Klohn Crippen Berger

Teck Resources Limited

Bullmoose Mine

Bullmoose Tailings Dam

2020 Annual Summary of Tailings Facility Performance

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March 2021

Klohn Crippen Berger

March 26, 2021

Teck Resources Limited
Legacy Properties
601 Knighton Road
Kimberley, British Columbia
V1A 1C7

Mr. Mark Slater, P.Eng.
Senior Geotechnical Engineer

Dear Mr. Slater:

Bullmoose Mine
Bullmoose Tailings Dam
2020 Annual Summary of Tailings Facility Performance

We are pleased to submit the 2020 Annual Summary of Tailings Facility Performance report for the Bullmoose Tailings Dam.

Please contact us if you have any questions regarding this report.

Yours truly,

KLOHN CRIPPEN BERGER LTD.

M. Cronk

Max Cronk, P.Eng.
Project Manager
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MC/LN:jc

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Teck Resources Limited

Bullmoose Mine

Bullmoose Tailings Dam

2020 Annual Summary of Tailings Facility Performance

EXECUTIVE SUMMARY

Klohn Crippen Berger Ltd. (KCB) was engaged by Teck Resources Limited (Teck) on behalf of the Bullmoose Operating Corporation to complete the 2020 Annual Summary of Tailings Facility Performance for the Bullmoose Tailings Dam (BTD) to comply with Section 10.5.3 of the Health, Safety and Reclamation Code (HSRC) for Mines in British Columbia (also referred to as the Code) (MEM 2017). This report was prepared following:

- Section 4.2 "Annual Tailings Facility and Dam Safety Inspection Report" of the 2016 HSRC Guidance Document (MEM[1] 2016).
- Teck's 2019 Guideline for Tailings and Water Retaining Structures (TWRS).

The site visit was completed by the Engineer of Record (EoR), KCB representatives, Mr. Bob Chambers, P.Eng., and Mr. Stephen Clark, P.Eng., on July 22, 2020. The responsibilities of the Tailings Storage Facility (TSF) Qualified Person, as defined in the Code (MEM 2017), were performed by Mr. Mark Slater, P.Eng., of Teck in 2020. Routine and event-driven visual inspections were completed by Facility Surveillance Officer (FSO) Mr. Rob Muise of Teck.

The annual performance report is issued before the end of the calendar year, so the period considered for climate data and instrumentation is from September 2019 to August 2020, herein referred to as the "review period".

This summary section is provided in accordance with the HSRC, and Teck's "Guideline for Tailings and Water Retaining Structures" (Teck 2019). The summary is provided solely for purposes of overview. Any party who relies on this report must read the full report. The summary omits a number of details, any one of which could be crucial to the proper application of this report.

Summary of Facility Description

The Bullmoose Mine has been closed since 2003. The mine site is about 45 km northwest of Tumbler Ridge in northeastern BC. Key aspects of the facility include:

- The BTD is a downstream-constructed embankment which forms a side-hill impoundment, with a design tailings storage capacity of 4.6 million m^3. The facility is situated on the south flank of the broad valley bottom, with South Bullmoose Creek to the west and Bullmoose Creek to the north.
- The BTD is constructed of compacted coarse coal rejects (CCR) up to a final crest elevation of 1,123 masl. The dam downstream and upstream slopes are approximately 2.5H:1V and 2H:1V, respectively. The crest is approximately 1,050 m long, and 10 m to 15 m wide. The maximum dam height is 38 m from crest to downstream toe.
- Fine coal refuse tailings (approximately 4.4 million m^3), produced during operations (1983 to 2003), were placed between the BTD and the natural valley slope, forming the TSF. The TSF is reclaimed with a vegetation cover over the slopes and tailings.

[1] Now referred to as the Ministry of Energy, Mines, and Low Carbon Innovation (EMLI).

- A closure spillway was constructed in 2002 at the left abutment of the BTD (inlet El. 1,122 masl). The spillway channel follows a southwesterly route from the tailings impoundment, discharging onto the natural ground at approximately El. 1,120 masl.
- The BTD impoundment has a catchment of 36 ha: 20 ha tailings impoundment and 16 ha upslope.

Summary of Key Potential Hazards and Failure Modes

KCB understands that Teck's long-term goal for all of their tailings facilities is to reach landform status with all potential failure modes that could result in catastrophic release of tailings and/or water being either not present or having been reduced to non-credible. Teck's long-term goal for the BTD is for all potential failure modes to be non-credible based on extreme loading conditions, or loading conditions appropriate using the principles of ALARP (i.e., As Low as Reasonably Practicable) when it is not practical to consider extreme conditions. Evaluation of failure modes with respect to this goal is ongoing. Potential failure modes reviewed as part of this annual summary include overtopping, slope instability, internal erosion and surface erosion. Based on 2020 conditions, failure modes that can result in an uncontrolled release of tailings are considered non-credible, under design loading, for the existing structure.

The BTD risk assessment was reviewed by Teck and KCB representatives in 2019. There have been no significant changes to the key hazards and the existing controls were adequate to manage potential failure modes with compliance and risk limits.

Consequence Classification of Dam

The existing condition of the BTD was assigned a "High" consequence classification (KCB 2014b) based on CDA (2013) category system. There were no changes to the downstream environment or operation of the structure during 2020 that would warrant a change of this classification.

Changes in Instrumentation and/or Visual Monitoring Records

Overall, piezometer readings are consistent with typical performance (post-operation) and there were no threshold exceedances in 2020. No changes are recommended to the instrument reading frequency or threshold levels for 2020.

A LiDAR survey was flown in June 2020. A comparison of the change in elevation between the 2020 LiDAR and the 2010 LiDAR does not indicate any changes of concern to the facility over that time period.

The 2020 routine inspections and annual site visit observations do not indicate any significant changes in the BTD, or any dam safety issues.

Changes to Surface Water Control

There were no changes to surface water control in 2020 and estimated seepage rates based on a simplified water balance accounting calculation are consistent with readings since 2013 (KCB 2014a).

OMS Manual and EPRP

The Operation, Maintenance and Surveillance (OMS) manual was being updated at the time of writing based on the template developed by Teck. Teck developed a Mine Emergency Response Plan (MERP) in March 2019, which incorporates the tailings and sedimentation pond Emergency Preparedness and Response Plan (EPRP) components (Teck 2019). The EPRP was reviewed and is suitable for the facility, although contact information should be updated to reflect current site personnel.

Dam Safety Review

The first DSR of the BTD was initiated in 2015 and finalized in 2016 (Golder 2016). Teck have addressed the recommendations from the 2016 DSR and there are none outstanding. The site visit for the latest DSR was completed in September 2020, and the report was in progress at the time of writing and is expected to be finalized in Q2 2021.

Summary of Recommendations

The observed performance of the BTD is consistent with past behavior and design requirements. There have been no significant changes to the condition of the structure during 2020. Recommendations are summarized in Table E-1. Closed recommendations are shown in grey italics and will be removed from the table in the next Annual Summary of Tailings Facility Performance report. Preliminary recommendations issued following the site visit were closed before this report was issued.

Priority guidelines, specified in the Code, are assigned to each recommendation by KCB. None of the outstanding recommendations are of a high priority nature and have been assigned Priority 4; in other words no issues that could be expected to result in a safety concern for the facility. Priority guidelines are as follows:

- Priority 1: A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant risk of regulatory enforcement.
- Priority 2: If not corrected could likely result in dam safety issues leading to injury, environmental impact or significant regulatory enforcement; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
- Priority 3: Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
- Priority 4: Best Management Practice – further improvements are necessary to meet industry best practices or reduce potential risks.

Table E-1 Summary of Recommendations

Structure	ID Number	Deficiency or Non-Conformance	Applicable Regulation or OMS Manual Reference	Recommended Action	Priority	Recommended Deadline / Status
Previous Recommendations Closed / Superseded						
BTD	*2017-01*	*Seismic Hazard Assessment for "Closure-Passive Care"*	*n/a*	*Following best practices, a site-specific seismic hazard assessment is recommended to support long-term performance of the dam. However, a site-specific seismic hazard assessment is not considered critical for BTD dam safety and Teck may seek an exemption for this Code requirement.*	*4*	*CLOSED*
BTD	*2019-02*	*Vegetation on Spillway Channel*	*OMS Manual*	*Clear vegetation growing within the spillway channel*	*3*	*CLOSED*
Previous Recommendations Ongoing						
BTD	2019-01	Piezometer Review and Decommissioning	n/a	Review which piezometers and wells are functioning and decommission those that are defunct. Re-label all active piezometers following the review.	4	Q4 2021 (piezometers re-labelled, decommissioning to be coordinated with drilling program)
BTD	2019-03	Survey Monuments	OMS Manual Section 6.3.3.2	Document the procedure used to survey the BTD survey monuments and include in the OMS Manual.	4	Q4 2021 (OMS Manual is being updated at the time of writing, Teck reviewing alternate technologies to achieve repeatable surveys)
2020 Recommendations – no new recommendations (recommendations closed prior to the issue of this report)						

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CLARIFICATIONS

This report is an instrument of service of Klohn Crippen Berger (KCB). The report has been prepared for the exclusive use of Teck Resources Limited. (Client) for the specific application to the Bullmoose Mine, and it may not be relied upon by any other party without KCB's written consent.

KCB has prepared this report in a manner consistent with the level of care, skill and diligence ordinarily provided by members of the same profession for projects of a similar nature at the time and place the services were rendered. KCB makes no warranty, express or implied.

Use of or reliance upon this instrument of service by the Client is subject to the following conditions:

1. The report is to be read in full, with sections or parts of the report relied upon in the context of the whole report.
2. The Executive Summary is a selection of key elements of the report. It does not include details needed for the proper application of the findings and recommendations in the report.
3. The observations, findings and conclusions in this report are based on observed factual data and conditions that existed at the time of the work and should not be relied upon to precisely represent conditions at any other time.
4. The report is based on information provided to KCB by the Client or by other parties on behalf of the client (Client-supplied information). KCB has not verified the correctness or accuracy of such information and makes no representations regarding its correctness or accuracy. KCB shall not be responsible to the Client for the consequences of any error or omission contained in Client-supplied information.
5. KCB should be consulted regarding the interpretation or application of the findings and recommendations in the report.

LIST OF ACRONYMS

Acronym	Definition
AEP	Annual Exceedance Probability
ASTFP	Annual Summary of Tailings Facility Performance
BC	British Columbia
BOC	Bullmoose Operating Corporation
BTD	Bullmoose Tailings Dam
CCR	Coarse Coal Rejects
CDA	Canadian Dam Association
DSR	Dam Safety Review
EDGM	Earthquake Design Ground Motion
EMLI	Ministry of Energy, Mines, and Low Carbon Innovation
EMPR	Ministry of Energy, Mines and Petroleum Resources (BC)
ENV	Ministry of Environment (BC)
EoR	Engineer of Record
EPRP	Emergency Preparedness and Response Plan
FMEA	Failure Mode and Effect Analysis
FSO	Facility Surveillance Officer
FoS	Factor of Safety
HSRC	Health, Safety and Reclamation Code for Mines in BC
IDF	Inflow Design Flood
KL	Klohn Leonoff
KCB	Klohn Crippen Berger Ltd.
MAC	Mining Association of Canada
MEM	Ministry of Energy and Mines
MRM	Monitoring Review Memorandum
NBCC	National Building Code of Canada
OMS	Operational, Maintenance and Surveillance
PGA	Peak Ground Acceleration
PMF	Probable Maximum Flood
QPO	Quantifiable Performance Objectives
SaRA	Species at Risk Act
TSF	Tailings Storage Facility
TWRS	Tailings and Water Retaining Structures

1 INTRODUCTION

1.1 General

KCB was engaged by Teck Resources Limited (Teck) to complete the 2020 Annual Summary of Tailings Facility Performance for the Bullmoose Tailings Dam (BTD), also previously referred to as the South Fork Tailings Dam. This report was prepared following:

- Section 10.5.3 of the Health, Safety and Reclamation Code for Mines in British Columbia (the Code) (MEM[2] 2017);
- Section 4.2 "Annual Tailings Facility and Dam Safety Inspection Report" of the 2016 HSRC Guidance Document (MEM[3] 2016); and
- Teck's Guidelines for Tailings and Water Retaining Structures (TWRS) (Teck 2019).

The 2020 site visit was completed by the Engineer of Record (EoR), Mr. Bob Chambers, P.Eng., and Mr. Stephen Clark, P.Eng., as representatives of KCB on July 22, 2020. The responsibilities of the TSF Qualified Person, as defined in the Code (MEM 2017), were performed by Mr. Mark Slater, P.Eng., of Teck in 2020. Routine and event-driven visual inspections were completed by Facility Surveillance Officer (FSOs) Mr. Rob Muise of Teck.

The annual performance report is issued before the end of the calendar year, so the period considered for climate data and instrumentation is from September 2019 to August 2020, herein referred to as the "review period".

1.2 Facility Description

The Bullmoose Mine site is located approximately 45 km west of Tumbler Ridge in northeastern BC, as shown on Figure 1. The mine has been inactive since 2003. The mine area is characterized by moderate topographic relief, with mountains several hundreds of meters above broad glacial and river formed valleys. The area is generally forested at lower elevations, with some ridgelines extending above tree line.

The BTD is a downstream-constructed embankment that forms a side-hill TSF located northeast of the former plantsite area, as shown on Figure 2. It is situated on the south flank of a broad valley bottom, with South Bullmoose Creek to the west and Bullmoose Creek to the north.

The facility was designed to store 4.6 million m^3 of tailings, with the potential to increase storage capacity if needed. A total of 4.4 million m^3 of fine coal refuse (i.e., tailings) were produced during operations (1983 to 2003) and stored in the facility. Currently, the average elevation of the tailings beach is El. 1118.5 masl.

The BTD is constructed of compacted coarse coal rejects (CCR) and has a minimum crest elevation of 1,123 masl. The dam crest varies from 10 m to 15 m wide and the embankment is approximately 1,050 m long. The dam maximum height is 38 m from crest to downstream toe. The BTD has a 15 m

[2] Now referred to as the Ministry of Energy, Mines, and Low Carbon Innovation (EMLI).
[3] Now referred to as the Ministry of Energy, Mines, and Low Carbon Innovation (EMLI).

wide low permeability zone extending from the starter dam along the upstream face. Refer to Drawing D-108 in Appendix III for typical cross-sections of the BTD. The downstream slope of the BTD was re-sloped to achieve the design 2.5H:1V slope in 2003 (BOC 2003).

The foundation consists of alluvial sands and gravels with interbedded silts and glacial till. The alluvial soils are sufficiently pervious to allow pond water to seep from the impoundment. As the thickness of the deposited tailings increased, the seepage rate decreased (Teck 2013a). There are two aquifers underlying the impoundment: an upper gravelly aquifer with piezometric level approximately 4 m below the original ground surface, which is similar to the elevation of Bullmoose Creek; and a lower gravelly aquifer with piezometric level 8 m to 10 m below the original ground surface. The two aquifers are reported to be separated by a low permeability glacial till layer.

There is an open channel spillway located at the west abutment of the BTD. The spillway was constructed in 2002 (BOC 2004). The spillway channel follows a southwesterly route from the tailings impoundment, discharging onto the natural ground at approximately El. 1,120 masl. The closure spillway invert is at El. 1,122 masl with a channel width of approximately 3 m and grades ranging from 3% to 1% (KCB 2015b). The spillway is excavated within overburden and bedrock. The portion excavated in overburden is armoured with riprap with D_{50} of 200 mm (KC 2004) and has side slopes of 2H:1V (KC 2002). The spillway excavated in bedrock has side slopes of 1H:1V (KC 2002) with no erosion protection.

A summary of BTD key information is presented in the Facility Data Sheet in Appendix I. The ultimate dam configuration is presented on design drawings in Appendix III.

1.3 Background Information and History

A summary of the available BTD reference documents is included in Appendix IV.

Coal production at Bullmoose Mine began in December 1983; the mine produced about 1.7 million tonnes of metallurgical coal and 0.6 million tonnes of thermal coal annually. Waste from the coal preparation process included CCR and fine coal refuse (i.e., tailings). Tailings production varied considerably depending on the ratio of thermal coal to metallurgical coal. Tailings were transported as slurry, 35% solids by weight, and deposited from a single discharge point located at the southern ridge of the impoundment.

Construction of the BTD began in 1983. A starter embankment, about 10 m high, was constructed of borrow material to store tailings from the first year of operations (KL 1984). Crest raises were constructed using downstream methodology to a final crest elevation of 1,122 masl. A layer of glacial till was placed on the crest for erosion protection (BOC 2003), which raised the tailings dam to El. 1,123 masl (based on 2010 LiDAR). However, field observations suggest the glacial till placement was likely not consistent (in terms of thickness and coverage) across the full length and width of the crest.

During operations, a diversion ditch was constructed upslope of the impoundment to divert approximately 14 ha away from the impoundment under normal conditions. The diversion channel was observed to be overgrown in 2015 (KCB 2016). KCB reviewed the water management of the facility in 2015 (KCB 2015b) and concluded that the diversion channel was no longer required to maintain an adequate water balance in the facility or to manage flood flows for dam safety.

Mine operations ceased in 2003 and the facility was reclaimed that same year. Reclamation work completed on the facility included re-sloping of the downstream slope and seeding on the tailings surface and dam slopes (upstream and downstream) (BOC 2003). There has been no construction since 2003.

The 2010 LiDAR survey indicates the current spillway invert and the crest elevations are 1 m higher than the post-construction as-built survey. This difference in survey does not impact this assessment as the difference in elevation between the crest and spillway invert (1 m) is the same for both surveys.

2 2020 ACTIVITIES

The Bullmoose TSF is a closed facility and does not require operational intervention, except for routine surveillance and maintenance activities. Vegetation was cleared from the BTD spillway in 2020 as part of routine maintenance under the OMS Manual (Teck 2018).

3 WATER MANAGEMENT, CLIMATE AND WATER ACCOUNTING

3.1 Water Management

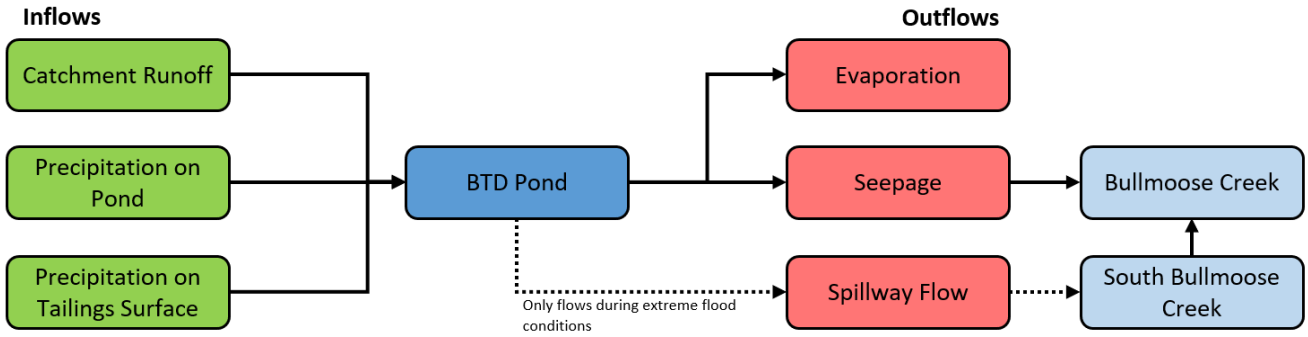
Under normal conditions, water enters the facility as runoff from the catchment, precipitation on the tailings impoundment and pond. Water accumulates in the low point of the tailings surface on the east side of the impoundment and exits as either seepage or evaporation with no surface discharge. The pond level typically fluctuates between El. 1115 masl and El. 1117 masl and has an estimated volume of 26,000 m^3 under normal conditions. The total catchment that reports to the BTD impoundment under normal conditions is 36 ha: 2 ha pond area; 18 ha impoundment area; and 16 ha upslope natural catchment.

