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TECK COAL LIMITED
FORDING RIVER OPERATIONS

2017 Dam Safety Inspection for North Tailings Pond and South Tailings Pond

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REPORT

Golder Associates

Executive Summary

This report presents the 2017 annual dam safety inspection (DSI) for the North Tailings Pond (NTP) and South Tailings Pond (STP) facilities at the Teck Coal Limited, Fording River Operations (FRO) mine site, located near Elkford, British Columbia. This report was prepared based on a site visit carried out by Golder Associates Ltd. (Golder) from 3 to 5 October 2017, discussion with FRO staff, and a review of data provided by FRO. The reporting period for the data review is from September 2016 to September 2017, unless otherwise noted. The dam inspection reports and photographs from the site visit are presented with this report. The DSI report was prepared in accordance with Part 10 of the Health, Safety and Reclamation Code (HSRC) for Mines in British Columbia (MEM 2017), which sets out the frequency for inspection of dams and tailings storage facilities.

John Cunning, P.Eng., of Golder is the Engineer of Record for the NTP and STP dams. Kerr Wood Leidal Associates Ltd. (KWL) has historically been the Designer of Record for hydraulics-related works and has completed the most recent Fording River hydraulics assessment, including design for erosion protection along the dam toes following the 2013 flood event. Golder, FRO, and KWL are in the process of clarifying and documenting the roles of the Engineers of Record for the geotechnical and hydraulics-related works. The annual riprap inspection report by KWL is appended.

Summary of Facility Description

The FRO site is an open pit coal mine located near Elkford, BC. FRO's tailings storage infrastructure includes two tailings pond facilities: the NTP and the STP. The NTP has been essentially filled to its design capacity and is currently inactive. Tailings discharge from the wash plant is currently directed to the STP.

The NTP is a zoned earth fill dam located on the west side of a realigned reach of the Fording River across from the wash plant. The NTP was developed on a segment of the Fording River flood plain and has a surface area of approximately 32 ha and a minimum crest elevation of 1,652.6 m.

The STP facility is located south of the wash plant, on the east side of a realigned reach of the Fording River, and occupies a total area of approximately 67 ha and a minimum crest elevation of 1,637.8 m. The STP was developed on the flood plain of the Fording River.

Summary of Key Hazards

The key hazards for the NTP and the STP facilities are as follows:

- internal erosion (suffusion and piping)
- overtopping
- instability
  - static
  - seismic
  - erosion of toe from the Fording River

Dam Classification

Both the NTP and STP dams meet the definition of a “dam” as defined in the HSRC (MEM 2017).

Both of the dams are classified as Very High consequence, following the dam consequence classification guidelines from HSRC Guidance Document Section 3.4 (MEM 2016), which references the Canadian Dam Association (CDA) *Dam Safety Guidelines* (CDA 2013). The updated consequence classification requires a reassessment of the seismic stability and the freeboard (based on the inflow design flood). This reassessment is in progress at the time of writing.

An incremental inundation assessment was completed to assess the consequence of failure of the NTP and STP during a major flood event of the Fording River (Golder 2017g). The assessment concluded that the consequence of a failure occurring coincident with a major river flood event was High. A risk-informed assessment, which would be supported by a design level flood-induced dam break and inundation assessment, is recommended to determine the appropriate criteria for the flood protection requirements along the downstream toes of the NTP and STP dams.

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

A probable maximum flood assessment was completed for the Fording River watershed above the NTP and STP facilities by KWL (2017b). The probable maximum flood peak Fording River flow estimate is 790 m^3/s for the Fording River watershed with consideration of planned future mining activities. Additional details are available in the KWL report (2017b).

North Tailings Pond

The Liverpool outlet channel and fish barrier at the north abutment area of the NTP facility were completed in late 2016. They are not considered part of the NTP facility, but as part of the Liverpool Sediment Pond system. A figure outlining the NTP facility boundary has been prepared and should be included in the OMS for each facility. Discussions between Engineers of Record for each facility and FRO should be held to review the boundary.

Riprap upgrade works to accommodate the revised Q200 design flow plus 0.5 m were completed in 2017 at the NTP under the direction of KWL. In 2017, the setback riprap between Sta. 0+165 and 0+205 was constructed to complete the riprap revetment and the riprap elevation between Sta. 0+205 and 0+930 was increased to meet the 2016 design basis, however, there remains areas that are about 0.1 to 0.2 m below the design elevation. Riprap has been placed along a section approximately 1,030 m long, from the Fording River Multiplate haul road along the Fording River to approximately Sta. 1+080 (KWL 2017c).

There were no significant changes in visual monitoring records, instrumentation, dam stability, or surface water control for the NTP since the 2016 DSI. Draft quantitative performance objectives (QPOs) for the inclinometers have been developed.

