Klohn Crippen Berger

Teck Highland Valley Copper Partnership

2017 Dam Safety Inspection Report

7-Day Pond

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March 2018

March 29, 2018

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

Mr. Chris Anderson
Superintendent, Tailings and Water Management

Dear Mr. Anderson:

2017 Dam Safety Inspection Report
7-Day Pond

We are pleased to submit the 2017 Dam Safety Inspection report for the 7-Day Pond 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), Section 4.2 "Annual Tailings Facility and Dam Safety Inspection Report" of the Code Guidance Document.

Yours truly,

KLOHN CRIPPEN BERGER LTD.

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

AP/EH:cd

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Teck Highland Valley Copper Partnership

2017 Dam Safety Inspection Report

7-Day Pond

EXECUTIVE SUMMARY

Klohn Crippen Berger Ltd. (KCB) were engaged by Teck Highland Valley Copper Partnership (THVCP) to complete the 2017 dam safety inspection (DSI) of the 7-Day Pond facility on the Highland Valley Copper (HVC) mine site in accordance with the requirements of the Health, Safety and Reclamation Code for Mines in British Columbia (the Code). The inspection was completed by a representative of the Engineer of Record (EoR), Mrs. Emma Hill, P.Eng, on March 23, 2018. Mr. Rick Friedel, P.Eng., is the EoR for 7-Day Pond and Mr. Chris Anderson, P. Eng., THVCP Tailings and Water Superintendent, is the TSF Qualified Person (as defined by the Code) for the 7-Day Pond.

The HVC site is located near Logan Lake, approximately 45 km south of Kamloops, in the interior of British Columbia. The 7-Day Pond is located 180 m north of the flotation building. The pond is used as emergency storage for tailings and water from the Highland Mill. The pond also serves as contingency storage for other pumped flows as needed. Discharge of tailings from the south of the pond has formed a beach sloping to the north and a pond at the north end of the basin.

The 7-Day Pond has been assigned a “Low” consequence classification as defined by CDA (2013). The Code requires a dam safety review (DSR) to be undertaken for any tailings facility, regardless of consequence category, every five years (MEM 2016). No DSR has been completed on the 7-Day Pond previously. The next DSR is scheduled for 2021, which is five years after the implementation of the Code.

The 7-Day Pond has existed at the HVC site for several decades. The pond is contained by haul roads and access roads of varying crest widths and heights on all sides. The minimum crest elevation is along the eastern perimeter haul road where the road fill acts as a retaining berm which, if overtopped at this location, could develop a breach and result in uncontrolled release of water and tailings into the adjacent treed area. In 2013 and 2014, the pond was partially backfilled and reduced in size to accommodate the alignment of a new ore conveyor. No design or construction records are available and as a result, additional work has been recommended to meet the requirements under the Code: Operation, Maintenance and Surveillance (OMS); and water balance.

An intent of the Code is to define the operational and technical requirements to appropriately manage risks associated with the facility. KCB completed a review to assess whether the classification and management approach being implemented best manage risks associated with the structure, under existing conditions (KCB 2018a). Based on this review, KCB recommended THVCP consider the following:

- Since the purpose of the facility is to manage upset conditions in the Mill, Mill Operations, rather than the Tailings Water Management (TWM) group, should be responsible for managing the 7-Day Pond.
- As facility seepage and changes in pond level directly impacts the piezometric conditions in the adjacent Valley Pit wall, external technical oversight should be provided by the Pit Geotechnical Review Board (GRB), rather than as a tailings facility by the TWM group.

The reservoir level has been regularly monitored since 2015. The records show a trend of increasing pond level due to continued tailings discharge in the facility rather than accumulating water. There is no spillway for 7-Day Pond, which has insufficient capacity to store the Inflow Design Flood (IDF); instead, portable pumps are deployed when needed to draw down the water level.

Water quality in the Highland Valley Pit area, where the 7-day Pond is located, is monitored by HVC monthly to assess the effectiveness of the tailings facility in protecting the downstream receiving environment (ERM 2018). All permit sampling requirements and frequency were met in 2017.

Quarterly visual inspections were completed by THVCP. The pond level within the yellow alert range for most of the year because approximately 27,000 m^3 of tailings were discharged into the facility over than period. Revised pond alert levels have been defined form 2018 based on the latest bathymetry. There are no geotechnical instruments at 7-Day Pond and none are recommended for the existing condition.

The 7-Day Pond facility appears to be in good physical condition and the observed performance during the 2017 site inspections was consistent with past performance. The status of recommendations to address deficiencies and non-conformances identified during past DSIs are summarized in Table 1. Closed recommendations are shown in *italics*. Recommendations to address deficiencies and non-conformances identified during the 2017 DSI are summarized in Table 2.

Table 1 Previous Recommendations for Deficiencies and Non-Conformances – Status Update

ID No.	Deficiency or Non-Conformance	Applicable Reg. or OMS Reference	Recommended Action	Priority[1]	Recommended Deadline (Status)
SDP-2016-01	*Water Management*	*Flood Routing*	*Complete a flood routing and freeboard assessment to demonstrate compliance with the Code or identify requirements for upgrading the flood handling capabilities of this facility*	*3*	*Q3 2017 (CLOSED)*
SDP-2016-02	Operations	OMS and EPRP	Prepare an OMS manual and EPRP.	3	Q3 2017 (OPEN, scheduled May 2018)
SDP-2016-03	*Design*	*Slope Stability*	*Complete a slope stability analysis including assessment of performance under the EDGM under the Code.*	*3*	*Q3 2017 (CLOSED)*
SDP-2016-04	Water Management	Water Balance	Prepare a simplified water balance for the impoundment to meet the requirements of the Code.	3	Q4 2017 (OPEN)

Notes:

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

Table 2 2017 Recommendations for Deficiencies and Non-Conformances

ID No.	Deficiency or Non-Conformance	Applicable Reg. or OMS Reference	Recommended Action	Priority[1]	Recommended Deadline
SDP-2017-01	Tailings Management	Storage Capacity	Develop a long-term strategy for 7-Day Pond to manage ongoing tailings storage requirements (currently less than 2 years of tailings storage available based on 2017 tailings volume).	2	Q4 2018
SDP-2017-02	Water Management	Flood Routing	Complete an updated flood routing assessment to define the pumping capacity and threshold elevations to safely manage the IDF with adequate freeboard (to be defined as part of assessment).	2	Q4 2018

Notes:

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

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1 INTRODUCTION

Klohn Crippen Berger Ltd. (KCB) was engaged by Teck Highland Valley Copper Partnership (THVCP) to complete the 2017 dam safety inspection (DSI) of the 7-Day Pond facility on the Highland Valley Copper (HVC) mine site. The pond is used as emergency storage for tailings and water from the Highland Mill. Under the revised Health, Safety and Reclamation Code for Mines in British Columbia (the Code) issued in 2016, the 7-Day Pond is a tailings storage facility and is subject to the Code requirements for a "Low" consequence classification facility. Prior to 2016 this facility was classified as a sediment pond. This change has increased the requirements for this facility significantly relative to previous years which is reflected by the 2016 DSI recommendations.

The scope of work consisted of:

- a visual inspection of the physical condition;
- a review of climate data for the site;
- a review of the past year's construction and monitoring records, where applicable.

The inspection and this report were prepared to comply with Section 10.5.3 of the Code (MEM 2017), and Section 4.2 of the "Annual Tailings Facility and Dam Safety Inspection Report" of the Code Guidance Document (MEM 2016). Mr. Rick Friedel, P.Eng., is the Engineer of Record (EoR) for 7-Day Pond and Mr. Chris Anderson, P. Eng., THVCP Tailings and Water Superintendent, is the TSF Qualified Person (as defined by the Code) for the 7-Day Pond. The inspection was completed by a representative of the EoR, Mrs. Emma Hill, P.Eng, on March 23, 2018.

There is no permit specifically for the operation of the 7-Day Pond as a tailings facility; however, under the British Columbia Ministry of Environment (MOE) effluent permit PE-376, the pond, referred to as the Emergency Tailings Pond, has a requirement to maintain sufficient capacity to receive emergency discharges from the Mill and bulk flotation building. The pond is also operated under the general British Columbia Ministry of Energy, Mines and Petroleum Resources (MEM) geotechnical permit M-11 for the mine (Mine ref. 0300010 HVC).

