Klohn Crippen Berger

Teck Highland Valley Copper Partnership

2020 Annual Facility Performance Report

Trojan Tailings Storage Facility

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March 2021

March 19, 2021

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:

2020 Annual Facility Performance Report
Trojan Tailings Storage Facility

We are pleased to submit the 2020 Annual Facility Performance Report for the Trojan Tailings Storage Facility. The inspection and this report were prepared to comply with Section 10.5.3 of the Health, Safety and Reclamation Code for Mines in British Columbia (the Code) (MEM 2017), and Section 4.2 of the Code Guidance Document (MEM 2016).

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

2020 Annual Facility Performance Report

Trojan Tailings Storage Facility

EXECUTIVE SUMMARY

Klohn Crippen Berger Ltd. (KCB) was engaged by Teck Highland Valley Copper Partnership (THVCP) to complete the 2020 Annual Facility Performance Report[1] (AFPR) of the Trojan Tailings Storage Facility (TSF) for the period of October 2019 to September 2020. The Trojan TSF, located 4 km north of the operating mill, is a reclaimed, inactive facility constructed in 1973 and operated until 1989. The Trojan TSF is maintained by THVCP and considered to be in the active care closure phase as defined by the Canadian Dam Association (CDA 2019).

The review covers the following structures which comprise the Trojan TSF:

- Trojan Dam – comprises a rockfill starter dam which is approximately half the height of the dam. Above the starter dam, the dam was raised in an upstream manner with cycloned sand. Consequence classification, as defined by CDA (2019), of "Very High."
- R4 Seepage Pond Dam – located downstream from Trojan Dam, collects seepage from the toe of the Trojan Dam. Consequence classification of "Low."
- Lower Trojan Dam (LTD) – collects local runoff and outflows from R3 Seepage Pond (Bethlehem No. 1 TSF) and R4 Seepage Pond. Consequence classification of "Low."

The facility has been inactive for more than 30 years, the surface of the dam has been reclaimed and pond level has been lowered. During operations there were no significant dam safety incidents. 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 and internal erosion.

The LTD cannot safely pass the Inflow Design Flood (IDF) (100-year return period, spring runoff event) required under the Code (KCB 2019b) and upgrades or decommissioning of the facility are scheduled for completion in 2022. There is no permanent population downstream of the LTD. The LTD did safely route the recent large freshet events in 2017 and 2018 without engaging the spillway and maintaining more than the minimum specified freeboard (0.5 m). THVCP have implemented remote reservoir level monitoring and alert levels to increase monitoring and initiate pumping, if required.

The performance of the Trojan Dam is assessed based on the following:

- compliance with design criteria;
- comparison of actual conditions to design assumptions;
- consistency between measured response[2] and expected behaviour[3]; and
- presence or absence of potential dam safety concern indicators.

On this basis, the performance of the dam during the review period was acceptable.

[1] Past Annual Facility Performance Reports were referred to as Dam Safety Inspections (DSI).
[2] "Measured response" refers to instrumentation readings and visual observations during inspections.
[3] "Expected behaviour" for an inactive facility is based on interpretation of the historic measured response.

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

During the review period, Mr. Bryan Bale, P.Eng. (THVCP Chief Engineer - Tailings), transitioned into the role of TSF Qualified Person, replacing Mr. Chris Anderson, P.Eng.

The current Operation, Maintenance and Surveillance (OMS) Manual and the Emergency Preparedness and Response Plan (EPRP) (THVCP 2019) are suitable for the facility. As part of the routine update cycle both documents are being revised to align with the most recent industry guidance documents. A trial exercise of the EPRP was completed on December 9, 2020 in which THVCP and KCB representatives participated.

Due to the COVID 19 pandemic and to meet provincial health regulations THVCP implemented protocols limiting site resources. To support this change, the Engineer of Record (EoR) and THVCP agreed to modify the frequency of some routine surveillance activities which did not compromise the overall surveillance and management controls at the Trojan TSF but helped ensure priority activities were maintained.

The Trojan TSF surveillance program is appropriate for an inactive, reclaimed tailings facility which includes visual inspection, measured behaviour and routine performance reviews and a Trigger-Action-Response-Plan (TARP). The TARP includes four levels which represent conditions of potentially increasing concern ranging from a routine engineering review, design assumption deviation up to initiation of the ERP. The adequacy of the instrumentation was reviewed as part of this AFPR and remains sufficient for the existing condition of the structure.

Information from routine surveillance activities was reported and reviewed once completed by THVCP during weekly dam safety meetings. This information is also shared with and reviewed by the EoR. An overall performance assessment is completed by the EoR as part of the AFPR. In addition, a routine engineering review can be triggered by the first level of the TARP in response to a localized deviation from historic behaviour.

The behaviour of the facility is expected to remain consistent with historic patterns. Variation in performance from year to year is primarily related to climate (i.e., freshet flows, water balance) or extreme events (e.g., seismic or flood), none of which occurred during the review period. Key observations from the performance review completed as part of the AFPR are:

- No issues of dam safety concern or unacceptable performance were identified.
- One exceedance of the first level of the TARP was measured while other instrument readings were consistent with historic trends. The exceedance was at a piezometer in the cycloned sand beach upstream of the crest which has observed a modest rise (~0.5 m) starting in 2019 above the previous historic level but didn't exceed threshold until 2020. The measured level does not indicate a concern or unacceptable performance and since mid-2019, the level has remained relatively constant. The EoR recommended a revised threshold value for 2021 which would identify further deviation from trend and trigger a routine engineering review.

- A new method to survey monuments at either dam was implemented to monitor for potential movement trends. There are no downstream horizontal movement trends observed and settlement patterns for each dam remained consistent with historic behaviour.
- Visual inspections by the dam inspector, the EoR or others working in the area did not identify any indications of unacceptable behaviour at the dam.
- The reservoir levels and patterns were similar to historic trends. The seasonal fluctuation during 2020 was within the typical range and less than the larger freshet events from 2017 and 2018.
- Minimum freeboard at the Trojan Dam during the review period was 6.7 m, >2.5 m below the invert of the spillway which is designed to pass the routed PMF with adequate freeboard.

As required by permit (PE-376), water quality downstream of the Trojan TSF is monitored by THVCP. Water quality monitoring data for the area is summarized and reported in 2020 Annual Water Quality Monitoring Report. A copy of the report was provided to KCB as part of the AFPR and no significant non-compliances were noted.

Refer to Table 1 for status of outstanding recommendations from previous AFPRs, as of the issue date of this report. Recommendations that have been closed are shown in italics. No recommendations, related to facility performance, were identified during the 2020 AFPR. The deadline to complete the flood upgrade or decommissioning of the LTD and flood routing assessments were deferred to prioritize other flood routing activities at site which have a greater impact on risk reduction. Nine of the recommendations from the most recent DSR (SRK 2019) have been addressed. Close out documentation for two of the recommendations are in progress as of the date of this report. A workplan to address the remaining recommendations (seven) was prepared in 2020.

Table 1 Previous Recommendations Related to Facility Performance – Status Update

ID No.	Performance Area	Recommended Action	Priority[1]	Recommended Deadline (Status)
Trojan Dam				
TD-2018-02	Flood Routing	Update flood routing assessment for Trojan TSF structures based on the most recent site wide hydrology information for consistency and to confirm compliance.	3	Q2 2020 (Open – Revised Q4 2021)
TD-2019-01	*Failure Mode Review*	*Complete due diligence review of upstream dam failure modes as recommended by the DSR.*	*2*	*Q3 2020 (Closed)*
TD-2019-02	*DSR Recommendations*	*KCB and THVCP to develop a work plan to address 2018 DSR recommendations.*	*3*	*April 2020 (Closed)*
TD-2019-03	*Foundation Characterization*	*Complete an assessment to characterize softer zone at the base of the tailings identified during 2019 SCPT program.*	*2*	*Q2 2020 (Closed)*
R4 Seepage Pond				
No Outstanding Previous Recommendations				
Lower Trojan Dam				
LTD-2017-01	Inflow Design Flood	Complete appropriate upgrade works to allow LTD to safely pass IDF with adequate freeboard, including decommissioning of the spillway pipe.	2	Q4 2020 (Open – Revised 2022)

Notes:

1. Recommendation priority guidelines, specified by THVCP 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.

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

List of Tables

List of In-Text Figures

List of Figures

List of Appendices

1 INTRODUCTION

Klohn Crippen Berger Ltd. (KCB) was engaged by Teck Highland Valley Copper Partnership (THVCP) to complete the 2020 Annual Facility Performance Report (APFR) of the Trojan Tailings Storage Facility (TSF) on the Highland Valley Copper (HVC) mine site. The Trojan TSF is an inactive facility constructed in 1973 and operated until 1989. This APFR includes the performance review of the Trojan Dam and two downstream seepage dams (R4 Seepage Pond Dam and Lower Trojan Dam) for the review period from October 2019 through September 2020. Table 1.1 summarizes the dams' functions and consequence classes (CDA 2019). Refer to Figure 1 and Figure 2 for a layout of the facility.

Table 1.1 Trojan TSF Structures

Facility	Structure	Function	Consequence Class[1]
Trojan TSF	Trojan Dam	Retains tailings at the southern boundary of impoundment.	Very High
	R4 Seepage Pond Dam	Retains R4 Seepage Pond, which stores seepage from the Trojan Dam.	Low
	Lower Trojan Dam	Collects local surface runoff and flows from R4 Seepage Pond and R3 Seepage Pond.	Low

Notes:
1. Consequence classes are based on Canadian Dam Association guidelines (CDA 2019).

THVCP continues ongoing surveillance of the site including instrumentation monitoring, environmental sampling, visual inspections and maintenance activities. Under this level of site presence, the Trojan TSF is considered to be in the active care closure phase as defined by the Canadian Dam Association (CDA 2019).

The Annual Facility Performance Report scope of work consisted of:

- visual inspection of the physical conditions of the various containment facilities;
- review of surveillance data for the review period provided by THVCP;
- review of climate and water balance data for the site;
- review of the Operations, Maintenance & Surveillance (OMS) manual to confirm its appropriateness for the existing facility; and
- review of additional activities completed at the site during the review period, if any.

The inspection and this report were prepared to comply with Section 10.5.3 of the Health, Safety and Reclamation Code for Mines in British Columbia (MEM 2017), herein referred to as the Code, and Section 4.2 of the Code Guidance Document (MEM 2016). The visual inspection was completed by KCB representatives Mr. Rick Friedel, P.Eng. and Ms. Narges Solgi, EIT on July 15, 2020. During the inspection, the weather was mostly cloudy and did not impede the inspection. Designated roles related to tailings management, required under Part 10 of the Code, for the Trojan TSF at the end of the review period were filled by:

- Engineer of Record (EoR) - Mr. Friedel, P.Eng. (KCB representative); and

- TSF Qualified Person - Mr. Bryan Bale, P. Eng. (THVCP Tailings Chief Engineer):
  - Mr. Bale, P.Eng. transitioned into the TSF Qualified Person role in September 2020, replacing Mr. Chris Anderson, P.Eng.

Water discharge quantity and quality from the Trojan 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 licences C114183 and C068389, issued by the Ministry of Environment – Water Rights Branch.

2 FACILITY DESCRIPTION

The HVC mine site is located near Logan Lake, approximately 45 km south of Kamloops, in the interior of British Columbia. The Trojan TSF is located 4 km north of the operating mill and immediately west of the Bethlehem TSF; refer to Figure 1 and Figure 2. The facility was operated from 1973 to 1989 and stores an estimated 26 Mm^3 of tailings. Under existing conditions, a pond is present on the upstream (north) side of the impoundment, separated from the dam crest by the vegetated tailings beach. Layouts of the facility and structures are shown on Figure 3 to Figure 5. Typical geometry and key dimensions of the dam are summarized in Table 2.1.

Trojan Dam

- The Trojan Dam comprises a rockfill starter dam, built in 1973, with coarse rock placed downstream of the dam axis, finer rockfill placed upstream and underdrains to direct seepage to a collection ditch along the downstream toe (refer to Figure 2.1).
- The starter dam was raised in an upstream manner with cycloned sand. A sand and gravel filter zone separate the starter dam rockfill and cycloned tailings sand (KL 1982).
- The design specified minimum beach widths to be maintained under normal and temporary flood conditions are 152 m (500 ft) and 92 m (300 ft) respectively. Under existing conditions, at normal range of pond levels, the minimum beach width is more than 200 m along the crest.
- Seepage from the underdrain system is collected in a ditch along the toe and collected by R4 Seepage Pond.
- After operations, an open channel spillway (invert of inlet El. 1435.5 m) was constructed to route flood flows around the west abutment, discharging downstream of the dam toe.

R4 Seepage Pond

- The R4 Seepage Pond is located at the toe of the Trojan Dam (Figure 4) and collects seepage from the dam toe and local surface run-off in two collection ditches along the toe.
- The dam was built in 1984 and is comprised of compacted glacial till fill, on a glacial till foundation, with a 300 mm thick layer of waste rock on the upstream slope for erosion protection (refer to Figure 2.2).
- A 300 mm diameter Low-Level Outlet, and a 100 mm diameter overflow pipe are embedded in the dam near the left abutment. Flows from both pipes report to Lower Trojan Pond.
- An open channel spillway is located near the right abutment.

Lower Trojan Pond Dam (LTD)

- LTD is located approximately 1.1 km downstream of R4 Seepage Pond (Figure 5) and collects local surface runoff and flows from R4 Seepage Pond and R3 Reclaim Pond (at the toe of Bethlehem No. 1 Dam).

- Dam was constructed in 1989 but no as-built records are available. Figure 2.3 is a typical cross section, interpreted from existing conditions.
- Outflow from the pond is through a diversion pipeline (a 460 mm diameter culvert which is buried through the dam near the left abutment) with a control valve downstream of the dam. Flow is discharged to the same channel which conveys flow from the Trojan Diversion.
- An open channel spillway is located near the right abutment as well as a decant pipe (diameter: 810 mm) buried through the dam at the right abutment.

Trojan Diversion

- The Trojan Diversion is constructed around the northwestern perimeter of the Trojan TSF (Figure 3), and intercepts runoff from the upslope catchment and diverts the flow away from the impoundment.
- The diversion ditch transitions to a pipeline northwest of the impoundment which ultimately discharges into Witches Brook.

Table 2.1 Summary of Approximate Dam Geometry

Dam	Trojan Dam	R4 Seepage Pond Dam	Lower Trojan Dam
Length (m)	1500	100	100
Crest Elevation (m)	1414 (starter rockfill dam design) 1440	1365	1296.5 (minimum)
Minimum Crest Width (m)	39	5	5
Maximum Height[2] (m)	70	3	4
Upstream Slope	1.5H:1V (rockfill starter dam design)	unknown	2H:1V[3]
Downstream Slope	2.9H:1V (lower bench face) 3.5H:1V (upper bench face)[4] 3.7H:1V (overall)	2H:1V	2H:1V
Construction Method	Starter Dam with Upstream (Cycloned Sand) Crest Raises	Single Raise Dam with Cutoff Trench	Single Raise Dam

1. Dimensions are estimated from 2014 LiDAR data unless otherwise noted.
2. Height measured as the vertical distance between downstream toe and crest.
3. A 2005 report indicates an upstream slope of 1.75H:1V based on a November 2004 measurement (KC 2005).
4. These slopes are shallower than those on 1987 design drawings showing cycloned sand slopes on the upper face of the dam at 3H:1V and steeper but unspecified slopes on the rockfill toe face. However, the design drawings also show raises that were never constructed.

Figure 2.1 Typical Cross Section of Trojan Dam (KL 1987)

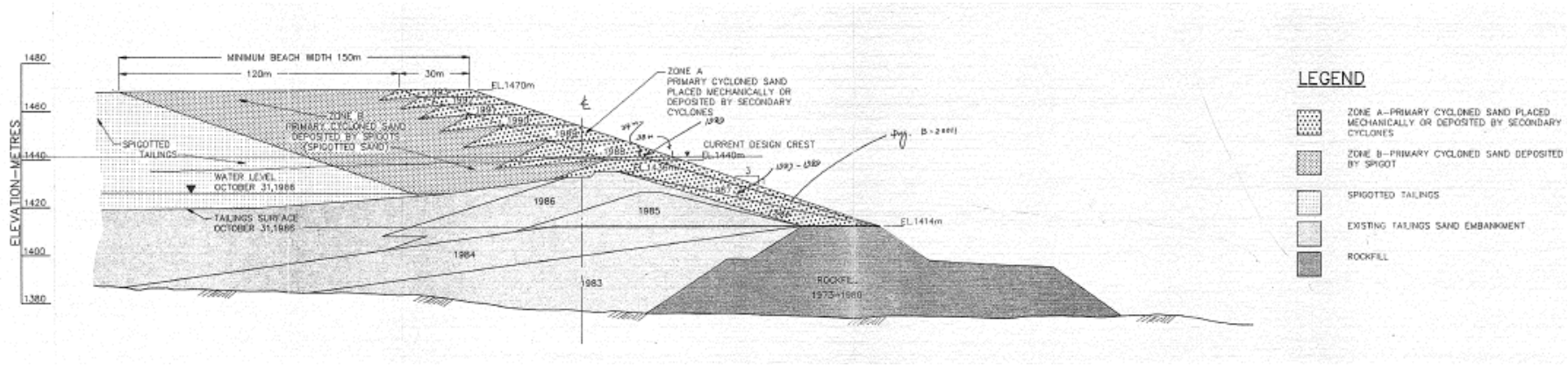
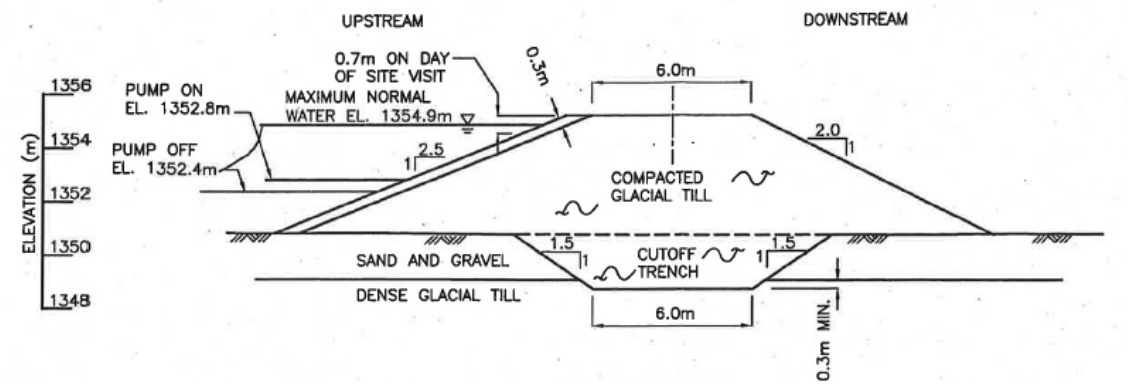
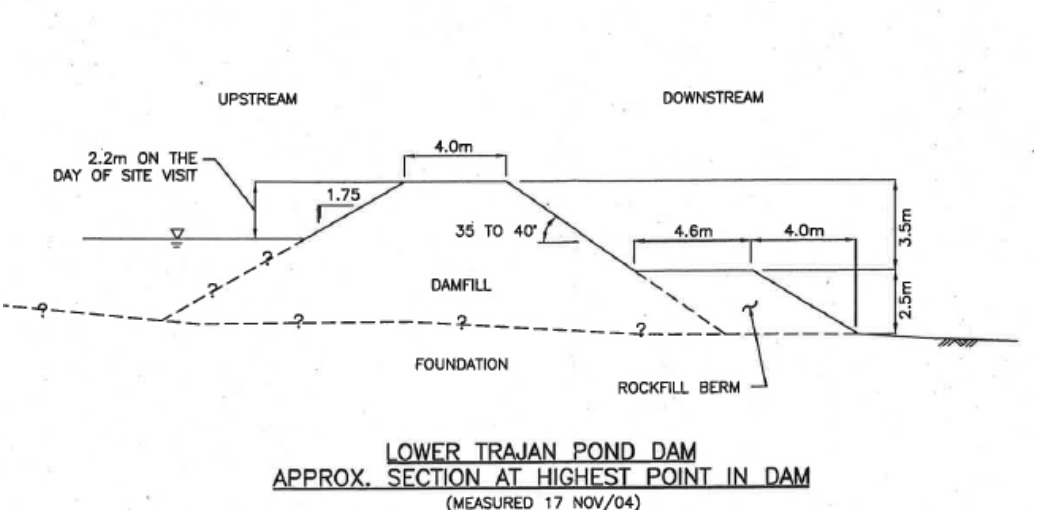


Figure 2.2 Typical Cross Section of R4 Seepage Pond Dam (KC 2005)



Note:
The elevations noted here are in different datum from Table 2.1.