South Tailings Pond

There was a potential tailings water discharge event in late June 2017 when FRO Environmental personnel noticed water seeping back into the STP dam in the area of the north abutment. Water was seeping into an incomplete section of the dam embankment, presumably into granular fill around the FortisBC gas line. No seepage was observed exiting the downstream slope of the north abutment and no soft spots were found on the crest of the north abutment. A sandbag berm was constructed near the STP discharge as a temporary measure to exclude tailings water from the area, and a till berm was later constructed directly behind the sandbag berm (Golder 2017e). Golder does not characterize this event as a "spill" as no tailings water was discharged to the environment, although FRO personnel pre-emptively reported to Emergency Management BC as a precautionary measure.

The berms along the West Dam of the STP's lower access road were repaired in August 2017 in the area adjacent to the Fording River bank. The ditches along the base of the West Dam were also cleaned out and regraded.

Riprap was placed along the upstream slope of STP between Sta. 0+700 and 1+700 from 20 to 29 September 2017.

An emergency riprap stockpile is typically maintained at the south end of the STP with an approximate volume of 4,500 m^3. The stockpile was removed to be used in a rock drain project for the Swift expansion. The riprap stockpile was replaced with better quality material in late 2017. The removal of the stockpile was completed in consultation with the tailings engineer and replaced within a timely manner.

There were no significant changes in visual monitoring records, instrumentation, dam stability, or surface water control for the STP since the 2016 DSI. Draft QPOs for the inclinometers have been developed.

Review of Operation, Maintenance, and Surveillance Manual

The most recent update of the operation, maintenance, and surveillance (OMS) manual was completed by FRO in 2015 (FRO 2015b). As required by HSRC Section 10.5.2 (MEM 2017), FRO is currently completing a review and update of the OMS manual for the NTP and STP which is expected to be issued in Q2 2018.

Review of Emergency Preparedness Plan and Emergency Response Plan Manuals

An update to the 2015 version of the emergency response plan (ERP) is in draft for the NTP and STP (SP&P EP.009) (FRO 2017a). The updated ERP now includes the in pit tailings storage facilities on site. This document was updated to meet the guidelines provided by the HSRC (MEM 2016, 2017), the CDA (2013), the Mining Association of Canada (MAC 2011, 2017), and Teck Resources Limited guidelines (Teck 2014).

FRO has also developed a *Tailings Impoundment Flood Response Protocol for the Fording River*. This document was issued on 26 September 2017 (FRO 2017c).

The emergency preparedness plan (EP.008.R1) was last updated on 15 December 2015 (FRO 2015a). FRO plans to update the emergency preparedness plan once the ERP is finalized as the document will outline the warnings FRO will issue and the expected actions of local authorities and other responders for dam breach flood emergencies.

The emergency planning documents should continue to be reviewed at least annually, with updates incorporated when required. The ERP should be tested annually. FRO plans to tabletop test the ERP in 2018.

Dam Safety Review

The most recent dam safety review (DSR) of the NTP and STP was completed in 2014 (KCB 2014). A DSR is required every five years for all water and tailings storage facilities regardless of dam consequence classification according to HSRC Section 10.5.4 (MEM 2017). The next DSR is required in 2019.

Annual Dam Inspection

The NTP and STP facilities were observed to be in good condition at the time of the 2017 annual inspection.

Status of 2016 Dam Safety Inspection Recommended Actions

A number of recommended actions were prepared as part of the 2016 annual DSI (Golder 2017b). A summary of the status of the 2016 annual DSI recommended actions is presented in Table E-1. Recommendations that are noted as complete can be closed out. Items from the 2016 DSI that are incomplete have been brought forward into the 2017 DSI recommendations (Table E-2).

There are a number of recommendations that are in progress and some that are incomplete, however Golder feels the work is being appropriately prioritized based on good communication between the EoR team and the FRO tailings engineer.

Table E-1: Current Status of 2016 Dam Safety Inspection Recommendations for the North Tailings Pond and South Tailings Pond

