Klohn Crippen Berger

Teck Highland Valley Copper Partnership

2021 Annual Facility Performance Report

Bethlehem No.1 Tailings Storage Facility

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Klohn Crippen Berger

March 29, 2022

Teck Highland Valley Copper Partnership
PO Box 1500
Logan Lake, British Columbia
V0K 1W0

Mr. Bryan Bale, P.Eng.
Chief Engineer, Tailings

Dear Mr. Bale:

2021 Annual Facility Performance Report
Bethlehem No. 1 Tailings Storage Facility

We are pleased to submit the Trojan Tailings Storage Facility Annual Facility Performance Report for the period from October 2020 through September 2021.

Yours truly,

KLOHN CRIPPEN BERGER LTD.

Rick Friedel, P.Eng.
Engineer of Record, Designated Representative
Senior Geotechnical Engineer, Principal

RF/NS:cd

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Teck Highland Valley Copper Partnership

2021 Annual Facility Performance Report

Bethlehem No.1 Tailings Storage Facility

EXECUTIVE SUMMARY

Klohn Crippen Berger Ltd. (KCB) was engaged by Teck Highland Valley Copper Partnership (HVC) to complete the 2021 Annual Facility Performance Report[1] (AFPR) of the Bethlehem Tailings Storage Facility (TSF) for the review period from October 2020 through September 2021. We have also reported on some key events that occurred during the reporting period of this document.

The Bethlehem TSF, located 4 km north of the operating mill, is a reclaimed, inactive facility that was operated from 1964 to 1989. The facility is maintained by HVC and is considered to be in the Closure – Active Care Phase, based on the Canadian Dam Association definition (CDA 2019).

The Bethlehem Tailings Storage Facility Structures

This review covers the following structures, which comprise the Bethlehem TSF:

- Dam No. 1 – comprises a glacial till starter dam, which was raised by a centerline method, with rockfill placed to form a downstream shell and spigotted or cycloned tailings hydraulically placed on the upstream beach. A downstream rockfill buttress was later added in the valley section.
- Bose Lake Dam – constructed of compacted glacial till with rockfill over the downstream slope for erosion protection, and a rockfill toe berm that includes a filter blanket and seepage collection system.
- R3 Seepage Pond Dam – located downstream from Dam No. 1, collects seepage from the Dam No. 1 underdrains.

The facility has been inactive for more than 30 years. The surface of the dam has been reclaimed and the pond level has been lowered. No significant dam safety incidents have occurred at the facility, including while the facility was active (i.e. while tailings were being deposited). In the current configuration, the piezometric levels and gradients through the tailings and dam fill are lower than during operations, which increases the factor of safety against slope failure and internal erosion.

During the review period the following key roles, according to the definitions in the Global Industry Standard on Tailings Management (GISTM 2020), were filled as follows:

- Mr. Bryan Bale, P.Eng. (HVC Chief Engineer - Tailings) acted in the role of Responsible Tailings Facility Engineer (RTFE) / TSF Qualified Person; and
- Mr. Rick Friedel, P.Eng. was the Engineer of Record (EoR), as a representative of KCB.

Activity During the Review Period

During the review period, the Bethlehem TSF was maintained within the design basis and conditions assumed in the approved design.

[1] Past Annual Facility Performance Reports were referred to as Dam Safety Inspections (DSI).

Other than routine maintenance activities, as defined in the OMS Manual (HVC 2019), such as clearing weirs of vegetation, there were no major repairs or construction activities completed during the review period.

November Regional Flooding

In November 2021, a combination of rainfall and early season snowmelt led to significant regional flooding and damage to public and private infrastructure, which impacted communities closest to the HVC site. The magnitude of the event was less at the HVC mine site and had no effect on the Bethlehem TSF. Regardless, HVC responded as they would have during any above-average flood on site, which included increased frequency of inspections, pond level monitoring, and reporting.

The Bethlehem TSF is designed to manage the Probable Maximum Flood (PMF) event, which is significantly greater than the regional flooding that occurred in November.

August Forest Fires

The site was under a temporary evacuation order from August 12 to 17, 2021, due to forest fires in the region. Prior to the evacuation, HVC and KCB prepared a modified monitoring program that prioritized surveillance activities. The forest fires did not reach the site, and there was no impact to the Bethlehem TSF. While the site was under the evacuation order, HVC was able to maintain a small site presence to manage essential site operations (e.g., water management).

This had no impact on the surveillance program defined in the OMS Manual (HVC 2019).

Surveillance Program

The current OMS Manual (HVC 2019) and the Emergency Preparedness and Response Plan (EPRP) (HVC 2019) are suitable for the facility. The OMS Manual was reviewed by HVC and KCB in 2021 with the updated version planned for issue in early 2022.

The Bethlehem TSF surveillance program is appropriate for an inactive, reclaimed tailings facility and includes:

- visual inspections;
- measured behaviour from piezometers, pond level readings, survey monuments, and an inclinometer installed at the facility;
- a Trigger-Action-Response-Plan (TARP); and
- review of surveillance information by HVC during weekly dam safety meetings, and annually by the EoR.

During 2021, routine surveillance activities were completed as per the OMS Manual (HVC 2019) with one modification as agreed with the EoR.

Bethlehem TSF Performance

The behaviour of the facility was observed to remain consistent with historical patterns; no issues of dam safety concern or unacceptable performance were identified. As the facility is inactive, changes in the conditions at the facility throughout the year, or on an annual basis, are primarily driven by variation in climate. KCB made the following key observations from the Bethlehem TSF performance review completed as part of the AFPR:

- There were no piezometric threshold exceedances at either dam, and trends remained consistent with historic trends.
- There were no downstream horizontal deformation trends observed. Settlement patterns for each dam remained consistent with historic behaviour.
- Visual inspections by the HVC dam inspector, the EoR, and others working in the area did not identify any indications of unacceptable behaviour at the dam.
- Pond levels and seasonal fluctuation were similar to historical trends. Despite a relatively dry spring where precipitation was well below average, pond level showed a typical rise during freshet suggesting this was driven by snowmelt.
- The pond level was >6.0 m below the dam crest, which is well above the minimum required (1.3 m) under normal (i.e. non-flood) conditions. There was no discharge through the spillway, as the pond level remained >0.3 m below the invert of the spillway.

Design Basis

Consequence classification is not part of HVC's tailings management governance, and they have instructed KCB not to include it when reporting on the Bethlehem TSF. Potential consequences from credible failure modes are managed through a rigorous risk management process. To support this approach, HVC are in the process of adopting design loading for earthquake and flood scenarios equivalent to an Extreme consequence classification (CDA 2019) for all tailings facilities. This approach has the following advantages:

- meets or exceeds Health Safety and Reclamation Code for Mines in B.C. (HSRC) (EMLCI 2021a) requirements.
- aligns with Teck's goal to eliminate any risk for loss of life.
- is consistent with the GISTM (2020), which supports evolving beyond the conventional consequence classification system.

The Bethlehem TSF is already designed to manage the Probable Maximum Flood (PMF) condition with adequate freeboard. The design earthquake for Dam No. 1 and Bose Lake Dam (1/2 between 2,475-year and the 10,000-year return period earthquakes) was selected to meet requirements of the HSRC (EMLCI 2021a). However, dam stability is not very sensitive to the magnitude of the seismic load, so slope failures with the potential to release tailings would still meet criteria if the design earthquake were increased to the 10,000-year return period event.

Flood Routing

Flood routing assessments for both the Bethlehem TSF and the R3 Seepage Pond were updated during the review period (KCB 2022) based on the most recent site hydrology (Golder 2021). The analysis closed outstanding recommendations from the Dam Safety Review (SRK 2019) and confirmed the R3 Seepage Pond can route the IDF (100-year return period) and the Bethlehem TSF can route the PMF.

Recommendations

As of the time of the issue of this report, all of the recommendations that were identified during past AFPRs (Table 1) and the most recent Dam Safety Review (SRK 2019) have been closed. No new recommendations were identified during the review period.

Table 1 Previous Recommendations Related to Facility Performance – Status Update

ID No.	Performance Area	Recommended Action	Priority(1)	Recommended Deadline (Status)
Bose Lake Dam				
BD-2020-01	*Maintenance*	*Complete inspection of the downstream slope of exposed Bose Lake Dam glacial till fill (above ~El. 1440.1 m) for animal burrows and fill or obstruct them.*	*3*	*CLOSED*
Dam No. 1				
BTSF-2018-01	*Flood Management*	*Update flood routing for Bethlehem TSF and R3 Seepage Pond based on the most recent site wide hydrology information for consistency and to confirm compliance.*	*3*	*CLOSED*

Notes:
1. Recommendation priority guidelines, specified by Teck and assigned by KCB:
   - 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.
2. No Outstanding Recommendations for R4 Seepage Pond

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CLARIFICATIONS REGARDING THIS REPORT

This report is an instrument of service of Klohn Crippen Berger (KCB). The report has been prepared for the exclusive use of Teck Highland Valley Copper Partnership (Client) for the specific application to the 2021 Dam Safety Support Project, 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.

1 INTRODUCTION

Klohn Crippen Berger Ltd. (KCB) was engaged by Teck Highland Valley Copper Partnership (HVC) to complete the 2021 Annual Facility Performance Report[2] (AFPR) of the Bethlehem Tailings Storage Facility (TSF) for the review period from October 2020 through September 2021. Key events that occurred during the reporting period of this document are also noted.

The Bethlehem TSF, located 4 km north of the operating mill (Figure 1), is a reclaimed, inactive facility operated from 1964 to 1989. The facility is maintained by HVC and is considered to be in the Closure – Active Care Phase based on the Canadian Dam Association definition (CDA 2019).

Table 1.1 summarizes the Bethlehem TSF structures and their function. Refer to Figure 2 for the facility layout.

Table 1.1 Bethlehem TSF Structures

Facility	Structure	Function
Bethlehem TSF	Dam No. 1	Retains tailings at western boundary of impoundment.
	Bose Lake Dam	Retains tailings at eastern boundary of impoundment.
	R3 Seepage Pond Dam	Retains R3 Seepage Pond, which stores seepage from Bethlehem TSF.

The Bethlehem TSF has been reclaimed and HVC continues ongoing management of the facility including instrumentation monitoring, environmental sampling, visual inspections and maintenance activities. Under this level of site presence, the Bethlehem TSF is in the Closure – Active Care Phase as based on the Canadian Dam Association (CDA) Mining Dam Technical Bulletin (CDA 2019).

The AFPR scope of work consisted of:

- site visit to observe the physical conditions of the various containment facilities;
- review of surveillance data for the review period provided by HVC;
- review of climate and water balance data for the site;
- review of the Operations, Maintenance & Surveillance (OMS) Manual (HVC 2019) and Emergency Preparedness and Response Plan (EPRP) to confirm it is appropriate for the existing facility; and
- review of construction activities completed at the site during the review period, if any.

The site visit of R3 Seepage Pond Dam was completed by KCB representatives Mr. Rick Friedel, P.Eng. and Mr. Delton Breckenridge, EIT on July 22, 2021. The site visit of Dam No. 1 and Bose Lake Dam was rescheduled to September 17, 2021 due to smoky conditions which impeded visibility. The Dam No. 1 and Bose Lake Dam site visits were completed by KCB representatives Mr. Rick Friedel, P.Eng. and Ms. Anna Geller, EIT.

[2] Past Annual Facility Performance Reports were referred to as Dam Safety Inspections (DSI).

During the review period, Mr. Bryan Bale, P.Eng. (HVC Chief Engineer – Tailings) acted in the role of Responsible Tailings Facility Engineer (RTFE) / TSF Qualified Person (QP), and Mr. Rick Friedel, P.Eng. was the Engineer of Record (EoR), as a representative of KCB. These roles are consistent with the definition in the Global Industry Standard on Tailings Management (GISTM 2020).

The Bethlehem Mine was operated under Permit M-11 issued by the Ministry of Energy, Mines and Petroleum Resources (EMPR) in January 1970 and reclamation work was carried out under Permit M55 issued on October 27, 1989. In July 1998, the mining permits for the Highmont Mine, the Lornex Mine, and the Bethlehem Mine were amalgamated under M-11 Permit (EMPR 2019). The most recent version of the permit was issued in 2021 (EMLCI 2021b).

Water discharge quantity and quality from the Bethlehem TSF are regulated under Permit PE 376 (09), issued by the Ministry of Environment – Waste Management Branch, dated January 1, 1971 and last amended on May 29, 2003. Other pertinent permits include water licenses C114183 and C068389, issued by the Ministry of Environment – Water Rights Branch.

2 FACILITY DESCRIPTION

The HVC Mine is located near Logan Lake, approximately 45 km south of Kamloops, in the interior of British Columbia. The Bethlehem TSF is located 4 km northeast of the operating mill and immediately east of the Trojan TSF; refer to Figure 1 and Figure 2. Bose Lake is a natural lake approximately 60 m downstream of the Bose Lake Dam toe. The facility was operated from 1963 to 1989 and stores an estimated 68 Mm^3 of tailings.

Tailings are retained in the Bethlehem TSF by two dams; Dam No. 1 (Figure 3) at the western boundary; and Bose Lake Dam (Figure 4) at the eastern boundary. The R3 Seepage Pond (Figure 5) is located approximately 200 m downstream of Dam No. 1. There are two free water ponds in the Bethlehem TSF that have formed in low points of the tailings surface and are present year-round (Figure 2): Pond No. 1 located centrally in the TSF; and Pond No. 2 located close to the Bose Lake Dam. Typical geometry and dimensions of the dams are summarized in Table 2.1. Figure 2.1, Figure 2.2, Figure 2.3 and Figure 2.4 show typical cross sections of Dam No. 1, Bose Lake Dam and R3 Seepage Pond.

Bethlehem Dam No. 1

- Dam No. 1 comprises a glacial till starter dam (up to 20 m high), built in 1963. The dam foundation generally comprises competent glacial overburden up to 24 m thick overlying bedrock.
- The dam was raised by centreline method with mine waste (i.e., rockfill) placed to form a downstream shell that supports an upstream beach of spigotted or cycloned tailings hydraulically placed on the upstream beach. A rockfill toe buttress was added to the Dam No. 1 design in 1970 (Golder Brawner 1970).
- The design relies on a wide tailings beach, minimum of 122 m (400 ft), between the tailings pond and dam rockfill. Under existing conditions, the minimum typical beach width is more than 800 m.
- Seepage from the underdrain system reports to R3 Seepage Pond. Prior to 2016, some of the flow which reports to R3 Seepage Pond was routed through Seepage Pond 1 before the retaining berm in Seepage Pond 1 was breached and replaced by a weir in 2016. This did not change the catchment or underdrain flow reporting to R3 Seepage Pond and eliminated potential failure modes related to the Seepage Pond 1 retaining embankment.

Bose Lake Dam

- The dam was constructed in four phases, predominantly of compacted glacial till with a rockfill toe berm that includes a filter blanket and seepage collection system that drains, by gravity, to a pump well at the low point along the downstream toe. The final (fourth) construction phase (Figure 2.3) that raised the crest to the existing level with glacial till fill that was supported by downstream rockfill. This rockfill is observed over the majority of the existing downstream slope and also provides erosion protection.

- Concrete manholes along the downstream toe allow access to observe and sample seepage flow in the collection system.
- The dam was built in four stages, the first of which was done in 1972. The final stage was completed in 1981 (KC 1994).
- In 1995, a permanent open channel spillway (invert of inlet at El. 1469.3 m) for the Bethlehem TSF was constructed at the left abutment of Bose Lake Dam (KC 2002). The channel extends to the public access road at the toe of the dam, where it is diverted through two culverts (1 x 1380 mm dia., 1 x 600 mm dia.) and discharges into Bose Lake.

R3 Seepage Pond

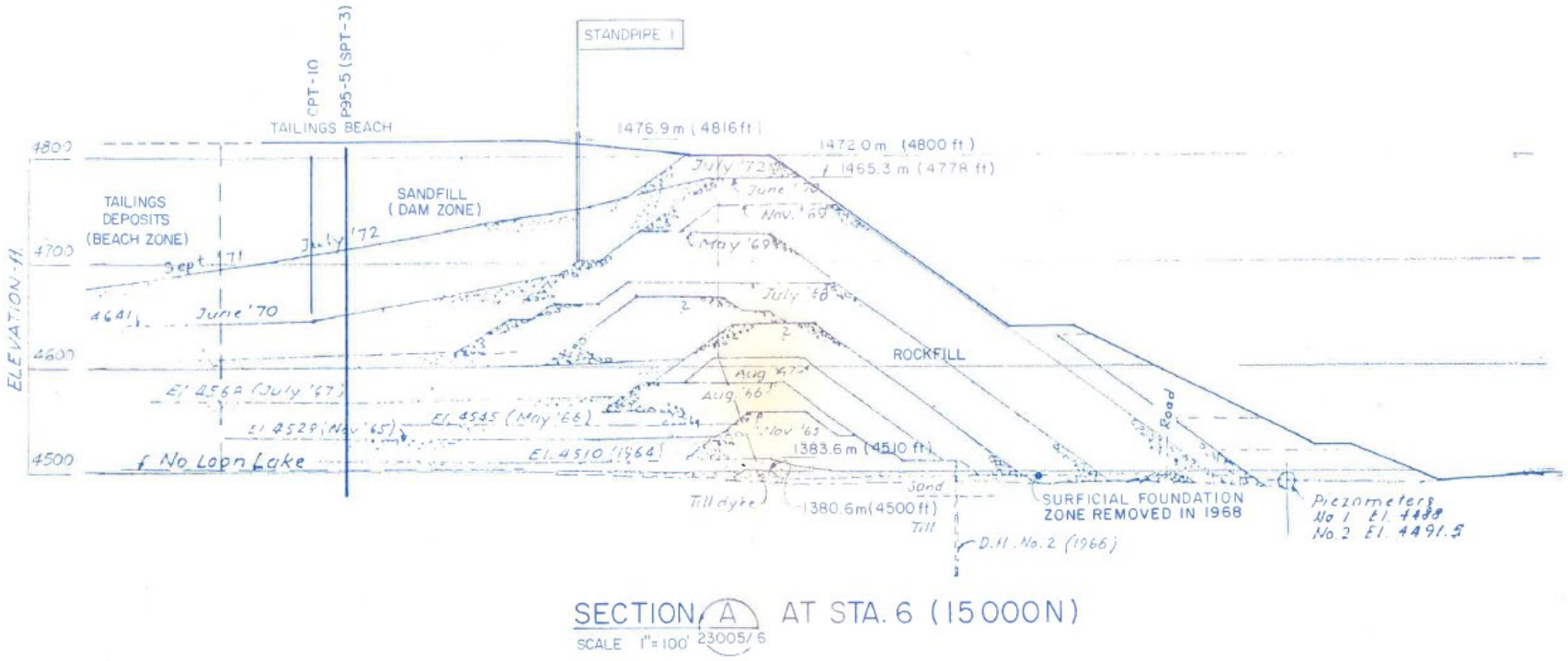
- The pond is approximately 170 m downstream of the Dam No. 1. A dam retains the R3 Seepage Pond reservoir along the west side.
- A spillway channel is constructed at the right (north) abutment and discharges flow to Lower Trojan Dam downstream of the dam toe. Water is typically discharged to Lower Trojan Dam via a buried pipeline (low-level outlet) at the left abutment, but flows can also be diverted to the Highland Mill.

Table 2.1 Summary of Approximate Dam Geometry

Dam	Construction Method	Nominal Crest Elevation (m)	Max. Dam Height (m) [2]	Crest Length (m)	Min. Crest Width (m)	Upstream Slope	Overall Downstream Slope
TAILINGS DAMS							
Dam No. 1	Modified Centreline	1477 (top of sand fill) 1472 (top of rockfill)	91	2000	25	N/A	3H:1V (from sandfill crest) 2.2H:1V (from rockfill crest)
Bose Lake Dam	Saddle Dam Downstream	1475	31	600	9	2H:1V	2H:1V
SEEPAGE COLLECTION DAM							
R3 Seepage Pond	Unknown (believed single raise)	1372	4	60	5	2H:1V	2.5H:1V

Notes:
1. Dimensions are estimated from 2014 LiDAR data unless otherwise noted.
2. Height measured as the vertical distance between downstream toe and crest.

Figure 2.1 Typical Cross Section of Dam No. 1 (KC 1996)



SOURCE

BETHLEHEM AS-BUILT DAM CONSTRUCTION SECTION.

Figure 2.2 Typical Cross Section of Bose Lake Dam – Construction Phases 1 to 3 (Gepac 1972)

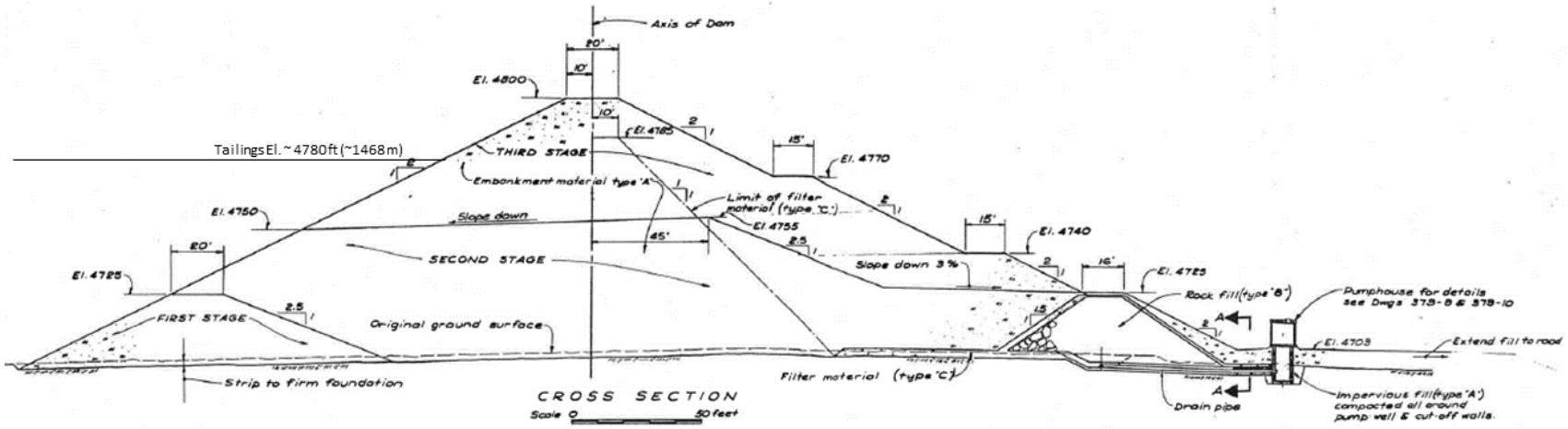


Figure 2.3 Typical Cross Section of Bose Lake Dam – Construction Phase 4

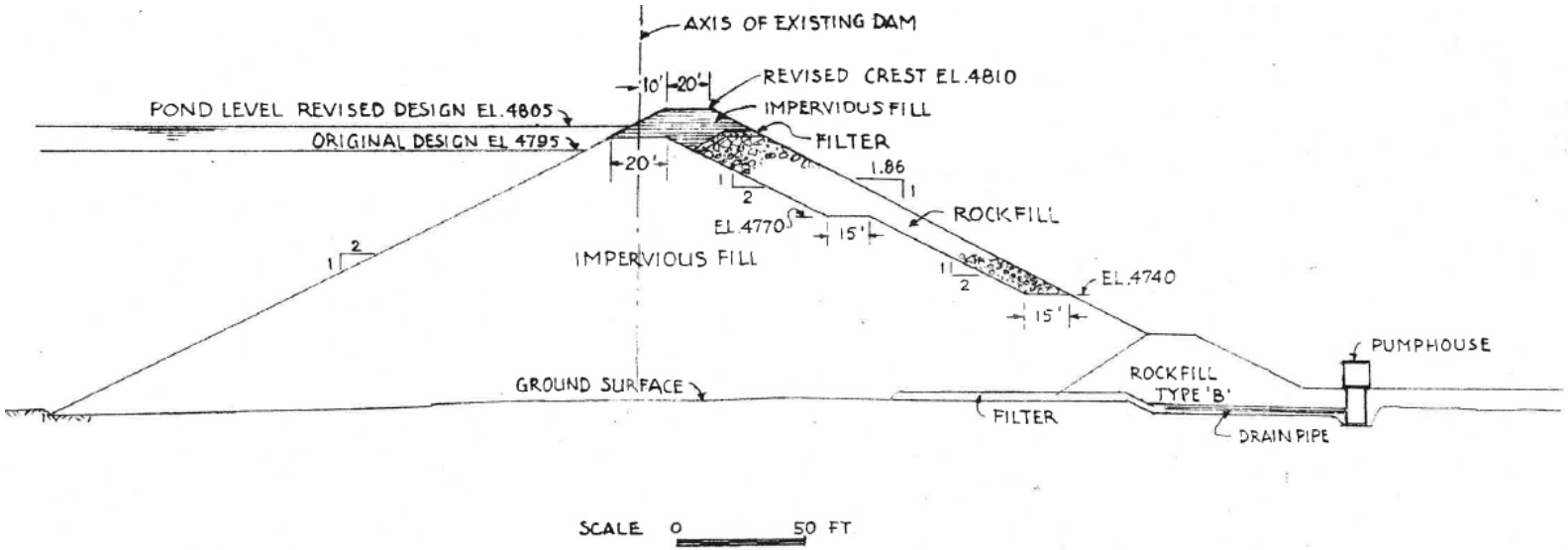
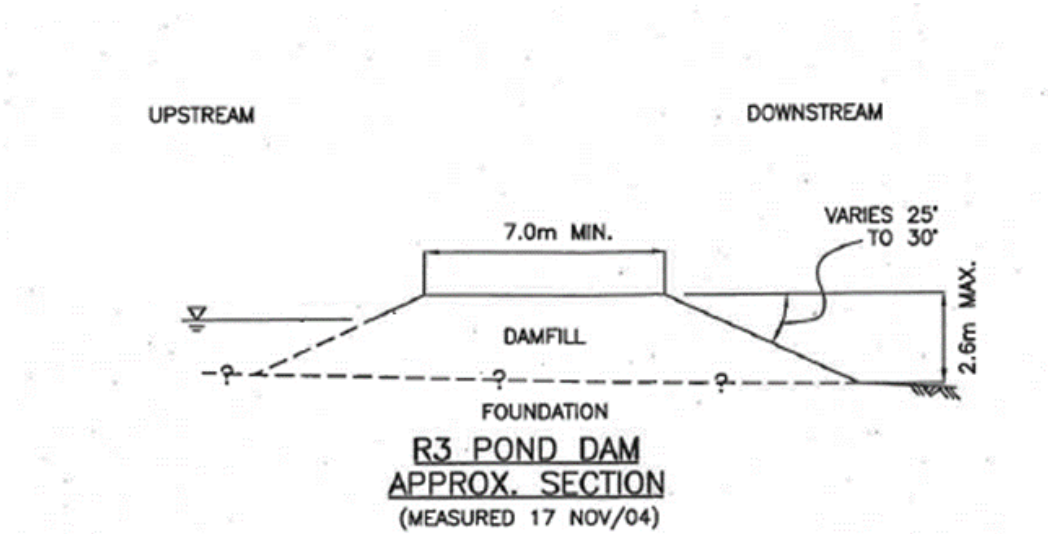


Figure 2.4 Typical Cross Section of R3 Seepage Pond Dam (KC 2005)



3 ACTIVITIES DURING REVIEW PERIOD

During the review period, the Bethlehem TSF was maintained within the design basis and specified operational conditions of the approved design.

Other than routine maintenance activities, as defined in the OMS Manual (HVC 2019) (e.g., clearing weirs of vegetation), there were no major repairs or construction activities completed during the review period.

During 2021, a shallow site investigations program of auger holes and cone penetration tests (CPT) was completed on the tailings beach between Dam No. 1 and Pond No. 1. The investigations were completed as part of quA-ymn Solar project being developed by a 3rd party that HVC is supporting. The HVC QP and EoR reviewed the scope of the project and investigation program to confirm neither would represent a risk to tailings facility performance and designate exclusion areas near the dams where no activity should be undertaken. Data from the program will be shared with HVC and KCB tailings teams when available to include in the data record for the facility.