Figure 2.3 Typical Cross Section of Lower Trojan Pond Dam (KC 2005)



3 2020 ACTIVITIES

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

4 WATER MANAGEMENT

4.1 Overview

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

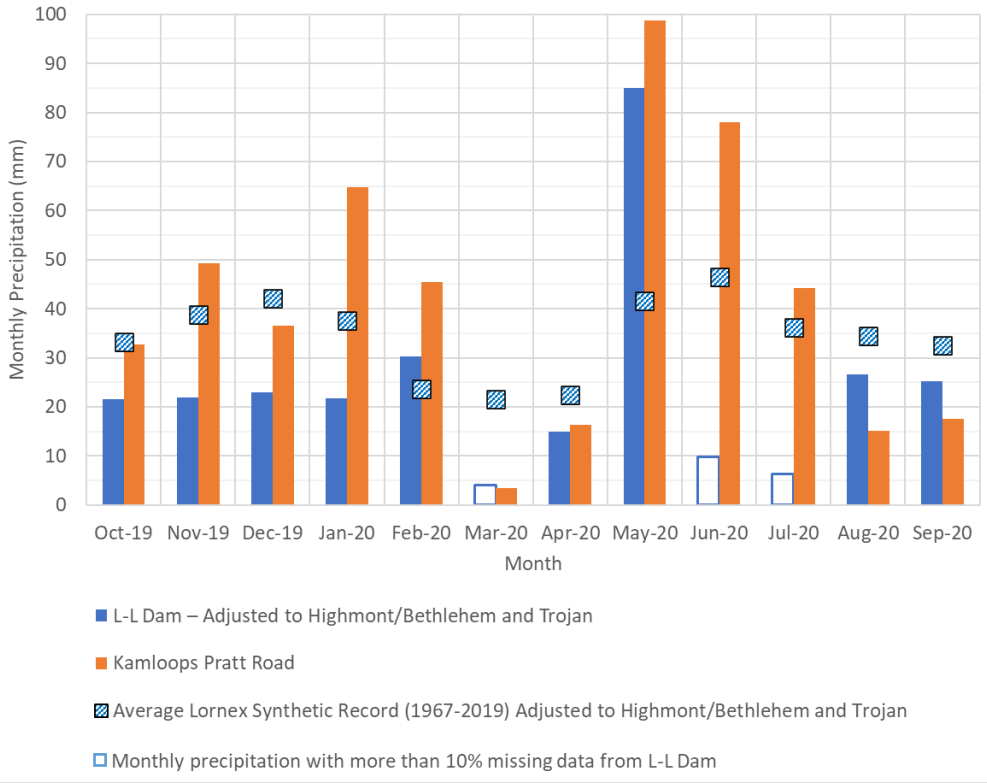
4.2 Climate

THVCP provided climate data from L-L Dam and Kamloops Pratt Road stations for the 2020 Annual Facility Performance reporting period to KCB for review. KCB applied the appropriate corrections to L-L Dam Weather Station data and Historical Average Lornex Synthetic Record, based on HVC site wide hydrology document (Golder 2019), and compared the climate data to typical values, refer to Appendix II-A.

The following observations were noted for the reporting period (refer to Figure 4.2):

- More than 10% of the L-L Dam weather station precipitation data were missing in March, June, and July. Due to these data gaps, the 2020 climate data from site was augmented with data from a regional weather station to support a comparison with historic normals.
- All storm events during 2020 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: 23.1 mm on May 30; 18.2 mm on May 17; and 12.9 mm on September 19.
- January through April precipitation was significantly less than historic normals except the precipitation in February which was higher than average.
- May precipitation was almost twice as much as the historic normals.
- Figure 4.2 indicates low precipitation at site during June and July; however, this is due to L-L Dam Weather Station data gaps during this period. THVCP inspection reports and regional climate station data indicate precipitation during this period was above historic normals.
- Snowpack depth measurements, from the Highland Valley station, indicate the snow had been melted by May 1, 2020.
- Seasonal rise and fall of pond levels is associated with freshet. The time of year when pond levels start to fall is associated with the end of freshet, in recent years this has started in April or May (Figure 5.1). In 2020, pond levels did not start to fall until mid to late June. This timing indicates that the 2020 response was driven primarily by precipitation, rather than snowmelt.

Figure 4.1 Monthly Precipitation



4.3 Water Balance

THVCP manages and tracks the annual water balance for the Trojan TSF. Table 4.1 is a summary of annual inflows and outflows, provided by THVCP. 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 Trojan TSF

Item	Volume in 2020[1] (m^3)
Inflows	
Direct Precipitation	118,800
Runoff	857,000
Groundwater	9,500
Outflow from Fish Spawning Channel Pond	0
Total Inflow:	985,300
Outflows	
Seepage	854,800
Evaporation	224,000
Total Outflow:	1,078,800
Balance	
Balance (inflow minus outflow)	-93,500

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

4.4 Flood Management

The flood management structures at the Trojan TSF, applicable design criteria, and flood characteristics are summarized in Table 4.2 with further discussion for each structure below.

Trojan TSF and R4 Seepage Pond

Trojan TSF and R4 Seepage Pond flood routing updates are scheduled for 2021. These were recommended by KCB (2019a) and SRK (2019) so that all facilities were based on the most recent hydrology. In 2020, THVCP reviewed the outstanding activities required for the tailings and water storage facilities at the site and prioritized them to suit available resources and expected timelines. Based on this review, the flood routing work at the Trojan TSF was deferred from 2020 to 2021. KCB agreed the deferral is the preferred approach in terms of prioritizing available resources because the Trojan TSF facilities have spillways and currently meet flood criteria.

Lower Trojan Dam

The LTD cannot safely pass the IDF (100-year return period) required under the Code (KCB 2019b) and upgrades or decommissioning of the facility were scheduled for completion in 2020. However, in 2020, THVCP reviewed the outstanding activities required for the tailings and water storage facilities at the site and prioritized them based on facility consequence classification. Based on this review, the LTD upgrades were deferred from 2020 to 2022. KCB agreed the deferral is the preferred approach in terms of prioritizing as there is no permanent population downstream of the LTD.

Work to calibrate the existing LTD flood routing model is underway which will inform the current flood routing capacity of the facility and will be used to confirm design requirements. Historical performance of the facility demonstrated the Lower Trojan facility has safely managed flows during its 32-year operational life. This includes the large freshet events during 2017 and 2018, which were managed without engaging the spillway and maintaining more than the 0.5 m OMS required freeboard based on pond levels recorded by THVCP.

Starting in 2017, THVCP implemented additional measures to manage potential overtopping risks in the event of a large flood: a remote monitoring system is used to monitor the Lower Trojan Pond level; and established alert levels which, if exceeded, trigger actions such as increased monitoring and deploying pumps to increase discharge capacity.

Table 4.2 Inflow Design Flood for Trojan TSF and Seepage Ponds

Dam	Outfall Type	Consequence Classification	Inflow Design Flood		Peak Design Flood Level	Spillway Design Reference
			Required[1]	Design Event		
Trojan Dam	Open channel	Very High	2/3rd between 1000-year and PMF	24-hour PMP[2] (182.2 mm, 26.1 m^3/s)	1438.5 m	(AMEC 2014b)
R4 Seepage Pond Dam	Open channel	Low	100-year	24-hour PMP[3] (180.7 mm, 1.57 m^3/s)	1364.6 m	(AMEC 2014c)
Lower Trojan Dam	Open channel and pipe	Low	100-year	100-year 24-hour[3] (75.2 mm, 6.4 m^3/s)	Note 4	(KCB 2019b)

Notes:
1. Per the Code (MEM 2017) for tailings and water retaining facilities.
2. Based on data from Atmospheric Environment Service (AES) climate stations at Kamloops Airport and Mamit Lake. A review of the spillway design was done in 2002 which concluded the 260 mm is comparable to the 230 mm estimated using the Highland Valley BCCL and Highland Valley Lornex climate stations and would accommodate a conservative snowmelt rate of 30 mm/day.
3. Based on data from the Environment Canada Highland Valley Lornex climate station (Station No. 1123469), adjusted for orographic effects.
4. The LTD cannot safely pass the IDF required under the Code, based on flood routing (KCB 2019b) and upgrades or decommissioning of the facility have been recommended (KCB 2019a, SRK 2019).

4.5 Freeboard

Trojan Dam and R4 Seepage Pond design and operating conditions meet freeboard requirements as shown in Table 4.3 which summarizes minimum freeboard required, as per the Code, under flood conditions and minimum available freeboard based on flood routing. As discussed in Section 4.4, upgrades are recommended for the LTD to safely pass the IDF with adequate freeboard unless it is decommissioned.

The minimum required freeboard under normal (i.e. non-flood) conditions will be defined as part of the flood routing works scheduled for 2021 which were recommended by SRK (2019). Documenting normal freeboard requirements is considered a due diligence activity because the large freeboard available under the existing condition will be greater than the expected requirement.

Table 4.3 Minimum Required Freeboard

Dam	Freeboard (m)		
	Required during IDF	Predicted During Peak Design Flood Level	Minimum Observed During the Review Period[3]
Trojan Dam	0.6 m[1]	>0.6 m	6.7 m[4]
R4 Seepage Pond	0.5 m[2]	0.6 m	1.6 m[5]
Lower Trojan Dam	0.5 m[2]	Note 6	1.7 m[5]

Notes:
1. As per KCB (2018).
2. Freeboard target of 0.5 m has been adopted by THVCP which is greater than the minimum required freeboard to accommodate wave run-up (0.2 m for R4, and 0.4 m for the Lower Trojan Dam) as per the method proposed by CDA (2013).
3. Based on maximum recorded pond elevation during the review period.
4. Using Oct 2019 through Sep 2020 recorded pond elevations, and crest elevations as per Table 2.1.
5. Based on THVCP Inspection Reports.
6. As discussed in Section 4.4, upgrades are recommended to safely pass the IDF with adequate freeboard.

5 REVIEW OF MONITORING RECORDS AND DOCUMENTS

5.1 Monitoring Plan

The Operation, Maintenance and Surveillance (OMS) Manual was issued by THVCP in December 2019 (THVCP 2019). As part of the routine update cycle the OMS Manual is being revised to align with the most recent industry guidance documents (MAC 2019). The update to the OMS Manual will include the recommended items from the DSR (SRK 2019).

Surveillance activities were completed as prescribed in the OMS manual or as agreed with the EoR (Table 5.1). Starting in March 2020, THVCP were required to implement protocols to meet provincial health regulations related to reducing the spread of the COVID 19 pandemic. This included reducing the number of people on site to essential personnel only. Prior to reducing site personnel at the dams, THVCP requested KCB review the Trojan TSF surveillance program to identify site activities which could be completed at a reduced frequency, that would allow THVCP to reduce site personnel, but not compromise the overall surveillance controls at the facility. The modified frequency recommended by KCB is summarized in Table 5.1 and remain appropriate during 2021 while site personnel restrictions remain in place.

The Trojan TSF surveillance program is appropriate for an inactive, reclaimed tailings facility which includes visual inspection, measured behaviour, routine performance reviews, and a Trigger-Action-Response-Plan (TARP). The TARP includes four levels which represent conditions of potentially increasing concern ranging from a routine engineering review, design assumption deviation up to initiation of the ERP. At Trojan, there were no exceedances of any level of the TARP levels during the review period. Instrumentation triggers, which notify THVCP if a TARP level has been exceeded, were reviewed and updated by the EoR, where appropriate, as part of this AFPR.

Information from routine surveillance activities was reported and reviewed once completed by the THVCP Tailings Group, including the QP, during the weekly intra-departmental meeting. This information is also shared with and reviewed by the EoR. An assessment of performance is completed by the EoR as part of the AFPR based on the following:

- compliance with design criteria;
- comparison of actual conditions to design assumptions;
- consistency between measured response[4] and expected behaviour[5]; and
- presence or absence of potential dam safety concern indicators.

On this basis, the performance of the dams during the review period was acceptable.

The site visit for the most recent dam safety review (DSR) (SRK 2019) was completed in 2018. The Code requires a DSR be undertaken every five years for tailings dams; therefore, the next DSR should be scheduled for 2023. The status of recommendations from the most recent DSR (SRK 2019) are discussed further in Section 7.2.

[4] "Measured response" refers to instrumentation readings and visual observations during inspections.
[5] "Expected behaviour" for an inactive facility is based on interpretation of the historic measured response.

Table 5.1 Monitoring Activities

TSF Monitoring	Facility	Minimum Frequency[1]	Responsibility	Documentation	2020 Frequency Compliance[1]	Notes for the Review Period
Inspections						
Routine Visual Inspection[2]	Trojan Dam	Monthly	THVCP	THVCP Inspection Reports	Yes	-
	LTD and R4 Seepage Pond	Quarterly	THVCP	THVCP Inspection Reports	Yes	-
Event-Driven Inspection	All	Event Driven[3]	THVCP	THVCP Inspection Reports	N/A	No event-driven inspections were triggered during 2020.
Annual Facility Performance Report	All	Annually	KCB	Inspection Report by KCB	Yes	This report.
Dam Safety Review	All	Every 5 years	THVCP	Report	n/a	Next DSR is due in 2023.
Instrumentation Monitoring						
Piezometers	Trojan Dam	Quarterly	THVCP	Annual Facility Performance Report	Yes	-
Inclinometers	Trojan Dam	Quarterly	THVCP		Yes	-
Seepage flow instruments	Trojan Dam	Quarterly	THVCP	THVCP Inspection Reports	Yes	-
	LTD	Quarterly	THVCP		Yes	
Pond level	Trojan Dam	Quarterly	THVCP		Yes	-
	LTD and R4 Seepage Pond	Quarterly	THVCP		Yes	-
Surveys						
Survey monuments	Trojan Dam	Annually	THVCP	Annual Facility Performance Report	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 for any evidence of unusual conditions and/or dam safety concerns (e.g. settlement, sinkholes, slope sloughing, erosion, seepage, piping, etc.)
3. THVCP 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 2019).

5.2 Pond Level

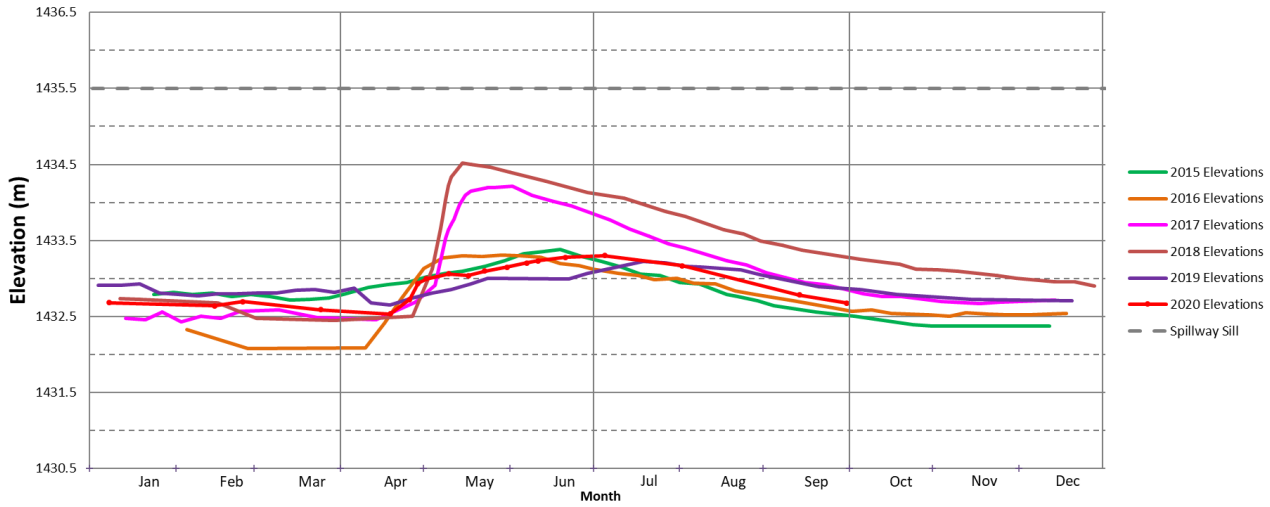
The Trojan Pond level was typically measured at least monthly during the review period with more readings during 2020 freshet. There was no discharge through the Trojan TSF spillway during 2020 and freeboard exceeded requirements as discussed in Section 4.5. Pond levels and patterns were similar to historic trends (Figure 5.1, Table 5.2). The seasonal fluctuation during 2020 was within the typical range and less than the larger freshet events from 2017 and 2018.

Table 5.2 Trojan TSF Change in Pond Elevation

Annual Change	Change in Pond Level 2019 to 2020	Range of Annual Pond Level Change 2015 to 2019
Peak Pond	0.1 m	-1.2 m to 0.1 m (avg. -0.4 m)
Pond at End of Review Period (1)	0.0 m	-0.2 m to 0.3 m (avg. 0.0 m)

Notes:
1. End of review periods, between 2015 and 2020 is in December.

Figure 5.1 Trojan Pond Water Elevations – 2015 to 2020



5.3 Piezometers

As of end of September 2020, there are 14 active piezometers in the Trojan TSF: eight standpipes; and six vibrating wire piezometers (VWPs). The current suite of instruments is considered sufficient monitor key performance indicators.

Maximum and minimum piezometric levels, since 2009, instrument thresholds, as well as piezometric levels during the review period are reported in Appendix II-B. 2020 piezometric levels are shown on typical design sections, along with the surface assumed in stability analyses (Figure II-B-8). Four of the VWPs installed during the 2019 seismic cone penetration test (SCPT) program were read once in 2020 but are not shown on the summary plots until there are multiple readings.

A summary of key observations for readings during the review period, are as follows:

- One threshold exceedance was measured, during the review period, at P86-1 (tip El. 1407.65) which historically was reported dry. The exceedance threshold was set in 2016 to identify a change of behaviour and deviations from established trends. The exceedance of the threshold does not indicate a concern with TSF performance. The piezometric level has been relatively steady over the past 3 years and is within design assumptions. KCB recommended a revision to the threshold value was appropriate, similar to the previous threshold, set at a level to identify a change from the more recent trend.
- The thresholds for the two VWPs installed in 2016 were also revised in 2020:
  - VWP16-2A levelled off in 2020, after a prolonged equilibration period after installation.
  - VWP16-2B previous threshold had been based on a limited measurement period and the threshold was revised based on overall behaviour based on 4 years of readings.
- Tailings Beach (Cycloned Sand): piezometric readings and trends during 2020 were typical based on readings over the past 10 years. Piezometers near the crest are typically steady or dry (i.e. piezometric level is below tip) throughout the year (Figure II-B-2) with piezometers in the impoundment, closer to the pond, showing a seasonal pattern similar to pond level fluctuation (Figure II-B-1). Readings in piezometers near the crest indicate piezometric levels are very low, at depths approximately 43 m or more below ground. This demonstrates that the cycloned sand beach is well-drained and is consistent with design assumptions (Figure II-B-8).
- Starter Dam Fill: Piezometers installed in sand and gravel fill zones of the starter dam (TB-PS-04/P13-3 and TB-PS-03/P13-4) measure low piezometric heads (Figure II-B-2). This indicates the sand and gravel fill of the starter dam is an effective toe drain.
- Foundation: Piezometers installed in the glacial till foundation at the starter dam upstream toe, near the low point of the valley, and beneath the downstream slope, measured low piezometric heads with little variance throughout the year (Figure II-B-2, Figure II-B-3, and Figure II-B-8). Piezometric levels at VW16-2A (installed in glacial sediments / debris) which had been rising since installation in 2016 started to level off in 2020 at ~El. 1367 m; refer to Figure II-B-3. The stabilized level is below the elevation of other piezometers in the foundation beneath the crest (Figure II-B-2).

5.4 Survey Monuments

Survey monuments at the Trojan TSF are shown on Figure 3. Starting in November 2019, THVCP changed the method used to survey the displacement monuments on the TSF. Previously monuments were surveyed using a ground based total station with digital level and have 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 2020 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. The baseline location for each monument using the RTK method is offset from the total station surveys. However, subsequent readings show this is related to the change in survey and not a movement trend. The horizontal surveys are plotted based on the new baseline location. However, KCB maintained a continuous record of settlement based on incremental change between RTK surveys.

During 2020, there were no threshold value exceedances and the surveys indicate dams are performing as expected and consistent with recent behaviour:

- No downstream horizontal movement trends; and
- Settlement trends continued, the highest rates (up to 4 mm/year) occurring in the mid portion of the crest where thickest overburden is present and little to no ongoing settlement at the right (west) abutment where bedrock is shallowest.

5.5 Inclinometers

The single inclinometer at Trojan Dam (IB16-2), installed in 2016, was read monthly during the review period, when the instrument was accessible. There are no significant movements in the downstream direction in the readings and no discrete zones of movement have been observed to date. Cumulative displacements measured at IB16-2 are plotted on Figure II-B-5.

There is no planned construction at, or significant change to, the existing condition of the facility. Therefore, the development of significant movements in the foundation are not expected. Based on measurements to date, a movement threshold was established (1 mm/month over any 3 m vertical section) to identify changes from typical behaviour that require review to confirm reading and assess response. This threshold was not exceeded along the inclinometer length based on the 2020 reading.

5.6 Seepage

Seepage flow measured at weirs downstream of the Trojan TSF are plotted and reported in Appendix II-B. The number and relative locations of the active weirs are listed below:

- two weirs (TB-R4-FS-01 and TB-R4-FS-02) located immediately upstream of R4 Seepage Pond, which measure flow from the collection ditch along the Trojan Dam toe; and
- two weirs located upstream (TB-LT-FS-02) and downstream (TB-LT-FS-01) of Lower Trojan Pond, which measure flow to and from Lower Trojan Dam, respectively. TB-LT-FS-01 measures a combination of outflow from LTD and the Trojan diversion pipe.

Manual readings were taken monthly but flows were also recorded by a data logger at each weir. Flows during the review period were consistent with previous trends with no observations of turbid flow or other unsatisfactory condition. The highest seepage flow at Lower Trojan weir (TB-LT-FS-01) is within the typical range for freshet.

