GOLDER

REPORT

2020 Dam Safety Inspection for South Tailings Pond and North Tailings Pond

Teck Coal Limited, Fording River Operations

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Reference No. 20136981-2020-219-R-Rev0-2000

18 March 2021

Distribution List

Electronic Copy - Teck Coal Limited

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Executive Summary

This report presents the 2020 annual dam safety inspection (DSI) for the South Tailings Pond (STP) and North Tailings Pond (NTP) facilities at the Teck Coal Limited (Teck), Fording River Operations (FRO) site, located near Elkford, British Columbia. This report was prepared based on a site visit carried out by Golder Associates Ltd. (Golder) from 18 to 19 August 2020, discussions with FRO staff, and a review of data provided by FRO. The reporting period for the data review is from 1 September 2019 to 31 August 2020, unless otherwise noted. The dam inspection reports and photographs from the site visit are presented within this report.

This report was prepared in accordance with Part 10 of the Health, Safety and Reclamation Code (HSRC) for Mines in British Columbia (EMLI 2021), which sets out the frequency for inspection of tailings storage facilities and associated dams. The scope and format of this DSI report follows the HSRC Guidance Document (Section 4.2, Ministry of Energy and Mines 2016).

Summary of Facility Description

The FRO site is an active open pit coal mine located near Elkford, BC. FRO's tailings storage infrastructure includes two tailings pond facilities, the STP and NTP, and two permitted destinations for in-pit tailings disposal, the 2 Pit and 3 Pit Tailings Storage Area and the Turnbull Tailings Storage Facility. Tailings discharge from the wash plant, within the processing plant, is currently directed to the STP. The NTP has been essentially filled to its design capacity and is currently inactive.

The STP facility is located south of the processing plant, on the east side of a realigned reach of the Fording River; it occupies a total area of approximately 80 ha and has a minimum dam crest elevation of 1,637.85 m (Elk Valley Elevation Datum). The STP is composed of two dams, the Main and West dams. Both the Main Dam and West Dam are downstream-constructed, zoned earth fill dams. The Main Dam was developed on the flood plain of the Fording River, while the West Dam was founded on the till bench that borders the western edge of the Fording River diversion channel and on a portion of the Fording River flood plain. Construction of the STP was initiated in 1977 and the dams were raised in six stages between 1983 and 2013.

The NTP facility is located on the west side of a realigned reach of the Fording River across from the processing plant. The facility occupies a total area of approximately 40 ha and has a minimum dam crest elevation of 1,652.6 m (Elk Valley Elevation Datum). The NTP dam is a downstream-constructed, zoned earth fill dam developed on a segment of the Fording River flood plain. Construction of the NTP was initiated in 1971 and the dam was raised in four stages between 1973 and 1979.

Summary of Key Hazards

Credible failure modes for the STP and NTP facilities include:

- Internal erosion (suffusion and piping)
  - For both the STP and NTP, filter compatibility is generally met between till fill material and coarse rejects or combined coarse and fine rejects shell and the foundation flood plain sand and gravel; however, is not met for the tailings and the flood plain sand and gravel. Migration of the tailings through the sand and gravel is considered low risk.
  - At the STP, internal erosion as a result of seepage along the decommissioned gas pipeline through the West Dam at the north abutment has a possible likelihood of occurrence. FRO has plans to remove this pipeline by 2022.

- Overtopping
  - Pond elevation in the NTP and STP is managed to be maintained below the normal operating range target. A trigger-action-response plan provides direction if a water elevation approaches a trigger level.
  - For the STP facility, the detailed design of a permanent spillway (Golder 2020e) is complete. The spillway is to be constructed in two phases, with phase one started in October 2020 and phase two planned to be completed in 2021.
  - Liquefaction of the STP tailings beach during a seismic event could result in tailings beach displacement that results in a wave that could overtop the Main Dam. Additional analyses are recommended to better characterize the failure potential of saturated tailings block and wave attenuation potential. (Golder 2020c, in draft).
- Instability
  - Static and seismic stability assessments (Golder 2018b) were undertaken using design criteria for "Very High" consequence dam classification for both the NTP and STP. The results indicated the factors of safety for failure surfaces that involve the full width of the dam crest meet design criteria.
  - Riprap protection (for a 200-year return period flood level) is in place along the NTP dam toe and part of the STP dam toe to mitigate against instability of the dams' toes from erosion from the Fording River. FRO is undertaking the Flood Plain Widening Project along the toe of the STP to reduce the risk of this hazard to the STP.
- Release of tailings, mine-affected water, or water through pipeline failure around either the STP or NTP
  - This failure mode is managed through inspection of active pipelines.

Dam Classification

Both the STP and NTP dams meet the definition of a "dam" as defined in the HSRC (EMLI 2021).

Both the STP and NTP facilities are classified as "Very High" consequence, following the dam consequence classification guidelines from the HSRC Guidance Document Section 3.4 (Ministry of Energy and Mines 2016), which references the Canadian Dam Association (CDA) *Dam Safety Guidelines* (CDA 2013). The classifications are governed by the consequences of a potential fair-weather failure scenario. Teck's internal approach for dam consequence classification requires any facility that has a risk to human life to adopt minimum design criteria of the "Extreme" dam class.

A dam safety review (DSR) was completed in 2019 by a third-party consultant (SNC-Lavalin 2020), which concurred with the assigned dam classification for the STP and NTP dams.

Summary of Significant Changes, and Changes to Instrumentation, Stability, and Surface Water Control

South Tailings Pond and North Tailings Pond

FRO developed an animal burrow inspection plan in 2019 for both the STP and NTP facilities. The spring animal burrow inspection was conducted at the STP on 5 May 2020, followed by trapping and relocation of ground squirrels between 5 May and 7 June 2020. No animal burrow inspection was carried out at the NTP as there were no signs of animal activity. The fall animal burrow inspection was conducted on 7 October 2020 at the STP.

FRO site entered Level 2 (Flood Season Monitoring II) and Level 3 (Active Flood Watch) flood monitoring during the 2020 freshet. FRO responded by following actions from the trigger-action-response plan in the FRO *Tailings Impoundment Flood Response Protocol for the Fording River* (FRO 2020a). Event-driven inspections of the NTP, STP, Fording River, and Fording Multiplate Embankment (upstream of NTP and STP) were conducted from 1 to 3 June 2020 in response to the site being under flood watch.

South Tailings Pond

The detailed design of a permanent spillway was conducted in 2020 (Golder 2020e). Construction of the spillway started in October 2020 and is planned to be completed in 2021.

A study was carried out to estimate liquefaction-induced displacements of the STP tailings beach for input to understand the STP dam overtopping potential as a result of a wave triggered by the liquefaction-induced displacement of tailings into the STP pond (Golder 2020c, in draft).

A staff gauge was installed at the reclaim barge in March 2020. A camera was installed downstream of the West Dam in August 2020 to allow remote access to view the STP West Dam and Fording River for real-time visual monitoring.

The 2020 dredging season occurred from 18 April to 16 October 2020, with a total of 1.65 million dry metric tonnes of tailings dredged from the STP to the Turnbull Tailings Storage Facility. Localized dredging was conducted around the reclaim barge at the end of June 2020 to remove accumulated solids around the barge.

The gas pipeline located under the north and south abutment of the STP was decommissioned and purged in June 2020 by FortisBC. Approximately 123 m of the gas pipeline was removed south of the south abutment. The section of the pipeline passing under the south abutment was backfilled with grouting, which was completed on 28 June 2020 (Golder 2020f).

The tailings pipeline at the discharge location at the north abutment was extended upstream by 300 m between July and August 2020. The pipeline was extended to allow tailings to deposit directly into the pond and to lower the risk of tailings backing up and overtopping at the north abutment of the STP dam.

Two bathymetric surveys were conducted by FRO to monitor remaining capacity in the facility: one survey was conducted on 12 April 2020 and the other on 15 October 2020. FRO reported that a localized depth sounding was conducted under the reclaim barge within the reporting period.

During the reporting period, site drainage was sent to the North Loop Pond (NLP) intermittently in November 2019, March and April 2020, and August 2020; it was diverted to the STP the rest of the time.

There were no significant changes in visual monitoring records, instrumentation, dam stability, or surface water control for the STP since the 2019 DSI.

North Tailings Pond

A staff gauge was installed in October 2019 to monitor the pond level.

A drainage channel at the northern end of the facility, upstream of the Liverpool Water Management Facility, was cleaned up on 20 March 2020 to prevent surface runoff from the haul road from entering the Liverpool facility.

Water was pumped from the NTP to the STP starting on 9 April 2020 when the monitoring of the NTP water level triggered a High Level alarm or freeboard warning. Pumping continued until the pond was below the normal operating level on 27 April 2020. Pumping to the STP continued intermittently through August 2020 to manage the NTP pond level to below the normal operating level (below High Level Alert).

A camera able to view the staff gauge was installed in June 2020 to facilitate real-time remote visual monitoring.

A new pipeline that crosses the dam crest at the south abutment area was constructed to facilitate water management within the NTP because the existing pipelines were frozen and damaged. The new pipeline ties into the existing Shandley pipeline and is used to pump water from the NTP to the STP. Construction activities during the pipeline installation disturbed the dam crest at approximately Sta. 1+410, which was filled and regraded in September 2020.

There were no significant changes in visual monitoring records, instrumentation, dam stability, or surface water control for the NTP since the 2019 DSI.

Review of Operation, Maintenance, and Surveillance Manual

The operation, maintenance, and surveillance (OMS) manual for the STP and NTP is Version 2020.04, issued on 25 May 2020 (FRO 2020b). The OMS manual was reviewed and approved by the Engineer of Record.

Review of Emergency Preparedness Plan and Emergency Response Plan Manuals

The emergency response plan (ERP) for the tailings facilities at FRO was updated in May 2020 (EP.009.R1; FRO 2020c). The ERP was developed to meet the guidelines provided by the HSRC (Ministry of Energy and Mines 2016, 2017), the CDA (2013), the Mining Association of Canada (MAC 2011, 2017), and Teck Resources Limited (Teck Resources 2019). The Engineer of Record reviewed and provided input to the updated ERP, and considered the ERP adequate.

The current emergency preparedness plan for tailings facilities is EP.008.R2, dated 25 May 2020 (FRO 2020d).

FRO has also developed a *Tailings Impoundment Flood Response Protocol for the Fording River*. This document was updated in 2020 (FRO 2020a) and should be reviewed prior to the 2021 freshet and updated as required.

The emergency planning documents should continue to be reviewed at least annually, with updates incorporated when required. The ERP should be tested every year. FRO carries out annual testing of the ERP, with the most recent internal tabletop exercise (with a field component) carried out on 26 November 2020.

Dam Safety Review

A DSR was completed in 2019 by a third-party consultant (SNC-Lavalin 2020). The DSR for the STP and NTP dams concluded the dams are reasonably safe with identified deficiencies and non-conformances. The next DSR for these facilities is scheduled for 2024.

Annual Dam Inspection

The STP facility was observed to be in good condition at the time of the 2020 annual inspection.

At the NTP facility, the dam crest at approximately Sta. 1+410 was observed to be disturbed as a result of installation of a dewatering pipeline. The crest in this area was backfilled with road crush and regraded in September 2020. The area of the downstream toe that was excavated for access for a monitoring well installation program in 2019 had not been repaired. The excavated dam toe area is to be backfilled and graded (recommended action 2019-03).

Status of Previous and New Dam Safety Inspection Recommended Actions

Table E-1 summarizes the status of recommended actions from the 2019 annual DSI (Golder 2020a) and new recommended actions from the 2020 annual inspection. Completed actions are shown with grey shading. For recommended actions carried over from previous years or new recommendations, only those of priority level 1 or 2 are listed in Table E-1. Recommendations of other priorities are presented in the report body.

A number of recommendations are in progress and some are incomplete, but Golder considers the work to be appropriately prioritized based on good communication between the Engineer of Record team and the FRO tailings team.

Table E-1: Current Status of 2019 Dam Safety Inspection Recommend Actions and New Actions from the 2020 Annual Inspection for the South Tailings Pond and North Tailings Pond Facilities

Facility	ID Number	Deficiency or Non-conformance	Applicable Guideline or OMS Manual Reference	Recommended Action	Priority Level	Recommended Timing for the Action	Status as of March 2021
STP	2015-12a, b	Riprap erosion protection along downstream toe north of STP Sta. 0+680, no riprap south of STP Sta. 0+680; risk-informed protection requirements not yet defined	HSRC §10.1.8	Perform risk-informed assessment to determine appropriate flood protection requirements for downstream toe of dam along Fording River and timeline to implement.	2	Construction for Fording River flood plain widening is scheduled to be completed by 2022	**In progress** – Fording River flood plain widening detailed design was completed in March 2021. Construction activities are being scheduled to implement design and construction is expected to be completed by 2022.
				Implement required protection measures for the operational phase according to the as-defined schedule.	2		
	2017-05	Potential overtopping hazard due to tailings liquefaction and redistribution during seismic event needs to be assessed	HSRC §10.6.10	Complete liquefaction and overtopping assessment for tailings within facility.	2	Q2 2021	**In progress** – pending finalization of technical memorandum (Golder 2020c).
	2018-03	The current spillway design does not meet the Very High dam consequence classification IDF	HSRC §10.6.7 MAC TSM	Update design of permanent spillway as per the new inflow design flood and requirements from HSRC Guidance Document (Ministry of Energy and Mines 2016). Develop a construction schedule accordingly.	2	Q2 2020	**Complete** – permanent spillway design is completed (Golder 2020e) and approved by the BC Ministry of Energy, Mines and Petroleum Resources. The spillway is scheduled to be constructed in two phases, with phase one started in October 2020 and phase two planned to be completed in 2021.
	2018-06	Construction of the AWTF-S is underway downstream of the STP Main Dam, potentially increasing the number of workers in the dam breach inundation zone	CDA 2013 §3.5.3	Review credible failure modes and potential for inundation from a failure of the Main Dam relative to the downstream facility. If required, update the emergency response plan for the downstream workers at the AWTF-S considering the results of the STP Main Dam breach and inundation study draft report.	2	Q1 2021	**In progress** – pending update to draft report (Golder 2020b)
	2019-01	Portions of the STP Main Dam upstream slope at south abutment area were eroded as a result of discharge of effluent on undesignated areas of the dam	HSRC §10.5.1(3)	Repair by placing breaker rock over geotextile on the eroded areas.	2	2020	**Complete** – repair completed in Fall 2020 during spillway construction
	2020-01	Current freeboard trigger levels in the OMS manual do not apply to the facility with a permanent spillway	Permit condition from Permit C-3 Amendment dated 3 July 2020 HSRC §10.1.13 HSRC Guidance Document §4.4.1	After the permanent spillway is constructed, update the QPOs in the OMS manual with freeboard triggers.	2	2021	**New** – to be implemented
	2020-02	No passive emergency system against overtopping	n/a	Construct permanent spillway.	2	2021	**New** – to be implemented
	2020-04	There is a major vertical erosion gully on the downstream slope of the Main Dam above the seepage collection well	n/a	Direct surface runoff onto a dam bench and away from the erosion gully on dam face.	2	Q2 2021	**New** – to be implemented

Table E-1: Current Status of 2019 Dam Safety Inspection Recommend Actions and New Actions from the 2020 Annual Inspection for the South Tailings Pond and North Tailings Pond Facilities

Facility	ID Number	Deficiency or Non-conformance	Applicable Guideline or OMS Manual Reference	Recommended Action	Priority Level	Recommended Timing for the Action	Status as of March 2021
NTP	2015-06a,b	Risk-informed criteria for flood erosion protection along toe of dams not defined	CDA 2013 §6.2	a) Perform risk-informed assessment to determine i) appropriate flood protection requirements for downstream toe of dam along the Fording River and ii) the timeline for the flood protection requirements. b) Implement the required flood protection measures for the operational phase according to the schedule defined from a).	2	2021	**Incomplete**

Note: Grey shaded rows indicate completed actions.

OMS = operation, maintenance, and surveillance; STP = South Tailings Pond; Sta. = Station; HSRC = Health, Safety and Reclamation Code; IDF = inflow design flood; AWTF-S = active water treatment facility-south; MAC = Mining Association of Canada; TSM = Towards Sustainable Mining; NTP = North Tailings Pond; QPO = quantifiable performance objective.

Priority Level	Description
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.
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.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice – Further improvements are necessary to meet industry best practices or reduce potential risks.

Source: HSRC Guidance Document, Section 4.2 (Ministry of Energy and Mines 2016).

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1.0 INTRODUCTION

1.1 Purpose, Scope of Work, Method

Golder Associates Ltd. (Golder) has completed this annual dam safety inspection (DSI) for the South Tailings Pond (STP) and North Tailings Pond (NTP) at the Teck Coal Limited (Teck), Fording River Operations (FRO) site, located near Elkford, BC. The reporting period for the data review is from 1 September 2019 to 31 August 2020, unless otherwise noted.

The report is based on a site visit carried out by Golder from 18 to 19 August 2020, discussions with FRO staff, and review of data provided by FRO. This report consists of the following and was prepared with consideration of the Teck Resources Limited *Guideline for Tailings and Water Retaining Structures* (Teck Resources 2019):

- a summary of the site conditions and background information for the facilities
- a summary of the operation, construction, and maintenance activities for the reporting period
- dam consequence classification and review of required operational documents
- site photographs and records of dam inspections
- review of dredging data
- review of assessment of dam safety relative to potential failure modes
- recommended actions

Photographs of STP and NTP from the site inspection are presented in Appendix A, and a summary of the observations is included in the inspection reports in Appendix B and Appendix C for the STP and NTP, respectively.

FRO switched coordinate systems on 25 October 2016 from FRO Mine Grid to Universal Transverse Mercator (UTM) with elevations referenced to the Elk Valley Elevation Datum. All coordinates presented in this report are in UTM with elevations referenced to the Elk Valley Elevation Datum unless otherwise noted.

The previous annual DSI for this facility was carried out in September 2019 and is reported in the 2019 DSI report (Golder 2020a).

This report is to be read in conjunction with the Study Limitations provided at the end of the report.

1.2 Regulatory Requirements

1.2.1 BC Health, Safety and Reclamation Code

The DSI report was prepared in accordance with Part 10 of the Health, Safety and Reclamation Code (HSRC) for Mines in British Columbia (EMLI 2021), which sets out the frequency for inspection of tailings storage facilities and associated dams. It is understood that this report will be submitted by FRO to the Chief Inspector of Mines.

The guidelines for annual DSI reports provided in the HSRC Guidance Document (Ministry of Energy and Mines 2016, Section 4.2) were followed where applicable during the preparation of this report.

1.2.2 Permits and Licences

Specific amendments to the permits concerning STP and NTP are as follows:

- Permit C-3 Amendment to permit approving work system – South Tailings Pond tailings dredging project. Issued by the Ministry of Energy, Mines and Petroleum Resources. 27 April 1995.
- Permit C-3 Amendment to permit approving work system and reclamation program – Raising the South Tails Pond Dyke. Issued by the Ministry of Energy, Mines and Petroleum Resources. 30 June 2008.
- Permit C-3 Amendment to permit approving work system and reclamation program – Turnbull South Pit Tailings Storage Facility. Issued by the Ministry of Energy and Mines. 14 November 2013.
- Permit C-3 Amendment to permit approving work system and reclamation program – Turnbull South Pit Tailings Storage Facility East Pipeline Route. Issued by the Ministry of Energy and Mines. 6 May 2015.
- Permit C-3 Amendment to permit approving work system and reclamation program – Fording River Swift Mine Plan and Reclamation Program. Issued by the Ministry of Energy and Mines. 15 December 2015.
- Permit C-3 Amendment to permit approving work system and reclamation program – South Tailings Pond Improvements - Spillway. Issued by the Ministry of Energy and Mines. 3 July 2020.
- Permit 424 Amendment to authorized discharges. Issued by the Ministry of Environment. 6 December 2016.
- Permit 424 Amendment to authorized discharges – Request for additional site water pumping to maintain freeboard at the South Tailings Pond. Issued by the Ministry of Environment. 22 March 2018.
- Permit 424 Amendment to authorized discharges – Request for additional site water pumping to maintain freeboard at the North Tailings Pond. Issued by the Ministry of Environment. 2 January 2019.

2.0 BACKGROUND

2.1 Fording River Operations Tailings Storage

The FRO site is an active open pit coal mine located near Elkford, BC, which currently has two tailings pond facilities, the STP and NTP, and two permitted destinations for in-pit tailings disposal, the 2 Pit and 3 Pit Tailings Storage Area and the Turnbull Tailings Storage Facility (TSF). This DSI report is for the STP and the NTP.

The STP facility is located south of the processing plant, on the east side of the Fording River. The STP is composed of two dams, the Main and West dams. Tailings discharge from the wash plant, within the processing plant, is currently directed to the STP.

The NTP is located on the west side of the Fording River across from the processing plant. The NTP has been essentially filled to its design capacity and is currently inactive.

A location and plan view of the STP and NTP facilities is shown in Figure 1.

2.2 System Description

At the STP, the earth fill dams provide the following:

- impoundment of the tailings slurry
- storage of settled tailings
- temporary storage of runoff, excess slurry water, and water from pit dewatering or sediment ponds (when viable based on freeboard)
- reservoir of water as the reclaim source of the coal processing plant

At the NTP, the earth fill dam provides storage for settled tailings and only retains a small pond, which receives runoff from the local tailings surface area and small surrounding catchment area. This facility is not in active use.

2.2.1 Coal Processing Waste Materials

The raw coal delivered to the breaker at FRO contains high-ash material in the form of carbonaceous mineral rock. To meet product specifications, this high-ash rock is separated from the raw coal at the wash plant within the processing plant. The high-ash waste consists of a coarse fraction and a fine fraction. The coarse fraction, referred to as coarse rejects (CR), consists of sand and gravel-sized fragments of washed, crushed rock ranging in size from approximately 1 to 100 mm. The fine fraction of the waste, comprising rock fragments smaller than approximately 1.0 mm, includes “coarse-fine” rejects (0.75 to 1.0 mm) and the flotation tailings (less than 0.75 mm). Since 2005, the coarse-fine rejects and the majority of the flotation tailings have been separated at the wash plant. The coarse-fine rejects are mixed with the CR to produce combined coarse and fine rejects (CCFR), which are hauled by trucks to a designated CCFR spoil.

Both the CR and CCRF materials have been used in the construction of the downstream dam shell for the NTP and STP dams.

2.2.2 Tailings Description

The flotation tailings from the wash plant are a slurry and are sent via pipeline to the STP where they are hydraulically deposited from the north single point discharge. At times when site drainage is not directed to the North Loop Settling Pond, site runoff and sediments are added to the tailings line and discharged into the STP. Site drainage includes wash water from the dryer building and clean coal building, water used in the plant site area, and surface water runoff from the plant site area and nearby waste rock piles.

Particle size distribution testing of tailings samples collected at the north end of the STP was carried out in 2018 (Golder 2020d) using a laser diffraction method. Six tests were conducted using samples from depths between 2.4 and 16 m. The results show that the particle size of the tailings has sand content from 5% to 68% and fines content from 32% to 95%. Atterberg limits tests were carried out on the same six samples. One of the samples was found to be non-plastic and the others had low plasticity, with liquid limit from 32% to 49% and corresponding plasticity index from 4% to 8%. Specific gravity ranged from 1.4 to 1.9 and an in situ dry density averaged 858 kg/m^3 considering four Shelby tube samples.

2.2.3 Tailings Impoundments

In the past, tailings were discharged to the STP and NTP alternately. The tailings stream has never discharged to the both ponds concurrently. The NTP is essentially full, and tailings have not been deposited there since 2006.

Tailings are seasonally dredged from the STP to increase available tailings storage capacity. Previously, the dredged tailings were pumped to the NTP, 2 Pit, or 3 Pit South (Golder 2016a). Dredging operations to the NTP ended in 2006. Dredging to 2 Pit was discontinued in 2004. No dredged tailings have been sent to 3 Pit South since 6 October 2015.

Seasonal dredging from the STP to the Turnbull TSF started in 2016 and is planned to continue for approximately the next 13 years until 2034 for the base case (Golder 2018a), which is the estimated life of the Turnbull TSF facility when it reaches capacity.

2.3 Overview of Design, Construction, and Previous Operation

A summary of the STP and NTP design, dam construction, and past operation is presented in the following subsections. Additional details of construction history are presented in the operation, maintenance, and surveillance (OMS) manual (FRO 2020b).

2.3.1 South Tailings Pond

A plan view of the STP facility is shown in Figure 2 and Figure 3. The STP occupies a total area of approximately 80 ha and is located to the south of the processing plant, on the east side of a realigned reach of the Fording River. The STP facility was developed on the flood plain of the Fording River. The Fording River was diverted to a new alignment outside the footprint of the STP by excavating a new channel through a topographic bench on the west side of the Fording River flood plain. This topographic bench consists of native glacial till soils overlying Fernie Shale. Confinement at the STP is provided by the Main Dam, which extends across the width of the Fording River flood plain, and by the West Dam, which extends parallel to the east side of the Fording River diversion channel. The West Dam is primarily founded on the glacial till bench.

Initial construction of the STP dams was performed between 1977 and 1979. From 1983 to 2013, the STP dams were raised in six stages using the downstream construction method:

1) 1983 to 1984 (FCL 1984)

2) 1985 to 1990 (FCL 1988, 1989, 1990)

3) 1993

4) 2008 (Golder 2009)

5) 2010 (FRO 2010)

6) 2012 to 2013 (Golder 2013, 2014d)

The design crest elevation of 1,637.85 m was specified in the original design report (reported as elev. 1,638.3 m FRO Mine Grid in Golder 1976), and this elevation was reached for the Main Dam with construction carried out in 2013. The design crest elevation of the north end of the West Dam is 1,639.5 m, and this elevation was reached with construction carried out in 2013; however, a section of the north abutment was not completed due to the gas pipeline in this area. Designs of the north and south abutment sections of the dam are presented in the design update report and design drawings (Golder 2011, 2012a). The latest construction summary of the STP raise is reported in the construction record report (Golder 2014d).

The current minimum crest of the STP dam is elev. 1,637.85 m (confirmed with 2020 LiDAR survey data from FRO).

The dam's construction prior to the 2008 raise was wider than design, which created a bench along the length of the facility when the 2008 and later lifts were constructed, as shown in the sections in Figure 4 and Figure 5.

The June 2013 flooding of the Fording River caused high flows along the downstream toe of the STP West Dam, which eroded the foundation soils and a minor portion of the CR shell. Repairs to the West Dam downstream toe area were completed in 2013.

Riprap upgrades were completed for the STP in 2016, and construction was carried out under the direction of Kerr Wood Leidal Associates Ltd. (KWL) as Designer of Record. KWL oversaw the placement of approximately 2.5 m thickness of riprap by FRO and FRO contractors along the existing STP riprap alignment for scour protection and to accommodate the revised 200-year return period (Q200) design flow (KWL 2017b). During construction, KWL provided oversight to the gradation and quality of the riprap, which was sourced on site. A construction completion report and record drawings for these riprap upgrades are included in KWL (2017b). Golder provided on-site services to oversee resloping of the till bench and cutting into weathered bedrock for key-in of the riprap material, and monitored seepage conditions and signs of instability (Golder 2017a).

One recommendation remains outstanding from the reconstruction and riprap upgrades (Golder 2014c): river flood protection south of STP Sta. 0+680 needs to be completed to improve long-term stability of the STP structure (recommendation 2015-12 in Table 26 in Section 6.5). The riprap upgrades south of Sta. 0+680 have not been completed.

A 168 mm outer diameter, 160.3 m internal diameter steel high-pressure gas pipeline crosses beneath the north abutment of the STP at Sta. -0+185 m and continues under the tailings along the western side of the railway embankment, then crosses under the STP's south abutment at approximately Sta. 1+850. This gas pipeline was decommissioned in 2020, as discussed in Section 3.2.5.1.

An environmental design flood is defined as the most severe flood that is to be managed without release of untreated water to the environment (CDA 2019). The 100-year return period, 10-day rain-on-snow event was adopted as the environmental design flood (Golder 2020e).

Golder carried out a site investigation in December 2018 on the tailings at the STP. The investigation included six cone penetration tests (CPTs), two seismic CPTs, sonic drilling, electronic field vane shear testing, vibrating wire (VW) piezometer installation, and laboratory testing. The data collected from the site investigation are summarized in a report by Golder (2020d). Results from the site investigation were used for liquefaction assessment and bearing capacity of tailings (Golder 2020d), as well as an assessment of potential of dam overtopping due to displacement induced by tailings liquefaction (Golder 2020c, in draft, further described in Section 3.2.2). Locations of the boreholes, CPT holes, and VW piezometers are shown in Figure 3. Some of the conclusions from the site investigation are as follows:

- The tailings below the phreatic surface are susceptible to liquefaction in all CPT locations.
- The phreatic surface was found to be 6.6 to 8.8 m below the tailings surface in December 2018.
- The allowable bearing capacity of tailings surface reduces with distance away from the discharge point due to the reduction in the undrained shear strength of tailing materials. The undrained allowable bearing capacity, when measured as radial distances from the end of the pipe discharge point, for a 1 m square footing was:
  - 160 kPa in areas within 200 m of the discharge point
  - 120 kPa between 200 and 350 m from the discharge point
  - 70 kPa between 350 and 500 m from the discharge point

Signage was placed at the dam toe, crest, and vicinity of the STP in June 2019 to notify passersby that the structure is a tailings dam and to provide direction and contact information to report any issues observed or any proposed work in the vicinity.

2.3.1.1 Main Dam

The STP Main Dam, which extends across the Fording River flood plain, has a maximum height of approximately 35 m. A typical section of the STP Main Dam is presented in Figure 4. The Main Dam was constructed and raised using a downstream construction method. It consists of a low permeability starter dam of compacted glacial till soil with a cut-off through the sand and gravel into the underlying in situ till. Raises above the starter dam included an inclined low permeability zone of compacted glacial till soil on the upstream side of the dam, supported by a zone of compacted CR or CCFR. The compacted CR or CCFR zone that forms the downstream shell of the Main Dam provides the structural strength of the dam.

As indicated in Figure 4, discontinuous flood plain sands and gravels extend beneath the whole downstream shell of the Main Dam. These sands and gravels extend through the Fording River flood plain gravels and are joined to in situ glacial till soils that underlie the flood plain gravels. These flood plain sediments are pervious and serve as an underdrain for the dam.

The Main Dam abuts high ground at the location of the reclaim barge. The south abutment till blanket and dam tie into both the high ground and in situ soil in the railway embankment. The till blanket was constructed to reduce potential seepage losses from the STP south abutment and to mitigate against a preferential flow path at the dam's tie-in to the south abutment.

A dam breach and inundation study was conducted by Golder (2020b) to assess the potential for inundation in the immediate downstream area of the Main Dam, which now includes the active water treatment facility-south (AWTF-S). The study was carried out as a result of recommended action 2018-06 (Table 26 in Section 6.5).

2.3.1.2 West Dam

The STP West Dam is founded on the till bench that borders the western edge of the Fording River diversion channel and on a portion of the Fording River flood plain. It was constructed and raised using a downstream construction method. A typical section through the West Dam, presented in Figure 5, consists of a low permeability zone of compacted glacial till soil on the upstream side of the STP West Dam, supported by a zone of compacted CR or CCFR. The West Dam abuts into the railway embankment at the north abutment. The West Dam ranges from a height of 16 m near Sta. 0+400 to 24 m near the transition to the Main Dam.

A key-in excavation was constructed for a portion of the north abutment, and the excavation was filled with compacted till. The construction of the north abutment section between Sta. -0+160 and -0+223 is on hold due to proximity to the high pressure gas pipeline. An interim berm was constructed approximately parallel to the gas pipeline.

Tailings were observed to periodically back up at the north single point discharge channel area and the backed up tailings would cause the tailings pipeline to become partially submerged. In 2018 and 2019, FRO contracted an earthworks company to excavate, with a long-arm excavator, tailings from the main discharge channel to direct tailings flow away from the discharge point and toward the main reclaim pond. The excavated tailings were stockpiled to the west of the channel and spread locally in the area using a dozer. The stockpiled tailings were regraded in 2019 across a larger area (than the stockpile) and to slope the tailings to the topography of the STP facility and dam, where elevation is the highest at the north end and slopes down toward the south. The Engineer of Record (EoR) provided recommendations (Golder 2019) on the maximum elevation of the graded surface tailings, setback between the graded tailings and STP dam upstream slope, and geotechnical considerations for safe working conditions in this area to FRO's safe work plan of this work.

The tailings pipeline was extended in 2020 to lower the risk of a tailings back up in the discharge channel, as discussed in Section 3.2.5.2.

2.3.1.3 Railway Embankment

A segment of the railway embankment south of the loading loop traverses an area that impounds tailings in the STP facility. A stability assessment of the embankment was previously carried out by Golder in 1984 (Golder 1984) and updated in 2010 (Golder 2010). The 1984 assessment recommended a buttress on both sides of the railway embankment to maintain stability of the embankment with respect to the increase in the pond elevation. FRO constructed this buttress in stages as the tailings and STP pond level increased between 1985 and 2014.

In 2010, Golder recommended that FRO grout the existing culverts that conveyed surface runoff through the railway embankment, install new culverts at a higher elevation, and backfill the area east of the railway embankment to provide further buttressing for the railway embankment to improve stability (Golder 2010). The corrugated steel culverts passing through the railway embankment were filled with concrete during 2009 and 2010 to prevent the flow of tailings from the STP to the east as the tailings level rose above the elevation of the existing culverts. The unused culverts were properly closed and abandoned, and in 2010 the area of the railway embankment was backfilled and graded. Surface runoff from the area upslope of the railway embankment, including Blackmore Creek, is now diverted around the backfilled area into the STP through twin 0.8 m diameter culverts installed in 2010.

A till cut-off was constructed through the rejects buttress fill that runs parallel to the railway embankment (Golder 2013).

Three culverts were installed in 2015 under the railway track to pass pipelines (two at 0.6 m diameter and one at 0.3 m diameter) as part of the STP to Turnbull TSF tailings transfer project. These culverts are located just north of the twin Blackmore Creek culverts.

2.3.2 North Tailings Pond

A plan view of the NTP facility is shown in Figure 6 and Figure 7. The NTP was developed on a segment of the Fording River flood plain and occupies a total area of approximately 40 ha. In the 1970s, the Fording River was diverted into a new constructed channel (McElhanney 1969) to allow construction of the NTP on the west side of the Fording River flood plain (Golder Brawner 1969). Along the eastern and southeastern sides of the NTP facility, confinement for water and the stored tailings is provided by a zoned earth fill dam that has a maximum height of approximately 24 m. The NTP dam was designed and constructed using a downstream construction method. A confining dam is not required along the west side of the facility because the natural ground to the west of the NTP is higher than the stored tailings or pond level.

A typical section through the zoned earth fill NTP dam is presented in Figure 8. The crest of the dam was raised in stages, as the tailings storage requirements increased progressively during the early years of operation at FRO. Stage 1 of the dam was constructed entirely of compacted glacial till soil, complete with a compacted glacial till cut-off that extends through the Fording River flood plain gravels and is joined to in situ glacial till soils that underlie the flood plain gravels.

During subsequent stages of construction, the compacted glacial till was extended upward in the form of an inclined zone on the upstream side of the NTP dam. Structural support for this inclined till zone is provided by compacted CR. As shown in Figure 4, the in situ fluvial sands and gravels of the Fording River flood plain extend beneath the cross-section of the dam. These fluvial sediments have a high hydraulic conductivity and serve as an underdrain that promotes downward seepage from the facility.

The original design for the NTP was completed by Golder (Golder Brawner 1969, 1970). Construction of the NTP was initiated in 1971 (Golder Brawner 1971), and the facility was put into service in March 1972. The NTP dam was raised four times between 1973 and 1979 (Golder Brawner 1973, 1974a,b, 1975a,b; Golder 1979) using a downstream construction method and reached its current elevation in 1979. The NTP facility was at its tailings storage capacity by 1980 (Golder 1981). Between 1980 and 1991, the NTP was inactive, and the facility was dewatered and excavated using scrapers to recover additional tailings storage capacity (FCL 1981; Golder 1981). The NTP was put back into active use and refilled with tailings between 1993 and 1997, after which the facility was again inactive. From 2001 to 2002, the NTP was dredged and the tailings were sent to 2 Pit and 3 Pit South. Dredged tailings from the STP were used to fill the excavated areas of the NTP seasonally between 2004 and 2006. No tailings have been sent to the NTP since 2006, and the tailings pipeline has been partially removed.

The design crest of the NTP dam is elev. 1,653 m with minimum elevation of the NTP dam crest at elev. 1,652.6 m (confirmed with 2020 LiDAR survey data from FRO).

Following the flood of June 1995, riprap was placed along the downstream/eastern toe of the dam, as well as along the opposite (left) side of the Fording River channel. The condition of the riprap placed in 1995 had degraded by the time of the 2006 dam safety review (DSR), and review of the riprap sizing and placement was recommended by Golder. Assessment of the riprap was performed by KWL (2007, 2009).

Between 19 and 20 June 2013, a significant 48-hour rainfall event occurred which resulted in flooding of the Fording River. High flows along the toes of the NTP dam triggered major erosion of the CR shell. Golder was retained by FRO to provide geotechnical input for flood repairs of the NTP dam. KWL was retained to provide recommendations for sizing and placement of the river bank protection along the downstream dam toe (KWL 2014). The dam shell was rebuilt using compacted CCFR material. A total CCFR fill of approximately 22,350 m³ was placed and compacted between 3 July and 8 August 2013 (Golder 2014b). Riprap revetment construction was carried out along the toe of NTP dam under the direction of KWL in 2013 and 2014.

In 2016, FRO constructed a sediment pond north of the NTP facility (the Liverpool Sediment Pond); the outlet channel from this pond is routed through the north end of the NTP tailings deposit and includes a fish barrier weir constructed through the north abutment of the NTP dam (AMEC-FW 2017).

Additional riprap upgrade works were designed and construction was carried out under the direction of KWL as Designer of Record in 2016 and 2017 (KWL 2017a). The 2016 work included placing riprap of approximately 2.5 m thickness along the existing NTP riprap alignment for scour protection and to accommodate the revised 200-year return period (Q200) design flow plus freeboard. During 2017, riprap construction was completed under the direction of KWL which included the excavation and placement of approximately 150 m of riprap at the upstream end of the NTP and the placement of approximately 745 m of riprap over the existing bank protection. During construction, KWL provided oversight to the gradation and quality of the riprap, which was sourced on site. A construction completion report and record drawings for these riprap upgrades are included in KWL (2017b).

Golder completed a screening-level flowability assessment of the tailings within NTP in 2016 (Golder 2017c) to assess the possibility of revising the NTP from a tailings dam to a mine waste facility or “landform” per Section 10.6.12 of the HSRC (Ministry of Energy and Mines 2017).

In September 2018, FRO installed two monitoring wells at the toe of the NTP dam to support the NTP transition scope of the Flood Mitigation Project. The location of these monitoring wells is shown in Figure 7.

On 18 May 2019, a VW piezometer was installed in the NTP pond to monitor pond elevation. A data logger was installed for the piezometer and it is connected to GeoExplorer. Readings from the NTP pond piezometer are live on GeoExplorer and are recorded every six hours.

A staff gauge was installed in the NTP pond in October 2019 to also monitor pond elevation. The staff gauge has been calibrated regularly as part of maintaining accurate readings.

2.3.3 Water Management of the South Tailing Pond and North Tailings Pond

2.3.3.1 Freeboard Management

The STP and NTP facilities were reclassified in 2018 from High to Very High consequence structures following the dam consequence classification guidelines from the HSRC Guidance Document Section 3.4 (Ministry of Energy and Mines 2016), which references the Canadian Dam Association (CDA 2013) dam safety guidelines. As a result of the reclassification, Golder updated the inflow design flood (IDF) and freeboard assessment for both facilities (Golder 2018b). The resulting minimum required freeboard during the IDF event and maximum operating water level for the STP and NTP are summarized in Table 1.

For the STP, a maximum operating water level at 1.2 m below the minimum dam crest elevation would provide the required minimum freeboard only if all external catchment areas which report to the STP through Blackmore Creek are diverted during the IDF event. A pump which could be used to divert water from Blackmore Creek before entering the STP was added in 2018. However, it was identified in 2019 that a diversion channel of water from the Blackmore Creek is not feasible. Detailed design of a spillway was completed in 2020 to pass the probable maximum flood (PMF) event (Golder 2020e) with construction of the spillway starting in October 2020. The maximum pond elevation and freeboard level for the STP will need to be updated following completion of the spillway construction (recommended action 2020-01 in Table 26 in Section 6.5).

For the NTP, the maximum operating water level must be 1.9 m below the minimum dam crest elevation to store the IDF while maintaining the required minimum freeboard.

Table 1: Maximum Pond Elevations and Freeboard Levels

Parameter	STP (m)	NTP (m)
Minimum dam crest elevation	1,637.85[(a)]	1,652.60[(b)]
Minimum required freeboard (during IDF)	0.40	0.35
IDF water level (dam crest elevation minus the minimum freeboard)	1,637.45	1,652.25
Maximum operating water level	1,636.65[(c)]	1,650.70

(a) Minimum Main Dam crest elevation following 2013 dam raise construction reported in Golder (2014d), checked with 2020 LiDAR survey data from FRO.

(b) Dam crest elevation from 2018 LiDAR, checked with 2020 LiDAR survey data from FRO.

(c) The maximum operating water level is calculated assuming all the STP external watershed areas through Blackmore Creek are diverted during the IDF event.

Source: Golder 2018b.

STP = South Tailings Pond; NTP = North Tailings Pond; IDF = inflow design flood; FRO = Fording River Operations.

2.3.3.2 Control of Inflows and Outflows

Floating reclaim pumps are used to recirculate water from the STP to the processing plant. Water demand at the plant is greater than the volume of water that is available from recirculation of tailings slurry transport water alone, creating a water deficit in the STP facility water balance. Makeup water is added to the STP from various locations on site to satisfy the reclaim water demand.

In the event of high water levels, the STP water level trigger-action-response plan (TARP) from Appendix B or the NTP water level TARP from Appendix C of the OMS manual (FRO 2020b) would be followed.

There are no permanent working pumps at the NTP. A pipeline is in place and a pump can be installed to pump water from the NTP to the STP when required.

2.3.4 Design Parameters for the South Tailings Pond and North Tailings Pond

The following design parameters apply to the STP and NTP. Typical sections of the dams are shown in Figure 4 and Figure 5 for the STP and in Figure 8 for the NTP.

2.3.4.1 Foundation Materials

The retention dams at the STP and the NTP are founded on Fording River flood plain sands and gravels, dense glacial till soils, or shale bedrock.

A subsurface investigation was completed by FRO to compile in situ density data and subsurface stratigraphy under the STP and NTP dams (FRO 2016).

2.3.4.2 Embankment Fill Materials

Materials that were used to construct the dams were till fill, CR, and CCFR.

2.3.4.2.1 Till Fill

A zone of compacted glacial till fill forms the upstream face of the retaining dams. This till fill zone serves as a low permeability zone to minimize seepage through the dam rather than as structural support. The glacial till material was sourced locally on site.

2.3.4.2.2 Coarse Rejects and Combined Coarse and Fine Rejects

At both the STP and the NTP, support for the low permeability zone of the dams is provided by compacted CR or CCFR. The CR is a waste product generated at the wash plant and consists of sand and gravel-sized, well-graded, washed crushed rock material.

For the 2010 and 2012 raises of the STP dams, CCFR was used in place of the CR following modifications to the wash plant waste streams. The CCFR is formed by combining the CR with finer material previously sent to the tailings ponds as tailings. The CCFR contains approximately 2% to 10% material finer than 0.075 mm. The engineering properties of the CCFR are similar to those of the CR and used in slope stability analysis (Golder 2018b).

Golder personnel were on site throughout the 2012 and 2013 dam raise construction period to provide quality control services following the Quality Control Specifications from Golder (2011). Results of the quality control program related to the dam raise, including construction observations and deficiencies noted by the Golder personnel, and recommendations to address the deficiencies, are included in the construction record reports (Golder 2013, 2014d).

2.3.4.3 Seismicity

The site is located in an area of relatively low seismicity in BC. Golder developed a site-specific seismic hazard model for the FRO site based on historical seismicity and a review of geological and paleoseismological features (Golder 2016b). Golder's model includes four area sources from the 5th Generation Seismic Hazard Model and nine faults and fault segments mapped in northwest Montana. The 5th Generation Seismic Hazard Model was developed by Natural Resources Canada for use in the 2015 National Building Code of Canada.

Probabilistic analysis results from site-specific hazard model are listed in Table 2. All site-specific peak ground acceleration values were evaluated for a soil Site Class C as described in the 2010 National Building Code of Canada (NRCC 2010) as this represents Golder's understanding of the general foundation conditions at the dam locations.

Table 2: Fording River Operations Site Seismic Hazard Values

Exceedance Probability	Return Period (years)	Peak Ground Acceleration (g)
40% in 50 years	100	0.020
10% in 50 years	475	0.063
5% in 50 years	1,000	0.097
2% in 50 years	2,475	0.158
1% in 50 years	5,000	0.222
½% in 50 years	10,000	0.300

Notes: For firm ground site class "C," very dense soil and soft rock foundation, as defined by 2010 National Building Code of Canada (NRCC 2010).
Return periods are not exact representations of annual exceedance probabilities; rounding per Canadian Dam Association (CDA 2013, 2019) is shown.
FRO (Fording River Operations) site coordinates: 50.202°N, -114.876°W.

The HSRC Guidance Document, Section 3.3.1 (Ministry of Energy and Mines 2016) recommends a return period of ½ between the 2,475-year and 10,000-year seismic event or the maximum credible earthquake for tailings dams with Very High consequence classification.

2.4 Key Personnel

The EoR for the STP and NTP dams is John Cunning, P.Eng., an employee of Golder. A succession plan for the EoR has been developed between Golder and FRO, where the EoR designate is Ms. Julia Steele, P.Eng., another employee of Golder. In the event neither Ms. Steele nor Mr. Cunning can be reached (e.g., they are travelling to site), Golder has provided FRO with backup EoRs' emergency contacts, and their contact details have been added to the FRO tailings emergency contact list.

KWL has historically been responsible for hydraulics-related works and has completed a Fording River hydraulics assessment (KWL 2017c) and prepared design and construction record reports for erosion protection along the STP and NTP dam toes following the 2013 flood event (KWL 2017a,b). Jason Miller of KWL is the Designer of Record for the erosion protection works for both the STP and NTP facilities.

As of 31 August 2020, the tailings engineer at FRO was Robyn Gaebel, P.Eng. The Qualified Professional for the STP and NTP facilities was Adam Langer, P.Eng., Superintendent Engineering, who is an employee of Teck. Ms. Gaebel became the Qualified Professional for the STP and NTP facilities on 1 December 2020. Patrick Lea, P.Eng., is the tailings engineer at FRO.

2.5 Quantifiable Performance Objectives

Quantifiable performance objectives (QPOs) have been established for the STP and NTP with consideration of the credible failure modes for the facilities. Golder has updated the QPOs for piezometers and GPS units at the STP and NTP based on the stability update completed in 2018 (Golder 2018b).

2.5.1 Piezometers

Slope stability analysis of the STP and NTP dams (Golder 2018b) informed the initial development of warning and alarm QPOs. The warning and alarm QPOs were based on the stability assessment for the Very High consequence dam classification Golder (2018b) and presented in the Elk Valley Elevation Datum system, rounded to the nearest 0.1 m. These QPOs are included in the 2020 version of the OMS manual (FRO 2020b).

Three VW piezometers (at BH-CPT18-05A and -07A) were installed in 2018 within the STP tailings deposit. No QPOs are required for these instruments as they were not installed for dam safety reasons. Data loggers were installed for these piezometers on 23 August 2019.

