1 End Land Use*

The overall objective of the reclamation and closure plan for the Johnny Mountain Mine is to return disturbed lands and anthropogenic landforms to their original land use and capability of alpine tundra wildlife habitat (Woznow and Yeager 1999). This aligns with the end land use requirement specified in Permit M-178. As described in Section 1.5 of this report, the target wildlife species associated with the end land use of alpine tundra wildlife habitat are marmots, mice, voles, and shrews, and their transient predators, including marten and grizzly bears.

The end land use as specified in Permit M-178 remained an objective for the 2019 reclamation activities and will remain the end land use objective for future reclamation efforts.

### *4.1.2 Land Capability*

The capability condition specified in Permit M-178 is as follows: *Excluding the tailings pond area, the average land capability to be achieved on the remaining lands shall not be less than the average that existed prior to mining.*

The land capability as specified in Permit M-178 was the objective for the 2019 reclamation activities and will remain the capability objective for future reclamation efforts.

#### *4.1.2.1 Pre-Disturbance Landscape*

In addition to historical information, LiDAR, historical airphotos, and recent imagery were used to identify pre-disturbance ecosystems and conduct a desk-based Terrestrial Ecosystem Mapping (TEM) of the areas adjacent to the site (RTEC 2018b).

The historic airphotos were georeferenced in ArcMap and used in combination with more recent imagery and LiDAR to create the TEM. The ecosystem types and boundaries were delineated based on the interpretation of the imagery and LiDAR and on site units described in *A Field Guide to Site Identification and Interpretation for the Prince Rupert Forest Region* (Banner et al. 1993) and the *Biogeoclimatic Ecosystem Classification of Non-Forested Ecosystems in British Columbia* (MacKenzie 2012). In areas disturbed by the former mine, ecosystems were delineated and identified using the historic airphotos. Two BEC zones were identified: the MHmm2p which occurs in the transition from treeline to the alpine; and the CMAun which is the true alpine zone and is not treed (Figure 4.1-1).

Within each BGC Unit, site units were mapped. Site units reflect a recurring pattern of variation in soil and physiographic properties. Site units are grouped according to their potential to produce similar "stable" plant communities as influenced by environmental properties such as soil moisture and soil nutrient regimes.

Almost one-third of the mapped area is comprised of non-vegetated morainal till and rock, upslope of the Mill Building and the decommissioned Airstrip/Runway, which reflects the relatively recent retreat of the glacier from the higher elevations.

The MHmm2 parkland unit is the most common. However, due to cold air drainage, trees are not present on most sites. The majority of the MHmm2p site is Sedge Meadows (SS) followed by Heather

Meadows (HM). There are minor amounts of Mountain Heather Parkland (i.e., contains gappy open trees) (MH) and Mountain hemlock – Sedge Meadows (SH), and non-vegetated morainal deposits (MN).

The CMAun occurs above the tailings pond and air strip, and is comprised of non-vegetated recent morainal till (MN), Mountain Heather Meadows (MM), Alpine Meadow (AM), and sparsely vegetated Mountain Heather – Rhacomitrium Scrub (MR).

Due to georeferencing and distortion issues, the spatial alignment with the historic imagery is imprecise in some areas.

#### *4.1.2.2 Existing Landscape*

The JMM site is located in a rugged area at approximately 1,100 to 1,200 m above sea level (masl). Surrounding peaks are up to 2,000 m in elevation. Much of the site above the airstrip is located on morainal till deposits exposed by the receding glacier. The deglaciated areas typically have limited, if any, soil development; where present, soils are derived from glacial till and colluvium.

The site is located in the subalpine parkland of the Mountain Hemlock moist maritime subzone leeward variant (MHmm2p) and in the Coastal Mountain-heather Alpine (undifferentiated; CMAun) Biogeoclimatic Zone (BGC) zone. Due to the cold air drainage from the glacier coniferous trees are largely absent and most of the area is comprised of heathers, herbs, and low shrub species. These BGC units have some of the harshest climates of any of the biogeoclimatic zones in British Columbia. Temperatures remain low even during the growing season, which has a short frost-free period.

Plant species located near the mine site include: *Leutkea pectinata* (partridgefoot), *Phyllodoce empetriformis* (pink mountain-heather), *Cassiope mertensiana* (white mountain-heather), *Empetrum nigrum* (crowberry), *Veratrum viride* (Indian hellebore), *Festuca altaica* (altai fescue), *Epilobium latifolium* (willow herb), *Epilobium angustifolium* (fireweed), *Senecio triangularis* (arrow-leaved groundsel), *Alnus viridis ssp. Sinuate* (green alder); *Tsuga mertensiana* (mountain hemlock), *Tsuga heterophylla* (western hemlock), and *Chaemaecyparis nootkensis* (yellow cedar).

### *4.1.3 Long-term Stability*

The long-term stability condition specified in Permit M-178 is as follows: *Land, watercourses and access roads shall be left in a manner that ensures long-term stability.*

The access road to the site from the Bronson airstrip needs to remain active for ongoing reclamation and exploration activities.