4 WATER MANAGEMENT

4.1 Overview

The flow schematic for the Bethlehem TSF and nearby Trojan TSF is shown in Figure 6.

4.2 Climate

HVC provided climate data from the L-L Dam Weather Station (El. 1186.0 m), for the 2021 AFPR review period, for KCB to review. KCB adjusted the L-L Dam Weather Station data and Historical Average Lornex Synthetic Record data using the Highmont, Bethlehem and Trojan Area adjustment factors provided in Golder (2021). The adjusted data over the review period were then compared to typical average values, refer to Appendix II-A. In addition, KCB downloaded the Kamloops Pratt Road station (El. 729.0 m) climate data from Environment Canada and was provided the Shula Weather Station (El. 1208 m) data by HVC, to review and compare precipitation trends against the L-L Dam Weather Station data. The Kamloops Pratt Road Weather Station was used for comparison rather than the Kamloops Airport Station (El. 345.3 m) as the elevation at the Pratt Road Station is closer to L-L Dam Weather Station (El. 1186.0 m).

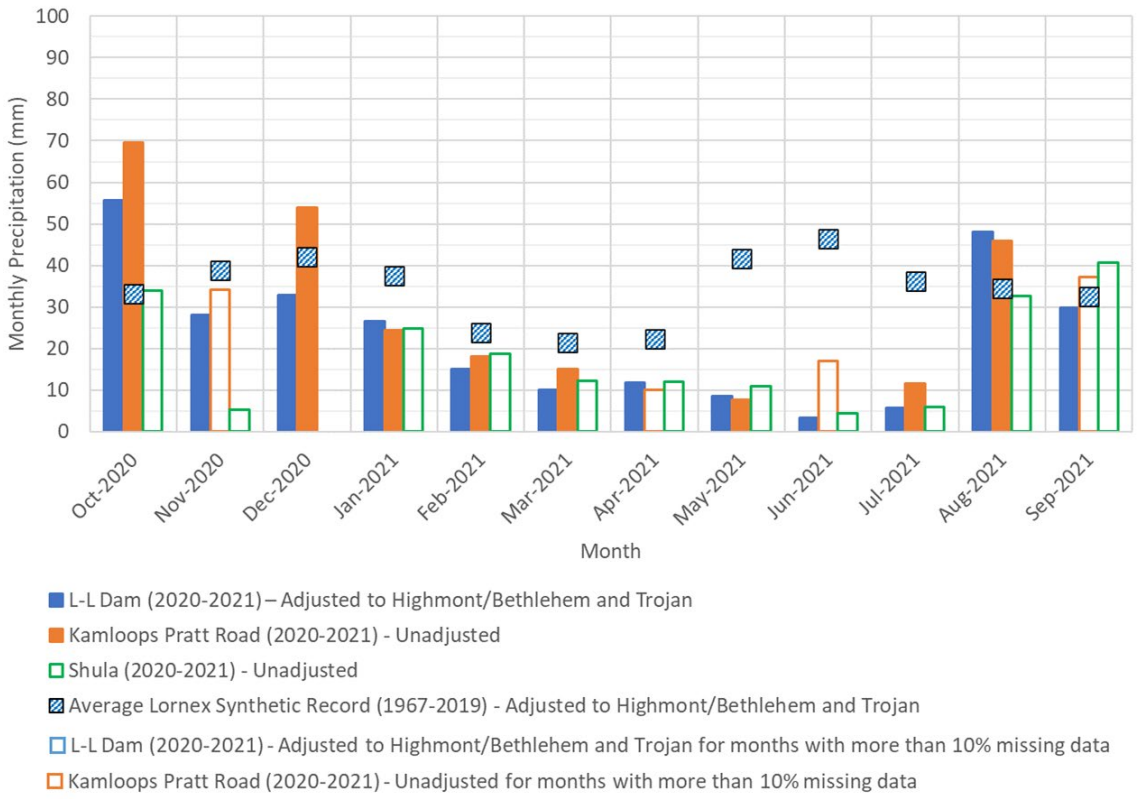
The monthly precipitation record for the reporting period is shown in Figure 4.1. The following observations are noted for the reporting period:

- All storm events during the review period were less than the 10-year return period rainfall event (40 mm in 24 hours). The largest 24-hour rainfall events measured at the L-L Dam Weather Station during the review period, were: 23.7 mm on October 23, 2020; 16.2 mm on December 21, 2020; and 18.5 mm on August 16, 2021.
- In Figure 4.1, all months, except for October 2020 and August 2021 reported 9% to 93% decreases relative to average precipitation. October 2020 precipitation increased 67% relative to the historic normals; August 2021 precipitation increased 40%.
- The L-L Dam Weather Station database included some gaps in 2020 measurements. HVC managed to improve the monitoring program and, as Figure 4.1 indicates, there were no data gaps in the 2021 measurements. In addition, consistency in trends between the Kamloops Pratt Road Station, the Shula Weather Station data for 2021, and the L-L Weather Station provides confidence in the L-L Weather Station data.
- Snowpack depth measurements, from the Highland Valley Station (El. 1268 m), indicate snow melted during April 2021, and was gone by May 1st. In comparison, the HVC site-wide water balance assumes 30% of snowmelt occurs in March and 70% in April (Golder 2020a).
- Figure 4.2 shows a comparison between snow water equivalent (SWE) and temperature at the HVC site from January to June 2021. The following observations are inferred from these data:
  - The daily temperature recorded between January and June 2021 is within the historical monthly average records (between 2000 and 2019).

- The snowpack was depleted over a period of three weeks (April 9 to April 29), which is a quicker rate than the forecast snowmelt pattern from the HVC site-wide water balance, which is based on Golder (2020a).
- The rise in temperature above 0°C in April coincides with the snowmelt period manually recorded at the Highland Valley station.
- Rain was not a major factor in 2021 snowmelt, as the maximum daily precipitation recorded close to the snowpack depletion period is less than 6 mm/day.

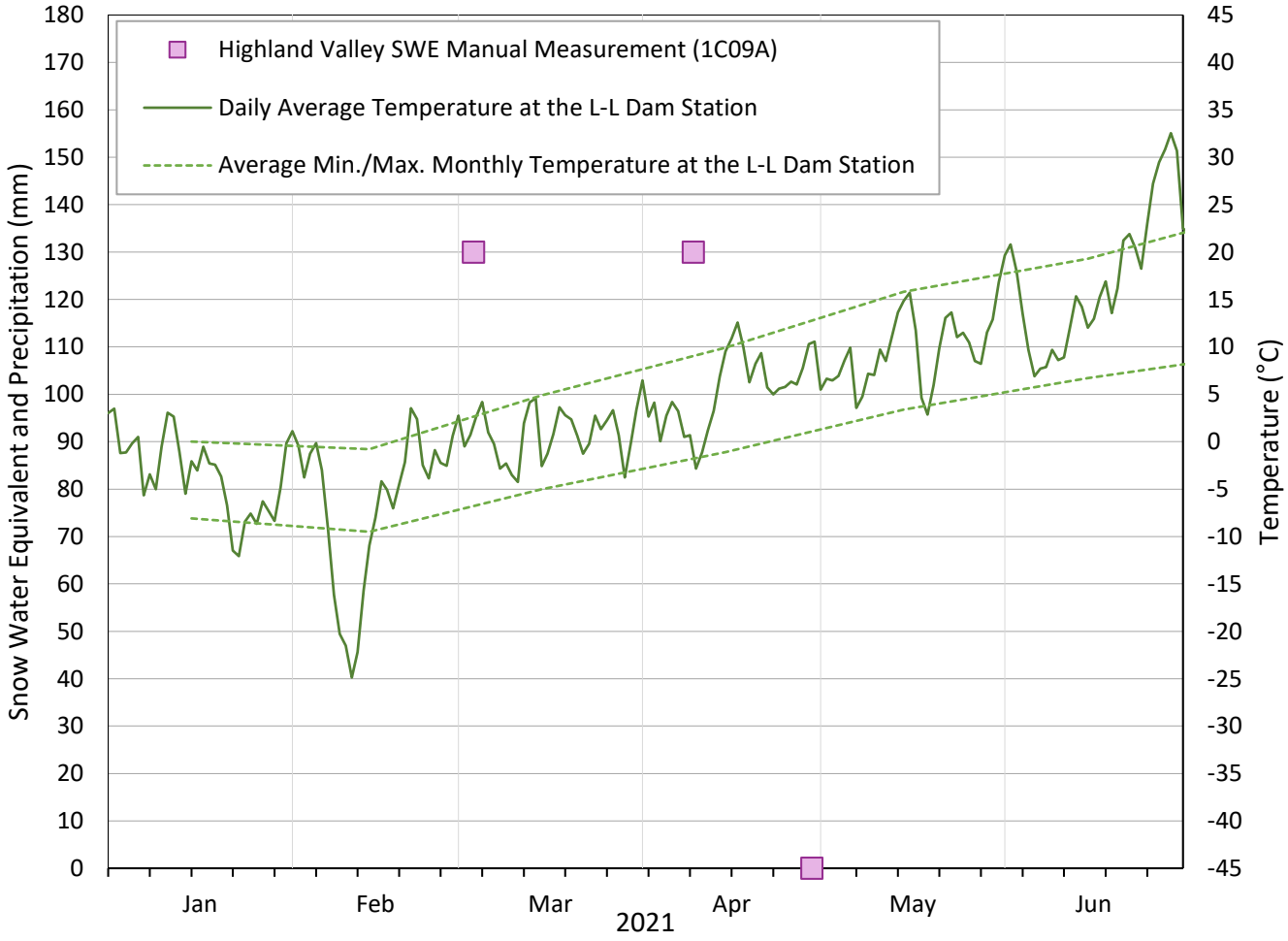
- Seasonal rise and fall of pond levels is associated with freshet. In 2021, pond levels dropped in May, coincident with completion of snowmelt, which is consistent with historic trends (Figure 5.1). Rainfall measured from March through May, when pond levels were rising, was approximately 35% of the historical average during that same period, which suggests the majority of the 2021 freshet was related to snowmelt.

Figure 4.1 Monthly Precipitation



Note:
1. The Shula weather station data used for this comparison only included monthly values (i.e., no daily data) and thus, KCB was not able to assess the completeness of the dataset.

Figure 4.2 Temperature Records and Measured Snowpack between January and June 2021



Notes:
1. SWE is manually measured at the Highland Valley snow pillow station (1C09A) typically once per month.
2. Daily average temperature data at the L-L Dam Station for 2021 was provided by HVC.
3. The average maximum and minimum monthly temperatures at the L-L Dam Station were developed by Golder (2021).

4.3 Water Balance

HVC manages and tracks the annual water balance for the Bethlehem TSF. Table 4.1 is a summary of annual inflows and outflows, provided by HVC. The water balance is based on simplified modelling results and therefore, the values should be treated as indicative only.

Table 4.1 Annual Water Balance for Bethlehem TSF

Item	Volume in 2021[1] (m^3)
Inflows	
Runoff to Beach	337,900
Runoff to Ponds	27,300
Total inflow:	*365,100*
Outflows	
Seepage	466,300
Evaporation	52,700
Total outflow:	*519,000*
Net Change	
Net Change (inflow minus outflow)	-153,900

Notes:
1. Values received from HVC have been rounded to the closest 100 m^3.

4.4 Flood Management

The flood management requirements for the Bethlehem TSF and R3 Seepage Pond are summarized in Table 4.2. Flood routing assessments for both facilities were updated (KCB 2022) based on the most recent site wide hydrology (Golder 2021). The analysis concluded the following:

- Bethlehem TSF can safely route, with adequate freeboard, the original spillway design event (PMF 24-hour) (KC 1994), which is greater than the IDF (Table 4.2) required under the Health, Safety and Reclamation Code for Mines in British Columbia (HSRC) (EMLCI 2021a).
- R3 Seepage Pond can safely route, with adequate freeboard, the IDF (Table 4.2) required under the HSRC (EMCLI 2021a). R3 Seepage Pond can route the original design event (PMF 24-hour event) but minimum freeboard is not met.

This work closes the related recommendations from the DSR (SRK 2019) and from the 2018 AFPR, as stated in Table 8.1.

Table 4.2 Inflow Design Flood Requirements for Bethlehem TSF

Facility	Outfall Type	Inflow Design Flood[1]	Spillway Design Event	Peak Design Flood Level	Peak Design Outflow
Bethlehem TSF	Open channel	2/3 between 1000-year and PMF	PMF 24-hour	1470.6	7.9 m^3/s
R3 Seepage Pond	Open channel	100-year	100-year, 24-hour[2]	1371.1 m	1.5 m^3/s

Notes:
1. As discussed in Section 7.1, Teck have instructed KCB to no longer report on consequence classification, as defined by CDA (2019). The spillway design event for the Bethlehem TSF exceeds equivalent IDF required under the HSRC (EMLCI 2021a).
2. The original spillway design event for R3 Seepage Pond (AMEC 2013) was the PMF but this event can no longer be routed with adequate freeboard based on KCB (2022), so the IDF is now the stated spillway design event.

5 REVIEW OF MONITORING RECORDS AND DOCUMENTS

5.1 Monitoring Plan

The Operation, Maintenance and Surveillance (OMS) Manual (HVC 2019) was reviewed during the review period and a revised document is planned to be issued in early 2022. This was a routine update to the OMS Manual which included revisions to align with the most recent industry guidance documents (MAC 2019).

The Bethlehem TSF surveillance program is appropriate for an inactive, reclaimed tailings facility that includes: visual inspections; measured behaviour from piezometers, pond level readings, survey monuments and an inclinometer installed at the facility; and a Trigger-Action-Response-Plan (TARP). Information from routine surveillance activities are reviewed by the HVC Tailings Group, including the QP, during weekly intra-departmental meetings.

HVC compliance with the surveillance program in the OMS Manual (HVC 2019) is summarized in Table 5.1. During 2021, routine surveillance activities were completed as per the OMS Manual (HVC 2019) with one exception: no readings were taken from impoundment piezometers during the review period. This was to allow time to prioritize other surveillance activities. As this had been agreed with the EoR in 2020 it is not a non-conformance.

Table 5.1 Monitoring Activities

TSF Monitoring	Facility	Minimum Frequency[1]	Responsible Party	Documentation	2021 Frequency Compliance[1]	Notes for the Review Period
INSPECTIONS						
Routine Visual Inspection[2]	Dam No. 1 and Bose Lake Dam	Every 2 Months	HVC	HVC Weekly Dam Safety Slides	Yes	-
	R3 Seepage Pond	Quarterly	HVC	HVC Weekly Dam Safety Slides	Yes	-
Event-Driven Inspection	All	Event Driven[3]	HVC	HVC Inspection Report	n/a	No event-driven inspections were triggered during 2021.
AFPR	All	Annually	KCB	This Report	Yes	-
Dam Safety Review	All	Every 5 years	HVC	Report	n/a	Next DSR is due in 2023.
INSTRUMENTATION MONITORING						
Piezometers	Dam No. 1 and Bose Lake Dam	Quarterly[4]	HVC	AFPR	Yes	Modified frequency as discussed in Section 5.1.
Inclinometers	Dam No. 1	Quarterly[4]	HVC		Yes	Readings were taken monthly when the instrument was accessible from May through September.
Seepage flow instruments	R3 Seepage Pond	Quarterly[4]	HVC	HVC Inspection Reports	Yes	Seepage flows were calculated as the difference in flow reporting to Lower Trojan Dam, minus the flows measured from R4 Seepage Pond.
Pond level	Pond No. 1	Every 2 Months[4]	HVC		Yes	Pond levels were surveyed in December 2020, May, and September 2021. However, they were visually inspected as per frequency.
	Pond No. 2	Monthly[4]	HVC		Yes	First reading after winter was collected in April.
SURVEYS						
Survey monuments	Dam No. 1 and Bose Lake Dam	Annually	HVC	AFPR	Yes	-

Notes:
1. Frequency of routine surveillance activities were modified in 2020 related to site resources restrictions required to meet COVID 19 provincial health regulations, as discussed in Section 5.1.
2. Visual inspections include pond level measurements and observations of unusual condition and/or dam safety concerns (e.g. settlement, sinkholes, slope sloughing, erosion, piping, etc.).
3. HVC staff are to complete an event-driven inspection in response to one of the following events:
   - Earthquake greater than magnitude 5 within 100 km of the site, or any earthquake felt at site.
   - Rainfall event greater than the 10-year, 24-hour duration storm: 39.9 mm (Golder 2020b).
4. When accessible.

5.2 Pond Levels and Freeboard

The Pond No. 1 and Pond No. 2 levels are measured and also visually checked during routine inspections for any unusual condition. There was no discharge through the Bethlehem TSF spillway during the review period and freeboard exceeded requirements as discussed in Section 1. General observations of pond level are as follows:

Pond No. 1:

- During 2021 pond level followed the established seasonal pattern (Figure 5.1).
- Pond levels early in 2021 were lower than those measured during the equivalent period in 2020 and that difference increased throughout the year (Table 5.2) which is consistent with precipitation records that show 2021 was a significantly drier year than 2020 (Section 4.2).

Pond No. 2:

- During freshet, 2021 levels were similar to 2020 levels, which were the highest on the record dating back to 2015 (Figure 5.1).
- Pond level reduced in 2021 at a faster rate following freshet in comparison to 2020 (Table 5.3) which is also consistent with precipitation records (Section 4.2).

Table 5.2 Change in Pond No. 1 Water Elevations

Annual Change	Change in Pond Level 2020 to 2021	Range of Annual Pond Level Change 2015 to 2020
Peak Pond	-0.3 m	-1.0 m to 0.0 m (avg. -0.4 m)
Pond at End of Review Period (1)	-0.6 m	-0.7 m to -0.3 m (avg. -0.5 m)

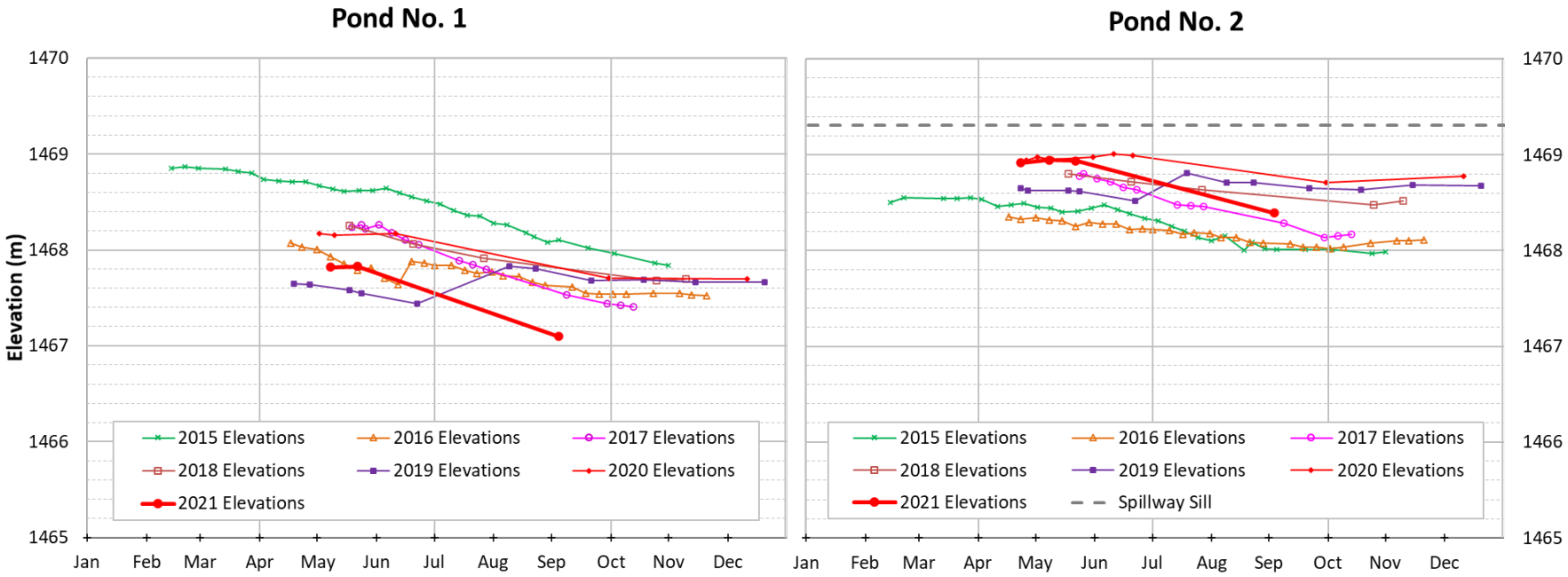
Notes:
1. End of review periods, between 2015 and 2020, varied between September and December.

Table 5.3 Change in Pond No. 2 Water Elevations

Annual Change	Change in Pond Level 2020 to 2021	Range of Annual Pond Level Change 2015 to 2020
Peak Pond	-0.1 m	-0.1 m to 0.6 m (avg. 0.2 m)
Pond at End of Review Period (1)	-0.3 m	-0.3 m to 0.4 m (avg. 0.3 m)

Notes:
1. End of review periods, between 2015 and 2020, varied between September and December.

Figure 5.1 Pond No. 1 and Pond No. 2 Water Elevations – 2015 to 2021



The minimum freeboard measured during the review period at Bose Lake Dam (based on Pond No. 2) and R3 Seepage Pond are summarized in Table 5.4. Target flood freeboards were met at all facilities during the review period.

Freeboard requirements and predictions during the IDF/spillway design event for R4 Seepage Pond and Trojan TSF (Table 5.4) were updated during the flood routing work discussed in Section 4.4 (KCB 2022). This closed outstanding recommendations from the DSR (SRK 2019).

Table 5.4 Freeboard at Bethlehem TSF and R3 Seepage Pond

Facility	Minimum Freeboard (m) [1]			
	Required during IDF	Predicted During IDF	Required During Non-Flood Conditions	Observed During the Review Period[3]
Bethlehem TSF	2.2	4.4[2]	1.3	6.0
R3 Seepage Pond	0.5	0.7	0.5	1.5

Notes:
1. Refers to minimum vertical distance between dam crest and pond level based on KCB (2022).
2. As per KCB (2022), Bethlehem TSF values are based on the spillway design flood event which is greater than the IDF, refer to Section 4.4.
3. Based on maximum recorded pond elevation during the review period.

5.3 Piezometers

The suite of piezometers at the Bethlehem TSF, as of September 2021, is summarized in Table 5.5 and shown on Figure II-B-1 to Figure II-B-3, and Figure II-B-7 to Figure II-B-9. The instruments are considered adequate for the existing condition of the structure. Several of the instruments are reported as “dry” meaning that the instrument tip is above the piezometric level at that location which provides some value by defining maximum possible levels. Piezometers in the impoundment were not measured during 2021, which was agreed with the EoR if site resources were restricted to focus on higher priority instruments, as discussed in Section 5.1. These instruments will be read in 2022.

Table 5.5 Bethlehem TSF Piezometers

Location	Total Piezometers	Measuring Positive Piezometric Pressure During the Review Period	Reported Dry
Impoundment	29	NR[1]	n/a
Dam No. 1	10	6	4
Bose Lake Dam	5	5	0

Notes:
1. NR=No Reading.

Dam No. 1

Piezometric readings at Dam No. 1 are plotted with the Pond No. 1 level, on Figure II-B-1 to Figure II-B-3. Maximum and minimum piezometric levels since 2013, instrument thresholds, as well as piezometric levels during the review period are reported in Appendix II-B. Key observations are as follows:

- There were no piezometric threshold exceedances during the review period.
- Dam No. 1 – Crest Area Piezometers: P13-5 continues to be the only piezometer near the dam crest which measures a piezometric head. Piezometric level increased 0.7 m in June and remained constant through July and August. However, in September the water level dropped to the level that is consistent with the historical behaviour. The other piezometers in the area are installed at higher elevations (~El. 1440 m to 1460 m), above the interpreted existing piezometric surface.
- Dam No. 1 – Downstream Slope Area Piezometers: levels are consistent with previous years and continue to indicate a downward gradient towards the foundation. VWP16-1B water levels started rising but the pore pressures remain negative, indicating the piezometer is above water table or the instrument tip is not fully saturated.

Bose Lake Dam

Piezometric readings at Bose Lake Dam are plotted, with the Pond No. 2 level, on Figure II-B-7 to Figure II-B-9. Maximum and minimum piezometric levels since 2013, instrument thresholds, as well as piezometric levels during the review period are reported in Appendix II-B. A summary of key observations is as follows:

- There were no piezometric threshold exceedances during the review period.
- Bose Lake Dam – Crest Area Piezometers: include three nested instruments installed in the dam fill and foundation. There is a general rise in piezometric level (<1 m) since 2017, which is consistent with Pond No. 2 level rise during that period. Overall piezometric levels in 2021 were lower than 2020, which is also consistent with the pond level trend (Section 5.2). Instruments continue to suggest an upward gradient from the foundation (bedrock) into the dam fill. The rate of rise is also slightly greater in the foundation piezometers than in the fill piezometers, indicating the foundation piezometers are more greatly influenced by change in pond level.
- Bose Lake Dam – Toe Area Piezometers: levels are consistent with recent years.

5.4 Survey Monuments

Survey of the monuments at the Dam No. 1 and Bose Lake Dam since November 2019, are plotted on Figure II-B-4 and Figure II-B-10, respectively. In November 2019, HVC started to use GPS Real Time Kinematic (RTK) to survey the monuments which has shown to have less variance, with respect to horizontal (Northing / Easting) deformation but increased variance in elevation. The horizontal surveys are plotted for the RTK method only, based on the baseline location from the November 2019 survey. However, a continuous record of settlement has been maintained based on incremental change between RTK surveys.

The incremental vertical settlement at three monuments exceeded threshold value (20 mm) by 1 mm to 2 mm. The threshold value was defined based on typical variance with the previous survey method. These exceedances are interpreted as the result of the higher variance in elevation surveys with the RTK method, which is visible in the summary plots included in Appendix III. Higher variability in vertical elevation is a trade-off for lower variance in horizontal measurements with the RTK survey method. KCB and HVC are planning to revise thresholds during 2022 based on typical variance using the RTK survey method. In the case that this settlement are representative of field behaviour they do not represent a dam safety concern as there is no horizontal deformation trend and the total magnitude of settlement to date is not sufficient to impact freeboard (Section 5.2).

5.5 Inclinometers

The single inclinometer at Dam No. 1 (IB16-1), installed in 2016, was read monthly during the review period, when the instrument was accessible. There are no significant deformations in the downstream direction in the readings and no discrete zones of deformation have been observed to date. Cumulative displacements measured at IB16-1 are plotted on Figure II-B-5.

Since the inclinometer was installed in 2017, the data over that period has shown no deformation trends or observations of concern. Based on this, KCB recommended to HVC that the reading frequency of the inclinometer could be reduced to twice per year (min. 5 months apart), which they have adopted and will be included in the next OMS Manual update.

5.6 Seepage

Seepage weir TB-R3-FS-01, that measured inflow to R3 Seepage Pond, was removed in January 2021. Seepage flows from the weir had been relatively consistent for more than 10 years, refer to plot in Appendix II-B, and discharge from the pond is measured by weirs further downstream as shown on Figure 6.