Seven piezometers were installed in three locations (CP17-NTP-01, -02, and -04) within the NTP tailings deposit in November and December 2017. These are being monitored to support NTP facility closure studies, and no QPOs are required for these instruments.

The piezometer QPOs are presented in Table 3.

Table 3: Piezometer Instrumentation Trigger Levels for the South Tailings Pond and North Tailings Pond

Dam	Monitoring Instrument	Warning Water Elevation (m)
NTP	TH15-05	>1,646.5
	TH15-06	>1,643.5
	TH15-07	>1,640.5
STP – Main Dam	SP-3	>1,604.0
	SP-5	>1,603.5
	TH15-04	>1,603.5
	TH15-01 / VW-5	>1,617.5
	TH15-02 / VW-4	>1,624.0
STP – West Dam	TH15-03 / VW-1 / VW-2	>1,627.5
	SP-W1	>1,623.1
	SP-W3	>1,623.0
	VW-3	>1,627.0

NTP = North Tailings Pond; STP = South Tailings Pond; > = greater than.

2.5.2 Dam Crest Displacement Monitoring

The STP has 10 GPS units to monitor displacements. FRO ceased the use of prisms on the NTP dam in May 2018 due to difficulties with surveying in winter (i.e., snow cover on the prisms) and with backsight readings. The prisms were replaced with GPS units, with three units installed at the NTP in June 2018. Dam crest displacement monitoring is considered a best practice, and warning levels for displacement data from the GPS units have been established.

Data from the GPS units are reviewed by FRO as part of the tailings dam inspections for the STP and NTP (weekly to monthly for the STP and monthly for the NTP) to check for movements or trends of concern. The data and results of the routine FRO review are provided to the EoR on a monthly basis for review.

Table 4 provides the updated trigger levels for GPS units on the STP and NTP dams from Golder (2018b). The trigger levels for 3D velocity with 12-point averaging are set above the noise level of the instruments.

Table 4: GPS Monitoring Instrumentation Trigger Levels for Both South and North Tailings Ponds

Dam	Monitoring Instrument	Survey Data	Warning	Alarm
STP & NTP	GPS	3D displacement (or cumulative relative displacement)	>100 mm	>150 mm
		3D point velocity with 12-point averaging	>100 mm/day	>150 mm/day

Note: Discuss with Engineer of Record prior to zeroing displacement data.
STP = South Tailings Pond; NTP = North Tailings Pond; > = greater than.

2.5.3 Inclinometers

In total, there are seven inclinometers (Table 5): four inclinometers are installed in the STP dam (TH15-01 to TH15-04) and three are installed in the NTP (TH15-05 to TH15-07). These were installed during 2015 drilling as a best practice, and not in response to any dam displacement concerns. Slope inclinometer data were collected quarterly up until September 2018. During the 2018 DSI site visit, the EoR and TSF Qualified Person agreed that the inclinometers should be read three times per year and the readings timed with the following events:

- shortly before freshet
- latter part of freshet
- late summer

Table 5: Inclinometer Summary

Location	Test Hole	Approximate A-A Axis Azimuth (°)	Hole Depth (m)	Casing Stickup (m)	Start Depth (m)	Reading Intervals (m)
STP	TH15-01	310	41.00	0.8	40.0	1.0
	TH15-02	10	40.00	1.0	40.0	1.0
	TH15-03	30	30.05	1.1	30.0	1.0
	TH15-04	15	6.00	1.0	6.0	1.0
NTP	TH15-05	235	20.90	0.9	21.0	1.0
	TH15-06	290	29.20	1.0	29.0	1.0
	TH15-07	305	40.80	0.9	41.0	1.0

Source: Summary table provided by email (Roseingrave 2017, pers. comm.).
STP = South Tailings Pond; NTP = North Tailings Pond.

FRO and the EoR discussed challenges with setting QPOs for inclinometers as they are not a critical dam safety control and it is not practical to set QPOs for inclinometers. Monitoring inclinometers is considered a best practice and Table 6 has been updated to provide suggested screening trigger levels for review of the inclinometer data.

Table 6: Trigger Levels for Inclinometers

Monitoring Instrument	Trigger Level	Severity	
		Acceptable	Warning
Inclinometer	Downstream displacement	<5 mm	>5 mm and <15 mm

Note: Trigger levels provided are for readings measured at depths greater than 1 m below ground surface. > = greater than; < = less than.

2.5.4 Freeboard Quantifiable Performance Objective

The warning and alarm triggers shown in Table 7 are currently used by FRO for the STP and NTP facilities' water level elevations. STP and NTP water level TARPs are provided in Appendix B and Appendix C, respectively, of the OMS manual (FRO 2020b). The STP water level TARP has been updated in response to the STP spillway construction.

Table 7: Freeboard Quantifiable Performance Objective Trigger Levels for the South Tailings Pond and the North Tailings Pond

Dam	Survey Data	High Level Warning	High Level Alarm (i.e., freeboard exceedance)
NTP	Water level	>1,650.4 m	>1,650.7 m
STP	Water level	>1,636.55 m	>1,636.65 m

NTP = North Tailings Pond; STP = South Tailings Pond; > = greater than.

The warning and alarm triggers shall be updated for STP after spillway construction is completed (recommended action 2020-01).

2.5.5 Swift Area Blasting

The Swift mining area has active open pit mining operations located near the STP and NTP dams. A blast monitoring TARP has been prepared to monitor potential effects from this nearby blasting. The response framework for the monitoring data is described in Golder (2018c), and the TARP is included in Appendix D of the OMS manual (FRO 2020b).

3.0 OPERATION, MAINTENANCE, AND CONSTRUCTION DURING 2019/2020 REPORTING PERIOD

A summary of the operations, maintenance, and any construction activities for the 2019/2020 DSI reporting period is presented in the following sections.

3.1 South Tailings Pond and North Tailings Pond

Operations and maintenance activities occurred for both the STP and NTP facilities during the reporting period are described as follows. Facility-specific activities are described in the subsequent subsections.

3.1.1 2020 Flood Monitoring

During the 2020 freshet, the FRO site entered two stages of flood monitoring, Flood Season Monitoring and Active Flood Watch, which are defined in the FRO *Tailings Impoundment Flood Response Protocol for the Fording River* (FRO 2020a) as follows:

- Level 1—Flood Season Monitoring I
  - defined as daily assessment of flood risk by site personnel and no risk to site
  - due to annual freshet cycle
  - occurred from 15 April to 28 May, and from 11 June to 6 July 2020
- Level 2—Flood Season Monitoring II
  - defined as heighted awareness in site personnel, elevated water levels, and no risk to the site
  - due to high streamflow advisory issued by the BC River Forecast Centre for East Kootenay
  - occurred from 29 to 31 May, and from 4 to 10 June 2020
- Level 3—Active Flood Watch
  - defined as notifications and non-invasive response activities
  - due to flood watch issued by the BC River Forecast Centre for East Kootenay
  - occurred from 1 to 3 June 2020

FRO responded to the Level 2 and Level 3 flood monitoring by following actions from the TARP in FRO (2020a), including conducting event-driven inspections of the NTP, STP, Fording River, and Fording Multiplate Embankment (upstream of NTP and STP) by the tailings engineer.

3.1.2 Dam Safety Review

A DSR was completed in 2019 by a third-party consultant (SNC-Lavalin 2020). The DSR concurred with the assigned dam classification for the STP and NTP dams and concluded the dams are reasonably safe with identified deficiencies and non-conformances.

One deficiency identified in the DSR for each of the STP and NTP dams is that the stability factor of safety (FoS) of the downstream slope is lower than required by regulation, guidelines, and submitted designs that were permitted. A response to this deficiency is presented in Golder (2020g). The EoR team identified that the DSR report considered a different interpretation of the HSRC (EMLI 2021) and HSRC Guidance Document (Ministry of Energy and Mines 2016) with respect to the application of results of slope stability analyses, which was not consistent with that used in Golder's previous slope stability analyses reports (Golder 2016c, 2018b). As such, Golder is currently not in agreement with the conclusions of the stability analysis results presented in the DSR report (SNC-Lavalin 2020) that were used to identify a deficiency for the downstream slope stability FoS.

The EoR team submitted a scope of work to FRO to provide recommended actions based on the deficiencies and non-conformances identified in the DSR. The scope of work is scheduled to commence in Q2 2021.

3.1.3 Animal Burrows

FRO developed an animal burrow inspection plan in 2019 for both the STP and NTP facilities. The spring animal burrow inspection was conducted at the STP on 5 May 2020, followed by trapping and relocation of ground squirrels between 5 May and 7 June 2020. No animal burrow inspection was carried out at the NTP as there were no signs of animal activity. The fall animal burrow inspection was conducted on 7 October 2020 at the STP.

3.2 South Tailings Pond

3.2.1 Spillway

Following the reclassification of the STP dam from a High to a Very High consequence structure, the hydrologic assessment of the STP (Golder 2018b) identified that the existing STP facility (without a spillway) does not have sufficient capacity to store the 72-hour IDF as required by the HSRC (Ministry of Energy and Mines 2017). Following a directive by Teck, the detailed design of a spillway was completed in June 2020 (Golder 2020e) and the spillway was sized to pass the PMF event. The spillway design consists of:

- a spillway invert (20 m long) with a 53 m wide base and a concrete sill with invert elevation at 1,637.1 m
- a spillway chute (78 m long) consisting of a channel, chute, and stilling basin; the chute tapers from 53 m at its connection with the spillway invert to 36 m at the stilling basin
- a channel stilling basin to account for a hydraulic jump that is expected at the base of the spillway chute during spillway flow events
- a spillway channel (440 m long) that starts at 36 m in width then tapers to 10 m except for the portion of the spillway channel that will act as an access road

The majority of the spillway channel will be excavated, with some sections requiring construction fill. Riprap armouring will be required along the spillway channel downstream of the invert.

The BC Ministry of Energy, Mines and Petroleum Resources approved spillway construction in July (Permit C-3 amendment dated 3 July 2020). Construction of the spillway is planned to be in two phases, with the first phase started in October 2020 and the second phase completed in 2021.

Construction of the spillway began in October 2020 and is planned to be completed in 2021.

3.2.2 Overtopping Potential due to Liquefaction-Induced Displacement in Tailings

A study was carried out to estimate liquefaction-induced displacements of the STP tailings beach for input to understand the STP dam overtopping potential as a result of a wave triggered by the liquefaction-induced displacement of tailings into the STP pond. The study was to address recommended action 2017-05 (Table 26 in Section 6.5). Preliminary findings from the study are provided in a draft technical memorandum (Golder 2020c).

The preliminary findings indicated that an energy transfer ratio over 2.5% exists which means there is a potential for the generated wave to overtop the STP dam crest as a result of the block failure of the liquefied tailings. This possibility is also based on estimates of lateral displacement into the reclaim pond as the wave run-up estimated range is greater that the minimum freeboard of 1.2 m.

There were high levels of uncertainty in the analysis of the study. Additional analyses were recommended to better characterize the failure potential of saturated tailings block and wave attenuation potential.

3.2.3 Fording River Flood Plain Widening

Detailed design of the Flood Plain Widening Project was completed in March 2021. Tree clearing and mulching across from the STP on the western side of the Fording River began on 9 March 2020. A soil test pitting program was completed in spring 2020.

3.2.4 Pond Capacity, Dredging, and Other Operation Updates

The STP was active and tailings were deposited into the STP throughout the reporting period.

A staff gauge was installed at the reclaim barge in March 2020. The staff gauge can be viewed from the STP barge camera.

The 2020 dredging season was between 18 April and 16 October 2020. A total of 1.65 million dry metric tonnes of tailings was dredged from the STP and sent to the Turnbull TSF.

Dredging was conducted around the reclaim barge at the end of June 2020 to remove accumulated solids around the barge.

Lowering of the pond level started in June 2020 in preparation for spillway construction. A maximum operating water elevation at 1,636.4 m was provided in the STP spillway detailed design report (Golder 2020e). The pond level was lowered to elev. 1,636.2 m as of 3 September 2020, and FRO manages the pond level following the most recent version of the STP water level TARP.

Bathymetric surveys were completed by FRO on 12 April (before dredging commenced) and 15 October 2020 (during dredging operations) as part of monitoring storage capacity in the STP. The storage capacity and operating pond volume of the STP are to be confirmed after each bathymetric survey is completed (recommended action 2020-03).

During the reporting period, site drainage was sent to the STP:

- on 20 January 2020 while the NLP was dewatered in anticipation of scheduled sediment removal until an unspecified time in March while the NLP was being cleaned out in February and March 2020
- from 23 to 27 March 2020
- from 5 to 13 April 2020

- from 17 April to 10 August 2020
- from 20 to 31 August 2020

A camera was installed downstream of the West Dam in August 2020 to allow remote access to view the STP West Dam and Fording River for real-time visual monitoring.

3.2.5 Construction and Maintenance

3.2.5.1 Grouting of Gas Pipeline at South Abutment

The gas pipeline that was located under the north and south abutment of the STP was decommissioned and purged in June 2020 by FortisBC, the owner of the pipeline.

A portion of the gas pipeline from the tree island (along the railway embankment) to downstream of the STP south abutment was exposed, cut, and surveyed by FRO in June 2020. The top of the gas pipeline at the tree island was found to be at elev. 1,638.4 m. The downstream end of the gas pipeline at the south abutment was found to be at elev. 1,636.5 m. Approximately 123 m of the gas pipeline was removed south of the south abutment. The portion of the gas pipeline that could not be removed was backfilled with a sanded grout mix (by CIF Construction Ltd.) supplemented by hydrated bentonite provided by Golder. Approximately 525 linear metres of the pipeline was backfilled, and grouting was completed in one day on 28 June 2020. The grouted pipeline was then capped by FRO. The construction record report of the decommissioning and grouting of the gas line is provided in Golder (2020f).

3.2.5.2 Northern Line Extension

The tailings pipeline was extended upstream by 300 m between July and August 2020. The pipeline was extended to allow tailings to deposit farther upstream from the north abutment area in response to past occurrences of tailings backup at the discharge point. The extended pipeline lowers the risk of tailings backing up and overtopping at the north abutment of the STP.

3.2.6 Inspections

The STP dams were inspected by FRO geotechnical personnel throughout the year per the inspection schedule outlined in Section 1.3.3 of the OMS manual (FRO 2020b). The STP dams were inspected weekly between May and October and twice per month between November and April except on 1 June and 3 June 2020 when event-driven inspections were conducted (described in Section 3.1). The inspections were completed at the required frequency despite challenges and restrictions as a result of the COVID-19 pandemic. A summary of the dam inspection action items is included in Appendix D, and the EoR team has reviewed them as part of the annual review.

Water quality testing is completed by FRO environmental personnel. Water quality testing results are provided in Section 4.3.

3.3 North Tailings Pond

3.3.1 Operation and Capacity

The NTP was not operational and there was no tailings deposition during the reporting period.

A staff gauge was installed in October 2019 to monitor the pond level.

On 19 February 2020, the piezometer installed in the NTP to monitor water level triggered an alert in GeoExplorer when the water level reading exceeded the Water Level Caution elevation of 1,650.3 m. An investigation found that the tip temperature had been below 0°C since early December and the top of ice on the pond was at an elevation of 1,650.28 m. The top of ice elevation was surveyed weekly starting on 19 February 2020 to monitor the pond level until 18 March 2020 when a drone survey was conducted and confirmed the pond was well below the trigger levels. The weekly surveyed elevations did not exceed the Water Level Caution elevation at any time, and the piezometer returned to normal operating condition after the frozen pond had thawed.

A High Level Alarm was triggered in late March/early April 2020 by the pond's VW piezometer. FRO began intermittent pumping of water from the NTP to the STP on 9 April 2020 to draw down the pond level and to increase pond capacity. Pumping continued until the pond was below the normal operating level on 27 April 2020. Pumping to the STP continued intermittently through August 2020 to manage the NTP pond level to below the normal operating level (below High Level Alert) per the procedures listed in the TARP.

In April 2020, FRO discovered a discrepancy between the elevation of readings from monitoring instruments and the instruments' alarm levels in GeoExplorer. The instrument readings were in Elk Valley Elevation Datum while the alarms were in Mine Grid, which is 0.454 m higher. FRO has since corrected the discrepancy and alarm levels and readings are now both Elk Valley Elevation Datum.

FRO has plans to direct surface water drainage from roadways away from NTP due to pond level increases and the future plan of decommissioning the facility and its use as a water management facility.

A camera able to view the staff gauge was installed in June 2020 to facilitate real-time remote visual monitoring.

3.3.2 Construction and Maintenance

A new pipeline that crosses the dam crest at the south abutment area was constructed during the reporting period because the existing pipelines were frozen and damaged. The new pipeline ties into the existing Shandley pipeline and is used to pump water from the NTP to the STP.

Construction activities during the pipeline installation disturbed the dam crest at approximately Sta. 1+410, which was filled and regraded in September 2020.

A drainage channel at the northern end of the facility, upstream of the Liverpool Water Management Facility, was cleaned up on 20 March 2020 to prevent surface runoff from the haul road from entering the Liverpool facility.

3.3.3 Liverpool Water Management Facility

The outlet channel and fish barrier of the Liverpool Water Management Facility, north of the north abutment area of the NTP facility were completed in late 2016, and are not considered part of the NTP facility. The Liverpool Sediment Pond outlet channel was constructed over the NTP tailings beach at the north end of the facility, and the fish barrier structure was constructed through the NTP dam's north abutment. The outlet works for the Liverpool system should continue to be inspected during both the monthly NTP and Liverpool Sediment Pond inspections.

3.3.4 Inspections

The NTP dam was inspected monthly by FRO geotechnical personnel, and event-driven inspections were carried out from 1 to 3 June 2020 (described in Section 3.1). The inspections were completed at the required frequency despite challenges and restrictions as a result of the COVID-19 pandemic. A summary of the dam inspection action items is included in Appendix D, and the NTP dam inspection reports have been reviewed by the EoR.

4.0 REVIEW OF CLIMATE DATA, WATER BALANCE, AND DAM REGISTRY

4.1 Climatic Review

Three local climate monitoring stations exist at FRO: waste water treatment plant, A Spoil, and Brownie Spoil. Records were available from the waste treatment plant and Brownie Spoil weather stations during the reporting period of 1 September 2019 to 31 August 2020. No precipitation data were available for the A Spoil station; data from the A Spoil station were not used for the climate review.

The Fording River Cominco station is the closest regional Environment and Climate Change Canada station to the FRO site; however, the station did not publish precipitation data over the reporting period. The waste water treatment plant station has been used as the main precipitation station for the Fording River Cominco infilling gap process since December 2013. The waste water treatment plant station precipitation data were used over the majority of the reporting period with the exception of 7 July to 9 July 2020 (inclusive), where missing data were infilled with data from the Sparwood CS regional station.

The total precipitation recorded at the waste water treatment plant and Brownie Spoil stations over the reporting period is shown in Table 8, with their monthly total precipitation presented in Chart 1. For comparison purposes, the long-term (1970 to 2019) average monthly precipitation at FRO (from the Fording River Cominco infilled dataset) is also presented in Chart 1. The long-term (1970 to 2019) average annual precipitation at the mine site is estimated to be 634 mm.

Note that data presented in Table 8 and Chart 1 for the waste water treatment plant and Brownie Spoil stations are raw data; no adjustments for station elevation or undercatch were made.

Table 8: Total Precipitation from 1 September 2019 to 31 August 2020

Weather Station	Total Precipitation (mm)
Waste water treatment plant	488
Brownie Spoil	510[(a)]

(a) The majority of data for January to March 2020 were omitted by FRO due to instrument malfunction or variable data.

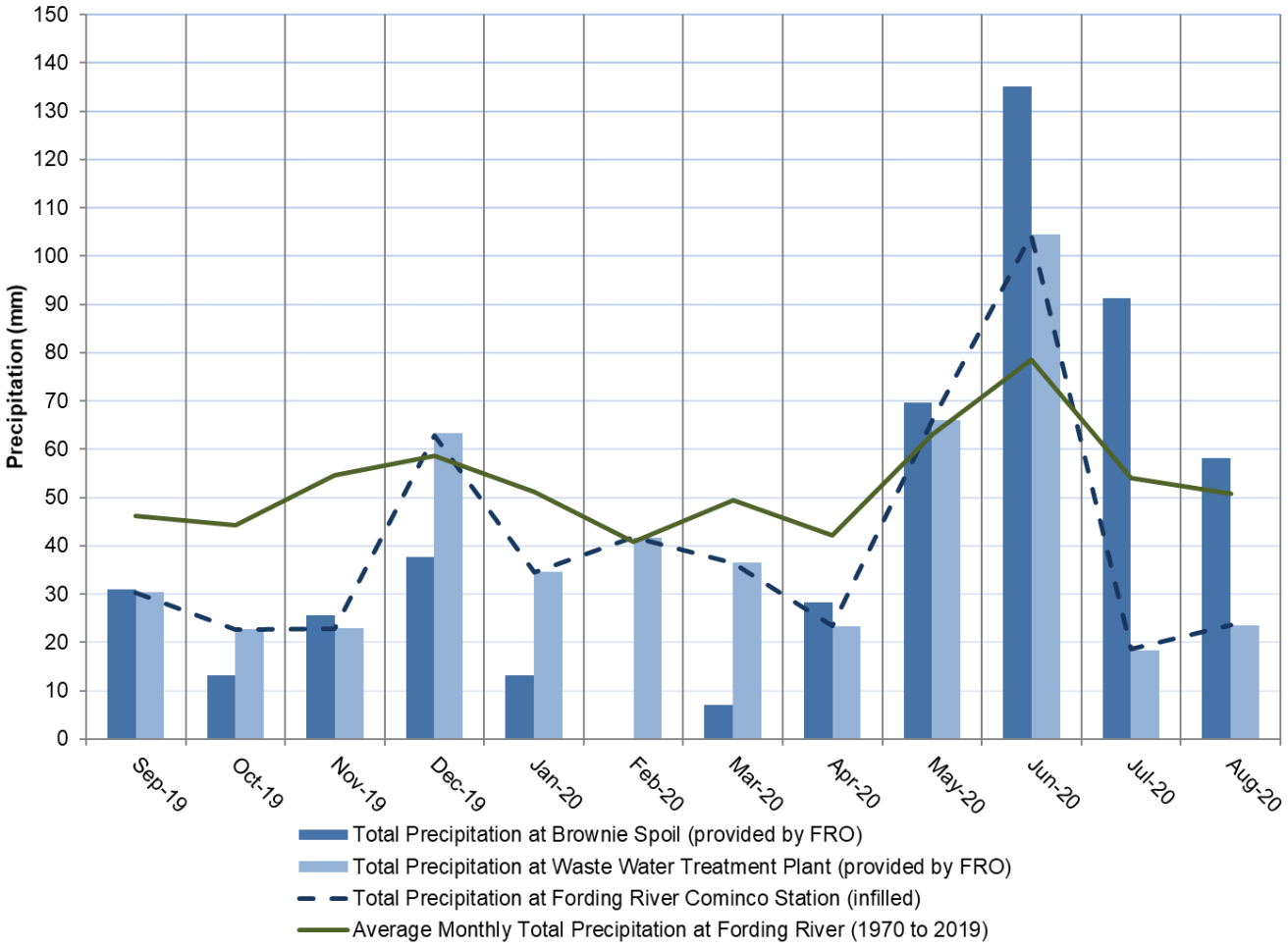


Chart 1: Monthly Precipitation Data from 1 September 2019 to 31 August 2020

The climate data in Table 8 indicate the annual precipitation received at the local FRO weather stations from 1 September 2019 to 31 August 2020 was lower than the long-term annual average of 634 mm. A similar observation could be made from Chart 1, where the total monthly precipitation data recorded at each of the local weather stations were generally at or lower than the long-term average except in:

- December 2019 at the waste water treatment plant station
- May and June 2020 at the waste water treatment plant station
- May through August 2020 at the Brownie Spoil station

Freshet typically starts in April to May at FRO with higher runoff flow events expected during those months as a result of combined rainfall and snowmelt. During the 2020 freshet, FRO noted a higher peak flow than in 2019. FRO started active flood season monitoring on 15 April 2020 and entered the following stages of flood monitoring:

- Level 1 (Flood Season Monitoring I) for active monitoring and no risk to site, from 15 April to 28 May, and from 11 June to 6 July 2020
- Level 2 (Flood Season Monitoring II) for heightened awareness with elevated water levels and no risk to site, from 29 to 31 May, and from 4 to 10 June 2020
- Level 3 (Active Flood Watch) for non-invasive response activities from 1 to 3 June 2020

4.2 Water Balance

4.2.1 South Tailings Pond

The water balance for STP from 1 September 2019 to 31 August 2020 is summarized in Table 9 using climate inputs from the waste water treatment plant station.

Table 9: South Tailings Pond Water Balance – 1 September 2019 to 31 August 2020

IN	Annual Volume (m^3)	OUT	Annual Volume (m^3)	Total Inventory Change (m^3)
Surface water runoff	59,000	Evaporation	260,000	309,000
Precipitation	211,000	Seepage loss	2,509,000	
Tailings slurry	23,244,000	Water retained in tailings	-342,000	
Makeup water	2,401,000	Dredged slurry to Turnbull TSF	2,445,000	
Miscellaneous	1,335,000	Clarified water return	22,070,000	
Sum	**27,248,000**	**Sum**	**26,940,000**	

Note: 12-month volumes and total inventory change may not exactly equal the sum of inflows and/or outflows due to rounding.
TSF = tailings storage facility.

For the reporting period, the water balance model estimates an increase in volume in the STP pond. FRO transferred less makeup water to the STP during the reporting period in an effort to decrease and manage the pond level during spillway construction.

Golder completed an update to the site-wide water balance at FRO in 2020. The water balance was to support FRO to meet requirements from the Ministry of Energy, Mines and Low Carbon Innovation for a mine water management plan, information requirements from the *Joint Application Information Requirements for Mines Act and Environmental Management Act Permits*, and Teck's own internal water governance and health and safety requirements. The FRO site-wide water balance update was completed with site data collected from 2014 to 2019.

4.2.2 North Tailings Pond

The water balance for NTP from 1 September 2019 to 31 August 2020 is summarized in Table 10 using climate inputs from the waste water treatment plant station.

Table 10: 1 September 2019 to 31 August 2020 – North Tailings Pond Water Balance

IN	Annual Volume (m^3)	OUT	Annual Volume (m^3)	Total Inventory Change (m^3)
Surface water runoff	104,000	Evaporation and seepage loss	227,000	
Precipitation	142,000	Pumping to STP	17,000	
Sum	**246,000**	**Sum**	**243,000**	**3,000**

Note: 12-month volumes and total inventory change may not exactly equal the sum of inflows and/or outflows due to rounding.

For the reporting period, the water balance model estimates a small increase in volume in the NTP pond, which is consistent with the observed small increase in pond elevation. Estimated seepage loss is similar to previous years.

4.3 Water Quality Monitoring

FRO Environment carries out water quality monitoring in and around the NTP and STP facility at the following locations. The FRO sample location codes are provided in brackets.

- NTP (FR _NTP)
- STP north seep, at culverts (FR_STPNSEEP)
- STP southwest corner, pond at toe of dam (FR_STPSWSEEP)
- STP west seep, at embankment below West Dam (FR_STPWSEEP)

It is understood that FRO Environment submits water quality monitoring results to the BC Ministry of Environment as part of compliance reporting. Water quality testing results at the above locations were provided by FRO and are included in Table 11; the assessment of the water quality results is beyond the scope of this DSI.

FRO plans to increase water quality sampling in 2021 to a quarterly frequency within the tailings facilities in addition to seep locations following a recommendation from the Independent Tailings Review Board.

Table 11: 1 September 2019 to 31 August 2020 – Water Quality Summary

Location	Date	Analyte			
		Nitrate Nitrogen (NO_3) as N, Fraction: N (mg/L)	Selenium, Fraction: D (µg/L)	Selenium, Fraction: T (µg/L)	Sulphate (as SO_4) Fraction: D (mg/L)
NTP	2019-10-03	not available	not available	4.36	not available
STP north seep	2019-10-01	6.68	22.9	21.9	191
	2020-06-12	4.00	16.6	15.6	73.1
STP southwest corner	2019-10-01	1.18	0.48	0.333	398
	2020-06-12	0.139	0.213	0.062	328
	2020-10-22	<0.025	0.086	0.082	357
STP west seep	2019-10-01	0.904	1.12	0.969	359
	2020-06-12	<0.025	0.198	0.173	258
	2020-10-22	0.036	0.206	0.14	283

NTP = North Tailings Pond; STP = South Tailings Pond; < = less than.

5.0 TAILINGS FACILITY DAM SAFETY ASSESSMENT

This section presents the dam safety assessment of the STP and NTP facilities based on the observations and data review for each of the failure modes that are most relevant to this type of dam.

5.1 Method

5.1.1 Site Visit

The site inspections at the STP and NTP were carried out on 18 and 19 August 2020 by Mr. John Cunning, P.Eng., of Golder. Mr. Cunning was accompanied by Ms. Robyn Gaebel and Mr. Patrick Lea from FRO. The temperature during the visit was 25°C and the weather was sunny.

Appendix A presents a summary of photographs of the STP and NTP from the site inspection. The location, direction, and number for each photograph are noted in Figure 2 (for the STP) and Figure 6 (for the NTP).

A summary of the observations is included in the inspection reports in Appendix B and Appendix C, for the STP and NTP respectively. The STP was observed to be in good condition at the time of the 2020 annual inspection.

The NTP crest at approximately Sta. 1+410 was observed to be disturbed as a result of installation of a dewatering pipeline (Photograph A-20 in Appendix A). The crest in this area was backfilled with road crush and regraded in September 2020. The area of the downstream toe that was excavated for access for a monitoring well installation program in 2019 had not been repaired. The excavated dam toe area is to be backfilled and graded (recommended action 2019-03).

Details of the site inspection are discussed in Sections 5.4 and 5.5.

5.1.2 Review of Background Information

FRO provided the following information for this DSI:

- 2020 FRO site LiDAR topographic data and orthophoto
- tailings pond bathymetric data for the STP from the April and October 2020 surveys
- dredging records for the STP to Turnbull TSF
- tailings pond water levels in STP and NTP
- VW piezometer and pond water level data
- dam movement data: GPS monitoring data and slope inclinometers on the STP and NTP
- records of routine visual inspections by FRO qualified personnel
- site climate data from 1 September 2019 to 31 August 2020

5.2 Dam Consequence Classification

Guidelines for the classification of dams are presented in the HSRC Guidance Document, Section 3.4 (Ministry of Energy and Mines 2016), which references the *Dam Safety Guidelines* (CDA 2013).

Table 12 presents the dam classification criteria. Consequence categories are based on the incremental losses that a failure of the dam may inflict on downstream or upstream areas, or at the dam location itself. Incremental losses are those over and above losses that might have occurred in the same natural event or condition had the dam not failed. The consequences of a dam failure are ranked as Low, Significant, High, Very High, or Extreme for each category. The classification assigned to a dam is the highest rank determined among the categories.

Table 12: Dam Classification

Dam Class	Population at Risk	Incremental Losses		
		Loss of Life	Environmental and Cultural Values	Infrastructure and Economics
Low	None	0	Minimal short term loss. No long term loss.	Low economic losses; area contains limited infrastructure or service.
Significant	Temporary only (e.g., seasonal cottage use, passing through on transportation routes, participating in recreation activities)	The appropriate level of safety required depends on the number of people, the exposure time, the nature of their activities, and other considerations	No significant loss or deterioration of fish or wildlife habitat, *or* Loss of marginal habitat only. Restoration or compensation in kind highly possible.	Losses to recreational facilities, seasonal workplaces, and infrequently used transportation routes.
High	Permanent – ordinarily located in the dam-breach inundation zone (e.g., as permanent residents)	10 or fewer	Significant loss or deterioration of important fish or wildlife habitat. Restoration or compensation in kind highly possible.	High economic losses affecting infrastructure, public transport, and commercial facilities.
Very High	Permanent – ordinarily located in the dam-breach inundation zone (e.g., as permanent residents)	100 or fewer	Significant loss or deterioration of critical fish or wildlife habitat. Restoration or compensation in kind possible but impractical.	Very high economic losses affecting important infrastructure or services (e.g., highway, industrial facility, storage facilities for dangerous substances).
Extreme	Permanent – ordinarily located in the dam-breach inundation zone (e.g., as permanent residents)	More than 100	Major loss of critical fish or wildlife habitat. Restoration or compensation in kind impossible.	Extreme losses affecting critical infrastructure or services (e.g., hospital, major industrial complex, major storage facilities for dangerous substances).

Source: HSRC Guidance Document (Ministry of Energy and Mines 2016) Table 3-3 based on CDA (2013) Table 2-1.

5.2.1 Facility Consequence Classification

An inundation study considering both flood-induced (overtopping) and sunny-day (piping) failure modes for the STP and NTP dams was performed to understand the potential incremental impacts on downstream receptors (Golder 2014e). The flood-induced (overtopping) inundation assumed a 1-in-2-year flood event (bankfull conditions) in the Fording River (Golder 2014e). A single classification for the dam system is based on the failure scenario that would result in worse consequences: either sunny-day failure or flood-induced failure (CDA 2013).

The rationale applied for assigning the consequence level for each attribute for the STP and NTP facilities is as follows:

- **Population at risk (High consequence)**—Permanent: as identified by Golder (2014e), some 18 permanent residences are located on the flood plains downstream of the dams within the flood inundation extents. In addition to the permanent residences, the AWTF-S downstream of the STP is undergoing construction.
- **Loss of life (Significant to High consequence)**—Since people are present in the inundation zone, it is foreseeable that there is a possibility for loss of life (for STP and NTP permanent downstream residences, Maxam Yard [site explosive storage facility including Maxam personnel offices], and workers at the AWTF-S). Quantification of off-site loss of life has been inferred from population at risk (Golder 2014e).
- **Environmental and cultural (High to Very High consequence)**—Presence of critical habitat for Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*), a species of Special Concern. Restoration is considered to be possible but difficult. The classification is Very High for the sunny-day failure scenario and High for the flood-induced failure scenario (Teck Coal 2016).
- **Infrastructure and economics (High consequence)**—Third-party economic losses are anticipated to be high in the event of a failure (Golder 2014e).

Table 13 presents a summary of the current dam consequence classifications for the FRO facilities.

Table 13: Dam Consequence Classification Results

FRO Facility	Dam Class	Population at Risk	Consequences of Failure		
			Loss of Life[(a)]	Environment and Cultural Values	Infrastructure and Economics
STP	**Very High**	High	Significant to High	High to Very High	High
NTP	**Very High**	High	Significant to High	High to Very High	High
STP and NTP river flood-induced components	**High**	High	Low to Significant	High	Significant

Note: River flood induced component classification based on dam inundation concurrent with major flood event. Lower design criteria related to “High” classification is for the riprap components of the STP and NTP only and does not change the overall classification of the facility. Refer to Section 2.5.4, CDA 2013.

(a) Teck’s internal approach for dam consequence classification requires any facility that has a risk to human life to adopt design criteria of the Extreme dam class.

FRO = Fording River Operations; STP = South Tailings Pond; NTP = North Tailings Pond.

The STP and NTP dams are classified as Very High consequence, while the components for a river flood-induced failure are classified as High consequence. The STP and NTP classifications are governed by the consequences of a potential fair-weather failure scenario.

5.2.2 River Flood Component Consequence Classification

An incremental inundation assessment (Golder 2017d) was completed to assess the consequence of failure of the STP and NTP during 200-year and 500-year Fording River flood events. The assessment concluded that the consequence of a failure occurring coincident with the flood events considered is High.

Detailed design of the STP Flood Plain Widening Project was completed in March 2021. Initial construction of the project began in 2020 and is planned to be completed in 2022. Construction completion of the project will address recommended action 2015-12 (Table 26 in Section 6.5).

5.2.3 Review of Downstream and Upstream Conditions

The following are changes or planned changes to the upstream and downstream conditions during the reporting period:

- FRO plans on completing a feasibility study on the preferred option for crossing the Fording River near the existing Fording Multiplate Embankment upstream of the STP and NTP facilities and is considering options for updating a closure plan for the NTP.
- FRO completed a detailed design to widen the Fording River flood plain west of the STP dam toe and to add riprap bank protection along the dam to reduce the likelihood of a dam failure due to erosion of the dam toe from a flood event. Construction to widen the Fording River flood plain west of the STP dam is planned for 2021 and 2022.
- FRO is undertaking construction of the AWTF-S downstream of the STP Main Dam. The facility is located above the estimated 500-year return period flood level of the Fording River. Preliminary assessments (Golder 2020b, in draft) of a failure of the Main Dam as a result of internal erosion/piping indicated the facility would be within the inundation zone. If required, an updated emergency response plan for the downstream workers at the AWTF-S should be prepared considering the results of the STP Main Dam breach and inundation study draft report.

5.3 Review of Operational Documents

5.3.1 Operation, Maintenance, and Surveillance Manual

The OMS manual for the STP and NTP is Version 2020.04, issued on 25 May 2020 (FRO 2020b). The OMS manual was reviewed and approved by the EoR.

5.3.2 Emergency Preparedness Plan / Emergency Response Plan

The emergency response plan (ERP) for the tailings facilities at FRO was updated in May 2020 (EP.009.R1; FRO 2020c). The ERP was developed to meet the guidelines provided by the HSRC (Ministry of Energy and Mines 2016, 2017), the CDA (2013), the Mining Association of Canada (MAC 2011, 2017), and Teck Resources Limited (Teck Resources 2019). The EoR reviewed and provided input to the updated ERP, and considered the ERP adequate.

The current emergency preparedness plan for tailings facilities is EP.008.R2, dated 25 May 2020 (FRO 2020d).

FRO has also developed a *Tailings Impoundment Flood Response Protocol for the Fording River*. This document was updated in 2020 (FRO 2020a) and should be reviewed prior to the 2021 freshet and updated as required.

The emergency planning documents should continue to be reviewed at least annually, with updates incorporated when required. The ERP should be tested every year. FRO carries out annual testing of the ERP, with the most recent internal tabletop exercise (with a field component) carried out on 26 November 2020.

5.3.3 Dam Safety Review

A DSR, as defined in Section 10.5.4 in the HSRC (EMLI 2021), was completed in 2019 by a third-party consultant (SNC-Lavalin 2020). The DSR report was submitted to the Ministry of Energy, Mines and Petroleum Resources on 26 June 2020. The next DSR is scheduled for 2024.

5.4 South Tailings Pond

The record of inspection for the FRO STP conducted by the EoR on 18 and 19 August 2020 is included in Appendix B. Figure 3 provides a plan of the STP with the location of the monitoring points. Typical sections of the STP dams are shown in Figure 4 and Figure 5.

This section presents an assessment of dam safety for the STP dam based on observations and data review and includes a review of the 2019 recommendations for the facility.

5.4.1 Assessment of Dam Safety Relative to Potential Failure Modes

A summary of the assessment and potential failure modes is presented in Table 14.

Table 14: Assessment of South Tailings Pond Dam Safety Relative to Potential Failure Modes

Potential Failure Mode	Observations/Data	Comments
Internal erosion (suffusion and piping)	Filter compatibility is generally met between till fill material and CR or CCFR shell and foundation flood plain sand and gravel; however, it is not met for the tailings and the flood plain sand and gravel. Ongoing seepage monitoring at West Dam since 2015. At the STP, internal erosion as a result of seepage along the decommissioned gas pipeline through the West Dam at the north abutment has a possible likelihood of occurrence.	The potential filter inadequacy between the foundation and tailings will not impact the stability of the dam (i.e., it does not contribute to potential failure of the dam due to internal erosion), as the stability is not reliant on the tailings. Migration of the tailings through the sand and gravel is considered low risk. FRO plans on removing the decommissioned gas pipeline from the north abutment at STP by 2022.
Overtopping	Pond elevation was maintained below normal operating range target throughout the reporting period. The STP water level TARP is being followed in response to high pond water level conditions.	IDF and freeboard assessment completed (Golder 2018b) with a list of IDF accommodation recommendations provided for STP. The design of a spillway to accommodate a PMF event (more severe than the IDF) has been completed and its construction is underway (recommended action 2018-03 in Table 20). Liquefaction of the tailings beach during a seismic event could result in tailings beach displacement that results in a wave that could overtop the Main Dam. Additional analyses are recommended to better characterize the failure potential of saturated tailings block and wave attenuation potential. (Golder 2020c, in draft)

Table 14: Assessment of South Tailings Pond Dam Safety Relative to Potential Failure Modes

Potential Failure Mode	Observations/Data	Comments
Instability	No evident instability.	Static and seismic stability assessments (Golder 2018b) were carried out for Very High dam consequence classification. The results from Golder (2018b) indicated that the FoS for failure surfaces that involve the full width of the dam crest meet or exceed the Very High consequence static and pseudo-static slope stability FoS design criteria considering 2017 maximum phreatic conditions. Phreatic conditions at piezometer locations during the 2019/2020 reporting period were lower than the maximum phreatic conditions from 2017 that were used in the previous stability assessment (Golder 2018b), except at the upper piezometer tips at TH15-01 and VW-5, where they were higher in 2019/2020 than in 2017, and would not change the result of the previous stability assessment.
River erosion along dam toe	Based on observations from 2020 annual riprap inspection (Appendix G), the riprap appeared to be in good condition. Continued weathering of riprap pieces along the entire length of the STP protection was observed, but the degradation had not affected the overall integrity of the riprap.	Detailed design of the STP Flood Plain Widening Project was completed in March 2021 and construction is planned to be completed by 2022.
Tailings, mine-affected water, or water pipeline failure	No leakage reported from active tailings pipelines.	Continue to manage this failure mode by routine inspection of the pipelines.

CR = coarse rejects; CCFR = combined coarse and fine rejects; STP = South Tailings Pond; TARP = trigger-action-response plan; IDF = inflow design flood; PMF = probable maximum flood; FoS = factor(s) of safety.

5.4.1.1 Internal Erosion (Suffusion and Piping)

Design Basis

The following filter relationships were checked for the STP:

- compatibility between the tailings and the upstream till blanket
- compatibility between the upstream till blanket and CR/CCFR shell
- compatibility between the till cut-off and flood plain sand and gravel foundation
- compatibility between the CR or CCFR shell and the flood plain sand and gravel foundation
- compatibility between tailings and the flood plain sand and gravel foundation
- internal stability of the CR/CCFR shell

Filter compatibility was reviewed based on gradation quality control data from the 2008, 2012, and 2013 as-built reports, as well as the 2002 till evaluation, which were used to confirm filter compatibility of all materials placed (Golder 2002, 2009, 2013, 2014d).

Various methods were used to check filter compatibility, including the United States Department of the Interior, Bureau of Reclamation (USBR 1977), the Sherard criteria (Sherard et al. 1984; Sherard and Dunnigan 1989), the Terzaghi method (Terzaghi 1922), US Army Corps of Engineers (USACE 2004), Kenney and Lau (1985), Li et al. (2009), and Fell et al. (2005).

A filter compatibility and internal stability assessment was completed by Golder in 2015 in response to a February 2015 Ministry of Energy, Mines and Petroleum Resources (formerly the Ministry of Energy and Mines) order to undertake an assessment to determine if the tailings facilities dams may be at risk of internal erosion (Golder 2015a).

All materials generally have filter compatibility by all methods except between the tailings and the flood plain sand and gravel. The potential filter inadequacy between the foundation and tailings will not impact the stability of the dam, as the dam stability is not reliant on the tailings. Migration of the tailings through the sand and gravel is expected to be contained by the till cut-off, and is therefore a low risk. No tailings have been observed downstream to date.

The internal stability of the CR shell was confirmed (Golder 2015a).

There are some gaps in construction quality control records, particularly for the 1983 to 1984, 1985 to 1990, and 1993 raises; however, the gradation of the CR and CCFR filter/shell material created by the wash plant appears to have remained relatively consistent since the 1970s (Golder 2015a). Where data were available, they indicated that filter compatibility between the local till and the CR/CCFR was achieved. Gaps in the construction quality control records are considered to be very low risk.

Based on the performance of the dam over the last 40 years, piping through the dam due to filter-incompatible materials is considered to have a rare likelihood of occurrence. Internal erosion as a result of seepage along the decommissioned gas pipeline through the uncompleted portion of the West Dam at the north abutment has a possible likelihood of occurrence. FRO has plans to remove this pipeline as part of works to address this by 2022 (recommended action 2017-01 in Table 26 in Section 6.5).

Continual seepage is evident in the foundation materials below the toe of the STP dam, particularly along the West Dam, and has been reported for many years. Cloudy seepage water can indicate internal erosion, but records of the seepage from the STP indicate clear water. Regular inspections for evidence of increased seepage and piping should continue. Quantitative monitoring of seepage at the West Dam began in late 2015 in response to a visual observation of increased year-over-year seepage rates. The critical hydraulic gradient through the Main Dam is to be assessed to better quantify the likelihood of a piping failure through the dam occurring and possibly impacting the AWTF-S downstream of the dam (recommended action 2020-05 in Table 26).

Instrumentation Data – Seepage Monitoring

In 1979, shortly after the STP was put into operation, it became apparent that at some location beneath the bottom of the STP, the lower gravel stratum had hydraulic connection with the surficial flood plain gravels that extend over the base of the pond. It is understood that the STP water balance showed unexpected losses.

The total seepage losses from the pond are not measured directly. The estimated rate of seepage loss noted in previous water balances for the STP contains uncertainties resulting from inaccuracies in the water balance modelling, such as not accounting for the mass balance.

Seepage losses from the STP from 1989, 2000, 2003, and 2006 through 2020 are shown in Table 15.

Table 15: Fording River Operations Reported Seepage Losses from the South Tailings Pond

Year	Approximate Average Pond Elevation (m)	Historical FRO Reported Seepage (m^3/min)	GoldSIM Seepage (m^3/min)
1989	1,629.1	7.5	n/a
2000	1,629.7	4.3	n/a
2003	1,629.5	5.5	n/a
2006	1,629.7	0.4	n/a
2007	1,629.0	3.2	n/a
2008	1,629.5	2.8	n/a
2009	1,630.0	2.3	n/a
2010	1,630.1	1.5	n/a
2011	1,631.9	3.4	n/a
2012	1,632.9	3.9	n/a
2013	1,634.5	10.6	n/a
2014	1,635.5	13.1	n/a
2015	1,636.3	n/a	9.9
2016	1,636.3	n/a	10.4
2017	1,636.2	n/a	5.0
2018	1,636.4	n/a	4.8
2019	1,636.5	n/a	4.7
2020	1,636.4	n/a	4.8

Note: Pond elevations reported in Elk Valley Elevation Datum.
FRO = Fording River Operations; n/a = not applicable.

In response to an increase in the observed seepage below the south end of the West Dam, FRO installed two seepage collection pipes within the seepage area in 2015. Seepage can also be observed and is monitored through twin culverts downstream of the north end of the West Dam. During the reporting period, seepage data from the collection pipes were only taken during the 2020 site inspection visit. Photograph A-8 in Appendix A shows the location of the collection pipes and the estimated flow measurements during the site inspection.

Seepage data should be collected regularly to develop long-term trending of seepage rates in this area. However, safe access to the area is not available during winter. Monthly monitoring by drone survey should be considered to as regular monitoring in addition to seepage rate collection.