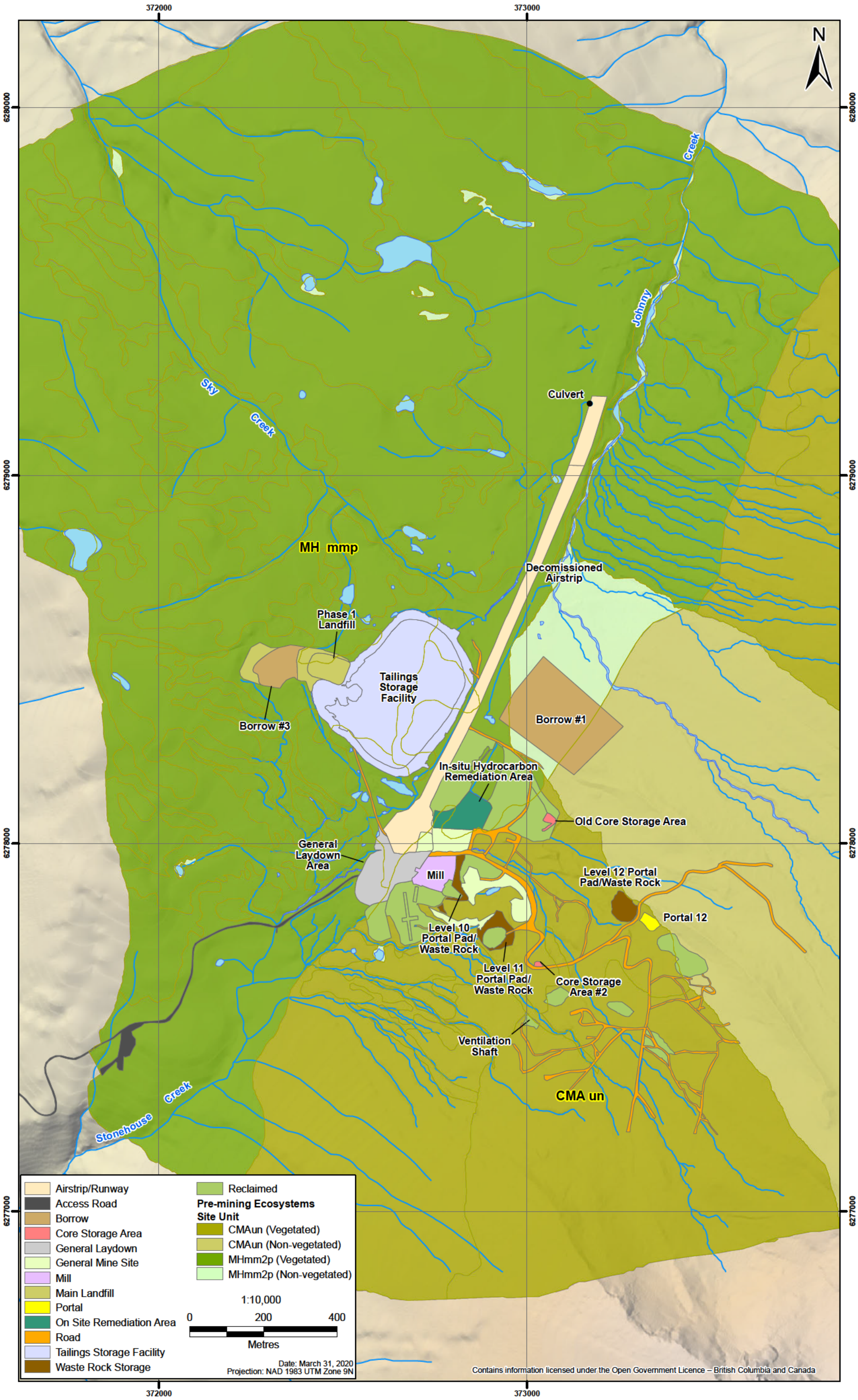
The long-term stability of the tailings dam was considered by conducting the required annual dam safety inspection in 2019 (Appendix J; KCB 2020). A dam breach analysis and consequence classification update was conducted in 2017 (KCB 2018a), and an updated closure design for the TSF was prepared in 2018 (KCB 2018b).

The five vent raises and three portals have all been closed, contributing to the long-term stability of the land and watercourses on site.

The Bronson dyke is required for the safe, continued operation of the Bronson airstrip.

**Figure 4.1-1**

**Terrestrial Ecosystem Mapping of the Johnny Mountain and Adjacent Areas**



### *4.1.4 Vegetation*

The vegetation condition specified in Permit M-178 is as follows: *On all lands suitable, as designated by the Chief Inspector, the land shall be re-vegetated to a self-sustaining state using appropriate plant species.*

#### *4.1.4.1 Initiation of Vegetation Trials in 2019*

In 2019, re-vegetation trials were initiated on the northern end of the decommissioned airstrip. This location was selected because it is relatively isolated from the historic mine area and is unlikely to be disturbed by other reclamation activities. The former airstrip is also the largest single feature that will be reclaimed.

Based on the expected conditions along with the historical ecosystems, the ecosystem unit targeted was heather meadows mixed with green alder and willow species, which establish on drier, poorer soils.

Prior to re-vegetation, site preparation was completed to reduce soil compaction and create more diverse microsites for plant growth. The technique termed 'rough and loose' was used as this is an effective treatment to improve conditions for establishment of plant communities and provides conditions that help in initiating the successional process (Polster 1989, 2013). The rough and loose treatment is also effective at reducing soil erosion and sedimentation, as it reduces compaction, increases surface roughness, and increases infiltration rates, all of which are factors in the universal soil loss equation used to assess erosion potential (Wischmeier and Smith 1965). The uneven, roughened surface will also help reduce wind shear (which causes desiccation and snow damage in alpine environments), and create micro-habitats for seed germination and development.

After site preparation and before planting, the prepared area was divided into four relatively equal areas (approximately 860 $m^2$ each) with various seeding rates. Grass species selected for seeding were chosen based on their occurrence in the MHmm2p as well as their availability from nurseries or seed suppliers, and included:

- 10% Canada Blue joint grass – *Calamagrostis canadensis*;
- 70% Rocky mountain Fescue – *Festuca saximontana*; and
- 20% Alpine blue grass – *Poa alpina*.

Intermingled low mats of pot-sized multiple species vegetation were transplanted to one of the trial areas (plot 1). The source plants were selected for transplantation based on their presence at the site, site conditions that they are capable of growing in, and suitability for transplantation. Dry sites were selected for sourcing plants so that species and individuals are already more tolerant of dry soil conditions. The majority of the species planted were heathers and partridgefoot. The plant species that were translocated are listed below in declining order of abundance, the last two species in the list represent only a few individuals.

- pink mountain-heather;
- yellow and white mountain-heather;
- partridgefoot;
- bilberry;
- altai fescue;

- Arctic raspberry;
- green reindeer lichen;
- curly heron's-bill moss;
- sedge species;
- green alder; and
- mountain hemlock.

When planting the loose and rough mounds and hollows, transplanted species were planted on the sides and tops of the mounds and hollows but not in the bottom of the depression. The planting density was 2,253 plants/ha and spacing was 2.1 m.

The re-vegetation trials initiated in 2019 will be monitored in future years and the results reported in the ARRs.

#### *4.1.4.2 Other Seeded Areas*

In addition to the areas seeded in the re-vegetation trials on the decommissioned airstrip, the area around the Portal 11 was contoured and seeded in 2019. A total of 2 ha was seeded in this area. The reclamation seed mix used was purchased from the Smithers Feed store and consisted of the following seed mix ratio:

- 10% Canadian Bluejoint;
- 70% Rocky Mountain Fescue; and
- 20% Coated Alpine Bluegrass.

### *4.1.5 Growth Medium*

The Growth Medium condition specified in Permit M-178 is as follows: a) On all lands to be *re-vegetated, the growth medium shall satisfy land use, capability, and water quality objectives; b) All severely compacted areas shall be deeply ripped prior to placement of growth media and/or vegetation.*

In-situ hydrocarbon remediation took place in 2019 in the In-situ Hydrocarbon Remediation Area (Appendix K; Wood 2020a), which aims to modify hydrocarbon contaminated soil on site towards appropriate standards for use in reclamation activities. In 2019, approximately 6,000 $m^3$ of hydrocarbon contaminated soils were treated on site by adding a biocatalyst product and aerating the soil. A high nitrogen fertilizer was also used with the bioremediation product.

### *4.1.6 Landforms*

The landforms condition specified in Permit M-178 is as follows: *where practicable, land and watercourses shall be reclaimed in a manner that is consistent with the adjacent landforms.*

No watercourses on site have been reclaimed to date. In 2019 a 0.2 ha area around the decommissioned and closed Portal 11 entrance was graded, recontoured and seeded. Additional drainage upgrades were made within the In-situ Hydrocarbon Remediation Area, see Section 3.1.9 above for detail.

In 2019 the base levelling course of Cell 2 of the upgraded Main Landfill was raised to an elevation of 1,098 m using borrow material located on site. Following relocation of excavated inert waste material to the Main Landfill the cells were then capped with mineral soils to a minimum of 300 mm depth and contoured to facilitate water run-off.

