TMAC RESOURCES

North Dam Weekly Walkover Survey Report

Date:	Oct 23, 2019
Inspected By:	Josh F[illegible]
Conditions:	(ie. snow on ground, clear) Snow

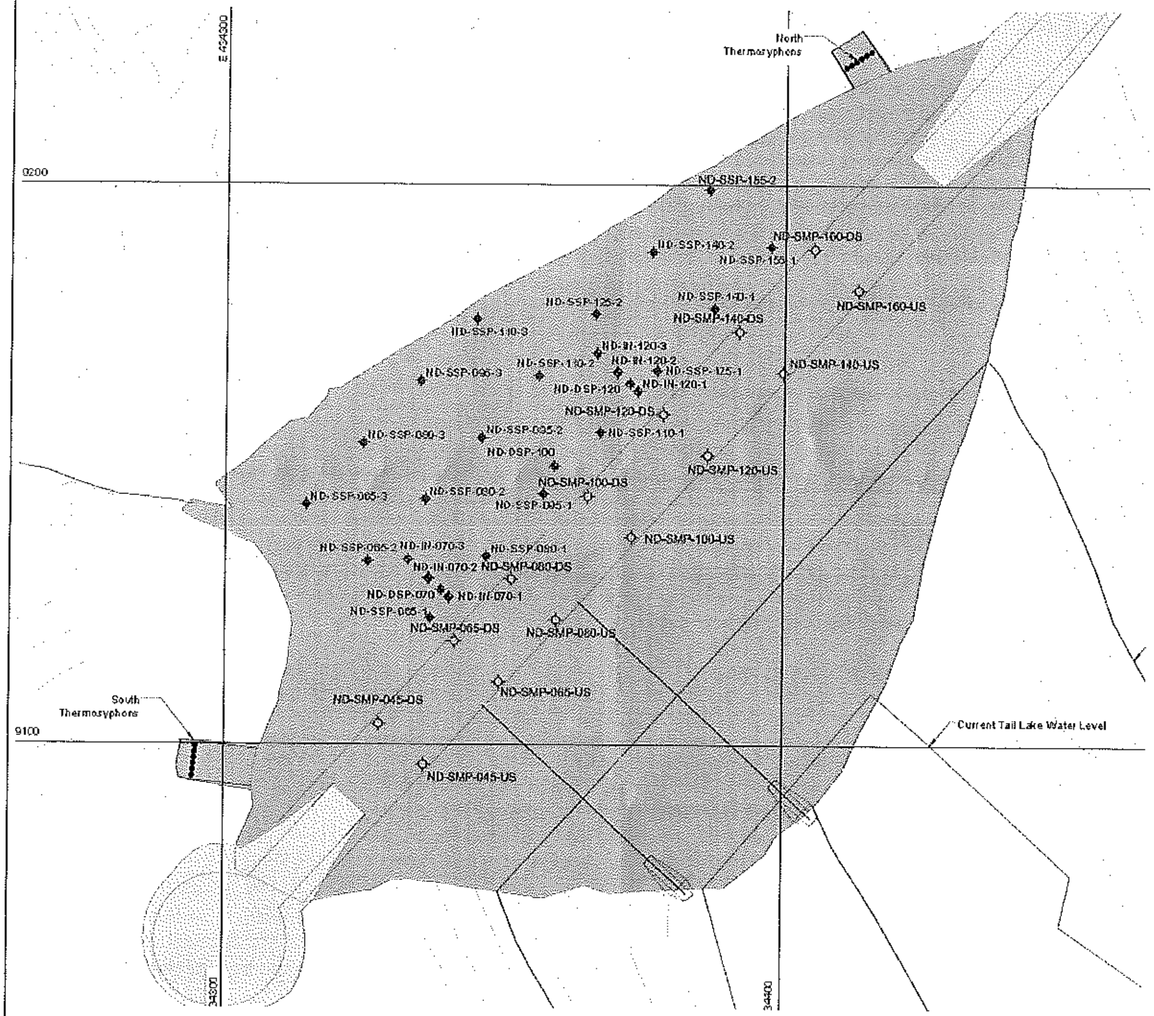
Visual Inspection:

This weekly walkover survey report is a means to track the condition on the North Dam, please provide details on changes that have developed since the previous inspection and/or any observations of particular concern. All photos are appreciated. Please send the completed form (scans are fine) and any photos to hopebaymonitoring@srk.com and pluedke@srk.com

Upstream Side of Dam Any visible concerns? (cracks, depressions, erosion, etc.)	Yes	[✓ No]
Downstream Side of Dam Any visible concerns? (cracks, depressions, erosion, seepage, etc.)	Yes	[✓ No]
Crest of Dam Any visible concerns? (cracks, depressions, erosion, etc.)	Yes	[✓ No]
Thermosyphons North Side Any visible concerns? (cracks, punctures, peeling paint, birds nests, etc.)	Yes	[✓ No]
Thermosyphons South Side Any visible concerns? (cracks, punctures, peeling paint, birds nests, etc.)	Yes	[✓ No]
Instrumentation (on crest and downstream side) Any visible concerns? (bent, rusted, cracked, etc.)	Yes	[✓ No]
Thermistors and Dataloggers Any visible concerns? (frayed or cut cables, damaged boxes, etc.)	Yes	[✓ No]
Suspended Sediment in TIA (When not frozen) Any suspended sediment in Tail Lake?	Yes	[✓ No]
Water at the Toe of the Downstream Side of the Dam (If yes refer to Doris North – North Dam and Tail Lake Outflow Seepage Monitoring Work Plan 2015)	Yes	[✓ No]

If you answered yes to any of the questions above please provide details and photos. Observations can be sketched on the figure provided on the next page. If seepage has been noted please estimate the flow.

Please provide any other observations you have made or items that did not fit in the space above



Photos:

Please collect the following photos:

- Photo from north end looking south along the dam ☑
- Photo from south end looking north along the dam ☑

Other photos, please describe – Photos taken

TMAC RESOURCES

North Dam Weekly Walkover Survey Report

Date:	Oct 31, 2019
Inspected By:	Josh Fris
Conditions:	(ie. snow on ground, clear) Snow

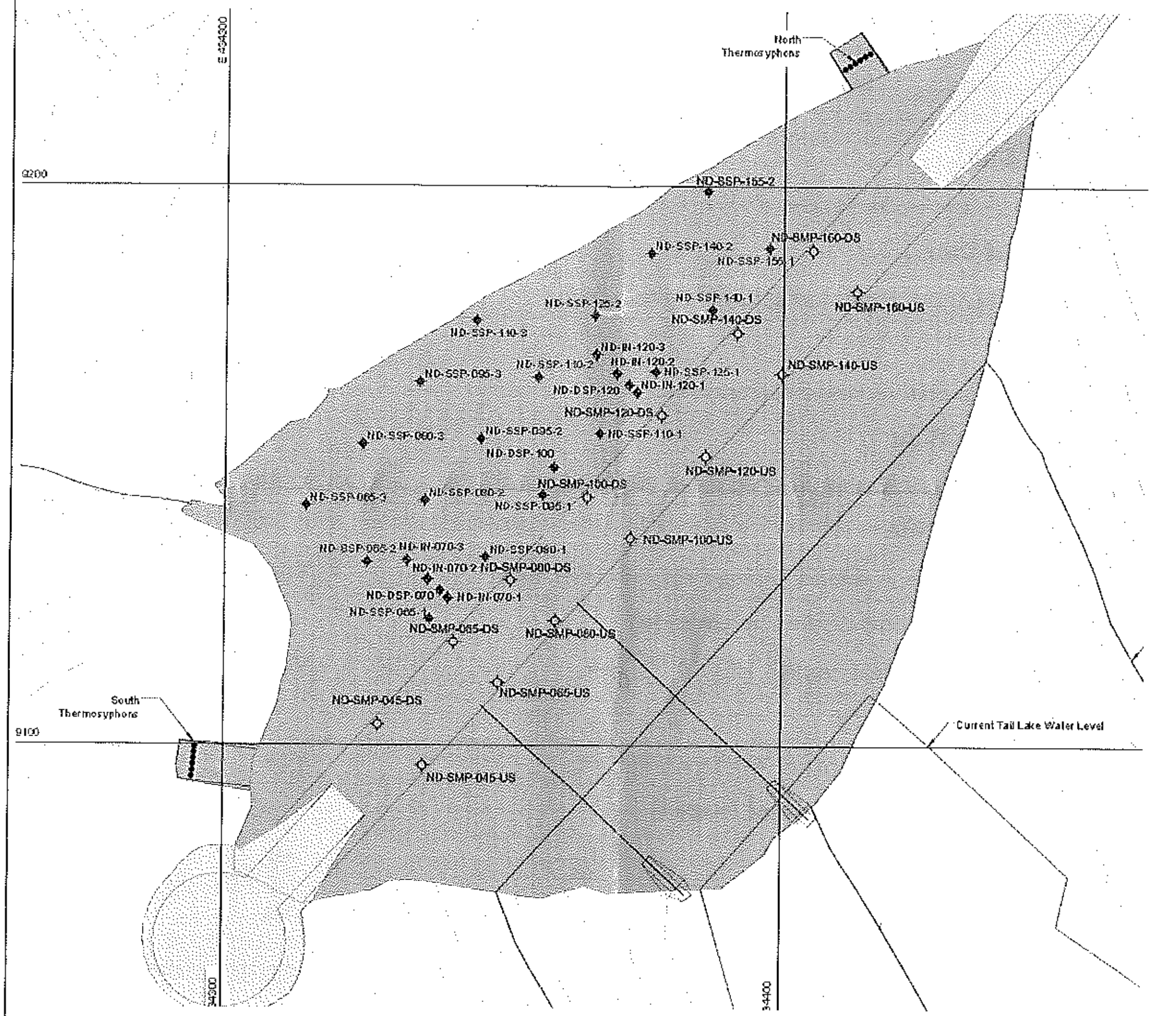
Visual Inspection:

This weekly walkover survey report is a means to track the condition on the North Dam, please provide details on changes that have developed since the previous inspection and/or any observations of particular concern. All photos are appreciated. Please send the completed form (scans are fine) and any photos to hopebaymonitoring@srk.com and pluedke@srk.com

Upstream Side of Dam Any visible concerns? (cracks, depressions, erosion, etc.)	Yes [✓ No]
Downstream Side of Dam Any visible concerns? (cracks, depressions, erosion, seepage, etc.)	Yes [✓ No]
Crest of Dam Any visible concerns? (cracks, depressions, erosion, etc.)	Yes [✓ No]
Thermosyphons North Side Any visible concerns? (cracks, punctures, peeling paint, bird's nests, etc.)	Yes [✓ No]
Thermosyphons South Side Any visible concerns? (cracks, punctures, peeling paint, birds nests, etc.)	Yes [✓ No]
Instrumentation (on crest and downstream side) Any visible concerns? (bent, rusted, cracked, etc.)	Yes [✓ No]
Thermistors and Dataloggers Any visible concerns? (frayed or cut cables, damaged boxes, etc.)	Yes [✓ No]
Suspended Sediment in TIA (When not frozen) Any suspended sediment in Tail Lake?	Yes [✓ No]
Water at the Toe of the Downstream Side of the Dam (If yes refer to Doris North – North Dam and Tail Lake Outflow Seepage Monitoring Work Plan 2015)	Yes [✓ No]

If you answered yes to any of the questions above please provide details and photos. Observations can be sketched on the figure provided on the next page. If seepage has been noted please estimate the flow.

Please provide any other observations you have made or items that did not fit in the space above



Photos:

Please collect the following photos:

Photo from north end looking south along the dam	☑
Photo from south end looking north along the dam	☑

Other photos, please describe – Photos taken

North Dam Weekly Walkover Survey Report

Date:	November 8, 2019
Inspected By:	MIKE TANASA
Conditions:	(ie. snow on ground, clear) SNOW

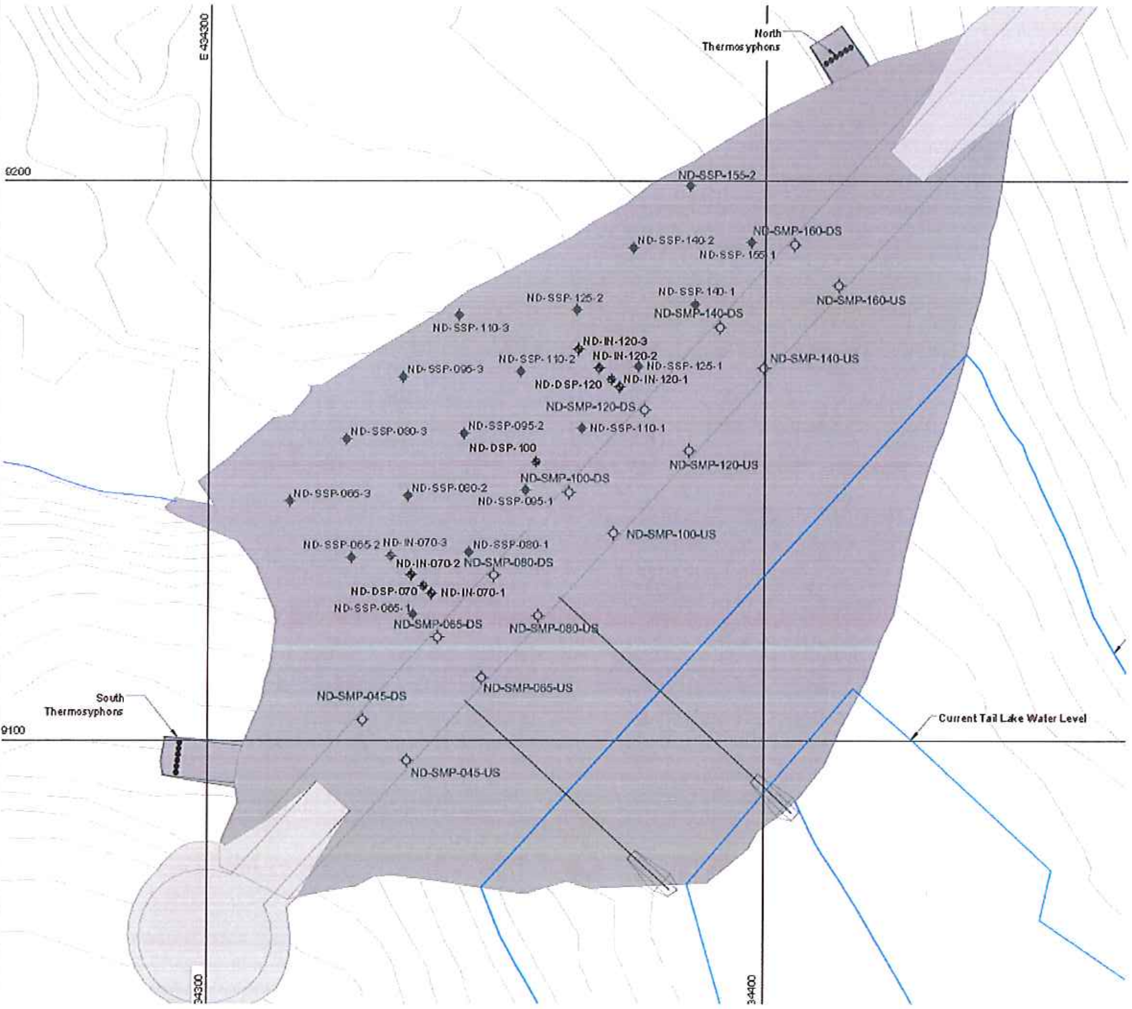
Visual Inspection:

This weekly walkover survey report is a means to track the condition on the North Dam, please provide details on changes that have developed since the previous inspection and/or any observations of particular concern. All photos are appreciated. Please send the completed form (scans are fine) and any photos to hopebaymonitoring@srk.com and pluedke@srk.com

Upstream Side of Dam Any visible concerns? (cracks, depressions, erosion, etc.)	Yes	[✓ No]
Downstream Side of Dam Any visible concerns? (cracks, depressions, erosion, seepage, etc.)	Yes	[✓ No]
Crest of Dam Any visible concerns? (cracks, depressions, erosion, etc.)	Yes	[✓ No]
Thermosyphons North Side Any visible concerns? (cracks, punctures, peeling paint, birds nests, etc.)	Yes	[✓ No]
Thermosyphons South Side Any visible concerns? (cracks, punctures, peeling paint, birds nests, etc.)	Yes	[✓ No]
Instrumentation (on crest and downstream side) Any visible concerns? (bent, rusted, cracked, etc.)	Yes	[✓ No]
Thermistors and Dataloggers Any visible concerns? (frayed or cut cables, damaged boxes, etc.)	Yes	[✓ No]
Suspended Sediment in TIA (When not frozen) Any suspended sediment in Tail Lake?	Yes	[✓ No]
Water at the Toe of the Downstream Side of the Dam (If yes refer to Doris North – North Dam and Tail Lake Outflow Seepage Monitoring Work Plan 2015)	Yes	[✓ No]

If you answered yes to any of the questions above please provide details and photos. Observations can be sketched on the figure provided on the next page. If seepage has been noted please estimate the flow.

Please provide any other observations you have made or items that did not fit in the space above



Photos:

Please collect the following photos:

Photo from north end looking south along the dam ☑

Photo from south end looking north along the dam ☑

Other photos, please describe – Photos taken

North Dam Weekly Walkover Survey Report

Date:	NOV. 15 2019
Inspected By:	MIKE TAMASA
Conditions:	(ie. snow on ground, clear) SNOW

Visual Inspection:

This weekly walkover survey report is a means to track the condition on the North Dam, please provide details on changes that have developed since the previous inspection and/or any observations of particular concern. All photos are appreciated. Please send the completed form (scans are fine) and any photos to hopebaymonitoring@srk.com and pluedke@srk.com

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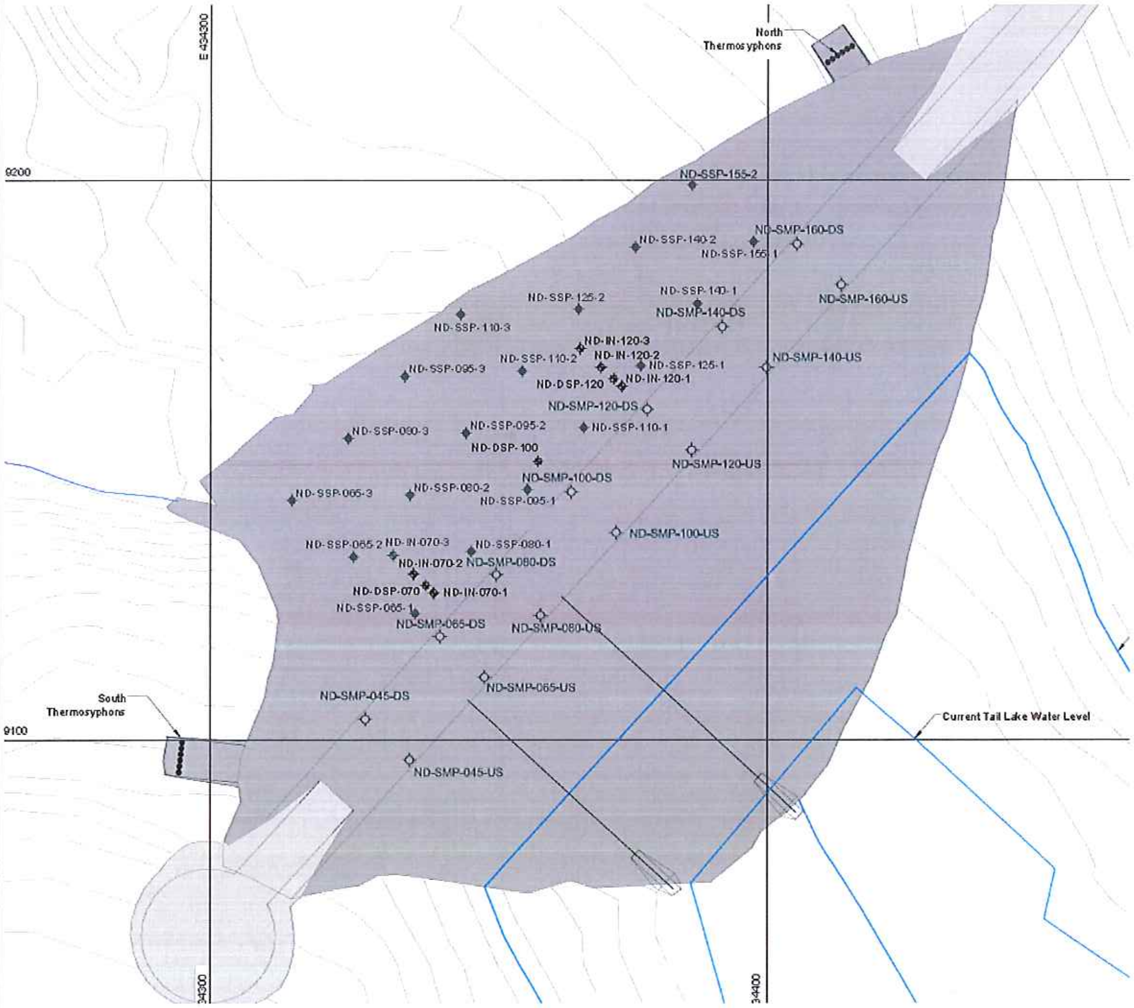
Downstream Side of Dam Any visible concerns? (cracks, depressions, erosion, seepage, etc.)	Yes	[✓ No]
Crest of Dam Any visible concerns? (cracks, depressions, erosion, etc.)	Yes	[✓ No]
Thermosyphons North Side Any visible concerns? (cracks, punctures, peeling paint, birds nests, etc.)	Yes	[✓ No]
Thermosyphons South Side Any visible concerns? (cracks, punctures, peeling paint, birds nests, etc.)	Yes	[✓ No]
Instrumentation (on crest and downstream side) Any visible concerns? (bent, rusted, cracked, etc.)	Yes	[✓ No]
Thermistors and Dataloggers Any visible concerns? (frayed or cut cables, damaged boxes, etc.)	Yes	[✓ No]
Suspended Sediment in TIA (When not frozen) Any suspended sediment in Tail Lake?	Yes	[✓ No]
Water at the Toe of the Downstream Side of the Dam (If yes refer to Doris North – North Dam and Tail Lake Outflow Seepage Monitoring Work Plan 2015)	Yes	[✓ No]

If you answered yes to any of the questions above please provide details and photos. Observations can be sketched on the figure provided on the next page. If seepage has been noted please estimate the flow.

Please provide any other observations you have made or items that did not fit in the space above



Photos:

Please collect the following photos:

Photo from north end looking south along the dam ☑

Photo from south end looking north along the dam ☑

Other photos, please describe – Photos taken

TMAC RESOURCES

North Dam Weekly Walkover Survey Report

Date:	NOV. 24. 2019
Inspected By:	MIKE TAMASA
Conditions:	(ie. snow on ground, clear) SNOW – COOLD AS IN THE ARCTIC!

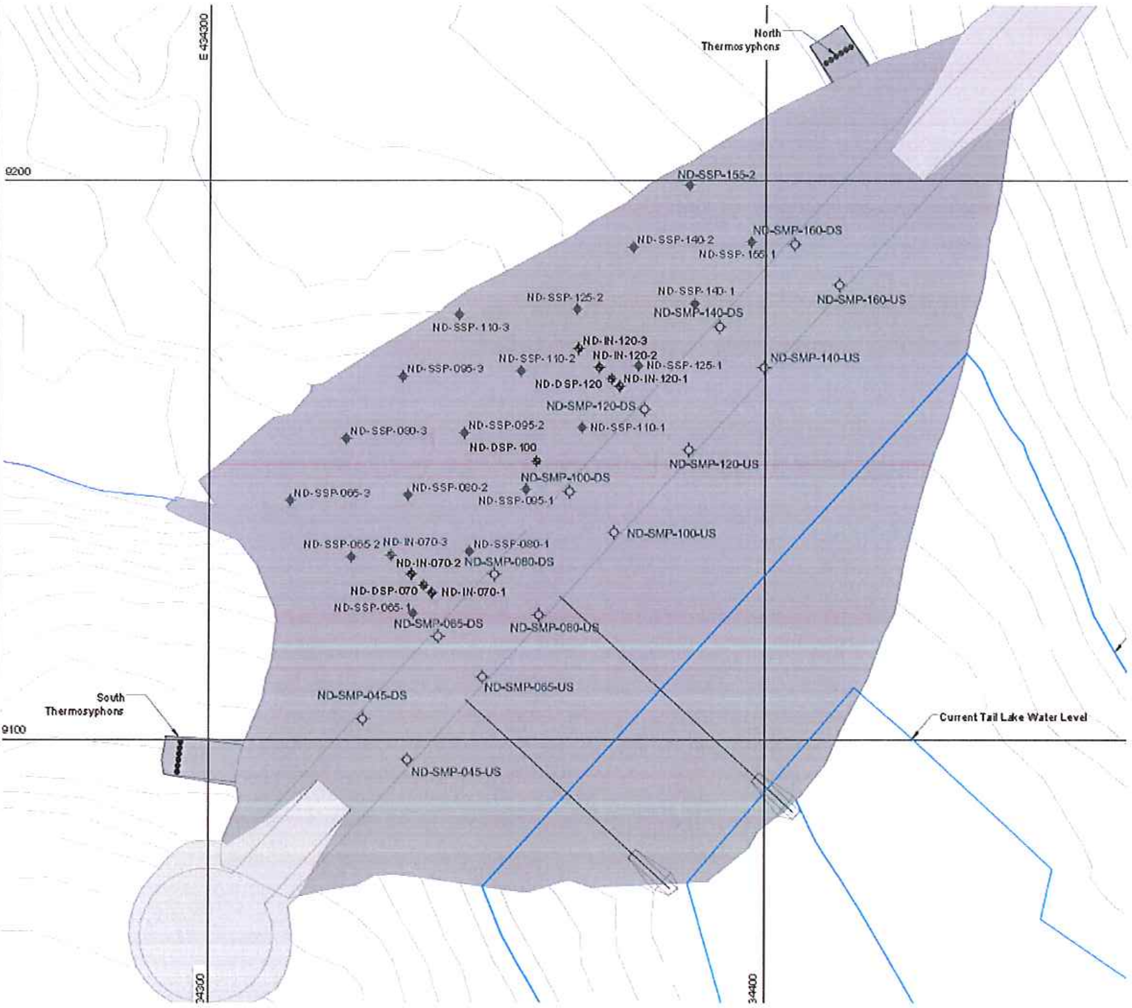
Visual Inspection:

This weekly walkover survey report is a means to track the condition on the North Dam, please provide details on changes that have developed since the previous inspection and/or any observations of particular concern. All photos are appreciated. Please send the completed form (scans are fine) and any photos to hopebaymonitoring@srk.com and pluedke@srk.com

Upstream Side of Dam Any visible concerns? (cracks, depressions, erosion, etc.)	Yes	[✓ No]
Downstream Side of Dam Any visible concerns? (cracks, depressions, erosion, seepage, etc.)	Yes	[✓ No]
Crest of Dam Any visible concerns? (cracks, depressions, erosion, etc.)	Yes	[✓ No]
Thermosyphons North Side Any visible concerns? (cracks, punctures, peeling paint, birds nests, etc.)	Yes	[✓ No]
Thermosyphons South Side Any visible concerns? (cracks, punctures, peeling paint, birds nests, etc.)	Yes	[✓ No]
Instrumentation (on crest and downstream side) Any visible concerns? (bent, rusted, cracked, etc.)	Yes	[✓ No]
Thermistors and Dataloggers Any visible concerns? (frayed or cut cables, damaged boxes, etc.)	Yes	[✓ No]
Suspended Sediment in TIA (When not frozen) Any suspended sediment in Tail Lake?	Yes	[✓ No]
Water at the Toe of the Downstream Side of the Dam (If yes refer to Doris North – North Dam and Tail Lake Outflow Seepage Monitoring Work Plan 2015)	Yes	[✓ No]

If you answered yes to any of the questions above please provide details and photos. Observations can be sketched on the figure provided on the next page. If seepage has been noted please estimate the flow.

Please provide any other observations you have made or items that did not fit in the space above



Photos:

Please collect the following photos:

- Photo from north end looking south along the dam ☐
- Photo from south end looking north along the dam ☐

Other photos, please describe – Photos taken

TMAC RESOURCES

North Dam Weekly Walkover Survey Report

Date:	Dec 4, 2019
Inspected By:	Josh Fris
Conditions:	(ie. snow on ground, clear) Snow

Visual Inspection:

This weekly walkover survey report is a means to track the condition on the North Dam, please provide details on changes that have developed since the previous inspection and/or any observations of particular concern. All photos are appreciated. Please send the completed form (scans are fine) and any photos to hopebaymonitoring@srk.com and pluedke@srk.com

Upstream Side of Dam Any visible concerns? (cracks, depressions, erosion, etc.)	Yes	[✓ No]
Downstream Side of Dam Any visible concerns? (cracks, depressions, erosion, seepage, etc.)	Yes	[✓ No]
Crest of Dam Any visible concerns? (cracks, depressions, erosion, etc.)	Yes	[✓ No]
Thermosyphons North Side Any visible concerns? (cracks, punctures, peeling paint, birds nests, etc.)	Yes	[✓ No]
Thermosyphons South Side Any visible concerns? (cracks, punctures, peeling paint, birds nests, etc.)	Yes	[✓ No]
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Thermistors and Dataloggers Any visible concerns? (frayed or cut cables, damaged boxes, etc.)	Yes	[✓ No]
Suspended Sediment in TIA (When not frozen) Any suspended sediment in Tail Lake?	Yes	[✓ No]
Water at the Toe of the Downstream Side of the Dam (If yes refer to Doris North – North Dam and Tail Lake Outflow Seepage Monitoring Work Plan 2015)	Yes	[✓ No]

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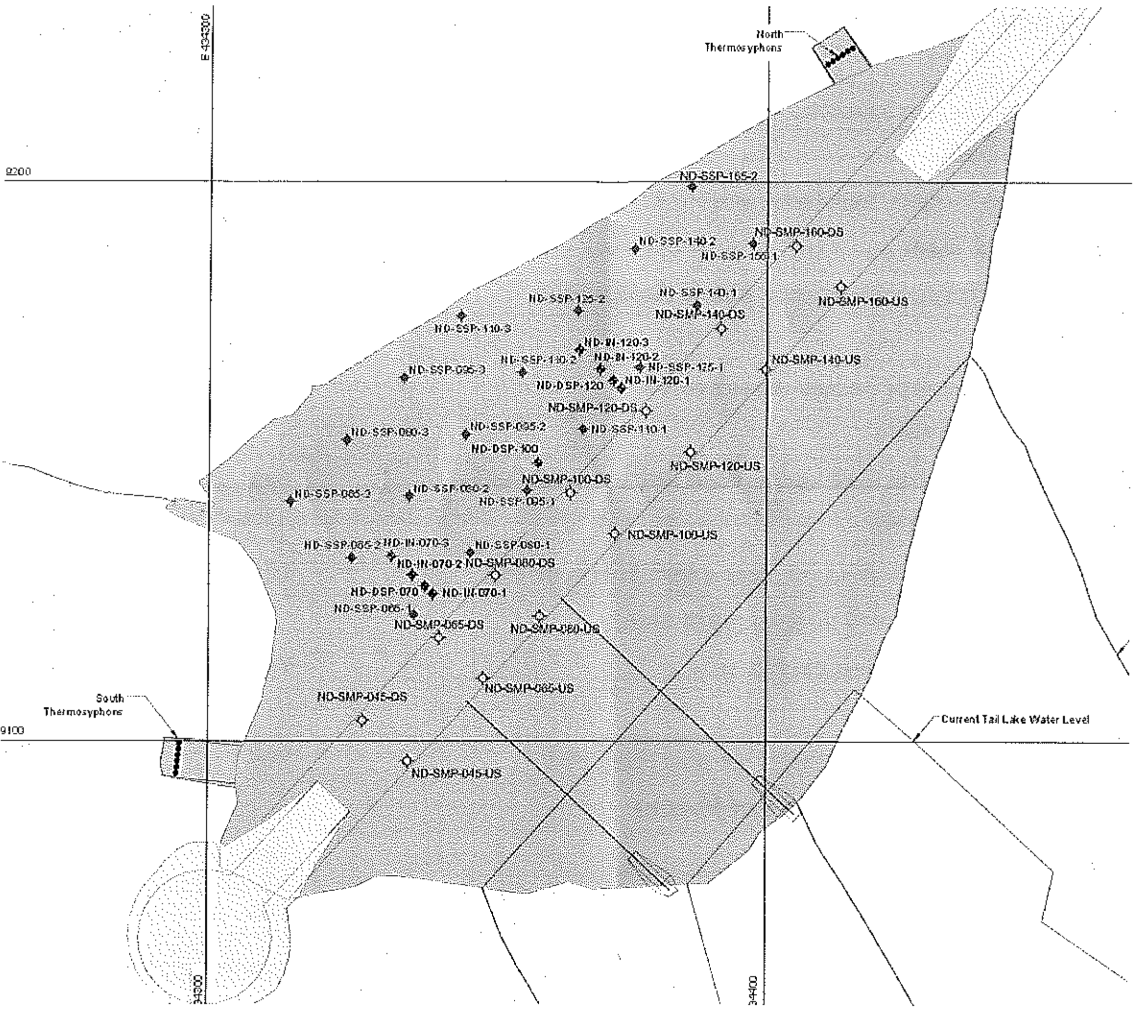
Please provide any other observations you have made or items that did not fit in the space above



Photos:

Please collect the following photos:
Photo from north end looking south along the dam ☑
Photo from south end looking north along the dam ☑

Other photos, please describe – Photos taken

North Dam Weekly Walkover Survey Report

Date:	Dec. 25. 2019
Inspected By:	MIKE TAHASA
Conditions:	(ie. snow on ground, clear) SNOW

Visual Inspection:

This weekly walkover survey report is a means to track the condition on the North Dam, please provide details on changes that have developed since the previous inspection and/or any observations of particular concern. All photos are appreciated. Please send the completed form (scans are fine) and any photos to hopebaymonitoring@srk.com and pluedke@srk.com

Upstream Side of Dam Any visible concerns? (cracks, depressions, erosion, etc.)	Yes	[✓ No]
Downstream Side of Dam Any visible concerns? (cracks, depressions, erosion, seepage, etc.)	Yes	[✓ No]
Crest of Dam Any visible concerns? (cracks, depressions, erosion, etc.)	Yes	[✓ No]
Thermosyphons North Side Any visible concerns? (cracks, punctures, peeling paint, birds nests, etc.)	Yes	[✓ No]
Thermosyphons South Side Any visible concerns? (cracks, punctures, peeling paint, birds nests, etc.)	Yes	[✓ No]
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Thermistors and Dataloggers Any visible concerns? (frayed or cut cables, damaged boxes, etc.)	Yes	[✓ No]
Suspended Sediment in TIA (When not frozen) Any suspended sediment in Tail Lake?	Yes	[✓ No]
Water at the Toe of the Downstream Side of the Dam (If yes refer to Doris North – North Dam and Tail Lake Outflow Seepage Monitoring Work Plan 2015)	Yes	[✓ No]

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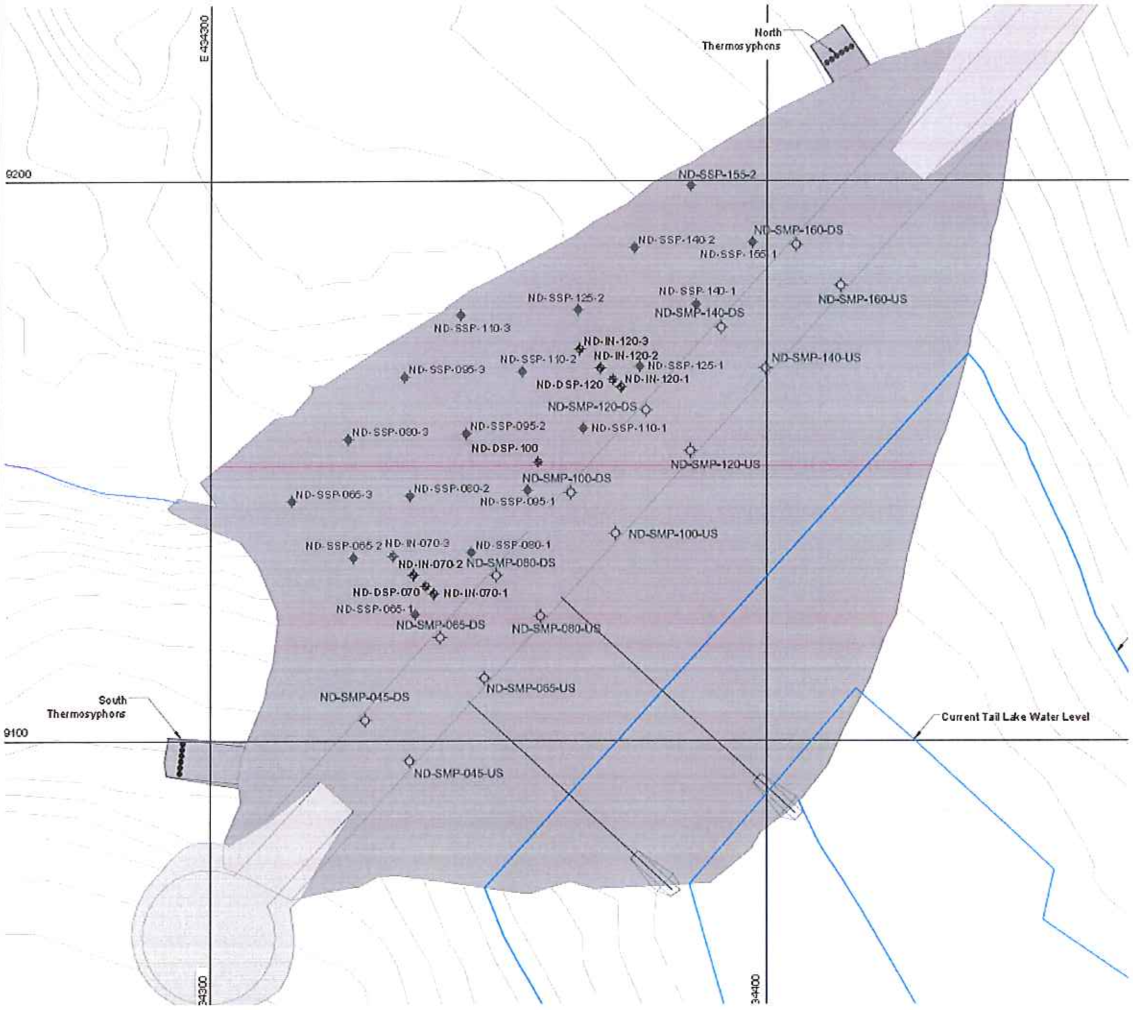


Photos:

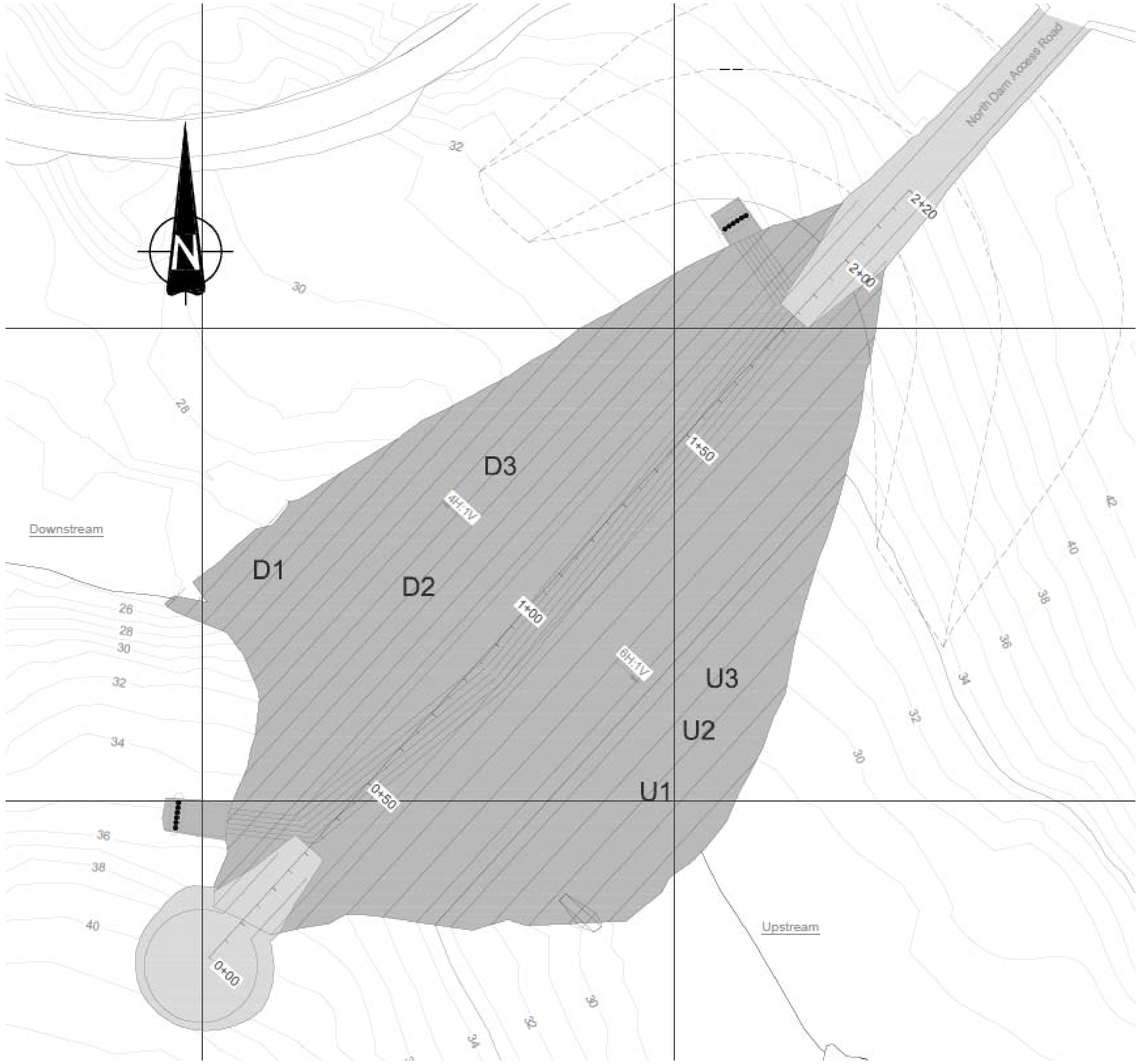
Please collect the following photos:

Photo from north end looking south along the dam ☑

Photo from south end looking north along the dam ☑

Other photos, please describe – Photos taken

Appendix H – Depression Monitoring



DEPRESSION TRACKING

ID	Location	Comments	Northing	Easting
U1	Upstream	First noted June 2014	7559104	434393
		Boundaries spray painted and ID given July 2014		
		No substantial changes from previous inspection		
U2	Upstream	First noted June 2014	7559117	434402
		Boundaries spray painted and ID given July 2014		
		No substantial changes from previous inspection		
U3	Upstream	First noted June 2014	7559128	434407
		Boundaries spray painted and ID given July 2014		
		July 4, 2015 - Expanding toward U2		
		No substantial changes from previous inspection		
D1	Downstream	Identified during 2014 annual geotechnical inspection, spray painted and given ID.	7559151	434311
		September 1, 2014 - expanded towards the south		
		September 20, 2014 - TMAC ESR noted the depression looks to have expanded, paint mark updated.		
		July 4, 2015 - Slight expansion toward the crest was noted in the daily report		
		No substantial changes from previous inspection		
D2	Downstream	First noted in 2013 Annual Geotechnical Inspection	7559147	434344
		September 14, 2014 - TMAC ESR noted that the depression may have expanded slightly		
		No substantial changes from previous inspection		
D3	Downstream	First noted in 2013 Annual Geotechnical Inspection	7559173	434360
		August 10, 2014 - larger area marked		
		No substantial changes from previous inspection		

Notes:

1. Depression locations are based on hand held GPS measurements, accuracy is at best +/- 4 m.
2. Other small depressions were removed from the tracking system in 2016. Only significant depression were carried forward from the 2016 Annual Inspection.

Job No: 1CT022.038
Filename: AppH_ND_AGI_DepressionTracking.pptx

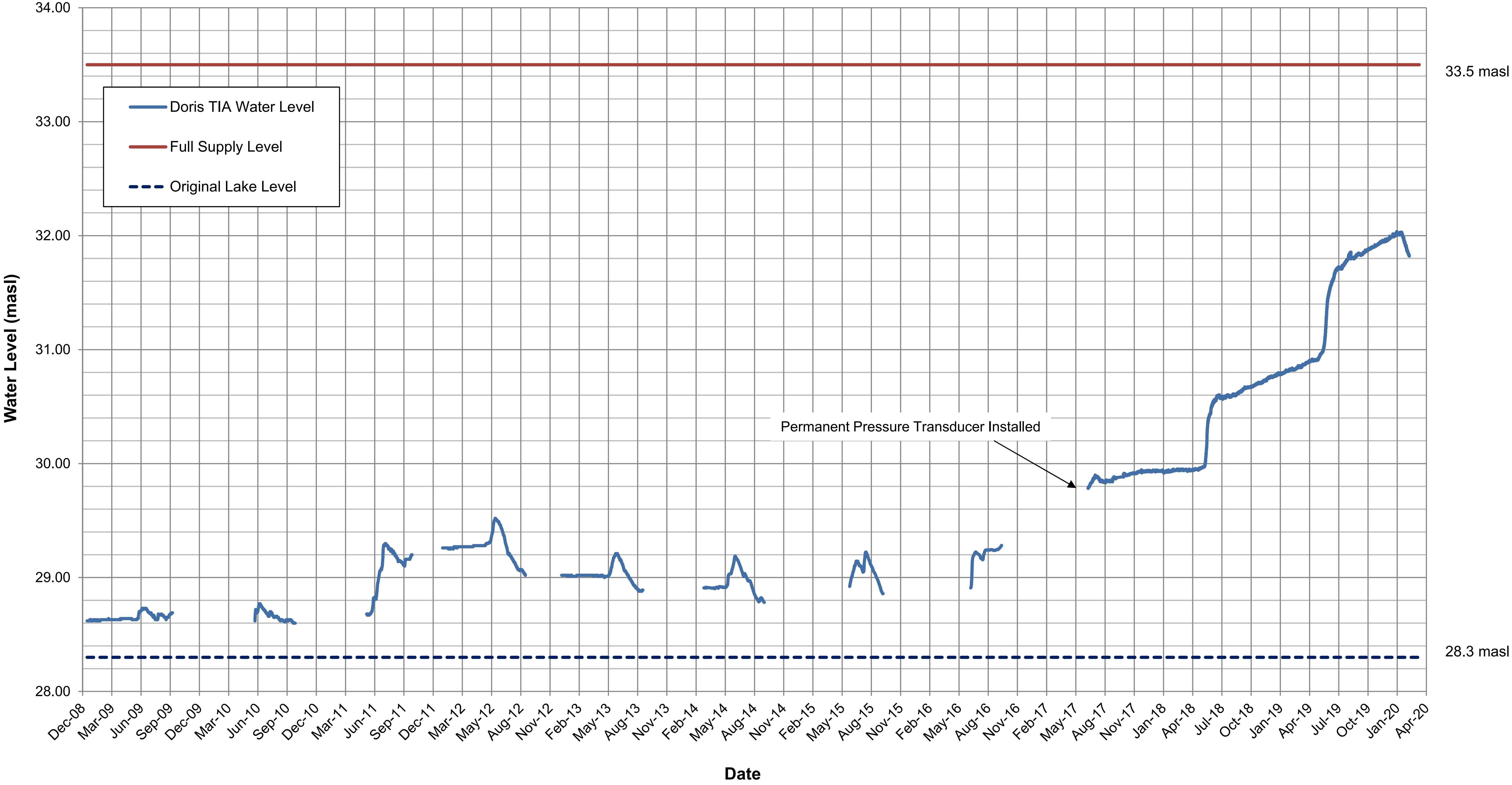
DORIS TIA

2019 AGI - North Dam

Historic Depression Summary

Date: Mar. 2020
Approved: PDL
Figure: **H.1**

Appendix I – TIA Water Levels



Notes:

- Water level collected by permanent pressure transducer installed Summer 2017

srk consulting

MAC RESOURCES

2019 AGI

TIA Reclaim Pond Water Level

Job No: 1CT022.038

Filename: AppendixI_WaterLevel.pptx

DORIS TIA

Date: Feb. 2020

Approved: AB

Figure: **I.1**

SRK Consulting (Canada) Inc.
2200–1066 West Hastings Street
Vancouver, BC V6E 3X2

T: +1.604.681.4196
F: +1.604.687.5532
vancouver@srk.com
www.srk.com

Memo

To:	Oliver Curran, Vice-President Environment Ashley Mathai, Environmental Engineer	**Client:**	TMAC Resources Inc.
From:	Andrea Bowie, PEng John Kurylo, PEng	**Project No:**	1CT022.045
Cc:	Cameron Hore, PEng	**Date:**	August 16, 2019
Subject:	Hope Bay – Doris TIA 2020 Water Level Targets		

1 Introduction

The Doris Tailings Impoundment Area (TIA) is the primary water management facility at the Hope Bay Project. The TIA is the sole reservoir available for long term storage of tailings, as well as contact and mine water (if / as needed). The Doris TIA is impounded by two dams; North Dam and South Dam. A key operating criterion of the TIA is the water level. This memo provides the operating maximum target water level targets for 2020. These targets are continuously reviewed by the Engineer of Record (John Kurylo) and may be updated at any time. If changes are made, they will be formally communicated to TMAC in similar form (memo or formal email).

As discussed in Section 4, the TIA is not expected to have an operational discharge system until October 2019 or later. Therefore, water level targets have not been set for 2019, as there is no mechanism to control the water level.

SRK developed an operational water balance for the TIA which is described in a separate dedicated memorandum (SRK 2019). This operational water balance has been utilized to assess various scenarios and forecasts which in turn were used to set the operating targets for 2020.

Details of the water management strategy for the site are provided in the approved water management plan (SRK 2017).

2 Water Level Targets

The following levels are considered maximum operational water levels for the TIA in 2020:

- ***May 31, 2020 (Pre-freshet): 31.5 m***
- ***September 30, 2020 (Pre-freeze-up): 31.0 m***

The water level targets for the TIA are set for two key annual points;

- **Pre-freshet (considered as the end of May)**
  - The majority of inflow occurs during freshet and therefore it is important to have the TIA water level prior to freshet sufficiently low such that the water level rise during freshet will not adversely impact the facility.
- **Pre-freeze-up (considered as the end of September)**
  - The primary discharge period is the open water season from June to September. It is important to effectively utilize this period of discharge to prepare for the winter where discharge is not anticipated to be required. This target is set based on prediction over the winter and for the following freshet, such that no pre-freshet discharge is required. In other words, this target is aimed to have the water level such that without winter discharge, the pre-freshet water level for the following year should be met.

These targets are continuously reviewed and may be updated at any time. At a minimum annual frequency, TMAC will be updated on the target water levels.

3 TIA Operating Criteria

The operating criteria for the TIA are detailed in the Operations, Maintenance and Surveillance (OMS) Manual (SRK 2017).

The key criteria which are relevant to setting the operating water level targets are provided below. The operating water level targets are set to minimise the risk of ever exceeding these criteria.

- **Full Supply Level (FSL) of 33.5 m**
  - The FSL is the maximum permissible operating water level for the TIA and is governed by the North Dam. Above this level the TIA is out of compliance with the Canadian Dam Association (CAD) guidelines. The FSL will also be reviewed (at least annually) to check that the existing volume of deposited tailings has not impacted the elevation required to be available to store the design storm event (as set by the CDA guidelines).
- **South Dam beach length of 100 m**
  - The South Dam is designed and constructed as a tailings retaining dam not a water retaining dam and as such has a minimum required tailings beach length, from the upstream dam slope to the TIA pond, that must be maintained. The current beach slope of the tailings is approximately 1% and therefore this criterion can be approximated by ensuring the water level is at least 1 m lower than the minimum beach elevation at the South Dam.

Based on the current beach level at the South Dam (33 m) the water level must currently be maintained below 32 m.

The current water level is expected to reach 32 m towards the end of 2019 which is why it is imperative that the deposition continues from the South Dam to further develop the tailings beach to as high an elevation as possible. Note that once freeze-up / winter conditions result on site the tailings discharge was planned to be moved to one location that will be used all winter. This one location would be use, and not moved around, to limit ice entrainment in the TIA. Additional details and the preferred winter tailings deposition location will be provided in September 2019 (before freeze-up). The expected winter tailings deposition location will also be discussed on site with the mill personnel as part of the 2019 TIA Annual Geotechnical Inspection (AGI).

In addition to the above noted key criteria, it is important to note that water in the TIA places thermal and pressure loading on the frozen core of the North Dam. The higher the water level in the TIA the higher these loadings are. This leads to increased deformation and degradation of the frozen core and ultimately reduces the service life of the structure. Therefore, where practical water levels should be minimised to increase the service life of the North Dam. This is why the target operating levels are defined as maximums. Operating below these levels, within practical limits, is recommended.

4 Current (July 2019) Scenario and Assumptions

The following points summarise the current scenario and assumptions for the TIA (as of the end of July 2019):

- The measured TIA water level is 31.7 m.
- The Roberts Bay Discharge System (RBDS) is not installed or operational; therefore, no discharge is currently possible.
  - The RBDS is planned to be operational in October 2019 for both Mine Water direct from the Doris Mine to Roberts Bay and for discharge of TIA water from the reclaim pond.
  - For forecasting purposes SRK have considered the full RBDS to be operational at 80% availability from January 1, 2020 onwards or, for comparison purposes, from June 2020 onwards.
- After 2020 all years are considered to discharge only during open water season (June-September).
- The tailings beach at the South Dam is at approximately 33 m and the tailings beach is at approximately 1%. Deposition is occurring from the South Dam now (in the ice-free months).
- Mine Water is being discharged to the TIA at a rate of approximately 880 m^3/day[1] with an increasing trend.
- A Mine Water TSS treatment plant has been procured and is planned to be operational in October 2019. This is intended to enable direct discharge of Mine Water to Roberts Bay within the MDMER limits. During periods of mine water discharge, for conservatism in the

---

[1] June 2019 daily average provided in monthly reporting from TMAC

scenario assessment it is assumed that 10% of the mine water is directed to the TIA and 90% is discharged directly to Roberts Bay.

- The Doris Process Plant has a throughput of approximately 2,400 tonnes per day.

5 Operating Water Balance Scenarios

The following key scenarios have been analysed using the Operational Water Balance, to aid in setting the operating target water levels and to asses the required actions to meet the targets. Details (the control panel) for each scenario are provided in Attachment 2 for reference.

The scenarios considered three variables:

- When the Mine water first commences discharge to Roberts Bay, January 2020 or June 2020
- When the TIA discharge first goes to Roberts Bay, January 2020 or June 2020
- The climate - either average conditions or 1:100 wet conditions (applied to all years)

The range of scenarios assessed and presented is provided in Table 1.

Table 1: Operating Water Balance Scenarios Presented

Scenario	Mine Water to Roberts Bay from:	TIA Discharge to Roberts Bay from:	Climate
1	January 2020	January 2020	average
2	June 2020	June 2020	average
3	January 2020	June 2020	average
4	June 2020	January 2020	average
5	January 2020	January 2020	wet
6	June 2020	June 2020	wet
7	January 2020	June 2020	wet
8	June 2020	January 2020	wet

For example:

- *Scenario 1* considers the full system to become operational in January 2020. Both Mine Water and TIA water are discharged to Roberts Bay from January 2020. Mine Water is then continuously discharged to Roberts Bay with 10% reporting to the TIA for upset conditions. TIA water is discharged from January to September in 2020 and then each open water season (June – September) for each following year. All years are considered to have average climatic conditions.
- *Scenario 7* considers the Mine Water discharge system to become operational in January 2020 and the TIA discharge system to become operational in June 2020. Mine Water is then continuously discharged to Roberts Bay with 10% reporting to the TIA for upset conditions.

TIA water is discharged from June to September in 2020 and then each open water season (June – September) for each following year. All years are considered to have wet (1:100) climatic conditions.

The water level plots (for the scenarios outlined in Table 1) are presented in Attachment 1. Plot 1 presents the four scenarios with average climatic conditions (Scenarios 1-4). Plot 2 presents the same scenarios for wet climatic conditions (Scenarios 5-8).

5.1 Discussion

To reach the defined operating target levels the RBDS must be operational in January 2020, with both Mine Water and TIA discharge commencing in January 2020 as shown on Plot 1 (Scenario 1) - considering average climatic conditions.

If TIA discharge does not commence until June 2020 the TIA operating criteria will be exceeded and the integrity of the South Dam will be at risk as shown on Plot 1 (Scenarios 2 and 3) – considering average climatic conditions.

Plot 2 demonstrates that under wet climatic conditions the TIA operating criteria will be exceeded, and the integrity of the South Dam will be at risk for all scenarios. Under these conditions it is even more critical that the RBDS be operational in January 2020, with both Mine Water and TIA discharge commencing in January 2020.

6 Conclusions

Based on the current beach level at the South Dam (33 m) the water level must be maintained below 32 m. This is the current governing water level criteria to protect the integrity of the South Dam.

The following levels are considered maximum water levels for the TIA in 2020:

- May 31, 2020 (Pre-freshet): 31.5 m
- September 30, 2020 (Pre-freeze-up): 31.0 m

To reach the defined operating target levels the RBDS must be operational in January 2020; with both Mine Water and TIA discharge commencing in January 2020.

If the RBDS is not operational in January 2020, additional mitigation measures to protect the integrity of the South Dam will be required.

7 References

SRK Consulting Canada Inc (SRK). 2019. Doris Mine Annual Water and Load Balance Assessment – 2018 Calendar Year. Memo prepared for TMAC Resources. March 19, 2019.

SRK Consulting Canada Inc (SRK). 2017. Operations, Maintenance and Surveillance Manual: Hope Bay Project, Phase 2, Doris Tailings Impoundment Area. Manual prepared for TMAC Resources. November 2017.

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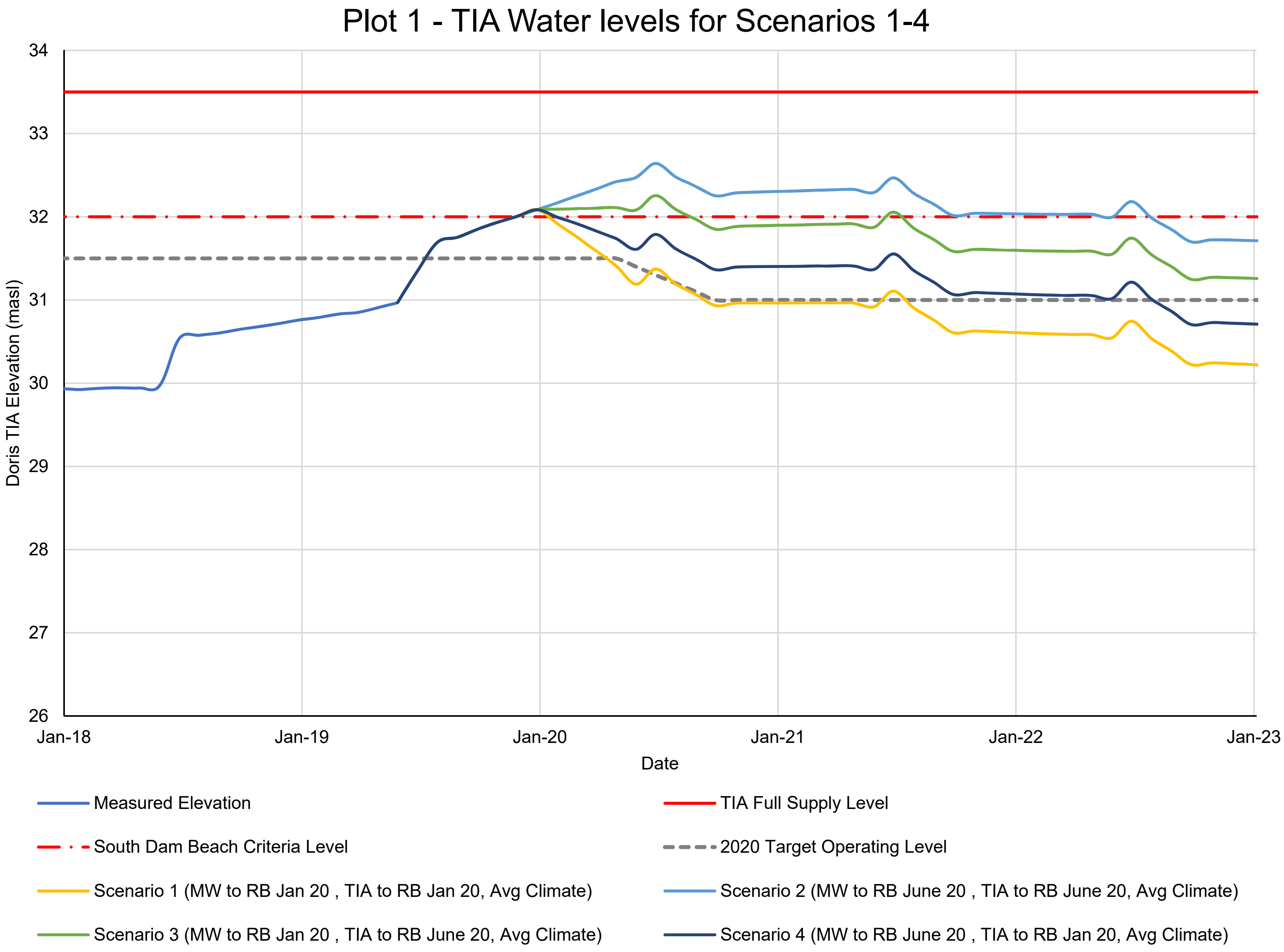
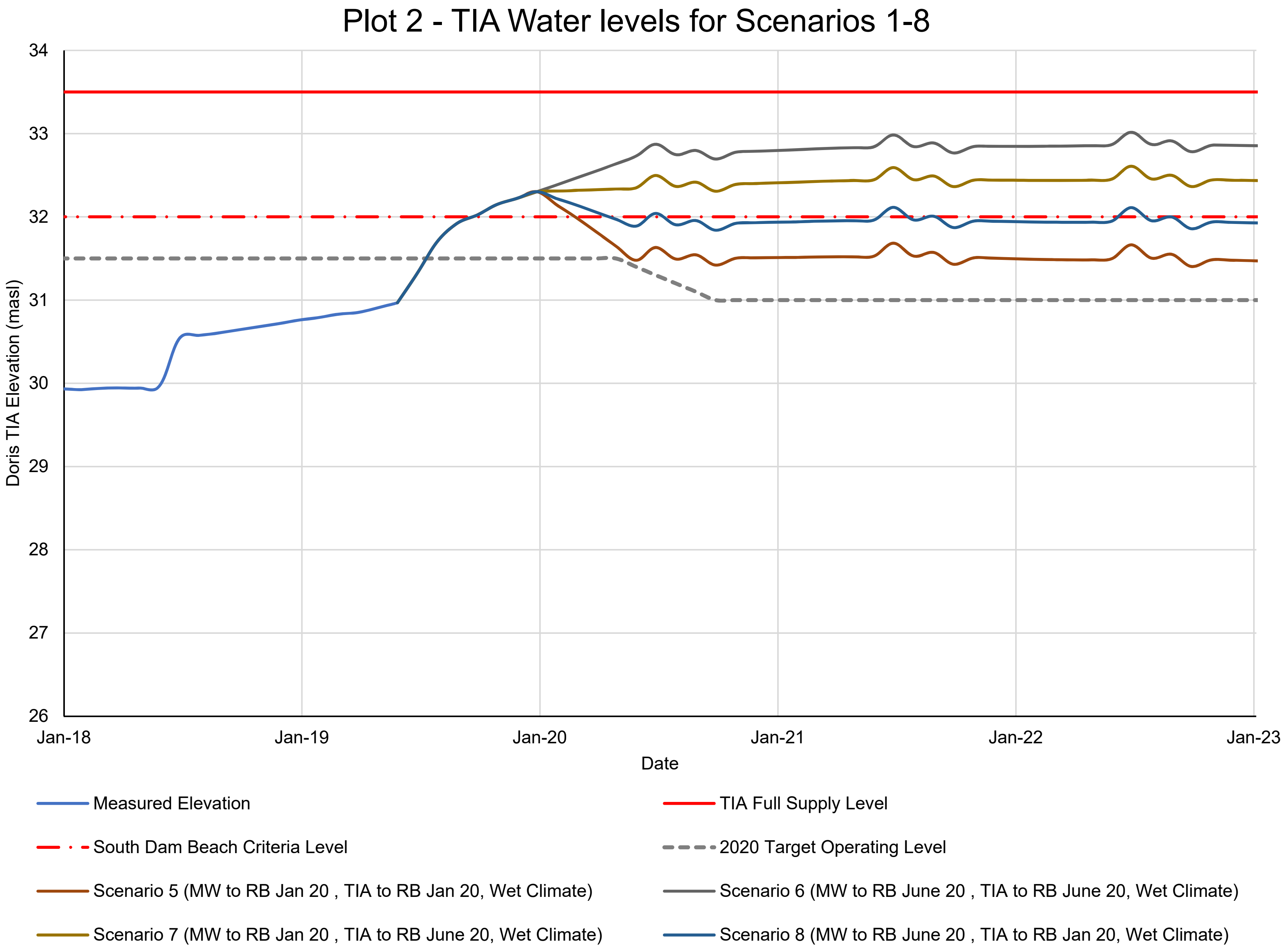
Attachment 1 – Water Level Plots


Plot 1 - TIA Water levels for Scenarios 1-4
Doris TIA Elevation (masl)
34
33
32
31
30
29
28
27
26
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Date
Measured Elevation
TIA Full Supply Level
South Dam Beach Criteria Level
2020 Target Operating Level
Scenario 1 (MW to RB Jan 20 , TIA to RB Jan 20, Avg Climate)
Scenario 2 (MW to RB June 20 , TIA to RB June 20, Avg Climate)
Scenario 3 (MW to RB Jan 20 , TIA to RB June 20, Avg Climate)
Scenario 4 (MW to RB June 20 , TIA to RB Jan 20, Avg Climate)


Plot 2 - TIA Water levels for Scenarios 1-8
Doris TIA Elevation (masl)
34
33
32
31
30
29
28
27
26
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Date
Measured Elevation
TIA Full Supply Level
South Dam Beach Criteria Level
2020 Target Operating Level
Scenario 5 (MW to RB Jan 20 , TIA to RB Jan 20, Wet Climate)
Scenario 6 (MW to RB June 20 , TIA to RB June 20, Wet Climate)
Scenario 7 (MW to RB Jan 20 , TIA to RB June 20, Wet Climate)
Scenario 8 (MW to RB June 20 , TIA to RB Jan 20, Wet Climate)

Attachment 2 – Operating Water Balance Scenarios

Project **Hope Bay**
Project Nu **1CT022-036**
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.1 Hydrology

Action: *Select Annual Return Period for green cells*

Year	Return Period
2016	Average
2017	Average
2018	Average
2019	Average
2020	Average
2021	Average
2022	Average
2023	Average

Section 2.5.1 Load Balance

Action: *Select Predictive Source Term*

Source Term: Base Case

Source Term Options

Upper Case
Base Case

Section 2.4.2 Mine Water

Action: *Select the future mine water curves*

Options	Description
1	Groundwater Model Curve
2	Adjusted Groundwater Curve to Start from todays observed flows
3	User Input

Action: None, list option for selecting where Mine Water will be directed

Options	Description
1	Doris TIA
2	Roberts Bay

Table M.3 Volume of Mine Water pumped to Doris TIA (via SCP/pumpbox) (m^3/month)

Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	40,300	8,990	7,831	7,332	3,491	3,649
2	47,600	8,410	6,776	6,650	3,186	3,419
3	65,100	8,990	7,499	7,400	3,553	3,652
4	75,000	9,006	6,345	7,173	3,468	3,534
5	77,500	9,337	7,006	7,425	3,602	3,652
6	75,000	9,078	6,411	2,571	3,498	3,534
7	372,000	9,415	6,792	2,868	3,621	3,652
8	40,300	8,820	6,938	3,019	3,636	3,655
9	51,000	8,553	6,807	3,051	3,522	3,537
10	65,100	8,246	7,121	3,271	3,646	3,652
11	75,000	8,043	6,978	3,255	3,531	3,531
12	86,800	7,812	7,276	3,432	3,655	3,643

Table M.1 Volume of Doris Mine Water pumped to Surface (m^3/day)

Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,300	2,900	2,400	1,700		
2	1,700	2,900	2,300	1,700		
3	2,100	2,900	2,300	1,700		
4	2,500	3,000	2,000	1,700		
5	2,500	3,000	2,000	1,700		
6	2,500	3,000	1,700			
7	12,000	3,000	1,700			
8	1,300	2,800	1,700			
9	1,700	2,800	1,700			
10	2,100	2,600	1,700			
11	2,500	2,600	1,700			
12	2,800	2,400	1,700			

Table M.4 Volume of Madrid North Mine Water pumped to Surface (m^3/day)

Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1			126	665	1,126	1,177
2			120	675	1,138	1,179
3			119	687	1,146	1,178
4		2	115	691	1,156	1,178
5		12	260	695	1,162	1,178
6		26	437	857	1,166	1,178
7		37	491	925	1,168	1,178
8		45	538	974	1,173	1,179
9		51	569	1,017	1,174	1,179
10		60	597	1,055	1,176	1,178
11		81	626	1,085	1,177	1,177
12		120	647	1,107	1,179	1,175

Table M.6 Volume of Madrid South Mine Water pumped to Surface (m^3/day)

Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table M.2 Directs Doris mine water to the Doris TIA (the rest goes to Robert's Bay directly)

Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	10%	10%	10%	10%	10%
2	100%	10%	10%	10%	10%	10%
3	100%	10%	10%	10%	10%	10%
4	100%	10%	10%	10%	10%	10%
5	100%	10%	10%	10%	10%	10%
6	100%	10%	10%	10%	10%	10%
7	100%	10%	10%	10%	10%	10%
8	100%	10%	10%	10%	10%	10%
9	100%	10%	10%	10%	10%	10%
10	100%	10%	10%	10%	10%	10%
11	100%	10%	10%	10%	10%	10%
12	100%	10%	10%	10%	10%	10%

Table M.5 Directs Madrid North mine water to the Doris TIA (the rest goes to Robert's Bay direc

Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	10%	10%	10%	10%	10%
2	100%	10%	10%	10%	10%	10%
3	100%	10%	10%	10%	10%	10%
4	100%	10%	10%	10%	10%	10%
5	100%	10%	10%	10%	10%	10%
6	100%	10%	10%	10%	10%	10%
7	100%	10%	10%	10%	10%	10%
8	100%	10%	10%	10%	10%	10%
9	100%	10%	10%	10%	10%	10%
10	100%	10%	10%	10%	10%	10%
11	100%	10%	10%	10%	10%	10%
12	100%	10%	10%	10%	10%	10%

Table M.7 Directs Madrid South mine water to the Doris TIA (the rest goes to Robert's Bay directly)

Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Section 2.4.3 Ore Processing and Tailings Deposition

Note *Assumes ore = total tailings = flotation tails + detoxified tails*

Assumptions:

Tailings thickener underflow solids:	45%	solids	*Roughly average percent solids (August - November 2018)*
Plant Effluent:	1.50	m^3/tonne c	*Value set to all water into mill*
End of pipe tailings solids content	27%		
Tailings Specific Gravity	2.8		
Deposited Dry Density Slurried Tailings	1.3	tonnes/m^3	
Flotation Tails (% of total tails to TIA)	95%	solids	
Density of Water	1.0	tonnes/m^3	
Tailings Void ratio	1.2		

Table T.1 Ore Processing Rate (tpd)

Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000	2,400	2,400	2,400	2,400	2,400
2	2,000	2,400	2,400	2,400	2,400	2,400
3	2,000	2,400	2,400	2,400	2,400	2,400
4	2,000	2,400	2,400	2,400	2,400	2,400
5	2,000	2,400	2,400	2,400	2,400	2,400
6	2,000	2,400	2,400	2,400	2,400	2,400
7	2,400	2,400	2,400	2,400	2,400	2,400
8	2,400	2,400	2,400	2,400	2,400	2,400
9	2,400	2,400	2,400	2,400	2,400	2,400
10	2,400	2,400	2,400	2,400	2,400	2,400
11	2,400	2,400	2,400	2,400	2,400	2,400
12	2,400	2,400	2,400	2,400	2,400	2,400

Table T.3 Total Tailings Solids to TIA (tonnes/month)

Table Calculates the total tailings solids input to the TIA from the process plant in tonnes/month

Month	2019	2020	2021	2022	2023	2024
1	58,900	70,680	70,680	70,680	70,680	70,680
2	53,200	66,120	63,840	63,840	63,840	66,120
3	58,900	70,680	70,680	70,680	70,680	70,680
4	57,000	68,400	68,400	68,400	68,400	68,400
5	58,900	70,680	70,680	70,680	70,680	70,680
6	57,000	68,400	68,400	68,400	68,400	68,400
7	70,680	70,680	70,680	70,680	70,680	70,680
8	70,680	70,680	70,680	70,680	70,680	70,680
9	68,400	68,400	68,400	68,400	68,400	68,400
10	70,680	70,680	70,680	70,680	70,680	70,680
11	68,400	68,400	68,400	68,400	68,400	68,400
12	70,680	70,680	70,680	70,680	70,680	70,680

Table T.2 Total Volume of water to TIA (m^3/month)

Table Calculates the total water input to the TIA from the process plant in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Table T.1a Doris Ore Processing Rate (tpd)

Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000					
2	2,000					
3	2,000					
4	2,000					
5	2,000					
6	2,000					
7	2,400					
8	2,400					
9	2,400					
10	2,400					
11	2,400					
12	2,400					

Table T.1 b Madrid North Ore Processing Rate (tpd)

Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1		2,400	2,400	2,400	2,400	2,400
2		2,400	2,400	2,400	2,400	2,400
3		2,400	2,400	2,400	2,400	2,400
4		2,400	2,400	2,400	2,400	2,400
5		2,400	2,400	2,400	2,400	2,400
6		2,400	2,400	2,400	2,400	2,400
7		2,400	2,400	2,400	2,400	2,400
8		2,400	2,400	2,400	2,400	2,400
9		2,400	2,400	2,400	2,400	2,400
10		2,400	2,400	2,400	2,400	2,400
11		2,400	2,400	2,400	2,400	2,400
12		2,400	2,400	2,400	2,400	2,400

Table T.1 c Madrid South Ore Processing Rate (tpd)

Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table T.1d Boston Ore Processing Rate (tpd)

Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Project **Hope Bay**
Project Nı **1CT022-036**
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.4 Process Plant Reclaim

Note *Update the water use values based on the hourly process flow breakdown*

0.7	To process water tank (m^3/tonne)	Based on average July to Dec 2018
0.8	To raw water tank (m^3/tonne)	Based on average July to Dec 2018

Note: *Defines the source of raw water to the process plant*

Option 1	Doris TIA	results in no change in net water to Doris TIA
Options 2	Doris Lake	results in net water addition to Doris TIA
Options 3	-	results in no model action when selected

Table R.1 Process Water to Process Plant (m^3/day)
Action: *Calculates reclaim for process water from the Doris TIA case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,400	1,680	1,680	1,680	1,680	1,680
2	1,400	1,680	1,680	1,680	1,680	1,680
3	1,400	1,680	1,680	1,680	1,680	1,680
4	1,400	1,680	1,680	1,680	1,680	1,680
5	1,400	1,680	1,680	1,680	1,680	1,680
6	1,400	1,680	1,680	1,680	1,680	1,680
7	1,680	1,680	1,680	1,680	1,680	1,680
8	1,680	1,680	1,680	1,680	1,680	1,680
9	1,680	1,680	1,680	1,680	1,680	1,680
10	1,680	1,680	1,680	1,680	1,680	1,680
11	1,680	1,680	1,680	1,680	1,680	1,680
12	1,680	1,680	1,680	1,680	1,680	1,680

Table R.2 Raw Water to Process Plant (m^3/day)
Action: *Calculates reclaim for raw water (location selected in table to the right) in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,600	1,920	1,920	1,920	1,920	1,920
2	1,600	1,920	1,920	1,920	1,920	1,920
3	1,600	1,920	1,920	1,920	1,920	1,920
4	1,600	1,920	1,920	1,920	1,920	1,920
5	1,600	1,920	1,920	1,920	1,920	1,920
6	1,600	1,920	1,920	1,920	1,920	1,920
7	1,920	1,920	1,920	1,920	1,920	1,920
8	1,920	1,920	1,920	1,920	1,920	1,920
9	1,920	1,920	1,920	1,920	1,920	1,920
10	1,920	1,920	1,920	1,920	1,920	1,920
11	1,920	1,920	1,920	1,920	1,920	1,920
12	1,920	1,920	1,920	1,920	1,920	1,920

Table R.3 Source of Raw Water
Action: *Select the source of Raw water to the Doris Process Plant from the drop-down list*

Month	2019	2020	2021	2022	2023	2024
1	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
2	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
3	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
4	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
5	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
6	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
7	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
8	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
9	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
10	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
11	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
12	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA

Table R.4 Total Reclaim Volume from the Doris TIA (m^3/month)
Table Calculates the reclaim water demand from the Doris TIA in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Section 2.4.5 Sewage Treatment Plant Effluent

Note *Table below shows relevant averages from historic data*

0.16	Average rate since operations (m^3/person/day)
-	

Table S.1 - Average number of people at the camp each month
Action: *Input the average number of people at camp*

Month	2019	2020	2021	2022	2023	2024
1		300	300	300	300	300
2		300	300	300	300	300
3		300	300	300	300	300
4		300	300	300	300	300
5	300	300	300	300	300	300
6	300	300	300	300	300	300
7	300	300	300	300	300	300
8	300	300	300	300	300	300
9	300	300	300	300	300	300
10	300	300	300	300	300	300
11	300	300	300	300	300	300
12	300	300	300	300	300	300

Table S.2 - Percent of sewage treatment plant effluent directed to the TIA (the rest reports to the tundra)
Action: *Define percent sewage to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1		100%	100%	100%	100%	100%
2		100%	100%	100%	100%	100%
3		100%	100%	100%	100%	100%
4		100%	100%	100%	100%	100%
5		100%	100%	100%	100%	100%
6		100%	100%	100%	100%	100%
7		100%	100%	100%	100%	100%
8		100%	100%	100%	100%	100%
9	100%	100%	100%	100%	100%	100%
10	100%	100%	100%	100%	100%	100%
11	100%	100%	100%	100%	100%	100%
12	100%	100%	100%	100%	100%	100%

Table S.3 - Calculates the volume of sewage treatment effluent pumped to the Doris TIA
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	1,484	1,484	1,484	1,484	1,484
2	0	1,388	1,340	1,340	1,340	1,388
3	0	1,484	1,484	1,484	1,484	1,484
4	0	1,436	1,436	1,436	1,436	1,436
5	0	1,484	1,484	1,484	1,484	1,484
6	0	1,436	1,436	1,436	1,436	1,436
7	0	1,484	1,484	1,484	1,484	1,484
8	0	1,484	1,484	1,484	1,484	1,484
9	1,436	1,436	1,436	1,436	1,436	1,436
10	1,484	1,484	1,484	1,484	1,484	1,484
11	1,436	1,436	1,436	1,436	1,436	1,436
12	1,484	1,484	1,484	1,484	1,484	1,484

Section 2.4.6 Sediment Control Pond (SCP) to Doris TIA

Note *Table below shows relevant averages from historic data (m^3/day)*

391	2018 June Data
222	2018 July Data
700	2018 August Data

Table C.1 Volume from SCP to Doris TIA - does not include mine water flows (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6	391	391	391	391	391	391
7	222	222	222	222	222	222
8	700	700	700	700	700	700
9						
10						
11						
12						

Table C.2 Volume from SCP to Doris TIA - does not include mine water flows (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	11,725	11,725	11,725	11,725	11,725	11,725
7	6,876	6,876	6,876	6,876	6,876	6,876
8	21,700	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.7 Doris TIA Discharge to Roberts Bay

Pump Capacity	7,200	m^3/day	For Reference Design Capacity of System = 7,200 m^3/day
Pump Availability	80%		

Table D.1 Doris TIA Discharge Pump Utilization (days/month)
Action: *Fill in the number of days in a month the pump is active*

Month	2019	2020	2021	2022	2023	2024
1		31				
2		28				
3		31				
4		30				
5		31				
6		30	30	30	30	30
7		31	31	31	31	31
8		31	31	31	31	31
9		30	30	30	30	30
10						
11						
12						

Table D.2 Doris TIA Discharge Pumping Rate (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	178,560	0	0	0	0
2	0	161,280	0	0	0	0
3	0	178,560	0	0	0	0
4	0	172,800	0	0	0	0
5	0	178,560	0	0	0	0
6	0	172,800	172,800	172,800	172,800	172,800
7	0	178,560	178,560	178,560	178,560	178,560
8	0	178,560	178,560	178,560	178,560	178,560
9	0	172,800	172,800	172,800	172,800	172,800
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.8 Madrid North Contact Water Pond (CWP) to Doris TIA

Note *Assumes the same as the Doris SCP*

391	2018 June Data
222	2018 July Data
700	2018 August Data

Table W.1 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6		391	391	391	391	391
7		222	222	222	222	222
8		700	700	700	700	700
9						
10						
11						
12						

Table W.2 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	11,725	11,725	11,725	11,725	11,725
7	0	6,876	6,876	6,876	6,876	6,876
8	0	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Project **Hope Bay**
Project Nu **1CT022-036**
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.1 Hydrology

Action: *Select Annual Return Period for green cells*

Year	Return Period
2016	Average
2017	Average
2018	Average
2019	Average
2020	Average
2021	Average
2022	Average
2023	Average

Section 2.5.1 Load Balance

Action: *Select Predictive Source Term*

Source Term: Base Case

Source Term Options

Upper Case
Base Case

Section 2.4.2 Mine Water

Action: *Select the future mine water curves*

Options	Description
1	Groundwater Model Curve
2	Adjusted Groundwater Curve to Start from todays observed flows
3	User Input

Action: None, list option for selecting where Mine Water will be directed

Options	Description
1	Doris TIA
2	Roberts Bay

Table M.3 Volume of Mine Water pumped to Doris TIA (via SCP/pumpbox) (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	40,300	89,900	7,831	7,332	3,491	3,649
2	47,600	84,100	6,776	6,650	3,186	3,419
3	65,100	89,900	7,499	7,400	3,553	3,652
4	75,000	90,006	6,345	7,173	3,468	3,534
5	77,500	93,037	7,006	7,425	3,602	3,652
6	75,000	9,078	6,411	2,571	3,498	3,534
7	372,000	9,415	6,792	2,868	3,621	3,652
8	40,300	8,820	6,938	3,019	3,636	3,655
9	51,000	8,553	6,807	3,051	3,522	3,537
10	65,100	8,246	7,121	3,271	3,646	3,652
11	75,000	8,043	6,978	3,255	3,531	3,531
12	86,800	7,812	7,276	3,432	3,655	3,643

Table M.1 Volume of Doris Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,300	2,900	2,400	1,700		
2	1,700	2,900	2,300	1,700		
3	2,100	2,900	2,300	1,700		
4	2,500	3,000	2,000	1,700		
5	2,500	3,000	2,000	1,700		
6	2,500	3,000	1,700			
7	12,000	3,000	1,700			
8	1,300	2,800	1,700			
9	1,700	2,800	1,700			
10	2,100	2,600	1,700			
11	2,500	2,600	1,700			
12	2,800	2,400	1,700			

Table M.4 Volume of Madrid North Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1			126	665	1,126	1,177
2			120	675	1,138	1,179
3			119	687	1,146	1,178
4		2	115	691	1,156	1,178
5		12	260	695	1,162	1,178
6		26	437	857	1,166	1,178
7		37	491	925	1,168	1,178
8		45	538	974	1,173	1,179
9		51	569	1,017	1,174	1,179
10		60	597	1,055	1,176	1,178
11		81	626	1,085	1,177	1,177
12		120	647	1,107	1,179	1,175

Table M.6 Volume of Madrid South Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table M.2 Directs Doris mine water to the Doris TIA (the rest goes to Robert's Bay directly)
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	100%	10%	10%	10%	10%
2	100%	100%	10%	10%	10%	10%
3	100%	100%	10%	10%	10%	10%
4	100%	100%	10%	10%	10%	10%
5	100%	100%	10%	10%	10%	10%
6	100%	10%	10%	10%	10%	10%
7	100%	10%	10%	10%	10%	10%
8	100%	10%	10%	10%	10%	10%
9	100%	10%	10%	10%	10%	10%
10	100%	10%	10%	10%	10%	10%
11	100%	10%	10%	10%	10%	10%
12	100%	10%	10%	10%	10%	10%

Table M.5 Directs Madrid North mine water to the Doris TIA (the rest goes to Robert's Bay direc
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	10%	10%	10%	10%	10%
2	100%	10%	10%	10%	10%	10%
3	100%	10%	10%	10%	10%	10%
4	100%	10%	10%	10%	10%	10%
5	100%	10%	10%	10%	10%	10%
6	100%	10%	10%	10%	10%	10%
7	100%	10%	10%	10%	10%	10%
8	100%	10%	10%	10%	10%	10%
9	100%	10%	10%	10%	10%	10%
10	100%	10%	10%	10%	10%	10%
11	100%	10%	10%	10%	10%	10%
12	100%	10%	10%	10%	10%	10%

Table M.7 Directs Madrid South mine water to the Doris TIA (the rest goes to Robert's Bay directly)
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Section 2.4.3 Ore Processing and Tailings Deposition

Note *Assumes ore = total tailings = flotation tails + detoxified tails*

Assumptions:

Tailings thickener underflow solids:	45%	solids	*Roughly average percent solids (August - November 2018)*
Plant Effluent:	1.50	m^3/tonne o	*Value set to all water into mill*
End of pipe tailings solids content	27%		
Tailings Specific Gravity	2.8		
Deposited Dry Density Slurried Tailings	1.3	tonnes/m^3	
Flotation Tails (% of total tails to TIA)	95%	solids	
Density of Water	1.0	tonnes/m^3	
Tailings Void ratio	1.2		