Observed Performance

The key observations made during the STP dam inspection were as follows:

- Seepage continues along the presumed till/bedrock contact in the diversion channel slope below the West Dam (Appendix A, Photographs A-8 and A-9. The seepage has pushed up mats of organics and created a hummocky, broken surface area. This is consistent with previous years' observations in this area. Ground movement of the surficial organic soils were noted in this area.
  - Seepage from the two collection pipes in this area was measured on 19 August 2020 site visit and recorded to be 0.09 and 0.03 L/s from the W Seep North and South pipes, respectively. The majority of the seepage in the area of the pipe outlets was bypassing the pipes and was flowing out of the slope, and the flow was estimated to be around 0.25 L/s.
  - Red staining was noted in some areas of seepage along the bedrock contact, consistent with observations from previous years.
- Water was observed to be ponding in portions of the ditch along the downstream toe of the West Dam. The water is likely from surface runoff and seepage exiting the dam. Vegetation growth was also observed along these ditches.
- All observed seepage, including external seepage water, was clear and had no sediments.
- No zones of subsidence or any sinkholes were observed that would indicate voids due to either suffusion or piping.
- Visual monitoring during routine inspections by FRO tailings personnel did not observe any signs of seepage related to the gas pipeline through the uncompleted portion of the north abutment of the West Dam. This is currently a deficiency in the facility and FRO plans on addressing this deficiency by 2022 (recommended action 2017-01 in Table 26).

5.4.1.2 Overtopping

Design Basis

An updated IDF and freeboard assessment for the Very High consequence classification was completed in 2018 (Golder 2018b). The HSRC Guidance Document (Ministry of Energy and Mines 2016) recommends that the IDF be designed to 2/3 between the 1,000-year flood/storm event and the PMF event for a structure classified as Very High consequence.

For impoundments with no emergency spillway (existing conditions as of writing of this report), HSRC Section 10.1.8 requires a minimum storage volume to contain runoff from a 72-hour IDF. The freeboard assessment from Golder (2018b) indicated:

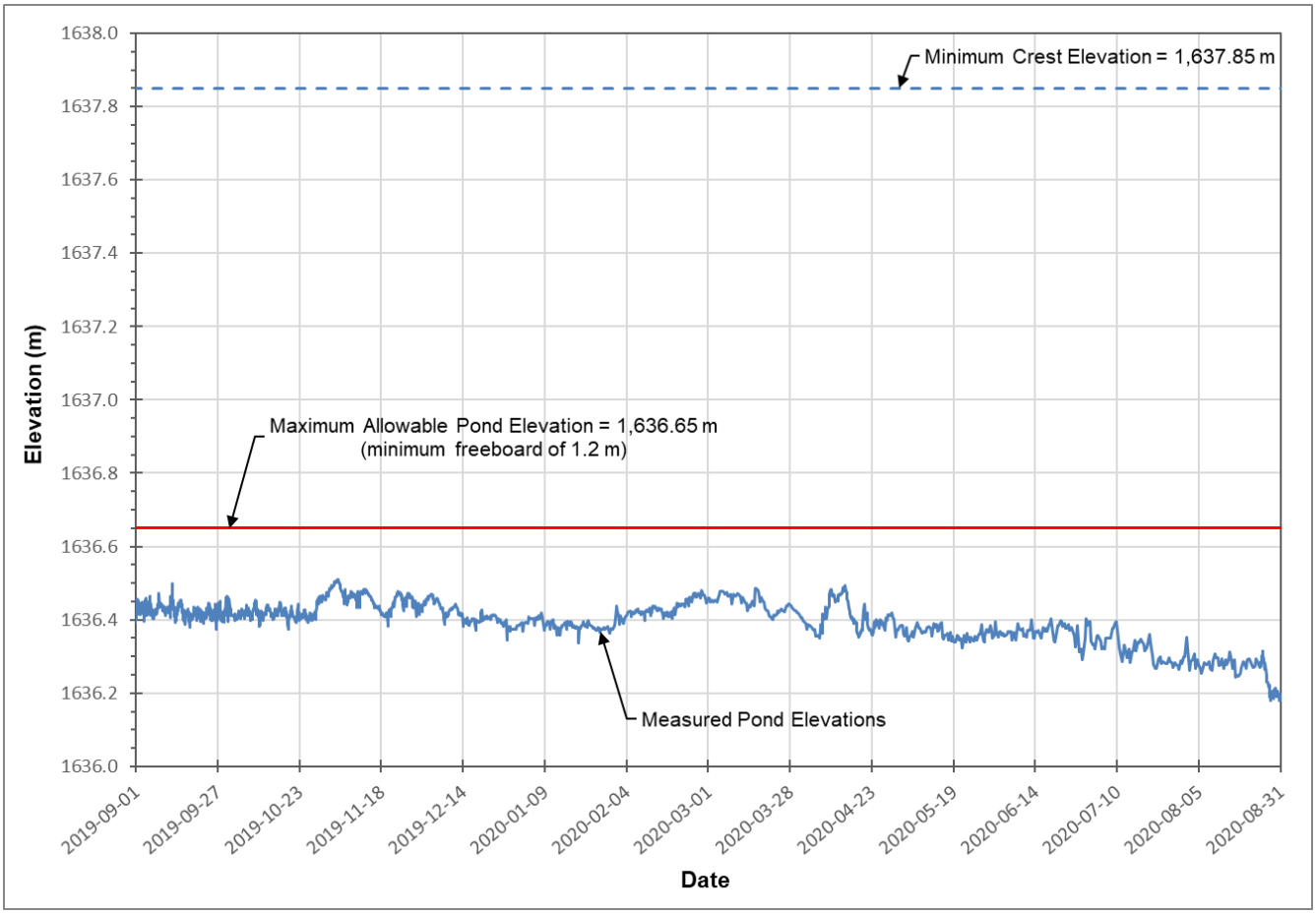
- The current maximum operating water level of elev. 1,636.65 m, which is 1.2 m below the minimum dam crest, provides the required freeboard during the 72-hour IDF if all external catchment areas are diverted. However, further work indicated the external catchment areas cannot be diverted in a channel. Runoff from the external catchment areas is currently being pumped and a spillway is under construction.
- The required minimum freeboard above the IDF is 0.4 m with the maximum flood level at elev. 1,637.45 m. This is based on the maximum operating water level of elev. 1,636.65 m and water from all catchment areas being diverted.

As part of the design of the STP spillway (Golder 2020e), IDF and freeboard assessments were conducted. The spillway was sized for the Extreme consequence classification as directed by FRO and used the PMF as the design event.

The freeboard trigger levels of the STP are to be updated after the spillway is constructed (recommended action 2020-01 in Table 26 in Section 6.5).

Instrumentation Data

Chart 2 presents the pond elevation data for 1 September 2019 to 31 August 2020 at the STP based on data received from FRO. Pond water levels in the STP are monitored in real time with a water level sensor located on the water reclaim barge, and levels are actively managed by FRO processing plant personnel. The pond elevation data were provided in Mine Grid then converted to Elk Valley Elevation Datum by Golder.



Note: Pond elevations reported in Elk Valley Elevation Datum.

Chart 2: South Tailings Pond Water Elevation from 1 September 2019 to 31 August 2020

The STP water level is shown to have been maintained below the maximum allowable water elevation during the reporting period. The water level in the STP was gradually lowered at the end of June 2020 in preparation for construction of the spillway.

In the event of high water levels at the STP, the current version of the STP water level TARP would be followed. Water management options for STP during freshet are also included in the OMS manual.

Observed Performance

The operating pond volume on 12 April 2020 prior to the start of dredging was 622,169 m^3, which was greater than the minimum water reservoir volume of 300,000 m^3.

Dredging operations at the STP were started as part of the plan to manage the high tailings volume in the facility. FRO dredged 1.65 million dry metric tonnes from 18 April to 16 October 2020. The pond volume of the STP had been updated by FRO using results from the October 2020 bathymetric survey.

The key observations made during the STP dam inspection were as follows:

- The pond was clear and free of major debris.
- Makeup water was being sent to the STP pond. Water from site drainage and reclaim water from the Turnbull TSF was being discharged into the STP.
- Minor rutting was observed on the dam crest.

The STP is not equipped with an overflow emergency spillway. An emergency spillway is considered to be best practice as it allows excess water to exit the facility passively (i.e., without any active intervention). The STP spillway design (Golder 2020e) is under construction and it is planned to be completed in 2021.

5.4.1.3 Instability

The STP West Dam is susceptible to instability from erosion during flooding of the Fording River. This has been assessed by KWL, and riprap was placed on the toe of the dam in late 2016 to prevent erosion (KWL 2017b). The south section of the West Dam from the pipe bridge southward (south of Sta. 0+680) does not have any erosion protection but consists partially of bedrock, which provides some erosion protection.

Design Basis

As a result of the reclassification of the STP dams from High to Very High, slope stability and liquefaction assessments were updated to comply with the Very High consequence design criteria (Golder 2018b) per the HSRC Guidance Document (Ministry of Energy and Mines 2016). An earthquake of ½ between the 1-in-2,475-year and 1-in-10,000-year event was used for Very High consequence dams. This event corresponded to a peak ground acceleration of 0.23 g and a mean moment magnitude of 6.2 based on the probabilistic analysis results from the site-specific hazard assessment (Golder 2016b). Teck's internal policy adopts design criteria of the Extreme dam class if the facility has any risk to human life.

Details of the assessment and results from the updated stability and liquefaction assessments were provided in Golder (2018b). A brief summary of the conclusions is provided below:

- The liquefaction assessment update was conducted for Very High dam class and considered the 2017 topography along with the 2016 riprap construction along the toe of the STP dam. The results indicated that the saturated soils below the dam are unlikely to liquefy during the design earthquake of ½ between the 1-in-2,475-year and 1-in-10,000-year event.

- The dam stability update used design criteria for Very High dam class based on the HSRC Guidance Document (Ministry of Energy and Mines 2016) Section 3.3 and CDA (2019) for minimum FoS. Both static and pseudo-static conditions were considered in the stability assessment. However, the post-earthquake conditions were not analyzed in the foundation because the liquefaction assessment results indicated that the alluvial soils below the dams and dam materials are unlikely to liquefy during the design earthquake event. The results of the stability assessment indicated that the FoS for failure surfaces that fully involve the crest of the STP dam met or exceeded the Very High consequence static and pseudo-static slope stability design criteria.
- The HSRC Part 10 (Ministry of Energy and Mines 2017) Section 10.1.9 indicates that design downstream slopes steeper than 2H:1V require the manager to submit justification from the EoR for the design slope and receive authorization prior to construction. The STP downstream slopes were constructed before this requirement came into effect. As noted above, the results of the stability assessment indicated that the stability FoS met or exceeded the design criteria.

Instrumentation Data – Dam Displacement Monitoring

There are 10 operational GPS units used for displacement monitoring on the STP West and Main dams.

A summary of the GPS units in use for the 2020 DSI reporting period is presented in Table 16.

Hourly readings from 1 September 2019 to 31 August 2020 were recorded in real time via GeoExplorer for each of the GPS units. The initial readings of the GPS units were used as locations of the GPS monitors and are shown in Figure 3. The tracked location (i.e., northing and easting), 3D point velocity, cumulative relative displacement, and elevation for each of the GPS monitors were downloaded from GeoExplorer for the Main Dam and West Dam. Due to the manner in which GPS elevation is referenced at FRO, the change in elevation data instead of the measured elevation data is reviewed, as shown in Appendix E.

A review of the GPS data shown in Appendix E did not indicate data or data trends of concern.

The survey data on the Main and West dams indicated little crest displacement during the reporting period.

GPS unit STP-GPS 06 was decommissioned as it is no longer needed and has been removed from the STP. The last reading recorded from STP-GPS 06 was 13 February 2020.

Instrumentation with no communications for over seven days should be inspected and repaired within the allotted time for the specific instrument as outlined in the OMS manual (FRO 2020b).

Table 16: GPS Monitoring Locations on South Tailings Pond

GPS Identification	Reading Start Date	Northing (m)	Easting (m)	Location Description
STP-GPS 01	October 2018	5,560,728.9	651,109.0	West Dam – crest
STP-GPS 02	August 2016	5,560,621.6	651,163.7	West Dam – crest above flood construction
STP-GPS 03	April 2016	5,560,537.4	651,186.9	West Dam – flood construction toe
STP-GPS 04	May 2017	5,560,540.1	651,239.9	West Dam – crest above flood construction
STP-GPS 05	October 2014	5,560,441.9	651,355.6	West Dam – crest above flood construction
STP-GPS 06	April 2016	5,560,349.1	651,369.2	West Dam – flood construction toe
STP-GPS 07	December 2013	5,560,259.9	651,525.9	West Dam – crest
STP-GPS 08	July 2018	5,560,152.6	651,659.4	West Dam – crest
STP-GPS 09_old	April 2016	5,560,081.3	651,844.4	Main Dam – crest
STP-GPS 09	April 2019	5,560,081.1	651,844.7	Main Dam – crest
STP-GPS 10_old [(a)]	April 2016	5,560,022.7	652,029.4	Main Dam – toe
STP-GPS 11	July 2018	5,560,089.4	652,051.2	Main Dam – crest

Note: Northings and Eastings reported in FRO UTM, Sensor locations downloaded from GeoExplorer.

(a) GeoExplorer indicated this GPS unit is decommissioned.

STP = South Tailings Pond; FRO = Fording River Operations; UTM = Universal Transverse Mercator.

Instrumentation Data – Slope Inclinometers

Slope inclinometers were installed at four locations in 2015 along the STP crest (Table 17) to monitor horizontal movement in the dam in addition to the GPS data. The A axis is oriented in the upstream to downstream direction (with negative displacements in the downstream direction) and the B axis is oriented along the dam centreline. The location of the inclinometers on the STP is presented in Figure 3.

Table 17: South Tailings Pond Inclinometers

Inclinometer ID	Northing (m)	Easting (m)	Elevation (m)	A-A Axis Azimuth (°)	Probe Serial No.	Reel Serial No.
TH15-01	5,560,086.2	652,037.3	1,638.2	310	DP15600000	DR21300000
TH15-02	5,560,093.0	651,786.4	1,638.3	10		
TH15-03	5,560,550.6	651,227.5	1,638.7	30		
TH15-04	5,559,997.8	652,003.4	1,604.6	15		

Note: Azimuth is approximate. The upper wheel should face the indicated direction for the first set of readings.
Northings and Eastings are reported in Universal Transverse Mercator and elevations are reported in Elk Valley Elevation Datum.

Inclinometer data were supplied to Golder by FRO. Readings have been taken approximately quarterly at the STP inclinometers since December 2015. Starting in September 2018, and as discussed with the EoR, FRO has been reading the inclinometers three times per year (shortly before freshet, in the latter part of freshet, and in late summer).

A total of three readings were taken at inclinometers TH15-01, TH15-02, and TH15-04 and two at inclinometer TH15-03 within the DSI reporting period, which include readings from 5 December 2019 (except TH15-03), 20 April 2020, and 7 July 2020. Inclinometer data were collected and plotted by FRO, and are shown with a plan view of each inclinometer location by Golder in Appendix F. Data readings are from 23 January 2017 to 7 July 2020 and include the initial reading from 18 December 2015 as a reference line.

Inclinometer data are plotted by FRO. All data readings from January 2017 to July 2020, including the initial reading from 18 December 2015 as a reference line, were plotted and are provided in Appendix F.

The inclinometer readings do not indicate any significant trends in deformation, and the maximum cumulative downstream deflection does not exceed 5 mm over a year for depths greater than 2 m below ground, which is in the acceptable range for the slope inclinometer QPO (Table 6).

Instrumentation Data – Piezometers on Main Dam

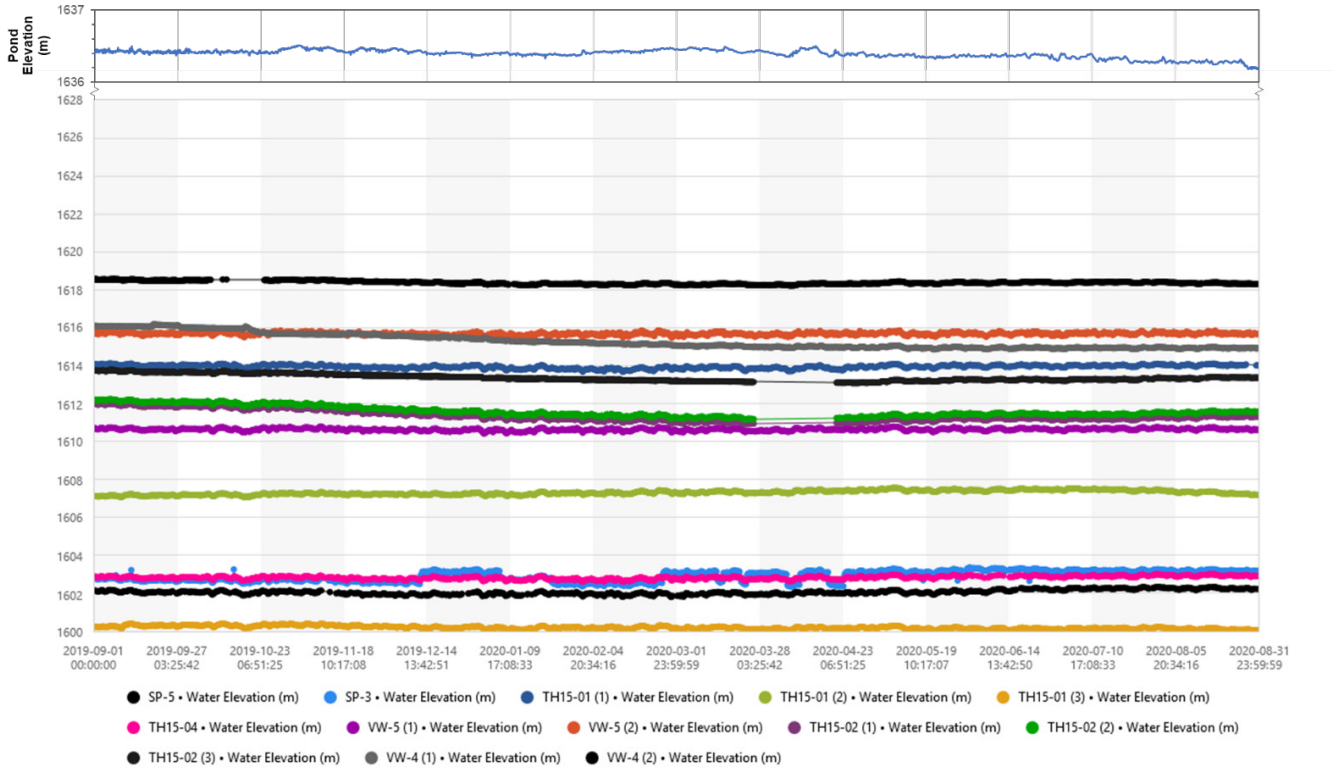
The VW piezometer and standpipe locations are shown in plan in Figure 3. A summary of the VW piezometer locations and sensor depths on the Main Dam is shown in Table 18. The performance at each VW piezometer was evaluated by assessing whether the warning levels were exceeded. The warning levels were confirmed in Golder (2018b) and are used in GeoExplorer.

Table 18: South Tailings Pond Main Dam Piezometer Installation Details and Performance Summary

Borehole / Piezometer ID	Northing (m)	Easting (m)	Top of Well Elevation (m)	Data Logger Serial No.	Piezometer Serial No.	GeoExplorer Sensor No.	Piezometer Tip Elevation (m)	Soil Unit of Piezometer Sensor	Warning Water Elevation (m)	Minimum Recorded Water Level (2019/2020) (m)	Maximum Recorded Water Level (2019/2020) (m)	Warning Water Elevation Exceeded?	Comments
VW-4	5,560,100.6	651,758.7	1,639.2	DT08079	VW27921	2	1,617.2	Coarse rejects (compacted)	>1,624.0	1,618.2	1,618.6	No	No concerns
				DT08082	VW27920	1	1,615.0			1,614.9	1,616.2	No	No concerns
VW-5	5,560,106.2	652,102.4	1,639.2	DT08073	VW27929	2	1,615.5	Coarse rejects (compacted)	>1,617.5	1,615.5	1,615.9	No	No concerns
				DT08075	VW27930	1	1,610.4			1,610.4	1,610.8	No	No concerns
TH15-01	5,560,086.2	652,037.3	1,638.2	DT04498	VW33227	1	1,611.1	Dam fill	>1,617.5	1,613.7	1,614.1	No	No concerns
					VW33229	2	1,604.9	Dam fill / foundation fluvial sands and gravel		1,607.1	1,607.6	No	No concerns
					VW33244	3	1,600.9	Foundation fluvial sands and gravel		n/a	n/a	n/a	Likely malfunctioning, negative water pressure
TH15-02	5,560,093.0	651,786.4	1,638.3	DT04499	VW33238	3	1,612.2	Granular drain	>1,624.0	1,613.1	1,613.8	No	No concerns
					VW33233	2	1,605.5	Foundation fluvial sands and gravel		1,611.2	1,612.2	No	No concerns
					VW33243	1	1,601.5	Bedrock		1,610.9	1,612.0	No	No concerns
TH15-04	5,559,997.8	652,003.4	1,604.6	DT09637	VW33224	n/a	1,599.6	Foundation fluvial sands and gravel	>1,603.5	1,602.6	1,603.0	No	No concerns
SP-3	5,560,032.4	652,043.8	1,610.4	DT08083	VW27931	n/a	1,600.6	Foundation fluvial sands and gravel	>1,604.0	1,602.4	1,603.4	No	No concerns
SP-5	5,560,057.5	652,163.7	1,605.0	DT08074	VW27918	n/a	1,595.9	Foundation fluvial sands and gravel / till contact	>1,603.5[(a)]	1,601.8	1,602.3	No	No concerns

Note: Northings and Eastings are reported in Universal Transverse Mercator and elevations are reported in Elk Valley Elevation Datum.
Warning water elevations from GeoExplorer.
n/a = not applicable; > = greater than.

Chart 3 presents the piezometer readings for 1 September 2019 to 31 August 2020, as well as the pond elevation over the same time period. The piezometer plots were taken from GeoExplorer. The number in parentheses next to the piezometer ID indicates the sensor number in GeoExplorer (for boreholes with more than one piezometer). The sensor number can be found in Table 18.



Note: Elevations reported in Elk Valley Elevation Datum.

Chart 3: Main Dam Vibrating Wire Piezometer and Standpipe Water Elevations and South Tailings Pond Elevation from 1 September 2019 to 31 August 2020

The phreatic level readings for the reporting period were generally stable, with very little to no response to spring freshet.

Instrumentation Data – Piezometers on West Dam

Golder installed two VW piezometers (boreholes BH-CPT18-05A and -07A) in the tailings of the STP during the 2018 drilling program. The readings from these piezometers are not provided in this section as they do not monitor the water levels in the dam, though they are shown in plan view in Figure 3.

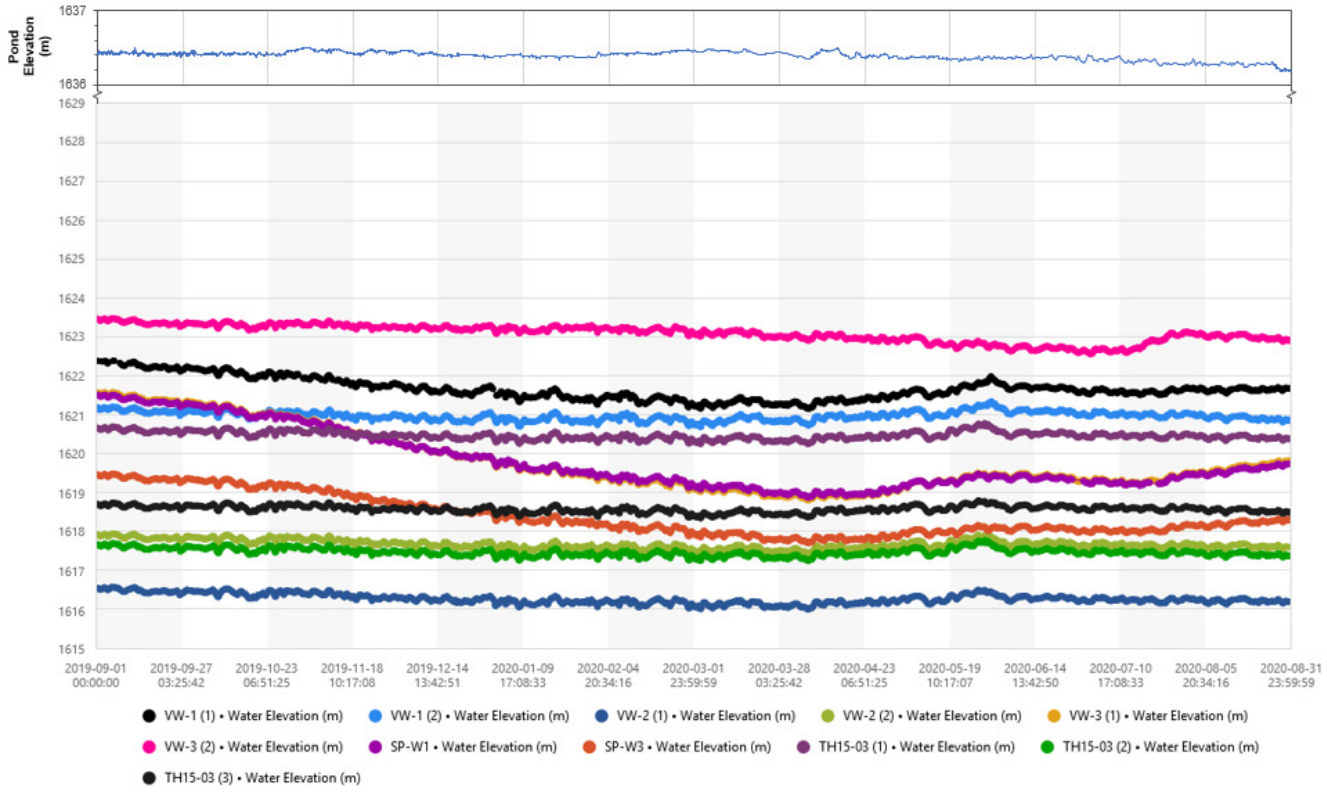
A summary of the VW piezometer locations and sensor depths on the West Dam is shown in Table 19.

Table 19: South Tailings Pond West Dam Piezometer Installation Details and Performance Summary

Borehole / Piezometer ID	Northing (m)	Easting (m)	Top of Well Elevation (m)	Data Logger Serial No.	Piezometer Serial No.	GeoExplorer Sensor No.	Piezometer Tip Elevation (m)	Warning Water Elevation (m)	Minimum Recorded Water Level (2019/2020) (m)	Maximum Recorded Water Level (2019/2020) (m)	Warning Water Elevation Exceeded?	Comments
VW-1	5,560,710.9	651,118.1	1,640.0	DT08070	VW27922	2	1,620.4	>1,627.5	1,620.7	1,621.3	No	No concerns
				DT08078	VW27923	1	1,606.4		1,621.2	1,622.4	No	No concerns
VW-2	5,560,494.1	651,310.0	1,639.3	DT08076	VW27926	2	1,616.9	>1,627.5	1,617.4	1,617.9	No	No concerns
				DT08077	VW27928	1	1,610.5		1,616.0	1,616.6	No	No concerns
VW-3	5,560,278.9	651,509.5	1,638.9	DT08071	VW27925	2	1,622.3	>1,627.0	1,622.6	1,623.5	No	Increased pressure head by 0.5 m from 12 to 31 July 2020, linked to seepage return well being shut down.
				DT08072	VW27924	1	1,611.4		1,618.8	1,621.6	No	Decreasing trend from September 2019 to April 2020, increasing overall trend since April 2020 with minor decrease in June 2020
TH15-03	5,560,550.6	651,227.5	1,638.7	DT04500	VW33225	3	1,618.2	>1,627.5	1,618.3	1,618.8	No	No concerns
					VW33228	1	1,614.2		1,620.2	1,620.8	No	No concerns
					VW33226	2	1,612.2		1,617.2	1,617.8	No	No concerns
SP-W1	5,560,273.7	651,497.3	1,633.9	DT08081	VW27927	n/a	1,613.4	>1,623.1	1,618.9	1,621.5	No	Decreasing trend from September 2019 to April 2020, increasing overall trend since April 2020 with minor decrease in June 2020
SP-W3	5,560,255.0	651,481.4	1,624.5	DT08080	VW27919	n/a	1,615.0	>1,623.0	1,617.7	1,619.5	No	Decreasing trend from September 2019 to April 2020, increasing overall trend since April 2020 with minor decrease in June 2020

Note: Northings and Eastings are reported in Universal Transverse Mercator and elevations are reported in Elk Valley Elevation Datum.
n/a = not applicable; > = greater than.

The location of VW piezometers and standpipes are presented in plan in Figure 3. Chart 4 presents the piezometer readings from 1 January 2019 to 31 August 2020, as well as the pond elevation over the same time period. The piezometer data were taken from GeoExplorer and the pond elevation was provided by FRO.



Note: Elevations reported in Elk Valley Elevation Datum.

Chart 4: West Dam Vibrating Wire Piezometer and Standpipe Water Elevations and South Tailings Pond Elevation from 1 January 2019 to 31 August 2020

As reported in the 2019 DSI (Golder 2020a), water elevations in some West Dam VW piezometers reported an increase likely due to 2019 dredging activities. The trend on these water elevations through April 2020 indicates decreases, ranging between 0.5 and 3 m, likely as a result of tailings deposition in areas upstream of this section of the West Dam.

No warnings were triggered in GeoExplorer for the piezometers.

Observed Performance

The key observations made during the STP dam inspection related to assessment of instability were as follows:

- No significant evidence of slope instability on the constructed dam (i.e., significant sloughing, cracking, crest subsidence) was observed during the 2020 DSI.
- Minor rutting was observed on the dam crest due to traffic and usage by the dredging crew.

- Erosion of the Main Dam's upstream slope near the Kilmarnock discharge at the south abutment area from 2019 had not been repaired.
- Minor erosion has been noted on the downstream slope over the years, generally in the CR material, with the exception of a major vertical erosion gully on the downstream slope of the Main Dam above the seepage collection well. Surface runoff is to be redirected onto a dam bench and away from the gully (recommended action 2020-04 in Table 26). The gully should continue to be monitored. FRO has repaired previous erosion channels present on the STP by placing breaker rock over geotextile on the eroded areas, creating armoured channels. Current and future erosion should continue to be monitored and repaired in a similar or equivalent manner as part of ongoing maintenance.
- The downstream slope has sections steeper than the design, but the overall embankment has been constructed wider than the design. The over-steepened areas are prone to increased erosion but are not an overall stability concern.

5.4.1.4 River Erosion Protection (KWL)

The annual riprap inspection was conducted on 24 August 2020 by KWL, and its associated inspection report is included in Appendix G.

5.4.1.5 Release of Tailings, Mine-Affected Water, or Water through Pipeline Failure

Design Basis

The pipelines present at STP and its vicinity are:

- tailings pipeline from the plant to the STP, crossing the West Dam at the north abutment
- dredged tailings pipeline from the STP to the Turnbull TSF, located along the south side of the STP
- reclaim water pipeline from the STP to the plant and from the Turnbull TSF to the STP, located on the east side of the STP
- makeup water pipeline from the Kilmarnock ponds, located on the Main Dam on south side of the STP

A failure of one of these pipelines could release tailings, mine-affected water, or water.

Observed Performance

This failure mode is managed by routine inspections of the pipelines.

5.4.2 Review of Previous Deficiencies and Non-conformances

The following deficiencies and non-conformances for the STP were raised in the previous DSI in 2019 (Golder 2020a). The current status of the 2019 DSI recommendations for the STP is provided in Table 20. Items from the 2019 DSI that are incomplete have been brought forward into the 2020 DSI recommendations (Table 26 in Section 6.5).

A number of recommended actions are in progress and some are incomplete, but Golder considers the work to be appropriately prioritized based on good communication between the EoR team and the FRO tailings engineer.

Table 20: Current Status of 2019 Dam Safety Inspection Recommended Actions for South Tailings Pond Facility

ID Number	Deficiency or Non-conformance	Recommended Action	Current Status as of March 2021
2015-12a, b	Riprap erosion protection along downstream toe north of STP Sta. 0+680, no riprap south of STP Sta. 0+680; risk-informed protection requirements not yet defined	Perform risk-informed assessment to determine appropriate flood protection requirements for downstream toe of dam along Fording River and timeline to implement. Implement required protection measures for the operational phase according to the as-defined schedule.	**In progress** – Fording River flood plain widening detailed design was completed in March 2021. Construction activities are being scheduled to implement design and construction is expected to be completed by 2022.
2016-04	EPP & ERP require updating	Reference to the TARPs needs to be included for actions required based on instrumentation warnings and alarms. Update EoR designate/backup contacts.	**Complete**
2017-01	North and south abutment construction deficiencies	Address construction deficiency by commencing office engineering then finishing dam construction at north abutment following gas line decommissioning and grout decommissioned gas line in south abutment. TARPs and controls are in place in the interim if excess seepage is observed at the abutments.	**Complete at south abutment** – grouting of decommissioned gas line at south abutment completed (Golder 2020f). **Incomplete at north abutment** – design for north abutment and removal of pipe through crest needed in 2021. Construction at north abutment should be scheduled for 2022.
2017-05	Potential overtopping hazard due to tailings liquefaction and redistribution during seismic event needs to be assessed	Complete liquefaction and overtopping assessment for tailings within facility.	**In progress** – pending finalization of draft technical memorandum (Golder 2020c).
2018-03	The current spillway design does not meet the Very High dam consequence classification IDF	Update design of permanent spillway as per the new inflow design flood and requirements from HSRC Guidance Document (Ministry of Energy and Mines 2016). Develop a construction schedule accordingly.	**Complete** – permanent spillway design is completed (Golder 2020e) and approved by the BC Ministry of Energy, Mines and Petroleum Resources. The spillway is scheduled to be constructed in two phases, with phase one started in October 2020 and phase two planned to be completed in 2021.
2018-05	No closure plan for STP	Develop a closure plan for STP.	**In progress** – draft conceptual closure plan being prepared by FRO.
2018-06	Construction of the AWTF-S is underway downstream of the STP Main Dam, potentially increasing the number of workers in the dam breach inundation zone	Review credible failure modes and potential for inundation from a failure of the Main Dam relative to the downstream facility and develop an emergency response plan for the downstream workers if required.	**In progress** – pending update to draft report (Golder 2020b)
2019-01	Portions of the STP Main Dam upstream slope at south abutment area were eroded as a result of discharge of effluent on undesignated areas of the dam	Repair by placing breaker rock over geotextile on the eroded areas.	**Complete** – repair completed in Fall 2020 during spillway construction
2019-02	The existing water level sensor is located near the upstream slope of the dam, where the sensor would detect dam/ground surface if the water level is lower	Dredge the tailings under the relocated existing water level sensor to re-establish free water or add a new sensor.	**Complete**
2019-05	The document *Tailings Impoundment Flood Response Protocol for the Fording River* (FRO 2017) requires an update	Review the *Tailings Impoundment Flood Response Protocol for the Fording River* and update as required prior to the 2020 freshet.	**Complete** – document updated in May 2020 (FRO 2020a)
2019-06	The facilities' risk assessments were not reviewed in 2019	Review and update (if required) the risk assessments of NTP and STP to reflect current conditions.	**Complete** – STP risk assessment completed on 29 September 2020

STP = South Tailings Pond; Sta. = Station; EPP = Emergency Preparedness Plan; ERP = Emergency Response Plan; TARP = trigger-action-response plan; EoR = Engineer of Record; IDF = inflow design flood; HSRC = Health, Safety and Reclamation Code; FRO = Fording River Operations; AWTF-S = active water treatment facility-south; NTP = North Tailings Pond.

5.5 North Tailings Pond

The record of the site inspection for the FRO NTP conducted by the EoR on 19 August 2020 is included in Appendix C. A plan of the NTP with the location of the monitoring points is shown in Figure 7, and a typical section of the NTP retaining dam is shown in Figure 8.

This section presents an assessment of dam safety for the NTP dam based on observations and data review and includes a review of the 2019 recommendations for the facility.

5.5.1 Assessment of Dam Safety Relative to Potential Failure Modes

A summary of the assessment and potential failure modes is presented in Table 21.

Table 21: Assessment of North Tailings Pond Dam Safety Relative to Potential Failure Modes

Potential Failure Mode	Observations/Data	Comments
Internal erosion (suffusion and piping)	Filter compatibility is generally met between till fill materials and CR shell and foundation flood plain sand and gravel; however, this is not met for the tailings and the foundation flood plain sand and gravel.	The potential filter inadequacy between the foundation and tailings will not impact the stability of the dam, as the stability is not reliant on the tailings. Migration of the tailings through the sand and gravel is expected to be contained by the till cut-off, and therefore a low risk.
Overtopping	In April 2020, the NTP pond level triggered the high level alarm. The existing NTP water level TARP was used and provided direction on pumping from NTP to STP in response to the high level alarm.	Updated IDF and freeboard assessment was completed for Very High dam classification (Golder 2018b), freeboard increased to 1.9 m. FRO had been lowering the pond level since April 2020 to increase pond capacity.
Instability	No evident instability.	Static and seismic stability assessments were completed for the Very High dam classification (Golder 2018b) and the results indicated that the FoS for failure surfaces that involve the full width of the dam crest meet or exceed the static and pseudo-static slope stability FoS design criteria considering the 2017 maximum phreatic conditions. Phreatic conditions at 3 piezometer locations during the 2019/2020 reporting period are lower than the maximum phreatic conditions from 2017 that were used in the previous stability assessment (Golder 2018b), except at the upper piezometer tip at TH15-07, where they were 0.5 m higher in 2019/2020 than in 2017, which does not change the results of the stability assessment.
River erosion along dam toe	Based on observations from 2020 annual riprap inspection, the riprap appeared to be in good condition except in areas where it is up to 0.4 m lower than the design elevation.	Signs of settling or subsidence in the riprap should be confirmed by survey and levels of protection should be raised if required, and FRO should seek opportunities to cost-effectively achieve the intended 1 m freeboard.
Mine-affected water pipeline failure	No leakage reported from tailings pond water pipeline.	Continue to manage this failure mode by routine inspection of the pipeline while in use from the NTP to the STP.

CR = coarse rejects; NTP = North Tailings Pond; TARP = trigger-action-response plan; STP = South Tailings Pond; IDF = inflow design flood; FRO = Fording River Operations; FoS = factor(s) of safety.

5.5.1.1 Internal Erosion (Suffusion and Piping)

Internal erosion of a dam can be caused by materials migrating out of the dam, leaving voids. This generally happens with materials that do not have filter compatibility; that is, the fines fraction of one material can migrate into or through the voids of the adjacent material under a sufficient hydraulic gradient. Piping is induced by regressive erosion of particles toward an outside environment until a continuous pipe is formed. Suffusion is the migration of soil particles through the soil matrix and can occur in a single material. If a material is internally stable, it is considered resistant to suffusion.

Design Basis

The following filter relationships were checked for the NTP:

- compatibility between the tailings and the upstream till blanket
- compatibility between the upstream till blanket and CR or the CCFR shell
- compatibility between the till cut-off and flood plain sand and gravel foundation
- compatibility between the CR or CCFR shell and the flood plain sand and gravel foundation
- compatibility between the tailings and the flood plain sand and gravel foundation
- internal stability of the CR shell

Filter compatibility was reviewed based on grain size distributions in the construction records (Golder Brawner 1973, 1974b); data obtained during an investigation of the existing coal tailings in 2 Pit, 3 Pit, and the NTP (Golder 2012b); data from the 2013 NTP flood repair works; and results from the 2015 site investigation (FRO 2016).

Various methods are available to check filter compatibility, including the Terzaghi method, the Sherard and Dunnigan criteria, and the USACE criteria (Terzaghi 1922; Sherard et al. 1984; Sherard and Dunnigan 1989; USACE 2004). The CR shell, which acts as a filter for the upstream till blanket, was constructed in accordance with the design. While not explicitly stated in the reports (Golder Brawner 1973, 1974b), the Terzaghi method was likely the method used to confirm filter compatibility during design and construction.

A filter compatibility and internal stability assessment was completed by Golder in 2015 in response to a February 2015 Ministry of Energy, Mines and Petroleum Resources order to undertake an assessment to determine if the tailings facilities dams may be at risk of internal erosion (Golder 2015a). The Sherard and Dunnigan criteria and the USACE criteria were also checked in this document. Filter compatibility was rechecked using the Sherard and Dunnigan criteria after additional foundation information was obtained in 2015.

All materials generally have filter compatibility by all methods except between the tailings and the flood plain sand and gravel. The potential filter inadequacy between the foundation and tailings will not impact the stability of the dam, as the dam stability is not reliant on the tailings. Migration of the tailings through the sand and gravel is expected to be contained by the till cut-off, and therefore a low risk.

The internal stability of the CR shell was confirmed (Golder 2015a).

There are some gaps in construction quality control records. Where data were available, they indicated that filter compatibility was achieved. The gaps in the quality control records are considered to be low risk to confirming filter compatibility.

Based on the performance of the dam over the last 45 years, piping due to filter-incompatible material or suffusion of internally unstable material is considered to have less than a very rare likelihood of occurrence and is not expected to be an issue.

Observed Performance

The key observations made during the NTP dam inspection were as follows:

- No significant zones of external seepage were observed that would indicate the possible development of internal piping.
- No zones of subsidence or sinkholes were observed that would indicate voids due to either suffusion or piping.

5.5.1.2 Overtopping

Design Basis

The CDA (2013) provides two calculations for freeboard; the more critical of the two cases sets the minimum freeboard:

- no overtopping by 95% of the waves caused by the most critical wind with a return period of 1 in 1,000 years, with the pond at its maximum normal operating elevation
- no overtopping by 95% of the waves caused by the most critical wind with a return period of 1 in 2 years (for Very High consequence structures), with the pond at the maximum level during the passage of IDF

The current minimum crest elevation of the dam at the NTP is 1,652.6 m.

The HSRC Guidance Document (Ministry of Energy and Mines 2016) recommends that the IDF be designed to 2/3 between the 1,000-year flood/storm event and the PMF for a structure classified as Very High consequence. Teck's internal policy adopts the minimum design criteria that exceeds requirements from the HSRC and adopts design criteria of the Extreme dam class if a facility has potential loss of life for credible failure modes.

For impoundments with no emergency spillway, HSRC Section 10.1.8 (Ministry of Energy and Mines 2017) requires a minimum storage volume to contain runoff from a 72-hour IDF.

As a result of the reclassification of the NTP dam from High to Very High, its freeboard assessment was updated with the HSRC requirements for a Very High consequence facility. The result of the updated assessment (Golder 2018b) indicated that:

- To store the IDF while maintaining the minimum freeboard, the maximum operating pond elevation is 1,650.7 m, 1.9 m below the minimum dam crest.
- The required minimum freeboard is 0.35 m with the IDF level at elev. 1,652.25 m.

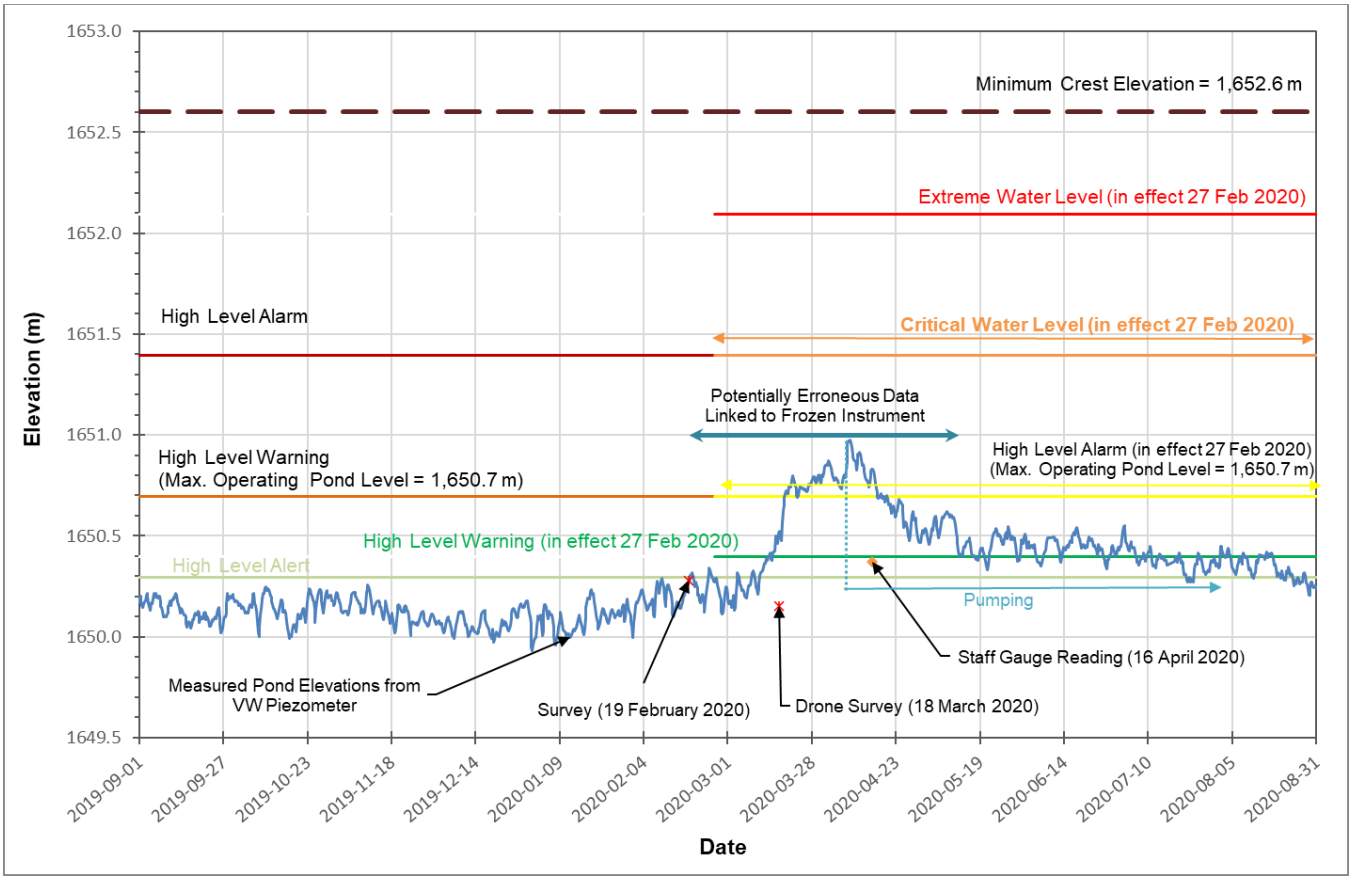
The NTP currently has no inputs of water except direct precipitation and some runoff from a small local catchment area, with outputs from the retained pond being evaporation and seepage. The water levels are maintained below freeboard by pumping excess water to the STP. If critical water levels in the pond are approached, the NTP water level TARP in Appendix C of the OMS manual (FRO 2020b) includes pumping and water diversion strategies for the NTP. The NTP is permitted to discharge into the STP only. The freeboard of 1.9 m (as assessed for Very High consequence structures) will be maintained with normal operations or emergency pumping as necessary.

The NTP is not equipped with an emergency spillway. A passive method of controlling water elevation would be a best practice. Golder has produced feasibility level drawings for an emergency spillway on the NTP (Golder 2015b).

An overtopping failure caused by landslide is a possible failure mode for the NTP due to the adjacent CR spoil to the west of the NTP. The CR spoil was resloped in 2015 per previous Golder recommendations and FRO analyses (Golder 2014a,e; FRO 2014). This work was performed to reduce the hazard of a potential spoil failure to impact the NTP and create wave action that could potentially overtop and breach the NTP dam. Based on stability and runout analyses, failure of the reconfigured CR spoil and subsequent wave generation is considered unlikely.

Instrumentation

Pond elevation data were recorded by a VW piezometer and the data were downloaded by Golder from GeoExplorer. The VW piezometer was set up to collect readings every six hours. Chart 5 presents the pond elevation during the reporting period. During the reporting period, the pond level was also read by on-site surveyors, a drone survey, and manual readings from the staff gauge at specific dates shown in Chart 4.