5.7 Water Quality

As required by permit (PE-376), water quality downstream of the Trojan TSF is monitored by THVCP. A summary of data to be included in the 2020 Annual Water Quality Monitoring Report was provided to KCB by THVCP for review as part of the AFPR. Select observations and findings from the monitoring data are summarized as follows:

- There are thirteen permitted surface water quality monitoring sites in the Trojan/Bethlehem area, as shown on the site monitoring plan in Appendix III.
- All sampling sites were in compliance with the permit levels, required sampling frequencies and parameters except for:
  - One sample collected in April at Sample Site #304 exceeded the permit level for total manganese concentration. This observation is atypical and is related to a non-compliance event where haul road runoff water was inadvertently diverted to lower Trojan Pond and subsequently to Trojan Creek End of Diversion via an impaired haul road berm.
  - Eleven samples collected between April and July at Sample Site #304 (Trojan Creek at End of Diversion) exceeded the permit limit for total copper concentration. HVC believes that 10 of the 11 exceedances are not a result of mine effluent due to exceedances at Sample Site #303, which during spring is a significant contributor to Site #304,Trojan Creek at End of Diversion.
  - There were no dissolved organic carbon (DOC) data for HVC Site 220 in August. In addition, HVC sites 801, 802, and 805 were missing in situ pH measurements in September, June, and June.

The 2020 monitoring results were screened against applicable BC Water Quality Guidelines (WQG). Further discussion on specific WQG exceedances and water quality trends observed during 2020 are separately reported in the 2020 Annual Water Quality Monitoring Report which is submitted by THVCP to Ministry of Environment and EMPR.

6 VISUAL OBSERVATIONS AND PHOTOGRAPHS

Copies of the field inspection forms, photographs and summary observations made during the Annual Facility Performance Report site visit are included in Appendix I. No issue in terms of dam safety was observed. A summary of general observations and comments during 2020 Annual Facility Performance Report site visit is as follows:

- Vegetation clearing (routine maintenance) is required at the spillway inlets and some other areas of each facility as noted in Appendix I. In December 2020, THVCP received permit approvals to complete the necessary clearing at the Trojan and Lower Trojan Dam spillways. The work is scheduled for completion in spring 2021. Clearing at R4 was completed in 2020, after the site visit.
- Lower Trojan Dam – the current configuration of the Lower Trojan pond comprises two basins, referred to as the upper and lower basins. There was active flow from the upper basin to the lower basin at the time of the inspection. During the site visit, THVCP confirmed the upper basin is included in routine visual inspections. The upper basin is included in the ongoing flood upgrade works (Section 4.4).
- Lower Trojan Dam Low-Level Outlet – build up of debris and algae on the intake cage was present and was removed after the site visit as part of routine maintenance.

7 ASSESSMENT OF DAM SAFETY

7.1 Dam Classification Review

Based on the 2013 DSR (AMEC 2014a) a “Very High” consequence classification, as defined by CDA (2013), was recommended for the Trojan Dam. The R4 Seepage Pond and Lower Trojan Dam were both assigned a “Low” consequence classification as defined by CDA (2013).

The dam consequence classifications were last reviewed by KCB and THVCP representatives during a workshop held on February 12, 2020 and remained unchanged.

7.2 Status of 2018 Dam Safety Review Recommendations

A DSR site visit of the Trojan TSF and seepage collection ponds was completed by SRK Consulting (SRK) in 2018 with the final report issued in March 2019 (SRK 2019) which 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 16 recommendations related to dam safety for the Trojan TSF and seepage ponds. Fifteen of the recommendations were assigned a Priority Level of either 3 or 4 which represent issues that should be resolved to meet compliance requirements or best practice but alone do not represent a dam safety concern. One recommendation was given a Priority Level 2 which has been completed by KCB and close out documentation is in progress as of the date of this report. Eight additional recommendations (total of 9) have been addressed. Close out documentation for two of the recommendations are in progress as of the date of this report. A workplan to address the remaining recommendations (seven) was prepared in 2020.

7.3 Failure Mode Review

KCB understands that Teck’s long-term goal for all tailings facilities is to reach landform status with all potential failure modes that could result in catastrophic release of tailings and/or water being reduced to non-credible. The long-term goal for the Trojan TSF is for all potential failure modes to be non-credible based on Extreme consequence loading conditions. Evaluation of failure modes with respect to this goal is ongoing.

Management and status of failure modes, and related controls, which have the greatest influence on design and performance are summarized herein. All potential failure modes are reviewed and characterized in the facility risk assessment (AMEC 2019) which remains appropriate for the current structure

7.3.1 Trojan Dam

- Overtopping: the open channel spillway is designed (AMEC 2014b) to safely pass a flood (PMF, 24-hour duration) greater than the minimum IDF recommended under the Code. Under existing conditions, the following additional controls and factors significantly reduce the potential for overtopping:
  - Beach width: even during a peak PMF flood level, the pond would be kept more than 90 m from the dam crest by the tailings beach.
  - Freeboard: under the existing condition the Trojan TSF has maintained a freeboard in excess of 5.5 m (since 2016) under normal and freshet conditions. Even under peak PMF flood level, the minimum freeboard between the pond and low point of the perimeter crest would be 1.5 m. This exceeds the minimum freeboard required to accommodate wave run-up and wind (~0.6 m).
- 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 2020b). The structural integrity of the dam is based on a competent Glacial Till foundation, compacted rockfill Starter Dam and unsaturated cycloned sand beach. SCPTs and piezometers installed in the cycloned sand beach are relied upon to demonstrate that the phreatic surface within the tailings, near the dam crest, remain at or below design assumptions. 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.
- Internal Erosion:
  - The tailings beach, which reduces the piezometric levels and seepage gradients near the dam, and the filter zones on the upstream slope of the Starter Dam are the primary controls to manage internal erosion risks through the dam.
  - There is a culvert buried below the Starter Dam, which was used to divert creek flows during Starter Dam construction. The upstream 15 m of the culvert were plugged with concrete prior to tailings deposition in the impoundment. No turbid seepage or other indicators of material being washed through the culvert have been observed under existing conditions and during operations, when seepage gradients and piezometric levels are higher than existing.

7.3.2 R4 Seepage Pond

- Overtopping: the open channel spillway is designed to safely pass a flood (PMF, 24-hour duration) significantly greater than the minimum IDF recommended under the Code (100-year flood) and provides an effective control to manage overtopping risks.

7.3.3 Lower Trojan Pond

- Overtopping:
  - An outlet pipe and spillway are present at the LTD to manage overtopping risks. As noted in Section 4.4, the existing facility cannot safely route the IDF required under the Code. The consequence of such overtopping during the IDF is limited to release of contact water to the environment with no safety concern to a permanent downstream population. Refer to Section 4.4 for further discussion on the ongoing upgrade works, interim mitigations and previous flood performance.

7.4 Emergency Preparedness and Response

The emergency preparedness and response plan (EPRP) for the Trojan TSF forms a part of the 2019 OMS manual and is appropriate for the current structure. The EPRP 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.

Training and testing of the EPRP was completed on December 9, 2020. The training consisted of a trial of the EPRP using hypothetical scenario at the L-L Dam. Participants included members of THVCP's operation team (including site management), THVCP QP and EoR. Along with testing of the system, THVCP contacts offsite emergency response resources to ensure that contact information is current.

8 SUMMARY

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

The status of recommendations identified during past Annual Facility Performance Reports are summarized in Table 8.1. Closed recommendation actions are shown in *italics*. No recommendations, related to facility performance, were identified during the 2020 AFPR.

Table 8.1 Previous Recommendations Related to Facility Performance – Status Update

ID No.	Performance Area	Recommended Action	Priority[1]	Recommended Deadline (Status)
Trojan Dam				
TD-2018-02	Flood Routing	Update flood routing assessment for Trojan TSF structures based on the most recent site wide hydrology information for consistency and to confirm compliance.	3	Q2 2020 (Open – Revised Q4 2021)
TD-2019-01	*Failure Mode Review*	*Complete due diligence review of upstream dam failure modes as recommended by the DSR.*	*2*	*Q3 2020 (Closed)*
TD-2019-02	*DSR Recommendations*	*KCB and THVCP to develop a work plan to address 2018 DSR recommendations.*	*3*	*April 2020 (Closed)*
TD-2019-03	*Foundation Characterization*	*Complete an assessment to characterize softer zone at the base of the tailings identified during 2019 SCPT program.*	*2*	*Q2 2020 (Closed)*
R4 Seepage Pond				
No Outstanding Previous Recommendations				
Lower Trojan Dam				
LTD-2017-01	Inflow Design Flood	Complete appropriate upgrade works to allow LTD to safely pass IDF with adequate freeboard, including decommissioning of the spillway pipe.	2	Q4 2020 (Open – Revised 2022)

Notes:

2. Recommendation priority guidelines, specified by THVCP 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.

9 CLOSING

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 2020 Annual Facility Performance Report 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.

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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.

KLOHN CRIPPEN BERGER LTD.

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FIGURES

To Ashcroft
Bayes Creek
Woods Creek
L-L Dam
Highland TSF
Coldstream Creek
Jim Black Lake
1
Howie Falls
Pukaist Creek
Raw Water Reservoir
H-H Dam
Trojan TSF
Bethlehem TSF
Ink-Ikuh Creek
Laura Lake
Valley Pit
To Kamloops
7-Day Pond
Mill Site
Southeast Dump Pond
97C
Calling Lake
Thompson River
Lornex Pit
Highmont TSF
Gnawed Lake
8
N
5,000
10,000
15,000
20,000
25,000
30,000
35,000
40,000

Legend
- L-L Dam Climate Station
- 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.

Date: 2021-01-18
Document Path: Z:\MVCR\M02341B83 - HVC 2020 Dam Safety Support\400 Drawings\GIS\Reports\DSI\Trojan\Fig1_Trojan_MineSitePlan.mxd

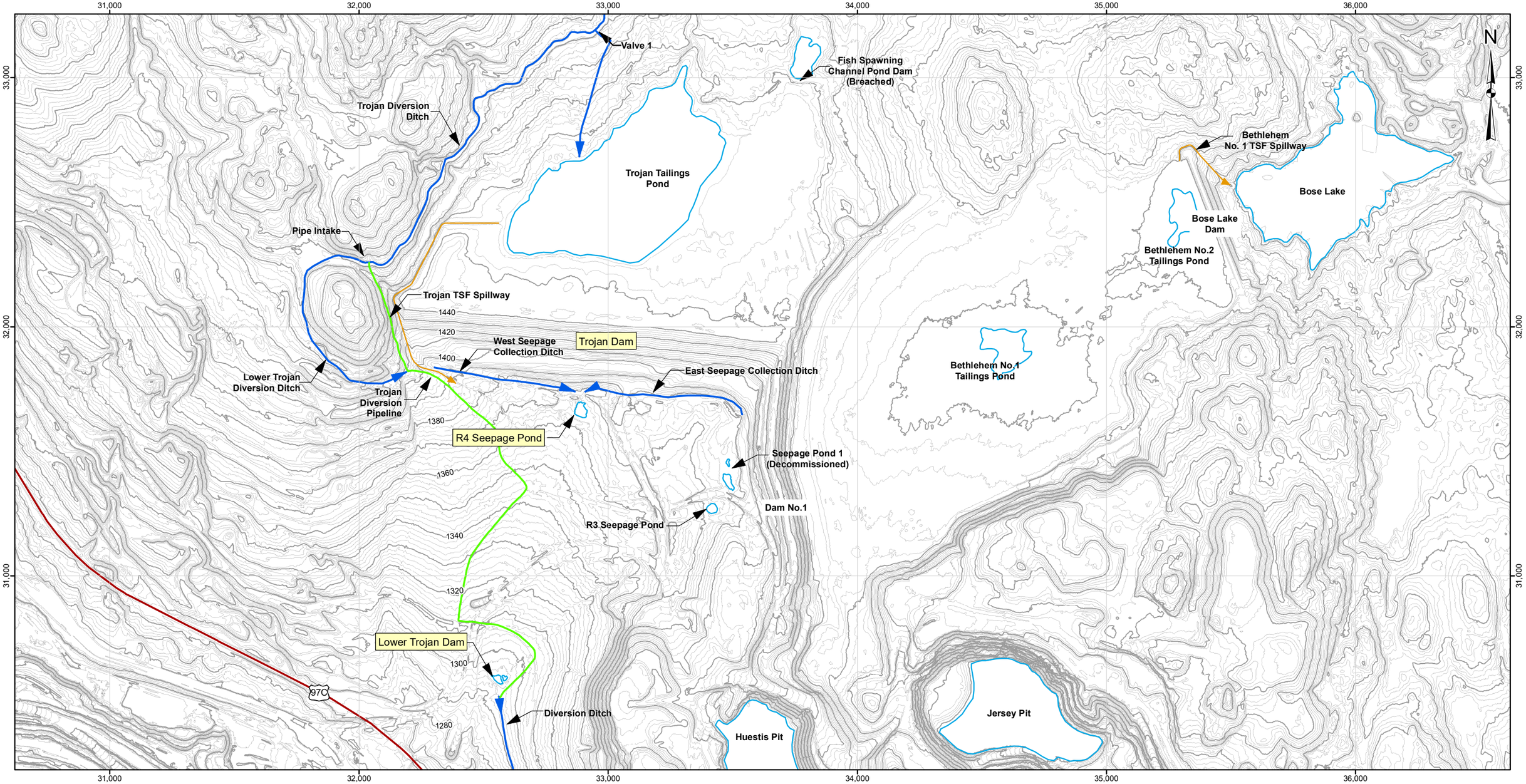
CLIENT
Highland Valley Copper / Teck

Klohn Crippen Berger

PROJECT
TROJAN TAILINGS STORAGE FACILITY
2020 ANNUAL FACILITY PERFORMANCE REPORT

TITLE
MINE SITE PLAN

SCALE	PROJECT No.	FIG No.
1:100,000	M02341B83	1



Legend

- Spillway
- Ditch
- Above Ground Pipeline
- Highway
- Index Contour (10 m)
- Intermediate Contour (2 m)
- Waterbody

0 0.5km

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.

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

PROJECT: TROJAN TAILINGS STORAGE FACILITY
2020 ANNUAL FACILITY PERFORMANCE REPORT

TITLE: TROJAN TAILINGS STORAGE FACILITY OVERVIEW

SCALE	PROJECT No.	FIG No.
1:15,000	M02341B83	2

Date: 2021-02-05
Document Path: Z:\MVCR\M02341B83 - HVC 2020 Dam Safety Support\400 Drawings\GIS\Reports\DS\T rojan\Fig2_ Trojan_Overview.mxd

Legend

Instrument Type (Active)
- Standpipe Piezometer
- Vibrating Wire Piezometer
- Inclinometer

Instrument Type (Defunct)
- Standpipe Piezometer
- Pneumatic Piezometer

- Waypoint (TRJ-2020-xx)
- Cone Penetration Test
- Weir
- Survey Monument

- Spillway
- Ditch
- Above Ground Pipeline
- Index Contour (25 m)
- Intermediate Contour (5 m)

0 250m

Notes:
1. Projection: HVC Mine Grid.
2. Imagery obtained September, 2020, supplemented with imagery from ESRI.
3. Topography from HVC, LiDAR flown on August 23rd, 2014.
4. Refer to Figure II-8 in Appendix II for section details.

CLIENT
Highland Valley Copper / Teck

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PROJECT
TROJAN TAILINGS STORAGE FACILITY
2020 ANNUAL FACILITY PERFORMANCE REPORT

TITLE
TROJAN DAM
PLAN

SCALE	PROJECT No.	FIG No.
1:10,000	M02341B83	3

Date: 2021-02-04
Document Path: Z:\MVCR\M02341B83 - HVC 2020 Dam Safety Support\400 Drawings\GIS\Reports\DS\IT\TrojanIT\Fig3_Trojan_DamPlan.mxd

Legend

Instrument Type (Active)
- Weir

Instrument Type (Defunct)
- Standpipe Piezometer

- Waypoint (TRJ-2020-xx)
- Spillway
- Ditch
- Buried Pipeline
- Index Contour (5 m)
- Intermediate Contour (1 m)

0 50m

Notes:
1. Projection: HVC Mine Grid.
2. Imagery obtained September, 2020.
3. Topography from HVC, LiDAR flown on August 23rd, 2014.
4. The status of the original outlet pipe is unknown.
5. Locations of buried pipes are approximate.

CLIENT: Highland Valley Copper / Teck

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PROJECT: TROJAN TAILINGS STORAGE FACILITY
2020 ANNUAL FACILITY PERFORMANCE REPORT

TITLE: R4 SEEPAGE POND DAM
PLAN

SCALE	PROJECT No.	FIG No.
1:1,000	M02341B83	4

Date: 2021-01-19
Document Path: Z:\MVCR\M02341B83 - HVC 2020 Dam Safety Support\400 Drawings\GIS\Reports\DSI\Trojan\Fig4_Trojan_R4SeepagePond.mxd

Legend

- Waypoint (TRJ-2020-xx)
- Instrument Type (Active)
  - Weir
- Spillway
- Buried Pipeline
- Ditch
- Above Ground Pipeline
- Index Contour (5 m)
- Intermediate Contour (1 m)

0 50m

Notes:
1. Projection: HVC Mine Grid.
2. Imagery obtained September, 2020.
3. Topography from HVC, LiDAR flown on August 23rd, 2014.
4. Locations of buried pipes are approximate.

Date: 2021-02-05
Document Path: Z:\MV\CRM\02341B83 - HVC 2020 Dam Safety Support\400 Drawings\GIS\Reports\DS\tTrojan\Fig5_Trojan_LowerTrojanDam.mxd

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

PROJECT: TROJAN TAILINGS STORAGE FACILITY
2020 ANNUAL FACILITY PERFORMANCE REPORT

TITLE: LOWER TROJAN DAM
PLAN

SCALE	PROJECT No.	FIG No.
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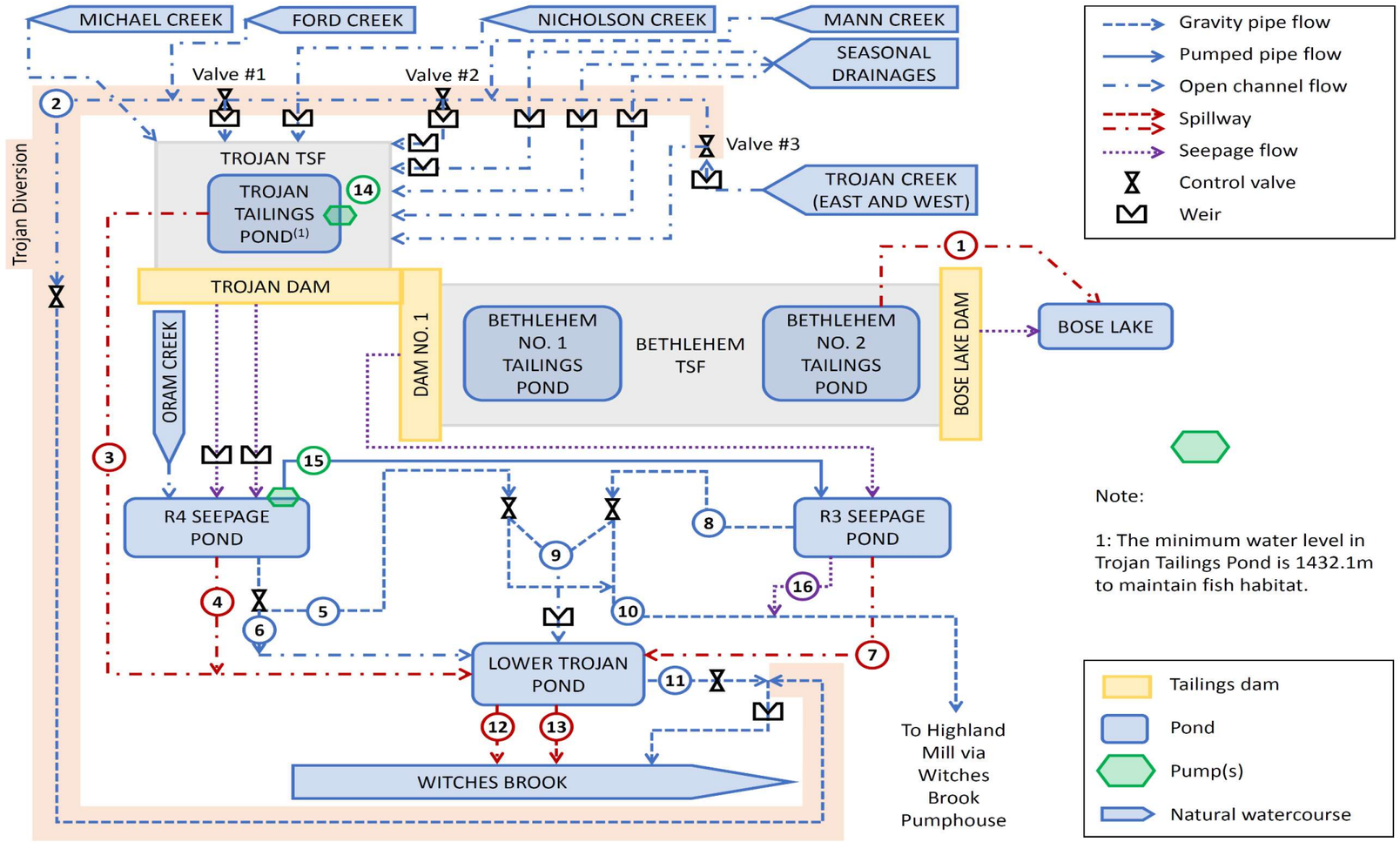


Gravity pipe flow
Pumped pipe flow
Open channel flow
Spillway
Seepage flow
Control valve
Weir

Note:

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

Tailings dam
Pond
Pump(s)
Natural watercourse

No.	Name	Description	Status
1	Bose Lake 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 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 steel pipeline	Operational
11	LTP Low-Level Outlet	460 mm dia. HDPE pipe with valve and intake trash rack	Operational
12	LTP Spillway	7 m wide channel	Operational
13	LTP 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 discharge to R3 Pond	Non-operational
16	R3 Overland Collector	8"-12" HDPE pipe collecting surface water	Operational

NOT FOR CONSTRUCTION

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

PROJECT: TROJAN TAILINGS STORAGE FACILITY
2020 ANNUAL FACILITY PERFORMANCE REPORT

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

SCALE	PROJECT No.	FIG. No.
NTS	M02341B83	6

APPENDIX I

Annual Facility Performance Report
Inspection Checklist, Observations and Photographs

APPENDIX I-A

Annual Facility Performance Report
Inspection Checklist, Observations and Photographs
Trojan Dam

Appendix I-A
Annual Facility Performance Report
Inspection Checklist, Observations and Photographs
Trojan Dam

INSPECTION CHECKLIST

Facility:	Trojan Dam	**Inspection Date:**	July 15, 2020
Consequence Classification:	Very High		
Weather:	Mostly cloudy	**Inspector(s):**	Rick Friedel, P.Eng. Narges Solgi, EIT
Freeboard (pond level to dam crest):	6.7 m based on the July 3rd 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 your dam in ***SATISFACTORY CONDITION***?