The 7-Day Pond has been assigned a "Low" consequence classification as defined by CDA (2013) based on a dam consequence review held on January 16, 2018, which the EoR (Mr. Rick Friedel, P.Eng. of KCB) participated in via teleconference. The Code requires a dam safety review (DSR) to be undertaken for any tailings facility, regardless of consequence category, every five years. No DSR has been completed on the 7-Day Pond previously, the next DSR is scheduled in 2021 which is 5 years after the implementation of the new Code, notwithstanding potential future changes to management of the facility, as discussed below.

The 7-Day Pond stores tailings and is therefore classified as a tailings facility under the Code. An intent of the Code is to define the operational and technical requirements to appropriately manage risks associated with the facility. KCB completed a review to assess whether the classification and

management approach being implemented best manage risks associated with the structure, under existing conditions (KCB 2018a). The review concluded:

- The current configuration of the 7-Day Pond and adjacent treed areas (Figure 2), does not meet the regulatory definition of a dam under the Code; however, the access road dividing the two areas does.
- There are no credible failure modes that could result in an uncontrolled breach of containment with negative impacts to site personnel, external parties or the environment.
- If classified as a dam, a consequence classification according to CDA (2013) greater than "Low" is not warranted.
- The purpose of the facility is to manage upset conditions in the Mill, thus Mill Operations, rather than the Tailings Water Management (TWM) group, should be responsible for managing the 7-Day Pond.
- As facility seepage and changes in pond level directly impacts the piezometric conditions in the adjacent Valley Pit wall, external oversight should be provided by the Pit Geotechnical Review Board (GRB), rather than as a tailings facility by the TWM group.
- This internal management change should not affect regulatory governance (i.e., still operated under MEM M-11, and MOE PE-376).

KCB recommend that THVCP engage with the Mill Operations team, Pit GRB and MEM to review whether the proposed management structure can be implemented.

2 FACILITY DESCRIPTION

The HVC site is located near Logan Lake, approximately 45 km south of Kamloops, in the interior of British Columbia. The 7-Day Pond is located approximately 1 km southeast of the Valley Pit; refer to Figure 1.

The pond is used as emergency storage for tailings from the Highland Mill (the Mill). Mill Operations control discharge of tailings, as well as contributing sources of water including overflow from the thickeners, sewage treatment plant (STP) effluent, and other pumped flows/surface runoff, as needed. Water leaves the 7-Day Pond mostly as seepage to the Valley Pit where it becomes part of pit water management. When needed, Mill Operations also deploy portable pumps to draw down the water level in the 7-Day Pond; pumped outflows are returned to the Mill.

Containment is provided by access roads of varying crest widths and heights on all sides of the 7-Day Pond; a low point is located along the eastern perimeter access road where the road fill (about El. 1260 m) creates a 30 m wide, 4 m high retaining berm. Immediately downstream of this low point are two vegetated depressions (also created by the surrounding access road fills with crests at about El. 1261.5 m), referred to herein as the treed areas. Thus, the 7-Day Pond and treed areas, together form a facility that is wholly below the surrounding grade with the eastern perimeter access road of the 7-Day Pond forming an internal dike whose crest elevation (El. 1260 m) is below the minimum perimeter crest (El. 1261.5 m).

Historical discharge of tailings from the south end of the 7-Day Pond has formed a beach sloping to the north and a semi-permanent pond at the north end of the basin. Typically, the pond is too shallow to require any sustained long periods of pumping over the course of a year. Pumping to keep the water level below the specified minimum freeboard (0.9 m) is generally not required outside of freshet periods.

3 BACKGROUND AND RECENT ACTIVITY

3.1 History

The 7-Day Pond has existed at the HVC site for several decades and there is no documentation of its construction history. Comparison of historic and current topography supports the interpretation of the surrounding access roads as fills. In 2013 and 2014, the interior of the pond was partially backfilled (packed using mine trucks and other heavy equipment) and reduced in size (by approximately 65% in area) to accommodate the alignment of a new ore conveyor to the northwest.

3.2 2017 Activities

During 2017, approximately 27,000 m^3 of tailings were discharged into the facility. No maintenance activities were undertaken during 2017, and portable pumps were not required to maintain water levels.

4 WATER MANAGEMENT

4.1 Overview

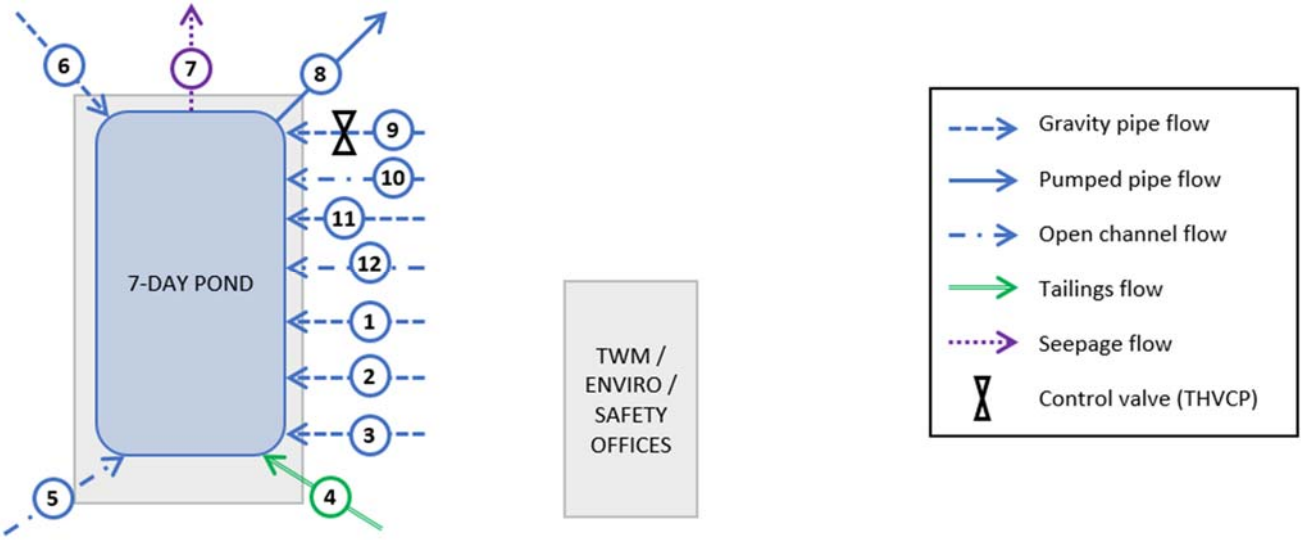
A schematic of the tailings and water management system for 7-Day Pond is shown on Figure 4.1. Inflow are outflow rates/volumes are not monitored.

In addition to precipitation and surface runoff, inflow to the pond includes discharge from eight sources:

- 1x regular: treated effluent from the STP;
- 5x irregular but annually recurring: Inflow #2 from Mill, Inflow #3 from thickeners, overflow from Mill Water Pumphouse, inflow from No. 4 Crusher and Truck Wash; and
- 2x emergency, i.e. irregular: tailings dump and Witches Brook.

Outflows include evaporation, seepage into the wishing well sump in the Valley Pit which are then pumped to the Mill, and pumped flows to the Mill Diversion Line (MDL) which is commissioned as needed. The portable pump at the northeast corner of the pond was decommissioned in August 2016 due to insufficient water levels for operation. The pump has not been deployed since, and there were no outflow controls at the time of inspection.