### *4.1.7 Structures and Equipment*

The Structures and Equipment condition specified in Permit M-178 is as follows: *a) prior to abandonment, and unless the Chief Inspector has made a ruling with respect to heritage project status or industrial use, i) all machinery, equipment and building superstructures shall be removed; ii) concrete foundations shall be covered and re-vegetated, unless because of impracticality, they have been exempted by an Inspector, and iii) all scrap material shall be disposed of in a manner acceptable to the district Inspector of Mines, Engineer.*

#### *4.1.7.1 Mill Building*

In 2019, reclamation of the Mill Building focused on further deconstruction of the remaining interior equipment including cyanide tanks, conveyors, pumps, as well as wood timbers and non-load bearing steel structural members.

During the dates of July 26 to August 27, 2019, approximately 2,900 $m^3$ of waste material was hauled from the Mill Building to the Main Landfill.

All steel, plastic, painted wood and non-hazardous waste removed from the Mill Building was transported to the upgraded Main Landfill with onsite equipment. All waste material in the Main Landfill was capped with mineral soils at the end of the 2019 season as required by site permits.

No hazardous waste was discovered during the deconstruction of the Mill Building. All hydrocarbon products discovered during deconstruction were drained or recovered from mill equipment and stored on site for offsite disposal.

Removal of Interior Wood Structures

On July 23, 2019, a structural engineer from Wood completed a secondary structural review of the Mill Building. The secondary structural review concentrated on the interior wooden support structures and their bearing capacity relative to the main steel structure.

It was determined by the Wood structural engineer that removal (deconstruction) of the interior wooden walls and beams (used for offices, labs and testing area), did not impact the overall structural integrity of the main Mill Building and could be removed, while leaving the main steel outer shell intact.

On July 25, 2019 (using a CAT 312 excavator), deconstruction of the interior wooden walls and beams began (Photo 4.1-1).

All non-painted wood, wood beams, plywood and construction waste were high piled south of the Mill Building and burned. All other inert and non-toxic waste (wire, steel pipe, PVC pipe, insulation, cladding and painted wood) were hauled to the upgraded Main Landfill and disposed of (Photos 4.1-2 and 4.1-3).


*Photo 4.1-1: Mill Building - Wooden construction waste piled and burned.*

*Photo 4.1-2: Steel construction waste hauled to Main Landfill.*

*Photo 4.1-3: Construction waste sorted and disposed of appropriately.*

Removal of Steel Cyanide Tanks

During the 2018 reclamation season, all ore concentrate which remained inside the cyanide tanks was removed and placed below water within the TSF. With the ore removed, deconstruction and disposal of the tanks was completed in the 2019 reclamation season. Eight (8) cyanide tanks were deconstructed from within the Mill Building, with all steel placed within the Main Landfill (Photos 4.1-4 to 4.1-7).

Removal of Mine Process Equipment from Mill Building

During the dates of July 26 to August 27 2019, Tahltan Nation Development Corporation (TNDC) supervision and labor crew, with support from SnipGold field supervision, were able to deconstruct, remove and dispose of the majority of the Mill Building process equipment (Photos 4.1-8 and 4.1-9).

An approximate volume of 2,900 $m^3$ of non-toxic, inert waste was removed from within The Mill Building and placed in the upgraded Main Landfill. All hydrocarbons were drained from pumps and motors prior to disposal and stored in containers for offsite disposal.

The majority of electrical wire was salvaged during Mill Building deconstruction and will be back-hauled off site for recycling in the 2020 season.

*Photo 4.1-4: Cyanide tanks within Mill Building.*

*Photo 4.1-5: Cyanide tanks within Mill Building.*

*Photo 4.1-6: Cyanide tanks being deconstructed inside Mill Building.*

*Photo 4.1-7: Cyanide tanks removed from inside Mill Building.*

*Photo 4.1-8: Steel waste hauled to Main Landfill.*

*Photo 4.1-9: Mill building after waste removed.*

Remaining Ore Removal and Interior Deconstruction

Ore concentrate was not removed in an area behind the main ball mill and under the conveyor system within the Mill Building during the 2019 season due to safety concerns and tight work areas. Once the conveyor, crusher and ball mill have been removed from this location the ore can be gathered and placed within the TSF.

### *4.1.7.2 Main Landfill Upgrades in 2019*

To facilitate the ongoing reclamation of the JMM Site and demolition of the Mill Building, the existing Main Landfill was further upgraded in the 2019 season to meet BC provincial landfill standards and to meet outstanding orders on the project. The Main Landfill is located at 56$^{0}$ 37' 59.4" N, 131$^{0}$ 04' 45.2" W, elevation of 1,100 m, on the west side of the existing TSF and has been designed to encompass the original Main Landfill location. As per the *Environmental Management Act* Permit PR-7927 the maximum authorized volume of solid waste that can be discharged at the facility is 38,000 m$^3$ and the discharge period is continuous between 2018 and 2022 during snow-free seasons.

Wood (formerly AMECFW) was contracted by SnipGold in 2018 to review the existing Main Landfill and design a phased construction schedule to accommodate the demolition waste generated from the planned reclamation of the JMM site (Appendix E; Wood 2020b). KCB was also contracted by SnipGold in 2018 to supply drainage details and drainage profiles, as required, between the proposed upgraded Main Landfill and the west side of the TSF (Appendix E; Wood 2020b).

Main Landfill upgrades carried out between June and October 2018, included re-grading of the landfill floor of Phase 1 of the Main Landfill to ensure waste material placed within the landfill was greater than 1.22 m above the inferred groundwater table (Appendix E). The Phase 1 - Cell 1 development included placement of demolition waste which was subsequently covered with soil. Levelling base course within Cell 2 was partially completed with grade elevations ranging from 1,097 m to 1,098 m (Photos 4.1-10 to 4.1-12; Appendix E). Material from Borrow Area 3 on site was used.

### *4.1.7.3 Placement of Waste Material within Main Landfill*

During the 2019 reclamation season, waste material from the following locations was relocated from around the JMM site and placed within the Main Landfill (Table 4.1-1).