Under flood conditions, the gravel roads upslope of the impoundment are assumed to be overtopped which increases the catchment by approximately 5 ha (KCB 2015b). Floods flows are still stored within the impoundment. If the pond were to rise above El. 1122 masl, under extreme conditions, water would discharge from the open channel spillway into South Bullmoose Creek.

The diversion channel was observed to be overgrown in 2015 (KCB 2016) and was assumed to not operate under normal or flood conditions. As discussed in Section 1.3, the diversion is not required to maintain an adequate water balance or to manage floods.

A flow schematic is shown on Figure 3.1. The catchment, spillway, and diversion channel are shown on Figure 4.

Figure 3.1 Flow Schematic for Bullmoose TSF



3.2 Climate

There is no climate station at the Bullmoose site. The nearest is the Environment Canada climate station at Chetwynd Airport (No. 1181508), approximately 62 km north at El. 610 masl. KCB prepared factors to correct precipitation and temperature data from Chetwynd Airport climate station to site conditions based on a comparison of climate data from the Chetwynd Airport climate station to the Bullmoose Climate station (No. 1181120 at El. 1,102 masl) between 1983 and 2002 when both stations were operated. Further discussion of the correlation factors is provided in Appendix V.

Corrected precipitation and temperature data for the Bullmoose during the review period (September 1, 2019 to August 31, 2020) and climate normals[4] are summarized in Table 3.1 and Figure 3.2:

- In general, monthly average daily temperatures in 2020 were warmer than the average temperatures, except for January and March.
- Total 2020 precipitation (863 mm) was greater than climate normals (793 mm), but lower than the total precipitation reported in the last annual performance reports (KCB 2018d, 2019, 2020a).
- The wettest months during 2020 were June and July which is typical. Precipitation events of note include the following, both were followed shortly after by visual inspections (refer to Section 4.1):
  - June 14th – 49 mm (similar to the largest precipitation events in previous years); and
  - July 1st to July 2nd – 70 mm.
- No precipitation was recorded at Chetwynd Airport climate station in February 2020.

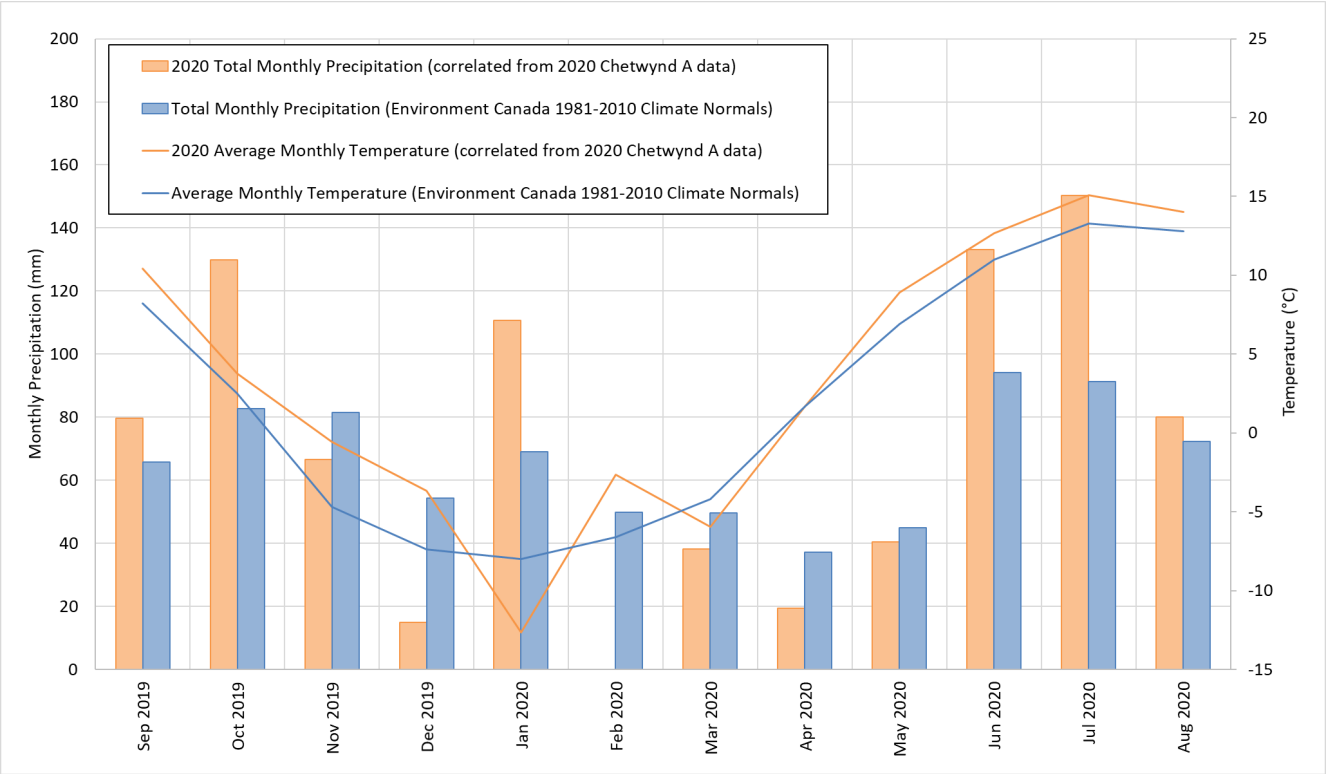
[4] Environment Canada climate normals for the Bullmoose site are based on data taken from 1982 to 2003.

Table 3.1 Climate Data for Bullmoose Site

Month	Normals Average Monthly Precipitation[1] (mm)	Corrected 2019-2020 Precipitation[2] (mm)	Climate Normals[1] Daily Temperature (°C)			2019 – 2020 Daily Temperature[3] (°C)		
			Max.	Min.	Average	Max.	Min.	Average
September	66	80	12.9	3.4	8.2	13.6	2.4	10.4
October	83	130	6.3	-1.2	2.5	6.2	-3.6	3.8
November	82	66	-1.0	-8.5	-4.7	2.9	-6.1	-0.6
December	54	15	-3.1	-11.6	-7.4	-0.2	-9.4	-3.7
January	69	111	-3.4	-12.6	-8.0	-8.0	-18.9	-12.7
February	50	0	-2.0	-11.2	-6.6	1.1	-9.7	-2.6
March	50	38	0.3	-8.7	-4.2	-2.0	-13.7	-5.9
April	37	19	6.7	-3.4	1.7	6.4	-7.8	1.7
May	45	40	12.4	1.5	6.9	13.9	-1.1	8.9
June	94	133	16.3	5.6	11.0	16.7	4.4	12.7
July	91	150	18.9	7.8	13.3	19.4	6.7	15.1
August	72	80	18.3	7.2	12.8	18.8	4.5	14.0
Total	**793**	**863**						

Notes:
1. Environment Canada Record - climate normals record based on Bullmoose climate station available data from 1981 to 2003.
2. 2020 annual and monthly precipitation were estimated using 2020 precipitation data from Chetwynd Airport climate station data and the precipitation correction factors summarized in Appendix V.
3. Bullmoose site monthly temperatures were estimated by applying temperature difference to monthly temperatures obtained from Chetwynd Airport climate station.

Figure 3.2 Climate Data for Bullmoose Mine Site – 2020 and Climate Normals



3.3 Water Accounting

Based on Figure 3.2, a simplified water accounting calculation for the review period was prepared (values rounded to the nearest hundred):

- Inflows:
  - Runoff from natural upstream catchment = 55,800 m^3 (assuming a runoff coefficient of 0.4);
  - Precipitation on pond surface = 17,600 m^3 (assumed pond surface on average is at El. 1,115.5 masl); and
  - Precipitation on tailings surface = 155,800 m^3 (average annual runoff coefficient of 0.6 assumed to account for water lost to evaporation from the beach surface and evapotranspiration).
- Outflows:
  - Evaporation from pond surface = 10,200 m^3 (evaporation rate for this site is 502 mm/year adopted from the Baseline Hydrology Report for the Quintette site (Teck 2013b)); and
  - Calculated seepage losses from the impoundment = 219,000 m^3 (the remainder of inflows minus evaporation).

Based on the water accounting calculation, average seepage losses from the impoundment are estimated at ~7 L/s over the review period. This is consistent with the estimated seepage rates over the past 6 years which ranged from 3 L/s (KCB 2014a) to 10 L/s (KCB 2019).

3.4 Freeboard and Flood Storage

3.4.1 Flood Storage

There is approximately 680,000 m^3 of flood storage in the facility between the Normal Operating Water Level (NOWL) and the spillway invert (KCB 2015b). The inflow design flood (IDF) for the BTD is the $^2/_3^{rds}$ between the 1,000-year return period and PMF, 24-hour duration event. The volume of the IDF is approximately 114,370 m^3 (KCB 2015b) which is less that one fifth of the available storage within the BTD under normal conditions. This indicates that a storm event significantly larger than the IDF (e.g., greater than a 30-day PMF) would be required to even raise the pond level to the spillway invert.

3.4.2 Freeboard

Based on a hydrotechnical assessment of the spillway (KCB 2015b), the minimum freeboard at the BTD during the IDF exceeds the minimum required as per the Code (Table 4.3), even assuming the pond level is at the spillway invert at the onset of the storm,. Freeboard requirements under normal flood conditions, as defined by CDA (2013), are also summarized in Table 4.3. Where available, freeboard measured during the review period based on monitoring records are also listed in Table 4.3.

Table 3.2 Freeboard for BTD

Freeboard (m) – Flood Conditions		Freeboard (m) – Normal Conditions	Freeboard Observed During the Review Period (September 1, 2019 to August 31, 2020)[3]
Minimum Required During IDF[1]	Minimum During IDF Based on Flood Routing[2]	Minimum Required Under Normal Conditions[1]	
0.2	0.5	0.4	7

Notes:
1. Based on CDA (2013), as reported in the hydrotechnical review by KCB (2015b).
2. Based on the hydrotechnical review by KCB (2015b).
3. As noted on Teck inspection forms.

4 MONITORING PROGRAM AND SITE OBSERVATIONS

4.1 Overview

The BTD monitoring program is summarized in Table 4.1, with comments on activities during the review period (September 2019 to August 2020). The monitoring program is appropriate for the existing conditions BTD given the long performance history of the dam, adequacy of instrumentation coverage, large flood storage capacity and provision of an open channel spillway.

Table 4.1 Summary of Monitoring Program

Surveillance Type/Task	Frequency	Responsible	OMS Compliance Met?	Notes for Review Period
Water Quality	Three times per year[1]	Teck FSO	Yes	Reported separately by Teck to the Ministry of Environment.
Routine Inspections	Monthly – March to November[2]	Teck FSO	Yes	No inspection completed in March due to heavy snow cover. November inspection had not occurred as of the time of writing.
Event-Driven Inspections	As required[3]	Teck FSO or Professional Geotechnical Engineer	Yes	Event-driven inspection conducted on July 3, 2020 in response to a significant rainfall event where 70 mm of rain fell between July 1 and July 2, 2020. No significant erosion was noted on the inspection form. No earthquake events occurred that triggered an inspection.
Piezometers	Annual	Teck	Yes	Read by KCB on behalf of Teck during the annual site visit.
Survey Monuments	Annual	Teck	No	LiDAR flown in 2020 in lieu of survey, Teck reviewing alternate technology to replace survey monuments.
Annual Summary of Tailings Facility Performance	Annual	EoR	Yes	This report
Dam Safety Review	Every 5 years	Third Party Consultant/ Qualified Registered Professional Engineer	Yes	Site visit completed in October 2020 by others. Reporting in progress at the time of writing.

Notes:
1. Three times per year – spring (freshet / high flow), summary, and fall (low flow).
2. Inspections are completed monthly when the site is accessible and when snow cover does not obstruct the inspection.
3. Triggers are defined for rainfall and earthquake events in the OMS Manual (Teck 2018).

4.2 Visual Inspections

There were no issues of concern noted during the routine and event-driven visual inspections. Inspection forms were provided to KCB and the TSF QP for review.

4.3 Annual Site Visit Observations and Photographs

Figure 3 provides an overview of the facility with 2020 photograph locations. Photographs are included in Appendix II. The following observations were made during the 2020 site visit:

- **Dam Crest**: Good condition. No signs of lateral movement, differential settlement or cracking of the dam crest
- **Downstream Slope and Toe**: Good condition. No signs of significant erosion, displacement, or bulging. Vegetation (grasses and moss) are well established.
  - A small erosion gulley was observed at the toe near the Right Abutment (Photo II-35). The gulley was first observed in 2017; in 2020, dimensions appeared similar to observations to previous DSIs (approximately 0.2 m to 0.3 m wide, 0.1 m deep and 10 m to 15 m long). The likely cause was concentrated local flow during spring freshet. This feature continues to be monitored and inspected for signs of change during routine visual inspections and annual site visits.
  - A small wet area was noted near the toe of the north arm of the BTD during the annual site visit (Photo II-45), which was first noted in 2019. There were no signs of seepage emerging from the downstream slope, and the wet area is believed to be due to ponding from snowmelt from the slopes.
- **Upstream Slope**: Good condition. No signs of significant erosion or displacement.
- **Left Abutment**: Good condition. The spillway is excavated through the left abutment, no signs of erosion at the abutment.
- **Right Abutment**: Good condition. No signs of significant erosion or displacement of the natural slope. Vegetation is well established at the abutment and along the abutment/downstream slope contact. There is a small channel running along the Right Abutment towards the toe which is unchanged from the 2018 condition (Photo II-32).
- **Tailings Impoundment and Pond**: A pond (approximately 2 ha) is located on the east side of the impoundment and is approximately 400 m from the spillway inlet. Outside of the pond, the impoundment surface is well vegetated. Away from the pond the tailings surface is well drained and supports human/animal traffic. The pond was below the pond level threshold stake at the time of the site visit.
- **Spillway:** Good condition. Minor vegetation in the spillway was noted in 2019. The vegetation in the spillway was cleared and spillway was noted to be clear during the 2020 site visit.

- **Historical Slope Failure on Natural Slope South of Impoundment:** A historical slope failure is present in the natural slope on the south side of the impoundment (Photo II-30). The failure is also visible in photographs from previous annual reports (Teck 2013a, KCB 2011, KCB 2014a, and KCB 2020a) indicating this has been present since at least 2010. The slide mass is overgrown with vegetation including small trees. Comparison of photographs between 2010 and 2020 does not indicate any visually identifiable changes. This feature is not a risk to the dam safety.

4.4 Piezometers

There are 13 functional piezometers at the BTD (11 standpipe piezometers and 2 pneumatic piezometers) as summarized on Figure 5, along with installation details and threshold levels. The piezometer locations are shown on Figure 3. Figure 6 summarizes recent and historical piezometer readings, while Figure 7 shows piezometric levels at select cross-sections of the facility. The following is a summary of key observations made based on the 2020 piezometer data:

- None of the measured piezometers exceed Threshold Level 1.
- PA-2, installed in the dam fill at the mid-slope, became dry in 2020 after exhibiting a gradual decreasing trend since 2014, providing evidence that the facility continues to drain down over time.
- Water levels at PA-4 and PA-5, installed at the downstream toe in the foundation and fill respectively, increased in 2020 by approximately 1 m; however, the most recent readings remain below historical maximums and are not a concern. The higher readings in 2020 appear to be the result of heavy rainfall that occurred in early July, which may have temporarily raised the water level. The rise does not appear to be related to a rise in phreatic surface because the instruments installed at the mid-slope, PA-1 and PA-2, have either been stable or decreasing over the same time period.
- Four monitoring wells in the vicinity of the BTD were measured for record purposes only, but are not part of the BTD surveillance program outlined in the OMS. The wells are not considered critical for on-going monitoring of the BTD. Water level readings in these wells agreed with the readings from nearby piezometers.
- The piezometer measurements show that pore pressures have been stable, and the dam shell is drained with low gradient of approximately 0.04 to 0.05 (KCB 2018c).

The procedure for responding to a piezometer exceedance is outlined in the OMS Manual (Teck 2018). The thresholds are being reviewed as part of the on-going update to the OMS Manual.

4.5 Survey Monuments

There are seven survey monuments on the crest of the BTD. These were not surveyed during 2020, as Teck are reviewing alternative methods to monitor embankment displacements moving forward due to issues with repeatability of the survey. In lieu of surveying monuments, Teck completed a LiDAR survey of the facility in 2020. The 2020 LiDAR surveys is approximately 0.3 m higher than the 2010

survey across the site, including areas where little to no change would be expected (e.g. bedrock outcrops). This difference is likely due to a change in survey datum used between the two surveys. The only area of the TSF which shows movement beyond this offset is the tailings beach which indicates settlement between 0.5 m and 1 m, with the greatest settlement occurring near the ponded area on the east side of the impoundment. The survey comparison does not show displacement trends or magnitude of concern (i.e., no slumping or toe bulging).

The procedure for responding to a survey monument threshold exceedance is outlined in the OMS Manual (Teck 2018). The thresholds and alternative monitoring methods are being reviewed as part of the on-going update to the OMS Manual.

4.6 Pond Level

Teck installed a permanent pond indicator approximately 1 m above the steady state pond level as Threshold Level 1 marker. The pond level indicator is checked visually during routine and event-driven inspections and is considered appropriate for on-going monitoring of the BTD pond level. Freeboard QPOs adopted for the BTD are summarized in the OMS Manual (Teck 2018).

There were no freeboard exceedances noted during the reporting period. As noted in Table 3.2 in Section 3.4.2, the minimum freeboard observed during the reporting period was 7 m which greatly exceeds the minimum required freeboard and the pond level would only approaches the spillway during extreme conditions (Section 3.4.1).

4.7 Discharge Water Quality

Inflows and outflows at the Bullmoose TSF are summarized in Section 3.1. Groundwater sampling wells are installed downstream of the tailings dam, with samples collected for water quality analyses. Teck have indicated that there have been no water quality exceedances and that the monitoring frequency meets their permit requirements. Teck reports the results to the Ministry of Environment (ENV) as specified in Permit No. PE-06757.

5 TAILINGS FACILITY SAFETY ASSESSMENT

5.1 Design Basis Review

The relevant criteria from CDA (2014) and the Code (MEM 2016, 2017) are compared in Table 5.1. The existing facility has been evaluated based on the "Closure-Passive Care" design criteria from CDA, which meet or exceed the criteria outlined in the Code (MEM 2017) for "High" consequence tailings facilities.

Table 5.1 Comparison of CDA and HSRC Design Criteria for Tailings Dams Classified as "High"

Parameter	CDA (2014) Closure – Passive Care	HSRC (MEM 2016, 2017)[1][2]
IDF Annual Exceedance Probability (AEP)	$^2/_3$ Between 1,000-Year and PMF	$^1/_3$ Between 975-Year and PMF
Earthquake Design Ground Motion (EDGM) AEP	½ Between 2,475-Year and 10,000-Year	2,475-Year
FoS for Slope Stability: 1) Static – Long-term 2) Pseudo-Static 3) Post-Earthquake	 1.5 1.0 1.2	 1.5 Not Specified Not Specified
Steepest Allowable Downstream Slope	Not Specified	2H:1V

Notes:
1. The HSRC Code (MEM 2017) does not specify IDF or EDGM for "Closure-Passive Care" phase.
2. Clause 10.1.19 (2) of the Code (MEM 2017) states that "*Sections 10.1.8 [Seismic and Flood Design Criteria], 10.1.9 [Design Slopes], and 10.1.10 [Minimum Static Factor of Safety] of this code do not apply to mines with respect to which the chief inspector has received an application for a permit before the date on which this subsection comes into force.*"

5.2 Dam Safety Review

The first DSR of the BTD was initiated in 2015 and finalized in 2016 (Golder 2016). Teck have addressed the recommendations from the 2016 DSR and there are none outstanding. To comply with the Code requirement to complete a DSR every 5 years, in 2020 Teck engaged Thurber to complete the next DSR. The site visit was completed in September 2020. The DSR was in progress at the time of writing and will be finalized in 2021.