Note: Elevations reported in Elk Valley Elevation Datum.
VW = vibrating wire.

Chart 5: North Tailings Pond Water Elevation from 1 September 2019 to 31 August 2020

The High Level Alert level for the NTP water level was triggered by the VW piezometer in the pond in GeoExplorer on 19 February 2020. Site inspections were conducted by FRO tailings engineers in response to the alert, and it was concluded that the VW piezometer was frozen in ice; its readings did not represent actual pond level. The elevation of the top of the frozen pond was surveyed on 19 February 2020 and it indicated the pond ice was below the High Level Alert level. FRO subsequently surveyed the pond/ice level weekly until 18 March 2020 when a drone survey was conducted for the frozen pond, where it continued to confirm the frozen pond was below alert levels. Inspection of the NTP returned to its regular, monthly frequency starting on 19 March 2020.

Following the VW piezometer data, FRO initiated pumping from the NTP starting on 9 April 2020 to the STP and pumping continued intermittently through August 2020 to manage the pond level to below the normal operating level (below High Level Alarm), per the procedures listed in the TARP. In June 2020, a camera was installed to facilitate real-time monitoring of the staff gauge. The staff gauge, which was observed to have been leaning slightly in the winter months, was also straightened at this time.

FRO reported that the VW piezometer was reading in Elk Valley Elevation Datum while the alarms in GeoExplorer were in Mine Grid datum. FRO has since updated the GeoExplorer alarms to be in Elk Valley Elevation Datum. The instrument alarms were turned off between 11 March and 23 April given the discrepancy between the alarm and the instrument levels.

Observed Performance

The key observations made during the NTP dam inspection were as follows:

- The tailings have filled most of the area upstream of the NTP dam, and there is a small reclaim pond at the southern end. The fetch distance on the surface of the NTP is short, so the potential for generation of significant waves when a pond is present is small.
- Unused and damaged pipelines that extend through the crest of the dam should ideally be removed or grouted to eliminate the hazard of future deformation or settlement of the abandoned pipes creating low points in the dam crest (locations shown in Golder 2017b).
- All pipes should continue to be inspected as part of the monthly NTP inspections to confirm that they remined capped on the upstream side. Pipes should be removed or grouted as part of the NTP decommissioning plan.

The current NTP pond stage storage curve was prepared using data from a 2018 bathymetry survey (Golder 2018a). FRO observes that sediment is reporting to the NTP pond and a bathymetry survey is recommended to be carried out in 2021 to update the NTP pond stage storage curve, which can also be used to check if pond storage is being lost to sediment build up and to confirm the facility can store the IDF while maintaining freeboard (recommended action 2020-06).

5.5.1.3 Instability

The stability of the NTP is monitored with piezometers, inclinometers, GPS units, and regular visual inspections.

Design Basis

The drainage conditions beneath the NTP dam are favourable with respect to structural stability. The downstream slope of sections rebuilt after the June 2013 flood is less steep (1.5 to 1.75H:1V) than the original design (1.3 to 1.4H:1V).

As a result of the reclassification of the NTP dam from High to Very High, its slope stability and liquefaction assessments were updated to comply with the Very High consequence design criteria (Golder 2018b). An earthquake of ½ between the 1-in-2,475-year and 1-in-10,000-year event was used for Very High consequence dams per the HSRC Guidance Document (Ministry of Energy and Mines 2016). This event corresponded to a peak ground acceleration of 0.23 g and a mean moment magnitude of 6.2 based on the probabilistic analysis results from the site-specific hazard assessment (Golder 2016b). Teck's internal policy adopts design criteria of the Extreme dam class if the facility has any risk to human life.

Details of the assessment and results were provided in Golder (2018b). A brief summary of the conclusions is provided below:

- The liquefaction assessment update was done for a Very High dam class and considered the 2017 topography along with the 2016 and 2017 riprap construction along the toe of the NTP dam and the maximum piezometer readings up to the end of 2017. The results indicated that the saturated soils below the dam are unlikely to liquefy during the design earthquake event.
- The dam stability update used design criteria for a Very High consequence facility based on HSRC Guidance Document (Ministry of Energy and Mines 2016) Section 3.3 and CDA (2019) for minimum FoS. A sensitivity case was analyzed for post-earthquake conditions for loose CR layers identified in the NTP. Both static and pseudo-static conditions were considered in the stability assessment. However, the post-earthquake conditions were not analyzed in the foundation because the liquefaction assessment results indicated that the alluvial soils below the dams and dam materials are unlikely to liquefy during the design earthquake event. The results of the stability assessment indicated that the FoS for failure surfaces that fully involve the crest of the NTP dam exceeded the Very High consequence static and pseudo-static slope stability design criteria.
- HSRC Part 10 (Ministry of Energy and Mines 2017) Section 10.1.9 indicates that design downstream slopes steeper than 2H:1V require the manager to submit justification from the EoR for the design slope and receive authorization prior to construction. The NTP downstream slopes were constructed before this requirement came into effect. As noted above, the results of the stability assessment indicated that the stability FoS met or exceeded the design criteria.

The NTP is also susceptible to instability from erosion during flooding of the Fording River. River erosion has been assessed by KWL, and riprap was placed on the toe of the dam in late 2016 and 2017 (KWL 2017b) to mitigate against river erosion up to a 200-year return period design flow. Risk-informed criteria should be established for the flood erosion protection along the toe of the NTP dam.

Instrumentation Data – Crest Displacement Monitoring

Four GPS monitors are located on the dam crest and have replaced the prisms to monitor crest displacement.

GPS data were downloaded from GeoExplorer for dates from 1 September 2019 to 31 August 2020. The survey data are summarized in Appendix E.

The initial coordinates of the GPS units at the NTP are listed in Table 22. Due to the manner in which GPS elevation is referenced at FRO, only change in elevation data is reviewed, as shown in Appendix E.

Table 22: Instrument Monitoring Locations on North Tailings Pond

Instrument Identification	Reading Start Date	Northing (m)	Easting (m)	Location Description
NTP-GPS 01	October 2014	5,562,143.7	651,102.6	Crest
NTP-GPS 02	June 2018	5,561,994.1	651,130.2	Crest
NTP-GPS 03	June 2018	5,561,641.8	651,047.0	Crest
NTP-GPS 04	June 2018	5,561,379.6	650,902.6	Crest

Note: Northings and Eastings reported in FRO UTM, Sensor locations downloaded from GeoExplorer.
NTP = North Tailings Pond; FRO = Fording River Operations; UTM = Universal Transverse Mercator.

Generally, the GPS devices recorded on an hourly frequency. The survey data indicate little crest displacement during the reporting period. Minor spikes in the data are most likely noise in the system and are not a concern. Movements are well below the GeoExplorer alarm trigger for 3D point velocity (150 mm/day, QPO alarm) and the updated QPOs provided by Golder (2018b) and listed in Section 2.5. No warnings were triggered in the reporting period.

A latent alarm is triggered in GeoExplorer when the measurement age of the GPS unit is greater than a day on the NTP. Any offline monitors will be inspected and repaired within one week (FRO 2020b).

Instrumentation Data – Slope Inclinometers

Slope inclinometers were installed at three locations in 2015 along the NTP crest (Figure 7) to monitor horizontal movement in the dam. The A axis is oriented in the upstream to downstream direction (with negative displacements in the downstream direction) and the B axis is oriented along the dam centreline. The location of the inclinometers at the NTP is presented in Table 23.

Table 23: North Tailings Pond Inclinometers

Inclinometer ID	Northing (m)	Easting (m)	Elevation (m)	A-A Axis Azimuth (°)	Probe Serial No.	Reel Serial No.
TH15-05	5,561,992.0	651,130.8	1,653.6	235	DP15600000	DR21300000
TH15-06	5,561,641.0	651,047.2	1,653.7	290		
TH15-07	5,561,379.7	650,904.4	1,653.4	305		

Note: Azimuth is approximate. The upper wheel should face the indicated direction.
Elevations are reported in Elk Valley Elevation Datum.

Slope inclinometer data were supplied to Golder by FRO. Readings were collected approximately quarterly at the NTP inclinometers since December 2015. Starting in September 2018, and as discussed with the EoR, FRO has been reading the inclinometer three times per year (shortly before freshet, in the latter part of freshet, and in late summer).

A total of three readings were taken at inclinometers TH15-06 and TH15-07 and two at inclinometer TH15-05 within the DSI reporting period, which include readings from 27 November 2019 (except TH15-05), 20 April 2020, and 7 July 2020. Inclinometer data were collected and plotted by FRO, and are shown with a plan view of each inclinometer location by Golder in Appendix F. Data readings are from 23 January 2017 to 7 July 2020 and include the initial reading from 18 December 2015 as a reference line.

The inclinometer readings do not indicate any significant trends in deformation and the maximum cumulative downstream deflection below a depth of 2 m from the crest does not exceed 5 mm over a year, which is in the acceptable range for the slope inclinometer QPO (Table 5).

Instrumentation Data – Piezometers

VW piezometers were installed in 2015 at three locations along the NTP crest to monitor water levels in and below the dam (Figure 7). Seven piezometers were installed at three locations in the NTP tailings, upstream of the dam, in 2018 (Norwest 2018).

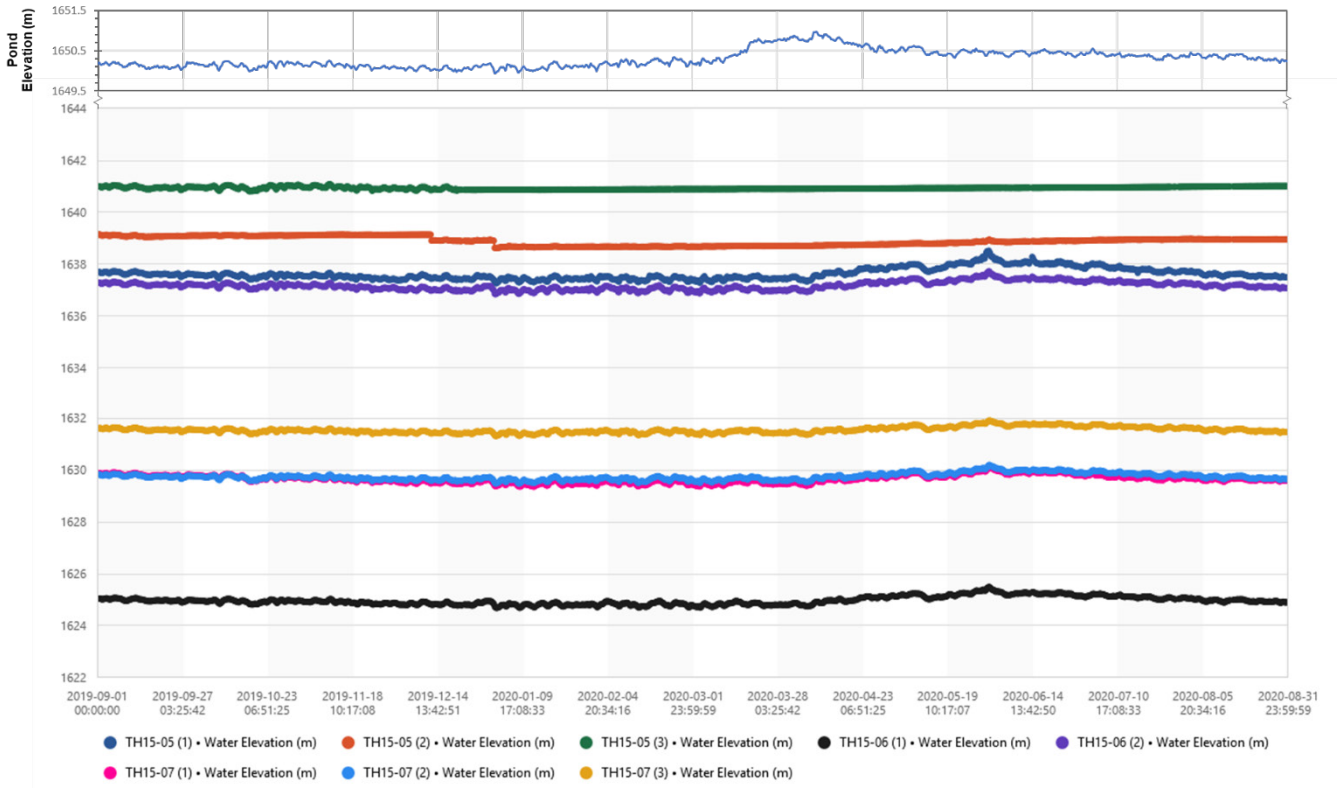
The piezometers located in the NTP dam are listed in Table 24. Data for the piezometers were downloaded from GeoExplorer. The piezometer readings from 1 September 2019 to 31 August 2020 are presented in Chart 6. Readings have been taken at TH15-05, TH15-06, and TH15-07 since August 2015.

The piezometers in the NTP tailings were not reviewed as part of this DSI as they do not monitor dam performance.

Table 24: North Tailings Pond Piezometer Installation Details and Performance Summary

Borehole / Piezometer ID	Northing (m)	Easting (m)	Collar Elevation (m)	Data Logger Serial No.	Piezometer Serial No.	GeoExplorer Sensor No.	Piezometer Tip Elevation (m)	Minimum Water Elevation (2019/2020) (m)	Maximum Water Elevation (2019/2020) (m)	Comments
TH15-05	5,561,992.0	651,130.8	1,653.6	DT09633	VW33222	3	1,641.3	n/a	n/a	Reading negative pressure head (dry)
				DT09636	VW33223	2	1,638.7	1,638.6	1,639.1	No concerns
				DT09638	VW33241	1	1,635.6	1,637.2	1,638.5	No concerns
TH15-06	5,561,641.0	651,047.2	1,653.7	DT09641	VW33240	2	1,628.5	1,636.8	1,637.7	No concerns
				DT09643	VW33239	1	1,626.3	n/a	n/a	Likely malfunctioning, reporting negative water level
TH15-07	5,561,379.7	650,904.4	1,653.4	DT094501	VW33231	3	1,630.0	1,631.3	1,631.9	No concerns
					VW33230	2	1,624.0	1,629.5	1,630.2	No concerns
					VW33242	1	1,614.7	1,629.4	1,630.1	No concerns

Note: Coordinates are reported in Universal Transverse Mercator and are elevations reported in Elk Valley Elevation Datum.
n/a = not applicable.



Note: Elevations reported in Elk Valley Elevation Datum.

Chart 6: North Tailings Pond Vibrating Wire Piezometers and Pond Elevation from 1 September 2019 to 31 August 2020

The phreatic level readings for the time period were generally stable, with minor gradual increases noted around spring freshet in early April 2020. No warnings were triggered in GeoExplorer for these piezometers.

All piezometers on the NTP collect data in real time. The piezometers should continue to be monitored regularly as outlined in the OMS manual (FRO 2020b).

For instruments that have had no communication or live data for seven days or less, FRO will follow actions outlined in Appendix A of the OMS manual (FRO 2020b) to check on the instrument and inform/notify the appropriate personnel.

Observed Performance

No evidence of major slope instability was observed during the 2020 DSI. The key observations made during the NTP dam inspection were as follows:

- A wet area of ponding water was noted downstream of the NTP dam near Sta. 1+200 (Appendix A, Photograph A-21). FRO backfilled this with local material and regraded this area to minimize ponding. The area will be monitored during monthly inspections for additional ponding water, and additional earthworks will be completed as required.
- Parts of the area downstream of the dam toe near Sta. 1+350 were excavated for the drill pad of a monitoring well installation program in 2019. The area is to be regraded (recommended action 2019-03).

5.5.1.4 River Erosion Protection (KWL)

KWL completed the annual inspection of the riprap along the toe of the STP on 24 August 2020. The annual riprap inspection report is provided in Appendix G.

5.5.1.5 Release of Mine-Affected Water through Pipeline Failure

Design Basis

There is a pipeline connecting the NTP to STP which is inactive except during emergency situations when the pond level in the NTP needs to be lowered and the water is sent to the STP. A failure of this pipeline could release tailings-affected water.

Observed Performance

This failure mode is managed by routine inspections of the pipeline.

5.5.2 Review of Previous Deficiencies and Non-conformances

The deficiencies and non-conformances presented in Table 25 were noted in the previous DSI in 2019 (Golder 2020a). Table 25 provides the current status of the 2019 DSI recommendations for the NTP. Items from the 2019 DSI that are incomplete have been brought forward into the 2020 DSI recommendations (Table 26 in Section 6.5).

A number of recommendations are in progress and some are incomplete, but Golder considers the work to be appropriately prioritized based on good communication between the EoR team and the FRO tailings engineer.

Table 25: Current Status of 2019 Dam Safety Inspection Recommended Actions for North Tailings Pond Facility

ID Number	Deficiency or Non-conformance	Recommended Action	Current Status as of March 2021
2015-05a,b	No passive emergency system against overtopping; emergency system requires active response	Assess the need for spillway after establishing an NTP closure plan.	**Ongoing** – closure planning ongoing as part of the Flood Mitigation Project, which should document when a spillway is required as part of facility closure plan. Real-time pond level monitoring using GeoExplorer includes alerts to tailings group of trigger level exceedances and camera added which can view pond staff gauge.
		If required, determine a construction schedule.	
2015-06a,b	Risk-informed criteria for flood erosion protection along toe of dams not defined	Perform risk-informed assessment to determine appropriate flood protection requirements for downstream toe of dam along the Fording River and the timeline to implement.	**Incomplete**
		Implement required protection measures for the operational phase according to the as-defined schedule.	**Incomplete**
2015-07b	Buried pipes passing through crest locations	Execute abandonment plan for identified pipes.	**Incomplete**
2016-04	EPP & ERP require updating	Update the ERP and EPP with EoR designate/backup contacts.	**Complete**
2016-06	No closure plan for NTP	Develop a closure plan for NTP.	**In progress** – draft conceptual closure plan being prepared by FRO.
2019-03	A part of the downstream toe area below the NTP dam was excavated for access for a monitoring well installation program in 2019	Backfill and grade excavated area.	**Incomplete** – Schedule this for 2021.
2019-04	A loose CR layer was identified in the NTP dam investigation, which is currently unsaturated. This loose CR layer may liquefy if it becomes saturated during the design earthquake event.	Currently, FRO does not plan to put NTP back into operation. The next update to the OMS manual is to document that if the NTP facility is put back into operation or for any proposed dam modifications, liquefaction and stability assessments considering the loose CR layer must be carried out.	**Complete** – included in current OMS manual (FRO 2020b)
2019-05	The document *Tailings Impoundment Flood Response Protocol for the Fording River* (FRO 2017) requires an update	Review the *Tailings Impoundment Flood Response Protocol for the Fording River* and update as required prior to the 2020 freshet.	**Complete** – document updated in May 2020 (FRO 2020a)
2019-06	The facilities' risk assessments were not reviewed in 2019	Review and update (if required) the risk assessments of NTP and STP to reflect current conditions	**Complete** – NTP risk assessment completed on 25 November 2020

NTP = North Tailings Pond; EPP = Emergency Preparedness Plan; ERP = Emergency Response Plan; EoR = Engineer of Record; CR = coarse rejects; FRO = Fording River Operations; OMS = operation, maintenance and surveillance; STP = South Tailings Pond.

6.0 SUMMARY AND RECOMMENDATIONS

6.1 Summary of Activities

Activities occurred for both the STP and NTP facilities during the reporting period were:

- The FRO site entered Level 2 (Flood Season Monitoring II) and Level 3 (Active Flood Watch) flood monitoring stages during the 2020 freshet. Actions from the TARP in FRO (2020a), including conducting event-driven inspections of the NTP and STP, were carried out.
- A DSR was conducted in 2019 and it included both the NTP and STP facilities (SNC-Lavalin 2020). The DSR concurred with the assigned dam classification for the STP and NTP dams and concluded the dams are reasonably safe with identified deficiencies and non-conformances. The next DSR is scheduled for 2024.
- FRO developed an animal burrow inspection plan in 2019 for both the STP and NTP facilities. The spring animal burrow inspection was conducted at the STP on 5 May 2020, followed by trapping and relocation of ground squirrels between 5 May and 7 June 2020. No animal burrow inspection was carried out at the NTP as there were no signs of animal activity. The fall animal burrow inspection was conducted on 7 October 2020 at the STP.

Activities conducted for the STP during the reporting period were as follows:

- Detailed design of a permanent spillway was conducted (Golder 2020e). Construction of the spillway started in October 2020.
- A study was carried out to estimate liquefaction-induced displacements of the STP tailings beach for input to understand the STP dam overtopping potential as a result of a wave triggered by the liquefaction-induced displacement of tailings into the STP pond (Golder 2020c, in draft).
- A staff gauge was installed at the reclaim barge on 26 March 2020. A camera was installed downstream of the West Dam in August 2020 to allow remote access to view the STP West Dam and Fording River for real-time visual monitoring.
- Dredging occurred from 18 April to 16 October 2020. A total of 1.65 million dry metric tonnes of tailings was dredged from the STP and sent to the Turnbull TSF.
- Localized dredging was conducted around the reclaim barge at the end of June 2020 to remove accumulated solids around the barge.
- The gas pipeline located under the north and south abutment of the STP was decommissioned and purged in June 2020 by FortisBC. Approximately 123 m of the gas pipeline was removed south of the south abutment. Approximately 525 linear metres of the pipeline was backfilled, and grouting was completed on 28 June 2020.
- The tailings pipeline at the discharge location at the north abutment was extended upstream by 300 m between July and August 2020. The pipeline was extended to allow tailings to deposit directly into the pond and to lower the risk of tailings backing up and overtopping the north abutment of the STP dam.
- Two bathymetric surveys were conducted by FRO to monitor remaining capacity in the facility: one survey was conducted on 12 April 2020 and the other on 15 October 2020.

- Site drainage was sent to the STP on 20 January, from 23 to 27 March, 5 to 13 April, 17 April to 10 August, and from 20 to 31 August 2020.
- Routine inspections of the STP by FRO geotechnical personnel were conducted during the reporting year at the following frequencies:
  - once per week from May to October
  - twice a month from November to April
- Event-driven inspections were conducted by the FRO tailings engineer on 1 and 3 June 2020 in response to the site being under flood watch.

Activities conducted for the NTP during the reporting period were as follows:

- A staff gauge was installed in October 2019 to monitor the pond level.
- A drainage channel at the northern end of the facility, upstream of the Liverpool Water Management Facility, was cleaned up on 20 March 2020 to prevent surface runoff from the haul road from entering the Liverpool facility.
- A High Level Alert water level was measured by the pond VW piezometer on 19 February 2020 when the instrument was frozen in pond ice. FRO responded by surveying the elevation of the frozen pond, which indicated the High Level Alert was not exceeded. Weekly surveys of the frozen pond were conducted until 18 March 2020 when a drone survey was conducted and confirmed the pond was well below the trigger levels.
- A High Level Alarm was triggered in late March / early April 2020 by the pond's VW piezometer. FRO then initiated pumping from the NTP starting on 9 April 2020 to the STP to lower the pond level. Pumping to the STP continued intermittently through August 2020 to manage the NTP pond level to below the normal operating level (below High Level Alert) per the procedures listed in the TARP.
- A new pipeline was constructed during the reporting period to discharge water to STP in the event of an emergency.
- In April 2020, FRO discovered a discrepancy between the elevation of readings from monitoring instruments and the instruments' alarm levels in GeoExplorer. The instrument readings were in Elk Valley Elevation Datum while the alarms were in Mine Grid datum, which is 0.454 m higher than Elk Valley Elevation Datum. FRO has since corrected the discrepancy and all readings and alarm levels in GeoExplorer are now in Elk Valley Elevation Datum.
- A camera able to view the staff gauge was installed was installed in June 2020 to facilitate real-time remote visual monitoring.
- Monthly inspections were conducted by FRO geotechnical personnel.
- Event-driven inspections were carried out by the tailings engineer from 1 to 3 June 2020 in response to the site being under flood watch.

6.2 Summary of Climate and Water Balance

The climate data during the reporting period indicates the annual precipitation received at the local FRO weather stations was lower than the long-term annual average.

6.3 Summary of Performance and Changes

The STP facility was observed to be in good condition at the time of the 2020 DSI field inspection.

At the NTP facility, the dam crest at approximately Sta. 1+410 was observed to be disturbed as a result of installation of a dewatering pipeline. The crest in this area was backfilled with road crush and regraded in September 2020. The area of the downstream toe that was excavated for access for a monitoring well installation program in 2019 had not been repaired. The excavated dam toe area is to be backfilled and graded (recommended action 2019-03).

No significant changes in visual monitoring records, dam stability, and surface water control were noted.

6.4 Consequence Classification

Both of the dams are classified as Very High consequence, following the dam consequence classification guidelines from HSRC Guidance Document Section 3.4 (Ministry of Energy and Mines 2016).

6.5 Current Deficiencies and Non-conformances

Table 26 summarizes the recommended actions for both the STP and NTP facilities.

Table 26: 2020 Dam Safety Inspection Recommended Actions for the South and North Tailings Pond Facilities

Facility	ID Number	Deficiency or Non-conformance	Applicable Guideline or OMS Manual Reference	Recommended Action	Priority Level	Recommended Timing for the Action
STP	2015-12a, b	Riprap erosion protection along downstream toe north of STP Sta. 0+680, no riprap south of STP Sta. 0+680; risk-informed protection requirements not yet defined	HSRC §10.1.8	Perform risk-informed assessment to determine appropriate flood protection requirements for downstream toe of dam along Fording River and timeline to implement.	2	Construction for Fording River flood plain widening is scheduled to be completed by 2022
				Implement required protection measures for the operational phase according to the as-defined schedule.	2	
	2017-01	North abutment construction deficiencies	HSRC §10.5.1(3)	Address construction deficiency by commencing office engineering in 2021 then finishing dam construction in 2022.	3	2021/2022
	2017-05	Potential overtopping hazard due to tailings liquefaction and redistribution during seismic event needs to be assessed	n/a	Complete liquefaction and overtopping assessment for tailings within facility.	2	Q2 2021
	2018-05	No closure plan for STP	HSRC §10.6.7 MAC TSM	Advance closure plan for STP.	4	2021
	2018-06	Construction of the AWTF-S is underway downstream of the STP Main Dam, potentially increasing the number of workers in the dam breach inundation zone.	HSRC §10.1.7 CDA 2013	Review credible failure modes and potential for inundation from a failure of the Main Dam relative to the downstream facility. If required, update the emergency response plan for the downstream workers at the AWTF-S considering the results of the STP Main Dam breach and inundation study draft report.	2	Q1 2021
	2020-01	Current freeboard trigger levels in the OMS manual do not apply to the facility with a permanent spillway.	Permit condition from Permit C-3 Amendment (July 2020) HSRC §10.1.13 HSRC Guidance Document §4.4.1	After the permanent spillway is constructed, update the QPOs in the OMS manual with freeboard triggers.	2	2021
	2020-02	No passive emergency system against overtopping	n/a	Construct permanent spillway.	2	2021
	2020-03	The stage storage relationship for the STP is continuously changing as tailings are continuously being deposited into and dredged out of the STP	n/a	Confirm the storage capacity and operating water volume of the STP after each bathymetric survey is completed.	4	Q3 2021
	2020-04	There is a major vertical erosion gully on the downstream slope of the Main Dam above the seepage collection well	n/a	Direct surface runoff onto a dam bench and away from the erosion gully on dam face.	2	Q2 2021
	2020-05	The critical hydraulic gradient through the Main Dam is unknown	HSRC Guidance Document §3.3.1 CDA 2013 §6.6	Complete an assessment to determine the critical hydraulic gradient in the Main Dam to better quantify the likelihood of a piping failure.	3	2021

Table 26: 2020 Dam Safety Inspection Recommended Actions for the South and North Tailings Pond Facilities

Facility	ID Number	Deficiency or Non-conformance	Applicable Guideline or OMS Manual Reference	Recommended Action	Priority Level	Recommended Timing for the Action
NTP	2015-05a,b	No passive emergency system against overtopping; emergency system requires active response	n/a	Assess the need for spillway after establishing an NTP closure plan.	4	2022
				If required, determine a construction schedule.	4	2022
	2015-06a,b	Risk-informed criteria for flood erosion protection along toe of dams not defined	CDA 2013 §6.2	a) Perform risk-informed assessment to determine i) appropriate flood protection requirements for downstream toe of dam along the Fording River and ii) the timeline for the flood protection requirements. b) Implement the required flood protection measures for the operational phase according to the schedule defined from a).	2	2021
	2015-07b	Buried pipes passing through crest locations	n/a	Execute abandonment plan for identified pipes.	3	2021
	2016-06	No closure plan for NTP	HSRC §10.6.7 MAC TSM	Develop a closure plan for NTP.	4	2021
	2019-03	A part of the downstream toe area below the NTP dam was excavated for access for a monitoring well installation program in 2019	HSRC §10.5.8	Backfill and grade excavated area.	3	Q2 2021
	2020-06	Inflow of sediments had been diverted to the NTP and may be reducing the available storage in the pond	n/a	Conduct a bathymetry survey to confirm the stage storage curve for the facility to understand rate of sediment built up and check the pond can store the IDF while maintaining the minimum freeboard.	4	2021

OMS = operation, maintenance and surveillance; STP = South Tailings Pond; Sta. = Station; HSRC = Health, Safety and Reclamation Code; n/a = not applicable; MAC = Mining Association of Canada; TSM = Towards Sustainable Mining; AWTF-S = active water treatment facility-south; CDA = Canadian Dam Association; QPO = quantifiable performance objective; n/a = not applicable; NTP = North Tailings Pond.

Priority Level	Description
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.
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.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice – Further improvements are necessary to meet industry best practices or reduce potential risks.

Source: HSRC Guidance Document, Section 4.2 (Ministry of Energy and Mines 2016).

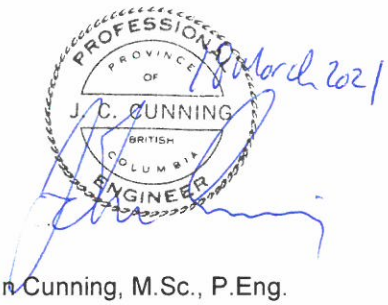
7.0 CLOSURE

The reader is referred to the Study Limitations section, which follows the text and forms an integral part of this report.

We trust the above meets your present requirements. If you have any questions or further requirements, please contact the undersigned.

Golder Associates Ltd.

Clara Lee, M.Eng., P.Eng.
Geotechnical Engineer



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https://golderassociates.sharepoint.com/sites/121039/project files/6 deliverables/issued/2020-219-r-rev0-2000-stp-ntp dsi report/20136981-2020-219-r-rev0-2000-stp-ntp dsi fro_18mar_21.docx

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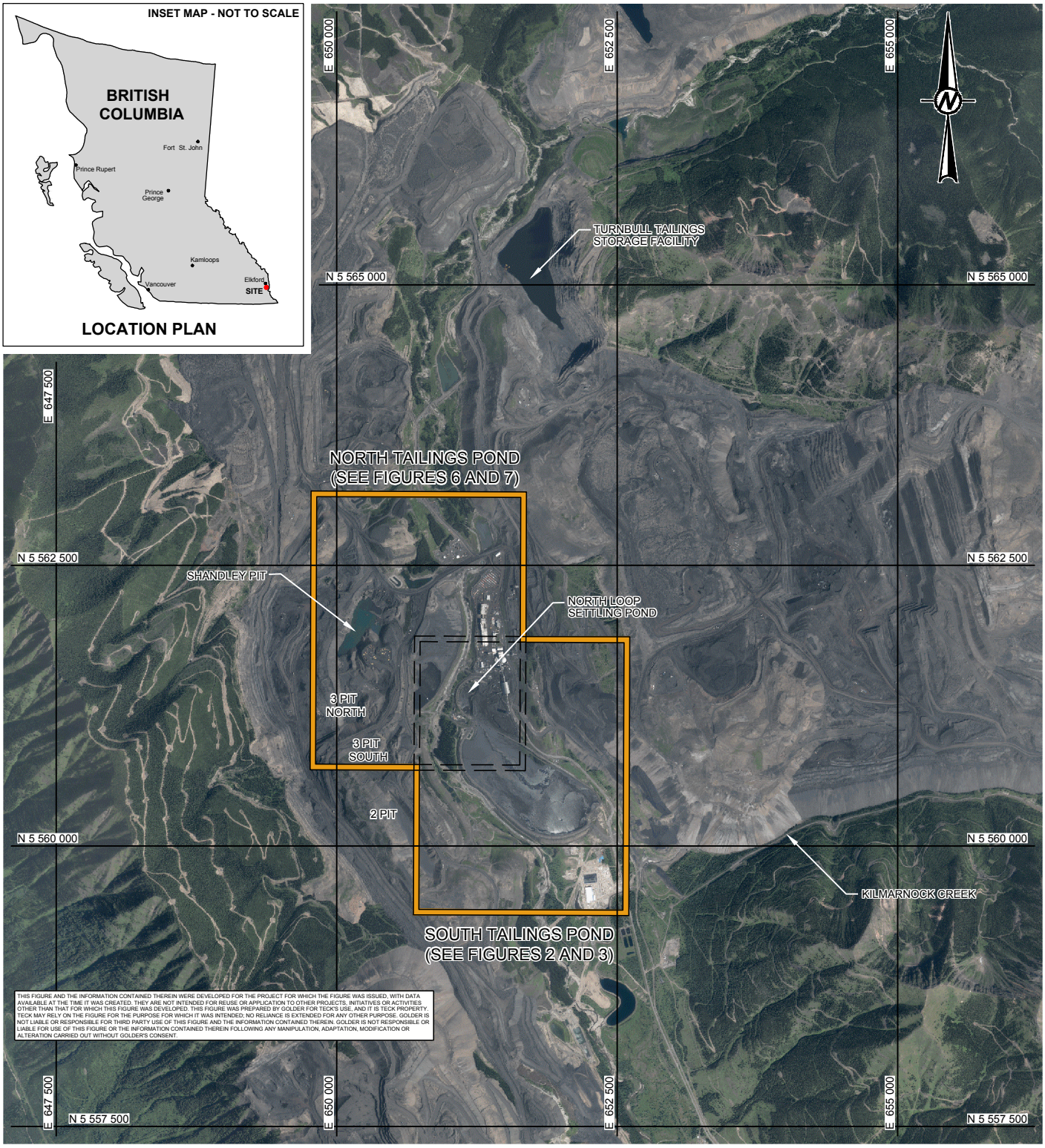

REFERENCE

1. 2020 AERIAL PHOTO AND LIDAR TOPOGRAPHY PROVIDED BY TECK COAL LIMITED, RECEIVED: 01 DECEMBER 2020, DATES FLOWN: 15-26 JULY 2020.

NOTES

1. ALL UNITS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATES ARE IN UTM ZONE 11, ELEVATIONS ARE REFERENCED TO THE ELK VALLEY ELEVATION DATUM.

0 1,000 2,000
1:50,000 METRES

CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-18
DESIGNED	A. VAN ENGELEN
PREPARED	A. KIM
REVIEWED	C. LEE
APPROVED	J. CUNNING

PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUNAL DAM SAFETY INSPECTION

TITLE
FORDING RIVER OPERATIONS SITE PLAN

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
20136981	2000/2005/2020-219	0	1

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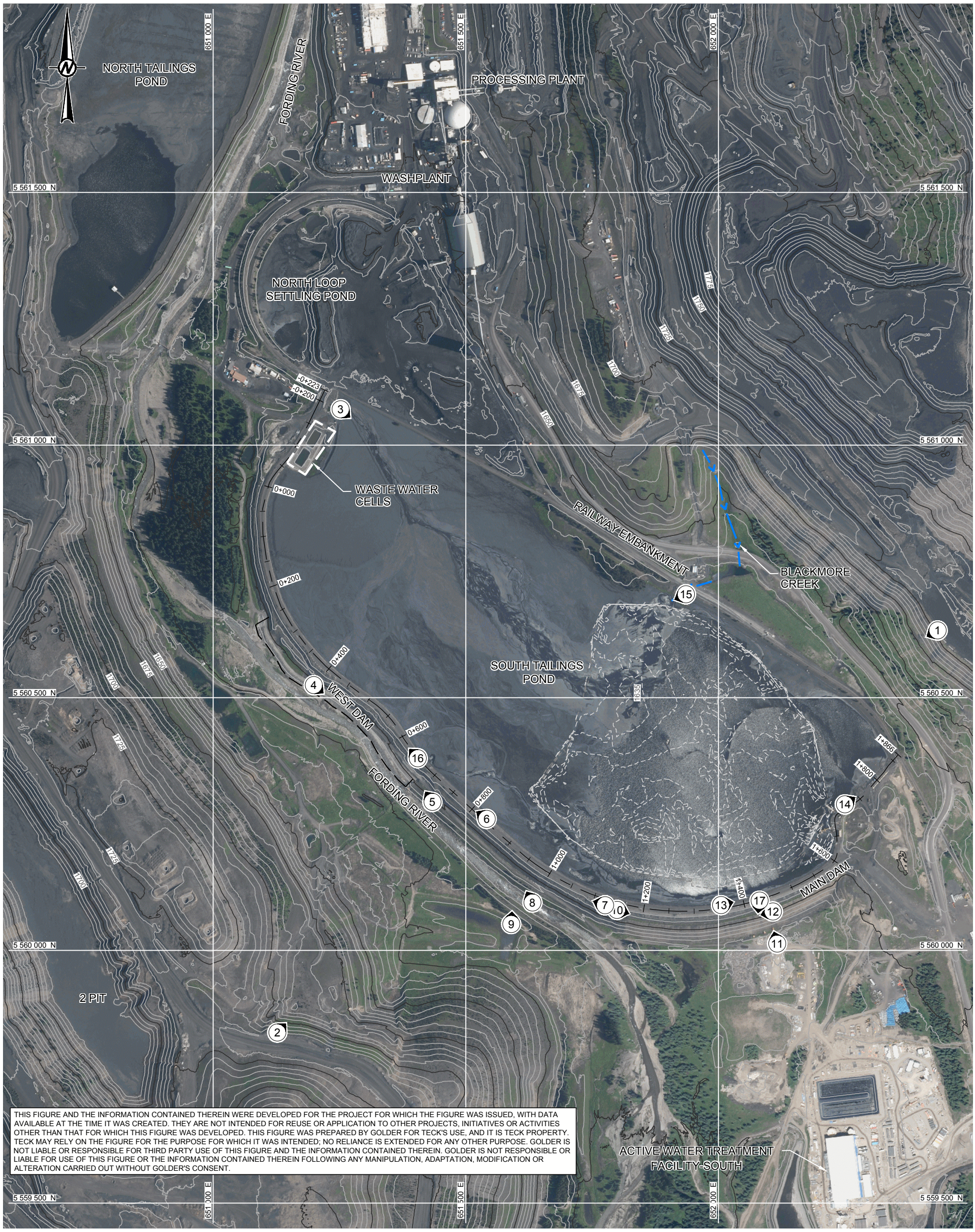
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

0 25 mm



LEGEND

- TOPOGRAPHIC CONTOURS
- BATHYMETRY CONTOURS
- EXTENT OF STP DOWNSTREAM RIPRAP
- (#) 2020 SITE VISIT PHOTOGRAPH LOCATION
- STP DAM REFERENCE LINE AND STATION

NOTES

1. ALL UNITS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATES ARE IN UTM ZONE 11, ELEVATIONS ARE REFERENCED TO THE ELK VALLEY ELEVATION DATUM.
3. TOPOGRAPHIC CONTOURS SHOWN AT 5.0 m MINOR AND 25.0 m MAJOR INTERVAL.
4. BATHYMETRY CONTOURS SHOWN AT 1.0 m MINOR AND 5.0 m MAJOR INTERVAL.

REFERENCES

1. 2020 AERIAL PHOTO AND LIDAR TOPOGRAPHY PROVIDED BY TECK COAL LIMITED, RECEIVED: 01 DECEMBER 2020, DATES FLOWN: 15-26 JULY 2020.
2. STP RIPRAP EXTENTS PROVIDED BY KERR WOOD LEIDAL ASSOCIATES LTD. RECEIVED: 17 JANUARY 2018.
3. 2020 BATHYMETRY DATA SURVEYED BY TECK COAL LIMITED FORDING RIVER OPERATIONS ON 15 OCTOBER 2020. FILE NAME: "201015 - STP Combined.dxf"

0 125 250
1:7,500 METRES

CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-18
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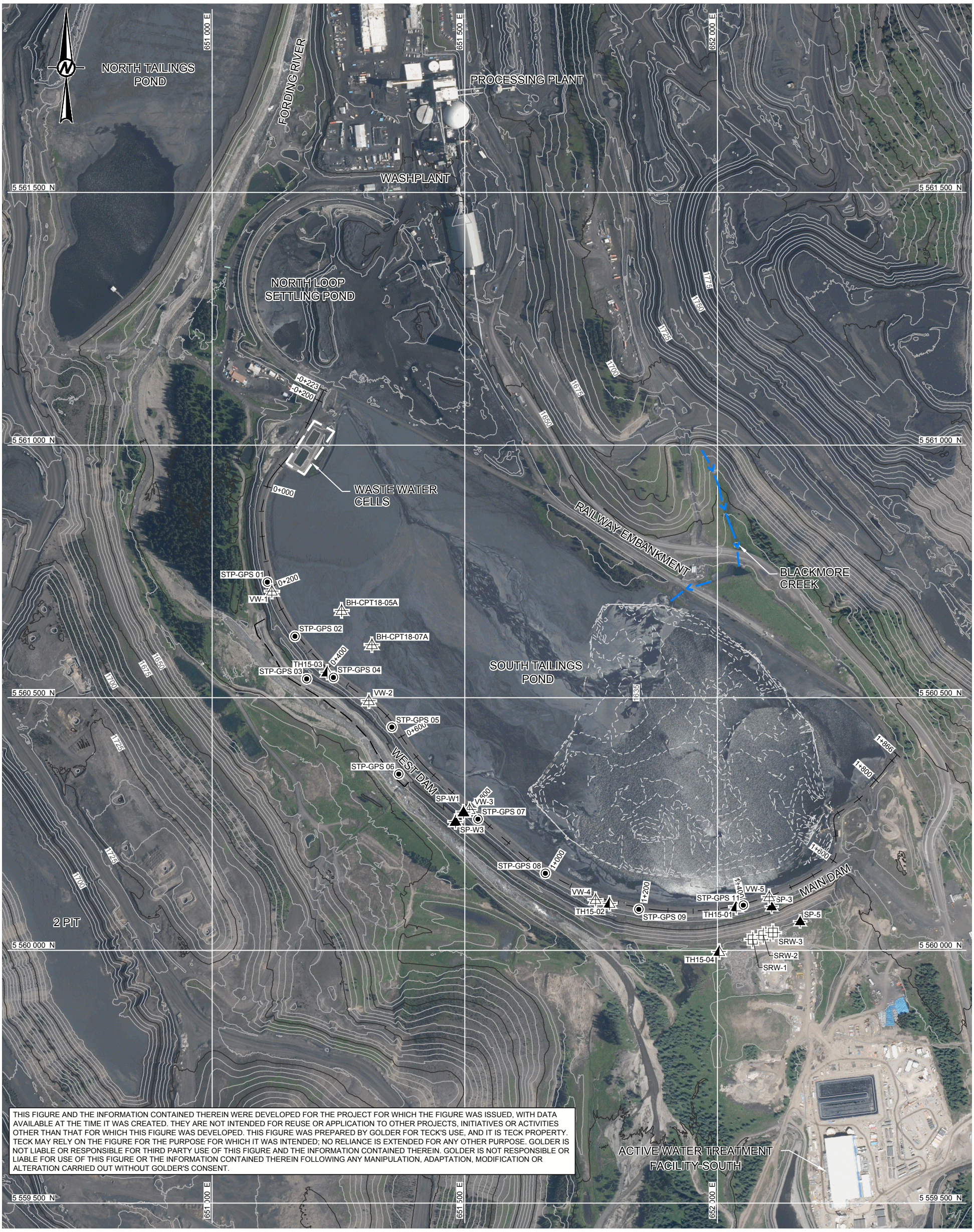
REVIEWED	C. LEE
APPROVED	J. CUNNING

PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUNAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND
2020 SITE VISIT PHOTOGRAPH LOCATIONS

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
20136981	2000/2005/2020-219	0	2



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LEGEND

- TOPOGRAPHIC CONTOURS
- BATHYMETRY CONTOURS
- EXTENT OF STP DOWNSTREAM RIPRAP
- GPS MONITORING LOCATION
- VIBRATING WIRE PIEZOMETER LOCATION
- VIBRATING WIRE PIEZOMETER AND INCLINOMETER LOCATION
- RETROFIT STANDPIPE WITH VIBRATING WIRE PIEZOMETER LOCATION
- SEEPAGE RETURN WELL LOCATION
- STP DAM REFERENCE LINE AND STATION

NOTES

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3. TOPOGRAPHIC CONTOURS SHOWN AT 5.0 m MINOR AND 25.0 m MAJOR INTERVAL.
4. BATHYMETRY CONTOURS SHOWN AT 1.0 m MINOR AND 5.0 m MAJOR INTERVAL.

REFERENCES

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3. GPS MONITORING LOCATIONS BASED ON INITIAL READINGS OF DATA DOWNLOADED FROM GEOEXPLORER ACCESSED 13 DECEMBER 2017.
4. LOCATIONS OF STANDPIPE PIEZOMETERS BASED ON SURVEY DATA DOWNLOADED FROM GEOEXPLORER, ACCESSED 13 DECEMBER 2017.
5. LOCATIONS OF 2014 VIBRATING WIRE PIEZOMETERS BASED ON SURVEY DATA DOWNLOADED FROM GEOEXPLORER, ACCESSED 13 DECEMBER 2017.
6. LOCATIONS OF 2015 VIBRATING WIRE PIEZOMETERS AND INCLINOMETERS BASED ON SURVEY DATA DOWNLOADED FROM GEOEXPLORER, ACCESSED 13 DECEMBER 2017.
7. 2020 BATHYMETRY DATA SURVEYED BY TECK COAL LIMITED FORDING RIVER OPERATIONS ON 15 OCTOBER 2020. FILE NAME: "201015 - STP Combined.dxf"
8. SEEPAGE RETURN WELL LOCATIONS APPROXIMATED FROM 2018 AERIAL PHOTO.
9. LOCATIONS OF 2018 VIBRATING WIRE PIEZOMETERS BASED ON SURVEY DATA FROM GEOEXPLORER, ACCESSED 24 OCTOBER 2019.

0 125 250
1:7,500 METRES

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TECK COAL LIMITED
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ELKFORD, B.C.