**Table 4.1-1: Waste Relocation in 2019 - Volume of Waste Placed in Upgraded Main Landfill**

| Waste Source Locations - 2019 | Volume of Waste Placed in Main Landfill (m$^3$) |
|---|---|
| Main Warehouse Disposal Site* | 100 |
| East-Secondary Warehouse Site* | 200 |
| Portal 11 - Mechanics shop* | 80 |
| South of Old Tank Farm* | 24 |
| North of Old Tank Farm* | 48 |
| Mill Building | 2,900 |
| **Total - Waste Placed in Main Landfill in 2019** | **3,352 m$^3$** |

** Denotes previously undocumented waste disposal sites where waste was discovered in 2019.*

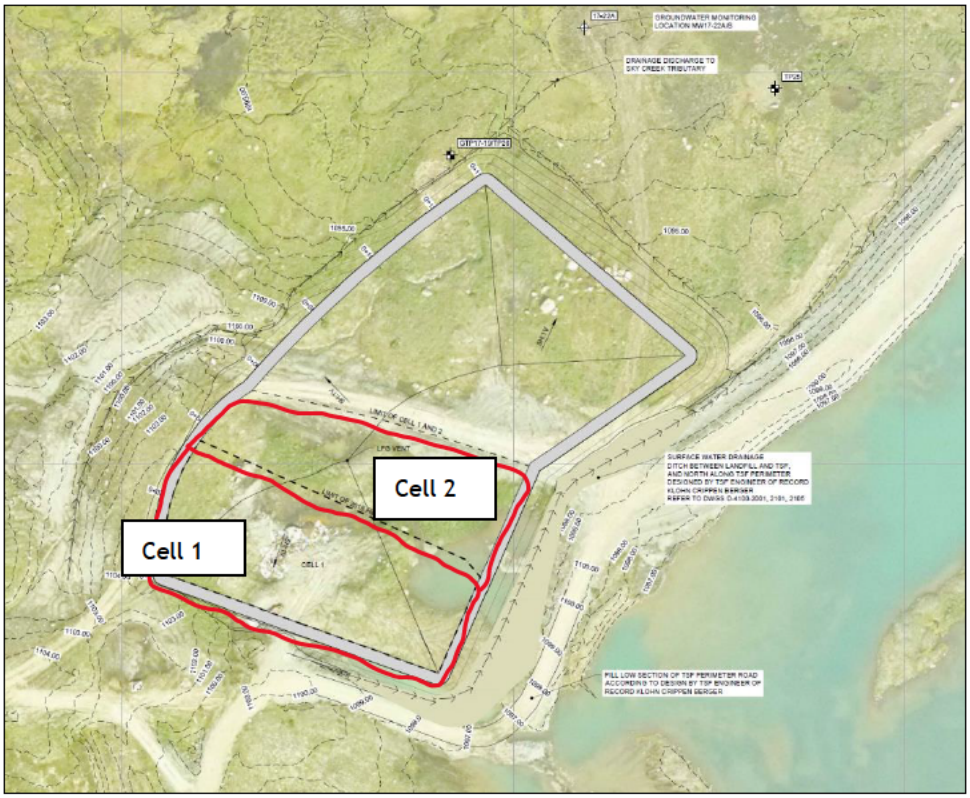



*Photo 4.1-10: Additional Gravel added to Base Elevation (1,098 m) - Cell 2, 2019 season (Dwg. 52655B-001).*

*Photo 4.1-11: Gravel placed in Cell 2 for base levelling course (July 1, 2019).*

*Photo 4.1-12: Test Pit - Cell 2 location to ensure adequate depth of levelling base course.*

Descriptions of Waste Type Encountered

Main Warehouse Disposal Site - north of Mill Building along the east edge of the decommissioned airstrip:

- Inert waste material excavated and relocated to the Main Landfill consisted of:
  - burnt timbers and lumber;
  - metal cladding;
  - metal beams and girders;
  - metal bins and tubing ;
  - PVC pipe; and
  - concrete slabs.
- Waste material encountered during excavation of the main warehouse that will be transported off site and disposed of at an approved disposal facility were:
  - Old 12-volt battery (stored on site to be disposed of at an appropriate site later); and
  - Unknown white substance believed to be used during the blasting process. A sample of the substance was sent to the lab for testing and showed levels of calcium, magnesium and aluminum.

East–Secondary Warehouse Site – located between Portal 10 and Portal 11:

- Inert waste material encountered and relocated to the Main Landfill consisted of:
  - burnt timbers, lumber and plywood;
  - electrical wire;
  - pumps and Electrical motors;
  - metal cladding;
  - metal beams and girders; and
  - PVC pipe.

During the excavation process, nine, partially full, 45-gallon drums of hydraulic oil and transmission oil were discovered. Any additional waste oil encountered was recovered and stored in 5-gallons pails for later off-site disposal.

Approximately 150 $m^3$ of contaminated soils were gathered and treated on site with Oil Gator and fertilizer, as directed and supervised by NWR and Wood. These activities were reported to Tahltan Nation and EMPR representatives.

Portal 11 – Mechanics Shop:

- Inert waste material encountered and relocated to the Main Landfill consisted of:
  - burnt timbers and lumber;
  - electrical wire;
  - metal parts for site equipment; and
  - metal sprockets, rollers and main track for a rock drill.

South of Old Tank Farm:

- The inert waste material encountered south of the Old Tank Farm consisted of:
  - metal culverts;
  - metal beams and girders;
  - electrical wire; and
  - metal piping.

North of Old Tank Farm:

- The inert waste material encountered north of the Old Tank Farm consisted of:
  - scrap metal;
  - metal pipes; and
  - crushed and empty 45-gallon drums.

Mill Building:

- The inert waste material encountered in the Mill Building consisted of:
  - metal beams and girders;

- metal tanks;
- pumps and motors (all motors drained of hydrocarbons prior to disposal);
- insulation;
- metal cladding;
- high-density polyethylene (HDPE) piping;
- steel ball bearings;
- wire mesh; and
- electrical wire (majority recovered for recycling).

All waste placed within the Main Landfill during the 2019 reclamation season complied with *EMA* Permit PR-7927 (Inert Solid Waste Disposal; Photo 4.1-13). No hazardous waste or hydrocarbons were placed within the Main Landfill during the 2019 season.

Main Landfill Cover

The waste material placed in the Main Landfill during the 2019 season was covered with mineral soils, free of boulders and organic material, to a minimum depth of 300 mm and compacted ensuring positive surface water flow away from Main Landfill location (Photo 4.1-14). All surface runoff water was directed toward a perimeter ditch then then into the TSF.

All work on the Main Landfill was completed under the direction of Wood site supervision and AllNorth Engineering survey layout, with support from SnipGold field managers. No environmental incidents nor health and safety incidents occurred during upgrades to the Main Landfill during the 2019 season.

*Photo 4.1-13: Waste material placed in Main Landfill – 2019 season.*

*Photo 4.1-14: Main Landfill Area – Waste material covered with mineral soils to a minimum depth of 300 mm.*

Disposal Sites Excavated in 2019

The total disturbance area associated with the five previously undocumented waste disposal locations was 0.87 ha (Table 2.5-2). None of these areas has undergone final reclamation. Some areas of Portal 11 were graded and seeded.

### *4.1.7.4 Onsite Equipment Repairs in 2019*

The onsite equipment is critical to the Johnny Mountain Mine reclamation/closure plan and ongoing repairs are necessary. Below is a summary of repairs completed to site equipment in 2019:

- CAT D8L Dozer
  - Replace track seals on left side of dozer
- CAT 235 Excavator
  - Engine overhaul and replacement
- Kenworth (6x6) Dump Truck
  - General maintenance
- CAT 312 Excavator
  - General maintenance
- CAT DJB Dump Truck
  - Engine removed and parts ordered for engine overhaul in 2020

- CAT 966D Rubber-Tired Loader
  - Engine removed and parts ordered for engine overhaul in 2020

### *4.1.7.5 Portal 11 Site Grading*

Portal 11 is located east of the Mill Building at UTM coordinate N6277726, E372954, elevation 1,100 m. The Portal 11 entrance was sealed during the 2018 reclamation season using soils natural to the site. Further grading and seeding were completed in the 2019 season at the portal entrance. An approximate area of 0.2ha was graded and seeded with a reclamation seed mix (Photos 4.1-15 and 4.1-16).