5.3 Failure Modes Review

KCB understands that Teck's long-term goal for all of their tailings facilities is to reach landform status with all potential failure modes that could result in catastrophic release of tailings and/or water being either not present or having been reduced to non-credible. Teck's long-term goal for the BTD is for all potential failure modes to be non-credible based on extreme loading conditions, or loading conditions appropriate using the principles of ALARP (i.e., As Low as Reasonably Practicable) when it is not practical to consider extreme conditions. Evaluation of failure modes with respect to this goal is ongoing.

The BTD risk assessment was reviewed by Teck and KCB representatives in 2019. There have been no significant changes to the key hazards and the existing controls were adequate to manage potential failure modes with compliance and risk limits.

The potential failure modes included in the CDA Dam Safety Guidelines (2013) were reviewed based on the site visit and review of available documents:

- **Overtopping:** The pond level (visually estimated) is typically 8 m below spillway invert level. At this level, the available flood storage before spilling is more than 5 times the IDF volume (KCB 2015b) (see Sections 3.4.1 and 5.6.2 for more details). An event more extreme than the IDF is required to precede the IDF before the spillway would be engaged. Despite this, the spillway was designed to safely route the IDF, with freeboard, assuming the pond is at the spillway invert level at the start of the storm (KCB 2015b). If the spillway was completely blocked and the pond was at the spillway invert at the start of the IDF event, the IDF can be contained with 0.4 m freeboard.

  Internal Erosion and Piping: The dam is a semi-pervious design (i.e., no compacted core or seepage barrier) which allows seepage flow through the dam fill, so the filter compatibility of the fill types and native materials was checked as part of the design process (KCB 2014c). The dam is constructed with zones of CCR, which were compacted differently to provide zoning. This includes a drainage blanket of lightly compacted CCR, which was designed to draw down the phreatic surface (BOC 1982). As-built gradations of the tailings and embankment fill materials were found to be filter compatible (KCB 2015a). Hydraulic gradients in the dam shell have been consistent over the past several years (approximately 0.04) and are well below the average critical gradient required to erode the dam fill (0.11) (KCB 2018c).

- **Slope Instability - Static:** The dam is composed of compacted fill with a free draining downstream shell and drainage layers. The downstream slope of the dam is 2.5H:1V (BOC 2003). The FoS reported in design was greater than 1.7 (KC 1996), which exceeds the Code requirements. This analysis and the long performance history with no visible or documented signs of instability indicates that the current condition of the structure is stable under normal loading.

- **Surface Erosion:** Both upstream and downstream slopes of the dam have a vegetation cover to protect against surface erosion. The erosion gully at the east downstream toe (Photo II-35) appeared to be well vegetated, indicating the erosion has not progressed since its formation.

  - Shallow rills were observed on the downstream slope. The rills appear to be stable based on comparison with previous photographs.

  - The existing rills and gulley do not represent a dam safety concern. On-going surface erosion represents a maintenance issue as part of long-term closure.

- **Toe Erosion During Bullmoose Creek Flood:** The maximum flood level in Bullmoose Creek near the BTD during the IDF[5] event is 2 m below Bullmoose Mine Road (see Figure 2 for

[5] $^{2}/_{3}$ between 1,000-year and PMF event

Bullmoose Mine road location) and the flood inundation extent is at least 40 m (horizontal) from the BTD toe (KCB 2018b).

- **Slope Stability - Earthquakes:** KCB (2017c) completed a pseudo-static assessment (Hynes-Griffen and Franklin 1984). The assessment determined that the yield ground acceleration that would cause FoS < 1 is 0.16g. The BTD would have to experience a PGA of approximately 0.32g before deformation greater than 1 m can be expected (KCB 2017c). This PGA greatly exceeds the EDGM for the facility of 0.12g, which was calculated based on a site-specific seismic hazard assessment (KCB 2020b) which indicates that the facility meets the Code requirements for stability under seismic conditions. The BTD has approximately 8 m of freeboard under normal conditions which is much greater than anticipated vertical settlements.

Based on the above, key hazards related to the BTD are being managed effectively under current conditions and external hydrological and seismic loading events. Teck have indicated that the BTD is a candidate for long-term landform status and KCB will be working with Teck over the near-term to establish the full nature of that candidacy.

5.4 Upstream and Downstream Conditions Review

5.4.1 Upstream

There have been no significant changes in the upstream condition since mine closure in 2003. No infrastructure is located upstream of the BTD TSF with the exception of forestry service/recreational roads, and a diversion ditch described in Section 1.3.

5.4.2 Downstream

The downstream conditions were assessed as part of a flood inundation study (KCB 2014b) and there have been no significant changes since that time

5.5 Dam Consequence Classification Review

The BTD was assigned a “High” consequence classification (KCB 2014b), based on the CDA (2013) classification system. The classifications assigned for each of the categories considered in CDA (2013) consequence classification system are summarized in Table 5.2. The current assessment remains appropriate as there has been no significant change in the dam failure modes or area downstream.

Table 5.2 Classification of BTD Based on Consequence Category

Population at Risk	Loss of Life	Economic and Social Loss	Environmental and Cultural Losses
No Permanent Population	Significant	High	High

5.6 Physical Performance

5.6.1 Geotechnical

The facility has performed adequately for over 30 years and has shown no indications of geotechnical instability. There have been no significant changes to the geotechnical characteristics of the facility since operations ceased in 2003. As noted in Section 4, there were no threshold exceedances or unusual conditions observed during the review period, and instrumentation readings were consistent with historic trends and expected behaviour.

5.6.2 Hydrotechnical

The hydrotechnical performance of the facility during the review period was consistent with historic trends and expectations. There have been no significant changes to the spillway or water management system since operations ceased in 2003. As noted in Section 4, there were no pond level exceedances or unusual conditions observed during the review period.

5.7 Operational Performance

The BTD has been closed since 2003 and there are no operational requirements.

5.8 Documentation Review

5.8.1 Operation, Maintenance and Surveillance Manual

The most recent Operation, Maintenance, and Surveillance (OMS) manual was issued in 2018 (Teck 2018). Teck were in the process of updating the OMS manual in 2020 into the new format that Teck developed.

The OMS document meets the CDA (2013) and Teck (2019) TWRS guidelines and the document follows the format recommended in MAC (2011).

5.8.2 Emergency Preparedness and Response Plan

The BTD EPRP was incorporated into the Bullmoose Mine Emergency Response Plan (MERP) dated March 27, 2019. BTD management and incident command organization charts are up to date in the MERP document. A review of the MERP by the EoR is scheduled for 2020.

6 SUMMARY AND RECOMMENDATIONS

The observed performance of the BTD is consistent with past behavior and design requirements. There have been no significant changes to the condition of the structure during 2020.

Recommendations are summarized in Table 6.1. Closed recommendations are shown in grey italics and will be removed from the table in the next Annual Summary of Tailings Facility Performance report. Preliminary recommendations issued following the site visit were closed before this report was issued.

Priority guidelines, specified in the Code, are assigned to each recommendation by KCB. Priority guidelines are as follows:

- Priority 1: A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant risk of regulatory enforcement.
- Priority 2: If not corrected could likely result in dam safety issues leading to injury, environmental impact or significant regulatory enforcement; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
- Priority 3: Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
- Priority 4: Best Management Practice – further improvements are necessary to meet industry best practices or reduce potential risks.

Table 6.1 Summary of Recommendations

Structure	ID Number	Deficiency or Non-Conformance	Applicable Regulation or OMS Manual Reference	Recommended Action	Priority	Recommended Deadline / Status
Previous Recommendations Closed / Superseded						
BTD	*2017-01*	*Seismic Hazard Assessment for "Closure-Passive Care"*	*n/a*	*Following best practices, a site-specific seismic hazard assessment is recommended to support long-term performance of the dam. However, a site-specific seismic hazard assessment is not considered critical for BTD dam safety and Teck may seek an exemption for this Code requirement.*	*4*	*CLOSED*
BTD	*2019-02*	*Vegetation on Spillway Channel*	*OMS Manual*	*Clear vegetation growing within the spillway channel*	*3*	*CLOSED*
Previous Recommendations Ongoing						
BTD	2019-01	Piezometer Review and Decommissioning	n/a	Review which piezometers and wells are functioning and decommission those that are defunct. Re-label all active piezometers following the review.	4	Q4 2021 (piezometers re-labelled, decommissioning to be coordinated with drilling program)
BTD	2019-03	Survey Monuments	OMS Manual Section 6.3.3.2	Document the procedure used to survey the BTD survey monuments and include in the OMS Manual.	4	Q4 2021 (OMS Manual is being updated at the time of writing, Teck reviewing alternate technologies to achieve repeatable surveys)
2020 Recommendations – no new recommendation (recommendations closed prior to the issue of this report)						

7 CLOSING

We thank you for the opportunity to work on this project. Should you have any questions, please do not hesitate to contact the undersigned.

Yours truly,
KLOHN CRIPPEN BERGER LTD.

Max Cronk, P.Eng.
Project
Civil Engineer

Robert W. Chambers, P.Eng.
Senior Geotechnical Engineer, Principal

MC/LN:jc

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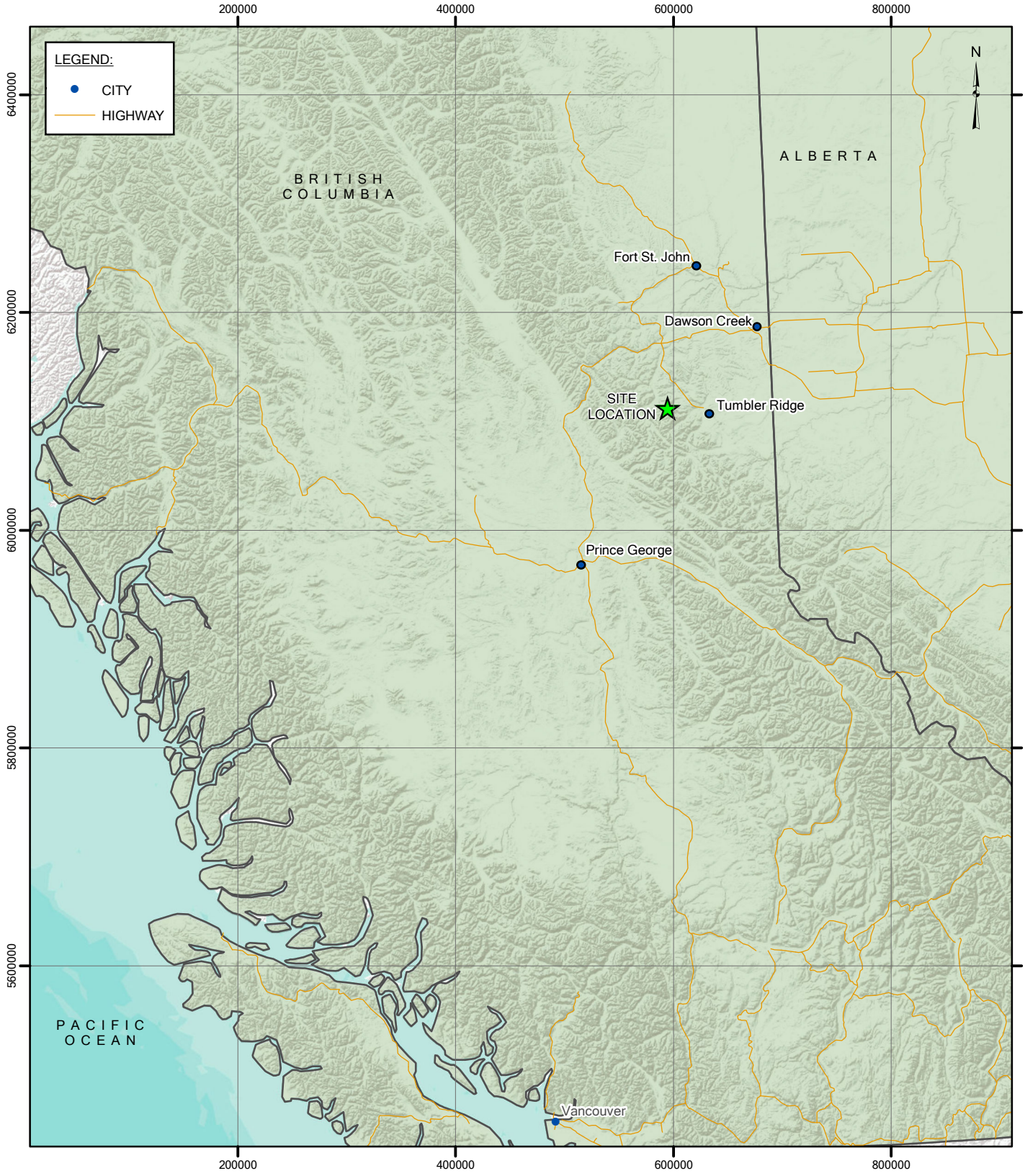
FIGURES



NOTES:
1. PROJECTION: NAD83 UTM ZONE 10N.
2. BASE DATA: ESRI.

SCALE 0 100,000 m

CLIENT: Teck

Klohn Crippen Berger

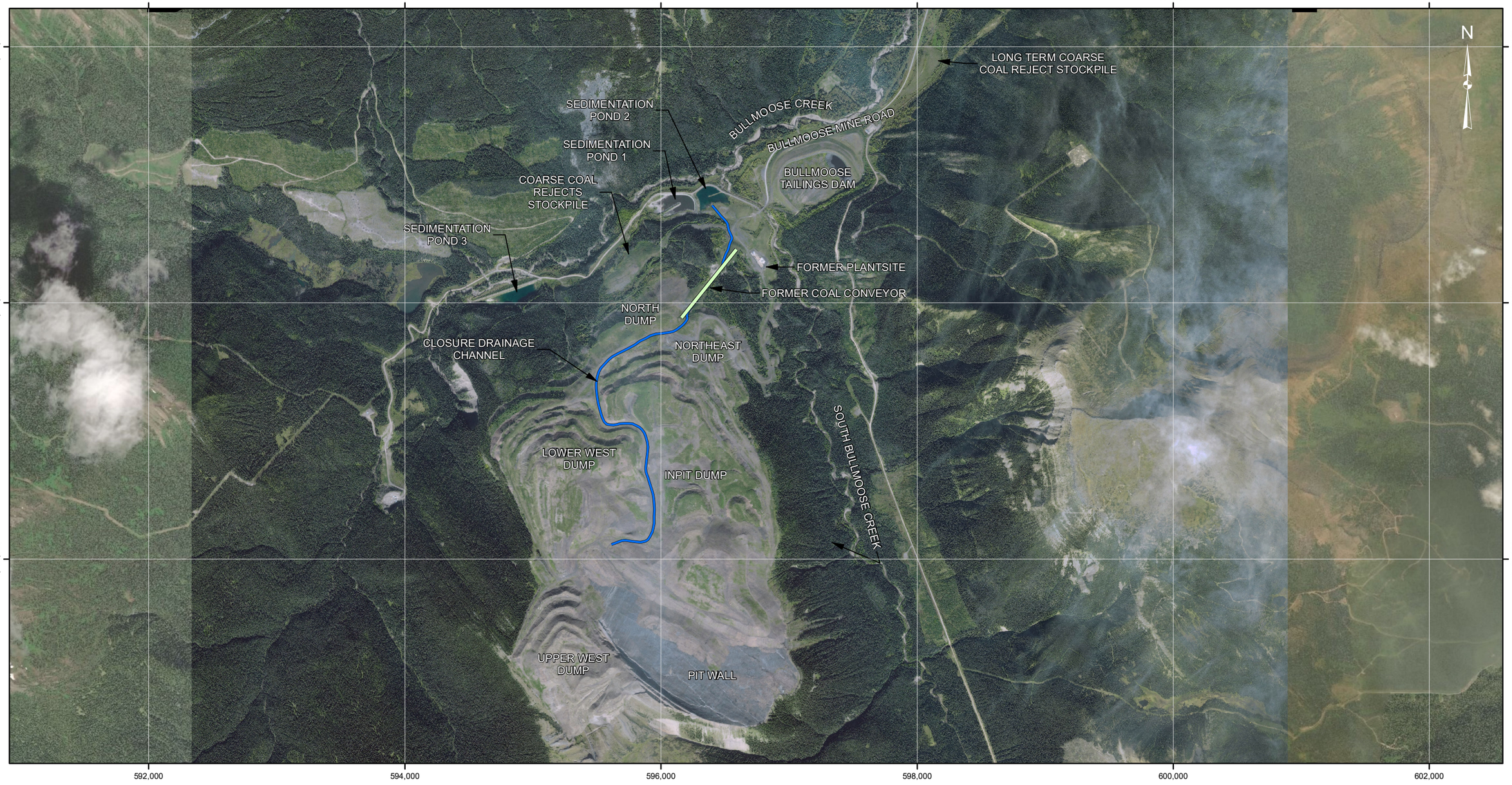
PROJECT: BULLMOOSE MINE
2020 ANNUAL REVIEW

TITLE: SITE LOCATION

PROJECT No. M09893A11

FIG No. 1

Path: Z:\MVCR\M09893A09-TML-Bullmoose 2019 Consulting\400 Drawings\GIS\02 Maps\Reports\DSI 2019\BTD\Site Location.mxd afischer



NOTES:
1. PROJECTION: NAD83 UTM ZONE 10N.
2. BASE DATA: ESRI.
3. SEPTEMBER 2013 IMAGERY FROM TECK.