5.7 Water Quality

Permit PE-376 specifies minimum water quality sampling requirements at HVC, including downstream of the Bethlehem TSF (refer to Appendix III). Water sampling activities and results are reported in the following report, which were provided to KCB for review:

- 2021 Annual Water Quality Monitoring Report (ERM 2022)

The report was signed by a qualified professional in the related field and should be referred to for monitoring data and discussion of results. The EoR (Mr. Friedel, P.Eng.) reviewed the documents (ERM 2022) for discussion related to items of compliance with sampling requirements and key observations, which are summarized as follows:

- There are fifteen permitted and one voluntary surface water quality monitoring sites in the Trojan-Bethlehem area, seven of which are upstream or downstream of the Bethlehem TSF, as shown on the site monitoring plan in Appendix III.
- HVC met the required sampling frequency and parameters tested with exceptions at three sites, as noted in the report (ERM 2022). At two of the sites not all parameters were tested, and one site was not sampled in August due to restricted access related to forest fires.
- Permit PE-376 establishes maximum permitted limits for specified parameters of interest at the point of discharge to the receiving environment. Seepage water coming from the Bethlehem TSF is a component of this discharge. Compliance is measured downstream of the facility in Witches Brook (Site 304, Appendix III). The permitted limit for total copper concentration was exceeded at Site 304 in five samples collected during freshet, in April and May 2021. The permit exceedances were reported to the British Columbia Ministry of Environment and Climate Change Strategy (ENV). HVC completed confirmatory sampling at an increased frequency, following the initial non-compliance, until total copper concentrations decreased below the permitted limit:
  - Site 304 is downstream of several mine areas, including the Bethlehem TSF, but also contains a non-mine influenced component, sourced upstream of the Bethlehem TSF and other HVC disturbances. The source of the exceedance has not been identified and may not be related to the Bethlehem TSF. HVC are planning to modify sampling during freshet in an attempt to identify the source of the exceedance.

6 SITE VISIT OBSERVATIONS AND PHOTOGRAPHS

Copies of the field site visit forms, photographs and summary observations made during the AFPR site visit are included in Appendix I. No dam safety issues were observed. Key observations and comments from the 2021 AFPR site visit are as follows:

- Bose Lake Dam vegetation clearing is required at the spillway inlet, approach channel and initial segment of riprap channel. HVC have scheduled this as part of routine maintenance activities as per the OMS Manual.
- The downstream slope of Dam No. 1 is not showing signs of ongoing erosion or observations of concern. Existing erosion features typically have vegetation growth along the base indicating the erosion rate, if any, is slow. Observations of erosion and shallow slumping of the downstream slope are local, shallow features restricted to the waste rock slope that do not extend to the dam crest.
- The sinkhole on the tailings beach, more than 340 m upstream of the Dam No. 1 crest, remains similar to previous observations. The feature first appeared in 1993 and was reviewed by the designers during operations (most recently in 1997). The designers concluded this is not a risk or concern for dam safety.
- Animal burrows on the downstream slope of Bose Lake Dam (glacial till zone) were visited by KCB and Mr. Aaron Sangha (HVC). The outstanding recommendation (BD-2020-01) has been closed based on the following:
  - Based on the most recent flood routing (KCB 2022), refer to Section 1, the peak flood level during the PMF design flood is ~4.4 m below the dam crest, which is below the elevation the burrow opening (i.e. within the Phase 4 glacial till crest raise shown on Figure 2.3).
  - HVC investigated the burrow patterns of the marmot species that are around the site and observed to burrow within some of the dams on site. These marmot burrows can extend 4 m to 6 m below ground. The horizontal distance between the downstream slope, where the burrows are observed, and the upstream fill slope is more than 30 m under normal pond levels and more than an estimated 20 m during flood levels, which are both much larger than the marmot burrow depth.

7 ASSESSMENT OF DAM SAFETY

7.1 Review of Potential Downstream Consequences

Consequence classification is not part of HVC's tailings management governance, and they have instructed KCB not to include it when reporting on the Bethlehem TSF or supplementary structures. Potential consequences from credible failure modes are managed through a rigorous risk management process. HVC provided the following regarding the change:

> *Consequence Classification has traditionally been used to select appropriate design criteria for tailings facilities. The use of Consequence Classification comes from the Water Dams industry and have components that do not align with Mining's safety culture – a culture that Teck fully embraces. Traditional and existing Consequence Classification schemes have a typical five level of hypothetical consequence that includes the potential for human fatality right down to the second lowest level. For Teck, any fatality would be of extreme consequence. Further, per the GISTM, designing for closure and the perpetual timeframe for the tailings facilities means adopting extreme loads (e.g., GISTM recommends both 1:10,000 earthquake and precipitation events) which render any other classification unnecessary. Finally, the use of hypothetical failures that are not based on credible modes, or lack thereof, for a given facility creates a false narrative that hampers effective and transparent community discussions and confusing discussions with regulators and investors.*

HVC are in the process of adopting design loading for earthquake and flood scenarios equivalent to an Extreme consequence classification (CDA 2019) for tailings facilities. This approach:

- meets or exceeds the HSRC (EMLCI 2021a) requirements;
- aligns with Teck's goal to eliminate any risk for loss of life; and
- is consistent with the GISTM (2020), which supports evolving beyond the conventional consequence classification system.

Bethlehem TSF is already designed to the extreme flood (i.e., PMF) condition and the design earthquake (1/2 between 2,475-year and the 10,000-year return period earthquakes) was selected to meet requirements of the HSRC (EMLCI 2021a). However, stability of either dam is not very sensitive to the magnitude of the seismic load so slope failures with potential to release tailings would still meet criteria if the design earthquake were increased to the 10,000-year return period event.

HVC utilize a similar approach to manage potential credible failure modes for management of the water retaining structures that supplement operation of the Bethlehem TSF (e.g., R3 Seepage Pond).

The conditions and land use downstream of the Bethlehem TSF were reviewed by HVC and KCB on April 15, 2021 and no significant changes were identified.

7.2 Status of 2018 Dam Safety Review Recommendations

A DSR of the Bethlehem TSF was started in 2018 by SRK Consulting (SRK) with the final report issued in March 2019 (SRK 2019). The report concluded the facility is well-managed with a high level of technical stewardship and appropriate operating procedures. The credible failure modes are understood and effectively controlled.

The DSR included 11 recommendations related to the Bethlehem TSF. At the start of the review period, five recommendations were outstanding and all were addressed during 2021, refer to Appendix IV. Recommendations that were addressed in a previous AFPR report are not included.

7.3 Failure Mode Review

HVC's long-term goal for all tailings storage facilities is to reach landform status, so that the structures can be declassified as a "dam." KCB fully supports HVC towards achieving this long-term goal and their adoption of the GISTM (2020) for tailings management.

Design and operational controls in place to manage potential failure modes, and their status at the end of the review period are summarized below. All potential failure modes are reviewed and characterized in the facility risk assessment (AMEC 2019), which was reviewed and updated by HVC and KCB during the review period.

7.3.1 Dam No. 1

Slope Stability

The existing condition of the dam meets design FOS criteria for global slip surfaces which would result in an uncontrolled release of tailings under static ($\geq$ 1.5) and post-earthquake ($\geq$ 1.2) loading (KCB 2020). The key design controls related to dam stability are the downstream rockfill shell and toe buttress as well as a low piezometric level in the upstream cycloned sand beach which is verified by piezometer readings. Under the current configuration, the piezometric levels and gradients through the tailings and dam are lower than during operations, which increase the factor of safety against slope failure.

The slope stability review (KCB 2020) identified a potential hazard to mine roads and downstream infrastructure (e.g., seepage ponds) related to slumping of the rockfill toe buttress under an extreme earthquake load. The toe buttress would most likely slump to a shallower slope but would not result in a flow failure and/or uncontrolled release of the contained materials.

7.3.2 Bose Lake Dam

Overtopping

The spillway design flood (PMF) greater than the minimum IDF (Table 4.2) recommended under the HSRC (EMLCI 2021a) and is an effective control to manage overtopping risks. In addition, under existing conditions, the following additional controls and factors significantly reduce the potential for overtopping:

- freeboard during the PMF is 2.2 m greater than the minimum required (Section 1); and
- the spillway design assumes the pond level is at the invert of the spillway at the onset of the storm; under normal conditions the pond level is >0.3 m below the invert, which provides additional flood attenuation that is not accounted for in the design and significantly reduces the potential for overtopping.

7.3.3 R3 Seepage Pond Dam

Overtopping

To manage overtopping risks, the design flood for the emergency spillway (100-year) meets the requirements under the HSRC (EMLCI 2021a). The spillway is capable of routing much larger events, including the PMF, 24-hour duration, albeit with less than minimum flood freeboard.

Slope Stability

The existing condition of the dam meets the design factor of safety criteria for global slip surfaces which would result in an uncontrolled release of water under static ($\geq$ 1.5) and post-earthquake ($\geq$ 1.2) loading (KCB 2021).

7.4 Emergency Preparedness and Response

The EPRP for the Trojan TSF forms a part of the OMS Manual (HVC 2019) and is being reviewed as part of the ongoing OMS Manual updates to ensure it remains consistent with changes made to the OMS Manual and site emergency response procedures.

As part of the update, HVC contacted off-site emergency response resources to ensure that all contact information was current. The EPRP includes a list of preventative measures to take in response to potential unusual or emergency conditions. The EPRP is appropriate for the existing structure and is linked to the site-wide emergency response plan.

On January 18, 2022, participants from HVC's operation team (including site management), the HVC QP, and the EoR tested the EPRP using a hypothetical scenario at tailings facility on-site.

8 SUMMARY

Based on the review of measured performance and observations summarized herein, KCB conclude the Bethlehem TSF performed as expected, and within design requirements during the review period from October 2020 through September 2021.

As of issue of this report, all of the recommendations that were identified during past AFPRs (Table 8.1) and the most recent Dam Safety Review (SRK 2019) have been closed. No new recommendations were identified during the review period.

Table 8.1 Previous Recommendations Related to Facility Performance – Status Update

ID No.	Performance Area	Recommended Action	Priority(1)	Recommended Deadline (Status)
Bose Lake Dam				
BD-2020-01	*Maintenance*	*Complete inspection of the downstream slope of exposed Bose Lake Dam glacial till fill (above ~El. 1440.1 m) for animal burrows and fill or obstruct them.*	*3*	*CLOSED*
Dam No. 1				
BTSF-2018-01	*Flood Management*	*Update flood routing for Bethlehem TSF and R3 Seepage Pond based on the most recent site wide hydrology information for consistency and to confirm compliance.*	*3*	*CLOSED*

Notes:
1. Recommendation priority guidelines, specified by Teck and assigned by KCB:
   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.
2. No Outstanding Recommendations for R3 Seepage Pond.

9 CLOSING

We thank you for the opportunity to work on this project. Should you have any questions, please contact the undersigned.

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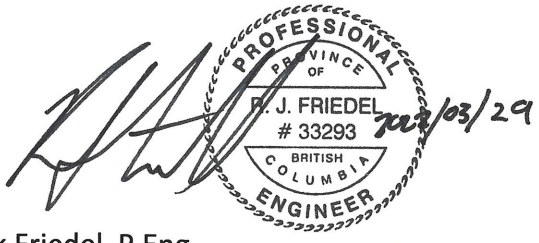
B.C Permit to Practice No. 1000171



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Senior Geotechnical Engineer, Principal

Robert W. Chambers, P.Eng.
Vice President, Mining Environmental Group

REFERENCES

AMEC Environment and Infrastructure (AMEC). 2013. “Spillway Design - Trojan Bethlehem (Reclaim 3)”. November 18.

AMEC. 2019. “2017 Risk Assessment on Tailings Dams Classified as High or Higher – Bethlehem Dam No. 1”, July 15.

Canadian Dam Association (CDA). 2013. “Dam Safety Guidelines 2007 (Revised 2013)”.

CDA. 2019. “Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams”.

ERM. 2022. “Annual Water Quality Monitoring Report”. March. This report was prepared by EMR and issued under HVC letterhead.

Gepac. 1972. “Engineering Report – Saddle Dam”, February 18.

Global Industry Standard on Tailings Management (GISTM). 2020. August.

Golder. 2020a. “Water Balance Model Report”. Prepared for Teck Highland Valley Copper Partnership. December 18.

Golder. 2020b. “Teck Highland Valley Copper – Spring Extreme Events and Wind Analysis”. July 7.

Golder member of WSP (Golder). 2021. “Surface Water Quantity Existing Conditions”. Prepared for Teck Highland Valley Copper Partnership – HVC 2040 Project. September 8.

Golder Brawner Associates (Golder Brawner). 1970. "Report to T. Ingledow & Associates Ltd. On Stability of Tailings Dam Bethlehem Copper Corporation".

Klohn Crippen Ltd. (KC). 1994. "Stability Review and Spillway Design - Bethlehem and Highmont Tailings Impoundments", December 14.

KC. 1996. "Bethlehem and Highmont Tailings Dams - Long-Term Stability Assessment”, December 9.

KC. 2002. "Bose Lake Dam and Trojan Dam – As-Built Spillways”, January 18.

KC. 2005. “Trojan Creek Ponds – Long Term Options”, June 10.

KCB. 2020. “2016 DSI Recommendations – Bethlehem Dam No.1 and Trojan Dam Stability Update”, April 3.

KCB. 2021. “DSI and DSR Recommendations Close Out – R3 and R4 Stability Review”, December 22.

KCB. 2022. “Legacy Tailings Storage Facilities Flood Routing Assessments - Bethlehem TSF and R3 Seepage Pond Flood Routing”. January.

Mining Association of Canada. (MAC). 2019. “Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities”, February.

Ministry of Energy and Mines (MEM). 2016. “Guidance Document – Health, Safety and Reclamation Code for Mines in British Columbia – Version 1.0”, July 20.

Ministry of Energy, Mines and Petroleum Resources (EMPR). 2019. “Permit M11 – Approving Mine Plan and Reclamation Program (Issued Pursuant Section of the Mines Act R.S.B.C. 1996, c. 293)”, May 27.

Ministry of Energy, Mines and Low Carbon Innovation (EMLCI). 2021a. “Health, Safety and Reclamation Code for Mines in British Columbia, Revised” February.

Ministry of Energy, Mines and Low Carbon Innovation (EMLCI). 2021b. “Permit M11 – Approving Mine Plan and Reclamation Program (Issued Pursuant Section of the Mines Act R.S.B.C. 1996, c. 293)”, June 1.

Ministry of Water, Land and Air Protection. 2003. "Permit PE-376 (09) on Specific Authorization Discharges", May 29.

SRK Consulting (SRK). 2019. “Bethlehem Tailings Storage Facility 2018 Dam Safety Review”, March.

Teck Highland Valley Copper Partnership. (HVC). 2019. “Bethlehem and Trojan Tailings Storage Facility Operation, Maintenance, and Surveillance Manual”, December.

HVC. 2022. “Annual Water Quality Monitoring Report”. March.

FIGURES

TO ASHCROFT

L-L DAM

HIGHLAND TSF

JIM BLACK LAKE

HOWIE FALLS

RAW WATER RESERVOIR

H-H DAM

TROJAN TSF

BETHLEHEM TSF

VALLEY PIT

LAURA LAKE

7-DAY POND TSF

MILL SITE

SOUTHEAST DUMP POND

TO KAMLOOPS

97C

CALLING LAKE

LORNEX PIT

GNAWED LAKE

HIGHMONT TSF

1

8

N

5,000 10,000 15,000 20,000 25,000 30,000 35,000 40,000

40,000 35,000 30,000 25,000

LEGEND

- L-L DAM CLIMATE STATION
- HIGHLAND VALLEY SNOW SURVEY STATION (NO. 1C09A)
- CREEK/RIVER
- HIGHWAY
- DITCH

0 5km

NOTES:
1. PROJECTION: HVC MINE GRID.
2. TSF = TAILINGS STORAGE FACILITY.
3. BASE DATA PROVIDED BY THE GOVERNMENT.
4. IMAGERY PROVIDED BY ESRI.
5. SNOW SURVEY LOCATION FROM GOVERNMENT OF BRITISH COLUMBIA SNOW STATIONS INTERACTIVE MAP, ACCESSED NOVEMBER 2021.

CLIENT
Highland Valley Copper / Teck

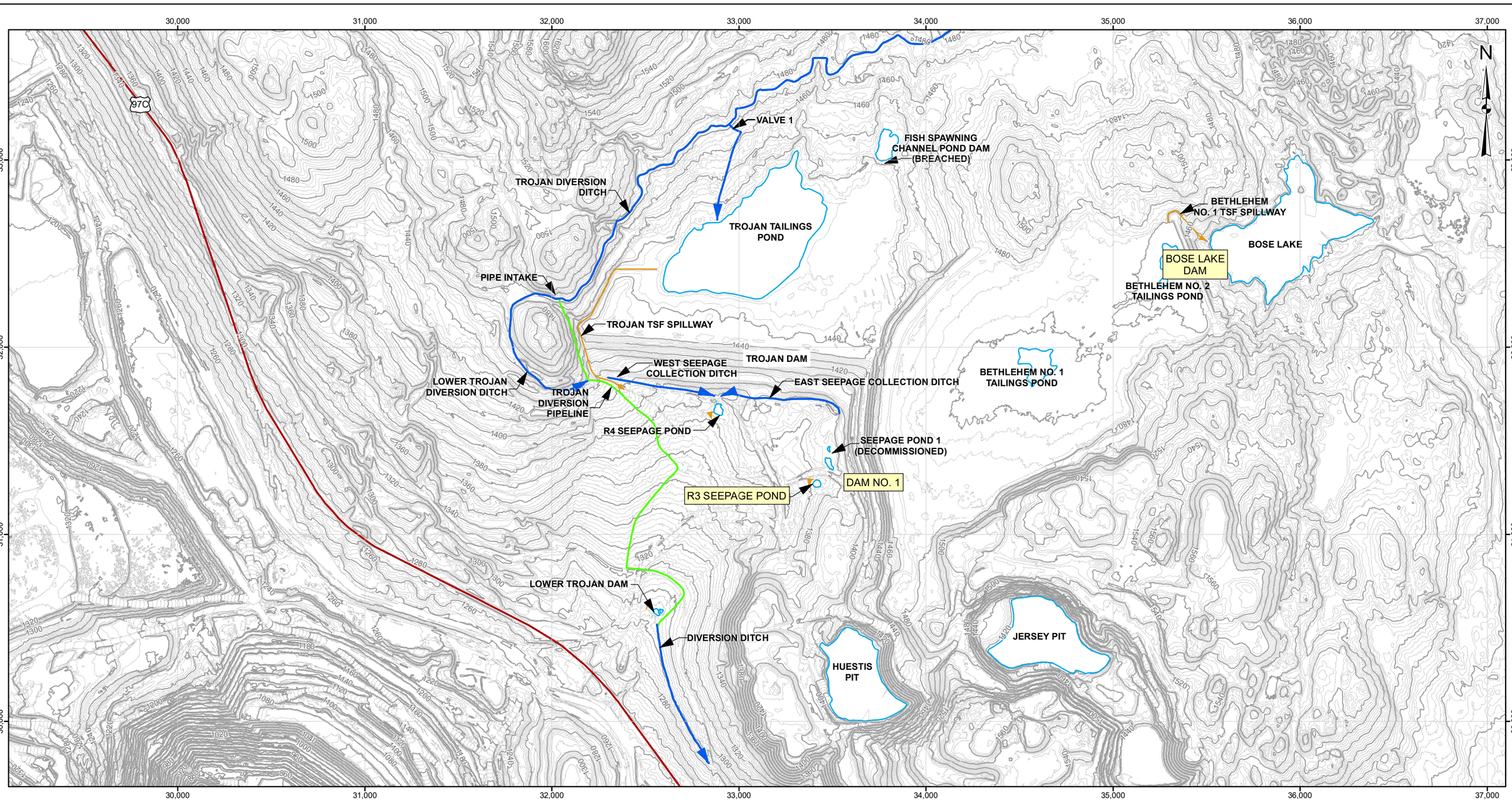
Klohn Crippen Berger

PROJECT
BETHLEHEM NO. 1 TAILINGS STORAGE FACILITY
2021 ANNUAL FACILITY PERFORMANCE REPORT

TITLE
MINE SITE PLAN

SCALE	PROJECT No.	FIG No.
AS SHOWN	M02341C12	1

Date: 2022-01-05
Document Path: \\nt.klohn.com\Proj\Data\MV\CRM\02341C12-HVC 2021 Dam Safety Support\400 Drawings\GIS\Reports\DS\Beth\Fig1_Bethlehem_MineSitePlan.mxd



LEGEND

- SPILLWAY
- DITCH
- ABOVE GROUND PIPELINE
- HIGHWAY
- WATERBODY

NOTES:
1. PROJECTION: HVC MINE GRID.
2. TSF = TAILINGS STORAGE FACILITY.
3. TOPOGRAPHY FROM HVC, LIDAR FLOWN ON AUGUST 23RD, 2014.
4. TAILINGS AND SEEPAGE POND EXTENTS BASED ON IMAGERY FROM SEPTEMBER, 2016.

0 1,000 m

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

PROJECT: BETHLEHEM NO. 1 TAILINGS STORAGE FACILITY
2021 ANNUAL FACILITY PERFORMANCE REPORT

TITLE: BETHLEHEM OVERVIEW

SCALE	PROJECT No.	FIG No.
AS SHOWN	M02341C12	2

Date: 2022-01-05
Document Path: \\mt.klohn.com\Proj\Data\MV\CRM\02341C12-HVC 2021 Dam Safety Support\400 Drawings\GIS\Reports\DS\Beth\Fig2_Bethlehem_Overview.mxd

LEGEND

INSTRUMENT TYPE (ACTIVE)

- STANDPIPE PIEZOMETER
- VIBRATING WIRE PIEZOMETER
- INCLINOMETER
- SURVEY MONUMENT
- SURVEY MONUMENT (NON-OPERATIONAL)
- △ WAYPOINT (BTH-2021-XX)

INSTRUMENT TYPE (DEFUNCT)

- STANDPIPE PIEZOMETER
- WEIR

0 500m

NOTES:
1. PROJECTION: HVC MINE GRID.
2. IMAGERY OBTAINED SEPTEMBER, 2020.
3. TOPOGRAPHY FROM HVC, LIDAR FLOWN ON AUGUST 23RD, 2014.

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

PROJECT: BETHLEHEM NO. 1 TAILINGS STORAGE FACILITY
2021 ANNUAL FACILITY PERFORMANCE REPORT

TITLE: DAM NO. 1
PLAN

SCALE	PROJECT No.	FIG No.
AS SHOWN	M02341C12	3

Date: 2022-01-21
Document Path: \\nt.klohn.com\Proj\Data\M\VCR\M02341C12-HVC 2021 Dam Safety Support\400 Drawings\GIS\Reports\DSI\Beth\Fig3_Bethlehem_DamNo1_Plan.mxd

LEGEND

INSTRUMENT TYPE (ACTIVE)

- STANDPIPE PIEZOMETER
- VIBRATING WIRE PIEZOMETER
- SURVEY MONUMENT (SEE NOTE 4)
- WAYPOINT (BTH-2021-XX)
- TOE DRAIN ACCESS POINT
- SPILLWAY

0 100m

NOTES:
1. PROJECTION: HVC MINE GRID.
2. IMAGERY OBTAINED SEPTEMBER, 2020.
3. TOPOGRAPHY FROM HVC, LIDAR FLOWN ON AUGUST 23RD, 2014.
4. LOCATIONS OF SURVEY MONUMENTS BD8, BD09, AND BD10 ARE APPROXIMATE.

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

PROJECT: BETHLEHEM NO. 1 TAILINGS STORAGE FACILITY
2021 ANNUAL FACILITY PERFORMANCE REPORT

TITLE: BOSE LAKE DAM
PLAN

SCALE	PROJECT No.	FIG No.
AS SHOWN	M02341C12	4

Date: 2021-12-24
Document Path: \\nt.klohn.com\Proj\Data\MVCR\M02341C12-HVC 2021 Dam Safety Support\400 Drawings\GIS\Reports\DSI\Beth\Fig4_Bethlehem_BoseLakeDam_Plan.mxd

LEGEND

INSTRUMENT TYPE (ACTIVE)
- STANDPIPE PIEZOMETER

INSTRUMENT TYPE (DEFUNCT)
- STANDPIPE PIEZOMETER
- WEIR

- WAYPOINT (BTH-2021XX)
- SPILLWAY
- BURIED PIPELINE

NOTES:
1. PROJECTION: HVC MINE GRID.
2. IMAGERY OBTAINED SEPTEMBER, 2020.
3. TOPOGRAPHY FROM HVC, LIDAR FLOWN ON AUGUST 23RD, 2014.
4. LOCATION OF BURIED PIPES ARE APPROXIMATE.

0 50m

CLIENT: Highland Valley Copper / Teck

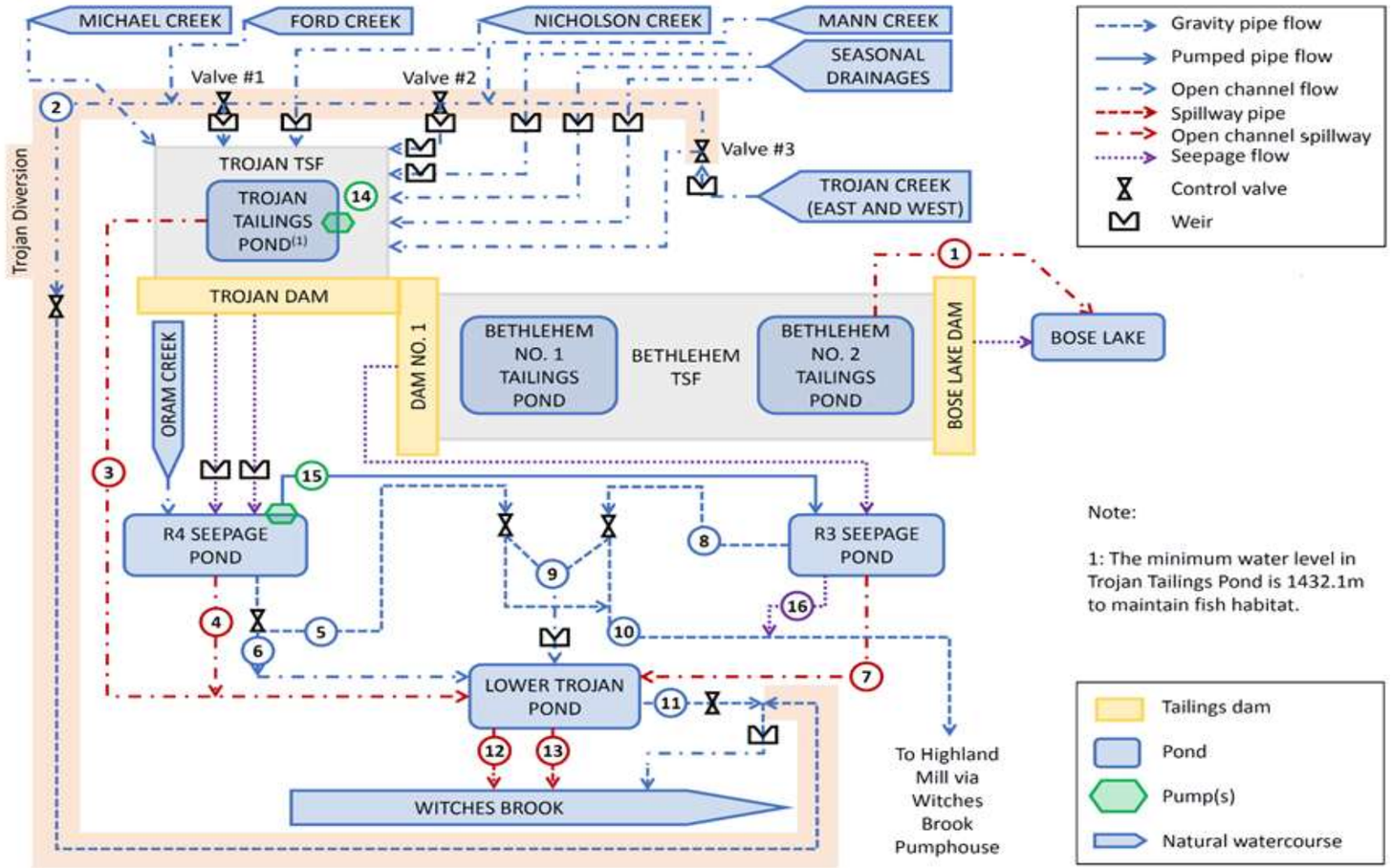
Klohn Crippen Berger

PROJECT: BETHLEHEM NO. 1 TAILINGS STORAGE FACILITY
2021 ANNUAL FACILITY PERFORMANCE REPORT

TITLE: R3 SEEPAGE POND DAM PLAN

SCALE	PROJECT No.	FIG No.
AS SHOWN	M02341C12	5

Date: 2022-01-21
Document Path: \\nt.klohn.com\Proj\Data\MVCR\M02341C12-HVC 2021 Dam Safety Support\400 Drawings\GIS\Reports\DS\BethlF g5_Bethlehem_R3Seepage_Plan.mxd



Note:

1: The minimum water level in Trojan Tailings Pond is 1432.1m to maintain fish habitat.