The reclamation seed mix consisted of the following:

- 10% Canadian Bluejoint;
- 70% Rocky Mountain Fescue; and
- 20% Coated Alpine Bluegrass.

### *4.1.7.6 Lowering Two Ore Islands in the TSF*

During the original JMM operation from 1986 to 1988, several islands of ore concentrate were left higher than the water level within the TSF. The JMM Closure Plan and Permit M-178 requires all ore concentrate placed within the TSF to be covered with a minimum of 300 mm of water.

During the 2018 reclamation season, two of four of the islands were lowered using pick and shovel to the required 300 mm below water level. During the 2019 reclamation season the two remaining islands were lowered using pick and shovel.


*Photo 4.1-15: Portal 11 – Additional Grading Required above Portal Entrance.*

*Photo 4.1-16: Portal 11 – Surface left rough and loose – seeded with reclamation seed mix.*

### *4.1.7.7 General Site Cleanup*

Copper Wire Salvage

During the process of decommissioning the Mill Building in 2019, the majority of electrical wire was salvaged and stored for later removal from site.

Burning of Untreated Wood Timbers

Untreated and unpainted wood timbers were gathered in 2018 during the deconstruction of the Portal 10 and stockpiled. Because of fire bans in BC in 2018, no burning was done last season and therefore was undertaken at the beginning of 2019.

Repairs to Piezometers Located on TSF (DH17-02 and DH17-05)

Five vibrating piezometers were installed along the perimeter of the TSF during the 2017 reclamation season. The recorded data from the piezometers has been downloaded several times during the 2017, 2018 and 2019 season and forwarded to Klohn Crippen Burger (KCB) for review.

Anomolies in the data recovered from DH17-02 and DH17-05 have been observed over the last two seasons by KCB and appear to be related to rain events on the JMM site. To eliminate the chance of water infiltrating the piezometer stand pipes, bentonite was added around the collar of DH17-02 and DH17-05 in the 2019 season (Photo 4.1-17).

Using the CAT 312 excavator, gravel material was removed from the base of the two suspect piezometer and bentonite added to the standpipe collar to prevent surface water infiltrating the stand pipe.

*Photo 4.1-17: Bentonite added at base of DH17-05.*

### *4.1.8 Dump Reclamation*

The dump condition specified in Permit M-178 is as follows: *Dumps shall be reclaimed to ensure a) long-term stability, and b) long-term erosion control*.

There are no waste rock dumps at JMM Site. However, there are three underground portals that were built up with waste rock to enable access to these sites. Each portal pad was found to contain a combination of non-acid generating and potentially acid generating materials, and segregation is not practical. In addition to placement of waste rock at the three portals, waste rock was used in the construction of on site roads, the decommissioned airstrip and the general laydown area (Price and Yeager 2004).

In 2019 a total of 2,620 $m^3$ of waste rock was excavated and relocated to the TSF as part of an initial trial. The trial was overseen by BQE Water. The waste rock was excavated from three locations on site. Two locations along the decommissioned airstrip and one from the Portal 10 area, north of the Mill Building.

As per requirements in Permit M-178, the waste rock was treated with hydrated lime prior to disposal in the TSF. Waste rock removed from the decommissioned airstrip was mixed with a lime mix ratio of 2kg of lime per 25 tonnes of waste rock. The waste rock excavated from the Portal 10 area was mixed at a higher lime content, as directed by BQE. A mix ratio of 5 kg per 25 tonnes was used for the waste rock from the Portal 10 area (Mill Building).

This relocation of waste rock material will continue to be included in the reclamation planning as documented in the 2020 Project Execution Plan (Appendix C).

### 4.1.9 Watercourse Reclamation

The watercourses condition specified in Permit M-178 is as follows: *Watercourses shall be reclaimed to a condition that ensures a) Drainage is restored either to original watercourses or to new watercourses which will sustain themselves without maintenance, and b) The level of productive capacity shall not be less than existed prior to mining, unless the Permittee can provide evidence, which demonstrates, to the satisfaction of the Chief Inspector, that impracticality of doing so.*

The local drainages can be seen on the local site map in Figure 3.1-1. There was no reclamation of watercourses on site conducted in 2019.

### 4.1.10 Open Pit Reclamation

There are no open pits at the Johnny Mountain site.

### 4.1.11 Tailings Storage Facility Reclamation

The TSF condition specified in Permit M-178 is as follows: *Impoundment facilities shall be inspected, monitored and maintained to ensure stability.*

The TSF continued to operate passively as it was intended to do in 2019. As per Permit M-178 conditions, a Dam Safety Inspection was carried out in August 2019 (Appendix J; KCB 2020).

A dam safety inspection was conducted on August 13 to 14, 2019 by Neil K. Hemrajani Singh, P.Eng. of KCB and Drew Hegadoren, P.Eng. of KCB with representatives of SnipGold (TSF Qualified Person Elizabeth Miller, Kevin Hidber and Brent Murphy). Neil K. Hemrajani Singh, P.Eng. of KCB is the Engineer of Record (EoR) for reporting to EMPR. There were no significant changes to the TSF reported in 2019, and there were no significant changes to stability or surface water control (Appendix J; KCB 2020).

A dam breach analysis and consequence classification update was conducted in 2017 (KCB 2018a).

### 4.1.12 Road Reclamation

The Roads condition specified in Permit M-178 is as follows: *a) All roads shall be reclaimed in accordance with land use objectives unless permanent access is required. This shall include the ripping of the road surface and re-contouring the roadway into adjacent landforms to reconstruct the areas' relative original landscape and moisture regime. b) Soil cover shall be replaced over the re-contoured surface and immediately re-vegetated with appropriate species that will lead to achieving end land use and productivity objectives. c) Included under this permit are all mine roads, the airstrip, and the 10 km Johnny Mountain Access Road.*

The Johnny Mountain access road from the Bronson airstrip is required to enable ongoing reclamation and exploration activities, therefore efforts will continue to maintain this road and not decommission it.

In 2017, Lidar data was obtained and this information was used to evaluate the area of historical exploration trails that have been overgrown and vegetated naturally overtime through disuse. Table 2.5-1 (i.e., Standard Table 1 (Summary of Areas Disturbed and Reclaimed) EMPR guidelines; see Section 2.5-1) captures the surface area for both these historical unused exploration trails and local site roads that remain active. Roads around the remaining infrastructure that will be needed until the completion of the on-going reclamation activities will remain active.

### *4.1.13 Infrastructure Decommissioning/Reclamation*

There is no specific condition in Permit M-178 relating to Infrastructure Decommissioning/Reclamation.