Facility	ID Number	Deficiency or Non-conformance	Recommended Action	Updated Status as of March 2018
NTP	2015-05a,b	No passive emergency system against overtopping; emergency system requires active response	Assess the need for spillway after finalizing the closure plan NTP.	**Incomplete –** see Table E-2 for updated recommended action and deadline
			If required, determine a construction schedule.	**Incomplete –** see Table E-2 for updated recommended action and deadline
	2015-06a,b,c	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 Fording River and timeline to implement.	**Incomplete –** see Table E-2 for updated recommended action and deadline
			Implement required protection measures for the operational phase according to the as-defined schedule.	**Incomplete—** see Table E-2 for updated recommended action and deadline
			Execute the flood risk mitigation plan until the flood protection requirements defined by the risk-informed assessment are in place.	**Ongoing**
	2015-07a,b	Buried pipes passing through crest locations	Complete review of pipe abandonment timeline as part of feasibility investigation into NTP decommissioning.	**Complete** – Golder provided recommendations for pipe abandonment in November 2017, pipes are currently capped on upstream side and are inspected regularly
			If required, execute abandonment plan.	**Incomplete –** see Table E-2 for updated recommended action and deadline
	2016-05	North abutment excavated without input or approvals from Engineer of Record or Qualified Person	Assess and revise required internal and external communication for work and construction activities carried out near the site TSFs.	**In Progress –** to be included in OMS manual
			Sediment pond designer to sign off on reconstruction of NTP dam north abutment.	**Complete** (AMEC 2017)
			Engineer of Record to review final NTP dam re-construction summary.	**Complete** – Liverpool outlet channel and fish barrier should now be considered outside of NTP facility and part of Liverpool Sediment Pond System.
	2016-06	No closure plan for NTP	Develop closure plan for NTP based on results of feasibility investigation into NTP decommissioning.	**In Progress** – prefeasibility design completed
	2016-7a,b	Additional animal burrows in toe of south abutment	Fill voids in downstream slope created by burrows.	**Complete**
			Perform regular inspection for new burrows. Burrows to be marked or identified by GPS during inspection to improve tracking of ongoing efforts.	**Ongoing**, include in OMS manual update
	2016-11	Discrepancy within the documentation regarding the minimum elevation of the NTP crest. The lower elevation value has been reported here (i.e., more conservative)	The NTP dam, particularly the dam crest, be surveyed to confirm the minimum dam elevation.	**Complete**
STP	2013-16	No passive emergency system against overtopping; emergency system requires active response	Assess the best combination of active and passive emergency systems during various stages of the pond life cycle. If the assessment determines that passive systems are warranted, then develop a construction schedule for the selected system(s).	**Incomplete –** see Table E-2 for updated recommended action and deadline
	2015-11	Over-steepened relative to design and susceptible to erosion from wave action	Regrade upstream slope to design (1.75H:1V) and place riprap on regraded slope.	**Complete**
	2015-12a,b,c	Riprap erosion protection along downstream toe north of STP Stn. 0+680, no riprap south of STP Stn. 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.	**In Progress** – completed drilling program for widening of Fording River channel
			Implement required protection measures for the operational phase according to the as-defined schedule.	**Incomplete –** see Table E-2 for updated recommended action and deadline
			Execute flood risk mitigation plan until flood protection requirements defined by the risk-informed assessment are in place.	**Ongoing**
	2016-08	Ditch adjacent road on West Dam bench filled in by haul truck traffic	Reinstate ditch to functional condition.	**Complete**
	2016-12	Hydroseeding in the repaired sections of the STP downstream slope did not root. No records available	Hydroseeding should be incorporated into the tailing management system and records of hydroseeding, including the success rate, should be kept.	**Incomplete** – recommendation moved to OMS manual updates (2016-03)

Facility	ID Number	Deficiency or Non-conformance	Recommended Action	Updated Status as of March 2018
	2016-13	The GoldSIM water balance model is not accurately accounting for the change in available volume in the STP due to dredging (increase in available volume) and tailings depositions (decrease in available volume)	The change in available volume be included in future water balances to improve the STP water balance.	**Complete**
NTP/STP	2015-03	Roles of Geotechnical and Hydraulics Engineers of Record undocumented	Golder, FRO, and KWL to document the roles of the Engineer of Record for the geotechnical and hydraulics related works in the OMS manual.	**In Progress –** to be included in OMS manual
	2016-01a,b	Seismic design criteria for stability out of date due to dam reclassification from High to Very High	Complete updated seismic stability assessment and liquefaction based on revised design criteria.	**In Progress** – draft assessment complete, seismic stability meets or exceeds new design criteria
			Update QPOs based on revised stability assessment.	**In Progress** – pending completion by Golder, updated GPS & prism QPOs in this DSI report; updated piezometer QPOs pending completion by Golder
	2016-02	IDF and freeboard out of date due to dam reclassification from High to Very High	Update the IDF and freeboard assessment for the NTP and STP.	**In Progress** – draft assessment complete.
	2016-03	OMS manual requires updating	Update OMS manual as follows: ■ Update all references to consequence classification of structures—change from High to Very High. ■ Include design criteria. ■ Review the manual using the updated HSRC and Guidance Document (MEM 2017, 2016). ■ QPOs to be included for surveillance. ■ The dredging section needs to be updated to identify that dredging is currently operating to the Turnbull Tailings Storage Facility. ■ Include safe work plans. ■ Include incident reporting procedures. ■ Include non-compliance reporting procedures. Complete minor updates identified in the 2015 DSI report (Golder 2016b).	**In Progress –** under review by FRO, QPO update pending completion by Golder
	2016-04	EPP & ERP require updating	Reference to the QPOs needs to be included for actions required based on instrumentation warnings and alarms.	**In Progress** – pending completion by FRO
	2016-09	No QPOs set for inclinometers	QPOs and frequency of readings should be set for the inclinometers.	**In Progress** – draft complete.
	2016-10	Warning level QPO for piezometers exceeded. Based on review of data, this is not a failure concern	Update warning level QPOs for piezometers based on review of data all available data (2014 to present).	**In Progress** – pending completion by Golder, recommendation incorporated in 2017-06