Figure 4.1 Process Flow Diagram for 7-Day Pond



No.	Name	Description	Status
1	Inflow #1	HDPE pipe	Non-operational
2	Inflow #2 (a.k.a. Dog & Easy)	36" dia. HDPE pipe, irregular flow from: i) overflow from MOP (connects U/S of discharge point); ii) overflow from sump in Mill which collects excess surface water from cleaning activities.	Operational
3	Inflow #3	HDPE pipe, semi-regular flow from thickener overflow (majority) and surface water around the Mill (minor component).	Operational
4	Tailings Dump Line	No line existing. If needed, a new one could be opened up to 7-Day Pond.	Non-operational
5	Overflow from Mill Water Pumphouse	Irregular open channel overflow from 325 ft Thickeners	Operational
6	Inflow Culvert	900 mm dia. HDPE legacy culvert	Decommissioned
7	Seepage to Valley Pit	Seepage reports to Wishing Well Sump in Valley Pit	N/A
8	Pump to Mill Diversion Line	1x HDPE pipeline and portable pump (deployed when needed)	N/A
9	Witches Brook Drain	1x HDPE pipe with control valve	Operational
10	Inflow from Sewage Treatment Plant	Regular, treated effluent in trench running south to north and discharging at the NE corner of the pond	Operational
11	Inflow from No. 4 Crusher	1x HDPE pipe, irregular flow	Operational
12	Inflow from Truck Wash	Surface runoff from truck wash collected by drainage ditch	Operational

4.2 Climate

Climate data was collected throughout the year from the L-L Dam weather station (El. 1122 m) and summarised on Table 4.1and Figure 4.2. Climate normals (1981 to 2010) from the Highland Valley Lornex Station (Environment Canada Station No. 1123469) are shown on the same figure for comparison. This climate station was located near the Highland Mill, and had the longest running record for the mine site from 1971 until being decommissioned in November 2011.

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 to track the changes in snowpack. The measurements are sorted by survey period (the first of January through May) to compare snowpack depths (in snow-water equivalent (SWE) around the same time each year. Historical average and 2017 snowpack depths based on available records are summarized in Table 4.2.

The following observations were noted for 2017:

- May through August appear noticeably drier than average. No data was missing during this time.
- On an annual basis, precipitation at the L-L Dam weather station was 28% lower than normal (at Lornex).
- Snowpack depths were not measured for the January 1st or February 1st survey periods. The March 1st, April 1st, and May 1st snowpack depths (in SWE) were 30%, 50%, and 271% greater than average, respectively.

During freshet, a period of rainfall followed by a sudden increase in temperature (Figure 4.3) triggered greater than normal surface runoff on site and in the region starting May 5, 2017. Available records also show the snowpack depth (in SWE) near the Trojan TSF was 3.7 times greater (relative percent difference = +271%) than average for that time of year. The combination of available snowpack and rapid melt-inducing changes led to a more severe freshet in 2017 than normal. Observations and actions in response are discussed in the relevant sections of this report.

Table 4.1 Monthly Precipitation in 2017

Month	Precipitation (mm)	
	L-L Dam – Unadjusted	Lornex Normals
January	13.5	27.5
February	37.1	21.0
March	21.2	16.7
April	34.6	21.3
May	15.6	41.3
June	5.9	47.9
July	2.8	43.5
August	10.8	31.7
September	28.8	31.2
October	33.5	30.0
November	46.2	40.4
December	34.8	40.8
Annual Total	284.7	393.3

Figure 4.2 Monthly Precipitation in 2017 and Climate Normals

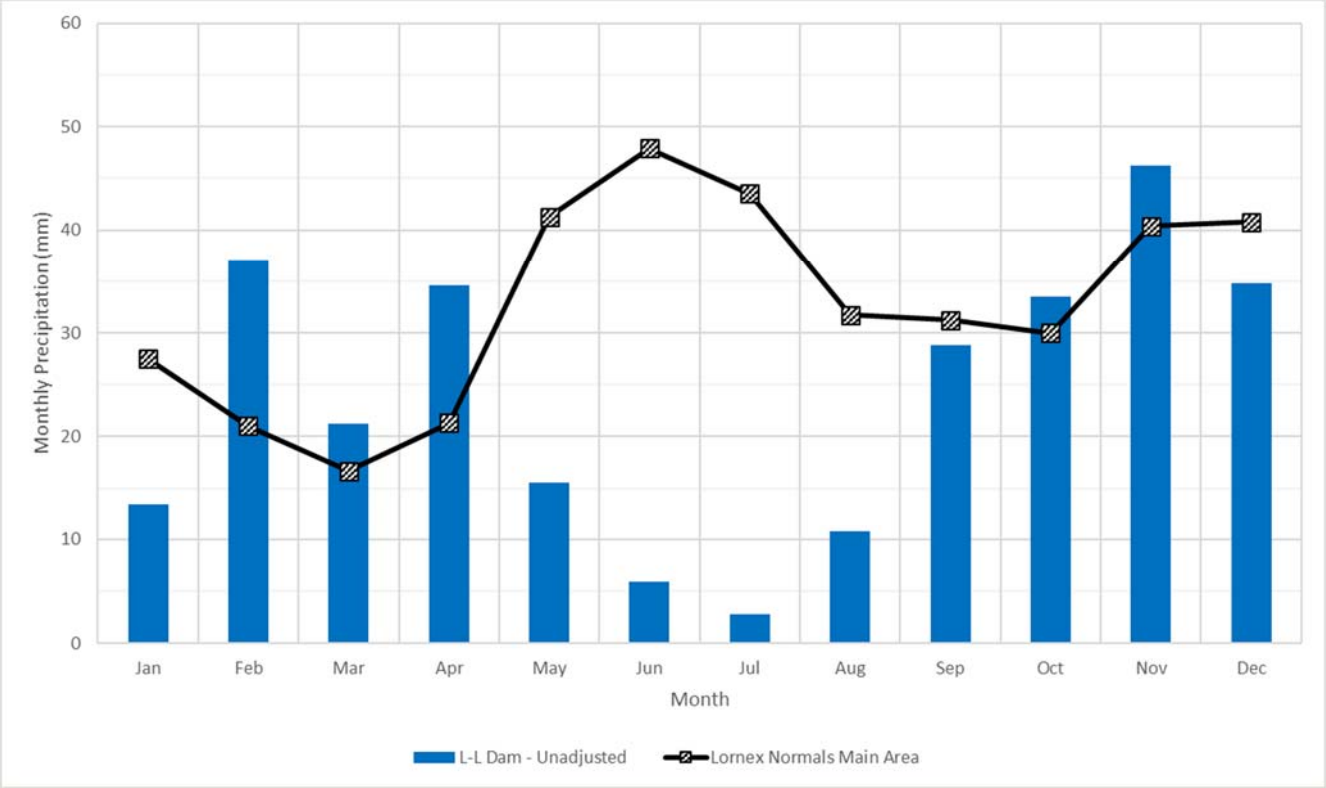
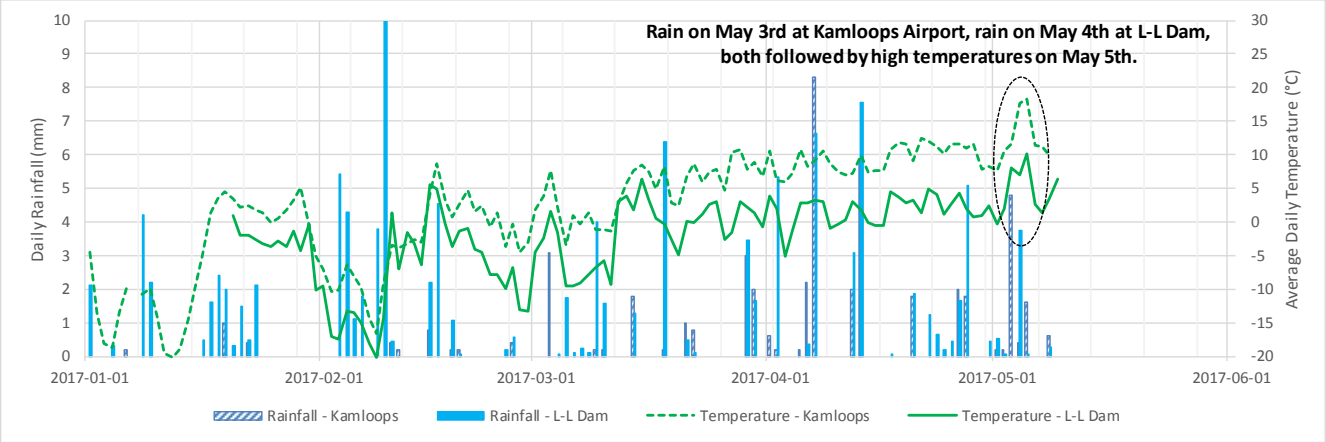


Table 4.2 Historical Average and 2017 Snowpack Depths

Survey Period	Years of Record[1]	Historic Average Snowpack Depth[2] (mm SWE[3])	2017 Snowpack Depth (mm SWE[3])	Percent Difference (%)
January 1st	11	50.2	Not surveyed	N/A
February 1st	25	83.5	Not surveyed	N/A
March 1st	51	89.5	116[4]	+30%
April 1st	51	96.3	144[4]	+50%
May 1st	48	27.3	101[4]	+271%

Notes:
1. At the Highland Valley snow survey station (Station No. 1C09A) near the Bethlehem TSF. Data prior to 1966 was 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.
4. The March 1st survey was conducted on March 4, 2017. The April 1st survey was conducted on April 3, 2017. The May 1st survey was conducted on May 3, 2017.