SCALE 0 1000 m

CLIENT: Teck

Klohn Crippen Berger

PROJECT: 2020 ANNUAL SUMMARY

TITLE: GENERAL SITE PLAN

PROJECT No. M09893A11

FIG No. 2

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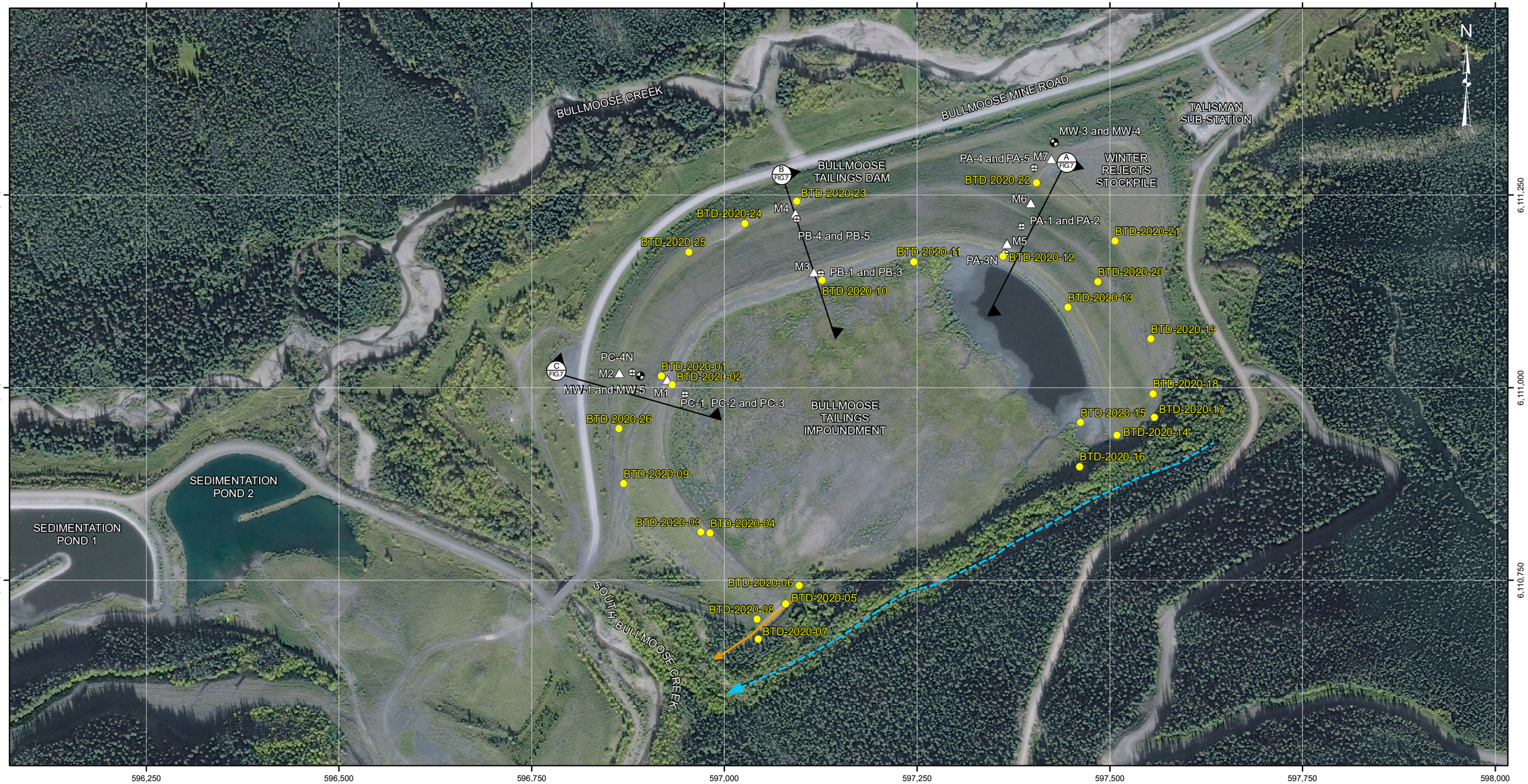

NOTES:
1. PROJECTION: NAD83 UTM ZONE 10N.
2. SEPTEMBER 2013 IMAGERY FROM TECK.

LEGEND:

- BTD-2020-01 — 2020 DSI PHOTOGRAPH LOCATION
- M1 — SURVEY MONUMENT
- PC-4N — PIEZOMETER
- MW1 — MONITORING WELL
- SPILLWAY
- DIVERSION CHANNEL (OVERGROWN)

SCALE 0 150 m

CLIENT: Teck

Klohn Crippen Berger

PROJECT: 2020 ANNUAL SUMMARY

TITLE: BULLMOOSE TAILINGS DAM GENERAL ARRANGEMENT

PROJECT No. M09893A11

FIG No. 3

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595,500 596,000 596,500 597,000 597,500 598,000 598,500 599,000

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6,110,000

N

BULLMOOSE CREEK

BULLMOOSE MINE ROAD

TALISMAN SUB-STATION

BULLMOOSE TAILINGS DAM

WINTER REJECTS STOCKPILE

BULLMOOSE TAILINGS IMPOUNDMENT

WEST BULLMOOSE CREEK

SEDIMENTATION POND 2

SEDIMENTATION POND 1

SOUTH BULLMOOSE CREEK

NOTES:
1. PROJECTION: NAD83 UTM ZONE 10N.
2. SEPTEMBER 2013 IMAGERY FROM TECK.

LEGEND:

- SPILLWAY
- DIVERSION CHANNEL (OVERGROWN)
- CATCHMENT AREA – NORMAL CONDITIONS
- ADDITIONAL CATCHMENT AREA – FLOOD CONDITIONS

SCALE 0 250 m

CLIENT: Teck

Klohn Crippen Berger

PROJECT: 2020 ANNUAL SUMMARY

TITLE: BULLMOOSE TAILINGS DAM CATCHMENT

PROJECT No. M09893A11

FIG No. 4

Path: Z:\MV\CR\M09893A11-TML-Bullmoose 2020 Consulting\400 Drawings\GIS\Reports\Annual_Summary\Fig4_BTD_Catchment.mxd

SECTION	PIEZOMETER	COORDINATES (m) (SEE NOTE 1)		ORIGINAL GROUND (masl) (SEE NOTE 2)	EXISTING GROUND ELEVATION (masl) (SEE NOTE 3)	PIEZO. SCREEN / TIP ELEVATION (masl)	MEASURED STICKUP (m)	2020 PNEUMATIC READING (PSI)	2020 STANDPIPE READING (m)	2020 DSI WATER ELEVATION (masl)	WATER ELEVATION LOWER THAN (IF DRY)	THRESHOLD (LEVEL 1) (masl)	WATER LEVEL ABOVE ORG. GROUND (m)	2019 DSI WATER ELEVATION (masl)	CHANGE FROM 2019 (m)	PIEZOMETER LOCATION	
		EASTING	NORTHING													LOCATION	UNIT
SECTION A	PA-1 (RELABELLED IN 2017)	597396	6111244	1084.0	1112.5	1077.3	0.76		34.8	1077.3	-	≥1100.0	-6.7	1078.3	-1.0	DOWNSTREAM SLOPE	FOUNDATION
	PA-2 (RELABELLED IN 2017)	597396	6111244	1084.0	1112.5	1083.4	0.71	-	30.4	DRY	1082.8	≥1100.0	N/A	1083.5	N/A	DOWNSTREAM SLOPE	DAM
	PA-4	597402	6111284	1081.0	1092.7	1077.3	1.74	-	11.1	1083.4	-	≥1088.0	2.4	1082.4	1.0	DOWNSTREAM SLOPE	FOUNDATION
	PA-5	597402	6111284	1081.0	1092.7	1079.0	1.83	-	11.3	1083.2	-	≥1088.0	2.2	1082.2	1.0	DOWNSTREAM SLOPE	DAM
	PA-3N	597364	6111174	1082.0	1123.0	1094.8	-	0	-	DRY	1094.8	≥1107.0	N/A	1095.0	N/A	CREST	DAM
	NO LABEL (MW-3)	597428	6111318	1076.7	1090.0	1053.7	1.30	-	22.3	1069.0	-	≥1095.0	-7.7	1070.6	-1.6	DOWNSTREAM SLOPE	FOUNDATION
	NO LABEL (MW-4)	597428	6111318	1076.7	1090.0	1068.3	1.23	-	15.6	1075.6	-	≥1095.0	-1.1	1076.5	-0.9	DOWNSTREAM SLOPE	FOUNDATION
SECTION B	NO LABEL (LIKELY PB-1)	597126	6111148	1086.0	1123.0	1081.9	0.20	-	40.0	DRY	1083.2	≥1107.0	N/A	DRY	N/A	CREST	FOUNDATION
	PB-3	597126	6111148	1086.0	1123.0	1099.5	1.06	-	24.2	DRY	1099.9	≥1107.0	N/A	DRY	N/A	CREST	DAM
	PB-4	597094	6111219	1086.0	1100.5	1080.1	1.33	-	22.0	DRY	1079.8	≥1095.0	N/A	1081.8	N/A	DOWNSTREAM SLOPE	FOUNDATION
	PB-5	597094	6111219	1086.0	1100.5	1081.6	1.36	-	20.2	DRY	1081.7	≥1095.0	N/A	1081.9	N/A	DOWNSTREAM SLOPE	FOUNDATION
SECTION C	PC-1	596949	6110991	1091.0	1120.5	1083.7	1.04	-	38.0	DRY	1083.5	≥1110.0	N/A	1085.5	N/A	CREST	FOUNDATION
	PC-2	596949	6110991	1091.0	1120.5	1090.3	1.74	-	30.6	DRY	1091.6	≥1110.0	N/A	DRY	N/A	CREST	DAM
	PC-3	596949	6110991	1091.0	1120.5	1101.8	1.38	-	19.6	DRY	1102.3	≥1110.0	N/A	DRY	N/A	CREST	DAM
	NO LABEL (MW-1/MW-5)	596891	6111015	1093.5	1111.5	UNKNOWN	0.68	-	26.6	DRY	1085.6	-	N/A	1089.3	N/A	DOWNSTREAM SLOPE	FOUNDATION
	NO LABEL (MW-1/MW-5)	596891	6111015	1093.5	1111.5	UNKNOWN	1.04	-	18.4	DRY	1094.1	-	N/A	1094.8	N/A	DOWNSTREAM SLOPE	FOUNDATION
	PC-4N	596881	6111020	1094.0	1109.5	1093.5	-	0	-	DRY	1093.5	≥1100.0	N/A	1094.4	N/A	DOWNSTREAM SLOPE	FOUNDTATION

NOTES

1. COORDINATES LOCATIONS ARE FROM GPS READINGS (NAD83 UTM ZONE 10N).
2. ORIGINAL GROUND ELEVATION IN TABLE ARE FROM KL (1982).
3. EXISTING GROUND ELEVATIONS WERE PROVIDED BY TECK.

CLIENT: Teck

Klohn Crippen Berger

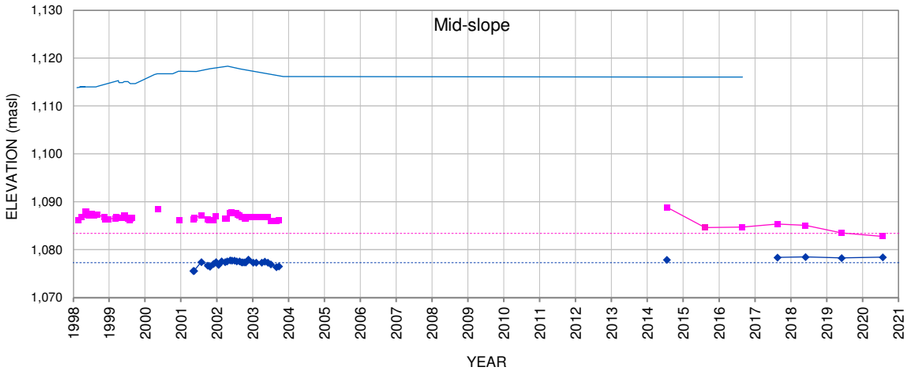
PROJECT: BULLMOOSE TAILINGS DAM
2020 PIEZOMETER READINGS

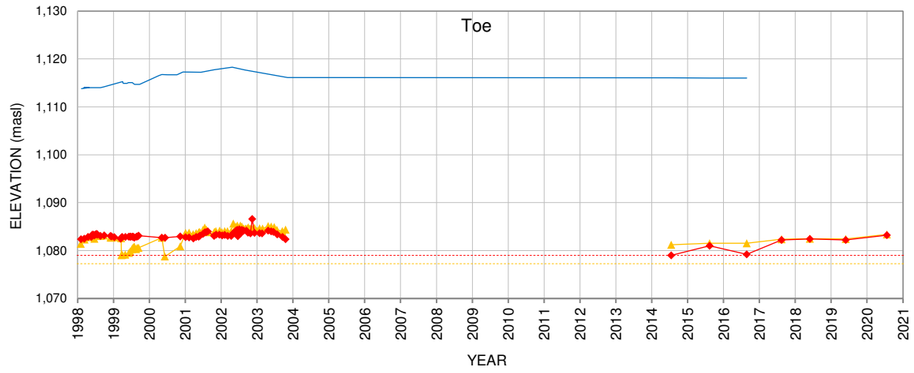
TITLE: BULLMOOSE TAILINGS DAM
2020 PIEZOMETER READINGS

PROJECT No. M09893A11

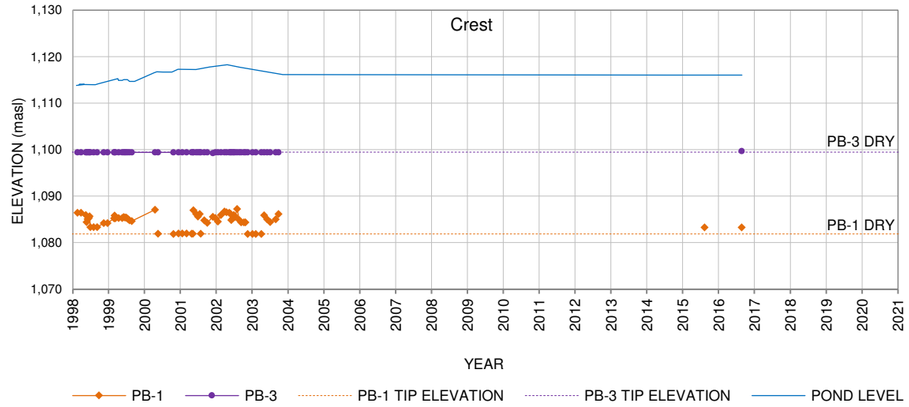
FIG. No. 5

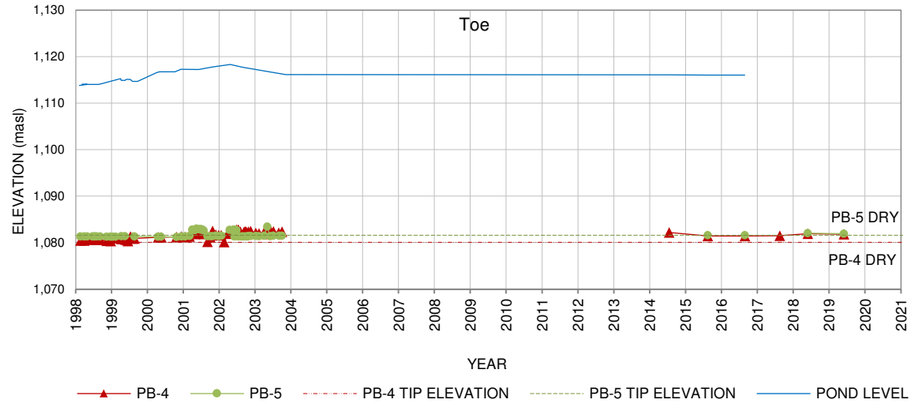
Date & Time: 2020-11-16 16:21
Figure File: Z:\M\VCR\M09893A11-TML-Bullmoose 2020 Consulting\300 Design\303 Instrumentation\BTD Piezometer\[200928 Bullmoose Piezometer.xlsx]Figure A



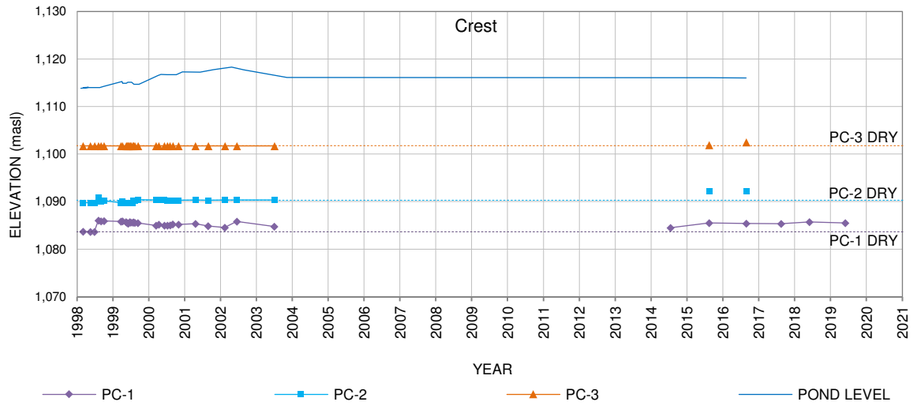


INSTRUMENTATION SECTION A





INSTRUMENTATION SECTION B



INSTRUMENTATION SECTION C

CLIENT: Teck

Klohn Crippen Berger

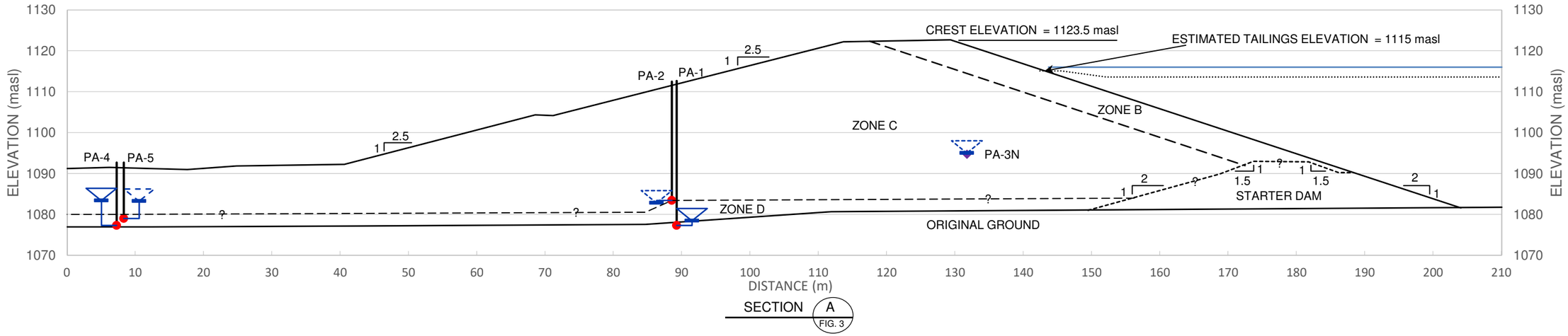
PROJECT: BULLMOOSE TAILINGS DAM
2020 PIEZOMETER READINGS

TITLE: BULLMOOSE TAILINGS DAM
HISTORICAL PIEZOMETER READINGS

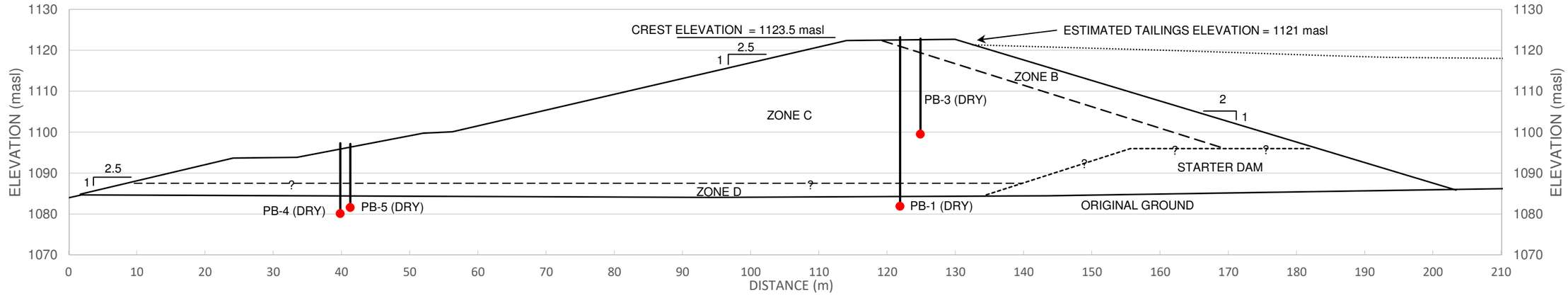
PROJECT No. M09893A11

FIG. No. 6

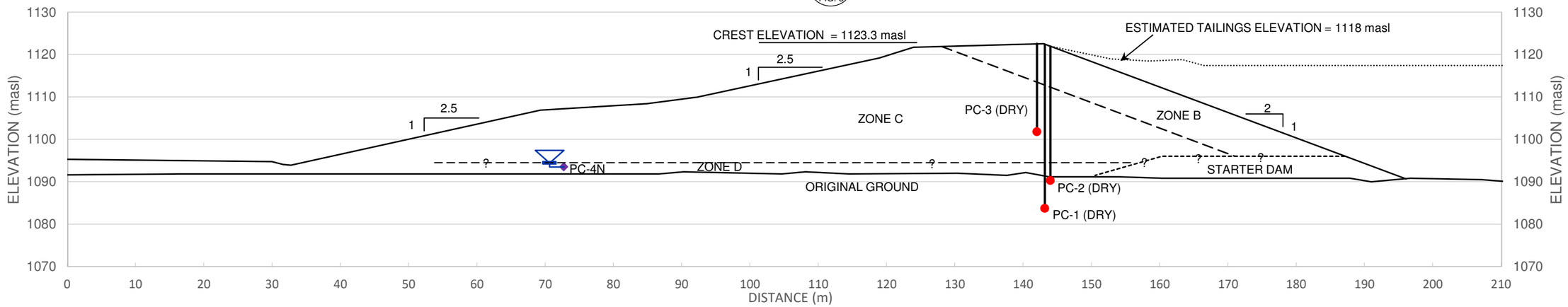
Date & Time: 2020-11-16 16:21
Figure File: Z:\M\VCR\M09893A11-TML-Bullmoose 2020 Consulting\300 Design\303 Instrumentation\BTD Piezometer\[200928 Bullmoose Piezometer.xlsx]Figure A



SECTION A (FIG. 3)



SECTION B (FIG. 3)



SECTION C (FIG. 3)

NOTES:

1. SECTION DRAWINGS PRODUCED BY TECK (2004).
2. STARTER DAM SECTION OBTAINED FROM KLOHN LEONOFF (1984).
3. ZONE B AS-BUILT PRODUCED BY TECK (2000).