IDF = inflow design flood; FRO = Fording River Operations; KWL = Kerr Wood Leidal Associates Ltd.; NTP = North Tailings Pond; STP = South Tailings Pond; HSRC = Health, Safety and Reclamation Code; DSI = dam safety inspection; TSF = tailings storage facility; OMS = operation, maintenance and surveillance; EPP = Emergency Preparedness Plan; ERP = Emergency Response Plan; QPO = quantitative performance objectives.

2017 Dam Safety Inspection Findings and Recommended Actions

Table E-2 summarizes the 2017 findings and recommended actions for the NTP and STP, along with incomplete and in progress items from previous DSIs. Previous recommendations have been reviewed and updated according to the information included in the 2017 DSI.

Table E-2: 2017 Dam Safety Inspection Recommended Actions for the North and South Tailings Pond Facilities

Structure	ID Number	Deficiency or Non-conformance	Applicable Guideline or OMS 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 finalizing the closure plan NTP.	4	Q3 2018
				If required, determine a construction schedule.	4	Q4 2018
	2015-06a,b,c	Risk-informed criteria for flood erosion protection along toe of dams not defined	CDA 2013 §6.2	Perform risk-informed assessment to determine appropriate flood protection requirements for downstream toe of dam along the Fording River and the timeline to implement.	2	Q3 2018
				Implement required protection measures for the operational phase according to the as-defined schedule.	2	2019
				Execute the flood risk mitigation plan until the flood protection requirements defined by the risk-informed assessment are in place.	1	Ongoing
	2015-07a,b,c	Buried pipes passing through crest locations	n/a	Inspect steel pipes as part of regular dam inspections until NTP closure plans are finalized. Include inspections in OMS manual update.	3	Q2 2018 (tentatively complete since December 2017, pending final OMS revision)
				Execute abandonment plan for PVC pipes.	3	Q4 2018
	2016-05a	North abutment excavated without input or approvals from Engineer of Record or Qualified Person	n/a	Assess and revise required internal and external communication for work and construction activities carried out near the site TSFs	1	Q2 2018 (tentatively complete since March 2018, pending final OMS revision)
	2016-06	No closure plan for NTP	n/a	Develop closure plan for NTP based on results of feasibility investigation into NTP decommissioning.	4	Q4 2018
STP	2013-16	No passive emergency system against overtopping; emergency system requires active response	n/a	Assess the best combination of active and passive emergency systems during various stages of the pond life cycle. If the assessment determines that passive systems are warranted, then develop a construction schedule for the selected system(s).	4	Q4 2018
	2015-12a,b,c	Riprap erosion protection along downstream toe north of STP Stn. 0+680, no riprap south of STP Stn. 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	Q3 2018
				Implement required protection measures for the operational phase according to the as-defined schedule.	2	2019 or as determined by schedule
				Execute flood risk mitigation plan until flood protection requirements defined by the risk-informed assessment are in place.	1	Ongoing
	2017-01	North abutment construction deficiencies	HSRC §10.5.1(3)	Address construction deficiency, finish dam construction.	2	2019
	2017-02	Tailings that were excavated along upstream slope to place the riprap zone impede water flow towards main pond	n/a	The tailings should be regraded with an excavator so that water will preferentially flow into the pond.	4	Q3 2018
	2017-03	Inspection frequency inadequate for active, Very High consequence facility	HSRC §10.1.12	Increase geotechnical inspections to weekly from April to October and twice per month from November to March for STP	3	Q2 2018 (in progress, pending final OMS revision)
	2017-04	Planned dredging of Tailings to Turnbull TSF is behind schedule and the result is a very high level of tailings in STP which is causing operational issues (e.g., disposition line	n/a	Dredging to Turnbull TSF should be started as soon as possible with an increased annual dredging target.	2	Q2 2018