(check one if applicable)

EMBANKMENT	Yes/No	SPILLWAY	Yes/No
U/S Beach	☒ Yes ☐ No	Debris Boom	☒ Yes ☐ No
Crest	☒ Yes ☐ No	Entrance	☒ Yes ☐ No
D/S Slope	☒ Yes ☐ No	Channel	☒ Yes ☐ No
D/S Toe	☒ Yes ☐ No	Channel Slopes	☒ Yes ☐ No
Drains	☒ 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	☐ 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:

- Refer to Inspection Observations Section.

INSPECTION OBSERVATIONS

Crest

No indication of erosion or deterioration, crest was observed to be in good physical condition. Local low points (<1 m) and "hummocky" surface observed and believed to be from differential settlement or formed for land reclamation. Freeboard is uncompromised by these features.

Left Abutment

Good physical condition, no excessive scour damage. Access road near the left abutment that required to be raised to El. 1440 m, per 2017 Annual Facility Performance Report (AFPR) recommendation has been raised. Related recommendation was closed in 2019 AFPR (KCB 2020a) (Photo I-A-2).

Right Abutment

Good physical condition. Spillway channel is excavated through bedrock and Glacial Till material, parallel to the dam abutment. No sign of deterioration or erosion at the abutment; however, some erosion was observed along the spillway channel (additional details noted in spillway channel observations).

Downstream Slope

Good physical condition. Downstream slope is well vegetated with grass and has no observed locations of concern or signs of adverse displacement (Photo I-A-3).

Toe Collection Ditches

Good physical condition. Extensive vegetation observed, which provides a measure of erosion protection. Seepage flow (clear, no turbidity observed) observed through ditches and weirs. Weirs in good condition, and no sign of obstructions in either toe collection ditches (Photo I-A-4).

Seepage

No seepage observed, except for seepage flow within the toe collection ditches.

Tailings Beach

Good physical condition. No issues of concerns observed during inspection. Elevation of the vegetated portion of the beach is approximately 2 m above the reservoir level (Photo I-A-5).

Pond

No indication of recent high-water event that encroached above typical levels, at the time of inspection (Photo I-A-5 and Photo I-A-6).

Spillway Inlet

Log booms secured in place, with no obstructions present besides minor vegetation. Spillway inlet in good condition with no signs of deterioration (Photo I-A-7).

Spillway Channel

- **General:**
  - Good physical condition. Initial section of channel is heavily vegetated with grass and slopes at minimal grade towards the first curve of the dam spillway (Photo I-A-8). Following the first curve the vegetated Glacial Till channel transitions to a bedrock excavated channel at the right abutment of the dam (Photo I-A-9 and Photo I-A-10). Spillway channel riprap increases in size as the channel grade steepens towards the outfall. No major obstructions or deterioration was observed along the channel (Photo I-A-11 and Photo I-A-13). In December 2020, THVCP received permit approvals to complete clearing of vegetation. The work is scheduled for completion in spring 2021.
- **Erosion features:**
  - No change to surface erosion scour at the riprap section of Trojan Dam spillway observed during 2018 Annual Facility Performance Review. No active seepage faces, or erosion were observed. This indicates there is no dam safety concern (Photo I-A-12).
- **Spillway extension section:**
  - Riprap appears to be in good condition; however, it does not appear to be uniform (Photo I-A-16). Vegetation build-up was observed in channel at start up. In December 2020, THVCP received permit approvals to complete clearing of vegetation. The work is scheduled for completion in spring 2021.

INSPECTION PHOTOGRAPHS

LEGEND:

- TRJ = Trojan Tailings Facility
- TRJ-2020-## refers to 2020 AFPR waypoint shown on Figure 3
- All photographs taken during inspection on July 15, 2020.

Photo I-A-1 Overview of Trojan Tailings Storage Facility (TSF) from access road between Trojan TSF and Bethlehem TSF (TRJ-2020-01)

Photo I-A-2 Trojan Dam left abutment access road. Portion of road surface raised to provide minimum freeboard at design minimum flood beach width. Related recommendation was closed in 2019 AFPR (TRJ-2020-02)

Photo I-A-3 Overview of Trojan Tailings Pond and Trojan Dam downstream slopes from left abutment. No visible erosion or scour (TRJ-2020-03)

Photo I-A-4 Overview of weir TD-R4-SF01 downstream of East and West Seepage Collection Ditches (TRJ-2020-04)

Photo I-A-5 Overview of Trojan Tailings Pond and tailings beach from Trojan Diversion Channel (TRJ-2020-05 and TRJ-2020-06)

Photo I-A-6 Overview of Trojan Tailings Pond. Sand beach is exposed. Spillway inlet is visible. Debris boom is secured (TRJ-2020-07)

Photo I-A-7 Trojan spillway inlet. Approach channel is clear and debris boom is secured. (TRJ-2020-07)

Photo I-A-8 Trojan spillway approach channel (TRJ-2020-07)

Photo I-A-9 **Overview of first length of spillway channel, looking toward southwest (top photo) and looking toward northeast (bottom photo). No sign of recent flow or weathering/disruption of riprap was observed. No evidence of sloughing of cut slopes was observed. Channel is heavily vegetated. In December 2020, THVCP received permit approvals to clear vegetation. The work is scheduled for spring 2021 (TRJ-2020-08)**

Photo I-A-10 Overview of spillway channel, downstream of chute. Slopes are in good condition. Channel is vegetated (TRJ-2020-09)

Photo I-A-11 Overview of riprap segment of spillway channel, looking toward south (TRJ-2020-10)

Photo I-A-12 **Sand on the base and on right bank of spillway. Sand appears to have been placed/deposited on top of riprap, suggesting this is not related to piping/seepage. No active seepage faces, or erosion were observed. This is not a dam safety concern. Compared to 2019 AFPR (bottom photo) (TRJ-2020-11)**

Photo I-A-13 Spillway channel downstream of the sand area observed in Photo I-A-12. No sand was observed downstream. No sign of recent flow or weathering/disruption of riprap was observed (TRJ-2020-12)

Photo I-A-14 Surface erosion / scour evidence observed upslope on dam slope in spillway channel during 2019 AFPR site visit was repaired by THVCP in 2019. Scour is not developing again (TRJ-2020-13)

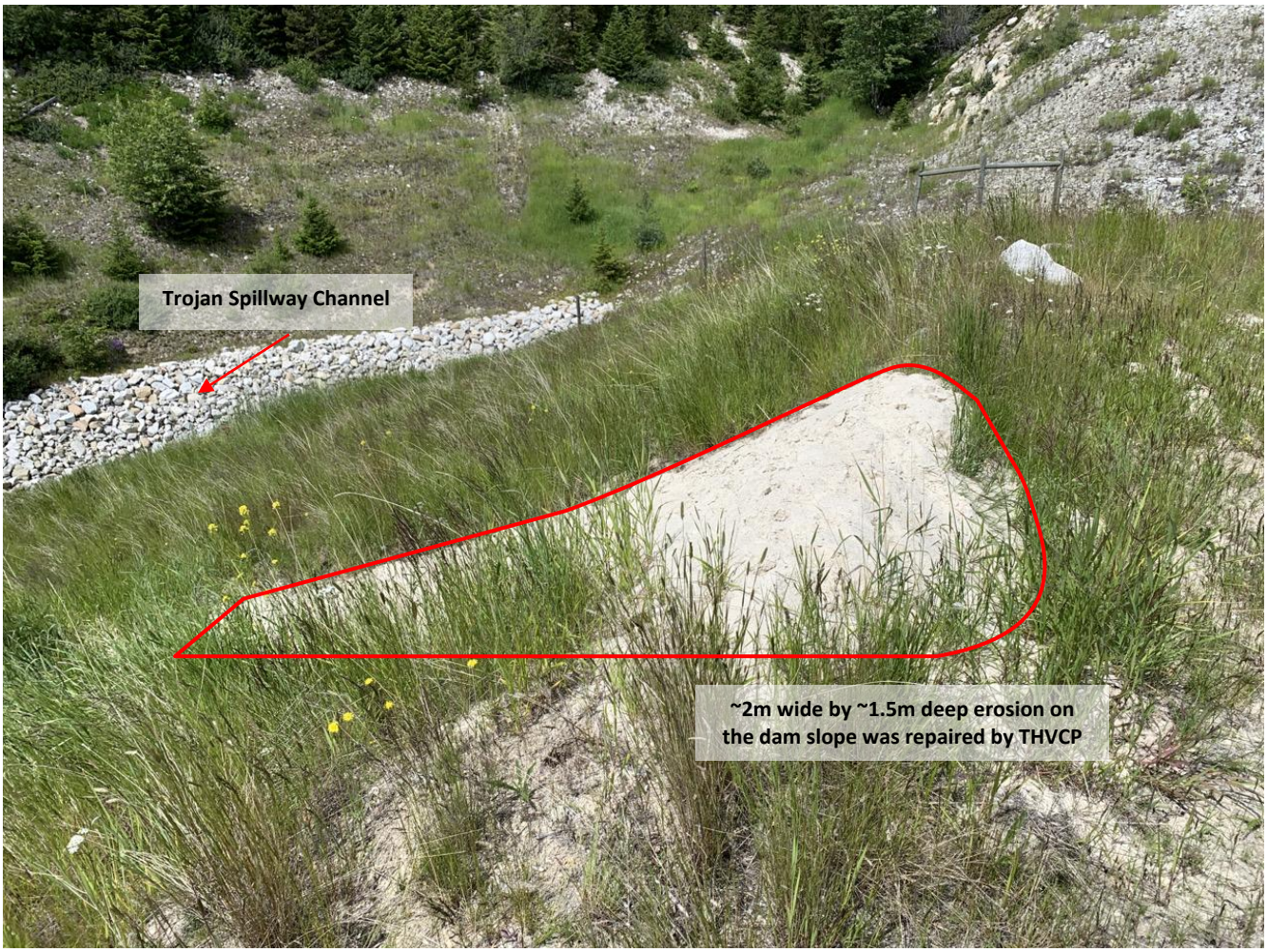


Photo I-A-15 Area of downstream slope without vegetation cover with sand exposed. Does not appear to be an active erosion area (TRJ-2020-14)

Photo I-A-16 Overview of 2018 Extension Trojan Dam spillway channel and the toe of the right abutment. Vegetation build-up observed in channel at start up. In December 2020, THVCP received permit approvals to clear vegetation. The work is scheduled for spring 2021 (TRJ-2020-15)

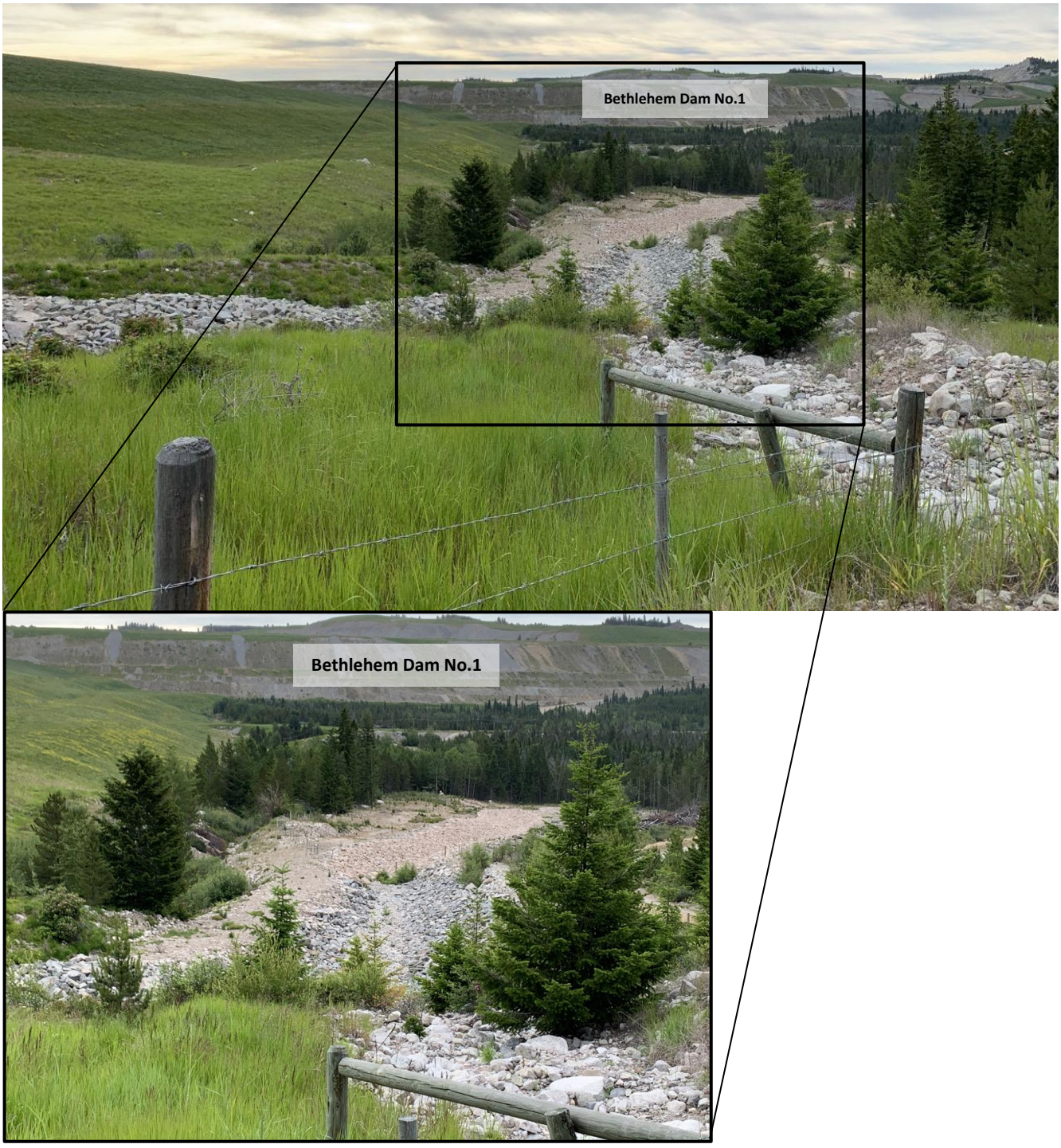


Photo I-A-17 Example of liner overlap point. No seepage faces observed on slope downstream of this area (TRJ-2020-16)

Photo I-A-18 Water flowing at the pipe intake southwest of Trojan TSF. Outlet valve here is open. Gate has minor debris accumulation. No flow bypassing diversion (i.e. flowing further downstream of channel. Trojan Diversion Valve 1 further upstream at Photo I-A-20 is closed (TRJ-2020-17)

Photo I-A-19 Diversion pipe that was observed disconnected during 2019 AFPR site visit is repaired. Water discharging / valve open (TRJ-2020-17)

Photo I-A-20 Trojan Diversion Valve 1 is closed (no flow into impoundment) and locked. Valve is located at the transition of unlined to lined channel. Increased vegetation at the unlined channel (bottom photo), should be cleared for routine maintenance but is not a risk to Trojan flood routing) (TRJ-2020-18)

Photo I-A-21 Clear water flowing in the unlined section of channel upstream of Trojan Diversion Valve 1. Slopes with shallow grade, unlined. Vegetation growth observed. Clearing vegetation here has lower priority to spillways as diversion is assumed to fail during Inflow Design Flood (TRJ-2020-19)

Photo I-A-22 Trojan Diversion (road junction). Culvert is clear. Low velocity flow of clear water into the unlined channel. (TRJ-2020-20)

Photo I-A-23 No scour was observed at Trojan Diversion Valve 1 pipe discharge point (TRJ-2020-18)

APPENDIX I-B

Annual Facility Performance Report
Inspection Checklist, Observations and Photographs
R4 Seepage Pond Dam

Appendix I-B
Annual Facility Performance Report
Inspection Checklist, Observations and Photographs
R4 Seepage Pond Dam

INSPECTION CHECKLIST

Facility:	Trojan R4 Seepage Pond Dam	**Inspection Date:**	July 15, 2020
Weather:	Cloudy	**Inspector(s):**	Rick Friedel, P.Eng. Narges Solgi, EIT
Freeboard (pond level to dam crest):	0.9 m based on maximum water elevations on July 15th from remote pond level monitoring system		

Outlet Condition Survey

Description	Outlet Controls?	Was it flowing?	Flow rate	Visual Review?	Testing / Detailed Inspection?
Low Level Outlet	☒ Yes ☐ No	☒ Yes ☐ No	Not estimated	☒ Yes ☐ No	☐ Yes ☒ No
Spillway Channel	N/A	☐ Yes ☒ No	N/A	☒ Yes ☐ No	N/A
Original Outlet Pipe	N/A	☐ Yes ☒ No	None	☐ Yes ☒ No	☐ Yes ☒ No

Are the following components in ***SATISFACTORY CONDITION***?
(check one if applicable)

EMBANKMENT	Yes/No	LOW LEVEL OUTLET	Yes/No	SPILLWAY CHANNEL	Yes/No
U/S Slope	☒ Yes ☐ No	Outlet Pipe	☒ Yes ☐ No	Entrance	☒ Yes ☐ No
Crest	☒ Yes ☐ No	Outlet Channel	☒ Yes ☐ No	Channel	☒ Yes ☐ No
D/S Slope	☒ Yes ☐ No	Outlet Controls	☒ Yes ☐ No	Channel Slopes	☒ Yes ☐ No
D/S Toe	☒ Yes ☐ No				

ORIGINAL OUTLET PIPE	Yes/No
Entrance	☒ Yes ☐ No
Pipe	☒ Yes ☐ No

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

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

List and describe any deficiencies:

- No dam safety deficiencies observed.

Comments / Notes:

- Refer to Inspection Observations Section.

INSPECTION OBSERVATIONS

Crest

Good physical condition. No observed signs of deterioration, lateral movement, or cracking (Photo I-B-1). THVCP removed heavy vegetation on the upstream slope after the site visit as part of routine maintenance.

Left and Right Abutments

Good physical condition. Little vegetation at abutments, and no signs of deterioration observed.

Downstream Slope

Good physical condition. Tall grass and vegetation present, no signs of deterioration or erosion (Photo I-B-2).

Pond

During inspection, the pond water level was observed to be approximately >0.5 m below the spillway invert which is typical for this time of the year (Photo I-B-3 and Photo I-B-5).

Spillway

Good physical condition. No observed signs of recent flow, channel erosion, or deterioration. THVCP cleared vegetation near inlet after the site visit as part of routine maintenance (Photo I-B-5).

Low-level Outlet

Good physical condition. Any obstructions or excess vegetation growth are monitored and cleared as part of THVCP ongoing monitoring and routine maintenance plan (Photo I-B-3). The valve cannot be hand turned (Photo I-B-4).

Seepage

No observed signs of seepage during inspection.

INSPECTION PHOTOGRAPHS

LEGEND:

- TRJ = Trojan Tailings Facility
- TRJ-2020-## refers to 2020 Annual Facility Performance Report (AFPR) waypoint shown on Figure 4.
- All photographs taken during inspection on July 15, 2020.