Table T.1 Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000	2,400	2,400	2,400	2,400	2,400
2	2,000	2,400	2,400	2,400	2,400	2,400
3	2,000	2,400	2,400	2,400	2,400	2,400
4	2,000	2,400	2,400	2,400	2,400	2,400
5	2,000	2,400	2,400	2,400	2,400	2,400
6	2,000	2,400	2,400	2,400	2,400	2,400
7	2,400	2,400	2,400	2,400	2,400	2,400
8	2,400	2,400	2,400	2,400	2,400	2,400
9	2,400	2,400	2,400	2,400	2,400	2,400
10	2,400	2,400	2,400	2,400	2,400	2,400
11	2,400	2,400	2,400	2,400	2,400	2,400
12	2,400	2,400	2,400	2,400	2,400	2,400

Table T.3 Total Tailings Solids to TIA (tonnes/month)
Table Calculates the total tailings solids input to the TIA from the process plant in tonnes/month

Month	2019	2020	2021	2022	2023	2024
1	58,900	70,680	70,680	70,680	70,680	70,680
2	53,200	66,120	63,840	63,840	63,840	66,120
3	58,900	70,680	70,680	70,680	70,680	70,680
4	57,000	68,400	68,400	68,400	68,400	68,400
5	58,900	70,680	70,680	70,680	70,680	70,680
6	57,000	68,400	68,400	68,400	68,400	68,400
7	70,680	70,680	70,680	70,680	70,680	70,680
8	70,680	70,680	70,680	70,680	70,680	70,680
9	68,400	68,400	68,400	68,400	68,400	68,400
10	70,680	70,680	70,680	70,680	70,680	70,680
11	68,400	68,400	68,400	68,400	68,400	68,400
12	70,680	70,680	70,680	70,680	70,680	70,680

Table T.2 Total Volume of water to TIA (m^3/month)
Table Calculates the total water input to the TIA from the process plant in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Table T.1a Doris Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000					
2	2,000					
3	2,000					
4	2,000					
5	2,000					
6	2,000					
7	2,400					
8	2,400					
9	2,400					
10	2,400					
11	2,400					
12	2,400					

Table T.1 b Madrid North Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1		2,400	2,400	2,400	2,400	2,400
2		2,400	2,400	2,400	2,400	2,400
3		2,400	2,400	2,400	2,400	2,400
4		2,400	2,400	2,400	2,400	2,400
5		2,400	2,400	2,400	2,400	2,400
6		2,400	2,400	2,400	2,400	2,400
7		2,400	2,400	2,400	2,400	2,400
8		2,400	2,400	2,400	2,400	2,400
9		2,400	2,400	2,400	2,400	2,400
10		2,400	2,400	2,400	2,400	2,400
11		2,400	2,400	2,400	2,400	2,400
12		2,400	2,400	2,400	2,400	2,400

Table T.1 c Madrid South Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table T.1d Boston Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Project **Hope Bay**
Project Nu **1CT022-036**
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.4 Process Plant Reclaim

Note *Update the water use values based on the hourly process flow breakdown*

0.7	To process water tank (m^3/tonne)	Based on average July to Dec 2018
0.8	To raw water tank (m^3/tonne)	Based on average July to Dec 2018

Note: *Defines the source of raw water to the process plant*

Option 1	Doris TIA	results in no change in net water to Doris TIA
Options 2	Doris Lake	results in net water addition to Doris TIA
Options 3	-	results in no model action when selected

Table R.1 Process Water to Process Plant (m^3/day)
Action: *Calculates reclaim for process water from the Doris TIA case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,400	1,680	1,680	1,680	1,680	1,680
2	1,400	1,680	1,680	1,680	1,680	1,680
3	1,400	1,680	1,680	1,680	1,680	1,680
4	1,400	1,680	1,680	1,680	1,680	1,680
5	1,400	1,680	1,680	1,680	1,680	1,680
6	1,400	1,680	1,680	1,680	1,680	1,680
7	1,680	1,680	1,680	1,680	1,680	1,680
8	1,680	1,680	1,680	1,680	1,680	1,680
9	1,680	1,680	1,680	1,680	1,680	1,680
10	1,680	1,680	1,680	1,680	1,680	1,680
11	1,680	1,680	1,680	1,680	1,680	1,680
12	1,680	1,680	1,680	1,680	1,680	1,680

Table R.2 Raw Water to Process Plant (m^3/day)
Action: *Calculates reclaim for raw water (location selected in table to the right) in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,600	1,920	1,920	1,920	1,920	1,920
2	1,600	1,920	1,920	1,920	1,920	1,920
3	1,600	1,920	1,920	1,920	1,920	1,920
4	1,600	1,920	1,920	1,920	1,920	1,920
5	1,600	1,920	1,920	1,920	1,920	1,920
6	1,600	1,920	1,920	1,920	1,920	1,920
7	1,920	1,920	1,920	1,920	1,920	1,920
8	1,920	1,920	1,920	1,920	1,920	1,920
9	1,920	1,920	1,920	1,920	1,920	1,920
10	1,920	1,920	1,920	1,920	1,920	1,920
11	1,920	1,920	1,920	1,920	1,920	1,920
12	1,920	1,920	1,920	1,920	1,920	1,920

Table R.3 Source of Raw Water
Action: *Select the source of Raw water to the Doris Process Plant from the drop-down list*

Month	2019	2020	2021	2022	2023	2024
1	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
2	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
3	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
4	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
5	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
6	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
7	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
8	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
9	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
10	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
11	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
12	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA

Table R.4 Total Reclaim Volume from the Doris TIA (m^3/month)
Table Calculates the reclaim water demand from the Doris TIA in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Section 2.4.5 Sewage Treatment Plant Effluent

Note *Table below shows relevant averages from historic data*

0.16	Average rate since operations (m^3/person/day)
-	

Table S.1 - Average number of people at the camp each month
Action: *Input the average number of people at camp*

Month	2019	2020	2021	2022	2023	2024
1		300	300	300	300	300
2		300	300	300	300	300
3		300	300	300	300	300
4		300	300	300	300	300
5	300	300	300	300	300	300
6	300	300	300	300	300	300
7	300	300	300	300	300	300
8	300	300	300	300	300	300
9	300	300	300	300	300	300
10	300	300	300	300	300	300
11	300	300	300	300	300	300
12	300	300	300	300	300	300

Table S.2 - Percent of sewage treatment plant effluent directed to the TIA (the rest reports to the tundra)
Action: *Define percent sewage to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1		100%	100%	100%	100%	100%
2		100%	100%	100%	100%	100%
3		100%	100%	100%	100%	100%
4		100%	100%	100%	100%	100%
5		100%	100%	100%	100%	100%
6		100%	100%	100%	100%	100%
7		100%	100%	100%	100%	100%
8		100%	100%	100%	100%	100%
9	100%	100%	100%	100%	100%	100%
10	100%	100%	100%	100%	100%	100%
11	100%	100%	100%	100%	100%	100%
12	100%	100%	100%	100%	100%	100%

Table S.3 - Calculates the volume of sewage treatment effluent pumped to the Doris TIA
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	1,484	1,484	1,484	1,484	1,484
2	0	1,388	1,340	1,340	1,340	1,388
3	0	1,484	1,484	1,484	1,484	1,484
4	0	1,436	1,436	1,436	1,436	1,436
5	0	1,484	1,484	1,484	1,484	1,484
6	0	1,436	1,436	1,436	1,436	1,436
7	0	1,484	1,484	1,484	1,484	1,484
8	0	1,484	1,484	1,484	1,484	1,484
9	1,436	1,436	1,436	1,436	1,436	1,436
10	1,484	1,484	1,484	1,484	1,484	1,484
11	1,436	1,436	1,436	1,436	1,436	1,436
12	1,484	1,484	1,484	1,484	1,484	1,484

Section 2.4.6 Sediment Control Pond (SCP) to Doris TIA

Note *Table below shows relevant averages from historic data (m^3/day)*

391	2018 June Data
222	2018 July Data
700	2018 August Data

Table C.1 Volume from SCP to Doris TIA - does not include mine water flows (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6	391	391	391	391	391	391
7	222	222	222	222	222	222
8	700	700	700	700	700	700
9						
10						
11						
12						

Table C.2 Volume from SCP to Doris TIA - does not include mine water flows (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	11,725	11,725	11,725	11,725	11,725	11,725
7	6,876	6,876	6,876	6,876	6,876	6,876
8	21,700	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.7 Doris TIA Discharge to Roberts Bay

Pump Capacity	7,200	m^3/day	For Reference Design Capacity of System = 7,200 m^3/day
Pump Availability	80%		

Table D.1 Doris TIA Discharge Pump Utilization (days/month)
Action: *Fill in the number of days in a month the pump is active*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6		30	30	30	30	30
7		31	31	31	31	31
8		31	31	31	31	31
9		30	30	30	30	30
10						
11						
12						

Table D.2 Doris TIA Discharge Pumping Rate (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	172,800	172,800	172,800	172,800	172,800
7	0	178,560	178,560	178,560	178,560	178,560
8	0	178,560	178,560	178,560	178,560	178,560
9	0	172,800	172,800	172,800	172,800	172,800
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.8 Madrid North Contact Water Pond (CWP) to Doris TIA

Note *Assumes the same as the Doris SCP*

391	2018 June Data
222	2018 July Data
700	2018 August Data

Table W.1 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6		391	391	391	391	391
7		222	222	222	222	222
8		700	700	700	700	700
9						
10						
11						
12						

Table W.2 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	11,725	11,725	11,725	11,725	11,725
7	0	6,876	6,876	6,876	6,876	6,876
8	0	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Project **Hope Bay**
Project Nu **1CT022-036**
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.1 Hydrology

Action: *Select Annual Return Period for green cells*

Year	Return Period
2016	Average
2017	Average
2018	Average
2019	Average
2020	Average
2021	Average
2022	Average
2023	Average

Section 2.5.1 Load Balance

Action: *Select Predictive Source Term*
Source Term: Base Case

Source Term Options

Upper Case
Base Case

Section 2.4.2 Mine Water

Action: *Select the future mine water curves*

Options	Description
1	Groundwater Model Curve
2	Adjusted Groundwater Curve to Start from todays observed flows
3	User Input

Action: None, list option for selecting where Mine Water will be directed

Options	Description
1	Doris TIA
2	Roberts Bay

Table M.3 Volume of Mine Water pumped to Doris TIA (via SCP/pumpbox) (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	40,300	8,990	7,831	7,332	3,491	3,649
2	47,600	8,410	6,776	6,650	3,186	3,419
3	65,100	8,990	7,499	7,400	3,553	3,652
4	75,000	9,006	6,345	7,173	3,468	3,534
5	77,500	9,337	7,006	7,425	3,602	3,652
6	75,000	9,078	6,411	2,571	3,498	3,534
7	372,000	9,415	6,792	2,868	3,621	3,652
8	40,300	8,820	6,938	3,019	3,636	3,655
9	51,000	8,553	6,807	3,051	3,522	3,537
10	65,100	8,246	7,121	3,271	3,646	3,652
11	75,000	8,043	6,978	3,255	3,531	3,531
12	86,800	7,812	7,276	3,432	3,655	3,643

Table M.1 Volume of Doris Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,300	2,900	2,400	1,700		
2	1,700	2,900	2,300	1,700		
3	2,100	2,900	2,300	1,700		
4	2,500	3,000	2,000	1,700		
5	2,500	3,000	2,000	1,700		
6	2,500	3,000	1,700			
7	12,000	3,000	1,700			
8	1,300	2,800	1,700			
9	1,700	2,800	1,700			
10	2,100	2,600	1,700			
11	2,500	2,600	1,700			
12	2,800	2,400	1,700			

Table M.4 Volume of Madrid North Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1			126	665	1,126	1,177
2			120	675	1,138	1,179
3			119	687	1,146	1,178
4		2	115	691	1,156	1,178
5		12	260	695	1,162	1,178
6		26	437	857	1,166	1,178
7		37	491	925	1,168	1,178
8		45	538	974	1,173	1,179
9		51	569	1,017	1,174	1,179
10		60	597	1,055	1,176	1,178
11		81	626	1,085	1,177	1,177
12		120	647	1,107	1,179	1,175

Table M.6 Volume of Madrid South Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table M.2 Directs Doris mine water to the Doris TIA (the rest goes to Robert's Bay directly)
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	10%	10%	10%	10%	10%
2	100%	10%	10%	10%	10%	10%
3	100%	10%	10%	10%	10%	10%
4	100%	10%	10%	10%	10%	10%
5	100%	10%	10%	10%	10%	10%
6	100%	10%	10%	10%	10%	10%
7	100%	10%	10%	10%	10%	10%
8	100%	10%	10%	10%	10%	10%
9	100%	10%	10%	10%	10%	10%
10	100%	10%	10%	10%	10%	10%
11	100%	10%	10%	10%	10%	10%
12	100%	10%	10%	10%	10%	10%

Table M.5 Directs Madrid North mine water to the Doris TIA (the rest goes to Robert's Bay direc
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	10%	10%	10%	10%	10%
2	100%	10%	10%	10%	10%	10%
3	100%	10%	10%	10%	10%	10%
4	100%	10%	10%	10%	10%	10%
5	100%	10%	10%	10%	10%	10%
6	100%	10%	10%	10%	10%	10%
7	100%	10%	10%	10%	10%	10%
8	100%	10%	10%	10%	10%	10%
9	100%	10%	10%	10%	10%	10%
10	100%	10%	10%	10%	10%	10%
11	100%	10%	10%	10%	10%	10%
12	100%	10%	10%	10%	10%	10%

Table M.7 Directs Madrid South mine water to the Doris TIA (the rest goes to Robert's Bay directly)
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Section 2.4.3 Ore Processing and Tailings Deposition

Note *Assumes ore = total tailings = flotation tails + detoxified tails*
Assumptions:

Tailings thickener underflow solids:	45%	solids	*Roughly average percent solids (August - November 2018)*
Plant Effluent:	1.50	m^3/tonne c	*Value set to all water into mill*
End of pipe tailings solids content	27%		
Tailings Specific Gravity	2.8		
Deposited Dry Density Slurried Tailings	1.3	tonnes/m^3	
Flotation Tails (% of total tails to TIA)	95%	solids	
Density of Water	1.0	tonnes/m^3	
Tailings Void ratio	1.2		

Table T.1 Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000	2,400	2,400	2,400	2,400	2,400
2	2,000	2,400	2,400	2,400	2,400	2,400
3	2,000	2,400	2,400	2,400	2,400	2,400
4	2,000	2,400	2,400	2,400	2,400	2,400
5	2,000	2,400	2,400	2,400	2,400	2,400
6	2,000	2,400	2,400	2,400	2,400	2,400
7	2,400	2,400	2,400	2,400	2,400	2,400
8	2,400	2,400	2,400	2,400	2,400	2,400
9	2,400	2,400	2,400	2,400	2,400	2,400
10	2,400	2,400	2,400	2,400	2,400	2,400
11	2,400	2,400	2,400	2,400	2,400	2,400
12	2,400	2,400	2,400	2,400	2,400	2,400

Table T.3 Total Tailings Solids to TIA (tonnes/month)
Table Calculates the total tailings solids input to the TIA from the process plant in tonnes/month

Month	2019	2020	2021	2022	2023	2024
1	58,900	70,680	70,680	70,680	70,680	70,680
2	53,200	66,120	63,840	63,840	63,840	66,120
3	58,900	70,680	70,680	70,680	70,680	70,680
4	57,000	68,400	68,400	68,400	68,400	68,400
5	58,900	70,680	70,680	70,680	70,680	70,680
6	57,000	68,400	68,400	68,400	68,400	68,400
7	70,680	70,680	70,680	70,680	70,680	70,680
8	70,680	70,680	70,680	70,680	70,680	70,680
9	68,400	68,400	68,400	68,400	68,400	68,400
10	70,680	70,680	70,680	70,680	70,680	70,680
11	68,400	68,400	68,400	68,400	68,400	68,400
12	70,680	70,680	70,680	70,680	70,680	70,680

Table T.2 Total Volume of water to TIA (m^3/month)
Table Calculates the total water input to the TIA from the process plant in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Table T.1a Doris Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000					
2	2,000					
3	2,000					
4	2,000					
5	2,000					
6	2,000					
7	2,400					
8	2,400					
9	2,400					
10	2,400					
11	2,400					
12	2,400					

Table T.1 b Madrid North Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1		2,400	2,400	2,400	2,400	2,400
2		2,400	2,400	2,400	2,400	2,400
3		2,400	2,400	2,400	2,400	2,400
4		2,400	2,400	2,400	2,400	2,400
5		2,400	2,400	2,400	2,400	2,400
6		2,400	2,400	2,400	2,400	2,400
7		2,400	2,400	2,400	2,400	2,400
8		2,400	2,400	2,400	2,400	2,400
9		2,400	2,400	2,400	2,400	2,400
10		2,400	2,400	2,400	2,400	2,400
11		2,400	2,400	2,400	2,400	2,400
12		2,400	2,400	2,400	2,400	2,400

Table T.1 c Madrid South Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table T.1d Boston Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Project **Hope Bay**
Project Nu **1CT022-036**
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.4 Process Plant Reclaim

Note *Update the water use values based on the hourly process flow breakdown*

0.7	To process water tank (m^3/tonne)	Based on average July to Dec 2018
0.8	To raw water tank (m^3/tonne)	Based on average July to Dec 2018

Note: *Defines the source of raw water to the process plant*

Option 1	Doris TIA	results in no change in net water to Doris TIA
Options 2	Doris Lake	results in net water addition to Doris TIA
Options 3	-	results in no model action when selected

Table R.1 Process Water to Process Plant (m^3/day)

Action: *Calculates reclaim for process water from the Doris TIA case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,400	1,680	1,680	1,680	1,680	1,680
2	1,400	1,680	1,680	1,680	1,680	1,680
3	1,400	1,680	1,680	1,680	1,680	1,680
4	1,400	1,680	1,680	1,680	1,680	1,680
5	1,400	1,680	1,680	1,680	1,680	1,680
6	1,400	1,680	1,680	1,680	1,680	1,680
7	1,680	1,680	1,680	1,680	1,680	1,680
8	1,680	1,680	1,680	1,680	1,680	1,680
9	1,680	1,680	1,680	1,680	1,680	1,680
10	1,680	1,680	1,680	1,680	1,680	1,680
11	1,680	1,680	1,680	1,680	1,680	1,680
12	1,680	1,680	1,680	1,680	1,680	1,680

Table R.2 Raw Water to Process Plant (m^3/day)

Action: *Calculates reclaim for raw water (location selected in table to the right) in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,600	1,920	1,920	1,920	1,920	1,920
2	1,600	1,920	1,920	1,920	1,920	1,920
3	1,600	1,920	1,920	1,920	1,920	1,920
4	1,600	1,920	1,920	1,920	1,920	1,920
5	1,600	1,920	1,920	1,920	1,920	1,920
6	1,600	1,920	1,920	1,920	1,920	1,920
7	1,920	1,920	1,920	1,920	1,920	1,920
8	1,920	1,920	1,920	1,920	1,920	1,920
9	1,920	1,920	1,920	1,920	1,920	1,920
10	1,920	1,920	1,920	1,920	1,920	1,920
11	1,920	1,920	1,920	1,920	1,920	1,920
12	1,920	1,920	1,920	1,920	1,920	1,920

Table R.3 Source of Raw Water

Action: *Select the source of Raw water to the Doris Process Plant from the drop-down list*

Month	2019	2020	2021	2022	2023	2024
1	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
2	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
3	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
4	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
5	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
6	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
7	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
8	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
9	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
10	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
11	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
12	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA

Table R.4 Total Reclaim Volume from the Doris TIA (m^3/month)

Table Calculates the reclaim water demand from the Doris TIA in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Section 2.4.5 Sewage Treatment Plant Effluent

Note *Table below shows relevant averages from historic data*

0.16	Average rate since operations (m^3/person/day)
-	

Table S.1 - Average number of people at the camp each month

Action: *Input the average number of people at camp*

Month	2019	2020	2021	2022	2023	2024
1		300	300	300	300	300
2		300	300	300	300	300
3		300	300	300	300	300
4		300	300	300	300	300
5	300	300	300	300	300	300
6	300	300	300	300	300	300
7	300	300	300	300	300	300
8	300	300	300	300	300	300
9	300	300	300	300	300	300
10	300	300	300	300	300	300
11	300	300	300	300	300	300
12	300	300	300	300	300	300

Table S.2 - Percent of sewage treatment plant effluent directed to the TIA (the rest reports to the tundra)

Action: *Define percent sewage to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1		100%	100%	100%	100%	100%
2		100%	100%	100%	100%	100%
3		100%	100%	100%	100%	100%
4		100%	100%	100%	100%	100%
5		100%	100%	100%	100%	100%
6		100%	100%	100%	100%	100%
7		100%	100%	100%	100%	100%
8		100%	100%	100%	100%	100%
9	100%	100%	100%	100%	100%	100%
10	100%	100%	100%	100%	100%	100%
11	100%	100%	100%	100%	100%	100%
12	100%	100%	100%	100%	100%	100%

Table S.3 - Calculates the volume of sewage treatment effluent pumped to the Doris TIA

Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	1,484	1,484	1,484	1,484	1,484
2	0	1,388	1,340	1,340	1,340	1,388
3	0	1,484	1,484	1,484	1,484	1,484
4	0	1,436	1,436	1,436	1,436	1,436
5	0	1,484	1,484	1,484	1,484	1,484
6	0	1,436	1,436	1,436	1,436	1,436
7	0	1,484	1,484	1,484	1,484	1,484
8	0	1,484	1,484	1,484	1,484	1,484
9	1,436	1,436	1,436	1,436	1,436	1,436
10	1,484	1,484	1,484	1,484	1,484	1,484
11	1,436	1,436	1,436	1,436	1,436	1,436
12	1,484	1,484	1,484	1,484	1,484	1,484

Section 2.4.6 Sediment Control Pond (SCP) to Doris TIA

Note *Table below shows relevant averages from historic data (m^3/day)*

391	2018 June Data
222	2018 July Data
700	2018 August Data

Table C.1 Volume from SCP to Doris TIA - does not include mine water flows (m^3/day)

Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6	391	391	391	391	391	391
7	222	222	222	222	222	222
8	700	700	700	700	700	700
9						
10						
11						
12						

Table C.2 Volume from SCP to Doris TIA - does not include mine water flows (m^3/month)

Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	11,725	11,725	11,725	11,725	11,725	11,725
7	6,876	6,876	6,876	6,876	6,876	6,876
8	21,700	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.7 Doris TIA Discharge to Roberts Bay

Pump Capacity	7,200	m^3/day For Reference Design Capacity of System = 7,200 m^3/day
Pump Availability	80%	

Table D.1 Doris TIA Discharge Pump Utilization (days/month)

Action: *Fill in the number of days in a month the pump is active*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6		30	30	30	30	30
7		31	31	31	31	31
8		31	31	31	31	31
9		30	30	30	30	30
10						
11						
12						

Table D.2 Doris TIA Discharge Pumping Rate (m^3/month)

Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	172,800	172,800	172,800	172,800	172,800
7	0	178,560	178,560	178,560	178,560	178,560
8	0	178,560	178,560	178,560	178,560	178,560
9	0	172,800	172,800	172,800	172,800	172,800
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.8 Madrid North Contact Water Pond (CWP) to Doris TIA

Note *Assumes the same as the Doris SCP*

391	2018 June Data
222	2018 July Data
700	2018 August Data

Table W.1 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/day)

Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6		391	391	391	391	391
7		222	222	222	222	222
8		700	700	700	700	700
9						
10						
11						
12						

Table W.2 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/month)

Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	11,725	11,725	11,725	11,725	11,725
7	0	6,876	6,876	6,876	6,876	6,876
8	0	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Project **Hope Bay**
Project Nu **1CT022-036**
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.1 Hydrology

Action: *Select Annual Return Period for green cells*

Year	Return Period
2016	Average
2017	Average
2018	Average
2019	Average
2020	Average
2021	Average
2022	Average
2023	Average

Section 2.5.1 Load Balance

Action: *Select Predictive Source Term*

Source Term: Base Case

Source Term Options

Upper Case
Base Case

Section 2.4.2 Mine Water

Action: *Select the future mine water curves*

Options	Description
1	Groundwater Model Curve
2	Adjusted Groundwater Curve to Start from todays observed flows
3	User Input

Action: None, list option for selecting where Mine Water will be directed

Options	Description
1	Doris TIA
2	Roberts Bay

Table M.3 Volume of Mine Water pumped to Doris TIA (via SCP/pumpbox) (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	40,300	89,900	7,831	7,332	3,491	3,649
2	47,600	84,100	6,776	6,650	3,186	3,419
3	65,100	89,900	7,499	7,400	3,553	3,652
4	75,000	90,006	6,345	7,173	3,468	3,534
5	77,500	93,037	7,006	7,425	3,602	3,652
6	75,000	9,078	6,411	2,571	3,498	3,534
7	372,000	9,415	6,792	2,868	3,621	3,652
8	40,300	8,820	6,938	3,019	3,636	3,655
9	51,000	8,553	6,807	3,051	3,522	3,537
10	65,100	8,246	7,121	3,271	3,646	3,652
11	75,000	8,043	6,978	3,255	3,531	3,531
12	86,800	7,812	7,276	3,432	3,655	3,643

Table M.1 Volume of Doris Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,300	2,900	2,400	1,700		
2	1,700	2,900	2,300	1,700		
3	2,100	2,900	2,300	1,700		
4	2,500	3,000	2,000	1,700		
5	2,500	3,000	2,000	1,700		
6	2,500	3,000	1,700			
7	12,000	3,000	1,700			
8	1,300	2,800	1,700			
9	1,700	2,800	1,700			
10	2,100	2,600	1,700			
11	2,500	2,600	1,700			
12	2,800	2,400	1,700			

Table M.2 Directs Doris mine water to the Doris TIA (the rest goes to Robert's Bay directly)
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	100%	10%	10%	10%	10%
2	100%	100%	10%	10%	10%	10%
3	100%	100%	10%	10%	10%	10%
4	100%	100%	10%	10%	10%	10%
5	100%	100%	10%	10%	10%	10%
6	100%	10%	10%	10%	10%	10%
7	100%	10%	10%	10%	10%	10%
8	100%	10%	10%	10%	10%	10%
9	100%	10%	10%	10%	10%	10%
10	100%	10%	10%	10%	10%	10%
11	100%	10%	10%	10%	10%	10%
12	100%	10%	10%	10%	10%	10%

Table M.4 Volume of Madrid North Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1			126	665	1,126	1,177
2			120	675	1,138	1,179
3			119	687	1,146	1,178
4		2	115	691	1,156	1,178
5		12	260	695	1,162	1,178
6		26	437	857	1,166	1,178
7		37	491	925	1,168	1,178
8		45	538	974	1,173	1,179
9		51	569	1,017	1,174	1,179
10		60	597	1,055	1,176	1,178
11		81	626	1,085	1,177	1,177
12		120	647	1,107	1,179	1,175

Table M.5 Directs Madrid North mine water to the Doris TIA (the rest goes to Robert's Bay direc
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	10%	10%	10%	10%	10%
2	100%	10%	10%	10%	10%	10%
3	100%	10%	10%	10%	10%	10%
4	100%	10%	10%	10%	10%	10%
5	100%	10%	10%	10%	10%	10%
6	100%	10%	10%	10%	10%	10%
7	100%	10%	10%	10%	10%	10%
8	100%	10%	10%	10%	10%	10%
9	100%	10%	10%	10%	10%	10%
10	100%	10%	10%	10%	10%	10%
11	100%	10%	10%	10%	10%	10%
12	100%	10%	10%	10%	10%	10%

Table M.6 Volume of Madrid South Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table M.7 Directs Madrid South mine water to the Doris TIA (the rest goes to Robert's Bay directly)
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Section 2.4.3 Ore Processing and Tailings Deposition

Note *Assumes ore = total tailings = flotation tails + detoxified tails*

Assumptions:

Tailings thickener underflow solids:	45%	solids	*Roughly average percent solids (August - November 2018)*
Plant Effluent:	1.50	m^3/tonne c	*Value set to all water into mill*
End of pipe tailings solids content	27%		
Tailings Specific Gravity	2.8		
Deposited Dry Density Slurried Tailings	1.3	tonnes/m^3	
Flotation Tails (% of total tails to TIA)	95%	solids	
Density of Water	1.0	tonnes/m^3	
Tailings Void ratio	1.2		

Table T.1 Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000	2,400	2,400	2,400	2,400	2,400
2	2,000	2,400	2,400	2,400	2,400	2,400
3	2,000	2,400	2,400	2,400	2,400	2,400
4	2,000	2,400	2,400	2,400	2,400	2,400
5	2,000	2,400	2,400	2,400	2,400	2,400
6	2,000	2,400	2,400	2,400	2,400	2,400
7	2,400	2,400	2,400	2,400	2,400	2,400
8	2,400	2,400	2,400	2,400	2,400	2,400
9	2,400	2,400	2,400	2,400	2,400	2,400
10	2,400	2,400	2,400	2,400	2,400	2,400
11	2,400	2,400	2,400	2,400	2,400	2,400
12	2,400	2,400	2,400	2,400	2,400	2,400

Table T.1a Doris Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000					
2	2,000					
3	2,000					
4	2,000					
5	2,000					
6	2,000					
7	2,400					
8	2,400					
9	2,400					
10	2,400					
11	2,400					
12	2,400					

Table T.3 Total Tailings Solids to TIA (tonnes/month)
Table Calculates the total tailings solids input to the TIA from the process plant in tonnes/month

Month	2019	2020	2021	2022	2023	2024
1	58,900	70,680	70,680	70,680	70,680	70,680
2	53,200	66,120	63,840	63,840	63,840	66,120
3	58,900	70,680	70,680	70,680	70,680	70,680
4	57,000	68,400	68,400	68,400	68,400	68,400
5	58,900	70,680	70,680	70,680	70,680	70,680
6	57,000	68,400	68,400	68,400	68,400	68,400
7	70,680	70,680	70,680	70,680	70,680	70,680
8	70,680	70,680	70,680	70,680	70,680	70,680
9	68,400	68,400	68,400	68,400	68,400	68,400
10	70,680	70,680	70,680	70,680	70,680	70,680
11	68,400	68,400	68,400	68,400	68,400	68,400
12	70,680	70,680	70,680	70,680	70,680	70,680

Table T.1 b Madrid North Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1		2,400	2,400	2,400	2,400	2,400
2		2,400	2,400	2,400	2,400	2,400
3		2,400	2,400	2,400	2,400	2,400
4		2,400	2,400	2,400	2,400	2,400
5		2,400	2,400	2,400	2,400	2,400
6		2,400	2,400	2,400	2,400	2,400
7		2,400	2,400	2,400	2,400	2,400
8		2,400	2,400	2,400	2,400	2,400
9		2,400	2,400	2,400	2,400	2,400
10		2,400	2,400	2,400	2,400	2,400
11		2,400	2,400	2,400	2,400	2,400
12		2,400	2,400	2,400	2,400	2,400

Table T.2 Total Volume of water to TIA (m^3/month)
Table Calculates the total water input to the TIA from the process plant in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Table T.1 c Madrid South Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table T.1d Boston Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Project **Hope Bay**
Project Nu **1CT022-036**
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.4 Process Plant Reclaim

Note *Update the water use values based on the hourly process flow breakdown*

0.7	To process water tank (m³/tonne)	Based on average July to Dec 2018
0.8	To raw water tank (m³/tonne)	Based on average July to Dec 2018

Note: *Defines the source of raw water to the process plant*

Option 1	Doris TIA	results in no change in net water to Doris TIA
Options 2	Doris Lake	results in net water addition to Doris TIA
Options 3	-	results in no model action when selected

Table R.1 Process Water to Process Plant (m^3/day)
Action: *Calculates reclaim for process water from the Doris TIA case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,400	1,680	1,680	1,680	1,680	1,680
2	1,400	1,680	1,680	1,680	1,680	1,680
3	1,400	1,680	1,680	1,680	1,680	1,680
4	1,400	1,680	1,680	1,680	1,680	1,680
5	1,400	1,680	1,680	1,680	1,680	1,680
6	1,400	1,680	1,680	1,680	1,680	1,680
7	1,680	1,680	1,680	1,680	1,680	1,680
8	1,680	1,680	1,680	1,680	1,680	1,680
9	1,680	1,680	1,680	1,680	1,680	1,680
10	1,680	1,680	1,680	1,680	1,680	1,680
11	1,680	1,680	1,680	1,680	1,680	1,680
12	1,680	1,680	1,680	1,680	1,680	1,680

Table R.2 Raw Water to Process Plant (m^3/day)
Action: *Calculates reclaim for raw water (location selected in table to the right) in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,600	1,920	1,920	1,920	1,920	1,920
2	1,600	1,920	1,920	1,920	1,920	1,920
3	1,600	1,920	1,920	1,920	1,920	1,920
4	1,600	1,920	1,920	1,920	1,920	1,920
5	1,600	1,920	1,920	1,920	1,920	1,920
6	1,600	1,920	1,920	1,920	1,920	1,920
7	1,920	1,920	1,920	1,920	1,920	1,920
8	1,920	1,920	1,920	1,920	1,920	1,920
9	1,920	1,920	1,920	1,920	1,920	1,920
10	1,920	1,920	1,920	1,920	1,920	1,920
11	1,920	1,920	1,920	1,920	1,920	1,920
12	1,920	1,920	1,920	1,920	1,920	1,920

Table R.3 Source of Raw Water
Action: *Select the source of Raw water to the Doris Process Plant from the drop-down list*

Month	2019	2020	2021	2022	2023	2024
1	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
2	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
3	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
4	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
5	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
6	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
7	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
8	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
9	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
10	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
11	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
12	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA

Table R.4 Total Reclaim Volume from the Doris TIA (m^3/month)
Table Calculates the reclaim water demand from the Doris TIA in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Section 2.4.5 Sewage Treatment Plant Effluent

Note *Table below shows relevant averages from historic data*

0.16	Average rate since operations (m³/person/day)
-	

Table S.1 - Average number of people at the camp each month
Action: *Input the average number of people at camp*

Month	2019	2020	2021	2022	2023	2024
1		300	300	300	300	300
2		300	300	300	300	300
3		300	300	300	300	300
4		300	300	300	300	300
5	300	300	300	300	300	300
6	300	300	300	300	300	300
7	300	300	300	300	300	300
8	300	300	300	300	300	300
9	300	300	300	300	300	300
10	300	300	300	300	300	300
11	300	300	300	300	300	300
12	300	300	300	300	300	300

Table S.2 - Percent of sewage treatment plant effluent directed to the TIA (the rest reports to the tundra)
Action: *Define percent sewage to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1		100%	100%	100%	100%	100%
2		100%	100%	100%	100%	100%
3		100%	100%	100%	100%	100%
4		100%	100%	100%	100%	100%
5		100%	100%	100%	100%	100%
6		100%	100%	100%	100%	100%
7		100%	100%	100%	100%	100%
8		100%	100%	100%	100%	100%
9	100%	100%	100%	100%	100%	100%
10	100%	100%	100%	100%	100%	100%
11	100%	100%	100%	100%	100%	100%
12	100%	100%	100%	100%	100%	100%

Table S.3 - Calculates the volume of sewage treatment effluent pumped to the Doris TIA
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	1,484	1,484	1,484	1,484	1,484
2	0	1,388	1,340	1,340	1,340	1,388
3	0	1,484	1,484	1,484	1,484	1,484
4	0	1,436	1,436	1,436	1,436	1,436
5	0	1,484	1,484	1,484	1,484	1,484
6	0	1,436	1,436	1,436	1,436	1,436
7	0	1,484	1,484	1,484	1,484	1,484
8	0	1,484	1,484	1,484	1,484	1,484
9	1,436	1,436	1,436	1,436	1,436	1,436
10	1,484	1,484	1,484	1,484	1,484	1,484
11	1,436	1,436	1,436	1,436	1,436	1,436
12	1,484	1,484	1,484	1,484	1,484	1,484

Section 2.4.6 Sediment Control Pond (SCP) to Doris TIA

Note *Table below shows relevant averages from historic data (m^3/day)*

391	2018 June Data
222	2018 July Data
700	2018 August Data

Table C.1 Volume from SCP to Doris TIA - does not include mine water flows (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6	391	391	391	391	391	391
7	222	222	222	222	222	222
8	700	700	700	700	700	700
9						
10						
11						
12						

Table C.2 Volume from SCP to Doris TIA - does not include mine water flows (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	11,725	11,725	11,725	11,725	11,725	11,725
7	6,876	6,876	6,876	6,876	6,876	6,876
8	21,700	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.7 Doris TIA Discharge to Roberts Bay

Pump Capacity	7,200	m³/day For Reference Design Capacity of System = 7,200 m³/day
Pump Availability	80%	

Table D.1 Doris TIA Discharge Pump Utilization (days/month)
Action: *Fill in the number of days in a month the pump is active*

Month	2019	2020	2021	2022	2023	2024
1		31				
2		28				
3		31				
4		30				
5		31				
6		30	30	30	30	30
7		31	31	31	31	31
8		31	31	31	31	31
9		30	30	30	30	30
10						
11						
12						

Table D.2 Doris TIA Discharge Pumping Rate (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	178,560	0	0	0	0
2	0	161,280	0	0	0	0
3	0	178,560	0	0	0	0
4	0	172,800	0	0	0	0
5	0	178,560	0	0	0	0
6	0	172,800	172,800	172,800	172,800	172,800
7	0	178,560	178,560	178,560	178,560	178,560
8	0	178,560	178,560	178,560	178,560	178,560
9	0	172,800	172,800	172,800	172,800	172,800
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.8 Madrid North Contact Water Pond (CWP) to Doris TIA

Note *Assumes the same as the Doris SCP*

391	2018 June Data
222	2018 July Data
700	2018 August Data

Table W.1 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6		391	391	391	391	391
7		222	222	222	222	222
8		700	700	700	700	700
9						
10						
11						
12						

Table W.2 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	11,725	11,725	11,725	11,725	11,725
7	0	6,876	6,876	6,876	6,876	6,876
8	0	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Project **Hope Bay**
Project Nu **1CT022-036**
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.1 Hydrology

Action: *Select Annual Return Period for green cells*

Year	Return Period
2016	Average
2017	Average
2018	Average
2019	1 in 100 Wet
2020	1 in 100 Wet
2021	1 in 100 Wet
2022	1 in 100 Wet
2023	1 in 100 Wet

Section 2.5.1 Load Balance

Action: *Select Predictive Source Term*

Source Term: Base Case

Source Term Options

Upper Case
Base Case

Section 2.4.2 Mine Water

Action: *Select the future mine water curves*

Options	Description
1	Groundwater Model Curve
2	Adjusted Groundwater Curve to Start from todays observed flows
3	User Input

Action: None, list option for selecting where Mine Water will be directed

Options	Description
1	Doris TIA
2	Roberts Bay

Table M.3 Volume of Mine Water pumped to Doris TIA (via SCP/pumpbox) (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	40,300	8,990	7,831	7,332	3,491	3,649
2	47,600	8,410	6,776	6,650	3,186	3,419
3	65,100	8,990	7,499	7,400	3,553	3,652
4	75,000	9,006	6,345	7,173	3,468	3,534
5	77,500	9,337	7,006	7,425	3,602	3,652
6	75,000	9,078	6,411	2,571	3,498	3,534
7	372,000	9,415	6,792	2,868	3,621	3,652
8	40,300	8,820	6,938	3,019	3,636	3,655
9	51,000	8,553	6,807	3,051	3,522	3,537
10	65,100	8,246	7,121	3,271	3,646	3,652
11	75,000	8,043	6,978	3,255	3,531	3,531
12	86,800	7,812	7,276	3,432	3,655	3,643

Table M.1 Volume of Doris Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,300	2,900	2,400	1,700		
2	1,700	2,900	2,300	1,700		
3	2,100	2,900	2,300	1,700		
4	2,500	3,000	2,000	1,700		
5	2,500	3,000	2,000	1,700		
6	2,500	3,000	1,700			
7	12,000	3,000	1,700			
8	1,300	2,800	1,700			
9	1,700	2,800	1,700			
10	2,100	2,600	1,700			
11	2,500	2,600	1,700			
12	2,800	2,400	1,700			

Table M.4 Volume of Madrid North Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1			126	665	1,126	1,177
2			120	675	1,138	1,179
3			119	687	1,146	1,178
4		2	115	691	1,156	1,178
5		12	260	695	1,162	1,178
6		26	437	857	1,166	1,178
7		37	491	925	1,168	1,178
8		45	538	974	1,173	1,179
9		51	569	1,017	1,174	1,179
10		60	597	1,055	1,176	1,178
11		81	626	1,085	1,177	1,177
12		120	647	1,107	1,179	1,175

Table M.6 Volume of Madrid South Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table M.2 Directs Doris mine water to the Doris TIA (the rest goes to Robert's Bay directly)
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	10%	10%	10%	10%	10%
2	100%	10%	10%	10%	10%	10%
3	100%	10%	10%	10%	10%	10%
4	100%	10%	10%	10%	10%	10%
5	100%	10%	10%	10%	10%	10%
6	100%	10%	10%	10%	10%	10%
7	100%	10%	10%	10%	10%	10%
8	100%	10%	10%	10%	10%	10%
9	100%	10%	10%	10%	10%	10%
10	100%	10%	10%	10%	10%	10%
11	100%	10%	10%	10%	10%	10%
12	100%	10%	10%	10%	10%	10%

Table M.5 Directs Madrid North mine water to the Doris TIA (the rest goes to Robert's Bay direc
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	10%	10%	10%	10%	10%
2	100%	10%	10%	10%	10%	10%
3	100%	10%	10%	10%	10%	10%
4	100%	10%	10%	10%	10%	10%
5	100%	10%	10%	10%	10%	10%
6	100%	10%	10%	10%	10%	10%
7	100%	10%	10%	10%	10%	10%
8	100%	10%	10%	10%	10%	10%
9	100%	10%	10%	10%	10%	10%
10	100%	10%	10%	10%	10%	10%
11	100%	10%	10%	10%	10%	10%
12	100%	10%	10%	10%	10%	10%

Table M.7 Directs Madrid South mine water to the Doris TIA (the rest goes to Robert's Bay directly)
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Section 2.4.3 Ore Processing and Tailings Deposition

Note *Assumes ore = total tailings = flotation tails + detoxified tails*

Assumptions:

Tailings thickener underflow solids:	45%	solids	*Roughly average percent solids (August - November 2018)*
Plant Effluent:	1.50	m^3/tonne o	*Value set to all water into mill*
End of pipe tailings solids content	27%		
Tailings Specific Gravity	2.8		
Deposited Dry Density Slurried Tailings	1.3	tonnes/m^3	
Flotation Tails (% of total tails to TIA)	95%	solids	
Density of Water	1.0	tonnes/m^3	
Tailings Void ratio	1.2		

Table T.1 Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000	2,400	2,400	2,400	2,400	2,400
2	2,000	2,400	2,400	2,400	2,400	2,400
3	2,000	2,400	2,400	2,400	2,400	2,400
4	2,000	2,400	2,400	2,400	2,400	2,400
5	2,000	2,400	2,400	2,400	2,400	2,400
6	2,000	2,400	2,400	2,400	2,400	2,400
7	2,400	2,400	2,400	2,400	2,400	2,400
8	2,400	2,400	2,400	2,400	2,400	2,400
9	2,400	2,400	2,400	2,400	2,400	2,400
10	2,400	2,400	2,400	2,400	2,400	2,400
11	2,400	2,400	2,400	2,400	2,400	2,400
12	2,400	2,400	2,400	2,400	2,400	2,400

Table T.3 Total Tailings Solids to TIA (tonnes/month)
Table Calculates the total tailings solids input to the TIA from the process plant in tonnes/month

Month	2019	2020	2021	2022	2023	2024
1	58,900	70,680	70,680	70,680	70,680	70,680
2	53,200	66,120	63,840	63,840	63,840	66,120
3	58,900	70,680	70,680	70,680	70,680	70,680
4	57,000	68,400	68,400	68,400	68,400	68,400
5	58,900	70,680	70,680	70,680	70,680	70,680
6	57,000	68,400	68,400	68,400	68,400	68,400
7	70,680	70,680	70,680	70,680	70,680	70,680
8	70,680	70,680	70,680	70,680	70,680	70,680
9	68,400	68,400	68,400	68,400	68,400	68,400
10	70,680	70,680	70,680	70,680	70,680	70,680
11	68,400	68,400	68,400	68,400	68,400	68,400
12	70,680	70,680	70,680	70,680	70,680	70,680

Table T.2 Total Volume of water to TIA (m^3/month)
Table Calculates the total water input to the TIA from the process plant in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Table T.1a Doris Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000					
2	2,000					
3	2,000					
4	2,000					
5	2,000					
6	2,000					
7	2,400					
8	2,400					
9	2,400					
10	2,400					
11	2,400					
12	2,400					

Table T.1 b Madrid North Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1		2,400	2,400	2,400	2,400	2,400
2		2,400	2,400	2,400	2,400	2,400
3		2,400	2,400	2,400	2,400	2,400
4		2,400	2,400	2,400	2,400	2,400
5		2,400	2,400	2,400	2,400	2,400
6		2,400	2,400	2,400	2,400	2,400
7		2,400	2,400	2,400	2,400	2,400
8		2,400	2,400	2,400	2,400	2,400
9		2,400	2,400	2,400	2,400	2,400
10		2,400	2,400	2,400	2,400	2,400
11		2,400	2,400	2,400	2,400	2,400
12		2,400	2,400	2,400	2,400	2,400

Table T.1 c Madrid South Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table T.1d Boston Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Project **Hope Bay**
Project Nu **1CT022-036**
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.4 Process Plant Reclaim

Note *Update the water use values based on the hourly process flow breakdown*

0.7	To process water tank (m^3/tonne)	Based on average July to Dec 2018
0.8	To raw water tank (m^3/tonne)	Based on average July to Dec 2018

Note: *Defines the source of raw water to the process plant*

Option 1	Doris TIA	results in no change in net water to Doris TIA
Options 2	Doris Lake	results in net water addition to Doris TIA
Options 3	-	results in no model action when selected

Table R.1 Process Water to Process Plant (m^3/day)
Action: *Calculates reclaim for process water from the Doris TIA case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,400	1,680	1,680	1,680	1,680	1,680
2	1,400	1,680	1,680	1,680	1,680	1,680
3	1,400	1,680	1,680	1,680	1,680	1,680
4	1,400	1,680	1,680	1,680	1,680	1,680
5	1,400	1,680	1,680	1,680	1,680	1,680
6	1,400	1,680	1,680	1,680	1,680	1,680
7	1,680	1,680	1,680	1,680	1,680	1,680
8	1,680	1,680	1,680	1,680	1,680	1,680
9	1,680	1,680	1,680	1,680	1,680	1,680
10	1,680	1,680	1,680	1,680	1,680	1,680
11	1,680	1,680	1,680	1,680	1,680	1,680
12	1,680	1,680	1,680	1,680	1,680	1,680

Table R.2 Raw Water to Process Plant (m^3/day)
Action: *Calculates reclaim for raw water (location selected in table to the right) in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,600	1,920	1,920	1,920	1,920	1,920
2	1,600	1,920	1,920	1,920	1,920	1,920
3	1,600	1,920	1,920	1,920	1,920	1,920
4	1,600	1,920	1,920	1,920	1,920	1,920
5	1,600	1,920	1,920	1,920	1,920	1,920
6	1,600	1,920	1,920	1,920	1,920	1,920
7	1,920	1,920	1,920	1,920	1,920	1,920
8	1,920	1,920	1,920	1,920	1,920	1,920
9	1,920	1,920	1,920	1,920	1,920	1,920
10	1,920	1,920	1,920	1,920	1,920	1,920
11	1,920	1,920	1,920	1,920	1,920	1,920
12	1,920	1,920	1,920	1,920	1,920	1,920

Table R.3 Source of Raw Water
Action: *Select the source of Raw water to the Doris Process Plant from the drop-down list*

Month	2019	2020	2021	2022	2023	2024
1	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
2	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
3	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
4	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
5	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
6	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
7	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
8	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
9	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
10	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
11	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
12	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA

Table R.4 Total Reclaim Volume from the Doris TIA (m^3/month)
Table Calculates the reclaim water demand from the Doris TIA in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Section 2.4.5 Sewage Treatment Plant Effluent

Note *Table below shows relevant averages from historic data*

0.16	Average rate since operations (m^3/person/day)
-	

Table S.1 - Average number of people at the camp each month
Action: *Input the average number of people at camp*

Month	2019	2020	2021	2022	2023	2024
1		300	300	300	300	300
2		300	300	300	300	300
3		300	300	300	300	300
4		300	300	300	300	300
5	300	300	300	300	300	300
6	300	300	300	300	300	300
7	300	300	300	300	300	300
8	300	300	300	300	300	300
9	300	300	300	300	300	300
10	300	300	300	300	300	300
11	300	300	300	300	300	300
12	300	300	300	300	300	300

Table S.2 - Percent of sewage treatment plant effluent directed to the TIA (the rest reports to the tundra)
Action: *Define percent sewage to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1		100%	100%	100%	100%	100%
2		100%	100%	100%	100%	100%
3		100%	100%	100%	100%	100%
4		100%	100%	100%	100%	100%
5		100%	100%	100%	100%	100%
6		100%	100%	100%	100%	100%
7		100%	100%	100%	100%	100%
8		100%	100%	100%	100%	100%
9	100%	100%	100%	100%	100%	100%
10	100%	100%	100%	100%	100%	100%
11	100%	100%	100%	100%	100%	100%
12	100%	100%	100%	100%	100%	100%

Table S.3 - Calculates the volume of sewage treatment effluent pumped to the Doris TIA
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	1,484	1,484	1,484	1,484	1,484
2	0	1,388	1,340	1,340	1,340	1,388
3	0	1,484	1,484	1,484	1,484	1,484
4	0	1,436	1,436	1,436	1,436	1,436
5	0	1,484	1,484	1,484	1,484	1,484
6	0	1,436	1,436	1,436	1,436	1,436
7	0	1,484	1,484	1,484	1,484	1,484
8	0	1,484	1,484	1,484	1,484	1,484
9	1,436	1,436	1,436	1,436	1,436	1,436
10	1,484	1,484	1,484	1,484	1,484	1,484
11	1,436	1,436	1,436	1,436	1,436	1,436
12	1,484	1,484	1,484	1,484	1,484	1,484

Section 2.4.6 Sediment Control Pond (SCP) to Doris TIA

Note *Table below shows relevant averages from historic data (m^3/day)*

391	2018 June Data
222	2018 July Data
700	2018 August Data

Table C.1 Volume from SCP to Doris TIA - does not include mine water flows (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6	391	391	391	391	391	391
7	222	222	222	222	222	222
8	700	700	700	700	700	700
9						
10						
11						
12						

Table C.2 Volume from SCP to Doris TIA - does not include mine water flows (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	11,725	11,725	11,725	11,725	11,725	11,725
7	6,876	6,876	6,876	6,876	6,876	6,876
8	21,700	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.7 Doris TIA Discharge to Roberts Bay

Pump Capacity	7,200	m^3/day
Pump Availability	80%	

For Reference Design Capacity of System = 7,200 m^3/day

Table D.1 Doris TIA Discharge Pump Utilization (days/month)
Action: *Fill in the number of days in a month the pump is active*

Month	2019	2020	2021	2022	2023	2024
1		31				
2		28				
3		31				
4		30				
5		31				
6		30	30	30	30	30
7		31	31	31	31	31
8		31	31	31	31	31
9		30	30	30	30	30
10						
11						
12						

Table D.2 Doris TIA Discharge Pumping Rate (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	178,560	0	0	0	0
2	0	161,280	0	0	0	0
3	0	178,560	0	0	0	0
4	0	172,800	0	0	0	0
5	0	178,560	0	0	0	0
6	0	172,800	172,800	172,800	172,800	172,800
7	0	178,560	178,560	178,560	178,560	178,560
8	0	178,560	178,560	178,560	178,560	178,560
9	0	172,800	172,800	172,800	172,800	172,800
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.8 Madrid North Contact Water Pond (CWP) to Doris TIA

Note *Assumes the same as the Doris SCP*

391	2018 June Data
222	2018 July Data
700	2018 August Data

Table W.1 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6		391	391	391	391	391
7		222	222	222	222	222
8		700	700	700	700	700
9						
10						
11						
12						

Table W.2 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	11,725	11,725	11,725	11,725	11,725
7	0	6,876	6,876	6,876	6,876	6,876
8	0	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Project **Hope Bay**
Project Nu **1CT022-036**
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.1 Hydrology

Action: *Select Annual Return Period for green cells*

Year	Return Period
2016	Average
2017	Average
2018	Average
2019	1 in 100 Wet
2020	1 in 100 Wet
2021	1 in 100 Wet
2022	1 in 100 Wet
2023	1 in 100 Wet

Section 2.5.1 Load Balance

Action: *Select Predictive Source Term*

Source Term: Base Case

Source Term Options

Upper Case
Base Case

Section 2.4.2 Mine Water

Action: *Select the future mine water curves*

Options	Description
1	Groundwater Model Curve
2	Adjusted Groundwater Curve to Start from todays observed flows
3	User Input

Action: None, list option for selecting where Mine Water will be directed

Options	Description
1	Doris TIA
2	Roberts Bay

Table M.3 Volume of Mine Water pumped to Doris TIA (via SCP/pumpbox) (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	40,300	89,900	7,831	7,332	3,491	3,649
2	47,600	84,100	6,776	6,650	3,186	3,419
3	65,100	89,900	7,499	7,400	3,553	3,652
4	75,000	90,006	6,345	7,173	3,468	3,534
5	77,500	93,037	7,006	7,425	3,602	3,652
6	75,000	9,078	6,411	2,571	3,498	3,534
7	372,000	9,415	6,792	2,868	3,621	3,652
8	40,300	8,820	6,938	3,019	3,636	3,655
9	51,000	8,553	6,807	3,051	3,522	3,537
10	65,100	8,246	7,121	3,271	3,646	3,652
11	75,000	8,043	6,978	3,255	3,531	3,531
12	86,800	7,812	7,276	3,432	3,655	3,643

Table M.1 Volume of Doris Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,300	2,900	2,400	1,700		
2	1,700	2,900	2,300	1,700		
3	2,100	2,900	2,300	1,700		
4	2,500	3,000	2,000	1,700		
5	2,500	3,000	2,000	1,700		
6	2,500	3,000	1,700			
7	12,000	3,000	1,700			
8	1,300	2,800	1,700			
9	1,700	2,800	1,700			
10	2,100	2,600	1,700			
11	2,500	2,600	1,700			
12	2,800	2,400	1,700			

Table M.4 Volume of Madrid North Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1			126	665	1,126	1,177
2			120	675	1,138	1,179
3			119	687	1,146	1,178
4		2	115	691	1,156	1,178
5		12	260	695	1,162	1,178
6		26	437	857	1,166	1,178
7		37	491	925	1,168	1,178
8		45	538	974	1,173	1,179
9		51	569	1,017	1,174	1,179
10		60	597	1,055	1,176	1,178
11		81	626	1,085	1,177	1,177
12		120	647	1,107	1,179	1,175

Table M.6 Volume of Madrid South Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table M.2 Directs Doris mine water to the Doris TIA (the rest goes to Robert's Bay directly)
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	100%	10%	10%	10%	10%
2	100%	100%	10%	10%	10%	10%
3	100%	100%	10%	10%	10%	10%
4	100%	100%	10%	10%	10%	10%
5	100%	100%	10%	10%	10%	10%
6	100%	10%	10%	10%	10%	10%
7	100%	10%	10%	10%	10%	10%
8	100%	10%	10%	10%	10%	10%
9	100%	10%	10%	10%	10%	10%
10	100%	10%	10%	10%	10%	10%
11	100%	10%	10%	10%	10%	10%
12	100%	10%	10%	10%	10%	10%

Table M.5 Directs Madrid North mine water to the Doris TIA (the rest goes to Robert's Bay direc
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	10%	10%	10%	10%	10%
2	100%	10%	10%	10%	10%	10%
3	100%	10%	10%	10%	10%	10%
4	100%	10%	10%	10%	10%	10%
5	100%	10%	10%	10%	10%	10%
6	100%	10%	10%	10%	10%	10%
7	100%	10%	10%	10%	10%	10%
8	100%	10%	10%	10%	10%	10%
9	100%	10%	10%	10%	10%	10%
10	100%	10%	10%	10%	10%	10%
11	100%	10%	10%	10%	10%	10%
12	100%	10%	10%	10%	10%	10%

Table M.7 Directs Madrid South mine water to the Doris TIA (the rest goes to Robert's Bay directly)
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Section 2.4.3 Ore Processing and Tailings Deposition

Note *Assumes ore = total tailings = flotation tails + detoxified tails*

Assumptions:

Tailings thickener underflow solids:	45%	solids	*Roughly average percent solids (August - November 2018)*
Plant Effluent:	1.50	m^3/tonne c	*Value set to all water into mill*
End of pipe tailings solids content	27%		
Tailings Specific Gravity	2.8		
Deposited Dry Density Slurried Tailings	1.3	tonnes/m^3	
Flotation Tails (% of total tails to TIA)	95%	solids	
Density of Water	1.0	tonnes/m^3	
Tailings Void ratio	1.2		

Table T.1 Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000	2,400	2,400	2,400	2,400	2,400
2	2,000	2,400	2,400	2,400	2,400	2,400
3	2,000	2,400	2,400	2,400	2,400	2,400
4	2,000	2,400	2,400	2,400	2,400	2,400
5	2,000	2,400	2,400	2,400	2,400	2,400
6	2,000	2,400	2,400	2,400	2,400	2,400
7	2,400	2,400	2,400	2,400	2,400	2,400
8	2,400	2,400	2,400	2,400	2,400	2,400
9	2,400	2,400	2,400	2,400	2,400	2,400
10	2,400	2,400	2,400	2,400	2,400	2,400
11	2,400	2,400	2,400	2,400	2,400	2,400
12	2,400	2,400	2,400	2,400	2,400	2,400

Table T.3 Total Tailings Solids to TIA (tonnes/month)
Table Calculates the total tailings solids input to the TIA from the process plant in tonnes/month

Month	2019	2020	2021	2022	2023	2024
1	58,900	70,680	70,680	70,680	70,680	70,680
2	53,200	66,120	63,840	63,840	63,840	66,120
3	58,900	70,680	70,680	70,680	70,680	70,680
4	57,000	68,400	68,400	68,400	68,400	68,400
5	58,900	70,680	70,680	70,680	70,680	70,680
6	57,000	68,400	68,400	68,400	68,400	68,400
7	70,680	70,680	70,680	70,680	70,680	70,680
8	70,680	70,680	70,680	70,680	70,680	70,680
9	68,400	68,400	68,400	68,400	68,400	68,400
10	70,680	70,680	70,680	70,680	70,680	70,680
11	68,400	68,400	68,400	68,400	68,400	68,400
12	70,680	70,680	70,680	70,680	70,680	70,680

Table T.2 Total Volume of water to TIA (m^3/month)
Table Calculates the total water input to the TIA from the process plant in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Table T.1a Doris Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000					
2	2,000					
3	2,000					
4	2,000					
5	2,000					
6	2,000					
7	2,400					
8	2,400					
9	2,400					
10	2,400					
11	2,400					
12	2,400					

Table T.1 b Madrid North Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1		2,400	2,400	2,400	2,400	2,400
2		2,400	2,400	2,400	2,400	2,400
3		2,400	2,400	2,400	2,400	2,400
4		2,400	2,400	2,400	2,400	2,400
5		2,400	2,400	2,400	2,400	2,400
6		2,400	2,400	2,400	2,400	2,400
7		2,400	2,400	2,400	2,400	2,400
8		2,400	2,400	2,400	2,400	2,400
9		2,400	2,400	2,400	2,400	2,400
10		2,400	2,400	2,400	2,400	2,400
11		2,400	2,400	2,400	2,400	2,400
12		2,400	2,400	2,400	2,400	2,400

Table T.1 c Madrid South Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table T.1d Boston Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Project **Hope Bay**
Project Nu **1CT022-036**
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.4 Process Plant Reclaim

Note *Update the water use values based on the hourly process flow breakdown*

0.7	To process water tank (m^3/tonne)	Based on average July to Dec 2018
0.8	To raw water tank (m^3/tonne)	Based on average July to Dec 2018

Note: *Defines the source of raw water to the process plant*

Option 1	Doris TIA	results in no change in net water to Doris TIA
Options 2	Doris Lake	results in net water addition to Doris TIA
Options 3	-	results in no model action when selected

Table R.1 Process Water to Process Plant (m^3/day)

Action: *Calculates reclaim for process water from the Doris TIA case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,400	1,680	1,680	1,680	1,680	1,680
2	1,400	1,680	1,680	1,680	1,680	1,680
3	1,400	1,680	1,680	1,680	1,680	1,680
4	1,400	1,680	1,680	1,680	1,680	1,680
5	1,400	1,680	1,680	1,680	1,680	1,680
6	1,400	1,680	1,680	1,680	1,680	1,680
7	1,680	1,680	1,680	1,680	1,680	1,680
8	1,680	1,680	1,680	1,680	1,680	1,680
9	1,680	1,680	1,680	1,680	1,680	1,680
10	1,680	1,680	1,680	1,680	1,680	1,680
11	1,680	1,680	1,680	1,680	1,680	1,680
12	1,680	1,680	1,680	1,680	1,680	1,680

Table R.2 Raw Water to Process Plant (m^3/day)

Action: *Calculates reclaim for raw water (location selected in table to the right) in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,600	1,920	1,920	1,920	1,920	1,920
2	1,600	1,920	1,920	1,920	1,920	1,920
3	1,600	1,920	1,920	1,920	1,920	1,920
4	1,600	1,920	1,920	1,920	1,920	1,920
5	1,600	1,920	1,920	1,920	1,920	1,920
6	1,600	1,920	1,920	1,920	1,920	1,920
7	1,920	1,920	1,920	1,920	1,920	1,920
8	1,920	1,920	1,920	1,920	1,920	1,920
9	1,920	1,920	1,920	1,920	1,920	1,920
10	1,920	1,920	1,920	1,920	1,920	1,920
11	1,920	1,920	1,920	1,920	1,920	1,920
12	1,920	1,920	1,920	1,920	1,920	1,920

Table R.3 Source of Raw Water

Action: *Select the source of Raw water to the Doris Process Plant from the drop-down list*

Month	2019	2020	2021	2022	2023	2024
1	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
2	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
3	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
4	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
5	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
6	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
7	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
8	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
9	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
10	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
11	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
12	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA

Table R.4 Total Reclaim Volume from the Doris TIA (m^3/month)

Table Calculates the reclaim water demand from the Doris TIA in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Section 2.4.5 Sewage Treatment Plant Effluent

Note *Table below shows relevant averages from historic data*

0.16	Average rate since operations (m^3/person/day)
-	

Table S.1 - Average number of people at the camp each month

Action: *Input the average number of people at camp*

Month	2019	2020	2021	2022	2023	2024
1		300	300	300	300	300
2		300	300	300	300	300
3		300	300	300	300	300
4		300	300	300	300	300
5	300	300	300	300	300	300
6	300	300	300	300	300	300
7	300	300	300	300	300	300
8	300	300	300	300	300	300
9	300	300	300	300	300	300
10	300	300	300	300	300	300
11	300	300	300	300	300	300
12	300	300	300	300	300	300

Table S.2 - Percent of sewage treatment plant effluent directed to the TIA (the rest reports to the tundra)

Action: *Define percent sewage to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1		100%	100%	100%	100%	100%
2		100%	100%	100%	100%	100%
3		100%	100%	100%	100%	100%
4		100%	100%	100%	100%	100%
5		100%	100%	100%	100%	100%
6		100%	100%	100%	100%	100%
7		100%	100%	100%	100%	100%
8		100%	100%	100%	100%	100%
9	100%	100%	100%	100%	100%	100%
10	100%	100%	100%	100%	100%	100%
11	100%	100%	100%	100%	100%	100%
12	100%	100%	100%	100%	100%	100%

Table S.3 - Calculates the volume of sewage treatment effluent pumped to the Doris TIA

Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	1,484	1,484	1,484	1,484	1,484
2	0	1,388	1,340	1,340	1,340	1,388
3	0	1,484	1,484	1,484	1,484	1,484
4	0	1,436	1,436	1,436	1,436	1,436
5	0	1,484	1,484	1,484	1,484	1,484
6	0	1,436	1,436	1,436	1,436	1,436
7	0	1,484	1,484	1,484	1,484	1,484
8	0	1,484	1,484	1,484	1,484	1,484
9	1,436	1,436	1,436	1,436	1,436	1,436
10	1,484	1,484	1,484	1,484	1,484	1,484
11	1,436	1,436	1,436	1,436	1,436	1,436
12	1,484	1,484	1,484	1,484	1,484	1,484

Section 2.4.6 Sediment Control Pond (SCP) to Doris TIA

Note *Table below shows relevant averages from historic data (m^3/day)*

391	2018 June Data
222	2018 July Data
700	2018 August Data

Table C.1 Volume from SCP to Doris TIA - does not include mine water flows (m^3/day)

Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6	391	391	391	391	391	391
7	222	222	222	222	222	222
8	700	700	700	700	700	700
9						
10						
11						
12						

Table C.2 Volume from SCP to Doris TIA - does not include mine water flows (m^3/month)

Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	11,725	11,725	11,725	11,725	11,725	11,725
7	6,876	6,876	6,876	6,876	6,876	6,876
8	21,700	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.7 Doris TIA Discharge to Roberts Bay

Pump Capacity	7,200	m^3/day
Pump Availability	80%	

For Reference Design Capacity of System = 7,200 m^3/day

Table D.1 Doris TIA Discharge Pump Utilization (days/month)

Action: *Fill in the number of days in a month the pump is active*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6		30	30	30	30	30
7		31	31	31	31	31
8		31	31	31	31	31
9		30	30	30	30	30
10						
11						
12						

Table D.2 Doris TIA Discharge Pumping Rate (m^3/month)

Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	172,800	172,800	172,800	172,800	172,800
7	0	178,560	178,560	178,560	178,560	178,560
8	0	178,560	178,560	178,560	178,560	178,560
9	0	172,800	172,800	172,800	172,800	172,800
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.8 Madrid North Contact Water Pond (CWP) to Doris TIA

Note *Assumes the same as the Doris SCP*

391	2018 June Data
222	2018 July Data
700	2018 August Data

Table W.1 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/day)

Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6		391	391	391	391	391
7		222	222	222	222	222
8		700	700	700	700	700
9						
10						
11						
12						

Table W.2 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/month)

Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	11,725	11,725	11,725	11,725	11,725
7	0	6,876	6,876	6,876	6,876	6,876
8	0	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Project **Hope Bay**
Project Nι **1CT022-036**
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.1 Hydrology

Action: *Select Annual Return Period for green cells*

Year	Return Period
2016	Average
2017	Average
2018	Average
2019	1 in 100 Wet
2020	1 in 100 Wet
2021	1 in 100 Wet
2022	1 in 100 Wet
2023	1 in 100 Wet

Section 2.5.1 Load Balance

Action: *Select Predictive Source Term*
Source Term: Base Case

Source Term Options

Upper Case
Base Case

Section 2.4.2 Mine Water

Action: *Select the future mine water curves*

Options	Description
1	Groundwater Model Curve
2	Adjusted Groundwater Curve to Start from todays observed flows
3	User Input

Action: None, list option for selecting where Mine Water will be directed

Options	Description
1	Doris TIA
2	Roberts Bay

Table M.3 Volume of Mine Water pumped to Doris TIA (via SCP/pumpbox) (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	40,300	8,990	7,831	7,332	3,491	3,649
2	47,600	8,410	6,776	6,650	3,186	3,419
3	65,100	8,990	7,499	7,400	3,553	3,652
4	75,000	9,006	6,345	7,173	3,468	3,534
5	77,500	9,337	7,006	7,425	3,602	3,652
6	75,000	9,078	6,411	2,571	3,498	3,534
7	372,000	9,415	6,792	2,868	3,621	3,652
8	40,300	8,820	6,938	3,019	3,636	3,655
9	51,000	8,553	6,807	3,051	3,522	3,537
10	65,100	8,246	7,121	3,271	3,646	3,652
11	75,000	8,043	6,978	3,255	3,531	3,531
12	86,800	7,812	7,276	3,432	3,655	3,643

Table M.1 Volume of Doris Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,300	2,900	2,400	1,700		
2	1,700	2,900	2,300	1,700		
3	2,100	2,900	2,300	1,700		
4	2,500	3,000	2,000	1,700		
5	2,500	3,000	2,000	1,700		
6	2,500	3,000	1,700			
7	12,000	3,000	1,700			
8	1,300	2,800	1,700			
9	1,700	2,800	1,700			
10	2,100	2,600	1,700			
11	2,500	2,600	1,700			
12	2,800	2,400	1,700			

Table M.4 Volume of Madrid North Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1			126	665	1,126	1,177
2			120	675	1,138	1,179
3			119	687	1,146	1,178
4		2	115	691	1,156	1,178
5		12	260	695	1,162	1,178
6		26	437	857	1,166	1,178
7		37	491	925	1,168	1,178
8		45	538	974	1,173	1,179
9		51	569	1,017	1,174	1,179
10		60	597	1,055	1,176	1,178
11		81	626	1,085	1,177	1,177
12		120	647	1,107	1,179	1,175

Table M.6 Volume of Madrid South Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table M.2 Directs Doris mine water to the Doris TIA (the rest goes to Robert's Bay directly)
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	10%	10%	10%	10%	10%
2	100%	10%	10%	10%	10%	10%
3	100%	10%	10%	10%	10%	10%
4	100%	10%	10%	10%	10%	10%
5	100%	10%	10%	10%	10%	10%
6	100%	10%	10%	10%	10%	10%
7	100%	10%	10%	10%	10%	10%
8	100%	10%	10%	10%	10%	10%
9	100%	10%	10%	10%	10%	10%
10	100%	10%	10%	10%	10%	10%
11	100%	10%	10%	10%	10%	10%
12	100%	10%	10%	10%	10%	10%

Table M.5 Directs Madrid North mine water to the Doris TIA (the rest goes to Robert's Bay direc
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	10%	10%	10%	10%	10%
2	100%	10%	10%	10%	10%	10%
3	100%	10%	10%	10%	10%	10%
4	100%	10%	10%	10%	10%	10%
5	100%	10%	10%	10%	10%	10%
6	100%	10%	10%	10%	10%	10%
7	100%	10%	10%	10%	10%	10%
8	100%	10%	10%	10%	10%	10%
9	100%	10%	10%	10%	10%	10%
10	100%	10%	10%	10%	10%	10%
11	100%	10%	10%	10%	10%	10%
12	100%	10%	10%	10%	10%	10%

Table M.7 Directs Madrid South mine water to the Doris TIA (the rest goes to Robert's Bay directly)
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Section 2.4.3 Ore Processing and Tailings Deposition

Note *Assumes ore = total tailings = flotation tails + detoxified tails*
Assumptions:

Tailings thickener underflow solids:	45%	solids	*Roughly average percent solids (August - November 2018)*
Plant Effluent:	1.50	m^3/tonne c	*Value set to all water into mill*
End of pipe tailings solids content	27%		
Tailings Specific Gravity	2.8		
Deposited Dry Density Slurried Tailings	1.3	tonnes/m^3	
Flotation Tails (% of total tails to TIA)	95%	solids	
Density of Water	1.0	tonnes/m^3	
Tailings Void ratio	1.2		

Table T.1 Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000	2,400	2,400	2,400	2,400	2,400
2	2,000	2,400	2,400	2,400	2,400	2,400
3	2,000	2,400	2,400	2,400	2,400	2,400
4	2,000	2,400	2,400	2,400	2,400	2,400
5	2,000	2,400	2,400	2,400	2,400	2,400
6	2,000	2,400	2,400	2,400	2,400	2,400
7	2,400	2,400	2,400	2,400	2,400	2,400
8	2,400	2,400	2,400	2,400	2,400	2,400
9	2,400	2,400	2,400	2,400	2,400	2,400
10	2,400	2,400	2,400	2,400	2,400	2,400
11	2,400	2,400	2,400	2,400	2,400	2,400
12	2,400	2,400	2,400	2,400	2,400	2,400

Table T.3 Total Tailings Solids to TIA (tonnes/month)
Table Calculates the total tailings solids input to the TIA from the process plant in tonnes/month

Month	2019	2020	2021	2022	2023	2024
1	58,900	70,680	70,680	70,680	70,680	70,680
2	53,200	66,120	63,840	63,840	63,840	66,120
3	58,900	70,680	70,680	70,680	70,680	70,680
4	57,000	68,400	68,400	68,400	68,400	68,400
5	58,900	70,680	70,680	70,680	70,680	70,680
6	57,000	68,400	68,400	68,400	68,400	68,400
7	70,680	70,680	70,680	70,680	70,680	70,680
8	70,680	70,680	70,680	70,680	70,680	70,680
9	68,400	68,400	68,400	68,400	68,400	68,400
10	70,680	70,680	70,680	70,680	70,680	70,680
11	68,400	68,400	68,400	68,400	68,400	68,400
12	70,680	70,680	70,680	70,680	70,680	70,680

Table T.2 Total Volume of water to TIA (m^3/month)
Table Calculates the total water input to the TIA from the process plant in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Table T.1a Doris Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000					
2	2,000					
3	2,000					
4	2,000					
5	2,000					
6	2,000					
7	2,400					
8	2,400					
9	2,400					
10	2,400					
11	2,400					
12	2,400					

Table T.1 b Madrid North Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1		2,400	2,400	2,400	2,400	2,400
2		2,400	2,400	2,400	2,400	2,400
3		2,400	2,400	2,400	2,400	2,400
4		2,400	2,400	2,400	2,400	2,400
5		2,400	2,400	2,400	2,400	2,400
6		2,400	2,400	2,400	2,400	2,400
7		2,400	2,400	2,400	2,400	2,400
8		2,400	2,400	2,400	2,400	2,400
9		2,400	2,400	2,400	2,400	2,400
10		2,400	2,400	2,400	2,400	2,400
11		2,400	2,400	2,400	2,400	2,400
12		2,400	2,400	2,400	2,400	2,400

Table T.1 c Madrid South Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table T.1d Boston Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Project **Hope Bay**
Project Nu **1CT022-036**
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.4 Process Plant Reclaim

Note *Update the water use values based on the hourly process flow breakdown*

0.7	To process water tank (m^3/tonne)	Based on average July to Dec 2018
0.8	To raw water tank (m^3/tonne)	Based on average July to Dec 2018

Note: *Defines the source of raw water to the process plant*

Option 1	Doris TIA	results in no change in net water to Doris TIA
Options 2	Doris Lake	results in net water addition to Doris TIA
Options 3	-	results in no model action when selected

Table R.1 Process Water to Process Plant (m^3/day)

Action: *Calculates reclaim for process water from the Doris TIA case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,400	1,680	1,680	1,680	1,680	1,680
2	1,400	1,680	1,680	1,680	1,680	1,680
3	1,400	1,680	1,680	1,680	1,680	1,680
4	1,400	1,680	1,680	1,680	1,680	1,680
5	1,400	1,680	1,680	1,680	1,680	1,680
6	1,400	1,680	1,680	1,680	1,680	1,680
7	1,680	1,680	1,680	1,680	1,680	1,680
8	1,680	1,680	1,680	1,680	1,680	1,680
9	1,680	1,680	1,680	1,680	1,680	1,680
10	1,680	1,680	1,680	1,680	1,680	1,680
11	1,680	1,680	1,680	1,680	1,680	1,680
12	1,680	1,680	1,680	1,680	1,680	1,680

Table R.2 Raw Water to Process Plant (m^3/day)

Action: *Calculates reclaim for raw water (location selected in table to the right) in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,600	1,920	1,920	1,920	1,920	1,920
2	1,600	1,920	1,920	1,920	1,920	1,920
3	1,600	1,920	1,920	1,920	1,920	1,920
4	1,600	1,920	1,920	1,920	1,920	1,920
5	1,600	1,920	1,920	1,920	1,920	1,920
6	1,600	1,920	1,920	1,920	1,920	1,920
7	1,920	1,920	1,920	1,920	1,920	1,920
8	1,920	1,920	1,920	1,920	1,920	1,920
9	1,920	1,920	1,920	1,920	1,920	1,920
10	1,920	1,920	1,920	1,920	1,920	1,920
11	1,920	1,920	1,920	1,920	1,920	1,920
12	1,920	1,920	1,920	1,920	1,920	1,920

Table R.3 Source of Raw Water

Action: *Select the source of Raw water to the Doris Process Plant from the drop-down list*

Month	2019	2020	2021	2022	2023	2024
1	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
2	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
3	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
4	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
5	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
6	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
7	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
8	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
9	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
10	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
11	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
12	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA

Table R.4 Total Reclaim Volume from the Doris TIA (m^3/month)

Table Calculates the reclaim water demand from the Doris TIA in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Section 2.4.5 Sewage Treatment Plant Effluent

Note *Table below shows relevant averages from historic data*

0.16	Average rate since operations (m^3/person/day)
-	

Table S.1 - Average number of people at the camp each month

Action: *Input the average number of people at camp*

Month	2019	2020	2021	2022	2023	2024
1		300	300	300	300	300
2		300	300	300	300	300
3		300	300	300	300	300
4		300	300	300	300	300
5	300	300	300	300	300	300
6	300	300	300	300	300	300
7	300	300	300	300	300	300
8	300	300	300	300	300	300
9	300	300	300	300	300	300
10	300	300	300	300	300	300
11	300	300	300	300	300	300
12	300	300	300	300	300	300

Table S.2 - Percent of sewage treatment plant effluent directed to the TIA (the rest reports to the tundra)

Action: *Define percent sewage to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1		100%	100%	100%	100%	100%
2		100%	100%	100%	100%	100%
3		100%	100%	100%	100%	100%
4		100%	100%	100%	100%	100%
5		100%	100%	100%	100%	100%
6		100%	100%	100%	100%	100%
7		100%	100%	100%	100%	100%
8		100%	100%	100%	100%	100%
9	100%	100%	100%	100%	100%	100%
10	100%	100%	100%	100%	100%	100%
11	100%	100%	100%	100%	100%	100%
12	100%	100%	100%	100%	100%	100%

Table S.3 - Calculates the volume of sewage treatment effluent pumped to the Doris TIA

Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	1,484	1,484	1,484	1,484	1,484
2	0	1,388	1,340	1,340	1,340	1,388
3	0	1,484	1,484	1,484	1,484	1,484
4	0	1,436	1,436	1,436	1,436	1,436
5	0	1,484	1,484	1,484	1,484	1,484
6	0	1,436	1,436	1,436	1,436	1,436
7	0	1,484	1,484	1,484	1,484	1,484
8	0	1,484	1,484	1,484	1,484	1,484
9	1,436	1,436	1,436	1,436	1,436	1,436
10	1,484	1,484	1,484	1,484	1,484	1,484
11	1,436	1,436	1,436	1,436	1,436	1,436
12	1,484	1,484	1,484	1,484	1,484	1,484

Section 2.4.6 Sediment Control Pond (SCP) to Doris TIA

Note *Table below shows relevant averages from historic data (m^3/day)*

391	2018 June Data
222	2018 July Data
700	2018 August Data

Table C.1 Volume from SCP to Doris TIA - does not include mine water flows (m^3/day)

Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6	391	391	391	391	391	391
7	222	222	222	222	222	222
8	700	700	700	700	700	700
9						
10						
11						
12						

Table C.2 Volume from SCP to Doris TIA - does not include mine water flows (m^3/month)

Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	11,725	11,725	11,725	11,725	11,725	11,725
7	6,876	6,876	6,876	6,876	6,876	6,876
8	21,700	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.7 Doris TIA Discharge to Roberts Bay

Pump Capacity	7,200	m^3/day	For Reference Design Capacity of System = 7,200 m^3/day
Pump Availability	80%		

Table D.1 Doris TIA Discharge Pump Utilization (days/month)

Action: *Fill in the number of days in a month the pump is active*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6		30	30	30	30	30
7		31	31	31	31	31
8		31	31	31	31	31
9		30	30	30	30	30
10						
11						
12						

Table D.2 Doris TIA Discharge Pumping Rate (m^3/month)

Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	172,800	172,800	172,800	172,800	172,800
7	0	178,560	178,560	178,560	178,560	178,560
8	0	178,560	178,560	178,560	178,560	178,560
9	0	172,800	172,800	172,800	172,800	172,800
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.8 Madrid North Contact Water Pond (CWP) to Doris TIA

Note *Assumes the same as the Doris SCP*

391	2018 June Data
222	2018 July Data
700	2018 August Data

Table W.1 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/day)

Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6		391	391	391	391	391
7		222	222	222	222	222
8		700	700	700	700	700
9						
10						
11						
12						

Table W.2 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/month)

Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	11,725	11,725	11,725	11,725	11,725
7	0	6,876	6,876	6,876	6,876	6,876
8	0	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Project **Hope Bay**
Project Nu **1CT022-036**
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.1 Hydrology

Action: *Select Annual Return Period for green cells*

Year	Return Period
2016	Average
2017	Average
2018	Average
2019	1 in 100 Wet
2020	1 in 100 Wet
2021	1 in 100 Wet
2022	1 in 100 Wet
2023	1 in 100 Wet

Section 2.5.1 Load Balance

Action: *Select Predictive Source Term*

Source Term: Base Case

Source Term Options

Upper Case
Base Case

Section 2.4.2 Mine Water

Action: *Select the future mine water curves*

Options	Description
1	Groundwater Model Curve
2	Adjusted Groundwater Curve to Start from todays observed flows
3	User Input

Action: None, list option for selecting where Mine Water will be directed

Options	Description
1	Doris TIA
2	Roberts Bay

Table M.3 Volume of Mine Water pumped to Doris TIA (via SCP/pumpbox) (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	40,300	89,900	7,831	7,332	3,491	3,649
2	47,600	84,100	6,776	6,650	3,186	3,419
3	65,100	89,900	7,499	7,400	3,553	3,652
4	75,000	90,006	6,345	7,173	3,468	3,534
5	77,500	93,037	7,006	7,425	3,602	3,652
6	75,000	9,078	6,411	2,571	3,498	3,534
7	372,000	9,415	6,792	2,868	3,621	3,652
8	40,300	8,820	6,938	3,019	3,636	3,655
9	51,000	8,553	6,807	3,051	3,522	3,537
10	65,100	8,246	7,121	3,271	3,646	3,652
11	75,000	8,043	6,978	3,255	3,531	3,531
12	86,800	7,812	7,276	3,432	3,655	3,643

Table M.1 Volume of Doris Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,300	2,900	2,400	1,700		
2	1,700	2,900	2,300	1,700		
3	2,100	2,900	2,300	1,700		
4	2,500	3,000	2,000	1,700		
5	2,500	3,000	2,000	1,700		
6	2,500	3,000	1,700			
7	12,000	3,000	1,700			
8	1,300	2,800	1,700			
9	1,700	2,800	1,700			
10	2,100	2,600	1,700			
11	2,500	2,600	1,700			
12	2,800	2,400	1,700			

Table M.4 Volume of Madrid North Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1			126	665	1,126	1,177
2			120	675	1,138	1,179
3			119	687	1,146	1,178
4		2	115	691	1,156	1,178
5		12	260	695	1,162	1,178
6		26	437	857	1,166	1,178
7		37	491	925	1,168	1,178
8		45	538	974	1,173	1,179
9		51	569	1,017	1,174	1,179
10		60	597	1,055	1,176	1,178
11		81	626	1,085	1,177	1,177
12		120	647	1,107	1,179	1,175

Table M.6 Volume of Madrid South Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table M.2 Directs Doris mine water to the Doris TIA (the rest goes to Robert's Bay directly)
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	100%	10%	10%	10%	10%
2	100%	100%	10%	10%	10%	10%
3	100%	100%	10%	10%	10%	10%
4	100%	100%	10%	10%	10%	10%
5	100%	100%	10%	10%	10%	10%
6	100%	10%	10%	10%	10%	10%
7	100%	10%	10%	10%	10%	10%
8	100%	10%	10%	10%	10%	10%
9	100%	10%	10%	10%	10%	10%
10	100%	10%	10%	10%	10%	10%
11	100%	10%	10%	10%	10%	10%
12	100%	10%	10%	10%	10%	10%

Table M.5 Directs Madrid North mine water to the Doris TIA (the rest goes to Robert's Bay direc
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	10%	10%	10%	10%	10%
2	100%	10%	10%	10%	10%	10%
3	100%	10%	10%	10%	10%	10%
4	100%	10%	10%	10%	10%	10%
5	100%	10%	10%	10%	10%	10%
6	100%	10%	10%	10%	10%	10%
7	100%	10%	10%	10%	10%	10%
8	100%	10%	10%	10%	10%	10%
9	100%	10%	10%	10%	10%	10%
10	100%	10%	10%	10%	10%	10%
11	100%	10%	10%	10%	10%	10%
12	100%	10%	10%	10%	10%	10%

Table M.7 Directs Madrid South mine water to the Doris TIA (the rest goes to Robert's Bay directly)
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Section 2.4.3 Ore Processing and Tailings Deposition

Note *Assumes ore = total tailings = flotation tails + detoxified tails*

Assumptions:

Tailings thickener underflow solids:	45%	solids	*Roughly average percent solids (August - November 2018)*
Plant Effluent:	1.50	m^3/tonne o	*Value set to all water into mill*
End of pipe tailings solids content	27%		
Tailings Specific Gravity	2.8		
Deposited Dry Density Slurried Tailings	1.3	tonnes/m^3	
Flotation Tails (% of total tails to TIA)	95%	solids	
Density of Water	1.0	tonnes/m^3	
Tailings Void ratio	1.2		

Table T.1 Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000	2,400	2,400	2,400	2,400	2,400
2	2,000	2,400	2,400	2,400	2,400	2,400
3	2,000	2,400	2,400	2,400	2,400	2,400
4	2,000	2,400	2,400	2,400	2,400	2,400
5	2,000	2,400	2,400	2,400	2,400	2,400
6	2,000	2,400	2,400	2,400	2,400	2,400
7	2,400	2,400	2,400	2,400	2,400	2,400
8	2,400	2,400	2,400	2,400	2,400	2,400
9	2,400	2,400	2,400	2,400	2,400	2,400
10	2,400	2,400	2,400	2,400	2,400	2,400
11	2,400	2,400	2,400	2,400	2,400	2,400
12	2,400	2,400	2,400	2,400	2,400	2,400

Table T.3 Total Tailings Solids to TIA (tonnes/month)
Table Calculates the total tailings solids input to the TIA from the process plant in tonnes/month

Month	2019	2020	2021	2022	2023	2024
1	58,900	70,680	70,680	70,680	70,680	70,680
2	53,200	66,120	63,840	63,840	63,840	66,120
3	58,900	70,680	70,680	70,680	70,680	70,680
4	57,000	68,400	68,400	68,400	68,400	68,400
5	58,900	70,680	70,680	70,680	70,680	70,680
6	57,000	68,400	68,400	68,400	68,400	68,400
7	70,680	70,680	70,680	70,680	70,680	70,680
8	70,680	70,680	70,680	70,680	70,680	70,680
9	68,400	68,400	68,400	68,400	68,400	68,400
10	70,680	70,680	70,680	70,680	70,680	70,680
11	68,400	68,400	68,400	68,400	68,400	68,400
12	70,680	70,680	70,680	70,680	70,680	70,680