LEGEND:

- STANDPIPE PIEZOMETER TIP
- PNEUMATIC PIEZOMETER TIP
- EMBANKMENT PIEZOMETER WATER LEVEL
- FOUNDATION PIEZOMETER WATER LEVEL

Klohn Leonoff (1982 Design Report:

ZONE	MATERIAL	LIFT THICKNESS	COMPACTION* %Standard proctor
A Impervious	Silty sand & gravel (borrow)	0.3m	98%
B low permeability	Coarse refuse	0.15m	98%
C General Fill	Coarse refuse	0.5m	98%
D Drainage	Coarse refuse	1.0m	95%

* 98% standard proctor should be achieved with 4 passes with a large vibratory roller and 95% with about 2 passes

CLIENT: Teck

Klohn Crippen Berger

PROJECT: BULLMOOSE TAILINGS DAM
2020 PIEZOMETER READINGS

TITLE: BULLMOOSE TAILINGS DAM
INSTRUMENTATION SCHEMATIC
SECTIONS A, B AND C

PROJECT No. M09893A11

FIG. No. 7

Date & Time: 2020-11-16 16:21
Figure File: Z:\MVCR\M09893A11-TML-Bullmoose 2020 Consulting\300 Design\303 Instrumentation\BTD Piezometer\[200928 Bullmoose Piezometer.xlsx]Figure A

MONUMENT	NORTHING (m)							
	October 15, 2015	December 14, 2015	February 22, 2016	September 6, 2016	February 21, 2017	May 21, 2017	October 4, 2018	July 2, 2019
M1	5082.830	5082.822	5082.849	5082.857	5082.853	5082.845	5082.853	5082.843
M2	5100.194	5100.186	5100.212	5100.220	5100.220	5100.208	5100.216	5100.205
M3	5231.547	5231.543	5231.560	5231.565	5231.551	5231.559	5231.563	5231.558
M4	5307.344	5307.335	5307.356	5307.357	5307.357	5307.355	5307.357	5307.355
M5	5257.995	5257.994	5258.012	5258.013	5258.012	5258.008	5258.012	5258.011
M6	5320.391	5320.390	5320.407	5320.409	5320.403	5320.405	5320.407	5320.406
M7	5371.856	5371.852	5371.865	5371.869	5371.869	5371.868	5371.869	5371.869

MONUMENT	EASTING (m)							
	October 15, 2015	December 14, 2015	February 22, 2016	September 6, 2016	February 21, 2017	May 21, 2017	October 4, 2018	July 2, 2019
M1	5239.400	5239.394	5239.434	5239.422	5239.407	5239.408	5239.410	5239.408
M2	5181.277	5181.269	5181.313	5181.301	5181.279	5181.286	5181.288	5181.285
M3	5438.104	5438.101	5438.120	5438.113	5438.113	5438.106	5438.108	5438.106
M4	5408.275	5408.271	5408.292	5408.289	5408.281	5408.281	5408.282	5408.280
M5	5687.275	5687.268	5687.275	5687.269	5687.274	5687.271	5687.272	5687.271
M6	5715.759	5715.756	5715.760	5715.757	5715.764	5715.760	5715.758	5715.760
M7	5739.531	5739.534	5739.532	5739.527	5739.531	5739.529	5739.530	5739.529

MONUMENT	ELEVATION (m)							
	October 15, 2015	December 14, 2015	February 22, 2016	September 6, 2016	February 21, 2017	May 21, 2017	October 4, 2018	July 2, 2019
M1	125.512	125.524	125.505	125.502	125.511	125.496	125.500	125.498
M2	109.830	109.845	109.827	109.823	109.835	109.817	109.818	109.825
M3	125.762	125.773	125.751	125.753	125.748	125.754	125.746	125.745
M4	100.020	100.020	100.018	100.014	100.018	100.013	100.008	100.008
M5	125.863	125.860	125.846	125.849	125.857	125.846	125.845	125.850
M6	100.320	100.322	100.315	100.312	100.313	100.307	100.313	100.310
M7	95.748	95.753	95.755	95.747	95.750	95.749	95.755	95.762

NOTES:

1. SURVEY DATA PROVIDED BY TECK RESOURCES LTD. LATEST READINGS RECEIVED ON NOV 5, 2019.
2. BASE READING: OCTOBER 2015
3. SURVEY COORDINATES ARE MEASURED USING LOCALLY ESTABLISHED DATUM.
4. SURVEY ACCURACY: +/- 10 MM HORIZONTAL, +/- 10 MM VERTICAL
5. THE 2020 SURVEY MONUMENT MEASUREMENTS WERE UNDERWAY AT THE TIME OF WRITING.

CLIENT: Teck

Klohn Crippen Berger

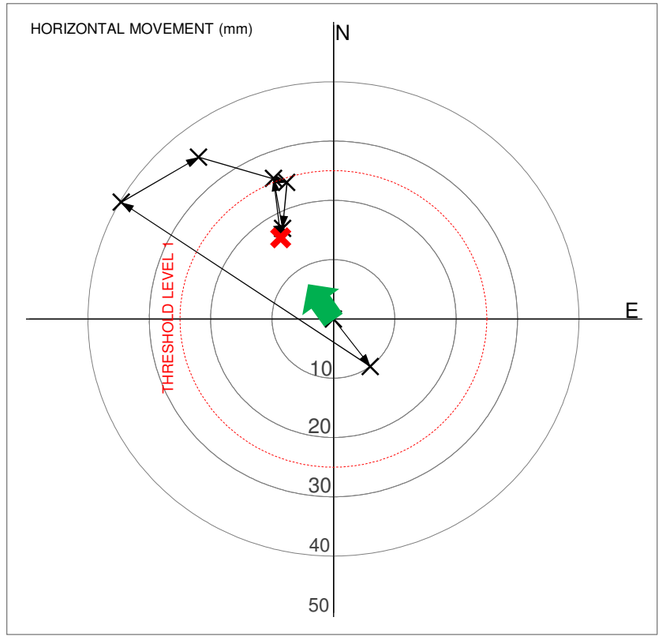
PROJECT: BULLMOOSE MINE
2020 ANNUAL REVIEW

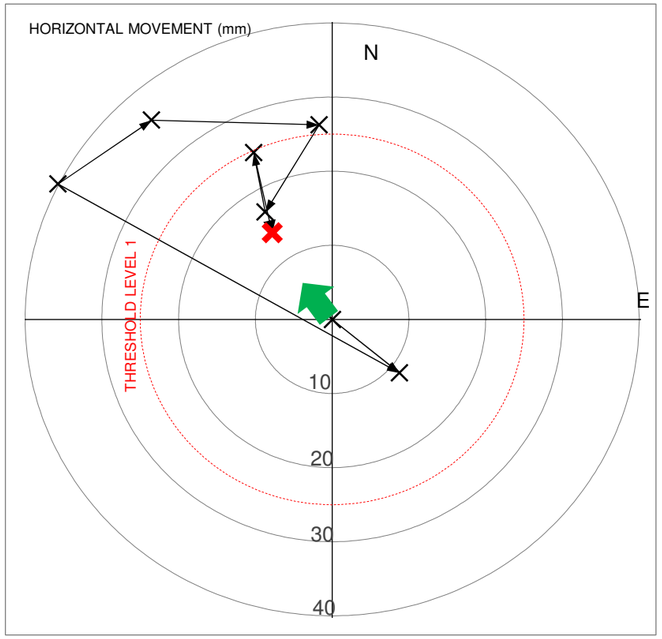
TITLE: BULLMOOSE TAILINGS DAM
2019 SURVEY MONUMENTS READINGS

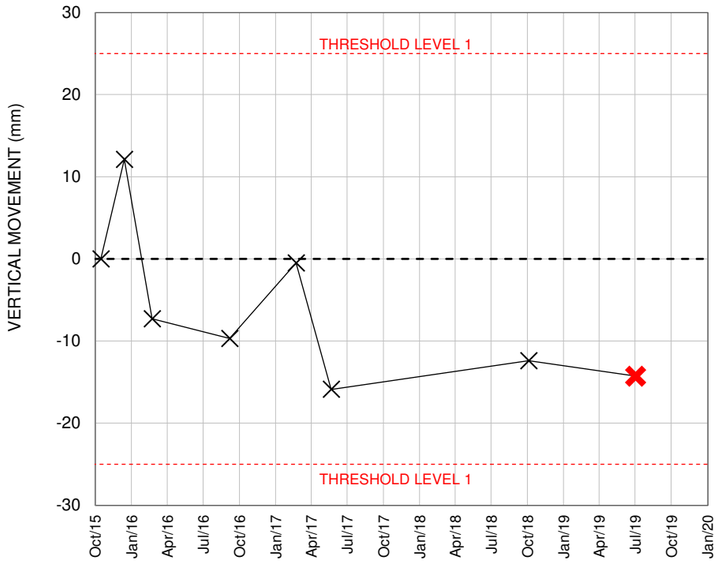
PROJECT No. M09893A11

FIG. No. 8

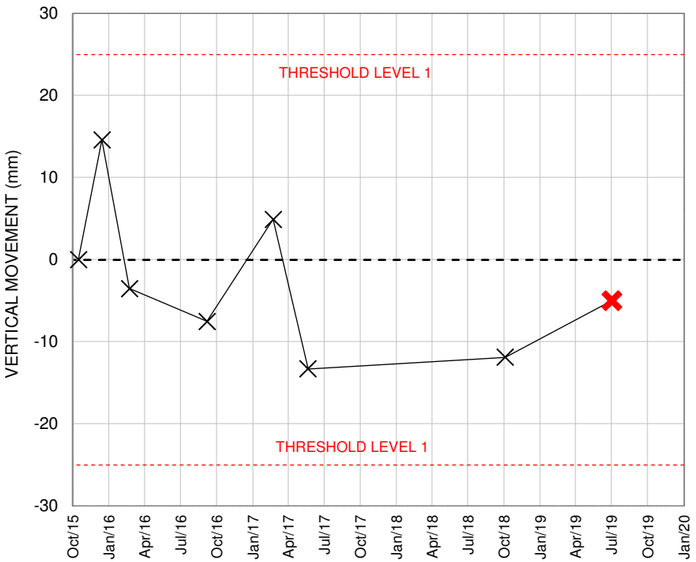
Date & Time: 2020-10-29 14:27
Figure File: \\int.klohn.com\ProjData\MVCR\M09893A11-TML-Bullmoose 2020 Consulting\300 Design\303 Instrumentation\BTD Survey\[201021 Bullmoose Survey.xlsx]Figure 11







M1 SURVEY RECORDS



M2 SURVEY RECORDS

NOTES:

1. SURVEY DATA PROVIDED BY TECK RESOURCES LTD. LATEST READINGS RECEIVED ON NOV 5, 2019.
2. SURVEY COORDINATES ARE MEASURED USING LOCALLY ESTABLISHED DATUM.
3. THE 2020 SURVEY MONUMENT MEASUREMENTS WERE UNDERWAY AT THE TIME OF WRITING.

THRESHOLD VALUES:

THRESHOLD LEVEL 1: ≥ 25 mm OF HORIZONTAL MOVEMENT FROM INITIAL READING;
≥ 25 mm OF VERTICAL MOVEMENT FROM INITIAL READING; OR
IF VERTICAL MOVEMENT ≥ 15 mm BETWEEN SUCCESSIVE READINGS.
THRESHOLD LEVEL 2: IF THERE IS A TREND OF THRESHOLD EXEEDANCE IN THE MONITORING MONUMENTS.

SURVEY ACCURACY:

HORIZONTAL: +/- 10 mm
VERTICAL: +/- 10 mm

LEGEND:

DOWNSTREAM DIRECTION
LATEST SURVEY READING

CLIENT: Teck

Klohn Crippen Berger

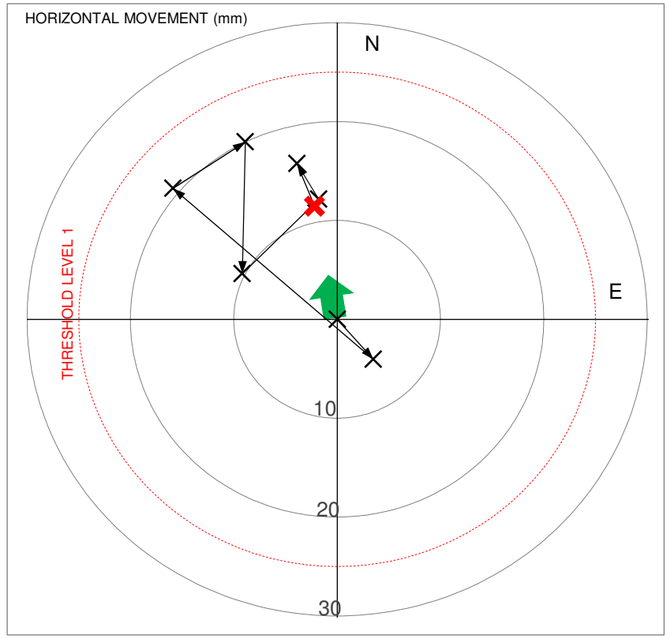
PROJECT: BULLMOOSE MINE
2020 ANNUAL REVIEW

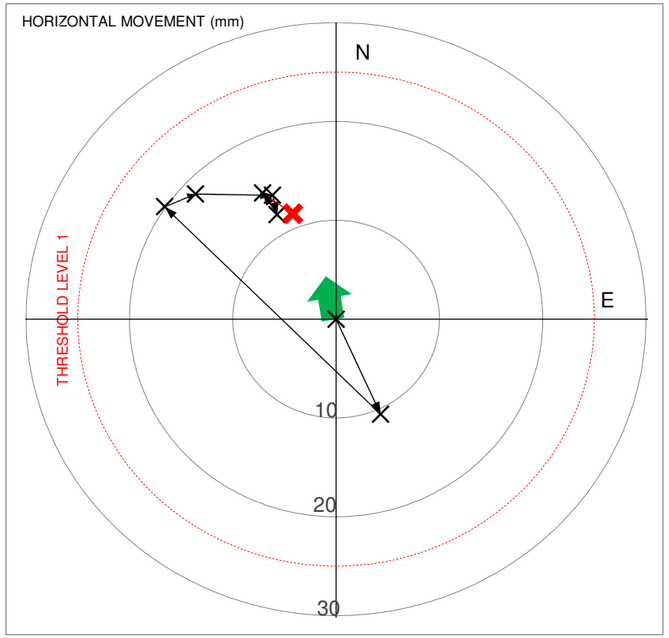
TITLE: BULLMOOSE TAILINGS DAM
SURVEY MONUMENTS (M1 AND M2) AND
THRESHOLD LEVELS

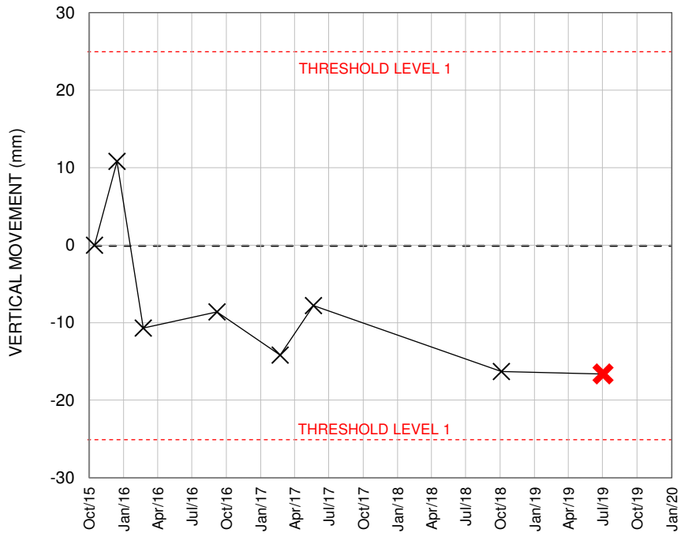
PROJECT No. M09893A11

FIG. No. 9

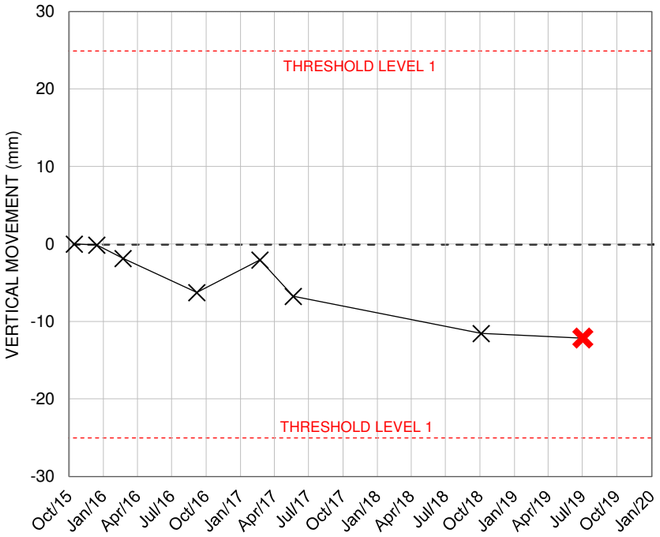
Date & Time: 2020-10-29 14:27
Figure File: \\int.klohn.com\ProjData\M\VCR\M09893A11-TML-Bullmoose 2020 Consulting\300 Design\303 Instrumentation\BTD Survey\[201021 Bullmoose Survey.xlsx]Figure 11







M3 SURVEY RECORDS



M4 SURVEY RECORDS

NOTES:

1. SURVEY DATA PROVIDED BY TECK RESOURCES LTD. LATEST READINGS RECEIVED ON NOV 5, 2019.
2. SURVEY COORDINATES ARE MEASURED USING LOCALLY ESTABLISHED DATUM.
3. THE 2020 SURVEY MONUMENT MEASUREMENTS WERE UNDERWAY AT THE TIME OF WRITING.