No.	Name	Description	Status
1	Bethlehem No.1 TSF Spillway	3 m wide channel with concrete sill founded in tailings (3 m wide, vegetated) and natural ground (3 m, riprap-lined)	Operational
2	Trojan Diversion	6.5 km long series of channels, culverts, and pipelines	Operational
3	Trojan Spillway	957 m long open channel founded in tailings (5 m wide, vegetated), natural ground (3 m, riprap-lined) and bedrock (3 m)	Operational
4	R4 Spillway	2 m wide riprap-lined channel	Operational
5	R4 Low-Level Outlet	300 mm dia. HDPE pipe with U/S and D/S control valves and intake trash rack	Operational
6	R4 Overflow	100 mm dia. HDPE pipe with U/S control valve	Operational
7	R3 Spillway	2 m wide riprap-lined channel	Operational
8	R3 Low-Level Outlet	460 mm dia. HDPE pipeline with D/S control valve	Operational
9	R3/R4 Seepage to Lower Trojan Pond	Open channel from Valve Box to Lower Trojan Pond	Operational
10	R3/R4 Seepage to Northern Collection Line	10" dia. buried pipeline	Operational
11	LTD Low-Level Outlet	460 mm dia. HDPE pipe with control valve and intake trash rack	Operational
12	LTD Spillway	7 m wide channel	Operational
13	LTD Overflow	810 mm dia. HDPE pipe	Operational
14	Trojan Pump	Pump for Trojan Tailings Pond	Non-operational
15	R4 Pump to R3 Pond	Steel pipe from R4 Pumphouse discharged to R3 Pond	Non-operational
16	R3 Overland Collector	8"-12" HDP pipe collecting surface water	Operational

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

PROJECT: BETHLEHEM NO.1 TAILINGS STORAGE FACILITY
2021 ANNUAL FACILITY PERFORMANCE REPORT

TITLE: FLOW SCHEMATIC FOR BETHLEHEM NO. 1 AND TROJAN TAILINGS STORAGE FACILITIES

SCALE	PROJECT No.	FIG. No.
NTS	M02341C12	6

APPENDIX I

Annual Facility Performance Report

Site Visit Checklist, Observations and Photographs

APPENDIX I-A

Dam No. 1

Site Visit Checklist, Observations and Photographs

Appendix I-A
Annual Facility Performance Report Site Visit Checklist, Observations and Photographs – Dam No. 1

SITE VISIT CHECKLIST

Facility:	Bethlehem Dam No. 1	**Site Visit Date:**	September 17, 2021
Weather:	Sunny	**Inspector(s):**	Rick Friedel, P.Eng. Anna Geller, EIT
Freeboard (pond level to dam crest):	9.9 m based on the September 3rd pond survey.		

Are the following components of the facility in ***SATISFACTORY CONDITION***?

EMBANKMENT	Yes/No
U/S Slope	☒ Yes ☐ No
Crest	☒ Yes ☐ No
D/S Slope	☒ Yes ☐ No
D/S Toe	☒ Yes ☐ No
Drains	☒ Yes ☐ No

Were any of the following ***POTENTIAL PROBLEM INDICATORS*** found?

INDICATOR	EMBANKMENT
Piping	☐ Yes ☒ No
Sinkholes	☐ Yes ☒ No (See Notes)
Seepage	☐ Yes ☒ No
External Erosion	☐ Yes ☒ No
Cracks	☐ Yes ☒ No (See Notes)
Settlement	☐ Yes ☒ No
Sloughing/Slides	☐ Yes ☒ No
Animal Activity	☐ Yes ☒ No
Excessive Growth	☐ Yes ☒ No
Excessive Debris	☐ Yes ☒ No

List and describe any deficiencies (all deficiencies require assessment and/or repair):

- No dam safety deficiencies observed.

Comments / Notes:

- Refer to Site Visit Observations section.

SITE VISIT OBSERVATIONS

Crest and Tailings Beach

Good physical condition. The highpoint between the pond and the downstream slope is upstream of the crest. The tailings beach is well vegetated. No observations of concern were noted (Photo I-A-1).

The sinkhole on the beach, more than 340 m upstream of the crest, remains similar to previous observations (Photo I-A-2). Feature first appeared in 1993 and was reviewed by the designers during operations (most recently in 1997). The designers concluded this is not a risk or concern for dam safety.

Left and Right Abutments

Good physical condition. The location of the left abutment is not visible due to the blending of dam fill and waste rock from a previously used waste dump. No signs of significant erosion, deterioration, or cracking at either abutment.

Downstream Slope

The remediated erosion gullies are in good physical condition and not showing signs of ongoing erosion. No significant change of the remediated or existing erosion features compared to recent Annual Facility Performance Reports (AFPRs). Existing erosion features typically have vegetation growth along the base indicating the ongoing erosion rate, if any, is slow. Observations of erosion and shallow slumping of the downstream slope are local features generally restricted to the waste rock fill benches. Cracking is present within the rockfill that was pushed over the downstream slope to fill the erosion gullies. This is related to shallow localized sloughing of the rockfill slope and does not extend to the dam crest. In addition, cracks appeared to be partially filled, indicating no recent displacement (Photo I-A-3 and Photo I-A-4).

Pond

No visual indicators along tailings beach (i.e., change in vegetation or wave scour) of a recent high-water event.

Seepage

No signs of unexpected seepage in addition to flow from the underdrains which discharge to the R3 Seepage Pond.

SITE VISIT PHOTOGRAPHS

LEGEND:

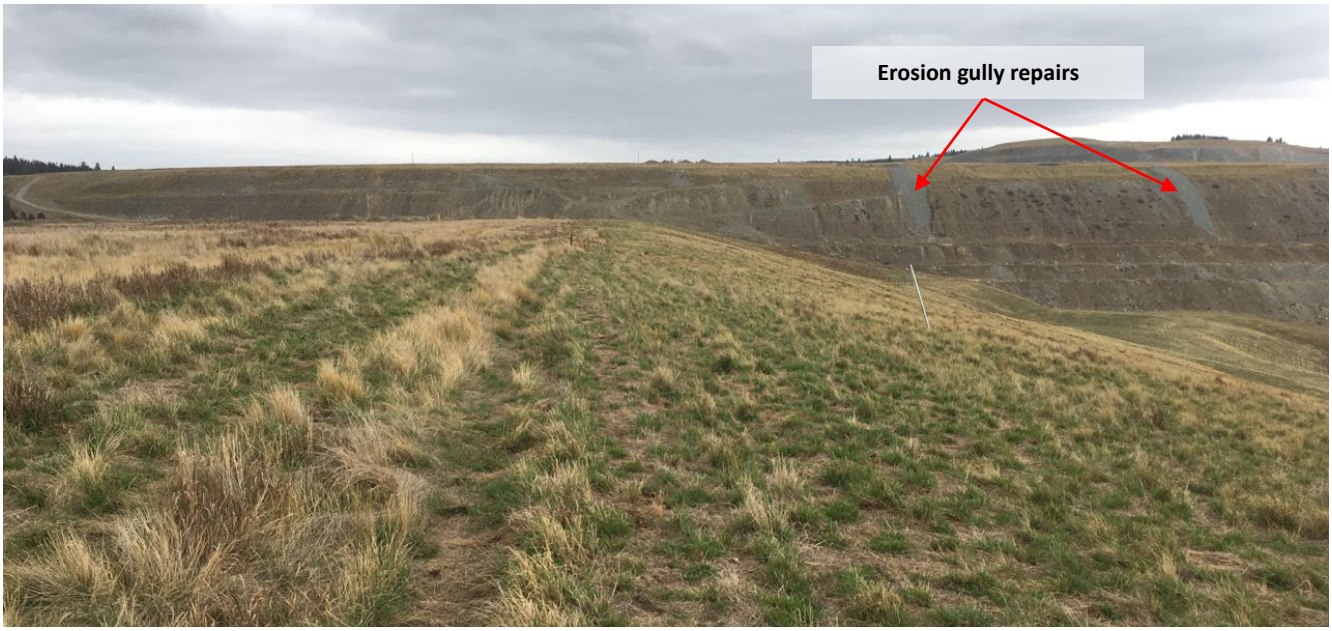
- BTH = Bethlehem Tailings Facility.
- BTH-2021-## refers to 2021 AFPR waypoint shown on Figure 3.
- All photographs taken during site visit on September 17, 2021.

Photo I-A-1 Dam No. 1 crest road. No evidence of erosion or depression was observed (BTH-2021-01)

Photo I-A-2 Bethlehem sinkhole on tailings beach, no visual change from previous visual observations (BTH-2021-03)

Photo I-A-3 Overview of downstream slope and toe area and of previously documented erosion area. Similar to the previous AFPR the cracking remains filled, indicating area has been inactive (BTH-2021-02)

Photo I-A-4 Overview of downstream slope and toe from Trojan Dam. No new erosion areas were observed, and previous repairs are holding up well (BTH-2021-04)



APPENDIX I-B

Bose Lake Dam
Site Visit Checklist, Observations and Photographs

Appendix I-B
Annual Facility Performance Report Site Visit Checklist, Observations and Photographs – Bose Lake Dam

SITE VIST CHECKLIST

Facility:	Bose Lake Dam	**Site Visit Date:**	September 17, 2021
Weather:	Partly cloudy	**Inspector(s):**	Rick Friedel, P.Eng. Anna Geller, EIT
Freeboard (pond level to dam crest):	6.6 m based on the September 2nd pond survey.		

Outlet Condition Survey

Description	Outlet Controls?	Was it flowing?	Flow rate
Spillway Channel	N/A	☐ Yes ☒ No	N/A

Are the following components of the facility in ***SATISFACTORY CONDITION***?

EMBANKMENT	Yes/No	SPILLWAY	Yes/No
U/S Slope	☒ Yes ☐ No	Debris Boom	☒ Yes ☐ No
Crest	☒ Yes ☐ No	Entrance	☒ Yes ☐ No
D/S Slope	☒ Yes ☐ No	Sill	☒ Yes ☐ No
D/S Toe	☒ Yes ☐ No	Road Culvert	☒ Yes ☐ No
Drains	☒ Yes ☐ No	Channel Invert	☒ Yes ☐ No
		Channel Slopes	☒ Yes ☐ No

Were any of the following ***POTENTIAL PROBLEM INDICATORS*** found?

INDICATOR	EMBANKMENT	SPILLWAY
Piping	☐ Yes ☒ No	☐ Yes ☒ No
Sinkholes	☐ Yes ☒ No	☐ Yes ☒ No
Seepage	☐ Yes ☒ No	☐ Yes ☒ No
External Erosion	☐ Yes ☒ No	☐ Yes ☒ No
Cracks	☐ Yes ☒ No	☐ Yes ☒ No
Settlement	☐ Yes ☒ No	☐ Yes ☒ No
Sloughing/Slides	☐ Yes ☒ No	☐ Yes ☒ No
Animal Activity	☒ Yes ☐ No (See Notes)	☐ Yes ☒ No
Excessive Growth	☐ Yes ☒ No	☐ Yes ☒ No
Excessive Debris	☐ Yes ☒ No	☐ Yes ☒ No

List and describe any deficiencies (all deficiencies require assessment and/or repair):

- No dam safety deficiencies observed.

Comments/ Notes:

- Animal burrows on the downstream slope of Bose Lake Dam (glacial till zone) were visited with Mr. Aaron Sangha (HVC) and discussed path forward to resolve outstanding observation. Initial step is to complete the site visit and identify animal types and burrowing habits to characterize potential impact on the dam.
- Refer to Site Visit Observations section.

SITE VIST OBSERVATIONS

Crest

Good physical condition. No indications of major lateral movement, depressions, or cracking (Photo I-B-1 to Photo I-B-3). Access road at downstream toe should be graded as part of HVC routine maintenance. The existing road could make the access to the left abutment and spillway difficult during flood events.

Left and Right Abutments

Good physical condition. An access road runs along the abutments which connects the crest and toe roads. No sign of seepage, excessive scour, or displacement (Photo I-B-3 and Photo I-B-5).

Animal burrows (Photo I-B-6) on the downstream slope of Bose Lake Dam (glacial till zone) were visited with Mr. Aaron Sangha (HVC) and a path forward to resolve outstanding observation was discussed. Initial step is to identify animal types and burrowing habits to characterize potential impact on the dam.

Downstream Slope

Good physical condition. No signs of adverse displacement or cracking. The majority of the slope is protected from erosion by coarse rockfill. The slope at the toe of the dam is well vegetated (Photo I-B-2 and Photo I-B-9).

Local sand piles on the downstream slope of the dam appear similar to previous observations. There were no signs of flow from the area which is well above nearest water level measurement. These sand piles are not interpreted as active seepage features or dam safety concerns.

Upstream Slope and Tailings Beach

Good physical condition. The beach immediately upstream of the dam is well vegetated with no visual issues of concern or indication of recent flooding observed (Photo I-B-10).

Pond

During the site visit, the pond appears typical for the time of year. The pond remains approximately 40 m upstream of the crest in a localized depression on the tailings beach (Photo I-B-10).

Spillway Inlet

Good physical condition and consistent trapezoidal shape. Vegetation throughout channel but no major obstructions or signs of deterioration. The debris boom is secured in place with no sign of damage. Vegetation observed at the spillway inlet should be cleared as part of HVC routine monitoring and maintenance (Photo I-B-11).

Spillway Channel and Outlet

Good physical condition. Initial segment of channel is vegetated with no or very modest grade. As the channel crosses the dam centerline, the spillway channel transitions to a riprap lined trapezoidal channel which continues downslope parallel to the dam abutment. There were no visible signs of significant degradation of the riprap or blockage of the culverts that pass flow below the public road downstream of the dam toe (Photo I-B-11 to Photo I-B-13).

Seepage Collection System

The seepage relief wells were locked and could not be inspected. The outer casings showed no signs of damage.

Water could be heard flowing within the culverts. At the gauge-house, water was observed flowing out of the outflow pipe and into the riprap lined basin. No surface outflow from the basin was observed; therefore, water is lost through seepage and/or evaporation.

SITE VIST PHOTOGRAPHS

LEGEND:

- BTH = Bethlehem Tailings Facility.
- BTH-2021-## refers to 2021 AFPR waypoint shown on Figure 4.
- All photographs taken during the site visit on September 17, 2021.

Photo I-B-1 Overview of dam crest from right abutment (BTH-2021-05)

Photo I-B-2 Overview of dam crest and downstream slope from approximately the right abutment (BTH-2021-06)

Photo I-B-3 Overview of dam crest, looking towards right abutment. No sign of erosion or depression was observed (BTH-2021-06)

Photo I-B-4 View of right abutment (BTH-2021-05)

Photo I-B-5 View of left abutment. No sign of erosion or unusual condition (BTH-2021-07 and BTH-2021-08)

Photo I-B-6 **An animal burrows observed at the downstream slope near the left abutment. HVC reviewed the burrow patterns, and the separation between the downstream and upstream slopes is more than 3x the expected burrow depth even under extreme flood conditions, and the pond level is not predicted to reach the elevation where the burrows are observed (BTH-2021-09)**

Photo I-B-7 View of downstream slope and toe area from crest looking downstream from approximately mid dam (BTH-2021-07)

Photo I-B-8 Upslope extent of toe drain along abutment. Toe drain access point is visible. Cap is sealed (BTH-2021-06)

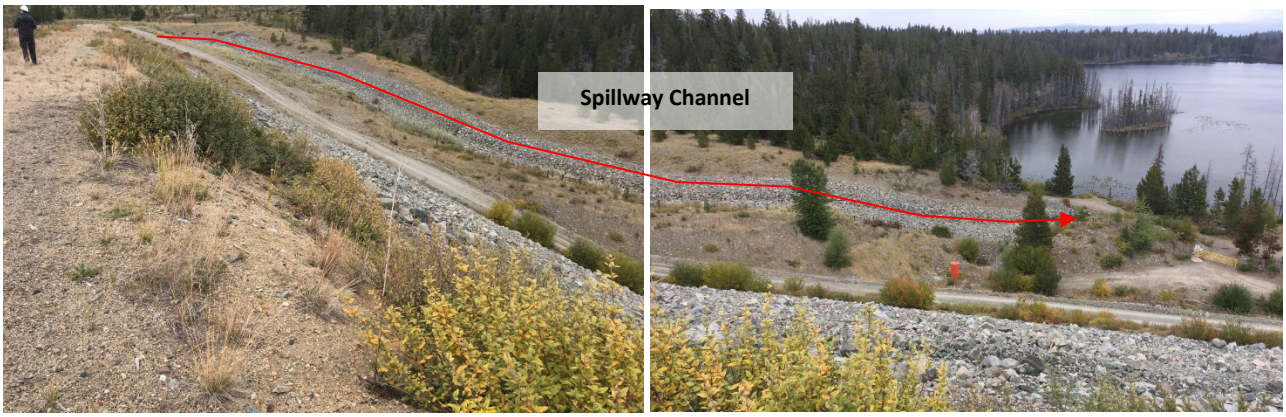
Photo I-B-9 View of downstream slope. Vegetation cover over lower portion of slope identifies the segment of downstream slope comprised of glacial till fill. No erosion of slope (rock or glacial till) was observed (BTH-2021-08)

Photo I-B-10 Overview of Bethlehem No. 2 Tailings Pond and tailings beach (BTH-2021-10)

Photo I-B-11 Spillway inlet and approach channel (BTH-2021-11)

Photo I-B-12 Spillway channel at transition point between inlet and riprap-lined segment, looking towards north (BTH-2021-12)

Photo I-B-13 Spillway channel to Bose Lake (BTH-2021-07)



APPENDIX I-C

R3 Seepage Pond Dam
Site Visit Checklist, Observations and Photographs

Appendix I-C
Annual Facility Performance Report Site Visit Checklist, Observations and Photographs – R3 Seepage Pond Dam

SITE VISIT CHECKLIST

Facility:	R3 Seepage Pond Dam	**Site Visit Date:**	July 22, 2021
Weather:	Mostly cloudy / smoky	**Inspector(s):**	Rick Friedel, P.Eng. Delton Breckenridge, EIT
Freeboard (pond level to dam crest):	2.1 m based on maximum water elevations on July 22nd from remote pond level monitoring system		

Outlet Condition Survey

Description	Outlet Controls?	Was it Flowing?	Flow rate	Visual Review?	Testing / Detailed Site Visit?
Low Level Outlet (LLO)	No outlet control was seen	☒ Yes ☐ No	Not estimated	☒ Yes ☐ No	☐ Yes ☒ No
Spillway Channel	N/A	☐ Yes ☒ No	N/A	☒ Yes ☐ No	N/A

Are the following in ***SATISFACTORY CONDITION***?

DAM	Yes/No	LOW LEVEL OUTLET	Yes/No	SPILLWAY CHANNEL	Yes/No
U/S Slope	☒ Yes ☐ No	Outlet Pipe	Inlet visible (clear), pipeline buried.	Invert	☐ Yes ☒ No (See Notes)
Crest	☒ Yes ☐ No	Outlet Controls	☐ Yes ☒ No (See Notes)	Side Slopes	☒ Yes ☐ No
D/S Slope	☒ Yes ☐ No			Erosion Protection	☒ Yes ☐ No
D/S Toe	☒ Yes ☐ No				

Were ***POTENTIAL PROBLEM INDICATORS*** found?

INDICATOR	DAM	SPILLWAY CHANNEL
Piping	☐ Yes ☒ No	☐ Yes ☒ No
Sinkholes	☐ Yes ☒ No	☐ Yes ☒ No
Seepage	☐ Yes ☒ No	☐ Yes ☒ No
Erosion	☐ Yes ☒ No	☐ Yes ☒ No
Cracks	☐ Yes ☒ No	☐ Yes ☒ No
Settlement	☐ Yes ☒ No	☐ Yes ☒ No
Sloughing/Slides	☐ Yes ☒ No	☐ Yes ☒ No
Animal Activity	☐ Yes ☒ No	☐ Yes ☒ No
Excessive Growth	☒ Yes ☐ No	☐ Yes ☒ No
Excessive Debris	☐ Yes ☒ No	☐ Yes ☒ No

Deficiencies:

- No dam safety deficiencies observed.

Comments:

- Low Level Outlet intake trash rack is clogged and requires cleaning (not related to flood routing).
- Excessive growth on upstream slope and spillway inlet should be cleared as part of HVC routine maintenance.

SITE VISIT OBSERVATIONS

Crest

Good physical condition. No indication of adverse lateral movement, depressions or cracking (Photo I-C-2).

Left and Right Abutment

Good physical condition. No signs of significant erosion, deterioration, or cracking.

Downstream Slope

Good physical condition. No indication of adverse displacement. No signs of erosion, deterioration, or seepage.

Upstream Slope

Heavy vegetation was observed on upstream slope which should be cleared as part of HVC routine maintenance.

Pond

At the time of the site visit, the pond was more than 1 m below the spillway invert (Photo I-C-3).

Low-level Outlet

At the time of the site visit, the outlet pipe trash rack was partially obstructed with vegetation. This should be cleared as part of HVC routine monitoring and maintenance.

The upstream debris fence was also obstructed, which may be cleared or replaced as part of routine maintenance but not required for dam safety (Photo I-C-3).

Spillway

Good physical condition. No indication of recent flow through the channel. No visual signs of riprap degradation (Photo I-C-4 to Photo I-C-7).

At the time of the site visit, heavy vegetation was obstructing the spillway inlet (Photo I-C-4). Vegetation should be cleared as part of HVC routine monitoring and maintenance.

Seepage

None observed.

SITE VISIT PHOTOGRAPHS

LEGEND:

- BTH = Bethlehem Tailings Facility.
- BTH-2021-## refers to 2021 Annual Facility Performance Report waypoint shown on Figure 5.
- All photographs taken during the site visit on July 22, 2021.

Photo I-C-1 Overview of R3 Seepage Pond (BTH-2021-13)

Photo I-C-2 R3 Seepage Pond dam crest. No cracking or no sign of distress was observed (BTH-2021-14)

Photo I-C-3 **View of R3 Seepage Pond and debris mesh for Low-Level Outlet (LLO). Clear water was flowing at the time of the site visit. The debris mesh is clogged below and above water. This does not impact ability to route the Inflow Design Flood but could be part of routine maintenance (BTH-2021-15)**

Photo I-C-4 View of spillway inlet, looking upstream. Vegetation to be cleared from inlet. Lock-block removed in 2020 (BTH-2021-16)

Photo I-C-5 Spillway channel and road crossing at right abutment, looking downstream (BTH-2021-16)

Photo I-C-6 Spillway channel at midpoint, looking upstream (BTH-2021-17)

Photo I-C-7 Spillway channel at midpoint, looking downstream (BTH-2021-17)

APPENDIX II

Climate and Instrumentation

APPENDIX II-A

Climate Data

Appendix II-A
Climate Data

HVC provided weather data from the L-L Dam Weather Station (El. 1186.0 m), for the 2021 AFPR review period, for KCB to review. KCB adjusted the L-L Dam Weather Station data and Historical Average Lornex Synthetic Record data using the Highmont/Bethlehem and Trojan Area adjustment factors provided in Golder (2021). KCB selected these adjustment factors as their elevation is consistent with the Bethlehem No.1 TSF catchment (crest ~El. 1477 m). To support key precipitation trends and impacts on observed dam performance, KCB downloaded data from the Kamloops Pratt Road Weather Station (Environment Canada Station No. 116C8P0, El. 729.0 m, 73 km away), and was provided data from the Shula Weather Station (El. 1208 m, station located on HVC property) by HVC, to review and compare precipitation trends against the L-L Dam Weather Station data. The Kamloops Pratt Road Weather Station (El. 729.0 m) was used for comparison rather than the Kamloops Airport Station (El. 345.3 m), as the elevation at the Pratt Road Station is closer to L-L Dam Weather Station (El. 1186.0 m).

The precipitation normals (adjusted Highland Valley Lornex Synthetic Record) and precipitation records between October 2020 and September 2021 (adjusted L-L Dam, unadjusted Kamloops Pratt Road and unadjusted Shula Flats data), are tabulated and plotted in Table II-A-1 and Figure II-A-1, respectively. The following observations are noted for the L-L Dam adjusted precipitation in the reporting period:

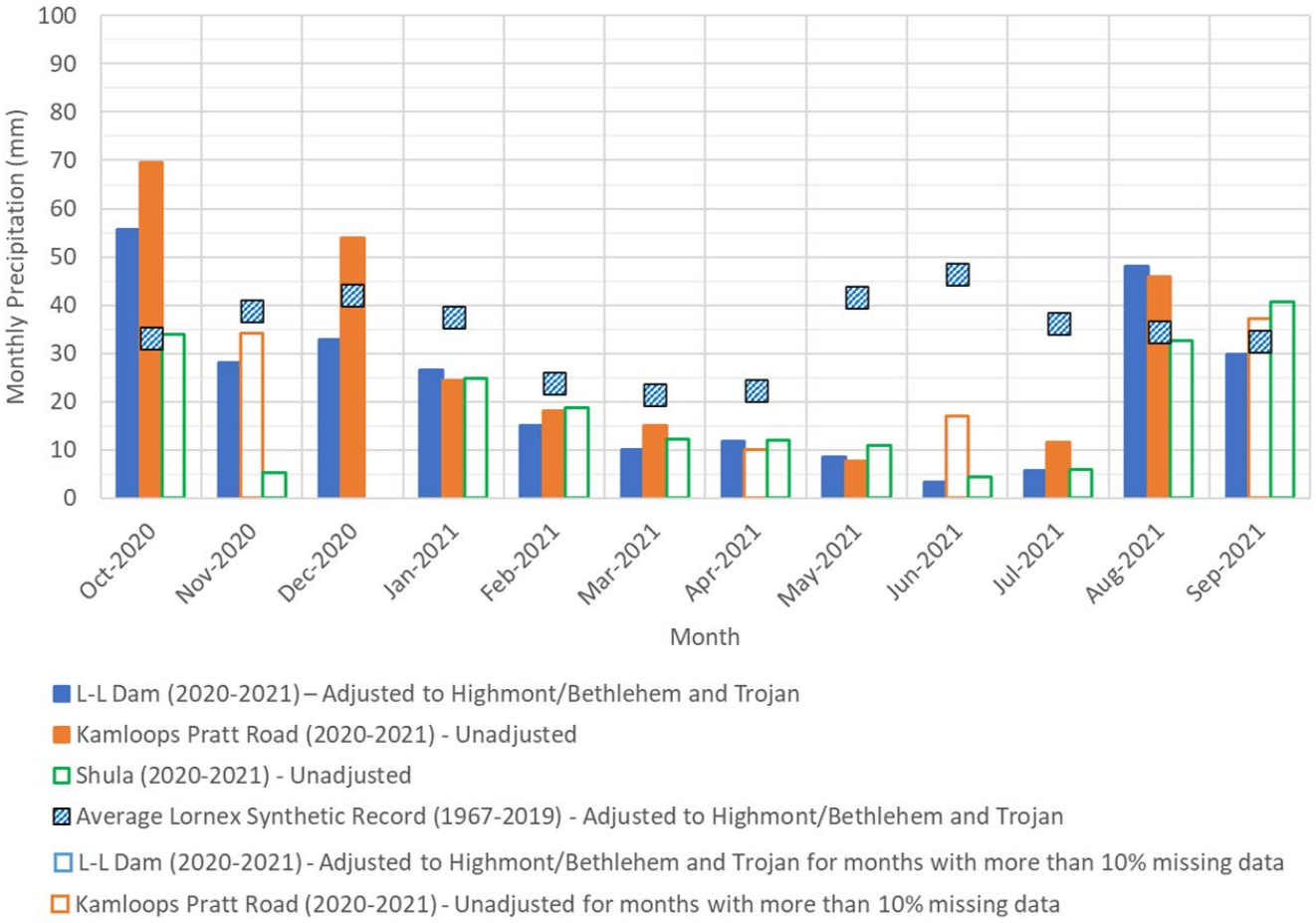
- All storm events during the review period were less than the 10-year return period rainfall event (40 mm in 24 hours). The largest 24-hour rainfall events measured at the L-L Dam Weather Station during the review period were: 23.7 mm on October 23, 2020; 16.2 mm on December 21, 2020; and 18.5 mm on August 16, 2021.
- In Figure II-A-1, all months, except for October 2020 and August 2021 reported 9% to 93% decreases relative to average precipitation. October 2020 precipitation increased 67% relative to the historic normals; August 2021 precipitation increased 40%.
- The L-L Dam Weather Station database included some gaps in 2020 measurements. HVC managed to improve the monitoring program and, as Figure II-A-1 indicates, there were no data gaps in the 2021 measurements. In addition, consistency in trends between the Kamloops Pratt Road Station, the Shula Weather Station data for 2021, and the L-L Weather Station provides confidence in the L-L Weather Station data.
- In Table II-A-2, snowpack depth measurements from the Highland Valley Station (El. 1268 m) indicate the snow had melted during April 2021, and was gone by May 1st. In comparison, the water balance assumes 30% of snowmelt occurs in March and 70% in April (Golder 2020a).
- Seasonal rise and fall of pond levels is associated with freshet. In 2021, pond levels dropped in May, coincident with completion of snowmelt, which is consistent with historic trends. Rainfall measured from March through May, when reservoir level was rising, was approximately 35% of the historical average during that same period, which suggests the majority of the 2021 freshet was related to snowmelt.