Photo I-B-1 Overview of crest and downstream slope looking towards left abutment (TRJ-2020-21)

Photo I-B-2 Overview of downstream slope looking towards left abutment (TRJ-2020-21)

Photo I-B-3 Overview of the pond and low-level outlet to Witches Brook via Lower Trojan Dam with view of Trojan Dam downstream slope (TRJ-2020-22)

Photo I-B-4 Low Level Outlet valve in enclosure downstream of toe. The valve cannot be hand turned (TRJ-2020-23)

Photo I-B-5 Overview of pond and spillway inlet – Spillway inlet is clear of debris. Vegetation on upstream slope and near inlet was cleared after inspection as part of routine maintenance (TRJ-2020-24)

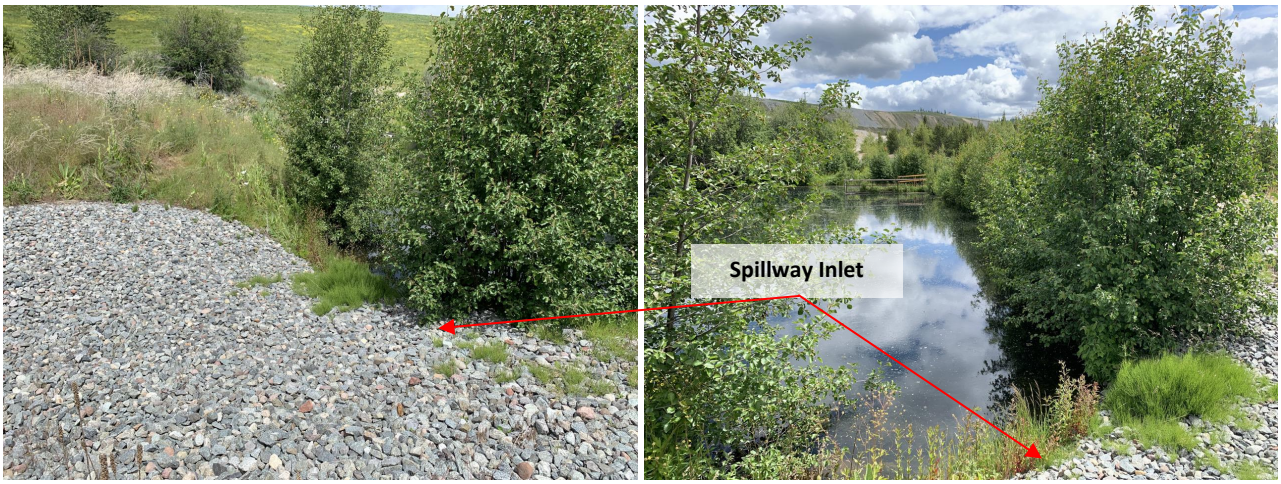


Photo I-B-6 Spillway Channel (TRJ-2020-24)

Photo I-B-7 Overview of weir TD-R4-SF01 downstream of East and West Seepage Collection Ditches (TRJ-2020-04)

APPENDIX I-C

Annual Facility Performance Report
Inspection Checklist, Observations and Photographs
Lower Trojan Dam

Appendix I-C
Annual Facility Performance Report
Inspection Checklist, Observations and Photographs
Lower Trojan Dam

INSPECTION CHECKLIST

Facility:	Lower Trojan Dm	**Inspection Date:**	July 15, 2020
Weather:	Mostly cloudy	**Inspector(s):**	Rick Friedel, P.Eng. Narges Solgi, EIT
Freeboard (pond level to dam crest):	1.3 m based on maximum water elevations on July 15th from remote pond level monitoring system		

Outlet Condition Survey

Description	Outlet Controls?	Was it flowing?	Flow rate	Visual Review?	Testing / Detailed Inspection?
460 mm HDPE Outlet to Weir	☒ Yes ☐ No	☒ Yes ☐ No	Not Estimated	☒ Yes ☐ No	☐ Yes ☒ No
200 mm HDPE Low Level Outlet	N/A	N/A	Decommissioned	N/A	N/A
810 mm HDPE Spillway Pipe	☐ Yes ☒ No	☐ Yes ☒ No	N/A	☒ Yes ☐ No	N/A
Spillway Channel	N/A	☐ Yes ☒ No	N/A	☒ Yes ☐ No	N/A

Are the following components in ***SATISFACTORY CONDITION***?
(check one if applicable)

EMBANKMENT	Yes/No	OUTLET TO WEIR	Yes/No	LOW LEVEL OUTLET	Yes/No
U/S Slope	☒ Yes ☐ No	Outlet Pipe	☒ Yes ☐ No	Outlet Pipe	☒ Yes ☐ No
Crest	☒ Yes ☐ No	Outlet Channel	☒ Yes ☐ No	Outlet Channel	☒ Yes ☐ No
D/S Slope	☒ Yes ☐ No	Outlet Controls	☒ Yes ☐ No	Outlet Controls	☒ Yes ☐ No
D/S Toe	☒ Yes ☐ No				

SPILLWAY PIPE	Yes/No	SPILLWAY CHANNEL	Yes/No
Entrance	☒ Yes ☐ No	Entrance	☒ Yes ☐ No
Pipe	☒ Yes ☐ No	Channel	☒ Yes ☐ No
		Channel Slopes	☒ Yes ☐ No

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

INDICATOR	EMBANKMENT	LOW LEVEL OUTLET (Decommissioned)	OUTLET TO WEIR
Piping	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No
Sinkholes	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No
Seepage	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No
Erosion	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No
Cracks	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No
Settlement	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No
Sloughing/Slides	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No
Animal Activity	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No
Excessive Growth	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No
Excessive Debris	☐ Yes ☒ No	☐ Yes ☒ No	☒ Yes ☐ No

INDICATOR	SPILLWAY PIPE	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

List and describe any deficiencies:

- No dam safety deficiencies observed.

Comments / Notes:

- Refer to Inspection Observations Section.

INSPECTION OBSERVATIONS

Crest

Good physical condition. Minor vegetation with no signs of erosion, deterioration, or cracking observed. Crest is uneven and appears to be sloped up to the west. THVCP should conduct a survey to confirm the low point (Photo I-C-1). KCB recommend new controls (e.g. freeboard raise, pump, outflow pipe outlet) be in place to manage overtopping risks in order to offset the delay in flood routing works.

Left and Right Abutment

Good physical condition (Photo I-C-2).

Downstream Slope

Good physical condition. Minor vegetation present, no signs of erosion or deterioration. Downstream outflow pipe shown on Photo I-C-3 does not have a defined channel or means of toe erosion protection. KCB recommends that a mitigation be advanced.

Pond

Level at time of inspection higher than the level at 2019 inspection. Pond level >0.5 m below the invert of spillway pipe which is typical for this time of the year. Basin is heavily vegetated (Photo I-C-4, Photo I-C-5, and Photo I-C-7).

Current configuration of the Lower Trojan pond comprises two basins, referred to as the upper and lower basins. There was active flow from the upper basin to the lower basin at the time of the inspection (Photo I-C-6). During the site visit, THVCP confirmed the upper basin is included in routine visual inspections. The upper basin is included in the ongoing flood upgrade works.

Spillway

Heavy vegetation present in front of the pond overflow pipe (Photo I-C-8 and Photo I-C-9). In December 2020, THVCP received permit approvals to complete the necessary clearing. This work is scheduled for completion in spring 2021.

Low-level Outlet

Debris boom is in good condition. Debris buildup present on intake cage was removed after the site visit as part of routine maintenance (Photo I-C-10). Low-level outlet valve can be hand turned (Photo I-C-11).

Seepage

None observed.

INSPECTION PHOTOGRAPHS

LEGEND:

- TRJ = Trojan Tailings Facility.
- TRJ-2020-## refers to 2020 Annual Facility Performance Report (AFPR) waypoint shown on Figure 5.
- All photographs taken during inspection on July 15, 2020.

Photo I-C-1 Overview of crest from right abutment. Crest is uneven and appears to be sloped up to the west. THVCP should conduct a survey to confirm the low point (TRJ-2020-25)

Photo I-C-2 Overview of crest looking toward left abutment (TRJ-2020-26)

Photo I-C-3 Downstream slope near right abutment with overflow pipe through the dam. (TRJ-2020-26)

Photo I-C-4 Lower Trojan Dam Pond (TRJ-2020-27)

Photo I-C-5 Lower Trojan upper basin. (TRJ-2020-27)

Photo I-C-6 Outlet which appeared to connect the upper basin to the lower basin at Lower Trojan Dam Pond. The inside was dry at the time of inspection and there were no sounds of flow. During inspection, flow from upper basin was reporting to lower basin via overland flow (TRJ-2020-28)

Photo I-C-7 Upstream Overflow Pipe (TRJ-2020-26)

Photo I-C-8 Spillway channel looking toward south. Channel is heavily vegetated. THVCP received permit approval in December 2020 to complete clearing. Work is scheduled for spring 2021 (TRJ-2020-25)

Photo I-C-9 Spillway channel is heavily vegetated. THVCP received permit approval in December 2020 to complete clearing. Work is scheduled for spring 2021 (TRJ-2020-25)

Photo I-C-10 Low-Level Outlet (LLO) inlet. Accumulated debris on trash rack was cleared by THVCP as part of routine maintenance after site visit (TRJ-2020-29)

Photo I-C-11 Low-Level Outlet (LLO) valve can be hand operated to open and close (TRJ-2020-30)

APPENDIX II

Climate and Instrumentation

APPENDIX II-A

Climate Data

Appendix II-A
Climate Data

THVCP provided weather data from the L-L Dam climate station (El. 1186 m) which is the nearest climate station to the site but is at a lower elevation than Trojan TSF catchment (>El. 1440 m, i.e. dam crest). Climate data was adjusted for elevation, using the recommended adjustment factors from L-L Dam to Highmont/Bethlehem and Trojan Area (Average El. 1550 m), from Golder (2019). To support key precipitation trends and impacts on observed dam performance, data from Kamloops Pratt Road (Environment Canada Station No. 116C8P0, El. 729.0 m) was reviewed for comparison. Previous Annual Facility Performance Reports compared the Trojan TSF data with Kamloops Airport (Environment Canada Station No. 1163781, El. 345 m) data, but this station was missing too much data in 2020. Precipitation records from L-L Dam (adjusted) and Kamloops Pratt Road between October 2019 and September 2020 are tabulated and plotted in Table II-A.1 and Figure II-A.1, respectively. Precipitation normals, reported in Table II-A.1, is based on the Highland Valley Lornex Synthetic Record, adjusted for elevation to Highmont/Bethlehem and Trojan Area using Golder (2019).

Seasonal snowpack depth is not measured at the L-L Dam weather station. Instead, monthly measurements at the Highland Valley snow survey station (Station No. 1C09A) near the Trojan TSF are used by THVCP to monitor snowpack. 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 2020 snowpack depths based on available records are summarized in Table II-A.2.

The following observations were noted for the reporting period (refer to Figure II-A.1):

- More than 10% of the L-L Dam weather station precipitation data were missing in March, June, and July. Due to these data gaps, the 2020 climate data from site was augmented with data from a regional weather station to support a comparison with historic normals.
- All storm events during 2020 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: 23.1 mm on May 30; 18.2 mm on May 17; and 12.9 mm on September 19.
- January through April precipitation was significantly less than historic normals except the precipitation in February which was higher than average.
- May precipitation was almost twice as much as the historic normals.
- Figure II-A.1 indicates low precipitation at site during June and July; however, this is due to L-L Dam Weather Station data gaps during this period. THVCP inspection reports and regional climate station data indicate precipitation during this period was above historic normals.
- Snowpack depth measurements, from the Highland Valley station, indicate the snow had been melted by May 1, 2020.

- Seasonal rise and fall of pond levels is associated with freshet. The time of year when pond levels start to fall is associated with the end of freshet, in recent years this has started in April or May (Figure 5.1 in the main text). In 2020, pond levels did not start to fall until mid to late June. This timing indicates that the 2020 response was driven primarily by precipitation, rather than 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]	Average Lornex Synthetic Record Adjusted to Highmont/Bethlehem and Trojan Area [2]	Kamloops Pratt Road Weather Station
Oct 2019	100	21.5	33.3	32.8
Nov 2019	100	21.9	38.9	49.2
Dec 2019	97	22.9	42.1	36.6
Jan 2020	100	21.8	37.5	64.8
Feb 2020	100	30.3	23.7	45.4
Mar 2020	89	4.1 [4]	21.5	3.4
Apr 2020	100	15.0	22.4	16.4
May 2020	100	85.1	41.7	98.8
Jun 2020	32	9.8 [4]	46.5	78.0
Jul 2020	11	6.3 [4]	36.3	44.2
Aug 2020	100	26.6	34.4	15.2
Sep 2020	100	25.2	32.6	17.6
Annual Total	-	-	410.8	502.4

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 2019).
2. Estimated by Golder (2019) using appropriate adjustment factors and average precipitation measured at Highland Valley Lornex climate station (Environment Canada ID No. 1123469 at El. 1268 m from 1976 to 2011). Golder (2019) infilled the data gaps prior to November 2011 and created a long-term synthetic precipitation record. 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 (2019) for detailed information.
3. Review period for the Trojan TSF Annual Facility Performance Report is from October 2019 through September 2020.
4. Monthly precipitation with more than 10% missing data.

Figure II-A-1 Monthly Precipitation

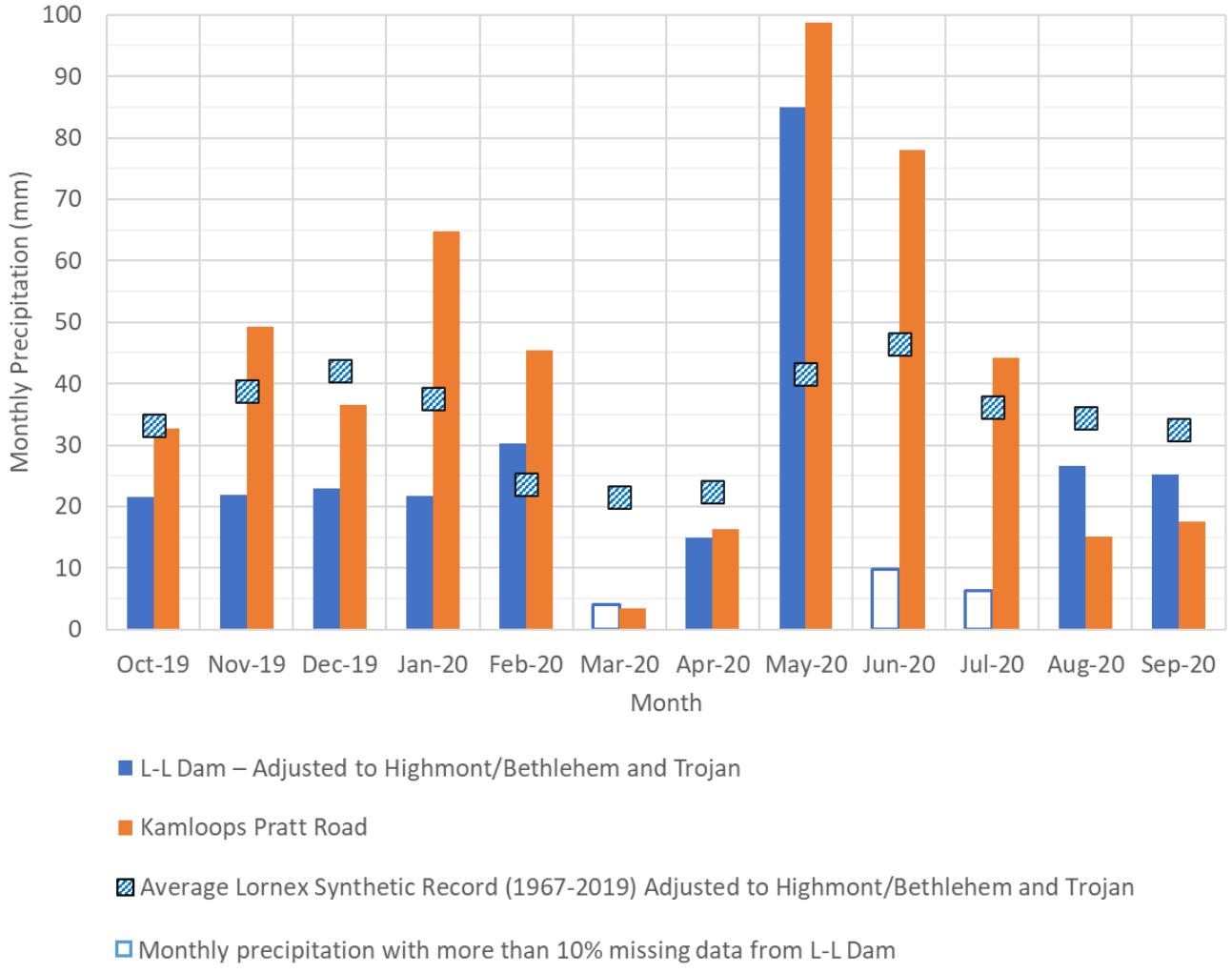


Table II-A-2 Historical Average and 2020 Snowpack Depths

Survey Period	Years of Record[1]	Historic Average Snowpack Depth[2] (mm SWE[3])	2020 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	54	91.2	100	10%
April 1st	52	100.8	Not surveyed	N/A
May 1st	53	28.1	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.

APPENDIX II-B

Instrumentation Summary and Plots

Appendix II-B
Instrumentation Summary and Plots

II-B-1 PIEZOMETERS

Historic piezometric readings are shown in Figure II-B-1 to Figure II-B-3.

Thresholds for piezometers were updated and reported in the 2016 Annual Facility Performance Report (KCB 2017a). The thresholds were set at 0.5 m above the maximum elevation head to identify any 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 2020 Annual Facility Performance Report (Refer to Table II-B-1). Three threshold value revisions are proposed for 2021 (Refer to Table II-B-1).

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

Instrument ID	Foundation Unit	Piezometric Levels during the review period [1] (m)		Proposed 2021 Threshold Value (m)[2]
		Maximum	Minimum	
P95-4	Sandfill	n/a	n/a	Note 3
P85-1A	Foundation	1396.4	1396.3	1399.2
TB-PS-02/P13-1	Cycloned Sand	1421.9	1420.0	1423.4
TB-PS-01/P13-2	Cycloned Sand	1417.1	1416.5	1418.6
TB-PS-04/P13-3	Sand and Gravel	1383.2	1383.1	1385.4
TB-PS-03/P13-4	Glacial Till	1388.9	1388.8	1390.5
P86-1	Sandfill	1408.6	1408.4	***1409.1***
VW16-2A	Glacial Sediments / Debris	1367.0	1366.8	***1367.5***
VW16-2B	Glacial Till	1379.5	1379.2	***1380.0***
P94-1	Sandfill	1421.2	1420.0	1423.6

Notes:
1. October 2019 through September 2020.
2. ***Bold Italics*** indicate revised threshold for 2021.
3. Piezometric level continues trending downward since 2015 falling head test; no threshold set until water level reaches steady state.
4. Four of the VWPs that were installed during the 2019 SCPT program were read once in 2020 but are not shown here or on the summary plots until there are multiple readings.

II-B-2 SURVEY MONUMENTS

Survey monuments at the Trojan Dam are shown on Figure 3. Starting in November 2019, THVCP changed the method used to survey the displacement monuments on the TSF. 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-10. The baseline location for each monument using the RTK method is offset from the total station surveys. However, subsequent readings show this is related to the change in survey and not a movement trend.

The horizontal surveys are plotted for the RTK method only, based on the new baseline location. However, KCB maintained a continuous record of settlement based on incremental change between RTK surveys.

Table II-B-2 summarizes incremental and cumulative displacement during the 2020 Annual Facility Performance Report review period. Incremental displacements are relative to the November 2019 RTK baseline. Change from initial survey for horizontal displacement is reported relative to the November 2019 RTK baseline.

KCB estimated change from initial survey for vertical displacement by adding the incremental vertical displacement over the reporting period to the cumulative vertical displacement from the last total station survey. This assumes no vertical displacement occurred between the last total station survey (October 2019) and the date of the GPS RTK survey.

Table II-B-2 2020 Survey Monument Incremental Displacement Summary

Monument	Incremental[1]		Change from Initial Survey	
	Vector Horizontal Displacement (mm)	Vertical Displacement (mm)	Vector Horizontal Displacement[2] (mm)	Vertical Displacement[3] (mm)
TD-1	9, upstream (toward northeast)	+2	9, upstream (toward northeast)	-6, upstream
TD-2A	7, parallel to dam crest (toward east)	+2	7, parallel to dam crest (toward east)	-7, parallel to dam crest
TD-3	7, upstream (toward north)	-9	7, upstream (toward north)	-87, upstream
TD-4	5, upstream (toward northeast)	-14	5, upstream (toward northeast)	-93, parallel to dam crest
TD-5	4, downstream (toward south)	-13	4, downstream (toward south)	-63, parallel to dam crest
TD-6	1, upstream (toward northeast)	-15	1, upstream (toward northeast)	-45, parallel to dam crest

Notes:
1. Incremental horizontal displacements are calculated between the November 2019 and September 2020 surveys.
2. Cumulative horizontal displacements calculated relative to the RTK November 2019 baseline.
3. Cumulative vertical displacements calculated by adding 2020 incremental displacement to displacement between October 2019 surveys and earliest historic reading:
   - TD-2A: 2014;
   - All other monuments: 1998.

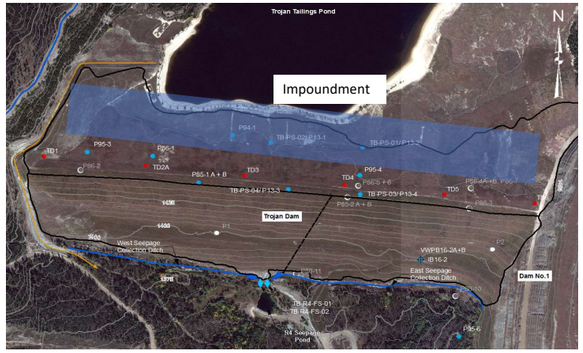
The current survey movement thresholds were set during the 2016 Annual Facility Performance Report based on typical variance and error using the total station method; refer to Table II-B-3. These thresholds are being revised by KCB and THVCP for 2021 based on the RTK survey method. The survey readings for this review period do not indicate any increased displacement and horizontal movement trends and settlement rate was consistent with recent behaviour.