Table T.2 Total Volume of water to TIA (m^3/month)
Table Calculates the total water input to the TIA from the process plant in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Table T.1a Doris Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000					
2	2,000					
3	2,000					
4	2,000					
5	2,000					
6	2,000					
7	2,400					
8	2,400					
9	2,400					
10	2,400					
11	2,400					
12	2,400					

Table T.1 b Madrid North Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1		2,400	2,400	2,400	2,400	2,400
2		2,400	2,400	2,400	2,400	2,400
3		2,400	2,400	2,400	2,400	2,400
4		2,400	2,400	2,400	2,400	2,400
5		2,400	2,400	2,400	2,400	2,400
6		2,400	2,400	2,400	2,400	2,400
7		2,400	2,400	2,400	2,400	2,400
8		2,400	2,400	2,400	2,400	2,400
9		2,400	2,400	2,400	2,400	2,400
10		2,400	2,400	2,400	2,400	2,400
11		2,400	2,400	2,400	2,400	2,400
12		2,400	2,400	2,400	2,400	2,400

Table T.1 c Madrid South Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table T.1d Boston Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Project **Hope Bay**
Project N **1CT022-036**
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.4 Process Plant Reclaim

Note *Update the water use values based on the hourly process flow breakdown*

0.7	To process water tank (m^3/tonne)	Based on average July to Dec 2018
0.8	To raw water tank (m^3/tonne)	Based on average July to Dec 2018

Table R.1 Process Water to Process Plant (m^3/day)
Action: *Calculates reclaim for process water from the Doris TIA case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,400	1,680	1,680	1,680	1,680	1,680
2	1,400	1,680	1,680	1,680	1,680	1,680
3	1,400	1,680	1,680	1,680	1,680	1,680
4	1,400	1,680	1,680	1,680	1,680	1,680
5	1,400	1,680	1,680	1,680	1,680	1,680
6	1,400	1,680	1,680	1,680	1,680	1,680
7	1,680	1,680	1,680	1,680	1,680	1,680
8	1,680	1,680	1,680	1,680	1,680	1,680
9	1,680	1,680	1,680	1,680	1,680	1,680
10	1,680	1,680	1,680	1,680	1,680	1,680
11	1,680	1,680	1,680	1,680	1,680	1,680
12	1,680	1,680	1,680	1,680	1,680	1,680

Table R.3 Source of Raw Water
Action: *Select the source of Raw water to the Doris Process Plant from the drop-down list*

Month	2019	2020	2021	2022	2023	2024
1	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
2	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
3	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
4	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
5	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
6	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
7	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
8	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
9	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
10	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
11	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
12	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA

Note: *Defines the source of raw water to the process plant*

Option 1	Doris TIA	results in no change in net water to Doris TIA
Options 2	Doris Lake	results in net water addition to Doris TIA
Options 3	-	results in no model action when selected

Table R.2 Raw Water to Process Plant (m^3/day)
Action: *Calculates reclaim for raw water (location selected in table to the right) in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,600	1,920	1,920	1,920	1,920	1,920
2	1,600	1,920	1,920	1,920	1,920	1,920
3	1,600	1,920	1,920	1,920	1,920	1,920
4	1,600	1,920	1,920	1,920	1,920	1,920
5	1,600	1,920	1,920	1,920	1,920	1,920
6	1,600	1,920	1,920	1,920	1,920	1,920
7	1,920	1,920	1,920	1,920	1,920	1,920
8	1,920	1,920	1,920	1,920	1,920	1,920
9	1,920	1,920	1,920	1,920	1,920	1,920
10	1,920	1,920	1,920	1,920	1,920	1,920
11	1,920	1,920	1,920	1,920	1,920	1,920
12	1,920	1,920	1,920	1,920	1,920	1,920

Table R.4 Total Reclaim Volume from the Doris TIA (m^3/month)
Table Calculates the reclaim water demand from the Doris TIA in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Section 2.4.5 Sewage Treatment Plant Effluent

Note *Table below shows relevant averages from historic data*

0.16	Average rate since operations (m^3/person/day)
-	

Table S.1 - Average number of people at the camp each month
Action: *Input the average number of people at camp*

Month	2019	2020	2021	2022	2023	2024
1		300	300	300	300	300
2		300	300	300	300	300
3		300	300	300	300	300
4		300	300	300	300	300
5	300	300	300	300	300	300
6	300	300	300	300	300	300
7	300	300	300	300	300	300
8	300	300	300	300	300	300
9	300	300	300	300	300	300
10	300	300	300	300	300	300
11	300	300	300	300	300	300
12	300	300	300	300	300	300

Table S.3 - Calculates the volume of sewage treatment effluent pumped to the Doris TIA
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	1,484	1,484	1,484	1,484	1,484
2	0	1,388	1,340	1,340	1,340	1,388
3	0	1,484	1,484	1,484	1,484	1,484
4	0	1,436	1,436	1,436	1,436	1,436
5	0	1,484	1,484	1,484	1,484	1,484
6	0	1,436	1,436	1,436	1,436	1,436
7	0	1,484	1,484	1,484	1,484	1,484
8	0	1,484	1,484	1,484	1,484	1,484
9	1,436	1,436	1,436	1,436	1,436	1,436
10	1,484	1,484	1,484	1,484	1,484	1,484
11	1,436	1,436	1,436	1,436	1,436	1,436
12	1,484	1,484	1,484	1,484	1,484	1,484

Table S.2 - Percent of sewage treatment plant effluent directed to the TIA (the rest reports to the tundra)
Action: *Define percent sewage to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1		100%	100%	100%	100%	100%
2		100%	100%	100%	100%	100%
3		100%	100%	100%	100%	100%
4		100%	100%	100%	100%	100%
5		100%	100%	100%	100%	100%
6		100%	100%	100%	100%	100%
7		100%	100%	100%	100%	100%
8		100%	100%	100%	100%	100%
9	100%	100%	100%	100%	100%	100%
10	100%	100%	100%	100%	100%	100%
11	100%	100%	100%	100%	100%	100%
12	100%	100%	100%	100%	100%	100%

Section 2.4.6 Sediment Control Pond (SCP) to Doris TIA

Note *Table below shows relevant averages from historic data (m^3/day)*

391	2018 June Data
222	2018 July Data
700	2018 August Data

Table C.1 Volume from SCP to Doris TIA - does not include mine water flows (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6	391	391	391	391	391	391
7	222	222	222	222	222	222
8	700	700	700	700	700	700
9						
10						
11						
12						

Table C.2 Volume from SCP to Doris TIA - does not include mine water flows (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	11,725	11,725	11,725	11,725	11,725	11,725
7	6,876	6,876	6,876	6,876	6,876	6,876
8	21,700	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.7 Doris TIA Discharge to Roberts Bay

Pump Capacity	7,200	m^3/day	For Reference Design Capacity of System = 7,200 m^3/day
Pump Availability	80%		

Table D.1 Doris TIA Discharge Pump Utilization (days/month)
Action: *Fill in the number of days in a month the pump is active*

Month	2019	2020	2021	2022	2023	2024
1		31				
2		28				
3		31				
4		30				
5		31				
6		30	30	30	30	30
7		31	31	31	31	31
8		31	31	31	31	31
9		30	30	30	30	30
10						
11						
12						

Table D.2 Doris TIA Discharge Pumping Rate (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	178,560	0	0	0	0
2	0	161,280	0	0	0	0
3	0	178,560	0	0	0	0
4	0	172,800	0	0	0	0
5	0	178,560	0	0	0	0
6	0	172,800	172,800	172,800	172,800	172,800
7	0	178,560	178,560	178,560	178,560	178,560
8	0	178,560	178,560	178,560	178,560	178,560
9	0	172,800	172,800	172,800	172,800	172,800
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.8 Madrid North Contact Water Pond (CWP) to Doris TIA

Note *Assumes the same as the Doris SCP*

391	2018 June Data
222	2018 July Data
700	2018 August Data

Table W.1 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6		391	391	391	391	391
7		222	222	222	222	222
8		700	700	700	700	700
9						
10						
11						
12						

Table W.2 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	11,725	11,725	11,725	11,725	11,725
7	0	6,876	6,876	6,876	6,876	6,876
8	0	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Project **Hope Bay**
Project Nı **1CT022-036**
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.1 Hydrology

Action: *Select Annual Return Period for green cells*

Year	Return Period
2016	Average
2017	Average
2018	Average
2019	Average
2020	Average
2021	Average
2022	Average
2023	Average

Section 2.5.1 Load Balance

Action: *Select Predictive Source Term*

Source Term: Base Case

Source Term Options

Upper Case
Base Case

Section 2.4.2 Mine Water

Action: *Select the future mine water curves*

Options	Description
1	Groundwater Model Curve
2	Adjusted Groundwater Curve to Start from todays observed flows
3	User Input

Action: None, list option for selecting where Mine Water will be directed

Options	Description
1	Doris TIA
2	Roberts Bay

Table M.3 Volume of Mine Water pumped to Doris TIA (via SCP/pumpbox) (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	40,300	89,900	78,306	73,315	34,906	36,487
2	47,600	84,100	67,760	66,500	31,864	34,191
3	65,100	89,900	74,989	73,997	35,526	36,518
4	75,000	90,060	63,450	71,730	34,680	35,340
5	77,500	93,372	70,060	74,245	36,022	36,518
6	75,000	90,780	64,110	25,710	34,980	35,340
7	372,000	94,147	67,921	28,675	36,208	36,518
8	40,300	88,195	69,378	30,194	36,363	36,549
9	51,000	85,530	68,070	30,510	35,220	35,370
10	65,100	82,460	71,207	32,705	36,456	36,518
11	75,000	80,430	69,780	32,550	35,310	35,310
12	86,800	78,120	72,757	34,317	36,549	36,425

Table M.1 Volume of Doris Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,300	2,900	2,400	1,700		
2	1,700	2,900	2,300	1,700		
3	2,100	2,900	2,300	1,700		
4	2,500	3,000	2,000	1,700		
5	2,500	3,000	2,000	1,700		
6	2,500	3,000	1,700			
7	12,000	3,000	1,700			
8	1,300	2,800	1,700			
9	1,700	2,800	1,700			
10	2,100	2,600	1,700			
11	2,500	2,600	1,700			
12	2,800	2,400	1,700			

Table M.4 Volume of Madrid North Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1			126	665	1,126	1,177
2			120	675	1,138	1,179
3			119	687	1,146	1,178
4		2	115	691	1,156	1,178
5		12	260	695	1,162	1,178
6		26	437	857	1,166	1,178
7		37	491	925	1,168	1,178
8		45	538	974	1,173	1,179
9		51	569	1,017	1,174	1,179
10		60	597	1,055	1,176	1,178
11		81	626	1,085	1,177	1,177
12		120	647	1,107	1,179	1,175

Table M.6 Volume of Madrid South Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table M.2 Directs Doris mine water to the Doris TIA (the rest goes to Robert's Bay directly)
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	100%	100%	100%	100%	100%
2	100%	100%	100%	100%	100%	100%
3	100%	100%	100%	100%	100%	100%
4	100%	100%	100%	100%	100%	100%
5	100%	100%	100%	100%	100%	100%
6	100%	100%	100%	100%	100%	100%
7	100%	100%	100%	100%	100%	100%
8	100%	100%	100%	100%	100%	100%
9	100%	100%	100%	100%	100%	100%
10	100%	100%	100%	100%	100%	100%
11	100%	100%	100%	100%	100%	100%
12	100%	100%	100%	100%	100%	100%

Table M.5 Directs Madrid North mine water to the Doris TIA (the rest goes to Robert's Bay direc
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	100%	100%	100%	100%	100%
2	100%	100%	100%	100%	100%	100%
3	100%	100%	100%	100%	100%	100%
4	100%	100%	100%	100%	100%	100%
5	100%	100%	100%	100%	100%	100%
6	100%	100%	100%	100%	100%	100%
7	100%	100%	100%	100%	100%	100%
8	100%	100%	100%	100%	100%	100%
9	100%	100%	100%	100%	100%	100%
10	100%	100%	100%	100%	100%	100%
11	100%	100%	100%	100%	100%	100%
12	100%	100%	100%	100%	100%	100%

Table M.7 Directs Madrid South mine water to the Doris TIA (the rest goes to Robert's Bay directly)
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Section 2.4.3 Ore Processing and Tailings Deposition

Note *Assumes ore = total tailings = flotation tails + detoxified tails*

Assumptions:

Tailings thickener underflow solids:	45%	solids	*Roughly average percent solids (August - November 2018)*
Plant Effluent:	1.50	m^3/tonne c	*Value set to all water into mill*
End of pipe tailings solids content	27%		
Tailings Specific Gravity	2.8		
Deposited Dry Density Slurried Tailings	1.3	tonnes/m^3	
Flotation Tails (% of total tails to TIA)	95%	solids	
Density of Water	1.0	tonnes/m^3	
Tailings Void ratio	1.2		

Table T.1 Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000	2,400	2,400	2,400	2,400	2,400
2	2,000	2,400	2,400	2,400	2,400	2,400
3	2,000	2,400	2,400	2,400	2,400	2,400
4	2,000	2,400	2,400	2,400	2,400	2,400
5	2,000	2,400	2,400	2,400	2,400	2,400
6	2,000	2,400	2,400	2,400	2,400	2,400
7	2,400	2,400	2,400	2,400	2,400	2,400
8	2,400	2,400	2,400	2,400	2,400	2,400
9	2,400	2,400	2,400	2,400	2,400	2,400
10	2,400	2,400	2,400	2,400	2,400	2,400
11	2,400	2,400	2,400	2,400	2,400	2,400
12	2,400	2,400	2,400	2,400	2,400	2,400

Table T.3 Total Tailings Solids to TIA (tonnes/month)
Table Calculates the total tailings solids input to the TIA from the process plant in tonnes/month

Month	2019	2020	2021	2022	2023	2024
1	58,900	70,680	70,680	70,680	70,680	70,680
2	53,200	66,120	63,840	63,840	63,840	66,120
3	58,900	70,680	70,680	70,680	70,680	70,680
4	57,000	68,400	68,400	68,400	68,400	68,400
5	58,900	70,680	70,680	70,680	70,680	70,680
6	57,000	68,400	68,400	68,400	68,400	68,400
7	70,680	70,680	70,680	70,680	70,680	70,680
8	70,680	70,680	70,680	70,680	70,680	70,680
9	68,400	68,400	68,400	68,400	68,400	68,400
10	70,680	70,680	70,680	70,680	70,680	70,680
11	68,400	68,400	68,400	68,400	68,400	68,400
12	70,680	70,680	70,680	70,680	70,680	70,680

Table T.2 Total Volume of water to TIA (m^3/month)
Table Calculates the total water input to the TIA from the process plant in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Table T.1a Doris Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000					
2	2,000					
3	2,000					
4	2,000					
5	2,000					
6	2,000					
7	2,400					
8	2,400					
9	2,400					
10	2,400					
11	2,400					
12	2,400					

Table T.1 b Madrid North Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1		2,400	2,400	2,400	2,400	2,400
2		2,400	2,400	2,400	2,400	2,400
3		2,400	2,400	2,400	2,400	2,400
4		2,400	2,400	2,400	2,400	2,400
5		2,400	2,400	2,400	2,400	2,400
6		2,400	2,400	2,400	2,400	2,400
7		2,400	2,400	2,400	2,400	2,400
8		2,400	2,400	2,400	2,400	2,400
9		2,400	2,400	2,400	2,400	2,400
10		2,400	2,400	2,400	2,400	2,400
11		2,400	2,400	2,400	2,400	2,400
12		2,400	2,400	2,400	2,400	2,400

Table T.1 c Madrid South Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table T.1d Boston Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Project **Hope Bay**
Project Nu **1CT022-036**
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.4 Process Plant Reclaim

Note *Update the water use values based on the hourly process flow breakdown*

0.7	To process water tank (m^3/tonne)	Based on average July to Dec 2018
0.8	To raw water tank (m^3/tonne)	Based on average July to Dec 2018

Note: *Defines the source of raw water to the process plant*

Option 1	Doris TIA	results in no change in net water to Doris TIA
Options 2	Doris Lake	results in net water addition to Doris TIA
Options 3	-	results in no model action when selected

Table R.1 Process Water to Process Plant (m^3/day)
Action: *Calculates reclaim for process water from the Doris TIA case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,400	1,680	1,680	1,680	1,680	1,680
2	1,400	1,680	1,680	1,680	1,680	1,680
3	1,400	1,680	1,680	1,680	1,680	1,680
4	1,400	1,680	1,680	1,680	1,680	1,680
5	1,400	1,680	1,680	1,680	1,680	1,680
6	1,400	1,680	1,680	1,680	1,680	1,680
7	1,680	1,680	1,680	1,680	1,680	1,680
8	1,680	1,680	1,680	1,680	1,680	1,680
9	1,680	1,680	1,680	1,680	1,680	1,680
10	1,680	1,680	1,680	1,680	1,680	1,680
11	1,680	1,680	1,680	1,680	1,680	1,680
12	1,680	1,680	1,680	1,680	1,680	1,680

Table R.2 Raw Water to Process Plant (m^3/day)
Action: *Calculates reclaim for raw water (location selected in table to the right) in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,600	1,920	1,920	1,920	1,920	1,920
2	1,600	1,920	1,920	1,920	1,920	1,920
3	1,600	1,920	1,920	1,920	1,920	1,920
4	1,600	1,920	1,920	1,920	1,920	1,920
5	1,600	1,920	1,920	1,920	1,920	1,920
6	1,600	1,920	1,920	1,920	1,920	1,920
7	1,920	1,920	1,920	1,920	1,920	1,920
8	1,920	1,920	1,920	1,920	1,920	1,920
9	1,920	1,920	1,920	1,920	1,920	1,920
10	1,920	1,920	1,920	1,920	1,920	1,920
11	1,920	1,920	1,920	1,920	1,920	1,920
12	1,920	1,920	1,920	1,920	1,920	1,920

Table R.3 Source of Raw Water
Action: *Select the source of Raw water to the Doris Process Plant from the drop-down list*

Month	2019	2020	2021	2022	2023	2024
1	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
2	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
3	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
4	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
5	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
6	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
7	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
8	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
9	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
10	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
11	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
12	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA

Table R.4 Total Reclaim Volume from the Doris TIA (m^3/month)
Table Calculates the reclaim water demand from the Doris TIA in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Section 2.4.5 Sewage Treatment Plant Effluent

Note *Table below shows relevant averages from historic data*

0.16	Average rate since operations (m^3/person/day)
-	

Table S.1 - Average number of people at the camp each month
Action: *Input the average number of people at camp*

Month	2019	2020	2021	2022	2023	2024
1		300	300	300	300	300
2		300	300	300	300	300
3		300	300	300	300	300
4		300	300	300	300	300
5	300	300	300	300	300	300
6	300	300	300	300	300	300
7	300	300	300	300	300	300
8	300	300	300	300	300	300
9	300	300	300	300	300	300
10	300	300	300	300	300	300
11	300	300	300	300	300	300
12	300	300	300	300	300	300

Table S.2 - Percent of sewage treatment plant effluent directed to the TIA (the rest reports to the tundra)
Action: *Define percent sewage to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1		100%	100%	100%	100%	100%
2		100%	100%	100%	100%	100%
3		100%	100%	100%	100%	100%
4		100%	100%	100%	100%	100%
5		100%	100%	100%	100%	100%
6		100%	100%	100%	100%	100%
7		100%	100%	100%	100%	100%
8		100%	100%	100%	100%	100%
9	100%	100%	100%	100%	100%	100%
10	100%	100%	100%	100%	100%	100%
11	100%	100%	100%	100%	100%	100%
12	100%	100%	100%	100%	100%	100%

Table S.3 - Calculates the volume of sewage treatment effluent pumped to the Doris TIA
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	1,484	1,484	1,484	1,484	1,484
2	0	1,388	1,340	1,340	1,340	1,388
3	0	1,484	1,484	1,484	1,484	1,484
4	0	1,436	1,436	1,436	1,436	1,436
5	0	1,484	1,484	1,484	1,484	1,484
6	0	1,436	1,436	1,436	1,436	1,436
7	0	1,484	1,484	1,484	1,484	1,484
8	0	1,484	1,484	1,484	1,484	1,484
9	1,436	1,436	1,436	1,436	1,436	1,436
10	1,484	1,484	1,484	1,484	1,484	1,484
11	1,436	1,436	1,436	1,436	1,436	1,436
12	1,484	1,484	1,484	1,484	1,484	1,484

Section 2.4.6 Sediment Control Pond (SCP) to Doris TIA

Note *Table below shows relevant averages from historic data (m^3/day)*

391	2018 June Data
222	2018 July Data
700	2018 August Data

Table C.1 Volume from SCP to Doris TIA - does not include mine water flows (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6	391	391	391	391	391	391
7	222	222	222	222	222	222
8	700	700	700	700	700	700
9						
10						
11						
12						

Table C.2 Volume from SCP to Doris TIA - does not include mine water flows (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	11,725	11,725	11,725	11,725	11,725	11,725
7	6,876	6,876	6,876	6,876	6,876	6,876
8	21,700	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.7 Doris TIA Discharge to Roberts Bay

Pump Capacity	7,200	m^3/day
Pump Availability	80%	

For Reference Design Capacity of System = 7,200 m^3/day

Table D.1 Doris TIA Discharge Pump Utilization (days/month)
Action: *Fill in the number of days in a month the pump is active*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6		30	30	30	30	30
7		31	31	31	31	31
8		31	31	31	31	31
9		30	30	30	30	30
10						
11						
12						

Table D.2 Doris TIA Discharge Pumping Rate (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	172,800	172,800	172,800	172,800	172,800
7	0	178,560	178,560	178,560	178,560	178,560
8	0	178,560	178,560	178,560	178,560	178,560
9	0	172,800	172,800	172,800	172,800	172,800
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.8 Madrid North Contact Water Pond (CWP) to Doris TIA

Note *Assumes the same as the Doris SCP*

391	2018 June Data
222	2018 July Data
700	2018 August Data

Table W.1 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6		391	391	391	391	391
7		222	222	222	222	222
8		700	700	700	700	700
9						
10						
11						
12						

Table W.2 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	11,725	11,725	11,725	11,725	11,725
7	0	6,876	6,876	6,876	6,876	6,876
8	0	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Project **Hope Bay**
Project Nu **1CT022-036**
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.1 Hydrology

Action: *Select Annual Return Period for green cells*

Year	Return Period
2016	Average
2017	Average
2018	Average
2019	1 in 100 Wet
2020	1 in 100 Wet
2021	1 in 100 Wet
2022	1 in 100 Wet
2023	1 in 100 Wet

Section 2.5.1 Load Balance

Action: *Select Predictive Source Term*
Source Term: Base Case

Source Term Options

Upper Case
Base Case

Section 2.4.2 Mine Water

Action: *Select the future mine water curves*

Options	Description
1	Groundwater Model Curve
2	Adjusted Groundwater Curve to Start from todays observed flows
3	User Input

Action: None, list option for selecting where Mine Water will be directed

Options	Description
1	Doris TIA
2	Roberts Bay

Table M.3 Volume of Mine Water pumped to Doris TIA (via SCP/pumpbox) (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	40,300	89,900	78,306	73,315	34,906	36,487
2	47,600	84,100	67,760	66,500	31,864	34,191
3	65,100	89,900	74,989	73,997	35,526	36,518
4	75,000	90,060	63,450	71,730	34,680	35,340
5	77,500	93,372	70,060	74,245	36,022	36,518
6	75,000	90,780	64,110	25,710	34,980	35,340
7	372,000	94,147	67,921	28,675	36,208	36,518
8	40,300	88,195	69,378	30,194	36,363	36,549
9	51,000	85,530	68,070	30,510	35,220	35,370
10	65,100	82,460	71,207	32,705	36,456	36,518
11	75,000	80,430	69,780	32,550	35,310	35,310
12	86,800	78,120	72,757	34,317	36,549	36,425

Table M.1 Volume of Doris Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,300	2,900	2,400	1,700		
2	1,700	2,900	2,300	1,700		
3	2,100	2,900	2,300	1,700		
4	2,500	3,000	2,000	1,700		
5	2,500	3,000	2,000	1,700		
6	2,500	3,000	1,700			
7	12,000	3,000	1,700			
8	1,300	2,800	1,700			
9	1,700	2,800	1,700			
10	2,100	2,600	1,700			
11	2,500	2,600	1,700			
12	2,800	2,400	1,700			

Table M.4 Volume of Madrid North Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1			126	665	1,126	1,177
2			120	675	1,138	1,179
3			119	687	1,146	1,178
4		2	115	691	1,156	1,178
5		12	260	695	1,162	1,178
6		26	437	857	1,166	1,178
7		37	491	925	1,168	1,178
8		45	538	974	1,173	1,179
9		51	569	1,017	1,174	1,179
10		60	597	1,055	1,176	1,178
11		81	626	1,085	1,177	1,177
12		120	647	1,107	1,179	1,175

Table M.6 Volume of Madrid South Mine Water pumped to Surface (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table M.2 Directs Doris mine water to the Doris TIA (the rest goes to Robert's Bay directly)
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	100%	100%	100%	100%	100%
2	100%	100%	100%	100%	100%	100%
3	100%	100%	100%	100%	100%	100%
4	100%	100%	100%	100%	100%	100%
5	100%	100%	100%	100%	100%	100%
6	100%	100%	100%	100%	100%	100%
7	100%	100%	100%	100%	100%	100%
8	100%	100%	100%	100%	100%	100%
9	100%	100%	100%	100%	100%	100%
10	100%	100%	100%	100%	100%	100%
11	100%	100%	100%	100%	100%	100%
12	100%	100%	100%	100%	100%	100%

Table M.5 Directs Madrid North mine water to the Doris TIA (the rest goes to Robert's Bay direc
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1	100%	100%	100%	100%	100%	100%
2	100%	100%	100%	100%	100%	100%
3	100%	100%	100%	100%	100%	100%
4	100%	100%	100%	100%	100%	100%
5	100%	100%	100%	100%	100%	100%
6	100%	100%	100%	100%	100%	100%
7	100%	100%	100%	100%	100%	100%
8	100%	100%	100%	100%	100%	100%
9	100%	100%	100%	100%	100%	100%
10	100%	100%	100%	100%	100%	100%
11	100%	100%	100%	100%	100%	100%
12	100%	100%	100%	100%	100%	100%

Table M.7 Directs Madrid South mine water to the Doris TIA (the rest goes to Robert's Bay directly)
Action: *Define percentage of Mine Water directed to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Section 2.4.3 Ore Processing and Tailings Deposition

Note *Assumes ore = total tailings = flotation tails + detoxified tails*
Assumptions:

Tailings thickener underflow solids:	45%	solids	*Roughly average percent solids (August - November 2018)*
Plant Effluent:	1.50	m^3/tonne c	*Value set to all water into mill*
End of pipe tailings solids content	27%		
Tailings Specific Gravity	2.8		
Deposited Dry Density Slurried Tailings	1.3	tonnes/m^3	
Flotation Tails (% of total tails to TIA)	95%	solids	
Density of Water	1.0	tonnes/m^3	
Tailings Void ratio	1.2		

Table T.1 Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000	2,400	2,400	2,400	2,400	2,400
2	2,000	2,400	2,400	2,400	2,400	2,400
3	2,000	2,400	2,400	2,400	2,400	2,400
4	2,000	2,400	2,400	2,400	2,400	2,400
5	2,000	2,400	2,400	2,400	2,400	2,400
6	2,000	2,400	2,400	2,400	2,400	2,400
7	2,400	2,400	2,400	2,400	2,400	2,400
8	2,400	2,400	2,400	2,400	2,400	2,400
9	2,400	2,400	2,400	2,400	2,400	2,400
10	2,400	2,400	2,400	2,400	2,400	2,400
11	2,400	2,400	2,400	2,400	2,400	2,400
12	2,400	2,400	2,400	2,400	2,400	2,400

Table T.3 Total Tailings Solids to TIA (tonnes/month)
Table Calculates the total tailings solids input to the TIA from the process plant in tonnes/month

Month	2019	2020	2021	2022	2023	2024
1	58,900	70,680	70,680	70,680	70,680	70,680
2	53,200	66,120	63,840	63,840	63,840	66,120
3	58,900	70,680	70,680	70,680	70,680	70,680
4	57,000	68,400	68,400	68,400	68,400	68,400
5	58,900	70,680	70,680	70,680	70,680	70,680
6	57,000	68,400	68,400	68,400	68,400	68,400
7	70,680	70,680	70,680	70,680	70,680	70,680
8	70,680	70,680	70,680	70,680	70,680	70,680
9	68,400	68,400	68,400	68,400	68,400	68,400
10	70,680	70,680	70,680	70,680	70,680	70,680
11	68,400	68,400	68,400	68,400	68,400	68,400
12	70,680	70,680	70,680	70,680	70,680	70,680

Table T.2 Total Volume of water to TIA (m^3/month)
Table Calculates the total water input to the TIA from the process plant in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Table T.1a Doris Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1	2,000					
2	2,000					
3	2,000					
4	2,000					
5	2,000					
6	2,000					
7	2,400					
8	2,400					
9	2,400					
10	2,400					
11	2,400					
12	2,400					

Table T.1 b Madrid North Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1		2,400	2,400	2,400	2,400	2,400
2		2,400	2,400	2,400	2,400	2,400
3		2,400	2,400	2,400	2,400	2,400
4		2,400	2,400	2,400	2,400	2,400
5		2,400	2,400	2,400	2,400	2,400
6		2,400	2,400	2,400	2,400	2,400
7		2,400	2,400	2,400	2,400	2,400
8		2,400	2,400	2,400	2,400	2,400
9		2,400	2,400	2,400	2,400	2,400
10		2,400	2,400	2,400	2,400	2,400
11		2,400	2,400	2,400	2,400	2,400
12		2,400	2,400	2,400	2,400	2,400

Table T.1 c Madrid South Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Table T.1d Boston Ore Processing Rate (tpd)
Action: *Input the user defined processing rate in tpd of ore*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Project **Hope Bay**
Project Nı 1CT022-036
Task **Control Panel**
Note: ***green = input cells, black = calculated cells for the model***
Sections numbers are linked back to the Hope Bay Mine Operational Water Balance Summary Memo dated April 5, 2018

Section 2.4.4 Process Plant Reclaim

Note *Update the water use values based on the hourly process flow breakdown*

0.7	To process water tank (m^3/tonne)	Based on average July to Dec 2018
0.8	To raw water tank (m^3/tonne)	Based on average July to Dec 2018

Note: *Defines the source of raw water to the process plant*

Option 1	Doris TIA	results in no change in net water to Doris TIA
Options 2	Doris Lake	results in net water addition to Doris TIA
Options 3	-	results in no model action when selected

Table R.1 Process Water to Process Plant (m^3/day)
Action: *Calculates reclaim for process water from the Doris TIA case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,400	1,680	1,680	1,680	1,680	1,680
2	1,400	1,680	1,680	1,680	1,680	1,680
3	1,400	1,680	1,680	1,680	1,680	1,680
4	1,400	1,680	1,680	1,680	1,680	1,680
5	1,400	1,680	1,680	1,680	1,680	1,680
6	1,400	1,680	1,680	1,680	1,680	1,680
7	1,680	1,680	1,680	1,680	1,680	1,680
8	1,680	1,680	1,680	1,680	1,680	1,680
9	1,680	1,680	1,680	1,680	1,680	1,680
10	1,680	1,680	1,680	1,680	1,680	1,680
11	1,680	1,680	1,680	1,680	1,680	1,680
12	1,680	1,680	1,680	1,680	1,680	1,680

Table R.2 Raw Water to Process Plant (m^3/day)
Action: *Calculates reclaim for raw water (location selected in table to the right) in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1	1,600	1,920	1,920	1,920	1,920	1,920
2	1,600	1,920	1,920	1,920	1,920	1,920
3	1,600	1,920	1,920	1,920	1,920	1,920
4	1,600	1,920	1,920	1,920	1,920	1,920
5	1,600	1,920	1,920	1,920	1,920	1,920
6	1,600	1,920	1,920	1,920	1,920	1,920
7	1,920	1,920	1,920	1,920	1,920	1,920
8	1,920	1,920	1,920	1,920	1,920	1,920
9	1,920	1,920	1,920	1,920	1,920	1,920
10	1,920	1,920	1,920	1,920	1,920	1,920
11	1,920	1,920	1,920	1,920	1,920	1,920
12	1,920	1,920	1,920	1,920	1,920	1,920

Table R.3 Source of Raw Water
Action: *Select the source of Raw water to the Doris Process Plant from the drop-down list*

Month	2019	2020	2021	2022	2023	2024
1	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
2	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
3	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
4	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
5	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
6	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
7	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
8	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
9	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
10	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
11	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA
12	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA	Doris TIA

Table R.4 Total Reclaim Volume from the Doris TIA (m^3/month)
Table Calculates the reclaim water demand from the Doris TIA in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	93,000	111,600	111,600	111,600	111,600	111,600
2	84,000	104,400	100,800	100,800	100,800	104,400
3	93,000	111,600	111,600	111,600	111,600	111,600
4	90,000	108,000	108,000	108,000	108,000	108,000
5	93,000	111,600	111,600	111,600	111,600	111,600
6	90,000	108,000	108,000	108,000	108,000	108,000
7	111,600	111,600	111,600	111,600	111,600	111,600
8	111,600	111,600	111,600	111,600	111,600	111,600
9	108,000	108,000	108,000	108,000	108,000	108,000
10	111,600	111,600	111,600	111,600	111,600	111,600
11	108,000	108,000	108,000	108,000	108,000	108,000
12	111,600	111,600	111,600	111,600	111,600	111,600

Section 2.4.5 Sewage Treatment Plant Effluent

Note *Table below shows relevant averages from historic data*

0.16	Average rate since operations (m^3/person/day)
-	

Table S.1 - Average number of people at the camp each month
Action: *Input the average number of people at camp*

Month	2019	2020	2021	2022	2023	2024
1		300	300	300	300	300
2		300	300	300	300	300
3		300	300	300	300	300
4		300	300	300	300	300
5	300	300	300	300	300	300
6	300	300	300	300	300	300
7	300	300	300	300	300	300
8	300	300	300	300	300	300
9	300	300	300	300	300	300
10	300	300	300	300	300	300
11	300	300	300	300	300	300
12	300	300	300	300	300	300

Table S.2 - Percent of sewage treatment plant effluent directed to the TIA (the rest reports to the tundra)
Action: *Define percent sewage to the Doris TIA*

Month	2019	2020	2021	2022	2023	2024
1		100%	100%	100%	100%	100%
2		100%	100%	100%	100%	100%
3		100%	100%	100%	100%	100%
4		100%	100%	100%	100%	100%
5		100%	100%	100%	100%	100%
6		100%	100%	100%	100%	100%
7		100%	100%	100%	100%	100%
8		100%	100%	100%	100%	100%
9	100%	100%	100%	100%	100%	100%
10	100%	100%	100%	100%	100%	100%
11	100%	100%	100%	100%	100%	100%
12	100%	100%	100%	100%	100%	100%

Table S.3 - Calculates the volume of sewage treatment effluent pumped to the Doris TIA
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	1,484	1,484	1,484	1,484	1,484
2	0	1,388	1,340	1,340	1,340	1,388
3	0	1,484	1,484	1,484	1,484	1,484
4	0	1,436	1,436	1,436	1,436	1,436
5	0	1,484	1,484	1,484	1,484	1,484
6	0	1,436	1,436	1,436	1,436	1,436
7	0	1,484	1,484	1,484	1,484	1,484
8	0	1,484	1,484	1,484	1,484	1,484
9	1,436	1,436	1,436	1,436	1,436	1,436
10	1,484	1,484	1,484	1,484	1,484	1,484
11	1,436	1,436	1,436	1,436	1,436	1,436
12	1,484	1,484	1,484	1,484	1,484	1,484

Section 2.4.6 Sediment Control Pond (SCP) to Doris TIA

Note *Table below shows relevant averages from historic data (m^3/day)*

391	2018 June Data
222	2018 July Data
700	2018 August Data

Table C.1 Volume from SCP to Doris TIA - does not include mine water flows (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6	391	391	391	391	391	391
7	222	222	222	222	222	222
8	700	700	700	700	700	700
9						
10						
11						
12						

Table C.2 Volume from SCP to Doris TIA - does not include mine water flows (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	11,725	11,725	11,725	11,725	11,725	11,725
7	6,876	6,876	6,876	6,876	6,876	6,876
8	21,700	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.7 Doris TIA Discharge to Roberts Bay

Pump Capacity	7,200	m^3/day	For Reference Design Capacity of System = 7,200 m^3/day
Pump Availability	80%		

Table D.1 Doris TIA Discharge Pump Utilization (days/month)
Action: *Fill in the number of days in a month the pump is active*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6		30	30	30	30	30
7		31	31	31	31	31
8		31	31	31	31	31
9		30	30	30	30	30
10						
11						
12						

Table D.2 Doris TIA Discharge Pumping Rate (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	172,800	172,800	172,800	172,800	172,800
7	0	178,560	178,560	178,560	178,560	178,560
8	0	178,560	178,560	178,560	178,560	178,560
9	0	172,800	172,800	172,800	172,800	172,800
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Section 2.4.8 Madrid North Contact Water Pond (CWP) to Doris TIA

Note *Assumes the same as the Doris SCP*

391	2018 June Data
222	2018 July Data
700	2018 August Data

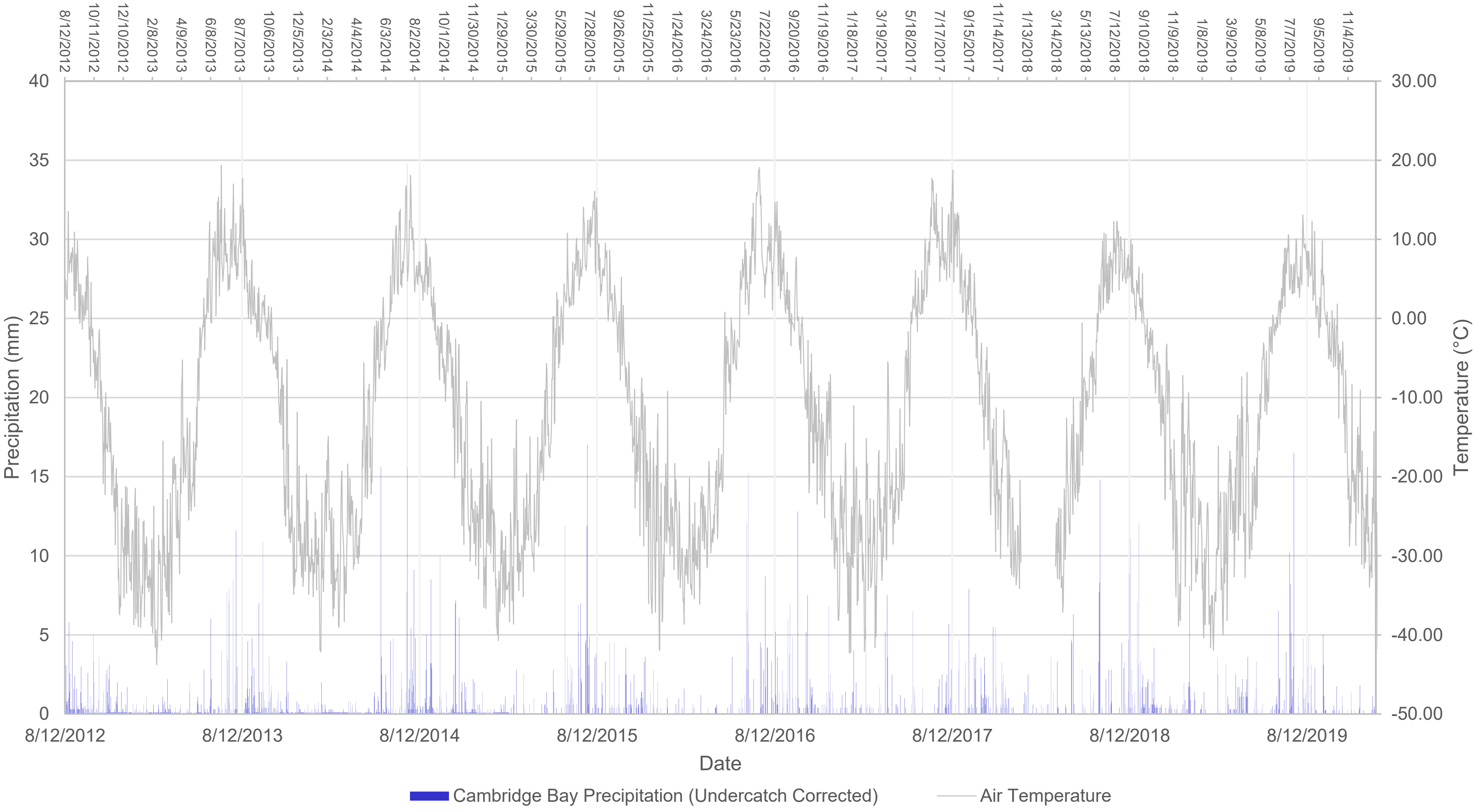
Table W.1 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/day)
Action: *Input the user defined case in m^3/day*

Month	2019	2020	2021	2022	2023	2024
1						
2						
3						
4						
5						
6		391	391	391	391	391
7		222	222	222	222	222
8		700	700	700	700	700
9						
10						
11						
12						

Table W.2 Volume from MN CWP to Doris TIA - does not include mine water flows (m^3/month)
Table Calculates the model input based on selection in m^3/month

Month	2019	2020	2021	2022	2023	2024
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	11,725	11,725	11,725	11,725	11,725
7	0	6,876	6,876	6,876	6,876	6,876
8	0	21,700	21,700	21,700	21,700	21,700
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

Appendix J – Climate Data



Notes:

- This data is intended for reference use in this report.

srk consulting

TMAC RESOURCES

2019 AGI

Climate Data

Job No: 1CT022.038

Filename: AppendixJ_ClimateData.pptx

DORIS TIA

Date: Mar. 2020

Approved: PDL

Figure: **J.1**

Appendix K – 2019 Seepage Review

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Memo

To:	John Kurylo, PEng, EOR Christopher Stevens, PhD Peter Luedke, EIT	**Client:**	TMAC Resources Inc.
From:	Andrea Bowie, PEng Derrick Midwinter, PGeo	**Project No:**	1CT022.037
Reviewed By:	Lisa Barazzuol, PGeo	**Date:**	July 3, 2020
Subject:	2019 North and South Dam Seepage Water Quality Investigation, Hope Bay Project		

1 Background

The North Dam forms the northern boundary of the Doris TIA, within a narrow natural valley blocking the original Tail Lake outlet to Doris Lake. The structure impounds the Reclaim Pond and was designed as a water retaining structure. The dam has a central frozen core with a secondary upstream Geosynthetic Clay Liner (GCL). The dam is constructed from local quarry rock and consists of processed fines for the core, 150 mm nominal sized transition material, and a run of quarry (ROQ) outer shell. To ensure maintenance of frozen foundation conditions, the key trench of the dam is equipped with 12 horizontal thermosyphon evaporators. Seepage of water has been observed along the downstream toe of the dam near the former outlet of Tail Lake since after the first winter of dam construction in 2011.

The South Dam is located at the southern end of the Doris TIA, on the watercourse to Ogama Lake. The South Dam is designed as a frozen foundation dam consisting of a compacted rock fill dam (sourced from a local quarry) with a GCL keyed into the permafrost overburden foundation for seepage control. The dam is designed to retain beached tailings as opposed to water. The dam is to be constructed in two phases, incorporating a single downstream raise. Construction of the first phase began in January 2018 and construction was completed in June 2018.

Key dates for North and South Dam construction and tailings impoundment area (TIA) operations are as follows:

- February 2011 – Initiation of North Dam construction (over two winter seasons),
- April 2012 – Completion of North Dam construction,
- February 2017 – Effective start of tailings discharge from a temporary berm within the TIA,
- January 2018 – Initiation of South Dam construction,
- February 2018 – Mine water discharged to the Doris TIA
- June 2018 – Completion of South Dam construction, deposition from the South Dam began in the same timeframe.

In 2017, based on a recommendation from the Engineer or Record (EOR), TMAC Resources Inc. initiated a monitoring program of North Dam seepage (SRK 2018a). After completion of the South Dam, a similar seepage monitoring program was initiated (SRK 2019a, 2019b).

Monitoring includes seepage inspections for the North and South dams, and water quality sampling and analysis of toe seepage when observed. The monitoring program also includes TIA Reclaim Pond water at surveillance network program (SNP) stations TL-1 and TL-5. Furthermore, at the recommendation of the EOR, three samples of TIA pond at the tailings slurry discharge points at the South Dam were sampled in August 2019 to quantify pond water chemistry and freezing point depression of the TIA tailings as the chemical composition of porewater within the tailings beach will directly impact heat transfer and freeze-back of the tailings over time (SRK 2020a). Delayed freezeback of the tailings beach could limit heat loss from the South Dam foundation immediately below the upstream toe.

The water quality assessment makes use of samples from SNP stations TL-1 and TL-5 that are monitored as part of and in compliance with Water Licence 2AM-DOH1335 Amendment No. 2 (Nunavut Water Board 2018). However, the North Dam seepage monitoring program and associated data analysis presented herein is not a compliance requirement and is the context of the North and South Dams monitoring program and at the request of the EOR. This memo documents a geochemical data review of the aforementioned stations with the following objectives:

- Document the results of the 2019 North and South Dam seepage monitoring programs;
- Understand the potential source of the North Dam toe seep; and
- Assess the major ion chemistry of water quality monitoring stations, including TIA pond water upstream of the South Dam.

2 Methods

2.1 2019 North Dam Toe Seepage Survey and Sampling Program

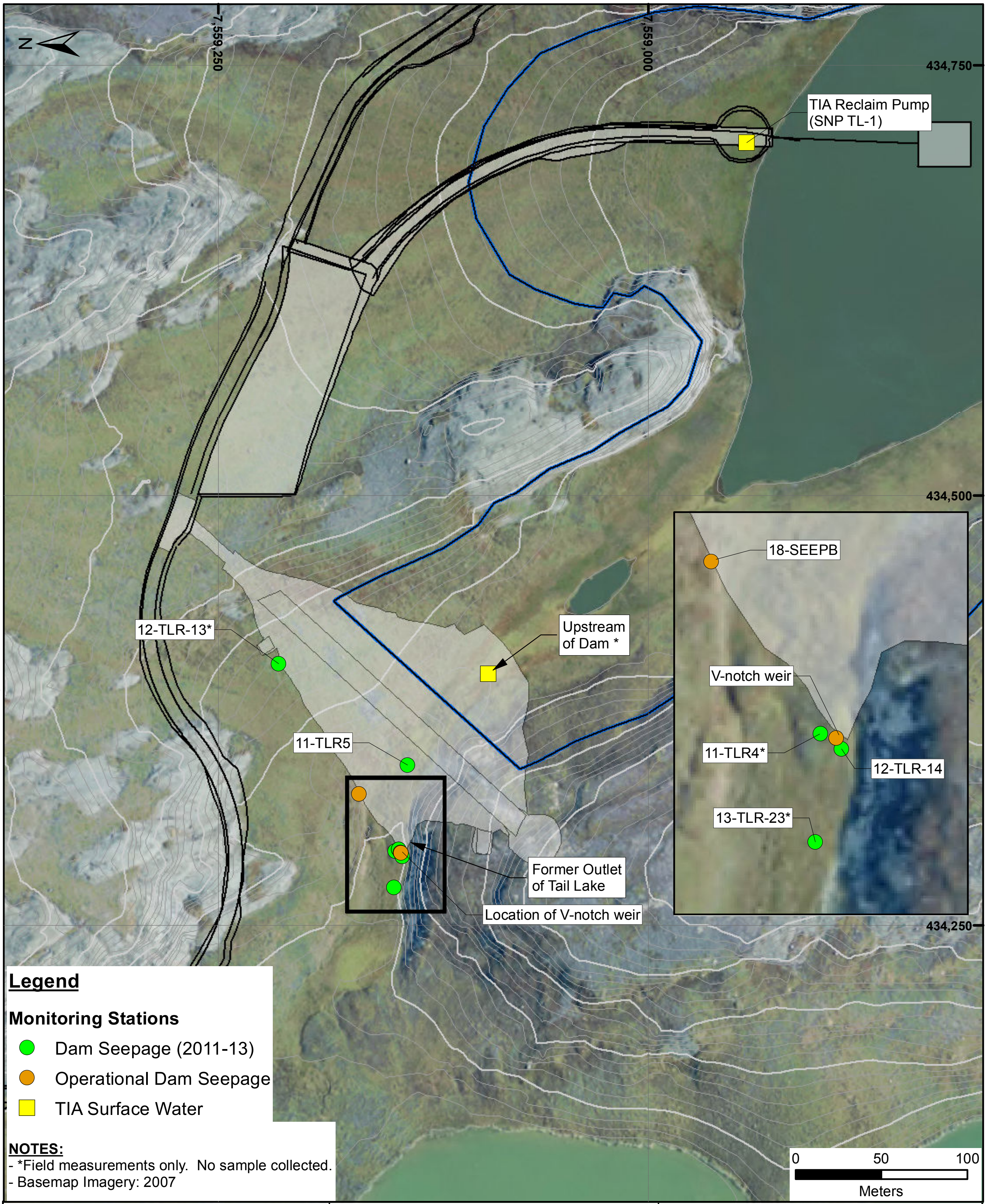
SRK Consulting (Canada) Inc. (2018a) outlines the North Dam toe seepage inspection and water quality monitoring program. In summary, TMAC conducts weekly inspections of the dam toe. If seepage is observed flowing at the dam toe, TMAC collects the following samples at a maximum frequency of once per week (Figure 2-1):

- North Dam toe seepage: field parameters and water quality samples for laboratory analysis are collected at all observed locations of seepage flow,
- TL-1 (reclaim pump): field parameters and water quality samples for laboratory analysis, and
- TIA Reclaim Pond water at upstream face of North Dam: field parameters only.

TMAC shipped samples to ALS Environmental in Burnaby, BC for the analysis of pH, electrical conductivity (EC), total alkalinity, sulphate, chloride, nutrients (ammonia, nitrate and nitrite), total cyanide, free cyanide, cyanate, and dissolved trace elements. At the time of sample collection, TMAC measured the following field parameters: pH, EC, oxidation-reduction potential (ORP), temperature, chloride and flow rate.

In 2019, TMAC collected 12 samples of seepage at the toe of the North Dam and TL-1 over a 13-week period between July 1 and September 23, 2019. On September 9, lab analysis did not include EC, alkalinity, sulphate and dissolved metals. Prior to July 1 and after September 23 seepage at the dam toe was frozen. At TL-1, monitoring occurs year-round. Field measurements of TIA Reclaim Pond water were collected for all of the sampling events, except on August 5, 2019.

The sampling methods for supernatant solution (TL-5) are detailed in SRK (2020) and briefly summarized herein. TMAC collected monthly samples (12 samples collected in 2019) of the process plant tailings supernatant (TL-5) from the flotation tailings thickener tank. The filtrate from the detox filter press (where detoxified tailings are dewatered) is pumped to the flotation tailings thickener tank prior to discharge to the TIA.



Legend

Monitoring Stations

- 🟢 Dam Seepage (2011-13)
- 🟠 Operational Dam Seepage
- 🟨 TIA Surface Water

NOTES:
- *Field measurements only. No sample collected.
- Basemap Imagery: 2007

srk consulting

MAC RESOURCES

ND Seepage Water Quality Investigation

Seepage Monitoring
Sampling Locations

Job No: 1CT022.037

Filename: 1CT022_037_WQsampling_2019

Doris TIA

Date: Mar 2020

Approved: LB

Figure: 2-1

Path: \srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.027_2018 Geochem ComplianceSupport\!040_AutoCAD\GIS\Maps\Figure_Maps\1CT022_027_WQsampling_2018.mxd

2.2 2019 South Dam Toe Seepage Survey and Sampling Program

SRK (2019a) outlines the South Dam toe seepage inspection and water quality monitoring program. Similar to the North Dam program, TMAC conducts weekly inspections of the dam toe. If seepage is observed flowing at the dam toe, TMAC collects the following samples at a maximum frequency of once per week:

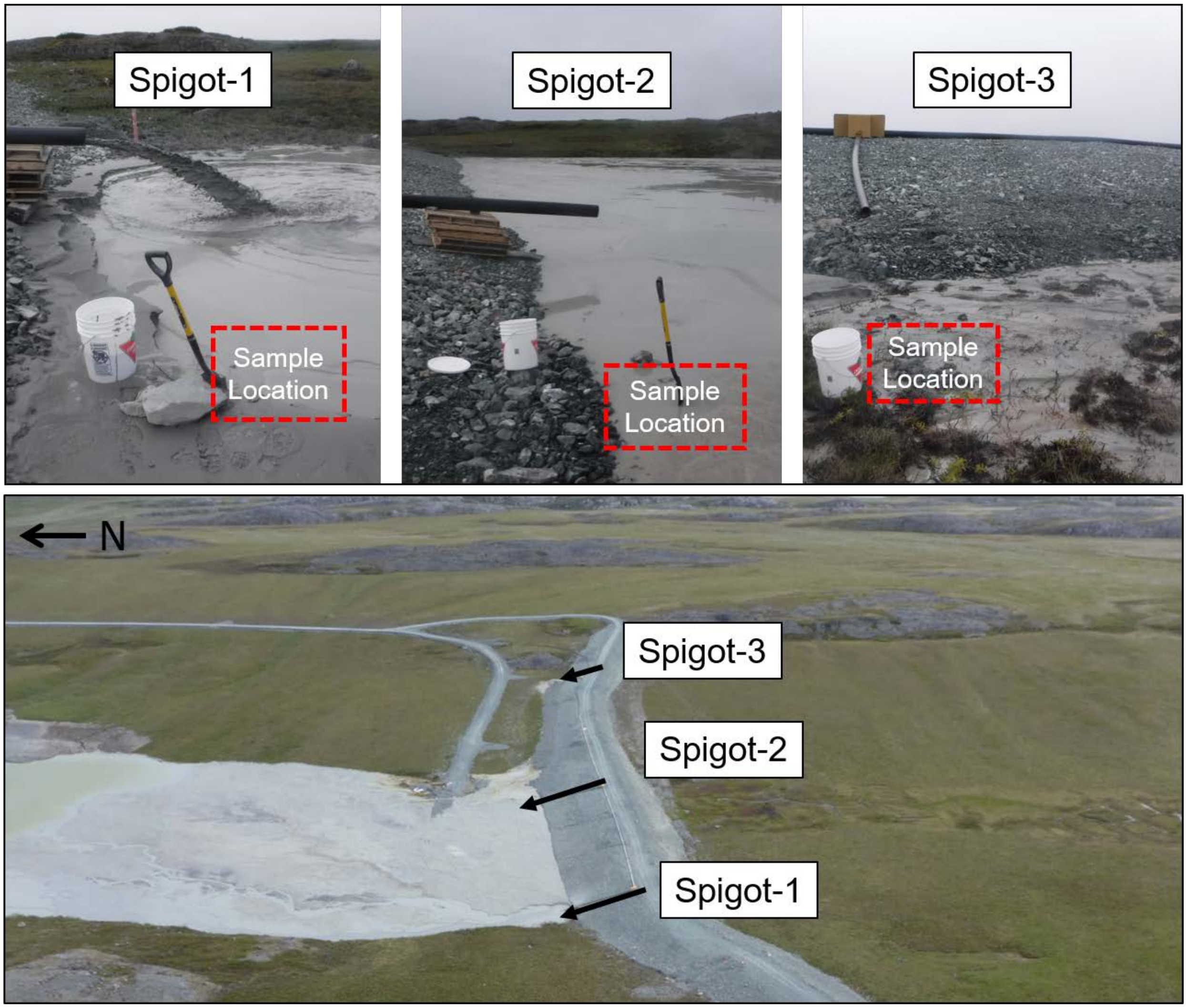
- South Dam toe seepage: field parameters and water quality samples for laboratory analysis are collected at all observed locations of seepage flow,
- TL-5 (tailings supernatant discharge from the mill): field parameters and water quality samples for laboratory analysis, and
- TIA Reclaim Pond water at upstream face of South Dam: field parameters only.

The recommended lab analyses and field parameters are the same as listed in Section 2.1. Seepage was not observed flowing from toe of the South Dam in 2019 and accordingly, samples were not collected.

2.3 TIA Pond Samples Upstream of South Dam

SRK collected one sample of tailings slurry from the upstream face of the south dam on August 4, 2019 near each of the three tailings discharge spigots (Figure 2-2). Prior to sampling, it had rained for several consecutive days. During sample collection, the top 10 cm of tailings were removed using a shovel to remove any meteoric water prior to sampling. In between samples, the shovel was cleaned using distilled water and a stiff brush. For each sample, approximately 10 to 20 kg of tailings slurry was collected in clean 20 L plastic buckets, with the volume of supernatant ranging from 2 to 4 L. At the time of sampling, tailings were being discharged from Spigot-1, with the tailings beach present between Spigot-1 and Spigot-2. The tailings sampled at Spigot-3 were from a tailings area that was not contiguous with the beach at Spigot-1 and Spigot-2 (Figure 2-2).

TMAC shipped samples to Global ARD Testing Service in Burnaby, BC. Global ARD collected samples of supernatant from each bucket for analysis of pH, electrical conductivity (EC), total alkalinity, sulphate, chloride, nutrients (ammonia, nitrate and nitrite), TSS, total cyanide, free cyanide, cyanate, and total and dissolved major and trace elements. It was not possible to measure field pH and EC because of the solids content in the samples.



Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\!080_Deliverables\202003_TIA Dam Seepage\Figures\Figure2.3_SpigotPhotos.png

Figure 2-2: Photos of South Dam Spigots and TIA Pond Samples

2.4 Water Quality Database Compilation

SRK compiled data provided by TMAC for the North Dam toe seepage assessment, with stations presented in Figure 2-1 and described in Table 2-1. An overview of additional water quality sampling data included in this assessment is described as follows:

- North Dam seepage:
  - 2011 to 2014: opportunistic seepage survey along the downstream toe of the dam (SRK 2012 to 2014), and
  - 2017 to 2018: seepage and monitoring program conducted as part of the North Dam seepage monitoring program (SRK 2018b). In 2017, all seepage samples were collected from the location of the v-notch weir;
- TL-1: samples collected as part of the SNP monitoring of TIA Reclaim Pond water, collected at the reclaim pump; and

- TL-5: tailings supernatant samples collected within the mill prior to discharge to the TIA and as part of the SNP monitoring program.

SRK previously conducted data QA/QC of these data, as documented in SRK (2019). A summary of data QA/QC of the 2019 monitoring data is presented in Section 2.3.

Table 2-1: Data Sources

Station ID	Station Description	Years	Reference
North Dam seepage	Downstream toe	2011 to 2014; 2017 to 2018	SRK (2012, 2013, 2014, 2018b)
TIA Reclaim Pond water	Upstream face of North Dam	2017 to 2018	SRK (2018b)
TL-1	Reclaim Pump	2011 to 2018	SNP monitoring program
TL-5	Tailings supernatant discharge to TIA	2017 to 2018	SNP monitoring program

2.5 Quality Control for 2019 Analytical Data

SRK reviewed all 2019 water quality data and conducted a geochemical quality control (QC) program to validate the data. This is routine practice by SRK to ensure confidence in the analysis, through identifying any possible limitations of the data. The outcomes of the QC program are summarized in Table 2-2 (2019 North Dam seepage samples), Table 2-3 (TL-1), and Table 2-4 (South Dam tailings supernatant). The results of data QC for TL-5 are documented in SRK (2020b). SRK flagged the following QC issues that that are summarized as follows:

- North Dam Seepage:
  - Four samples had a greater than 30% RPD between field and lab chloride; TMAC stated that the discrepancy may be the result of instrument not functioning properly. The instrument has since been replaced.
- TL-1:
  - One sample had a greater than 20% RPD between total and dissolved potassium, with both values >10x DL. The data has been confirmed by re-analysis.

All data were deemed acceptable. SRK accepted all data as received.

Table 2-2: Summary of QA/QC Assessment of 2019 Data, North Dam Seepage Samples

QC Test	SRK QC Criteria	North Dam Seepage Results
Physical Test[1]		
Field Blank	Minimum criteria is <2X DL, will accept <5X DL	(n=2) All passed.
Method Blank	<2X DL	(n=14) for Conductivity, (n=13) for TSS, (n=2) for TDS All passed.
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=2) All passed.
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=1) for TSS, (n=1) for Conductivity and (n=1) for pH All passed
Field pH vs. Lab pH	Difference should not be greater than 1 pH unit	(n=13) All passed.
Field EC vs Lab EC	For samples > 10X the detection limit (DL), % RPD should be within +/-30%	(n=12) All passed.
Standard Reference Materials	Within specified tolerance ranges.	(n=15) for pH, (n=14) for EC, (n=10) for TSS and (n=1) for ORP All passed.
Anions and Nutrients[2]		
Field Blank	Minimum criteria is <2X DL, will accept <5X DL	(n=2) All passed.
Method Blank	<2X DL	(n=13) for Total Ammonia (as N), (n=14) for Total Alkalinity, (n=14) for Cl, (n=14) for Nitrate (as N), (n=14) for Nitrite (as N), (n=3) for TKN, (n=15) for Total Nitrogen, (n=3) for Orthophosphate-Dissolved (as P), (n=3) for Phosphorus (P)-Total, (N=13) for SO4 All passed.
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=2) All passed.
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=5) for Total N, (n=1) for Total Ammonia, (n=1) for Total Alkalinity All passed.
Ion Balance	EC>100 uS/cm, % difference should be within +/-10%	(n=12) All passed.
Standard Reference Materials	Within specified tolerance ranges.	(n=13) for Total Ammonia (as N), (n=14) for Total Alkalinity, (n=14) for Cl, (n=14) for Nitrate (as N), (n=14) for Nitrite (as N), (n=3) for TKN, (n=15) for Total Nitrogen, (n=3) for Orthophosphate-Dissolved (as P), (n=3) for Phosphorus (P)-Total, (N=13) for SO4 All passed.
Cyanides[3]		
Field Blank	Minimum criteria is <2X DL, will accept <5X DL	(n=2) All passed.
Method Blank	<2X DL	(n=14) for WAD CN, (n=18) for Total CN, (n=13) for Cyanate, (n=19) for free CN, (n=14) for Thiocyanate (SCN) All passed.
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=2) All passed.
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=1) for Cyanate, (n=2) for SCN All passed.
Standard Reference Materials	Within specified tolerance ranges.	(n=14) for WAD CN, (n=18) for Total CN, (n=13) for Cyanate, (n=19) for free CN, (n=14) for Thiocyanate (SCN) All passed.
Trace Metals by ICP-MS		
Field Blank	Minimum criteria is <2X DL, will accept <5X DL	(n=2) All passed.

QC Test	SRK QC Criteria	North Dam Seepage Results
Method Blank	<2X DL	(n=14) for Total and (n=13) for Dissolved All passed.
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=2) All passed.
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=3) for Total All passed.
Total vs Dissolved Metals	Total Metals>Dissolved metals. Total Metals should be greater than Dissolved Metals, if not the % difference should be within +/-20%. ALS would use 10X DL, Maxxam would use 5X DL	(n=12) All passed.
Standard Reference Materials	Within specified tolerance ranges.	(n=14) for Total and (n=11) Dissolved All passed.
Hg-CVAAS		
Field Blank	Minimum criteria is <2X DL, will accept <5X DL	(n=2) All passed.
Method Blank	<2X DL	(n=14) for Total and (n=8) for Dissolved All passed.
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=2) All passed.
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=2) for Total and (n=3) for Dissolved All passed.
Standard Reference Materials	Within specified tolerance ranges.	(n=14) for Total and (n=8) for Dissolved All passed.

Source: \\VAN-SVR0\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\!020_Project_Data\Lab\Dam Seepage\!Summary Table QAQC_1CT022.037_2019_NorthDam_mlt_Rev01.xls

Notes:

1 Conductivity, pH, Hardness (as CaCO3), Total Suspended Solids

2 Total Alkalinity, Total Ammonia, Unionized Ammonia, Cl, NO3, NO2, Total N, SO4

3 WAD CN, Total CN, Cyanate, SCN, Free CN

Table 2-3: Summary of QA/QC Assessment of 2019 Data, SNP Station TL-1

QC Test	SRK QC Criteria	TL-1 Results
	Physical Test[1]	
Method Blank	<2X DL	(n=23) for Conductivity, (n=33) for TSS, (n=23) for TDS All passed.
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=1) All passed.
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=13) for TSS, (n=6) for TDS, (n=13) for Conductivity, (n=1) for ORP and (n=2) for All passed.
Field pH vs. Lab pH	Difference should not be greater than 1 pH unit	(n=46) All passed.
Field EC vs Lab EC	For samples > 10X the detection limit (DL), % RPD should be within +/-30%	(n=22) All passed.
Field Cl vs Lab Cl	For samples > 10X the detection limit (DL), % RPD should be within +/-30%	(n=5) All passed.
Standard Reference Materials	Within specified tolerance ranges.	(n=25) for pH, (n=25) for EC, (n=34) for TSS and (n=23) for TDS All passed.
	Anions and Nutrients[2]	
Method Blank	<2X DL	(n=23) for Total Ammonia (as N), (n=25) for Total Alkalinity, (n=14) for Cl, (n=14) for Nitrate (as N), (n=14) for Nitrite (as N), (n=3) for TKN, (n=15) for Total Nitrogen, (n=3) for Orthophosphate-Dissolved (as P), (n=3) for Phosphorus (P)-Total, (N=24) for SO4 All passed.
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=1) All passed.
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=5) for Total N, (n=3) for Total Ammonia, (n=1) for Total Alkalinity, (n=1) for Orthophosphate-Dissolved (as P) All passed.
Ion Balance	EC>100 uS/cm, % difference should be within +/-10%	(n=18) All passed.
Standard Reference Materials	Within specified tolerance ranges.	(n=25) for Total Alkalinity, (n=23) for Total Ammonia, (n=14) for Cl, (n=14) for NO3, (n=14) for NO2, (n=16) for Total N, (n=24) for SO4, (n=3) for TKN, (n=1) for Orthophosphate-Dissolved (as P), (n=3) for Phosphorus (P)-Total All passed.
	Cyanides[3]	
Method Blank	<2X DL	(n=23) for WAD CN, (n=27) for Total CN, (n=25) for Cyanate, (n=16) for free CN, (n=18) for Thiocyanate (SCN) All passed.
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=1) All passed.
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=1) for Cyanate, (n=6) for SCN All passed.
Standard Reference Materials	Within specified tolerance ranges.	(n=24) for WAD CN, (n=27) for Total CN, (n=24) for Cyanate, (n=26) for SCN, (n=19) for Free CN, (n=3) for Cyanide All passed.

QC Test	SRK QC Criteria	TL-1 Results
Trace Metals by ICP-MS		
Method Blank	<2X DL	(n=31 for Total) and (n=34) for Dissolved All passed.
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=1) All passed.
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=16) for Total and (n=14) for Dissolved All passed.
Total vs Dissolved Metals	Total Metals>Dissolved metals. Total Metals should be greater than Dissolved Metals, if not the % difference should be within +/-20%. ALS would use 10X DL, Maxxam would use 5X DL	(n=46) - L2387698 - Total and Dissolved K has 26% RPD and >10x DL. The data has been confirmed by re-analysis.
Standard Reference Materials	Within specified tolerance ranges.	(n=34) for Total and (n=30) Dissolved All passed.
Hg-CVAAS		
Method Blank	<2X DL	(n=34) for Total and (n=31) for Dissolved All passed.
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=1) All passed.
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=23) for Total and (n=25) for Dissolved All passed.
Standard Reference Materials	Within specified tolerance ranges.	(n=34) for Total and (n=30) for Dissolved All passed.

Source: \\VAN-SVR0\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\!020_Project_Data\Lab\Dam Seepage\!Summary Table QAQC_1CT022.037_2019_NorthDam_mlt_Rev01.xls

Notes:

1 Conductivity, pH, Hardness (as CaCO3), Total Suspended Solids

2 Total Alkalinity, Total Ammonia, Unionized Ammonia, Cl, NO_3, NO_2, Total N, SO_4

3 WAD CN, Total CN, Cyanate, SCN, Free CN

Table 2-4: Summary of QA/QC Assessment of 2019 Data, TIA Pond at South Dam

QC Test	SRK QC Criteria	Results
Physical Test[1]		
Split Duplicate (n=1) for pH	Within +/10% RPD	All passed.
Split Duplicate (n=1) for EC	For samples >10X DL should be within +/- 30% RPD	All passed.
Anions and Nutrients[2]		
Method Blank (n=1) for SO4, (n=1) for Cl, (n=1) for NO3 (n=1) for NO2, (n=1) for NH4, (n=1) for Total N, (n=1) for TSS	<2X DL	All passed.
Split Duplicate (n=1) for Total Alkalinity, (n=1) for SO4, (n=1) for Cl, (n=1) for NO3 (n=1) for NO2, (n=1) for NH4, (n=1) for Total N, (n=1) for TSS	For samples >10X DL should be within +/- 30% RPD	All passed.
Lab Duplicate (n=1) for SO4, Cl, NO3, NO2, NH4, Total N, TSS	For samples >10X DL should be within +/- 20% RPD	All passed.
Ion Balance (n=3)	EC>100 uS/cm, % difference should be within +/-10%	All passed.
Cyanides Species[3]		
Split Duplicate (n=1) for Free CN, (n=1) for EDTA-CN, (n=1) for Thiocyanate, (n=1) for Cyanate	For samples >10X DL should be within +/- 30% RPD	All passed.
Standard Reference Material (n=0)	Within specified tolerance ranges.	All passed.
Metals		
Method Blank (n=1) for Total and (n=1) for Dissolved	<2X DL	All passed.
Split Duplicate (n=1) for Total and (n=1) for Dissolved	For samples >10X DL should be within +/- 30% RPD	All passed.
Lab Duplicate (n=1) for Total (n=1) for Dissolved	For samples >10X DL should be within +/- 20% RPD	All passed.
Total vs Dissolved Metals (n=3)	Total Metals>Dissolved metals. Total Metals should be greater than Dissolved Metals, if not the % difference should be within +/-20%. ALS would use 10X DL, Maxxam would use 5X DL	All passed.

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\!020_Project_Data\Lab\Tailings\COA 3 SouthDam Monitoring Tailings Supernatant (rec'd 3-Sep19)_QAQC_mlt.xlsx]

Notes:

1 Conductivity, pH, Hardness (as CaCO3), Total Suspended Solids

2 Total Alkalinity, Total Ammonia, Unionized Ammonia, Cl, NO3, NO2, Total N, SO4

3 WAD CN, Total CN, Cyanate, SCN, Free CN

3 Results

3.1 North Dam Seepage Monitoring

North Dam seepage data from 2019 are summarized in Table 3-1 with full results presented in Attachment 1. Summary statistics for the North Dam Seepage, TL-1 and TL-5 is shown in Table 3-2 and Table 3-3. The scope of the water chemistry assessment is to determine if TIA Reclaim Pond water is present in seepage at the downstream toe of the North Dam. This section discusses a subset of the water quality data, specifically EC, ammonia, nitrite, chloride, sulphate, and other major ions, which were identified as geochemical tracers of TIA Reclaim Pond. For other parameters, there were no appreciable differences in concentration between toe seepage samples and TL-1.

Table 3-1: Summary of 2019 North Dam Seepage Monitoring Data

Location	Date[1]	pH	EC uS/cm	Total Alkalinity mg/L as $CaCO_3$	SO_4 mg/L	Cl mg/L	Total Ammonia mg/L as N	NO_3 mg/L as N	NO_2 mg/L as N	Ca mg/L	Mg mg/L	Na mg/L	Ka mg/L	As mg/L	Co mg/L	Cu mg/L	Mn mg/L	Mo mg/L	Ni mg/L	Zn mg/L
V-notch weir	01-Jul-19	8.2	280	110	21	15	0.0095	0.10	0.001	34	6.9	15	2	0.00056	0.0003	0.0069	0.006	0.001	0.001	0.005
	08-Jul-19	8.2	290	110	23	14	0.012	0.15	0.0011	35	7	16	2	0.00064	0.0003	0.0066	0.0036	0.001	0.001	0.005
	15-Jul-19	7.8	290	110	18	17	0.014	0.12	0.001	36	7.7	15	2	0.00054	0.0003	0.0076	0.004	0.001	0.001	0.005
	22-Jul-19	8.3	330	130	22	17	0.012	0.23	0.001	42	8	18	2	0.00056	0.0003	0.0073	0.004	0.001	0.001	0.005
	29-Jul-19	8.1	340	130	27	19	0.013	0.43	0.02	40	9.6	22	2	0.00056	0.0003	0.0081	0.0039	0.001	0.001	0.005
	05-Aug-19	8.3	350	130	26	17	0.014	0.3	0.0011	39	8.5	21	2	0.00062	0.0003	0.0079	0.0032	0.001	0.0011	0.005
	12-Aug-19	8.3	340	150	20	19	0.014	0.19	0.0015	39	9	19	2	0.00059	0.0003	0.0084	0.0042	0.001	0.0015	0.005
	19-Aug-19	8.3	360	140	17	20	0.012	0.19	0.001	42	9.5	19	2	0.00069	0.0003	0.0085	0.0041	0.001	0.0015	0.005
	26-Aug-19	8.3	340	130	16	20	0.013	0.16	0.001	40	9.6	18	2	0.00062	0.0003	0.0083	0.0039	0.001	0.0014	0.005
	02-Sep-19	8.4	350	140	14	23	0.018	0.15	0.001	41	10	19	2	0.00055	0.0003	0.0082	0.006	0.001	0.0015	0.005
	09-Sept-19	8.4	--	--	--	38	0.013	0.26	0.0012	--	--	--	--	--	--	--	--	--	--	--
	16-Sep-19	8	370	140	20	26	0.01	0.14	0.0013	43	9.5	20	2	0.0005	0.0003	0.007	0.0058	0.001	0.0013	0.005
	23-Sep-19	8.4	380	130	16	33	0.014	0.11	0.0014	46	11	22	2	0.00056	0.0003	0.0083	0.0083	0.001	0.0017	0.005

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 145 - TIA Dam Seepage\Database Export\!TMAC_DMS_LinkedSpreadsheet_WQ_pivot_rtc.xlsx]

Notes:

Trace element for all samples is dissolved.

[1] For September 09, 2019, conductivity, alkalinity, sulphate and dissolved metals were not measured.

Table 3-2: Statistical Summary of Physical Parameters and Nutrients at North Dam Seepage, TL-1 and TL-5

Station	Year*	Statistic	pH		EC		Total Alkalinity mg/L as $CaCO_3$	SO_4 mg/L	Cl mg/L	Total Ammonia	NO_3	NO_2
			Field	Lab	Field	Lab						
					uS/cm					mg/L as N		
North Dam Seepage	2011	Min	7.9	8	180	--	230	190	690	29	82	--
		Median	7.9	8	1800	--	230	190	690	29	82	--
		Max	7.9	8	3500	--	230	190	690	29	82	--
		n	2	1	2	--	1	1	1	1	1	--
	2012	Min	7.3	8	140	370	150	9	30	0.72	0.73	0.021
		Median	7.5	8	270	370	150	9	30	0.72	0.73	0.021
		Max	7.6	8	410	370	150	9	30	0.72	0.73	0.021
		n	2	1	2	1	1	1	1	1	1	1
	2017-2018	Min	7.1	7.6	280	270	100	11	15	0.005	0.022	0.001
		Median	7.5	7.9	380	380	130	25	21	0.007	0.39	0.001
		Max	8.8	8.3	420	410	150	39	29	0.019	1.4	0.0021
		n	14	15	14	15	15	15	15	15	15	15
	2019	Min	7.6	7.8	290	280	110	14	14	0.0095	0.1	0.001
		Median	7.8	8.3	350	340	130	20	19	0.013	0.16	0.0011
		Max	8.7	8.4	400	380	150	27	38	0.018	0.43	0.02
		n	13	13	13	12	12	12	13	13	13	13
TL-1 (TIA Reclaim Pump)	2011-2016	Min	7.5	7.1	150	85	32	1	3.5	0.005	0.005	0.001
		Median	7.5	7.8	150	210	35	2.4	39	0.05	0.05	0.05
		Max	7.5	9	150	340	45	5.7	63	0.26	1.2	0.05
		n	1	84	1	43	10	49	84	84	84	84
	2017	Min	7.5	7.4	340	530	75	81	60	0.21	0.085	0.0017
		Median	7.9	7.9	540	530	75	81	70	1.1	0.67	0.023
		Max	8.6	8.1	790	530	75	81	92	1.9	1.6	0.12
		n	14	17	13	1	1	1	17	30	19	19
	2018	Min	7.3	7.6	1100	1900	82	260	110	0.92	0.61	0.02
		Median	7.9	8.2	1900	2200	93	300	380	2.7	1.1	0.2
		Max	10	9.2	2700	3100	110	380	660	9.8	2	0.3
		n	34	39	30	8	10	10	18	49	18	18
	2019	Min	7.2	7.7	39	3600	110	65	38	3.5	2.3	0.12
		Median	7.8	8.1	4700	4500	120	490	1100	4.9	2.7	0.19
		Max	8.7	8.7	8000	5900	170	660	1500	7.5	3.9	0.99
		n	50	46	50	22	18	19	21	46	19	19
TL-5 (Tailings Supernatant)	2017-2018	Min	--	7.7	--	--	--	6	--	11	0.1	0.02
		Median	--	8.2	--	--	--	1400	--	21	14	0.41
		Max	--	8.5	--	--	--	2800	--	61	40	18
		n	--	22	--	--	--	22	--	30	22	22
	2019	Min	6.1	6.2	7100	8100	66	1300	1200	13	6.7	0.29
		Median	8.2	8.2	8300	8500	290	2000	1500	31	11	0.54
		Max	8.4	8.4	10000	9300	350	2900	1800	38	25	0.8
		n	11	12	11	9	9	12	9	12	12	12

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 125 - Tailings Monitoring\1. Working File\!DamSeepage_HistoricalWQ_Compilation_amd_lnb_knk_Rev07.xlsx

Note:

Trace element data for all other stations are dissolved.

*Tailings deposition in the TIA commenced in 2017.

Table 3-3: Statistical Summary of Dissolved Trace Element Data*, North Dam Seepage, TL-1 and TL-5

Station	Year**	Statistic	Ca mg/L	Mg mg/L	K mg/L	Na mg/L	As mg/L	Co mg/L	Cu mg/L	Mn mg/L	Mo mg/L	Ni mg/L	Zn mg/L
North Dam Seepage	2011	Min	73	62	34	460	0.0035	0.005	0.017	0.54	0.0053	0.0025	0.015
		Median	73	62	34	460	0.0035	0.005	0.017	0.54	0.0053	0.0025	0.015
		Max	73	62	34	460	0.0035	0.005	0.017	0.54	0.0053	0.0025	0.015
		n	1	1	1	1	1	1	1	1	1	1	1
	2012	Min	38	9.9	3.8	27	0.00041	0.00054	0.0038	0.14	0.00066	0.0015	0.0029
		Median	38	9.9	3.8	27	0.00041	0.00054	0.0038	0.14	0.00066	0.0015	0.0029
		Max	38	9.9	3.8	27	0.00041	0.00054	0.0038	0.14	0.00066	0.0015	0.0029
		n	1	1	1	1	1	1	1	1	1	1	1
	2017-2018	Min	27	7.4	1.3	20	0.00044	0.0001	0.007	0.0032	0.00045	0.00081	0.001
		Median	38	9	1.8	26	0.00052	0.00015	0.0083	0.0051	0.00072	0.0011	0.001
		Max	47	9.7	2.8	39	0.00062	0.0003	0.014	0.0081	0.001	0.0014	0.0067
		n	13	13	13	13	13	13	13	13	13	13	13
	2019	Min	34	6.9	2	15	0.0005	0.0003	0.0066	0.0032	0.001	0.001	0.005
		Median	40	9.1	2	19	0.00056	0.0003	0.0078	0.004	0.001	0.0012	0.005
		Max	43	10	2	22	0.00069	0.0003	0.0085	0.0067	0.001	0.0015	0.005
		n	12	12	12	12	12	12	12	12	12	12	12
TL-1 (TIA Reclaim Pump)	2011-2016	Min	5.8	1.3	1.3	12	0.00017	0.0001	0.00072	0.0033	0.00053	0.0005	0.0013
		Median	12	5.7	1.6	14	0.0004	0.002	0.0013	0.005	0.005	0.002	0.002
		Max	21	9.7	2.6	24	0.0004	0.002	0.0014	0.018	0.005	0.002	0.012
		n	47	47	13	13	6	6	6	6	6	6	3
	2017	Min	28	8.3	4.4	61	0.0004	0.0007	0.0067	0.054	0.00064	0.0016	0.0016
		Median	28	8.3	4.4	61	0.0004	0.0007	0.0067	0.054	0.00064	0.0016	0.0016
		Max	28	8.3	4.4	61	0.0004	0.0007	0.0067	0.054	0.00064	0.0016	0.0016
		n	1	1	1	1	1	1	1	1	1	1	1
	2018	Min	56	21	15	220	0.00054	0.0014	0.0076	0.16	0.0013	0.0039	0.001
		Median	67	30	18	300	0.00058	0.0015	0.013	0.31	0.0016	0.0042	0.002
		Max	100	50	27	510	0.00087	0.0027	0.029	0.4	0.0026	0.0081	0.005
		n	13	13	13	14	13	13	13	13	13	13	14
	2019	Min	12	6.4	3.1	6	0.00076	0.0028	0.024	0.36	0.0028	0.007	0.002
		Median	140	74	35	750	0.11	0.3	0.19	0.45	0.29	0.12	0.5
		Max	160	110	52	1100	0.97	0.45	0.56	0.62	0.37	0.96	0.5
		n	46	46	46	46	46	46	46	46	46	46	46
TL-5 (Tailings Supernatant)	2017-2018 (Total Metals)	Min	33	22	36	520	0.00088	0.0053	0.0057	0.063	0.0032	0.011	0.006
		Median	96	40	75	910	0.0042	0.012	0.11	0.17	0.0068	0.063	0.033
		Max	220	140	130	1800	0.11	0.089	0.9	0.88	0.012	0.14	0.87
		n	30	30	30	30	30	30	30	30	30	30	30
	2019 (Total Metals)	Min	110	65	53	1000	0.0015	0.0069	0.036	0.14	0.0093	0.016	0.015
		Median	140	86	85	1800	0.0041	0.022	0.53	0.21	0.026	0.095	0.023
		Max	160	120	99	2100	0.031	0.029	160	1.4	0.11	3.5	0.29
		n	12	12	12	12	12	12	12	12	12	12	12
	2019 (Dissolved Metals)	Min	110	76	62	1500	0.0014	0.007	0.0069	0.1	0.014	0.0069	0.005
		Median	130	89	79	1800	0.0021	0.01	0.2	0.18	0.042	0.077	0.005
		Max	160	110	100	2000	0.0063	0.025	150	1.3	0.11	3.5	0.26
		n	9	9	9	9	9	9	9	9	9	9	9

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 125 - Tailings Monitoring\1. Working File\!DamSeepage_HistoricalWQ_Compilation_amd_lnb_knk_Rev07.xlsx

Note:

*All trace elements are dissolved except TL-5 monitoring data, as noted.

**Tailings deposition in the TIA commenced in 2017.

3.1.1 Comparison of TIA Surface Water Measurements

For each North Dam seepage sampling event, field measurements of EC and chloride are collected at TIA stations TL-1 and surface water immediately upstream of the North dam (Figure 2-1). Field measurements of field EC and chloride at TL-1 and upstream of the dam face are at near parity for the majority of samples, suggesting that TIA Reclaim Pond water is well mixed in this area and that samples collected at TL-1 are representative of pond chemistry at the upstream side of the North Dam. Samples with higher field EC and chloride at TL-1 were sampled in July.

Saline mine water from the underground is typically pumped to the process plan pumpbox in the mill and then discharged to the TIA with the tailings slurry. At the end of June, saline mine water was pumped to the Doris Sediment Control Pond and then to the reclaim pump station (TL-1) resulting in discharge of saline water to TL-1. Subsequent measurements of field EC at TL-1 (July 1, 8, 15, 2019) are elevated compared to TIA pond water upstream of the North Dam. For field Cl, only one sample was collected in July (July 1, 2019), and a similar trend of elevated concentrations at TL-1 was observed. The likely cause of this difference was the change of mine water input to the TIA. After July, samples were at near parity for field EC and Cl.

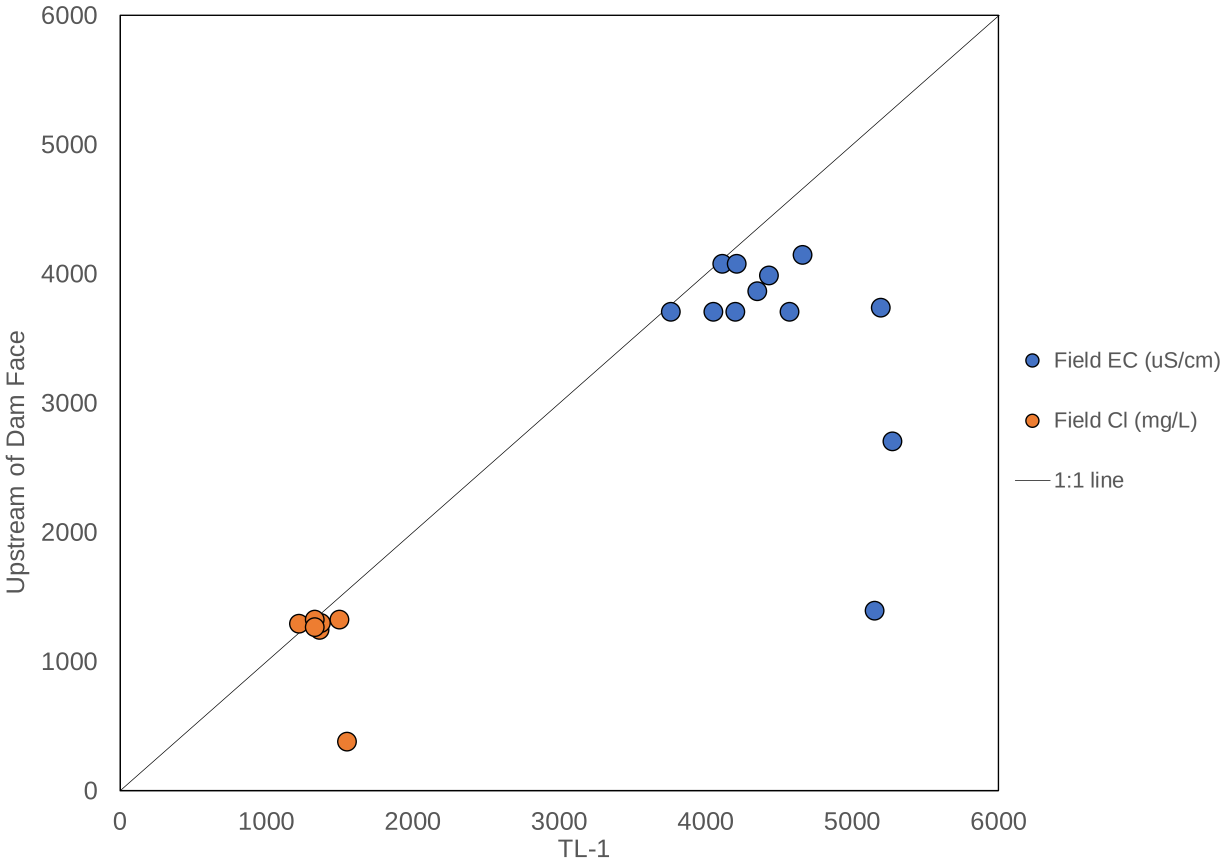


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Figure 3-1: Comparison of Field EC and Chloride at TIA Surface Stations, 2019 Monitoring Data

3.1.2 pH and EC

The pH for North Dam seepage samples ranged from 7.6 to 8.7 in 2019 and has been stable since 2011 (Figure 3-2).