THRESHOLD VALUES:

THRESHOLD LEVEL 1: ≥ 25 mm OF HORIZONTAL MOVEMENT FROM INITIAL READING;
≥ 25 mm OF VERTICAL MOVEMENT FROM INITIAL READING; OR
IF VERTICAL MOVEMENT ≥ 15 mm BETWEEN SUCCESSIVE READINGS.
THRESHOLD LEVEL 2: IF THERE IS A TREND OF THRESHOLD EXEEDANCE IN THE MONITORING MONUMENTS.

SURVEY ACCURACY:

HORIZONTAL: +/- 10 mm
VERTICAL: +/- 10 mm

LEGEND:

DOWNSTREAM DIRECTION
LATEST SURVEY READING

CLIENT: Teck

Klohn Crippen Berger

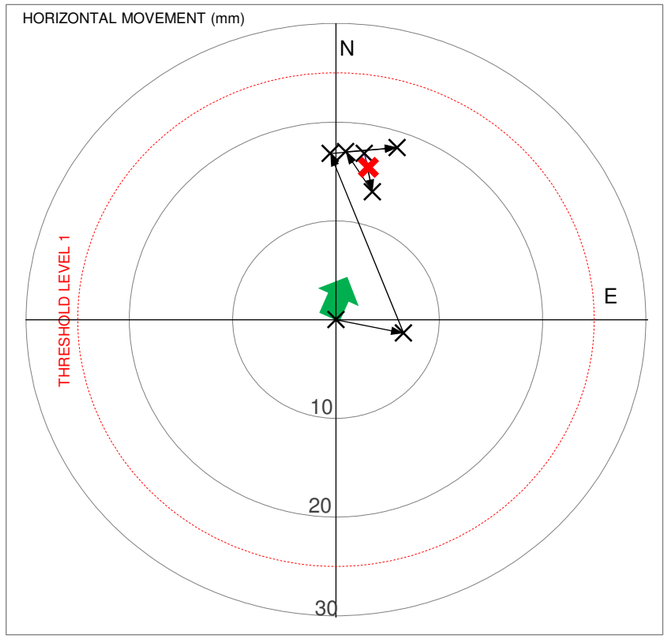
PROJECT: BULLMOOSE MINE
2020 ANNUAL REVIEW

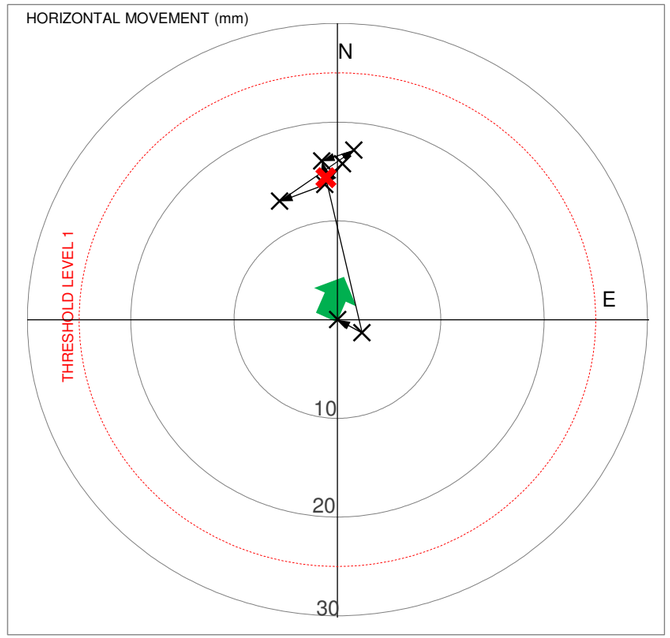
TITLE: BULLMOOSE TAILINGS DAM
SURVEY MONUMENTS (M3 AND M4) AND
THRESHOLD LEVELS

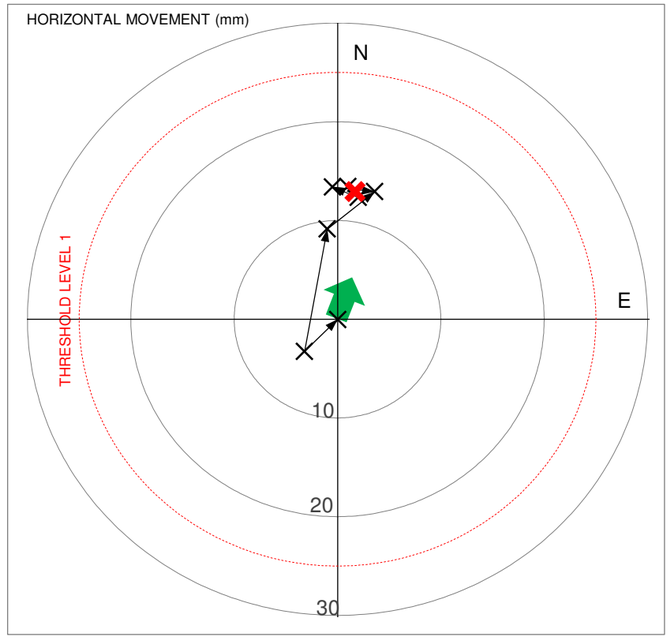
PROJECT No. M09893A11

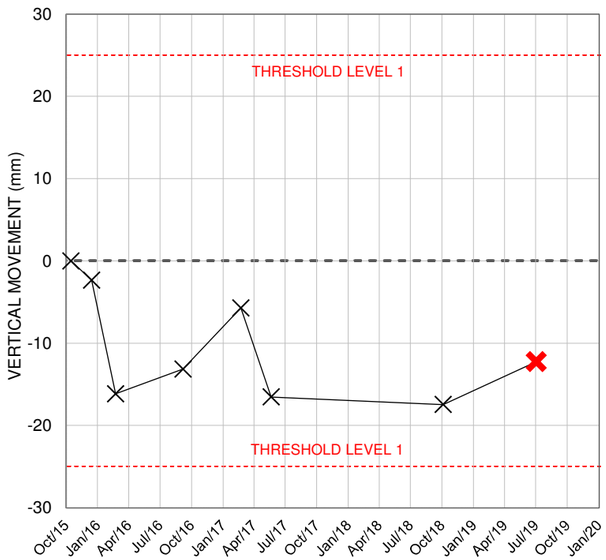
FIG. No. 10

Date & Time: 2020-10-29 14:27
Figure File: \\int.klohn.com\Proj\Data\M\VCR\M09893A11-TML-Bullmoose 2020 Consulting\300 Design\303 Instrumentation\BTD Survey\[201021 Bullmoose Survey.xlsx]Figure 11

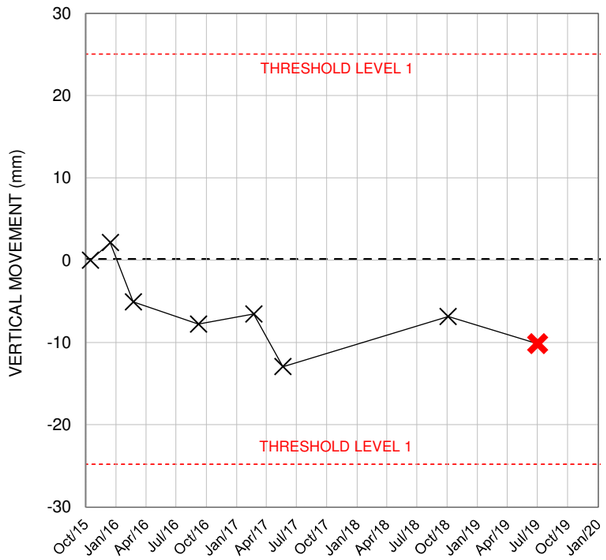




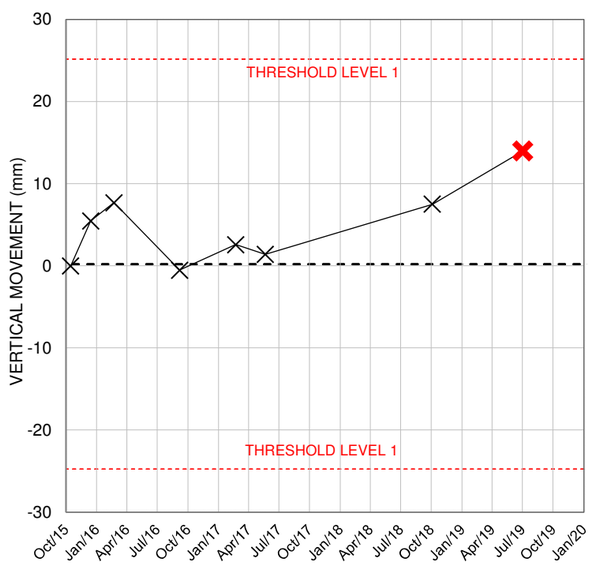




M5 SURVEY RECORDS



M6 SURVEY RECORDS



M7 SURVEY RECORDS

NOTES:

1. SURVEY DATA PROVIDED BY TECK RESOURCES LTD. LATEST READINGS RECEIVED ON NOV 5, 2019.
2. SURVEY COORDINATES ARE MEASURED USING LOCALLY ESTABLISHED DATUM.
3. THE 2020 SURVEY MONUMENT MEASUREMENTS WERE UNDERWAY AT THE TIME OF WRITING.

THRESHOLD VALUES:

THRESHOLD LEVEL 1: ≥ 25 mm OF HORIZONTAL MOVEMENT FROM INITIAL READING;
≥ 25 mm OF VERTICAL MOVEMENT FROM INITIAL READING; OR
IF VERTICAL MOVEMENT ≥ 15 mm BETWEEN SUCCESSIVE READINGS.
THRESHOLD LEVEL 2: IF THERE IS A TREND OF THRESHOLD EXEEDANCESIN THE MONITORING MONUMENTS.

SURVEY ACCURACY:

HORIZONTAL: +/- 10 mm
VERTICAL: +/- 10 mm

LEGEND:

DOWNSTREAM DIRECTION
LATEST SURVEY READING

CLIENT: Teck

Klohn Crippen Berger

PROJECT: BULLMOOSE MINE
2020 ANNUAL REVIEW

TITLE: BULLMOOSE TAILINGS DAM
SURVEY MONUMENTS (M5 TO M7) AND
THRESHOLD LEVELS

PROJECT No. M09893A11

FIG. No. 11

Date & Time: 2020-10-29 14:27
Figure File: \\int.klohn.com\Proj\Data\M\VCR\M09893A11-TML-Bullmoose 2020 Consulting\300 Design\303 Instrumentation\BTD Survey\[201021 Bullmoose Survey.xlsx]Figure 11

APPENDIX I

Facility Data Sheet

Appendix I
Facility Data Sheet

Item	Information
Dam Type	Zoned Earthfill comprises of Coarse Coal Refuse - CCR
Foundation	Silty Sand and Gravel, Glacial Till and Alluvial Soils
Construction Methodologies	Downstream Raises
Operation	1983 to 2003
Maximum Dam Height	38 m (crest to downstream toe)
Crest Elevation	1,123 masl
Dam Length	1,050 m
Dam Crest Width	10 m to 15 m
Slopes	Upstream 2H:1V; Downstream 2.5H:1V
Impoundment Area	20 ha (surface area of covered tailings plus 2 ha of pond)
Pond Volume	26,000 m^3 (approximate)
Volume of Tailings Stored	4.4 million m^3
Design Storage Capacity	4.6 million m^3
Consequence Classification	"High"
Phase	"Closure-Passive Care" based on CDA (2014)
Inflow Design Flood (IDF)	$^2/_3$ between 1,000-year return period and PMF (based on "High" consequence classification)
Design Earthquake	½ between 2,475-year and 10,000-year return period earthquake (based on "High" consequence classification)
Spillway Capacity	Invert El. 1,122 masl. Spillway has the capacity to route IDF while leaving 0.5 m of freeboard.
Minimum Required Freeboard	0.2 m based on CDA (2013) wave setup + wave runup methodologies
Catchment Area	36 ha (16 ha upslope; 20 ha impoundment)
Access to Dam	Vehicle access to the mine from Tumbler Ridge, BC, is 27 km northwest along BC Highway 29, and then 18 km southwest along Bullmoose Road.

APPENDIX II

Inspection Photographs

Appendix II
Inspection Photographs

LEGEND:

- BTD = Bullmoose Tailings Dam
- BTD-2020-## refers to the 2020 DSI photograph location, as shown on Figure 3

Photographs were taken during site inspection on July 22, 2020.

Photo II-1 BTD crest – looking south (BTD-2020-01)

Photo II-2 BTD downstream slope, looking east (BTD-2020-01)

Photo II-3 BTD downstream slope from dam crest, looking north (BTD-2020-01)

Photo II-4 BTD upstream slope and impoundment, looking east (BTD-2020-02)

Photo II-5 BTD impoundment, looking southeast (BTD-2020-02)

Photo II-6 BTD crest, looking southeast (BTD-2020-03)

Photo II-7 BTD crest, looking north (BTD-2020-03)

Photo II-8 BTD impoundment, looking east (BTD-2020-04)

Photo II-9 BTD crest and upstream slope, looking southeast (BTD-2020-04)

Photo II-10 BTD crest and upstream slope, looking northwest (BTD-2020-04)

Photo II-11 BTD spillway inlet, looking northeast (BTD-2020-05)

Photo II-12 BTD spillway channel, looking southwest (BTD-2020-05)

Photo II-13 BTD spillway inlet, looking northeast (BTD-2020-06)

Photo II-14 BTD spillway outlet to forest, looking southwest (BTD-2020-07)

Photo II-15 BTD spillway outlet, looking northeast (BTD-2020-07)

Photo II-16 BTD downstream slope, looking north from spillway (BTD-2020-08)

Photo II-17 BTD downstream slope, looking east from dam toe (BTD-2020-09)

Photo II-18 BTD toe, looking northeast (BTD-2020-09)

Photo II-19 BTD crest and upstream slope, looking west (BTD-2020-10)

Photo II-20 BTD upstream slope, looking east (BTD-2020-10)

Photo II-21 BTD upstream slope, and pond, looking southeast (BTD-2020-11)

Photo II-22 BTD upstream slope and pond, looking southeast (BTD-2020-12)

Photo II-23 BTD pond, looking southwest (BTD-2020-12)

Photo II-24 BTD crest, looking northwest (BTD-2020-13)

Photo II-25 BTD upstream slope and pond, looking south (BTD-2020-13)

Photo II-26 BTD upstream slope and pond, looking north (BTD-2020-14)

Photo II-27 BTD impoundment, looking west (BTD-2020-14)

Photo II-28 BTD pond, looking north (BTD-2020-15)

Photo II-29 BTD pond, looking north (BTD-2020-16)

Photo II-30 Historical landslide upslope of BTD (BTD-2020-16)

Photo II-31 BTD right abutment, looking west (BTD-2020-17)

Photo II-32 Small channel along right abutment, looking east (BTD-2020-17)

Photo II-33 BTD downstream slope, looking north (BTD-2020-17)

Photo II-34 Small pond and rock outcrop near east abutment (BTD-2020-18)

Photo II-35 Erosion gulley at toe of dam (BTD-2020-19)

Photo II-36 BTD downstream slope from dam toe, looking northwest (BTD-2020-20)

Photo II-37 BTD downstream slope from dam toe, looking upstream (west) (BTD-2020-20)

Photo II-38 BTD downstream slope from dam toe, looking south (BTD-2020-20)

Photo II-39 BTD downstream slope from dam toe, looking south (BTD-2020-21)

Photo II-40 BTD downstream slope from dam toe, looking northwest (BTD-2020-21)

Photo II-41 BTD downstream slope from dam toe, looking southwest (BTD-2020-22)

Photo II-42 BTD downstream slope from dam toe, looking east (BTD-2020-23)

Photo II-43 BTD downstream slope and piezometers, looking south (BTD-2020-23)

Photo II-44 BTD downstream slope from dam toe, looking west (BTD-2020-23)

Photo II-45 Wet spot noted near dam toe. Same spot noted from previous year (BTD-2020-24)

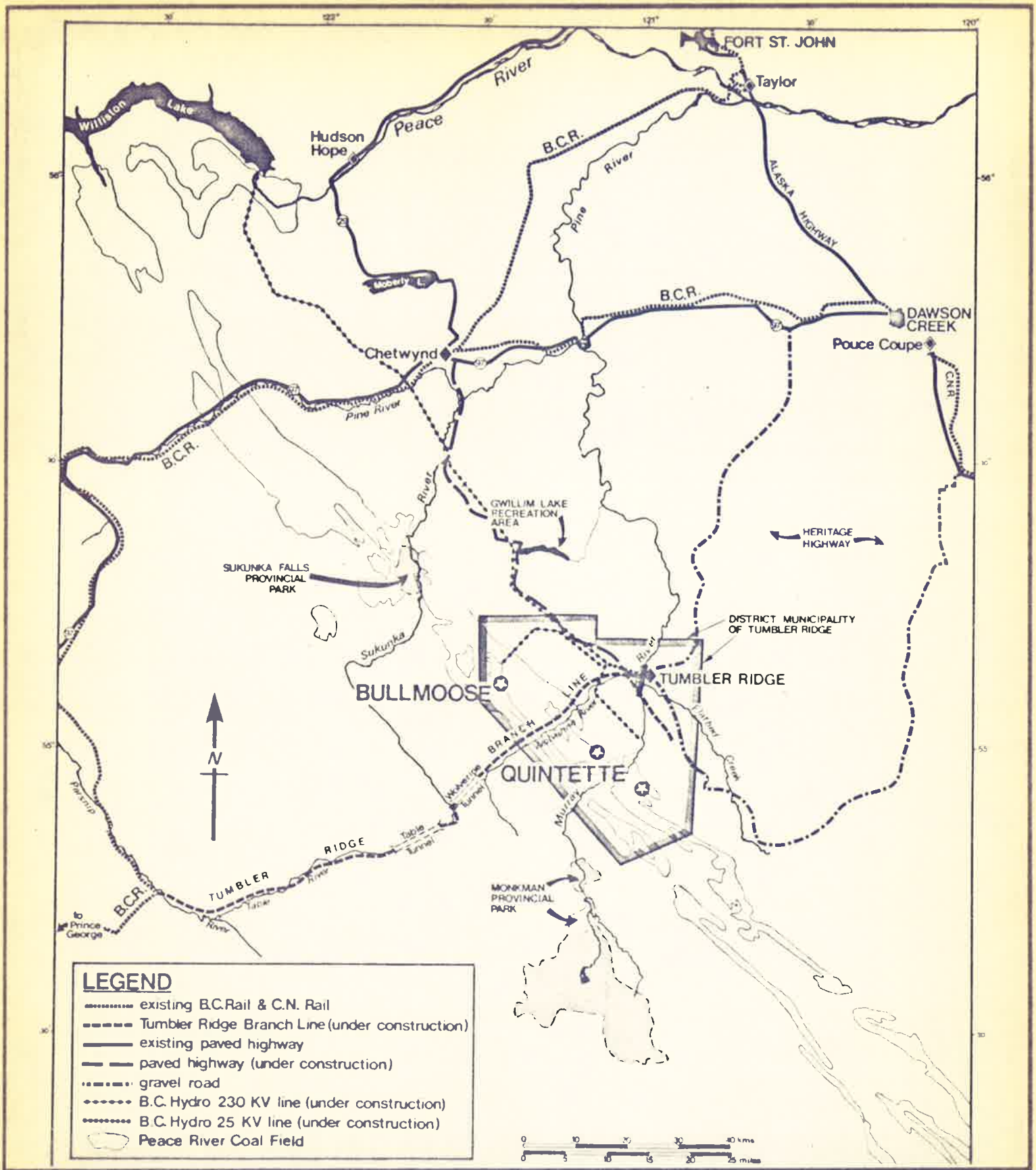
Photo II-46 Downstream slope of dam, minor rilling (BTD-2020-25)

Photo II-47 Downstream slope of dam, looking northeast (BTD-2020-26)