Structure	ID Number	Deficiency or Non-conformance	Applicable Guideline or OMS Reference	Recommended Action	Priority Level	Recommended Timing for the Action
		backing up and reclaimed process water with too much sediment)				
NTP/STP	2015-03	Roles of Geotechnical and Hydraulics Engineers of Record undocumented	HSRC §10.1.5	Golder, FRO, and KWL to document the roles of the Engineer of Record for the geotechnical and hydraulics related works in the OMS manual.	4	Q2 2018
	2016-01	Seismic design criteria for stability out of date due to dam reclassification from High to Very High	HSRC §10.1.4 & 8	Complete updated seismic stability assessment and liquefaction based on revised design criteria. Check effects of upward gradient noted in STP piezometers.	2	Q2 2018 (draft in review)
	2016-02	IDF and freeboard out of date due to dam reclassification from High to Very High	HSRC §10.1.4 & 8	Update the IDF and freeboard assessment for the NTP and STP.	2	Q2 2018 (draft in review)
	2016-03	OMS manual requires updating	HSRC §10.5.2(4)	Update OMS manual as follows: ■ Update all references to consequence classification of structures—change from High to Very High. ■ Include design criteria. ■ Review the manual using the updated HSRC and Guidance Document (MEM 2017, 2016). ■ Review the manual using most recent MAC guidelines ■ QPOs to be included for surveillance. ■ The dredging section needs to be updated to identify that dredging is currently operating to the Turnbull Tailings Storage Facility. ■ Include safe work plans. ■ Include incident reporting procedures. ■ Include non-compliance reporting procedures. ■ Include animal burrow inspection and procedures ■ Include NTP pipe inspections ■ Include hydroseeding records ■ Include Liverpool and NTP boundaries Complete minor updates identified in the 2015 DSI report (Golder 2016b).	4	Q2 2018 (draft in progress)
	2016-04	EPP & ERP require updating	HSRC §10.4.2(1)	Reference to the QPOs needs to be included for actions required based on instrumentation warnings and alarms.	4	Q3 2018
	2016-09	No QPOs set for inclinometers	HSRC §10.1.13	QPOs and frequency of readings should be set for the inclinometers.	3	Q2 2018 (draft in this document)
	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	Q4 2018
	2017-06 (supersedes 2016-01b and 2016-10)	Trigger-action-response plans (TARPs) and related QPOs not strongly tied to risk assessment results	HSRC §10.5.2	TARPs with related monitoring plans and QPOs should be reviewed with consideration of the results from the 2017 TSF risk assessment	3	Q3 2018

STP = South Tailings Pond; NTP = North Tailings Pond; FRO = Fording River Operations; KWL = Kerr Wood Leidal Associates Ltd.; OMS = operation, maintenance and surveillance; CDA = Canadian Dam Association; HSRC = Health, Safety and Reclamation Code; QPO = quantitative performance objectives; EPP = Emergency Preparedness Plan; ERP = Emergency Response Plan; Stn. = Station; n/a = not applicable; DSI = dam safety inspection; TSF = tailings storage facility.

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 (MEM 2016).

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APPENDICES

1.0 INTRODUCTION

1.1 Purpose, Scope of Work, Methodology

The report presents the annual dam safety inspection (DSI) for the North Tailings Pond (NTP) and South Tailings Pond (STP) at the Teck Coal Limited (Teck), Fording River Operations (FRO) site, located near Elkford, BC. The reporting period for the data review is from September 2016 to September 2017, unless otherwise noted.

This report was prepared by Golder Associates Ltd. (Golder) at the request of Teck, in accordance with the Teck Guidelines for Tailings and Water Retaining Structures (Teck 2014).

The report is based on a site visit carried out by Golder from 3 to 5 October 2017, discussions with FRO staff, and review of data provided by FRO. The report consists of the following:

- a summary of the site conditions and background information for the facilities
- a summary of the construction, operating, and/or maintenance activities for the 2016/2017 period
- review of dam consequence classification and required operational documents
- site photographs and records of dam inspection
- review of climate data
- review of water balance
- review of dredging data
- review of assessment of dam safety relative to potential failure modes
- findings and recommended actions

Photographs of NTP and STP 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 C.

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 2016, and is reported in the 2016 DSI report (Golder 2017b).

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 *Mines Act* and 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 (MEM 2017), which sets out the frequency for inspection of dams and tailings storage facilities. It is understood that this report will be submitted by FRO to the Chief Inspector of Mines.

The guidelines for annual safety inspection reports provided in the HSRC Guidance Document (Section 4.2, MEM 2016) were followed where applicable during the preparation of this report.

1.2.2 Permits and Licences

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

- Permit C-3 Amendment to permit approving work system – South Tailings Pond tailings dredging project. Issued by 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 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 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 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 Ministry of Energy and Mines. 15 December 2015.
- Permit 424 Amendment to permit to discharge effluent. Issued by Ministry of Environment. 6 December 2016.

2.0 BACKGROUND

2.1 Site History

The FRO site is an open pit coal mine located near Elkford, BC. This DSI report is for two of the site's tailings pond facilities: the NTP and the STP. The NTP has been essentially filled to its design capacity and is currently inactive. Tailings discharge from the wash plant is currently directed to the STP.

The NTP is located on the west side of the Fording River across from the wash plant. The STP facility is located south of the wash plant, on the east side of the Fording River. Figure 1 shows a location and plan view of the NTP and STP facilities.