Figure 4.3 Daily Rainfall and Average Temperature at Kamloops Airport and L-L Dam Climate Stations Leading up to Freshet



4.3 Water Balance

There is insufficient information regarding inflows and outflows to estimate a water balance for this facility. As described in Section 4.1, inflows and outflows were not measured. The pond level at the end of the year rose in 2017 (0.4 m) relative to 2016 end of year (refer to Section 5.3). Based on photographs in previous DSIs, the pond was a similar size during the 2017 DSI site visit but the tailings level was higher, consistent with THVCP records which show active tailings deposition in 2017. THVCP should prepare a simplified water balance for the impoundment to meet the requirements in Section 10.1.12 of the Code.

4.4 Flood Management

Based on the dam's consequence classification of "Low", the Inflow Design Flood (IDF) required by the Code is one-third between the 975-year flood and Probable Maximum Flood (PMF). For facilities that store the IDF and have no outfall structure (e.g. spillway), a minimum IDF duration of 72 hours is required, per the Code.

In 2017, a flood routing assessment was completed, and concluded the pond has insufficient capacity to store the appropriate IDF volume for a tailings facility under the Code (KCB 2017). KCB understands THVCP plan to update the flood routing assessment in 2018 based on the latest bathymetry and catchments (changes were made to the Mill area in 2017), as part of a long-term strategy for tailings storage on site. The conclusion from the KCB (2017) review is unlikely to change; therefore, the flood routing assessment should identify the appropriate pumping capacity required to manage the IDF.

4.5 Freeboard

The Code specifies that an evaluation of available freeboard above the peak IDF water level is required but defers to CDA (2013) for freeboard design standards. Consideration should be given to the mining dam specific factors highlighted in the CDA Technical Bulletin: Application of Dam Safety

Guidelines to Mining Dams (2014). This should be included in the updated flood routing assessment; however, based on the pond size (i.e. shallow pond depth, fetch length) and freeboard assessments completed for other similarly sized ponds on the HVC site, KCB does not expect the freeboard requirement to exceed the minimum freeboard adopted by THVCP for dams on the site 0.5 m.

The minimum freeboard recorded in 2017 is 1.3 m on February 20, 2017. The pond level was near the top end of the yellow alert level range during this time, as further discussed in Section 5.3.

5 REVIEW OF MONITORING RECORDS AND DOCUMENTS

5.1 Monitoring Plan

An Operation, Maintenance and Surveillance (OMS) manual has not been prepared for the 7-Day Pond because under the previous Code, one was not required for a dam with a "Low" consequence classification. However, one is required under the current Code and therefore KCB recommended one be prepared in 2017. THVCP commissioned KCB to prepare the document which is currently in progress, scheduled to be completed in May 2018. The OMS manual will be similar to other similar documents for the site and be consistent with the intent of the Mining Association of Canada (MAC 2011) and CDA (2013) guidelines.

5.2 Inspections

The monitoring program includes the following inspections:

- Annual DSI (this report) – completed by the EoR to comply with Section 10.5.3 of the Code and submitted to MEM.
- Routine – completed by THVCP staff quarterly for 7-Day Pond. Summaries of dam inspection observations are provided to the EoR and have been reviewed as part of this DSI. *THVCP to provide inspection reports.*
- Event-driven – completed by THVCP staff in response to the following threshold exceedances (to be included in the OMS manual):
  - Earthquake greater than magnitude 5, within 100 km of the site.
  - Rainfall event greater than the 10-year, 24-hour duration storm.

During 2017, the following event-driven inspections were triggered:

- **May 2017:**
  - On May 4 and 5, severe freshet conditions (localized flooding) triggered increased site-wide monitoring efforts.
  - On May 6, Mr. Rick Friedel (EoR) of KCB accompanied THVCP to inspect the 7-Day Pond, amongst other structures, via helicopter fly-over. No immediate dam safety concerns were noted for 7-Day Pond during this fly-over.
  - THVCP increased visual inspection frequency to daily during the freshet period.

5.3 Reservoir Level

THVCP monitors 7-Day Pond levels roughly weekly throughout the year; refer to Figure 5.1. Alert levels for 7-Day Pond defined by THVCP and reviewed by KCB for 2018 are summarized in Table 5.1. The following observations were noted in 2017:

- The peak pond level in 2017 was 0.40 m greater than the peak level recorded in 2016.
- The pond level at the end of 2017 was approximately 0.37 m higher than at the start of 2017.
- The pond level remained more than 1.3 m below the minimum dam crest elevation (i.e. corresponding to the east perimeter haul road) throughout 2017.
- The pond was operated within the yellow alert range throughout 2017 with the exception of two separate occasions in end of January and May.
- Trend of rising pond level is more influence by tailings deposition than water accumulation:
  - Between the 2016 and 2017 bathymetry surveys approximately 27,000 m^3 of tailings were deposited in 7-Day Pond which reduced the available storage to the dam crest by one-third. THVCP need to develop a long-term strategy for 7-Day Pond and management of overflow tailings from the Mill.

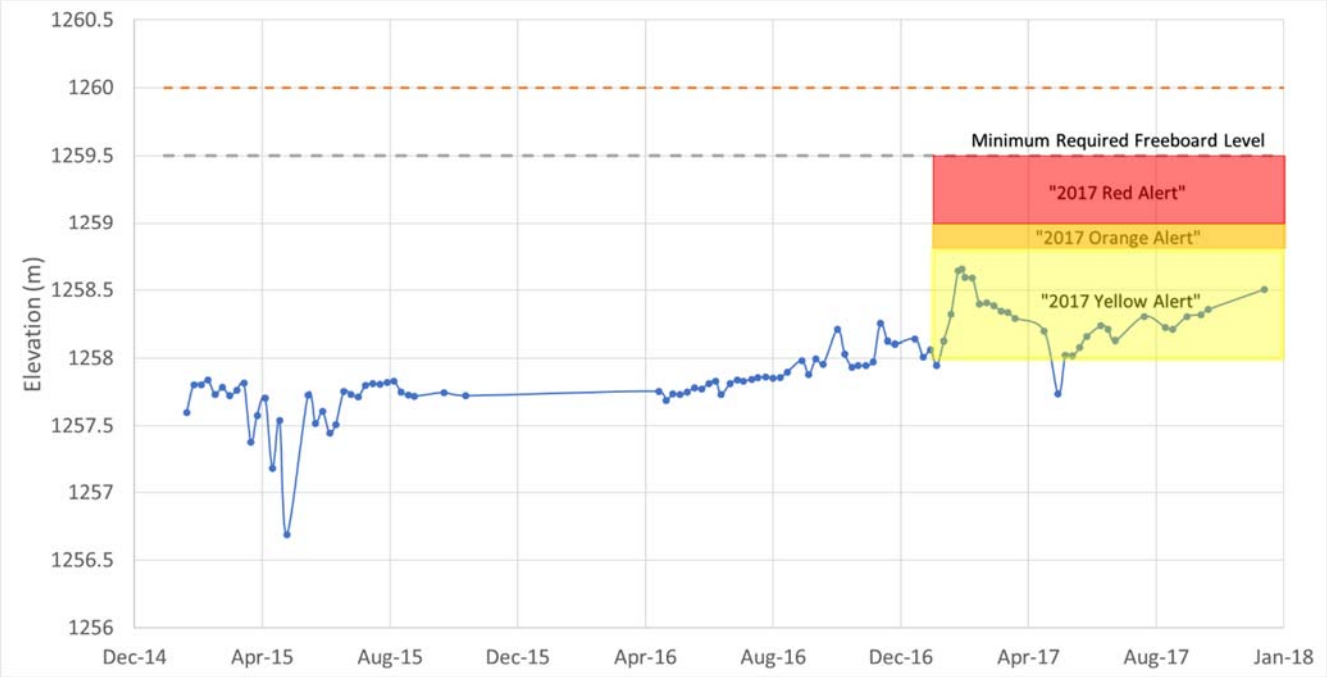
KCB understands the alert levels may be revised as part of the updated flood routing assessment, planned for 2018.