Many activities took place in 2019 for decommissioning infrastructure on site. Refer to Section 4.1.7 of this document for a description of the decommissioning activities for the Mill Building and other structures (e.g., waste sites).

In 2019, the decommissioned airstrip was the site of re-vegetation trials, which included preparing a 'rough and loose' topography. Approximately 0.8 ha on the north end of the decommissioned airstrip was excavated to give a rough and loose topography, as detail in the David F. Polster - 2013, "Boreal Reclamation Program". Of the 0.8 ha of the rough and loose area, 0.2 ha was re-vegetated with vegetation harvested from the surrounding area, with the entire 0.8 ha area seeded with an Alpine Seed mixture. See Section 4.1.4 of this document for further details.

### *4.1.14 Securing Openings*

The Secure Openings condition specified in Permit M-178 is as follows: *a) All access roads shall be effectively blocked to prevent inadvertent vehicular access to surface areas of the mine that may be dangerous. b) All shafts, raises, stope openings, adits, or drifts opening to the surface shall either be capped with reinforced concrete or filled with material so that subsidence of the material will not pose a future hazard. c) In the case of shafts or raises, the cap shall be secured to solid rock, or to a concrete collar secured to solid rock, and capable of supporting a uniformly distributed load of 12 Kpa or a concentrated load of 24 kn, whichever is greater. d) Where there is evidence or a potential for use by wildlife, mine openings may be fitted with a barrier that allows wildlife passage but prevents human entry. e) When mine openings are permanently closed and it may be possible for mine water to build to dangerous pressures, a permanent drain shall be installed.*

In 2018 the five vent raises and the three portals were permanently closed as described in the 2018 ARR. No additional reclamation activities to secure openings were necessary in 2019.

### *4.1.15 Disposal of Hazardous Materials, Chemicals, and Reagents*

The Disposal of Fuels and Toxic Chemicals condition specified in Permit M-178 is as follows: *Fuels, chemicals or reagents, which cannot be returned to the manufacture/supplier, are to be disposed of as directed by the Chief Inspector in compliance with municipal, regional, provincial and federal statutes.*

In 2019, hazardous materials encountered during excavation of waste disposal sites and reclamation of the Mill Building were stored on site until they could be removed and disposed of at authorized facilities off-site. Details of the types of waste encountered are provided in Section 4.1.7.3 above.

The in-situ hydrocarbon remediation program conducted on-site in 2019 is detailed in Section 3.1.9 above. In short, the 2019 season was a continuation of the NWR in-situ hydrocarbon remediation program started in 2018. The first activities in 2019 (June) involved turning of the 2018 stockpiled materials (approximately 3,000 $m^3$) that had been treated with Oil Gator in 2018. Approximately 6,000 $m^3$ of additional contaminated soil was treated in 2019, using 6,000 kg of fertilizer and 420 bags of Oil Gator. The program is ongoing and is located in the In-situ Hydrocarbon Remediation Area.

### *4.1.16 Reclamation Research*

Vegetation trials were initiated in 2019 as described in Section 4.1.4 of this document. The trials were carried out on 0.8 ha of the northern section of the decommissioned airstrip and employed the rough

and loose technique (Polster 2013) and planting with a mix of native plants and seeding with a reclamation grass mix.

## 4.2 Next Year: 2020 Reclamation Program

The following text provides an overview of the planned 2020 reclamation activities as described in the 2020 Project Execution Plan (Appendix C; SnipGold 2020). The primary goal of the 2020 season is the excavation and relocation of ML/ARD waste rock from the portal areas, as well as waste rock located on the decommissioned airstrip and site roads surfaced with waste rock. All excavated waste rock will be mixed with hydrated lime to abate potential pH rise as the waste rock is placed below water elevation inside the TSF.

2020 Planned Reclamation Related Activities:

- Excavation and Relocation of ML/ARD waste rock. A significant scope of the JMM reclamation plan is the relocation of waste rock, generated during the mine operation. The waste rock will be relocated from the portal locations into the TSF. Hydrated lime will be added to the waste rock prior to being placed in the TSF to offset the potential pH increase.
- Disposal of Old Mining Equipment. All miscellaneous site equipment will be disposed into the expanded Main Landfill (e.g., grader, crane, D6 dozer and snow cat). The old mining equipment has been deemed unsalvageable by Finning and Matrix mechanics and will be cut down and placed into the Main Landfill. All fluids will be drained from equipment prior to disposal and transported off site and disposed in an approved disposal facility.
- Conduct annual Dam Safety Inspection (DSI). KCB has been retained by SnipGold to perform the yearly dam safety review of the TSF.
- Test pits and material testing. Conduct additional test pits and material testing to prove borrow source material on site.
- Piezometer Data collection. Download data from the TSF vibrating wire piezometers to support the DSI.
- Ongoing Environmental Monitoring. A key component of the JMM Reclamation Program is to show continued improvement to the JMM site as the reclamation program moves toward returning the site to its natural state as per permits PE-8415 and M-178. See Section 3.2 of this report, including a description of monitoring as per permits PE-8415 and PR-7927.
- In-situ Hydrocarbon Remediation. An estimated soil volume of 9,000 $m^3$ was treated within the In-situ Hydrocarbon Remediation Area during the 2018 and 2019 seasons. 2020 will continue with treatment of contaminated soils within the historic tank farm and a portion of the decommissioned airstrip. Fertilizer and a natural biocatalyst (oil Gator) will be added to the soils and turned several times during the 2020 season to speed aeration and the treatment process. The treatment process and material testing will be overseen by Wood and NWR.
- Complete minor upgrades to JMM access road. The JMM access road will require upgrades early in the 2020 season. This will involve ditching, brushing, culvert installation and upgrades where wash outs occurred late in the 2019 season.
- Equipment Repairs and upgrades. Complete ongoing repairs and upgrades to site equipment to ensure minimal delays due to breakdowns. Repairs to DJB Rock Truck, CAT 235 excavator, Kenworth dump truck, CAT 966 Loader.

Additional opportunities to complete reclamation activities may arise through 2020. Should this occur, activities will be reported in the 2020 Annual Reclamation Report.

## 4.3 Next Five Years: Planned 2020-2024 Activities

SnipGold will continue to execute on the JMM Closure Plan objectives and actions in order to achieve the overall land use objective of returning disturbed lands and new anthropogenic landforms to alpine tundra wildlife habitat (Woznow and Yeager 1999).

Complete reclamation and closure of the JMM Site is anticipated within the next few years. This will be achieved through sequenced decommissioning of remaining on site infrastructure (e.g., conveyor and Mill Building), removal of waste materials from the surface of the site and subsequent re-vegetation of target areas as identified in Section 4.1.2 above.

The Main Landfill will be used to dispose of all inert authorized waste types generated on site. Phase 2 expansion of the Main Landfill will occur should SnipGold need additional capacity beyond the 38,000 $m^3$ of Phase 1's Cell 1 and 2. Hazardous wastes will continue to be disposed of at appropriately authorized facilities off site.