Table II-A-1 Monthly Precipitation

Month	Availability of Data (%)	Precipitation (mm)			
	L-L Dam Weather Station	L-L Dam Weather Station Data Adjusted to Highmont/Bethlehem and Trojan Area [1] (2020 to 2021)	Average Lornex Synthetic Record Adjusted to Highmont/Bethlehem and Trojan Area [2] (1967 to 2019)	Unadjusted Kamloops Pratt Road Weather Station (2020 to 2021)	Unadjusted Shula Weather Station [5] (2020-2021)
Oct 2020	99	55.6	33.3	69.6	33.9
Nov 2020	100	28.1	38.9	34.2 [4]	5.2 [4]
Dec 2020	100	32.9	42.1	54.0	N/A [6]
Jan 2021	100	26.5	37.5	24.4	24.9
Feb 2021	100	15.0	23.7	18.0	18.7
Mar 2021	100	10.1	21.5	15.0	12.3
Apr 2021	100	11.7	22.4	10.0 [4]	11.9
May 2021	100	8.4	41.7	7.6	10.9
Jun 2021	100	3.4	46.5	17.0 [4]	4.4
Jul 2021	100	5.8	36.3	11.6	5.9
Aug 2021	100	48.1	34.4	45.8	32.6
Sep 2021	100	29.7	32.6	37.2 [4]	40.7
Annual Total	-	275.4	410.8	344.4	201.4

Notes:
1. Available data from L-L Dam climate station was adjusted by a L-L Dam-to-Highmont/Bethlehem and Trojan Area adjustment factor of 1.02 (Golder 2021).
2. Estimated by Golder (2021) using appropriate adjustment factors and average precipitation measured at Highland Valley Lornex climate station (Environment Canada ID No. 1123469 at El. 1268 m from 1967 to 2011). Golder (2021) infilled the data gaps prior to November 2011 and created a long-term synthetic precipitation record to the end of 2019. Monthly average of the synthetic record adjusted to Highmont/Bethlehem and Trojan Area by a Lornex-to-Highmont/Bethlehem and Trojan Area adjustment factor of 1.12 are shown herein, refer to Golder (2021) for detailed information.
3. Review period for the Bethlehem No. 1 TSF Annual Facility Performance Reports is from October 2020 through September 2021.
4. Monthly precipitation with more than 10% missing data.
5. 2021 monthly precipitation data provided to KCB as summarized data for the given month; therefore, the completeness of the data was not independently verified.
6. HVC noted that the data set was not complete enough to report, and as a result it was not counted.

Figure II-A-1 Monthly Precipitation



Note:
1. The Shula weather station data used for this comparison only included monthly values (i.e., no daily data) and thus, KCB was not able to assess the completeness of the dataset.

Seasonal snowpack depth is not measured at the L-L Dam weather station. Instead, HVC to monitors snowpack with monthly measurements at the Highland Valley snow survey station (Station No. 1C09A) near the Trojan TSF. The measurements are sorted by survey period (the first of January through May) to compare snowpack depths, in snow-water equivalent (SWE), for the same period each year. Historical average and 2021 snowpack depths, based on available records, are summarized in Table II-A-2.

Figure II-A-2 compares SWE data and temperature data from January to June 2021. The following observations are inferred from these data:

- The daily temperature recorded between January and June 2021 is within the historical monthly average records (between 2000 and 2019).

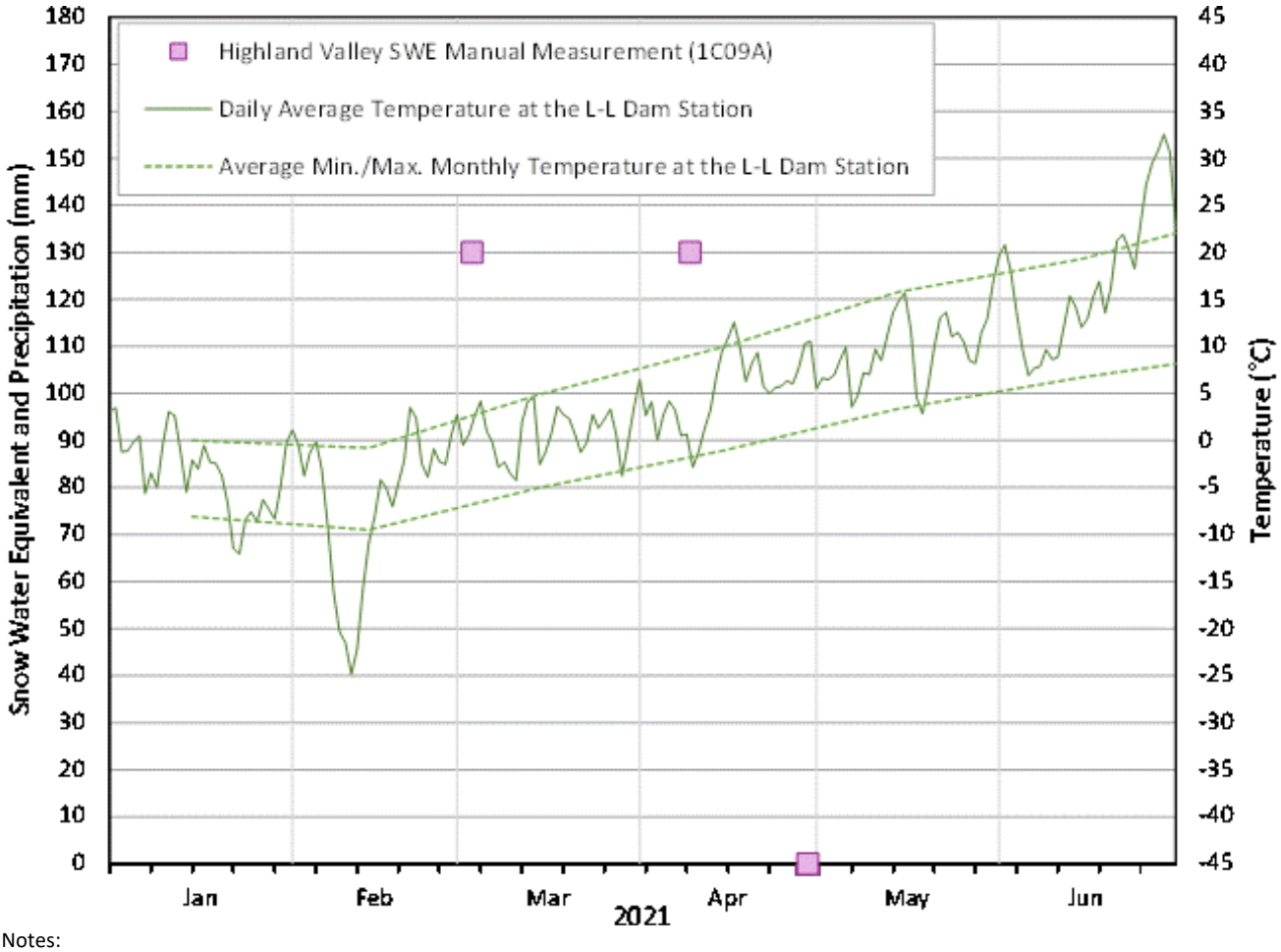
- The snowpack was depleted over a period of three weeks (between April 9 to 29), which is a quicker rate than the forecast snowmelt pattern from the HVC site wide water balance based on Golder (2020a).
- The rise in temperature above 0°C in April coincides with the snowmelt period manually recorded at the Highland Valley station.
- Rain was not a major factor in 2021 snowmelt, as the maximum daily precipitation recorded close to the snowpack depletion period is less than 6 mm/day.

Table II-A-2 Historical Average and 2021 Snowpack Depths

Survey Period	Years of Record[1]	Historic Average Snowpack Depth[2] (mm SWE[3])	2021 Snowpack Depth (mm SWE[3])	Percent Change Relative to Historic Average
January 1st	11	50.2	Not surveyed	N/A
February 1st	25	83.5	Not surveyed	N/A
March 1st	55	91.9	130	42%
April 1st	53	101.3	130	28%
May 1st	54	27.6	0	-100%
May 15th	25	2.4	Not surveyed	N/A
June 1st	8	0	Not surveyed	N/A

Notes:
1. At the Highland Valley snow survey station (Station No. 1C09A) near the Bethlehem TSF. Data prior to 1966 were not included as the station was moved to its current location in 1965.
2. Calculated based on available period on record.
3. SWE = snow water equivalent.

Figure II-A-2 Temperature Records and Measured Snowpack between January and June 2021



Notes:
1. SWE is manually measured at the Highland Valley snow pillow station (1C09A), typically once per month.
2. Daily average temperature data at the L-L Dam Station for 2021 was provided by HVC.
3. The average maximum and minimum monthly temperatures at the L-L Dam Station were developed by Golder (2021).

APPENDIX II-B

Instrumentation Summary and Plots

Appendix II-B
Instrumentation Summary and Plots

II-B-1 PIEZOMETERS

Piezometric readings at Dam No. 1 and Bose Lake Dam are plotted on Figure II-B-1 to Figure II-B-3 and Figure II-B-7 to Figure II-B-9, respectively.

Recent threshold values for piezometers are intended to identify changes from established behaviour as a trigger to review the data and are not linked to dam performance criteria. Therefore, thresholds have been set at 0.5 m above the maximum historic water levels to identify deviations from established trends. Questionable readings (e.g., where there was a spike that has not been repeated) were not used when defining thresholds.

Maximum and minimum water levels during this review period and instrument thresholds were reviewed as part of 2021 AFPR. Threshold values remain unchanged for 2022 (Refer to Table II-B-1).

Table II-B-1 Piezometric Levels during the review period and 2021 Thresholds

Instrument ID	Dam Zone or Foundation Unit	Status of Piezometer	Piezometric Levels during the review period[1] (m)		2021 Threshold Value (m) (See Note 2)
			Maximum	Minimum	
Dam No. 1					
STANDPIPE No. 1A	Dam Fill	Plugged	Reported plugged in 2019		1457.9
STANDPIPE No. 1B	Dam Fill	Dry	-		1440.4
STANDPIPE No. 3	Dam Fill	Dry	-		1443.1
STANDPIPE No. 4	Dam Fill	Dry	-		1453.6
STANDPIPE No. 6	Upstream Dam Fill	Defunct	n/a		n/a
STANDPIPE No. 7	Dam Fill	Dry	-		1440.5
P95-1	Downstream Foundation	Active	1377.9	1375.9	1379.0
P95-2	Downstream Foundation	Destroyed	n/a		n/a
P95-5	Dam Foundation	Destroyed	n/a		n/a
P95-6	Downstream Foundation	Active	1371.9	1371.2	1373.6
13-SRK-09/P13-5	Tailings	Active	1410.6	1409.9	1411.0
13-SRK-12B/P13-6	Glacial Till	Active	1377.3	1377.1	1377.9
VWPB16 - 1A	Glacial Till	Active	1350.0	1349.9	1351.7
VWPB16 - 1B	Glacial Till	Active	1359.6	1359.5	1369.8
BP3A	Glacial Till	Active	-[3]		1454.8
BP3B	Tailings	Active	-[3]		1455.9
BP3C	Tailings	Active	-[3]		1466.6
BP4A	Glacial Till	Active	-[3]		1466.7
BP4B	Tailings	Active	-[3]		1454.6
BP5A	Glacial Till	Active	-[3]		1461.6
BP5B	Tailings	Active	-[3]		1465.3
BP9A	Tailings	Active	-[3]		1403.4
BP9B	Tailings	Active	-[3]		1424.9
BP9C	Tailings	Active	-[3]		1449.6
BP10A	Tailings	Active	-[3]		1465.2
BP10B	Tailings	Active	-[3]		1466.8

Instrument ID	Dam Zone or Foundation Unit	Status of Piezometer	Piezometric Levels during the review period[1] (m)		2021 Threshold Value (m) (See Note 2)
			Maximum	Minimum	
BP12A	Tailings	Active	-[3]		1420.8
BP12B	Tailings	Active	-[3]		1441.8
BP12C	Tailings	Active	-[3]		1463.9
BP13A	Glacial Till	Active	-[3]		1441.5
BP13B	Tailings	Active	-[3]		1446.0
BP14A	Glacial Till	Active	-[3]		1425.0
BP-14B	Tailings	Active	-[3]		1425.7
BP14C	Tailings	Active	-[3]		1447.9
BP15A	Glacial Till	Active	-[3]		1447.7
BP15B	Tailings	Active	-[3]		1451.0
BP15C	Tailings	Active	-[3]		1458.6
Bose Lake Dam					
No. 1	Overburden / Bedrock Contact	Active	1444.7	1444.5	1445.3
No. 2	Overburden / Bedrock Contact	Active	1444.5	1444.3	1445.2
BD-VWP14-1A	Bedrock	Active	1451.5	1451.3	1452.0
BD-VWP14-1B	Overburden	Active	1451.4	1451.2	1451.8
BD-VWP14-1C	Dam Fill	Active	1448.8	1448.6	1449.9
BP6A	Glacial Till	Active	-[4]		1462.8
BP6B	Tailings	Active	-[4]		1466.0
BP6C	Tailings	Active	-[4]		1467.3
BP7A	Glacial Till	Active	-[4]		1469.1
BP7B	Tailings	Active	-[4]		1469.1
BP7C	Tailings	Active	-[4]		1468.3

Notes:
1. October 2020 through September 2021.
2. No change of threshold values is proposed for 2022.
3. No reading taken since December 2019.
4. No reading taken since October 2017.

II-B-2 SURVEY MONUMENTS

Survey monuments at Dam No. 1 and Bose Lake Dam are shown on Figure 3 and Figure 4, respectively. Starting in November 2019, HVC changed the method used to survey the displacement monuments. Previously, monuments were surveyed using a ground based total station with digital level. This has changed to a GPS Real Time Kinematic (RTK) survey. Based on the survey data collected to date, the RTK method is suitable to monitor displacement. In comparison to the total station method, the RTK surveys show less variance (i.e., error) in the horizontal plane but increased variance in elevation.

Survey results using the RTK method are shown on Figure II-B-4 and Figure II-B-10. Horizontal surveys using the previous method are not shown as they reference a different basepoint.

Table II-B-2 summarizes incremental and cumulative displacement from October 2020 to September 2021. The incremental vertical settlement at three monuments exceeded threshold value by 1 mm to 2 mm. These are not interpreted as a dam safety concern as there is no horizontal movement trend and the total magnitude of settlement to date is not sufficient to impact freeboard or other aspects of performance. The threshold value (20 mm) was defined based on typical variance with the previous survey method (refer to Table II-B-3). These exceedances are interpreted as the result of the higher variance in elevation surveys with the RTK method. KCB and HVC are to revise thresholds during 2022 based on typical variance using the first RTK survey method (November 2019).

Table II-B-2 2021 Survey Monument Displacement Summary

Monument ID	Incremental[1]		Cumulative	
	Vector Horizontal Displacement (mm)	Vertical Displacement (mm)	Vector Horizontal Displacement[2] (mm)	Vertical Displacement[3] (mm)
Dam No. 1				
MON 1-73	7, downstream (toward south)	+3	6, downstream (toward southwest)	-213
DM-2	4, parallel to crest (toward south)	+16	3, parallel to crest (toward south)	-153
DM-3	7, upstream (toward east)	+6	5, upstream (toward east)	-102
PIN-2	3, downstream (toward west)	+14	6, downstream (toward northwest)	-90
Bose Lake Dam				
BD-1	14, upstream (toward southwest)	-18	13, upstream (toward southwest)	-23
BD-2	10, upstream (toward southwest)	-22	14, upstream (toward southwest)	-28
BD-3	13, upstream (toward southwest)	-22	18, upstream (toward southwest)	-19
BD-4	1, upstream (toward southwest)	-21	12, upstream (toward southwest)	-25
BD-5	6, upstream (toward southwest)	-14	14, upstream (toward southwest)	-23
BD-6	7, upstream (toward southwest)	-17	7, upstream (toward southwest)	-28
BD-7	3, downstream (toward northeast)	-6	12, parallel (toward south)	-25

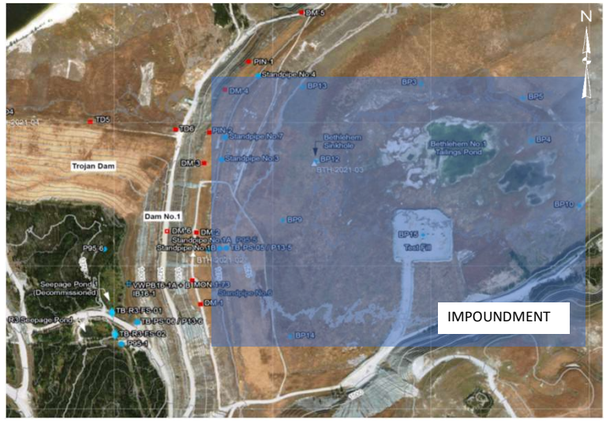
Notes:
1. Incremental displacements are calculated between the September 2020 and September 2021 surveys.
2. Cumulative horizontal displacements calculated relative to the RTK November 2019 baseline.
3. Cumulative vertical displacements calculated relative to full survey record, regardless of survey method: BD-7 since 2008; BD-3 since 2013 (shift pre- and post-2013 possibly attributed to damage or change to datum; no observations this was an indicator of dam safety issue); all other monuments since 1983.
4. The incremental vertical settlement exceedances are shown in red.

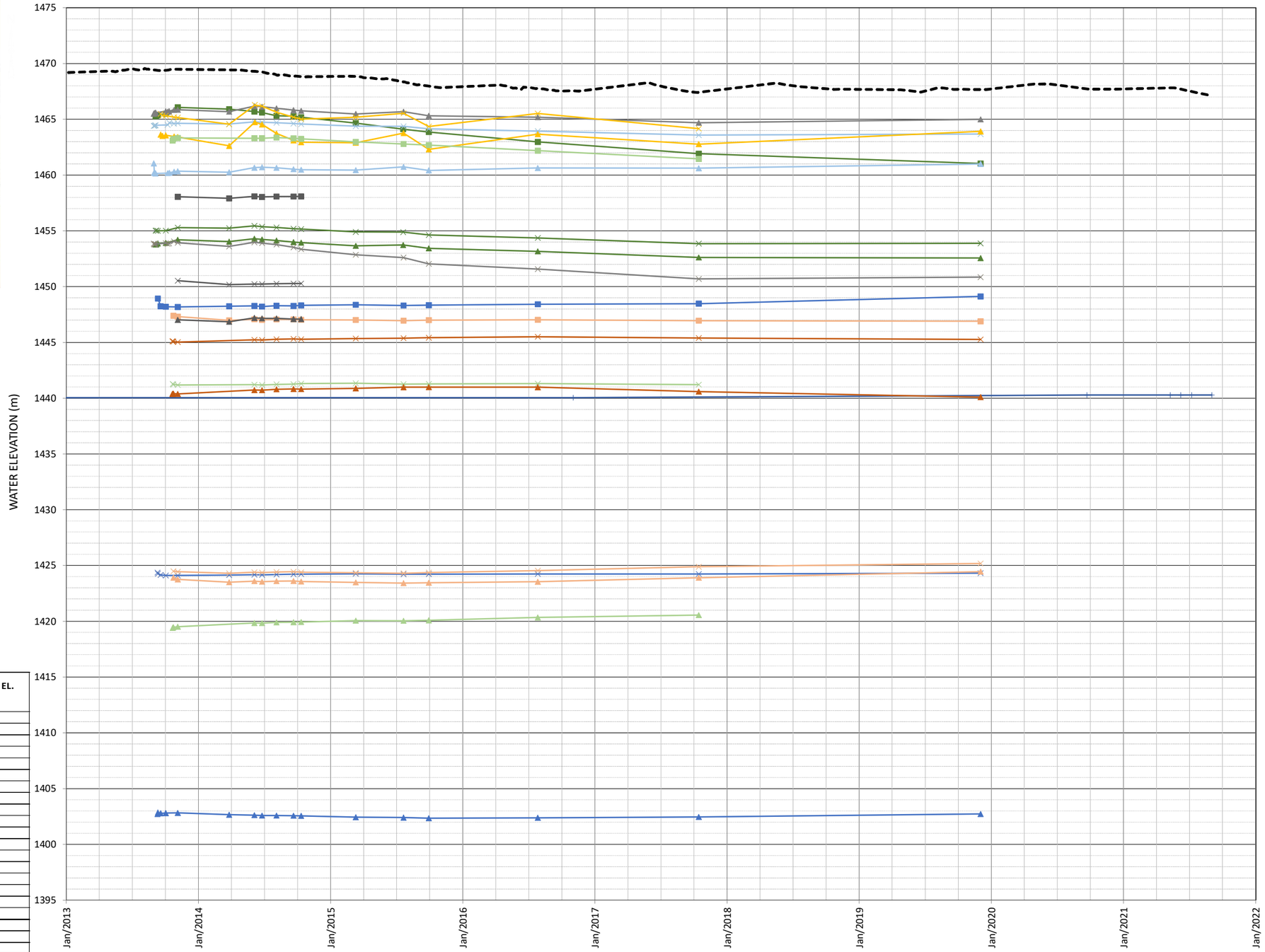
The current survey movement thresholds were set during the 2016 Annual Facility Performance Report based on typical variance and error using the total station method (refer to Table II-B-3). Threshold values for 2022 are to be reviewed by KCB and HVC during preparation of the next OMS Manual update.

Table II-B-3 Total Station Survey Monument Displacement Thresholds

Instrument ID	Instrument Threshold (mm)		
	Total Horizontal Vector Displacement from Original Position	Incremental Vertical Displacement Between Readings	Total Vertical Displacement
DAM NO. 1			
MON 1-73	80	20	240
DM-2			170
DM-3			125
PIN-2			125
BOSE LAKE DAM			
BD-1	80	20	75
BD-2			50
BD-3			75
BD-4			50
BD-5			50
BD-6			50
BD-7			50

INSTRUMENTATION PLOTS





LEGEND:

- STANDPIPE NO. 7 (TIP El. 1439.9 m, UPSTREAM DAM FILL, DRY ELEVATION)
- BP3A (TIP El. 1439.4 m, GLACIAL TILL)
- BP3B (TIP El. 1444 m, TAILINGS)
- BP3C (TIP El. 1457.7 m, TAILINGS)
- BP4A (TIP El. 1421.9 m, GLACIAL TILL)
- BP4B (TIP El. 1449.4 m, TAILINGS)
- BP5A (TIP El. 1450 m, GLACIAL TILL)
- BP5B (TIP El. 1459.1 m, TAILINGS)
- BP9A (TIP El. 1371.8 m, TAILINGS)
- BP9B (TIP El. 1411.5 m, TAILINGS)
- BP9C (TIP El. 1441.9 m, TAILINGS)
- BP10A (TIP El. 1452.8 m, TAILINGS)
- BP10B (TIP El. 1462 m, TAILINGS)
- BP12A (TIP El. 1404 m, TAILINGS)
- BP12B (TIP El. 1426.1 m, TAILINGS)
- BP12C (TIP El. 1456.6 m, TAILINGS)
- BP13A (TIP El. 1431.6 m, GLACIAL TILL)
- BP13B (TIP El. 1442.9 m, TAILINGS)
- BP14A (TIP El. 1417.8 m, GLACIAL TILL)
- BP-14B (TIP El. 1423.9 m, TAILINGS)
- BP14C (TIP El. 1447 m, TAILINGS)
- BP15A (TIP El. 1394.9 m, GLACIAL TILL)
- BP15B (TIP El. 1411.7 m, TAILINGS)
- BP15C (TIP El. 1440.6 m, TAILINGS)
- BETHLEHEM NO.1 POND LEVEL

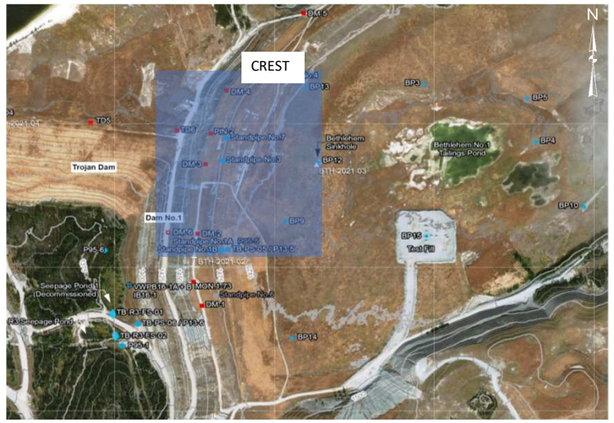
PIEZOMETER ID	2021 THRESHOLD EL. (m)
BP3A	1454.8
BP3B	1455.9
BP3C	1466.6
BP4A	1466.7
BP4B	1454.6
BP5A	1461.6
BP5B	1465.3
BP9A	1403.4
BP9B	1424.9
BP9C	1449.6
BP10A	1465.2
BP10B	1466.8
BP12A	1420.8
BP12B	1441.8
BP12C	1463.9
BP13A	1441.5
BP13B	1446.0
BP14A	1425.0
BP-14B	1425.7
BP14C	1447.9
BP15A	1447.7
BP15B	1451.0
BP15C	1458.6

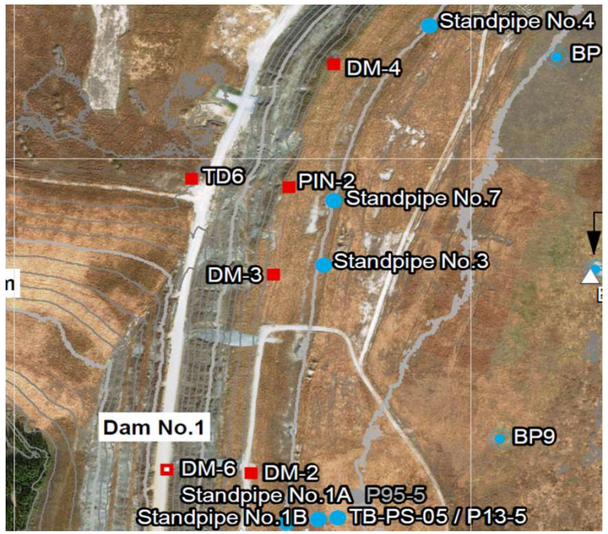
NOTES:

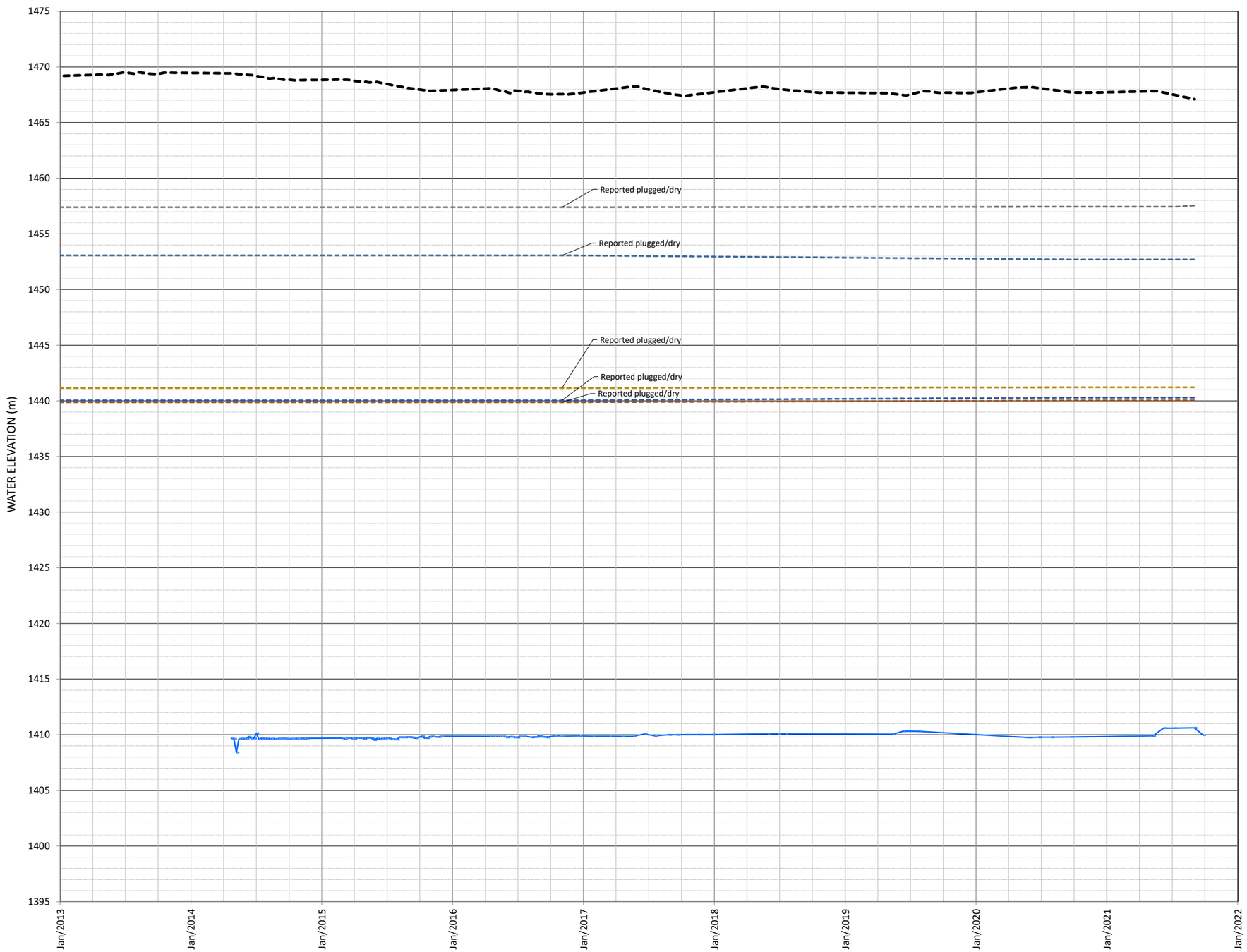
1. ONE READING WAS TAKEN FOR EACH PIEZOMETER IN DECEMBER 2019. NO READINGS WERE COLLECTED THEREAFTER.
2. NO READING WAS TAKEN IN DECEMBER 2019 FOR BP10B AS THE WIRE WAS CUT.
3. NO READINGS WERE COLLECTED FOR BP12 OR B15 SERIES IN DECEMBER 2019.

December 23, 2021
Z:\MVCR\M02341C12-HVC 2021 Dam Safety Support\300 Design\320 Piezometer Data\Bethlehem\[211203 Bethlehem Piezo.xlsx]No1 Base Plot

CLIENT: Highland Valley Copper / Teck
Klohn Crippen Berger
PROJECT: BETHLEHEM NO. 1 TAILINGS STORAGE FACILITY
2021 ANNUAL FACILITY PERFORMANCE REPORT
TITLE: DAM No. 1 PIEZOMETRIC DATA 2013-2021
IMPOUNDMENT
PROJECT No. M02341C12
FIG No. II-B-1







LEGEND:

- STANDPIPE NO. 1A (TIP El. 1446.6 m, UPSTREAM DAM FILL, PLUGGED ELEVATION)
- STANDPIPE NO. 1B (TIP El. 1440.26684 m, UPSTREAM DAM FILL, PLUGGED ELEVATION)
- STANDPIPE NO. 3 (TIP El. 1442.8 m, UPSTREAM DAM FILL, DRY ELEVATION (NOTE 1))
- STANDPIPE NO. 4 (TIP El. 1451.8 m, UPSTREAM DAM FILL, DRY ELEVATION)
- STANDPIPE NO. 7 (TIP El. 1439.9 m, UPSTREAM DAM FILL, DRY ELEVATION)
- 13-SRK-09/P13-5 (TIP El. 1391.2 m, TAILINGS)
- BETHLEHEM NO.1 POND LEVEL

PIEZOMETER ID	2021 THRESHOLD EL. (m)
STANDPIPE No. 1A	1457.9
STANDPIPE No. 1B	1440.4
STANDPIPE No. 3	1443.1
STANDPIPE No. 4	1453.6
STANDPIPE No. 7	1440.5
13-SRK-09/P13-5	1411.0

NOTES:

1. STANDPIPE NO. 3 HAS BEEN NOTED AS DRY/PLUGGED IN THE RECORDS AND LIKELY EXPLAINS THE ERRATIC JUMPS IN MEASUREMENTS. HOWEVER A FALLING HEAD TEST CONDUCTED IN 2015 INDICATED THE PIEZOMETER WAS STILL RESPONDING.
2. STANDPIPE NO. 6 WAS TESTED IN 2015 AND FOUND TO BE DEFUNCT.

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

PROJECT: BETHLEHEM NO. 1 TAILINGS STORAGE FACILITY
2021 ANNUAL FACILITY PERFORMANCE REPORT

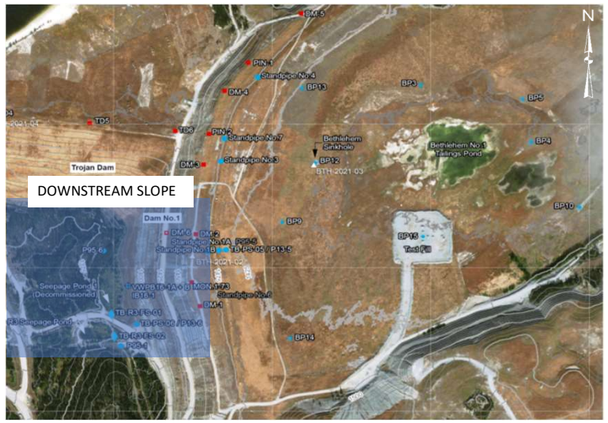
TITLE: DAM No. 1 PIEZOMETRIC DATA
2013-2021

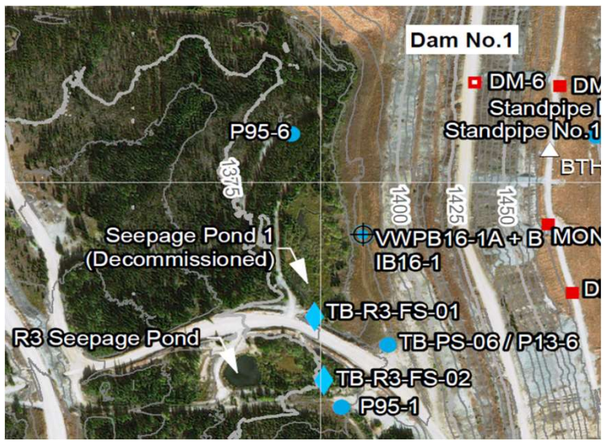
CREST

PROJECT No. M02341C12

FIG No. II-B-2

December 23, 2021
Z:\MVCR\M02341C12-HVC 2021 Dam Safety Support\300 Design\320 Piezometer Data\Bethlehem\[211203 Bethlehem Piezo.xlsx]No1 Base Plot

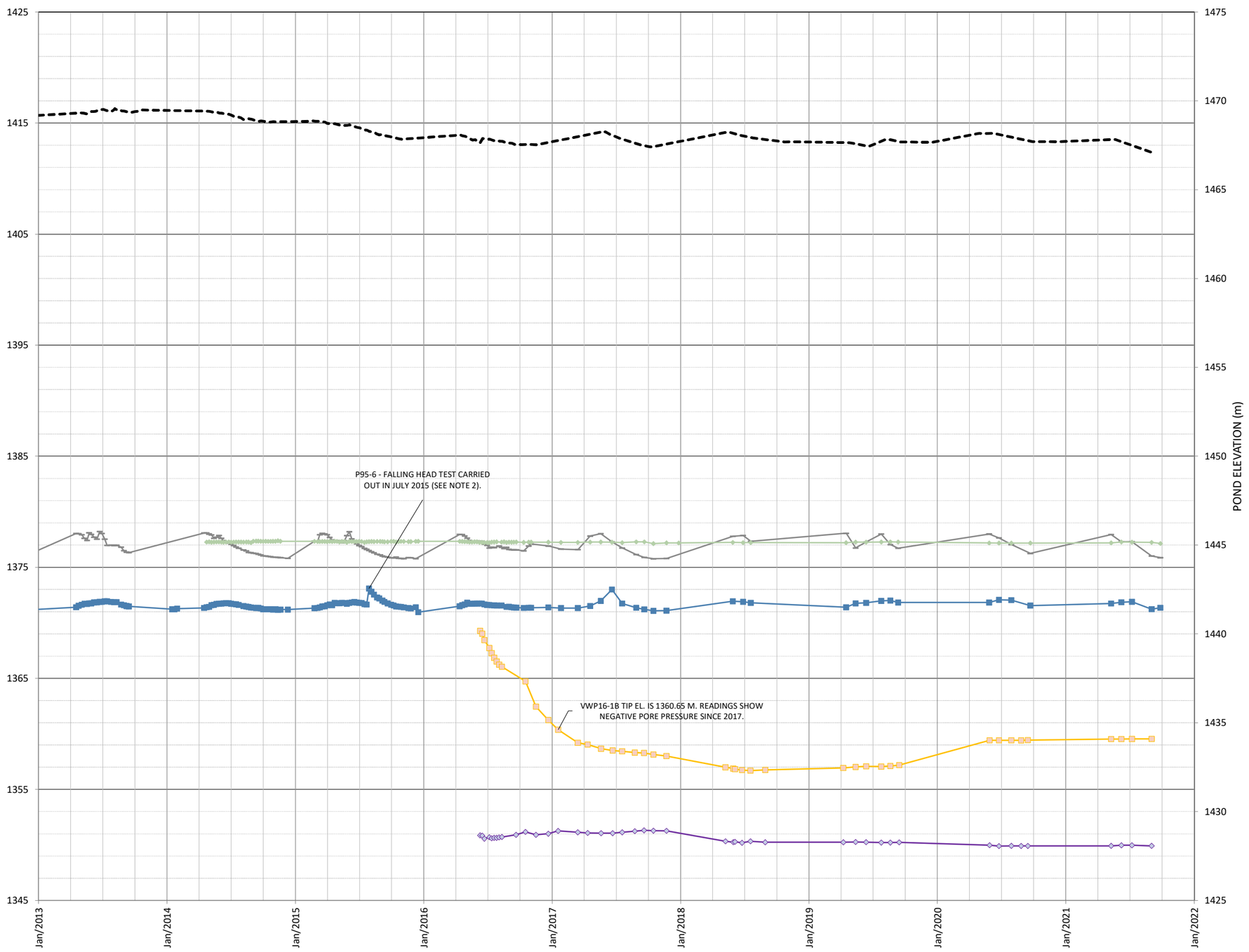




LEGEND:

- VWP16-1B (TIP El. 1360.7 m, GLACIAL TILL)
- P95-1 (TIP El. 1373.7 m, DOWNSTREAM FOUNDATION)
- P95-6 (TIP El. 1368.2 m, DOWNSTREAM FOUNDATION)
- 13-SRK-12B/P13-6 (TIP El. 1357.2 m, GLACIAL TILL)
- VWP16-1A (TIP El. 1346.2 m, GLACIAL TILL)
- BETHLEHEM NO.1 POND LEVEL

PIEZOMETER ID	2021 THRESHOLD EL. (m)
P95-1	1379.0
P95-6	1373.6
13-SRK-12B/P13-6	1377.9
VWP16-1A	1351.7
VWP16-1B	1369.8



NOTES:

1. PIEZOMETER WATER ELEVATIONS PLOTTED ON PRIMARY (LEFT) AXIS, POND ELEVATION PLOTTED ON SECONDARY (RIGHT) AXIS.
2. FALLING HEAD TEST CARRIED OUT ON P95-6 DURING JULY 2015 - CAUSE OF SPIKE IN PIEZOMETRIC LEVELS.
3. JUNE 25, 2020 WATER LEVELS AT VWP16-1A AND VWP16-1B ARE NOT MEASURED AND PLOTTED BECAUSE THE BAROMETRIC PRESSUER READINGS WERE NOT TAKEN.

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

PROJECT: BETHLEHEM NO. 1 TAILINGS STORAGE FACILITY
2021 ANNUAL FACILITY PERFORMANCE REPORT

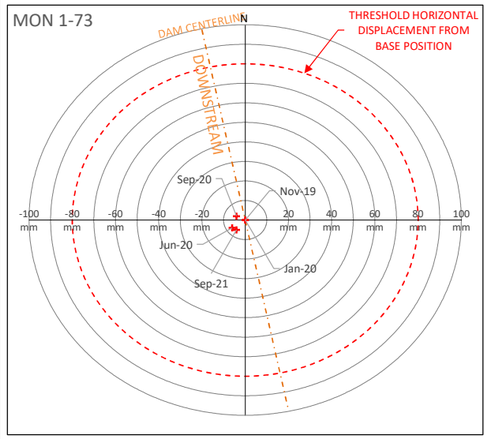
TITLE: DAM No. 1 PIEZOMETRIC DATA
2013-2021

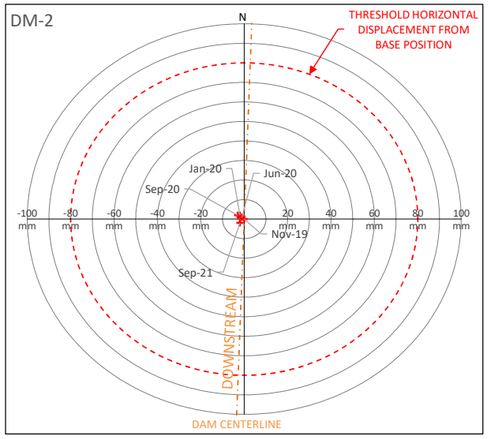
DOWNSTREAM SLOPE

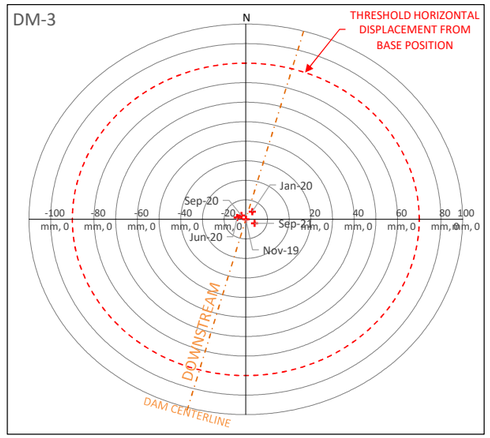
PROJECT No. M02341C12

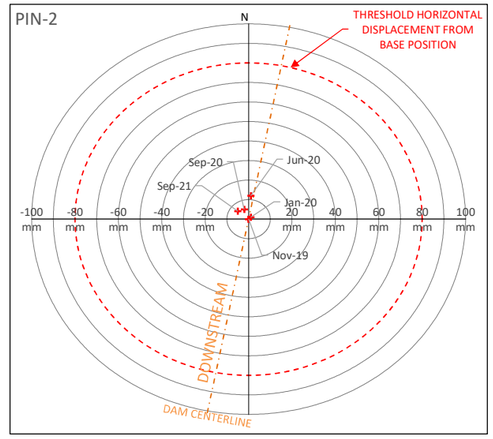
FIG No. II-B-3

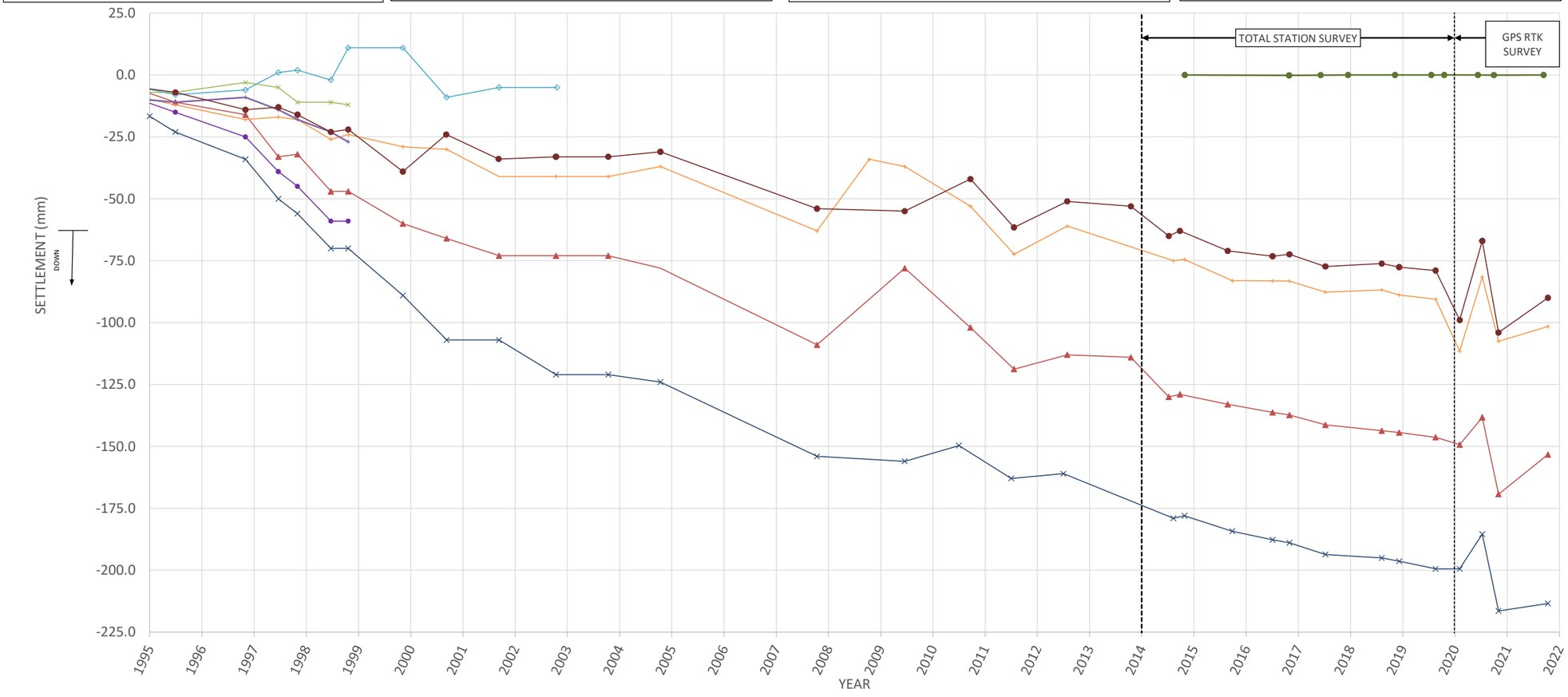
December 23, 2021
Z:\MVCR\M02341C12-HVC 2021 Dam Safety Support\300 Design\320 Piezometer Data\Bethlehem\[211203 Bethlehem Piezo.xlsx]No 1 Base Plot











NOTES:

1. SURVEY METHOD SWITCHED FROM TOTAL STATION TO GPS RTK ON NOVEMBER 26, 2019.
2. HORIZONTAL DISPLACEMENT PRIOR TO NOVEMBER 2019 NOT SHOWN. HORIZONTAL DISPLACEMENT BASELINES SET TO NOVEMBER 26, 2019 GPS RTK SURVEY READINGS.
3. DAM No. 1 MOVEMENT MONITORING DATA PRIOR TO 1995 NOT SHOWN.
4. REFER TO FIGURE 3 FOR MONUMENT LOCATIONS IN PLAN VIEW.
5. DM-1, DM-4 AND DM-5 DESTROYED IN 1999.
6. DM-6 DESTROYED IN 2002.
7. 2008 SETTLEMENT DATA OF DM-2, MON. 1-73, AND PIN-2 WERE OUTLIERS AND NOT PLOTTED.
8. 2021 SETTLEMENT PLOTTED BY ADDING INCREMENTAL DISPLACEMENT BETWEEN GPS RTK SURVEY READINGS TO CUMULATIVE TOTAL DISPLACEMENT ON JULY 16, 2019. THIS ASSUMES NO SETTLEMENT OCCURED BETWEEN JULY 16 AND NOVEMBER 26, 2019.

MONUMENT ID	TOTAL STATION SURVEY METHOD THRESHOLDS		
	HORIZONTAL DISPLACEMENT FROM ORIGINAL POSITION (mm)	INCREMENTAL SETTLEMENT BETWEEN READINGS (mm)	TOTAL SETTLEMENT (mm)
MON 1-73	80	20	240
DM-2			170
DM-3			125
PIN-2			125
Bethlehem Sinkhole			250

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

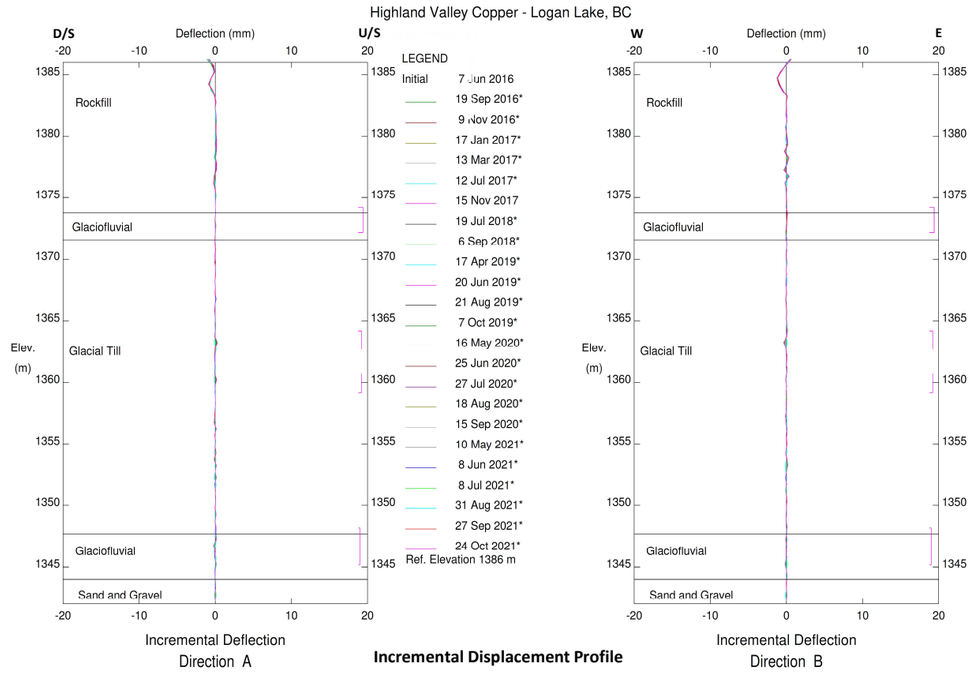
PROJECT: BETHLEHEM NO. 1 TAILINGS STORAGE FACILITY
2021 ANNUAL FACILITY PERFORMANCE REPORT

TITLE: DAM NO. 1
SURVEY MONUMENT READINGS

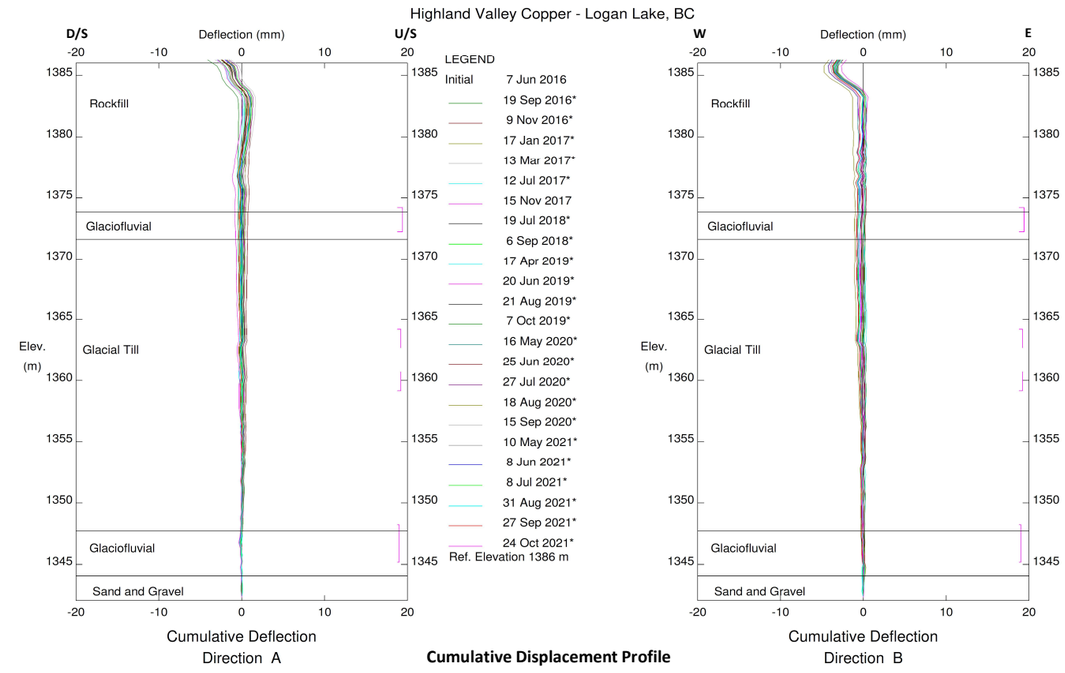
PROJECT No. M02341C12

FIG No. II-B-4

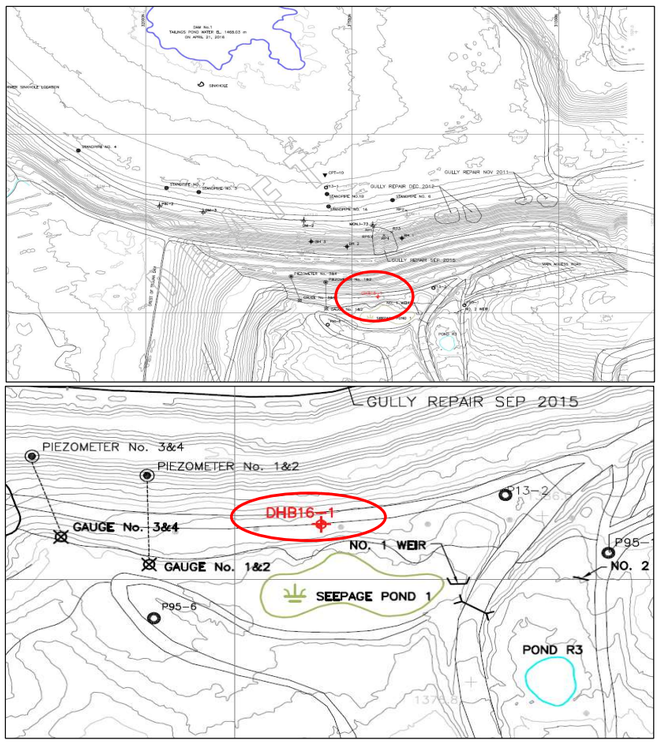
December 22, 2021
Z:\MV\CRM\02341C12-HVC 2021 Dam Safety Support\300 Design\340 Dam Movement Monitoring\347 Survey Monument\Bethlehem\[211203 BethMainDamMonitoring.xlsm]Fig V-B-4