Table 5.1 7-Day Pond Reservoir 2018 Alert Levels

Water Level	Elevation Range (m)
Yellow Alert Level	1258.9 to 1259.2
Orange Alert Level	1259.2 to 1259.5
Red Alert Level (exceedance of minimum freeboard)	1259.5 to 1260 (crest)

Notes:
1. Alert levels are defined by THVCP and reviewed by KCB.

Figure 5.1 7-Day Pond 2017 Reservoir Level



5.4 Geotechnical Instrumentation

There are no geotechnical instruments at 7-Day Pond. None are recommended at this time.

5.5 Seepage

Seepage from 7-Day Pond is collected in the wishing well sump located in the Valley Pit. This sump also collects water from other sources and the total pumped volumes to the thickeners are measured. Direct measurements of seepage from 7-Day Pond are not regularly taken and none was observed during the 2017 DSI site visit.

5.6 Water Quality

Water quality in the Highland Valley Pit area, where the 7-day Pond is located, is monitored by HVC monthly to assess the effectiveness of the tailings facility in protecting the downstream receiving environment. A copy of the HVC 2017 Annual Water Quality Monitoring Report (ERM 2018) was provided to KCB for review as part of the DSI. Select observations and findings from the monitoring report are summarized as follows:

- There are three permitted surface water quality monitoring sites in the Highland Valley Pit area, as shown on the site monitoring plan in Appendix III.
- All permit sampling requirements and frequency were met in 2017.

The 2017 monitoring results were screened against applicable BC Water Quality Guidelines (WQG). Further discussion on specific WQG exceedances and water quality trends observed during 2017 can be found in the 2017 Annual Water Quality Monitoring Report (ERM 2018).

6 VISUAL OBSERVATIONS AND PHOTOGRAPHS

The visual observations made during the DSI site visit are summarized below. A copy of the field inspection forms is included in Appendix I. Photographs are included in Appendix II.

- **Crest**: The haul road which forms the crest of the dam around 7-Day Pond was in good physical condition. No indicators of significant concern were observed (e.g. cracking, slumping).
- **Upstream and Downstream Slopes:** Upstream slopes were in good physical. The upstream slopes were not vegetated, but no indicators of significant concern were observed (e.g. animal activity, cracking, slumping, surface erosion features). The visible parts of the downstream slope of the haul road forming the eastern containment of the impoundment was in good physical condition. Ponding was observed in the two adjacent treed areas, i.e. at the downstream toe of the eastern embankment.
- **Tailings Beach**: Was partially covered by tailings piles (southern and northwest end of pond) and by the pond (northeast end of pond) at time of inspection.
- **Pond**: At the time of the inspection was approximately 1.5 m below the crest low point on the eastern perimeter and approximately 2.5 m below the crest of the north access road at the north end.
- **Outflow Pump**: Decommissioned at time of inspection.
- **Seepage**: None observed.

7 ASSESSMENT OF DAM SAFETY

7.1 Dam Classification Review

The 7-Day Pond has been assigned a "Low" consequence classification as defined by CDA (2013) based on a dam consequence review held on January 16, 2018, which the EoR (Mr. Rick Friedel, P.Eng. of KCB) participated in via teleconference.

7.2 Failure Mode Review

Based on the DSI and review of available documents, the potential failure modes included in the Canadian Dam Safety Guidelines (CDA 2013) were reviewed:

Overtopping

A flood routing model for the IDF was completed for the 7-Day Pond to assess overtopping potential in 2017 but that is now superseded based on refinements to surface water management around the Mill area and the most recent bathymetry. The conclusion that the IDF under the Code cannot be stored within the pond is unlikely to change. THVCP plan to use pumping to manage the IDF rather than raising the perimeter. Additional flood routing analysis is required to confirm what pumping capacity is required to manage the IDF with adequate freeboard.

THVCP need to develop a long-term strategy for management of overflow tailings from the Mill as there is limited remaining capacity within 7-Day Pond.

Internal Erosion and Piping

No seepage or piping related indicators have been observed along the berm section of the western perimeter. Based on the low seepage gradient through the berm and that the pond under normal conditions is north of this area, the likelihood of a piping related failure mode developing under existing conditions is low.

Slope Instability – Foundation Irregularities / Dam Fill / Earthquake

Given that the maximum height of the berm (i.e. east perimeter haul road) is only about 4.5 m and that its downstream slope is relatively flat at about 5H:1V, the likelihood of slope instability is considered low. This is consistent with the lack of observed stability related issues of concern over its operating life.

Based on the geometry and observed performance, the only potential credible failure mode would be due to a loss of shear strength under seismic loading. This would only be possible if there are materials in the foundation that are susceptible to loss of shear strength under seismic loading. There is no foundation information available for the access road embankment to confirm whether this failure mode is credible. However, if it were to occur the only consequences of such a failure would be slumping of material and potential for some tailings and water to flow into the treed area on the downstream side of the access road. The incremental impact of this is small as the area is

already impacted by seepage from 7-Day Pond and there is no infrastructure or population downstream that could be impacted. Based on this conclusion and the limited value added, no stability analysis or site investigation is believed necessary for the access road.

Surface Erosion

No significant erosion damage of the downstream slopes has been observed. The likelihood of surface erosion over a dam slope resulting in a failure from a single event is considered low provided a regular inspection and maintenance program is maintained.

7.3 Emergency Preparedness and Response

An Emergency Preparedness and Response Plan (EPRP) has not been prepared for the 7-Day Pond and was not a requirement under the previous Code for a dam with a “Low” consequence classification. However, one is required under the current Code and therefore KCB recommended that one be prepared in 2017. The EPRP manual should meet the intent of the Mining Association of Canada (MAC 2011) and CDA (2013) guidelines with similar content to the EPRP documents for other tailings facilities on the site.

8 SUMMARY

The 7-Day Pond facility appears to be in good physical condition and the observed performance during the 2017 site inspections was consistent with past performance. The status of recommendations to address deficiencies and non-conformances identified during past DSIs are summarized in Table 8.1. Closed recommendations are shown in *italics*. Recommendations to address deficiencies and non-conformances identified during the 2017 DSI are summarized in Table 8.2.

Table 8.1 Previous Recommendations for Deficiencies and Non-Conformances – Status Update

ID No.	Deficiency or Non-Conformance	Applicable Reg. or OMS Reference	Recommended Action	Priority[1]	Recommended Deadline (Status)
SDP-2016-01	*Water Management*	*Flood Routing*	*Complete a flood routing and freeboard assessment to demonstrate compliance with the Code or identify requirements for upgrading the flood handling capabilities of this facility*	*3*	*Q3 2017 (CLOSED)*
SDP-2016-02	Operations	OMS and EPRP	Prepare an OMS manual and EPRP.	3	Q3 2017 (OPEN, scheduled May 2018)
SDP-2016-03	*Design*	*Slope Stability*	*Complete a slope stability analysis including assessment of performance under the EDGM under the Code.*	*3*	*Q3 2017 (CLOSED)*
SDP-2016-04	Water Management	Water Balance	Prepare a simplified water balance for the impoundment to meet the requirements of the Code.	3	Q4 2017 (OPEN)

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

Table 8.2 2017 Recommendations for Deficiencies and Non-Conformances

ID No.	Deficiency or Non-Conformance	Applicable Reg. or OMS Reference	Recommended Action	Priority[1]	Recommended Deadline
SDP-2017-01	Tailings Management	Storage Capacity	Develop a long-term strategy for 7-Day Pond to manage ongoing tailings storage requirements (currently less than 2 years of tailings storage available based on 2017 tailings volume).	2	Q4 2018
SDP-2017-02	Water Management	Flood Routing	Complete an updated flood routing assessment to define the pumping capacity and threshold elevations to safely manage the IDF with adequate freeboard (to be defined as part of assessment).	2	Q4 2018

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

9 CLOSING

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KLOHN CRIPPEN BERGER LTD.