2.2 System Description

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

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 for the wash plant

2.2.1 Tailings Description

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. 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 mixed with the CR to produce combined coarse and fine rejects (CCFR) which are hauled by trucks to a designated CCFR spoil. The flotation tailings from the wash plant are transferred in slurry and are hydraulically deposited from an end of pipe discharge into the south tailings pond.

2.2.2 Tailings Impoundments

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

Tailings are periodically dredged from the STP to restore available tailings storage capacity. Previously, the dredged tailings were pumped to either the NTP, 2 Pit, or 3 Pit South (Golder 2016c). Dredging discharge into the NTP and 2 Pit was discontinued due to capacity constraints in 2008. No dredged tailings have been sent to 3 Pit South since 6 October 2015. Starting in 2016, tailings have been dredged seasonally from the STP to the Turnbull Tailings Storage Facility (TSF) and dredging to the Turnbull TSF is planned to continue annually.

2.3 Overview of Design, Construction, and Previous Operation

A summary of the NTP and STP design, dam construction, and operations is presented in the following subsections. Additional details of construction history are presented in the operation, maintenance, and surveillance (OMS) manual (FRO 2015b).

2.3.1 North Tailings Pond

A plan view of the NTP facility is shown in Figure 2 and 3. The NTP was developed on a segment of the Fording River flood plain and has a surface area of approximately 32 ha. The Fording River was diverted into a new constructed channel (McElhanney 1969) to allow for construction of the NTP against the west side of the Fording River flood plain (Golder Brawner 1969). Along the eastern and southeastern sides of the pond, confinement for water and the stored tailings is provided by a zoned earth fill dam that has a maximum height of approximately
24 m. A confining dam is not required along the west side of the pond because the natural topography to the west of the NTP is higher than the pond level.

The dam extending along the eastern side of the NTP consists of a zoned earth fill dam. Figure 4 presents a typical section through this dam. 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 glacial till dam was extended upward in the form of an upstream inclined zone. Structural support for this inclined till zone is provided by 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 are expected to serve as an underdrain that promotes downward seepage from the dam.

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 was raised four times between 1973 and 1979 (Golder Brawner 1973, 1974a,b, 1975a,b; Golder 1979) when the NTP reached its current elevation and full tailings capacity. Between 1979 and 1991, the NTP was inactive and the facility was dewatered and excavated via scrapers to recover additional tailings storage capacity (FCL 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. 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.

The current ultimate crest of the dam at the NTP is elev. 1,653.09 m (reported as elev. 1,653.54 m FRO Mine Grid FRO 2015b). The minimum elevation of the NTP is at elev. 1,652.6 m (2017 survey completed by FRO).

Following the flood of June 1995, riprap was placed along the outside toe of the dam, as well as along the opposite (left) side of the 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 Kerr Wood Leidal Associates Ltd. (KWL 2007, 2009, 2014b).

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 triggered major erosion of the CR shell. Golder was retained by FRO to provide geotechnical input for flood repairs of the NTP. KWL was retained to provide recommendations for sizing and placement of the riprap (KWL 2014a,b). The dam shell was rebuilt using CCFR. A total CCFR fill of approximately 22,350 m^3 was placed and compacted between 3 July and 8 August 2014 (Golder 2014b).

In 2016, FRO constructed a sediment pond north of the NTP (Liverpool Sediment Ponds), and 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 NTP dam (AMEC-FW 2017). The sediment pond system has a future option for a polishing pond which would be located on the northern area of the NTP tailings deposit.

Riprap upgrade works began under the direction of KWL in 2016. The 2016 work included placing approximately 2.5 m of riprap along the existing NTP riprap alignment for scour protection and to accommodate the revised Q200 design flow. Construction completed during 2017 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. Approximately 40 m of buried riprap and 95 m of riprap topping were to be completed in 2017 (KWL 2017c). KWL provided oversight to the gradation and quality of the riprap, which was sourced on site. Two deficiencies following the 2016 works at the NTP dam were noted in KWL (2017a). The deficiencies were addressed in 2017 as described in Section 3.1.4 (KWL 2017c).

The future use of the NTP is under review.

2.3.2 South Tailings Pond

A plan view of the STP facility is shown in Figure 5 and 6. The STP occupies a total area of approximately 67 ha and is located to the south of the wash plant, on the east side of a realigned reach of the Fording River. The STP 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 full 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 have been raised in six stages:

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 1,637.8 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 with construction carried out in 2013. Designs of the north and south abutment sections of the dam are presented in the design update report and design drawings (Golder 2011, 2012c), and the construction summary of the STP raise is reported in the construction record report (Golder 2014c).