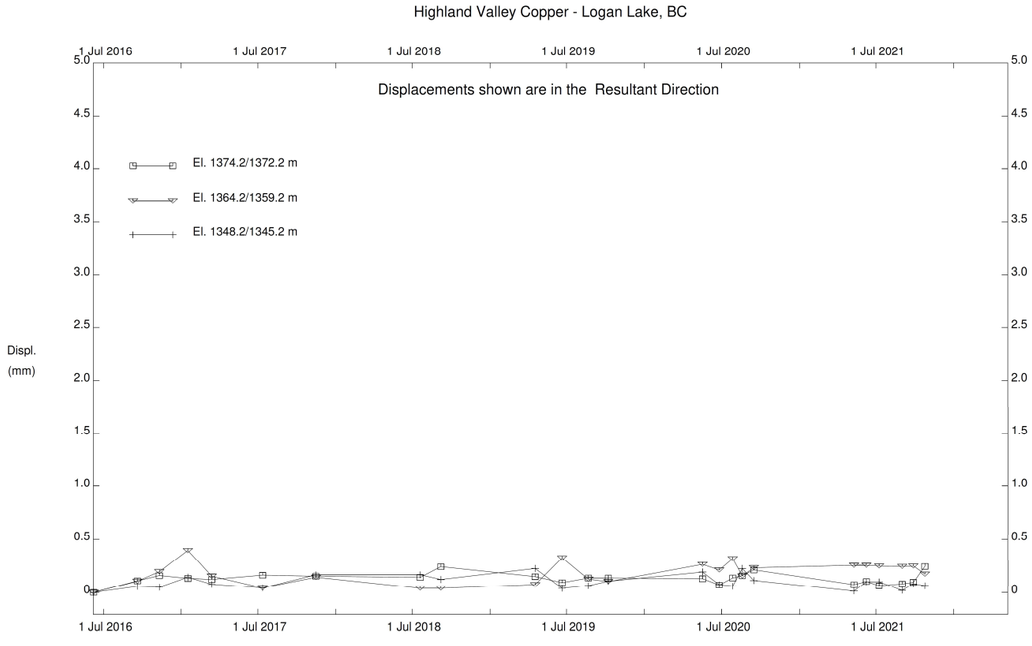


Incremental Displacement Profile



Cumulative Displacement Profile





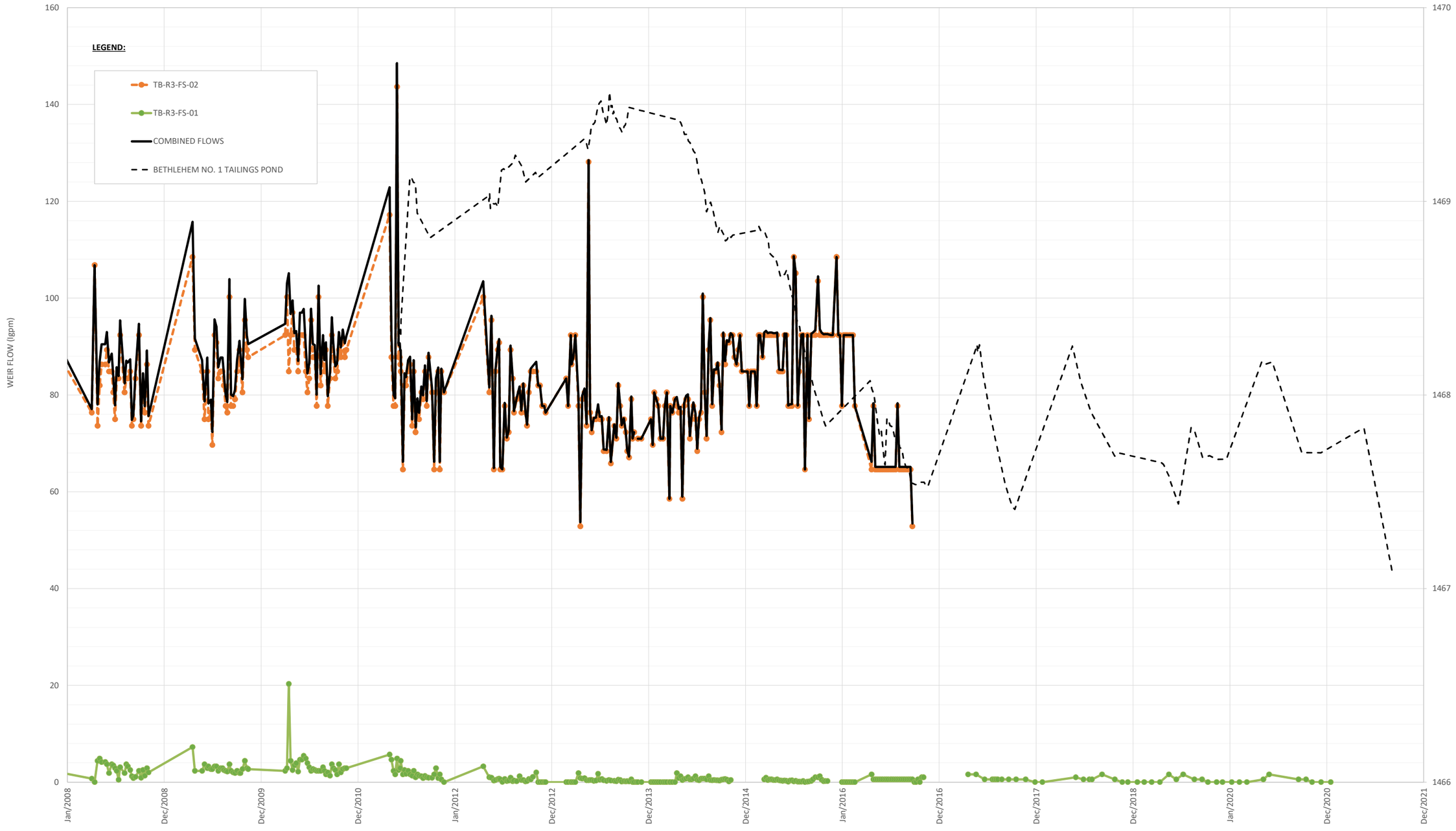
Cumulative Displacement Profile vs. Time

NOTES:

1) IB16-1 was installed on April 20, 2016.
2) IB16-1 was initialized on June 07, 2016.
3) Reel/Probe Serial Number for the initial reading: DR15020000/DP06580000.

CLIENT: Highland Valley Copper / Teck; Klohn Crippen Berger	PROJECT: BETHLEHEM NO. 1 TAILINGS STORAGE FACILITY 2021 ANNUAL FACILITY PERFORMANCE REPORT
	TITLE: INCLINOMETER DISPLACEMENT PROFILE IB16-1
	PROJECT No. M02341C12 / FIG No. II-B-5

November 29, 2021
Z:\MVCR\M02341C12-HVC 2021 Dam Safety Support\300 Design\340 Dam Movement Monitoring\346 SI\Beth & Trojan\[211129 Inclinometer plots (Beth and Troj).xlsx]II-B-5 IB-1 Beth



NOTES:
1. WEIR FLOW PLOTTED ON PRIMARY (LEFT) AXIS, BETHLEHEM NO. 1 TAILINGS POND ELEVATION PLOTTED ON SECONDARY (RIGHT) AXIS.
2. TB-R3-FS-02 (WEIR 1) REMOVED OCTOBER 2016, COMBINDED FLOW ONLY PLOTTED UNTIL THAT DATE.

CLIENT: Highland Valley Copper / Teck; Klohn Crippen Berger

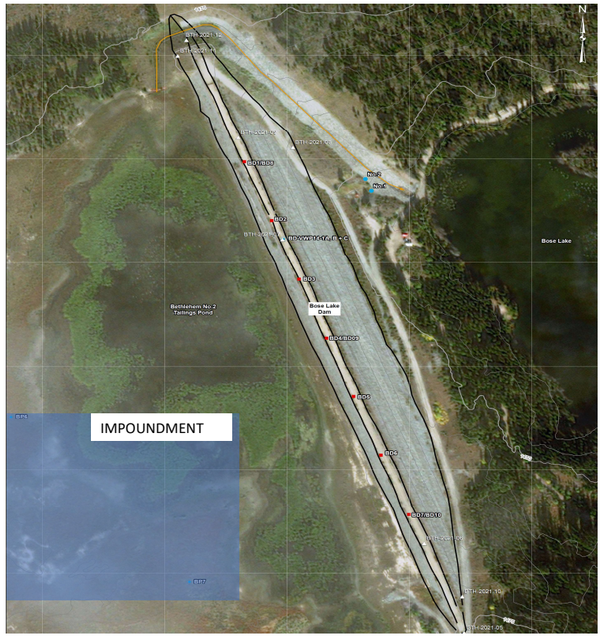
PROJECT: BETHLEHEM NO. 1 TAILINGS STORAGE FACILITY
2021 ANNUAL FACILITY PERFORMANCE REPORT

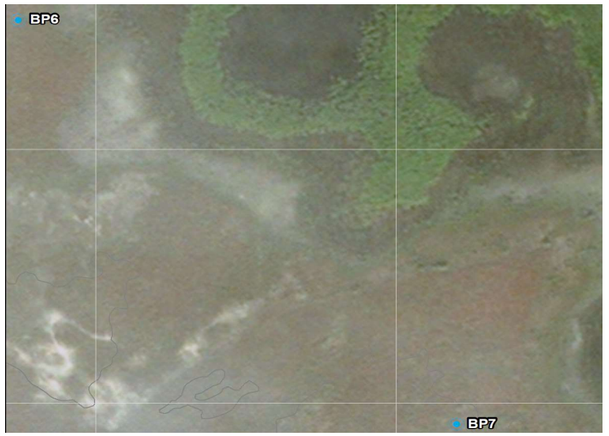
TITLE: DAM NO. 1
WEIR FLOWS

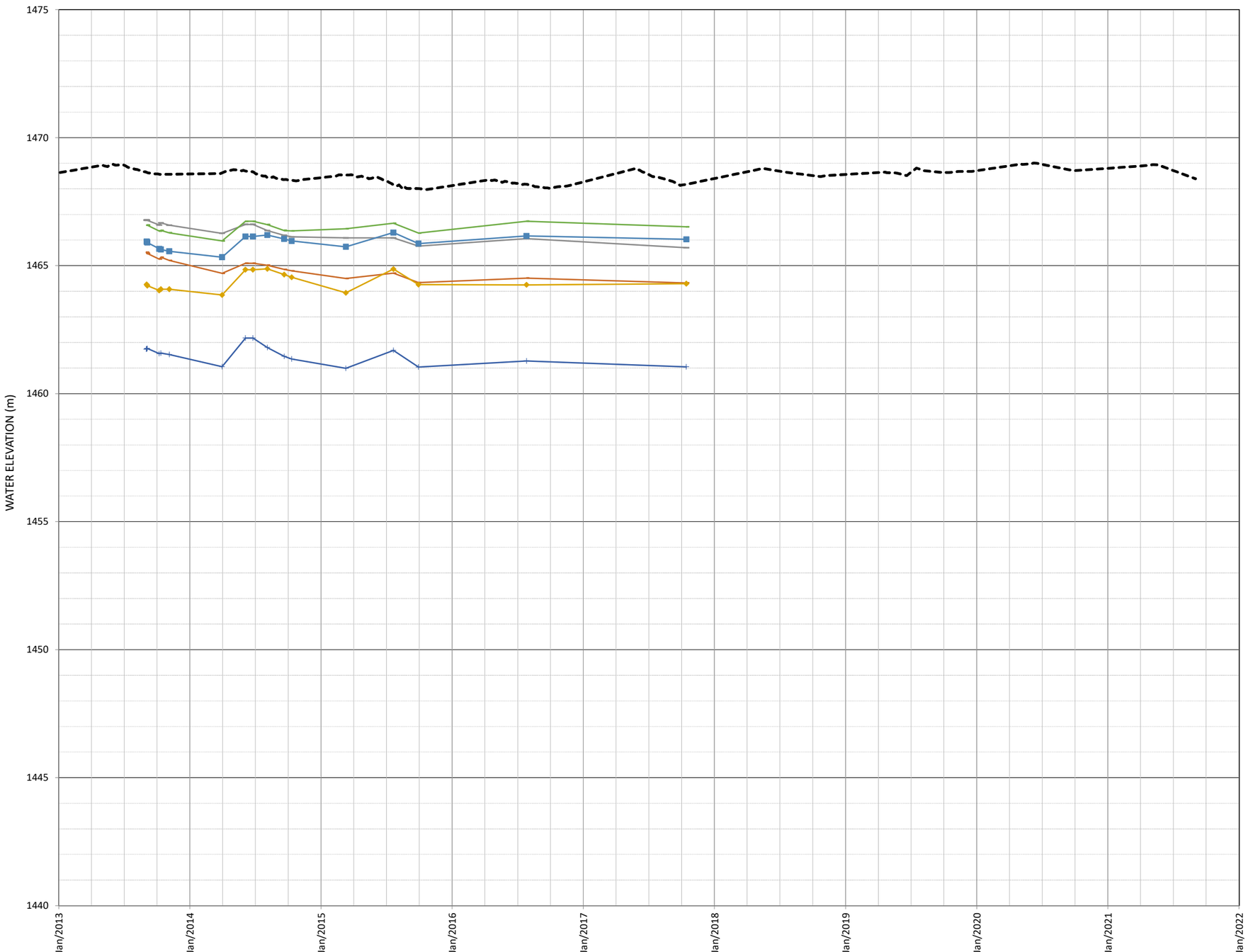
PROJECT No. M02341C12

FIG No. II-B-6

December 21, 2021







LEGEND:

- BP6A (TIP El. 1431.1 m, GLACIAL TILL)
- BP6B (TIP El. 1441.8 m, TAILINGS)
- BP6C (TIP El. 1455.5 m, TAILINGS)
- BP7A (TIP El. 1439.6 m, GLACIAL TILL)
- BP7B (TIP El. 1448.7 m, TAILINGS)
- BP7C (TIP El. 1459.4 m, TAILINGS)
- BETHLEHEM NO.2 POND LEVEL

PIEZOMETER ID	2021 THRESHOLD EL. (m)
BP6A	1462.8
BP6B	1466.0
BP6C	1467.3
BP7A	1469.1
BP7B	1469.1
BP7C	1468.3

NOTES:

1. NO READINGS WERE TAKEN IN 2019 or 2020.

December 21, 2021

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

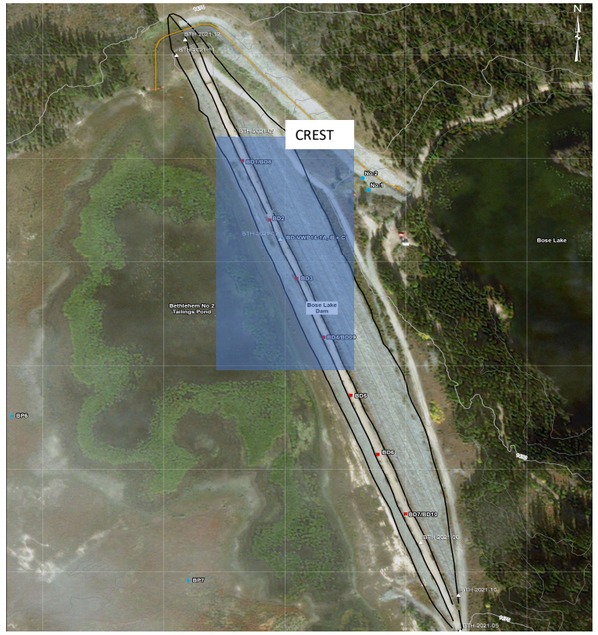
PROJECT: BETHLEHEM NO. 1 TAILINGS STORAGE FACILITY
2021 ANNUAL FACILITY PERFORMANCE REPORT

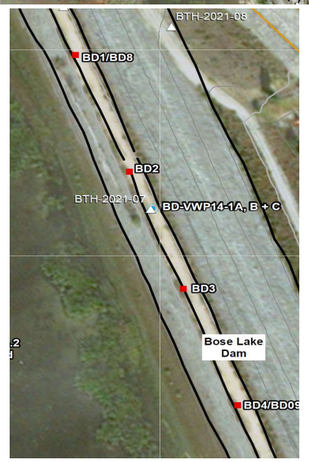
TITLE: BOSE LAKE DAM PIEZOMETRIC DATA
2013-2021

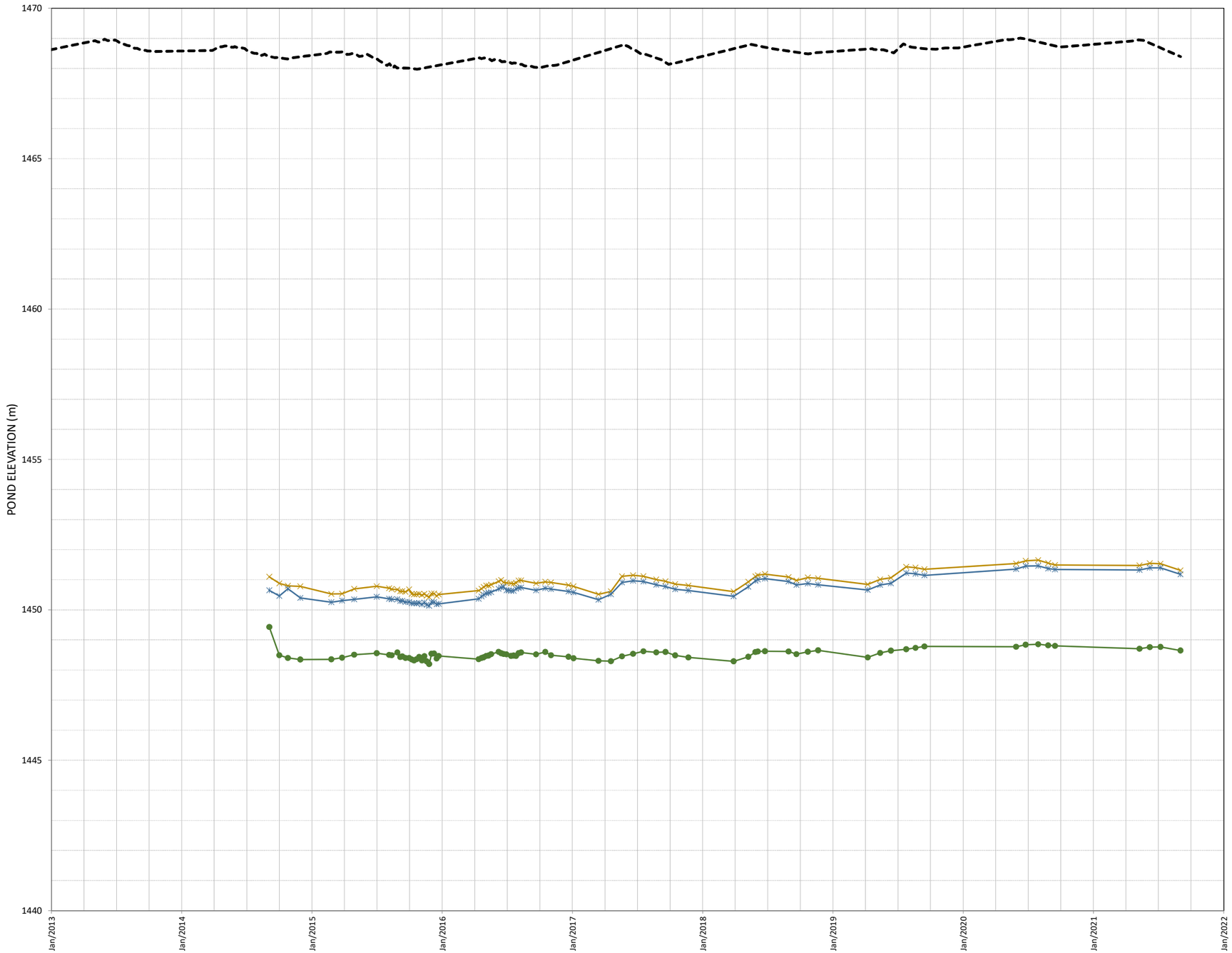
IMPOUNDMENT

PROJECT No. M02341C12

FIG No. II-B-7







LEGEND:

- BD-VWP14-1A (TIP El. 1425.1 m, BEDROCK)
- BD-VWP14-1B (TIP El. 1435.1 m, OVERBURDEN)
- BD-VWP14-1C (TIP El. 1448.1 m, DAM FILL)
- BETHLEHEM NO.2 POND LEVEL

PIEZOMETER ID	2021 THRESHOLD EL. (m)
BD-VWP14-1A	1452.0
BD-VWP14-1B	1451.8
BD-VWP14-1C	1449.9

NOTES:

1. PIEZOMETER WATER ELEVATIONS PLOTTED ON PRIMARY (LEFT) AXIS, POND ELEVATION PLOTTED ON SECONDARY (RIGHT) AXIS.
2. JUNE 25, 2020 WATER LEVELS ARE NOT MEASURED AND PLOTTED BECAUSE THE BAROMETRIC PRESSUER READINGS WERE NOT TAKEN.

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

PROJECT: BETHLEHEM NO. 1 TAILINGS STORAGE FACILITY
2021 ANNUAL FACILITY PERFORMANCE REPORT

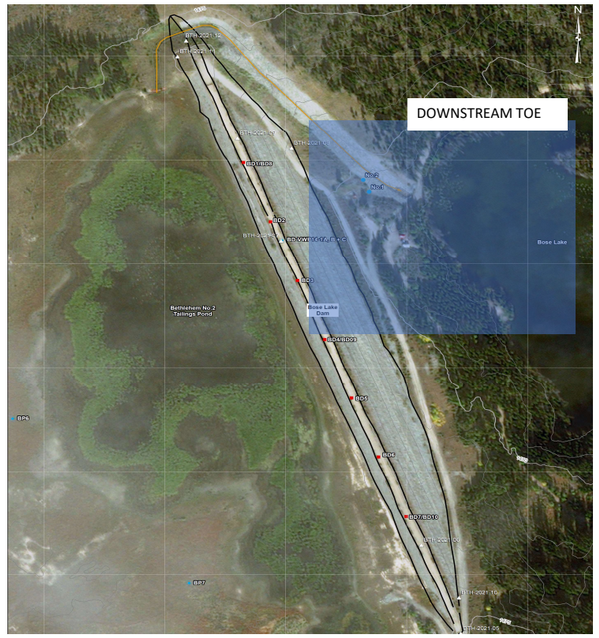
TITLE: BOSE LAKE DAM PIEZOMETRIC DATA
2013-2021

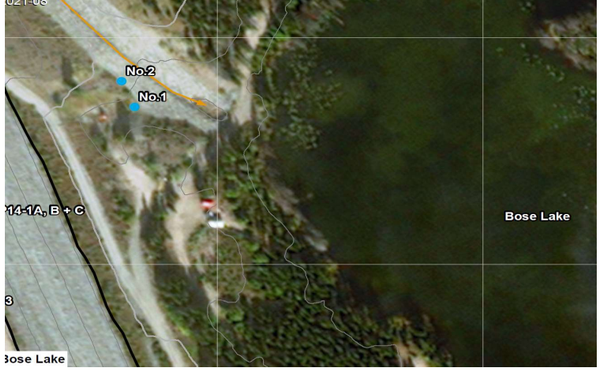
CREST

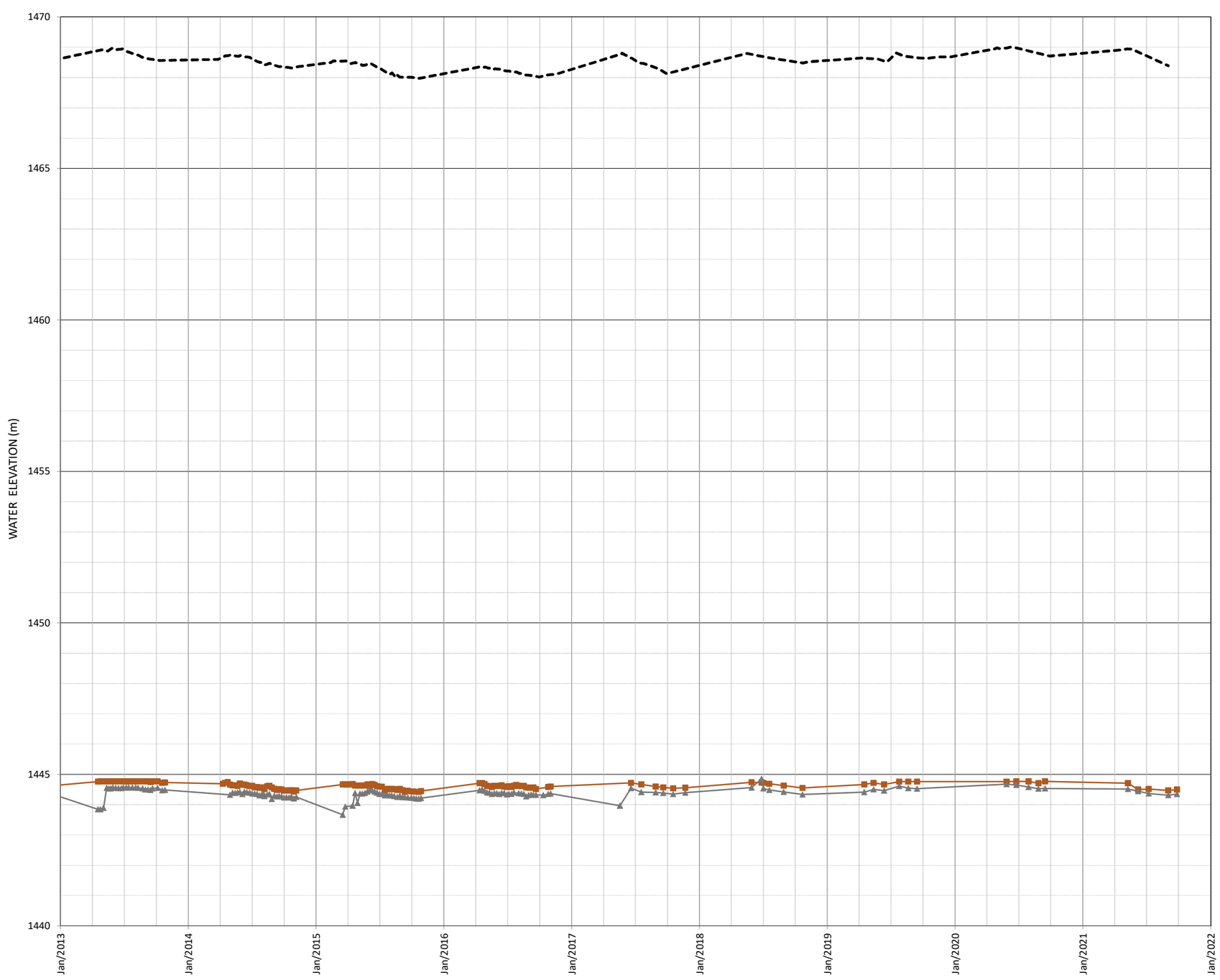
PROJECT No. M02341C12

FIG No. II-B-8

December 21, 2021







LEGEND:

- No. 1 (TIP El. 1433.0126 m, OVERBURDEN / BEDROCK)
- No. 2 (TIP El. 1434.2318 m, OVERBURDEN / BEDROCK)
- BETHLEHEM NO.2 POND LEVEL

PIEZOMETER ID	2021 THRESHOLD EL. (m)
No. 1	1445.3
No. 2	1445.2

NOTES:

1. PIEZOMETER WATER ELEVATIONS PLOTTED ON PRIMARY (LEFT) AXIS, POND ELEVATION PLOTTED ON SECONDARY (RIGHT) AXIS.

December 21, 2021

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

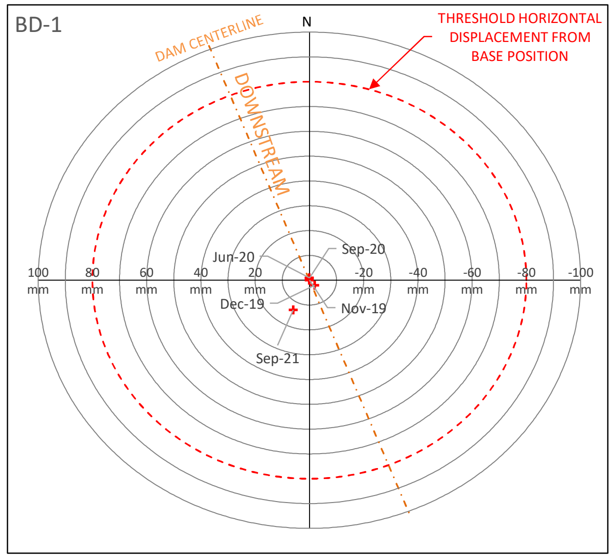
PROJECT: BETHLEHEM NO. 1 TAILINGS STORAGE FACILITY
2021 ANNUAL FACILITY PERFORMANCE REPORT

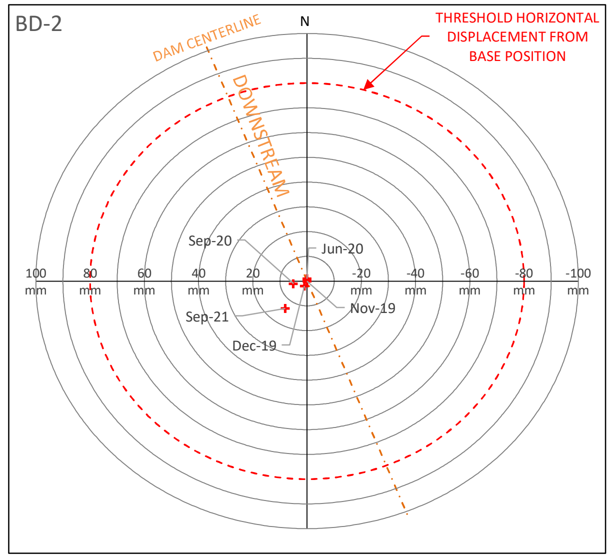
TITLE: BOSE LAKE DAM PIEZOMETRIC DATA
2013-2021

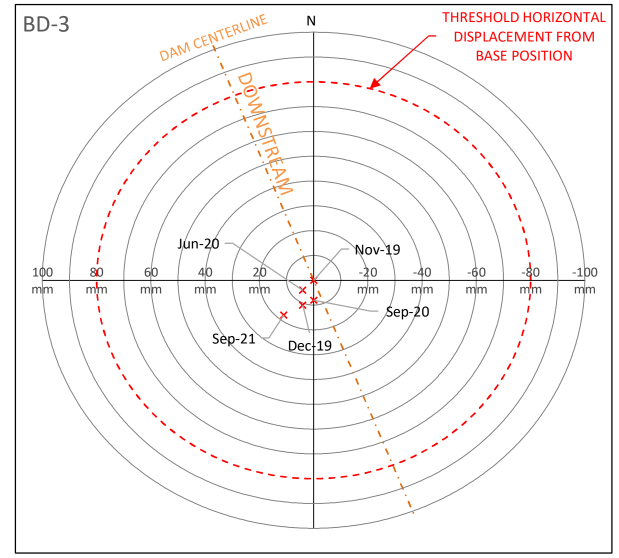
DOWNSTREAM TOE

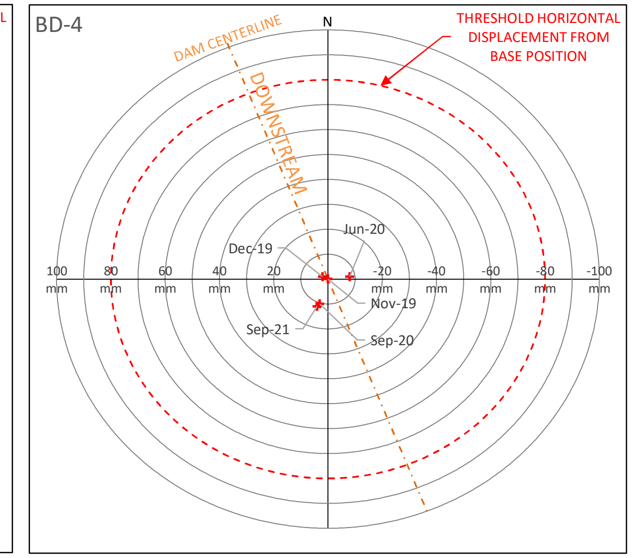
PROJECT No. M02341C12

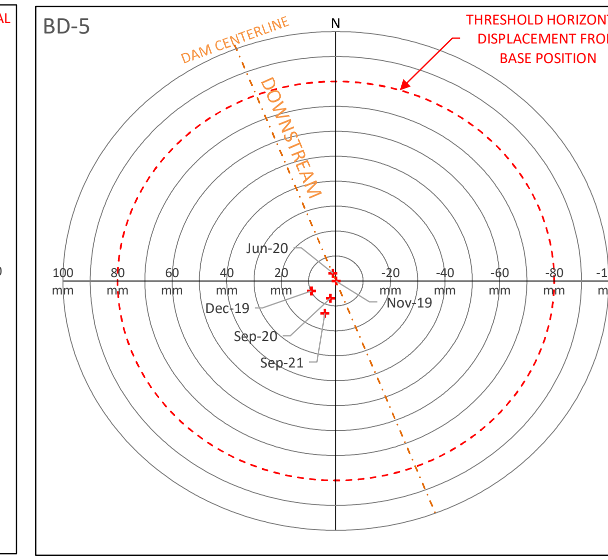
FIG No. II-B-9

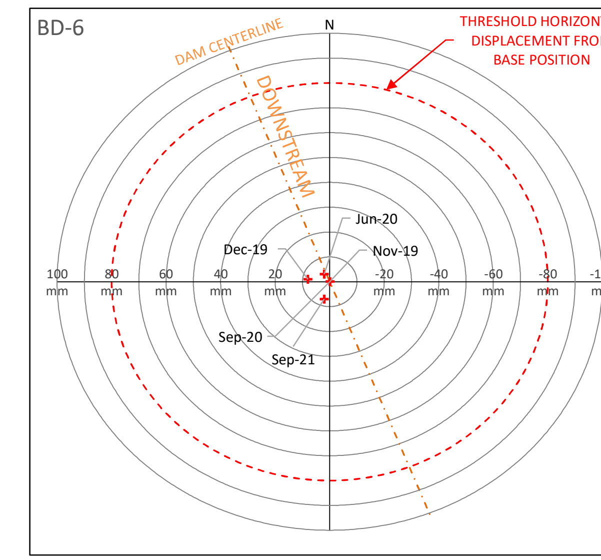


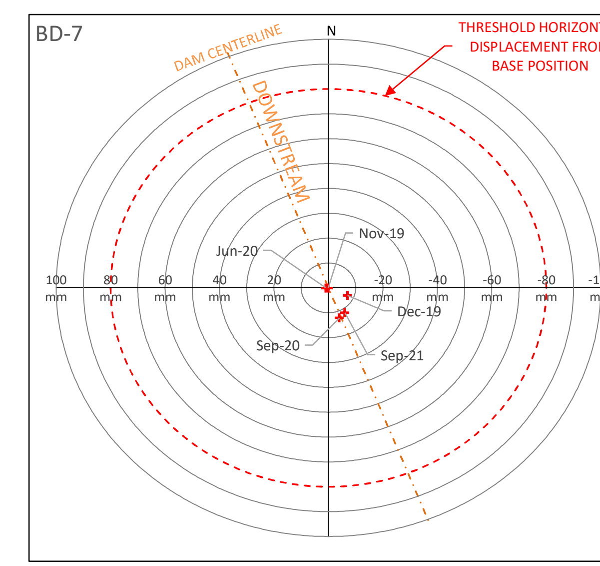


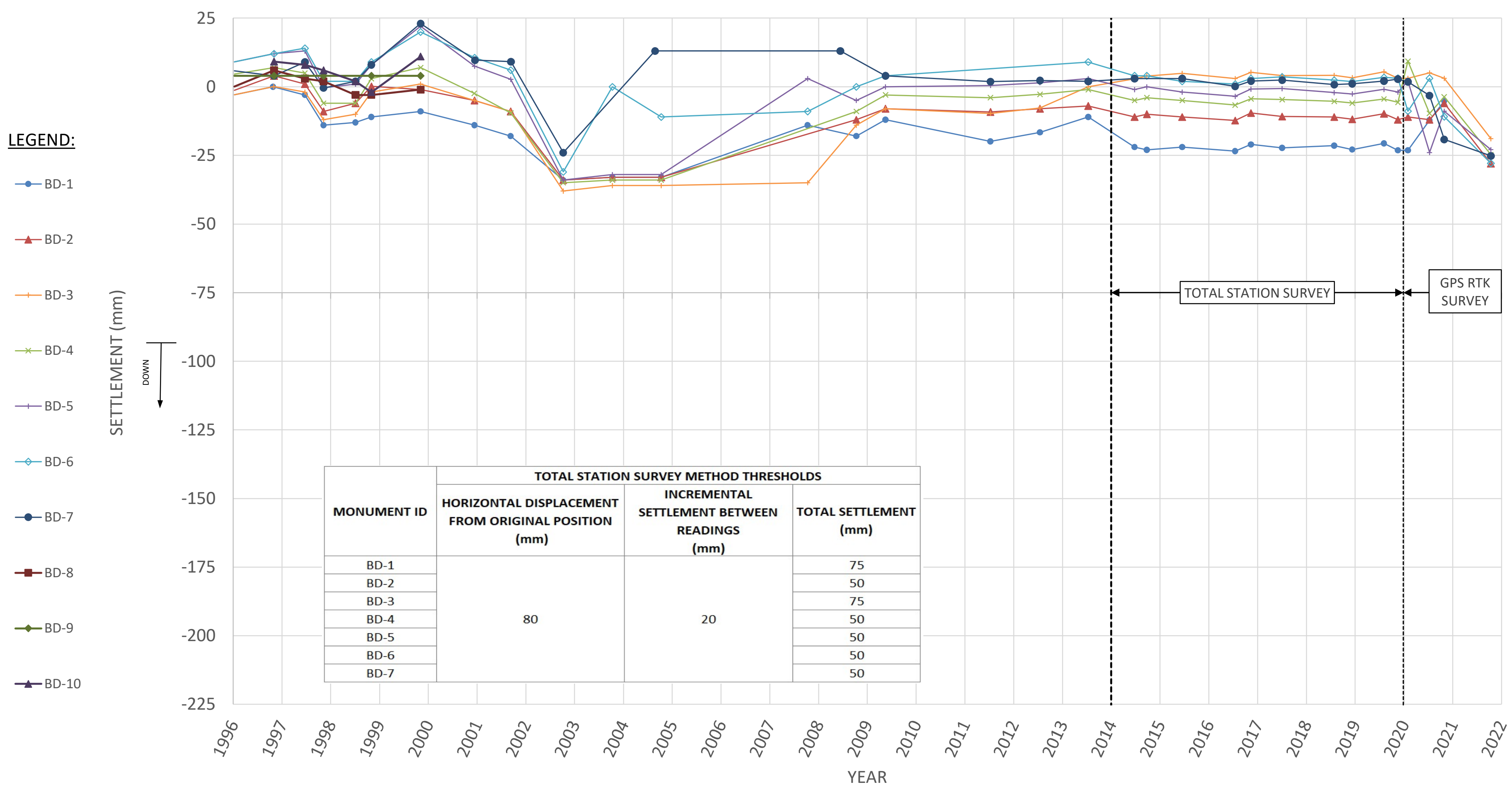












MONUMENT ID	HORIZONTAL DISPLACEMENT FROM ORIGINAL POSITION (mm)	INCREMENTAL SETTLEMENT BETWEEN READINGS (mm)	TOTAL SETTLEMENT (mm)
TOTAL STATION SURVEY METHOD THRESHOLDS			
BD-1	80	20	75
BD-2			50
BD-3			75
BD-4			50
BD-5			50
BD-6			50
BD-7			50

NOTES:

1. SURVEY METHOD SWITCHED FROM TOTAL STATION TO GPS RTK ON NOVEMBER 12, 2019.
2. HORIZONTAL DISPLACEMENT PRIOR TO NOVEMBER 2019 NOT SHOWN. HORIZONTAL DISPLACEMENT BASELINES SET TO NOVEMBER 12, 2019 GPS RTK SURVEY READINGS.
3. BOSE LAKE DAM CREST MOVEMENT MONITORING DATA PRIOR TO 1996 NOT SHOWN.
4. REFER TO FIGURE 4 FOR MONUMENT LOCATIONS IN PLAN VIEW.
5. BD-8, BD-9 AND BD-10 DESTROYED IN 1999 OR 2000.
6. BD-1 2010 READING (NOT SHOWN IN PLAN PLOT) LOCATED 1505 mm FROM INITIAL 1993 READING. READING WAS REVIEWED AND FOUND MORE LIKELY RELATED TO SURVEY ERROR THAN DISPLACEMENT.
7. BD-5 2010 READING (NOT SHOWN IN PLAN PLOT) LOCATED 294 mm FROM INITIAL 1993 READING. READING WAS REVIEWED AND FOUND MORE LIKELY RELATED TO SURVEY ERROR THAN DISPLACEMENT.
8. BD-3 SHIFT BETWEEN PRE AND POST 2013 SURVEYS WHICH COULD BE THE RESULT OF DAMAGE OR SURVEY DATUM. NOT AN INDICATOR OF DAM SAFETY ISSUE.
9. BD-7 2003 SETTLEMENT DATA WAS OUTLIER AND NOT PLOTTED.
10. 2007 SETTLEMENT DATA OF BD-4, AND BD-2 WERE OUTLIERS AND NOT PLOTTED.
11. 2021 SETTLEMENT PLOTTED BY ADDING INCREMENTAL DISPLACEMENT BETWEEN GPS RTK SURVEY READINGS TO CUMULATIVE TOTAL DISPLACEMENT ON OCTOBER 15, 2019. THIS ASSUMES NO SETTLEMENT OCCURED BETWEEN OCTOBER 15, AND NOVEMBER 12, 2019.

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

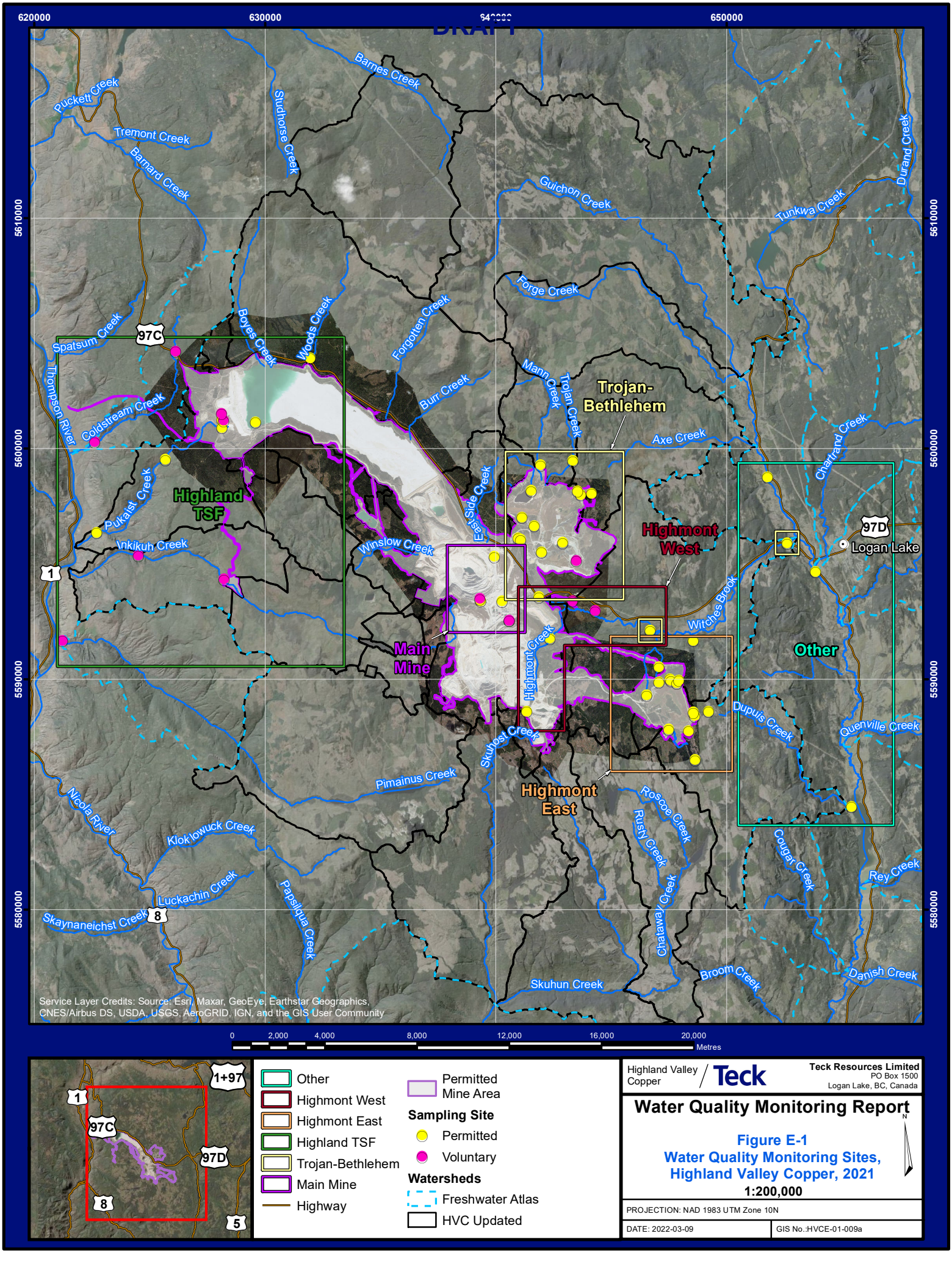
PROJECT: BETHLEHEM NO. 1 TAILINGS STORAGE FACILITY
2021 ANNUAL FACILITY PERFORMANCE REPORT

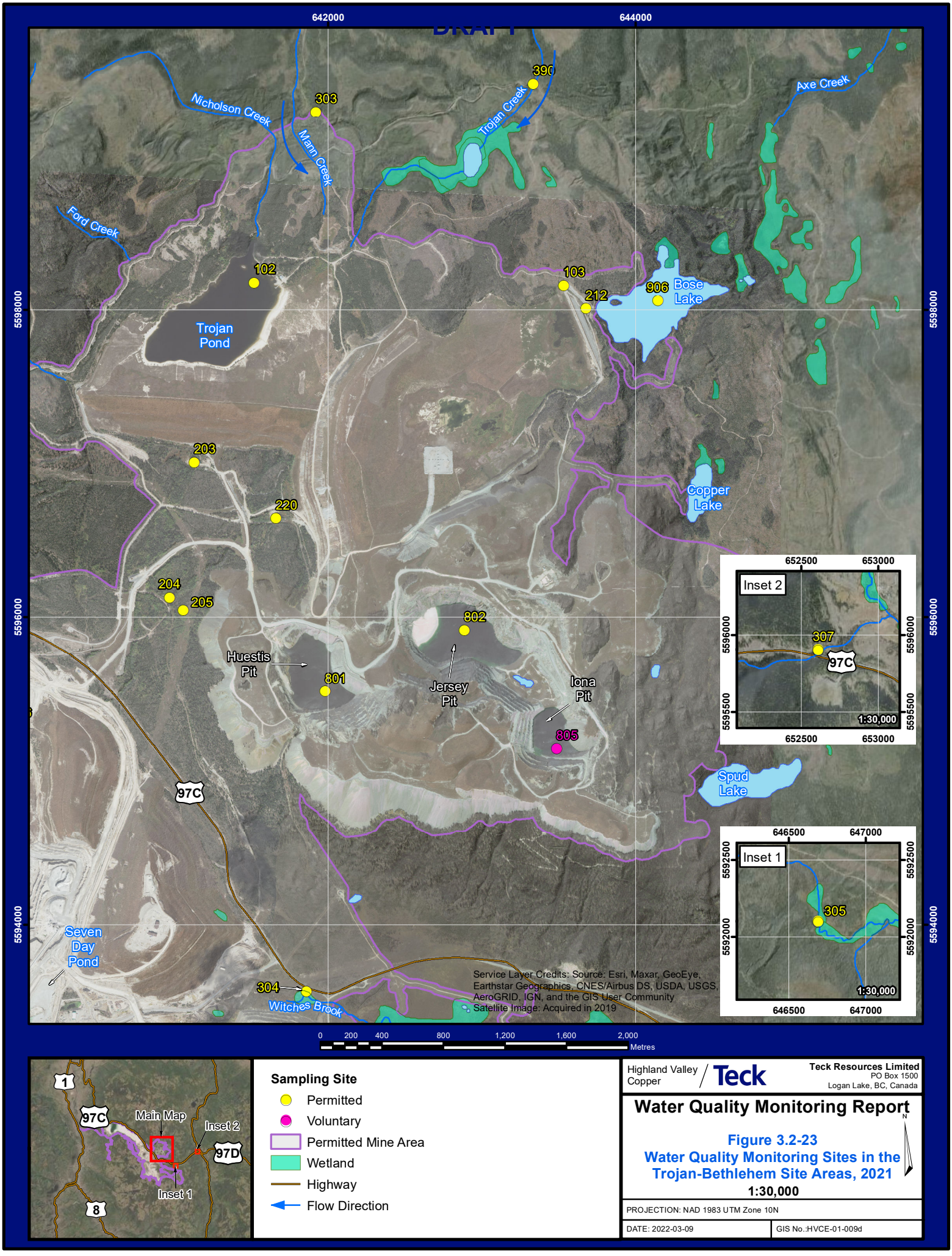
TITLE: BOSE LAKE DAM
SURVEY MONUMENT READINGS

PROJECT No. M02341C12 | FIG No. II-B-10

APPENDIX III

Map of Water Quality Monitoring Points


DRAFT
620000
630000
640000
650000
5610000
5600000
5590000
5580000
Puckett Creek
Tremont Creek
Barnard Creek
Barnes Creek
Studhorse Creek
Guichon Creek
Tunkwa Creek
Durand Creek
Forge Creek
Spatsum Creek
97C
Boyes Creek
Woods Creek
Forgotten Creek
Thompson River
Coldstream Creek
Burr Creek
Mann Creek
Trojan Creek
Trojan-Bethlehem
Axe Creek
Chartrand Creek
Pukaist Creek
Highland TSF
East Side Creek
Highmont West
97D
Logan Lake
Inkikuh Creek
1
Winslow Creek
Witches Brook
Main Mine
Highmont Creek
Other
Dupuis Creek
Quenville Creek
Skuhost Creek
Pimainus Creek
Highmont East
Roscoe Creek
Rusty Creek
Nicola River
Klokiowuck Creek
Cougar Creek
Rey Creek
Luckachin Creek
Papsilqua Creek
Skaynaneichst Creek
8
Chatawai Creek
Broom Creek
Danish Creek
Skuhun Creek
Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
0
2,000
4,000
8,000
12,000
16,000
20,000
Metres
1+97
1
97C
97D
8
5
Other
Highmont West
Highmont East
Highland TSF
Trojan-Bethlehem
Main Mine
Highway
Permitted Mine Area
Sampling Site
Permitted
Voluntary
Watersheds
Freshwater Atlas
HVC Updated
Highland Valley Copper
Teck
Teck Resources Limited
PO Box 1500
Logan Lake, BC, Canada
Water Quality Monitoring Report
N
Figure E-1
Water Quality Monitoring Sites, Highland Valley Copper, 2021
1:200,000
PROJECTION: NAD 1983 UTM Zone 10N
DATE: 2022-03-09
GIS No.:HVCE-01-009a


DRAFT
642000
644000
5598000
5596000
5594000
Nicholson Creek
Mann Creek
Trojan Creek
Axe Creek
Ford Creek
303
390
102
103
212
906
Bose Lake
Trojan Pond
203
220
Copper Lake
204
205
802
Huestis Pit
801
Jersey Pit
Iona Pit
805
97C
Spud Lake
Seven Day Pond
304
Witches Brook
Inset 2
652500
653000
5596000
5595500
307
97C
1:30,000
Inset 1
646500
647000
5592500
5592000
305
1:30,000
Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Satellite Image: Acquired in 2019
0 200 400 800 1,200 1,600 2,000
Metres
1
97C
Main Map
Inset 2
97D
Inset 1
8
Sampling Site
Permitted
Voluntary
Permitted Mine Area
Wetland
Highland Valley Copper
Teck
Teck Resources Limited
PO Box 1500
Logan Lake, BC, Canada
Water Quality Monitoring Report
N
Figure 3.2-23
Water Quality Monitoring Sites in the Trojan-Bethlehem Site Areas, 2021
1:30,000
PROJECTION: NAD 1983 UTM Zone 10N
DATE: 2022-03-09
GIS No.:HVCE-01-009d

APPENDIX IV

DSR Recommendations – HVC Workplan

Appendix IV
DSR Recommendations – HVC Workplan

Table IV-1 Bethlehem TSF: 2018 SRK DSR Recommendations for Deficiencies and Non-Conformances

ID No.	Recommended Action	DSR Assigned Priority[1]	Status (Scheduled completion)	Workplan To Complete
Bethlehem No. 1 Tailings Storage Facility				
SRK19-BD-01	*HVC have installed public safety signs as recommended by AMEC in the previous DSR (AMEC 2014a). However, these signs do not identify hazards specifically.* *Include identification and description of hazards in the public safety signs near the Bose Lake Dam.*	*4*	*CLOSED*	*The AMEC DSR is specific to public safety signs bystanders for hazards near dams, specifically the site gates near Bose Lake Dam and Trojan Pond. HVC reviewed the BC Dam Safety Regulations. HVC concluded that public signage is not warranted as the risk of failure does not plot in the "unacceptable" category.*
SRK19-BD-04	*The PMF design flood was not evaluated in accordance with CDA (2013)* *Evaluate the spring and summer/autumn PMF as per CDA (2013) and update the flood routing analysis.*	*3*	*CLOSED*	*Completed with summary of findings and report reference in main text.*
SRK19-BD-05	*Determine normal operating water level if different than spillway invert and evaluate the required normal freeboard as per CDA (2013).*	*3*	*CLOSED*	*Completed with summary of findings and report reference in main text.*
R3 Seepage Pond				
SRK19-R3-02	*The 100-year inflow design flood is not based on the most recent hydrology.* *Update the inflow design flood and flood routing with the most recent hydrology.*	*4*	*CLOSED*	*Completed with summary of findings and report reference in main text.*
SRK19-R3-03	*The required normal freeboard as per CDA (2013) was not evaluated.* *Determine maximum normal operating water level if different than spillway invert and evaluate the required normal freeboard as per CDA (2013).*	*3*	*CLOSED*	*Completed with summary of findings and report reference in main text.*

Notes:

1. Recommendation priority guidelines, specified by Teck and assigned by DSR author:
   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.