Photo II-48 Downstream slope of dam, looking south (BTD-2020-26)

APPENDIX III

Dam Design Drawings



KLOHN LEONOFF LTD.
CONSULTING ENGINEERS

PROJECT: BULLMOOSE COAL PROJECT

TITLE: LOCATION PLAN

CLIENT: BULLMOOSE OPERATING CORPORATION

DATE OF ISSUE: OCT. 22, 1982

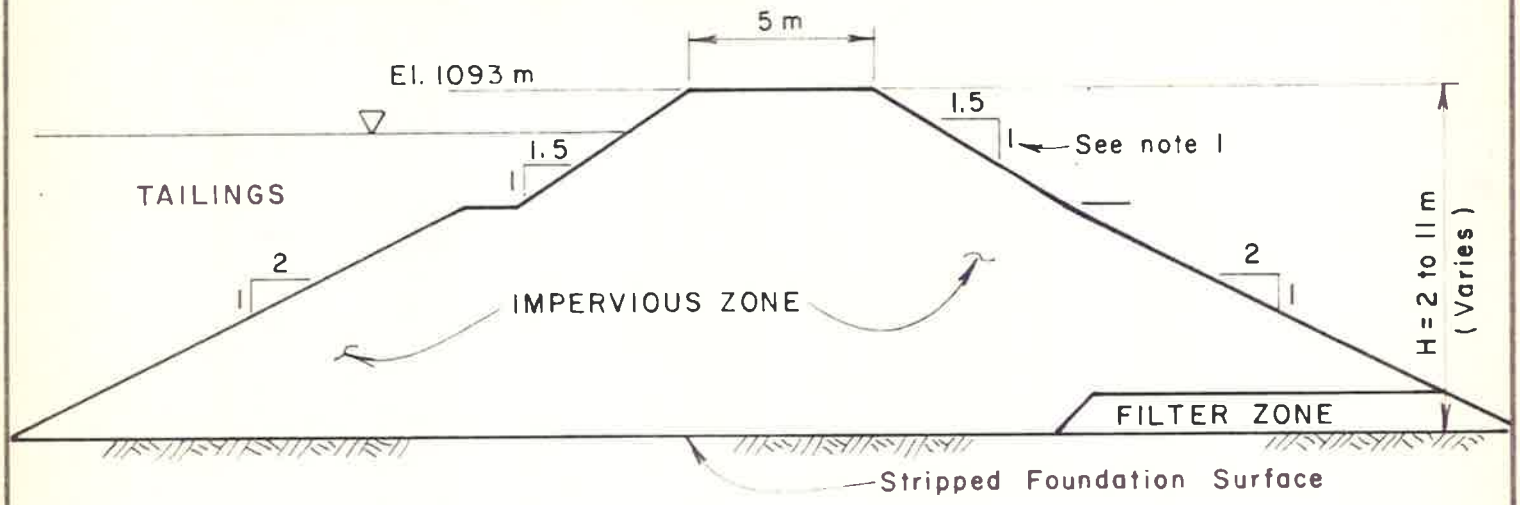
APPROVED: H. N. McLEOD

PROJECT No: PB2971-02

DWG No: A-101

REV:

PROFESSIONAL ENGINEER — BRITISH COLUMBIA



FOUNDATION SOILS

(Vary from medium dense sand and gravel to silty sands and sandy silts)

NOTES

1. Dam slope revised to 1.5 : 1, H:V over maximum top 5.0 metres of dam in October, 1984.
2. Impervious zone consists of silty sand and gravel compacted to 98 % of the Standard Proctor Density.
3. Filter zone consists of blasted mudstone and sandstone, moderately well graded; 15 percent greater than 150 mm.

SCALE 1:200

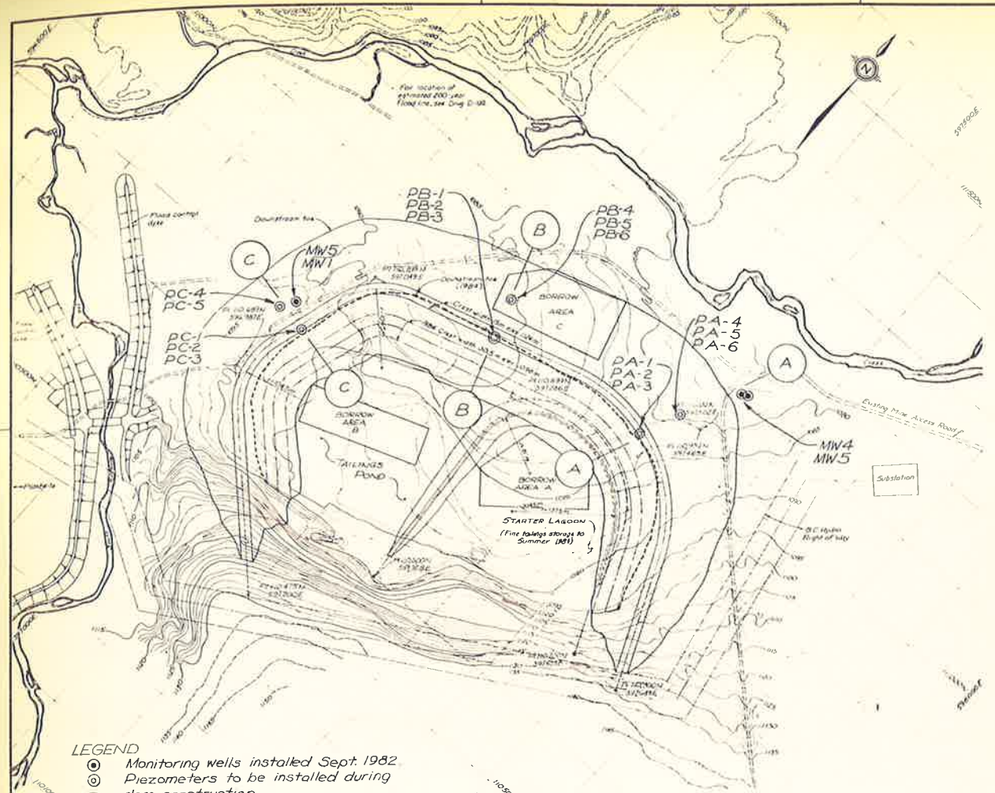
KLOHN LEONOFF LTD.
CONSULTING ENGINEERS

PROJECT: BULLMOOSE COAL PROJECT

TITLE: TAILINGS STARTER DAM
TYPICAL AS-BUILT SECTION

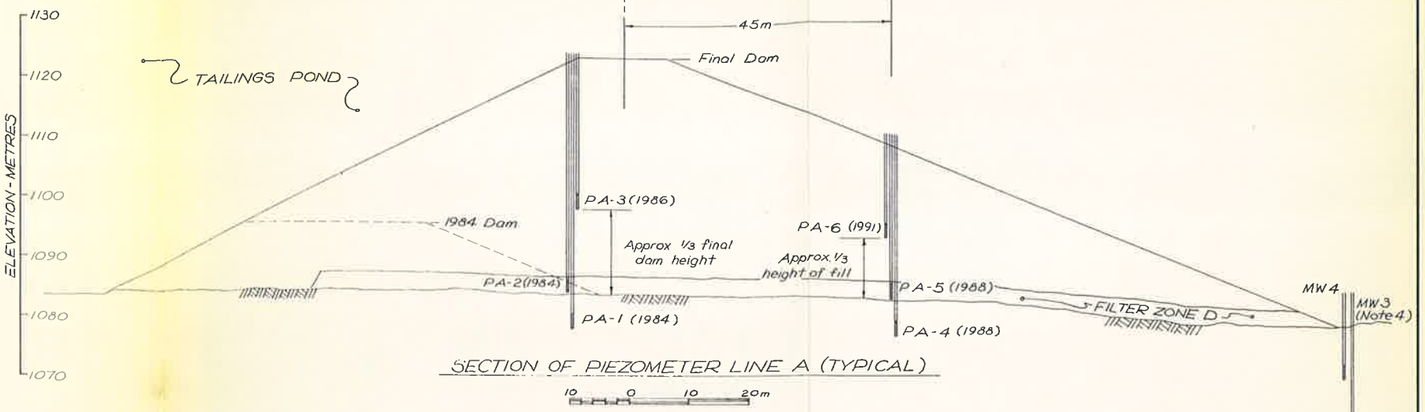
CLIENT: BULLMOOSE OPERATING CORPORATION

DATE OF ISSUE	PROJECT No	DWG No	REV
MARCH 15, 1984	PB2971-02	A-117	
APPROVED			

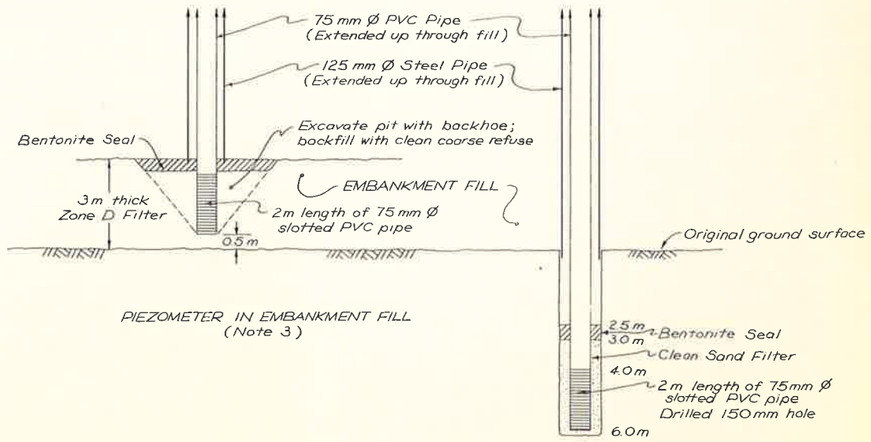


LEGEND
- ◉ Monitoring wells installed Sept 1982
- ◎ Piezometers to be installed during dam construction.
- (A) Piezometer Lines

LOCATION PLAN
50 0 50 100m



SECTION OF PIEZOMETER LINE A (TYPICAL)
10 0 10 20m



PIEZOMETER IN EMBANKMENT FILL (Note 3)

FOUNDATION PIEZOMETER (Note 1)

TYPICAL PIEZOMETER INSTALLATION DETAILS

N.T.S.

NOTES:

1. Standpipe piezometers will be installed during construction of the dam and will be extended up through the embankment fill. PA-1, PA-2 and PB-1, PB-2 and PC-1, PC-2 to be installed in 1984. Additional piezometers to be installed as shown during later construction.
2. Foundation piezometers to be installed with a drilling rig.
3. Piezometers in embankment fill to be installed with a backhoe.
4. Monitoring wells installed by Klohn Leonoff Ltd. in Sept. 1982.

TO BE READ WITH KLOHN LEONOFF REPORT DATED OCT. 22, 1982

SCALE: AS SHOWN

REV.	DATE	REVISION DETAILS

DESIGN	DRAWN	DATE	SCALES
H.M.	D.T.	OCT. 1982	AS SHOWN

KLOHN LEONOFF LTD.
CONSULTING ENGINEERS

PROJECT: BULLMOOSE COAL PROJECT

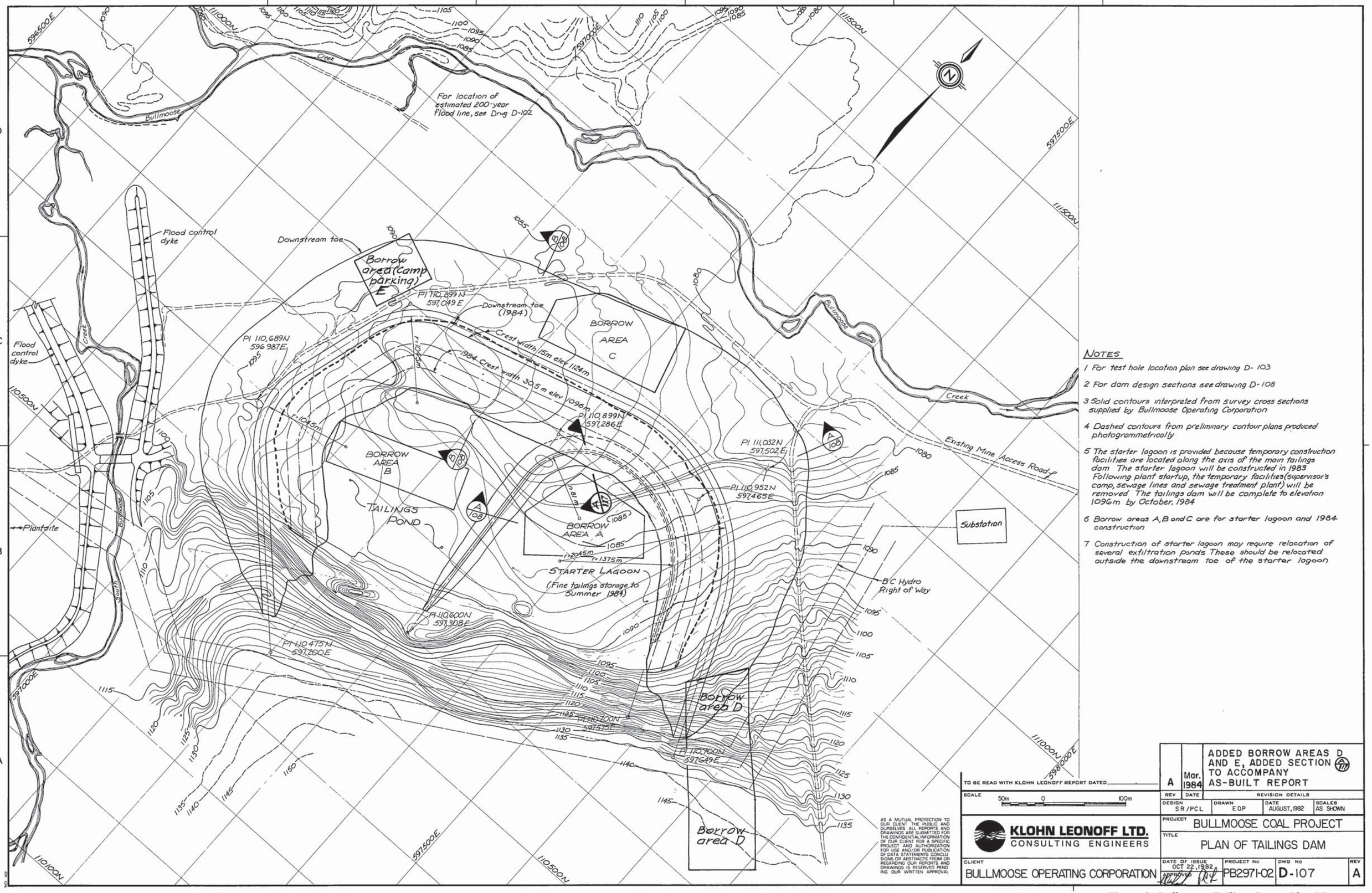
TITLE: PLAN, SECTION & DETAILS OF TAILINGS DAM PIEZOMETERS

CLIENT: BULLMOOSE OPERATING CORPORATION

DATE OF ISSUE	PROJECT No.	DWG. No.	REV.
OCT. 22, 1982	PB2971-02	D-112	

APPROVED

P. C. LIGHTHALL
PROFESSIONAL ENGINEER
BRITISH COLUMBIA



NOTES

1 For test hole location plan see drawing D-103

2 For dam design sections see drawing D-108

3 Solid contours interpreted from survey cross sections supplied by Bullmoose Operating Corporation

4 Dashed contours from preliminary contour plans produced photogrammetrically

5 The starter lagoon is provided because temporary construction facilities are located along the axis of the main tailings dam The starter lagoon will be constructed in 1983 Following plant startup, the temporary facilities (supervisor's camp, sewage lines and sewage treatment plant) will be removed The tailings dam will be complete to elevation 1096m by October, 1984

6 Borrow areas A, B and C are for starter lagoon and 1984 construction

7 Construction of starter lagoon may require relocation of several exfiltration ponds These should be relocated outside the downstream toe of the starter lagoon

TO BE READ WITH KLOHN LEONOFF REPORT DATED

REV	DATE	REVISION DETAILS
A	Mar. 1984	ADDED BORROW AREAS D AND E, ADDED SECTION (A-111) TO ACCOMPANY AS-BUILT REPORT

SCALE 50m 0 100m

DESIGN	DRAWN	DATE	SCALES
SR/PCL	EDP	AUGUST, 1982	AS SHOWN

KLOHN LEONOFF LTD. CONSULTING ENGINEERS

PROJECT BULLMOOSE COAL PROJECT

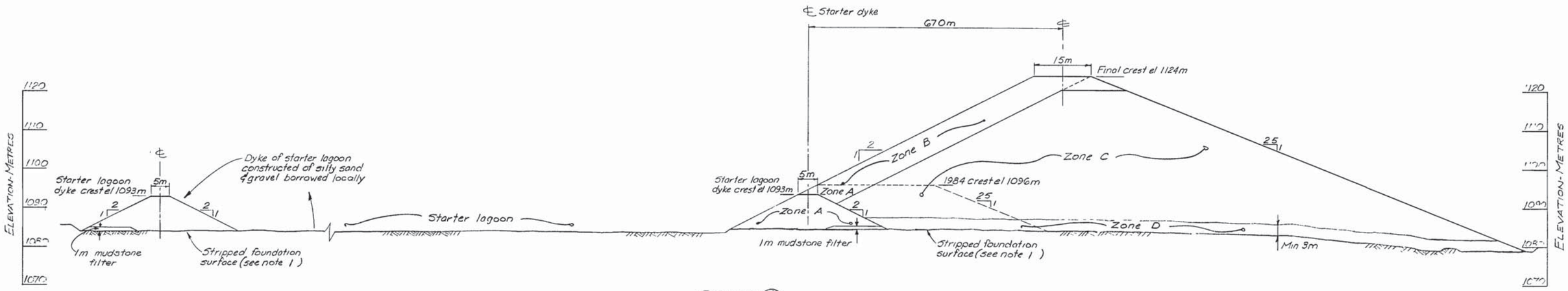
TITLE PLAN OF TAILINGS DAM

CLIENT BULLMOOSE OPERATING CORPORATION

DATE OF ISSUE	PROJECT No	DWG No	REV
OCT 22, 1982	PB2971-02	D-107	A

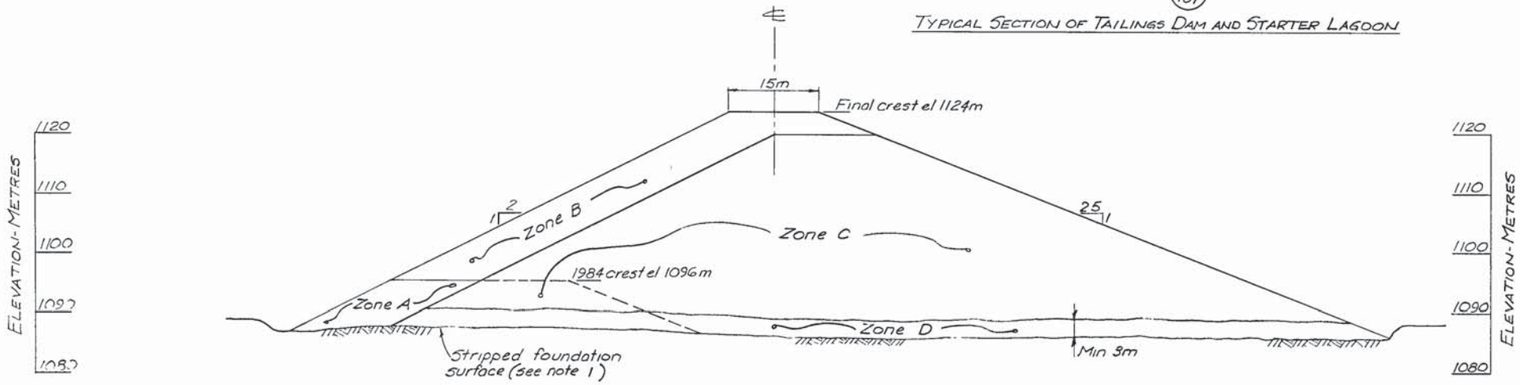
APPROVED

Figure 6 Bullmoose Tailings Dam - Plan View



SECTION A/107

TYPICAL SECTION OF TAILINGS DAM AND STARTER LAGOON



SECTION B/107

TYPICAL SECTION OF TAILINGS DAM

ZONE	MATERIAL	LIFT THICKNESS	COMPACTION* %Standard proctor
A Impervious	Silty sand & gravel (borrow)	0.3m	98 %
B Low permeability	Coarse refuse	0.15m	98 %
C General fill	Coarse refuse	0.5m	98 %
D Drainage	Coarse refuse	1.0m	95 %