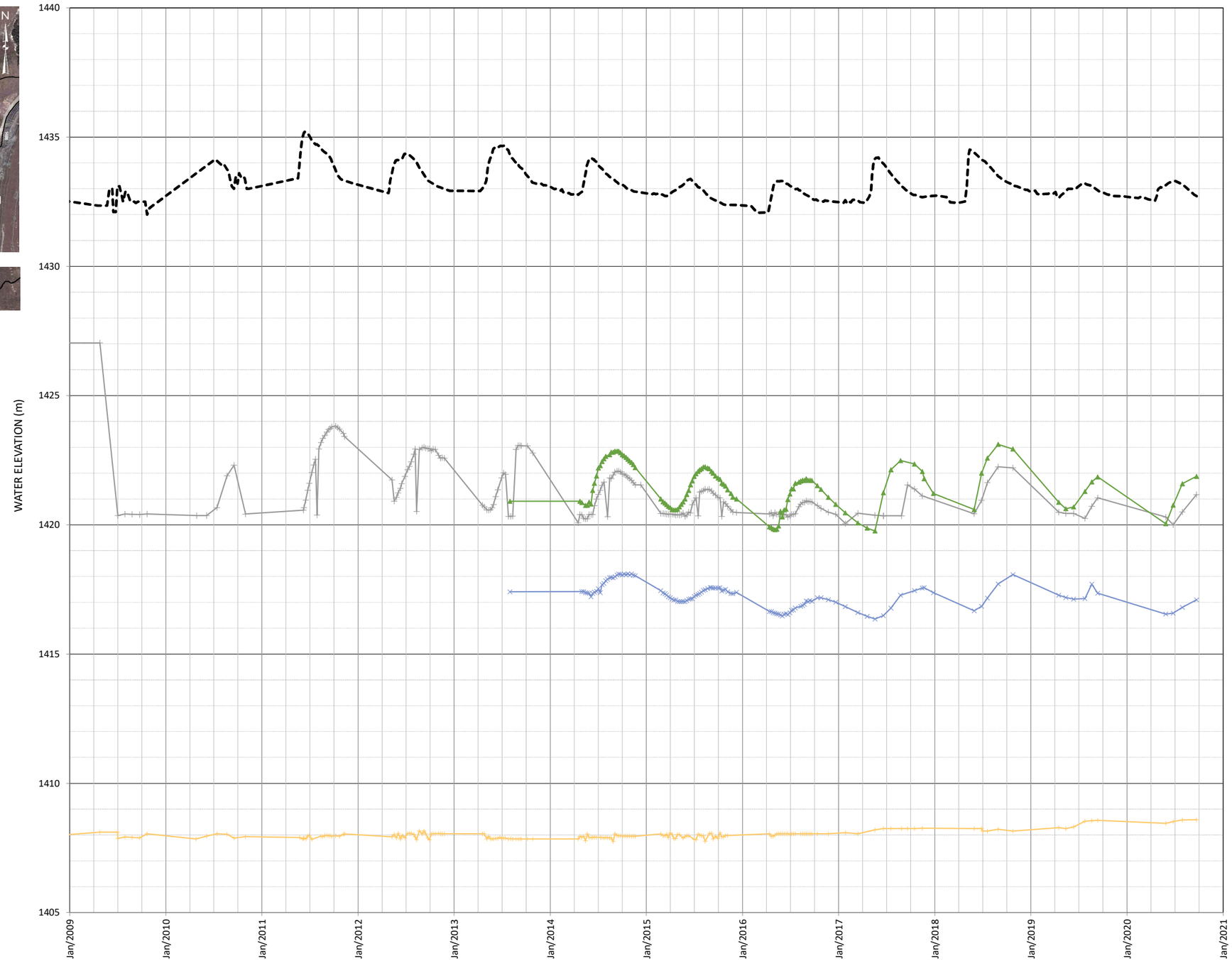
Table II-B-3 Total Station Survey Monument Displacement Thresholds

Instrument ID	Horizontal Vector Displacement from Original Position Threshold (mm)	Incremental Vertical Displacement Between Readings Threshold (mm)	Total Vertical Displacement Threshold (mm)
TD1	80	20	50
TD2A			50
TD3			100
TD4			100
TD5			75
TD6			75

Notes:
1. Thresholds are being revised by KCB and THVCP based on the GPS Real Time Kinematics (RTK) method. The presented thresholds are not applicable to the GPS RTK survey data from the 2020 AFPR review period.

INSTRUMENTATION PLOTS





LEGEND:

- P94-1 (Tip El. unknkown m, Sandfill)
- TB-PS-02/P13-1 (Tip El. 1409.5 m, Cycloned Sand)
- TB-PS-01/P13-2 (Tip El. 1413 m, Cycloned Sand)
- P86-1 (Tip El. 1407.65 m, Sandfill)
- Trojan Pond Level

PIEZOMETER ID	2020 THRESHOLD EL. (m)
TB-PS-02/P13-1	1423.4
TB-PS-01/P13-2	1418.6

NOTES:

1. P94-1 and P86-1 have historically been reported plugged/dry.

January 15, 2021
Z:\M1VCP\M02341B83 - HVC 2020 Dam Safety Support\300 Design\320 Piezometer Data\Trojan\[201127 Trojan Piezo.xlsx]II-B-3 DOWNSTREAM SLOPE

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

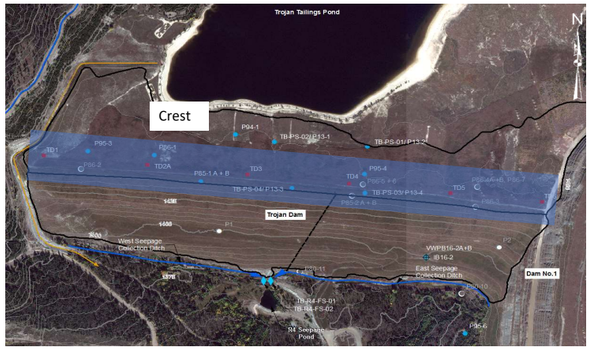
PROJECT: TROJAN TAILINGS STORAGE FACILITY
2020 ANNUAL FACILITY PERFORMANCE REPORT

TITLE: TROJAN DAM PIEZOMETRIC DATA
2009-2020

IMPOUNDMENT

PROJECT No. M02341B83

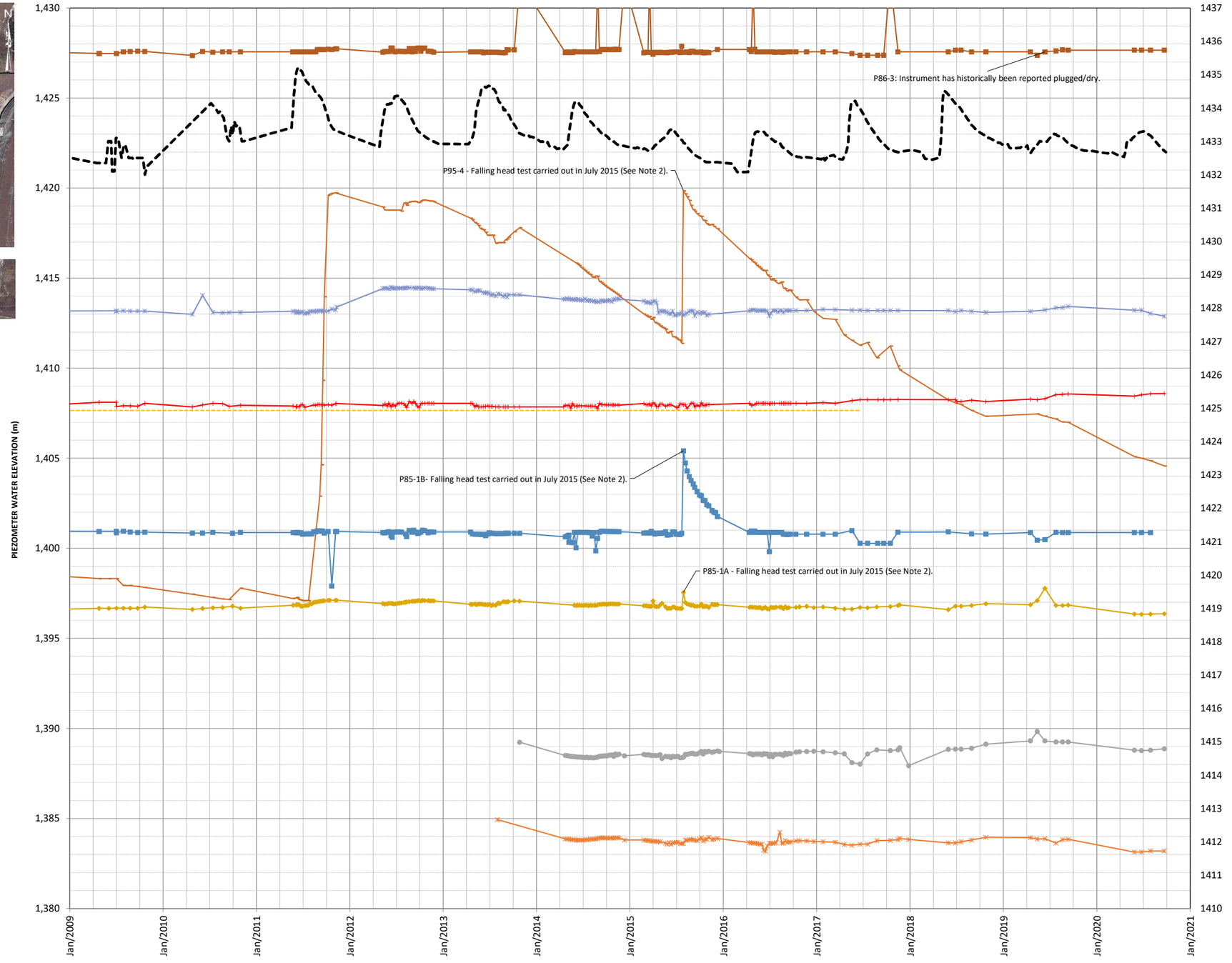
FIG No. II-B-1



LEGEND:

- P95-4 (Tip El. 1389.09 m, Unknown)
- P85-1A (Tip El. 1388.12 m, Foundation)
- P85-1B (Tip El. 1398.78 m, Sandfill)
- TB-PS-04/P13-3 (Tip El. 1376.2 m, Sand and Gravel)
- TB-PS-03/P13-4 (Tip El. 1376.6 m, Till)
- P86-1 dry elevation
- P95-3 (Tip El. 1412.7 m, Foundation)
- P86-1 (Tip El. 1407.65 m, Sandfill)
- P86-3 (Tip El. 1395.83 m, Sandfill)
- Trojan Pond Level

PIEZOMETER ID	2020 THRESHOLD EL. (m)
P85-1A	1399.2
P86-1	1408.2
P86-7	n/a
P95-3	n/a
TB-PS-04/P13-3	1385.4
TB-PS-03/P13-4	1390.5



NOTES:

1. POND ELEVATIONS AND P86-3 WATER ELEVATIONS PLOTTED ON SECONDARY (RIGHT) AXIS. OTHER PIEZOMETER WATER ELEVATIONS PLOTTED ON PRIMARY (LEFT) AXIS.
2. FALLING HEAD TESTS WERE CONDUCTED IN P85-1A (JULY 23, 2015), P95-4 (JULY 24, 2015) AND P85-1B (JULY 23, 2015). IN P95-4, PIEZOMETRIC MEASUREMENTS SHOWED A STEADY DECREASE UNTIL 2019, WHEN THE PIEZOMETRIC LEVEL WAS RELATIVELY CONSTANT AT EL. 1407.5 m (BELOW THE CREST OF THE STARTER DAM). PIEZOMETRIC LEVELS DROPED FURTHER DURING 2020, AND AS OF NOW, HAVE NOT REACHED PRE-TEST LEVELS. ASSUMING 2019 LEVELS ARE REPRESENTATIVE FOR THIS LOCATION, THERE IS NO DAM SAFETY CONCERN AS THE 2019 PIEZOMETRIC LEVEL IS BELOW THAT ASSUMED IN DESIGN.
3. THE FOLLOWING PIEZOMETERS HAVE BEEN REPORTED PLUGGED/DRY: P86-1, P86-7, P95-3, P86-4A, P86-4B, and P85-2A.

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

PROJECT: TROJAN TAILINGS STORAGE FACILITY
2020 ANNUAL FACILITY PERFORMANCE REPORT

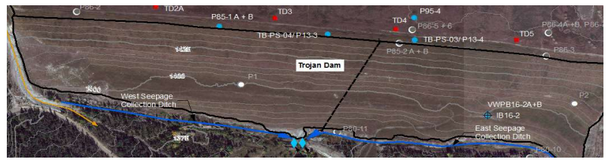
TITLE: TROJAN DAM PIEZOMETRIC DATA
2009-2020

CREST

PROJECT No. M02341B83

FIG No. II-B-2

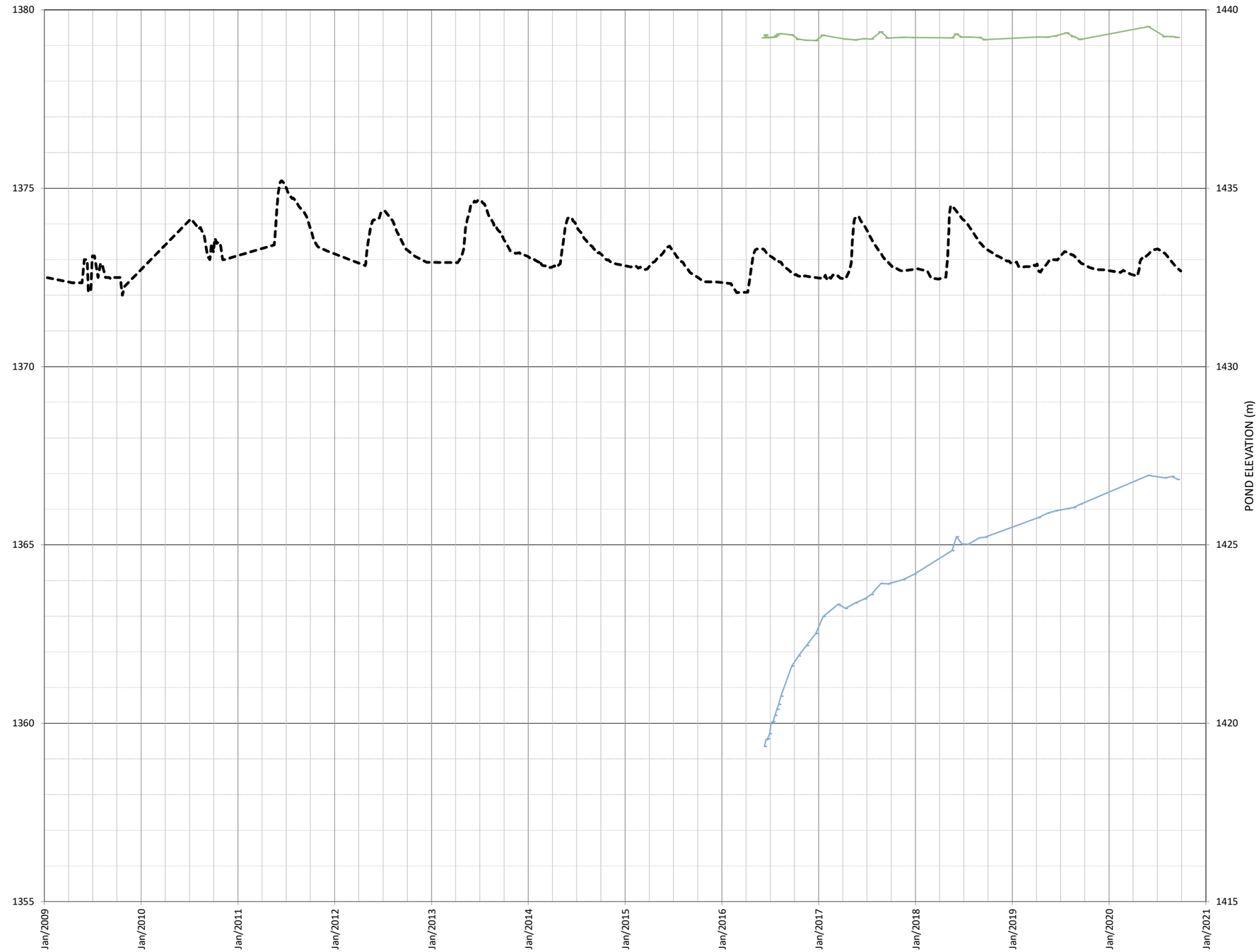
January 15, 2021
Z:\MVCR\M02341B83 - HVC 2020 Dam Safety Support\300 Design\320 Piezometer Data\Trojan\[2011Z7 Trojan Piezo.xlsx]II-B-3 DOWNSTREAM SLOPE



LEGEND:

- VW16-2A (Tip El. 1321.85 m, Glacial Sediments / Debris)
- VW16-2B (Tip El. 1373.35 m, Glacial Till)
- Trojan Pond Level

PIEZOMETER ID	2020 THRESHOLD EL. (m)
VW16-2A	1367.2
VW16-2B	1379.9



NOTES:

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

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

PROJECT: TROJAN TAILINGS STORAGE FACILITY
2020 ANNUAL FACILITY PERFORMANCE REPORT

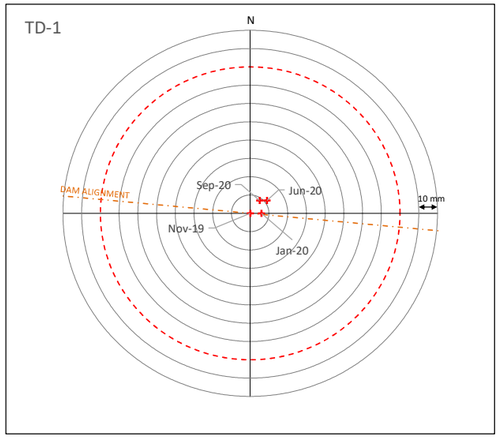
TITLE: TROJAN DAM PIEZOMETRIC DATA
2009-2020

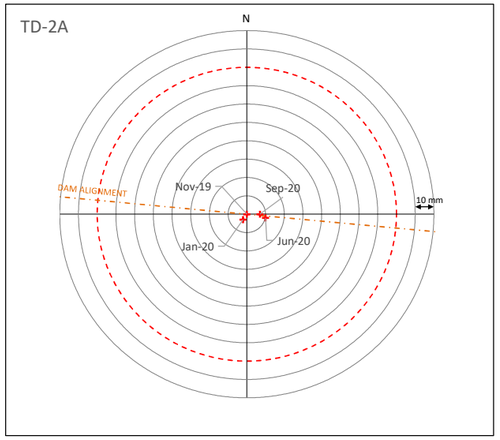
DOWNSTREAM SLOPE

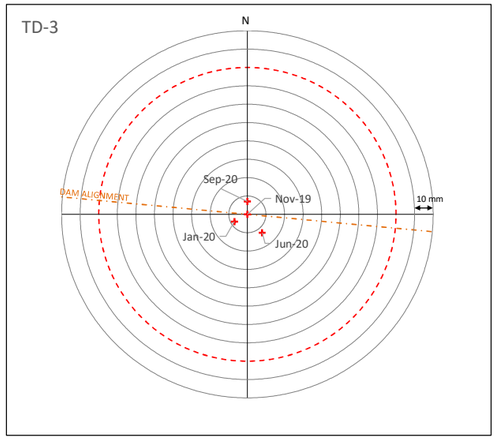
PROJECT No. M02341B83

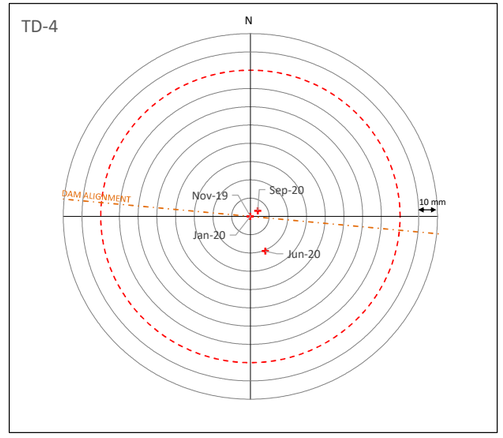
FIG No. II-B-3

January 15, 2021
Z:\MV\CR\M02341B83 - HVC 2020 Dam Safety Support\300 Design\320 Piezometer Data\Trojan\[201127 Trojan Piezo.xlsx]II-B-3 DOWNSTREAM SLOPE