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Engineer of Record
Senior Geotechnical Engineer, Principal

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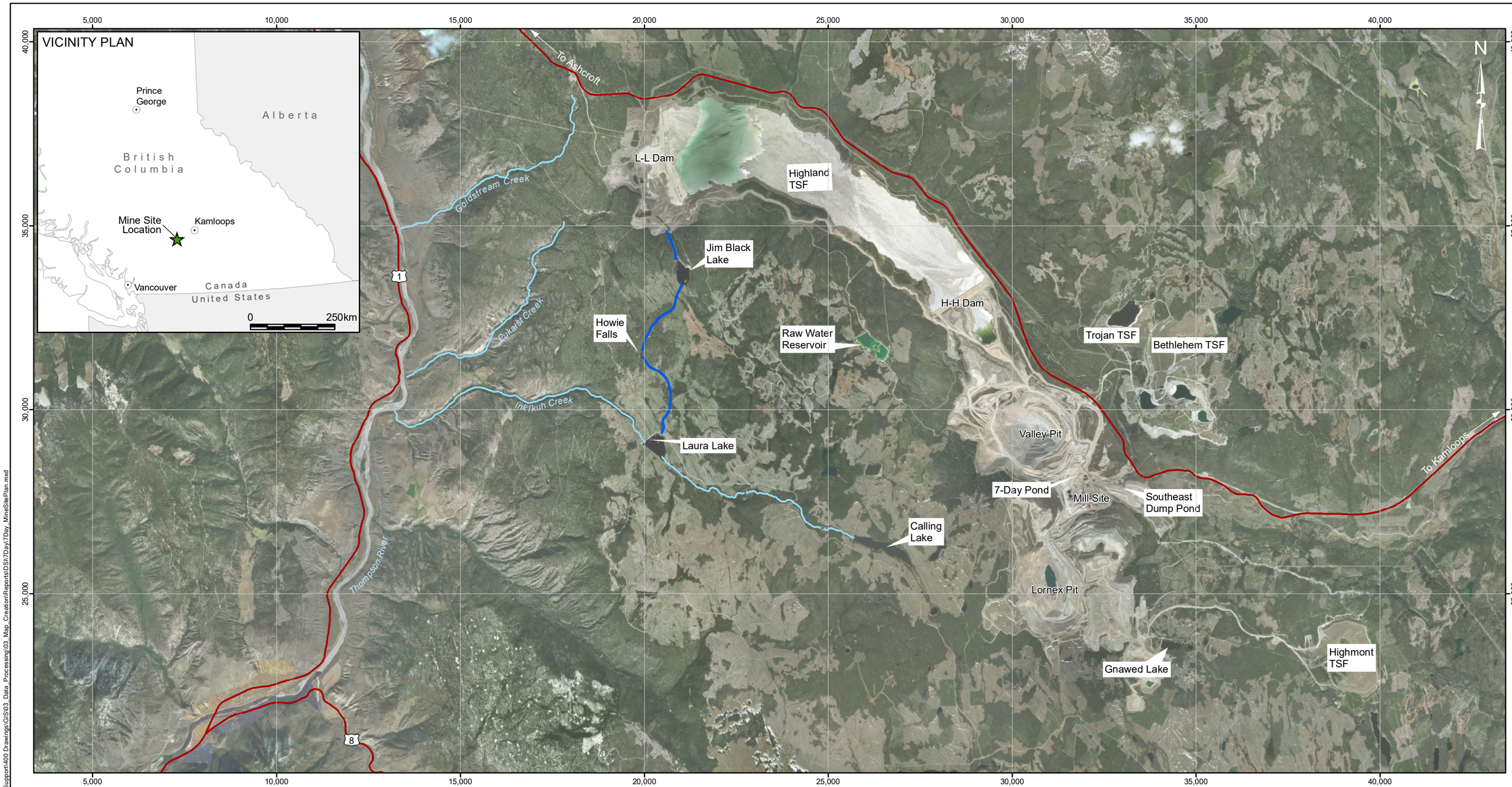
FIGURES



Legend

- 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.

CLIENT	TECK HIGHLAND VALLEY COPPER PARTNERSHIP
PROJECT	7-DAY POND STORAGE FACILITY 2017 DAM SAFETY INSPECTIONS
TITLE	MINE SITE PLAN
SCALE	1:100,000
PROJECT No.	M02341B26
FIG No.	1

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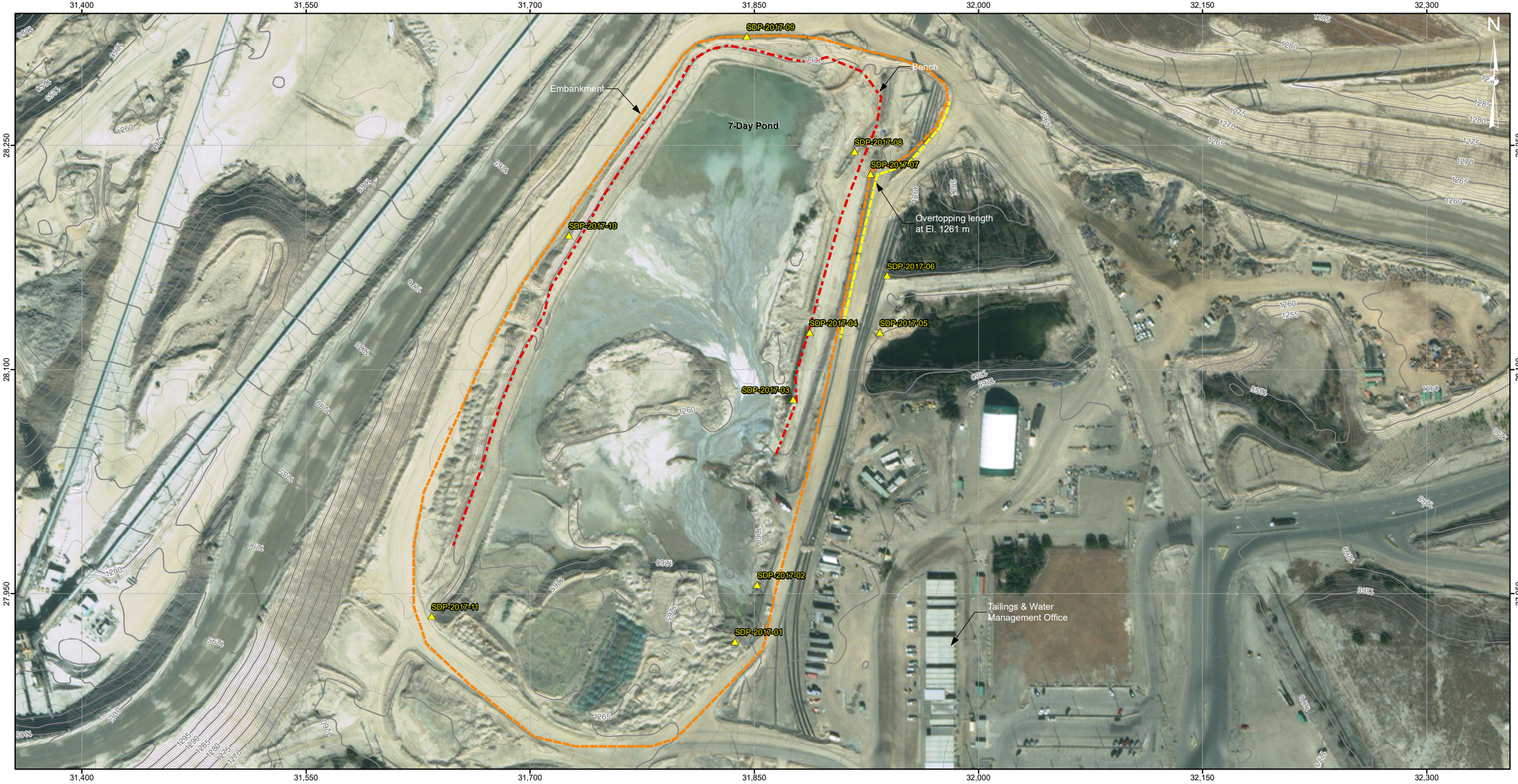
Date: 2018-03-27
Document Path: Z:\MVCR\M02341B26 - HVC-2017 Dam Safety Support\400 Drawings\GIS\03. Data Processing\03. Map Creation\Reports\DSI\7Day\7Day_MineSitePlan.mxd