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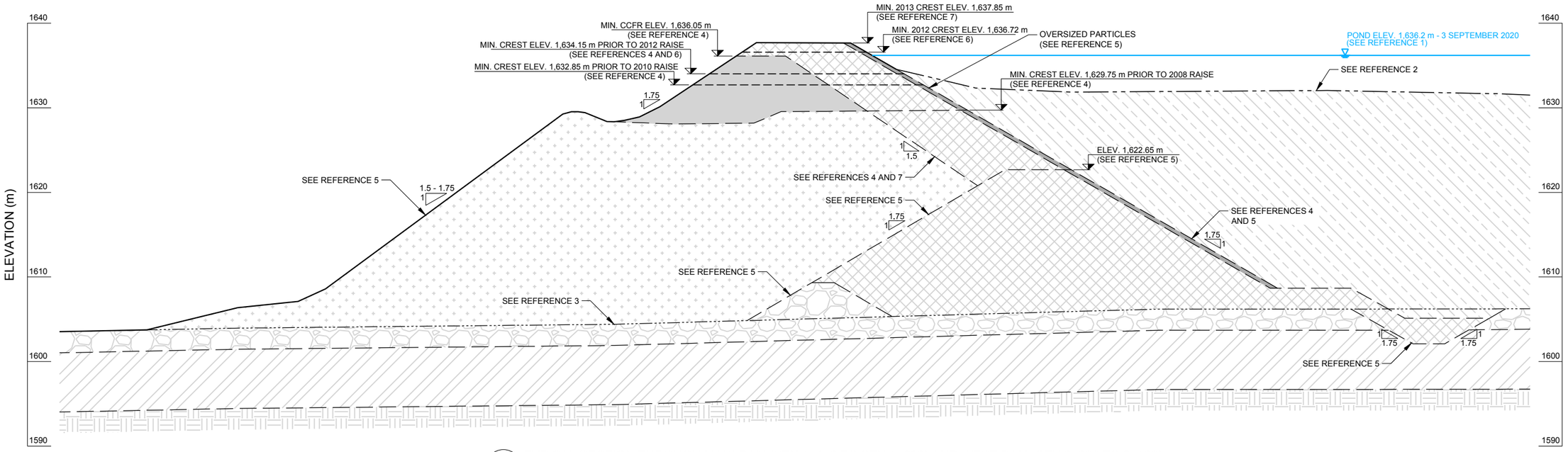
PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUNAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND MONITORING LOCATIONS

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
20136981	2000/2005/2020-219	0	3



SCALE 1:500 m

B TYPICAL SECTION THROUGH MAIN DAM (STN 1+150 TO STN 1+600) AND WEST DAM (STN 0+000 TO 0+400)

LEGEND

- APPROXIMATE GROUND SURFACE
- APPROXIMATE POND ELEVATION
- APPROXIMATE PREVIOUSLY DESIGNED CREST
- APPROXIMATE ORIGINAL GROUND SURFACE
- APPROXIMATE MATERIALS BOUNDARY BENEATH SURFACE
- APPROXIMATE TAILINGS SURFACE
- COARSE REJECTS (CR)
- COMBINED COARSE AND FINE REJECTS (CCFR)
- TILL
- IN SITU TILL
- FLOODPLAIN DEPOSITS (SAND AND GRAVEL)
- TAILINGS
- BEDROCK

NOTES

1. ALL UNITS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
2. MATERIALS SHOWN SCHEMATICALLY ONLY.
3. RIPRAP PRESENT FROM APPROXIMATELY 0+205 TO 0+680, NOT SHOWN ON SECTION.
4. ELEVATIONS ARE REFERENCED TO THE ELK VALLEY ELEVATION DATUM.

REFERENCES

1. POND ELEVATION IS LAST RECORDED READING FROM DATA PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS, RECEIVED: 16 SEPTEMBER 2020.
2. TAILINGS SURFACE SHOWN FOR MAIN DAM SECTION AND ESTIMATED BASED ON 2017 BATHYMETRY PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS, RECEIVED: 28 NOVEMBER 2017. SURVEYED: 11 SEPTEMBER 2017.
3. ORIGINAL GROUND ESTIMATED BASED ON 1968 ORIGINAL GROUND SURFACE CONTOURS PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS, FILE NAME: "1968_CONTOURS_BG.dwg", RECEIVED: 8 DECEMBER 2015 AND GOLDER. 1976. TAILINGS STORAGE PROPOSED 1977 EXTENSION. REPORT PREPARED FOR FORDING COAL LTD. REFERENCE NO. V75193. SUBMITTED JANUARY 1976 (GROUND SURFACE DIGITIZED BY GOLDER FROM COMINCO DRAWING (UNNAMED), FIGURE 1 LOCATION OF BOREHOLES).
4. FRO. 2010. SOUTH TAILINGS POND DESIGN AND CONSTRUCTION REPORT JULY-SEPTEMBER 2010. SUBMITTED NOVEMBER 2010.
5. GOLDER. 1976. REPORT TO FORDING COAL LTD. ON TAILINGS STORAGE PROPOSED 1977 EXTENSION. REPORT PREPARED FOR FORDING COAL LTD. REFERENCE NO. V75193. SUBMITTED JANUARY 1976.
6. GOLDER. 2013. SOUTH TAILINGS POND DAM 2012 CONSTRUCTION DAM RAISE AS-BUILT REPORT. REPORT PREPARED FOR TECK COAL LIMITED FORDING RIVER OPERATIONS. PROJECT NO. 1214270098-2013-303-R-REV0-6400. SUBMITTED 1 APRIL 2013.
7. GOLDER. 2014d. SOUTH TAILINGS POND DAM CONSTRUCTION RECORD REPORT FOR THE 2013 DAM RAISE. REPORT PREPARED FOR TECK COAL LIMITED FORDING RIVER OPERATIONS. REFERENCE NO. 1314270098-2014-542-R-REV0-6000. SUBMITTED 30 OCTOBER 2014.

0 10 20
1:500 METRES

CLIENT
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FORDING RIVER OPERATIONS
ELKFORD, B.C.

CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-18
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REVIEWED	C. LEE
APPROVED	J. CUNNING

PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUNAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND
TYPICAL SECTION THROUGH MAIN DAM (STN. 1+150 TO 1+600) AND WEST DAM (STN. 0+000 TO 0+400)

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
20136981	2000/2005/2020-219	0	4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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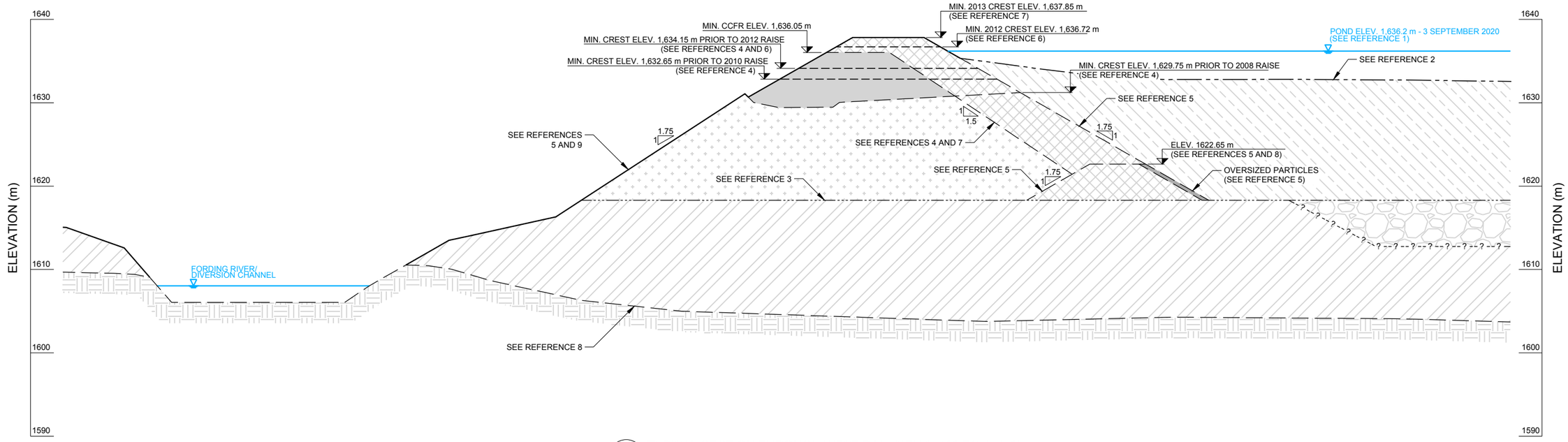

SCALE 1:500 m C TYPICAL SECTION THROUGH WEST DAM (STN 0+400 TO 1+150)

LEGEND

- APPROXIMATE GROUND SURFACE
- APPROXIMATE POND ELEVATION
- APPROXIMATE PREVIOUSLY DESIGNED CREST
- APPROXIMATE ORIGINAL GROUND SURFACE
- APPROXIMATE MATERIALS BOUNDARY BENEATH SURFACE
- APPROXIMATE TAILINGS SURFACE
- COARSE REJECTS (CR)
- COMBINED COARSE AND FINE REJECTS (CCFR)
- TILL
- IN SITU TILL
- FLOODPLAIN DEPOSITS (SAND AND GRAVEL)
- TAILINGS
- BEDROCK

NOTES

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3. RIPRAP PRESENT FROM APPROXIMATELY 0+205 TO 0+680, NOT SHOWN ON SECTION.
4. ELEVATIONS ARE REFERENCED TO THE ELK VALLEY ELEVATION DATUM.

REFERENCES

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8. GOLDER. 2015. SOUTH TAILINGS POND WEST DAM GEOPHYSICAL INVESTIGATION. REPORT PREPARED FOR TECK COAL LIMITED FORDING RIVER OPERATIONS. REFERENCE NO. 1522835-2015-002-R-REV0-3000. SUBMITTED 26 MAY 2015.
9. KWL. 1976. DRAWING NO. 8-76-3. DRAWING PREPARED FOR FORDING COAL LTD. SUBMITTED 1976.

0 10 20
1:500 METRES

CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-18
DESIGNED	A. VAN ENGELEN
PREPARED	A. KIM
REVIEWED	C. LEE
APPROVED	J. CUNNING

PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUNAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND
TYPICAL SECTION THROUGH WEST DAM (STN. 0+400 TO 1+150)

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
20136981	2000/2005/2020-219	0	5

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0 25 mm

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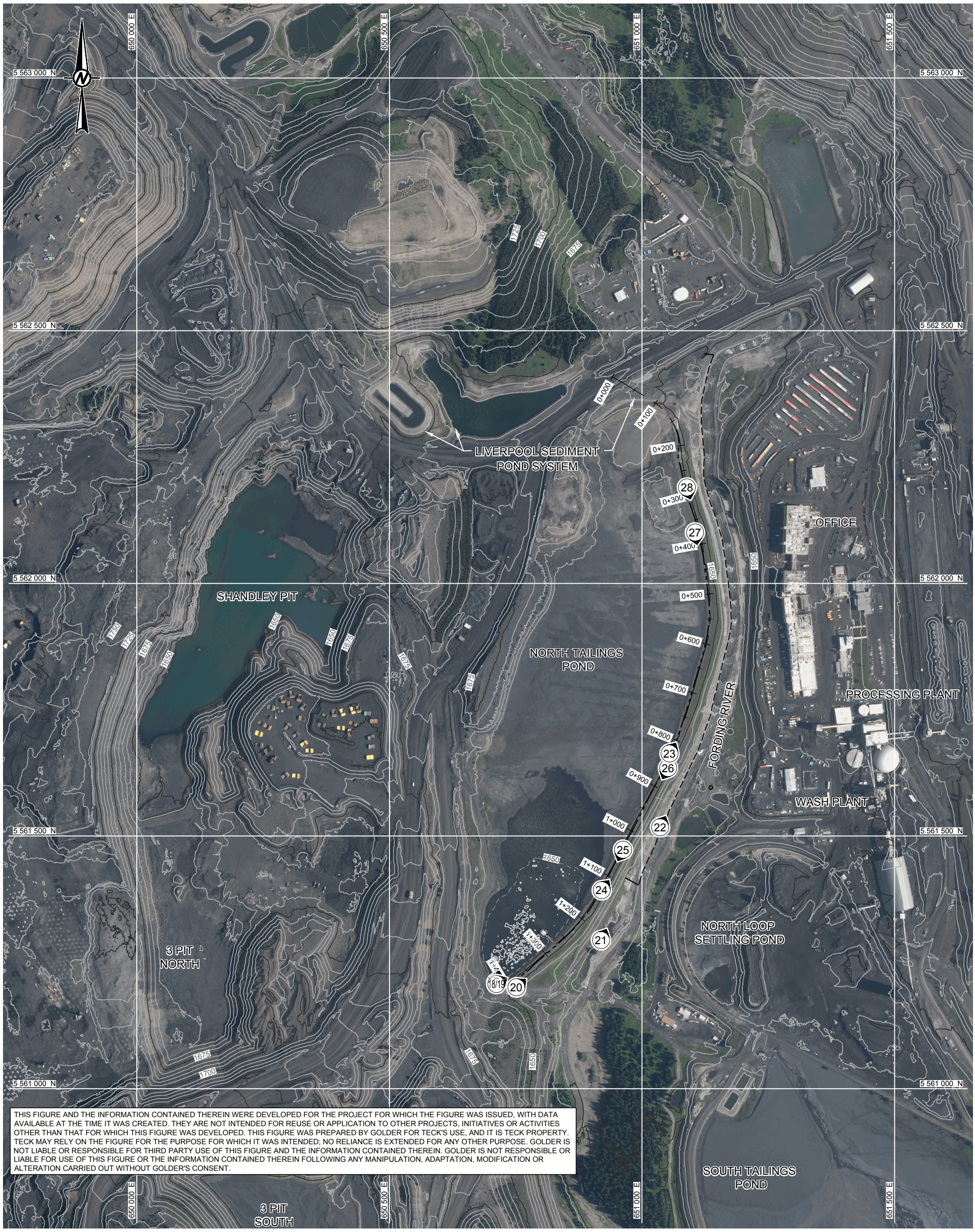

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LEGEND

- TOPOGRAPHIC CONTOURS
- BATHYMETRY CONTOURS
- 2017 NTP CREST SURVEY
- EXTENT OF NTP DOWNSTREAM RIPRAP
- # 2020 SITE VISIT PHOTOGRAPH LOCATION
- NTP DAM REFERENCE LINE AND STATION

NOTES

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2. COORDINATES ARE IN UTM ZONE 11, ELEVATIONS ARE REFERENCED TO THE ELK VALLEY ELEVATION DATUM.
3. TOPOGRAPHIC CONTOURS SHOWN AT 5.0 m MINOR AND 25.0 m MAJOR INTERVAL.
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REFERENCES

1. 2020 AERIAL PHOTO AND LIDAR TOPOGRAPHY PROVIDED BY TECK COAL LIMITED, RECEIVED: 01 DECEMBER 2020, DATES FLOWN: 15-26 JULY 2020.
2. GOLDER. 2018. TECK COAL LIMITED, FORDING RIVER OPERATIONS - TURNBULL TSF AND NORTH TAILINGS POND BATHYMETRY SURVEY. GOLDER DOC. NO. 18100013-2018-130-TM-REV0-1000. 29 NOVEMBER 2018.
3. 2017 NTP CREST SURVEY PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS. RECEIVED: 8 JANUARY 2018. FILE NAME: NTP CREST SURVEY - 171121C.xls.
4. NTP RIPRAP EXTENTS PROVIDED BY KERR WOOD LEIDAL ASSOCIATES LTD. RECEIVED: 17 JANUARY 2018.

0 125 250
1:7,500 METRES

CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

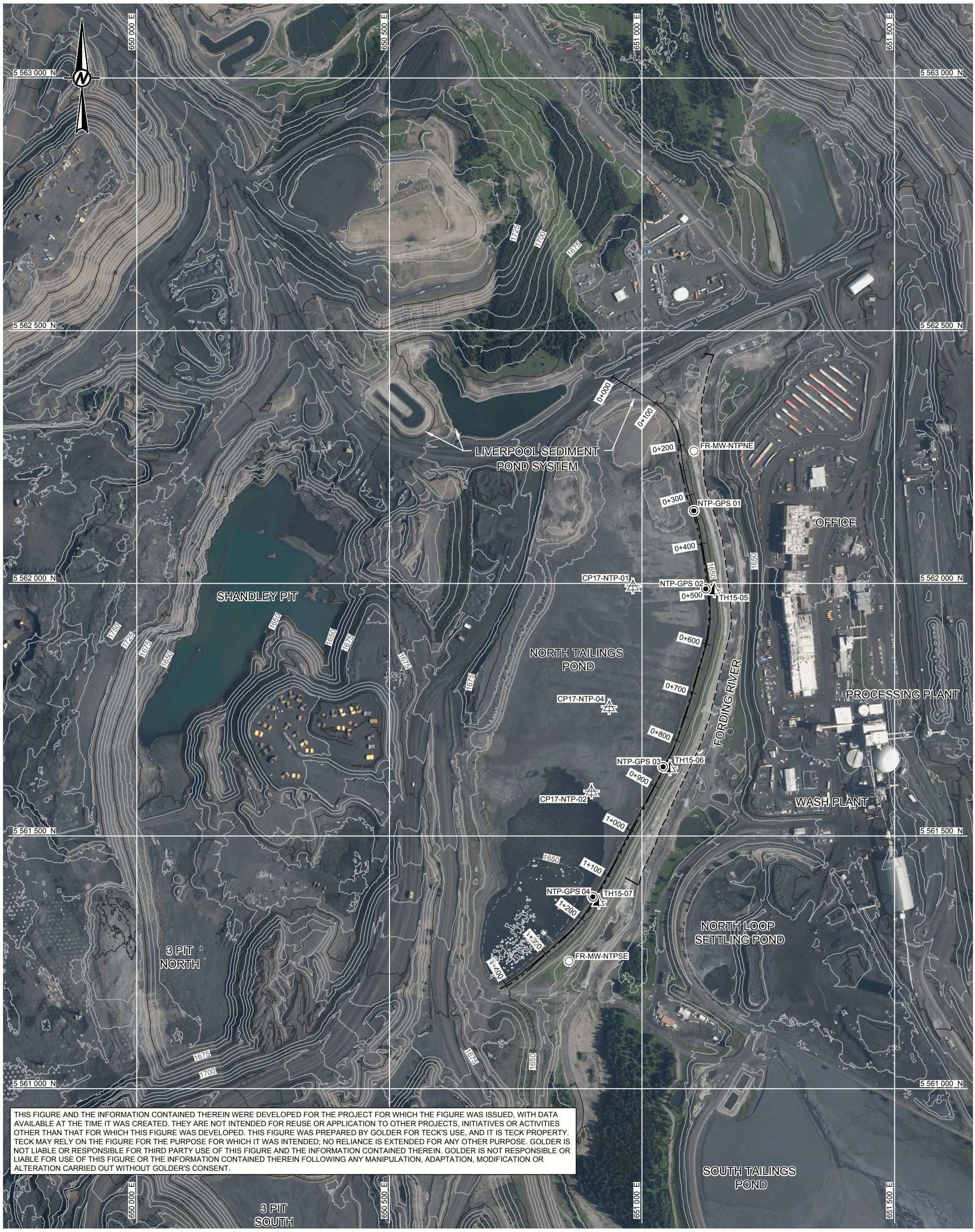
CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-18
DESIGNED	A. VAN ENGELEN
PREPARED	A. KIM
REVIEWED	C. LEE
APPROVED	J. CUNNING

PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUNAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND
2020 SITE VISIT PHOTOGRAPH LOCATIONS

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
20136981	2000/2005/2020-219	0	6



LEGEND

- TOPOGRAPHIC CONTOURS
- BATHYMETRY CONTOURS
- 2017 NTP CREST SURVEY
- EXTENT OF NTP DOWNSTREAM RIPRAP
- GPS MONITORING LOCATION
- FRO MONITORING WELL LOCATION
- VIBRATING WIRE PIEZOMETER LOCATION
- VIBRATING WIRE PIEZOMETER AND INCLINOMETER LOCATION
- NTP DAM REFERENCE LINE AND STATION

0 125 250
1:7,500 METRES

NOTES

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3. GPS MONITORING LOCATIONS BASED ON INITIAL READINGS OF DATA FROM GEOEXPLORER, ACCESSED: 13 DECEMBER 2017.
4. NTP RIPRAP EXTENTS PROVIDED BY KERR WOOD LEIDAL ASSOCIATES LTD. RECEIVED: 17 JANUARY 2018.
5. LOCATION OF INCLINOMETERS AND ALL VIBRATING WIRE PIEZOMETERS (EXCEPT FOR CP17-NTP-01, -02, AND -04) DOWNLOADED FROM FRO'S GEOEXPLORER, ACCESSED ON 13 DECEMBER 2017.
6. 2017 NTP CREST SURVEY PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS. RECEIVED 8 JANUARY 2018. FILE NAME: NTP CREST SURVEY - 171121C.xls
7. LOCATION OF VIBRATING WIRE PIEZOMETERS CP17-NTP-01, -02, AND -04 FROM NORWEST CORPORATION. 2018. FORDING RIVER OPERATIONS NORTH TAILINGS POND - GEOTECHNICAL INVESTIGATION RESULTS. PROJECT NO. 324-37. 17 MAY 2018.

CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-18
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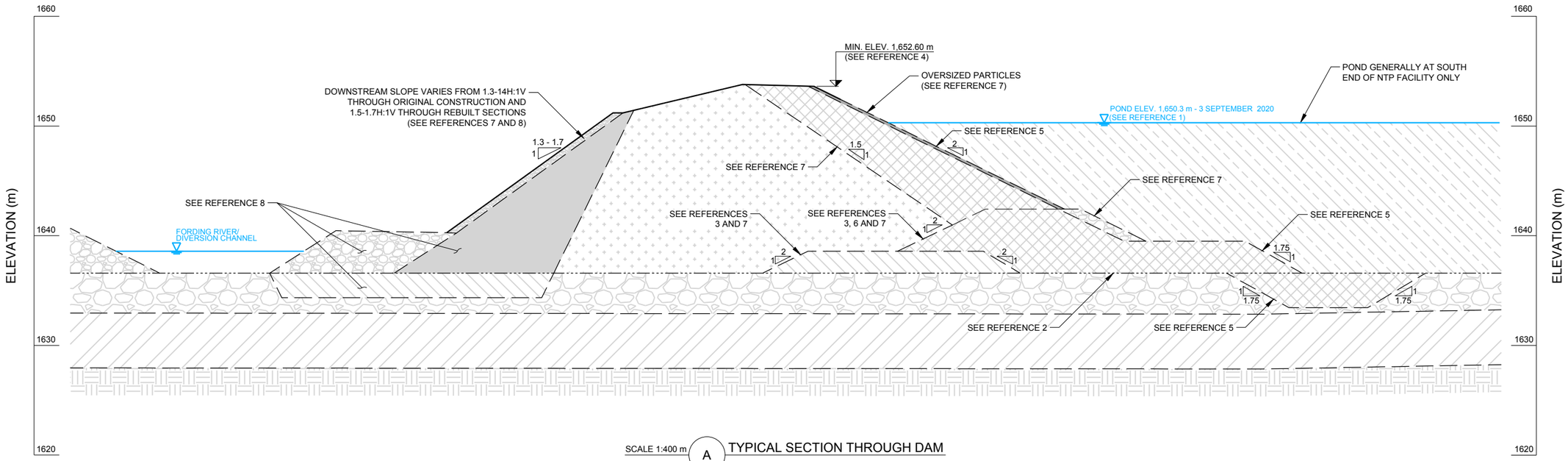
PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUNAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND
MONITORING LOCATIONS

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
20136981	2000/2005/2020-219	0	7



SCALE 1:400 m (A) TYPICAL SECTION THROUGH DAM

LEGEND

- APPROXIMATE GROUND SURFACE
- APPROXIMATE POND ELEVATION
- APPROXIMATE ORIGINAL GROUND SURFACE
- APPROXIMATE MATERIALS BOUNDARY BENEATH SURFACE
- COARSE REJECTS (CR)
- COARSE REJECTS (CR) OR REBUILT WITH COMBINED COARSE AND FINE REJECTS (CCFR)
- TILL
- IN SITU TILL
- FLOODPLAIN DEPOSITS (SAND AND GRAVEL)
- FLOODPLAIN DEPOSITS (SAND AND GRAVEL) OR REBUILT RIPRAP
- RIPRAP
- TAILINGS
- TOPSOIL
- BEDROCK

NOTES

1. ALL UNITS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
2. MATERIAL ZONING SHOWN SCHEMATICALLY ONLY.
3. ELEVATIONS ARE REFERENCED TO THE ELK VALLEY ELEVATION DATUM.

REFERENCES

1. POND ELEVATION IS LAST RECORDED READING FROM DATA PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS, RECEIVED 16 SEPTEMBER 2020.
2. ORIGINAL GROUND ESTIMATED BASED ON 1968 ORIGINAL GROUND SURFACE CONTOURS PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS, FILE NAME: "1968_CONTOURS_BG.dwg", RECEIVED: 8 DECEMBER 2015.
3. COMINCO (COMINCO LTD.). 1973. FEASIBILITY PROPOSAL FOR FORDING OPERATIONS TAILINGS DIKE EXTENSION TO ELEVATION 5,400 FEET. SUBMITTED 3 JULY 1973.
4. 2017 NTP CREST SURVEY PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS. RECEIVED 8 JANUARY 2018. FILE NAME: NTP CREST SURVEY - 171121C.xls
5. GOLDER BRAWNER. 1970. SECOND REPORT TO COMINCO LTD., ON TAILINGS POND AND DYKE PROPOSED FORDING RIVER COAL PROJECT FORDING RIVER BRITISH COLUMBIA. REPORT PREPARED FOR COMINCO LTD. REFERENCE NO. V6994. SUBMITTED APRIL 1970.
6. GOLDER BRAWNER. 1974. REPORT TO FORDING COAL LTD. ON PHASE II TAILINGS DAM CONSTRUCTION SPARWOOD B.C. REPORT PREPARED FOR FORDING COAL LTD. REFERENCE NO. V73020-5. SUBMITTED FEBRUARY 1974.
7. GOLDER. 1975. REPORT TO FORDING COAL LTD. RE CONSTRUCTION OF PHASE 4, ZONE 1b OF THE FORDING COAL TAILINGS DYKE. REPORT PREPARED FOR FORDING COAL LTD. REFERENCE NO. V75013. SUBMITTED 17 FEBRUARY 1975.
8. GOLDER. 2014d. NORTH TAILINGS POND DAM 2013 FLOOD REPAIRS CONSTRUCTION SUMMARY. REPORT PREPARED FOR TECK COAL LIMITED FORDING RIVER OPERATIONS. PROJECT NO. 1314270098-2014-R-REV0-7000. SUBMITTED OCTOBER 30, 2014.

0 10 20
1:400 METRES

CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-18
DESIGNED	A. VAN ENGELEN
PREPARED	A. KIM
REVIEWED	C. LEE
APPROVED	J. CUNNING

PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUNAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND
TYPICAL SECTION THROUGH DAM

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
20136981	2000/2005/2020-219	0	8

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25 mm

Path: \\golder.gds\gal\Vancouver\CAD-GIS\Client\Teck Coal\Fording River\99_PROJECTS\20136981\2000\2005\219\02_PRODUCTION\DWG\ | File Name: 20136981-2000-2005-2020-219-08.dwg

APPENDIX A

Site Photographs

2020 Dam Safety Inspection for South Tailings Pond and North Tailings Pond

PHOTOGRAPH A-1 **20 August 2020**

South Tailings Pond (STP) overview, looking southwest

PHOTOGRAPH A-2

20 August 2020

STP overview, looking northeast

PHOTOGRAPH A-3

18 August 2020

STP north single point discharge pipeline extension and channel to main pond, looking southeast

PHOTOGRAPH A-4

18 August 2020

STP West Dam downstream slope and riprap along Fording River, looking southeast from approximately Sta. 0+400

PHOTOGRAPH A-5

19 August 2020

STP West Dam downstream slope and access road, looking northwest from approximately Sta. 0+650

PHOTOGRAPH A-6 **18 August 2020**

STP West Dam crest and downstream slope, Fording River, and Pipeline Bridge; looking northwest from approximately Sta. 0+800

PHOTOGRAPH A-7

18 August 2020

STP West Dam downstream slope and Fording River; looking northwest from approximately Sta. 1+050

PHOTOGRAPH A-8

19 August 2020

Pipe	Seepage Rate (L/s)
North (left)	0.09
South (right)	0.03
Bypassing pipes (estimated)	0.25

STP West Dam till slope below dam toe and West Seepage collection Pipes, looking northwest from approximately Sta. 1+000

PHOTOGRAPH A-9 **20 August 2020**

STP West Dam downstream slope, diversion channel till cut, and Fording River; looking north from west side of river at approximately Sta. 1+000

PHOTOGRAPH A-10 **18 August 2020**

STP West Dam downstream slope, looking southeast from approximately Sta. 1+150

PHOTOGRAPH A-11

19 August 2020

STP Main Dam downstream slope showing erosion above seepage return wells, looking southeast from approximately Sta. 1+450

PHOTOGRAPH A-12 **19 August 2020**

STP Main Dam downstream slope and bench at top of CR section of slope, looking southwest from approximately Sta. 1+450

PHOTOGRAPH A-13

18 August 2020

STP Main Dam crest, upstream slope, and tailings beach; looking northeast from approximately Sta. 1+430

PHOTOGRAPH A-14

18 August 2020

STP Main Dam crest and upstream slope at south abutment, looking northeast from approximately Sta. 1+700

PHOTOGRAPH A-15

18 August 2020

STP water reclaim line from Turnbull TSF, looking southwest

PHOTOGRAPH A-16 **18 August 2020**

STP West Dam crest and upstream beach, looking northwest from approximately Sta. 0+650

PHOTOGRAPH A-17

18 August 2020

STP Main Dam downstream slope with some erosion on till, and view of riprap stockpile downstream of Main Dam; looking south from approximately Sta. 1+450

PHOTOGRAPH A-18

19 August 2020

North Tailings Pond (NTP) overview of pond and upstream slope at south end, looking north from approximately Sta. 1+400.

PHOTOGRAPH A-19 **19 August 2020**

NTP Dam crest and upstream slope, looking northeast from approximately Sta. 1+400

PHOTOGRAPH A-20

19 August 2020

NTP Dam crest and downstream slope; looking northeast from approximately Sta. 1+400

PHOTOGRAPH A-21

19 August 2020

NTP Dam toe and area of ponding water at Sta. 1+200, looking northeast

PHOTOGRAPH A-22 **19 August 2020**

NTP Dam downstream slope and riprap along Fording River; looking northeast from approximately Sta. 0+950

PHOTOGRAPH A-23

19 August 2020

NTP Dam crest, looking northeast from approximately Sta. 0+850

PHOTOGRAPH A-24 **19 August 2020**

NTP Dam crest and downstream slope, looking northeast from approximately Sta. 1+150

PHOTOGRAPH A-25 **19 August 2020**

NTP Dam crest, downstream slope, and black PVC pipe on downstream; looking southwest from approximately Sta. 1+050

PHOTOGRAPH A-26 **19 August 2020**

NTP Dam downstream slope, looking southwest from approximately Sta. 0+850

PHOTOGRAPH A-27 **19 August 2020**

NTP Dam crest, upstream slope, and tailings surface; looking south from approximately Sta. 0+350

PHOTOGRAPH A-28

19 August 2020

NTP Dam crest and downstream slope, looking south from approximately Sta. 0+250

APPENDIX B

South Tailings Pond Inspection Report

Client:	**Teck Coal Limited, Fording River Operations**	**By:**	**John Cunning, P.Eng.**
Project:	**20136981 FRO Tailings Facilities 2020 Annual Dam Safety Inspection**	**Date:**	**18 and 19 August 2020**
Location:	**South Tailings Pond**	**Reviewed:**	**Clara Lee, P.Eng.**

GENERAL INFORMATION			
Dam Type:	Zoned Earth Fill		
Weather Conditions:	Sunny	**Temp:**	25°C

Inspection Item	Observations/Data	Photo	Comments & Other Data
1.0 DAM CREST		6, 13, 14, 16	
1.1 Crest Elevation	Elev. 1,637.85 m (minimum) for Main Dam confirmed with 2020 LiDAR survey		
1.2 Reservoir Level / Freeboard	Elev. 1,636.20 m (3 September 2020) 1.65 m freeboard		
1.3 Distance to Tailings Pond (if applicable)	0 m (south end) Sta. 1+500 to 1+700 Full beach at Sta. -0+223 to 1+500	1	
1.4 Surface Cracking	None		
1.5 Unexpected Settlement	None		
1.6 Lateral Movement	None		
1.7 Other Unusual Conditions or Structures	Minor rutting and small depressions on dam crest due to traffic and usage by dredging crew. North abutment crest is low compared to design, to be raised with completion works in 2021.		

Inspection Item	Observations/Data	Photo	Comments & Other Data
2.0 UPSTREAM SLOPE		13, 14, 16	
2.1 Slope Angle	Generally 1.4H to 1.75H:1V		Crest graded to drain upstream. Riprap placed along upstream slope of Main Dam and part of West Dam.
2.2 Signs of Erosion	2 areas of erosion, at 5 m east and west of the Kilmarnock discharge pipelines approx. 1+780		Erosions due to vacuum truck discharging into non-designated locations on the upstream slope.
2.3 Signs of Movement (Deformation)	None		
2.4 Cracks	None		
2.5 Face Liner Condition (if applicable)	n/a		
2.5 Other Unusual Conditions	Vegetation growth along all upstream slopes of Main and West dams	13, 14	Unused dredge line along upstream slope of Main Dam and West Dam.
3.0 DOWNSTREAM SLOPE		4, 5, 6, 7, 9, 10, 11, 12, 17	
3.1 Slope Angle	± 1.5 to 1.75H:1V		Lower portion of Main Dam slope locally over-steepened with respect to design, bench in Main Dam slope provides and overall slope around 1.75 H:1 V.
3.2 Signs of Erosion	Yes. No new erosion observed in repaired erosion channels	11, 17	■ One area of a larger vertical erosion channel down face of Main Dam above seepage collection well observed. ■ Minor erosion channels on till and CCFR faces of downstream slope. ■ Erosion channels in Main and West dams should be filled with coarse rock fill as was done for previously repaired channels.
3.3 Signs of Movement (Deformation)	None		
3.4 Cracks	None		
3.5 Seepage or Wet Areas	None		

Inspection Item	Observations/Data	Photo	Comments & Other Data
3.6 Vegetation Growth	Good on lower portion of Main Dam Poor on West Dam	9, 10, 12	Limited growth noted along till and CCFR downstream slopes.
3.7 Other Unusual Conditions			
4.0 DOWNSTREAM TOE AREA		4, 8, 9	
4.1 Seepage from Dam	Yes, below West and Main dams	8	West Dam ■ Persistent seepage from till bench above Fording River diversion channel below West Dam south of Sta. 0+700. ■ Ponding in ditch along downstream toe at the north (between Sta. 0+200 and 0+400) and south (south of Sta. 1+000) ends of West Dam CR shell.
4.2 Signs of Erosion	Yes		Minor sloughing of organic topsoil in area around West seepage collection pipes
4.3 Signs of Turbidity in Seepage Water	None		
4.4 Discoloration/Staining	Yes (green, red), below West Dam	8, 9	Green and red mineral deposits and minor areas with red staining in seepage face at bedrock contact in Fording River diversion channel cut below West Dam.
4.5 Outlet Operating Problem (if applicable)	n/a		
4.6 Other Unusual Conditions	n/a		
5.0 ABUTMENTS		14	
5.1 Seepage at Contact Zone (abutment/embankment)	None		
5.2 Signs of Erosion	None		
5.3 Excessive Vegetation	None		
5.4 Presence of Rodent Burrows	None		

Inspection Item	Observations/Data	Photo	Comments & Other Data
5.5 Other Unusual Conditions	Yes		■ Gas pipeline in north abutment area did not allow abutment section of dam to tie into interim berm built. ■ Till berm constructed near north abutment in 2017 remains in good condition. ■ Gas pipeline in south abutment was grouted in June 2020 and capped.
6.0 RESERVOIR		1, 2	
6.1 Stability of Slopes	Stable		■ Railway embankment on east side of impoundment has a buttress berm and tailings beach upstream. ■ Small natural ground slope present north of the railway embankment on east side of reservoir (low potential for slide generation).
6.2 Distance to Nearest Slide (if applicable)	Rail embankment adjacent to impoundment		■ Slide from adjacent slopes would impact tailings beach.
6.3 Estimate of Slide Volume (if applicable)	Minor		■ Potential slide volume from railway embankment or small slope estimated to be small.
6.4 Floating Debris	None		
6.5 Other Unusual Conditions	Yes		■ Tailings at the north end of the facility have been graded. Vegetation growth noted on flat tailings surface. ■ Tailings being dredged to Turnbull TSF from April to October 2020. ■ Waste water cells in operation near the north abutment.
7.0 EMERGENCY SPILLWAY/ OUTLET STRUCTURE			No spillway or emergency outlet. Detailed design of emergency spillway completed (Golder 2020e)
7.1 Surface Condition	n/a		
7.2 Signs of Erosion	n/a		
7.3 Signs of Movement (Deformation)	n/a		

Inspection Item	Observations/Data	Photo	Comments & Other Data
7.4 Cracks	n/a		
7.5 Settlement	n/a		
7.6 Presence of Debris or Blockage	n/a		
7.7 Closure Mechanism Operational	n/a		
7.8 Slope Protection	n/a		
7.9 Instability of Side Slopes	n/a		
7.10 Other Unusual Conditions	n/a		
8.0 INSTRUMENTATION			
8.1 Piezometers	Yes		West Dam: ■ 2 standpipes (not read). ■ 2 retrofit standpipes with vibrating wire. ■ 4 VW piezometers. Main Dam: ■ 1 standpipe (not read). ■ 2 retrofit standpipes with vibrating wire. ■ 5 VW piezometers. In tailings: ■ 2 VW piezometers. Locations shown in plan in Figure 3 of the DSI report.
8.2 Settlement Cells	None		
8.3 Thermistors	None		
8.4 Settlement Monuments	Yes		GPS units monitor crest and toe movements – see Appendix E of the DSI report. Locations shown in plan in Figure 3 of the DSI report.
8.5 Accelerograph	None		
8.6 Inclinometer	Yes		West Dam ■ 1 location. Main Dam ■ 3 locations. See Appendix F of the DSI report. Locations shown in plan in Figure 3 of the DSI report.

Inspection Item	Observations/Data	Photo	Comments & Other Data
8.7 Weirs and Flow Monitors	Yes	8	Below West Dam, seepage flow monitoring from collection pipes, north seepage area culverts, and ditch at south end of West Dam see Section 5.4.1.1 of the DSI report.
8.8 Data Logger(s)	Yes		On piezometers and GPS units, all instrumentation connected to GeoExplorer system.
8.9 Other	Water level sensor, staff gauge, and camera		A sensor and staff gauge are mounted on the reclaim barge. A camera was installed in August 2020 to view the STP West Dam and Fording River for real-time visual monitoring.
9.0 DOCUMENTATION			
9.1 Operation, Maintenance and Surveillance (OMS) Manual 9.1.1 OMS Manual Exists	FRO Tailings Facility OMS Manual Yes		
9.1.2 OMS Plan Reflects Current Dam Conditions	Yes		
9.1.3 Date of Last Revision	25 May 2020		Version 2020.04
9.2 Emergency Response Plan (ERP) 9.2.1 ERP Exists	ERP: Internal to Teck Yes		STP included in site tailings facilities ERP. (SP&P EP.009.R1)
9.2.2 ERP Reflects Current Conditions	Yes		
9.2.3 Date of Last Revision	25 May 2020		Version R1
9.3 Emergency Preparedness Plan (EPP) 9.3.1 EPP Exists	EPP: External to Teck Yes		STP included in site tailings pond dam breach EPP. (SP&P EP.008.R2)
9.2.2 ERP Reflects Current Conditions	Yes		
9.2.3 Date of Last Revision	25 May 2020		Version R2
10. NOTES ■ The north abutment construction has been on hold since 2013 due to gas main pipeline; interim berm in place until gas main relocated or north abutment redesigned. ■ The tailings pipeline at the discharge location at the north abutment was extended by 300 m between July and August 2020.			
Inspectors:	John Cunning, P.Eng.	**Date:**	18 and 19 August 2020

APPENDIX C

North Tailings Pond Inspection Report

Client:	**Teck Coal Limited, Fording River Operations**	**By:**	**John Cunning, P.Eng.**
Project:	**20136981 FRO Tailings Facilities 2020 Annual Dam Safety Inspection**	**Date:**	**19 August 2020**
Location:	**North Tailings Pond**	**Reviewed:**	**Clara Lee, P.Eng.**

GENERAL INFORMATION			
Dam Type:	Zoned Earth Fill		
Weather Conditions:	Sunny	**Temp:**	25°C

Inspection Item	Observations/Data	Photo	Comments & Other Data
1.0 DAM CREST		19, 20, 23, 25, 27, 28	
1.1 Crest Elevation	Elev. 1,652.60 m (minimum) conformed with 2020 LiDAR survey		
1.2 Reservoir Level/ Freeboard	Elev. 1,650.3 m (3 September 2020) 2.3 m freeboard		High water level in spring, required pumping to STP Staff gauge added in pond, and camera installed to allow view of dam at south abutment including staff gauge
1.3 Distance to Tailings Pond (if applicable)	**Full beach** Approx. Sta. 0+000 to 1+100 **0 m (south end)** Approx. Sta. 1+100 to 1+400	27 18	Usually no beach at south end.
1.4 Surface Cracking	None		
1.5 Unexpected Settlement	None		
1.6 Lateral Movement	None		

Inspection Item	Observations/Data	Photo	Comments & Other Data
1.7 Other Unusual Conditions	Yes	20 25 (Site 4)	Dam crest at Sta. 1+410 was disturbed/uneven as a result of installation of pipeline. This area was regraded in September 2020. Abandoned pipes crossings under the crest all observed to be closed on upstream at time of inspection: ■ Site 1: old tailings delivery pipe at former bridge abutment – capped. ■ Site 2: dual steel pipes – capped. ■ Site 3: steel pipe valve closed on upstream, leading to pipe in culvert on downstream face. ■ Site 4: black shallow PVC pipes only observed on downstream face.
2.0 UPSTREAM SLOPE		18, 19, 27	
2.1 Slope Angle	1.4H to 1.5H:1V		
2.2 Signs of Erosion	Minor surficial erosion		
2.3 Signs of Movement (Deformation)	None		
2.4 Cracks	None		
2.5 Face Liner Condition (if applicable)	n/a		
2.6 Other Unusual Conditions	Yes	19	■ Unused reclaim pipes near barge. ■ Small trees and vegetation growth.
3.0 DOWNSTREAM SLOPE		22, 24, 25, 26, 28	
3.1 Slope Angle	1.4 to 1.75 H:1 V		Original design of 1.4 H:1 V; rebuilt design of 1.5 to 1.75H:1 V following 2013 flood repairs.
3.2 Signs of Erosion	Minor surficial erosion, not a stability concern		■ Areas of new minor new erosion noted on downstream slope ■ Minor stepped erosion throughout downstream slope.

Inspection Item	Observations/Data	Photo	Comments & Other Data
3.3 Signs of Movement (Deformation)	None		
3.4 Cracks	None		
3.5 Seepage or Wet Areas	Dry		
3.6 Vegetation Growth	Variable	22, 24, 25, 26, 28	Good grass growth along most areas of the downstream slope.
3.7 Other Unusual Conditions	Yes	22, 26	Vertical culvert and abandoned pipes on downstream slope.
4.0 DOWNSTREAM TOE AREA		21, 22	
4.1 Seepage from Dam	None		
4.2 Signs of Erosion	No		Riprap placed to protect from Fording River erosion, in good condition.
4.3 Signs of Turbidity in Seepage Water	None		
4.4 Discoloration/Staining	None		
4.5 Outlet Operating Problem (if applicable)	n/a		
4.6 Other Unusual Conditions	Ponded water at downstream toe near Sta. 1+200	21	Fill and re-grade toe at Sta. 1+200 to divert water away from dam toe. Small area of the downstream dam toe was excavated for a monitoring well installation program in 2019 and should be backfilled.
5.0 ABUTMENTS			
5.1 Seepage at Contact Zone (Abutment/Embankment)	None		
5.2 Signs of Erosion	Minor		
5.3 Excessive Vegetation	None		
5.4 Presence of Rodent Burrows	Yes		
5.5 Other Unusual Conditions	Yes		Surface runoff from haul road reports to north end of tailings beach. Re-graded in spring 2020 to direct runoff into NTP area

Inspection Item	Observations/Data	Photo	Comments & Other Data
6.0 RESERVOIR		18	
6.1 Stability of Slopes			Spoils resloped in March 2015. Ongoing erosion noted
6.2 Distance to Nearest Slide (if applicable)	n/a		
6.3 Estimate of Slide Volume (if applicable)	n/a		
6.4 Floating Debris	None		
6.5 Other Unusual Conditions	Yes	19 27	■ Barge is crooked from being stuck in tailings, barge not in use. ■ Silt fences installed on tailings surface for dust control.
7.0 EMERGENCY SPILLWAY/ OUTLET STRUCTURE			No spillway or emergency outlet.
7.1 Surface Condition	n/a		
7.2 Signs of Erosion	n/a		
7.3 Signs of Movement (Deformation)	n/a		
7.4 Cracks	n/a		
7.5 Settlement	n/a		
7.6 Presence of Debris or Blockage	n/a		
7.7 Closure Mechanism Operational	n/a		
7.8 Slope Protection	n/a		
7.9 Instability of Side Slopes	n/a		
7.10 Other Unusual Conditions	n/a		

Inspection Item	Observations/Data	Photo	Comments & Other Data
8.0 INSTRUMENTATION			
8.1 Piezometers	Yes		■ Piezometers installed in three vertical boreholes drilled on dam crest in 2015. ■ Seven piezometers installed in tailings in 2017 to support closure studies. ■ See Section 5.5 of the DSI report for details of the instrumentation. Locations shown in plan in Figure 7 of the DSI report.
8.2 Settlement Cells	None		
8.3 Thermistors	None		
8.4 Settlement Monuments	Yes		GPS units monitor crest and toe movements – see Appendix E of the DSI report. Locations shown in plan in Figure 7 of the DSI report.
8.5 Accelerograph	None		
8.6 Inclinometer	Yes		Three inclinometers installed in 2015. See Appendix F of the DSI report. Locations shown in plan in Figure 7 of the DSI report.
8.7 Weirs and Flow Monitors	None		
8.8 Data Logger(s)	Yes		On piezometers and GPS, all instrumentation connected to GeoExplorer system.
8.9 Other	Water level monitor		Piezometer has been placed in ponded water to read water level in the pond.

Inspection Item	Observations/Data	Photo	Comments & Other Data
9.0 DOCUMENTATION			
9.1 Operation, Maintenance and Surveillance (OMS) Manual 9.1.1 OMS Manual Exists	FRO Tailings Facility OMS Manual Yes		
9.1.2 OMS Plan Reflects Current Dam Conditions	Yes		
9.1.3 Date of Last Revision	25 May 2020		Version 2020.04
9.2 Emergency Response Plan (ERP) 9.2.1 ERP Exists	ERP: Internal to Teck Yes		NTP included in site tailings facilities ERP (SP&P EP.009.R1).
9.2.2 ERP Reflects Current Conditions	Yes		
9.2.3 Date of Last Revision	25 May 2020		Version R1
9.3 Emergency Preparedness Plan (EPP) 9.3.1 EPP Exists	EPP: External to Teck Yes		NTP included in site tailings pond dam breach EPP (SP&P EP.008.R2).
9.2.2 ERP Reflects Current Conditions	Yes		
9.2.3 Date of Last Revision	25 May 2020		Version R2
10. NOTES ■ Currently, there is no active deposition of tailings into the NTP. The barge is not being operated and pipes are not connected. ■ The NTP facility remains inactive and its future use is under review by FRO.			
Inspectors:	John Cunning, P.Eng.	**Date:**	18 and 19 August 2020

APPENDIX D

Summary of FRO Dam Inspection Action Items

Inspected By: Natasha Carriere

Inspection Date: Sept 10-12 2019

Weather & Temperature: 11°C Cloudy

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
	n/a		

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: Clara Lee

Inspection Date: Sept 20, 2019

Weather & Temperature: Sunny, 15°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
Downstream slope of West Dam and Main Dam	Continue monitoring erosion gullies. Schedule repair of gullies before winter 2019 if possible.	4	Before winter / freeze-up 2019

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Inspected By: Natasha Carriere

Inspection Date: 24 Sept 2019

Weather & Temperature: 10°C Cloudy

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
Main Dam & West Dam downstream slopes	Continue to monitor erosion gullies, repair if needed	4	Ongoing

Inspected By: PATRICK LEA / NATASHA CARRIERE / ROBYN GAEBEL
Inspection Date: OCT 2 and OCT 3, 2019
Weather & Temperature: Overcast 5 - 15°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA

Inspection Date: 10 OCTOBER 2019

Weather & Temperature: -10°C to -5°C, Overcast w/Sunny Breaks

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment Existing gully/ Dredge rockbox	Dredge pipeline rockbox had been discharged into existing washout gullys increasing erosion. - contractor notified & will stop practice and ensure no addition material is discharged at location.	3	Completed.
SA, MD, WD	Erosion gullies, continue to monitor. Repair U/S gullies on South Abutment before winter 19/20	4	Repair U/S gullies prior to winter 19/20
South Abutment	Dredge anchor cable rubbing on top of berm ontop of crest. Opevator notified and corrective action taken.	3	completed
WD	Piezometer VW-4(2) giving intermittent readings. Additional troubleshooting required.	4	Repair by OCT 21

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA

Inspection Date: 16 - OCT - 2019

Weather & Temperature: Sunny 0°c - 5°c

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
SA, MD, WD	Erosion gullies, continue to monitor Get repaired before winter 19/20	4	Before winter 19/20
WD	SP-5 & VW4-(2) Intermittent readings SP-5 → Replace Battery VW4-(2) → Replace datalogger - Sourcing	4	Nov 2019.