EC data are summarized as follows:

- TL-5: EC was relatively stable ranging from 8,130 to 9,310 µS/cm in 2019 and was not previously monitored at this station.
- TL-1: Since 2017, EC at TL-1 has exhibited an increasing trend up to 5,480 µS/cm on June 3, 2019, after which values decreased to a minimum of 4,020 µS/cm during the open water season and then increased again at the end of the year to a maximum value of 5,850 µS/cm on December 12, 2019.
- North Dam toe seepage: EC levels in 2019 ranged from 288 to 377 µS/cm, with levels at TL-1 15 to 20 times higher than toe seep samples. EC levels have consistently been <500 µS/cm since 2011, except for 12-TLR-13. Seep sample 12-TLR-13 was collected from the apron of the dam after the first year of construction and had an anomalously high EC of ~3,500 µS/cm.

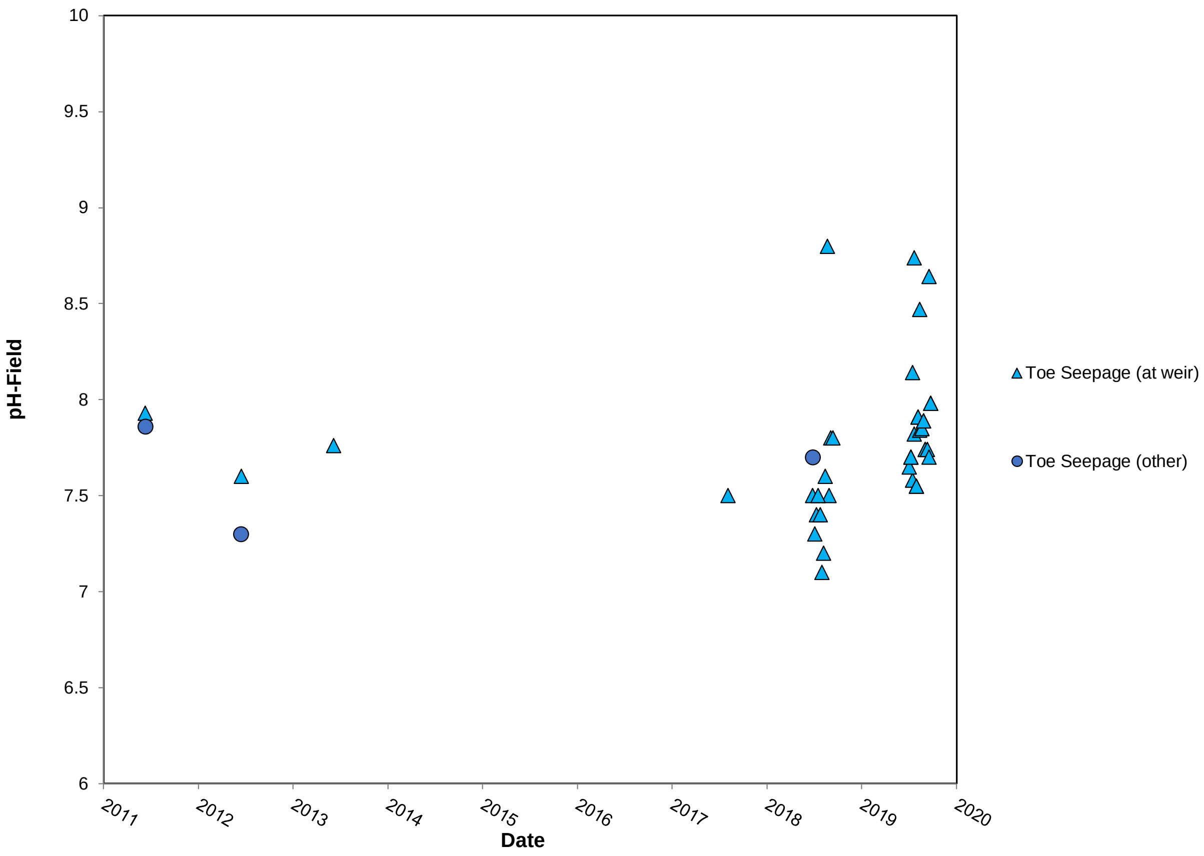

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Figure 3-2: pH Monitoring Data

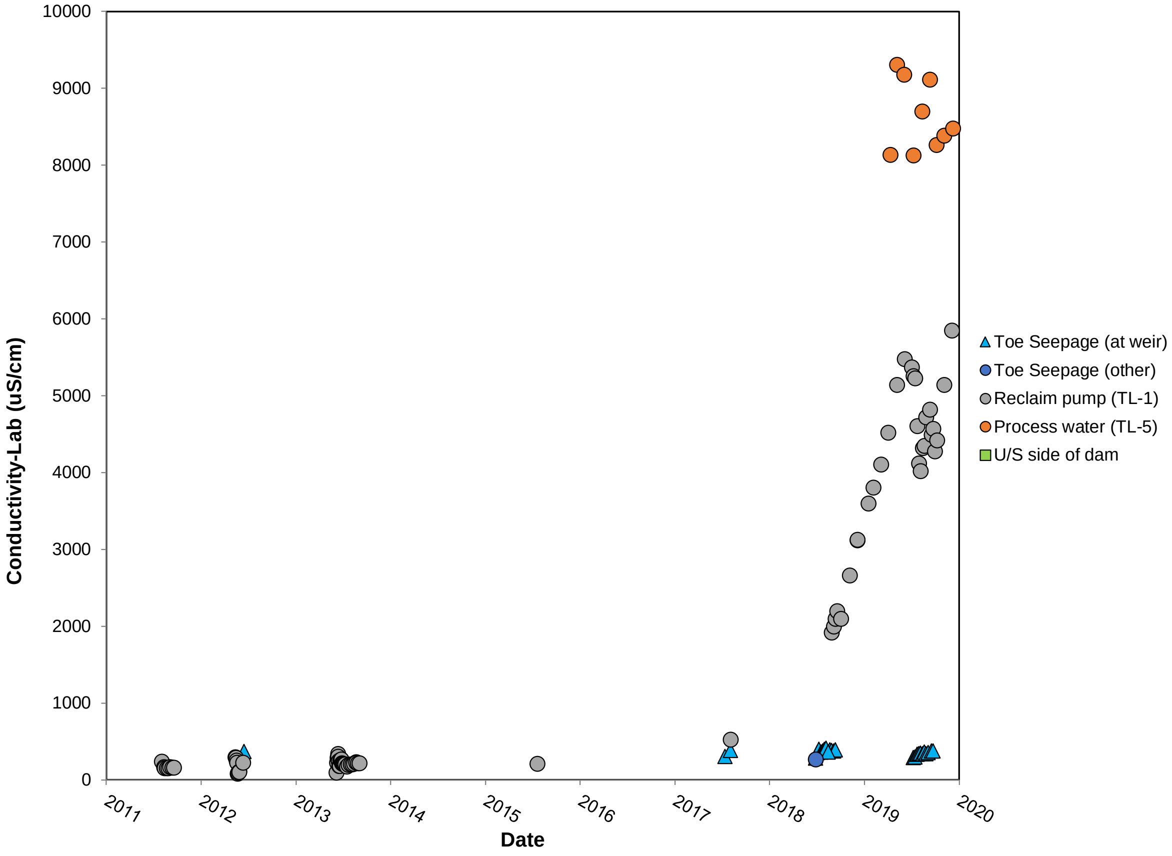

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Figure 3-3: EC Monitoring Data

3.1.3 Ammonia and Nitrite

Sources of ammonia and nitrite introduced to the TIA by tailings include i) ore and waste rock containing blasting residues ii) process water containing the cyanide destruction supernatant and iii) biological degradation in the TIA of cyanate and thiocyanate, which are produced as a by-product of the cyanide destruction circuit in the mill. Ammonia from the process plant represents approximately 80% of source loads to the TIA.

Ammonia data are summarized as follows (Figure 3-4):

- TL-5: ammonia concentrations in 2019 ranged from 13 to 38 mg/L as N and are showing a increasing trend since 2017. Concentrations at TL-5 were consistently higher than TL-1 by at least threefold.
- TL-1: ammonia concentrations in 2019 ranged from 3.5 to 7.5 g/L as N. Since 2017, ammonia concentrations have been exhibiting an increasing trend with biologically-mediated seasonal fluctuations, where maximum concentrations are exhibited in winter and minimum concentrations in summer.

- North Dam toe seepage: ammonia concentrations in 2019 ranged from 0.0095 to 0.018 mg/L as N, with levels at TL-1 at least 190 times higher than toe seep samples. Ammonia concentrations for seepage in 2019 were on the same order of magnitude as those observed in 2017 and 2018 and lower than samples from 2011 and 2012 (29 and 0.72 mg/L as N, respectively). However, all measured concentrations in 2019 were greater than those measured in 2018, except for 0.019 mg/L on June 25, 2018. Ammonia concentrations for the 2012 North dam seepage sample are typical of seepage samples collected from other Doris as-built infrastructure using Quarry 2 rock (ranging from 0.0098 to 0.66 mg/L with an average of 0.1 mg/L, n=43). This suggests that the observed decrease of ammonia concentrations in North Dam seepage since construction of the dam is likely due to the flushing of blast residues.

Nitrite data are summarized as follows (Figure 3-5):

- TL-5: nitrite concentrations in 2019 ranged from 0.30 to 0.80 mg/L as N and have been slightly increasing since 2017, following the biological-mediated trends at TL-1 (which is the source of reclaim water for the process plant). Concentrations at TL-5 were consistently higher than TL-1.
- TL-1: nitrite concentrations in 2019 ranged from 0.0012 to 0.24 mg/L as N. Since 2017, nitrite concentrations have been exhibiting an increasing trend with data suggesting the following seasonal trend: decrease during period of spring ice melt, followed by a steady increase between June and August, and relatively stable concentrations during Fall and Winter.
- North Dam toe seepage: nitrite concentrations in 2019 were all below or near the limit of detection (0.001 mg/L as N) except for 0.02 mg/L measured on July 29, 2019 which was a method detection limit. Concentrations at TL-1 were at least 1.2 times higher. Nitrite concentrations were roughly equivalent or slightly lower than values observed in 2017 (0.0012 to 0.021 mg/L as N).

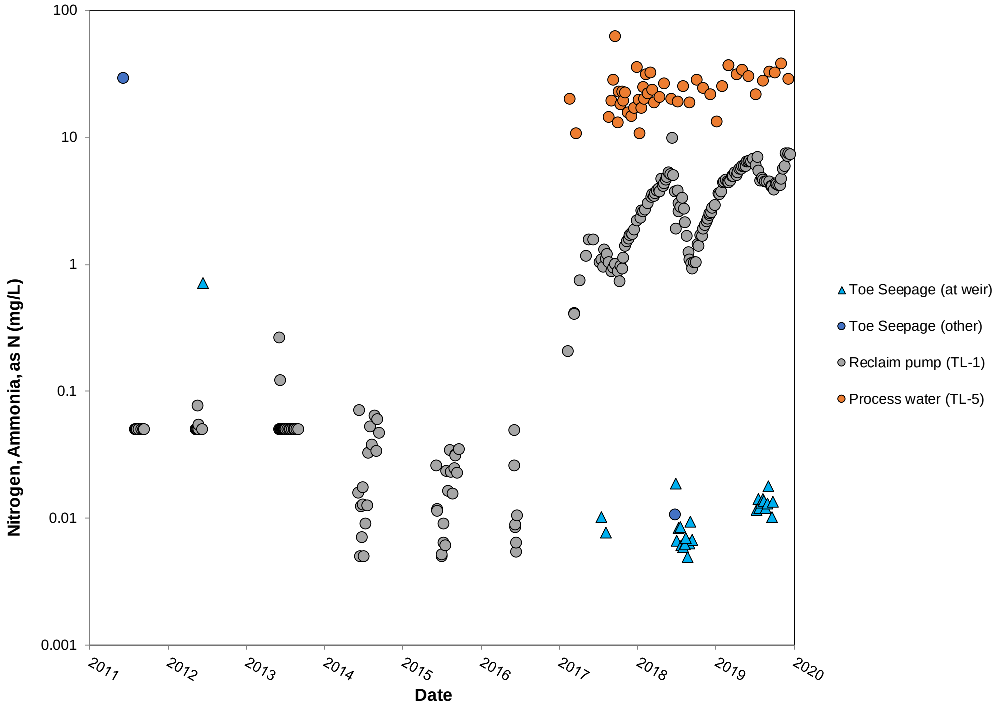

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Figure 3-4: Ammonia Monitoring Data

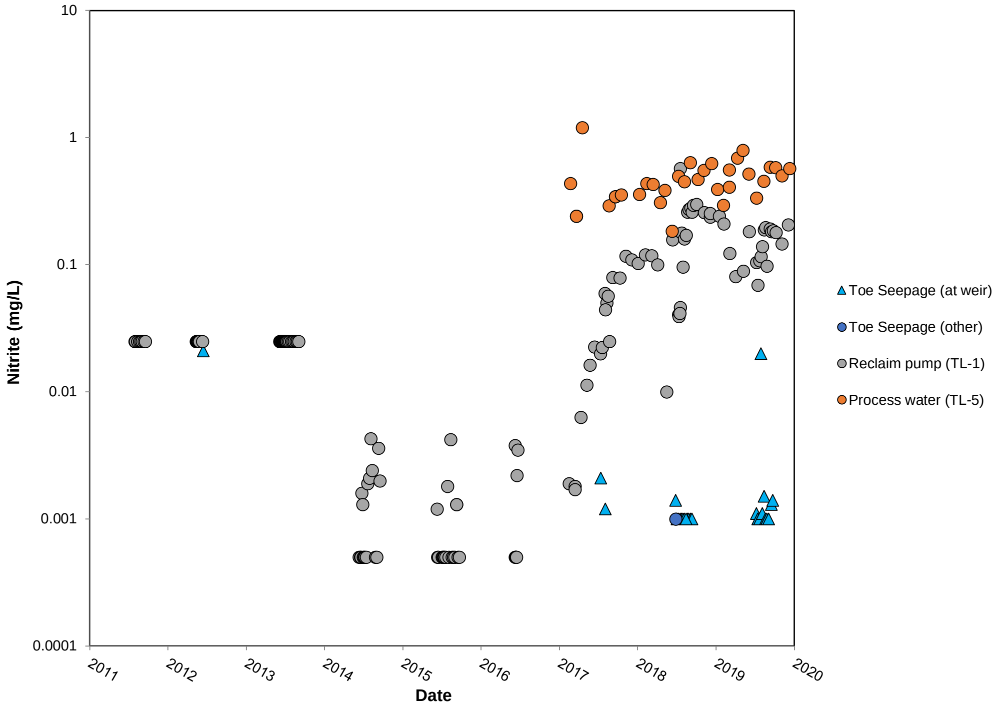

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Figure 3-5: Nitrite Monitoring Data

3.1.4 Chloride and Sulphate

Calcium chloride drilling brines are used in the underground mine. As a result, the ore contains calcium chloride salts, which are processed in the mill and subsequently discharged into the TIA. In addition, saline mine water containing calcium chloride is pumped to the TIA (with the exception of June, as noted in Section 3.1.1). Drilling brines are not used during quarry development therefore construction rock does not contain calcium chloride drilling brines. Chloride data are summarized as follows (Figure 3-6):

- TL-5: chloride concentrations in 2019 ranged from 1,200 to 2,878 mg/L.
- TL-1: chloride concentrations in 2019 ranged from 861 to 1,460 mg/L. Since 2018, chloride concentrations have been exhibiting an increasing trend with a seasonal decrease during the open water season.
- North dam toe seepage: chloride concentrations in 2019 ranged from 14 to 33 mg/L, with levels at TL-1 at least 25 times higher than toe seepage samples. Chloride concentrations in 2019 were equivalent to 2013, 2017, and, 2018 North dam seepage samples (ranging from 15 to 30 mg/L) but lower than the 2011 seepage sample 11-TLR5. 11-TLR5 was collected from the apron of the dam and had an anomalously higher chloride concentration (685 mg/L) compared to the other seepage samples.

The source of sulphate to the TIA is the processing of ore containing sulphide minerals and milling reagents. Sulphate data are summarized as follows (Figure 3-7):

- TL-5: sulphate concentrations in 2019 ranged from 1,250 to 2,870 mg/L and were roughly equivalent with levels in 2017 and 2018. Concentrations at TL-5 were consistently higher than TL-1 by at least twofold.
- TL-1: sulphate concentrations in 2019 ranged from 402 to 655 mg/L. Since 2017, sulphate data indicate an increasing trend, however concentrations decreased in July 2019 after which an increasing trend was observed.
- North Dam toe seepage: sulfate concentrations in 2019 ranged from 14 to 27 mg/L, with levels at TL-1 at least 15 times higher than toe seepage samples. Sulphate concentrations in 2019 were equivalent or higher than 2012, 2017, and 2018 North dam seepage samples (ranging from 9 to 365 mg/L) but lower than the 2011 seepage sample 11-TLR5. 11-TLR5 was collected from the apron of the dam and had an anomalously higher sulphate concentration (193 mg/L) compared to the other seepage samples.

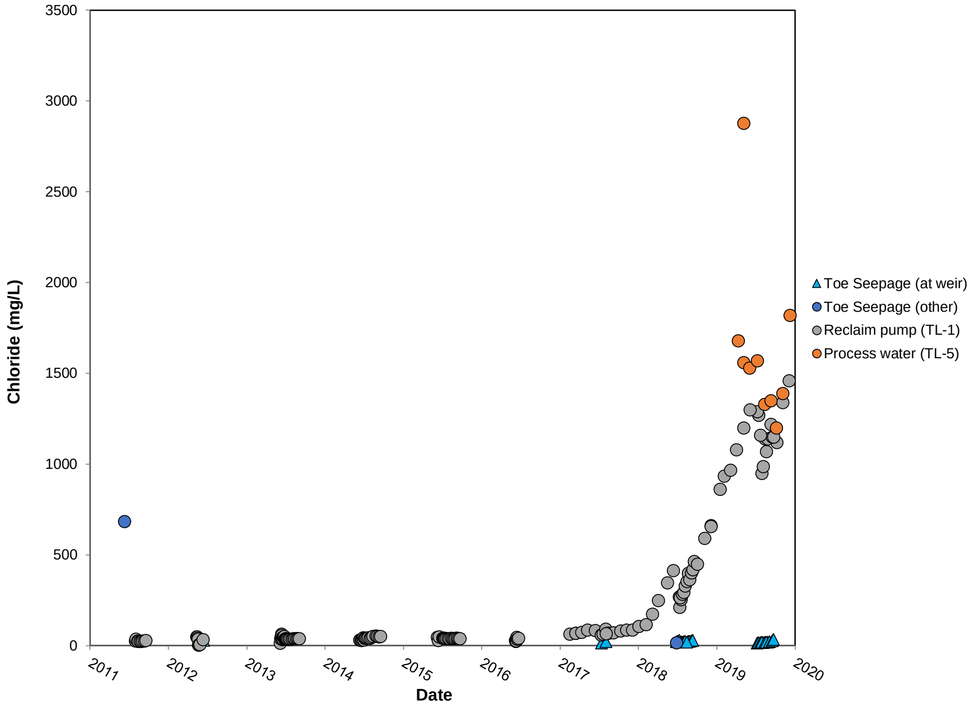

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Figure 3-6: Chloride Monitoring Data

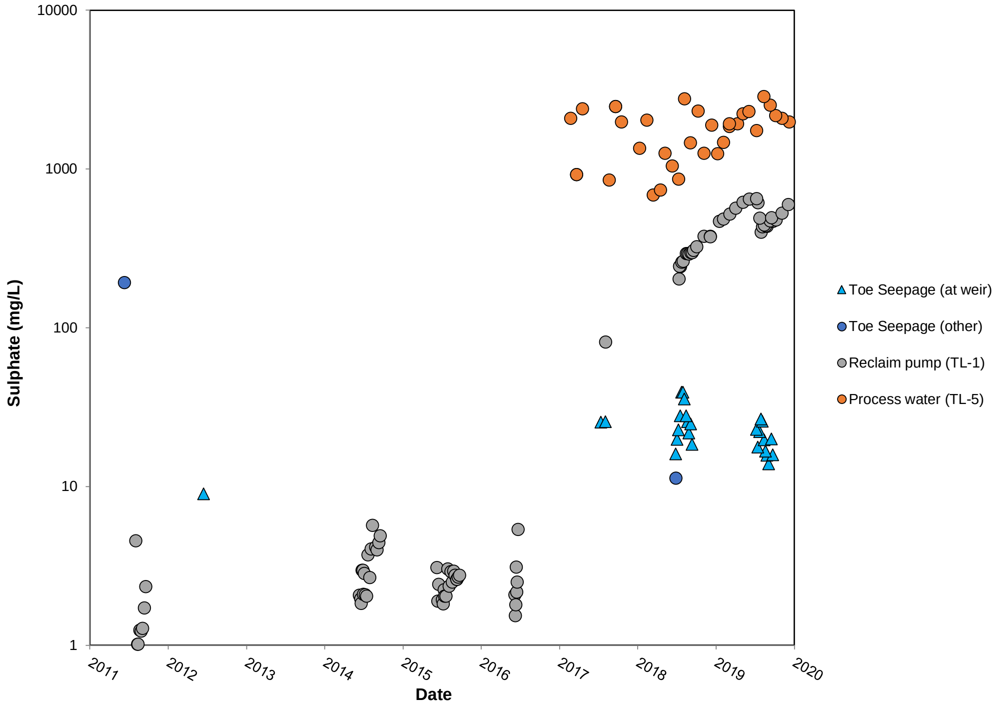

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Figure 3-7: Sulphate Monitoring Data

3.2 Major Ions

Table 3-4 summarizes the major ion chemistry of the three TIA pond samples collected upstream of the South Dam; and TL-1 and North dam seepage samples prior to tailings deposition (2011-16) and since tailings deposition (2017-19) and Figure 3-8 presents the results in a Piper diagram Of note, is that most TL-1 samples could not be plotted because the major ion data set was incomplete.

Figure 3-8 indicates that almost all samples can be categorized into the five following geochemical groups: i) TL-1 samples collected prior to tailings deposition (2011-16); ii) TL-1 in 2017 (note one sample plotted in Figure 3-8); iii) TL-1 in 2018 and 2019; iv) North dam seepage samples from all years (2011-18); and v) TIA pond water at the south dam (2019). Of note is that the major ion chemistry of the North dam seepage samples is geochemically distinct from TL-1, both prior to and after tailings deposition. Each group is discussed as follows:

- TL-1
  - 2011-16: Prior to tailings deposition the major cations were characterized by sodium and calcium (medians of 14 and 7.5 mg/L, respectively) and the major anions by bicarbonate and chloride (medians of 35 mg/L as $CaCO_3$ and 26 mg/L, respectively).
  - 2017: Tailings deposition commenced in January 2017. The data from the one sample collected in August indicated that the major cation chemistry continued to be dominated by sodium and calcium but at higher concentrations (61 and 28 mg/L, respectively) and major anion chemistry shifted from bicarbonate-chloride to sulphate-bicarbonate (81 mg/L as $CaCO_3$ and 75 mg/L, respectively).
  - 2018 and 2019: the major cation chemistry continued to be dominated by sodium and calcium but at increasingly higher concentrations each year (medians increasing from 290 to 690 and 62 to 130 mg/L, respectively) and that the major anion chemistry shifted from sulphate-bicarbonate to chloride-sulphate (medians increasing from 440 to 1100 and 300 to 480 mg/L, respectively).
- TIA Pond Water at South Dam:
  - 2019: Samples from Spigot-1 and Spigot 2 (located at the tailings beach) were geochemically distinct from Spigot-3. At the time of sampling, tailings slurry had not yet been discharged from Spigot-3. The major cation chemistry for all three samples was dominated by sodium (range from 360 to 1,100 mg/L) while concentrations of calcium, magnesium and potassium were near equivalent (range from 44 to 97, 43 to 78, and, 33 to 63 mg/L, respectively). For samples Spigot-1 and Spigot-2, the major anion chemistry was dominated by chloride and sulphate (range from 850 to 1,300 mg/L and 1,300 to 1,500 mg/L, respectively) whereas the dominant anions at Spigot-2 bicarbonate and chloride (580 mg/L and 410 mg/L, respectively). Notably, sulphate concentrations at Spigot-3 were low (3.5 mg/L). Lower anion concentrations may be linked to a flushing of this area with spring runoff.

- North Dam Seepage: all seepage samples are grouped together in Figure 3-8 except the seepage sample collected in 2011 (sample ID 11-TLR5). Major ion concentrations are higher for 11-TLR-15 compared to all other North dam seepage samples, including sample 12-TLR-14. The higher ion concentrations may be attributable to the hypersaline pocket of groundwater was intersected during the construction season prior to sample collection.
  The major ion chemistry of 12-TLR-14 and the 2017-19 seepage samples is summarized as follows:
  - 12-TLR-14 was collected at the same location as the v-notch weir with the major cation chemistry characterized by calcium and sodium (38 and 27 mg/L, respectively) and major anion chemistry characterized by bicarbonate and chloride (150 mg/L as $CaCO_3$ and 30 mg/L, respectively).
  - 2017-19: Compared to 12-TLR-14, the major ion chemistry was equivalent for cations (median calcium and sodium concentrations of 37 and 24 mg/L, respectively) but variable compared to selected anions. Consistent with 12-TLR-14, major anion chemistry was dominated by bicarbonate with equivalent concentrations (median of 130 mg/L as $CaCO_3$), however based on median concentrations, chloride and sulphate were both significant anions (20 and 22 mg/L, respectively). Chloride and sulphate concentrations for the 2017-19 seepage samples are variable and the range of concentrations (14 to 33 mg/L and 11 to 40 mg/L, respectively) are equivalent to 12-TLR-14.

Table 3-4: Summary of Major Ion Chemistry, North Dam Seepage, TL-1 and TIA Pond at South Dam

Station	Date Range	Statistic[1]	Cations[2]				Anions[2]		
			Ca	Mg	K	Na	Total Alkalinity[3]	Cl	SO_4
North Dam Seepage	2011-13	11-TLR5	73	62	34	460	230	690	190
		12-TLR-14	38	9.9	3.8	27	150	30	9
	2017-19	Median	39	9.0	2.0	21	130	20	22
		Count	28	28	28	28	28	28	28
TL-1	2011-16	Median	7.5	5	1.6	14	35	26	1.5
		Count	10	10	10	10	10	10	10
	2017	August	28	8.3	4.4	61	75	67	81
	2018	Median	62	28	17	290	100	370	300
		Count	8	8	8	8	8	8	8
	2019	Median	130	72	31	690	120	1100	480
		Count	21	21	21	21	21	21	21
TIA Pond at South Dam	2019	SRK19-SD-SPIGOT1	97	78	63	1300	290	1300	1500
		SRK19-SD-SPIGOT2	60	73	58	1100	290	850	1300
		SRK19-SD-SPIGOT3	44	45	33	360	580	410	3.5

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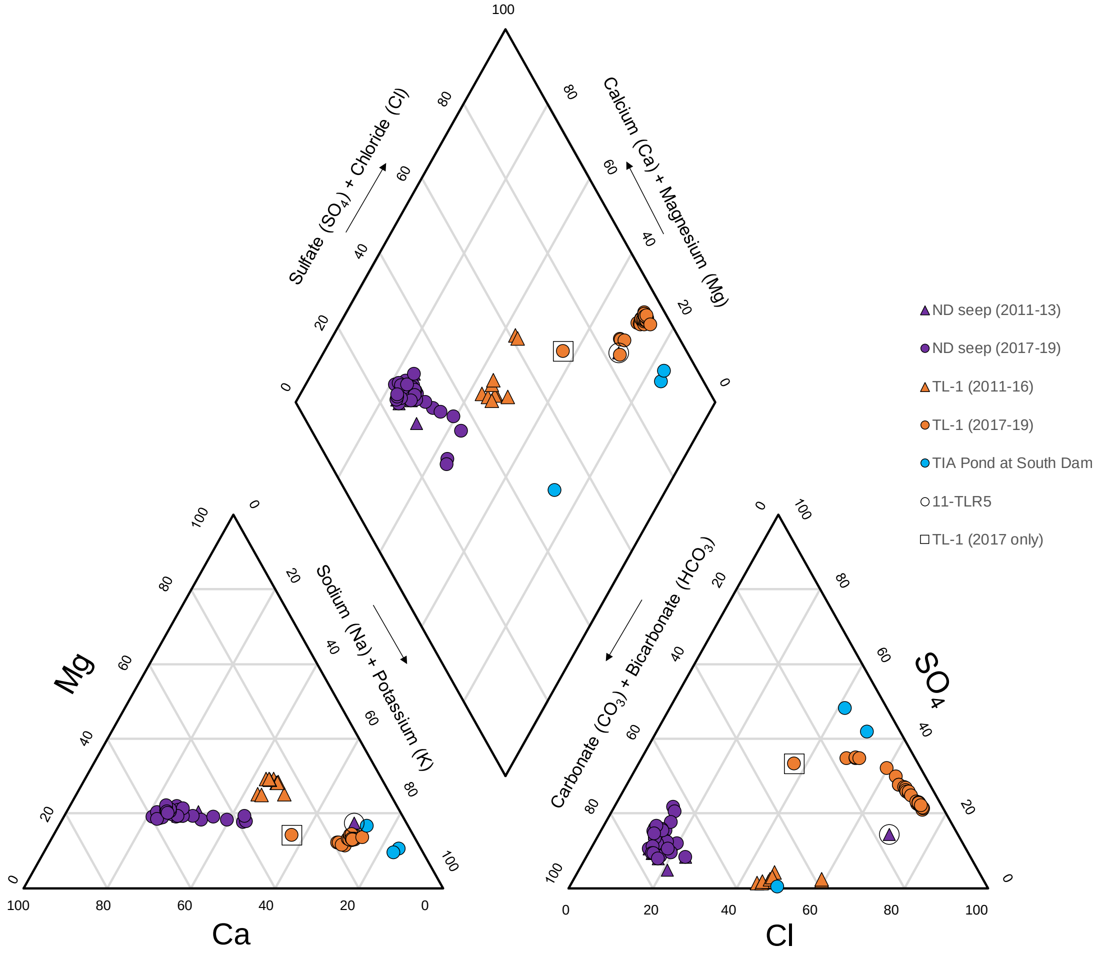
Notes

[1] Sample IDs presented for North Dam Seepage (2011-13) and TIA pond water at South Dam sample sets

[2] All units mg/L. Units for alkalinity are mg/L as $CaCO_3$.

[3] Alkalinity in Figure 3-8 plotted as bicarbonate. Referred to as bicarbonate in text in Section 3.5.



\\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 145 - TIA Dam Seepage\Piper Plots\[CompiledDataforPiperPlots_1CT022.037_JED_Rev01.xlsx]

Figure 3-8: Piper Plot of TL-1, North Dam Seepage Samples, and South Dam Tailings Samples

4 Conclusion and Recommendations

In 2017, TMAC initiated a monitoring program of North Dam seepage by request from the EOR, including sample collection for water quality analysis. After construction of the South Dam, a similar seepage monitoring program of the South Dam was implemented; however, no seepage was observed in 2019. SRK reviewed the water quality database for North Dam seepage samples, and SNP stations TL-1 (TIA Reclaim Pond water collected at the reclaim pump), TL-5 (tailings supernatant discharge from mill) to investigate the potential source of the North Dam toe seep. Furthermore, three samples of TIA pond water upstream of the South Dam were collected to quantify pond water chemistry and freezing point depression of the TIA tailings as the chemical composition of porewater within the tailings beach will directly impact heat transfer and freeze-back of the tailings over time (SRK 2020a). Delayed freezeback of the tailings beach could limit heat loss from the South Dam foundation immediately below the upstream toe.

The major ion chemistry of TIA pond water for the South Dam tailings beach was dominated by sodium, sulphate and chloride. Based on the 2019 slurry tailings water chemistry, the estimated tailings freezing point depression is currently expected to have a negligible impact on tailings beach freezeback and thermal performance of the South Dam (SRK 2020a).

A review of the geochemical data related to the North Dam seepage assessment is summarized as follows:

- EC, ammonia, nitrite, chloride and sulphate were identified as geochemical tracers of TIA Reclaim Pond water, with concentrations in TIA Reclaim Pond water uniformly higher than North Dam toe seepage samples.
- Major ion concentrations and chemistry as assessed using a Piper diagram indicated that North Dam toe seepages are geochemically distinct from TIA Reclaim Pond water, prior to and after tailings deposition in the TIA.
- For other parameters, there were no appreciable differences in concentration between the toe seepage samples and TIA Reclaim Pond water.
- No data suggest the presence of TIA Reclaim Pond water in the North Dam toe seepage.

SRK also recommends a QA/QC program of field blanks and duplicates as a method of validating the geochemical data set. These recommended changes are to be included in an updated version of the North Dam seepage water quality monitoring program (SRK 2018a) and implemented in 2020.

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Attachment 1: Water Quality Data, 2019 North and South Dam Samples

Attachment 1: Water Quality Data

Location	Sample ID (field or lab)	Date	Height at V-notch (cm)	pH Field Measurement	Conductivity Field Measurement	Oxidation - Reduction Potential, Field	Temperature Field Measurement	Flow	Field Cl	Conductivity (lab)	Hardness (as CaCO3)	pH	Total Suspended Solids	Total Dissolved Solids	Acidity (as CaCO3)	Alkalinity, Total (as CaCO3)	Ammonia, Total (as N)	Bromide (Br)	Chloride (Cl)	
			cm	pH	µS/cm		C	L/s	mg/L	µS/cm	mg/L	pH	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Process Water (TL-5)	L2217608-1	1/6/2019	-	-	-	-	-	-	-	-	619	8.3	24.4	-	-	-	13.1	-	-	
	L2228565-1	2/3/2019	-	8.1	7120	427	8.1	-	-	-	580	8.2	21.1	-	-	-	24.9	-	-	
	L2239803-1	3/3/2019	-	8.2	7760	-20	12.4	-	-	-	738	8.1	31.1	-	-	-	36.6	-	-	
	L2256607-1	4/10/2019	-	8.4	8190	2602	13.6	-	-	8140	779	8.2	23	-	-	290	31	-	1680	
	L2268345-1	5/5/2019	-	8.3	9240	42	14.3	-	2878	9310	701	8.0	30.6	-	-	299	33.8	-	1560	
	L2285440-1	6/2/2019	-	8.2	9320	88	12.9	-	3044	9180	720	8.2	22.5	-	-	354	30.1	-	1530	
	L2307093-1	7/7/2019	-	8.3	7750	87	13.9	-	2380	8130	716	8.4	20.7	-	-	279	21.7	-	1570	
	L2327981-1	8/11/2019	-	6.1	8260	231	17.2	-	2652	8700	662	6.2	45.8	-	-	66.4	27.8	-	1330	
	L2344220-1	9/8/2019	-	8.3	8250	203	14.3	-	-	9120	580	8.2	30	-	-	261	32.5	-	1350	
	L2361827-1	10/5/2019	-	8.2	7380	58	12.2	-	-	8270	637	8.3	21.2	-	-	291	32.2	-	1200	
	L2377610-1	11/3/2019	-	8.3	10070	167	9.9	-	-	8390	672	8.4	12.8	-	-	292	38	-	1390	
	L2394082-1	12/8/2019	-	8.2	9860	80	7	-	-	8480	788	8.3	26.4	-	-	290	28.3	-	1820	
Reclaim Pump (TL-1)	TL1 WEEKLY	1/2/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	TL1 WEEKLY	1/7/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	TL1-MONTHLY	1/15/2019	-	7.3	3030	187	1.8	-	-	3600	473	7.8	18	2170	-	118	3.57	-	861	
	TL1 WEEKLY	1/21/2019	-	7.9	3110	39	2	-	-			7.9	18.7	-	-	-	3.51	-	-	
	TL1 WEEKLY	1/28/2019	-	7.2	3520	233	0.4	-	-			7.7	16.6	-	-	-	3.7	-	-	
	TL1-MONTHLY	2/4/2019	-	7.4	4940	444	5.2	-	-	3810	555	7.8	13.9	2380	-	121	4.34	-	934	
	TL1-WEEKLY	2/11/2019	-	7.9	3530	109	2.1	-	-		556	8.0	16.8	-	-	-	4.42	-	-	
	TL1-WEEKLY	2/18/2019	-	7.5	3870	240	4.1	-	-			7.9	13.1	-	-	-	4.6	-	-	
	TL1-WEEKLY	2/25/2019	-	7.7	3790	242	4.1	-	-		590	8.0	13.2	-	-	-	4.44	-	#NA	
	TL1-MONTHLY	3/4/2019	-	7.4	3990	161	5.8	-	-	4110	584	7.8	14.7	2560	-	128	4.35	-	967	
	TL1-WEEKLY	3/11/2019	-	7.4	4350	161	1.8	-	-			8.7	9.6	-	-	-	4.49	-	-	
	TL1-WEEKLY	3/18/2019	-	7.2	4260	133	4.1	-	-		662	7.8	13.4	-	-	-	4.9	-	-	
	TL1-WEEKLY	3/25/2019	-	7.6	4630	119	4.4	-	-		659	7.7	9	-	-	-	4.92	-	#NA	
	TL1-MONTHLY	4/1/2019	-	7.6	4850	95	4.8	-	-	4520	622	7.7	5.5	2690	-	147	5.21	-	1080	
	TL1-WEEKLY	4/8/2019	-	7.6	4700	226	8.1	-	-		610	7.8	6.9	-	-	-	4.95	-	-	
	TL1-WEEKLY	4/15/2019	-	7.8	4830	109	3.3	-	-		646	7.9	5.4	-	-	-	5.26	-	-	
	TL1-WEEKLY	4/22/2019	-	7.5	4880	131	4.2	-	-		633	7.8	3.5	-	-	-	5.57	-	-	
	TL1-WEEKLY	4/29/2019	-	7.6	5140	67	4.1	-	-		707	8.1	5	-	-	-	5.6	-	-	
	TL1-MONTHLY	5/6/2019	-	7.5	5180	89	4.4	-	-	5140	684	8.3	6.7	3050	-	161	5.91	-	1200	
	TL1-WEEKLY	5/13/2019	-	7.6	5540	71	3.9	-	-		726	8.2	5	-	-	-	5.9	-	-	
	TL1-WEEKLY	5/20/2019	-	7.5	5340	-9	8.6	-	-		655	8.2	6	-	-	-	5.86	-	-	
	TL1-WEEKLY	5/27/2019	-	7.7	-	147	737	-	-		760	8.2	5	-	-	-	6.42	-	#NA	
	TL1-MONTHLY	6/3/2019	-	7.6	5590	14	4.6	-	-	5480	741	8.1	6.8	3340	-	167	6.35	-	1300	
	TL1-WEEKLY	6/10/2019	-	7.5	5790	44	3.6	-	-		711	8.1	4.4	-	-	-	6.53	-	-	
	TL1-WEEKLY	6/17/2019	-	7.7	5380	26	3.9	-	-		794	8.1	3.3	-	-	-	6.38	-	-	
	TL1-WEEKLY	6/24/2019	-	7.6	5570	35	2.3	-	-		745	8.2	5.2	-	-	-	6.68	-	-	
	TL1-MONTHLY	7/1/2019	-	7.6	5150	61	3.6	-	1550	5370	709	8.1	4.9	3450	-	169	6.11	-	-	
	TL1-WEEKLY	7/8/2019	-	7.6	5270	23	5.6	-	-	5260	706	8.2	6.3	-	-	160	5.92	-	1290	
	TL1-WEEKLY	7/15/2019	-	7.6	5190	66	5.2	-	-	5230	700	-	-	-	-	-	-	-	1270	
	TL1-WEEKLY	7/22/2019	-	7.8	4570	55	8.6	-	-	4610	670	8.2	1.3	-	-	116	5.4	-	1160	
	TL1-WEEKLY	7/29/2019	-	7.8	4050	58	11.9	-	-	4120	569	8.2	6.3	-	-	105	5.92	-	949	
	TL1-WEEKLY	8/5/2019	-	8.2	3990	124	12.6	-	-	4020	531	8.2	11.4	-	-	107	4.72	-	986	
	TL1-MONTHLY	8/12/2019	-	8.5	4200	82	12.8	-	1361	4320	583	8.2	16	2610	-	109	4.59	-	1140	
	TL1-MONTHLY	8/19/2019	-	8.4	3760	63	15.4	-	1218	4350	592	8.3	15.5	-	-	108	4.47	-	1070	
	TL1-WEEKLY	8/26/2019	-	8.5	4350	86	12.3	-	1370	4720	-	-	-	-	-	-	-	-	1140	
	TL1-WEEKLY	9/2/2019	-	8.6	4660	95	9.9	-	1495	4820	-	-	-	-	-	-	-	-	-	
	TL1-MONTHLY	9/9/2019	-	8.7	4430	92	8.4	-	-		649	8.4	23.1	2890	-	114	4.46	-	-	
	TL1-WEEKLY	9/16/2019	-	8.6	4110	82	6.3	-	1328	4490	612	8.4	18.7	-	-	112	4.1	-	1150	
	TL1-WEEKLY	9/23/2019	-	8.1	4210	64	5.7	-	1328	4570	576	8.4	17.9	-	-	113	4.11	-	1150	
	TL1-WEEKLY	9/29/2019	-	8.0	4210	26	5.1	-	-	4280	606	8.4	22.5	-	-	-	3.8	-	-	
	TL1-MONTHLY	10/7/2019	-	8.4	4240	112	3.7	-	-		628	8.2	19.2	2740	-	113	4.33	-	1120	
	TL1-WEEKLY	10/14/2019	-	8.1	4410	59	4.1	-	-	4420	650	8.3	20.2	-	-	-	4.24	-	-	
	TL1-WEEKLY	10/21/2019	-	8.7	39.3	101	6.1	-	-		673	8.3	16.9	-	-	-	4.18	-	-	
	TL1-WEEKLY	10/28/2019	-	8.0	4250	22	6.2	-	-		676	8.1	14.2	-	-	-	4.16	-	-	
	TL1-MONTHLY	11/4/2019	-	7.9	6310	187	0.9	-	-		674	8.2	15.6	3200	-	122	4.66	-	1340	
	TL1-WEEKLY	11/11/2019	-	7.8	6120	166	2.9	-	-	5140	667	8.1	16.7	-	-	-	5.63	-	-	

Location	Sample ID (field or lab)	Date	Height at V-notch (cm)	pH Field Measurement	Conductivity Field Measurement	Oxidation - Reduction Potential, Field	Temperature Field Measurement	Flow	Field Cl	Conductivity (lab)	Hardness (as CaCO3)	pH	Total Suspended Solids	Total Dissolved Solids	Acidity (as CaCO3)	Alkalinity, Total (as CaCO3)	Ammonia, Total (as N)	Bromide (Br)	Chloride (Cl)	
			cm	pH	µS/cm		C	L/s	mg/L	µS/cm	mg/L	pH	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
	TL1-WEEKLY	11/18/2019	-	7.8	6480	74	7.1	-	-		657	8.1	20.3	-	-	-	5.91	-	-	
	TL1-WEEKLY	11/25/2019	-	7.8	7080	207	5	-	-		850	8.1	17.9	-	-	-	7.39	-	-	
	TL1-MONTHLY	12/2/2019	-	7.9	7200	198	3.7	-	-		769	7.9	19.8	3650	-	-	7.04	-	1460	
	TL1-WEEKLY	12/9/2019	-	7.8	7190	155	2.6	-	-	5850	773	8.2	13.8	-	-	-	7.45	-	-	
	TL1-WEEKLY	12/16/2019	-	7.9	5910	156	4.3	-	-	-	845	8.1	9.9	-	-	-	7.32	-	-	
	TL1-WEEKLY	12/23/2019	-	7.5	6320	29	3.3	-	-	-	-	-	10.4	-	-	-	-	-	-	
	TL1-WEEKLY	12/30/2019	-	8.0	8000	143	2.3	-	-	-	-	-	10	-	-	-	-	-	-	
At V-notch Weir	NDSEEP	7/1/2019	4.0	7.7	285	92	4.5	0.06	-	278	114	8.2	3	-	-	112	0.0095	-	14.7	
	NDSEEP	7/8/2019	4.5	7.7	322	194	6.4	0.06	55	288	116	8.2	3	-	-	113	0.0116	-	14.1	
	NDSEEP	7/15/2019	5.0	8.1	302	57	3.1	0.07	-	-	-	-	-	-	-	-	-	-	16.7	
	NDSEEP	7/22/2019	5.5	8.7	349	41	5.5	0.08	-	333	139	8.3	4.7	-	-	126	0.012	-	17.3	
	NDSEEP	7/29/2019	-	7.6	376	45	8.5		-	343	139	8.1	3	-	-	127	0.0133	-	19	
	NDSEEP	8/5/2019	-	7.9	379	52	7.6		-	348	132	8.3	3	-	-	134	0.0143	-	17.3	
	NDSEEP	8/12/2019	6.0	7.8	354	82	6.4	0.08	13	343	135	8.3	3	-	-	147	0.0138	-	19.3	
	NDSEEP	8/19/2019	7.5	7.9	338	65	6.4	0.1	16	360	144	8.3	4.3	-	-	141	0.012	-	20.1	
	NDSEEP	8/26/2019	8.0	7.9	332	80	6.6	0.11	16	-	-	-	-	-	-	-	-	-	19.9	
	NDSEEP	9/2/2019	7.5	7.7	395	60	4.6	0.1	111	-	-	-	-	-	-	-	-	-	22.7	
	NDSEEP	9/9/2019	4.5	7.7	399	71	4.9	0.06	1496	-	-	-	-	-	-	-	-	-	-	
	NDSEEP	9/16/2019	6.0	7.7	354	56	2.2	0.08	-	374	145	8.0	-3	-	-	142	-	-	26.2	
	NDSEEP	9/23/2019	4.5	8.0	347	0.91	0.4	0.06	-	377	143	8.4	-3	-	-	134	-	-	33.2	
TIA at upstream face of North Dam	ND Upstream	7/1/2019	-	7.7	1397	100	4.9	-	387	-	-	-	-	-	-	-	-	-	-	
	ND Upstream	7/8/2019	-	7.6	2710	110	8.9	-	775	-	-	-	-	-	-	-	-	-	-	
	ND Upstream	7/15/2019	-	7.9	3740	90	8.1	-	-	-	-	-	-	-	-	-	-	-	-	
	ND Upstream	7/22/2019	-	8.0	3710	51	10.1	-	-	-	-	-	-	-	-	-	-	-	-	
	ND Upstream	7/29/2019	-	8.3	3710	54	11.4	-	-	-	-	-	-	-	-	-	-	-	-	
	ND Upstream	8/5/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	ND Upstream	8/12/2019	-	8.7	3710	100	12.8	-	1249	-	-	-	-	-	-	-	-	-	-	
	ND Upstream	8/19/2019	-	8.8	3710	63	11.6	-	1297	-	-	-	-	-	-	-	-	-	-	
	ND Upstream	8/26/2019	-	8.6	3870	82	12.7	-	1300	-	-	-	-	-	-	-	-	-	-	
	ND Upstream	9/2/2019	-	8.6	4150	66	5.9	-	1328	-	-	-	-	-	-	-	-	-	-	
	ND Upstream	9/9/2019	-	8.9	3990	84	7.6	-	1469	-	-	-	-	-	-	-	-	-	-	
	ND Upstream	9/16/2019	-	8.7	4080	89	5.8	-	1328	-	-	-	-	-	-	-	-	-	-	
	ND Upstream	9/23/2019	-	8.3	4080	23	2.7	-	1273	-	-	-	-	-	-	-	-	-	-	
TIA at upstream face of South Dam	SRK19-SD-Spigot-1	8/4/2019	-	-	-	-	-	-	-	7120	563	8.0	966	-	-	291	17.0	-	1290	
	SRK19-SD-Spigot-2	8/4/2019	-	-	-	-	-	-	-	5990	450	8.3	505	-	-	290	20.7	-	854	
	SRK19-SD-Spigot-3	8/4/2019	-	-	-	-	-	-	-	2240	296	8.3	3570	-	-	578	3.28	-	407	

Location	Sample ID (field or lab)	Date	Fluoride (F)	Nitrate (as N)	Nitrite (as N)	Total Nitrogen	Cyanide, Total	Cyanide, Free	Cyanide, WAD	Cyanate	Thiocyanate	Phosphorus (P)-Total	Sulphate (SO4)	Aluminum (Al)-Dissolved	Antimony (Sb)-Dissolved	Arsenic (As)-Dissolved	Barium (Ba)-Dissolved	Beryllium (Be)-Dissolved	Bismuth (Bi)-Dissolved	Boron (B)-Dissolved	Cadmium (Cd)-Dissolved	Calcium (Ca)-Dissolved
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Process Water (TL-5)	L2217608-1	1/6/2019	-	8.42	0.393	-	5.69	1.75	1.9	11.7	10.5	0.25	1250	-	-	-	-	-	-	-	-	-
	L2228565-1	2/3/2019	-	6.66	0.294	-	16	5.38	6.62	45.3	14.4	0.5	1480	-	-	-	-	-	-	-	-	-
	L2239803-1	3/3/2019	-	17.2	0.559	-	3.47	1.08	1.31	72.9	27.2	0.25	1860	-	-	-	-	-	-	-	-	-
	L2256607-1	4/10/2019	-	25.1	0.693	-	4.75	0.546	0.656	52.8	17.9	0.25	1930	0.0631	0.00147	0.00164	0.0288	0.0001	0.00025	0.69	0.000025	161
	L2268345-1	5/5/2019	-	19.7	0.795	-	4.17	0.31	0.33	42.3	19.1	0.51	2230	0.0301	0.002	0.00153	0.0306	0.0001	0.00025	0.636	0.000025	142
	L2285440-1	6/2/2019	-	9.18	0.52	-	3.99	0.121	0.229	57	17.3	0.5	2310	0.0536	0.00235	0.0021	0.0395	0.0001	0.00025	0.806	0.000026	126
	L2307093-1	7/7/2019	-	11	0.336	-	5.64	0.738	1.4	28.2	13	0.5	1750	0.0375	0.00224	0.00178	0.0318	0.0001	0.00025	0.728	0.000058	141
	L2327981-1	8/11/2019	-	8.65	0.455	-	0.005	0.005	0.005	51.1	0.62	2.5	2870	0.05	0.005	0.005	0.0824	0.001	0.0025	0.99	0.00193	140
	L2344220-1	9/8/2019	-	12.5	0.587	-	3.77	0.013	0.027	55	20.3	0.5	2540	0.042	0.0029	0.0023	0.039	0.0002	0.0005	0.75	0.00005	106
	L2361827-1	10/5/2019	-	10.7	0.584	-	2.68	0.076	0.131	77.1	10.5	0.51	2180	0.029	0.0019	0.0014	0.0256	0.0002	0.0005	0.56	0.00005	118
	L2377610-1	11/3/2019	-	11.2	0.501	-	5.36	0.33	0.41	53.5	21	0.25	2100	0.0645	0.0042	0.00249	0.0242	0.0001	0.00025	0.592	0.000025	113
	L2394082-1	12/8/2019	-	11.2	0.572	-	2.16	0.11	-0.1	63.4	22.5	0.51	1980	0.0432	0.00328	0.00629	0.0287	0.0001	0.00025	0.753	0.000035	128
Reclaim Pump (TL-1)	TL1 WEEKLY	1/2/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TL1 WEEKLY	1/7/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TL1-MONTHLY	1/15/2019	-	2.61	0.242	-	0.116	0.005	0.005	2.58	0.98	0.0746	471	0.0089	0.0005	0.0009	0.02	0.0002	0.2	0.28	0.00001	104
	TL1 WEEKLY	1/21/2019	-	-	-	-	0.123	-	0.005	1.29	1	0.25	-	0.71	0.5	0.88	0.119	0.5	0.25	0.282	0.25	19
	TL1 WEEKLY	1/28/2019	-	-	-	-	0.133	-	0.005	3.3	2.5	0.1	-	0.95	0.5	0.82	0.115	0.5	0.25	0.315	0.25	119
	TL1-MONTHLY	2/4/2019	-	2.63	0.21	8.32	0.131	0.5	0.005	3.42	0.89	0.71	484	0.67	0.5	0.87	0.2	0.2	0.2	0.31	0.1	12
	TL1-WEEKLY	2/11/2019	-	-	-	-	0.154	-	0.0075	3.63	0.71	0.25	-	0.85	0.29	0.97	0.122	0.4	0.1	0.317	0.11	121
	TL1-WEEKLY	2/18/2019	-	-	-	-	0.131	-	0.0268	2.82	0.5	0.25	-	0.7	0.29	0.96	0.124	0.2	0.1	0.316	0.15	127
	TL1-WEEKLY	2/25/2019	-	-	-	-	0.182	-	0.0071	2.49	0.86	-	-	0.57	0.33	0.12	0.145	0.4	0.1	0.318	0.12	123
	TL1-MONTHLY	3/4/2019	-	2.55	0.123	7.9	0.158	0.57	0.005	1.47	0.75	0.611	522	0.69	0.5	0.16	0.2	0.5	0.2	0.34	0.25	126
	TL1-WEEKLY	3/11/2019	-	-	-	-	0.155	-	0.0072	1.89	0.72	0.25	-	0.76	0.29	0.96	0.158	0.2	0.1	0.277	0.1	117
	TL1-WEEKLY	3/18/2019	-	-	-	-	0.198	-	0.0102	2.73	0.97	-	-	0.81	0.5	0.113	0.146	0.1	0.25	0.319	0.25	145
	TL1-WEEKLY	3/25/2019	-	-	-	-	0.184	-	0.0124	2.4	0.97	-	-	0.67	0.5	0.15	0.2	0.2	-	0.38	0.1	145
	TL1-MONTHLY	4/1/2019	-	2.58	0.81	8.8	0.193	0.145	0.0179	3.33	0.69	0.631	569	0.54	0.5	0.17	0.2	0.4	0.2	0.34	0.1	136
	TL1-WEEKLY	4/8/2019	-	-	-	-	0.215	-	0.0209	1.62	0.83	-	-	0.5	0.5	0.114	0.159	0.1	0.25	0.331	0.25	129
	TL1-WEEKLY	4/15/2019	-	-	-	-	0.261	-	0.0411	4.17	0.38	-	-	0.359	0.5	0.14	0.158	0.1	0.25	0.346	0.25	139
	TL1-WEEKLY	4/22/2019	-	-	-	-	0.253	-	0.033	2.28	0.97	-	-	0.73	0.5	0.17	0.158	0.1	0.25	0.339	0.25	131
	TL1-WEEKLY	4/29/2019	-	-	-	-	0.3	-	0.0412	1.44	1.12	-	-	0.71	0.5	0.12	0.174	0.1	0.25	0.44	0.25	154
	TL1-MONTHLY	5/6/2019	-	2.54	0.89	9.75	0.285	0.42	0.0418	2.94	1.08	0.774	618	0.65	0.5	0.115	0.2	0.1	0.2	0.36	0.25	136
	TL1-WEEKLY	5/13/2019	-	-	-	-	0.285	-	0.0383	1.32	1.18	-	-	0.59	0.5	0.19	0.186	0.1	0.25	0.416	0.25	156
	TL1-WEEKLY	5/20/2019	-	-	-	-	0.293	-	0.0358	1.68	1.18	-	-	0.59	0.5	0.13	0.184	0.1	0.25	0.374	0.25	138
	TL1-WEEKLY	5/27/2019	-	-	-	-	0.282	-	0.0358	2.43	1.21	-	-	0.52	0.37	0.112	0.188	0.4	0.1	0.439	0.1	157
	TL1-MONTHLY	6/3/2019	-	2.65	0.182	1.9	0.321	0.43	0.05	0.75	1.26	0.628	65	0.55	0.5	0.14	0.2	0.1	0.2	0.42	0.25	152
	TL1-WEEKLY	6/10/2019	-	-	-	-	0.282	-	0.042	2	1.42	-	-	0.5	0.5	0.113	0.194	0.1	0.25	0.46	0.25	146
	TL1-WEEKLY	6/17/2019	-	-	-	-	0.283	-	0.0284	1.44	1.4	-	-	0.41	0.38	0.116	0.211	0.2	0.5	0.424	0.88	16
	TL1-WEEKLY	6/24/2019	-	-	-	-	0.32	-	0.036	0.27	1.29	-	-	0.92	0.5	0.113	0.194	0.1	0.25	0.418	0.25	159
	TL1-MONTHLY	7/1/2019	-	2.28	0.99	12.9	0.326	0.266	0.0271	1.83	1.32	0.592	652	0.58	0.5	0.16	0.2	0.1	0.2	0.41	0.25	148
	TL1-WEEKLY	7/8/2019	-	2.73	0.14	1.2	0.287	0.271	0.026	2.1	1.28	0.3	655	0.5	0.5	0.111	0.2	0.1	0.2	0.35	0.13	149
	TL1-WEEKLY	7/15/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TL1-WEEKLY	7/22/2019	-	2.84	0.18	9.32	0.138	0.23	0.0188	1.8	1.08	0.3	491	0.67	0.5	0.9	0.2	0.1	0.2	0.34	0.167	141
	TL1-WEEKLY	7/29/2019	-	2.73	0.14	1.2	0.287	0.271	0.026	2.1	1.28	0.3	655	0.5	0.5	0.111	0.2	0.1	0.2	0.35	0.13	149
	TL1-WEEKLY	8/5/2019	-	2.71	0.139	8.9	0.193	0.5	0.005	0.2	0.64	0.3	433	0.95	0.5	0.67	0.2	0.2	0.2	0.32	0.12	113
	TL1-MONTHLY	8/12/2019	-	3.46	0.188	9.1	0.46	0.156	0.0136	0.2	0.64	0.352	446	0.97	0.5	0.8	0.2	0.4	0.2	0.31	0.1	12
	TL1-MONTHLY	8/19/2019	-	3.1	0.196	8.7	0.334	0.132	0.0103	2.82	0.68	0.3	441	0.93	0.5	0.84	0.2	0.2	0.2	0.34	0.1	121
	TL1-WEEKLY	8/26/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TL1-WEEKLY	9/2/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TL1-MONTHLY	9/9/2019	-	3.24	0.192	8.87	0.0482	0.0163	0.0162	2.49	0.73	0.0565	474	0.0108	0.0005	0.00078	0.02	0.0005	0.2	0.38	0.000025	130
	TL1-WEEKLY	9/16/2019	-	2.79	0.183	7.73	0.0321	0.0118	0.011	2.16	0.5	0.3	495	0.011	0.0005	0.00076	0.02	0.0005	0.2	0.34	0.000025	126
	TL1-WEEKLY	9/23/2019	-	2.99	0.185	8	0.044	0.0149	0.0129	4.8	0.7	0.3	471	0.0102	0.0005	0.00079	0.02	0.0002	0.2	0.32	0.00001	122
	TL1-WEEKLY	9/29/2019	-	-	-	-	0.0413	-	0.0093	3.57	0.5	-	-	0.0112	0.0005	0.00094	0.0179	0.0001	0.00025	0.332	0.000025	120
	TL1-MONTHLY	10/7/2019	-	2.88	0.179	8.87	0.0657	0.0145	0.0128	1.68	0.81	0.0567	479	0.0123	0.0005	0.00082	0.02	0.0001	0.2	0.37	0.000025	135
	TL1-WEEKLY	10/14/2019	-	-	-	-	0.0531	-	0.0143	0.48	0.75	-	-	0.0106	0.0005	0.00098	0.0199	0.0001	0.00025	0.366	0.000025	136
	TL1-WEEKLY	10/21/2019	-	-	-	-	0.0482	-	0.008	1.2	0.79	-	-	0.0116	0.00035	0.00092	0.0184	0.00004	0.0001	0.367	0.00001	134
	TL1-WEEKLY	10/28/2019	-	-	-	-	0.0445	-	0.0075	4.2	0.69	-	-	0.0117	0.00032	0.00089	0.0184	0.00004	0.0001	0.368	0.00001	129
	TL1-MONTHLY	11/4/2019	-	3.45	0.146	9.04	0.0542	0.005	0.005	5.52	0.89	0.0346	530	0.0122	0.0005	0.00103	0.02	0.0001	0.2	0.41	0.000025	145
	TL1-WEEKLY	11/11/2019	-	-	-	-	0.151	-	0.005	7.59	1.06	-	-	0.0115	0.00051	0.0014	0.0202	0.0001	0.00025	0.396	0.000025	136

Location	Sample ID (field or lab)	Date	Fluoride (F)	Nitrate (as N)	Nitrite (as N)	Total Nitrogen	Cyanide, Total	Cyanide, Free	Cyanide, WAD	Cyanate	Thiocyanate	Phosphorus (P)-Total	Sulphate (SO4)	Aluminum (Al)-Dissolved	Antimony (Sb)-Dissolved	Arsenic (As)-Dissolved	Barium (Ba)-Dissolved	Beryllium (Be)-Dissolved	Bismuth (Bi)-Dissolved	Boron (B)-Dissolved	Cadmium (Cd)-Dissolved	Calcium (Ca)-Dissolved
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	TL1-WEEKLY	11/18/2019	-	-	-	-	0.119	-	0.005	4.35	0.97	-	-	0.0135	0.0005	0.00106	0.017	0.0001	0.00025	0.388	0.000025	130
	TL1-WEEKLY	11/25/2019	-	-	-	-	0.209	-	0.005	6.03	1.31	-	-	0.0202	0.00056	0.00117	0.0204	0.00004	0.0001	0.419	0.000013	152
	TL1-MONTHLY	12/2/2019	-	3.91	0.206	12.6	0.312	0.005	0.005	0.42	1.32	0.0765	600	0.0138	0.00059	0.00128	0.021	0.0001	0.2	0.48	0.000025	148
	TL1-WEEKLY	12/9/2019	-	-	-	-	0.338	-	0.005	17.2	2.28	-	-	0.0163	0.00057	0.00113	0.0203	0.0001	0.00025	0.458	0.000107	147
	TL1-WEEKLY	12/16/2019	-	-	-	-	0.327	-	0.0058	7.98	1.63	-	-	0.0107	0.00062	0.00115	0.022	0.0005	0.2	0.53	0.000025	163
	TL1-WEEKLY	12/23/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TL1-WEEKLY	12/30/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
At V-notch Weir	NDSEEP	7/1/2019	-	0.103	0.001	0.487	0.005	0.005	-	1	0.5	0.3	20.5	0.0143	0.0005	0.00056	0.02	0.0001	0.2	0.1	0.000005	34.3
	NDSEEP	7/8/2019	-	0.15	0.0011	0.525	0.005	0.005	-	2	-	0.3	22.9	0.013	0.0005	0.00064	0.02	0.0001	0.2	0.1	0.000005	34.9
	NDSEEP	7/15/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	NDSEEP	7/22/2019	-	0.225	0.001	0.707	0.005	0.005	-	1	-	0.3	22.1	0.0166	0.0005	0.00056	0.02	0.0001	0.2	0.1	0.000005	42.2
	NDSEEP	7/29/2019	-	0.43	0.02	0.86	0.005	0.005	-	1	-	0.3	26.6	0.0378	0.0005	0.00056	0.02	0.0001	0.2	0.1	0.000005	40
	NDSEEP	8/5/2019	-	0.3	0.0011	0.77	0.005	0.005	-	2	-	0.3	25.8	0.0272	0.0005	0.00062	0.02	0.0001	0.2	0.1	0.000005	38.7
	NDSEEP	8/12/2019	-	0.189	0.0015	0.853	0.005	0.005	-	0.2	-	0.3	19.7	0.0532	0.0005	0.00059	0.02	0.0001	0.2	0.1	0.000005	39.4
	NDSEEP	8/19/2019	-	0.191	0.001	0.839	0.005	0.005	-	0.2	-	0.3	16.7	0.0244	0.0005	0.00069	0.02	0.0001	0.2	0.1	0.000005	42
	NDSEEP	8/26/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	NDSEEP	9/2/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	NDSEEP	9/9/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	NDSEEP	9/16/2019	-	0.143	0.0013	0.666	-	-0.005	-	-	-	-	20	0.0256	0.0005	0.0005	0.02	0.0001	0.2	0.1	0.000005	42.5
	NDSEEP	9/23/2019	-	0.112	0.0014	0.656	-	-0.005	-	-	-	-	15.8	0.0361	0.0005	0.00051	0.02	0.0001	0.2	0.1	0.000005	42.2
TIA at upstream face of North Dam	ND Upstream	7/1/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	7/8/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	7/15/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	7/22/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	7/29/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	8/5/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	8/12/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	8/19/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	8/26/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	9/2/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	9/9/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	9/16/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	9/23/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TIA at upstream face of South Dam	SRK19-SD-Spigot-1	8/4/2019	-	0.05	0.05	19.6	-	0.1	0.05	8.14	0.784	-	1450	0.008	0.0012	0.001	0.0211	0.0001	0.0001	0.92	0.00001	97
	SRK19-SD-Spigot-2	8/4/2019	-	23	0.82	40.5	-	0.1	0.05	12.7	0.784	-	1330	0.01	0.0007	0.0024	0.0139	0.0001	0.0001	1.61	0.00001	60.1
	SRK19-SD-Spigot-3	8/4/2019	-	0.005	0.005	5.6	-	0.1	0.63	4.42	1.23	-	3.5	0.015	0.0004	0.0048	0.0214	0.0001	0.0001	0.15	0.00001	43.8

Location	Sample ID (field or lab)	Date	Cesium (Cs)-Dissolved	Chromium (Cr)-Dissolved	Cobalt (Co)-Dissolved	Copper (Cu)-Dissolved	Iron (Fe)-Dissolved	Lead (Pb)-Dissolved	Lithium (Li)-Dissolved	Magnesium (Mg)-Dissolved	Manganese (Mn)-Dissolved	Mercury (Hg)-Dissolved	Molybdenum (Mo)-Dissolved	Nickel (Ni)-Dissolved	Phosphorus (P)-Dissolved	Potassium (K)-Dissolved	Rubidium (Rb)-Dissolved	Selenium (Se)-Dissolved	Silicon (Si)-Dissolved	Silver (Ag)-Dissolved	Sodium (Na)-Dissolved
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Process Water (TL-5)	L2217608-1	1/6/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	L2228565-1	2/3/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	L2239803-1	3/3/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	L2256607-1	4/10/2019	-	0.0005	0.0249	0.828	1.31	0.00025	0.0405	91.8	0.179	0.000005	0.0135	0.136	0.25	96.1	-	0.0013	1.55	0.00005	1550
	L2268345-1	5/5/2019	-	0.0005	0.0091	0.195	1.11	0.00025	0.0496	84.3	0.185	0.0000058	0.0152	0.0767	0.44	86.1	-	0.00142	1.61	0.00005	1550
	L2285440-1	6/2/2019	-	0.0005	0.0199	0.02	1.2	0.00025	0.0557	98.3	0.144	0.000005	0.0347	0.0561	0.55	103	-	0.00247	1.83	0.00005	1990
	L2307093-1	7/7/2019	-	0.0005	0.0248	1.3	1.54	0.00025	0.0458	88.5	0.196	0.0000051	0.045	0.119	0.54	78.6	-	0.00296	1.7	0.000176	1460
	L2327981-1	8/11/2019	-	0.005	0.007	150	0.5	0.0025	0.076	75.7	1.27	0.0006	0.0265	3.51	2.5	65.5	-	0.0035	3.9	0.0005	1710
	L2344220-1	9/8/2019	-	0.001	0.0104	0.062	1.41	0.0005	0.041	76.7	0.13	0.0000141	0.0836	0.0069	0.5	77.3	-	0.00266	1.81	0.0001	1950
	L2361827-1	10/5/2019	-	0.001	0.0089	0.0579	0.99	0.0005	0.034	82.9	0.179	0.0000135	0.106	0.0428	0.5	66.7	-	0.00875	1.6	0.0001	1790
	L2377610-1	11/3/2019	-	0.0005	0.00893	0.446	1.28	0.00025	0.0335	94.3	0.134	0.000005	0.0612	0.0396	0.25	61.5	-	0.00588	1.27	0.00005	1820
	L2394082-1	12/8/2019	-	0.0005	0.0164	0.0069	0.772	0.00025	0.0563	114	0.0997	0.000025	0.0416	0.12	0.61	82	-	0.00208	1.49	0.00005	1790
Reclaim Pump (TL-1)	TL1 WEEKLY	1/2/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TL1 WEEKLY	1/7/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TL1-MONTHLY	1/15/2019	-	0.001	0.00277	0.0283	0.133	0.0005	0.0211	52.2	0.363	0.000005	0.0028	0.0079	0.3	27.9	-	0.00031	1.95	0.00002	541
	TL1 WEEKLY	1/21/2019	0.5	0.5	0.272	0.186	0.135	0.25	0.23	54.5	0.361	-	0.248	0.8	0.25	28.3	0.119	0.32	2.1	0.5	54
	TL1 WEEKLY	1/28/2019	0.5	0.5	0.28	0.193	0.116	0.25	0.225	6.8	0.398	-	0.264	0.86	0.25	31.6	0.126	0.3	2.8	0.5	6
	TL1-MONTHLY	2/4/2019	-	0.1	0.291	0.252	0.9	0.5	0.239	62.1	0.427	0.5	0.28	0.87	0.3	31.4	-	0.23	2.17	0.2	627
	TL1-WEEKLY	2/11/2019	-	0.2	0.294	0.315	0.136	0.1	0.225	61.4	0.442	0.5	0.27	0.83	0.1	32.9	-	0.26	2.25	0.2	666
	TL1-WEEKLY	2/18/2019	0.43	0.2	0.34	0.413	0.127	0.1	0.221	62	0.436	0.5	0.267	0.91	0.1	33	0.119	0.15	2.28	0.2	623
	TL1-WEEKLY	2/25/2019	-	0.2	0.341	0.341	0.131	0.1	0.234	68.6	0.52	0.5	0.297	0.93	0.1	34.4	-	0.25	2.38	0.2	686
	TL1-MONTHLY	3/4/2019	-	0.1	0.332	0.168	0.97	0.5	0.241	65.5	0.464	0.5	0.28	0.96	0.3	32.6	-	0.35	2.27	0.5	643
	TL1-WEEKLY	3/11/2019	0.42	0.2	0.315	0.127	0.15	0.1	0.24	6.5	0.482	0.5	0.279	0.9	0.1	32.1	0.129	0.3	2.58	0.2	613
	TL1-WEEKLY	3/18/2019	-	0.5	0.336	0.222	0.152	0.25	0.249	72.5	0.5	0.5	0.35	0.11	0.25	35.5	-	0.48	2.21	0.5	693
	TL1-WEEKLY	3/25/2019	-	0.1	0.334	0.185	0.141	0.5	0.269	72.2	0.499	0.5	0.29	0.11	-	36.1	-	0.33	-	0.2	698
	TL1-MONTHLY	4/1/2019	-	0.1	0.349	0.213	0.173	0.5	0.244	68.5	0.511	0.5	0.3	0.11	0.3	36.1	-	0.4	2.45	0.2	689
	TL1-WEEKLY	4/8/2019	-	0.5	0.375	0.288	0.246	0.25	0.247	7.2	0.511	0.5	0.315	0.17	0.25	35.3	-	0.41	2.19	0.5	71
	TL1-WEEKLY	4/15/2019	-	0.5	0.37	0.31	0.265	0.25	0.24	72.9	0.58	0.5	0.311	0.17	0.25	35.4	-	0.51	2.38	0.5	738
	TL1-WEEKLY	4/22/2019	-	0.5	0.373	0.27	0.229	0.25	0.246	74.2	0.533	0.5	0.35	0.111	0.25	35.4	-	0.33	2.48	0.5	752
	TL1-WEEKLY	4/29/2019	-	0.5	0.376	0.341	0.24	0.25	0.284	78.3	0.538	0.5	0.343	0.119	0.25	39.4	-	0.36	2.75	0.5	797
	TL1-MONTHLY	5/6/2019	-	0.1	0.45	0.29	0.279	0.5	0.263	83.7	0.588	0.5	0.3	0.125	0.3	39.5	-	0.47	2.64	0.5	817
	TL1-WEEKLY	5/13/2019	-	0.5	0.377	0.224	0.297	0.25	0.277	81.5	0.538	0.5	0.356	0.117	0.25	38.3	-	0.47	2.65	0.5	755
	TL1-WEEKLY	5/20/2019	-	0.5	0.379	0.189	0.142	0.25	0.271	75.7	0.554	0.5	0.358	0.119	0.25	39.1	-	0.36	2.71	0.5	835
	TL1-WEEKLY	5/27/2019	-	0.2	0.392	0.181	0.338	0.1	0.312	89	0.622	0.5	0.359	0.122	0.1	43.4	-	0.36	2.89	0.2	844
	TL1-MONTHLY	6/3/2019	-	0.1	0.42	0.234	0.141	0.5	0.297	87.7	0.578	0.5	0.36	0.118	0.3	42.2	-	0.61	2.85	0.5	839
	TL1-WEEKLY	6/10/2019	-	0.5	0.386	0.241	0.31	0.25	0.293	84.5	0.567	0.5	0.339	0.129	0.25	41.7	-	0.26	2.79	0.5	869
	TL1-WEEKLY	6/17/2019	-	0.1	0.41	0.246	0.339	0.5	0.38	95.6	0.624	0.5	0.366	0.13	0.6	48.5	-	0.323	2.98	0.1	929
	TL1-WEEKLY	6/24/2019	-	0.5	0.45	0.17	0.277	0.25	0.281	84.5	0.556	0.5	0.347	0.132	0.25	39.8	-	0.25	2.65	0.5	883
	TL1-MONTHLY	7/1/2019	-	0.1	0.387	0.135	0.259	0.5	0.27	82.3	0.549	0.5	0.36	0.124	0.3	38.4	-	0.44	2.71	0.5	81
	TL1-WEEKLY	7/8/2019	-	0.1	0.384	0.211	0.199	0.5	0.25	8.9	0.595	0.53	0.35	0.122	0.3	41.5	-	0.539	2.58	0.2	823
	TL1-WEEKLY	7/15/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TL1-WEEKLY	7/22/2019	-	0.1	0.317	0.444	0.131	0.5	0.228	77.6	0.446	0.5	0.31	0.91	0.3	36.7	-	0.376	2.15	0.2	759
	TL1-WEEKLY	7/29/2019	-	0.1	0.384	0.211	0.199	0.5	0.25	8.9	0.595	0.53	0.35	0.122	0.3	41.5	-	0.539	2.58	0.2	823
	TL1-WEEKLY	8/5/2019	-	0.1	0.279	0.466	0.18	0.5	0.25	6.4	0.381	0.5	0.3	0.74	0.3	3.1	-	0.18	2.1	0.2	63
	TL1-MONTHLY	8/12/2019	-	0.1	0.293	0.562	0.83	0.5	0.187	69	0.374	0.5	0.33	0.8	0.3	28.5	-	0.19	2.4	0.2	64
	TL1-MONTHLY	8/19/2019	-	0.1	0.285	0.527	0.56	0.5	0.216	7.7	0.392	0.91	0.36	0.76	0.3	28.7	-	0.26	1.96	0.2	66
	TL1-WEEKLY	8/26/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TL1-WEEKLY	9/2/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TL1-MONTHLY	9/9/2019	0	0.001	0.00306	0.056	0.084	0.0005	0.0227	79.2	0.402	0.000005	0.004	0.0077	0.3	33	-	0.00025	2.06	0.00005	775
	TL1-WEEKLY	9/16/2019	-	0.001	0.00292	0.0488	-	0.0005	0.0217	72.3	0.387	0.000005	0.0042	0.0076	0.3	30.3	-	0.00039	2.01	0.00005	680
	TL1-WEEKLY	9/23/2019	-	0.001	0.00282	0.0469	-	0.0005	0.0206	66.1	0.381	0.0000108	0.0044	0.007	0.3	30.3	-	0.00023	1.97	0.00002	675
	TL1-WEEKLY	9/29/2019	-	0.0005	0.00304	0.0499	-	0.00025	0.0199	74.2	0.397	0.000019	0.0049	0.0079	0.25	30.7	-	0.00025	2.05	0.00005	691
	TL1-MONTHLY	10/7/2019	0	0.001	0.00303	0.0524	0.069	0.0005	0.023	70.6	0.399	0.0000159	0.0049	0.008	0.3	30.9	-	0.00025	1.92	0.00005	715
	TL1-WEEKLY	10/14/2019	-	0.0005	0.00312	0.0518	-	0.00025	0.022	75.4	0.418	0.000005	0.00523	0.0079	0.25	32.2	-	0.0004	2.04	0.00005	727
	TL1-WEEKLY	10/21/2019	-	0.0002	0.00324	0.051	-	0.0001	0.0236	82.3	0.415	0.000005	0.00543	0.0079	0.1	35.2	-	0.00018	2.05	0.00002	788
	TL1-WEEKLY	10/28/2019	-	0.0002	0.00326	0.0506	-	0.0001	0.0236	85.7	0.441	0.0000164	0.00524	0.0083	0.1	35.2	-	0.00016	2.32	0.00002	854
	TL1-MONTHLY	11/4/2019	0	0.001	0.00315	0.0481	0.086	0.0005	0.0246	75.8	0.415	0.0000138	0.0066	0.0082	0.3	33.5	-	0.0005	2.25	0.00005	777
	TL1-WEEKLY	11/11/2019	-	0.0005	0.00353	0.0513	-	0.00025	0.0237	79.7	0.401	0.0000081	0.00846	0.0097	0.25	37.7	-	0.00054	2.17	0.00005	838

Location	Sample ID (field or lab)	Date	Cesium (Cs)-Dissolved	Chromium (Cr)-Dissolved	Cobalt (Co)-Dissolved	Copper (Cu)-Dissolved	Iron (Fe)-Dissolved	Lead (Pb)-Dissolved	Lithium (Li)-Dissolved	Magnesium (Mg)-Dissolved	Manganese (Mn)-Dissolved	Mercury (Hg)-Dissolved	Molybdenum (Mo)-Dissolved	Nickel (Ni)-Dissolved	Phosphorus (P)-Dissolved	Potassium (K)-Dissolved	Rubidium (Rb)-Dissolved	Selenium (Se)-Dissolved	Silicon (Si)-Dissolved	Silver (Ag)-Dissolved	Sodium (Na)-Dissolved
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	TL1-WEEKLY	11/18/2019	-	0.0005	0.00346	0.055	-	0.00025	0.0219	80.4	0.402	0.000005	0.0086	0.0092	0.25	37.3	-	0.00037	2.03	0.00005	806
	TL1-WEEKLY	11/25/2019	-	0.0002	0.00334	0.0622	-	0.0001	0.027	114	0.464	0.0000149	0.01	0.0091	0.1	52.3	-	0.00053	2.51	0.00002	1100
	TL1-MONTHLY	12/2/2019	-	0.001	0.00395	0.0511	0.159	0.0005	0.0275	97.3	0.442	0.0000082	0.0101	0.009	0.3	41.2	-	0.0005	2.5	0.00005	993
	TL1-WEEKLY	12/9/2019	-	0.0005	0.00397	0.0394	0.208	0.00025	0.0258	98.6	0.393	0.0000195	0.0108	0.0103	0.25	39.9	-	0.0004	2.13	0.00005	1010
	TL1-WEEKLY	12/16/2019	-	0.001	0.00389	0.0244	0.281	0.0005	0.0306	106	0.453	0.0000133	0.0104	0.0095	0.3	43.9	-	0.00037	2.33	0.00005	1050
	TL1-WEEKLY	12/23/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TL1-WEEKLY	12/30/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
At V-notch Weir	NDSEEP	7/1/2019	-	0.001	0.0003	0.0069	0.086	0.0005	0.0021	6.88	0.00596	0.000005	0.001	0.001	0.3	2	-	0.00012	2.87	0.00002	14.6
	NDSEEP	7/8/2019	-	0.001	0.0003	0.0066	0.06	0.0005	0.0024	6.95	0.0036	-	0.001	0.001	0.3	2	-	0.000145	2.99	0.00002	15.5
	NDSEEP	7/15/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	NDSEEP	7/22/2019	-	0.001	0.0003	0.0073	0.104	0.0005	0.0027	8.04	0.00396	-	0.001	0.001	0.3	2	-	0.00017	3.47	0.00002	17.6
	NDSEEP	7/29/2019	-	0.001	0.0003	0.0081	0.083	0.0005	0.0026	9.58	0.00385	-	0.001	0.001	0.3	2	-	0.000154	3.55	0.00002	22
	NDSEEP	8/5/2019	-	0.001	0.0003	0.0079	0.074	0.0005	0.003	8.46	0.00316	-	0.001	0.0011	0.3	2	-	0.000188	3.66	0.00002	21.3
	NDSEEP	8/12/2019	-	0.001	0.0003	0.0084	0.121	0.0005	0.0032	8.95	0.00421	-	0.001	0.0015	0.3	2	-	0.000202	4.4	0.00002	19.3
	NDSEEP	8/19/2019	-	0.001	0.0003	0.0085	0.101	0.0005	0.0035	9.48	0.00407	-	0.001	0.0015	0.3	2	-	0.000181	4.44	0.00002	19.4
	NDSEEP	8/26/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	NDSEEP	9/2/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	NDSEEP	9/9/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	NDSEEP	9/16/2019	-	0.001	0.0003	0.007	0.098	0.0005	0.0032	9.5	0.00578	0.000005	0.001	0.0013	0.3	2	-	0.00015	4.58	0.00002	20
	NDSEEP	9/23/2019	-	0.001	0.0003	0.0075	0.148	0.0005	0.003	9.17	0.00667	0.0000114	0.001	0.0013	0.3	2	-	0.0001	4.82	0.00002	20.1
TIA at upstream face of North Dam	ND Upstream	7/1/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	7/8/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	7/15/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	7/22/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	7/29/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	8/5/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	8/12/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	8/19/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	8/26/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	9/2/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	9/9/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	9/16/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	9/23/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TIA at upstream face of South Dam	SRK19-SD-Spigot-1	8/4/2019	-	0.0005	0.0052	0.0097	0.06	0.0005	0.0649	78	0.255	0.0005	0.0469	0.0013	0.05	62.9	-	0.0011	3.92	0.00008	1280
	SRK19-SD-Spigot-2	8/4/2019	-	0.0005	0.0042	0.0393	0.02	0.0005	0.0123	72.8	0.13	0.0005	0.0197	0.0044	0.05	57.5	-	0.004	1.45	0.00008	1080
	SRK19-SD-Spigot-3	8/4/2019	-	0.0016	0.001	0.0006	0.32	0.0005	0.0336	45.2	0.0323	0.0005	0.0012	0.0019	0.23	33	-	0.0005	10.1	0.00008	358

Location	Sample ID (field or lab)	Date	Strontium (Sr)-Dissolved	Sulfur (S)-Dissolved	Tellurium (Te)-Dissolved	Thallium (Tl)-Dissolved	Thorium (Th)-Dissolved	Tin (Sn)-Dissolved	Titanium (Ti)-Dissolved	Tungsten (W)-Dissolved	Uranium (U)-Dissolved	Vanadium (V)-Dissolved	Zinc (Zn)-Dissolved	Zirconium (Zr)-Dissolved
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Process Water (TL-5)	L2217608-1	1/6/2019	-	-	-	-	-	-	-	-	-	-	-	-
	L2228565-1	2/3/2019	-	-	-	-	-	-	-	-	-	-	-	-
	L2239803-1	3/3/2019	-	-	-	-	-	-	-	-	-	-	-	-
	L2256607-1	4/10/2019	1.2	755	-	0.00005	-	0.0005	0.0015	-	0.000748	0.0025	0.005	0.0003
	L2268345-1	5/5/2019	1.1	842	-	0.00005	-	0.0005	0.0015	-	0.000554	0.0025	0.005	0.0003
	L2285440-1	6/2/2019	1.2	945	-	0.00005	-	0.0005	0.0015	-	0.000869	0.0025	0.005	0.001
	L2307093-1	7/7/2019	1.1	627	-	0.00005	-	0.0005	0.0015	-	0.000477	0.0025	0.005	0.001
	L2327981-1	8/11/2019	1.1	970	-	0.0005	-	0.005	0.015	-	0.0005	0.025	0.263	0.01
	L2344220-1	9/8/2019	1.1	983	-	0.0001	-	0.001	0.003	-	0.00065	0.005	0.01	0.002
	L2361827-1	10/5/2019	0.9	857	-	0.0001	-	0.001	0.003	-	0.00028	0.005	0.01	0.002
	L2377610-1	11/3/2019	1.0	820	-	0.00005	-	0.0005	0.0015	-	0.000224	0.0025	0.005	0.001
	L2394082-1	12/8/2019	1.1	707	-	0.00005	-	0.0005	0.0015	-	0.000632	0.0025	0.005	0.001
Reclaim Pump (TL-1)	TL1 WEEKLY	1/2/2019	-	-	-	-	-	-	-	-	-	-	-	-
	TL1 WEEKLY	1/7/2019	-	-	-	-	-	-	-	-	-	-	-	-
	TL1-MONTHLY	1/15/2019	-	-	-	0.0002	-	0.0005	0.01	-	0.0002	0.001	0.005	-
	TL1 WEEKLY	1/21/2019	0.78	173	0.1	0.5	0.5	0.5	0.15	0.5	0.192	0.25	0.5	0.3
	TL1 WEEKLY	1/28/2019	0.78	178	0.1	0.5	0.5	0.5	0.15	0.5	0.195	0.25	0.5	0.3
	TL1-MONTHLY	2/4/2019	0.87	-	-	0.2	-	0.5	0.1	-	0.2	0.1	0.5	-
	TL1-WEEKLY	2/11/2019	0.83	26	-	0.2	-	0.2	0.6	-	0.179	0.1	0.2	0.3
	TL1-WEEKLY	2/18/2019	0.86	193	0.4	0.2	0.2	0.2	0.6	0.36	0.28	0.1	0.2	0.12
	TL1-WEEKLY	2/25/2019	0.95	23	-	0.2	-	0.2	0.6	-	0.29	0.1	0.2	0.3
	TL1-MONTHLY	3/4/2019	0.83	-	-	0.2	-	0.5	0.1	-	0.21	0.25	0.5	-
	TL1-WEEKLY	3/11/2019	0.88	25	0.4	0.2	0.2	0.2	0.6	0.3	0.238	0.1	0.2	0.12
	TL1-WEEKLY	3/18/2019	1	21	-	0.5	-	0.5	0.15	-	0.23	0.25	0.5	0.3
	TL1-WEEKLY	3/25/2019	-	-	-	0.2	-	0.5	0.1	-	0.21	0.1	0.5	-
	TL1-MONTHLY	4/1/2019	1.8	199	-	0.2	-	0.5	0.1	-	0.21	0.1	0.5	0.3
	TL1-WEEKLY	4/8/2019	1.1	23	-	0.5	-	0.5	0.15	-	0.234	0.25	0.5	0.3
	TL1-WEEKLY	4/15/2019	1.8	215	-	0.5	-	0.5	0.15	-	0.232	0.25	0.5	0.3
	TL1-WEEKLY	4/22/2019	1.8	219	-	0.5	-	0.5	0.15	-	0.21	0.25	0.5	0.3
	TL1-WEEKLY	4/29/2019	1.15	227	-	0.5	-	0.5	0.15	-	0.234	0.25	0.5	0.3
	TL1-MONTHLY	5/6/2019	0.952	235	-	0.2	-	0.5	0.1	-	0.23	0.25	0.5	0.3
	TL1-WEEKLY	5/13/2019	1.16	214	-	0.5	-	0.5	0.15	-	0.242	0.25	0.5	0.3
	TL1-WEEKLY	5/20/2019	1.17	241	-	0.5	-	0.5	0.15	-	0.247	0.25	0.5	0.3
	TL1-WEEKLY	5/27/2019	1.2	267	-	0.2	-	0.2	0.6	-	0.237	0.1	0.2	0.3
	TL1-MONTHLY	6/3/2019	1.19	252	-	0.2	-	0.5	0.1	-	0.26	0.25	0.5	0.1
	TL1-WEEKLY	6/10/2019	1.16	243	-	0.5	-	0.5	0.15	-	0.263	0.25	0.5	0.1
	TL1-WEEKLY	6/17/2019	1.2	262	-	0.1	-	0.1	0.3	-	0.253	0.5	0.1	0.3
	TL1-WEEKLY	6/24/2019	1.27	225	-	0.5	-	0.5	0.15	-	0.255	0.25	0.5	0.1
	TL1-MONTHLY	7/1/2019	1.17	229	-	0.2	-	0.5	0.1	-	0.26	0.25	0.5	0.1
	TL1-WEEKLY	7/8/2019	1.18	-	-	0.2	-	0.5	0.1	-	0.24	0.5	0.5	-
	TL1-WEEKLY	7/15/2019	-	-	-	-	-	-	-	-	-	-	-	-
	TL1-WEEKLY	7/22/2019	1.4	-	-	0.2	-	0.5	0.1	-	0.2	0.5	0.5	-
	TL1-WEEKLY	7/29/2019	1.18	-	-	0.2	-	0.5	0.1	-	0.24	0.5	0.5	-
	TL1-WEEKLY	8/5/2019	0.916	-	-	0.2	-	0.5	0.1	-	0.2	0.1	0.5	-
	TL1-MONTHLY	8/12/2019	0.989	16	-	0.2	-	0.5	0.1	-	0.2	0.1	0.5	0.4
	TL1-MONTHLY	8/19/2019	0.987	-	-	0.2	-	0.5	0.1	-	0.2	0.1	0.5	-
	TL1-WEEKLY	8/26/2019	-	-	-	-	-	-	-	-	-	-	-	-
	TL1-WEEKLY	9/2/2019	-	-	-	-	-	-	-	-	-	-	-	-
	TL1-MONTHLY	9/9/2019	1.12	0	-	0.0002	-	0.0005	0.01	-	0.0002	0.0025	0.005	-
	TL1-WEEKLY	9/16/2019	1.03	0	-	0.0002	-	0.0005	0.01	-	0.0002	0.0025	0.005	-
	TL1-WEEKLY	9/23/2019	1.08	0	-	0.0002	-	0.0005	0.01	-	0.0002	0.001	0.005	-
	TL1-WEEKLY	9/29/2019	0.958	190	-	0.00005	-	0.0005	0.0015	-	0.000181	0.0025	0.005	0.001
	TL1-MONTHLY	10/7/2019	1.04	165	-	0.0002	-	0.0005	0.01	-	0.0002	0.0025	0.005	0.001
	TL1-WEEKLY	10/14/2019	1.14	182	-	0.00005	-	0.0005	0.0015	-	0.000179	0.0025	0.005	0.001
	TL1-WEEKLY	10/21/2019	1.08	194	-	0.00002	-	0.0002	0.0006	-	0.0002	0.001	0.002	0.0004
	TL1-WEEKLY	10/28/2019	1.09	213	-	0.00002	-	0.0002	0.0006	-	0.0002	0.001	0.002	0.0004
	TL1-MONTHLY	11/4/2019	1.26	201	-	0.0002	-	0.0005	0.01	-	0.00022	0.0025	0.005	0.001
	TL1-WEEKLY	11/11/2019	1	216	-	0.00005	-	0.0005	0.0015	-	0.000237	0.0025	0.005	0.001

Location	Sample ID (field or lab)	Date	Strontium (Sr)-Dissolved	Sulfur (S)-Dissolved	Tellurium (Te)-Dissolved	Thallium (Tl)-Dissolved	Thorium (Th)-Dissolved	Tin (Sn)-Dissolved	Titanium (Ti)-Dissolved	Tungsten (W)-Dissolved	Uranium (U)-Dissolved	Vanadium (V)-Dissolved	Zinc (Zn)-Dissolved	Zirconium (Zr)-Dissolved
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	TL1-WEEKLY	11/18/2019	1.14	215	-	0.00005	-	0.0005	0.0015	-	0.00022	0.0025	0.005	0.001
	TL1-WEEKLY	11/25/2019	1.25	267	-	0.00002	-	0.0002	0.0006	-	0.000208	0.001	0.0028	0.0004
	TL1-MONTHLY	12/2/2019	1.27	249	-	0.00002	-	0.0005	0.01	-	0.00022	0.0025	0.005	0.001
	TL1-WEEKLY	12/9/2019	1.25	244	-	0.00005	-	0.0005	0.0015	-	0.00023	0.0025	0.0153	0.001
	TL1-WEEKLY	12/16/2019	1.45	0	-	0.00002	-	0.0005	0.01	-	0.00022	0.0025	0.0164	-
	TL1-WEEKLY	12/23/2019	-	-	-	-	-	-	-	-	-	-	-	-
	TL1-WEEKLY	12/30/2019	-	-	-	-	-	-	-	-	-	-	-	-
At V-notch Weir	NDSEEP	7/1/2019	0.0432	-	-	0.0002	-	0.0005	0.01	-	0.0002	0.0005	0.005	-
	NDSEEP	7/8/2019	0.0435	-	-	0.0002	-	0.0005	0.01	-	0.0002	0.0005	0.005	-
	NDSEEP	7/15/2019	-	-	-	-	-	-	-	-	-	-	-	-
	NDSEEP	7/22/2019	0.0472	-	-	0.0002	-	0.0005	0.01	-	0.0002	0.0005	0.005	-
	NDSEEP	7/29/2019	0.0589	-	-	0.0002	-	0.0005	0.01	-	0.0002	0.0005	0.005	-
	NDSEEP	8/5/2019	0.0564	-	-	0.0002	-	0.0005	0.01	-	0.0002	0.0005	0.005	-
	NDSEEP	8/12/2019	0.0523	-	-	0.0002	-	0.0005	0.01	-	0.0002	0.0005	0.005	-
	NDSEEP	8/19/2019	0.0545	-	-	0.0002	-	0.0005	0.01	-	0.0002	0.0005	0.005	-
	NDSEEP	8/26/2019	-	-	-	-	-	-	-	-	-	-	-	-
	NDSEEP	9/2/2019	-	-	-	-	-	-	-	-	-	-	-	-
	NDSEEP	9/9/2019	-	-	-	-	-	-	-	-	-	-	-	-
	NDSEEP	9/16/2019	0.0522	-	-	0.0002	-	0.0005	0.01	-	0.0002	0.0005	0.005	-
	NDSEEP	9/23/2019	0.0535	-	-	0.0002	-	0.0005	0.01	-	0.0002	0.0005	0.005	-
TIA at upstream face of North Dam	ND Upstream	7/1/2019	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	7/8/2019	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	7/15/2019	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	7/22/2019	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	7/29/2019	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	8/5/2019	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	8/12/2019	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	8/19/2019	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	8/26/2019	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	9/2/2019	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	9/9/2019	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	9/16/2019	-	-	-	-	-	-	-	-	-	-	-	-
	ND Upstream	9/23/2019	-	-	-	-	-	-	-	-	-	-	-	-
TIA at upstream face of South Dam	SRK19-SD-Spigot-1	8/4/2019	0.855	503	0.0002	0.00005	0.0001	0.0005	0.0011	0.0005	0.00005	0.001	0.001	0.0001
	SRK19-SD-Spigot-2	8/4/2019	0.53	479	0.0002	0.00005	0.0001	0.0005	0.0007	0.0022	0.0006	0.001	0.001	0.0001
	SRK19-SD-Spigot-3	8/4/2019	0.237	3.6	0.0002	0.00005	0.0001	0.0005	0.0027	0.0027	0.00008	0.001	0.001	0.0002

Appendix L – South Dam Ground Temperature Cable Review

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Memo

To:	Project file	**Client:**	TMAC Resources Inc.
From:	Christopher Stevens, PhD	**Project No:**	1CT022.038
Reviewed By:	John Kurylo, PEng	**Date:**	June 19, 2020
Subject:	Hope Bay South Dam: Thermal Performance Review		

1 Introduction

The tailings management system (TMS) for the Hope Bay Project includes sub-aerial tailings deposition into the Doris tailings impoundment area (TIA). The South Dam is one of three dams that will be constructed to form the ultimate Tail Lake TIA. The TIA currently consists of the water retaining, frozen core North Dam commissioned in 2012 and the frozen foundation South Dam to retain tailings solids (Figure 1).