The current minimum crest of the dam at the STP has remained at elev. 1,637.8 m (reported as elev. 1,638.3 m FRO Mine Grid in FRO 2015b). The 2017 LiDAR survey provided by FRO confirms the dam crest is on average between elev. 1,638 and 1,639 m.

The dam construction prior to 2008 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 Figures 7 and 8.

The June 2013 flooding of the Fording River caused high flows along the toe of the STP dam, which eroded the foundation soils and a minor portion of the CR shell. Repairs to the STP toe area were completed in 2013, after the NTP flood repairs as the damage to the STP was considered to be less critical.

Riprap upgrades were completed for the STP in 2016. KWL oversaw the placement of approximately 2.5 m of riprap by FRO and FRO contractors along the existing STP riprap alignment for scour protection and to accommodate the revised Q200 design flow (KWL 2017c). Golder provided on site services to oversee resloping of the till bench, cutting into existing bedrock for key-in of the riprap material, and monitoring seepage conditions and signs of instability (Golder 2017a).

Outstanding recommendations from the reconstruction (Golder 2014c) are as follows:

- Repaired sections of the downstream slope and toe were recommended to be hydroseeded to minimize surface erosion. The seed did not root in the area. Hydroseeding should be incorporated into the tailing management system and records of hydroseeding, including the success rate, should be kept.
- River flood protection (updated from resloping and riprap placement) south of STP Stn. 0+680 (updated from 0+600) should be completed to improve long-term stability of the STP structure.

2.3.2.1 Main Dam

The STP Main Dam, which extends across the Fording River flood plain, has a maximum height of approximately 35 m. Figure 7 presents a typical section of the STP Main Dam, which consists of an upstream low permeability starter dam of compacted glacial till soil that has been raised with an inclined upstream low permeability zone of compacted glacial till soil, supported by a zone of CR or CCFR. The CR or CCFR zone that forms the downstream shell of the Main Dam provides the structural strength of the dam.

As indicated in Figure 7, discontinuous flood plain sands and gravels extend beneath the whole downstream shell of the Main Dam. These flood plain sediments are very pervious and serve as an underdrain for the dam.

2.3.2.2 West Dam

The STP West Dam is founded on the till bench that borders the western edge of the Fording River flood plain. A typical section through the West Dam is presented in Figure 8. The dam consists of an upstream low permeability zone of compacted glacial till soil supported by a zone of CR or CCFR.

2.3.2.3 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 assessment recommended a buttress west of the embankment to maintain stability of the railway embankment with respect to the increase in the pond elevation. Golder also recommended that FRO backfill the area east of the railway embankment to provide a buttress for the railway and improve stability (Golder 2010).

In 2012, the rejects buttress fill west of the railway embankment was raised to maintain the stability of the embankment. A till cut-off was constructed through a section, close to the south abutment, of the rejects buttress (Golder 2012c). In 2014, the rejects buttress fill was further raised by FRO personnel to maintain a trafficable surface.

The Golder (2010) recommendations included grouting the existing culverts that conveyed surface runoff through the railway embankment and installing new culverts at a higher elevation. 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 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 STP through twin culverts installed in 2010.

2.3.2.4 Waste Water Cells

Waste water cells were built on the north end of the STP (Figure 6) to store waste water from the truck shop sumps for a period of time that would allow hydrocarbons to be floated and sludge to settle prior to removal from site. These cells are designed to decant to the STP, with minimal surface water and hydrocarbons reaching the STP. Samples are taken monthly to ensure the permitted limit of 15 mg/L of hydrocarbons is not exceeded.

2.3.3 Water Management of North Tailings Pond and South Tailing Pond

Water levels in the NTP and the STP are managed to maintain the required minimum freeboard at each facility.

Floating reclaim pumps are used to recirculate water from the STP to the wash plant. Water demand at the wash plant is greater than the volume of water that is available from recirculation of slurry transport water alone, creating a water deficit in the system which is accommodated through introduction of makeup water to the STP from various locations on site. There are no permanent working pumps at the NTP.

In the event of high pond levels in either the NTP or the STP, the OMS manual indicates the pond levels will be controlled by shutting off all input sources and pumping the excess water to other locations on site (FRO 2015b). A passive system of controlling pond levels (such as a spillway) is not currently available in either the NTP or the STP.

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

The following design parameters apply to the NTP and STP. Typical sections of the dams are shown in Figure 4 for the NTP and in Figures 7 and 8 for the STP.

2.3.4.1 Foundation Materials

The retention dams at the NTP and the STP 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 NTP and STP dams (FRO 2016).

2.3.4.2 Embankment Fill Materials

The following materials were used in the construction of the dams: till fill and CR and CCFR.

2.3.4.2.1 Till Fill

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

2.3.4.2.2 Coarse Rejects and Combined Coarse and Fine Rejects

At both the NTP and the STP, the bulk of the fill that provides support for the low permeability zone of the dams consists of CR. The CR is a waste product generated at the wash plant and consists of sand and gravel-sized, well-graded, washed crushed rock.