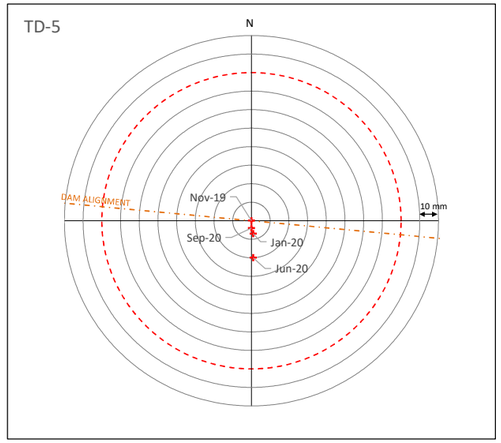


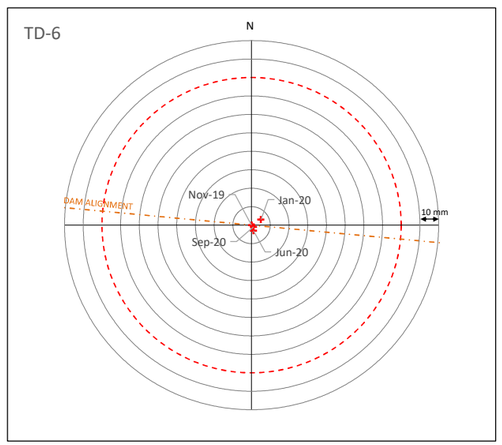




DAM CENTERLINE ORIENTATION

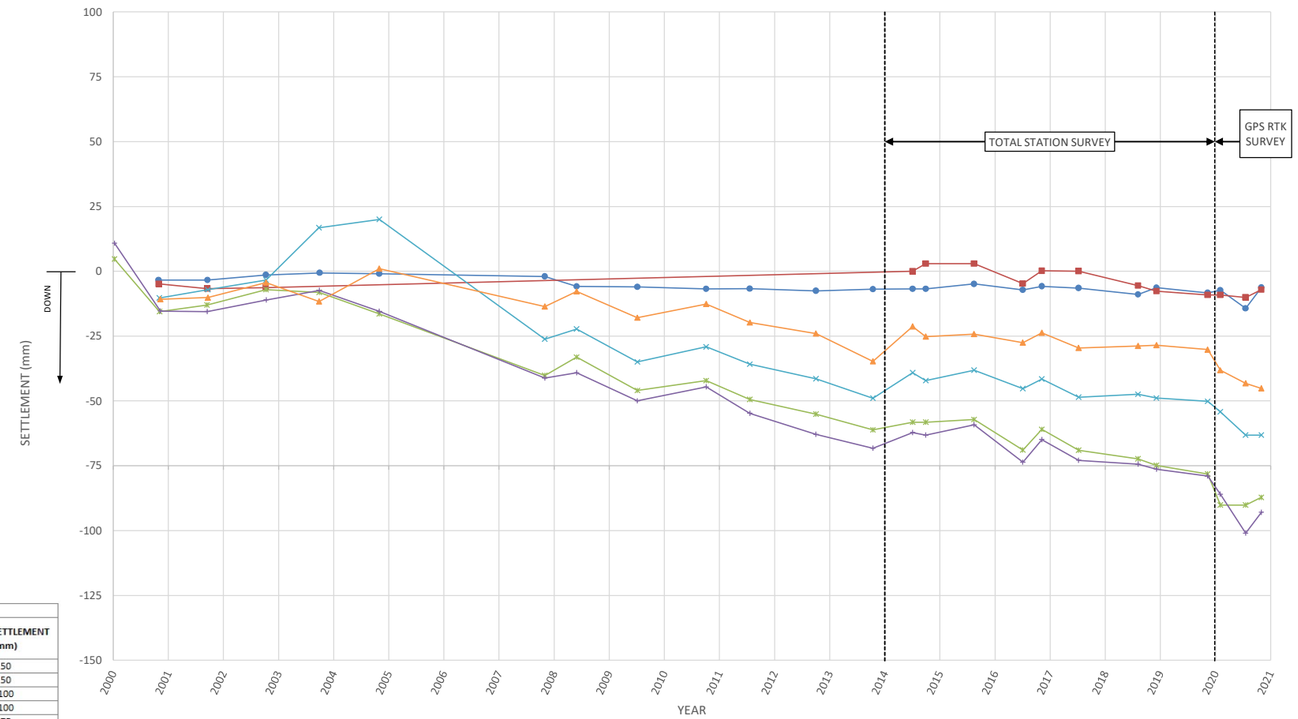
THRESHOLD HORIZONTAL DISPLACEMENT FROM ORIGINAL POSITION





LEGEND:

- TD-1
- TD-2/2A
- TD-3
- TD-4
- TD-5
- TD-6



MONUMENT ID	TOTAL STATION SURVEY METHOD THRESHOLDS		
	HORIZONTAL DISPLACEMENT FROM ORIGINAL POSITION (mm)	INCREMENTAL SETTLEMENT BETWEEN READINGS (mm)	TOTAL SETTLEMENT (mm)
TD1	80	20	50
TD2A			50
TD3			100
TD4			100
TD5			75
TD6			75

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. TROJAN DAM MOVEMENT MONITORING DATA PRIOR TO 2000 NOT SHOWN.
4. REFER TO FIGURE 3 FOR MONUMENT LOCATIONS IN PLAN VIEW.
5. TD-1 RELOCATED AFTER OCT 2001.
6. TD-1 2009 READING (NOT SHOWN IN PLAN PLOT) LOCATED 297 mm FROM INITIAL 1998 READING . READING WAS REVIEWED AND FOUND MORE LIKELY RELATED TO SURVEY ERROR THAN DISPLACEMENT.
7. 2020 SETTLEMENT PLOTTED BY ADDING INCREMENTAL DISPLACEMENT BETWEEN GPS RTK SURVEY READINGS TO CUMULATIVE TOTAL DISPLACEMNENT ON OCT. 9, 2019. THIS ASSUMES NO SETTLEMENT OCCURED BETWEEN OCT. 9 AND NOVEMBER 12, 2019.

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

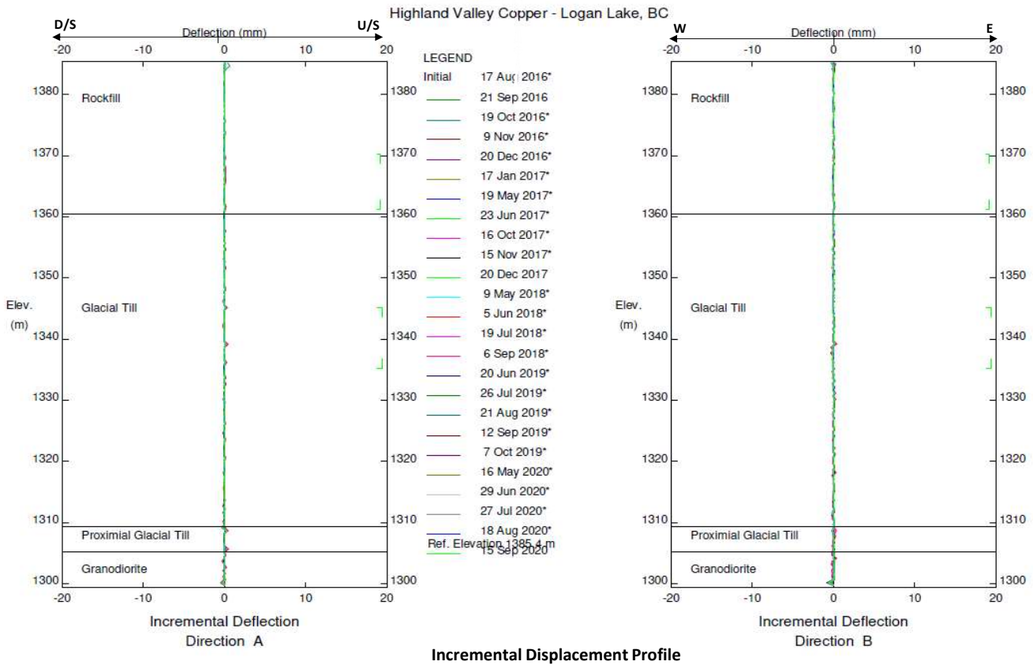
PROJECT: TROJAN TAILINGS STORAGE FACILITY
2020 ANNUAL FACILITY PERFORMANCE REPORT

TITLE: TROJAN DAM
SURVEY MONUMENT READINGS

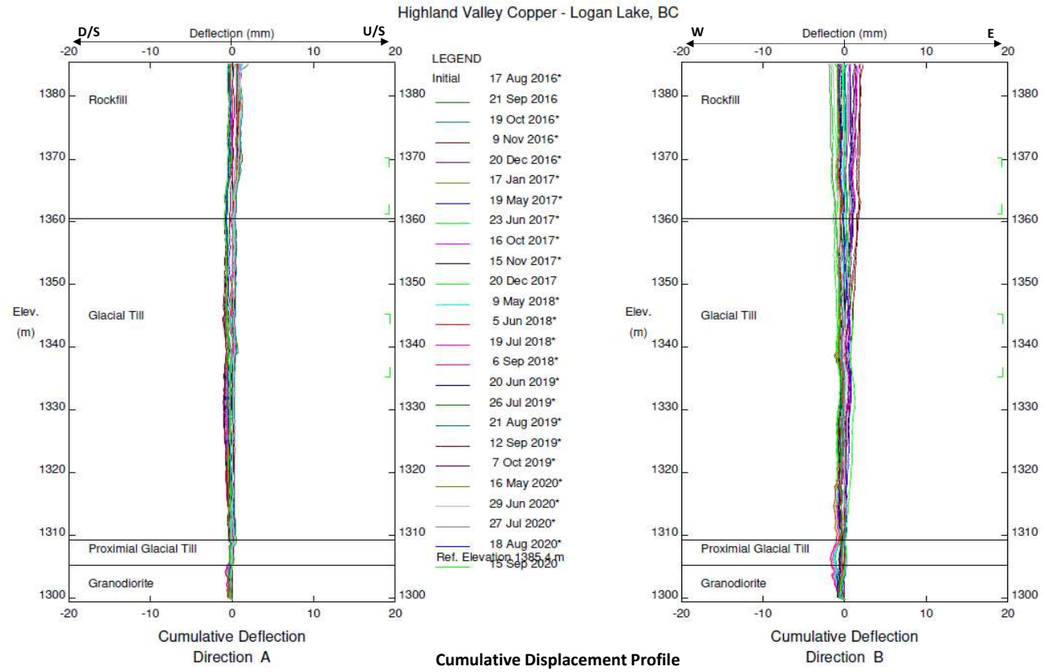
PROJECT No. M02341B83

FIG No. II-B-4

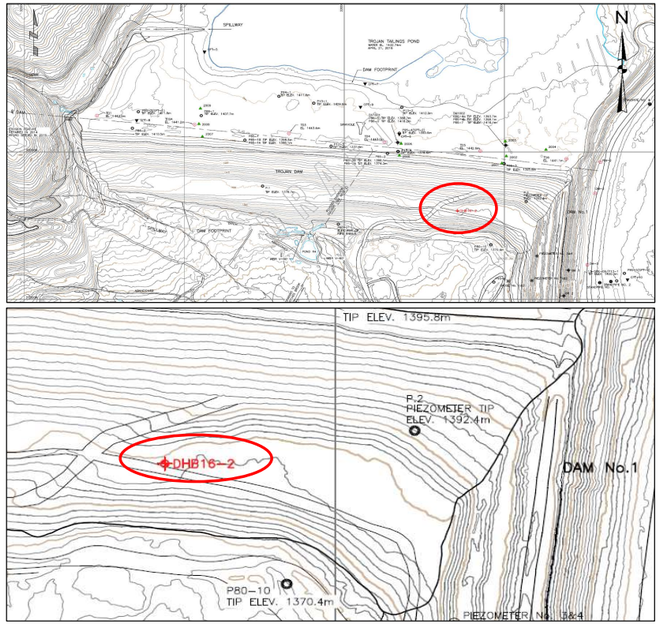
January 19, 2021
\\in.klohn.com\busdata\MVCR\600 QMS & PM\620 PM\623 Staff Planning\[Staff Planning Detailed .xlsx]Name Summary

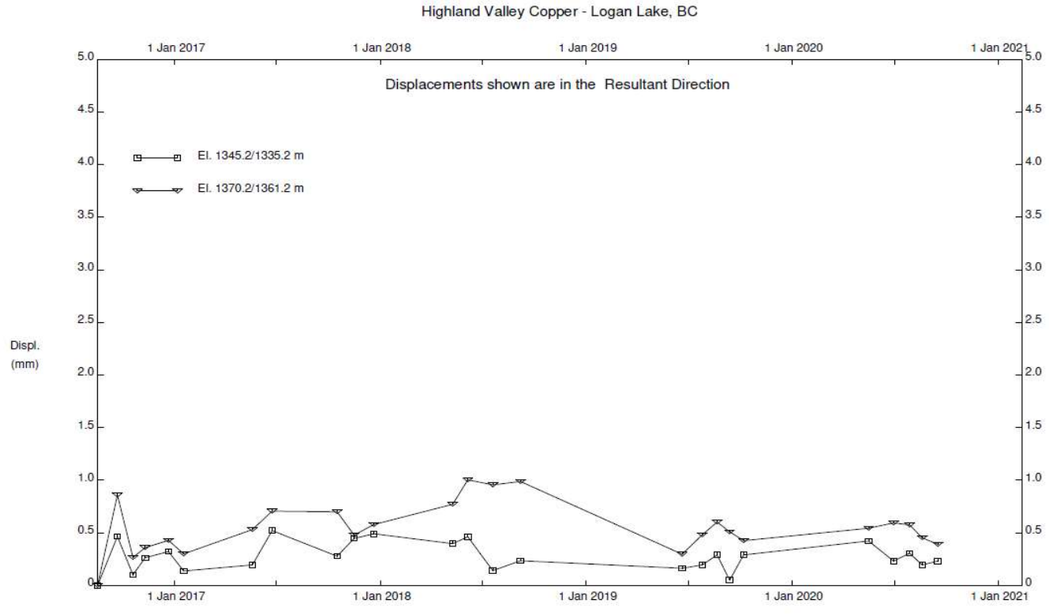


Incremental Displacement Profile



Cumulative Displacement Profile





Cumulative Displacement Profile vs. Time

NOTES:

1) IB16-2 was installed on April 29, 2016.
2) IB16-2 was initialized on June 10, 2016.
3) Reel/Probe Serial Number for the initial reading: DR15020000/DP06580000.

CLIENT: Highland Valley Copper / Teck

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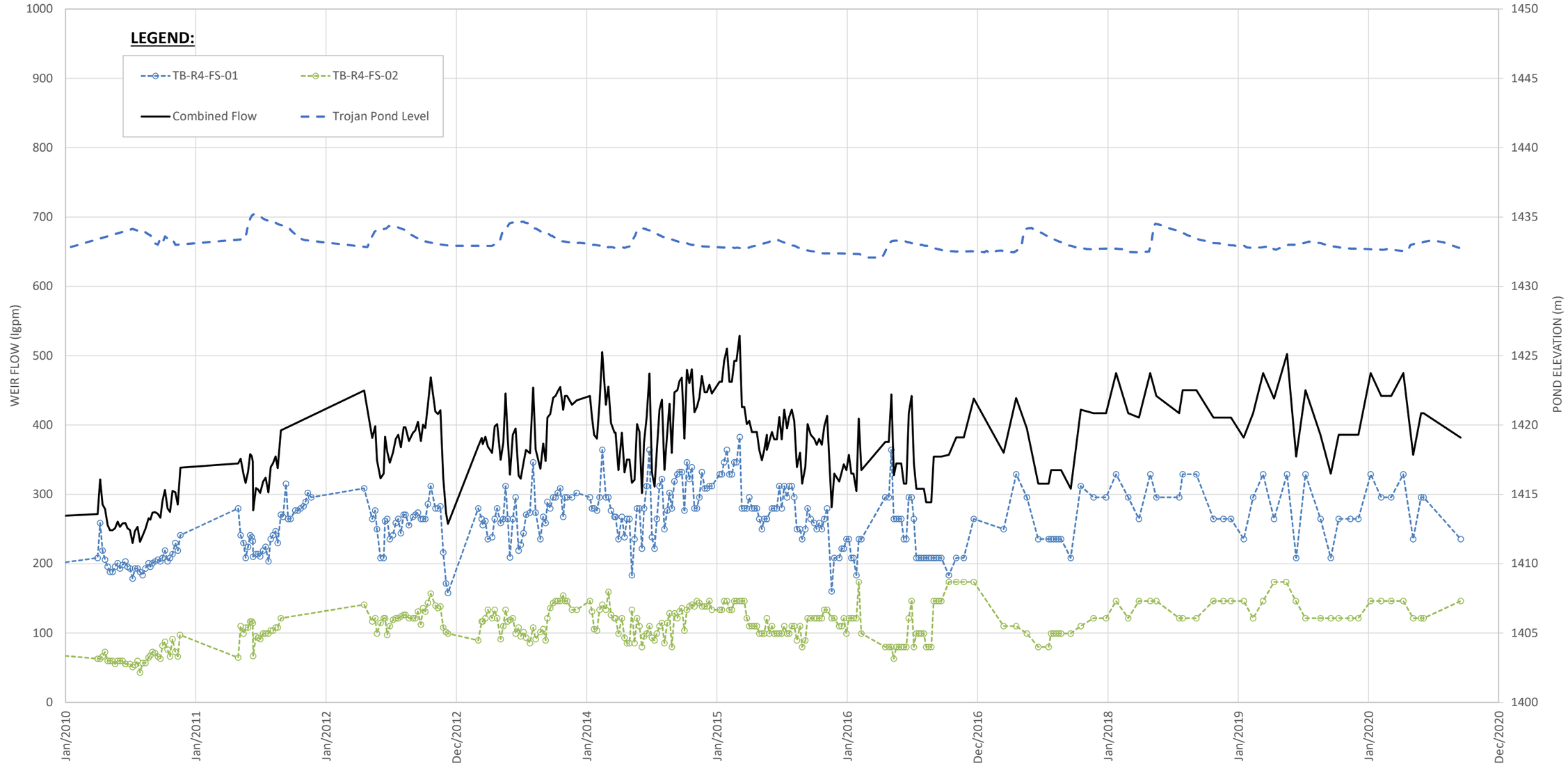
PROJECT: TROJAN TAILINGS STORAGE FACILITY
2020 ANNUAL FACILITY PERFORMANCE REPORT

TITLE: INCLINOMETER DISPLACEMENT PROFILE
IB16-2

PROJECT No. M02341B83

FIG No. II-B-5

November 30, 2020
Z:\MVCR\M02341B83 - HVC 2020 Dam Safety Support\300 Design\340 Dam Movement Monitoring\349 Legacy\(20)1030 Inclinometer plots (Beth and Troj) .xlsx]II-B-5 IB-2 Trojan



NOTES:

1. WEIR FLOW PLOTTED ON PRIMARY (LEFT) AXIS, TROJAN POND ELEVATION PLOTTED ON SECONDARY (RIGHT) AXIS.
2. POND WATER LEVEL RECORDED ON NOVEMBER 8, 2009 HAD A 10 m JUMP AND IS NOT PLOTTED AS IT IS ALMOST CERTAINLY A MEASUREMENT OR DATA ENTRY ERROR.

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

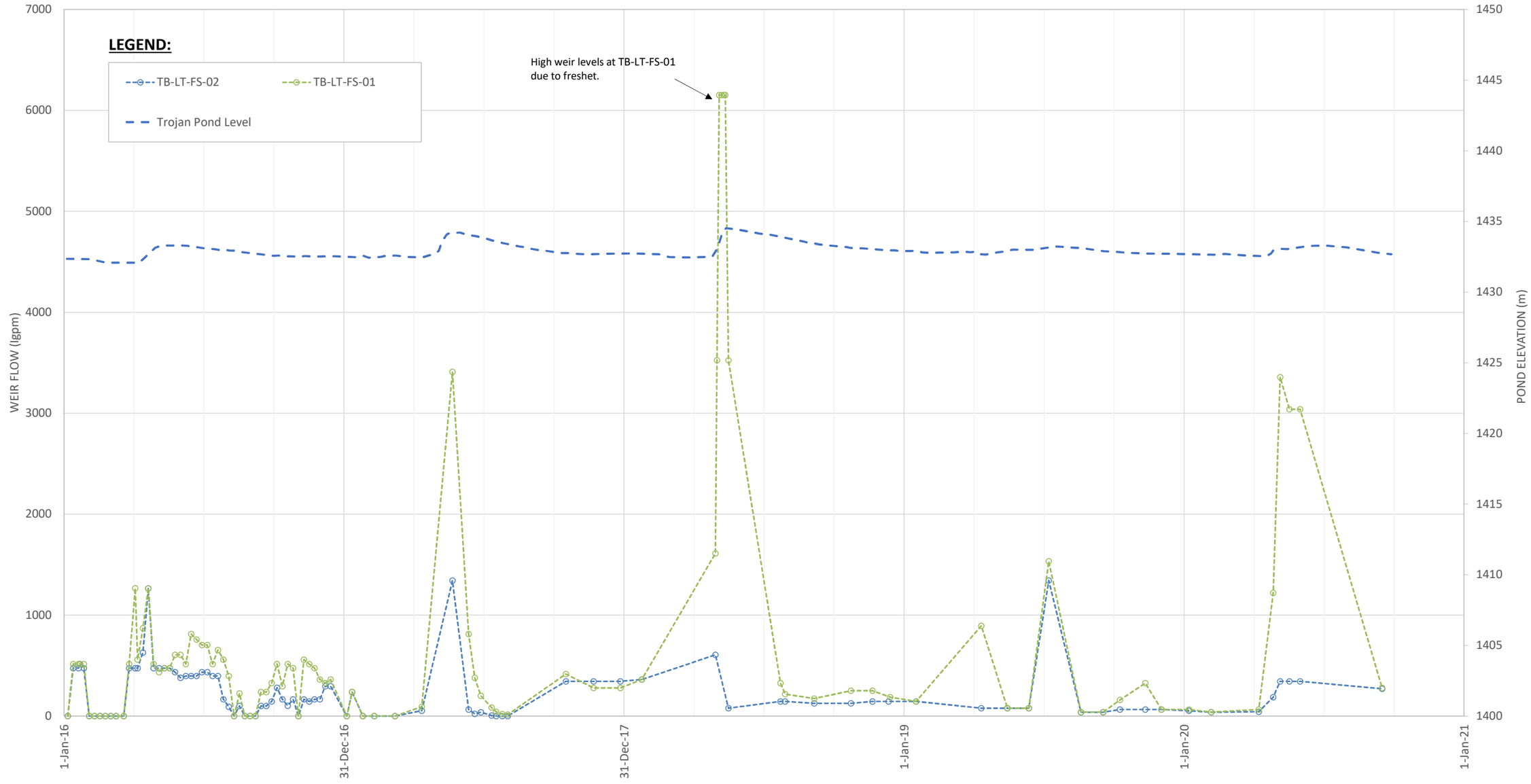
PROJECT: TROJAN TAILINGS STORAGE FACILITY
2020 ANNUAL FACILITY PERFORMANCE REPORT