Phase 1 construction of the South Dam was undertaken over the winter of 2018 (SRK 2019a; 2019b). The structure was designed and constructed as a frozen foundation dam with an upstream geosynthetic clay liner (GCL) keyed into the permafrost foundation to achieve containment (Figure 1). To further limit water seepage and heat transfer to the foundation, the TIA is operated to allow for continuous tailings beach along the upstream face of the dam. It is imperative that both the key trench and underlying permafrost foundation be maintained in a frozen state to achieve the required stability and containment over the 25-year design life.

This memo reviews measured ground temperature and thermal performance of the South Dam from completion of construction to December 31, 2019.

2 Design and Construction

2.1 Dam Components

The main components of the South Dam include the excavated key trench, GCL, and dam shell (Figure 1). The key trench was excavated using drill and blast techniques to tie into permafrost. The GCL was design with a chevron shape along the upstream slope of the key trench and above ground portion of the dam fill. The GCL is placed above and below bedding and transition material and surrounding by the of run-of-quarry (ROQ) forming the dam shell.

Phase 1 of the South Dam, approved under the existing Water License, has a crest elevation of 38.0 m. Phase 2 of the dam will include a downstream raise of the dam with tie-in of the existing GCL. Phase 2 design includes a downstream dam raise to the ultimate crest elevation of 46 m.

The entire key trench was designed for Phase 1 as it would be difficult to tie into the liner below ground during Phase 2. A minimum fill was designed to allow for thermal protection of the foundation during Phase 1 tailings deposition.

Additional details on design of the South Dam is provided by SRK (2019a). Phase 1 As-built reporting including as-built drawings and quality assurance (QA) records and quality control (QC) documentation are provided by SRK (2019b).

2.2 Foundation

The South Dam is located on the south end of the former Tail Lake on the watershed boundary that separates the TIA from Ogama Lake. The dam alignment extends across a local valley, with slightly higher surface elevation on either side of the valley (Figure 1). Geotechnical programs were completed under four separate investigations to inform design of the dam. The investigations included recovery of frozen soil core and cuttings, the logging and sampling of the soil and rock, laboratory testing of soil index properties, percolation testing of the foundation, and installation of ground temperature cables in select boreholes.

The cross-valley dam alignment is characterized by a thin veneer of hummocky organic soil underlain by saline marine silty clay and clayey and silt which transitions to sand and gravel till over bedrock. Overburden thickness generally decreases toward the east and west abutments and increase in thickness toward two central gullies that are separated by a bedrock outcrop (Figure 1). The average permafrost temperature within the dam footprint prior to construction was -8°C.

Frozen soil cores were used to visually estimated excess ground ice. The excess ground ice was up to approximately 90%, with some discrete bodies of nearly pure massive ground near 100%. Additional observations of ground ice were based on cuttings, gravimetric moisture content results, and visual inspection of the excavated key-trench during construction. Ice-wedges have been inferred from airphoto interpretations and were visually confirmed during key trench excavation.

Soil porewater samples recovered using brine drilling in the summer of 2003 and winter of 2006 were found to average 36 ppt (n=12) which is equivalent to a freezing point depression of approximately -2°C. The soil porewater freezing point depression used in the design was based on these measurements. More recently in the winter of 2018, sonic drill samples indicated an average porewater salinity of 3.1 ppt (n=55) resulting in an estimated freezing point depression of -0.2°C (maximum value of 8.5 ppt, estimated freezing point depression of -0.5°C). Air-hammer drillholes completed with a rock quarry drill rig prior to dam construction also indicated an average porewater salinity of 4.5 ppt (n=55) resulting in an estimated freezing point depression of -0.2°C (maximum value of 11.7 ppt, freezing point depression of -0.6°C). The higher salinity values from 2003 and 2006 are likely caused by brine contamination of the sample during drilling.

2.3 Construction

Construction of the Phase 1 dam was undertaken between January 2018 and mid-July 2018. Mean daily air temperatures over the construction period ranged from a minimum of -42°C on February 17, 2018 to a maximum of +13°C on July 11, 2018. Civil earthwork included key trench excavation, sub-grade preparation, GCL installation in the lower portion of the key trench, below ground backfill of the key trench, placement of above ground downstream and upstream dam fill. Ground temperature cables were installed at selection monitoring locations (Figures 1 and 2).

Key trench drill and blast excavation was followed by material removal and surface preparation, and below ground backfill of the key trench between April and June. Downstream dam fill was placed between early May and early June, followed by GCL installation and above ground placement of dam fill between early June and mid-July. A previously constructed temporary deposition berm was raised in May 2018 to limit TIA was from impacting the active construction area (Figure 1).

3 Thermal Design and Modeling

The thermal design of the South Dam has allowed for sufficient rockfill cover to limit warming and thaw of the permafrost foundation. The effectiveness of the thermal cover decreases as the width and height of the structure decreases toward the eastern and western abutments, and seasonal heat loss and gain are more pronounced within the embankment and key trench. The thermal regime of the dam is controlled largely by atmosphere-to-surface heat exchange, thermal and physical conditions along the upstream face of the dam, and heat transfer through the fill material.

The design does not consider the affects of heat advected by surface water infiltration (snowmelt or precipitation) or water seepage from the facility. The latter is mitigated by the fine-grained, low permeability tailings beach developed immediately upstream and GCL installed within the upstream face and keyed into the permafrost foundation.

Thermal modeling was carried to support thermal design of the dam using a commercially available finite element program SVHeat from SoilVision (SRK 2019c). The thermal design for the dam was carried out using two-dimensional cross sections representative of the dam geometry with consideration for thermal conduction. Two critical sections were modeled; the typical maximum and minimum fill sections of the dam.

The modeling was completed to determine if the design is suitable to maintain the liner within a frozen key-in trench and to estimate extent of thaw beneath the foundation. The foundation was considered to be frozen during design if the ground temperature remained colder than -2°C which accounted for the average site-wide porewater freezing point depression within natural overburden soil.

Thermal modeling completed as apart of engineering design concluded:

- For the maximum dam section, the maximum temperature at the monitoring point with a bedrock foundation and thin overburden foundation was -4.0°C and -4.8°C, respectively (Figure 3).
- For the minimum dam section, the maximum modeled temperature at the key trench monitoring point with a thin overburden and thick overburden foundation was -3.0°C and -3.3°C, respectively (Figure 4).
- Seasonal variations in foundation temperature generally decreases as the size of the dam and fill thickness increased, due to an increased distance for conductive heat transfer of energy.
- Tailings were expected to freezeback over time under due to sub-aerial exposure and atmospheric heat transfer, which consequently provides additional containment and promotes lateral heat transfer with the dam.

4 Tailings Deposition

The South Dam was designed as a tailings solid retaining structure and thermal performance is contingent on maintaining an exposed tailings beach along the upstream face (minimum width of 100 m). To achieve these conditions, tailings deposition has been monitored to ensure ponding of supernatant water does not occur along the face of the dam.

The TIA is currently designed for storage of 16.2 Mm^3 of tailings with 20% allowance for ice entrainment (SRK 2016). The total Phase 1 tailings storage capacity is 2.32 Mm^3. Phase 2 tailings deposition will include a downstream raise of the South Dam and construction of a new West Dam to provide additional capacity. Six spigot points are planned for Phase 1; three spigots located from the South Dam and two spigots from the east side of the TIA.

Phase 1 tailings deposition at the TIA began in January 2017 at two spigot locations on the east side of the TIA. In August 2017 the deposition was switched a temporary deposition berm to develop a tailings beach and minimize the risk of the TIA pond encroaching on the South Dam footprint prior to construction. Over the winter of 2018, the tailings deposition was moved to east side of the TIA until late June of 2019. Deposition commenced from the upstream face of the South Dam from June of 2019 to October 2019. Tailings deposition again switched to the east side of the TIA in October of 2019 to allow for winter heat loss from the South Dam tailings beach and to limit ice entrapment in this area.

5 Ground Temperature Monitoring System

The South Dam is routinely inspected by TMAC during operation and includes an annual inspection completed by the Engineer of Record. In addition, monitoring points have been installed as part of the design to evaluate deformation and thermal regime of the dam and foundation. This monitoring has been developed to allow for evaluation of dam performance over the life of the structure and implementation of mitigation measures, if required. Ground temperature cables (GTCs) were install in the foundation of the dam and within the fill to monitor temperature of the permafrost foundation and along the upstream slope of the key trench

(Figure 2). Ground temperature measurements for all instrumented sites are provided by SRK (2020).

5.1 Instrument Layout

Digital GTCs and data loggers manufactured by BeadedStream were installed at 6 representative monitoring sections along the dam alignment during construction. The instrumented sections include Stations 0+065, 0+155, 0+240, 0+365, 0+460, 0+510 (Figure 1). Temperature is recorded every four hours using the datalogger and transmitted every twelve hours via iridium satellite to allow for near real-time monitoring.

The general arrangement of the GTCs includes vertical cables (VTS) installed beneath the upstream, downstream and key trench and horizontal cables installed along the upstream slope of the key trench and the above ground portion of the GCL (Figure 2). One GTC (SD-HST-B1-KT) was installed on top of the lower/upper GCL overlap near the upstream crest of the key trench.

Two additional ground temperature cables (SD-VTS-US1 and SD-VTS-US2) were installed to monitor conditions within an area susceptible to melting of massive ground ice. These locations are near the lowest elevation of the dam alignment where ice wedges form a polygonal network and surface water was expected to pond prior to tailings beach development. The two cables also provide long-term temperatures beneath the tailing beach.

Active tailings deposition from the South Dam has extended across monitoring Section 3+65. At the end of 2019, the additional monitoring section were outside of the tailings beach.

5.2 Instrument Function

A total of twenty-seven GTCs were installed during Phase 1 construction (SRK 2019b). A total of twenty GTCs were functioning at the start of March 2020 (Table 1). Of the seven inactive GTCs, three were damaged throughout or immediately following Phase 1 construction. Attempts were made to repair these cables. Three cables cease to transmit data in 2019 (SD-VTS-155-US, SD-HTS-240-KT, SD-VTS-240-KT) and two cables cease to transmit data beyond January 29, 2020 (SD-HTS-155-KT, SD-VTS-365-KT). The cause(s) of some of the inactive cables has not been determined and warrants further onsite investigation.

Table 1: Ground Temperature Cable Status

Station ID	GTC ID	Datalogger	# of Sensors (Functional / As-built)	Status	Comment
0+65	SD-VTS-065-KT	SD-DL01B	11 / 11	Active	-
0+65	SD-HTS-065-US	SD-DL01A	5 / 5	Active	-
1+55	SD-VTS-155-KT	SD-DL01B	11 / 11	Active	-
1+55	SD-HTS-155-US	SD-DL01A	5 / 5	Active	-
1+55	SD-VTS-155-US	SD-DL01A	1 / 11	Inactive	Sensor 1 functional, ended on 11/8/2019
1+55	SD-VTS-155-DS	SD-DL01A	11 / 11	Active	-
1+55	SD-HTS-155-KT	-	0 / 11	Inactive	Damaged during construction
2+40	SD-HTS-240-KT	SD-DL02A	0 / 11	Inactive	Measurements ended on 1/29/2020
2+40	SD-VTS-240-KT	SD-DL02A	0 / 11	Inactive	Measurements ended on 1/29/2020
2+40	SD-HTS-240-US	SD-DL02B	7 / 7	Active	-
2+40	SD-VTS-240-US	SD-DL02A	0 / 11	Inactive	Measurements ended on 10/22/2019
2+40	SD-VTS-240-DS	SD-DL02A	0 / 11	Inactive	Measurements ended on 10/10/2019
3+65	SD-VTS-365-KT	-	0 / 11	Inactive	Damaged following construction
3+65	SD-HTS-365-KT	SD-DL03A	11 / 11	Active	-
3+65	SD-HTS-365-US	SD-DL03B	11 / 11	Active	-
3+65	SD-VTS-365-US	SD-DL03A	11 / 11	Active	-
3+65	SD-VTS-365-DS	SD-DL03B	11 / 11	Active	-
3+65	SD-VTS-US1	SD-DL03A	2 / 13	Active	Sensors 1 and 2 active
3+65	SD-VTS-US2	SD-DL03A	1 / 15	Active	Sensor 1 active
4+60	SD-VTS-460-KT	SD-DL04A	11 / 11	Active	-
4+60	SD-HTS-460-KT	SD-DL04B	11 / 11	Active	-
4+60	SD-VTS-460-US	SD-DL04A	11 / 11	Active	-
4+60	SD-VTS-460-DS	SD-DL04A	11 / 11	Active	-
4+60	SD-HTS-460-US	SD-DL04B	0 / 5	Inactive	Damaged following construction
5+10	SD-VTS-510-KT	SD-DL04B	11 / 11	Active	-
5+10	SD-HTS-510-US	SD-DL04B	5 / 5	Active	-
NA	SD-HTS-B1-KT	SD-DL04A	20 / 20	Active	-

Notes:

1. Number of functional GTC sensors on 3/1/2020

6 Thermal Response

6.1 Construction Period

Ground temperature was measured throughout the construction period to monitoring thermal conditions during material placement and to identify possible instrument damage during construction. The data record over this period was limited to the time of cable installation and availability of field staff to make the daily measurements.

Over the construction period, the dam fill material temperature generally followed the air temperature. Fill placed below grade in the key trench over the winter was able to maintain the relatively colder initial material temperature, compared to above ground fill placed at the start of the spring freshet. The general difference in material temperature was expected and emphasis was placed on completed prior to air temperature rising above 0°C.

In early June of 2018, an unexpected warming of ground temperature was observed from the horizontal GTC installed along the upstream slope of the key trench and from the top sensors on vertical GTC installed below the base of the key trench (Figure 5). The warming events consisted of rapid increase temperature of approximately 12°C in less than 24 hrs along the upstream key trench slope (Figure 5).

The observe warming was not consistent with the increase in air temperature and displayed traits of non-conductive heat transfer through the dam fill. The increase in ground temperature propagated from deeper on the key trench slope to shallower depth sensors which indicates a deeper heat source. The lack of attenuation of the warming event with time and depth also suggests non-conductive heat transfer which results in more immediate changes in sensible heat when compared to thermal conduction. Heat from the warming event was conducted beneath the key trench foundation but was determined to have minor thermal influence on the long-term ground thermal regime.

The rapid increase in ground temperature (warming event) was inferred to be caused by the advection of heat from seepage of surface water along the upstream slope of the key trench fill (ROQ material). The thermal response was immediately verified in the field and an interceptor ditch was installed to limit surface water contact with the fill.

6.2 Base of Tailings

Ground temperature near the base of tailings beach is monitored immediately upstream of the toe at SD-VTS-US-2. Since late January of 2019, the ground temperature 0.5 m below the base of tailings beach has seasonally varied from -0.4°C to -7.2°C. Ground cooling was measured over both the winter of 2019 and 2020. The measurements suggest that heat sourced from the tailings is seasonally lost during winter periods of non-deposition, and extensive thaw of the upstream foundation has not occurred beneath the tailings at the monitoring location. The seasonal variability in ground temperature is expected to decrease as additional tailings are deposited and the effective depth of the sensor increases.

Over the same period, ground temperature measured at a similar depth beneath the upstream toe at SD-VTS-US-1 has slightly cooled from -0.1°C to -0.6°C. Ground cooling is expected to continue at a slow rate as this location is beneath the upstream fill of the dam.

6.3 Upstream and Downstream Toe

Figures 6 through 11 show the minimum, maximum, and average foundation ground temperature for 2019. Table 2 shows the average ground temperature and seasonal active thaw depth beneath the upstream and downstream toe. The average ground temperature is provided for the uppermost sensor located 0.5 m below grade.

The reported thaw depth is based on the 0°C and the -2°C isotherm which considers the average design freezing point depression for saline overburden soil. Active layer thaw beneath the upstream toe ranged from 0 to 0.9 m based on the 0°C isotherm and 0.5 to 2.5 m with consideration of the -2°C freezing point depression. As previously noted, the porewater salinity collected immediately prior to construction indicate salinity values were significantly less than those collected with brine drilling. The brine drill samples are considered to be contaminated by drill fluid and not representative of the in-situ conditions.

The upstream and downstream toe average ground temperature was measured to be -5.5°C to -7.6°C, with exception of warmer temperatures (-0.7°C) measured at SD-VTS-365-US (Table 2; Figures 6 through 11). The relatively warm ground temperatures measured at SD-VTS-365-US are due to active tailings deposition across the site. Permafrost warming with depth is the most pronounced at the upstream toe, as observed by the decrease in ground temperature with depth (Figure 9). The thermal regime is characteristic of degrading permafrost. At Section 3+65, tailings deposition over the upstream toe has increased in the effective depth of the sensors which limits seasonal variations from atmospheric heat transfer to the ground.

Table 2: Average Ground Temperature and Thaw Depth for Upstream and Downstream Toe

Station	GTC ID	Location	Thaw Depth, 0°C Isotherm (m)	Thaw Depth, -2°C Isotherm[1] (m)	Average Ground Temperature[2], 2019 (°C)
0+155	SD-VTS-155-US	Upstream Toe	-	-	-6.7
	SD-VTS-155-DS	Downstream Toe	0.0	0.5	-5.7
0+240	SD-VTS-240-US	Upstream Toe	0.9	1.4	-
	SD-VTS-240-DS	Downstream Toe	0.6	1.0	-5.5
0+365	SD-VTS-365-US	Upstream Toe	0.0	2.5	-0.7
	SD-VTS-365-DS	Downstream Toe	0.1	1.0	-7.6
0+460	SD-VTS-460-US	Upstream Toe	0.9	1.8	-
	SD-VTS-460-DS	Downstream Toe	0.9	1.8	-6.4

Notes:

1. Thaw depth based on the -2°C isothermal represents the design freezing point depression for soil porewater
2. Average ground temperature based on uppermost sensors

6.4 Key Trench

The maximum ground temperature measured at the base of the key trench for 2018 and 2019 is shown in Table 3. The maximum annual key trench temperature for the thickest fill sections ranged from -6.0°C to -7.3°C at Station 0+240 and 0+365, and -5.4°C at Station 0+155. At the thinnest fill sections (Stations 0+065, 0+460, and 0+510), the maximum temperature ranged from -3.2°C to -4.7°C in 2018 and -4.7°C to -4.8°C in 2019. Thaw, as defined by the design freezing point depression of -2°C, was not observed in the ground temperature measured beneath the key trench.

The relatively warmer key trench temperature measured at Stations 0+065, 0+460, and 0+510 results from reduced fill over the key trench compared to thicker fill sections (2+40 and 3+65). The foundation at these stations also consists of bedrock or are characterized by thin overburden soil which results in greater seasonal heat gain to the foundation. The relatively colder key trench temperatures were measured at the sections with greater fill thickness founded on ice-rich soil with a higher heat capacity and latent heat requirement.

Seasonal variations in ground temperature due to heat gain and loss from the ground were also measured beneath the key trench (Figures 6 through 11). The greatest variation in temperature were at sections with the minimum fill thickness and decrease as fill thickness increase, as expected. The seasonal change in foundation temperature are in general agreement with the previous thermal modeling results.

Table 3: Maximum Key Trench Ground Temperature

Station	GTC ID	Ground Temperature (°C)[1]	
		2018	2019
0+065	SD-VTS-065-KT	-4.7	-4.7
0+155	SD-VTS-155-KT	-	-5.4
0+240	SD-VTS-240-KT	-6.6	-7.3
0+365	SD-VTS-365-KT	-6.9[2]	-6.0[3]
0+460	SD-VTS-460-KT	-3.9	-4.8
0+510	SD-VTS-510-KT	-3.2	-4.8

Notes:

1. Maximum temperature at base of key trench
2. Ground temperature for 0+365 based mid-April to mid-July data
3. Measurement from Sensor 7 of SD-HTS-365-KT supplemented due to missing data for from SD-VTS-365-KT

Horizonal GTCs installed along the upstream slope of the key trench at SD-HTS-365-KT and SD-HTS-460-KT are shown in Figure 12. The warmest ground temperatures were recorded by the uppermost sensors installed at the crest of the key trench which represents the shallowest depth for HTS-KT sensors (Figure 2). At SD-HTS-365-KT, the minimum and maximum temperature for the upper most sensor was -1.3°C and -16.6°C, respectively. The range in temperature at SD-HTS-240-KT is -2.4°C to -8.2°C. The equivalent GTC installed at SD-HTS-460-KT ranged in temperature from -1.0°C and -10.9°C.

The upstream slope key trench temperature observed confirm seasonal heat gain and loss. The upstream key trench ground temperature decreases with increased sensors depth and decreased offset from the dam centerline (Figure 12). Thaw would not be expected along the upstream slope of the key trench based on the measured temperature and assuming a freezing point depression near 0°C.

7 Energy Balance

An energy balance approach was used to evaluate the annual gain and loss of energy from the dam foundation. Fourier's law of heat conduction was used to calculate daily heat flux using the average daily ground temperature measured in the key trench and soil and bedrock thermal properties from SRK (2019c). A daily negative flux indicates heat loss and a positive flux indicates gain to the foundation. All fluxes were added to estimate the net annual gain or loss of heat to the foundation.

This approach assumes that the top of the soil foundation is homogenous and governed by heat conduction, advection of heat from water seepage is not present, and latent heat of fusion during the freezing and thaw periods is equivalent at the end of the year. The estimates neglect temperature-dependent changes in the thermal properties and unfrozen water content of the frozen soil. The analysis was completed for sites with suitable ground temperature data.

Table 4 shows the annual heat flux beneath the key trench and downstream toe. The results are shown graphically in Figure 13. The net annual heat flux is positive for all sites, indicating more thermal energy was gained vs. lost from the permafrost foundation. Greater seasonal variability in heat gain and loss from the foundation is observed beneath the downstream toe when compared to beneath the key trench, as expected.

The net annual heat flux with the foundation was estimated to range from +21 to +63 MJ m^{-2} and +7.5 to +29.3 MJ m-^{2} beneath the downstream toe and key trench, respectively (Table 4). Minimal heat transfer with the foundation beneath the key trench at SD-VTS-240-KT is the result of greater dam fill which reduces annual heat transfer between the atmosphere and foundation. The net positive heat flux over one-year will result warming of the permafrost foundation and eventual thaw. Over time the annual energy transfer to the foundation is expected to change as Phase 2 dam construction takes place and with completion of tailings beaching at the South Dam.

Table 4: Total Annual Heat Flux with Foundation

GTC ID	Heat Loss (MJ m^{-2})	Heat Gain (MJ m^{-2})	Net Heat Flux (MJ m^{-2})
SD-VTS-155-KT	-2.0	43.1	41.1
SD-VTS-240-KT	-1.5	9.0	7.5
SD-VTS-460-KT	-2.3	31.7	29.3
SD-VTS-510-KT	-2.7	19.7	17.1
SD-VTS-155-DS	-15.5	78.0	62.6
SD-VTS-365-DS	-30.2	58.5	28.3
SD-VTS-460-DS	-87.7	109.0	21.4

8 Findings and Recommendations

The South Dam was designed and constructed as a frozen foundation dam to retain tailings solids. The safe operation of the dam requires careful consideration of thermal performance of the structure. Review of the South Dam ground temperature data collected in 2019 has led to the following findings and recommendations.

- The dam is generally performing as thermally designed. Figure 14 shows a summary of the maximum and average temperature for key locations of the dam.
- Design freezing point depression of -2°C based on porewater samples recovered from brine drilling may not be representative of in-situ conditions due to contamination of the core by drilling fluids. The finding is supported by more recent soil samples collected over representative depths with sonic and air-hammer drilling. The average porewater freezing point depression for 110 recent samples was -0.2°C (minimum value of -0.6°C).
- Maximum annual key trench ground temperature decreased in the year following construction. The slightly warmer key trench temperature immediately following construction (2018) was expected due to the extended construction season and observed advection of heat from surface meltwater. The maximum annual key trench temperature for the monitoring sections for 2019 is within the expected range of temperature.
- Ground thermal regime beneath the key trench shows minimal seasonal heat gain or loss beneath the dam sections with thicker fill, such as Section 2+40. A similar thermal regime is expected beneath the key trench at Section 3+65. Relatively slow rates of permafrost warming in the key trench foundation are expected for dam sections with thicker fill until active tailings deposition cease, and sufficient time has past for tailings freezeback to occur.
- Greater seasonal variation in key trench temperature have been measured beneath dam sections with minimum fill cover (Sections 0+65. 1+55, 4+60, 5+10). The measured seasonal variation in key trench temperature are generally comparable to the modeled values for 2019.
- Active layer thaw beneath the upstream and downstream toe based on the 0°C isotherm and -2°C isotherm range from 0 to 0.9 m and 0.5 to 2.5 m, respectively. Thaw beneath the dam toe can be expected over the life of the structure and should be monitored to ensure conditions remain within the design limits.
- Thermal evidence of water seepage at the base of the GCL tie-in and within the permafrost foundation was not observed in 2019.
- Four GTCs cease to transmit measurements from Section 2+40. All four cables are recorded by the same data logger. Further investigation of the cause(s) leading to the inactive status of the GTCs is warranted.
- GTCs provide thermal monitoring of the dam to ensure conditions remain within the intended design for safe operation and tailings containment. Replacement GTC are recommended to maintain the monitoring system; SD-VTS-155-US; SD-VTS-240-US; SD-VTS-240-DS. Prior to GTC replacement, the surface cable lead and connection with the data loggers should be

checked for damage and repair, where possible. The upstream toe at section 2+40 is currently outside of tailings beach which would allow for replacement of SD-VTS-240-US prior to burial by tailings.

- As part of additional thermal evaluation of the dam, it is recommended that the existing thermal models be updated to reflect construction as-built conditions, tailings deposition, and the new understanding of the soil freezing point depression. The later is expected to alter the unfrozen water content curve and thermal properties of the soil and therefore heat transfer in the foundation over time.
- In support of ongoing surveillance of the dam, ground temperature data loggers and cables should be routinely inspected following the dam operation, maintenance, and surveillance (OMS) manual.

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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

9 References

SRK Consulting (Canada) Inc., 2019a. Phase 1 South Dam Design Report, Hope Bay, Nunavut, Canada. Submitted to TMAC Resources Inc.

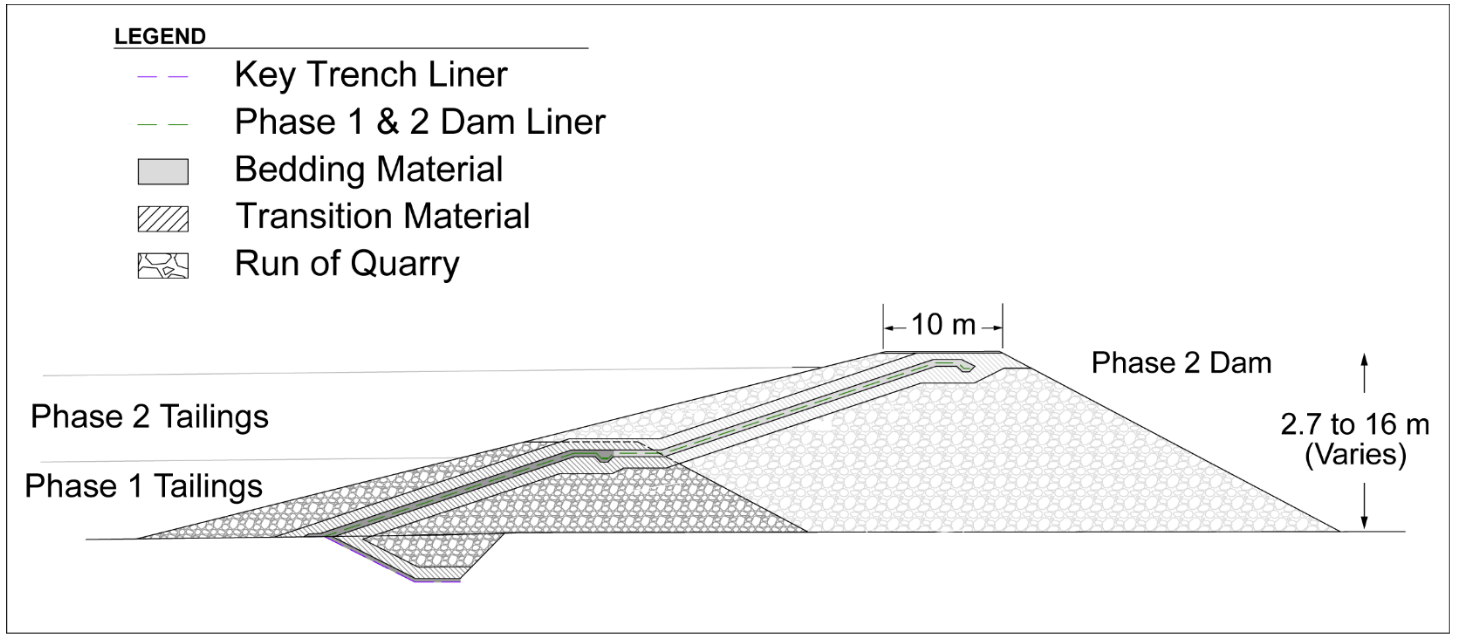
SRK Consulting (Canada) Inc., 2019b. Hope Bay Project, Phase 1 South Dam As-Built Report. Submitted to TMAC Resources Inc.

SRK Consulting (Canada) Inc., 2019c. South Dam – Detail Design Thermal Modeling. Submitted to TMAC Resources Inc.

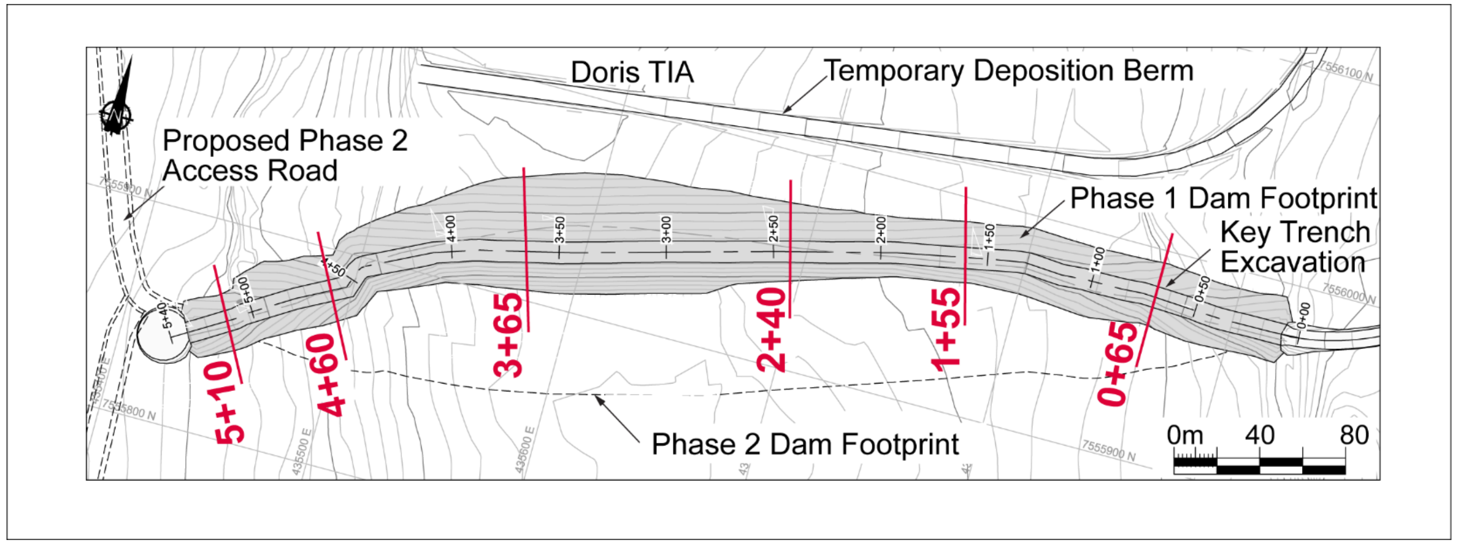
SRK Consulting (Canada) Inc., 2020. 2019 Annual Geotechnical Inspection Tailings Impoundment Area Hope Bay Project, Hope Bay, Nunavut. Submitted to TMAC Resources Inc.

Figures

South Dam Phase 1 and Phase 2 (Simplified Cross Section)



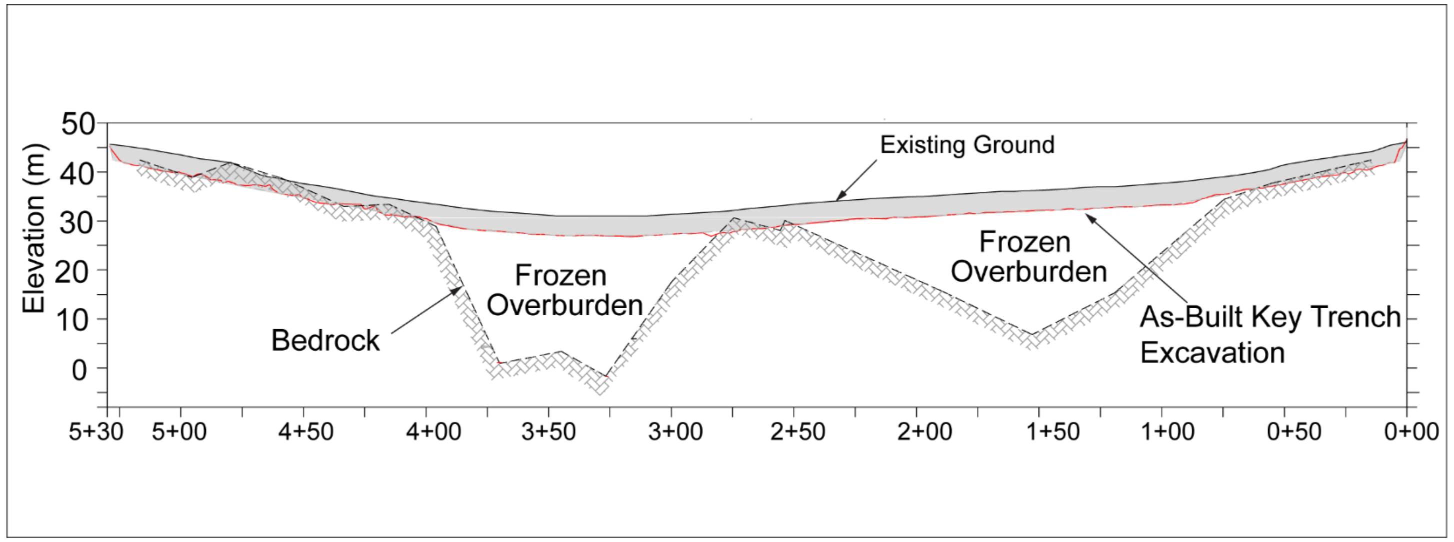
As-built Phase 1 – Plan View



Notes:

1. Red lines and section numbers represent ground temperature cables (GTC) monitoring sections

As-built Phase 1 – Key Trench



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MAC RESOURCES

2019 Annual Geotechnical Inspection
Tailings Impoundment Area

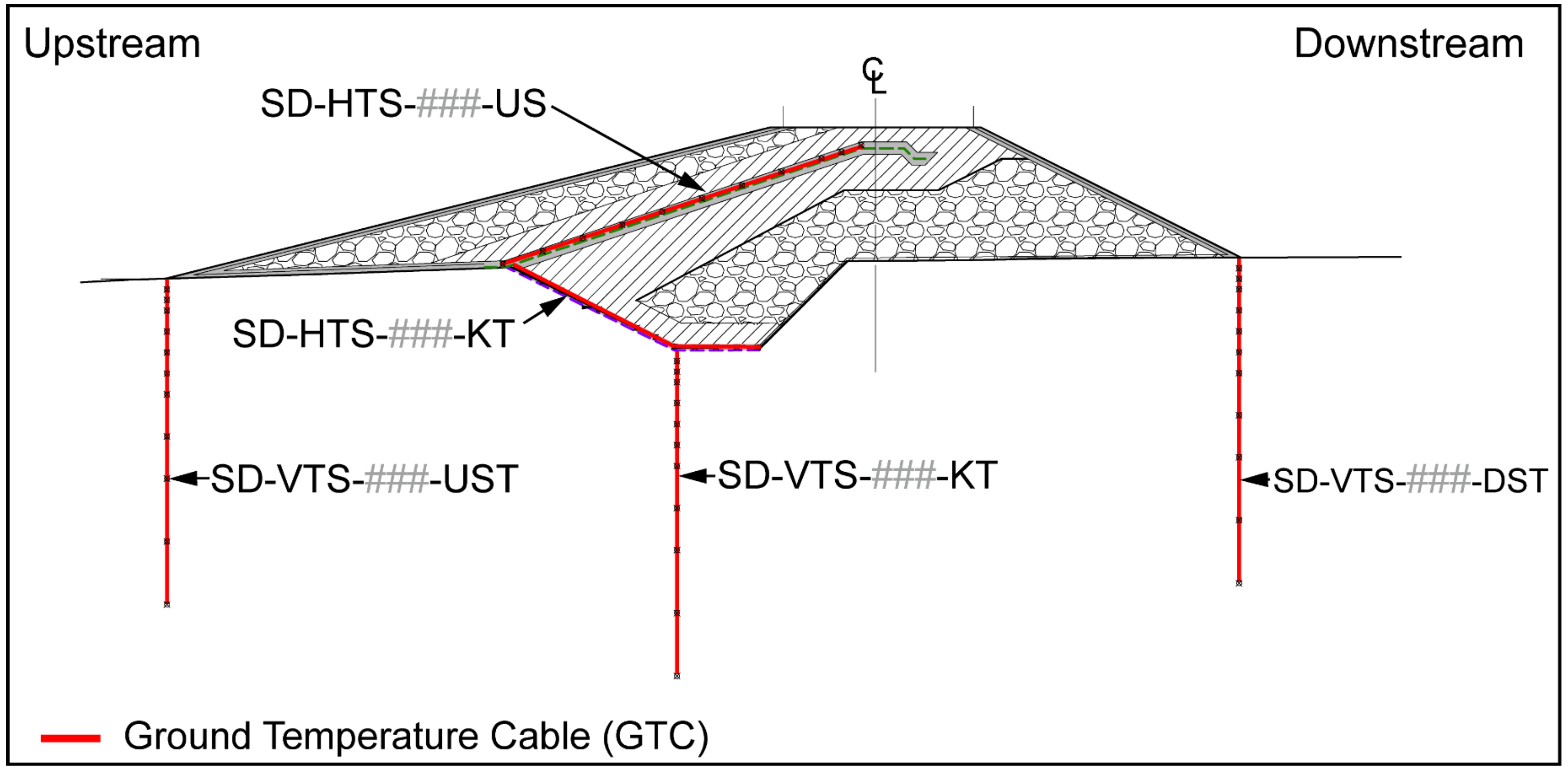
South Dam
Cross Section and Plan View

Job No: 1CT022.038
Filename: South Dam Thermal Review2019

HOPE BAY PROJECT

Date: March 2020
Approved: CWS
Figure: 1

Ground Temperature Cable (GTC) Configuration



Notes:

1. As-built drawings for each GTC monitoring section provided by SRK (2019c)

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MAC RESOURCES

2019 Annual Geotechnical Inspection
Tailings Impoundment Area

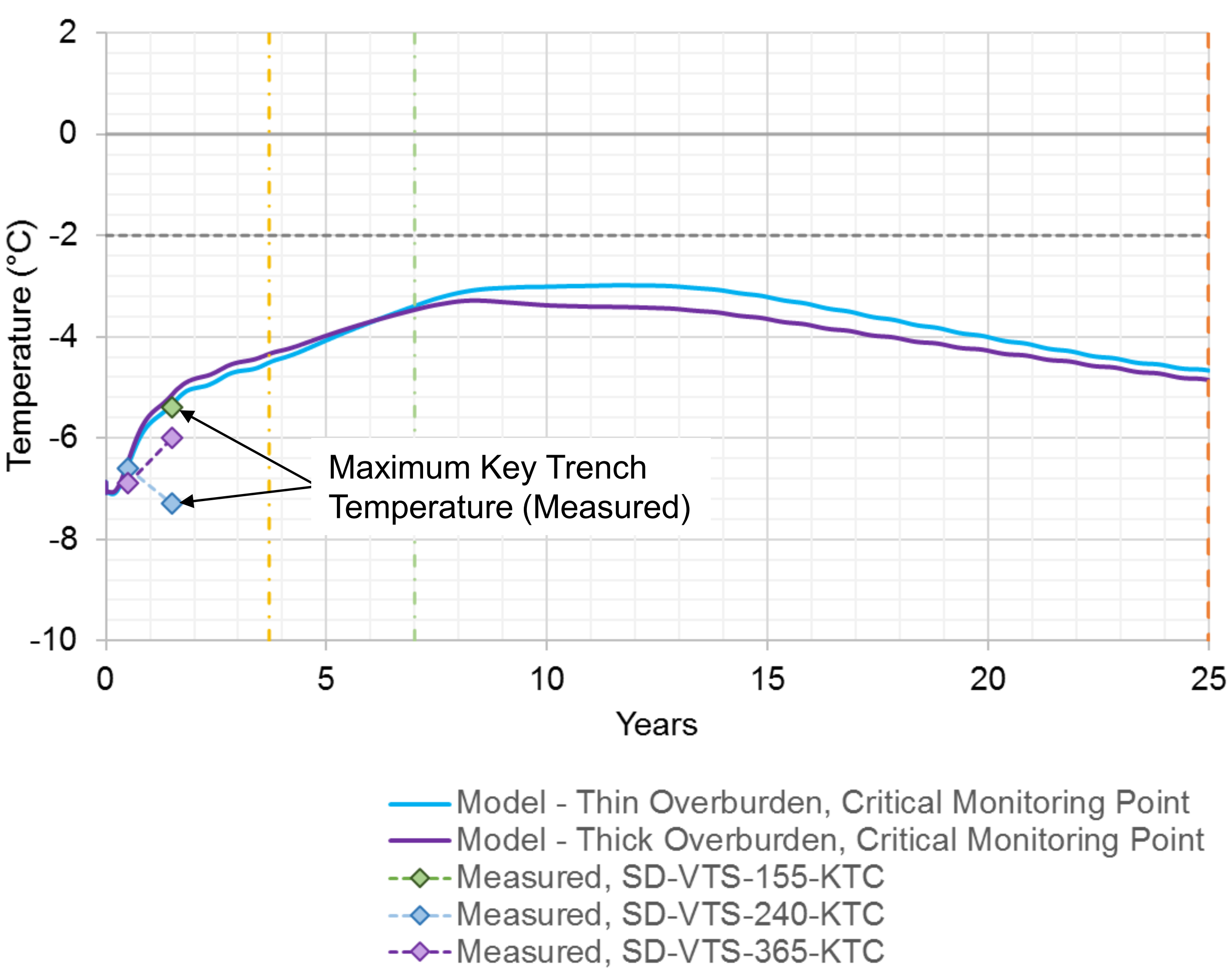
Typical Configuration of Ground Temperature Cables

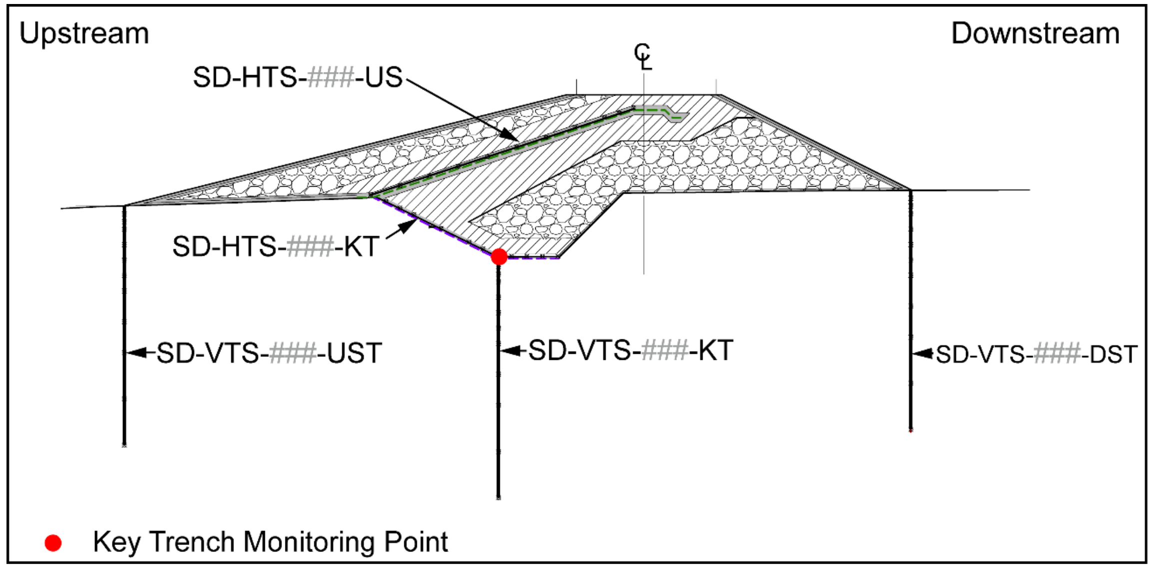
Job No: 1CT022.038
Filename: South Dam Thermal Review2019

HOPE BAY PROJECT

Date: March 2020
Approved: CWS
Figure: 2

Maximum Section of Dam – Key Trench Monitoring Point





Notes:

1. Maximum modeled ground temperature for critical key trench monitoring point from SRK (2019c)
2. Maximum temperature measured at the base of key trench shown for SD-VTS-155-KT, -240-KT, -365-KT

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MAC RESOURCES

2019 Annual Geotechnical Inspection
Tailings Impoundment Area

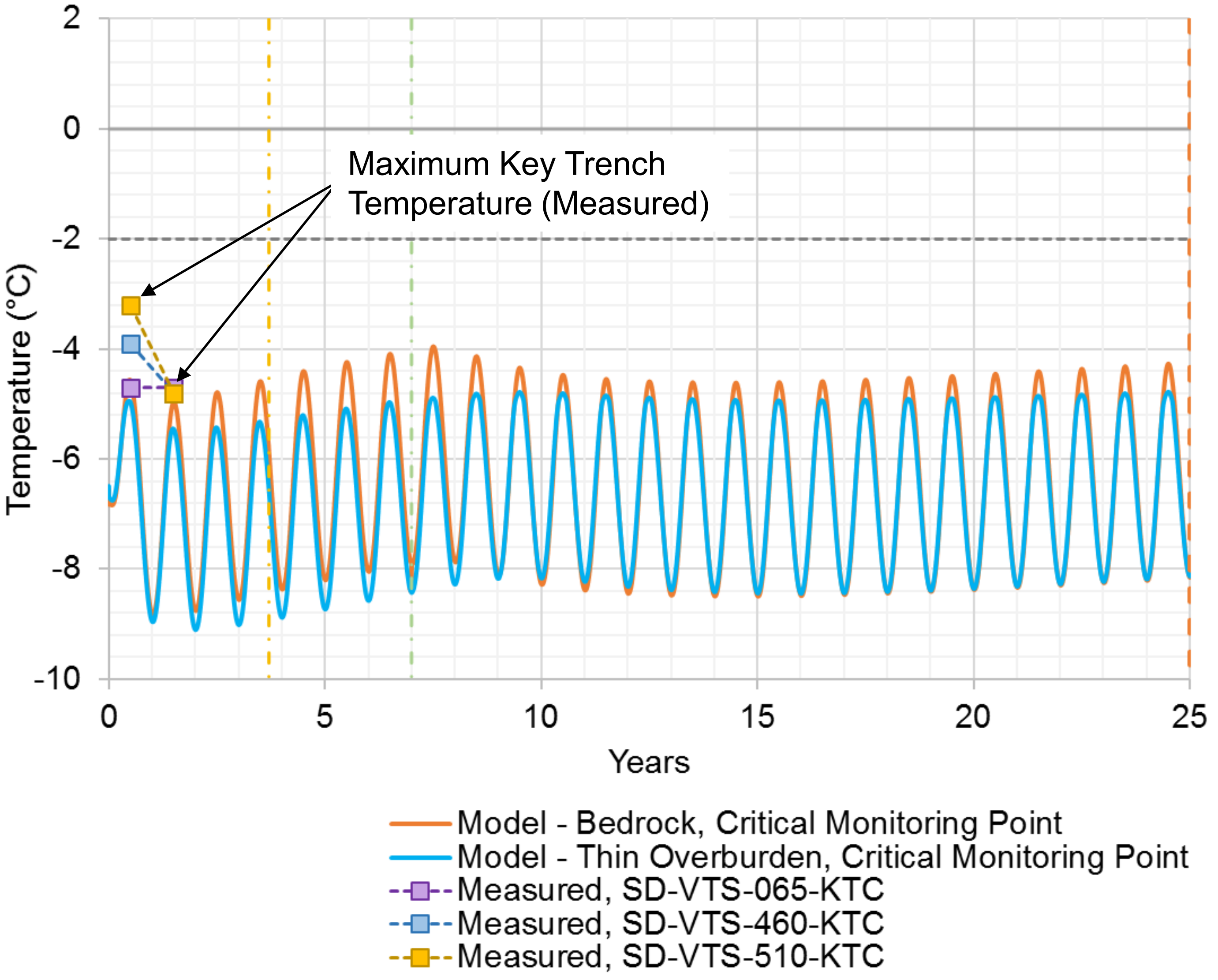
**Maximum Section of Dam –
Key Trench Monitoring Point**

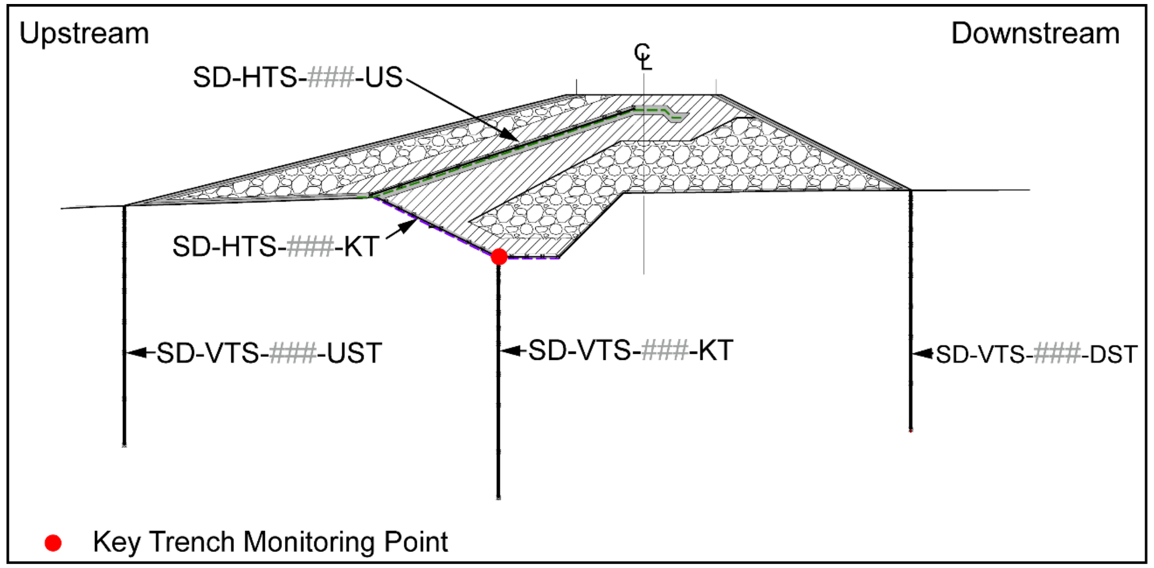
Job No: 1CT022.038
Filename: South Dam Thermal Review2019

HOPE BAY PROJECT

Date: March 2020
Approved: CWS
Figure: 3

Minimum Section of Dam – Key Trench Monitoring Point





Notes:
1. Maximum modeled ground temperature for critical key trench monitoring point from SRK (2019c)
2. Maximum temperature measured at the base of key trench shown for SD-VTS-155-KT, -240-KT, -365-KT

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MAC RESOURCES

Job No: 1CT022.038
Filename: South Dam Thermal Review2019

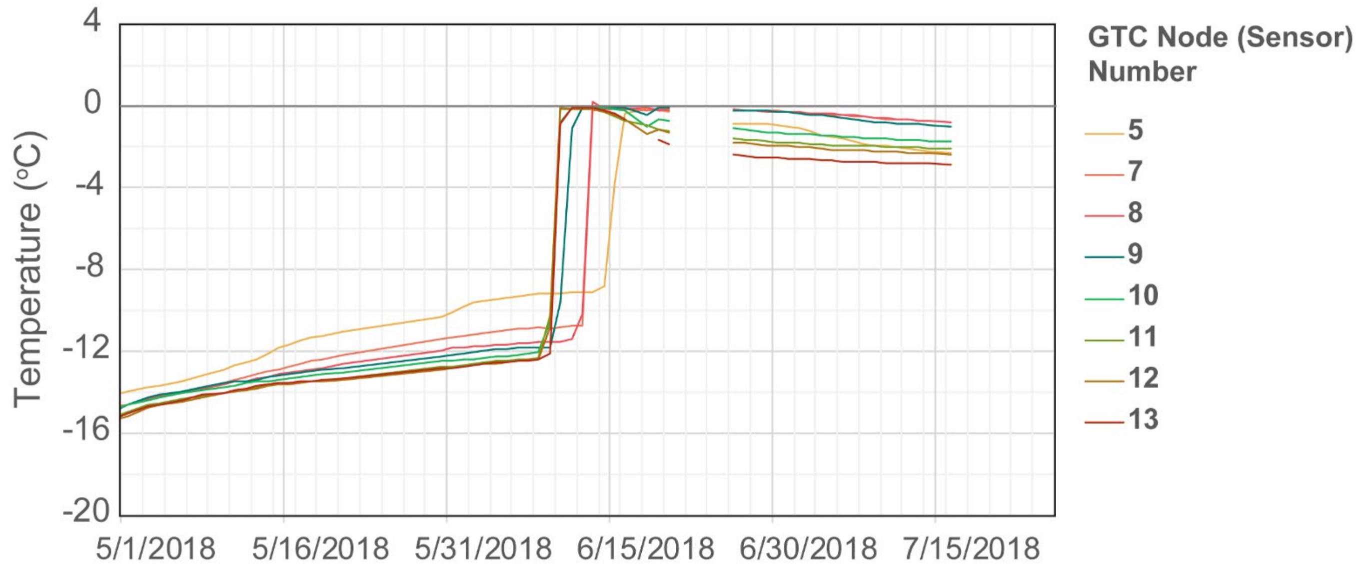
HOPE BAY PROJECT

2019 Annual Geotechnical Inspection
Tailings Impoundment Area

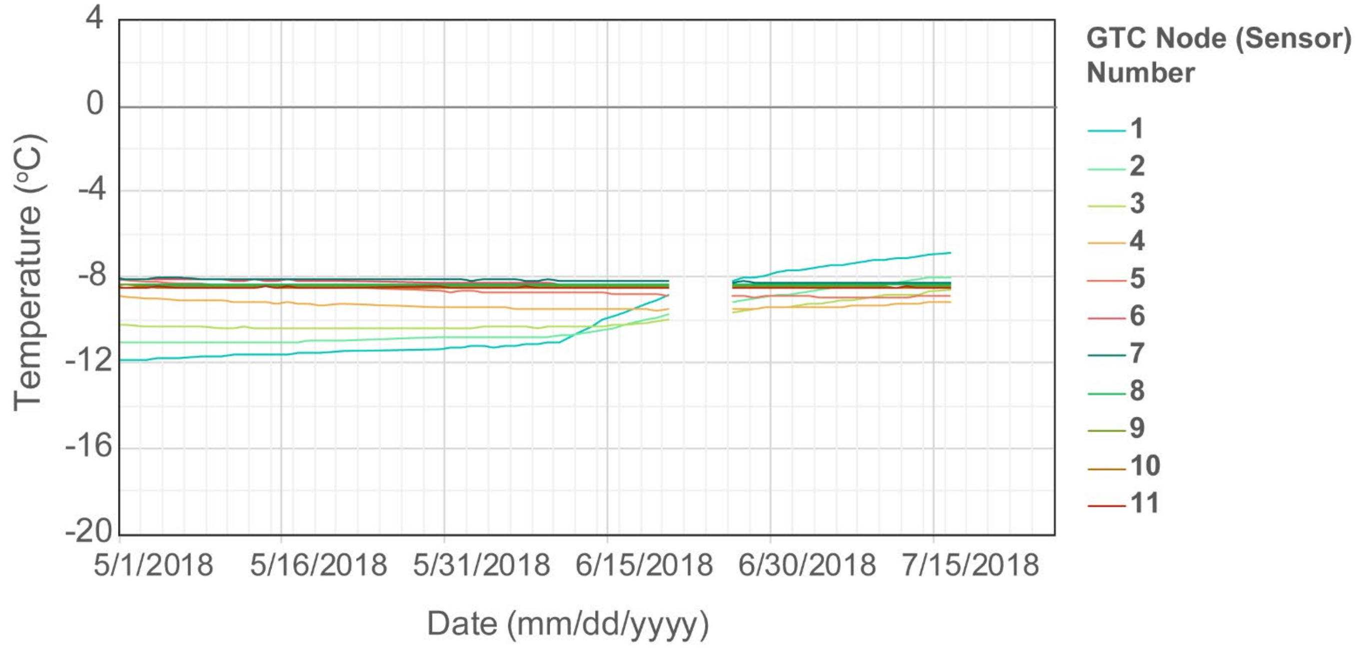
Minimum Section of Dam –
Key Trench Monitoring Point

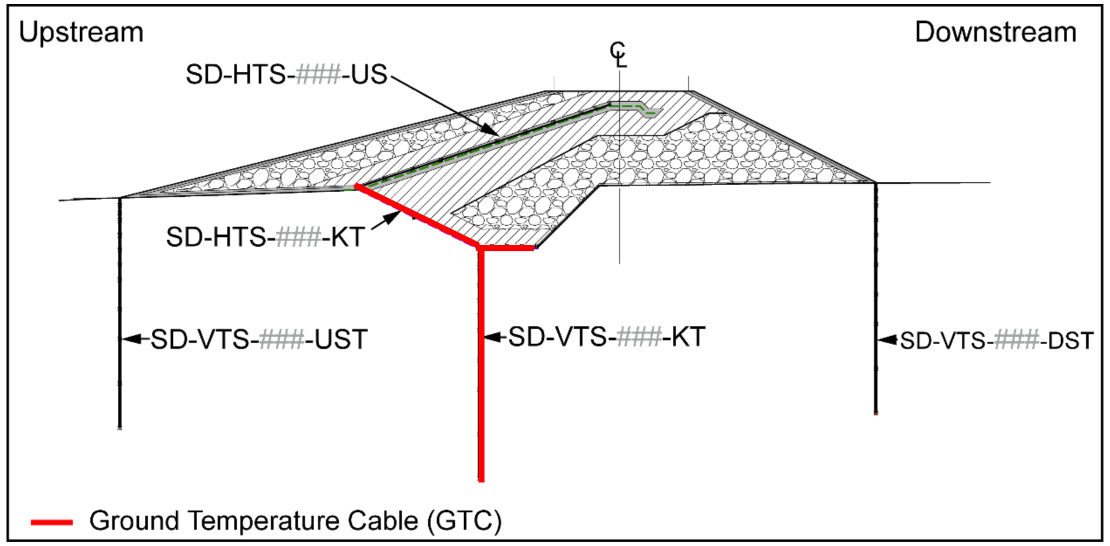
Date: March 2020
Approved: CWS
Figure: 4

Construction Period – Ground Temperature at SD-HTS-365-KT



Construction Period – Ground Temperature at SD-VTS-365-KT





Notes:
1. Ground temperature measured over construction period at SD-HTS-365-KT and SD-VTS-365-KT
2. Rapid warming of ground temperature observed other monitoring sections over a similar period of time

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MAC RESOURCES

2019 Annual Geotechnical Inspection
Tailings Impoundment Area

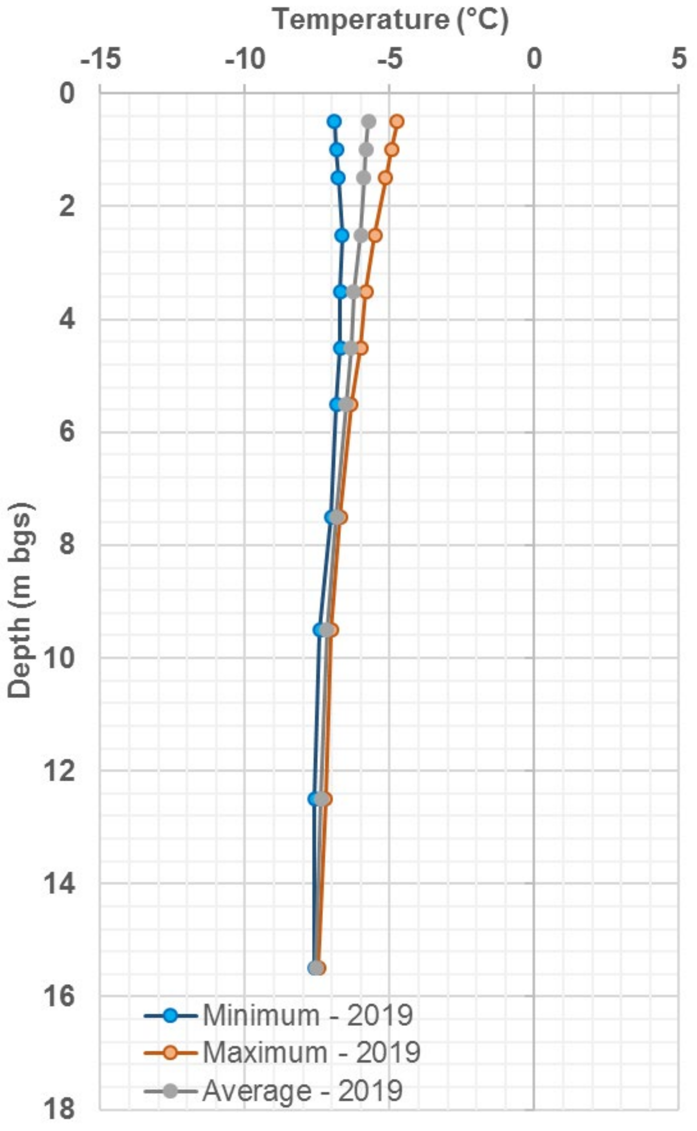
Construction Period –
Rapid Ground Temperature Warming

Job No: 1CT022.038
Filename: South Dam Thermal Review2019

HOPE BAY PROJECT

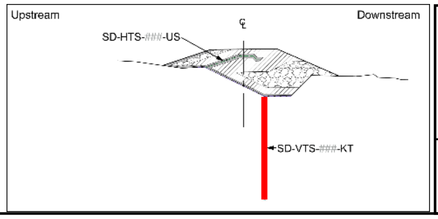
Date: March 2020
Approved: CWS
Figure: 5

SD-VTS-065-KT



Notes:

1. Ground temperature cables not installed beneath upstream and downstream toe at Section 0+65



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2019 Annual Geotechnical Inspection
Tailings Impoundment Area

Foundation Ground Temperature – Section 0+65

Job No: 1CT022.038

Filename: South Dam Thermal Review2019

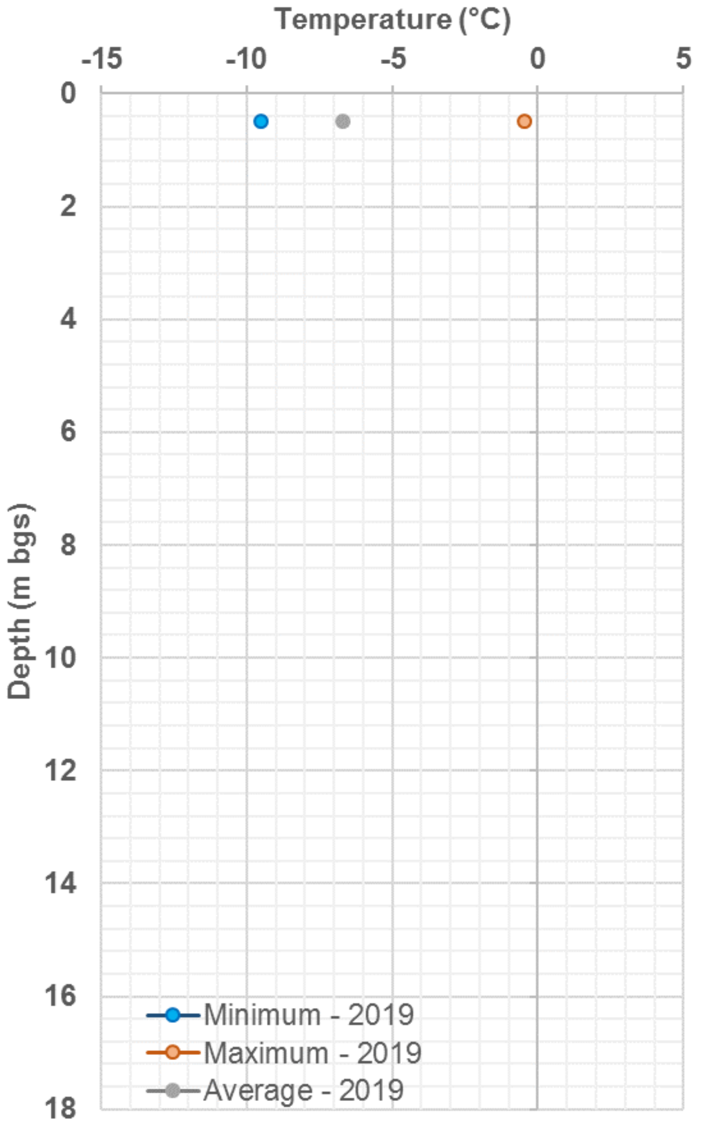
HOPE BAY PROJECT

Date: March 2020

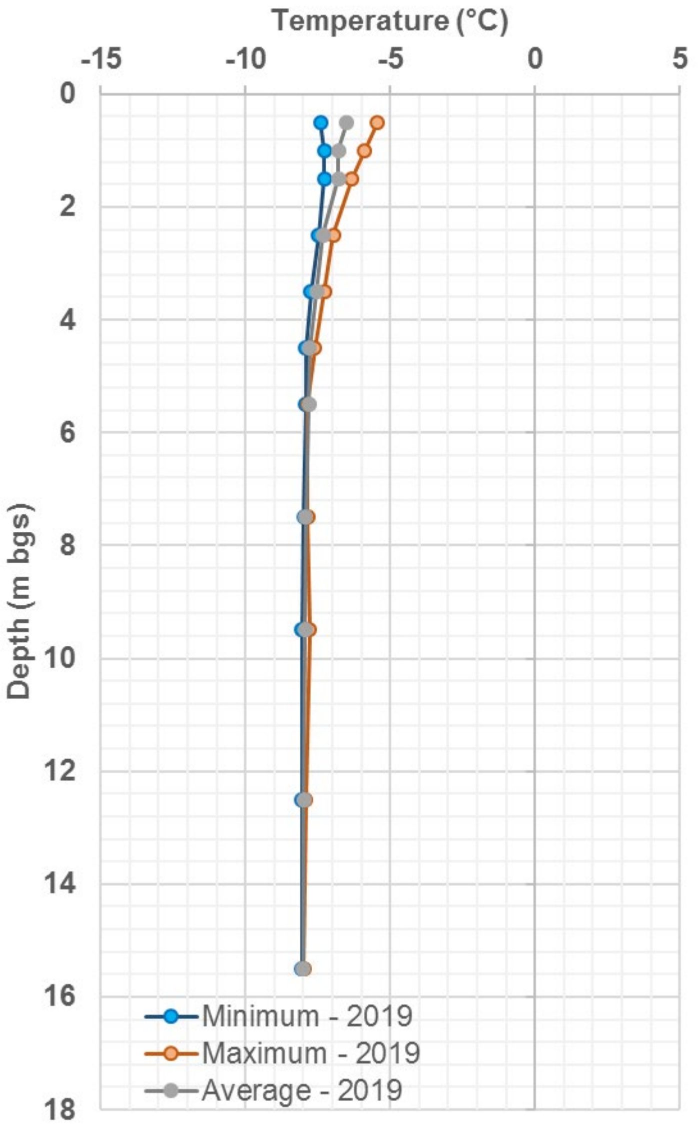
Approved: CWS

Figure: 6

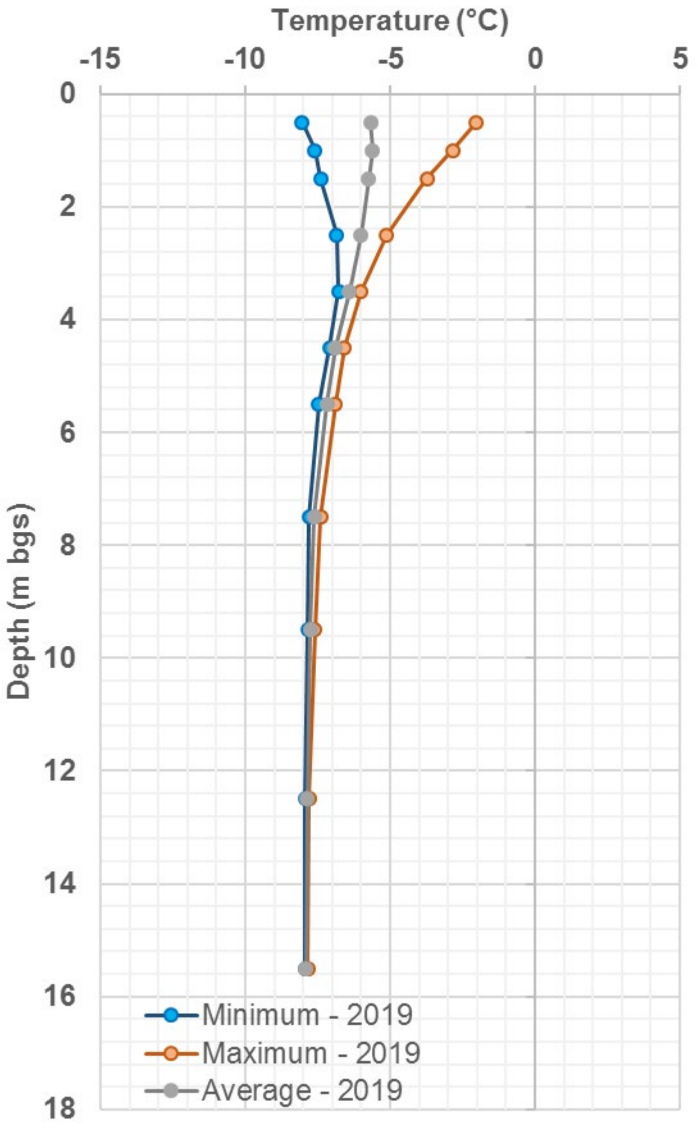
SD-VTS-155-US



SD-VTS-155-KT

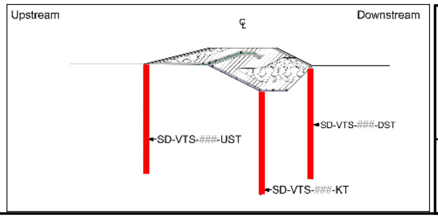


SD-VTS-155-DS



Notes:

1. Ground temperature sensors failure below uppermost node at SD-VTS-155-US



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Job No: 1CT022.038

Filename: South Dam Thermal Review2019

TMAC RESOURCES

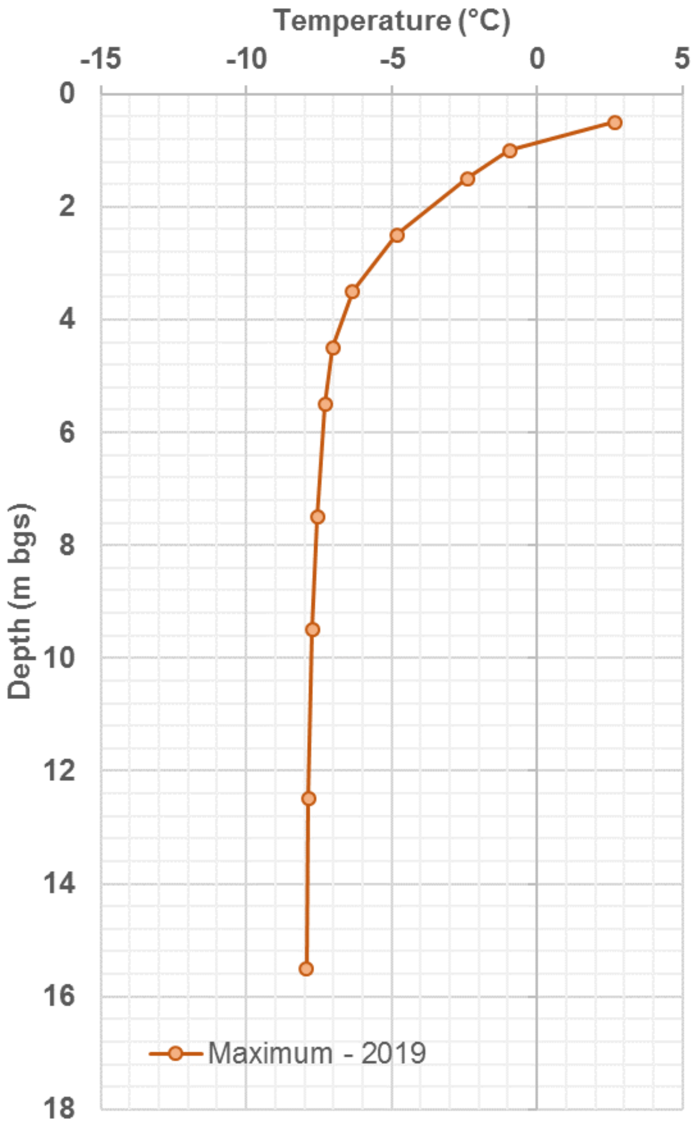
HOPE BAY PROJECT

2019 Annual Geotechnical Inspection
Tailings Impoundment Area

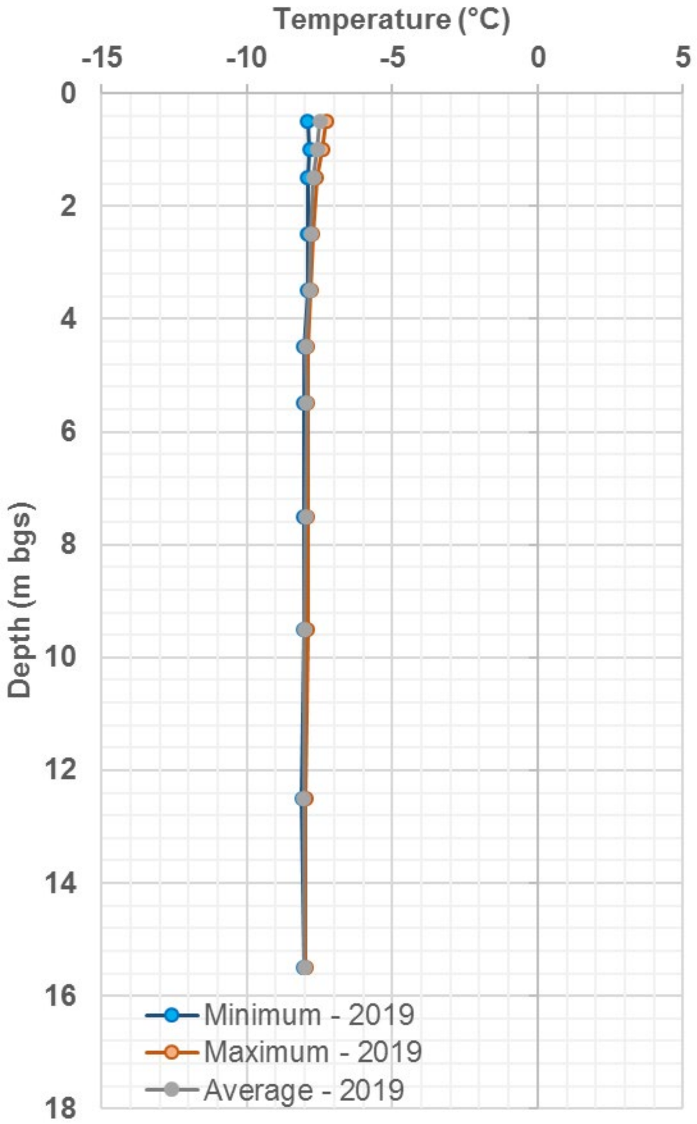
Foundation Ground Temperature – Section 1+55