Legend

- Waypoint (SDP-2017-xx)
- Embankment
- Bench
- Overtopping
- Index Contour (5 m)
- Intermediate Contour (1 m)

0 125m

Notes:
1. Projection: HVC Mine Grid.
2. Topo & Imagery obtained September 15th, 2017

CLIENT	TECK HIGHLAND VALLEY COPPER PARTNERSHIP
PROJECT	7-DAY POND STORAGE FACILITY 2017 DAM SAFETY INSPECTION
TITLE	7-DAY POND PLAN
SCALE	1:2,500
PROJECT No.	M02341B26
FIG No.	2

Klohn Crippen Berger

Date: 2018-03-28
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APPENDIX I

Dam Safety Inspection Checklist

2016 ANNUAL DAM INSPECTION CHECKLIST

Klohn Crippen Berger

Facility:	7-Day Pond	**Inspection Date:**	**Facility:** 23-Mar-2018 (EH)
Weather:	Cloudy with sunny periods	**Inspector(s):**	Emma Hill
Freeboard (pond level to dam crest):	1.5 m (based on field observation) 1.3 m (based on HVC pond survey)		

Outlet Condition Survey

Description	Outlet Controls?	Was it flowing?	Flow rate	Visual Review?	Testing / Detailed Inspection?
Portable Pump	Not present	N/A	N/A	N/A	N/A

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

WASTE DUMP WALLS	Yes/No
U/S Slope	☒ Yes ☐ No
Crest	☒ Yes ☐ No

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

INDICATOR	WASTE DUMP WALLS
Piping	☐ Yes ☒ No
Sinkholes	☐ Yes ☒ No
Seepage	☐ Yes ☒ No
External Erosion	☐ Yes ☒ No
Cracks	☐ Yes ☒ No
Settlement	☐ Yes ☒ No
Sloughing/Slides	☐ Yes ☒ No
Animal Activity	☐ Yes ☒ No
Excessive Growth	☐ Yes ☒ No
Excessive Debris	☐ Yes ☒ No

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

1) None

Comments / Notes:

1) The inflow pipe in the northwest corner of the pond was not flowing at time of inspection.
2) Inflow pipes #1 and #3 at the southern end of pond were flowing at time of inspection. Flow rates were not measured. Inflow pipe #2 was not flowing at time of inspection.
3) Inflow pipe #1 is buried by tailings.
4) No outflow was noted at time of inspection. Inflows were either seeping out of the pond or accumulating in the pond.

SITE PLAN
(May 1, 2016 PhotoSat image)

APPENDIX II

Inspection Photographs

Appendix II
Inspection Photographs

LEGEND:

- SDP = 7-Day Pond.
- SDP-2017-## refers to 2017 DSI waypoint shown on Figure 2.
- All photographs taken during inspection on March 23, 2018.

Photo II-1 Overview of pond looking northwest (SDP-2017-01)

Photo II-2 Standing on east bench looking northwest at upstream slope of north embankment (SDP-2017-08)

Photo II-3 Overview of pond looking southwest (SDP-2017-08)

Photo II-4 Haul road crest and upstream slope of east embankment looking southeast (SDP-2017-07)

Photo II-5 Divider road between treed areas downstream of east embankment (SDP-2017-06)

Photo II-6 Downstream slope of east embankment looking at southern treed area with ponding at toe (SDP-2017-05)

Photo II-7 Ponding in southern treed area looking west (SDP-2017-05)

Photo II-8 Inflow pipes with one (right) flowing at time of inspection (SDP-2017-02)

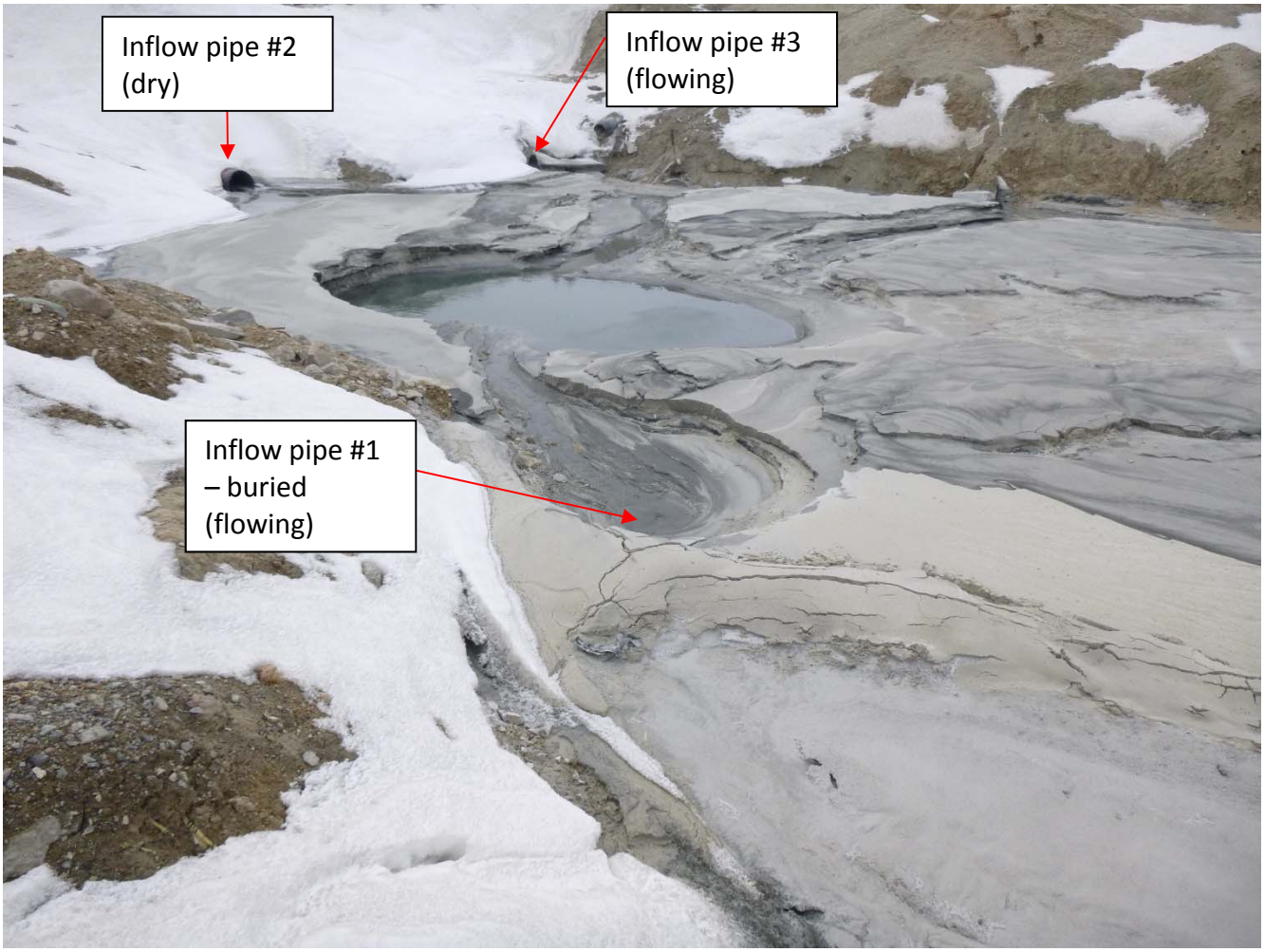

Photo II-9 Minor inflow from pipe along east embankment. Photo taken looking north (SDP-2017-03)

Photo II-10 Disconnected segment of pipe, partially buried along eastern embankment. Photo taken looking northwest (SDP-2017-04)

Photo II-11 Pond overview and upstream slope of west embankment looking south (SDP-2016-09)

Photo II-12 Haul road crest and upstream slope of north embankment looking east (SDP-2016-09)