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: Patrick Lea

Inspection Date: 21-OCT-2019

Weather & Temperature: Overcast, 0°C to 5°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment	SEE Note 4: Dredging contractor discharged rockbox on existing erosion gully. Discussed with contractor and they are placing protection w/ Plywood. To ~~inspect tomorrow~~ Thursday. To be repaired ASAP.	P4	21-OCT-2019.
West DAM	SEE NOTE 5: VW-4(2) reporting periodic readings. Datalogger to be replaced, sourcing datalogger	4	NOV 2019
WD} MD	Erosion gullies, continue to monitor, repair if required	4	ongoing.
Tailing Pipeline	NLP pipeline from NLP to STP leaking in multiple locations into pipeline ditch. leak to be repaired by Pump crew.	4	completed.

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA

Inspection Date: 31-OCT-2019

Weather & Temperature: -5°C, Overcast w/ Sunny breaks

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South abutment	Erosion gully enlarged by dredge rock box, Dredging ceased for yr. To be repaired before winter 19/20	P4	Before winter 19/20
WD & MD	Erosion gullies, continue to monitor	P4	ongoing.
West Dam	See note: 8 VW-4(2) replacement datalogger not reporting to geoexplorer, currently being fixed	P4	Nov 8

Inspected By: PATRICK LEA

Inspection Date: 6 Nov 2019 & 7 Nov 2019

Weather & Temperature: -19°c to -5°c, Sunny

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
STP	VW-4(2) not reporting to GeoExplorer. see Note 6, to be fixed by FRO Inst Technician. Data to be manually collected & reviewed	P4	Nov 13

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA

Inspection Date: 19 - NOV - 2019

Weather & Temperature: 0°C, Overcast, light Snow

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
MD, WD, SA	Erosion gullies, continue to monitor. Gullies located on U/S South Abutment to be repaired before winter 2019	P4	Before Winter 2019
West Dam	VW-4(2) still not reporting to GeoExplorer Data manually downloaded & checked, no issue. Waiting on RST for fix	P4	Dec 1, 2019

Fording River Operations

Monthly Tailings Dam Inspection Form

Teck

Inspected By: PATRICK LEA

Inspection Date: Dec 3, 4, 5 2019

Weather & Temperature: 0°C, overcast on Dec 3 & 4 to 5°C sunny on Dec 5

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
STP South Abutment	Upstream Erosion Gully repair work - delayed until Spring 2020 To continue to monitor	P4	Spring 2020
STP Main Dam	VW-4(2) Piezometer not reporting live data to GeoExplorer due to technical issue w/Hub. To continue to manually collect / Review data Monthly	P4	Ongoing

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA / Robyn Gaeble

Inspection Date: 19 Dec 2019

Weather & Temperature: -3°C, Sunny

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment MD & ND	U/S & D/S Erosion gullies, will not be Fixed until spring 2020. Continue to monitor	P4	Ongoing
WD	Seepage noted on lower rd ~~cut~~ location where WD & MD meet. To be inspected on Dec 24.	P4	Dec 24

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA & Robyn Gaebel

Inspection Date: 2 Jan 2020

Weather & Temperature: Sunny, -4°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
Toe MD	Wet spot in low point by the seepage return wells. Monitor during inspections	P4	Ongoing.
South Abutment MD and WD	U/S & D/S erosion gullies. Continue to monitor. To be repaired spring/summer 2020	P4	Ongoing.

Inspected By: PATRICK LEA

Inspection Date: JAN 14 - 15 2020

Weather & Temperature: -20°C → -15°C, Overcast

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
STP South Abutment	Upstream erosion gullies repair, delayed to spring 2020. Continue to monitor	P4	Spring 2020.

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA

Inspection Date: 27 - JAN - 2020

Weather & Temperature: +5, Sunny

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
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4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment MD, WD	D/S & U/S erosion gullies, see note 1 and 2 Continue to monitor D/S gullies Repair U/S erosion gullies in Q2 2020	P4	Ongoing.

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA

Inspection Date: 6 FEB 2020

Weather & Temperature: -12°C, SUNNY

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
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Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment MD & WD	U/S & D/S erosion gullies. Continue to monitor. Fix U/S erosion gullies in Q2 2020	P4	Q2 2020

Inspected By: PATRICK LEA

Inspection Date: 19-FEB-2020, NTP inspected 25-Feb-2020

Weather & Temperature: Sunny (-15°C)-(-5°C), NTP: Sunny, -3°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
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3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
STP South Abutment	Upstream erosion gullies repair delayed until spring 2020. To continue to monitor	P4	Q2 2020

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA

Inspection Date: 5 March 2020

Weather & Temperature: Sunny, -15°C to -10°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
STP South Abutment	Upstream erosion gullies repair delayed until spring 2020. To continue to monitor	P4	Q2
STP West Dam	Piezometer THIS-02 (1), (2) & (3) reporting latent alarm. Troubleshooting requested for datalogger	P4	April 1, 2020

Inspected By: Patrick Lea & Robyn Gaebel
Inspection Date: March 16 - 18
Weather & Temperature: Sunny, -10°C to +3°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
NTP	NTP Water Elevation sensor damaged by ice, ↳To be repaired when ice has melted on the pond. -staff gauge or survey to be used for Pond elevation	P4	Before May 1

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA & Robyn Gaebel

Inspection Date: 17 - MARCH - 2020

Weather & Temperature: +3°C, Sunny

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
All	Increase in size in existing D/S erosion gullies and new minor D/S erosion gullies due to runoff. Continue to closely monitor.	P4	Ongoing.
STP South Abutment	U/S erosion gullies repair work delayed until spring 2020. Continue to monitor	P4	Q2
STP West Dam	VW Piezometer THIS-02 (1), (2) & (3) reporting latent alarm. Being repaired by Instrumentation Technician	P4	April 1/2020

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA

Inspection Date: 30 March 2020

Weather & Temperature: Snowing, 0°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment	Up stream erosion gullies repair work delayed. To continue to monitor. work to be completed in Q2 2020.	P4	Q2 2020
All	Down stream erosion gullies due to spring runoff Continue to monitor.	P4	Ongoing
West Dam	VW Piezometer TH15-02 (1), (2) & (3), issues with datalogger communication. will download manual data until replaced. Datalogger to be replaced.	P4	April 22/2020

Inspected By: PATRICK LEA

Inspection Date: April 15 & 16, 2020

Weather & Temperature: -5°C, Sunny with Cloudy/Snow Periods

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
STP	THIS-02 Datalogger not reporting to GeoExplorer ↳ Datalogger replaced ↳ Datalogger to be connected to GeoExplorer next week	P4	April 24/2020

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: Patrick Lea

Inspection Date: April 21, 2020

Weather & Temperature: Sunny, 5°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment	U/S erosion gullies inspected and additional minor erosion caused by dredging operations. - Additional protection to be installed	P4	April 29/20
South Abutment	- U/S erosion gullies - To be repaired by June 2020	P4	June 2020

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: R. GAETZEL

Inspection Date: 29 APR 2020

Weather & Temperature: SUNNY +10°C (TRANSITIONED TO RAIN)

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
SOUTH ABUTMENT	U/S EROSION GULLIES TO BE REPAIRED BY JUNE 2020	P4	JUNE 2020
MAIN & WEST DAM	D/S EROSION GULLIES CONTINUE TO MONITOR REPAIR AS PART OF DAM MAINTENANCE	P3	JUNE ~~NOV~~ 2020

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: R. GAEBEL

Inspection Date: 6 MAY 2020

Weather & Temperature: SUNNY + 3°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
SOUTH ABUTMENT	U/S EROSION GULLIES TO BE REPAIRED	P4	JUNE 2020
MAIN & WEST DAM	D/S EROSION GULLIES CONTINUE TO MONITOR REPAIR AS PART OF DAM MAINTENANCE	P3	JUNE 2020

Inspected By: PATRICK LEA

Inspection Date: 13/14 MAY 2020

Weather & Temperature: 0°C, Cloudy w/ Sunny Breaks.

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment	U/S erosion gullies, To be repaired June 2020 continue to monitor.	P4	June 2020
MD, WD	D/S erosion gullies, continue to monitor	P4	ongoing

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA

Inspection Date: 20 MAY 2020

Weather & Temperature: Overcast, 8°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment	Upstream erosion gullies - Continue to monitor. - To be repaired during Spillway Construction	P4	Summer/ July 2020

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA

Inspection Date: 25 MAY 2020

Weather & Temperature: 8°C, Overcast

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment	Upstream Erosion Gullies - To cont. to monitor - To be repaired during Spillway Construction	P4	Summer 2020

Inspected By: Robyn Gaebel
Inspection Date: June 1 2020
Weather & Temperature: Sunny, ~12°C

ACTION ITEMS * SPECIAL EVENT DRIVEN * DUE TO FLOOD WATCH (LEVEL 3) - DAILY INSPECTION

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
—	—	—	—

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: Robyn Gaebel

Inspection Date: June 1 2020

Weather & Temperature: Sunny 12°C

SPECIAL EVENT DRIVEN DUE TO FLOOD WATCH (LEVEL 3) - DAILY INSPECTION

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment	Upstream Erosion Gullies - continue to monitor - repair during Spillway Construction	P4	Summer 2020

Inspected By: Robyn Gaebel
Inspection Date: June 2 2020
Weather & Temperature: Sunny 8°C *EVENT DRIVEN*
& Monthly Inspection. DUE TO FLOOD WATCH (LEVEL 3) DAILY INSPECTION REQUIREMENT

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
Crest	Staff Gauge on angle.	P4	Q3 2020

Inspected By: Robyn Gaebel

Inspection Date: June 3 2020

Weather & Temperature: Sunny 7° C

EVENT DRIVEN due to flood watch (Level 3) Daily Inspection Requirement.

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
—	—	—	—

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: Robyn Graebel

Inspection Date: 3 June 2020

Weather & Temperature: Sunny ~8°C

EVENT DRIVEN due to flood watch (Level 3) Daily Inspection Requirement

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
—	—	—	—

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: Robyn Gaetz

Inspection Date: June 8 2020

Weather & Temperature: Sunny 3°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
Main & West Dams	Erosion Gullies - continue to monitor - repair during Spillway Construction	P4	Summer 2020
—	—		—

Inspected By: PATRICK LEA

Inspection Date: STP: 17-June, NTP/2P-3P/TBS 18-June

Weather & Temperature: 10°C, Sunny

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment	U/S Erosion gullies: ↳ Continue to monitor ↳ To be repaired during spillway construction	P4	Summer 2020
MB, WD	D/S Erosion gullies: ↳ Continue to monitor during weekly inspections	P4	Ongoing.

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: ROBYN GAETZ

Inspection Date: JUNE 28 2020

Weather & Temperature: PARTIAL CLOUD, 12°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
MAIN & WEST DAMS	EROSION GULLIES - CONTINUE TO MONITOR - REPAIR DURING SPILLWAY CONSTRUCTION	PH	SUMMER 2020
—	—	—	—

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA

Inspection Date: 29 June 2020

Weather & Temperature: overcast, scattered showers, 10°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment	U/S Erosion Gullies: ↳ Continue to monitor ↳ To be repaired during spillway construction	P4	Summer 2020
Main Dam West Dam	D/S Erosion Gullies: ↳ Continue to monitor during weekly inspections	P4	Ongoing

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA

Inspection Date: 8 - July - 2020

Weather & Temperature: Overcast, 12°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment	U/S Erosion Gullies: - Continue to monitor - To be repaired during July spillway Const.	P4	July 2020
Main Dam West Dam	D/S Erosion Gullies: - Continue to monitor during weekly inspections	P4	Ongoing

Inspected By: PATRICK LEA

Inspection Date: 15 July 2020

Weather & Temperature: Sunny, 10°C to 20°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment	Upstream Erosion Gullies: - Continue to monitor - To be repaired during spillway construction	P4	August 2020
Main Dam West Dam	Downstream Erosion Gullies - Continue to monitor during weekly inspections	P4	Ongoing

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA

Inspection Date: 20 - ~~JUNE~~ July - 2020

Weather & Temperature: Sunny, 20°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment	U/S erosion gullies: - Continue to monitor - To be repaired during July/Aug spillway construction.	P4	July / Aug 2020
Main Dam West Dam	D/S erosion gullies: - Continue to monitor during weekly inspections.	P4	Ongoing.

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA

Inspection Date: 30-July-2020

Weather & Temperature: 15°C, Sunny

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment	Upstream erosion gullies: - Continue to monitor - To be repaired during spillway construction	P4	Aug 2020
Main Dam West Dam	Down stream erosion gullies: - Continue to monitor during weekly inspections	P4	Ongoing

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA

Inspection Date: 6-August-2020

Weather & Temperature: Overcast, Showers, 15°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment	Upstream erosion gullies: - Continue to monitor - To be repaired during spillway construction	P4	August 2020
Main Dam West Dam	Downstream erosion gullies: - Continue to monitor during weekly inspections	P4	Ongoing

Fording River Operations

Monthly Tailings Dam Inspection Form

Teck

Inspected By: PATRICK LEA

Inspection Date: 10 to 11 August 2020

Weather & Temperature: Sunny, 18°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment	Upstream erosion gullies: - Continue to monitor - To be repaired during spillway construction	P4	August 2020
Main Dam West Dam	Downstream erosion gullies: - Continue to monitor during weekly inspections	P4	Ongoing

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA w/ Robyn Gaebel & John Gunning during 2020 DSI site visit

Inspection Date: 18 & 19 August 2020

Weather & Temperature: Sunny 20°C - 25°C

ACTION ITEMS

Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment	Upstream Erosion gullies: -Continue to monitor -To be repaired during spillway construction	P4	August 2020
Main Dam West Dam	Downstream erosion gullies: -Continue to monitor during weekly inspections	P4	Ongoing

Fording River Operations

STP Dam Inspection Form

Weekly Inspections from May – October, Inspections twice per month from November – April

Teck

Inspected By: PATRICK LEA

Inspection Date: 26 August 2020

Weather & Temperature: 20°C, Sunny

ACTION ITEMS

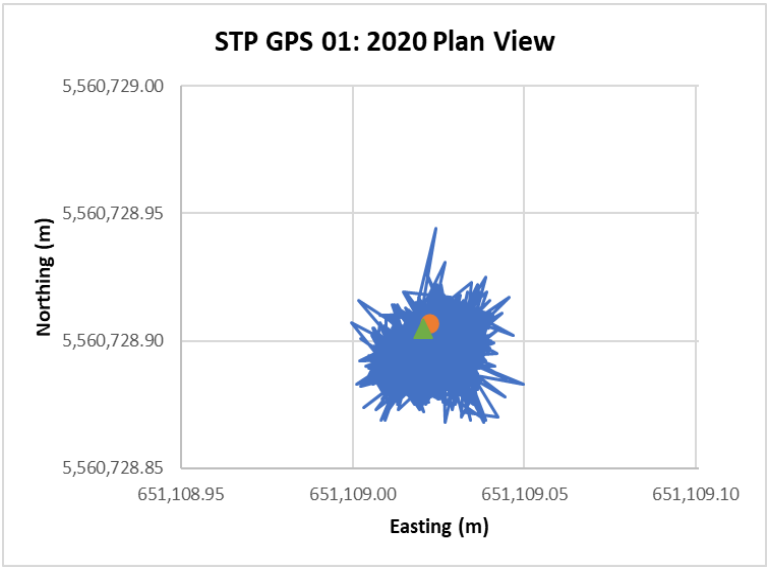
Record any items of concern noted during the inspection; location of each action item shall be marked on the attached facility maps. If required, additional items can be included in the "Additional Comments" section.

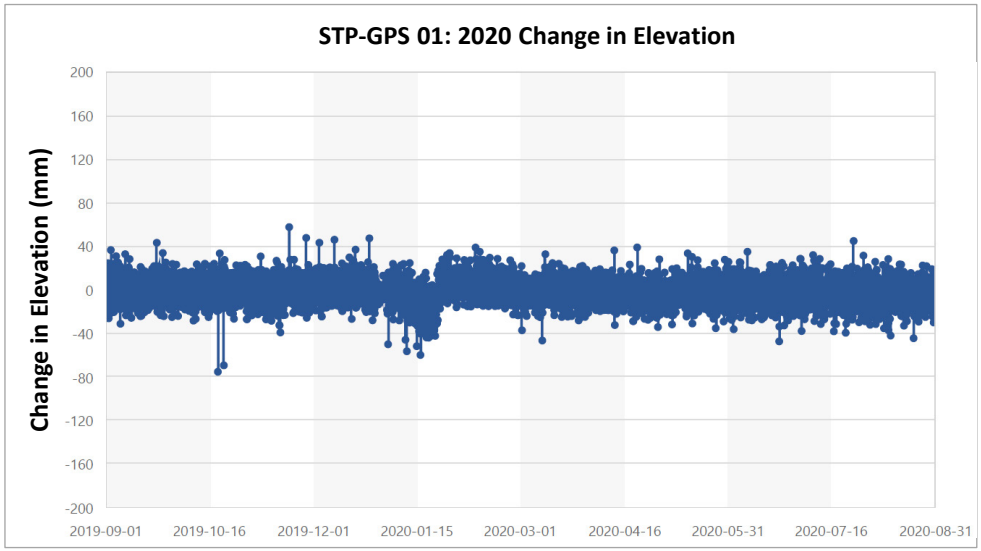
Priority	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

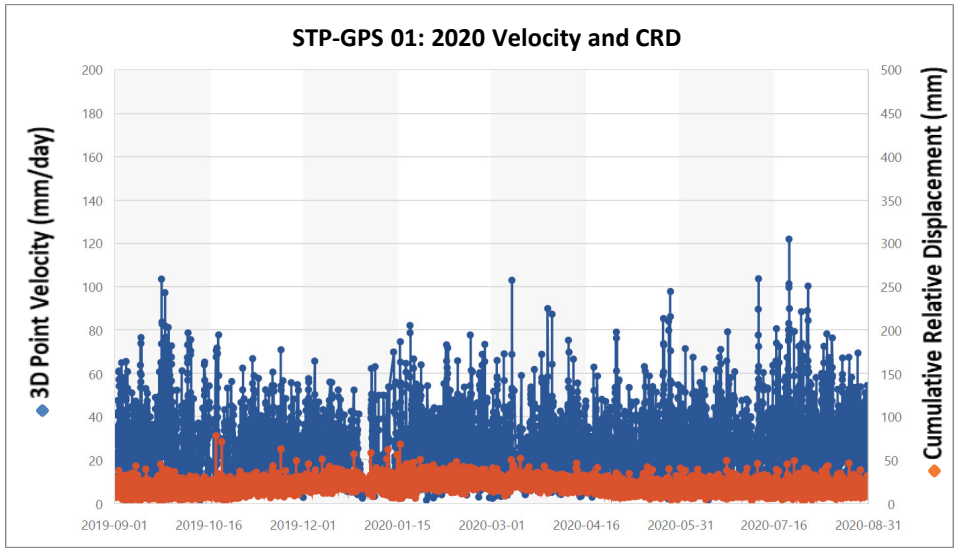
Location	Item Description & Responsibility	Priority	Target Completion Date
South Abutment	Upstream erosion gullies: - Continue to monitor - To be repaired during spillway Construction	P4	August 2020
Main Dam West Dam	Downstream erosion gullies: - Continue to monitor during weekly inspections	P4	Ongoing

APPENDIX E

GPS Plots







LEGEND

- INITIAL READING (SEPTEMBER 2019)
- 2019/2020 READINGS
- LAST READING (AUGUST 2020)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN SEPTEMBER 2020.
2. THIS GPS UNIT WAS REPLACED AND THE BASE STATION SWITCHED IN OCTOBER 2018. CHANGE IN ELEVATION VS. TIME IS PLOTTED FOR COMPARISON WITH DATA OF OLD GPS, WHICH REFERENCED A DIFFERENT BASE STATION.

CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

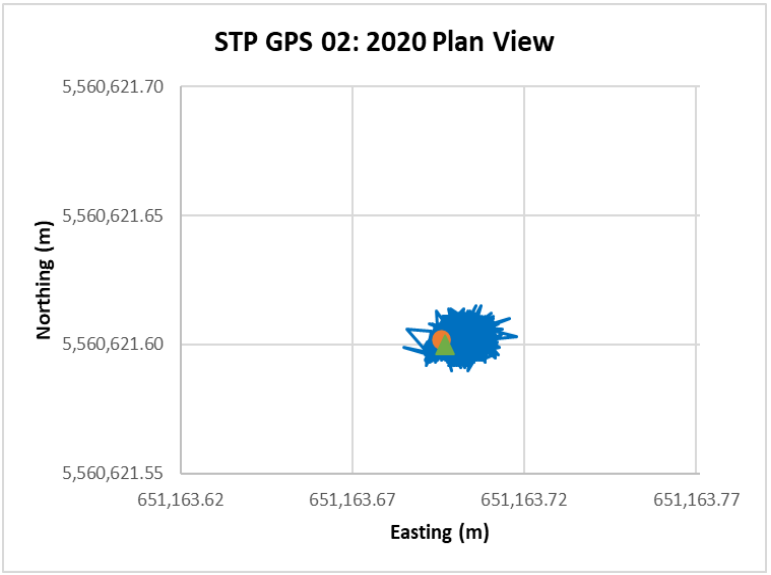
CONSULTANT
GOLDER

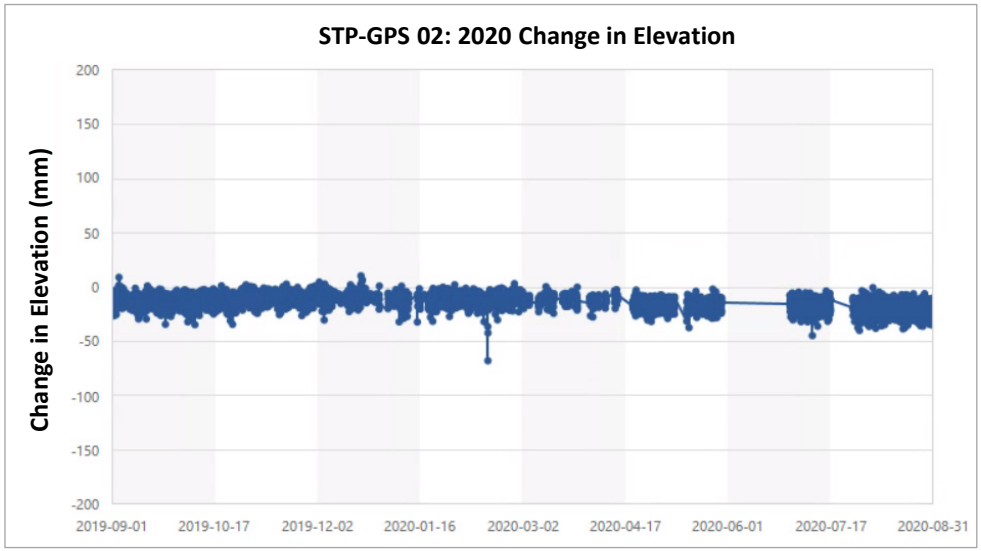
YYYY-MM-DD	2021-03-18
PREPARED	N. CARRIÈRE
DESIGN	N. CARRIÈRE
REVIEW	C. LEE
APPROVED	J. CUNNING

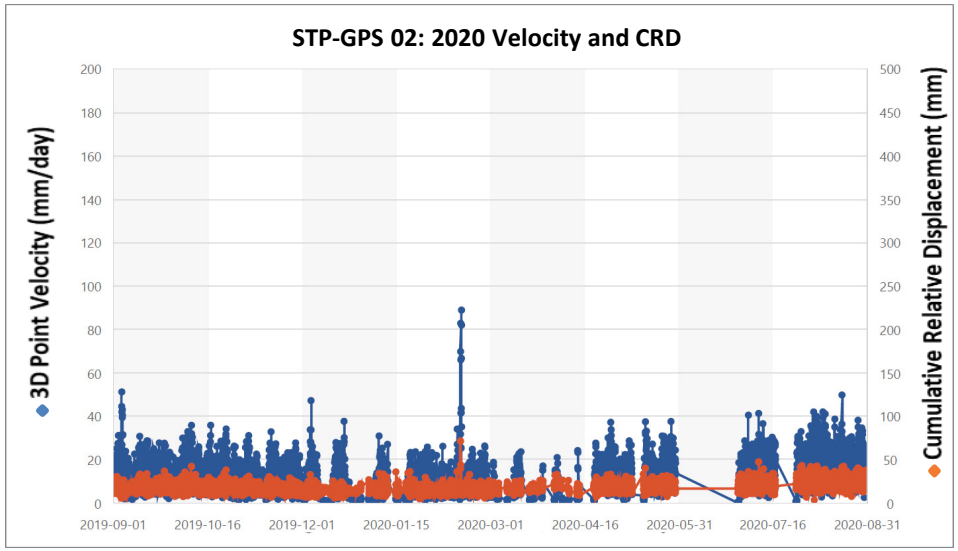
PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND - GPS MONITORING DATA AT STP-GPS 01

PROJECT No.	Phase/Task/Doc.	Rev.	FIGURE
20136981	**2000/2005/2020-219**	**0**	**E-1**







LEGEND

- INITIAL READING (SEPTEMBER 2019)
- 2019/2020 READINGS
- LAST READING (AUGUST 2020)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN SEPTEMBER 2020.
2. DUE TO THE MANNER IN WHICH GPS DATA IS REFERENCED AT FRO, CHANGE IN ELEVATION VS. TIME IS PLOTTED FOR REVIEW.

CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-18
PREPARED	N. CARRIÈRE
DESIGN	N. CARRIÈRE
REVIEW	C. LEE
APPROVED	J. CUNNING

PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND - GPS MONITORING DATA AT STP-GPS 02

PROJECT No.	Phase/Task/Doc.	Rev.	FIGURE
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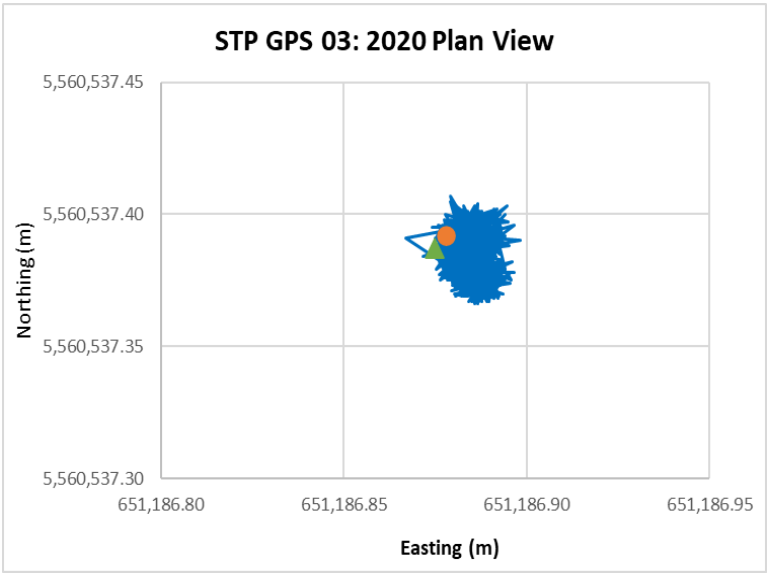
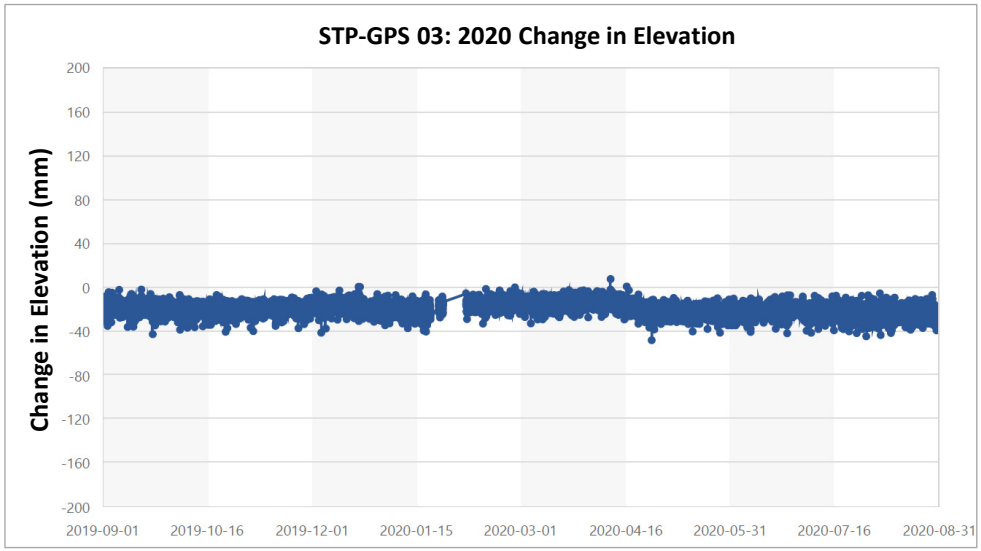
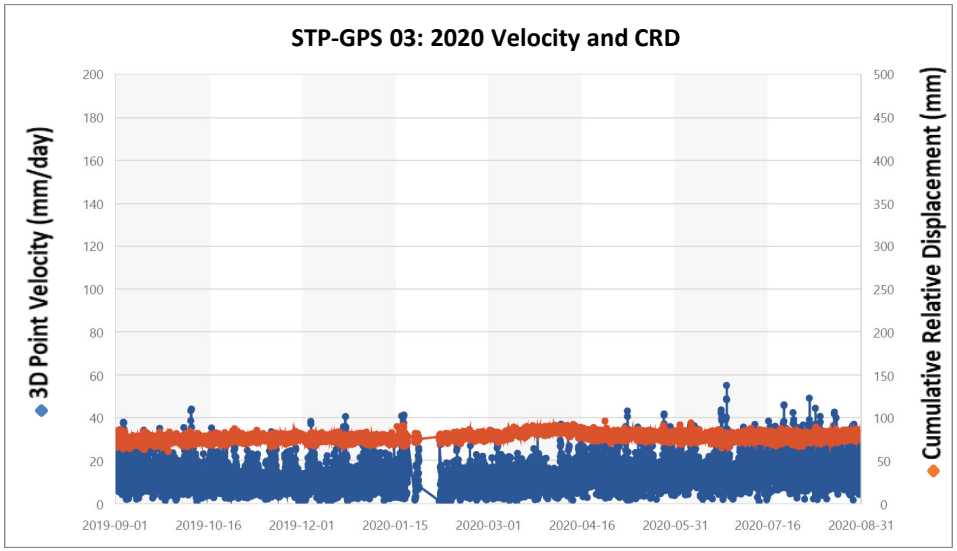






LEGEND

- INITIAL READING (SEPTEMBER 2019)
- 2019/2020 READINGS
- LAST READING (AUGUST 2020)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN SEPTEMBER 2020.
2. DUE TO THE MANNER IN WHICH GPS DATA IS REFERENCED AT FRO, CHANGE IN ELEVATION VS. TIME IS PLOTTED FOR REVIEW.

CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

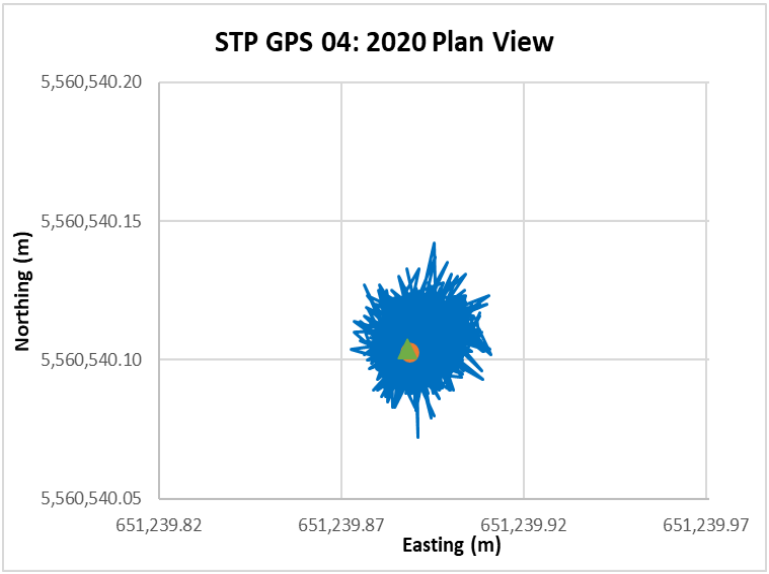
CONSULTANT
GOLDER

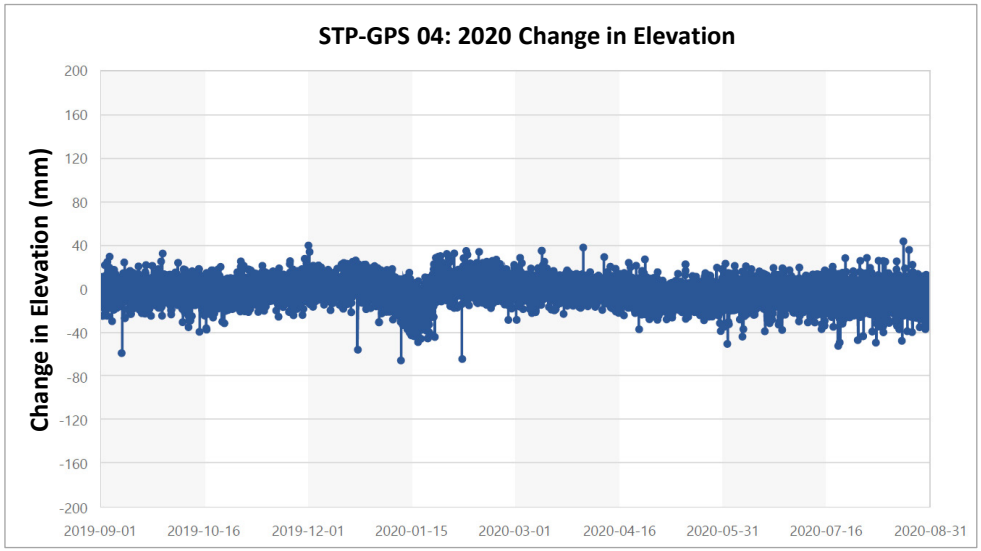
YYYY-MM-DD	2021-03-18
PREPARED	N. CARRIÈRE
DESIGN	N. CARRIÈRE
REVIEW	C. LEE
APPROVED	J. CUNNING

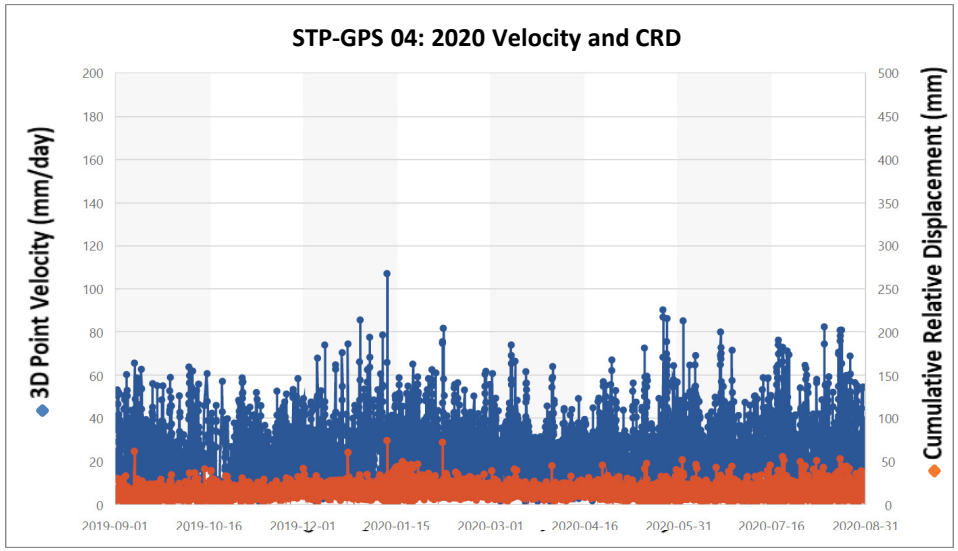
PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND - GPS MONITORING DATA AT STP-GPS 03

PROJECT No.	Phase/Task/Doc.	Rev.	FIGURE
20136981	**2000/2005/2020-219**	**0**	**E-3**







LEGEND

- INITIAL READING (SEPTEMBER 2019)
- 2019/2020 READINGS
- LAST READING (AUGUST 2020)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN SEPTEMBER 2020.
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CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
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CONSULTANT
GOLDER

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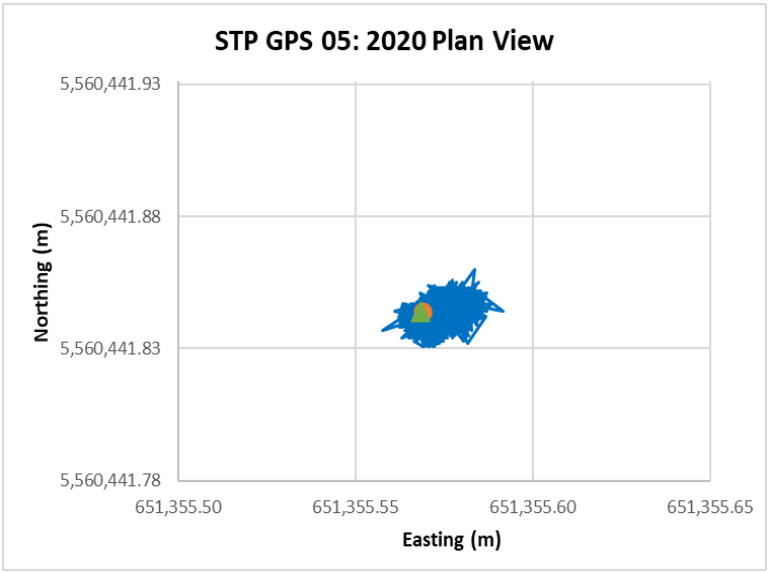
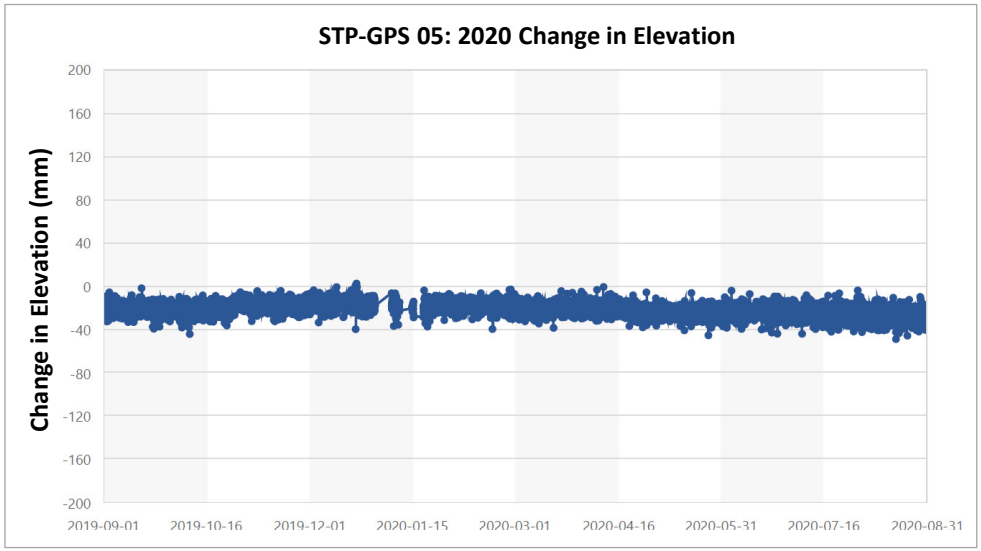
REVIEW	C. LEE
APPROVED	J. CUNNING

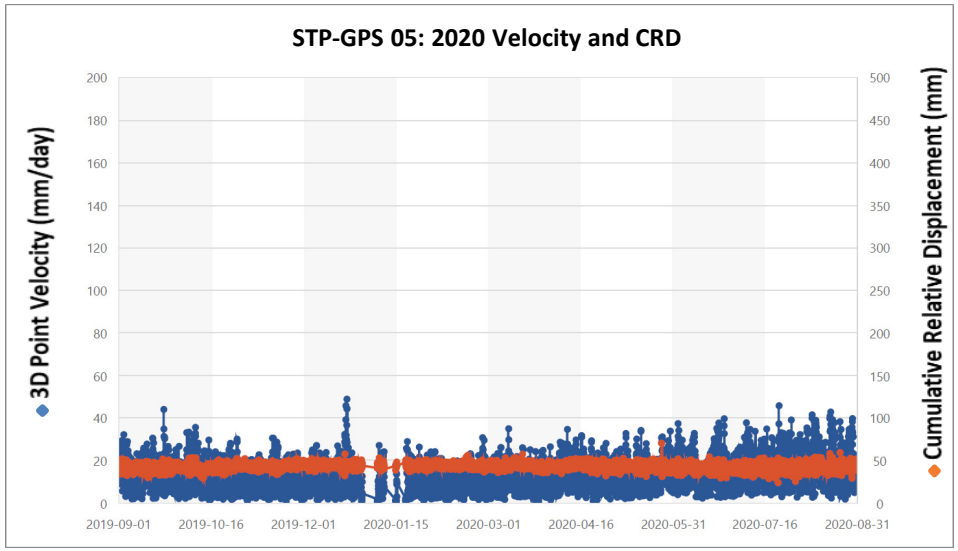
PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND - GPS MONITORING DATA AT STP-GPS 04

PROJECT No.	Phase/Task/Doc.	Rev.	FIGURE
20136981	**2000/2005/2020-219**	**0**	**E-4**







LEGEND

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- LAST READING (AUGUST 2020)

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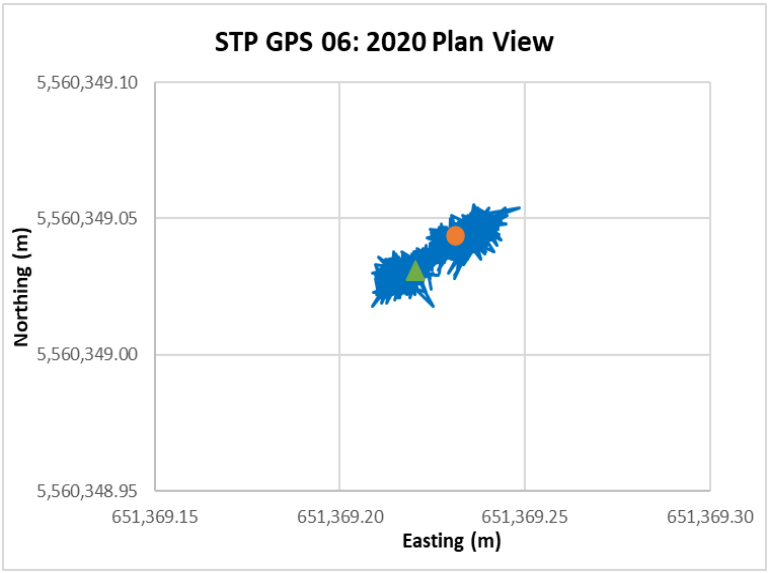
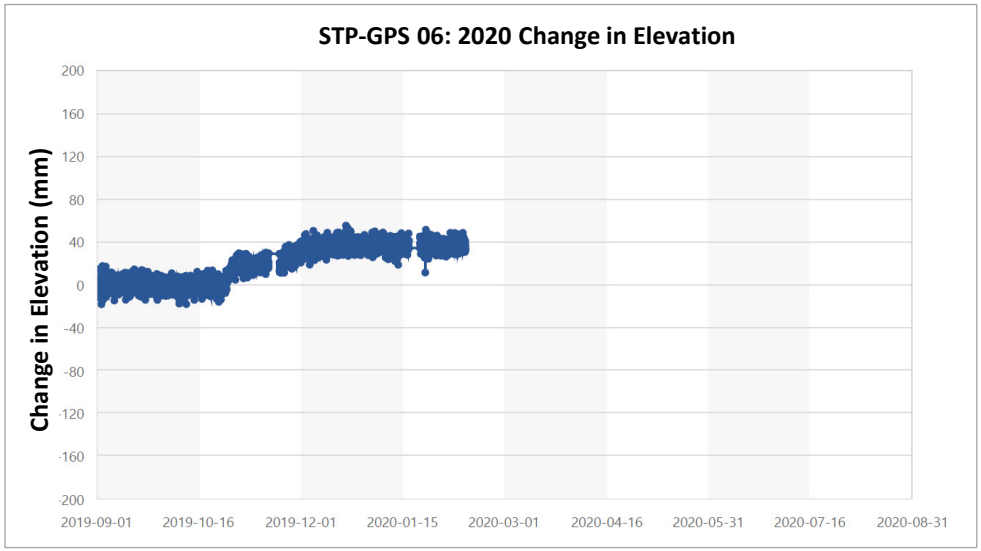
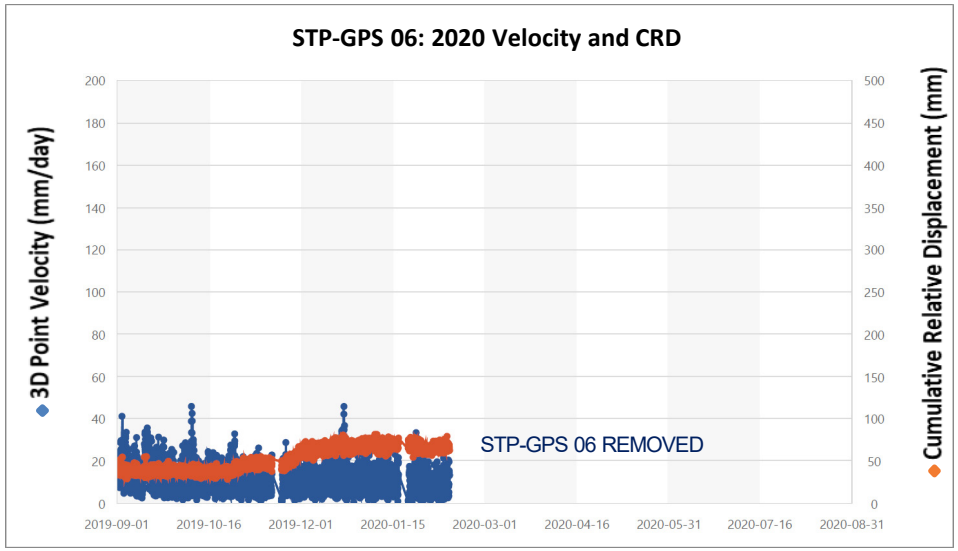
2020 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND - GPS MONITORING DATA AT STP-GPS 05