Date:	Approved:	Figure:
March 2020	CWS	7

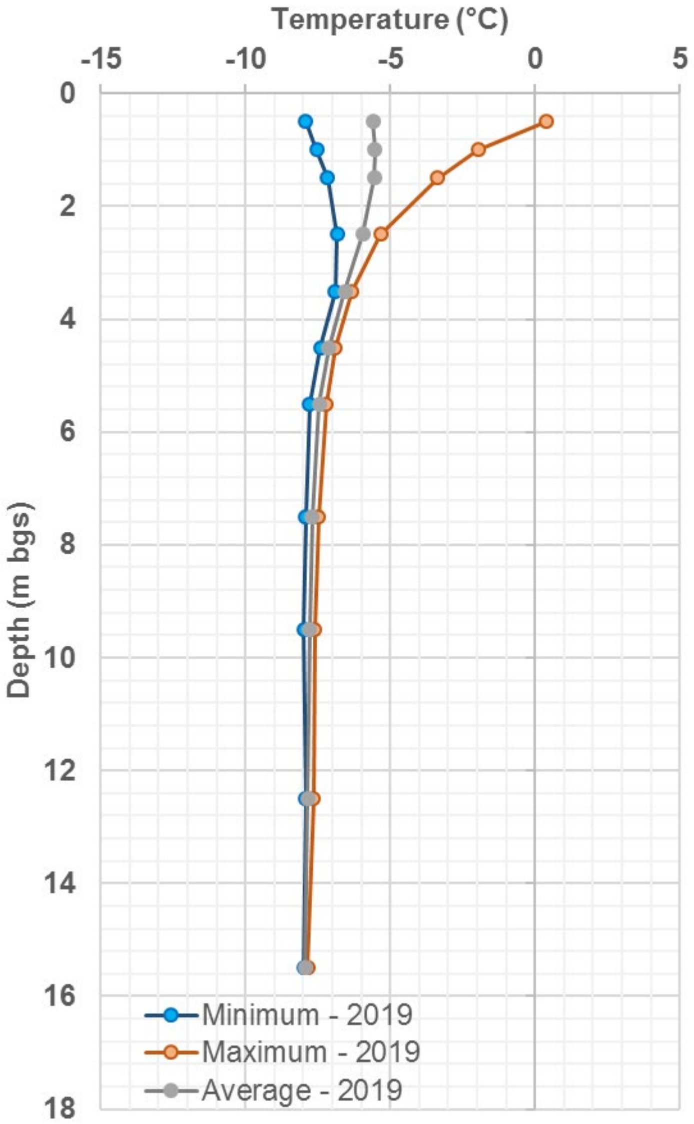
SD-VTS-240-US



SD-VTS-240-KT

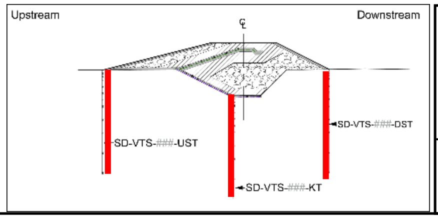


SD-VTS-240-DS



Notes:

1. Insufficient data for calculation of minimum ground temperature at SD-VTS-240-US



Job No: 1CT022.038

Filename: South Dam Thermal Review2019

HOPE BAY PROJECT

2019 Annual Geotechnical Inspection
Tailings Impoundment Area

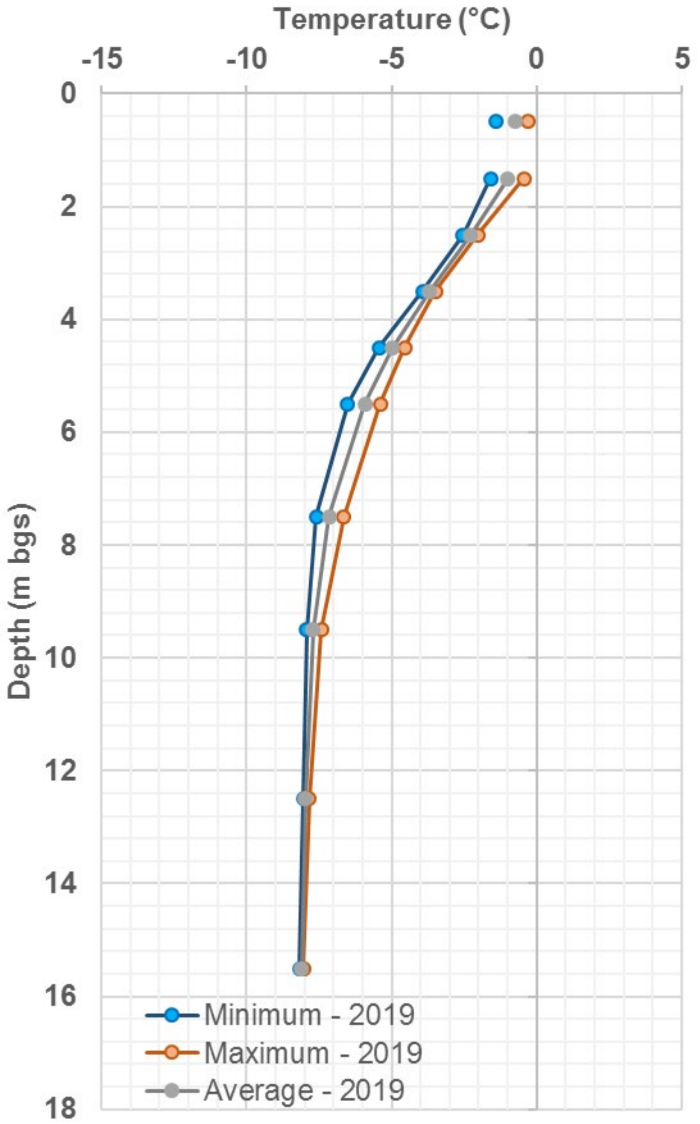
Foundation Ground Temperature – Section 2+40

Date: March 2020

Approved: CWS

Figure: 8

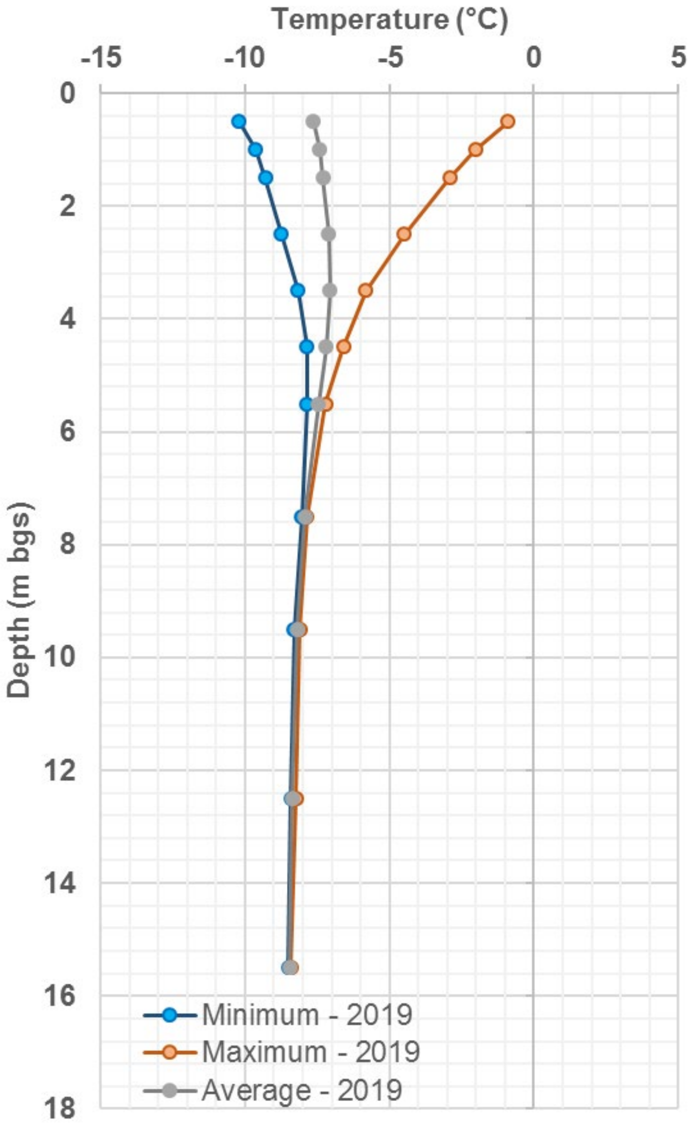
SD-VTS-365-US



SD-VTS-365-KT

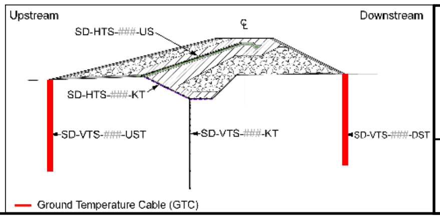
Ground Temperature Data Not Received for 2019

SD-VTS-365-DS



Notes:

1. Ground temperature data not received from GTC SD-VTS-365



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MAC RESOURCES

2019 Annual Geotechnical Inspection
Tailings Impoundment Area

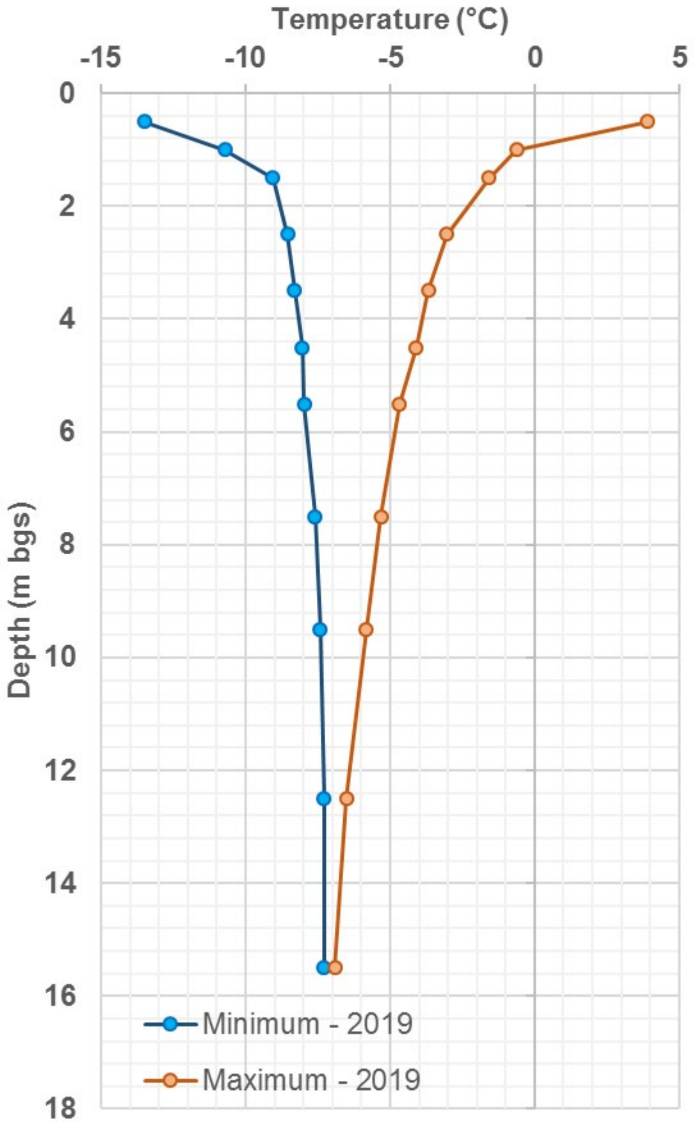
Foundation Ground Temperature – Section 3+65

Job No: 1CT022.038
Filename: South Dam Thermal Review2019

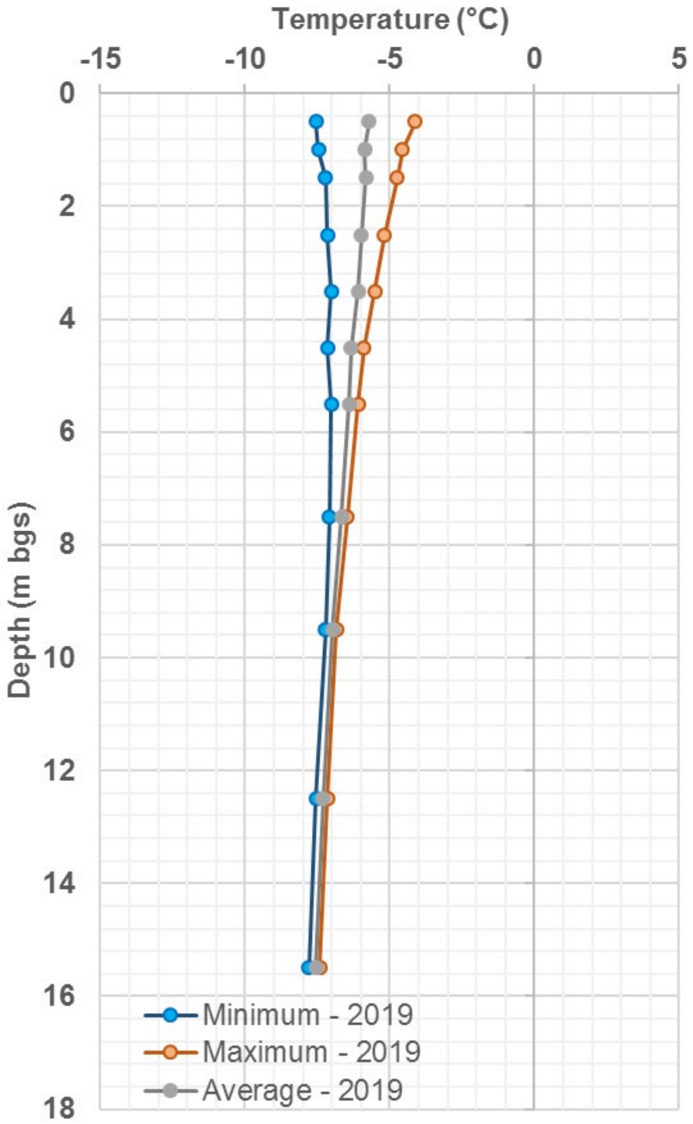
HOPE BAY PROJECT

Date: March 2020
Approved: CWS
Figure: 9

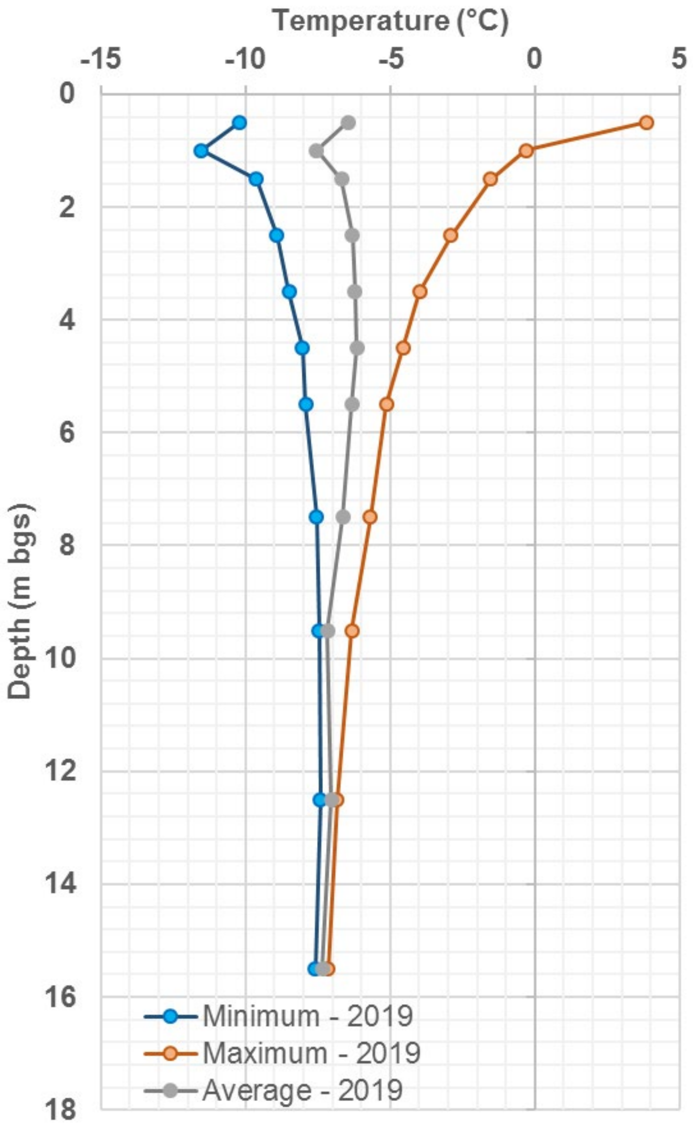
SD-VTS-460-US



SD-VTS-460-KT

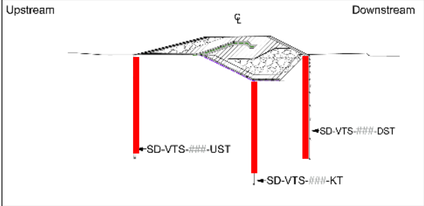


SD-VTS-460-DS



Notes:

1. Insufficient data for calculation of average ground temperature at SD-VTS-460-US



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Job No: 1CT022.038

Filename: South Dam Thermal Review2019

MAC RESOURCES

HOPE BAY PROJECT

2019 Annual Geotechnical Inspection
Tailings Impoundment Area

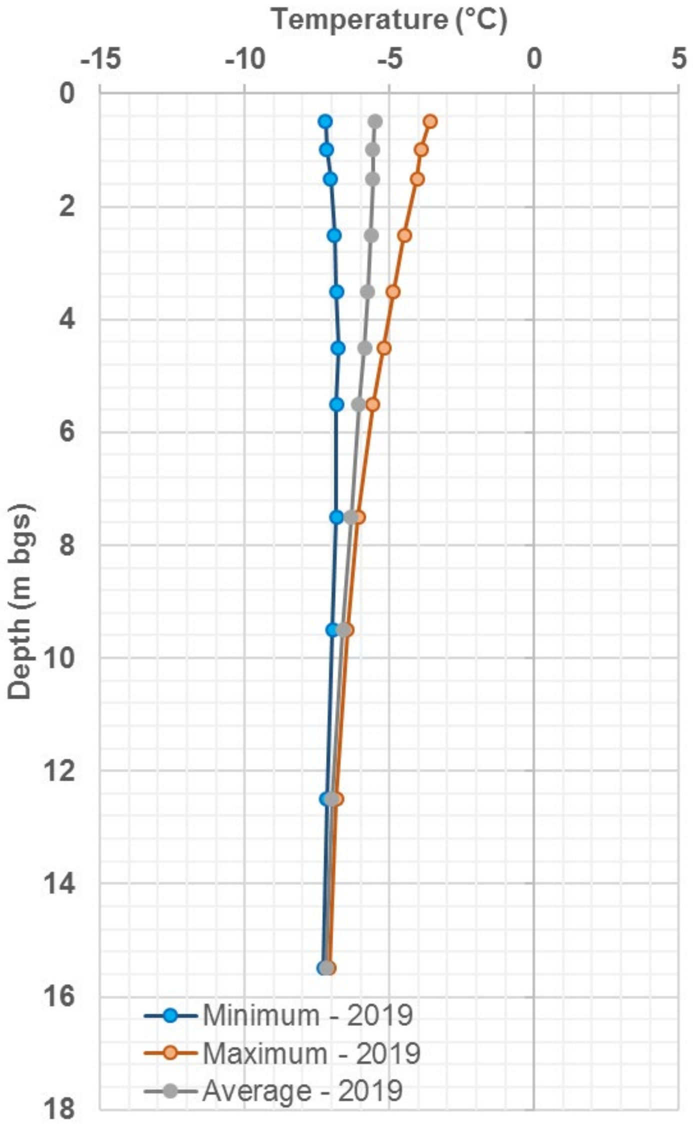
Foundation Ground Temperature – Section 4+60

Date: March 2020

Approved: CWS

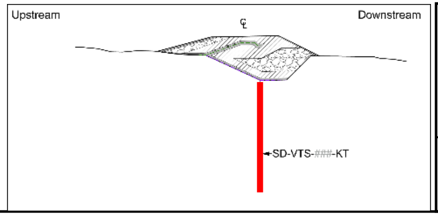
Figure: 10

SD-VTS-510-KT



Notes:

1. Ground temperature cables not installed beneath upstream and downstream toe at Section 5+10



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TMAC RESOURCES

Job No: 1CT022.038

Filename: South Dam Thermal Review2019

HOPE BAY PROJECT

2019 Annual Geotechnical Inspection
Tailings Impoundment Area

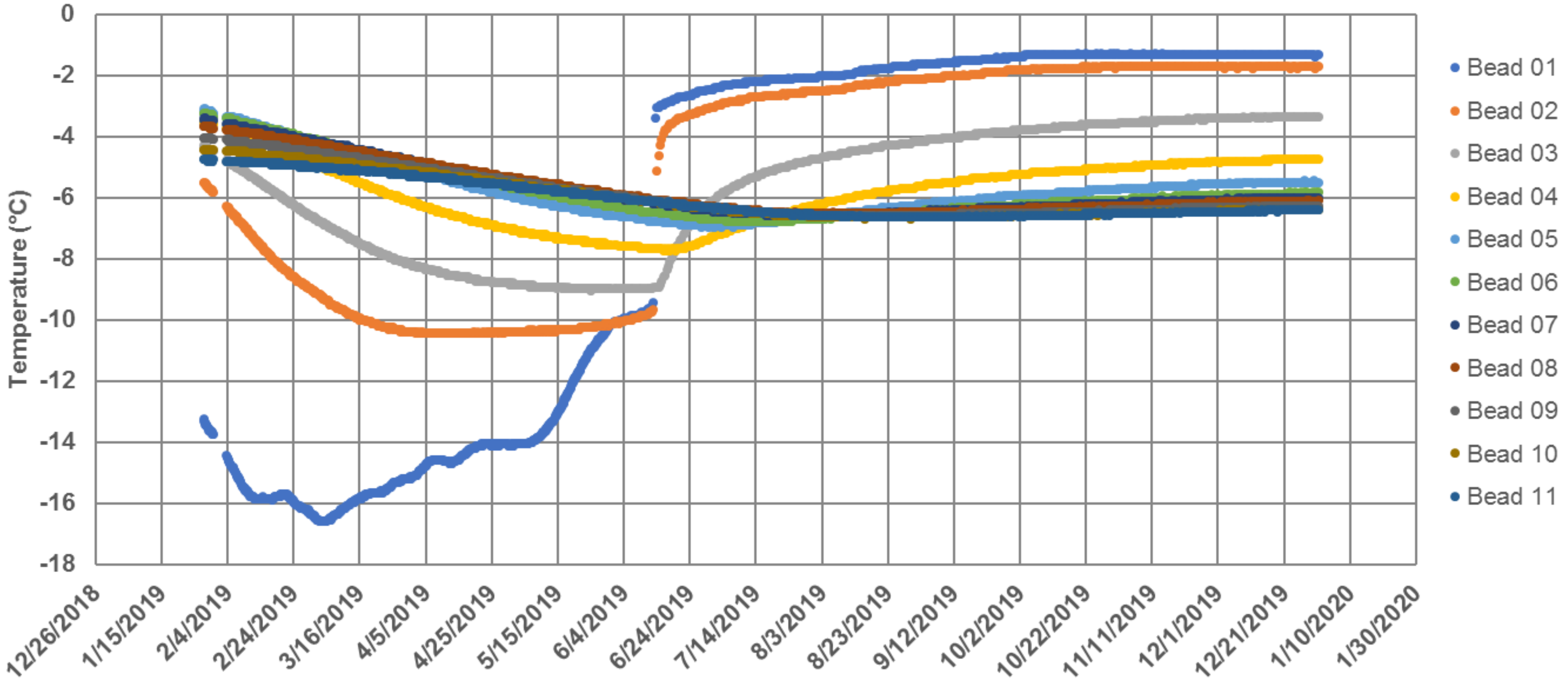
Foundation Ground Temperature – Section 5+10

Date: March 2020

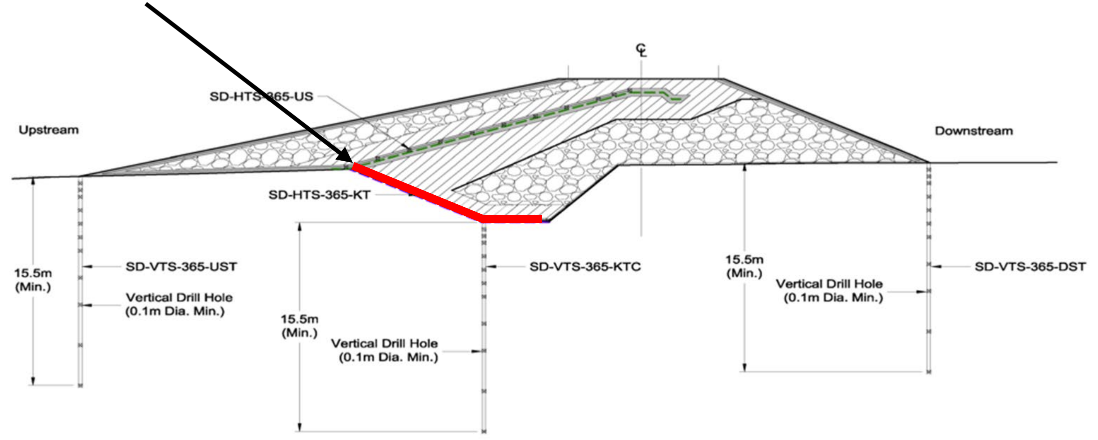
Approved: CWS

Figure: 11

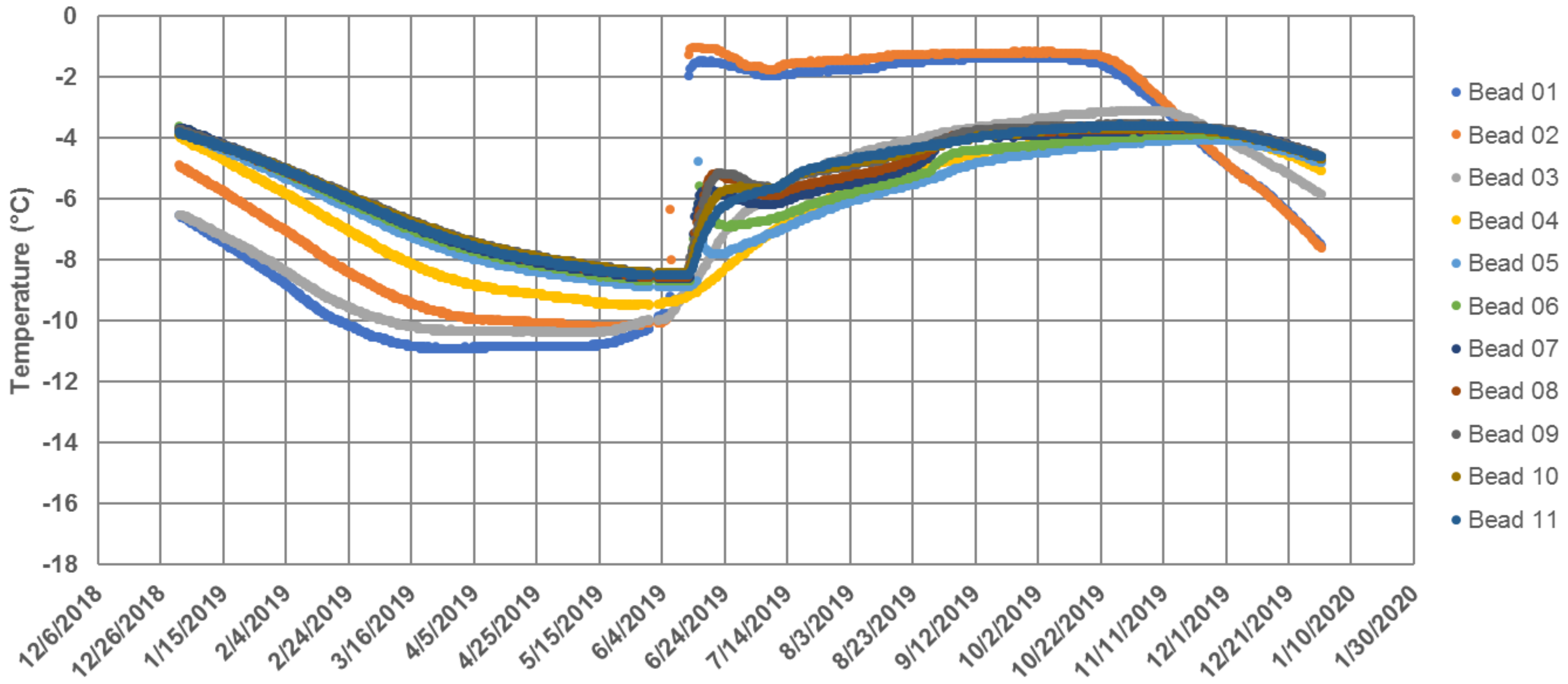
SD-HTS-365-KT



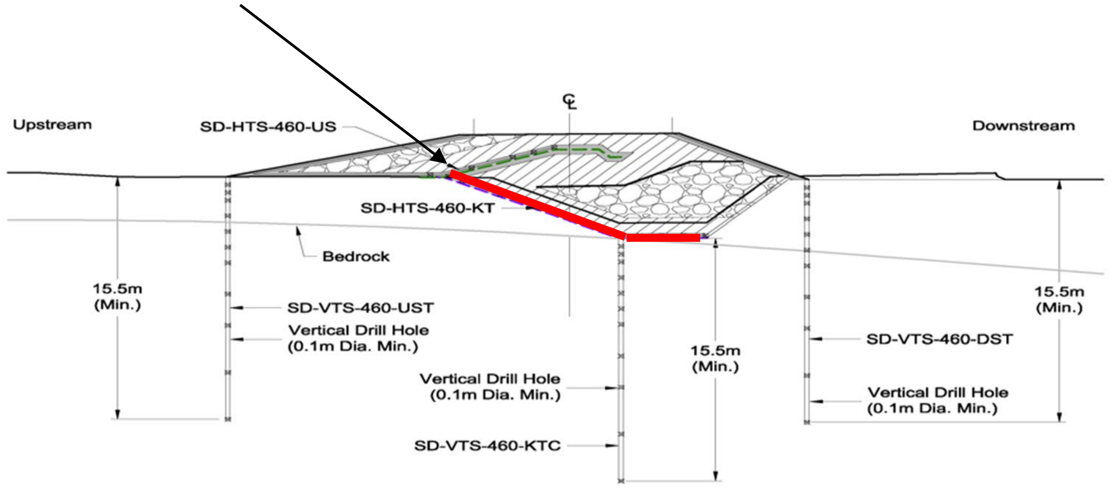
Uppermost Sensor (Bead 1)



SD-HTS-460-KT



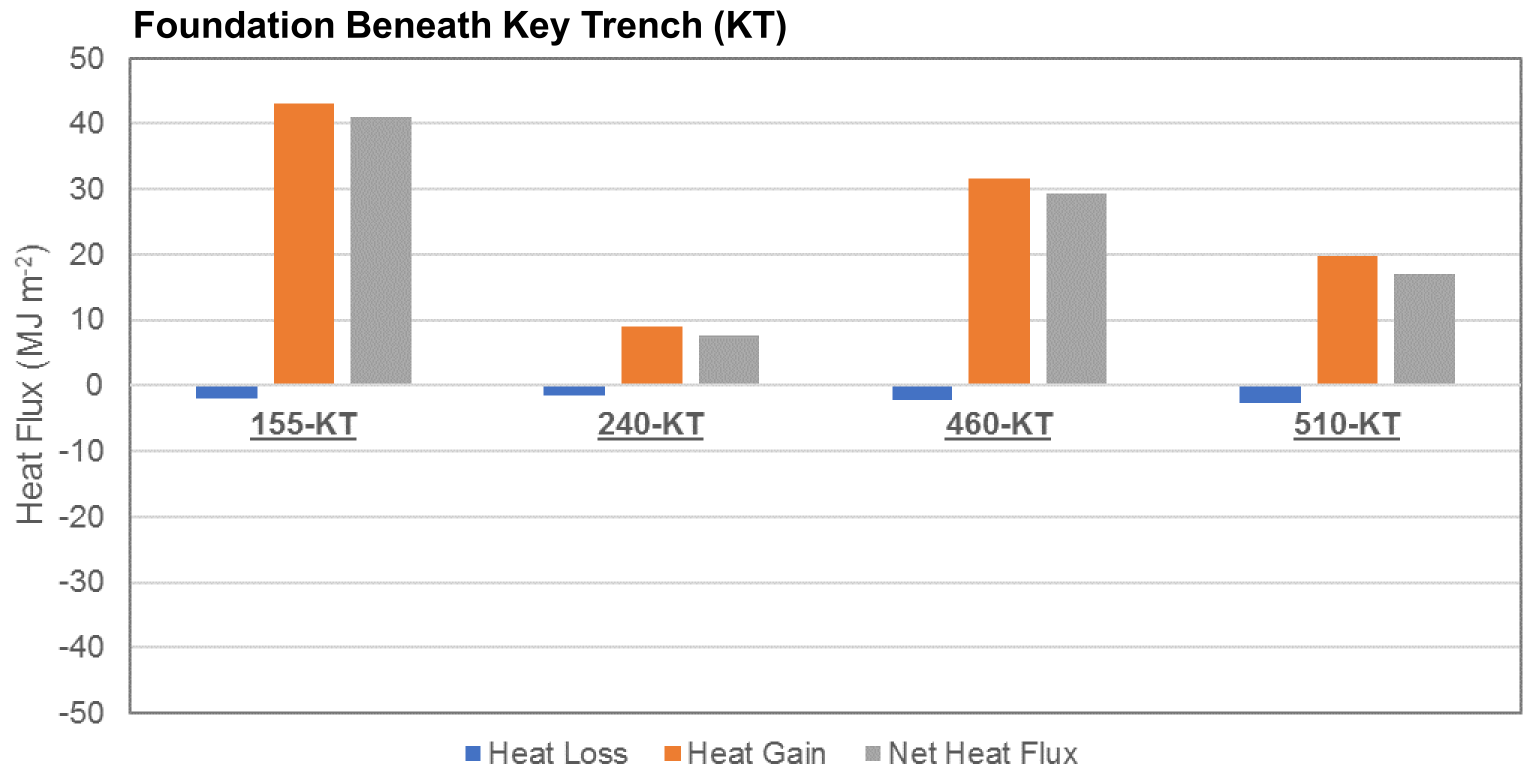
Uppermost Sensor (Bead 1)



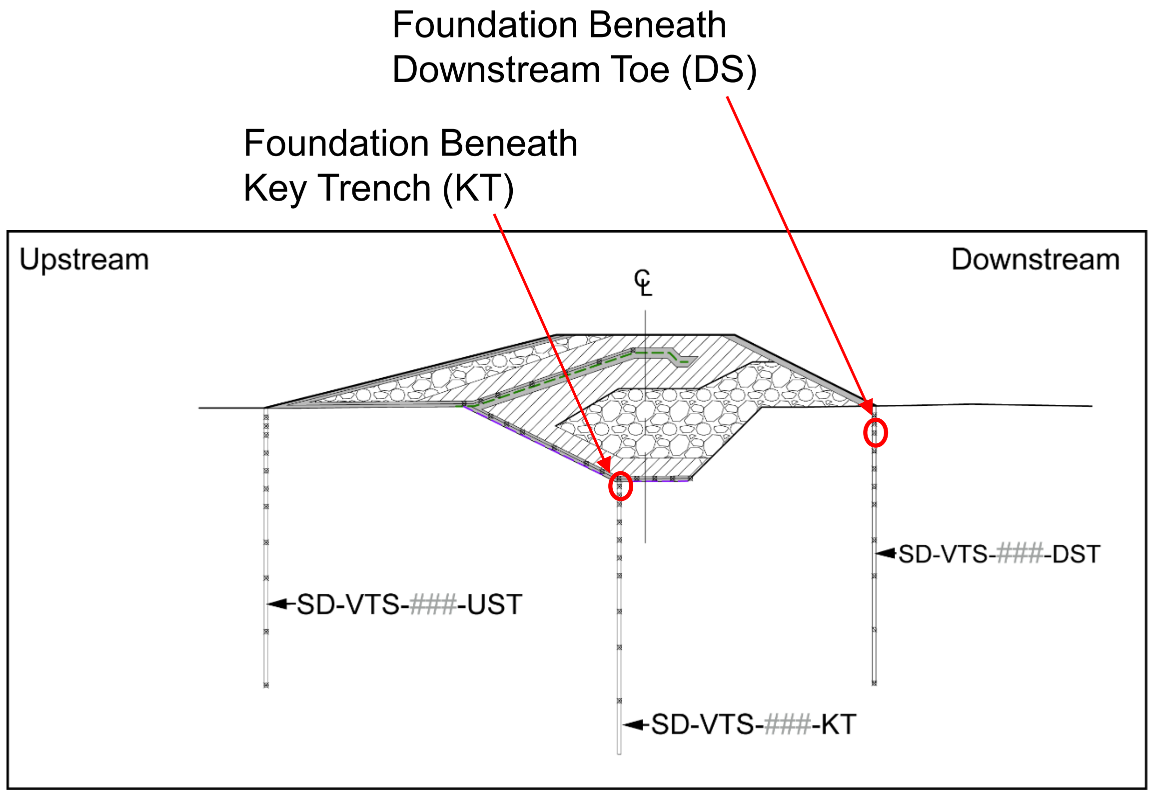
Notes:

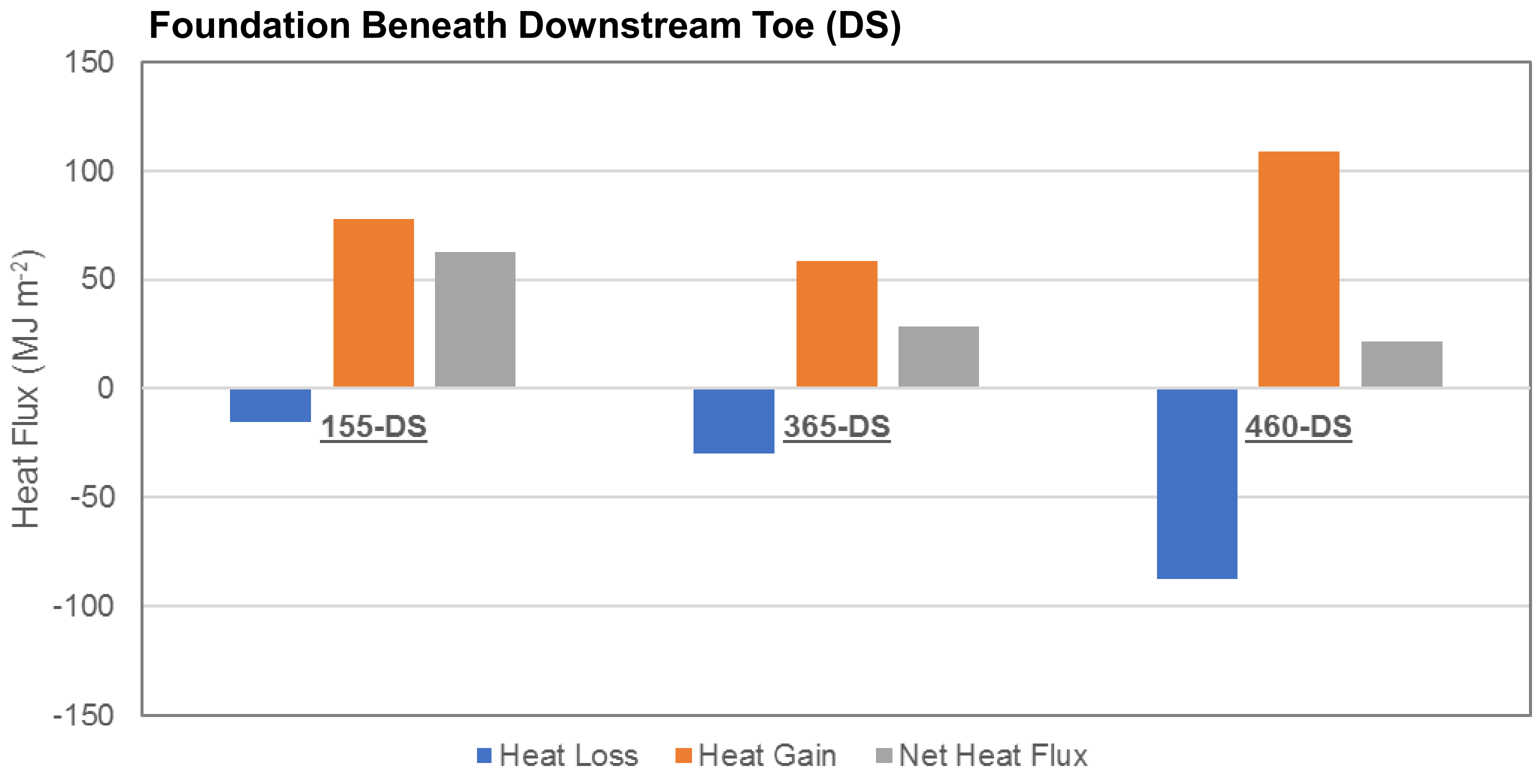
1. Uppermost sensor (Bead 1) located at the shallowest key trench depth furthest upstream from the dam centerline

srk consulting	MAC RESOURCES	2019 Annual Geotechnical Inspection Tailings Impoundment Area
		Key Trench Upstream Slope – Sections 3+65 & 4+60
Job No: 1CT022.038 Filename: South Dam Thermal Review2019	HOPE BAY PROJECT	Date: March 2020 Approved: CWS Figure: 12



Foundation Beneath Key Trench (KT)





Foundation Beneath Downstream Toe (DS)

Notes:

1. Heat gain, loss, and net annual heat flux for 2019 at monitoring sites with sufficient data for analysis

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MAC RESOURCES

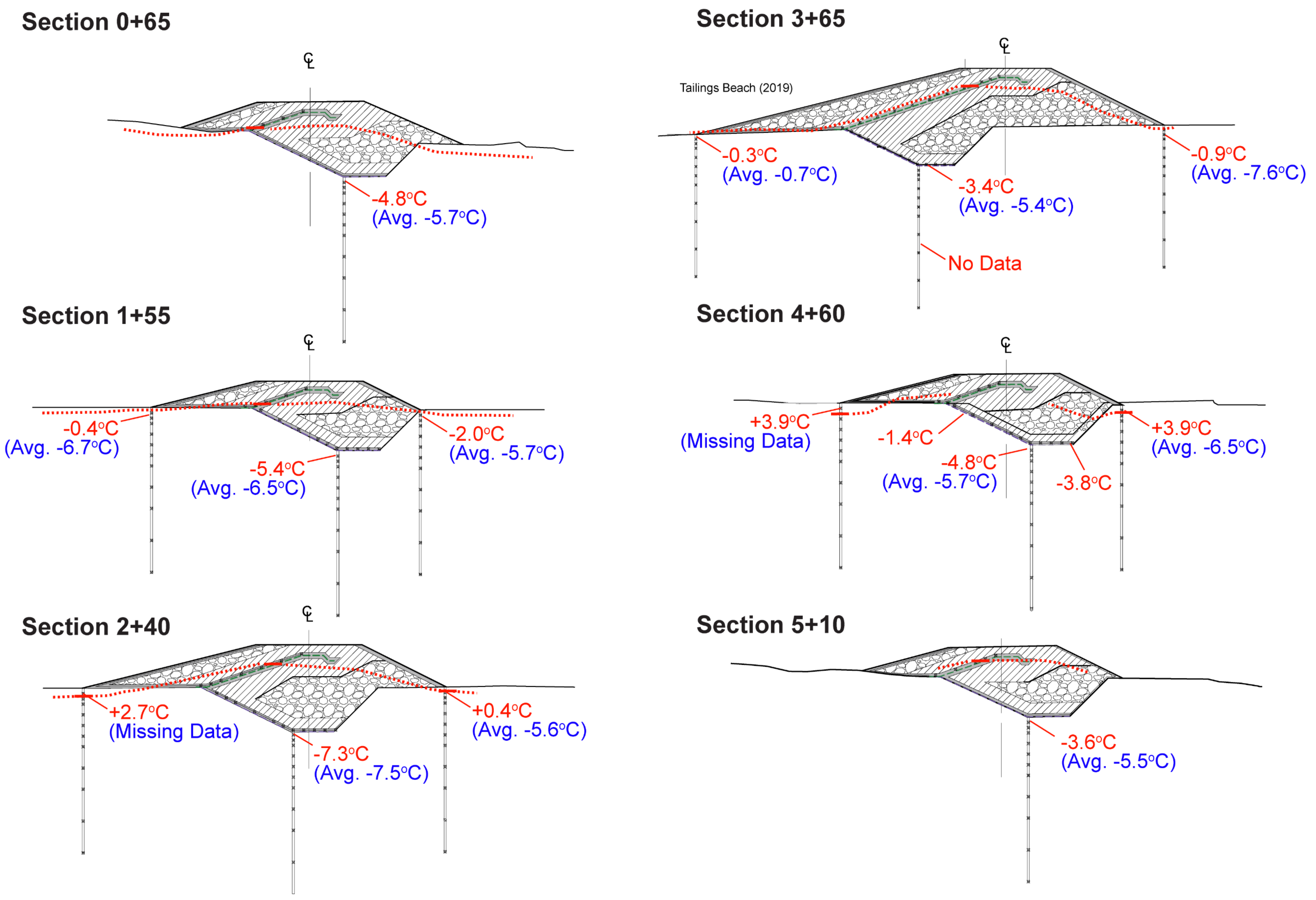
Job No: 1CT022.038
Filename: South Dam Thermal Review2019

HOPE BAY PROJECT

2019 Annual Geotechnical Inspection
Tailings Impoundment Area

Annual Energy Balance – Dam Foundation

Date: March 2020
Approved: CWS
Figure: 13



Section 0+65

Section 1+55

Section 2+40

Section 3+65

Section 4+60

Section 5+10

Notes:
1. Temperature shown in blue represent average (Avg.) values for 2019
2. Temperature shown in red represent maximum values for 2019
3. Solid red line represent approximate position of thaw based on 0°C isotherm
4. Red dashed line represent interpreted position of thaw for the 0°C isotherm

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MAC RESOURCES

2019 Annual Geotechnical Inspection
Tailings Impoundment Area

Monitoring Sections –
2019 Summary

Job No: 1CT022.038
Filename: South Dam Thermal Review2019

HOPE BAY PROJECT

Date: March 2020
Approved: CWS
Figure: 14

Appendix M – Tailings Porewater Freezing Point Depressions Checks

SRK Consulting (Canada) Inc.
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Memo

To:	Project File	**Client:**	TMAC Resources
From:	Christopher Stevens, PhD	**Project No:**	1CT022.038
Reviewed By:	John Kurylo, PEng	**Date:**	June 19, 2020
Subject:	Tailings Porewater Freezing Point Depression		

1 Introduction

The South Dam is designed as a frozen foundation tailings solid retention dam. Thermal performance of the dam is partly reliant on maintaining a tailings beach against the upstream face. In the winter, active tailings deposition is shifted to the east side of the tailings impoundment area (TIA). The change in location of active tailings deposition allows for the thermal loading along the upstream face of the dam to be reduced as winter heat loss from the tailings beach surface takes place. It is expected that the exposed tailings will freezeback and contribute to ground cooling beneath the upstream toe of the dam.

The chemical composition of porewater within the tailings beach will directly impact heat transfer and freezeback of the tailings over time. The composition of dissolved solids in the fluid is known to influence the fluid freezing point and the fraction of unfrozen water in the tailings at below freezing temperatures. These conditions have a direct impact on the tailing thermal conductivity, heat capacity, and latent heat of fusion which control heat transfer.

2 Tailings Samples

Bulk tailings beach samples were collected from three locations along the upstream face of the South Dam in 2019. The supernatant water from the bulk samples was analyzed to evaluate the water chemistry and freezing point depression of the TIA tailings. Table 1 summarizes the approximate locations of the tailings sampling points at the location of the South Dam spigot (Spigot 1 through 3).

Table 1: Location of Tailings Sampling

Sample ID	Easting[1]	Northing[1]	Elevation
SRK19-SD-SPIGOT1	435534	7555937	205
SRK19-SD-SPIGOT2	435632	7555967	203
SRK19-SD-SPIGOT3	435819	7556003	204

Notes:

1. Coordinates of sample locations are approximate.

Bulk surface tailings samples were collected by Derrick Midwinter (SRK) using a shovel and a clean 20 L plastic buckets. The buckets were sealed with lids and stored onsite until shipment to Global ARD Testing Service Inc. in Burnaby, British Columbia. Rain had occurred at the site several days prior to tailings sampling (personal comm. D. Midwinter).

Consolidation of the tailings during transport resulted in supernatant water forming in each sample bucket. Laboratory testing was completed on the supernatant water and included pH, EC, alkalinity, dissolved trace metals and anions SO4, Cl, ammonia, NO3 and NO2. SRK (2020) provides additional details on sample collection, laboratory testing, data QA/QC, and geochemical analysis.

3 Freezing Point Depression

The freezing point depression was calculated from the chemical composition of the tailings supernatant water results. Major ions and anions considered included calcium, magnesium, manganese, sodium, and potassium. The freezing point depression was calculated as:

$$\delta T = iK_f m$$

where:

δT is the change in temperature (°C)
i is the van't Hoff factor
K_f is the molar freezing point depression constant (°C kg mol^{-1})
m is the molarity of the solutes

The calculated freezing point depression for the supernatant water was 0.10°C, 0.21°C, and 0.25°C for sample SRK19-SD-SPIGOT1, SRK19-SD-SPIGOT2, and SRK19-SD-SPIGOT3, respectively. Based on the available information, the estimated tailings freezing point depression would be expected to have a negligible impact on freezeback of the tailings beach when compared to freshwater. The fine-grained tailings are expected to have a high unfrozen water content which has a larger influence on the thermal properties and heat transfer through the tailings over time. Additional collection of tailings samples to evaluate the freezing point depression may be warranted following suspected changes in the chemistry of the groundwater or mill water received by the TIA.

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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

4 References

SRK Consulting (Canada) Inc. (SRK). 2020. 2019 North and South Dam Seepage Water Quality Investigation, Hope Bay Project. Submitted to TMAC Resources Inc.

Appendix N – Tailings Deposition Update

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Memo

To:	Project File	**Client:**	Sabina Gold & Silver Corp.
From:	Murray McGregor	**Project No:**	1CT022.038
Reviewed By:	John Kurylo, MSc, PEng	**Date:**	March, 2020
Subject:	TSF Tailings Deposition Plan – March 2020 Update		

1 Introduction

The Hope Bay Project is a gold mining (and milling) project which is being undertaken by TMAC Resources Inc. The project is located 705 km northeast of Yellowknife and 153 km southwest of Cambridge Bay in Nunavut Territory, east of Bathurst Inlet. The project encompasses three areas of mineralization with additional exploration targets. The three mineral resources are Doris, Madrid, and Boston.

The Project consists of two phases. Phase 1 includes mining and infrastructure at Doris, while Phase 2 includes mining and infrastructure at Madrid and Boston located approximately 10 and 60 km due south from Doris, respectively. As of December 2018, the Doris Type A Water Licence was amended to include Madrid (2AM-DOH1335), and Boston was granted its own Type A Water Licence (2AM-BOS1835). The tailings are deposited sub-aerially into the Doris Tailings Impoundment Area (TIA) approximately 5 km from the Doris Mill area. The Doris TIA was previously a natural lake (Tail Lake) but has been delisted in accordance with Schedule II of the Metal Mining Effluent Regulations (MMER).

Tailings containment is currently provided by two structures; a water retaining frozen core dam (North Dam) and a frozen foundation tailings containment dam (South Dam). The North Dam construction was completed in 2012 (SRK, 2012) and the South Dam starter dam was completed in July 2018 (SRK, 2019). A deposition plan was previously prepared to identify options for increased tailings storage capacity within the Doris TIA (SRK, 2017).

In order to accommodate the additional tailings from Phase 2 works, additional containment is required. As part of the Annual Geotechnical Inspection (AGI), and to assist with the TMAC Prefeasibility Study update that was in progress the deposition plans were revisited. In general tailings deposition plans for the TIA will be reviewed annually as part of the AGI. As part of the Phase 2 plans, the South Dam will be raised, and a new dam will need to be constructed at the south-western edge of the TIA (West Dam). The West Dam will be constructed and operated similarly to the South Dam (i.e. tailings containment dam with frozen foundation).

This memo presents the results of deposition modelling in support of the Annual Geotechnical Inspection (AGI). This assessment considers the currently projected Life of Mine (LoM) tailings and discounts for tailings placed by the end of 2019.

2 Operation Philosophy

2.1 Deposition Strategy

The overall deposition strategy begins with discharging tailings from several points starting from the South Dam and progressively moving the tailings beach toward the north. The intent is to maintain a free-draining surface that drains to the reclaim pond at closure.

The use of single spigot points at a given time was done to simplify as much as practical the operation strategy. Single point deposition has been specified for the winter months in order to minimize the risk of ice entrainment. During the summer periods, three spigot points are specified; however, these can be operated one at a time splitting deposition between each point evenly.

A beach has been formed at the South Dam in 2019. Tailings deposition will continue to progressively move water away from South Dam while maintaining a free draining surface to the north. After construction of the West Dam, summer deposition will move to the West Dam in order to form a beach to move the pond away from the dam. Moving water away from the South Dam and West Dam will facilitate freeze-back of the foundation and eliminate seepage potential under the dams. Deposition will then continue progressively along the east side of the TIA for the remaining life of mine tailings.

The North Dam will continue to act as a water retaining dam for the life of the TIA. The water demands will need to be checked as tailings deposition continues and the size of the reclaim pond reduces.

Best Management Practices will be adopted to schedule seasonal changes in discharge locations to minimize ice buildup and possibly permanent entrapment of ice within the tailings mass. The deposition planning presented in this memo does not present complete details of such seasonal operations; seasonal operations will be developed and presented in an Operations, Maintenance and Surveillance (OMS) Manual. This OMS Manual will be prepared by TMAC in accordance with the requirements under the mine’s Water Licence.

2.2 Reclaim

The water reclaim is currently situated at the north end of the tailings pond adjacent the North Dam. It consists of an on-land pump connected to a barge with a floating pipe. Water sourced from the reclaim will be pumped to the mill area for reuse in the mill circuit or discharge following treatment.

The full supply level of 33.5 masl should not be exceeded under normal operating circumstances. The barge has been anchored in a locally deep area (>2m depth) at the north end of the TIA to facilitate pumping during winter periods when relatively deep ice can develop. The position of the barge may need to be re-evaluated as tailings deposition begins to encroach in the area; however, preliminary deposition modelling suggests this is many years away.

3 Objectives, Operational Criteria and Assumptions

The tailings deposition plan has been completed to determine the following:

- Allow for the development of an accurate tailings surface which would facilitate the development of a representative stage-capacity curve for the TSF through its life;
- Determining optimum tailings discharge locations and durations that coincide with the deposition philosophy;
- Optimization of deposition locations to facilitate use of reclaim water and limit ice entrainment
- Identify the timing requirements for construction the West Dam and South Dam raise
- Determine the sensitivity of beach angle

Tailings deposition planning was completed using the program Muk3D 2018. The deposition modeling assumptions are summarized in Table 1, and are based on actual site survey data, laboratory testing, and experience with tailings that have similar characteristics. The as-built surfaces from 2019 were incorporated into the base surface for the analysis to account for existing tailings placement.

Table 1: Summary of Tailings Deposition Modeling Assumptions

Component	Value
Total Tailings Storage Requirement [1]	20.0 Mt (15.4 Mm^3)
Tailings currently Deposited [1]	1.2 Mt
Remaining Tailings Storage Requirement [1]	18.8 Mt (14.5 Mm^3)
Deposited Tailings Dry Density	1.3 t/m^3 (based on testing)
Tailings Beach Slope (Subaerial Portion)	0.5% to 1.0% [2]
Tailings Beach Slope (Sub-aqueous Portion)	1.0%
TSF Full Supply Level (normal operations)	33.5 m
Discharge Method	Single/multi point discharge

Notes: [1] Tailings storage requirements based on information provided beginning of 2020

[2] Short term tailings modelled at 0.5% subaerial slope (similar to 2019 survey); life of mine tailings modelled at both 0.5% and 1.0% subaerial slopes to capture the likely range of possible outcomes

Tailings throughput has been modelled at 2000 t/day initially, then ramped up to a maximum allowance of 4000 t/day (to look at potential variability in the mining plan and milling rates). The scheduled of production rates looked at as part of this annual check is summarized in Table 2 below.

Table 2: Summary of Tailings Production Rates (TMAC 2020)

Year (inclusive)	Tonnes/Day
2020 to 2023	2000
2024	3500
2025 to 2034	4000

4 Deposition Modelling Results

Deposition modelling was undertaken for three scenarios:

- Short term-deposition with subaerial slope of 0.5% and subaqueous slope of 1.0% (pond level near current elevation of 33.0masl)
- Life of Mine deposition with subaerial slope of 0.5% and subaqueous slope of 1.0% (pond level at full supply level of 33.5masl)
- Life of Mine deposition with subaerial and subaqueous slope both modelled at 1.0% (pond level at full supply level of 33.5masl)

Variable deposition and beach slope angles were looked at was due to the fact that as-built surveys are showing slightly variable beach slopes; slope angles are ultimately dependent on solids content and if other water stream such as underground inflows are being deposited with or beside the tailings streams. Looking at the variable beach slopes gives a bit of a sensitivity analysis on the overall tailings storage volumes and reclaim pond size.

The plan view of the modelling results for the three scenarios are presented in Figures 1, 2 and 3. Discharge points are consistent in each scenario and have been labelled in each (D01 to D13); however, not all deposition points appear in each scenario. A further breakdown of deposition models is shown in Attachment 1.

The near-term deposition was completed based on the current discharge point operating until spring 2020 (D01). Tailings are then discharged from the South Dam to continue raising the beach (D02). As the following winter approaches, tailings are discharged from a single point away from the South Dam beach (D03). For subsequent years, deposition is split into two phases representing 7 months summer and 5 months winter deposition. The deposition location and elevations for the two Life of Mine (LoM) scenarios are presented in Table 3. In all scenarios, winter deposition is completed from discharge points internal to the TIA and away from the dams.

The 1.0% subaerial beach slope represents the more conservative scenario in terms of rate of rise and required discharge locations. Based on the 1.0% deposition model outputs reported in Table 3, the South Dam raise will be required in 2022. Tailings begin to encroach on the West Dam foundation area in 2025; therefore, the West Dam construction should begin in winter 2023.

In both scenarios modelled, the final volume of the pond under normal operating circumstances is relatively small (less than 400,000m^3).

Table 3: Summary of Deposition Modelling

		Subaerial slope = 0.5%				Subaerial slope = 1.0%			
Year	Modelling Stage	Discharge Location	Elevation	Tonnage	Pond Volume	Discharge Location	Elevation	Tonnage	Pond Volume
			[masl]	[tonnes]	[m3]		[masl]	[tonnes]	[m3]
2020	1	D01	35.1	360,000	6,589,000	D01	36.2	360,000	6,617,000
2020	2	D02	36.1	183,000	6,542,000	D02	37.8	183,000	6,603,000
2020	3	D02 (D99)	36.1	57,000	6,498,000	D02 (D99)	37.8	57,000	6,559,000
2020	4	D03	34.8	30,000	6,485,000	D03	35.1	30,000	6,544,000
2020	5	D03 (D99)	34.8	90,000	6,416,000	D03 (D99)	35.1	90,000	6,475,000
2021	6	D02 (D99)	36.1	430,000	6,086,000	D02 (D99)	37.8	430,000	6,144,000
2021	7	D03	35.8	300,000	5,964,000	D03	37.1	300,000	6,042,000
2022	8	D02	37.7	430,000	5,873,000	D02	40.2	430,000	6,020,000
2022	9	D03	36.5	300,000	5,700,000	D03	38.5	300,000	5,928,000
2023	10	D02	38.5	430,000	5,576,000	D02	41.8	430,000	5,910,000
2023	11	D03	37.3	300,000	5,409,000	D03	39.4	300,000	5,764,000
2024	12	D02	39.3	430,000	5,295,000	D02	42.9	430,000	5,728,000
2024	13	D03	37.9	300,000	5,127,000	D03	40.3	300,000	5,588,000
2025	14	D02	40.2	752,500	4,893,000	D02	44.3	752,500	5,479,000
2025	15	D03	39.0	525,000	4,611,000	D03	41.9	525,000	5,257,000
2026	16	D02	41.2	860,000	4,369,000	D02	45.8	860,000	5,171,000
2026	17	D03	39.9	600,000	4,043,000	D03	43.3	600,000	4,921,000
2027	18	D02	42.1	860,000	3,801,000	D03	44.5	860,000	4,630,000
2027	19	D03	40.7	600,000	3,471,000	D03	47.0	600,000	4,551,000
2028	20	D02	42.9	860,000	3,228,000	D05	43.2	860,000	4,258,000
2028	21	D03	41.4	600,000	2,907,000	D04	43.9	600,000	4,030,000
2029	22	D02	43.6	860,000	2,670,000	D05	44.5	860,000	3,776,000
2029	23	D03	42.2	600,000	2,365,000	D04	45.1	600,000	3,574,000
2030	24	D02	44.3	860,000	2,148,000	D05	45.6	860,000	3,347,000
2030	25	D03	42.8	600,000	1,868,000	D06	44.2	600,000	3,087,000
2031	26	D02	45.0	860,000	1,685,000	D06	45.0	860,000	2,726,000
2031	27	D03	43.5	600,000	1,444,000	D07	43.6	600,000	2,439,000
2032	28	D02	45.6	860,000	1,299,000	D08	43.1	860,000	2,046,000
2032	29	D03	44.2	600,000	1,069,000	D09	42.4	600,000	1,783,000
2033	30	D05	43.3	860,000	810,000	D10	41.5	860,000	1,437,000
2033	31	D04	43.7	600,000	680,000	D11	41.3	600,000	1,193,000
2034	32	D05	44.1	860,000	494,000	D12	41.8	860,000	871,000
2034	33	D04	44.4	600,000	418,000	D12	42.4	600,000	721,000
2035	34	D05	44.7	860,000	286,000	D13	42.4	860,000	490,000
2035	35	D04	45.1	600,000	246,000	D13	43.0	600,000	392,000

Note: Discharge D99 in parenthesis indicates tailings spilling into deep portion of tailings pond without significant rise at discharge location.

5 Discussion

Two deposition scenarios have been modelled for the currently projected LoM tailings:

I. Subaerial slopes of 0.5% and subaqueous slopes of 1.0%
II. Subaerial and subaqueous of 1.0%

One additional short-term deposition scenario was also modelled, as outlined in Section 4, but is not discussed in detail in this section. The focus of these discussions is on the LoM tailings deposition.

The 2019 tailings beach was measured (based on as-built surveys) at roughly 0.5% to 0.7% subaerial slope; therefore, the subaerial slopes modelled can represent the range of expected outcomes for future deposition.

The modelling exercise undertaken indicates that the existing TIA can accommodate the LoM tailings with limited modification (including the maximum production rates assumed, although these may not be realized on site). A raise of the South Dam is required by 2022 and West Dam construction needs to begin in winter 2023 based on the more conservative of the two scenarios (1.0% subaerial slopes). It should be noted that there is some flexibility in tailings deposition. For example, a northern discharge location could be used for in the short term if the tailings beach rises to the crest of the South Dam faster than anticipated.

The modelling was completed for an overall density of 1.3t/m^3. The capacity of the TIA could be significantly impacted by tailings density; therefore, as-placed density needs to be checked throughout to ensure this assumption remains valid. Localized density tests will likely not capture potential entrained ice; therefore, density should be checked by comparing ground surveys and bathymetry to the mill throughput.

In early stages of deposition, the winter discharge points are relatively close to the pond and the modelling suggests that most of the winter deposition results in subaqueous tailings which limits the potential for ice entrainment. In later years, the distance from winter discharge points to the pond increases and potential for ice entrainment will increase. Monitoring ice entrainment and as placed density in the next few years will help establish the associated risks. If the risk is significant, alternate deposition strategies could be developed that move winter deposition points closer to the pond.

The overall capacity of the TIA in the currently planned form is not particularly sensitive to the tailings slope angle; however, additional discharge locations are required in order to maintain the free draining surface to the north if the beach angle is steeper. Note that the deposition strategy for 1.0% subaerial slopes has roughly twice the discharge locations than for the 0.5% subaerial slope scenario.

Water management may be an issue toward the end of mine life since the reclaim pond becomes significantly smaller (less than 400,000m^3). The water balance should continue to be constantly checked (and reviewed in detail annually) in order to confirm that process water demands can be met from the reduced pond volume. It is also likely that significant quantities of water will need to be treated and discharged annually in order to progressively reduce the volume in the pond and remain below the normal operating water level of 33.5masl.

The deposition plan should be reviewed as part of the next AGI to ensure the assumptions remain valid and there is capacity for the projected life of mine tailings.

6 References

SRK Consulting (Canada) Inc. (SRK, 2012). North Dam As-Built Report, Hope Bay Project. Report prepared for Hope Bay Mining Ltd. Project Number 1CH008.058. October 2012.

SRK Consulting (Canada) Inc. (SRK, 2017). Phase 2 Doris Tailings Impoundment Area Tailings Deposition Plan, Hope Bay Project. Report prepared for TMAC Resources Inc. Project Number 1CT002.013. November 2017.

SRK Consulting (Canada) Inc. (SRK, 2019). Phase 1 South Dam As-Built Report, Hope Bay Project. Report prepared for TMAC Resources Inc. Project Number 1CT022.031. March 2019.

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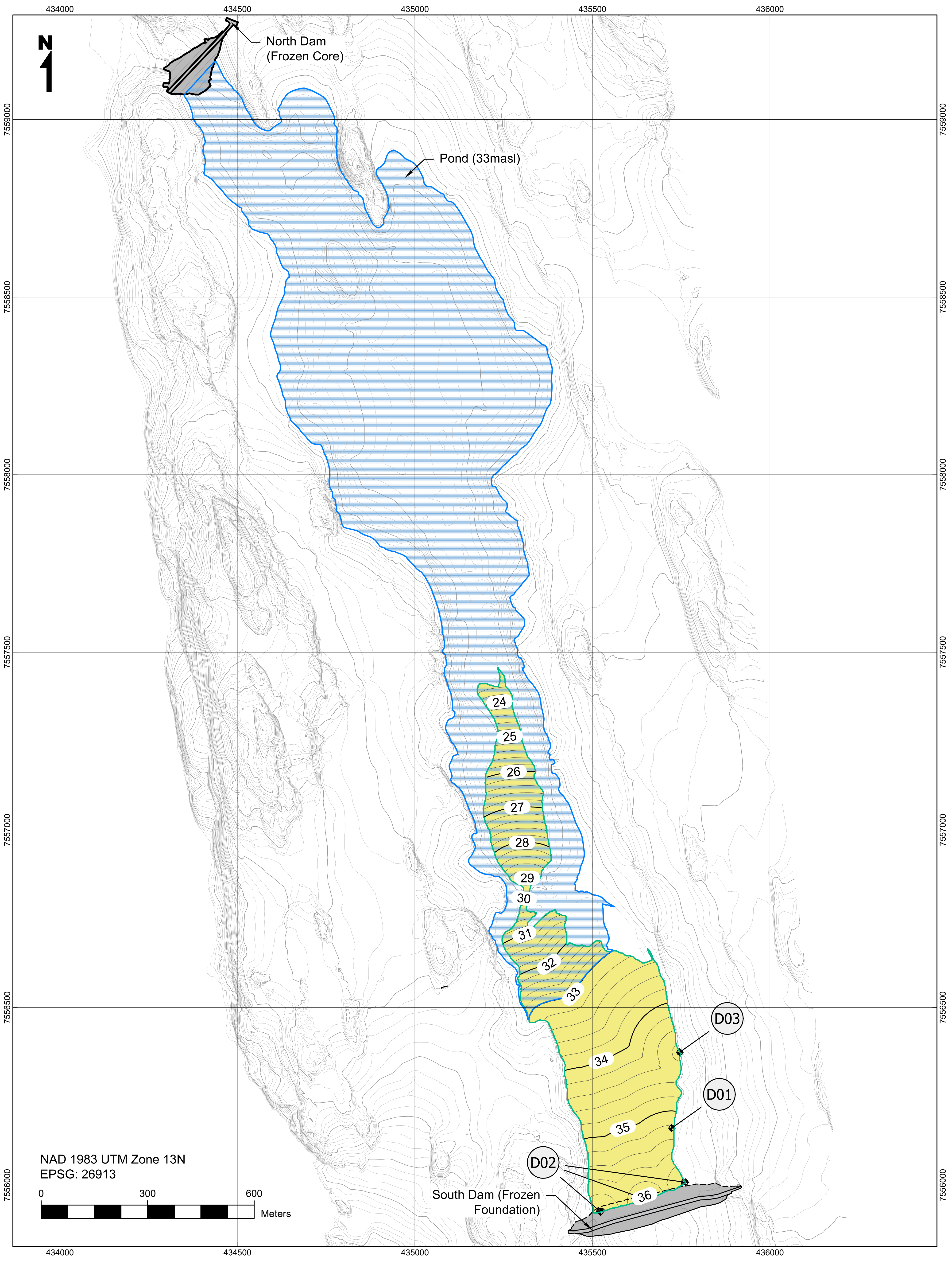
Figures



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Projected Tailings Deposition 2020

Figure 1

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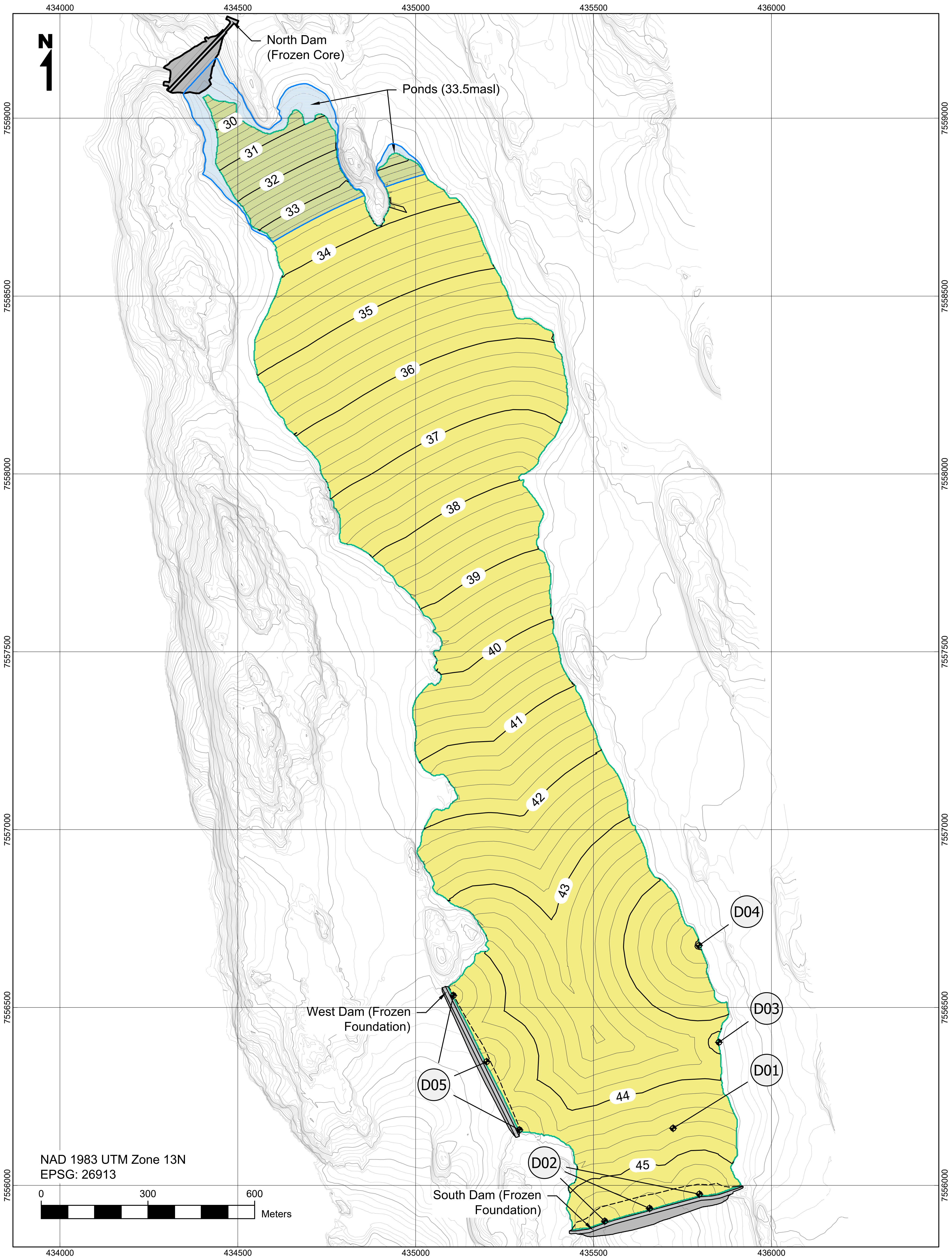

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Life of Mine Deposition Plan (0.5% Subaerial slope)

Figure
2

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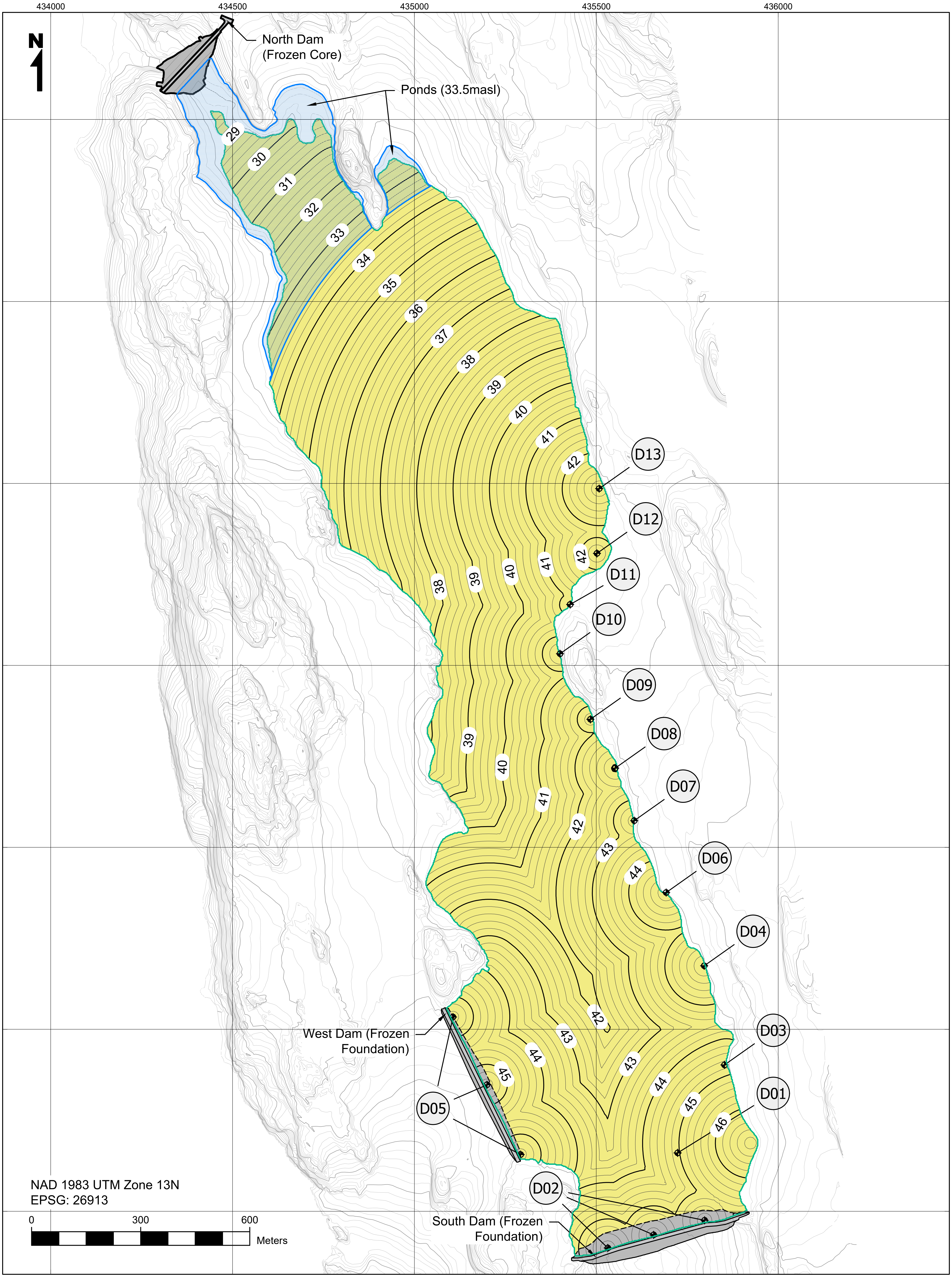

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srk consulting		Life of Mine Deposition Plan (1.0% Subaerial slope)	Figure 3

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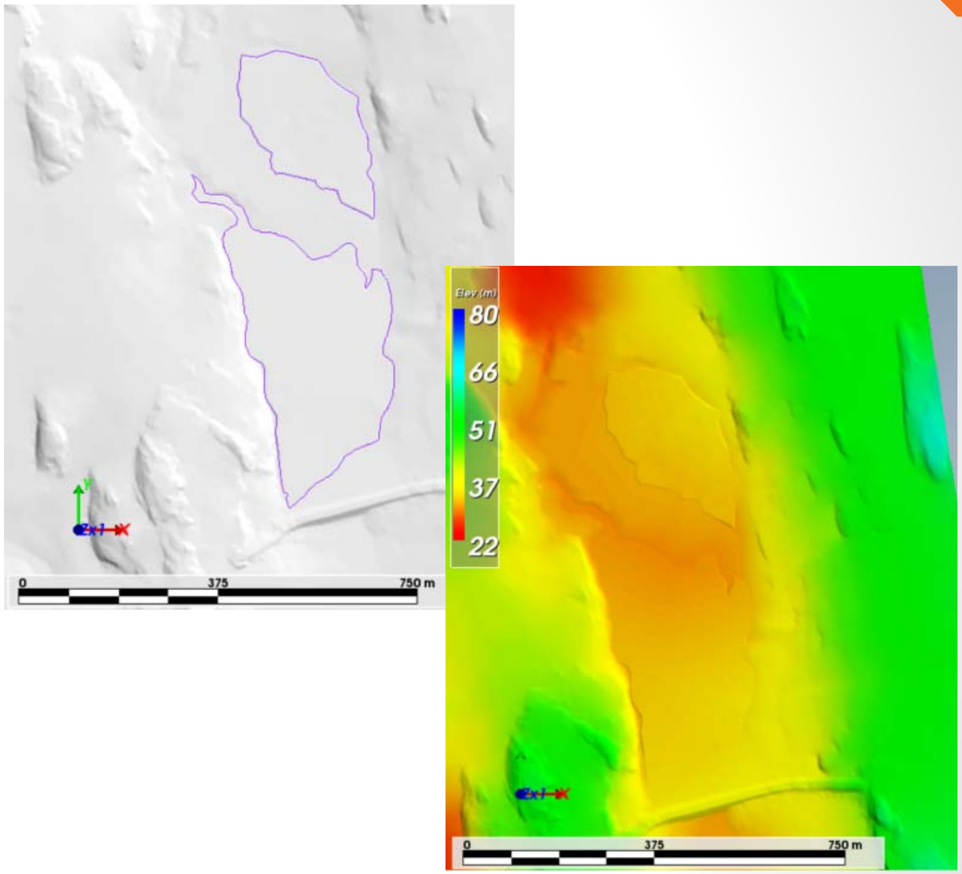
Attachment 1

Hope Bay Deposition Plan - Notes

Surfaces:

- Surfaces seem to load in alright (blue outlines)
- Minor differences in surface elevation approximately 0.5-0.7m at tie-in points
- Small gap between survey and cliff face on west side of southern tails surface
- Surface area:
    - East tails 50,000m^2
    - South tails 107,000m^2
- Assume maximum error of 0.5m, then volume error would be about 78,500m^3
- However, I think this is certainly an overestimate of error and these surfaces are fit for the task
- These will be smoothed out very rapidly during deposition modelling (i.e. less than a year and these will be smoothed into the underlying surface)



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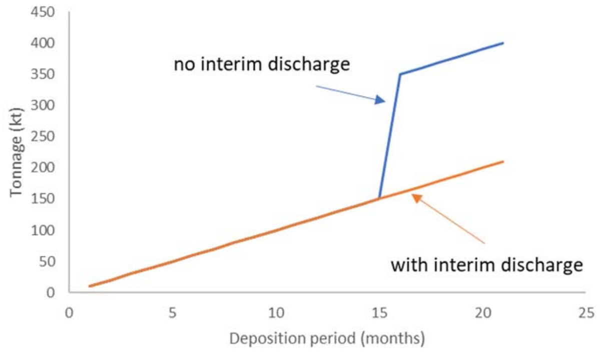
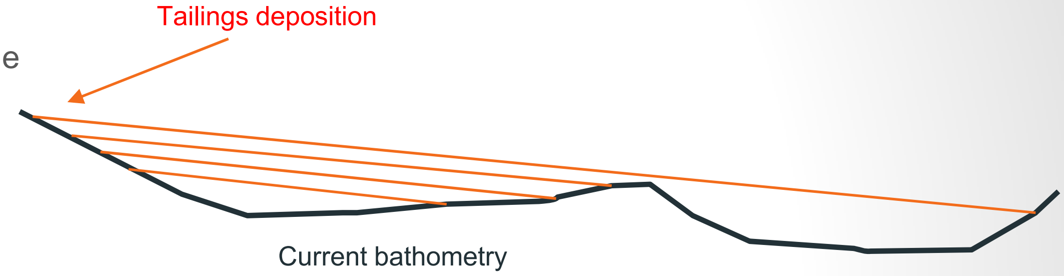
Hope Bay Deposition Plan - Notes

Surfaces:

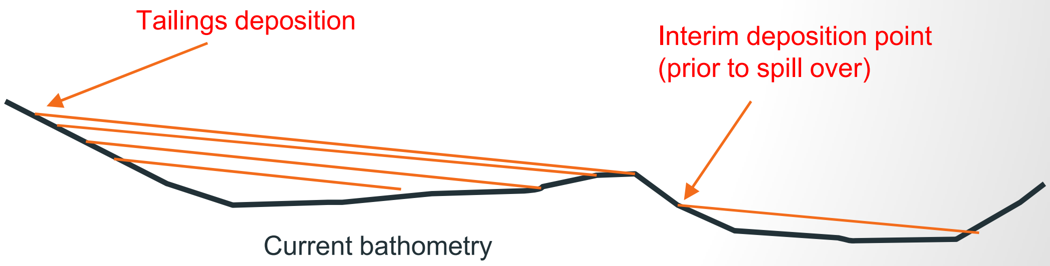
- Geometry of topography will lead to some modelling issues based on deposition grading
- Basically the modelling will crash because of the stepwise jumps in deposition volumes with minimal increment in height due to spill over
- See graphic illustration to right →
- This can be overcome by adding a new interim deposition point in the lower basin that can account for spill over into the central deep portion of Tail Lake



Scenario 1:



Scenario 2:



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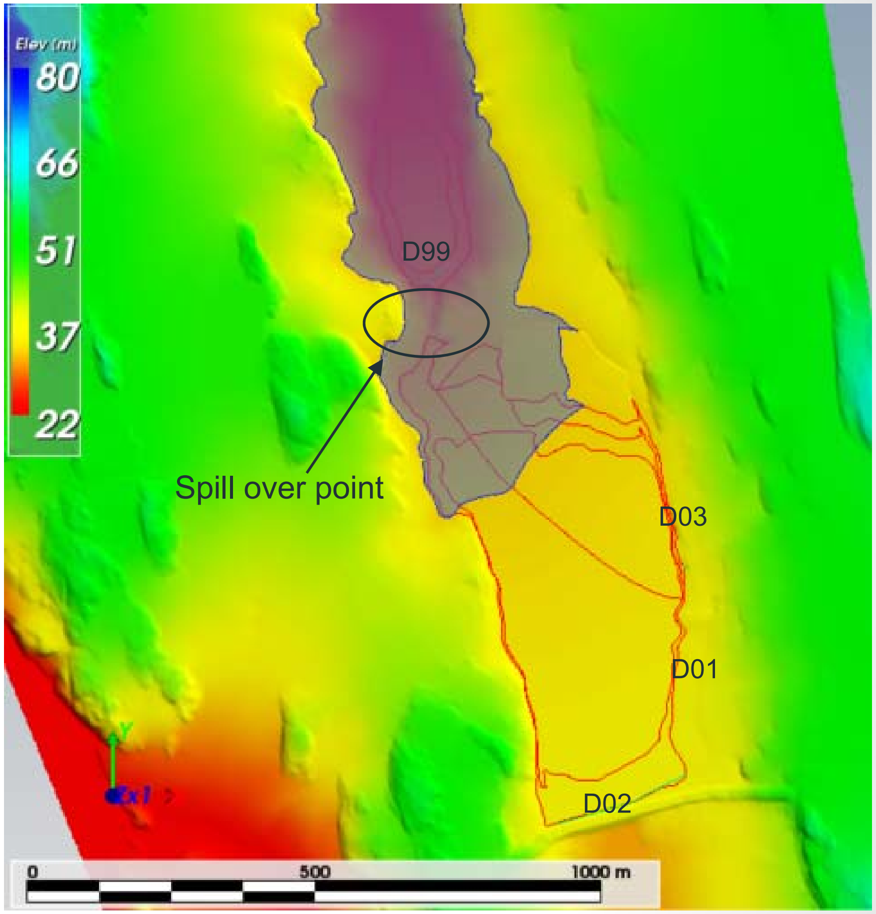
Hope Bay Deposition Plan - Notes

Preliminary test model for deposition 2020:

- Beach angles:
    - Slope 0.5% sub-aerial
    - Slope 1.0% sub- aqueous
- 50,000 t/month (assumed based on cursary look at throughput to TIA)
- Assume 1.2t/m³ (probably conservative, data suggests upwards of 1.3t/m³)
- Deposition points
    - 300,000 tonnes - D01 (current until July)
    - 182,000 tonnes - D02 (from south dam until pre-Nov spill over)
    - 18,000 tonnes – D99 (spill over from D02 until end Oct)
    - 30,000 tonnes – D03 (east deposition Nov)
    - 70,000 tonnes – D99 (spill over from D03 until end Dec)



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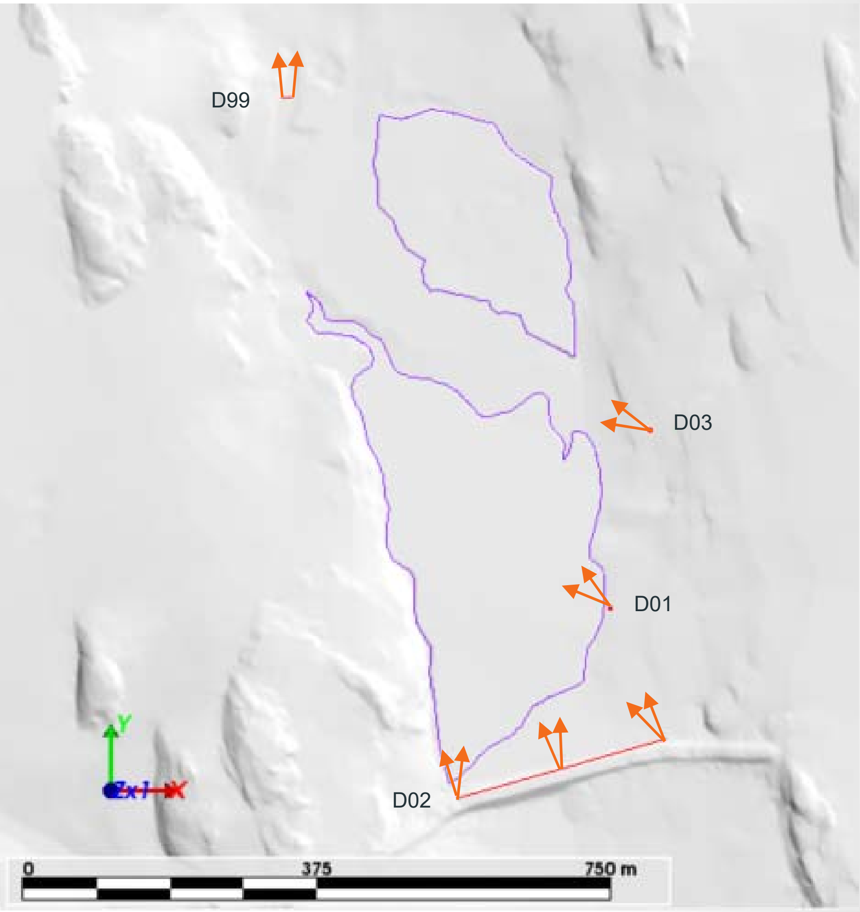
Hope Bay Deposition Plan - Notes

Preliminary model for deposition 2020:

- Beach angles:
  - Slope 0.5% sub-aerial
  - Slope 1.0% sub- aqueous
- 60,000 t/month (assumed based on 2000 t/day current milling capacity)
- Assume placed dry density 1.3 t/m^3

Deposition plan:

Year	Start	End	Duration	Primary Deposition Point	Total	From Primary Point	Overflow (D99)
	Month	Month	Months		(2000t/day)	Tonnes	tonnes
2020	01	06	6	D01	360000	360000	0
2020	07	10	4	D02	240000	202000	38000
2020	11	12	2	D03	120000	30000	90000



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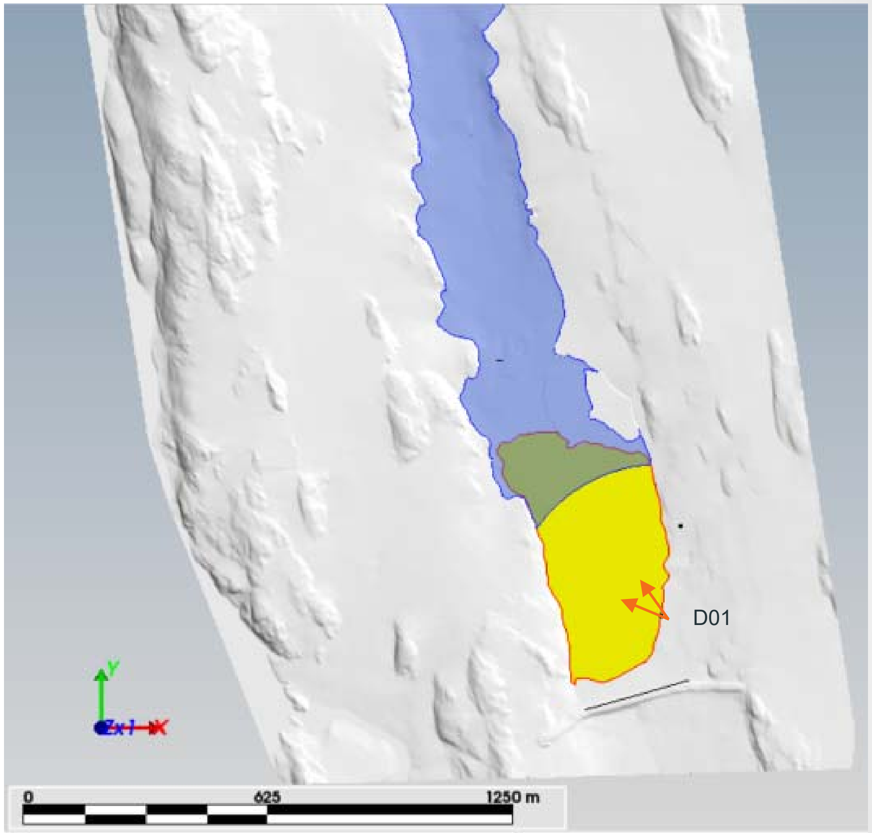
Hope Bay Deposition Plan - Notes

- Deposition from current discharge point (D01)
- 360,000 tonnes by end of June
- Volumes:
  - Sub-aerial tailings: 90,600m3
  - Sub-aqueous tailings: 186,100m3
  - Pond volume at 33mAD: 6,010,000m3



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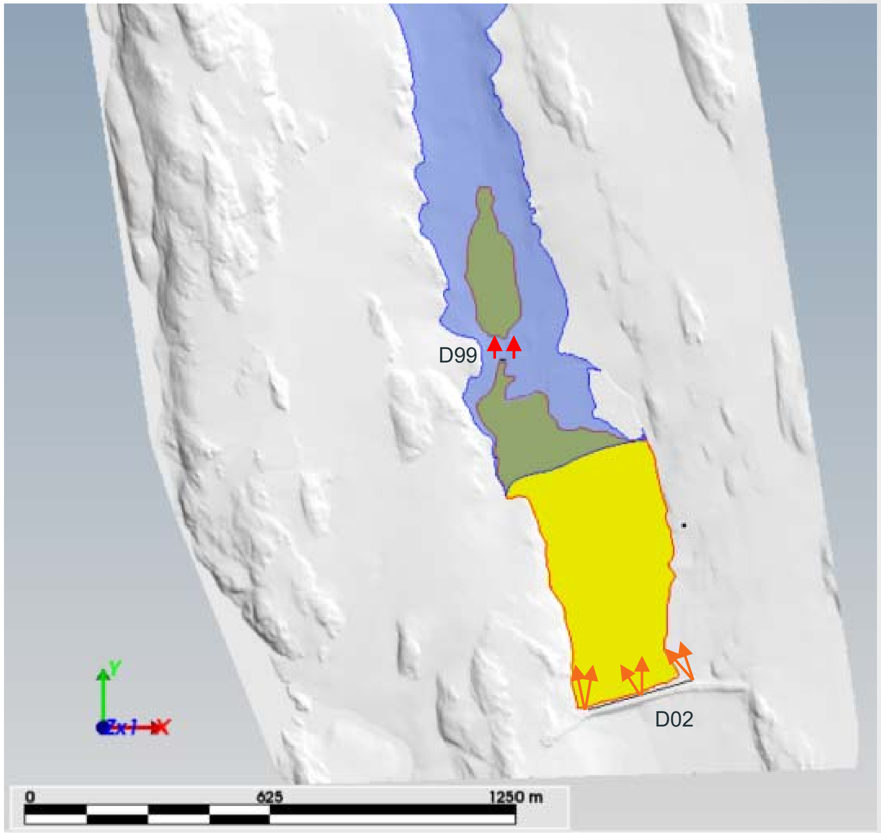
Hope Bay Deposition Plan - Notes

- Deposition from current discharge point (D01)
- 360,000 tonnes by end of June
- 240,000 tonnes from start of July to end of October
  - Discharge from South Dam beach (D02)
  - Overflow to deep lake occurs after 202,000 tonnes are deposited from D02
  - Remaining 38,000 modelled from spill point to deep lake (D99)
- Volumes:
  - Sub-aerial tailings: 203,900m3
  - Sub-aqueous tailings: 257,200m3
  - Pond volume at 33mAD: 5,939,000m3



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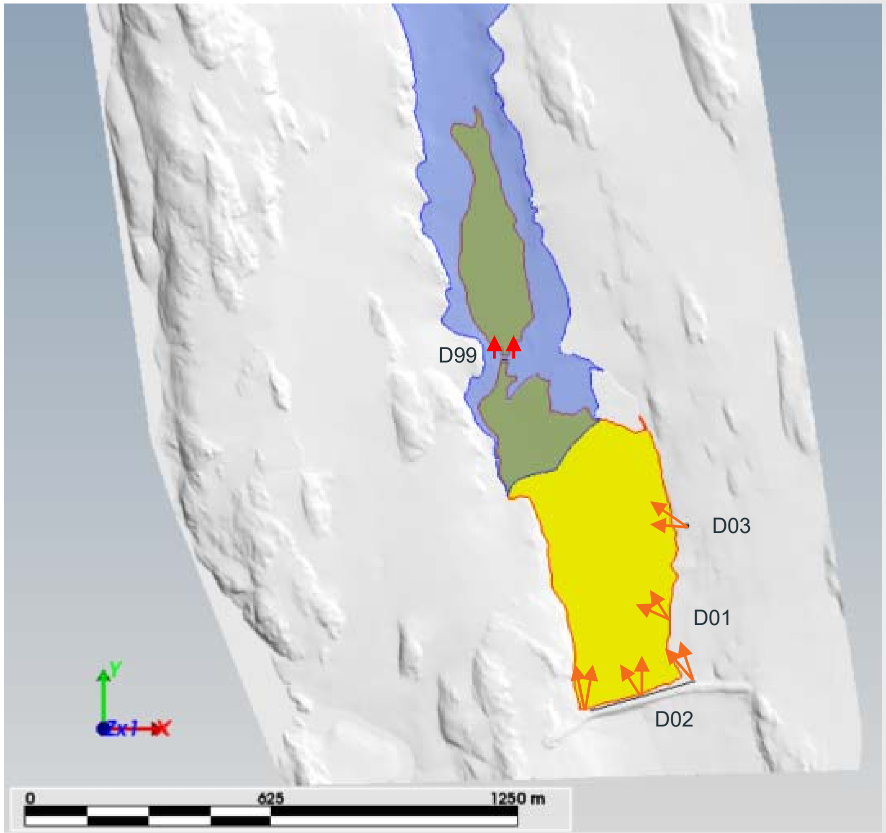
Hope Bay Deposition Plan - Notes

- Deposition from current discharge point (D01)
- 360,000 tonnes by end of June
- 240,000 tonnes from start of July to end of October
    - Discharge from South Dam beach (D02)
    - Overflow to deep lake occurs after 202,000 tonnes are deposited from D02
    - Remaining 38,000 modelled from spill point to deep lake (D99)
- 120,000 tonnes in November and December
    - Discharge from new winter discharge point (D03)
    - Overflow to deep lake occurs after 30,000 tonnes are deposited from D03
    - Remaining 90,000 modelled from spill point to deep lake (D99)
- Volumes:
    - Sub-aerial tailings: 219,600m3
    - Sub-aqueous tailings: 333,700m3
    - Pond volume at 33mAD: 5,862,000m3



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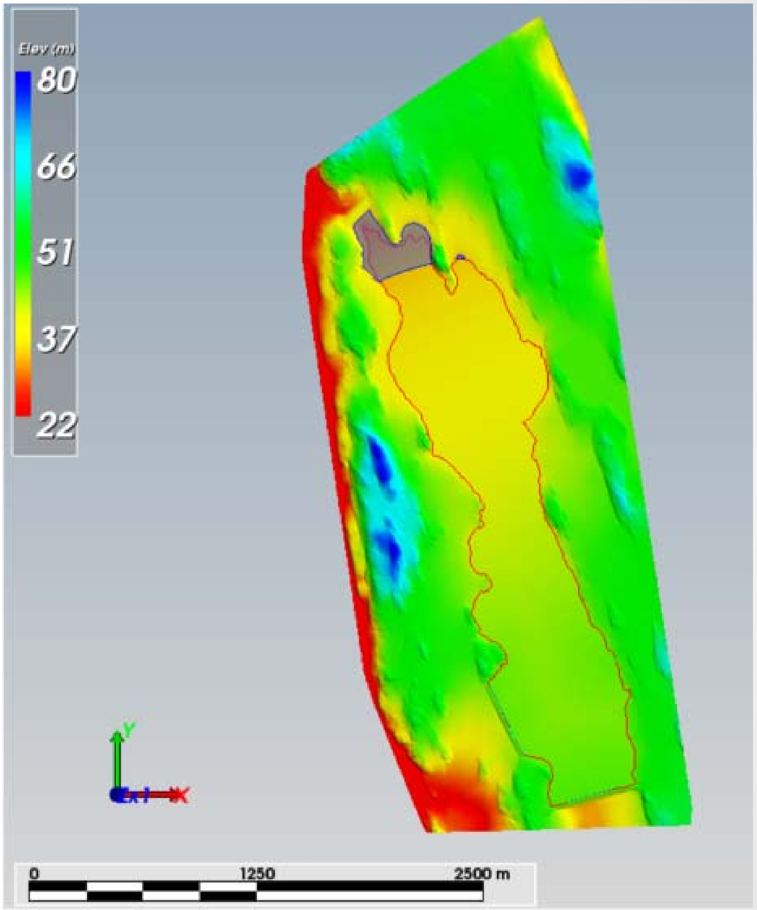
Hope Bay Deposition Plan – LOM tailings

- Deposition from discharge points near south of TSF
- Total tonnage 19.5Mt start of 2020 onwards
    - Note there is a discrepancy in tonnage reported in TMAC schedule
- Tailings outlines from staged deposition indicate flow remains to the north throughout deposition
- Total tailings and pond volumes at end of LOM:
    - Sub-aerial tailings: 8.5 Mm3
    - Sub-aqueous tailings: 6.5 Mm3
    - Pond volume at 33mAD: 245,000 m3



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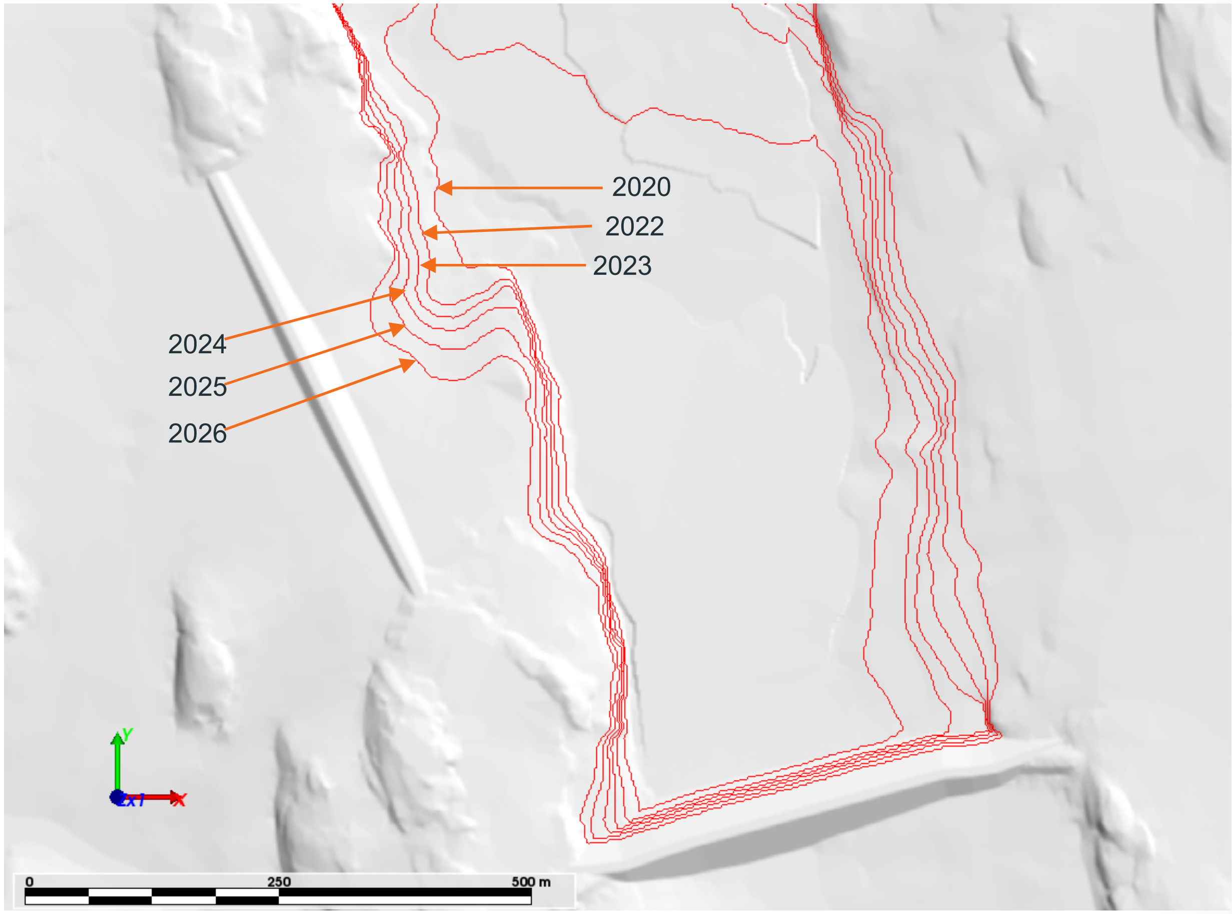
Hope Bay Deposition Plan - LOM tailings



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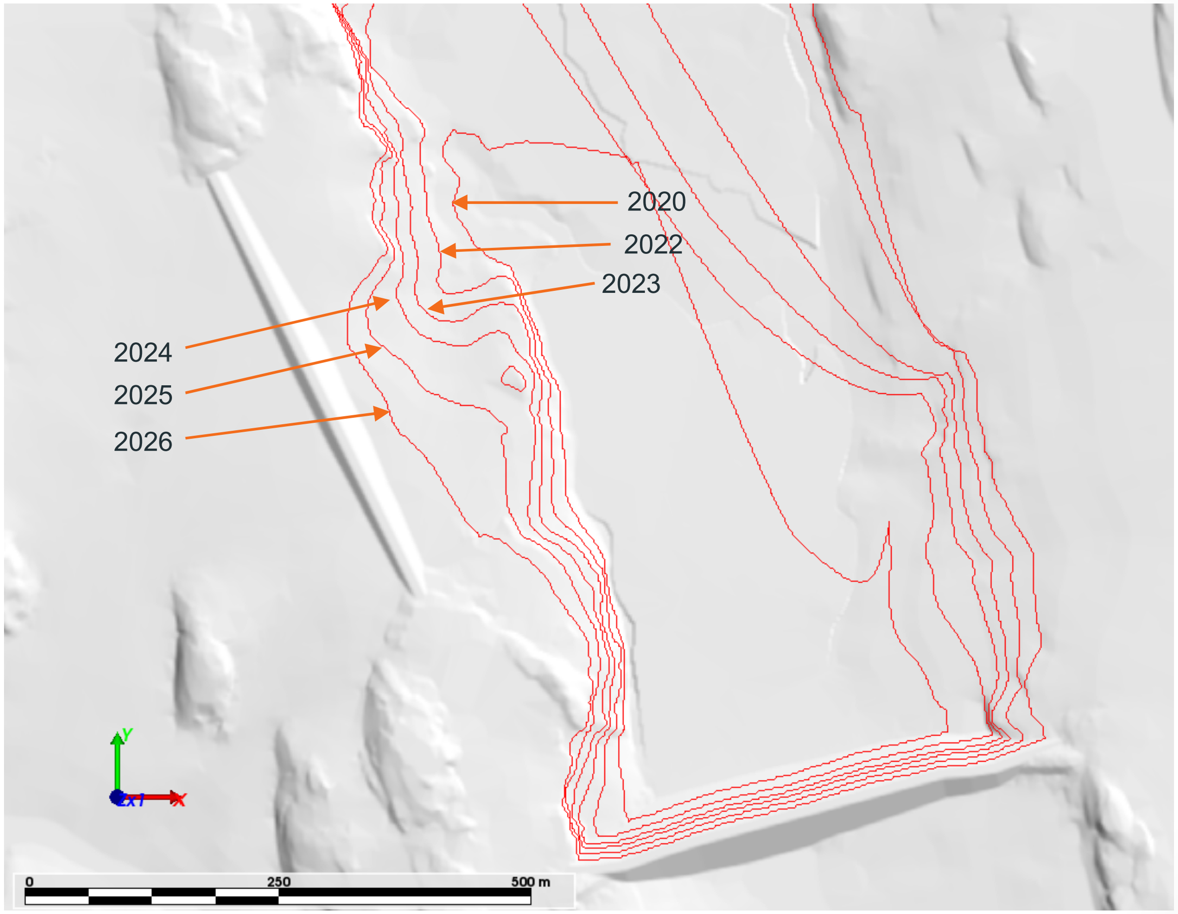
Hope Bay Deposition Plan – LOM 2 tailings



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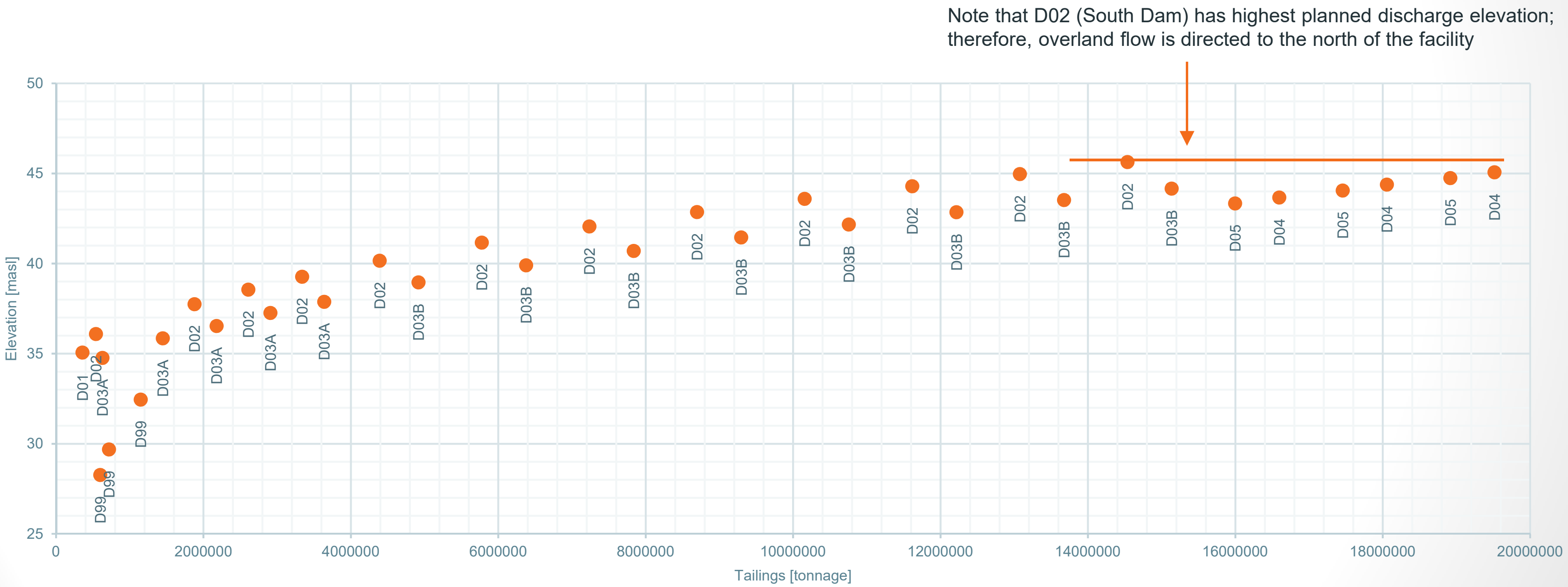
Hope Bay Deposition Plan - LOM tailings

- Deposition plan throughout LOM tailings presented below
- Alternating deposition between summer and winter
- Summer deposition from D02 and D05 (South and West Dam respectively)


Note that D02 (South Dam) has highest planned discharge elevation; therefore, overland flow is directed to the north of the facility

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Hope Bay Deposition Plan - LOM tailings

Short term deliverables:

- Prepare CAD drawing for end of LOM tailings surface
- Prepare memo summarizing method and findings

Next steps:

- Investigate discrepancy between TMAC tonnages
- What about ice entrainment?
  - this assessment is based on the 1.3 t/m3 achieved to date
  - As deposition continues, the distance to the pond becomes much longer
  - Need to reassess design assumptions at end of 2020 to see if ice entrainment starts to become a significant issue

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Appendix O – EOR Notification Letter

srk consulting

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vancouver@srk.com
www.srk.com

June 27, 2019
Project No: 1CT022.042

TMAC Resources Inc.
Suite 1010 – 95 Wellington Street West
Toronto, Ontario, M5J 2N7

Attention: **Oliver Curran, MSc. Vice President, Environmental Affairs**
Gil Lawson, P.Eng. Chief Operating Officer

Dear Oliver, Gil:

Re: Change of Engineer of Record - Doris Tailings Impoundment Area

This letter is to notify of the change of Engineer of Record for the Doris Tailings Impoundment Area. This role and responsibility was previously held by Dr. Maritz Rykaart, PEng.

From the 1st of June 2019, the Engineer of Record for the Doris Tailings Impoundment Area is John Kurylo, PEng.

John is a Northwest Territories and Nunavut Association of Professional Engineers and Geoscientists (NAPEG) registered professional engineer. John's contact details are provided below.

John Kurylo *MSc (DIC), PEng.*
Senior Consultant (Geotechnical)
SRK Consulting (Canada) Inc.
22nd Floor, 1066 West Hastings Street, Vancouver, BC, V6E 3X2, Canada
Tel: +1-604-681-4196; **Fax**: +1-604-687-5532
Mobile:+ 1-604-345-2211; **Direct**: +1-604-235-8541
Email: jkurylo@srk.com

Sincerely,
SRK Consulting (Canada) Inc.

Cameron Hore, PEng.
Senior Consultant

U.S. Offices:		Canadian Offices:		Group Offices:
Anchorage	907.677.3520	Saskatoon	306.955.4778	Africa
Denver	303.985.1333	Sudbury	705.682.3270	Asia
Elko	775.753.4151	Toronto	416.601.1445	Australia
Fort Collins	970.407.8302	Vancouver	604.681.4196	Europe
Reno	775.828.6800	Yellowknife	867.873.8670	North America
Tucson	520.544.3688			South America

Appendix P – OMS Updates and Training – Presentation

Doris TIA – Overview and OMS Discussions

John Kurylo, MSc (DIC), PEng

Site Discussions
November 22nd & 23rd, 2019
November 24th, 2019 *(shortened version)*

Outline

1. Background
2. OMS Structure Overview
3. ***Discussions:*** Review of water flow, and current pipe and pumps
4. Web Portal
5. ***Discussions:*** Revisit OMS in more detail and have additional operation discussions and feedback

BACKGROUND

Project Introduction

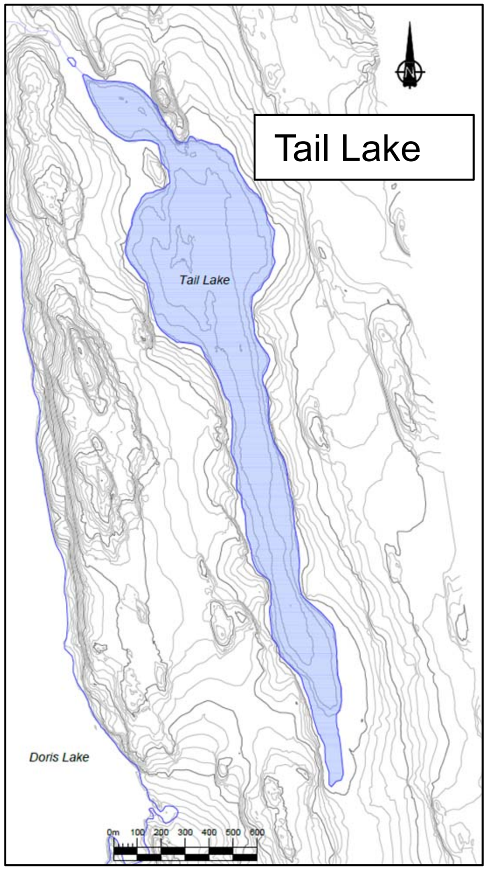
Image Source: https://jsis.washington.edu/archive/canada/file/archive/taskforce09/maps.shtml

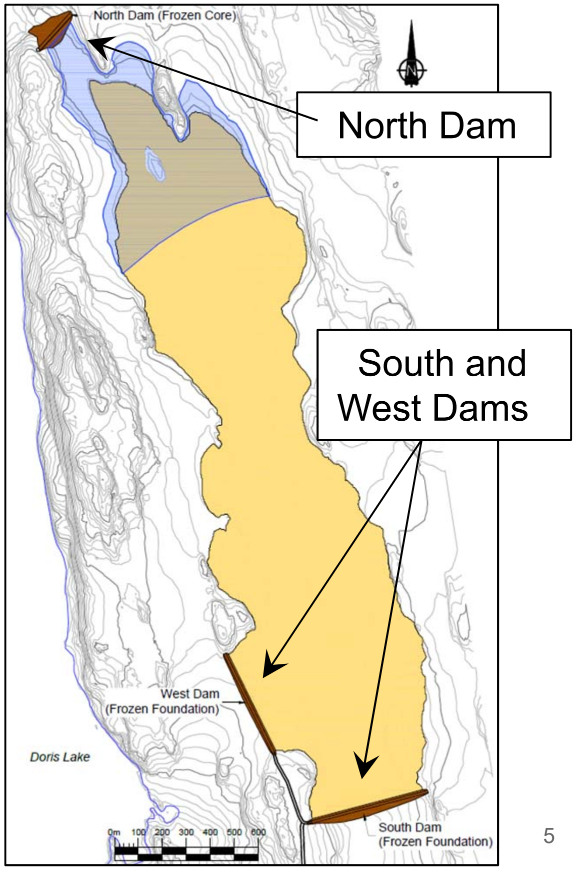
Geographic location of mine

Mine Site

Tailings Impoundment Area (TIA)

- Former lake listed as Schedule II
- Sub-aerial deposition of tailings slurry
- Environmental containment
- High degree of safety





Design Considerations

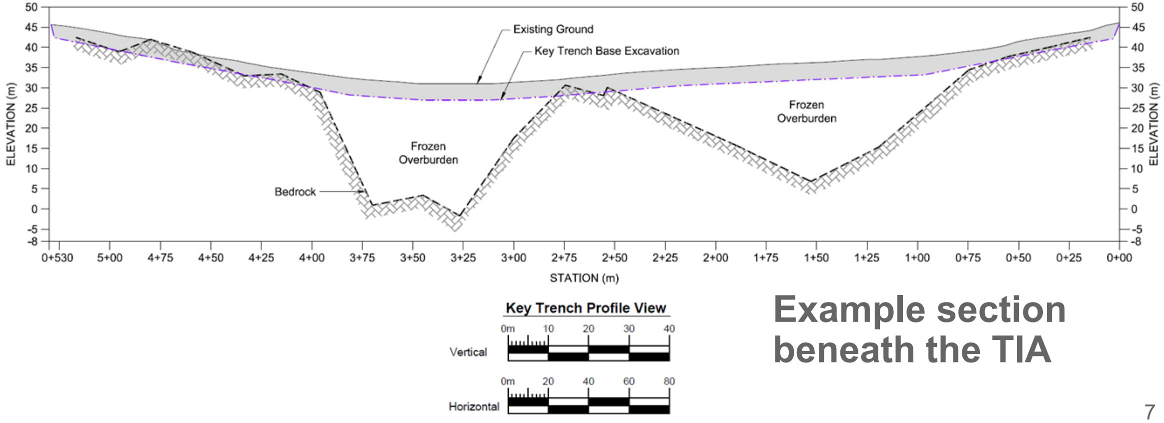
Ice-rich material present beneath the TIA

- Challenging foundation
  - Thick permafrost soils
  - Porewater salinity / depressed freezing point
  - Creep susceptible
  - Low strength soils when thawed
- Lack of borrow materials
  - Material with low permeability not available, or not suitable
- Climate and construction timing
- Project location

Foundation Conditions - SD

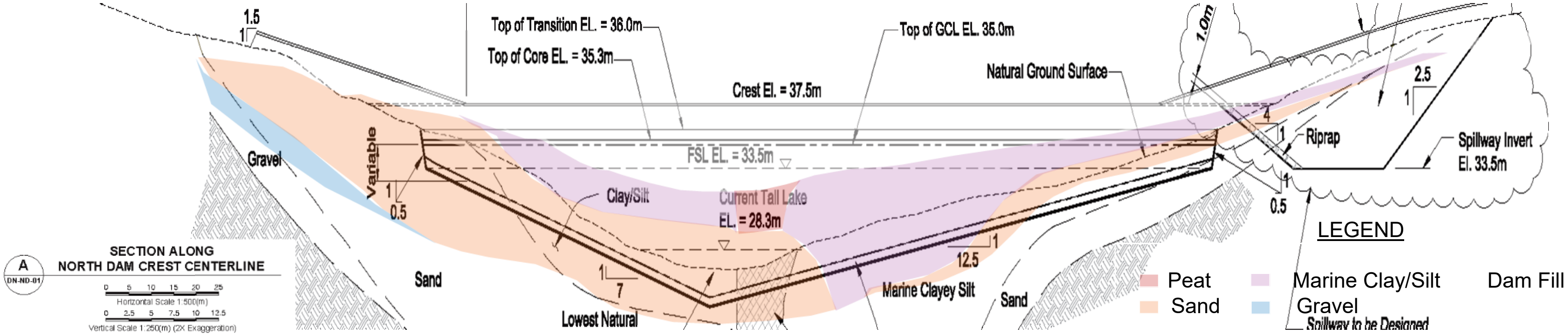
- Continuous cold (-8°C) permafrost
- Bedrock – basalt outcrops
- Thick deposits (>15m) of ice-rich sand and marine silts/clays
- Saline porewater

Ice-rich material present beneath the TIA



Example section beneath the TIA

Foundation Conditions - ND



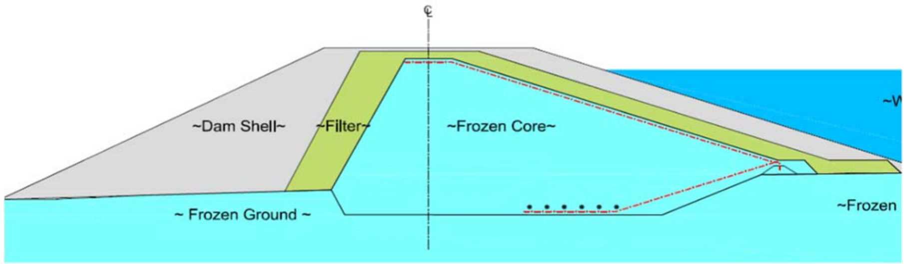
Ice lenses on exposed high wall

Organic rich soil (peat)

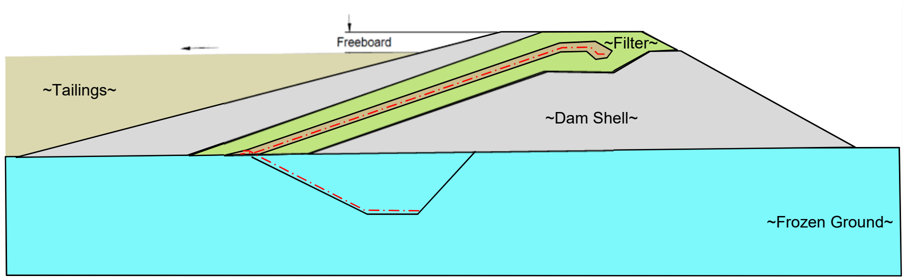
Hyper-saline overburden excavation ‘soft spot’

Definitions

- **Frozen Core Dam:** The water retaining structure is an impermeable frozen mass consisting of the dam core and foundation

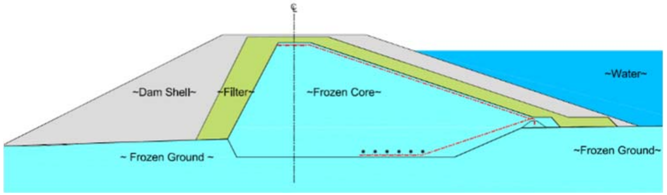


- **Frozen Foundation Dam:** A more classical (thawed) above ground structure that is bonded to a frozen (impermeable) foundation

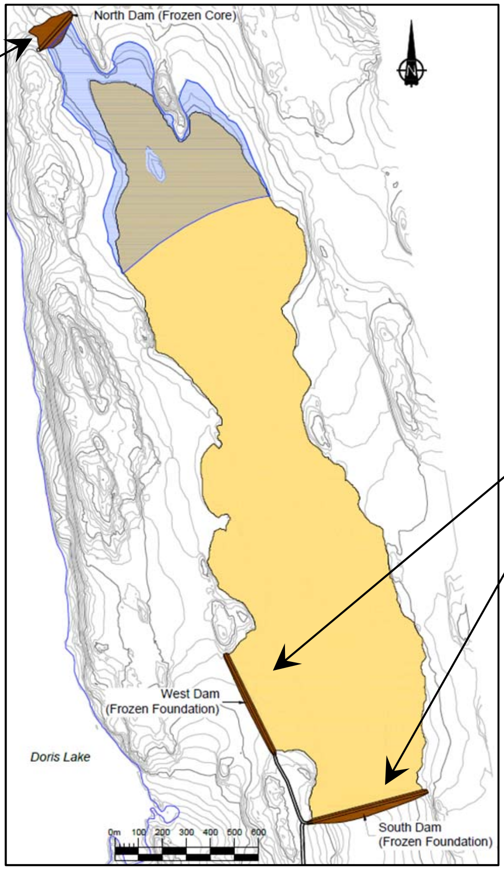


Tailings Impoundment Area (TIA)

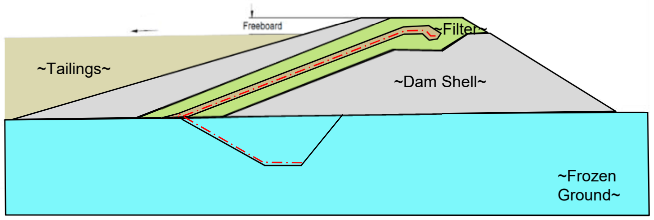
Frozen Core



North Dam



Frozen Foundation

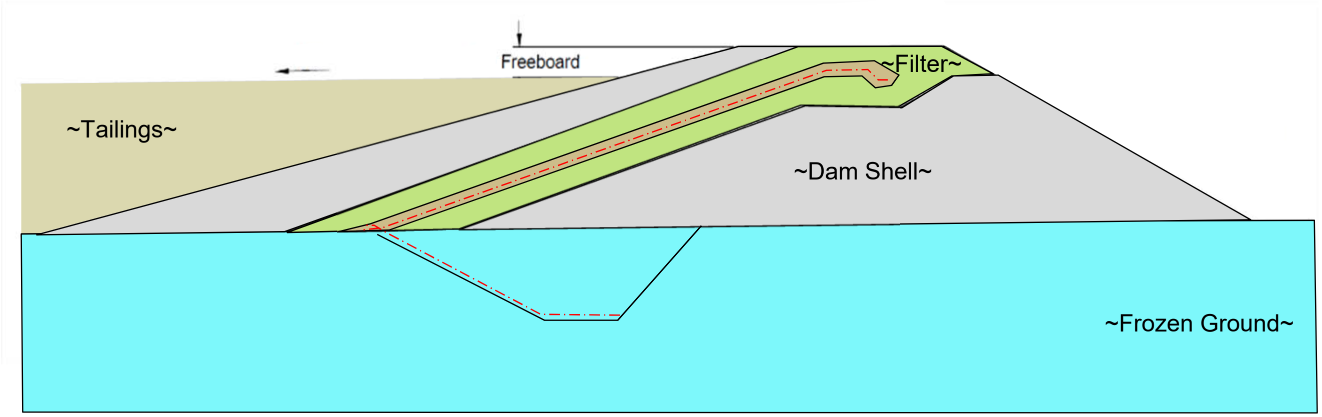


South and West Dams

Frozen Foundation Dam – South Dam

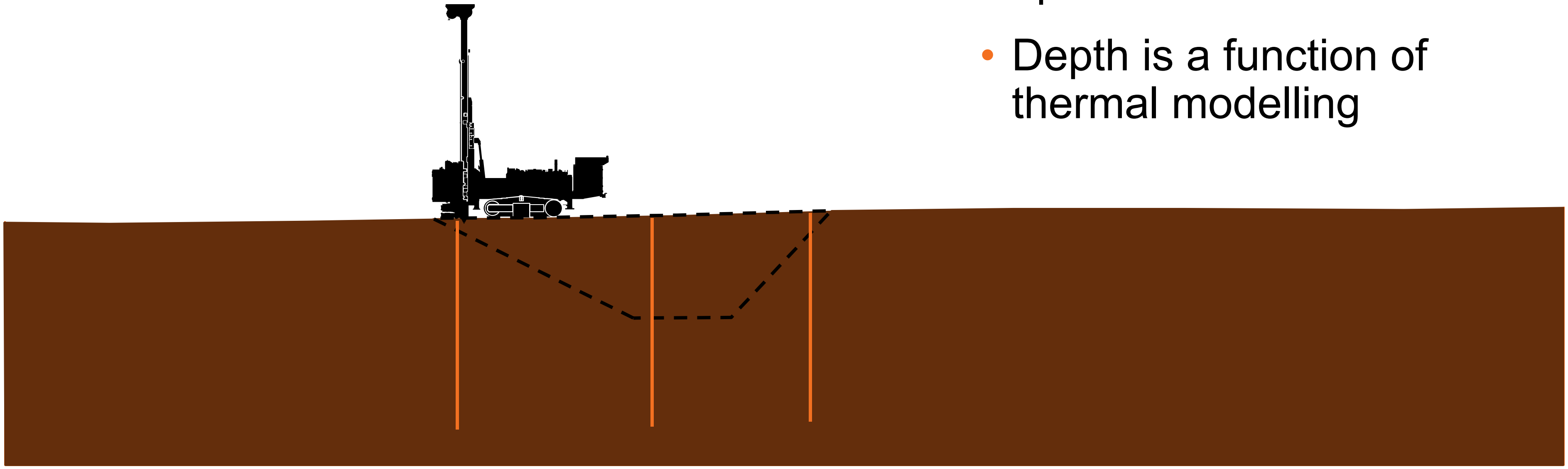
- Key that <u>tailings (solids) </u>deposited upstream

- Upstream geosynthetic clay liner (GCL) system keyed into the frozen foundation as a water retaining element for the unlikely case of foundation thawing / seepage



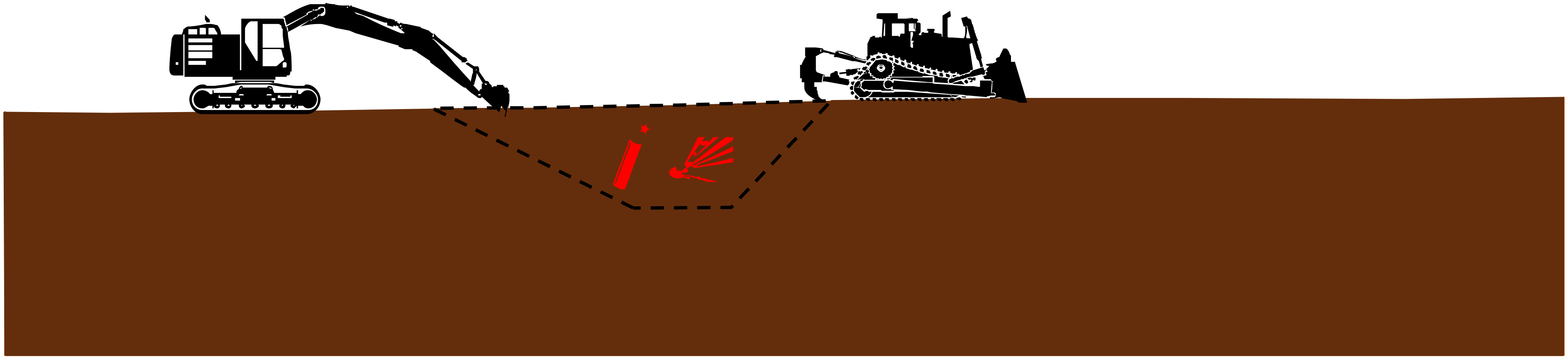
Frozen Foundation Dam

- Percolation testing
- Foundation confirmation
- Key trench depth optimization
- Depth is a function of thermal modelling



Frozen Foundation Dam

- Ripping in frozen overburden
- Drill/blast in bedrock
- 3 to 4 m depth

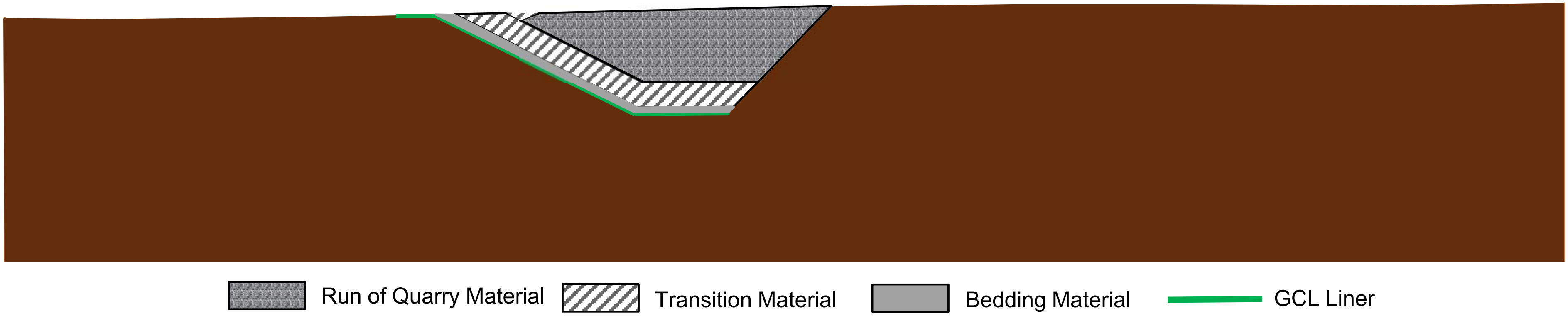


Foreground: Drilling of blast holes
Background: Key trench excavation

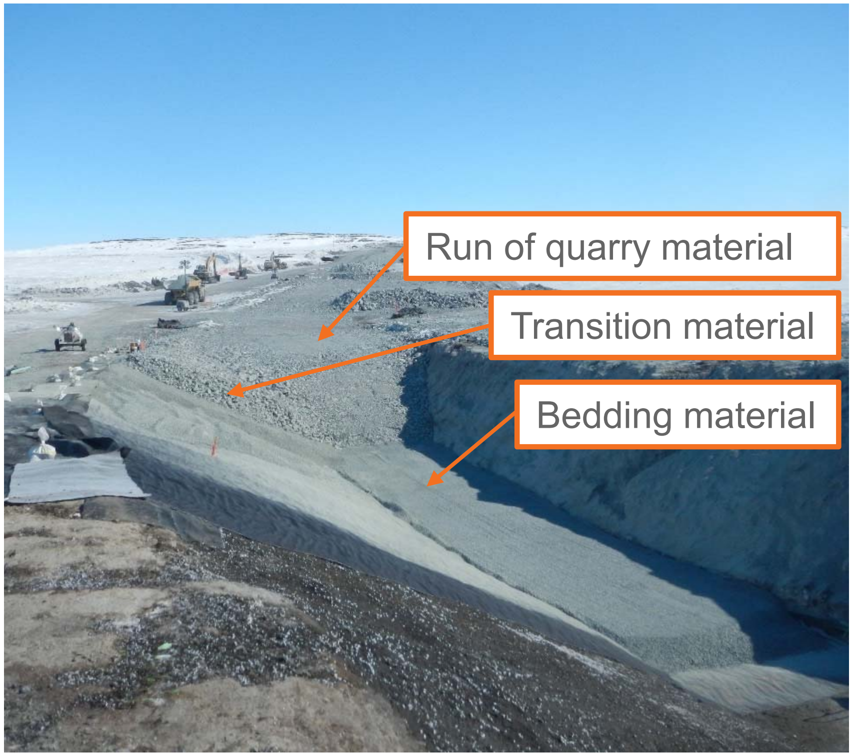
Near complete section of key trench

Frozen Foundation Dam

- Liner keyed into frozen foundation
- Winter construction



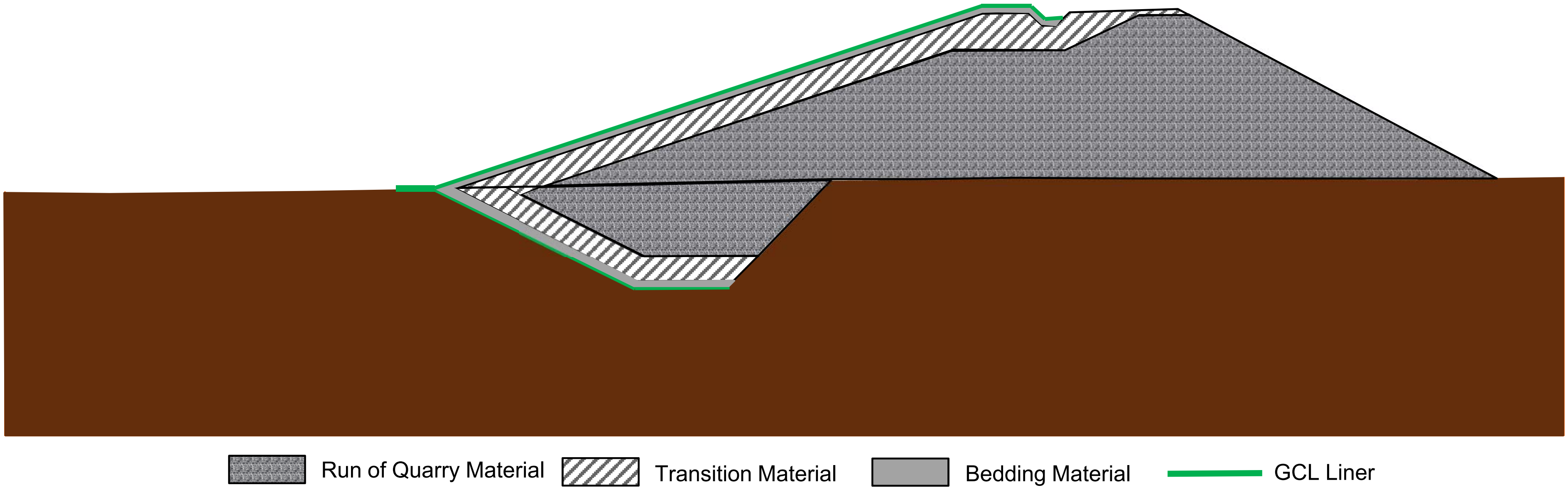
Deployment of liner on upstream slope of key trench



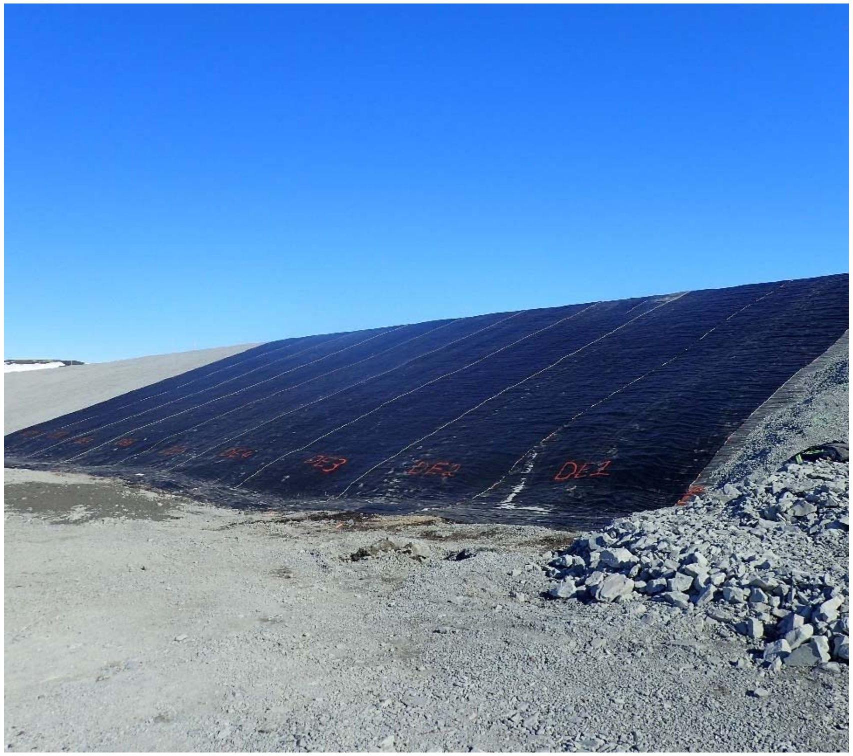
Backfilling of key trench above liner

Frozen Foundation Dam

- Thermal protection
- Minimum cover section

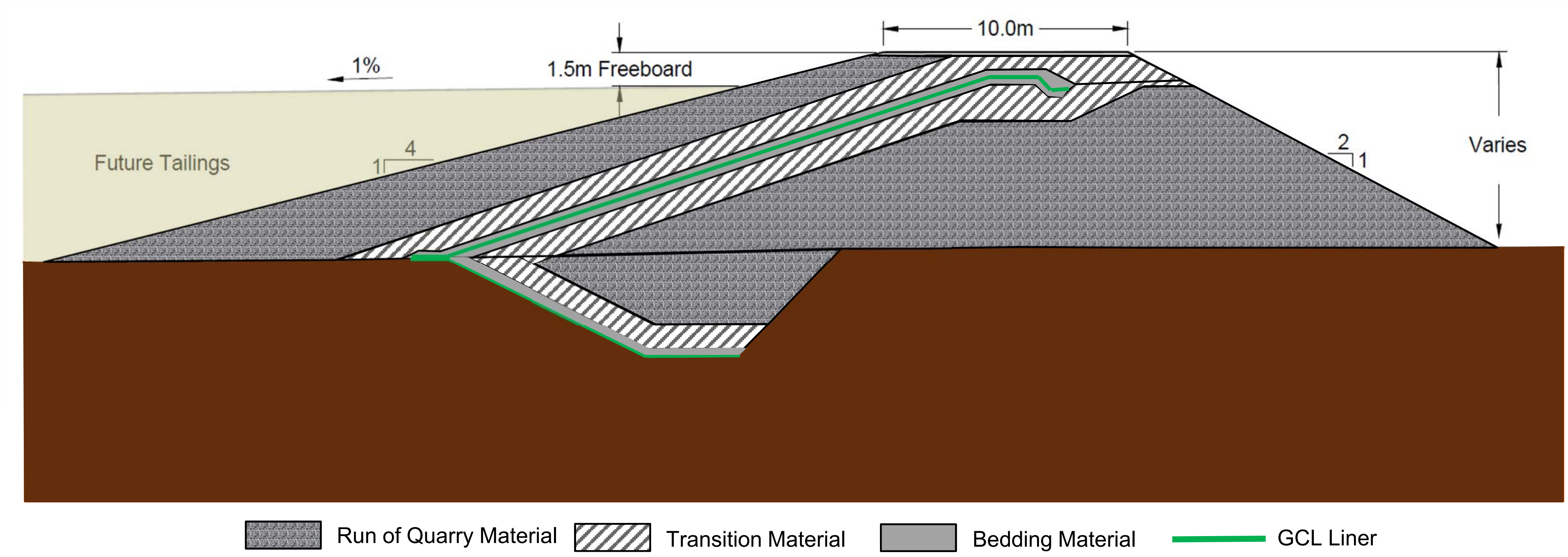


Deployment of liner on upstream slope of above ground fill



Deployed liner on upstream slope of above ground fill

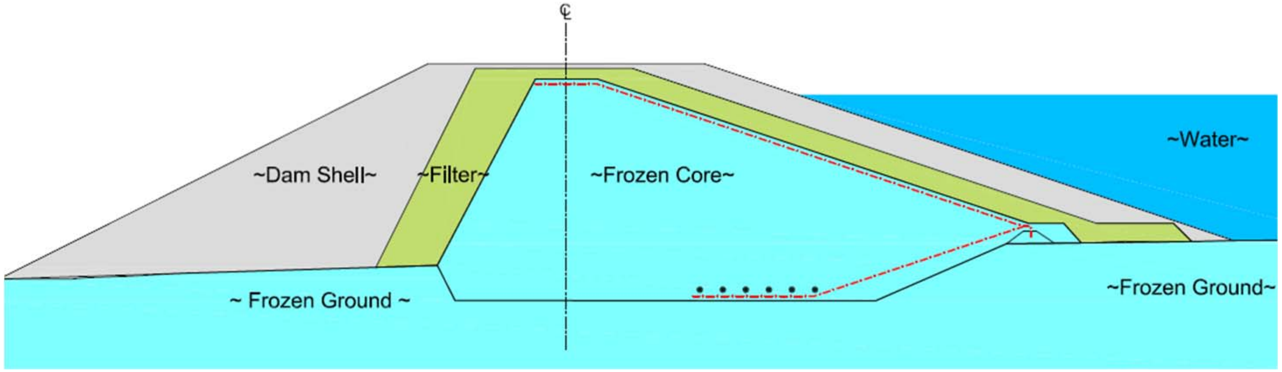
Frozen Foundation Dam



Frozen Core Dam – North Dam

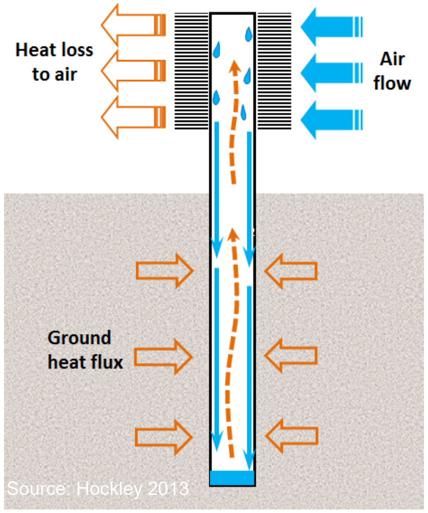
- Water retaining structure

- Thermosyphon evaporator pipes provide passive cooling during the winter

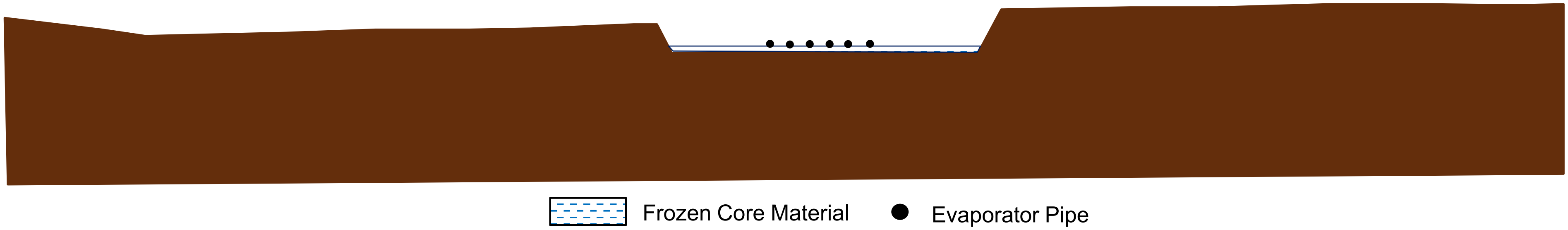


Frozen Core Dam

- Passive refrigeration system
- Pressurized sealed pipes charged with a two-phase working gas (CO_2)
- Radiators help heat exchange



Source: Hockley 2013

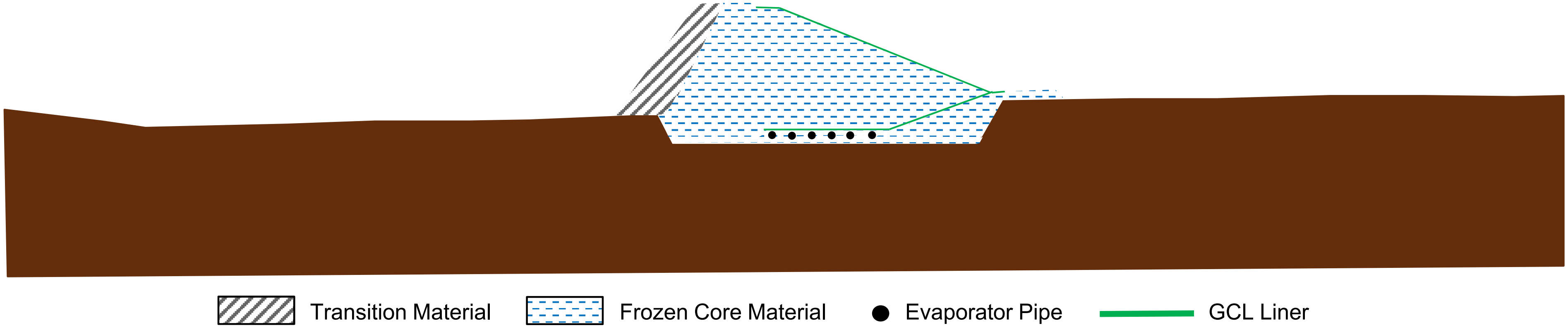


Thermosyphon evaporator pipes connected to radiator

Thermosyphon evaporator pipes installed along the key trench base

Frozen Core Dam

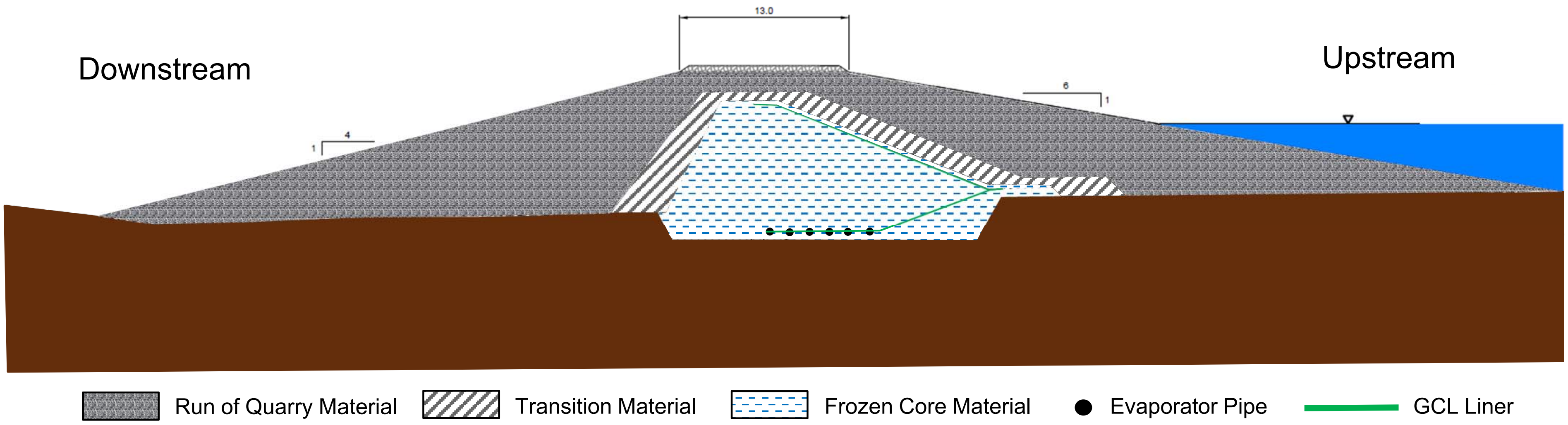
- Saturated crushed rock
- Placed in thin lifts
- Freeze back prior to next lift



Frozen core construction

Liner installation in key trench

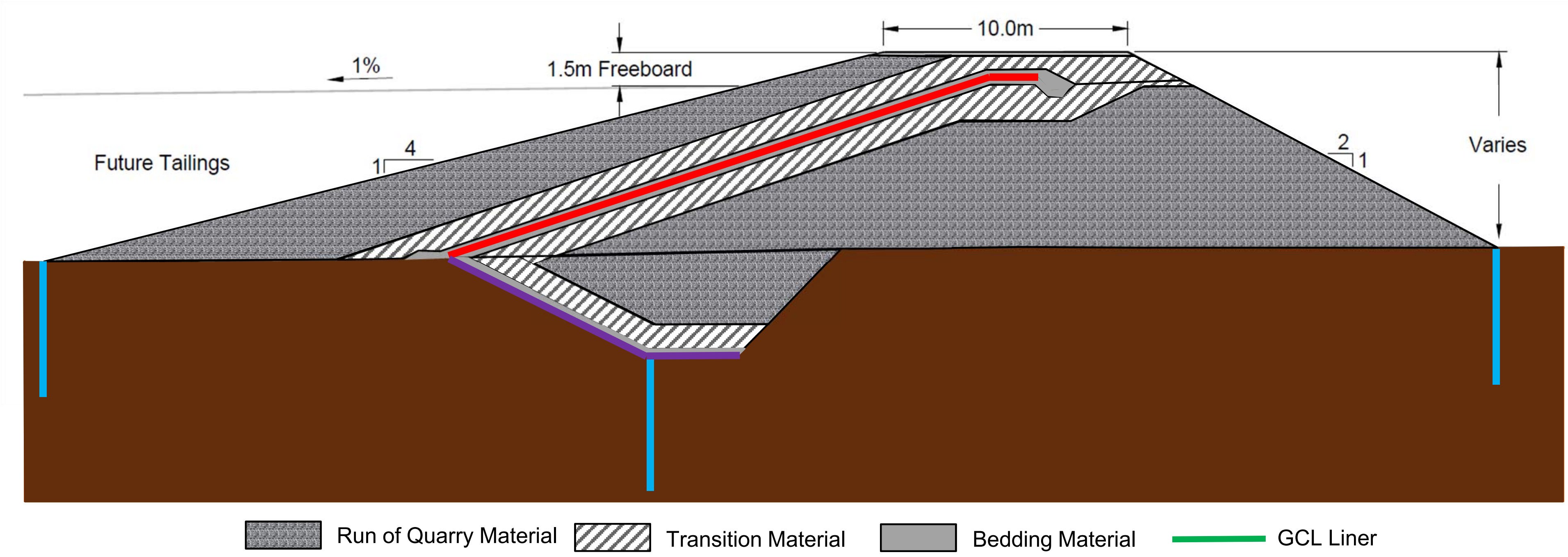
Frozen Core Dam



Instrumentation

Ground Temperature Cables

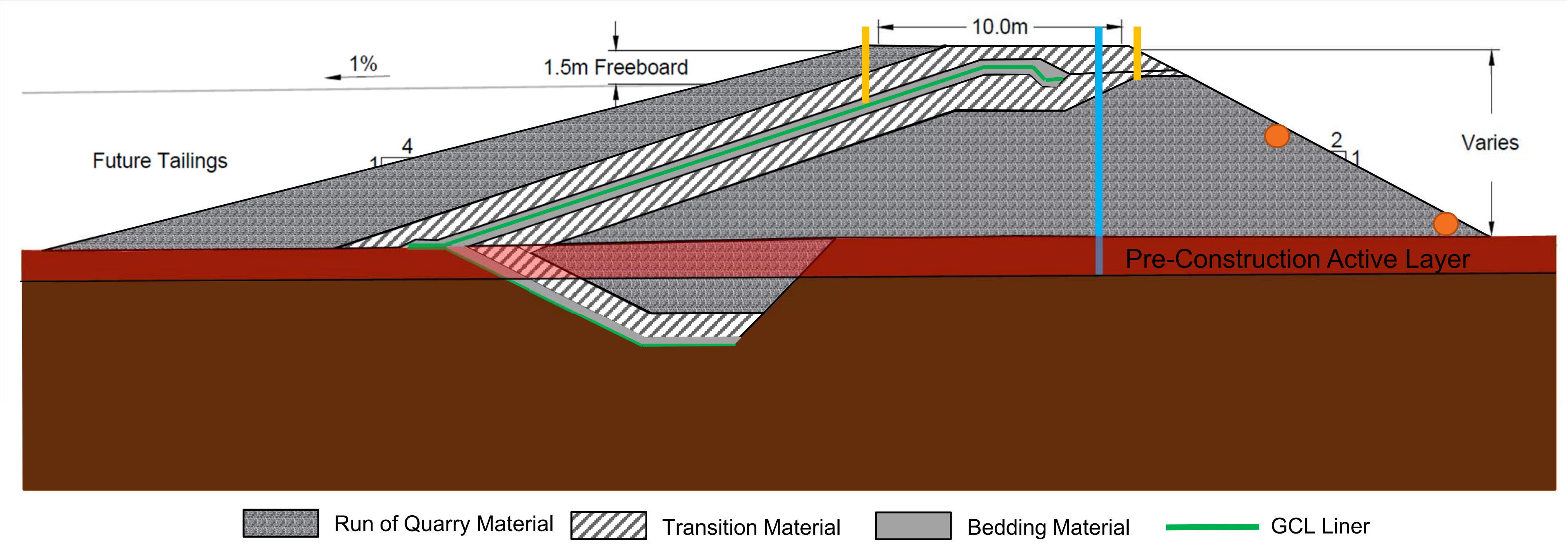
- Ground temperature cables monitor the thermal regime of the foundation and overall deformation performance



Instrumentation

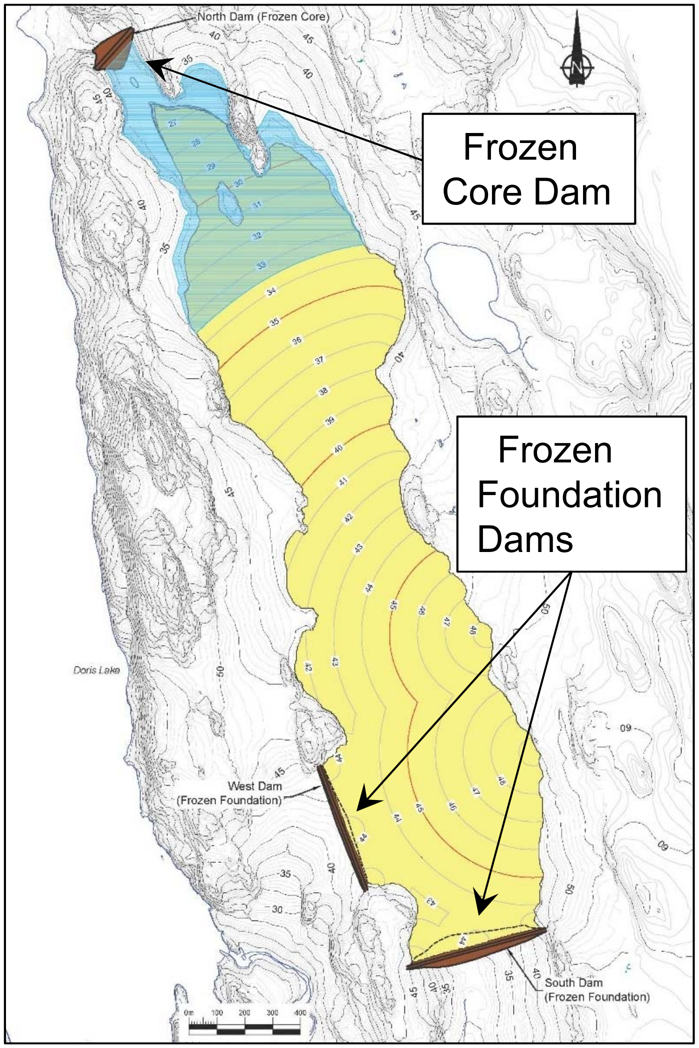
Settlement Monitoring

- Surficial, shallow, and deep settlement surveillance to monitor deformation



Tailings Deposition

- Development of substantive tailings beaches from the Frozen Foundation Dams (West and South Dams)
- No tailings deposition against the Frozen Core Dam (North Dam)
- Least amount of environmental risk
- Tailings freeze back

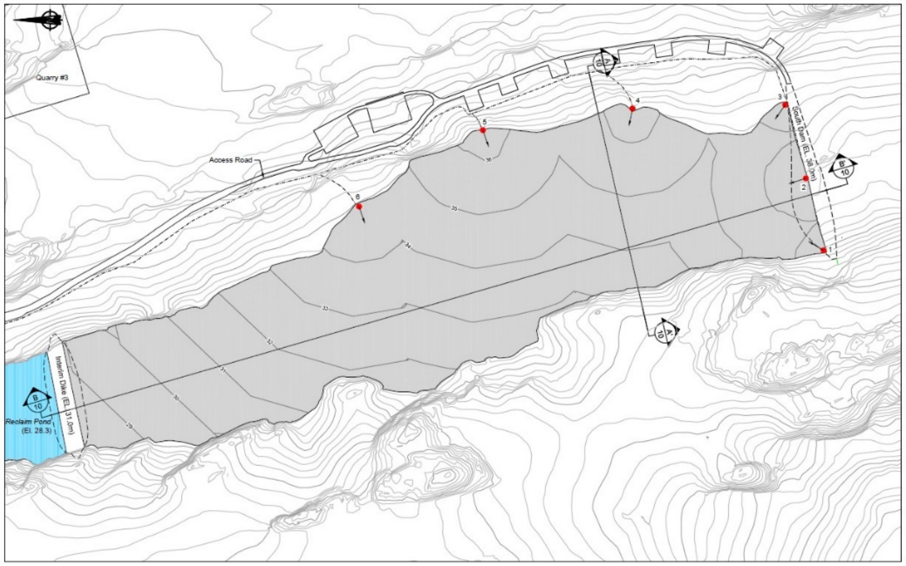


Frozen Core Dam

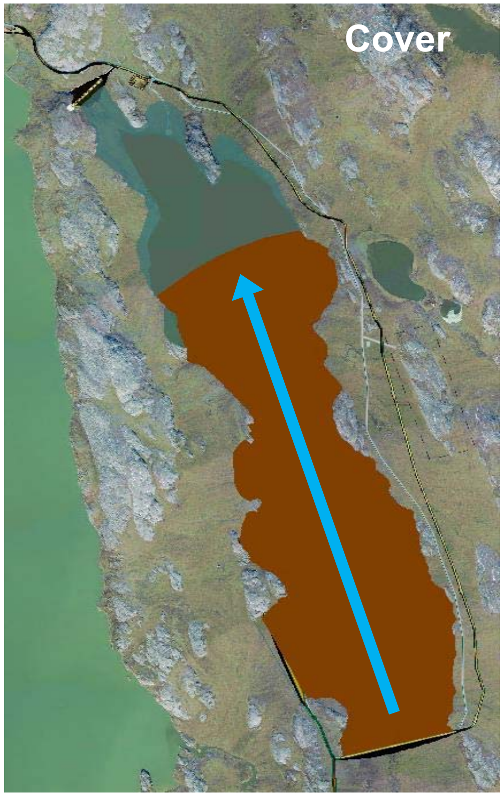
Frozen Foundation Dams

Tailings Deposition

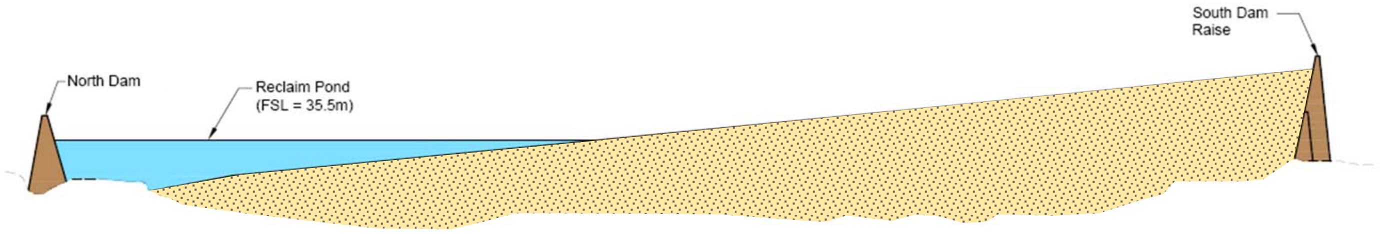
- Develop minimum 100 m beach from South Dam asap!
- Single point discharge (3 spigot locations)
- Implement diversion protocol for low solids content tailings near Dam
- No saline water (or other non tailings water) to be discharged with tailings



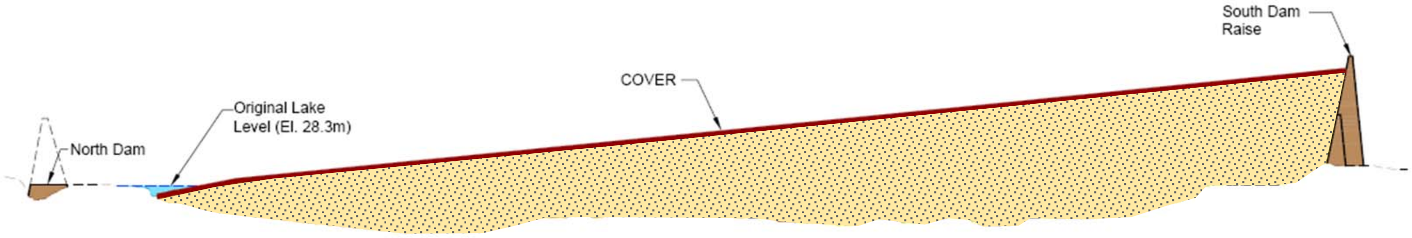
Closure of the TIA



Closure of the TIA



End of Mine



Post Closure

LEGEND

- - - - - Existing Ground Surface

▨ Deposited Tailings

General Comments

- Imperative to maintain the frozen state of the core and foundation of these containment structures to:
  - Retain primary element of impermeable functionality
  - Mitigate long term deformation

- Unique and innovative containment designs were required to overcome site-specific challenges

- Tailings management designs need to be adapted to account for local conditions to ensure the design is appropriate and will provide a high degree of safety in environmental containment

Photos (from 2018)

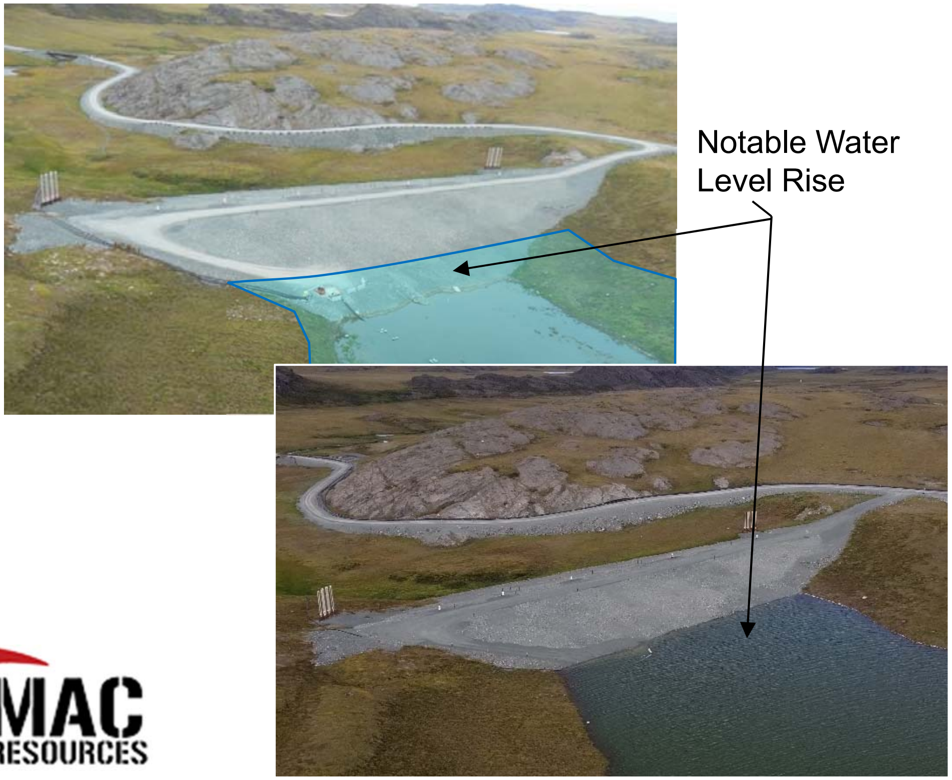
srk consulting

TMAC RESOURCES

Photos (from 2019)

Photos (2018 vs 2019)

North Dam



Notable Water Level Rise

South Dam

Tailings Beach Development

OMS Structure

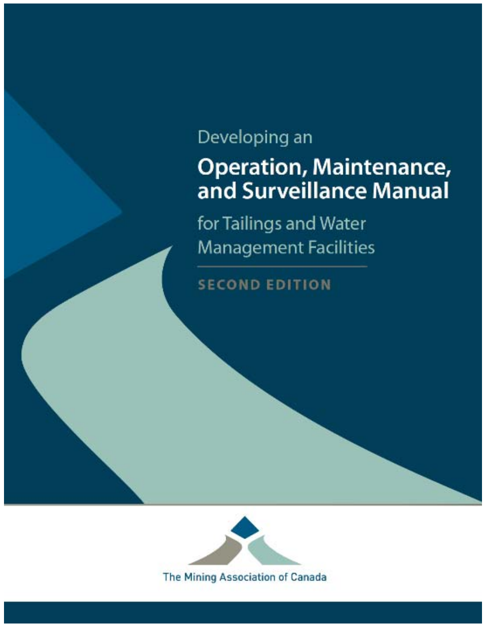
New Considerations / Guidelines

AT SITE:

- North Dam constructed in 2011and 2012 winters
- South Dam constructed in 2018
- 2019 active tailings deposition and Roberts Bay Marine Discharge now set up

IN INDUSTRY:

- Recent dam failure and shift in prioritizing dam safety
- New guidelines



Developing an

Operation, Maintenance, and Surveillance Manual

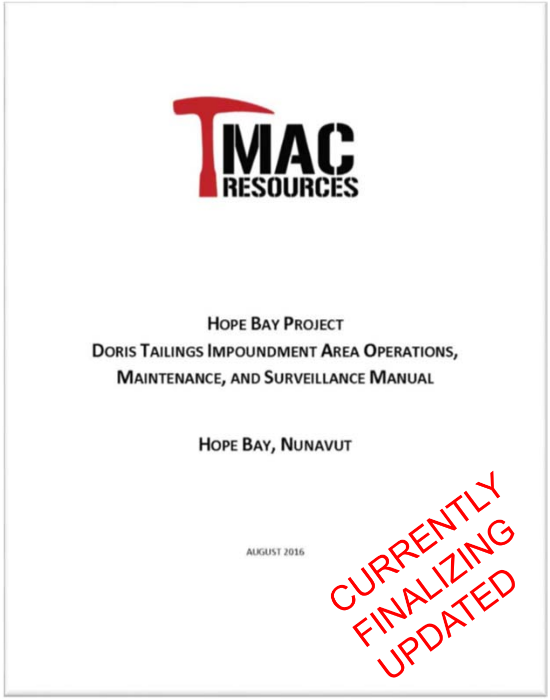
for Tailings and Water Management Facilities

SECOND EDITION

The Mining Association of Canada

Doris TIA OMS

- Operations Maintenance and Surveillance (OMS) Manual
- Conforms to industry standard Mining Association of Canada (MAC) guidelines
- Includes
  - Governance
  - Reference documents
  - Roles and responsibilities
  - Facility overview
  - Operations
  - Maintenance
  - Surveillance
- ★ A substantive update/rewrite is required (2018 recommendation)



TMAC RESOURCES

HOPE BAY PROJECT
DORIS TAILINGS IMPOUNDMENT AREA OPERATIONS, MAINTENANCE, AND SURVEILLANCE MANUAL

HOPE BAY, NUNAVUT

AUGUST 2016

CURRENTLY FINALIZING UPDATED

Framework *– MAC Guidelines*

Figure 1: Elements of the Tailings Management Framework

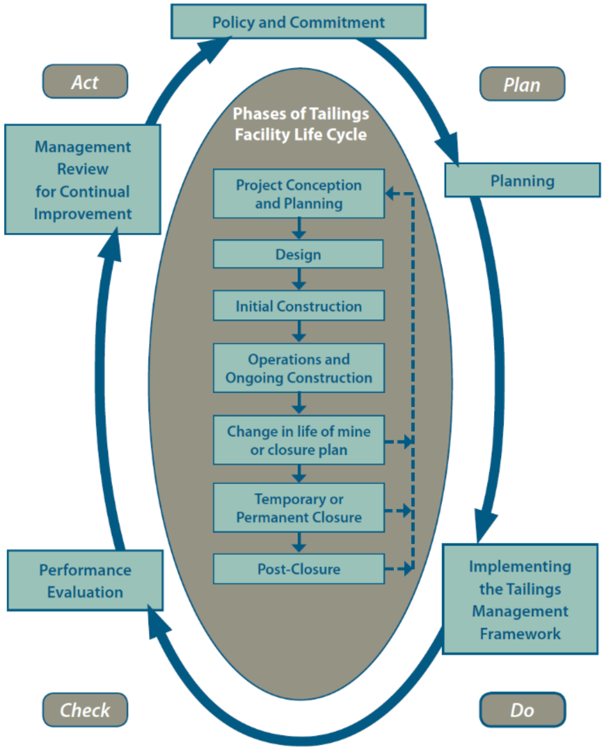
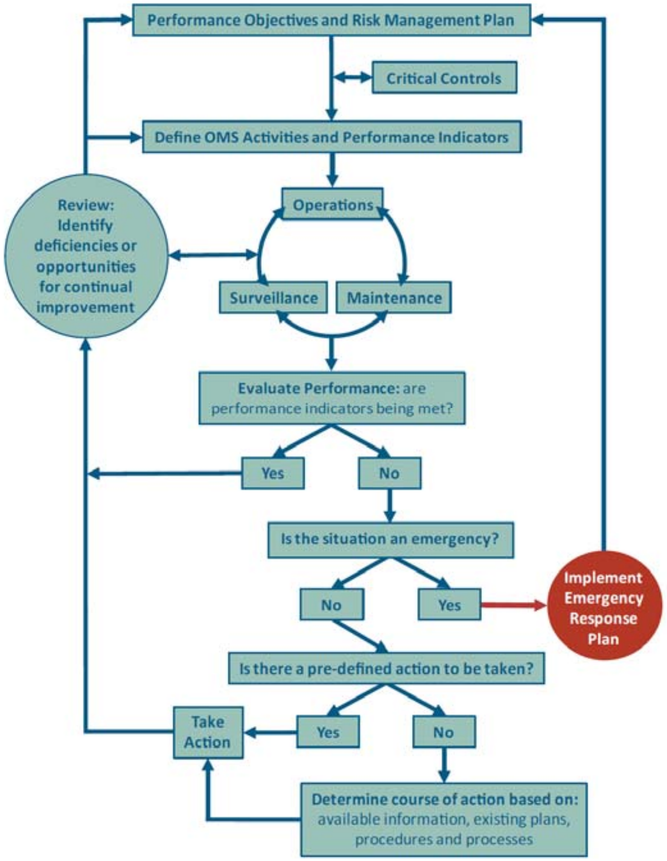
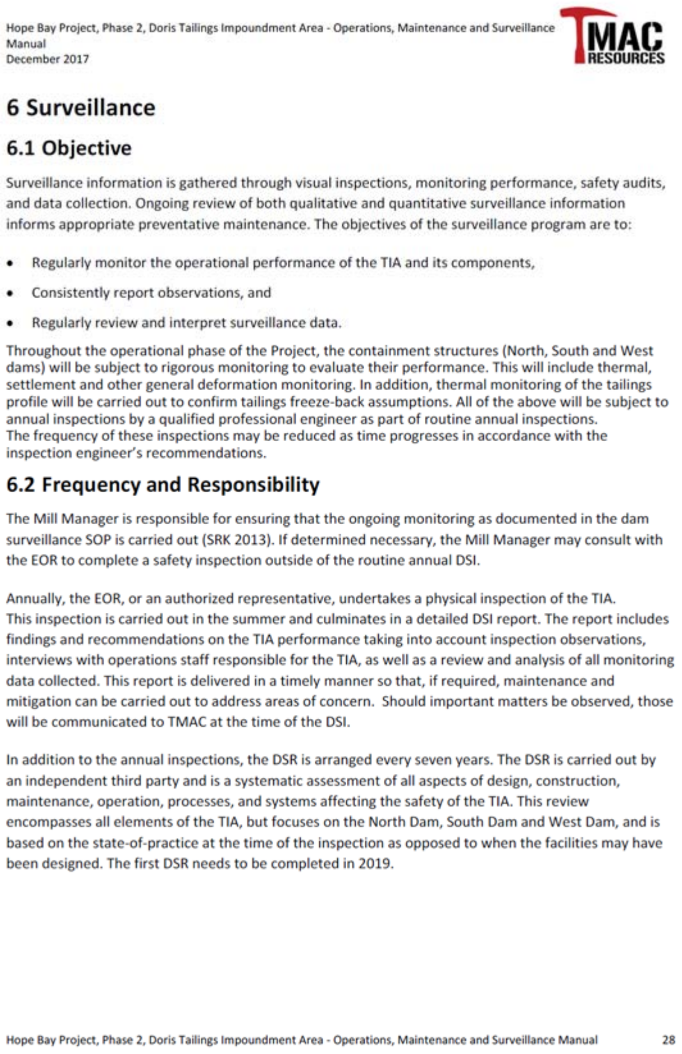


Figure 3: Decision-making framework for tailings management



OLD



Hope Bay Project, Phase 2, Doris Tailings Impoundment Area - Operations, Maintenance and Surveillance Manual
December 2017

6 Surveillance

6.1 Objective

Surveillance information is gathered through visual inspections, monitoring performance, safety audits, and data collection. Ongoing review of both qualitative and quantitative surveillance information informs appropriate preventative maintenance. The objectives of the surveillance program are to:

- Regularly monitor the operational performance of the TIA and its components,
- Consistently report observations, and
- Regularly review and interpret surveillance data.