SnipGold have a planned program to excavate, treat with hydrated lime and remove the waste rock pads remaining on the surface of the JMM Site to the TSF. As per Permit M-178, all waste rock will be submerged in the TSF. Additionally, once it is safe to do so, the remaining ore concentrate in the Mill Building will be collected and disposed of in the TSF.

In-situ remediation of hydrocarbon contaminated soils will continue. The water management and drainage system associated with the In-situ Hydrocarbon Remediation Area where the treatment is occurring will be maintained, as required.

SnipGold will continue to conduct the necessary environmental programs and compliance monitoring associated with the JMM Site throughout the closure phase. As per the *Mines Act* and EMA permits requirements, compliance reports will be submitted to the relevant regulatory bodies annually.

# 5. OUTSTANDING RECLAMATION LIABILITY

The total reclamation expenditures in 2019 were [redacted] The net outstanding reclamation liability estimate is [redacted]. This is based on the 2018 estimate (prepared to an AACE Class 2 Construction Cost Estimate level, with an expected accuracy range of 10%/+20%).

The scope of this estimate includes costs for the following areas where active reclamation work was carried out in 2019 (see Table 5-1):

**Code: 2200. Landfills/In-situ Hydrocarbon Remediation**. Upgrades were completed on the Main Landfill, including certification and record drawings report. In-situ hydrocarbon remediation continued in 2019. The estimated expenditures in 2019 were: [redacted].

**Code 3100. Mill Demolition**. In 2019 tasks included the removal of ore from the Mill Building to the TSF. Further interior demolition and removal of internal Mill Building infrastructure occurred in 2019. The estimated expenditures in 2019 were: [redacted].

**Code 9100. Engineering and Technical Services**. In 2019 tasks included civil engineering at the Main Landfill services, including certification and record drawings reporting on Phase 1 of the facility. The estimated expenditures for 2019 were: [redacted].

**Code 9400. Construction Support**. Temporary Construction Maintenance estimated expenditures were: [redacted].

**Code 9700. Health, Safety, Security and Environment**. This included safety supplies and training estimated expenditures were: [redacted].

**Code 9800. Temporary Camp and Catering Costs**. This included rental of the construction camp, equipment rentals, labour, rotations and maintenance. The estimated expenditures in 2019 were: [redacted].

**Code 9900. Freight and Logistics/Contractor Support**. This included freight shipping, transport shuttle and helicopter support for 2019. Estimated expenditures were: [redacted]

SnipGold internal salaries were: [redacted].

Ongoing monitoring costs for 2019 are provided in Table 5-2.

**Table 5-1: 2019 Reclamation Costing Estimate for Johnny Mountain Mine**

| Code | WBS # | Description | Detail | 2017 Closure Cost Estimate | 2018 Closure Cost Expenditures | 2019 Closure Cost Expenditures |
|---|---|---|---|---|---|---|
| 2017 Cost Estimate | 1100 | Mine Adits | 10 Level, 11 Level, 12 Level Adits | [redacted] | - | - |
| | 1200 | Vent Raises | Vent raises 11-17-76, 11-29B Stope, 11-28-66, 12-06-05, 12-13-03 | [redacted] | [redacted] | - |
| | 2100 | Waste dumps (waste rock) | Waste rock dump Level 10, Level 11, Level 12 | [redacted] | - | - |
| | 2200 | Landfills/In-situ hydrocarbon remediation | Main landfill, Burial Site #1, Burial Site #2, in-situ hydrocarbon remediation | [redacted] | [redacted] | [redacted] |
| | 2300 | Surface Water Management | Site grading, restoration of channels, airstrip grading, re-soiling and vegetation | [redacted] | - | - |
| | 3100 | Mill Demolition | Removal of ore from mill build., demolition and removal of Mill Building | [redacted] | [redacted] | [redacted] |
| | 3200 | Tank Farm Deconstruction | Tank farm deconstruction | [redacted] | - | - |
| | 4100 | Civil Works Associated with TSF Design | TSF dewatering, water treatment, improvements to TSF embankment, tailings and PAG Rock co-disposal, improvements to TSF spillway | [redacted] | - | - |
| | 6200 | Asset Management (Equipment Value) | 325 excavator, D8K, B931 Loader, D8L, Knelson concentrator, misc. equipment | [redacted] | - | - |
| | 9100 | Engineering and Technical | Civil and Landfill services, TSF Support, UG Closure Services, Hazmat specialist | [redacted] | [redacted] | [redacted] |
| | 9300 | Temporary Construction Utilities | Temporary fuel storage and distribution, fuel consumption | [redacted] | - | - |
| | 9400 | Construction Support | Temporary Construction Maintenance | [redacted] | [redacted] | [redacted] |
| | 9600 | Site Survey | Site survey- Setting out/Topography collection, bathymetry of TSF | [redacted] | - | - |
| | 9700 | Health, Safety, Security and Environment | Safety Supplies and Training | [redacted] | [redacted] | [redacted] |

| Code | WBS # | Description | Detail | 2017 Closure Cost Estimate | 2018 Closure Cost Expenditures | 2019 Closure Cost Expenditures |
|---|---|---|---|---|---|---|
| | 9800 | Temporary Camp and Catering | Construction Camp Set-up, rentals, labour, rotations, maintenance | [redacted] | [redacted] | [redacted] |
| | 9900 | Freight and Logistics/ Contractor Support | Freight, transport shuttle, helicopter support | [redacted] | [redacted] | [redacted] |
| | P200 | Taxes | Provincial sales taxes | [redacted] | | |
| | | | SnipGold Corp. internal salaries* | | [redacted] | [redacted] |
| | | | **Closure Costs** | | [redacted] | [redacted] |
| Closure Securities held by MEMPR | Guaranteed Investment Certificates and Cash | | | [redacted] | [redacted] | [redacted] |
| | Mining Equipment Posted as Collateral | | | [redacted] | [redacted] | [redacted] |
| | **Total Security Held by Government** | | | [redacted] | [redacted] | [redacted] |
| **TOTAL OUTSTANDING CLOSURE LIABILITY (2019)** | | | | [redacted] | [redacted] | [redacted] |

** 2018 includes a one-time internal salary adjustment. SnipGold has decided to manage the reclamation project internally. These funds include salary dollars for staff time.*

**Table 5-2: Monitoring Costs for 2019**

| Monitoring Item | Cost |
|---|---|
| Water Quality Sampling (PE-8415 & PR 7927) and reporting | [redacted] |
| Hydrology | [redacted] |
| Annual Reclamation Reporting | [redacted] |
| Annual Dam Inspection | [redacted] |
| Helicopter | [redacted] |
| Camp | [redacted] |
| **Total** | [redacted] |

*Notes:*

*Camp costs assume one trip per month in June, July, August, and September; 4 days per trip, [redacted] /day.*

*Helicopter costs assume 2 hours of helicopter time per trip, at [redacted] per hour.*

# 6. REFERENCES

Definitions of the acronyms and abbreviations used in this reference list can be found in the Glossary and Abbreviations section.

AMECFW. 2018. Johnny Mountain Mine Reclamation Project, 2017 Site Investigation. AMEC Foster Wheeler, March 2018.