PROJECT No.	Phase/Task/Doc.	Rev.	FIGURE
20136981	**2000/2005/2020-219**	**0**	**E-5**







LEGEND

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PROJECT
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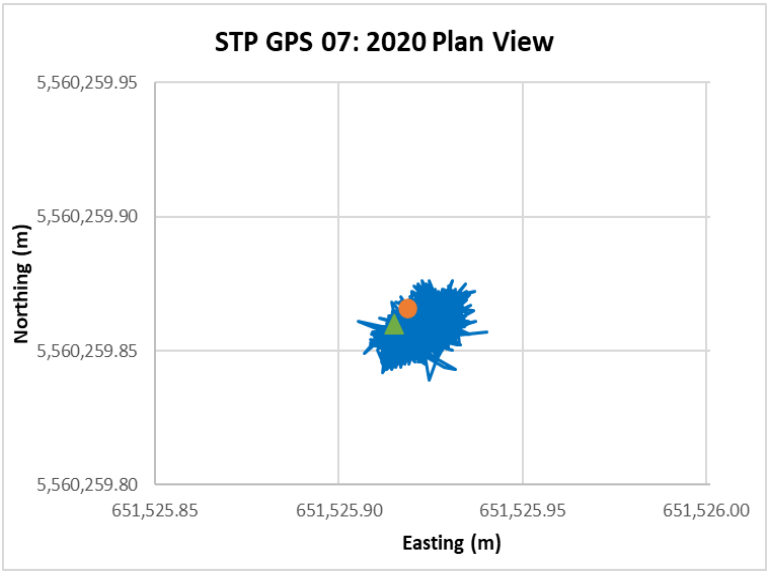
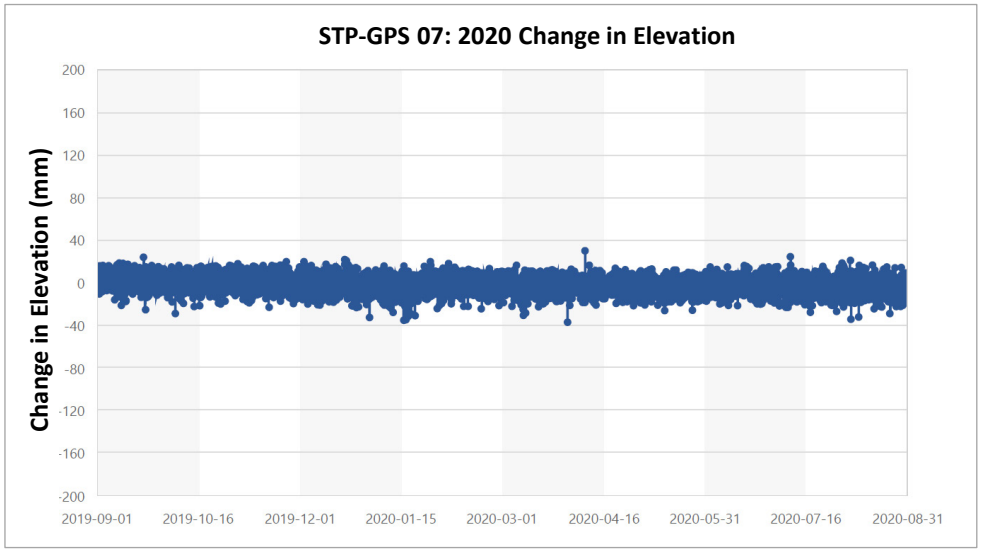
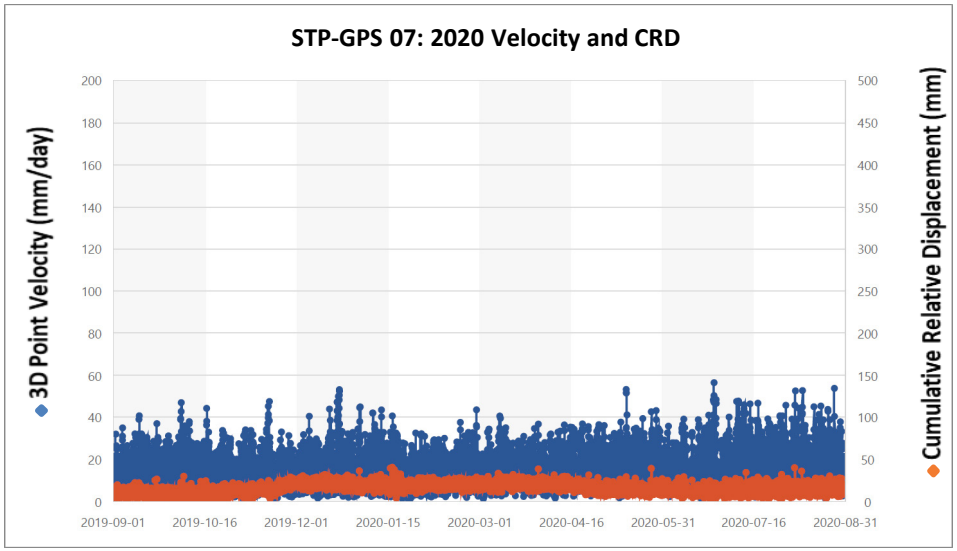
2020 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND - GPS MONITORING DATA AT STP-GPS 06

PROJECT No.	Phase/Task/Doc.	Rev.	FIGURE
20136981	**2000/2005/2020-219**	**0**	**E-6**







LEGEND

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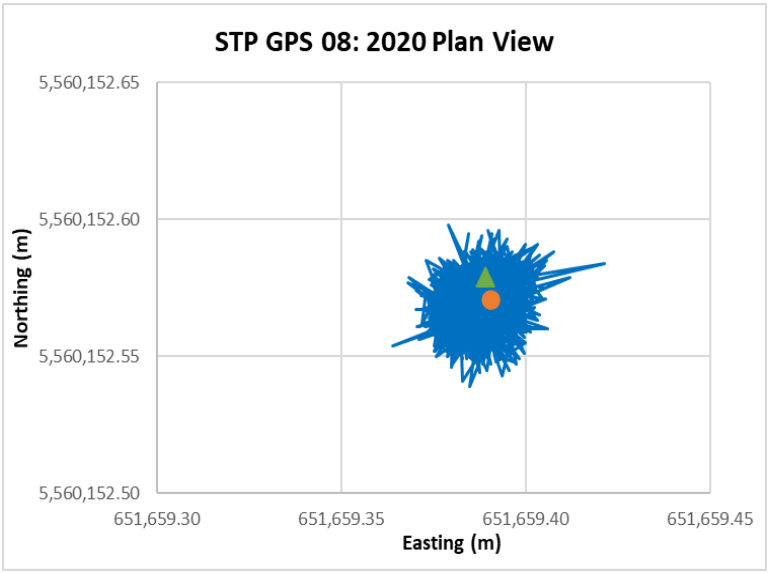
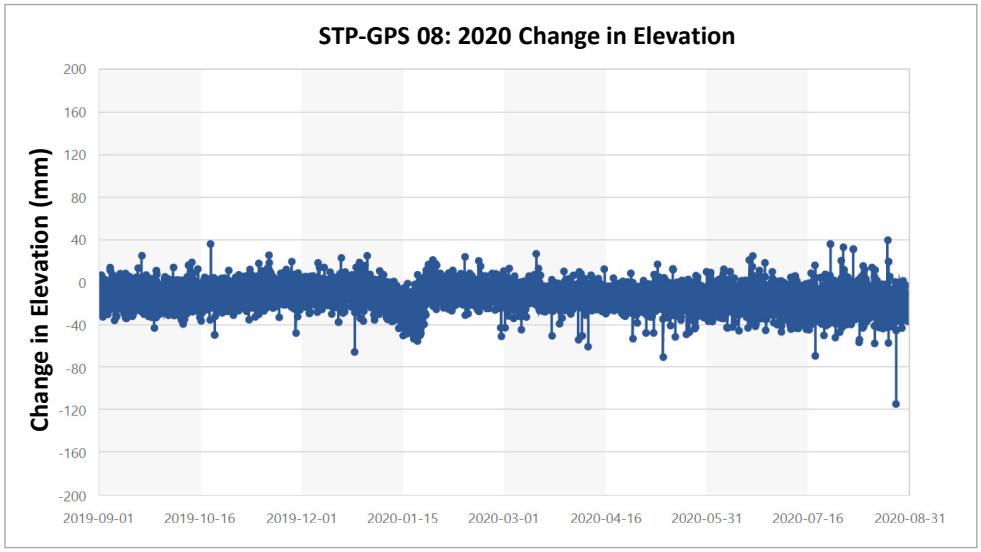
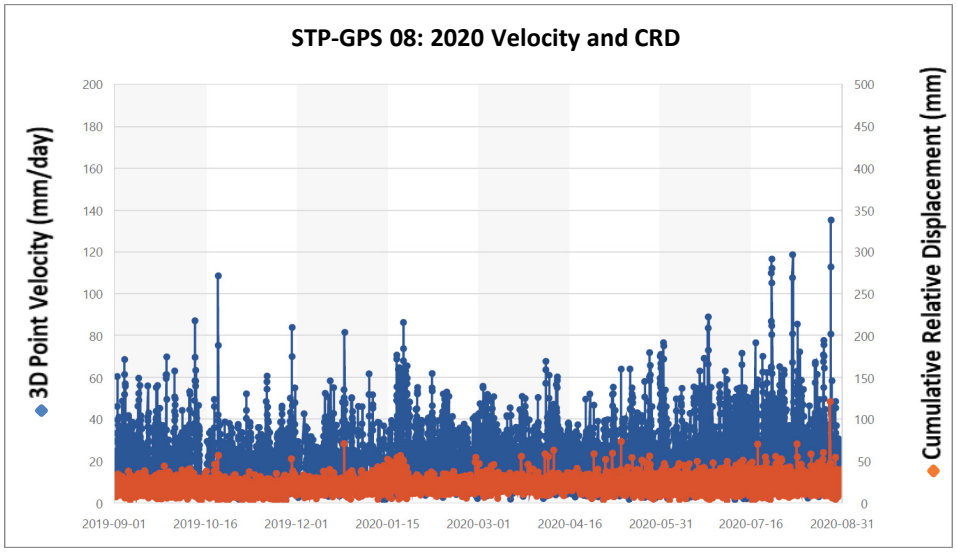
TITLE
SOUTH TAILINGS POND - GPS MONITORING DATA AT STP-GPS 07

PROJECT No.	Phase/Task/Doc.	Rev.	FIGURE
20136981	**2000/2005/2020-219**	**0**	**E-7**







LEGEND

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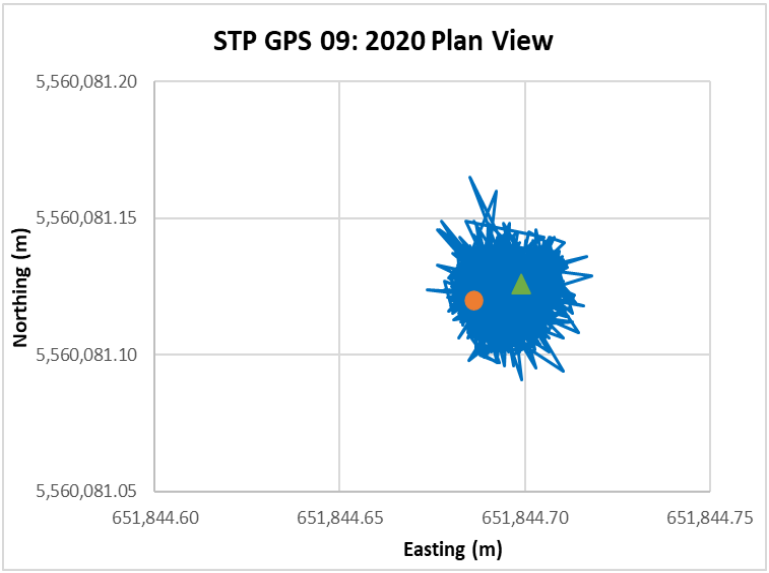
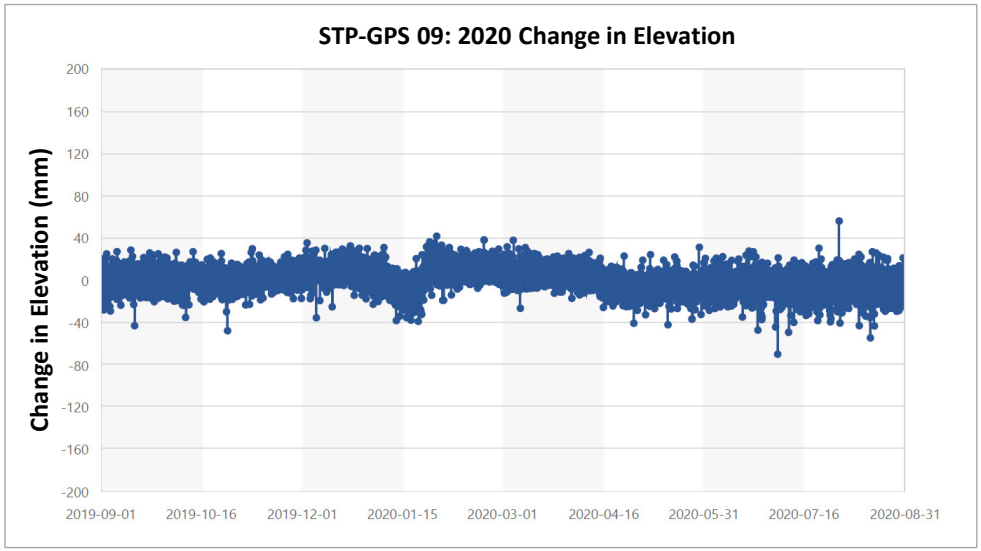
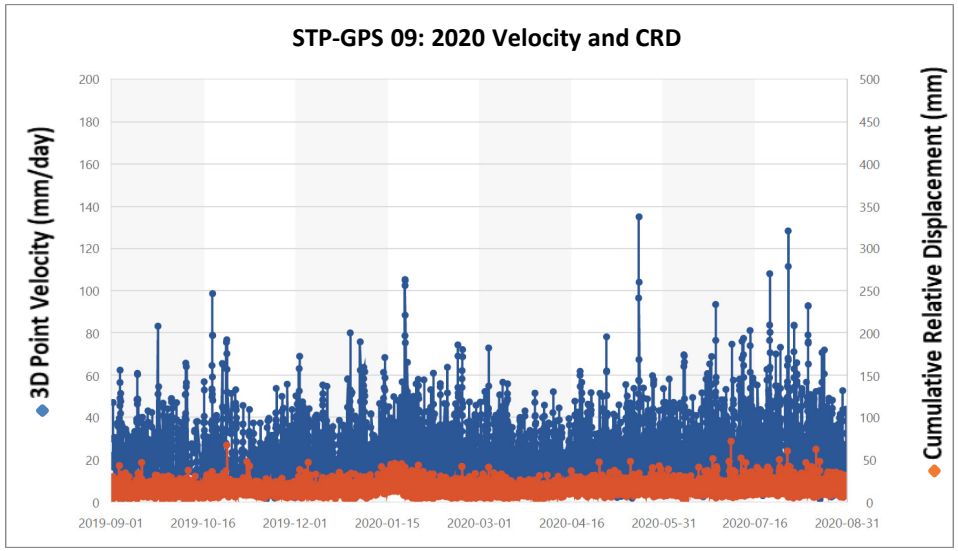
TITLE
SOUTH TAILINGS POND - GPS MONITORING DATA AT STP-GPS 08

PROJECT No.	Phase/Task/Doc.	Rev.	FIGURE
20136981	**2000/2005/2020-219**	**0**	**E-8**







LEGEND

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1. DATA DOWNLOADED FROM GEOEXPLORER IN SEPTEMBER 2020.
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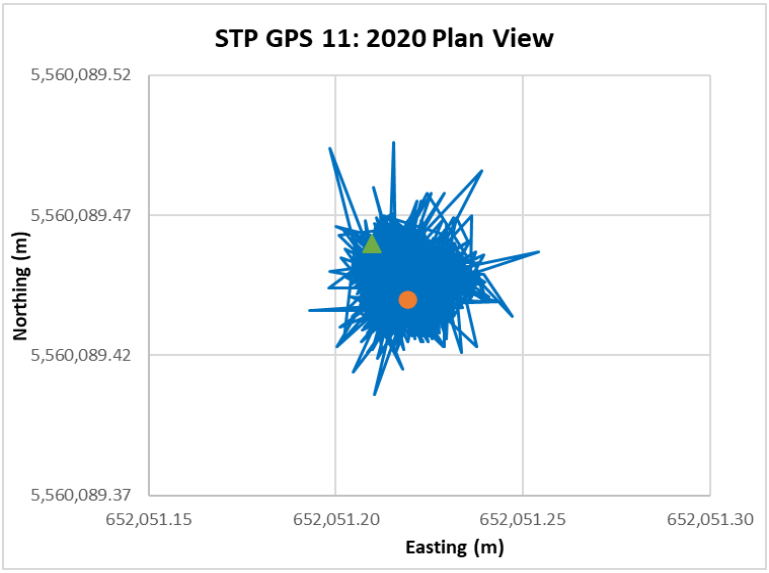
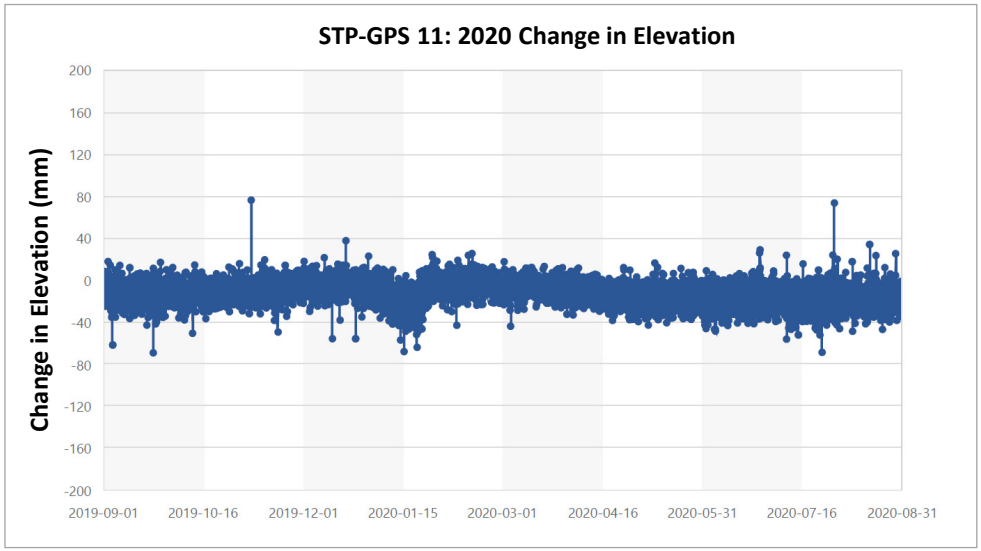
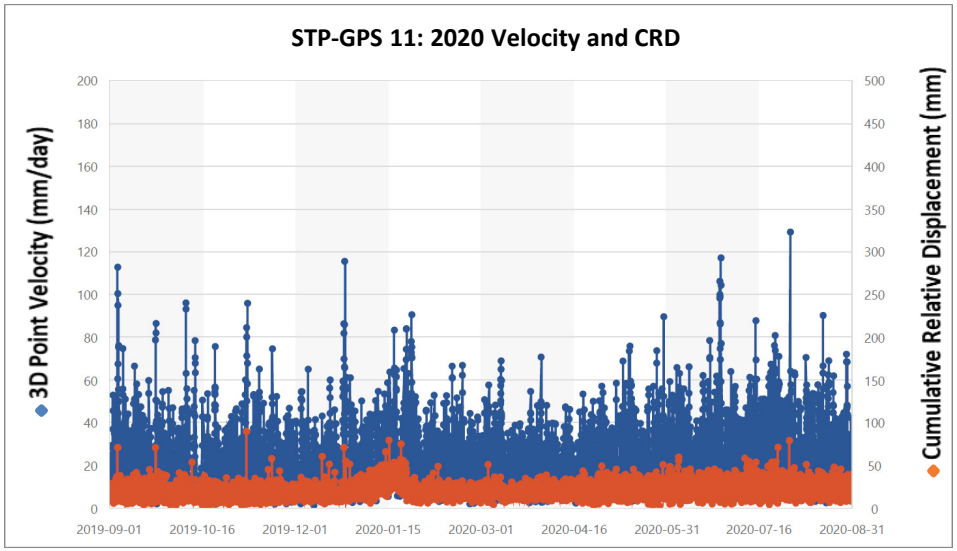
PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND - GPS MONITORING DATA AT STP-GPS 09

PROJECT No.	Phase/Task/Doc.	Rev.	FIGURE
20136981	**2000/2005/2020-219**	**0**	**E-9**







LEGEND

- INITIAL READING (SEPTEMBER 2019)
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NOTES

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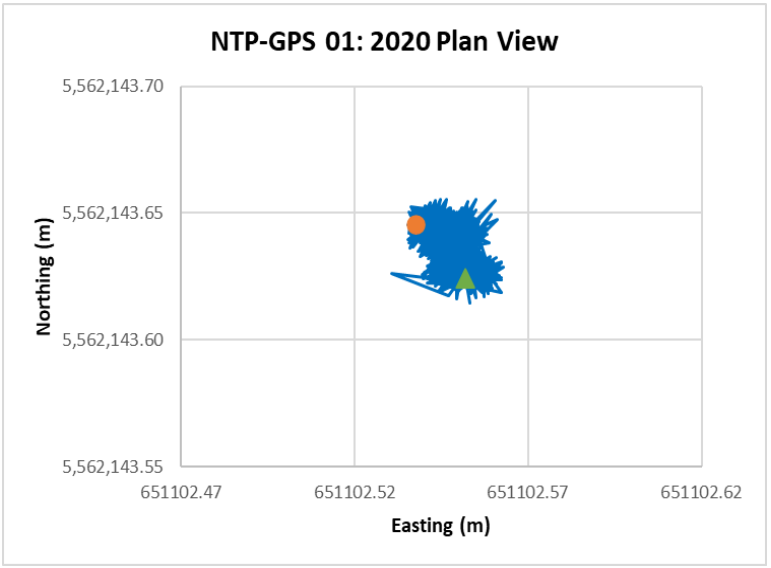
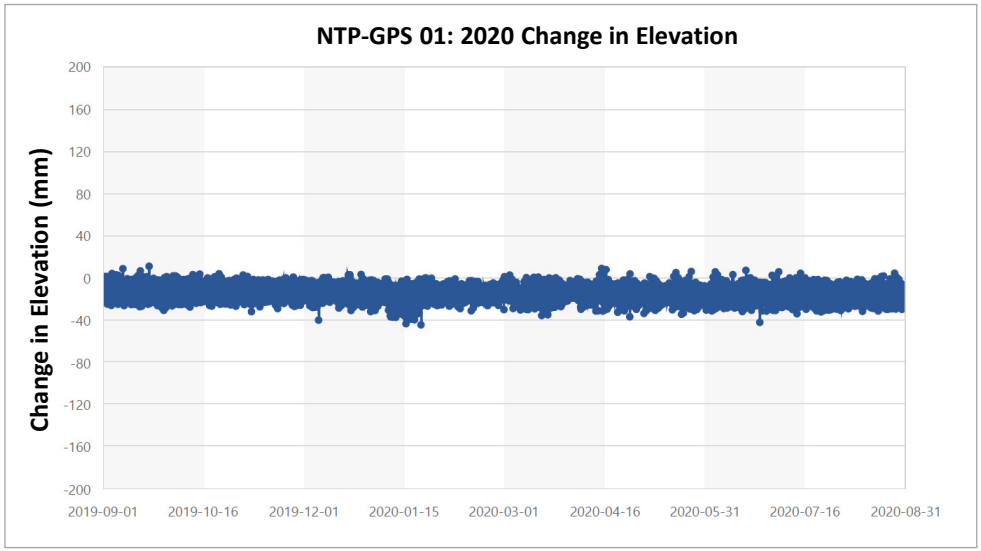
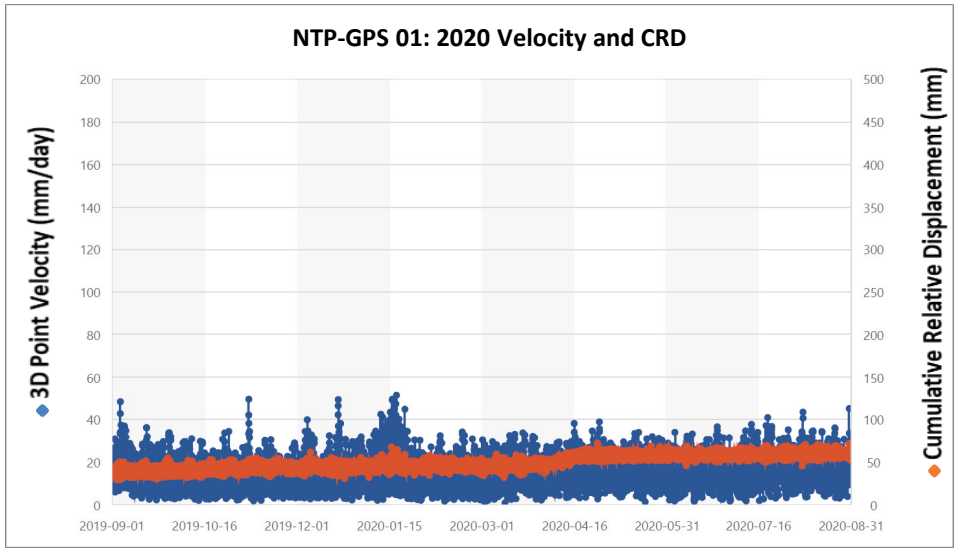
PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND - GPS MONITORING DATA AT STP-GPS 11

PROJECT No.	Phase/Task/Doc.	Rev.	FIGURE
20136981	**2000/2005/2020-219**	**0**	**E-10**







LEGEND

- INITIAL READING (SEPTEMBER 2019)
- 2019/2020 READINGS
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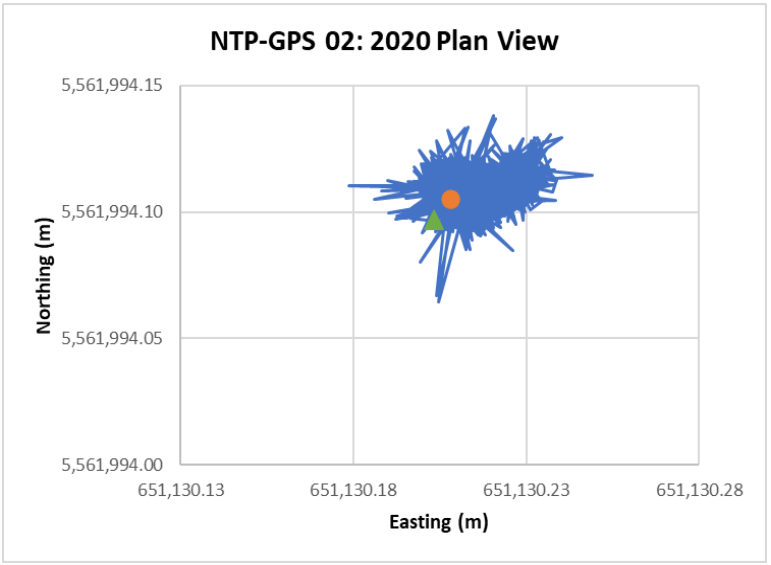
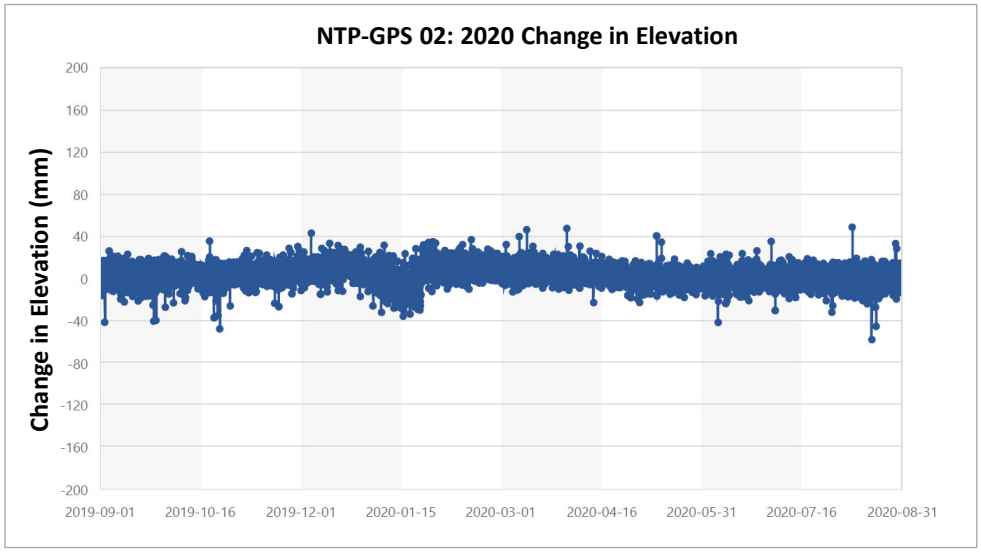
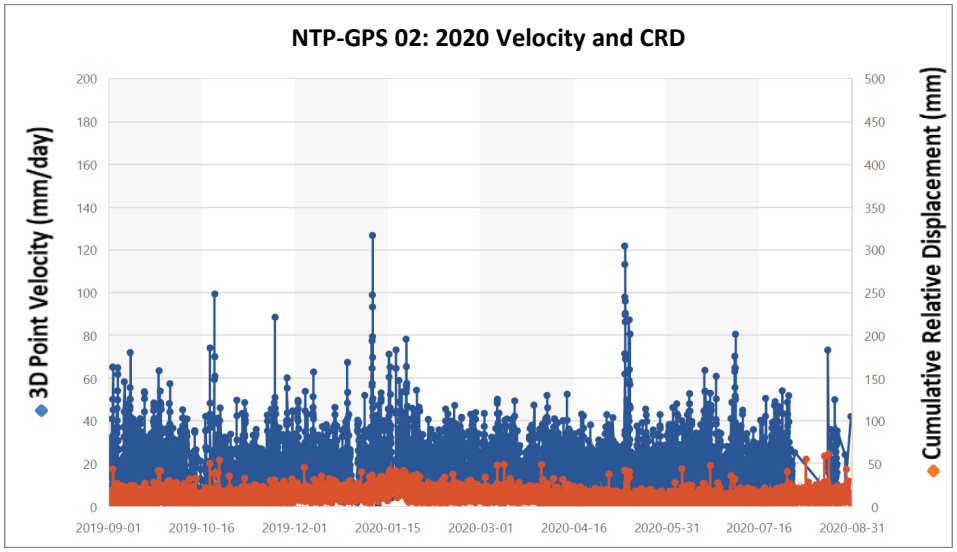
PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND - GPS MONITORING DATA AT NTP-GPS 01

PROJECT No.	Phase/Task/Doc.	Rev.	FIGURE
20136981	**2000/2005/2020-219**	**0**	**E-11**







LEGEND

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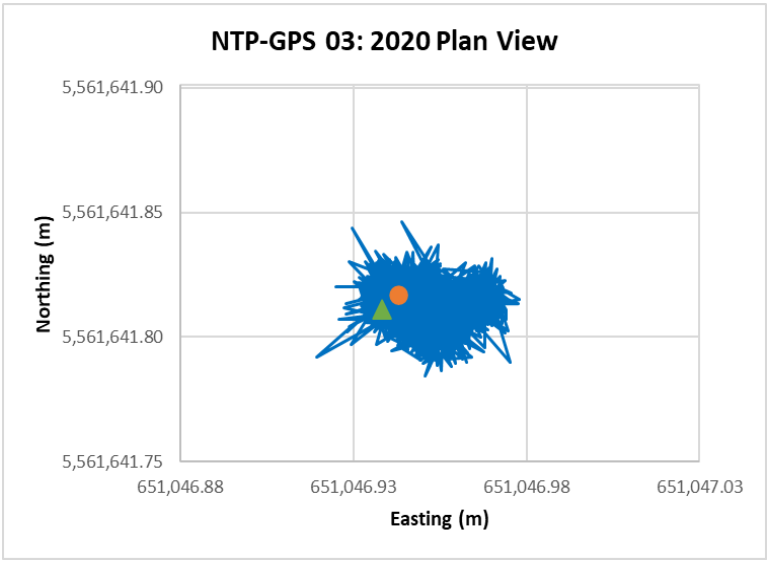
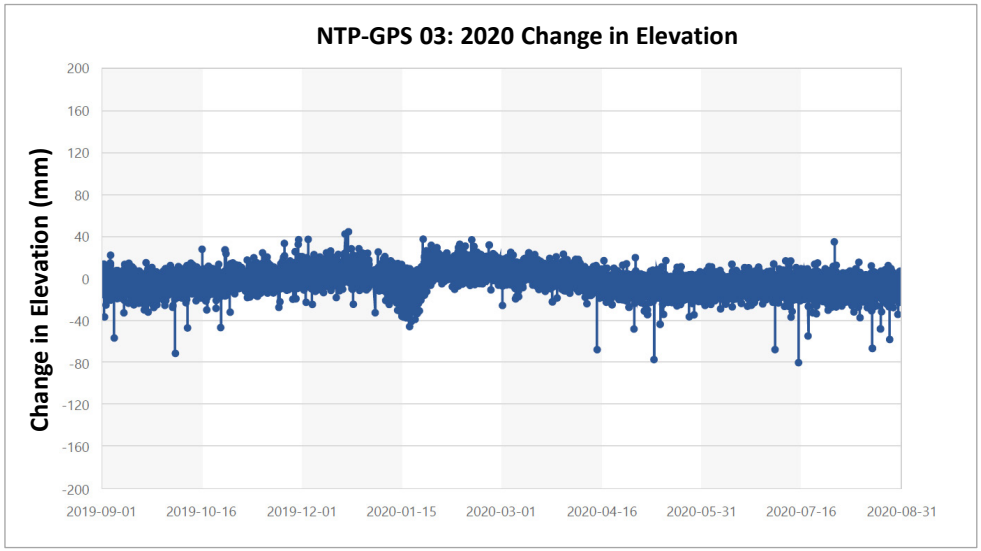
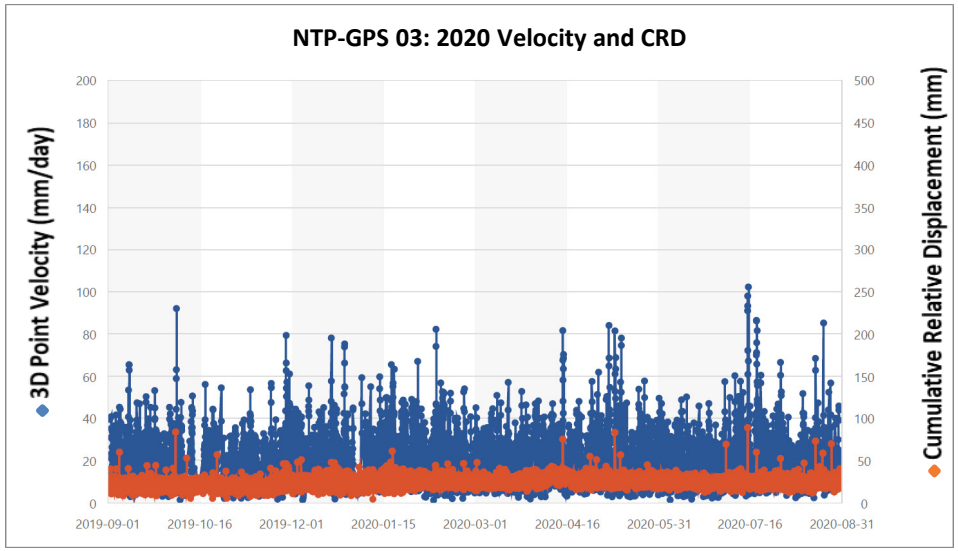
TITLE
NORTH TAILINGS POND - GPS MONITORING DATA AT NTP-GPS 02

PROJECT No.	Phase/Task/Doc.	Rev.	FIGURE
20136981	**2000/2005/2020-219**	**0**	**E-12**







LEGEND

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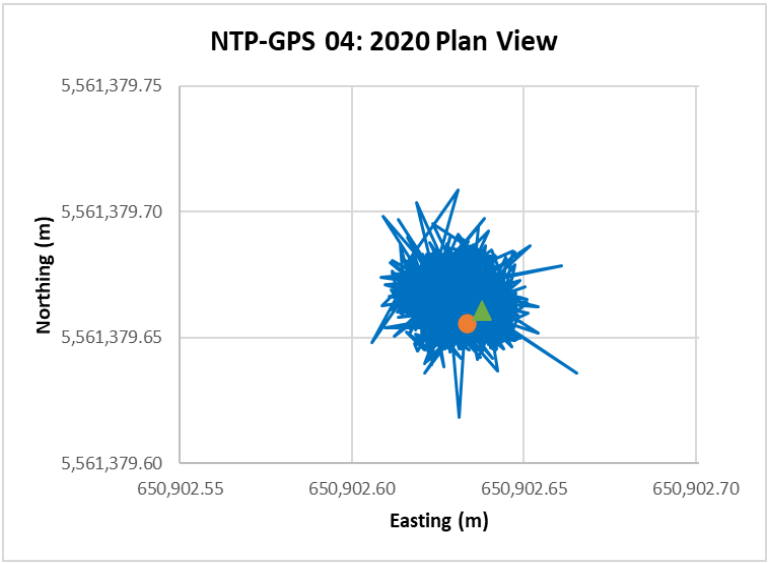
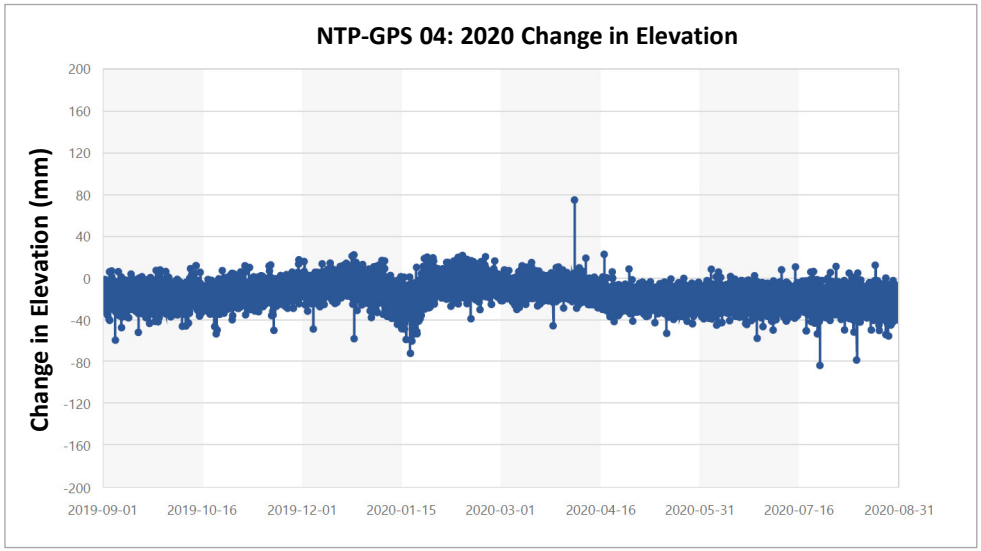
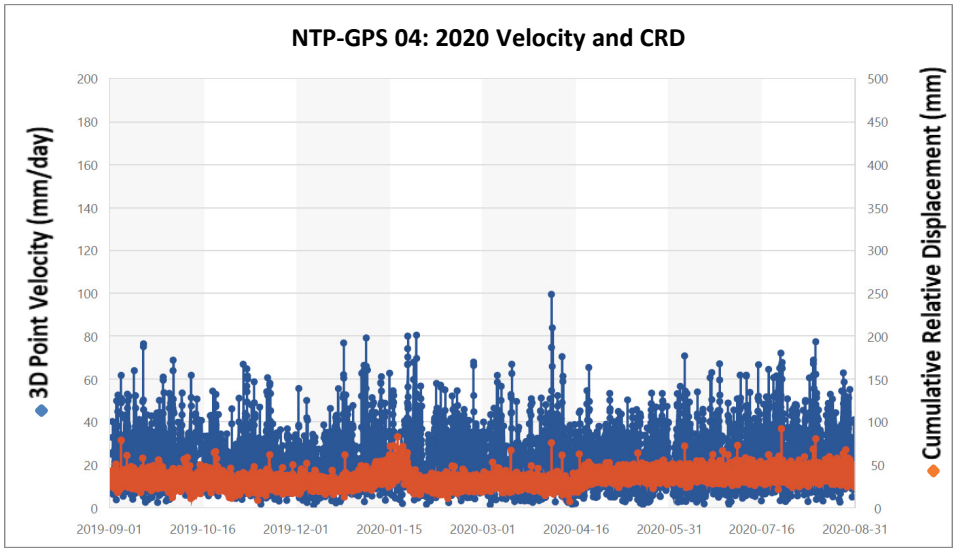
TITLE
NORTH TAILINGS POND - GPS MONITORING DATA AT NTP-GPS 03

PROJECT No.	Phase/Task/Doc.	Rev.	FIGURE
20136981	**2000/2005/2020-219**	**0**	**E-13**







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- LAST READING (AUGUST 2020)

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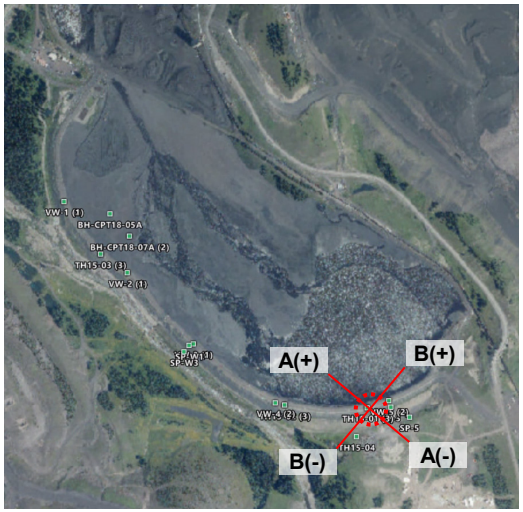
PROJECT No.	Phase/Task/Doc.	Rev.	FIGURE
20136981	**2000/2005/2020-219**	**0**	**E-14**

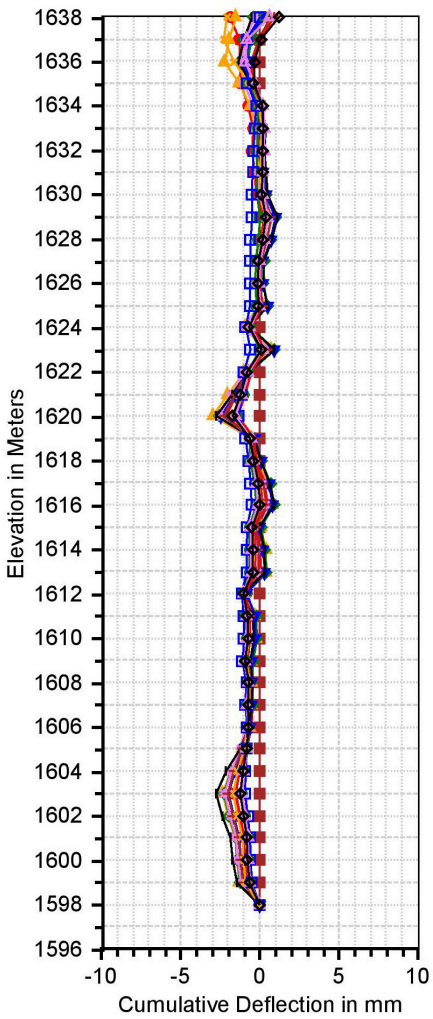
APPENDIX F

Slope Inclinometer Data

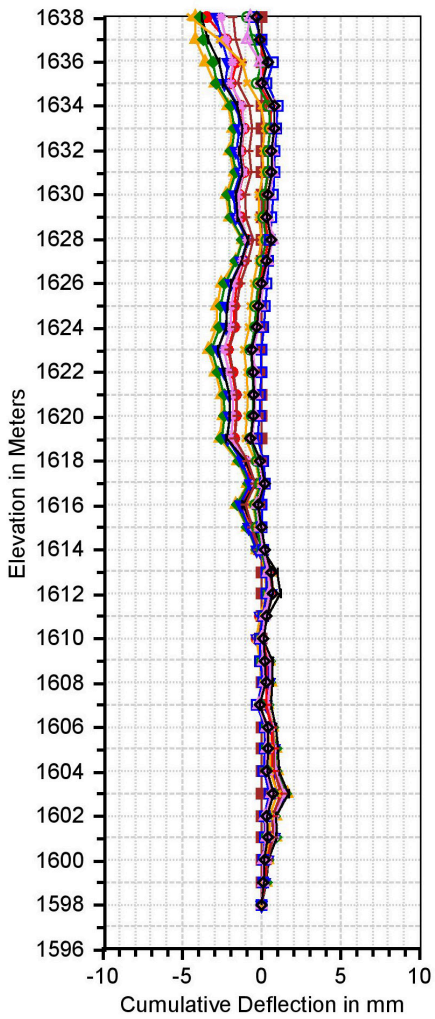


LEGEND

DIRECTION A



DIRECTION B



South Tailings Pond Main Dam, Inclinometer TH15-01
Fording River Operations

REFERENCES
1. DATA PROVIDED BY FORDING RIVER OPERATIONS JULY 2020.
2. LOCATIONS FROM GEOEXPLORER.
3. A-A AXIS AZIMUTH PROVIDED BY FORDING RIVER OPERATIONS 15 NOVEMBER 2017.
4. ELEVATIONS ARE IN ELK VALLEY ELEVATION DATUM.

CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

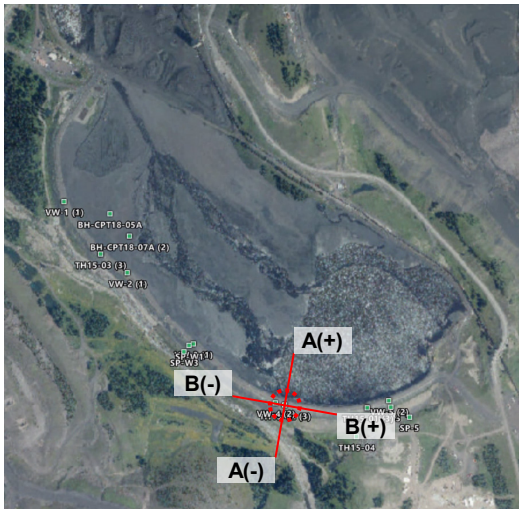
CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-18
PREPARED	N. CARRIÈRE
DESIGN	N. CARRIÈRE
REVIEW	C. LEE
APPROVED	J. CUNNING

PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND - SLOPE INCLINOMETER DATA AT TH15-01

PROJECT No.	Phase	Rev.	FIGURE
20136981	**2000/2006/2020-219**	**0**	**F-1**



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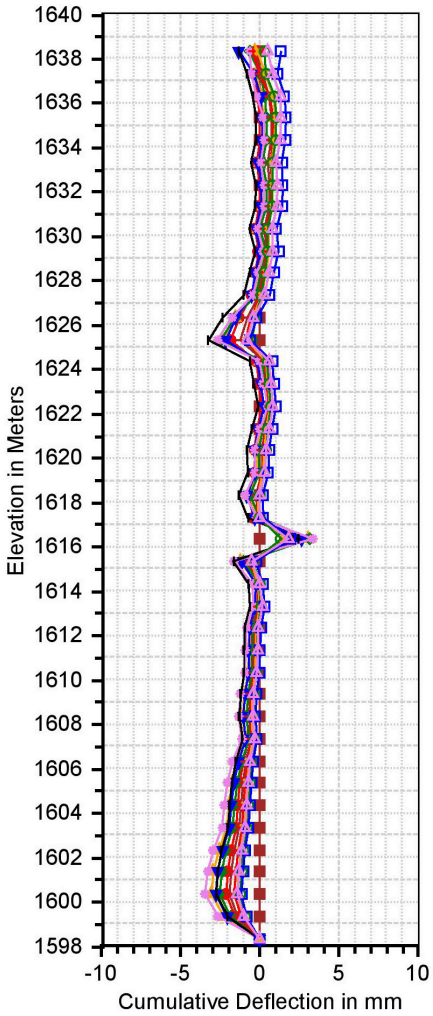
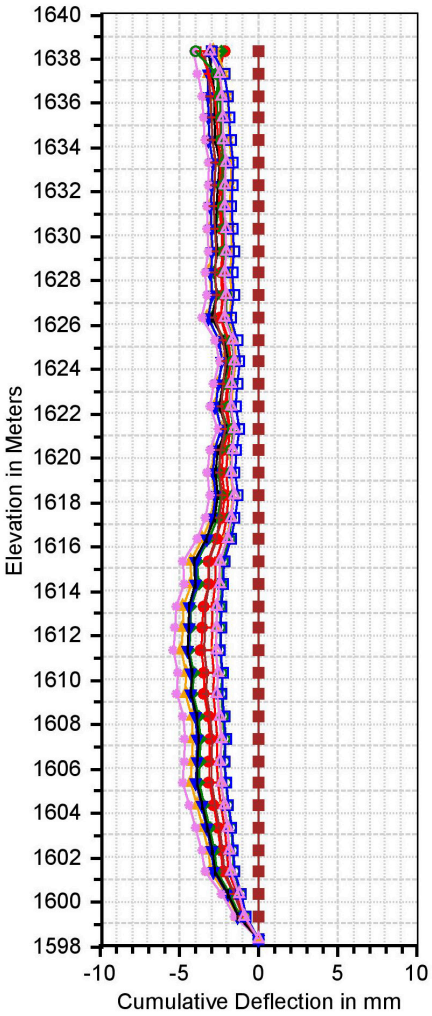




South Tailings Pond Main Dam, Inclinometer TH15-02
Fording River Operations

REFERENCES
1. DATA PROVIDED BY FORDING RIVER OPERATIONS JULY 2020.
2. LOCATIONS FROM GEOEXPLORER.
3. A-A AXIS AZIMUTH PROVIDED BY FORDING RIVER OPERATIONS 15 NOVEMBER 2017.
4. ELEVATIONS ARE IN ELK VALLEY ELEVATION DATUM.

CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

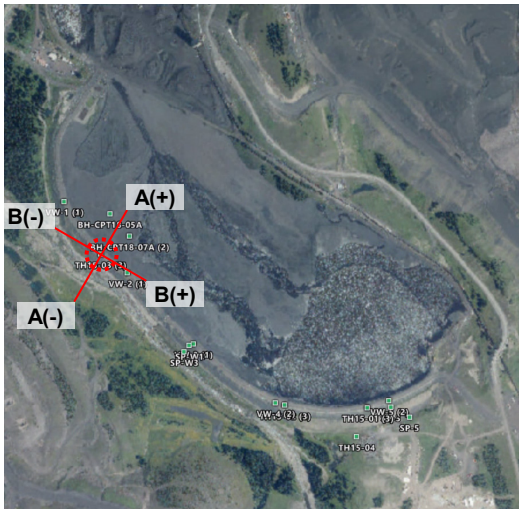
CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-18
PREPARED	N. CARRIÈRE
DESIGN	N. CARRIÈRE
REVIEW	C. LEE
APPROVED	J. CUNNING

PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND - SLOPE INCLINOMETER DATA AT TH15-02

PROJECT No.	Phase	Rev.	FIGURE
20136981	**2000/2006/2020-219**	**0**	**F-2**



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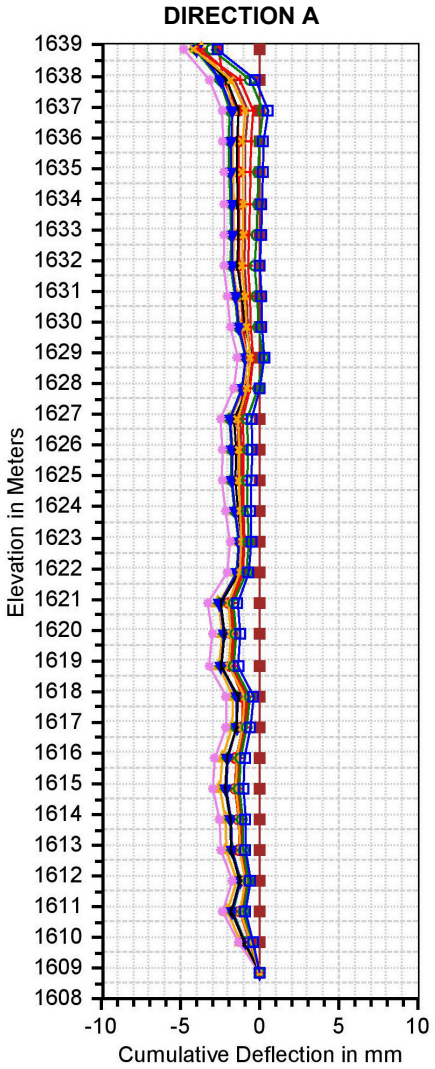

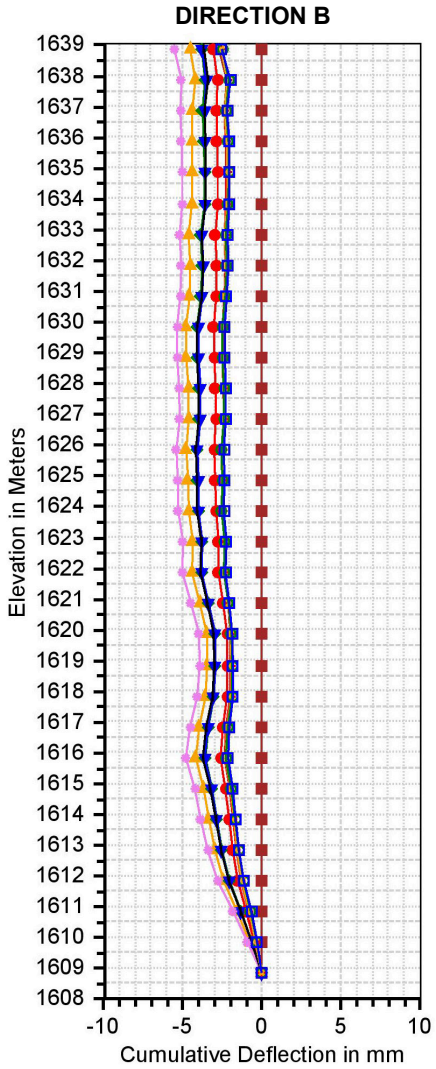

South Tailings Pond Main Dam, Inclinometer TH15-03
Fording River Operations

REFERENCES
1. DATA PROVIDED BY FORDING RIVER OPERATIONS JULY 2020.
2. LOCATIONS FROM GEOEXPLORER.
3. A-A AXIS AZIMUTH PROVIDED BY FORDING RIVER OPERATIONS 15 NOVEMBER 2017.
4. ELEVATIONS ARE IN ELK VALLEY ELEVATION DATUM.

CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

CONSULTANT
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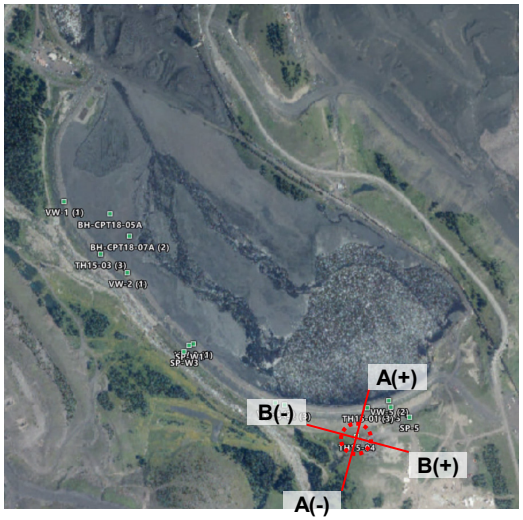
YYYY-MM-DD	2021-03-18
PREPARED	N. CARRIÈRE
DESIGN	N. CARRIÈRE
REVIEW	C. LEE
APPROVED	J. CUNNING

PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND - SLOPE INCLINOMETER DATA AT TH15-03

PROJECT No.	Phase	Rev.	FIGURE
20136981	**2000/2006/2020-219**	**0**	**F-3**



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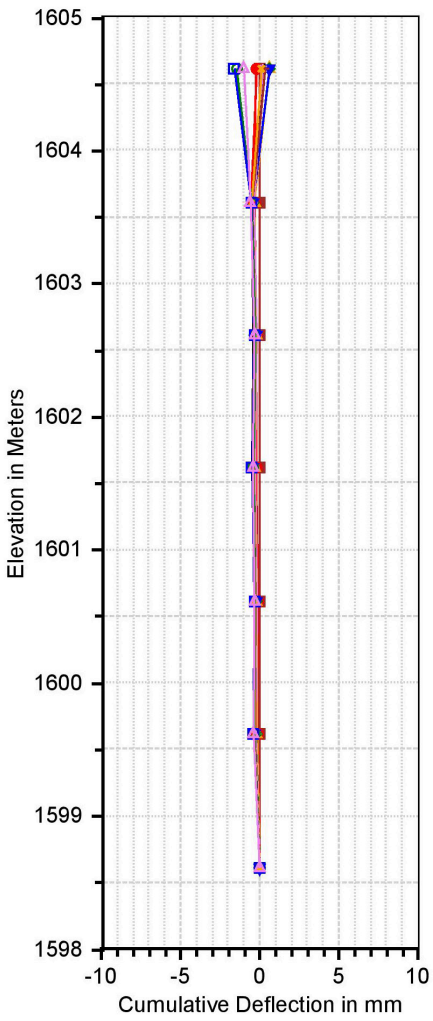
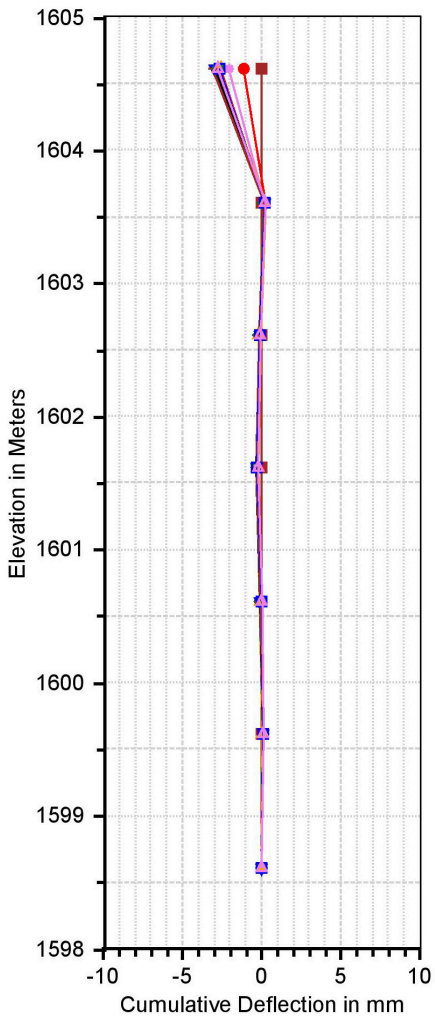




South Tailings Pond Main Dam, Inclinometer TH15-04
Fording River Operations

REFERENCES
1. DATA PROVIDED BY FORDING RIVER OPERATIONS JULY 2020.
2. LOCATIONS FROM GEOEXPLORER.
3. A-A AXIS AZIMUTH PROVIDED BY FORDING RIVER OPERATIONS 15 NOVEMBER 2017.
4. ELEVATIONS ARE IN ELK VALLEY ELEVATION DATUM.

CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

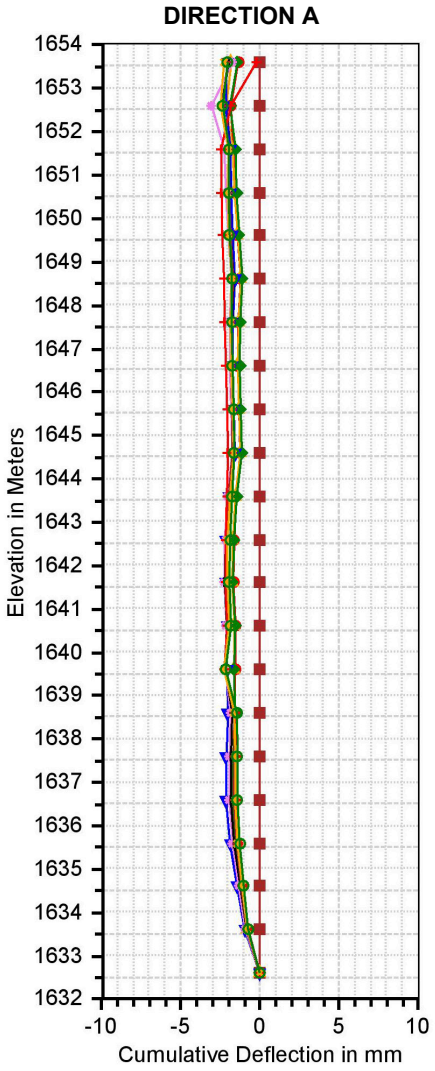
CONSULTANT
GOLDER

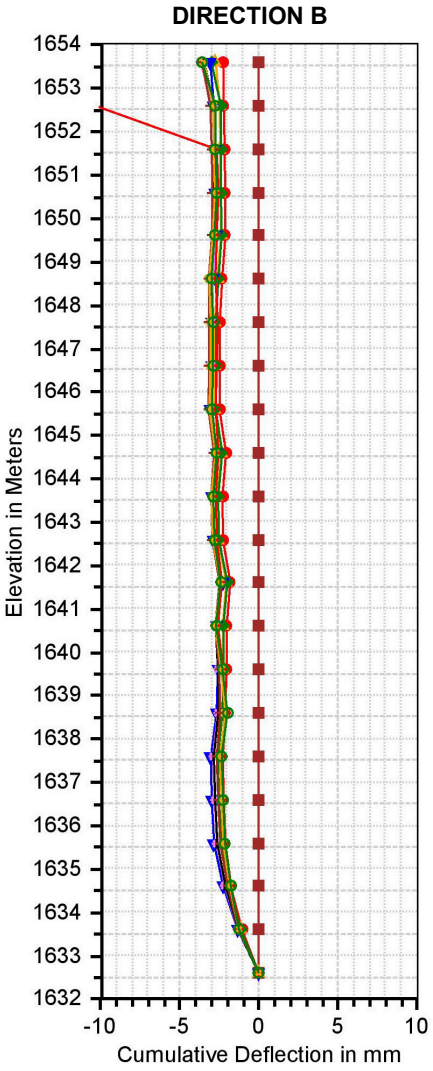
YYYY-MM-DD	2021-03-18
PREPARED	N. CARRIÈRE
DESIGN	N. CARRIÈRE
REVIEW	C. LEE
APPROVED	J. CUNNING

PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND - SLOPE INCLINOMETER DATA AT TH15-04

PROJECT No.	Phase	Rev.	FIGURE
20136981	**2000/2006/2020-219**	**0**	**F-4**





LEGEND

North Tailings Pond, Inclinometer TH15-05
Fording River Operations

REFERENCES
1. DATA PROVIDED BY FORDING RIVER OPERATIONS JULY 2020.
2. LOCATIONS FROM GEOEXPLORER.
3. A-A AXIS AZIMUTH PROVIDED BY FORDING RIVER OPERATIONS 15 NOVEMBER 2017.
4. ELEVATIONS ARE IN ELK VALLEY ELEVATION DATUM.

CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-18
PREPARED	N. CARRIÈRE
DESIGN	N. CARRIÈRE
REVIEW	C. LEE
APPROVED	J. CUNNING

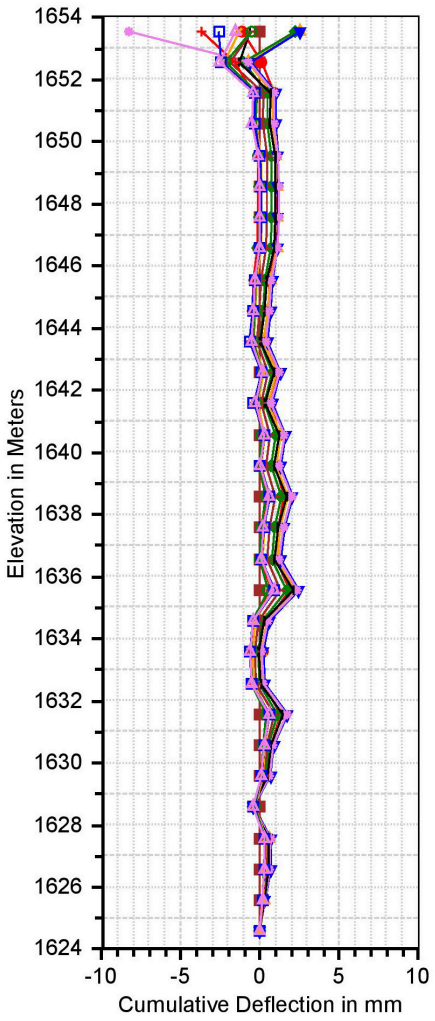
PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND - SLOPE INCLINOMETER DATA AT TH15-05

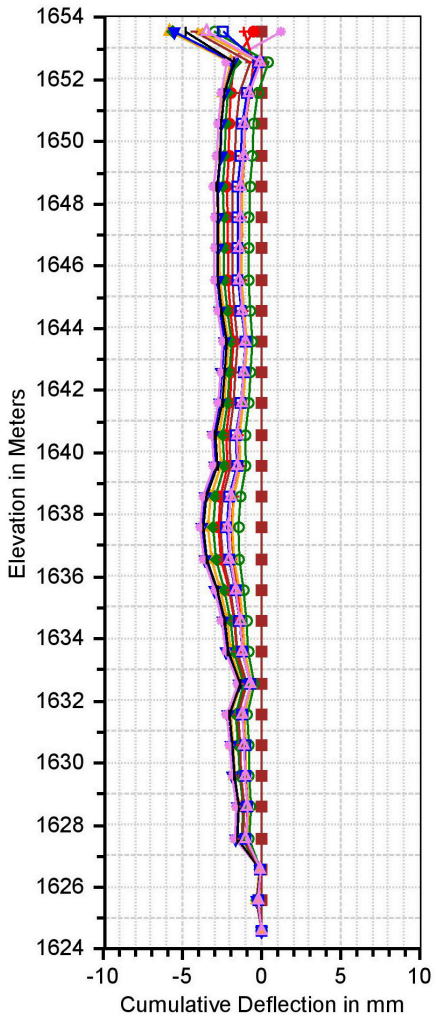
PROJECT No.	Phase	Rev.	FIGURE
20136981	**2000/2006/2020-219**	**0**	**F-5**

LEGEND

DIRECTION A



DIRECTION B



North Tailings Pond, Inclinometer TH15-06
Fording River Operations

REFERENCES
1. DATA PROVIDED BY FORDING RIVER OPERATIONS JULY 2020.
2. LOCATIONS FROM GEOEXPLORER.
3. A-A AXIS AZIMUTH PROVIDED BY FORDING RIVER OPERATIONS 15 NOVEMBER 2017.
4. ELEVATIONS ARE IN ELK VALLEY ELEVATION DATUM.

CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-18
PREPARED	N. CARRIÈRE
DESIGN	N. CARRIÈRE
REVIEW	C. LEE
APPROVED	J. CUNNING

PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND - SLOPE INCLINOMETER DATA AT TH15-06

PROJECT No.	Phase	Rev.	FIGURE
20136981	**2000/2006/2020-219**	**0**	**F-6**

LEGEND

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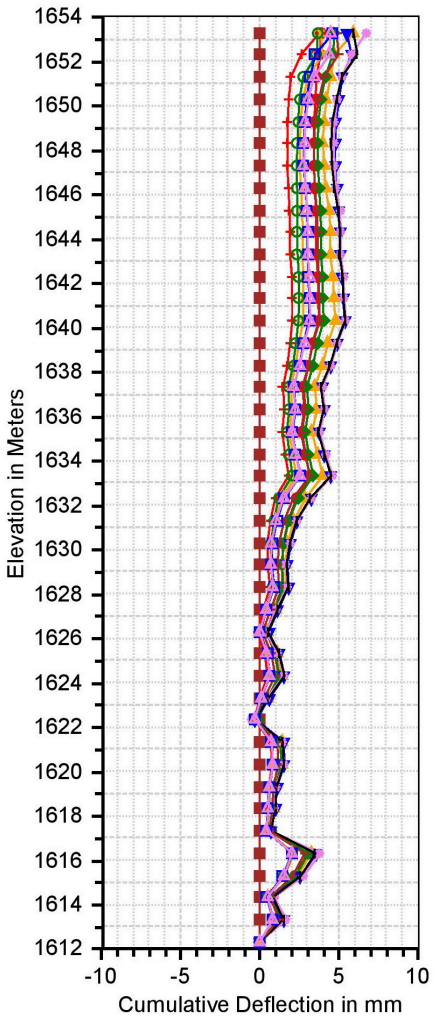
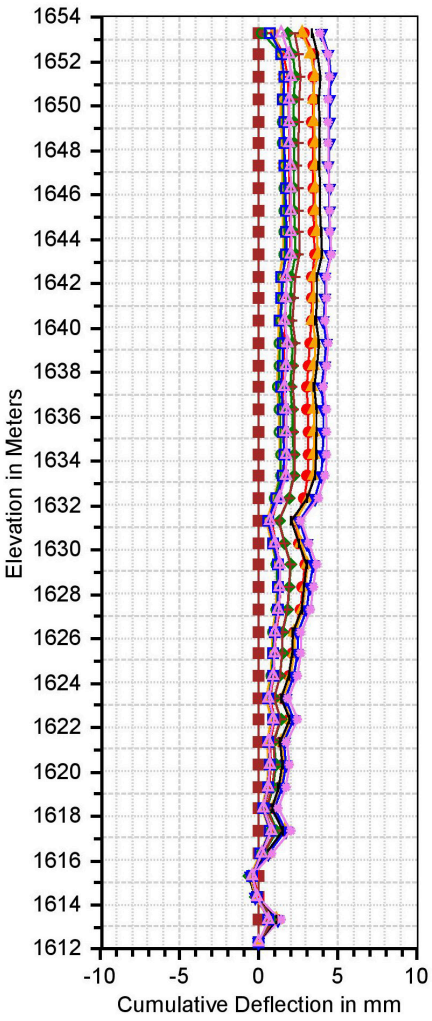


DIRECTION B



North Tailings Pond, Inclinometer TH15-07
Fording River Operations

REFERENCES
1. DATA PROVIDED BY FORDING RIVER OPERATIONS JULY 2020.
2. LOCATIONS FROM GEOEXPLORER.
3. A-A AXIS AZIMUTH PROVIDED BY FORDING RIVER OPERATIONS 15 NOVEMBER 2017.
4. ELEVATIONS ARE IN ELK VALLEY ELEVATION DATUM.

CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-18
PREPARED	N. CARRIÈRE
DESIGN	N. CARRIÈRE
REVIEW	C. LEE
APPROVED	J. CUNNING

PROJECT
SOUTH AND NORTH TAILINGS PONDS
2020 ANNUAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND - SLOPE INCLINOMETER DATA AT TH15-07

PROJECT No.	Phase	Rev.	FIGURE
20136981	**2000/2006/2020-219**	**0**	**F-7**

APPENDIX G

KWL Riprap Inspection Report

KERR WOOD LEIDAL
consulting engineers

Okanagan
202 - 3334 30th Avenue
Vernon, BC V1T 2C8
T 250 503 0841
F 250 503 0847

Technical Memorandum

DATE: November 23, 2020

TO: Riley McCutcheon
Teck Coal Ltd. – Fording River Operations

CC: John Cunning, P.Eng.
Golder Associates Ltd.

FROM: Jason Miller, P.Eng.

RE: **TECK COAL LIMITED – FORDING RIVER OPERATIONS**
2020 NTP/STP Riprap Inspection
Our File 8.284 – 300

Introduction

Teck Coal Ltd. – Fording River Operations (FRO) retained Kerr Wood Leidal Associates Ltd. (KWL) to complete an inspection of the riprap along the North Tailings Pond (NTP) and South Tailings Pond (STP). Jason Miller, P.Eng. of KWL is the design engineer of record for bank protection works along the NTP and STP.

The riprap inspection is a component of the Annual Dam Safety Inspection (DSI) currently being completed by Golder Associates Ltd. (Golder). Golder is the Engineer of Record (EoR) for the tailings storage facilities at FRO. This technical memorandum summarizes the findings of KWL's riprap inspection and will be appended to the 2020 Annual DSI.

Background

KWL has a long history working at FRO. KWL was involved in the design and construction of the Fording River diversion to allow the construction of the STP. KWL has also provided hydrotechnical support to FRO following major flood events on the Fording River.

A severe flood on the Fording River in June 2013 caused extensive damage to FRO infrastructure, and necessitated emergency mitigation works. Post-flood works included design and construction of a new riprap revetment to protect the NTP and part of the STP. Construction of bank protection works occurred in 2013, 2014, 2016 and 2017. Upon completion, continuous bank protection works had been constructed along the Fording River channel where it flows along the toe of the NTP dam, and along about one-third of the channel where it flows along the toe of the STP dam. The existing NTP and STP riprap is designed to the 200-year return period flood[1]. FRO is continuing a parallel process to implement longer-term flood risk mitigation for its tailings storage facilities.

[1] Kerr Wood Leidal Associates Ltd. 2016 Bank Protection Design for NTP/STP – Design Brief. Prepared for Teck Coal Ltd. – Fording River Operations. January 2017.

Field Inspection

A site visit was conducted on August 24, 2020 by Jason Miller, P.Eng. of KWL to assess the condition of the NTP and STP riprap bank protection works. The assessment began at the STP and then moved to the NTP. At the time of the inspection, the ground and riprap were snow free.

NTP Inspection

Riprap extends from upstream of the NTP to about Sta. 1+075 of the Golder NTP dam baseline as shown on Figure 1. Visual inspection of the lower riprap slope is impeded by gravel placed over the riprap during 2013 construction. The upper riprap slope placed during 2016/2017 is visible. The 2020 riprap inspection confirmed the riprap appears to be in good condition. Details of the inspection are provided below.

The section of riprap from approximately Sta. 0+100 to 0+200 is fully buried and no part of the revetment is visible. The surface above the riprap was checked for signs of movement such as cracks or settlement. It is understood that in Spring 2020 work was completed around the NTP sumps. The work included placing low permeability material in the sumps and did not require excavation into the buried riprap. There was one location, away from the 2020 work, where a hole has formed at the surface of the ground around Sta. 0+140 m (north of the Liverpool outlet culvert crossing). The hole is 0.3 m wide by 0.5 m long and appears to be material that has fallen into the void between the riprap (i.e. interlocked riprap is visible in the hole). It does not appear that any riprap has moved as this is an isolated location with no other visible signs of movement.

Gravel-covered sections of the revetment were checked for signs of movement such as cracks or openings in the gravel along the slope that would indicate voids developing within the revetment or settlement of the upper riprap. At a few of the riffles (at Sta. 0+175 and between Sta. 0+450 and 0+550) , there has been some erosion of the gravel and some movement of boulders where the riffle crest joins the bank. The erosion extends about 0.75 m up the slope for a length of 2 m to 7 m depending on the riffle. The boulders that moved are part of the riffle and were placed against the gravel-covered slope in an attempt to tie the riffle into the bank. The banks are over-steepened in these areas at 1 horizontal to 1 vertical (1H:1V). The boulder movement does not impact the integrity of the bank protection riprap, but may need to be addressed in the future as part of riffle maintenance.

At approximately Sta. 0+950, there is erosion of the river gravels placed over the riprap along the bank about 1.5 m high for a length of about 30 m. The erosion has exposed a small amount of underlying riprap and there does not appear to be any movement or displacement of the riprap. No additional visual signs of movement were observed over the length of the revetment slope.

A small 0.35 m diameter sinkhole remains on top of the riprap about 1.5 m from the top of the slope (approximate Sta. 0+710) with no visible changes since it was observed in 2019. The 0.3 m deep opening appears to be the result of finer road surface material falling into the voids between the large riprap pieces.

The exposed toe and slope of the revetment was observed and appears to be in good condition with no visual signs of scour or displacement except as noted above.

Some of the locally-supplied rock is known to weather and degrade. Degradation was observed on several rocks along the revetment with increased degradation from the 2019 riprap inspection; however, the degradation is intermittent and has not affected the overall integrity of the protection works. If degradation becomes more wide-spread, the average size (mass) of the riprap will decrease and rock interlocking may be compromised. Both of these processes can reduce the level of protection provided by the riprap. Remedial work may be required if future inspections confirm ongoing weathering and degradation. This year's inspection did not include any test holes to review rock degradation below the visible rock layer.

Previously, test holes were excavated in 2016 and 2017 during riprap upgrades. These test holes found the riprap placed in 2013 to be of good quality, but the riprap gradation was smaller than the expected gradation at the top of the test holes. This may be a result of selective placement to construct an access road on top of the revetment. In the absence of further test holes, it is reasonable to assume that degradation of the buried rock is similar to that of exposed sections.

Generally, the crest of the NTP riprap revetment is within ±0.1 m of the design elevation; however, there are a few areas where the riprap crest is up to 0.4 m lower than the design elevation (refer to profile on record drawings in in completion report[2]). The low areas correspond to approximate stationing 0+215 to 0+290, 0+470 to 0+545, 0+625 to 0+665, 0+685 to 0+755 and 0+920 to 0+940. This reduces the freeboard in these areas from the design freeboard of 1.0 m to 0.6 m. A reduced freeboard means that the revetment has a reduced capacity to handle variations from the design conditions; 0.6 m freeboard is considered the minimum acceptable freeboard for many flood protection projects throughout BC. Particular attention in regard to signs of settlement or water nearing the crest should be paid to these areas on annual inspection and during high water events. Signs of settling or subsidence should be confirmed by topographic survey and levels of protection should be raised if required. No evidence of systematic settling or subsidence was observed during the 2020 inspection. FRO should take advantage of future opportunities to cost-effectively raise the revetment to achieve the design freeboard (e.g., if future work is required along the river side slope of the NTP).

STP

A riprap revetment protects the STP embankment toe from Sta. 0+240 to 0+685 of the Golder STP dam baseline (refer to Figure 2). Most of the riprap slope is exposed and visible along the length of the revetment, with the exception of a 20 m length at the upstream end which is covered in finer rock (200 mm minus rock). The riprap is well interlocked with smaller riprap filling the voids of the larger riprap. The riprap slope is about 2H:1V. The 2020 riprap inspection confirmed the riprap appears to be in good condition. Details of the inspection are provided below.

The top of the riprap apron is covered in river gravel and is not visible for inspection; its condition is assumed similar to that observed along the revetment slope. The gravel-covered apron was checked for signs of movement such as cracks or openings in the gravel that would indicate voids or settlement developing within the toe apron. No signs of movement were observed. The Fording River currently flows on the opposite side of the channel for most of the length with the exception of the downstream 125 m where the active channel flows against the riprap embankment. There is evidence that water levels were about 0.75 m up the riprap slope in several locations during freshet 2020. Gravel was noted to be deposited in some of the voids in the riprap toe apron in the downstream 125 m of the protection.

There is continued weathering (cracking and flaking) of individual riprap pieces along the entire length of the STP protection works. Currently, the degradation remains intermittent and has not affected the overall integrity of the protection works. If degradation becomes more wide-spread, the average size (mass) of the riprap will decrease and rock interlocking may be compromised. Both of these processes can reduce the level of protection provided by the riprap. Remedial work may be required if future inspections confirm ongoing weathering and degradation.

While not formally part of the inspection, erosion was observed along the toe of the diversion channel slope below the STP West Dam downstream of the riprap revetment and pipe bridge. The erosion has exposed some bedrock. Teck should continue to monitor this area as part of the regular facilities inspections.

[2] Kerr Wood Leidal Associates Ltd. 2016/2017 Bank Protection for NTP/STP – Completion Report. Prepared for Teck Coal Ltd. – Fording River Operations. December 2017.

General Observations

All riprap used for NTP and STP bank protection works was salvaged from toes of spoils or sorted from spoils or hauled directly from the pit. The resistance to weathering is therefore expected to vary locally throughout both revetments. Over time, inspections may identify pockets of more resistant and/or less resistant material. More frequent visual monitoring by FRO staff should occur in areas where a significant portion of the riprap slope (i.e., more than the occasional rock) is found to be showing signs of degradation. Presently there are no areas identified as requiring increased monitoring.

Teck currently has an emergency stockpile of riprap located south of the STP for use at either tailings facility in case of an emergency. KWL reviewed the stockpile as part of the riprap inspection to confirm it remains suitable for use. The stockpile of rock was sourced from on-site mining operations, same as the rock used to build the riprap bank protection for the tailings facilities. Similar to the other riprap on site, some of the rock is weathering and degrading. At this time, the rock remains suitably sized for emergency use on the Fording River. The stockpile should be reviewed annually as part of the NTP / STP riprap inspection to confirm it remains suitable for use.

Teck may consider using a drone to capture the riprap embankment on an annual basis as a secondary tool for comparing the riprap condition year over year. Where settlement, cracking, voids, or other signs of movement become visible on the surface, test pits should be completed to confirm the quality and integrity of buried riprap (and if needed, remediated). Each annual inspection should review the inspection history and highlight potential changes.

Summary and Recommendations

Exposed riprap along the NTP and STP is generally in good condition and is designed to provide erosion protection during the 200-year return period flood. Some erosion was noted at a few riffles along the NTP; however, the erosion does not impact the integrity of the NTP bank protection and no action is required at this time for the riprap bank protection. There continues to be deterioration of some of the riprap from weathering located intermittently along the NTP and STP riprap revetments. This is also expected to be the case for buried riprap. Two small sinkholes on the top of the riprap were identified; however, the field assessment did not identify any evidence that raises concerns about the performance of concealed (i.e., buried or gravel-covered) riprap, and its condition is assumed to be comparable or better than that of equivalent exposed sections. The emergency stockpile of riprap located south of the STP has some weathering, but remains suitable for use in case of emergency.

Erosion of the toe of the diversion channel was noted downstream of the riprap revetment and pipe bridge. This area should continue to be monitored as part of the regular facilities inspections.

Inspections of the riprap and riprap stockpile should be completed at least annually. The riprap should continue to be monitored for weathering during these annual inspections. Teck may consider developing a flight path and obtain drone imagery of the riprap embankment on an annual basis as a secondary tool to monitor the condition of the riprap. This would allow the imagery to be compared year over year to help identify areas that may be deteriorating faster than others.

Test pits may be required if surface deformation suggests potential problems with buried riprap, for example if future inspections document ongoing surface anomalies in the vicinity of NTP Sta. 0+140 and 0+710. Mitigative action (e.g., riprap replacement) may be required if several rocks in close proximity to one another show evidence of degradation. Supplementary inspections should continue to be conducted after high water events on the Fording River, which include freshet or precipitation driven events. Any deficient sections should be repaired as soon as possible to limit further degradation and risk to the NTP or STP.

There are areas along the NTP riprap where the riprap is up to 0.4 m lower than the design elevation. This reduces the design freeboard in these areas to 0.6 m. Particular attention should be paid to these areas on annual inspection and during high water events. Signs of settling or subsidence should be confirmed by survey and levels of protection should be raised if required. Teck should seek opportunities to cost-effectively achieve the intended 1 m freeboard (e.g., by combining with an independent but adjacent construction project).

Design of the riprap erosion protection works is based on the 200-year return period flood, which is subject to numerous uncertainties. For example, the energy of the flood can significantly change channel conditions. In addition, larger floods are possible, including the breach of an upstream valley-spanning structure like the Fording River Multiplate embankment. The design and status of the NTP and STP riprap should be reviewed and revised as needed within the context of FRO's larger review of design and performance requirements for the NTP and STP tailings storage facilities.

Closure

We trust this provides a satisfactory assessment of the riprap protection along the NTP and STP. Should you have any questions, please contact the undersigned.

KERR WOOD LEIDAL ASSOCIATES LTD.

Prepared by:

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
2020-11-23
J. W. MILLER
34433

Jason Miller, P.Eng.
Water Resources Engineer

Reviewed by:

David Roche, M.A.Sc., P.Eng.
Senior Water Resources Engineer

/jm

Encl.: Photos, Figure 1, Figure 2

ENGINEERS & GEOSCIENTISTS BRITISH COLUMBIA OQM CERTIFIED

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Revision History

Revision #	Date	Status	Revision Description	Author
0	November 23, 2020	FINAL		JM

Photos

		
Photo 1: Looking upstream along alignment of NTP riprap that is buried (approx. Sta. 0+125). Work was completed at the NTP Sumps in Spring 2020.		Photo 2: Small sinkhole about 0.5 by 0.5 m at approx. Sta. 0+140. This is along the alignment of the buried setback riprap.
		
Photo 3: Looking downstream at NTP riprap (from approx. Sta. 0+225).		Photo 4: Looking downstream at NTP riprap (from approx. Sta. 0+475).

		
Photo 5: Looking at erosion of the gravel material placed on top of the riprap at one of the riffle crest bank tie-ins on the NTP (approx. Sta. 0+550).		Photo 6: Looking downstream at NTP riprap (from approx. Sta. 0+725).
		
Photo 7: Looking downstream at STP riprap (from approx. Sta. 0+240).		Photo 8: Looking downstream at STP riprap (approx. Sta. 0+380).

		
Photo 9: Looking upstream at STP riprap (from approx. Sta. 0+540).		Photo 10: Riprap degradation due to weathering on several pieces of riprap.
		
Photo 11: Looking upstream at STP riprap (from approx. Sta. 0+670).		Photo 12: Erosion along the toe of the STP downstream of the pipe bridge. The erosion has exposed bedrock in some areas.

Photo 13: Emergency riprap stockpile south of STP.

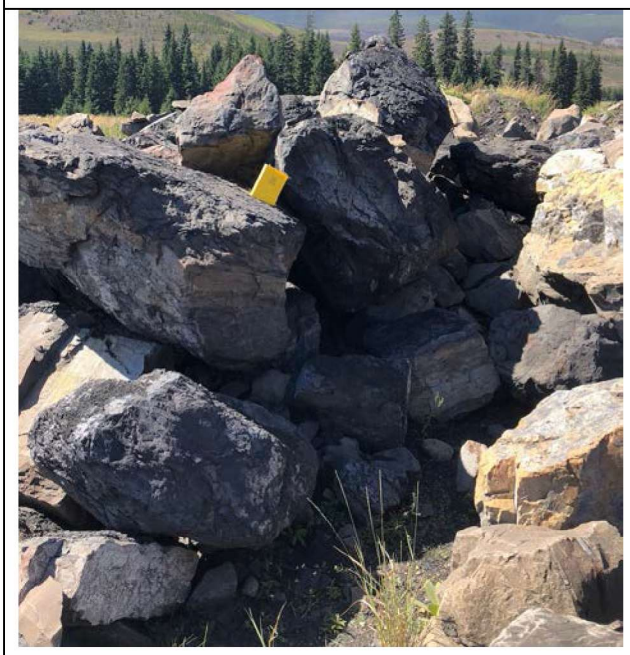


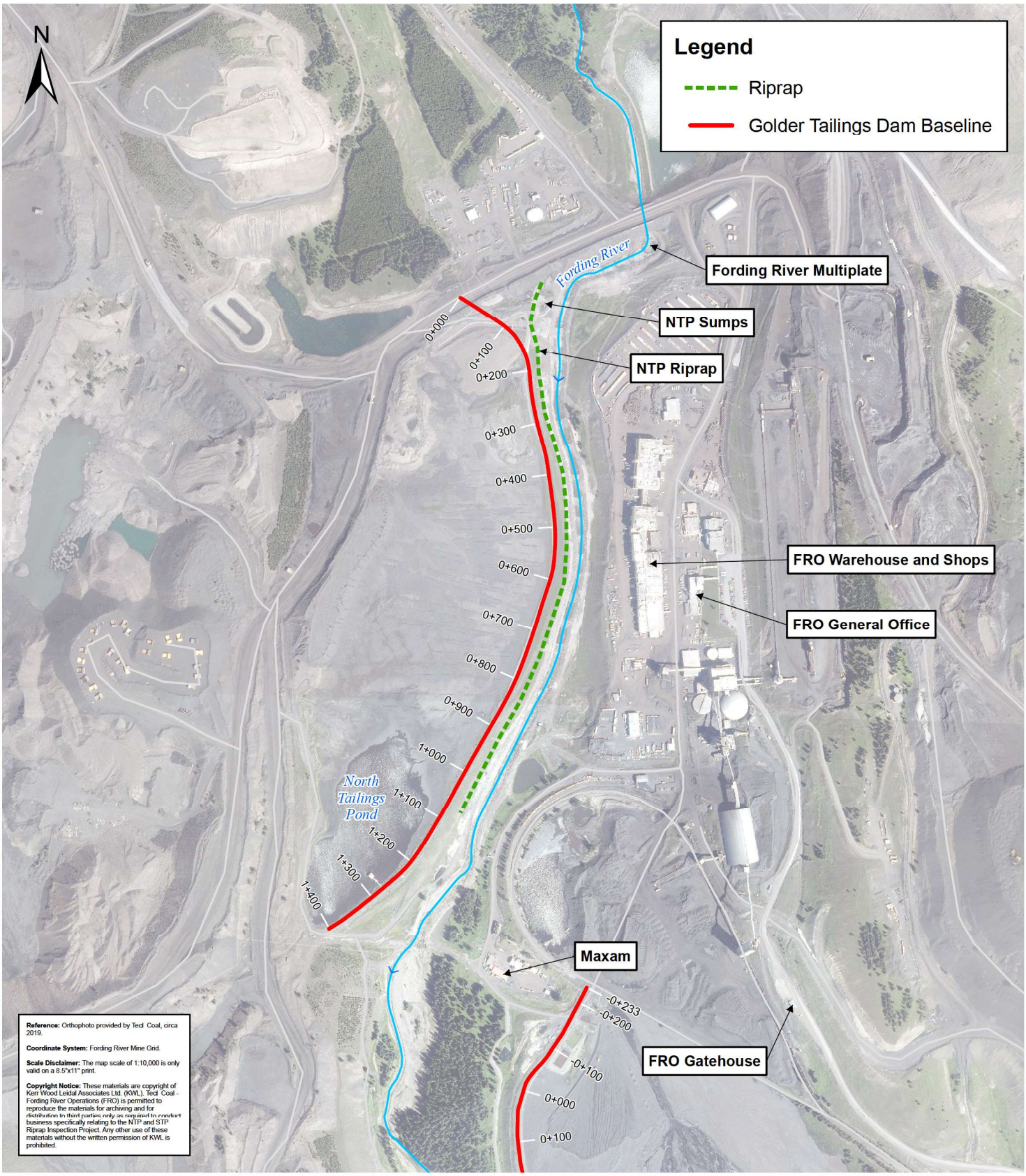
Photo 14: Weathering riprap at the emergency riprap stockpile.

Photo 15: Riprap at emergency riprap stockpile.

Teck Coal - Fording River Operations (FRO)

NTP and STP Riprap Inspection

KERR WOOD LEIDAL consulting engineers



Project No.	8-284
Date	November 2020
Scale	1:10,000

0 50 100 200 Meters

North Tailings Pond

Figure 1

Teck Coal - Fording River Operations (FRO)

NTP and STP Riprap Inspection

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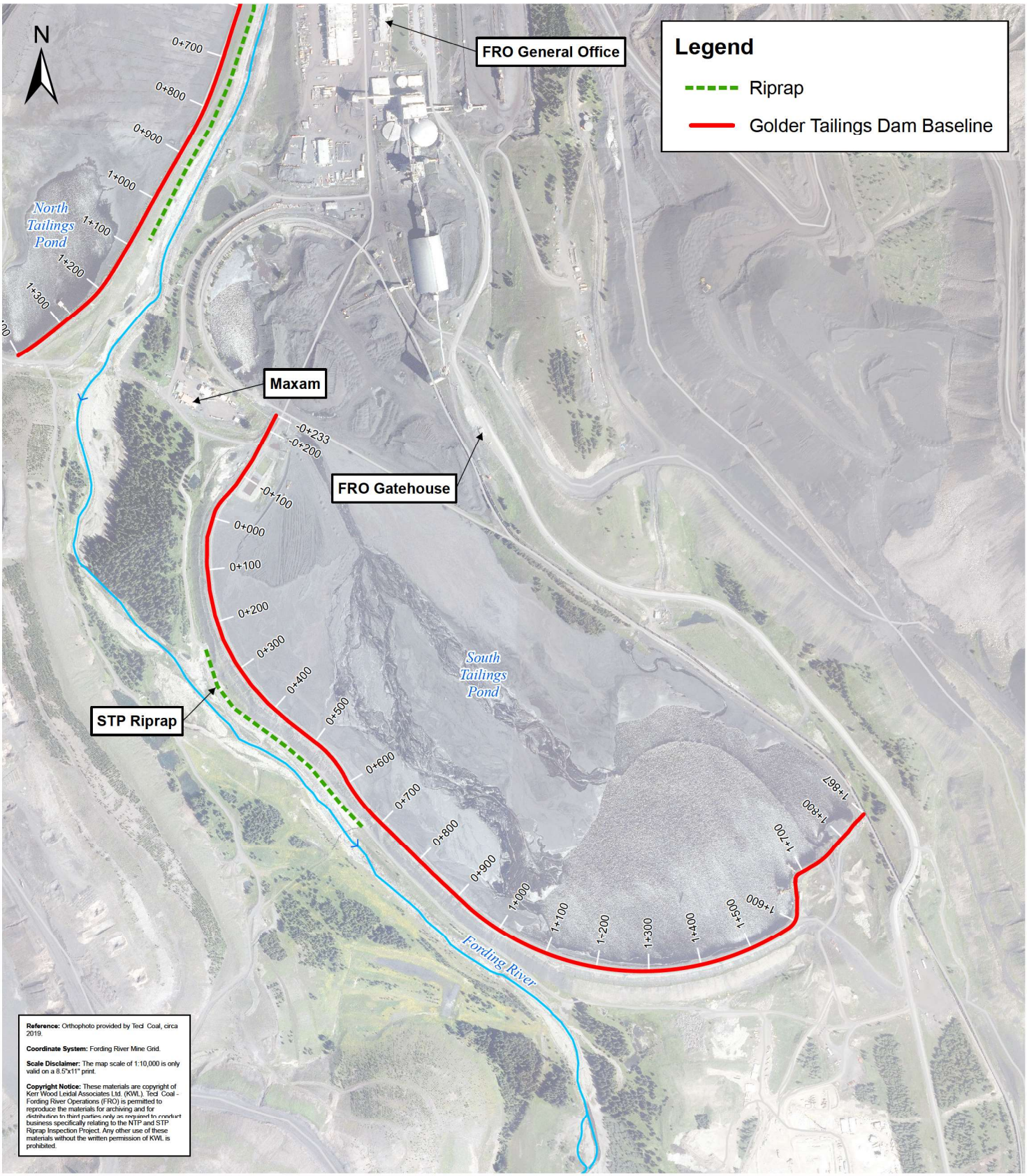

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Scale 1:10,000

0 50 100 200 Meters

South Tailings Pond

Figure 2

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