Throughout the operational phase of the Project, the containment structures (North, South and West dams) will be subject to rigorous monitoring to evaluate their performance. This will include thermal, settlement and other general deformation monitoring. In addition, thermal monitoring of the tailings profile will be carried out to confirm tailings freeze-back assumptions. All of the above will be subject to annual inspections by a qualified professional engineer as part of routine annual inspections.
The frequency of these inspections may be reduced as time progresses in accordance with the inspection engineer's recommendations.

6.2 Frequency and Responsibility

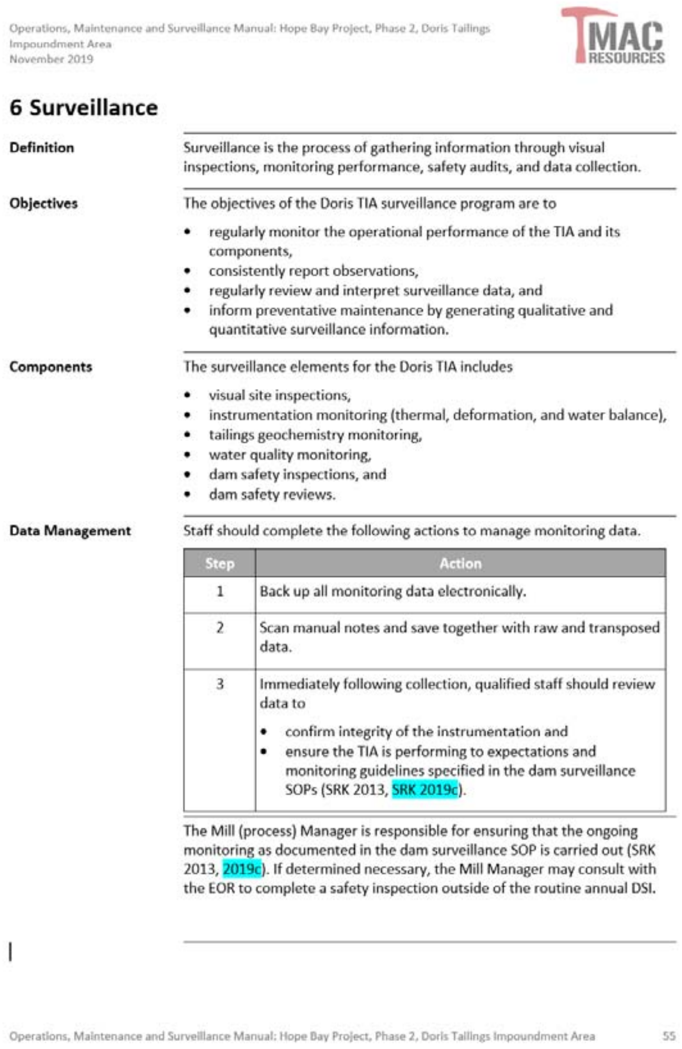
The Mill Manager is responsible for ensuring that the ongoing monitoring as documented in the dam surveillance SOP is carried out (SRK 2013). If determined necessary, the Mill Manager may consult with the EOR to complete a safety inspection outside of the routine annual DSI.

Annually, the EOR, or an authorized representative, undertakes a physical inspection of the TIA.
This inspection is carried out in the summer and culminates in a detailed DSI report. The report includes findings and recommendations on the TIA performance taking into account inspection observations, interviews with operations staff responsible for the TIA, as well as a review and analysis of all monitoring data collected. This report is delivered in a timely manner so that, if required, maintenance and mitigation can be carried out to address areas of concern. Should important matters be observed, those will be communicated to TMAC at the time of the DSI.

In addition to the annual inspections, the DSR is arranged every seven years. The DSR is carried out by an independent third party and is a systematic assessment of all aspects of design, construction, maintenance, operation, processes, and systems affecting the safety of the TIA. This review encompasses all elements of the TIA, but focuses on the North Dam, South Dam and West Dam, and is based on the state-of-practice at the time of the inspection as opposed to when the facilities may have been designed. The first DSR needs to be completed in 2019.

Hope Bay Project, Phase 2, Doris Tailings Impoundment Area - Operations, Maintenance and Surveillance Manual 28

NEW



Operations, Maintenance and Surveillance Manual: Hope Bay Project, Phase 2, Doris Tailings Impoundment Area
November 2019

MAC RESOURCES

6 Surveillance

Definition

Surveillance is the process of gathering information through visual inspections, monitoring performance, safety audits, and data collection.

Objectives

The objectives of the Doris TIA surveillance program are to

- regularly monitor the operational performance of the TIA and its components,
- consistently report observations,
- regularly review and interpret surveillance data, and
- inform preventative maintenance by generating qualitative and quantitative surveillance information.

Components

The surveillance elements for the Doris TIA includes

- visual site inspections,
- instrumentation monitoring (thermal, deformation, and water balance),
- tailings geochemistry monitoring,
- water quality monitoring,
- dam safety inspections, and
- dam safety reviews.

Data Management

Staff should complete the following actions to manage monitoring data.

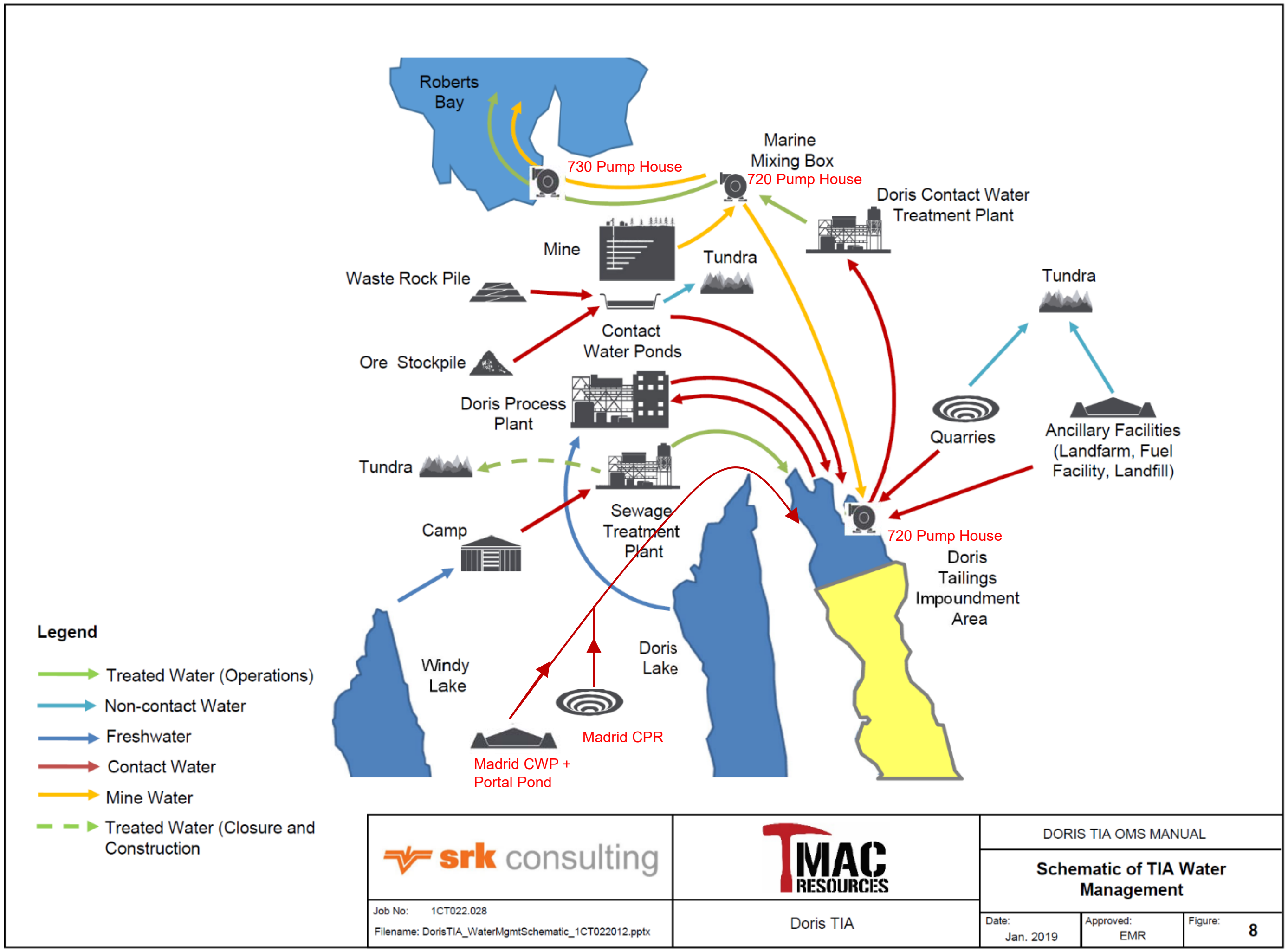
Step	Action
1	Back up all monitoring data electronically.
2	Scan manual notes and save together with raw and transposed data.
3	Immediately following collection, qualified staff should review data to • confirm integrity of the instrumentation and • ensure the TIA is performing to expectations and monitoring guidelines specified in the dam surveillance SOPs (SRK 2013, SRK 2019c).

The Mill (process) Manager is responsible for ensuring that the ongoing monitoring as documented in the dam surveillance SOP is carried out (SRK 2013, 2019c). If determined necessary, the Mill Manager may consult with the EOR to complete a safety inspection outside of the routine annual DSI.

Operations, Maintenance and Surveillance Manual: Hope Bay Project, Phase 2, Doris Tailings Impoundment Area 55

Discussions:

Review of water flow, and current pipe and pumps connection to TIA water balance.



Updates to be made:

- Need to add in Madrid
- Need to put in more of the actual names used on site. (i.e. 720 pump house etc…)

WEB PORTAL

Background on Instrumentation

Monitoring Requirements

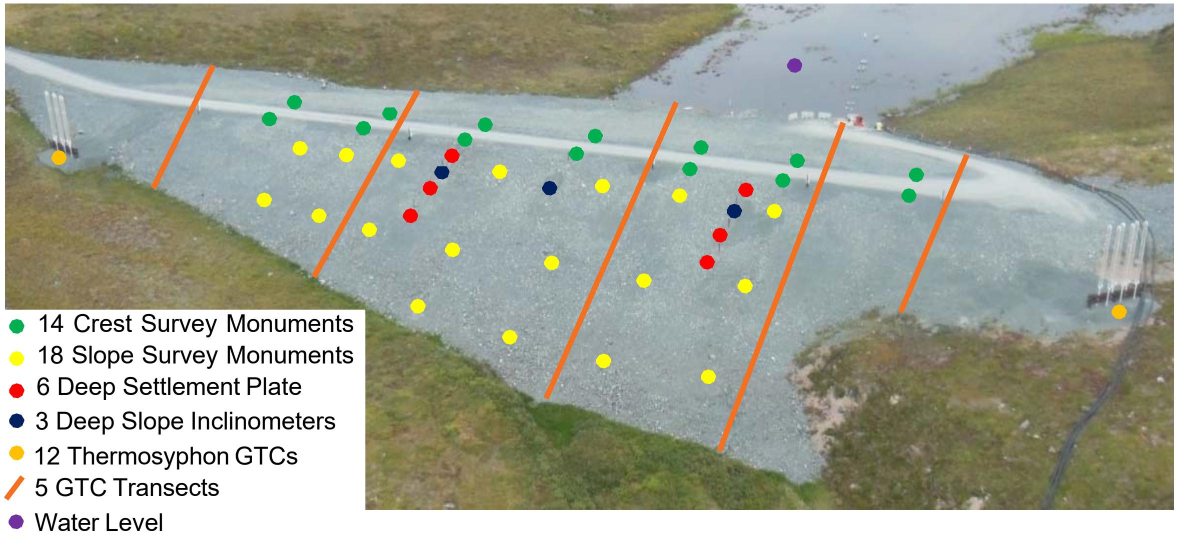
- Think about TMAC groups responsibility and how they interact with TIA.

- Mill team currently ‘champions’ of TIA OMS.
- Get notable support from Environment (specifically on instrumentation data collection).
- Also get support from
  - Projects
  - Mine
  - Site Services
- We are all somehow linked to the TIA on site. ☺

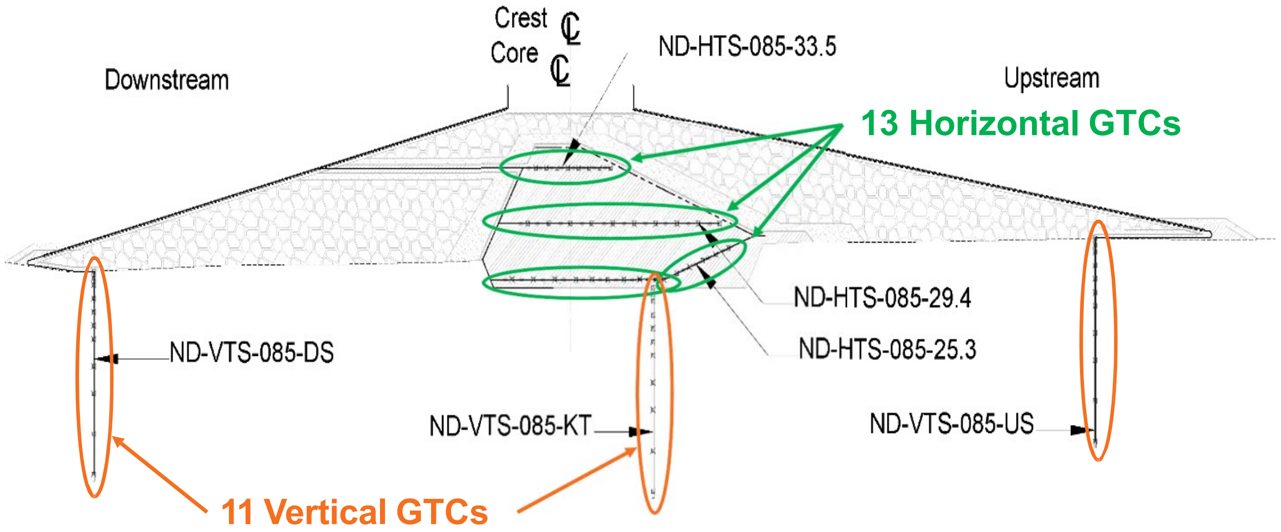
Element	Item	Method	Responsibility	Frequency
Thermal	Ground Temperature Cables	Dataloggers(3)	TMAC	Daily readings, monthly downloads
	Thermosyphons Status Thermistors	Dataloggers(3)	TMAC	Daily readings, monthly downloads
Deformation	Downstream Deep Settlement	Manual	TMAC	Monthly, May to November(1)
	Downstream Surface Settlement	Manual	TMAC	
	Crest Settlement	Manual	TMAC	
	Depression	Manual	TMAC	
	Inclinometers	Manual	TMAC	
Water Balance	Water Level	Datalogger Station(4)(5)	TMAC	Daily readings (online portal)
	Water Level	Manual	TMAC	Minimum of once per year, when Reclaim pond is not frozen
	Seepage	Manual	TMAC	Weekly when seepage is observed
Visual	Walkover Survey	Manual	TMAC	Weekly (below FSL(2)) Daily (at or above FSL)
	Geotechnical Inspection	Manual	Engineer of Record	Annually
			Independent Engineer	7-year cycle
Maintenance				
North Dam Thermal Datalogger	Datalogger(3) Primary Batteries	Manually recharge	TMAC	Annually
	Datalogger(3) Backup Batteries	Manually replace	TMAC	5-year cycle
	Datalogger(3) Recalibration	Manual	TMAC	5-year cycle
	Desiccant Packs	Manually replace	TMAC	As required
Water Level Datalogger Station (TIA-2)	Datalogger Transmission Subscription(4)	Online	TMAC	Annually
	Physical Datalogger Station(4)(5)(6)	Manually recalibrate or replace	TMAC	As required

Mill taking over walkover surveys?

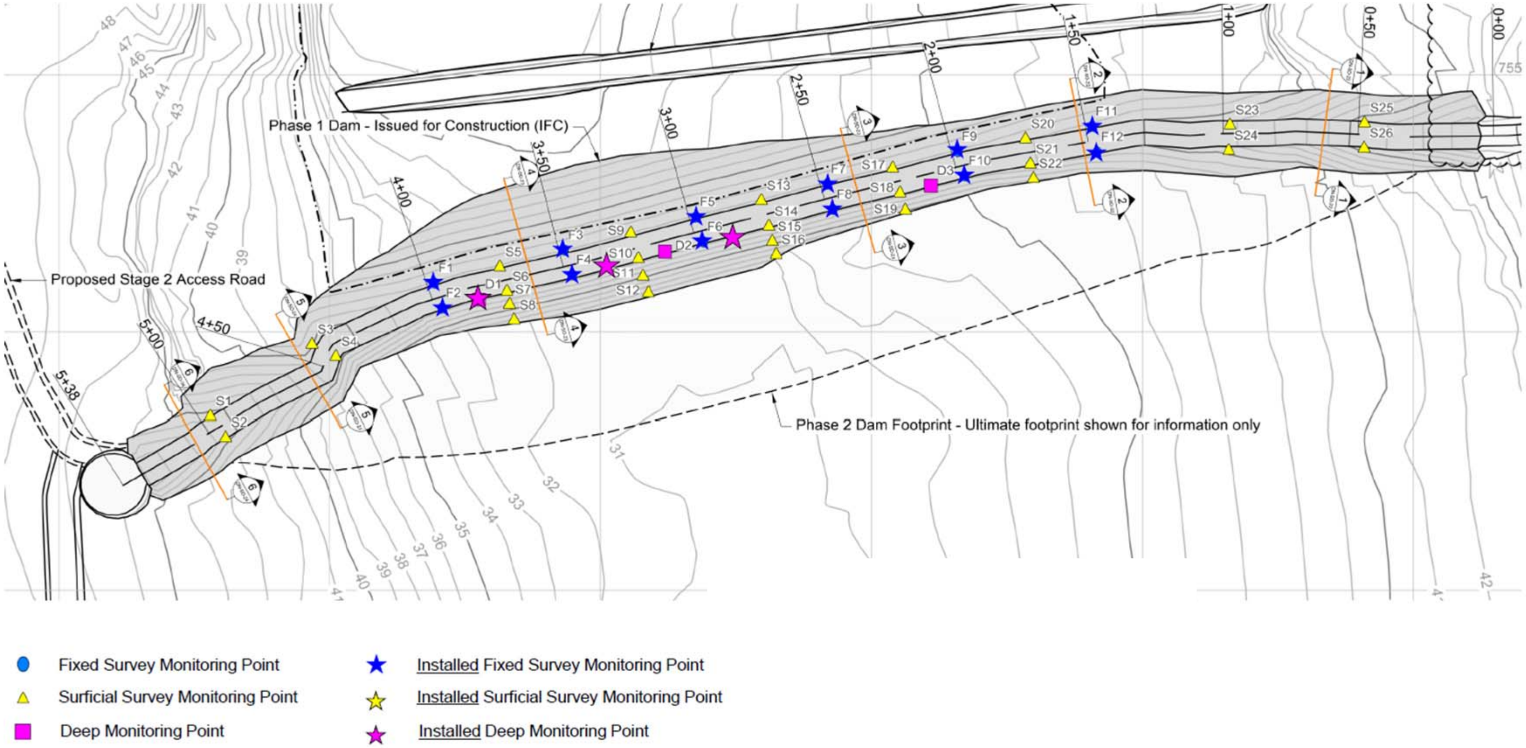
North Dam Instrumentation



North Dam Instrumentation (cont.)



South Dam Instrumentation

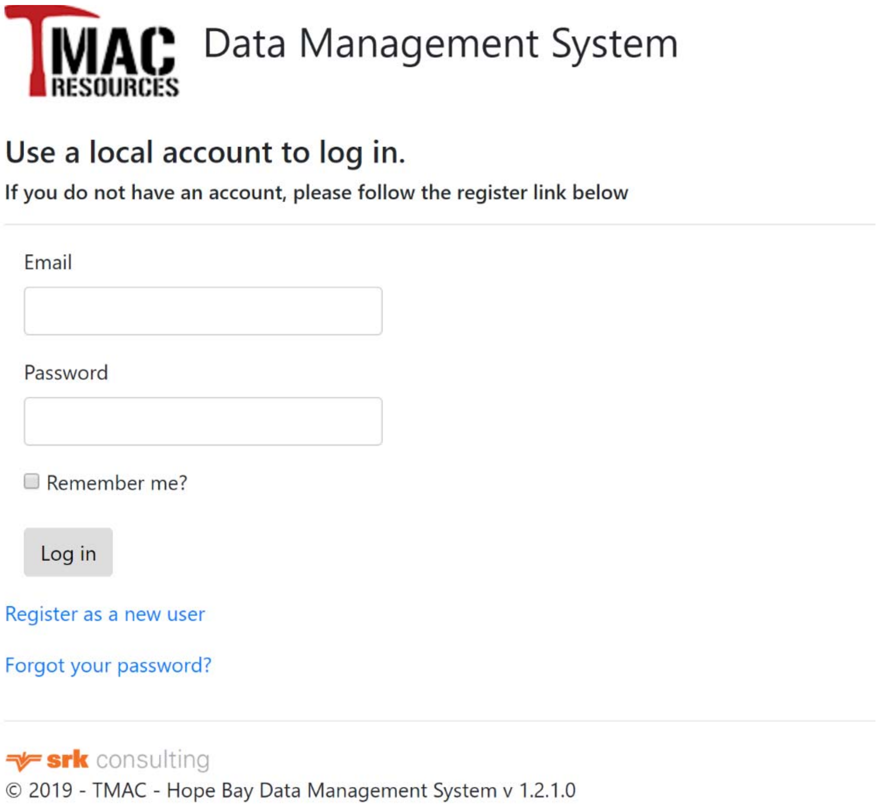


WEB PORTAL

Overview

maps.srk.com

https://maps.srk.com/HopeBay/



Data Management System

Use a local account to log in.

If you do not have an account, please follow the register link below

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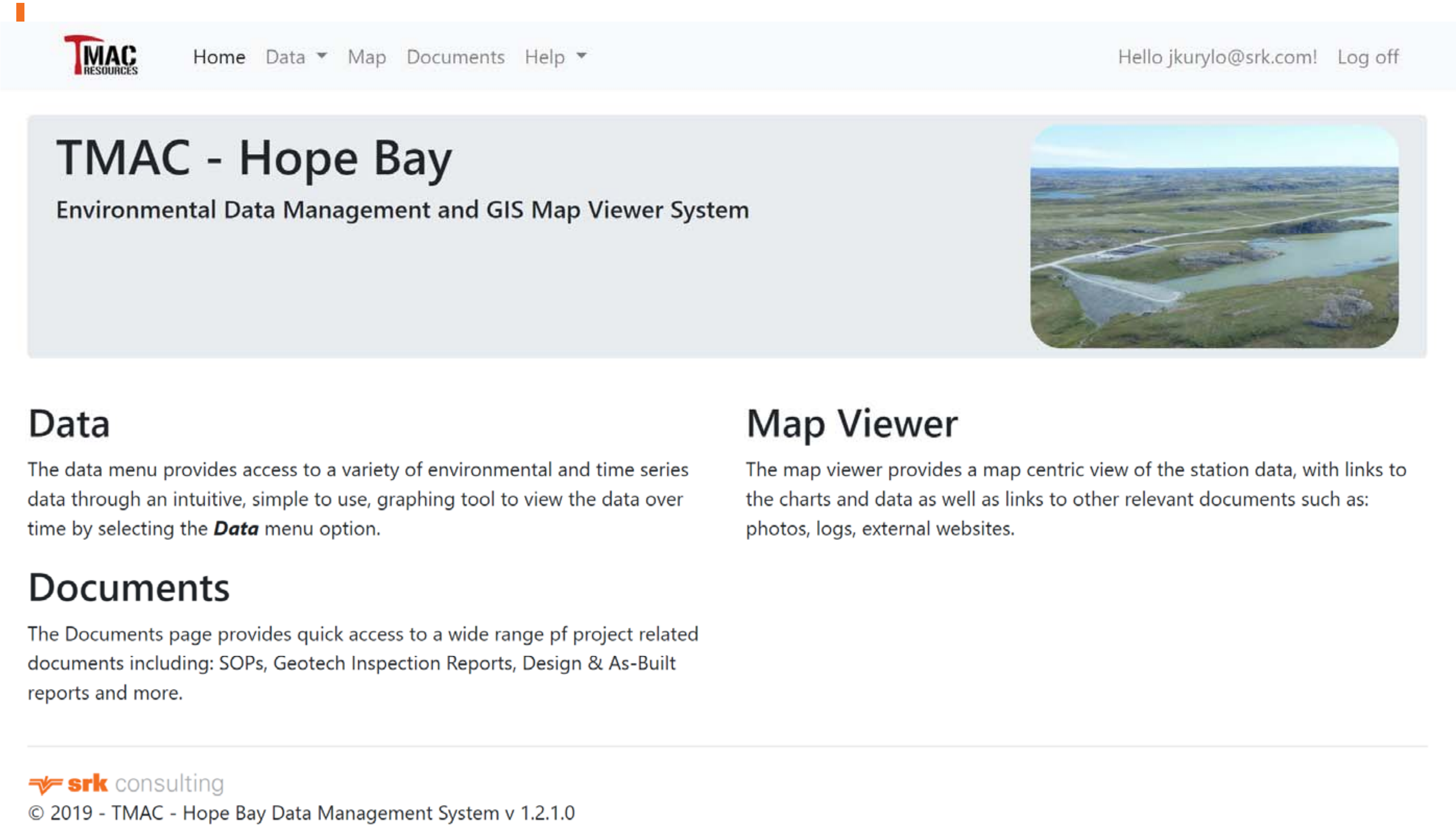

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Environmental Data Management and GIS Map Viewer System

Data

The data menu provides access to a variety of environmental and time series data through an intuitive, simple to use, graphing tool to view the data over time by selecting the ***Data*** menu option.

Documents

The Documents page provides quick access to a wide range pf project related documents including: SOPs, Geotech Inspection Reports, Design & As-Built reports and more.

Map Viewer

The map viewer provides a map centric view of the station data, with links to the charts and data as well as links to other relevant documents such as: photos, logs, external websites.

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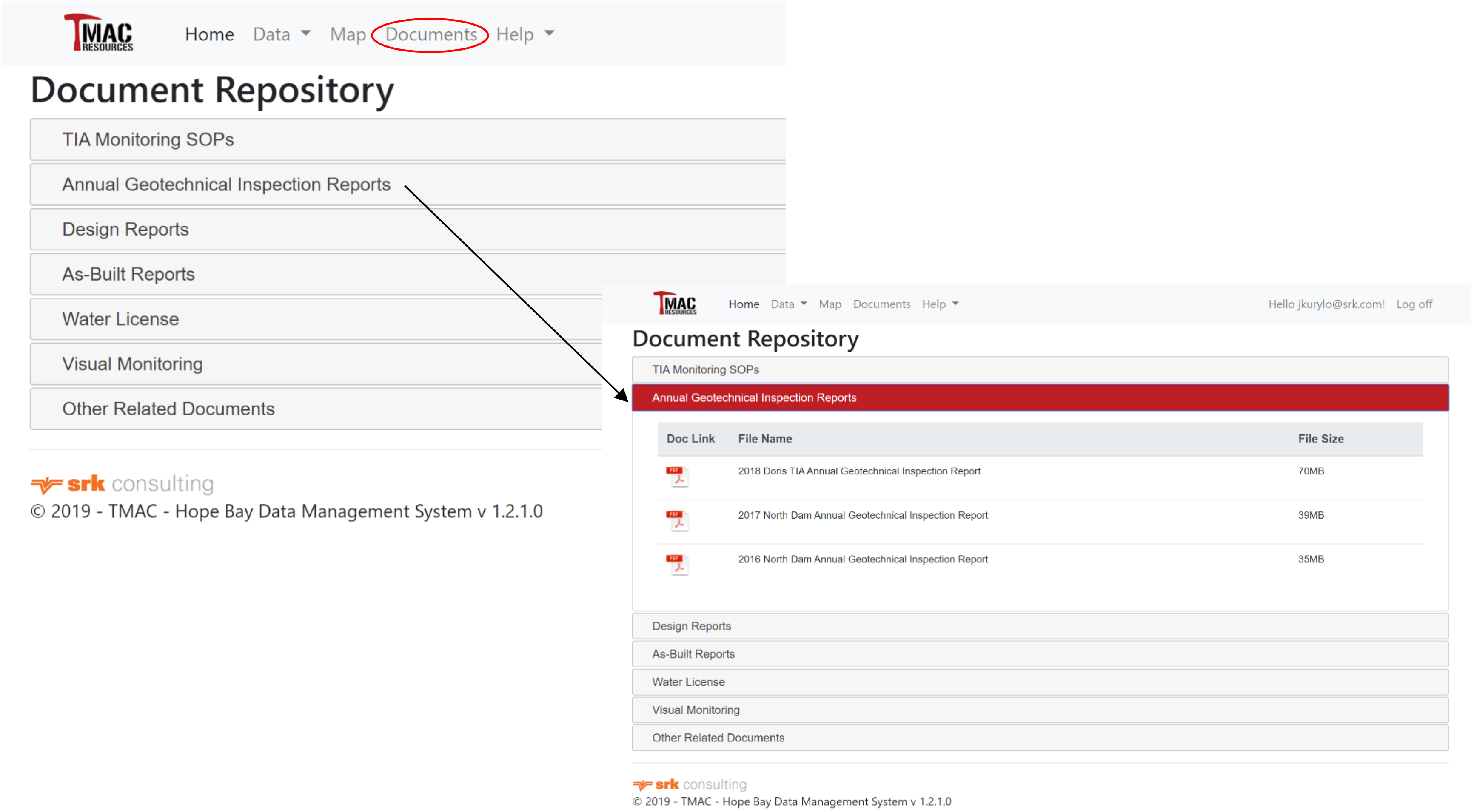

Document Repository

- TIA Monitoring SOPs
- Annual Geotechnical Inspection Reports
- Design Reports
- As-Built Reports
- Water License
- Visual Monitoring
- Other Related Documents

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Document Repository

- TIA Monitoring SOPs
- Annual Geotechnical Inspection Reports

Doc Link	File Name	File Size
PDF	2018 Doris TIA Annual Geotechnical Inspection Report	70MB
PDF	2017 North Dam Annual Geotechnical Inspection Report	39MB
PDF	2016 North Dam Annual Geotechnical Inspection Report	35MB

- Design Reports
- As-Built Reports
- Water License
- Visual Monitoring
- Other Related Documents

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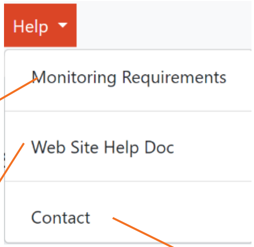

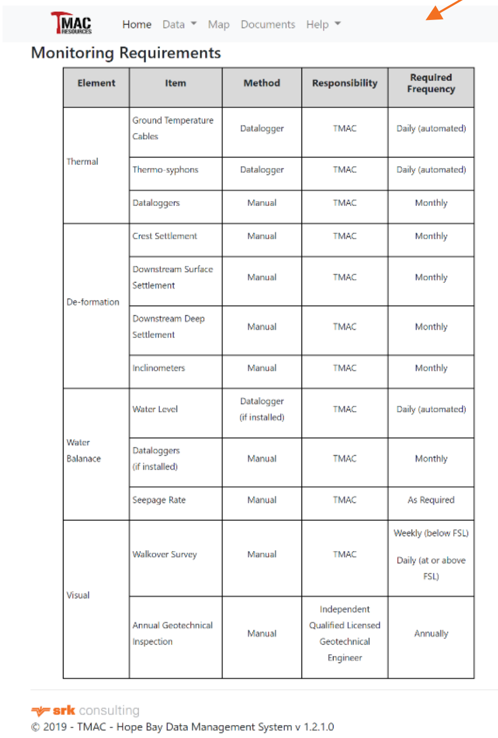

Monitoring Requirements

Element	Item	Method	Responsibility	Required Frequency
Thermal	Ground Temperature Cables	Datalogger	TMAC	Daily (automated)
	Thermo-syphons	Datalogger	TMAC	Daily (automated)
	Dataloggers	Manual	TMAC	Monthly
De-formation	Crest Settlement	Manual	TMAC	Monthly
	Downstream Surface Settlement	Manual	TMAC	Monthly
	Downstream Deep Settlement	Manual	TMAC	Monthly
	Inclinometers	Manual	TMAC	Monthly
Water Balanace	Water Level	Datalogger (if installed)	TMAC	Daily (automated)
	Dataloggers (if installed)	Manual	TMAC	Monthly
	Seepage Rate	Manual	TMAC	As Required
Visual	Walkover Survey	Manual	TMAC	Weekly (below FSL) Daily (at or above FSL)
	Annual Geotechnical Inspection	Manual	Independent Qualified Licensed Geotechnical Engineer	Annually

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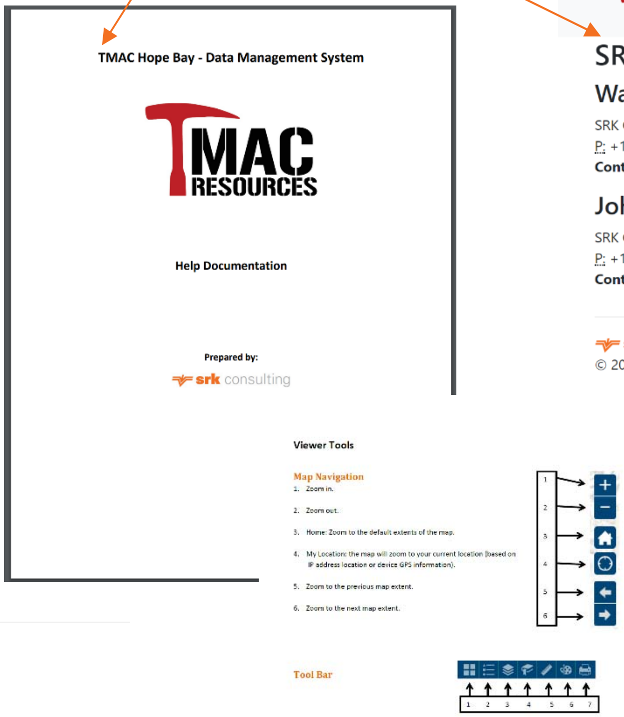


TMAC Hope Bay - Data Management System

Help Documentation

Prepared by:

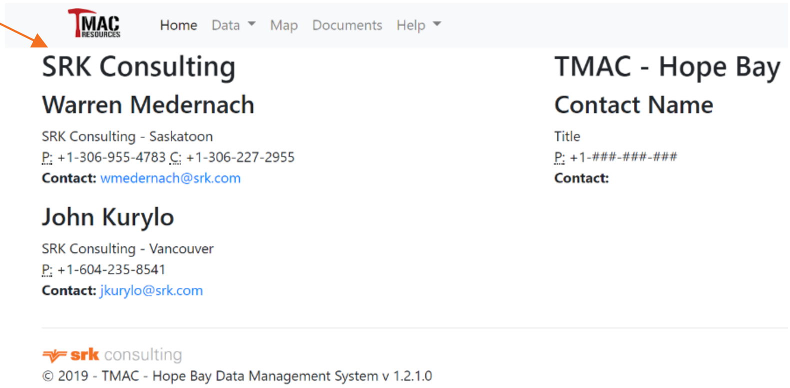
srk consulting

Viewer Tools

Map Navigation

1. Zoom in.
2. Zoom out.
3. Home: Zoom to the default extents of the map.
4. My Location: the map will zoom to your current location (based on IP address location or device GPS information).
5. Zoom to the previous map extent.
6. Zoom to the next map extent.

Tool Bar



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Warren Medernach

SRK Consulting - Saskatoon
P: +1-306-955-4783 C: +1-306-227-2955
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Contact: jkurylo@srk.com

TMAC - Hope Bay

Contact Name

Title
P: +1-###-###-###
Contact:

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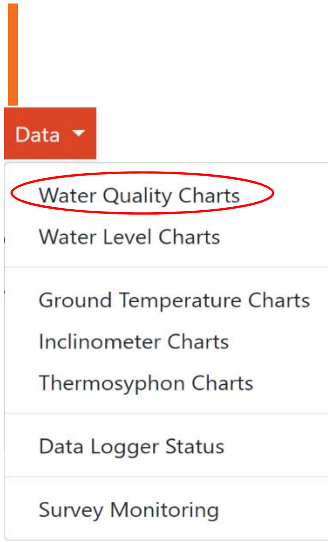

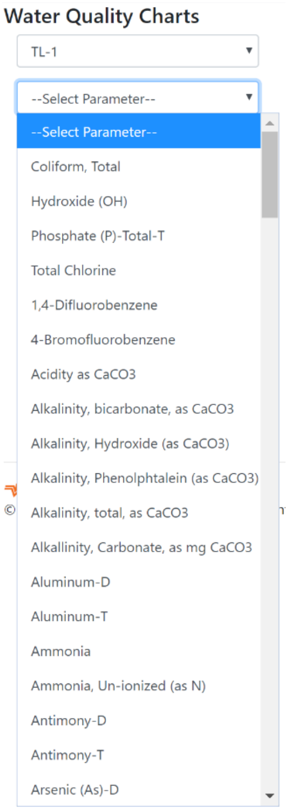

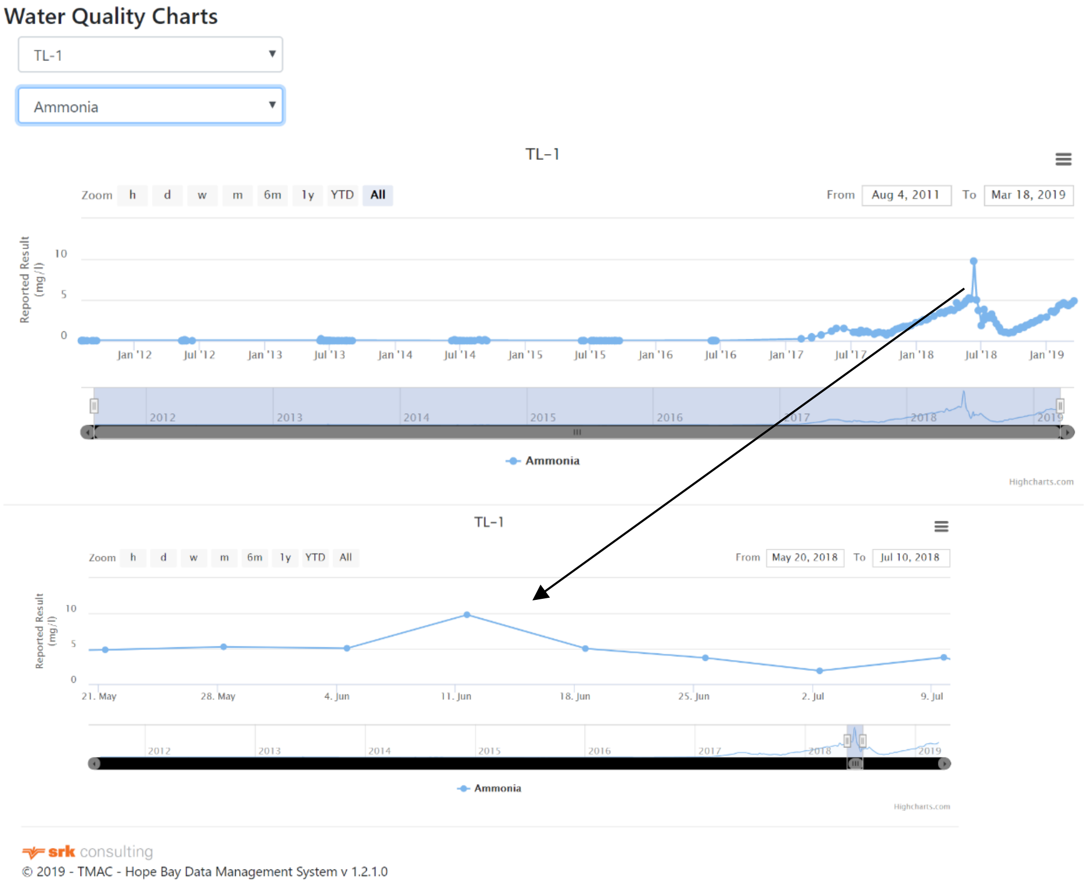

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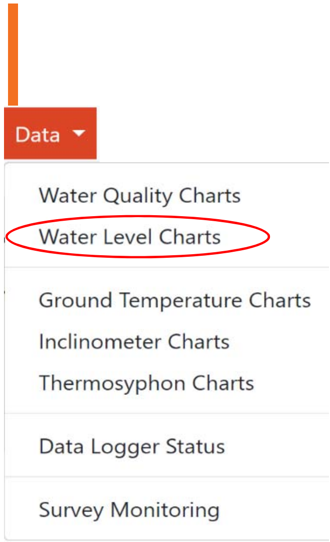
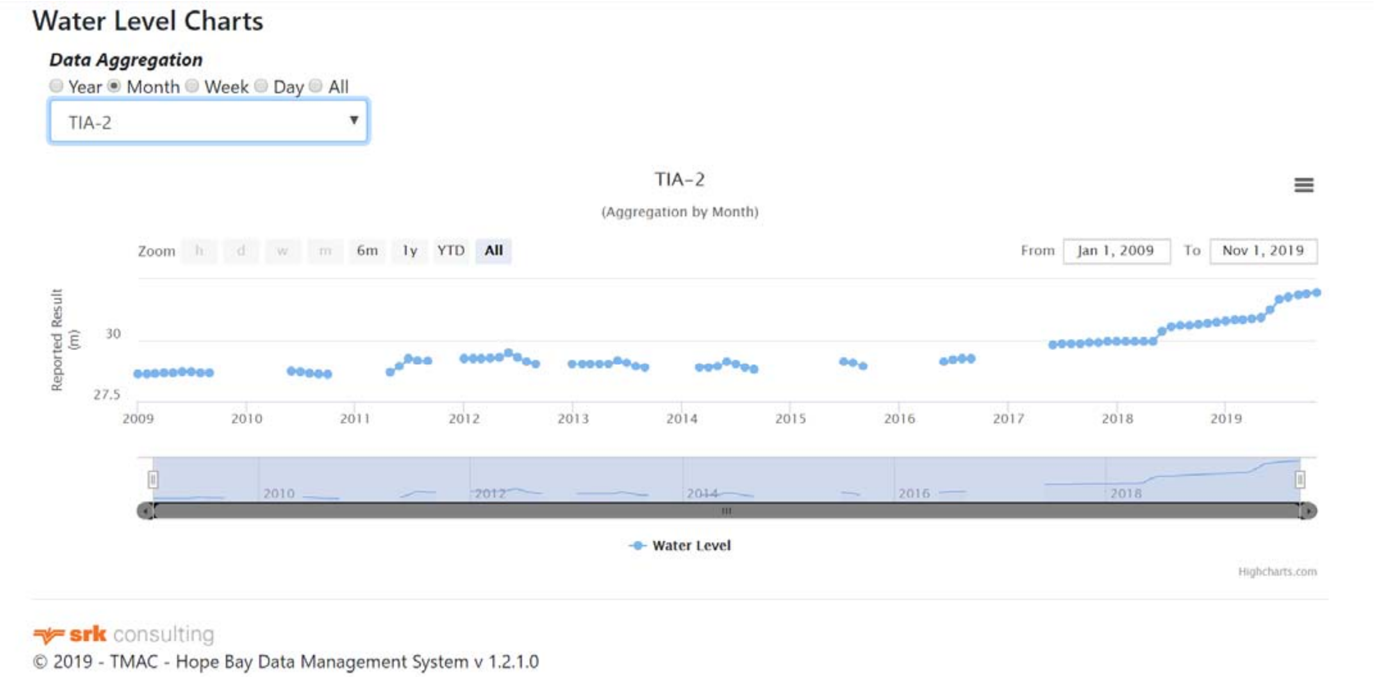


Data

- Water Quality Charts
- Water Level Charts
- Ground Temperature Charts
- Inclinometer Charts
- Thermosyphon Charts
- Data Logger Status
- Survey Monitoring



Water Level Charts

Data Aggregation

○ Year ● Month ○ Week ○ Day ○ All

TIA-2

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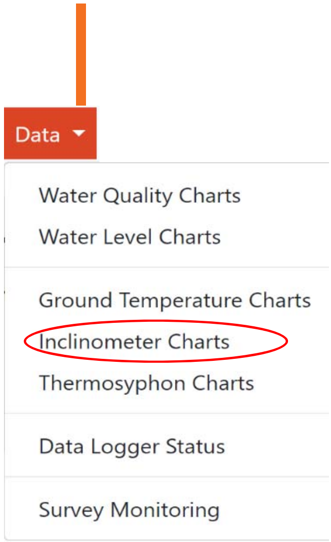
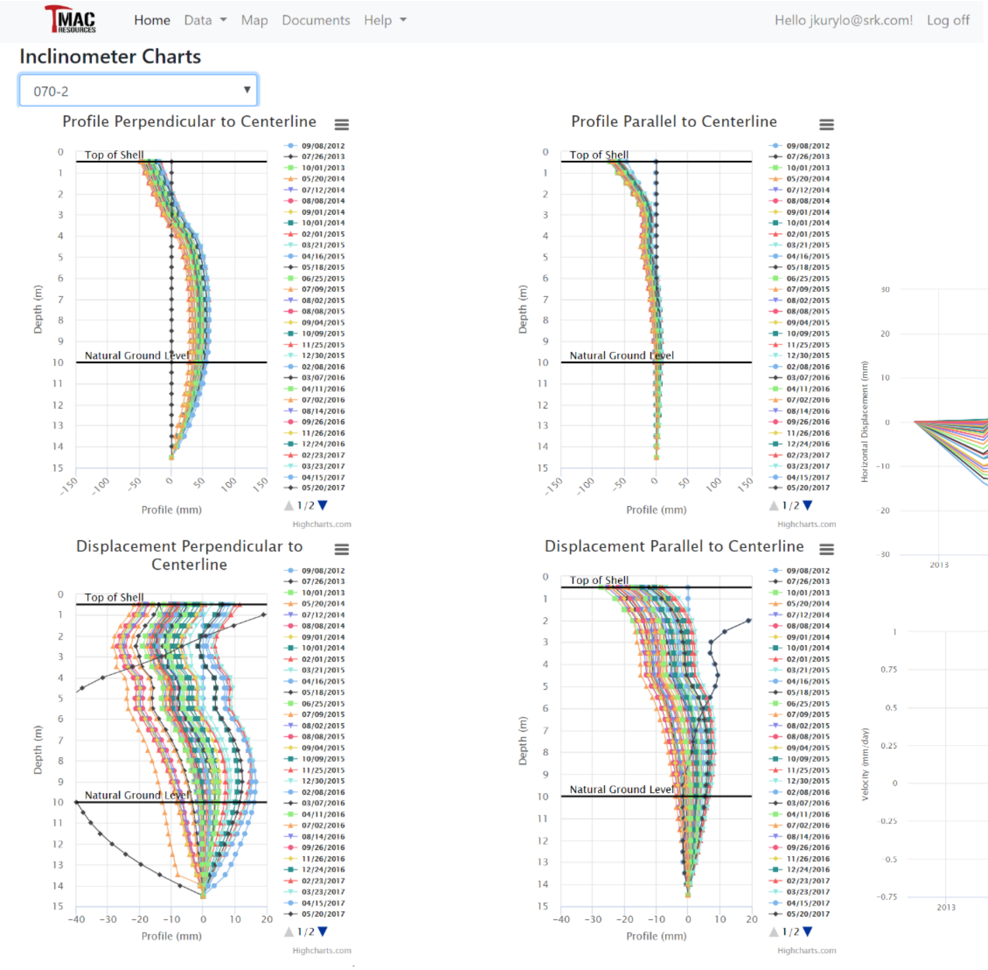

Data
Water Quality Charts
Water Level Charts
Ground Temperature Charts
Inclinometer Charts
Thermosyphon Charts
Data Logger Status
Survey Monitoring


TMAC RESOURCES
Home
Data
Map
Documents
Help
Hello jkurylo@srk.com!
Log off
Inclinometer Charts
070-2
Profile Perpendicular to Centerline
Profile Parallel to Centerline
Displacement Perpendicular to Centerline
Displacement Parallel to Centerline
Top of Shell
Natural Ground Level
Depth (m)
Profile (mm)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
-150
-100
-50
0
50
100
150
-40
-30
-20
-10
0
10
20
09/08/2012
07/26/2013
10/01/2013
05/20/2014
07/12/2014
08/08/2014
09/01/2014
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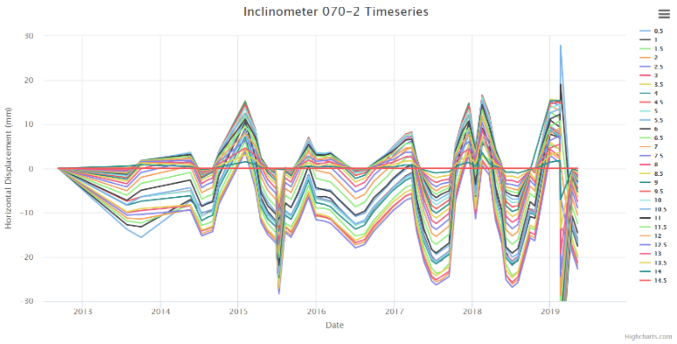
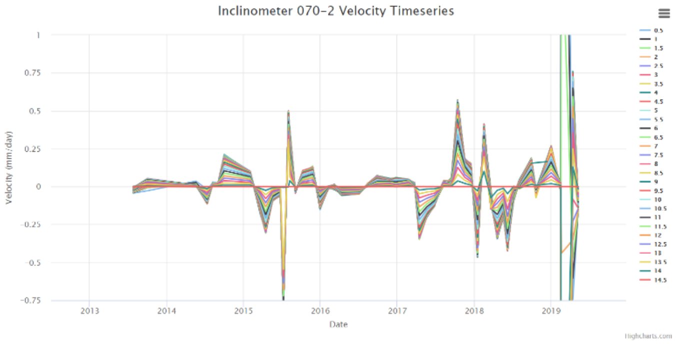
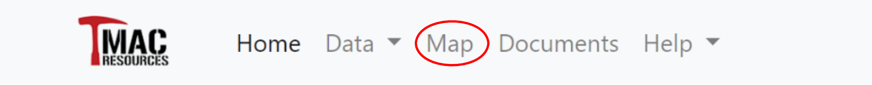
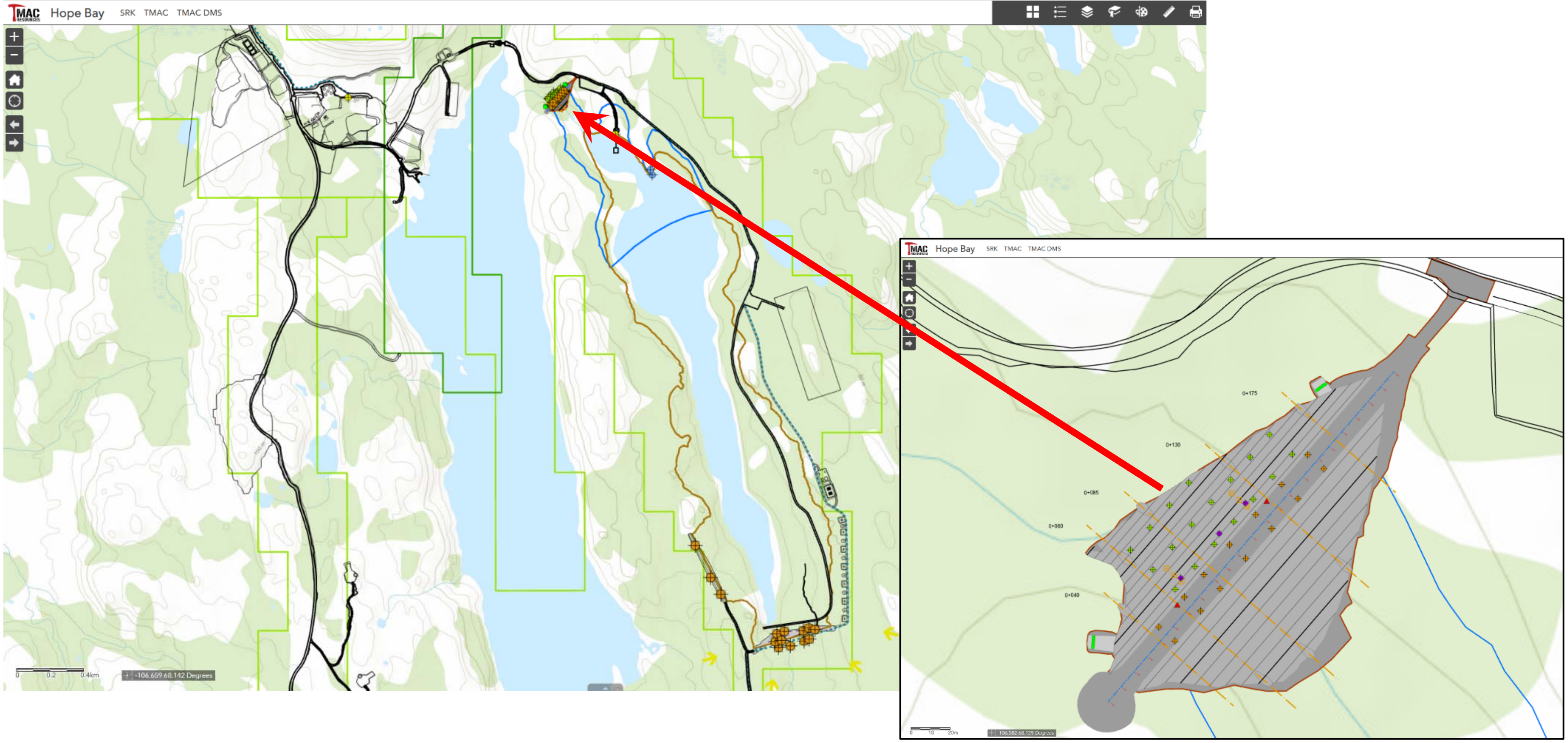
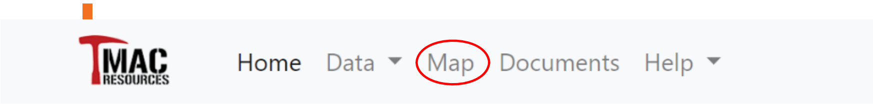
07/02/2016
08/14/2016
09/26/2016
11/26/2016
12/24/2016
02/23/2017
03/23/2017
04/15/2017
05/20/2017
1/2
Highcharts.com

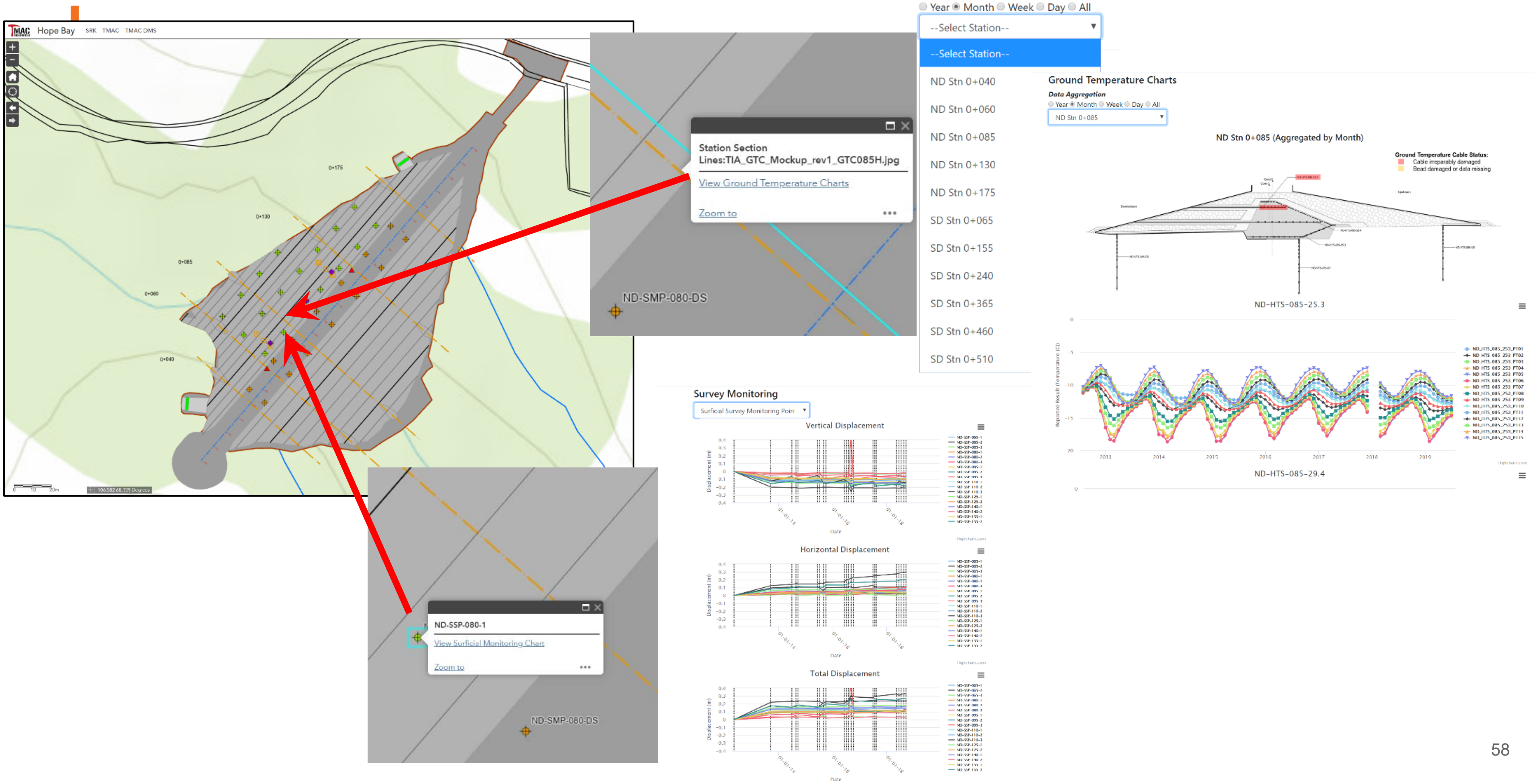

Inclinometer 070-2 Timeseries
Horizontal Displacement (mm)
30
20
10
0
-10
-20
-30
2013
2014
2015
2016
2017
2018
2019
Date
Highcharts.com


Inclinometer 070-2 Velocity Timeseries
Velocity (mm/day)
1
0.75
0.5
0.25
0
-0.25
-0.5
-0.75
2013
2014
2015
2016
2017
2018
2019
Date
Highcharts.com


TMAC RESOURCES
Home
Data
Map
Documents
Help


TMAC
Hope Bay
SRK
TMAC
TMAC DMS
0
0.2
0.4km
-106.659 68.142 Degrees
0+175
0+130
0+085
0+060
0+040





Station Section Lines:TIA_GTC_Mockup_rev1_GTC085H.jpg

View Ground Temperature Charts

Zoom to

ND-SMP-080-DS

ND-SSP-080-1

View Surficial Monitoring Chart

Zoom to

ND-SMP-080-DS

Ground Temperature Charts

Data Aggregation

○ Year ● Month ○ Week ○ Day ○ All

--Select Station--

- --Select Station--
- ND Stn 0+040
- ND Stn 0+060
- ND Stn 0+085
- ND Stn 0+130
- ND Stn 0+175
- SD Stn 0+065
- SD Stn 0+155
- SD Stn 0+240
- SD Stn 0+365
- SD Stn 0+460
- SD Stn 0+510

Ground Temperature Charts

Data Aggregation

○ Year ● Month ○ Week ○ Day ○ All

ND Stn 0+085

ND Stn 0+085 (Aggregated by Month)

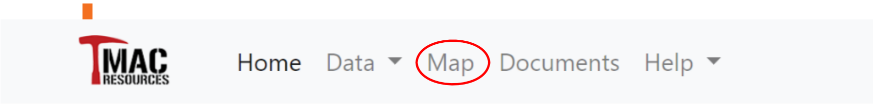
Ground Temperature Cable Status:

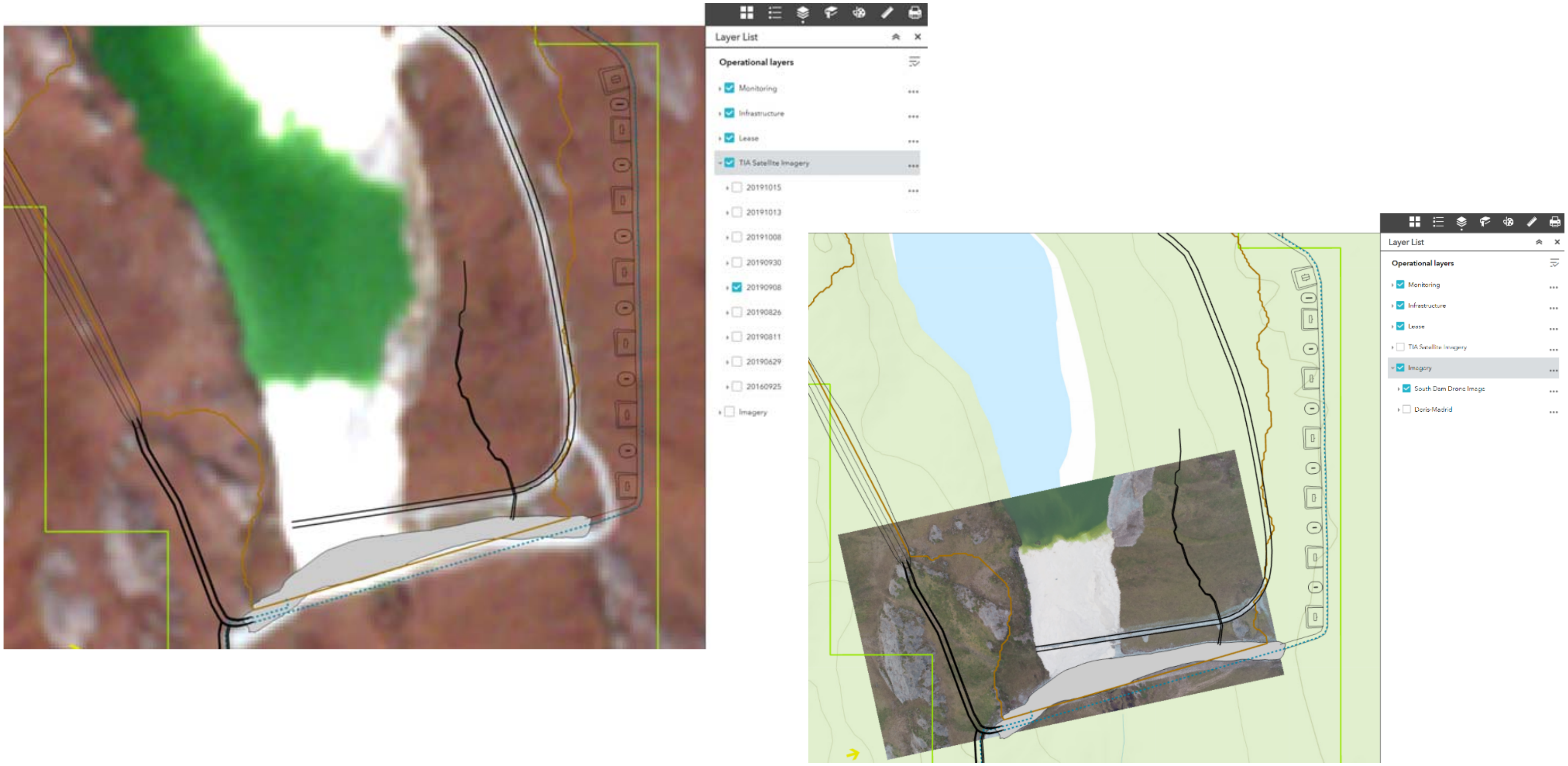
🟥 Cable irreparably damaged

🟨 Bead damaged or data missing

Survey Monitoring

Surficial Survey Monitoring Point





Layer List

Operational layers

- ☑ Monitoring
- ☑ Infrastructure
- ☑ Lease
- ☑ TIA Satellite Imagery
  - ☐ 20191015
  - ☐ 20191013
  - ☐ 20191008
  - ☐ 20190930
  - ☑ 20190908
  - ☐ 20190826
  - ☐ 20190811
  - ☐ 20190629
  - ☐ 20160925
- ☐ Imagery

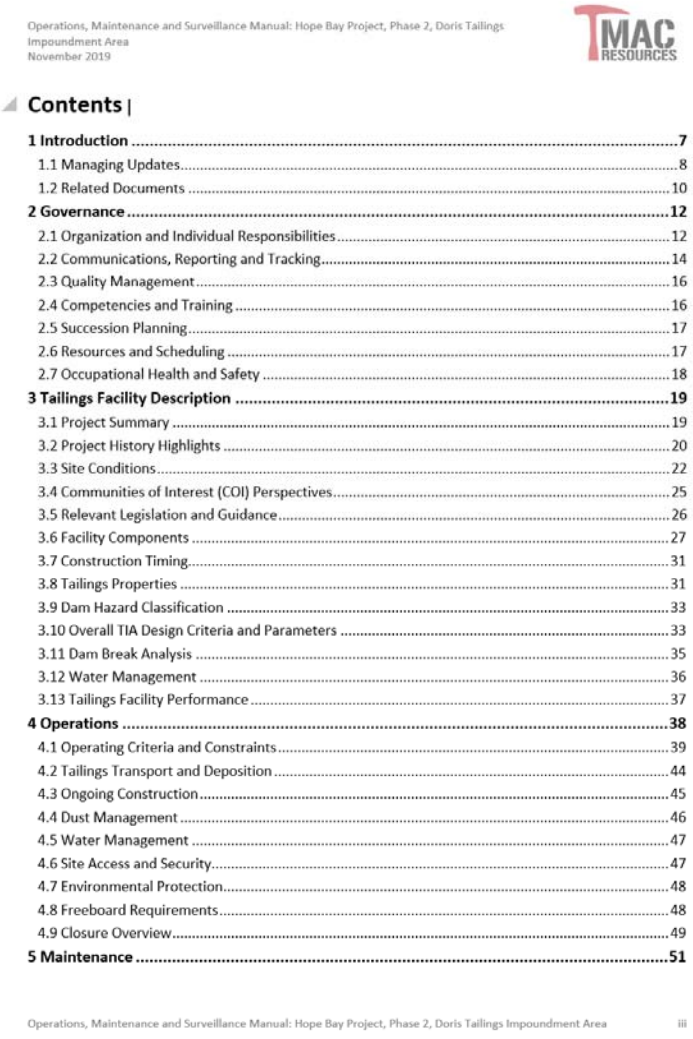
Layer List

Operational layers

- ☑ Monitoring
- ☑ Infrastructure
- ☑ Lease
- ☐ TIA Satellite Imagery
- ☑ Imagery
  - ☑ South Dam Drone Image
  - ☐ Doris-Madrid

Discussions:

Revisit OMS in more detail, discuss some things to looks for in inspections, have additional operation discussions, get feedback



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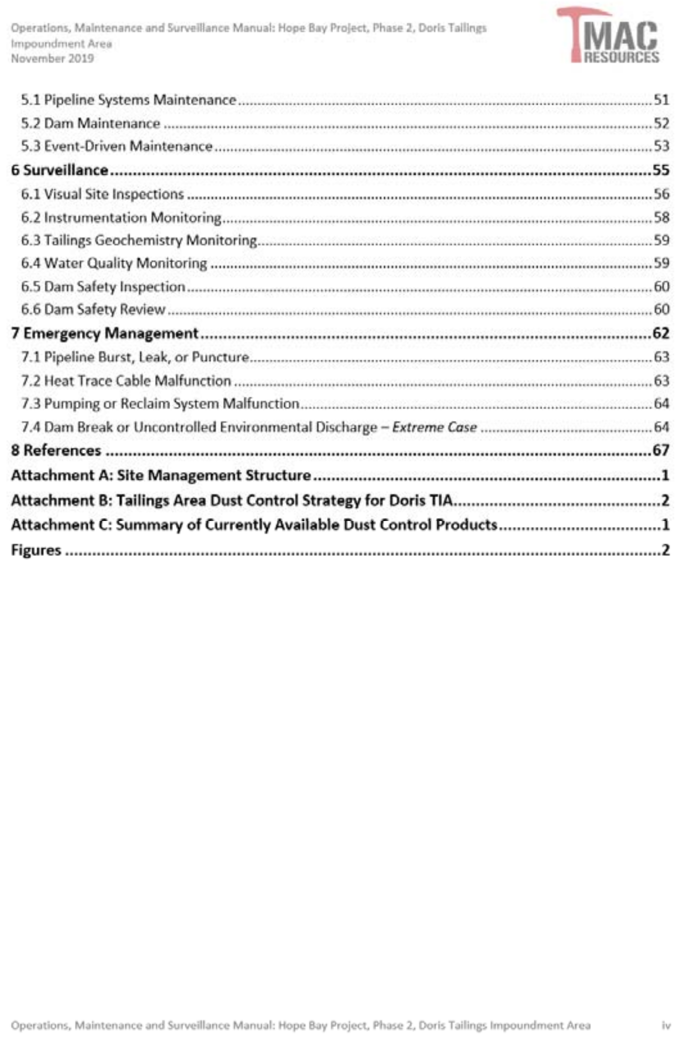
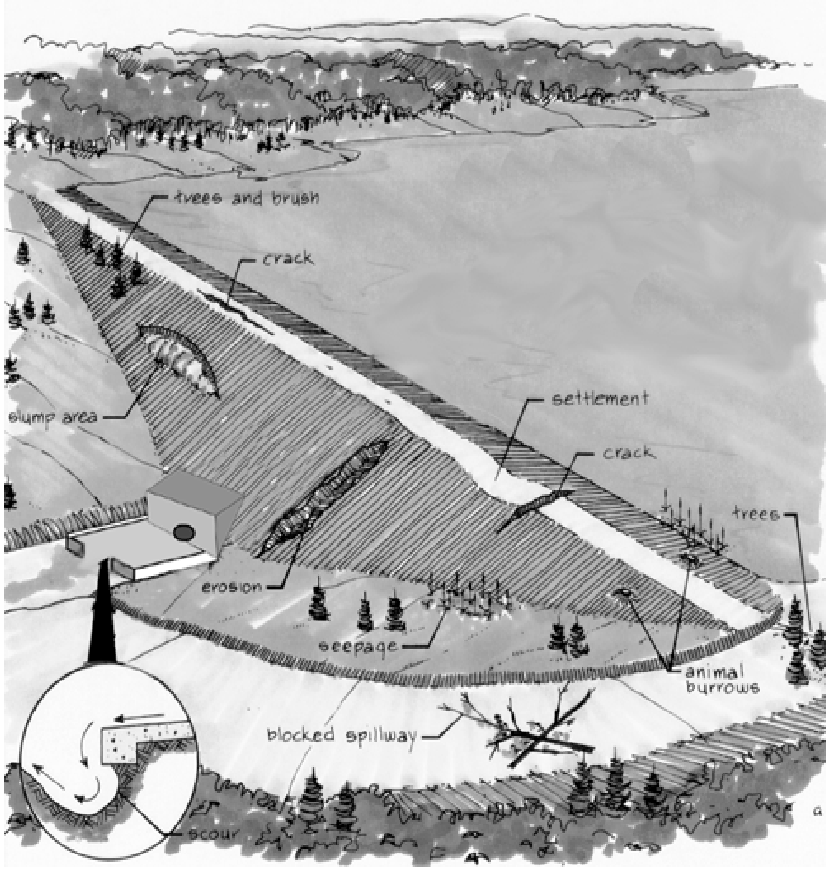


Dam Inspections



Ref: BC Dam Safety Program – Emergency Dam Assessment and Immediate Response Plan

Dam Inspections – examples

North Dam (past notes that were watched or corrected)

- Watch tension cracks on upstream slope near shoreline
- Backfill with crush around inclinometer housing of Station 0+130 m
- Replace bottom weatherproof housing for node D

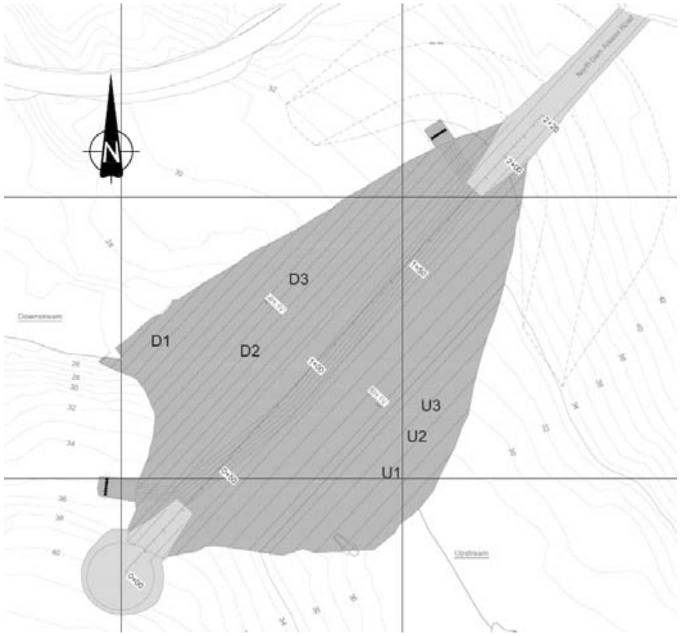
Other TIA Inspections – examples

Pumps and Pipeline

- Damage to pipelines
- Settlement around equipment
- Function of pumps
- Housekeeping

Reporting / Tracking Examples

Depression / settlement tracking



DEPRESSION TRACKING

ID	Location	Comments	Northing	Easting
U1	Upstream	First noted June 2014 Boundaries spray painted and ID given July 2014 No substantial changes from previous inspection	7559104	434393
U2	Upstream	First noted June 2014 Boundaries spray painted and ID given July 2014 No substantial changes from previous inspection	7559117	434402
U3	Upstream	First noted June 2014 Boundaries spray painted and ID given July 2014 July 4, 2015 - Expanding toward U2 No substantial changes from previous inspection	7559128	434407
D1	Downstream	Identified during 2014 annual geotechnical inspection, spray painted and given ID. September 1, 2014 - expanded towards the south September 20, 2014 - TMAC ESR noted the depression looks to have expanded, paint mark updated. July 4, 2015 - Slight expansion toward the crest was noted in the daily report No substantial changes from previous inspection	7559151	434311
D2	Downstream	First noted in 2013 Annual Geotechnical Inspection September 14, 2014 - TMAC ESR noted that the depression may have expanded slightly No substantial changes from previous inspection	7559147	434344
D3	Downstream	First noted in 2013 Annual Geotechnical Inspection August 10, 2014 - larger area marked No substantial changes from previous inspection	7559173	434360

Notes:
1. Depression locations are based on hand held GPS measurements, accuracy is at best +/- 4 m.
2. Other small depressions were removed from the tracking system in 2016. Only significant depression were carried forward from the 2016 Annual Inspection.

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TMAC RESOURCES

2018 Annual Geotechnical Inspection

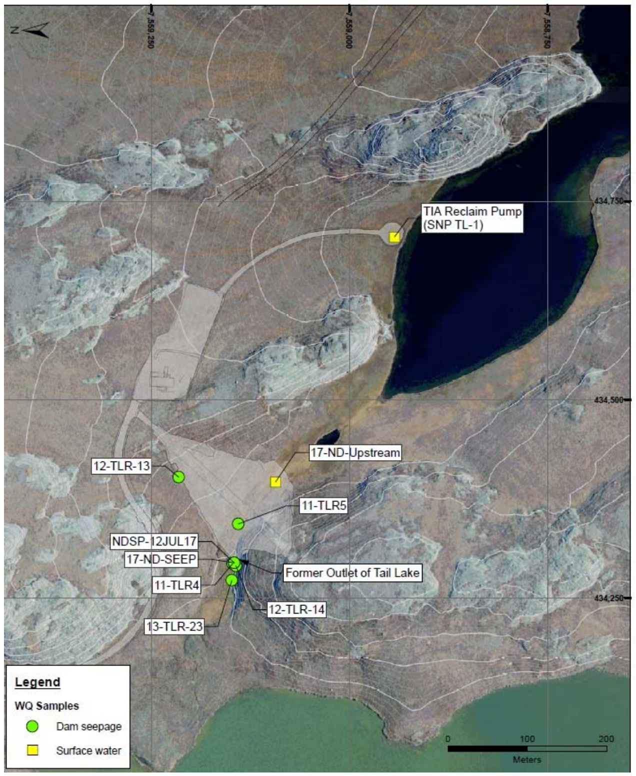
Historic Depression Summary

Job No: 1CT022.028
Filename: AppH_ND_AGI_DepressionTracking.pptx

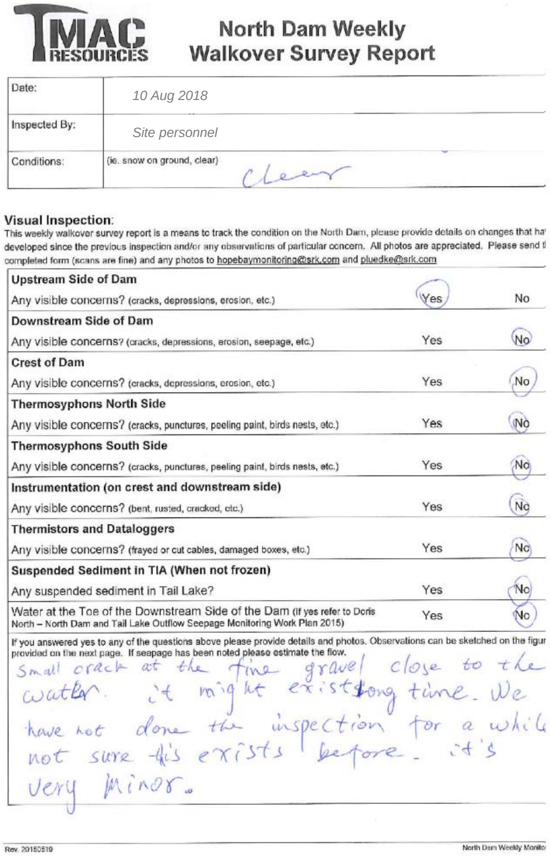
DORIS TIA

Date: Dec. 2018
Approved: PDL
Figure: **H.65**

Reporting / Tracking Examples



Seepage Tracking & Testing



TMAC RESOURCES

North Dam Weekly Walkover Survey Report

Date:	10 Aug 2018
Inspected By:	Site personnel
Conditions:	(ie. snow on ground, clear) Clear

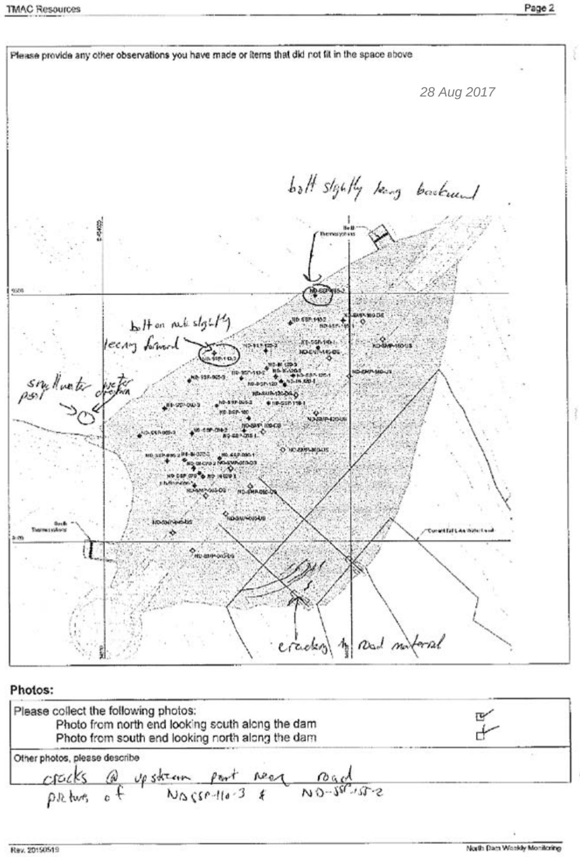
Visual Inspection:
This weekly walkover survey report is a means to track the condition on the North Dam, please provide details on changes that ha developed since the previous inspection and/or any observations of particular concern. All photos are appreciated. Please send t completed form (scans are fine) and any photos to hopebaymonitoring@srk.com and pluedke@srk.com

Upstream Side of Dam Any visible concerns? (cracks, depressions, erosion, etc.)	[✓ Yes]	No
Downstream Side of Dam Any visible concerns? (cracks, depressions, erosion, seepage, etc.)	Yes	[✓ No]
Crest of Dam Any visible concerns? (cracks, depressions, erosion, etc.)	Yes	[✓ No]
Thermosyphons North Side Any visible concerns? (cracks, punctures, peeling paint, birds nests, etc.)	Yes	[✓ No]
Thermosyphons South Side Any visible concerns? (cracks, punctures, peeling paint, birds nests, etc.)	Yes	[✓ No]
Instrumentation (on crest and downstream side) Any visible concerns? (bent, rusted, cracked, etc.)	Yes	[✓ No]
Thermistors and Dataloggers Any visible concerns? (frayed or cut cables, damaged boxes, etc.)	Yes	[✓ No]
Suspended Sediment in TIA (When not frozen) Any suspended sediment in Tail Lake?	Yes	[✓ No]
Water at the Toe of the Downstream Side of the Dam (If yes refer to Doris North – North Dam and Tail Lake Outflow Seepage Monitoring Work Plan 2015)	Yes	[✓ No]

If you answered yes to any of the questions above please provide details and photos. Observations can be sketched on the figur provided on the next page. If seepage has been noted please estimate the flow.

Small crack at the fine gravel close to the water. it might exists long time. We have not done the inspection for a whil not sure this exists before. it's very minor.

Rev. 20150519 North Dam Weekly Monito



TMAC Resources Page 2

Please provide any other observations you have made or items that did not fit in the space above

28 Aug 2017

Photos:

Please collect the following photos: Photo from north end looking south along the dam Photo from south end looking north along the dam	☑ ☑
Other photos, please describe cracks @ upstream part near road	

pictures of NDSSP-110-3 & ND-SSP-155-2

Rev. 20150519 North Dam Weekly Monitoring

Visual Inspections

Appendix Q – ERP and Dam Break Considerations - Presentation

Doris TIA –
Emergency Response Plan (ERP) Inputs & Discussions

John Kurylo, MSc, PEng
Site Discussions - November 24th, 2019

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