Banner, A., W. H. MacKenzie, S. Haeussler, S. Thomson, J. Pojar, and R. Trowbridge. 1993. *A Field Guide to Site Identification and Interpretation for the Prince Rupert Forest Region*. Research Branch Ministry of Forests, Victoria, BC.

BC ILMB. 2000a. *Cassiar Iskut-Stikine Land and Resource Management Planning Process Completed (Press Release)*. British Columbia Integrated Land Management Bureau. http://archive.ilmb.gov.bc.ca/slrp/lrmp/smithers/cassiar/news/newsreleases/lrmp_completed.htm (accessed December 2012).

BC ILMB. 2000b. *Cassiar Iskut - Stikine Land and Resource Management Plan*. British Columbia Integrated Land Management Bureau. http://ilmbwww.gov.bc.ca/slrp/lrmp/smithers/cassiar/index.html (accessed July 2010).

BC MOE. 2009. *Habitat Wizard*. BC Ministry of Environment, Ecosystems Branch. http://webmaps.gov.bc.ca/imfx/imf.jsp?session=954648956850

BC MOE. 2013. *British Columbia Field Sampling Manual, Part E - Water and Wastewater Sampling, Sections: Ambient Freshwater and Effluent Sampling, and Groundwater Pollution Monitoring*.

BC MOE. 2017. *Technical Guidance on Contaminated Sites, Groundwater Investigation and Characterization*.

BC MOE. 2018. *British Columbia Approved Water Quality Guidelines*. http://www2.gov.bc.ca/gov/topic.page?id=044DD64C7E24415D83D07430964113C9 (accessed January 2018).

BC MOE. 2018. *Working Water Quality Guidelines for British Columbia*. http://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/waterqualityguidesobjs/wwqgs_23_oct_2015.pdf (accessed January 2018).

BQE. 2020 . *AMD Mitigation at the Johnny Mountain Mine by Amending Waste Rock with Lime*. Prepared for SnipGold Corp. by BQE Water: Vancouver, British Columbia. November 2019.

EMPR. 2019. Ministry of Energy, Mines and Petroleum Resources (EMPR) Annual Reclamation Report-General Information and Format Requirements. Updated January 2019.

ENV. 2013. *British Columbia Field Sampling Manual: For Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples*. 2013 ed. Victoria, BC: Water, Air and Climate Change Branch, Ministry of Water, Land and Air Protection.

KCB. 2018a. *Johnny Mountain Mine. Tailings Storage Facility Dam Breach Analysis and Consequence Classification Update*. Prepared for Snip Gold Corporation by Klohn Crippen Berger.

KCB. 2018b. *SnipGold Corporation: Johnny Mountain Mine Reclamation Tailings Storage Facility Closure Design.* Prepared for Snip Gold Corporation by Klohn Crippen Berger.

KCB. 2020. Johnny Mountain Mine – *Tailings Storage Facility 2019 Dam Safety Inspection.* Prepared for Snip Gold Corporation by Klohn Crippen Berger.

MacKenzie, W. H. 2012. *Biogeoclimatic ecosystem classification of non-forested ecosystems in British Columbia.* Prov. B.C., Victoria, B.C. Tech. Rep. 068.www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr068.htm

Polster, D. F. 1989. *Successional reclamation in Western Canada: New light on an old subject*. Paper presented at the Canadian Land Reclamation Association and American Society for Surface Mining and Reclamation conference, Calgary, Alberta, August 27-31, 1989.

Polster, D. F. 2013. Making site rough and loose: A soil adjustment technique. Boreal Reclamation Program, Technical Notes, June 2013.

Price, W. A. and D. A. Yeager. 2004. *ML/ARD Assessment and Mitigation and Johnny Mountain Gold Mine*. MEND Report 9.1a, August 2004.

RTEC. 2016. *Iskut Goat Management Program Presentation.* Prepared for SnipGold Corp. by RTEC: Vancouver, British Columbia.

RTEC. 2017a. *Iskut Project: 2017 Johnny Mountain Aquatic Characterization Report*. Prepared for SnipGold Corp. by RTEC: Vancouver, British Columbia.

RTEC. 2017b. *Iskut Project: 2016 Johnny Mountain Aquatic Characterization Report*. Prepared for SnipGold Corp. by RTEC: Vancouver, British Columbia. February 2017.

RTEC. 2018a. *Hoary marmot salvage of Main Landfill and borrow area at Johnny Mountain.* Memo prepared for SnipGold Corp. by RTEC: Vancouver, British Columbia.

RTEC. 2018b. *Iskut Project: Annual Reclamation Report for 2017:* Mines Act *Permit Number M-178.* Prepared for SnipGold Corp. by RTEC: Vancouver, British Columbia.

RTEC. 2019. *Iskut Project: Annual Reclamation Report for 2018:* Mines Act *Permit Number M-178.* Prepared for SnipGold Corp. by RTEC: Vancouver, British Columbia.

RTEC. 2020a. *Iskut Project: 2019 Meteorological Data Report*. Prepared for SnipGold Corp. by RTEC: Vancouver, British Columbia.

RTEC. 2020b. 2019 Compliance Water Quality Results for Permit PR-7927. Memo prepared for SnipGold Corp. by RTEC: Vancouver, British Columbia. November 2019.

RTEC. 2020c. *Iskut Project: 2019 Johnny Mountain Tailings Pond and Portal Hydrologic Monitoring Summary*. Prepared for SnipGold Corp. by RTEC: Vancouver, British Columbia.

RTEC. 2020d. 2019 Iskut Project Standpipe Piezometer Groundwater Monitoring Summary Memo prepared for SnipGold Corp. by RTEC: Vancouver, British Columbia. December 2019.

RTEC. 2020e. *Iskut Project: Archaeological Impact Assessment Final Report, Heritage Inspection Permit 2016-0229*. Prepared for SnipGold Corp. by RTEC: Vancouver, British Columbia.

SnipGold. 2016. *Goat Management at the Iskut Project*. Prepared for SnipGold Corp. and Matrix by SnipGold Corp.

Wischmeier, W. H. and D. D. Smith. 1965. Prediction Rainfall Erosion Losses from Cropland East of the Rocky Mountains: A Guide for Selection of Practices for Soil and Water Conservation. *Agricultural Handbook*, No. 282, 47 p.

Wood. 2019. *Supplementary Environmental Site Investigation Report – Johnny Mountain Mine Reclamation Project, BC*. Rev A. Prepared on behalf of SnipGold Corp.

Wood. 2020a. *2019 Supplemental Site Investigation Report*. Prepared on behalf of SnipGold Corp.

Wood. 2020b. *Post Construction Report – 2019 Main Landfill Upgrades*. Prepared on behalf of SnipGold Corp.

Woznow and Yeager.1999. *Closure Plan for the Johnny Mountain Gold Mine*. Reclamation Permit No. M-178. Prepared for International Skyline Gold Corporation. October 13, 1999.

Yeager, D. A. 2001. *Annual Reclamation Report for 2000, Johnny Mountain Property, Reclamation Permit No M-178*. Skyline Gold Corporation, July 23, 2001

# APPENDICES

Under separate cover