* 98% standard proctor should be achieved with 4 passes with a large vibratory roller and 95 % with about 2 passes

CONSTRUCTION NOTES

1 FOUNDATION PREPARATION

All vegetation, organics and soft material shall be removed from the dam foundation area to expose silty sand and gravel soils Loose materials include areas where waste from the plantsite and construction camp excavation were placed during the 1982 site development The foundation surface should be heavily compacted prior to fill placement

2 CONSTRUCTION MATERIALS, PLACEMENT COMPACTION

GENERAL

Fill placement should be carried out during warmer parts of the year so that no frozen materials or lenses of ice or snow are incorporated in the fill

Where a vibratory roller is specified for compaction in following sections, the compactor should have a minimum static weight of 8 tonnes

ZONE A

Zone A material will be used for the starter dyke and for the upstream zone of the tailings dam for 1984 construction The material should consist of silty sand and gravel borrowed from the alluvial deposits within the tailings dam reservoir Zone A is intended to be a zone of low permeability and should have a minimum of 15 percent by weight passing the 0 075 mm sieve size

Zone A material should be placed in maximum loose lift thicknesses of 0 3 m and compacted to a minimum density equivalent to 98 percent of the maximum Standard Proctor density (ASTM D-698 Method D) This density should be achieved by compacting with at least four passes of a vibratory roller, provided the water content of the fill material is near optimum

ZONE B

Zone B is a 15 m wide zone of coarse refuse on the upstream side of the tailings dam which will be heavily compacted to provide a zone of low permeability The coarse refuse should be placed in maximum loose lift thicknesses of 0 15 m and compacted with at least 4 complete passes of a vibratory roller

ZONE C

Zone C is the general fill portion of the dam, constructed of compacted coarse refuse The coarser refuse should be placed in maximum loose lift thicknesses of 0 5 m and compacted with a minimum of 4 complete passes of a vibratory roller The fill surface should be scarified between lifts

ZONE D

Zone D is a drainage zone, constructed of loosely compacted, select coarse refuse

The coarse refuse used in Zone D should be selected to have the minimum amount of fines There should be a maximum of 5 percent, by weight, passing the 0 075 mm sieve size Coarse refuse should be placed in lifts 1 m thick Compaction should consist of 2 complete passes of a vibratory roller The fill surface should be scarified between lifts

3 QUALITY CONTROL AND TESTING

COMPACTION CONTROL

Standard Proctor compaction tests conforming to ASTM D-698 Method D should be carried out a minimum of once per week during construction or at any time when the material quality changes Compaction control should consist of frequent inspection of placement and compaction procedures, augmented by field density tests One field density test for every 1500 m^3 of fill placed should be performed Zones A, B and C should be compacted to 98% Standard Proctor density and the filter Zone D to 95% Standard Proctor

GRAIN SIZE ANALYSES

For Zone A, grain size analyses of the fill material should be performed at a minimum frequency of twice weekly For the coarse refuse, grain size analyses should be performed weekly on samples from the stockpile and the fill after compaction

4 TAILINGS DISCHARGE

Tailings may be deposited to the pond by a single point discharge, with the discharge point located at intervals along the dam crest Discharge should be adjusted so as to form a beach adjacent to the dam and to maintain the ponded water at the back of the pond adjacent to the hillside During freezing weather, tailings should be discharged near or beneath the surface of the water pond so as to minimize ice formation on the beaches.

TO BE READ WITH KLOHN LEONOFF REPORT DATED OCT 22, 1982

SCALE 10m 0 30m

REV	DATE	REVISION DETAILS

DESIGN	DRAWN	DATE	SCALES
SR/PCL	EDP	SEPT, 1982	AS SHOWN

KLOHN LEONOFF LTD.
CONSULTING ENGINEERS

PROJECT: BULLMOOSE COAL PROJECT

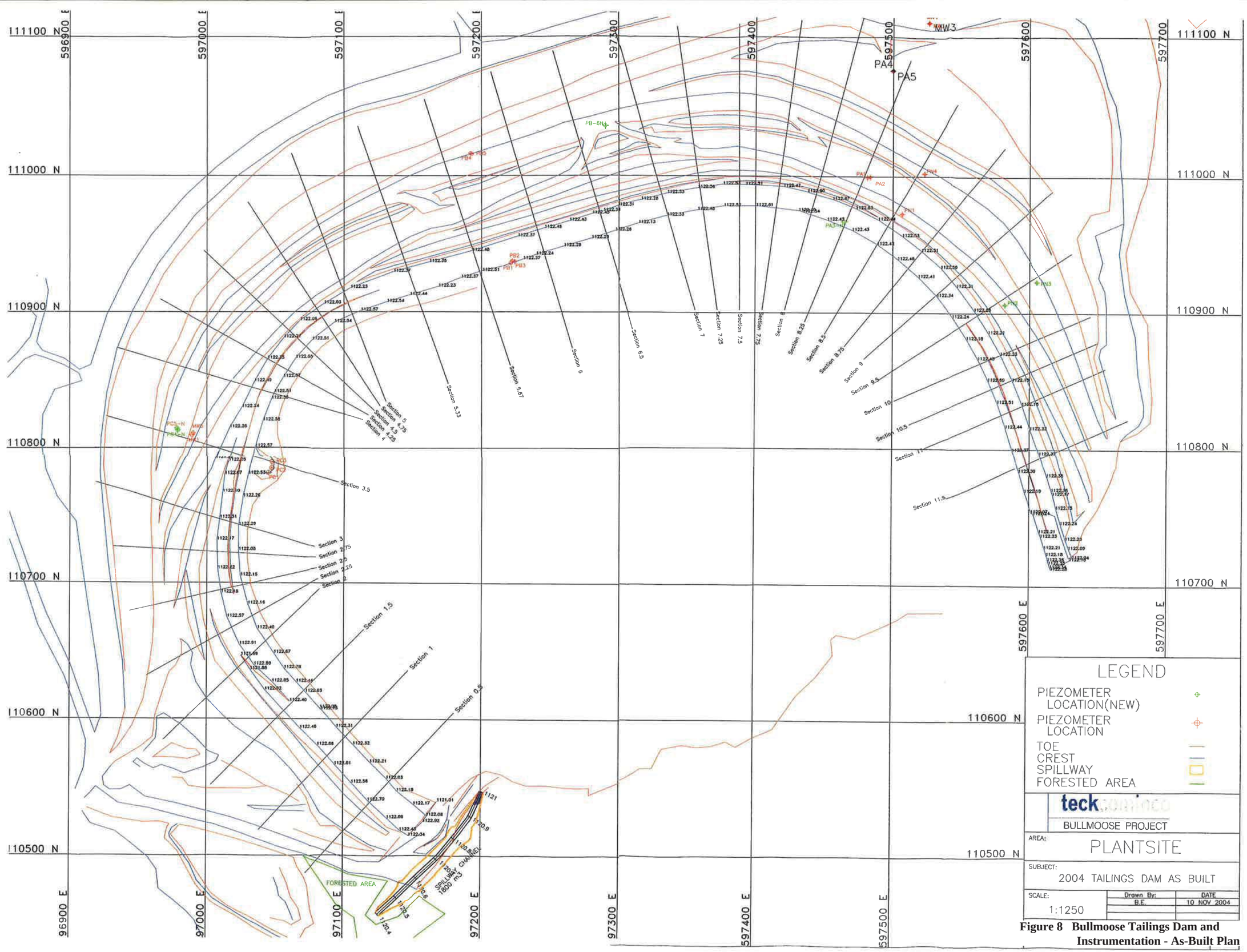
TITLE: TYPICAL SECTIONS OF TAILINGS DAM

CLIENT: BULLMOOSE OPERATING CORPORATION

DATE OF ISSUE	PROJECT No	DWG No	REV
OCT 22, 1982	PB297-02	D-108	

APPROVED

Figure 7 Bullmoose Tailings Dam - Typical Sections



LEGEND

- PIEZOMETER LOCATION(NEW)
- PIEZOMETER LOCATION
- TOE
- CREST
- SPILLWAY
- FORESTED AREA

teck COMINCO

BULLMOOSE PROJECT

AREA: PLANTSITE

SUBJECT: 2004 TAILINGS DAM AS BUILT

SCALE:	Drawn By:	DATE
1:1250	B.E.	10 NOV 2004

Figure 8 Bullmoose Tailings Dam and Instrumentation - As-Built Plan

APPENDIX IV

Register of Reference Documents

Appendix IV
Register of Reference Documents

Document Title	Author	Date of Issue
Bullmoose Coal Project - Phase II - Geotechnical, Hydrogeological and Water Management Study - Report II - Project Description, Geologic Setting and Phase II Field Investigation	Hardy Associates Ltd.	08-Jan-82
Bullmoose Coal Project - Phase II - Geotechnical, Hydrogeological and Water Management Study - Report VI - Tailings Disposal Facility Geotechnical Study	Hardy Associates Ltd.	23-Feb-82
Bullmoose Coal Project - Phase II - Geotechnical, Hydrogeological and Water Management Study - Report X - Construction Materials	Hardy Associates Ltd.	30-Mar-82
Sedimentation Ponds No. 1 and No. 2 Bullmoose Coal Project - Geotechnical Design Report	Klohn Leonoff	25-Jun-82
Bullmoose Coal Project - Tailings Dam Design Report	Klohn Leonoff	Oct-82
Bullmoose Coal Project - DESIGN: Sedimentation Pond No. 3	Klohn Leonoff	25-Feb-83
Bullmoose Tailings Disposal 1983 Starter Dam Construction	Klohn Leonoff	14-Mar-1984
Annual Review of Tailings Dam - 1984/85	Bullmoose Operating Corporation	Aug-85
Annual Review of Tailings Dam 1986/87	Klohn Leonoff	11-Aug-87
Report on Site Visit July 24, 1987 and Annual Review of Tailings Dam 1986/87	Klohn Leonoff	11-Aug-87
Bullmoose Coal Project Hydrogeology Study	Klohn Leonoff	Nov-87
Annual Review of Tailings Dams for 1987/88	Klohn Leonoff	09-Sep-88
Annual Review of Operations - 1987/88	Bullmoose Operating Corporation	Aug-88
Annual Review of Tailings Dams for 1988/1989	Klohn Leonoff	28-Aug-89
Annual Review of Operations - 1988/89	Bullmoose Operating Corporation	Aug-89
1989-90 Annual Review of Tailings Dam	Klohn Leonoff	30-Aug-90
Tailings Pond Annual Review of Operations - 1989/90	Bullmoose Operating Corporation	Aug-90
1990-91 Annual Review of Tailings Dam	Klohn Leonoff	29-Aug-91
Annual Review of Operations - 1990/91	Bullmoose Operating Corporation	Jul-91
1991-92 Annual Review of Tailings Dam	Klohn Leonoff	26-Aug-92
Annual Review of Operations 1991/92	Bullmoose Operating Corporation	Jul-92
1992-93 Annual Review of Tailings Dam	Klohn Crippen	30-Aug-93
Annual Review of Operations 1992/93	Bullmoose Operating Corporation	Jul-93
Annual Review of Operations 1993/94	Bullmoose Operating Corporation	Jul-94
May Site Visit: Tailings Dam Recommendations	Klohn Crippen	01-Jun-95
South Fork Tailings Dam - Seepage and Stability Review	Klohn Crippen	Oct. 1996
1996 Annual Review of Tailings Facility	Klohn Crippen	17-Dec-96
Density Comparison, Tailings Dam Construction - Bullmoose Mine, Tumbler Ridge, BC	Peace Country Materials Testing Ltd.	04-Jun-97
1997 Annual Review of Tailings Facility	Klohn Crippen	17-Dec-97
Annual Review of Operations 1997/98 Tailings Pond	Bullmoose Operating Corporation	Dec-98
1998 Annual Review of Tailings Facility	Klohn Crippen	13-Jan-99
Bullmoose Tailings Facility Establishment of Threshold Warning Levels of Piezometers	Klohn Crippen	Oct-99
Summary of Site Visit on September 23, 1999	Klohn Crippen	19-Nov-99
Annual Review of Operations 1998/99 Tailings Pond	Bullmoose Operating Corporation	Nov-99
Tailings Impoundment Closure Report - Draft	Bullmoose Operating Corporation	Jan-00
1999 Annual Review	Klohn Crippen	07-Feb-00
Annual Review of Operations	Bullmoose Operating Corporation	Nov-00
Review of 2000 Tailings Operations Report	Klohn Crippen	Dec-00
Annual Review of Operations	Bullmoose Operating Corporation	Nov-01
Tailings Impoundment Closure Spillway Design	Klohn Crippen	Dec-01
Review of 2001 Tailings Operations Report	Klohn Crippen	18-Dec-01
Tailings Impoundment Closure Spillway - Review of Proposed Layout	Klohn Crippen	Oct-02
Bullmoose Mine Review of 2002 Tailings Operations Report	Klohn Crippen	18-Dec-02
Annual Review of Operations	Bullmoose Operating Corporation	Nov-2003
Bullmoose Mine Review of 2003 Tailings Operations Report	Klohn Crippen	18-Dec-2003
Bullmoose Tailings Facility Closure Spillway Inspection on September 22, 2004	Klohn Crippen	Oct-2004
Tailings Dam Annual Review of Operations	Bullmoose Operating Corporation	01-Nov-04
Bullmoose Mine Review of 2004 Tailings Operations Report	Klohn Crippen	Dec. 2004
Bullmoose 2010 Dam Safety Inspection and Consequence Classification	Klohn Crippen Berger	01-Mar-11
Bullmoose Tailings Impoundment 2012 Dam Safety Inspection	Teck	Aug-13
Bullmoose Mine 2013 Dam Safety Inspection	Klohn Crippen Berger	25-Mar-14
Bullmoose Mine Tailings Dam Design Review	Klohn Crippen Berger	15-Aug-14
Bullmoose Mine Tailings Storage Dam 2014 Dam Safety Inspection Revision 1	Klohn Crippen Berger	26-Nov-14
Bullmoose Mine Tailings Storage Facility - Dam Breach and Inundation Study	Klohn Crippen Berger	27-Nov-14
Bullmoose Mine Tailings Storage Facility - Response to February 3, 2015 MEM Memorandum	Klohn Crippen Berger	29-Jun-15
Bullmoose Mine 2015 Consulting - Tailings Storage Facility Hydrotechnical Review	Klohn Crippen Berger	22-Dec-15
Bullmoose Mine Tailings Storage Dam – 2015 Dam Safety Inspection	Klohn Crippen Berger	22-Mar-16
Bullmoose Tailings Storage Facility Engineer of Record	Klohn Crippen Berger	23-Sep-16
Bullmoose Mine Tailings Dam - Water Management, Water Balance and Quantifiable Performance Objectives	Klohn Crippen Berger	22-Dec-16
Bullmoose Mine Tailings Storage Dam – 2016 Dam Safety Inspection	Klohn Crippen Berger	01-Mar-17
Bullmoose Tailings Dam - Review of Monument Survey Data - May, 2017	Klohn Crippen Berger	09-Jun-17
Survey Monuments Quantifiable Performance Objectives	Klohn Crippen Berger	25-Aug-17
Review of Seismic Hazard Assessment	Klohn Crippen Berger	13-Oct-17
Bullmoose Mine Tailings Storage Dam – 2017 Dam Safety Inspection - Revision 1	Klohn Crippen Berger	16-Mar-18
Bullmoose Tailings Dam – Closure Passive Care - Draft	Klohn Crippen Berger	26-Feb-18
Bullmoose Creek Flood Study	Klohn Crippen Berger	22-Jun-18
Bullmoose Tailings Dam - Internal Stability Assessment	Klohn Crippen Berger	03-Dec-18

APPENDIX V

Climate

Appendix V
Climate

There is currently no active climate station at the Bullmoose site. The nearest active climate station is the Environment Canada climate station at Chetwynd Airport (No. 1181508) which is located approximately 62 km north of the site at El. 610 masl. Precipitation and temperature data from Chetwynd Airport are adjusted based on correlation factors developed with the Bullmoose Climate station (No. 1181120 at El. 1,102 masl) which was operated until 2003.

Correlation factors for precipitation were developed by comparing monthly precipitation data from Bullmoose and Chetwynd Airport for the period of time when records overlapped (1981 – 2002). Monthly precipitation correlation factors are summarized in Table V-1.

Temperature climate normals at the Chetwynd Airport climate station were compared against climate normals from Bullmoose climate station. The temperature differences between the two stations for the period of overlap are summarize in Table V-1.

Table V-1 Chetwynd Airport/Bullmoose Precipitation and Temperature Correlation Factors

Item	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Monthly Precipitation Correlation Factors												
Bullmoose climate station / Chetwynd Airport climate station[1]	3.3	3.6	2.9	1.7	1.3	1.3	1.2	1.5	1.9	3.3	3.3	3.1
Daily Average Temperature (°C)												
Chetwynd Airport climate station (1981-2010)	-10.2	-7.2	-2.9	4.6	9.5	13.4	15.4	14.5	9.9	4.1	-5.5	-9.1
Bullmoose climate station (1981-2003)	-8.0	-6.6	-4.2	1.7	6.9	11.0	13.3	12.8	8.2	2.5	-4.7	-7.4
Temperature Difference (Bullmoose – Chetwynd)	2.2	0.6	-1.3	-2.9	-2.6	-2.4	-2.1	-1.7	-1.7	-1.6	0.8	1.7
Daily Maximum Temperature (°C)												
Chetwynd Airport climate station (1981-2010)	-5.0	-1.4	2.9	11.2	16.6	20.1	22.2	21.6	16.3	9.4	-1.1	-4.1
Bullmoose climate station (1981-2003)	-3.4	-2.0	0.3	6.7	12.4	16.3	18.9	18.3	12.9	6.3	-1.0	-3.1
Temperature Difference (Bullmoose – Chetwynd)	1.6	-0.6	-2.6	-4.5	-4.2	-3.8	-3.3	-3.3	-3.4	-3.1	0.1	1.0
Daily Minimum Temperature(°C)												
Chetwynd Airport climate station (1981-2010)	-15.3	-12.9	-8.7	-2.1	2.4	6.6	8.5	7.4	3.5	-1.3	-10.0	-14.1
Bullmoose climate station (1981-2003)	-12.6	-11.2	-8.7	-3.4	1.5	5.6	7.8	7.2	3.4	-1.2	-8.5	-11.6
Temperature Difference (Bullmoose – Chetwynd)	2.7	1.7	0.0	-1.3	-0.9	-1.0	-0.7	-0.2	-0.1	0.1	1.5	2.5

Notes:

1. Excludes outliers and months with incomplete or missing data.