Photo II-13 Upstream slope of west embankment looking northeast (SDP-2016-10)

Photo II-14 Upstream slope of west embankment looking southwest (SDP-2016-10)

Photo II-15 Inflow pipes at southwest corner of pond. No flow from pipes. Photo taken looking northeast (SDP-2017-11)

APPENDIX III

Map of Water Quality Monitoring Points

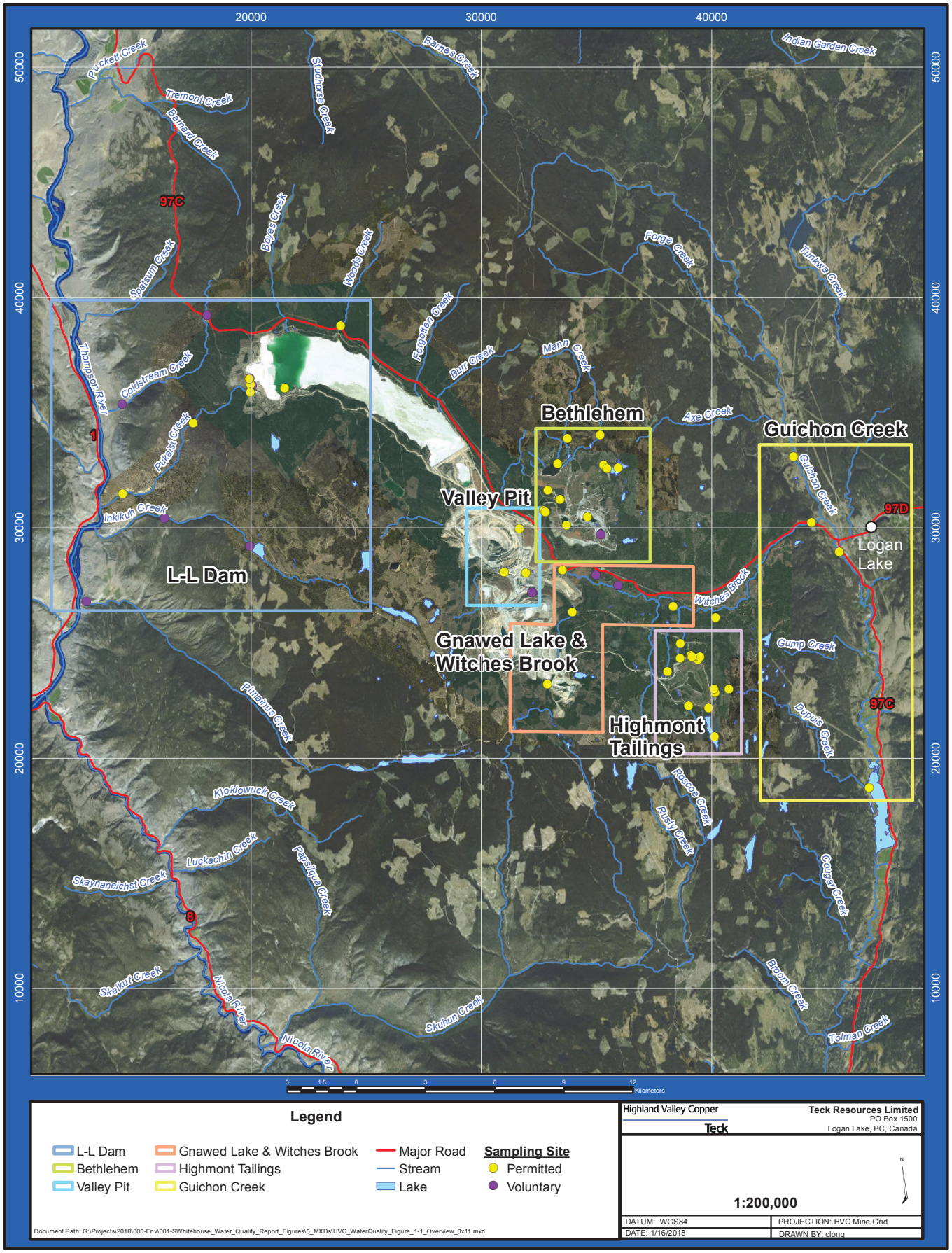

Figure 1-1 Water Quality Monitoring Sites Highland Valley Copper, 2017

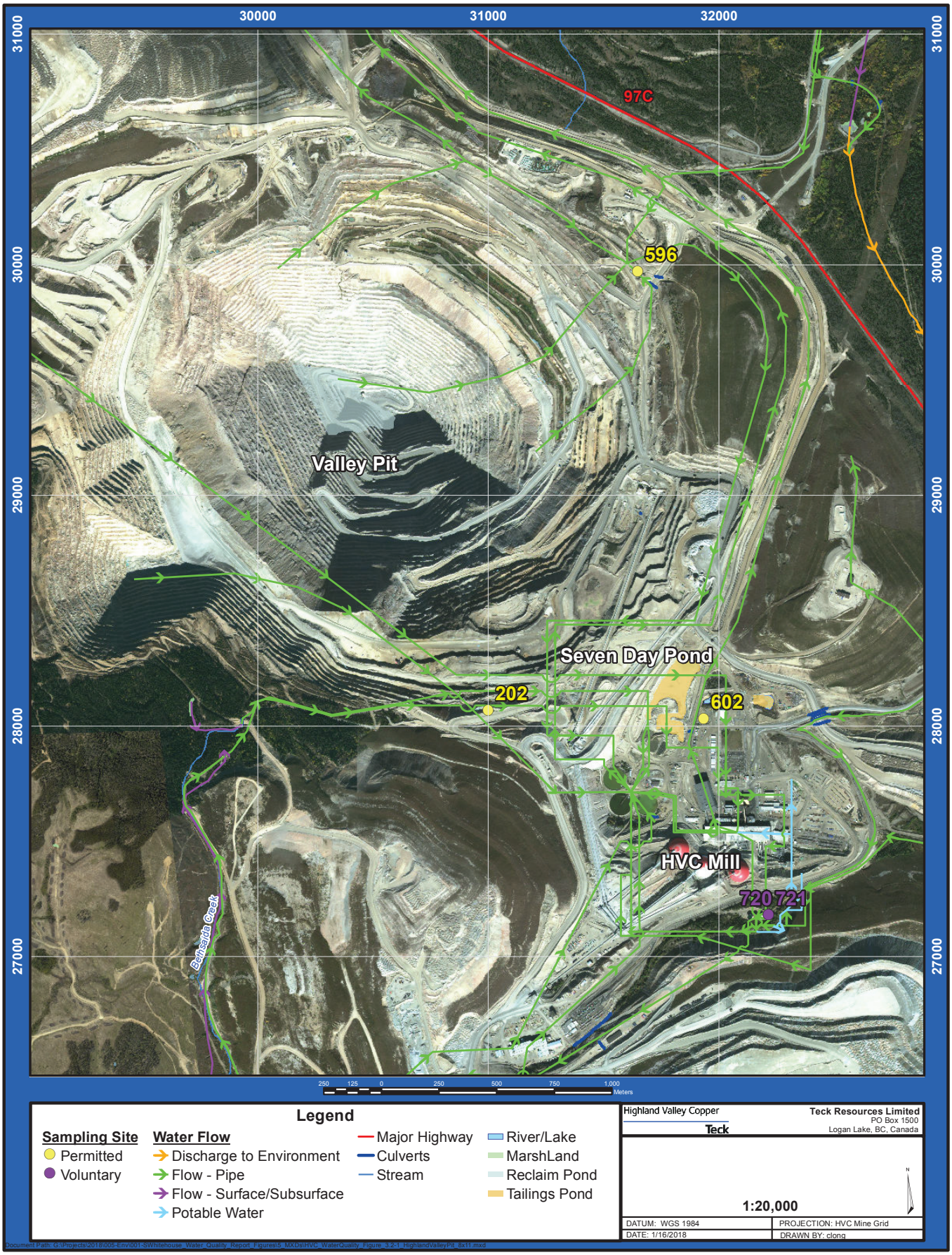

Figure 3.2-1 Water Quality Monitoring Sites in the Highland Valley Pit Area, Highland Valley Copper, 2017