TITLE: TROJAN DAM
WEIR FLOWS

PROJECT No. M02341B83

FIG No. II-B-6

November 30, 2020
Z:\MV\CRM\02341B83 - HVC 2020 Dam Safety Support\300 Design\350 Seepage Data\Trojan\[201126 Trojan Weir.xlsx]Fig. V-B-7 Lower Trojan Weir



CLIENT

Highland Valley Copper / Teck

Klohn Crippen Berger

PROJECT

TROJAN TAILINGS STORAGE FACILITY
2020 ANNUAL FACILITY PERFORMANCE REPORT

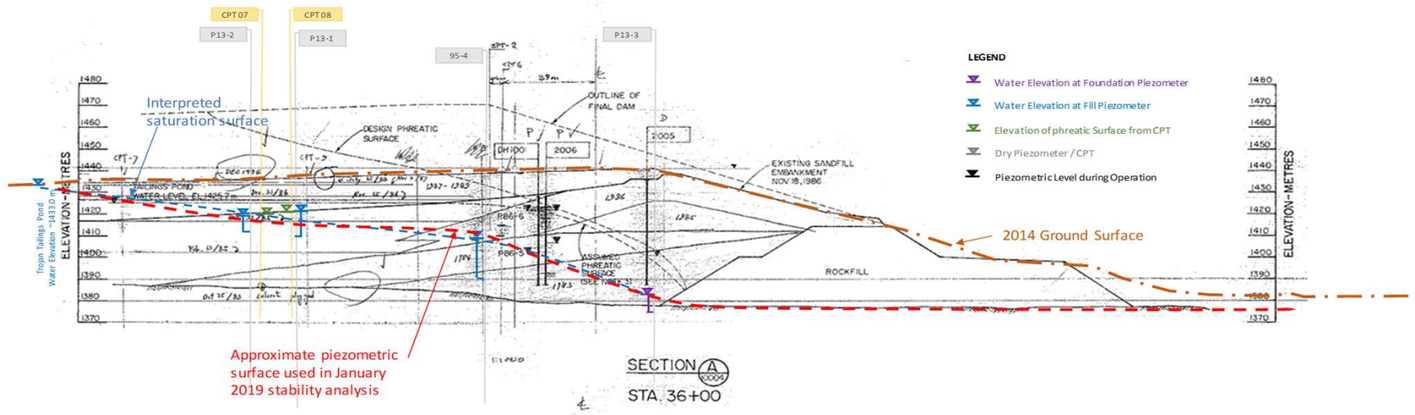
TITLE

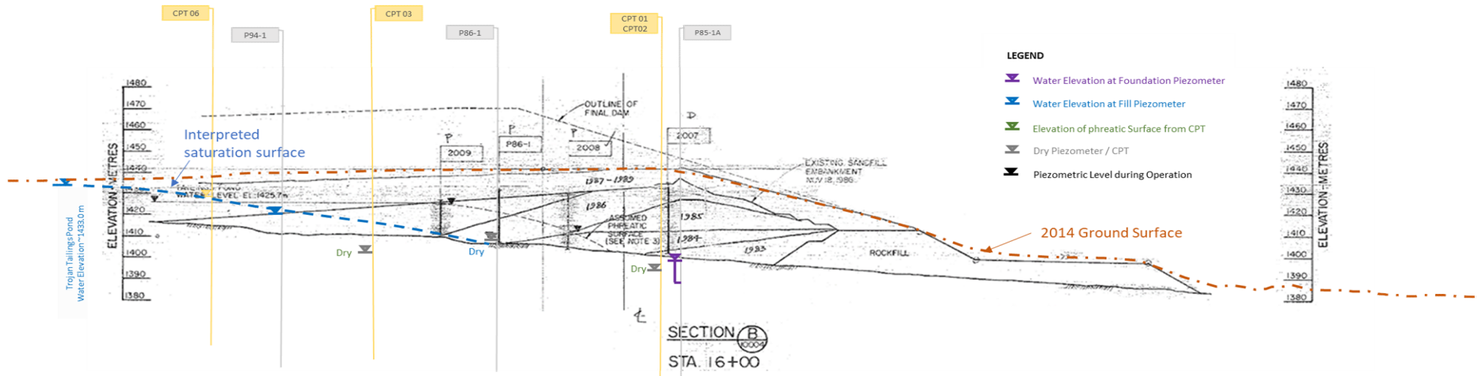
LOWER TROJAN POND
WEIR FLOWS

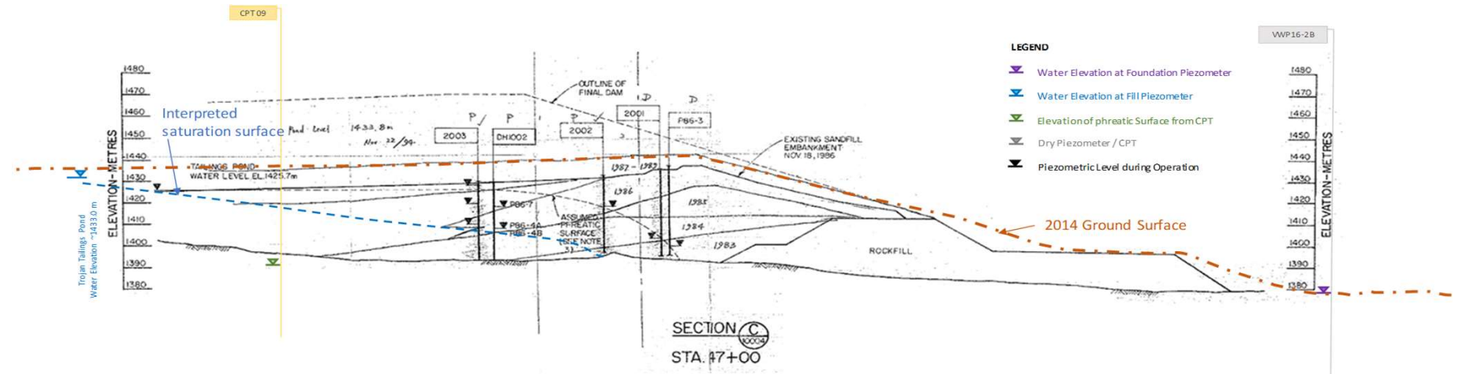
PROJECT No. M02341B83

FIG No. II-B-7

November 30, 2020
Z:\MVCR\M02341B83 - HVC 2020 Dam Safety Support\300 Design\350 Seepage Data\Trojan\201126 Trojan Weir.xlsx]Fig. V-B-7 Lower Trojan Weir







NOTES:

1. Refer to Figure 3 for the location of Sections.
2. 2014 ground surface is at the approximate location from the sections.
3. Piezometer and CPT locations are approximate.
4. Piezometric elevations are based on September 2020 Readings.

CLIENT: Highland Valley Copper / Teck

Klohn Crippen Berger

PROJECT: TROJAN TAILINGS STORAGE FACILITY
2020 ANNUAL FACILITY PERFORMANCE REPORT

TITLE: TROJAN DAM INSTRUMENTATION SECTIONS

DOWNSTREAM SLOPE

PROJECT No. M02341B83

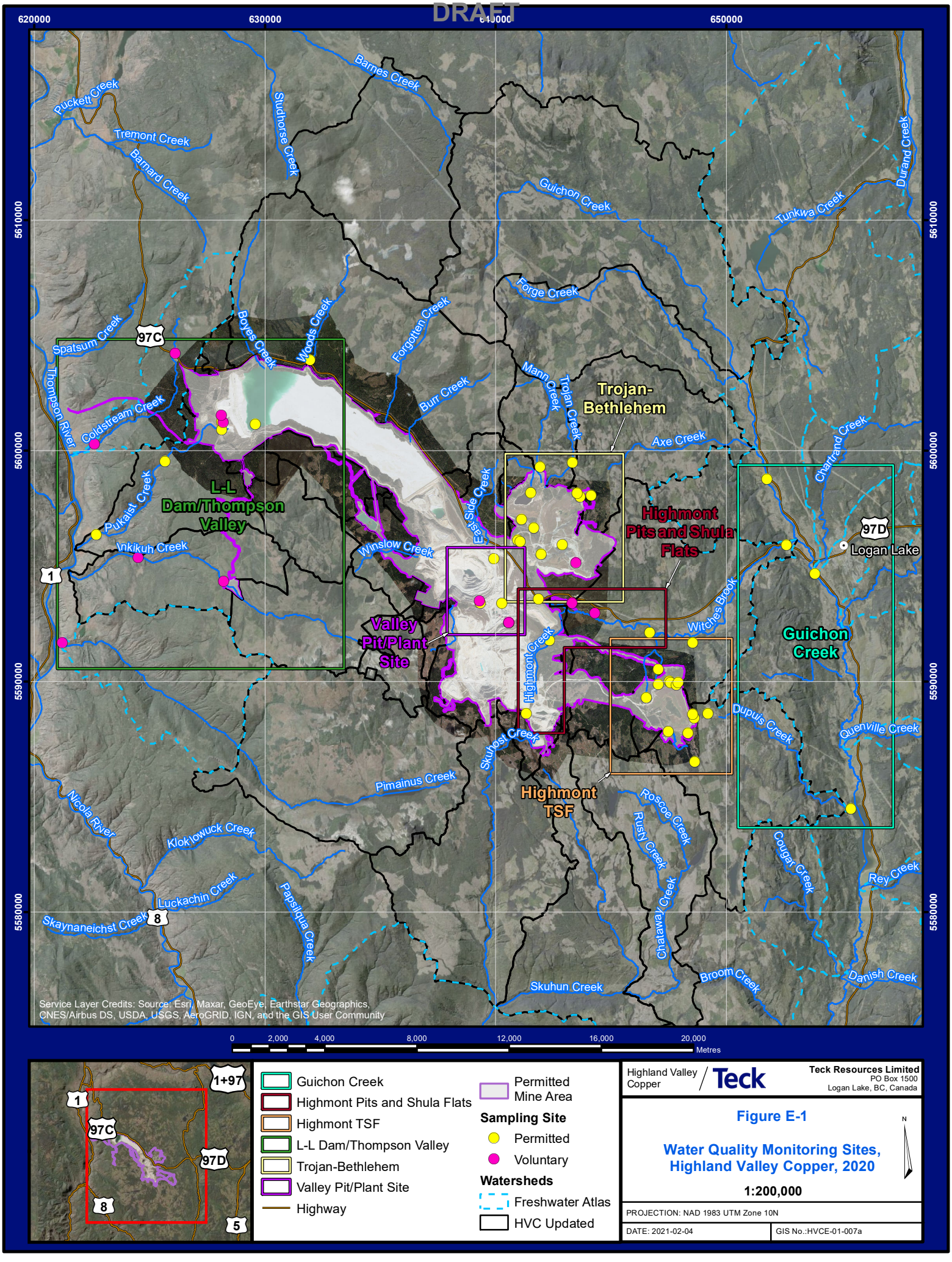
FIG No. II-B-8

November 30, 2020
Z:\MVCR\M02341B83 - HVC 2020 Dam Safety Support\300 Design\330 Instrumentation Sections\Trojan Dam Sections\[201110 Figure II-8.xlsx]IV-B-3 DOWNSTREAM SLOPE

APPENDIX III

Map of Water Quality Monitoring Points

DRAFT



- Guichon Creek
- Highmont Pits and Shula Flats
- Highmont TSF
- L-L Dam/Thompson Valley
- Trojan-Bethlehem
- Valley Pit/Plant Site
- Highway
- Permitted Mine Area

Sampling Site
- Permitted
- Voluntary

Watersheds
- Freshwater Atlas
- HVC Updated

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Figure E-1

Water Quality Monitoring Sites, Highland Valley Copper, 2020

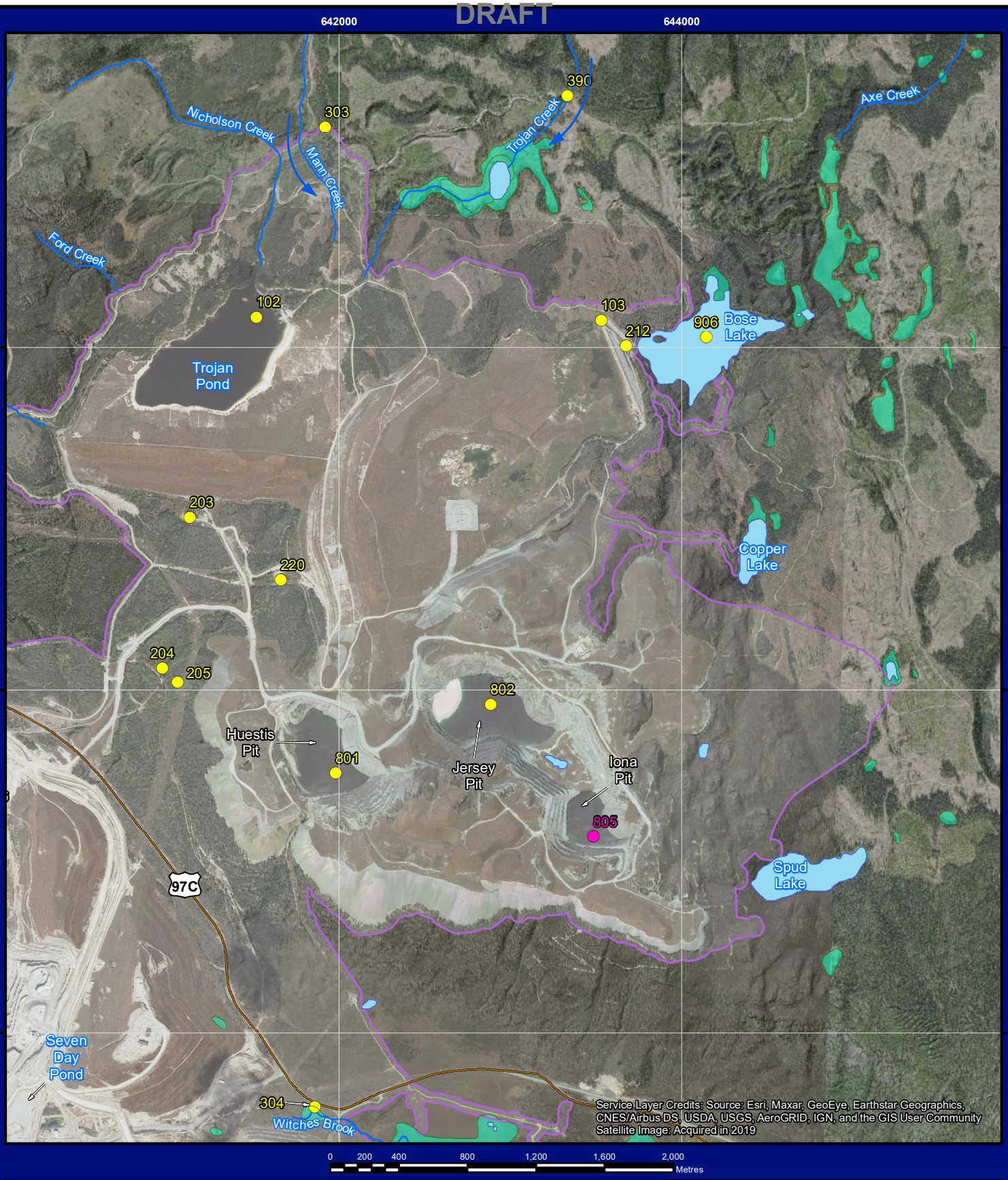
1:200,000

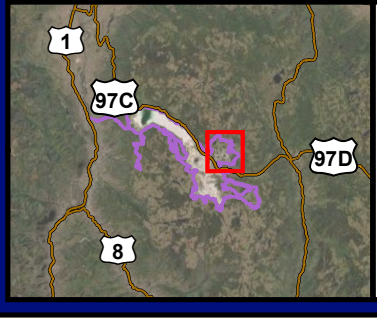
PROJECTION: NAD 1983 UTM Zone 10N

DATE: 2021-02-04

GIS No.:HVCE-01-007a

DRAFT





Sampling Site

- Permitted
- Voluntary
- Permitted Mine Area
- Wetland
- Highland Valley Copper
- Highway
- Flow Direction

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Figure 3.2-30
Water Quality Monitoring Sites in the Trojan-Bethlehem Area, Highland Valley Copper, 2020

1:30,000

N

PROJECTION: NAD 1983 UTM Zone 10N

DATE: 2021-02-05 | GIS No.:HVCE-01-007d

APPENDIX IV

DSR Recommendations – THVCP Work Plan

Appendix IV
DSR Recommendations – THVCP Workplan

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

ID No.	Recommended Action	DSR Assigned Priority[1]	Status (Scheduled completion)	Workplan To Complete
SRK19-GEN-001	THVCP relies on KCB for retaining many documents related to the TSF in contravention with the document control section of the OMS manual. Store all required documents in THVCP's SharePoint site. Ideally, a list of all available documents is appended or referenced in the OMS manual.	4	OPEN (2021)	THVCP is planning for KCB to prepare a consolidated summary of key reference documents which will be included in the next OMS Manual update and used to identify which reports to store on SharePoint.
SRK19-GEN-002	There is a discrepancy in dam crest elevation for all TSF dams (Trojan dam and seepage pond dams) among various documents from the Tailings Management System, such as the latest DSIs (KCB 2016, 2017) and the current version of the OMS manual (THVCP 2016). The OMS manual should have the latest information on dam crest elevations and note the reason for the recent use of different values.	4	*CLOSED*	*Clarified in the OMS Manual update started in 2020.*
SRK19-TD-01	In view of its Very High consequence classification, a re-evaluation of potential liquefaction triggers and consequences should be undertaken. The basis of this assessment should be a sensitivity analysis which considers more conservative assumptions than have been used to date including, for example, significant increases in phreatic levels and increases in the extent of liquefiable tailings.	2	*CLOSED*	*KCB completed a review of typical failure modes associated with upstream raised dams which confirmed controls and design assumptions remain appropriate. Documentation of this assessment is in progress as of the issue date for this report.*
SRK19-TD-02	*Evaluate the effect variance in the phreatic surface has on the stability of the dam. Based on the findings from this evaluation, update as necessary the trigger levels and their corresponding action (s) and then update the OMS manual.*	*4*	*CLOSED*	*Piezometric sensitivity analysis was completed as part of updated slope stability assessment finalized by KCB in 2020 (KCB 2020a).*
SRK19-TD-03	THVCP 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 Trojan fish pond.	4	OPEN (2021)	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. THVCP is to review signage requirements and action as appropriate.
SRK19-TD-04	*There is a developing erosion gully in the dam at the right abutment at a steeper section in the cycloned sand. A similar occurrence developed in the past and will most likely develop again if the area is not modified.* *Repair the erosion gully and evaluate the feasibility of reshaping this area to mitigate the risk of erosion*	*4*	*CLOSED*	*In 2019, area was regraded to divert flow away from area and scour repaired. Erosion did not reappear following 2020 freshet.*
SRK19-TD-05	The flood routing analysis for the Trojan TSF should be updated. The PMF IDF is greater than the Code requirement but was not determined in accordance with CDA (2013) requirements (i.e. spring PMF vs summer/autumn PMF).	3	OPEN (2021)	Refer to Annual Facility Performance Report recommendation TD-2018-02.
SRK19-TD-06	Required and available normal freeboards have not been reported. Evaluate and report required and available normal freeboards.	3	OPEN (2021)	Will be completed as part of planned flood routing review, refer to Annual Facility Performance Report recommendation TD-2018-02.
SRK19-TD-07	*Include reference to where instrumentation location and measured data information for the Trojan Dam can be located in the OMS manual*	*4*	*CLOSED*	*Clarified in the OMS Manual update started in 2020.*
SRK19-TD-08	*Update OMS manual to include operating protocols for the Trojan Diversion – i.e. at what water level in the Trojan TSF pond should valves be closed.*	*3*	*CLOSED*	*Clarified in the OMS Manual update started in 2020.*
SRK19-TD-09	*The OMS manual should include a maintenance protocol for the log boom at the inlet of the Trojan spillway channel.* *Include maintenance requirements for the log boom in the OMS manual.*	*3*	*CLOSED*	*Clarified in the OMS Manual update started in 2020.*
SRK19-R4-01	The required normal freeboard as per CDA (2013) guidelines has not been evaluated. Evaluate required and available normal freeboards.	3	OPEN (2021)	Will be completed as part of planned flood routing review, refer to Annual Facility Performance Report recommendation TD-2018-02.
SRK19-R4-02	*KCB (2018) reports that a stability analysis carried out to support the DSI indicated that the FOS for a deep-seated failure was compliant with the Code, but there is no reference for such analysis. Include the references for the stability assessments of R4 Reclaim Pond in the OMS manual.*	*3*	*CLOSED*	*KCB completed stability analysis which concluded structure met slope stability design criteria for static and seismic loading conditions.*
SRK19-LTD-01	Risk of overtopping. The minimum freeboard requirement set by THVCP (0.5 m) is not met during the IDF. As recommended in the 2017 DSI (LTD-2017-01), the spillway should be upgraded to be compliant with CDA (2013).	3	OPEN (2022)	Refer to Annual Facility Performance Report recommendation LTD-2017-01. Note: deadline extended to prioritize other flood routing activities at site.
SRK19-LTD-02	*The spillway inlet and channel are full of woody debris and the channel flow path is no longer visible.* *As recommended in the 2017 DSI (LTD-2017-01), the spillway channel should be cleared.*	*3*	*CLOSED*	*Vegetation cleared as part of routine maintenance.*
SRK19-LTD-03	The required normal freeboard as per CDA (2013) guidelines was not evaluated. Evaluate required and available normal freeboards.	3	OPEN (2021)	Will be completed as part of planned flood routing review, refer to Annual Facility Performance Report recommendation TD-2018-02.

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.