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 presented in Table 1.

Table 1: Engineering Properties of Compacted Coarse Rejects

Property	Value
Average in situ density	1.75 t/m^3
Friction angle	38 to 40.5 degrees
Compressibility	Low

2.3.4.3 Seismicity

The site is located in an area of relatively low seismicity for British Columbia. 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 2016a). 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 CDA (2013, 2014) is shown.

FRO site coordinates: 50.202°N, -114.876°W.

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

2.4 Dam Consequence Classification

Guidelines for the classification of dams are presented in the HSRC Guidance Document, Section 3.4 (MEM 2016), which references the Canadian Dam Association (CDA) *Dam Safety Guidelines* (CDA 2013). Table 3 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 of four loss categories. The classification assigned to a dam is the highest rank determined among the four loss categories.

Table 3: 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 (MEM 2016), Table 3-3 based on CDA (2013), Table 2-1.

2.4.1 Facility Consequence Classification

An inundation study considering both flood-induced (overtopping) and sunny day (piping) failure modes for the NTP and STP 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 NTP and STP facilities is as follows:

- **Population at risk (High)**—Permanent, as identified by Golder (2014e), some 18 permanent residences are located on the floodplains downstream of the dams within the flood inundation extents.
- **Loss of life (Significant to High)**—Since people may be present in the inundation zone, it is foreseeable that there is a possibility for loss of life (for STP and NTP permanent downstream residences and for Maxam Yard [site explosive storage facility including Maxam personnel offices]). Quantification of loss of life has been conservatively inferred from population at risk (Golder 2014e; KCB 2014).
- **Environmental and cultural (High to Very High)**—Presence of critical habitat for Westslope Cutthroat Trout, a species of Special Concern. Restoration is considered to be possible but difficult. The classification is Very High for fair weather failure scenario and High for flood-induced failure scenarios (Teck 2016).
- **Infrastructure and economics (High)**—Economic losses are anticipated to be high in the event of a failure (Golder 2014e).

Table 4 presents a summary of the current dam consequence classifications for the FRO facilities.

Table 4: Dam Consequence Classification Results

FRO Facility	Dam Class	Population at Risk	Consequences of Failure		
			Loss of Life	Environment and Cultural Values	Infrastructure and Economics
NTP	**Very High**	High	Significant to High	High to Very High	High
STP	**Very High**	High	Significant to High	High to Very High	High
NTP and STP 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 NTP and STP only and does not change the overall classification of the facility. Refer to Section 2.5.4, CDA 2013.

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

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

2.4.2 River Flood Component Consequence Classification

An incremental inundation assessment was recently completed (Golder 2017g) to assess the consequence of failure of the NTP and STP 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 was High.

A risk-informed assessment, which would be supported by a design level flood-induced dam break and inundation assessment, is recommended to determine the appropriate criteria for the flood protection requirements along the downstream toes of the NTP and STP dams.

2.5 Key Personnel

The Engineer of Record for the NTP and STP dams is John Cunning, P.Eng., an employee of Golder.

KWL has historically been responsible for hydraulics-related works and has completed the most recent Fording River hydraulics assessment, including design for erosion protection along the NTP and STP dam toes following the 2013 flood event. Jason Miller of KWL is the Designer of Record for the erosion protection works for both the NTP and STP facilities. Inspection of riprap for both the NTP and STP was completed in 2017 by KWL (KWL 2018).

The NTP and STP Qualified Person is Heather Brickner, P.Eng., a Tailings Engineer and employee of FRO.

Golder, FRO, and KWL are in the process of clarifying and documenting the roles of the Engineers of Records for the geotechnical and hydraulics-related works.

2.6 Quantitative Performance Objectives

Golder is currently reviewing all QPOs and this report includes information that may be updated or changed based on subsequent review by Teck and/or Golder. Specifically, trigger-action-response plans (TARPs), related monitoring plans, and QPOs should be reviewed with consideration of the results from the 2017 TSF risk assessment.

The current QPOs for the piezometers as they are set in the GeoExploer monitoring system are presented in Table 5. These QPOs are currently under review based on the updated stability assessment for the Very High dam class.

Table 5: GeoExplorer Piezometer Instrumentation Trigger Levels for NTP and STP

Dam	Monitoring Instrument	Warning Water Elevation (m)
NTP	TH15-05	> 1,646.546 m
	TH15-06	> 1,643.546 m
	TH15-07	> 1,640.546 m
STP – Main Dam	SP-3	> 1,604.046 m
	VW-3	> 1,627.046 m
	TH15-01 / VW-5	> 1,617.546 m
	TH15-02 / VW-4	> 1,624.046 m
STP - West Dam	TH15-03 / VW-1 / VW-2	> 1,627.546 m
	SP-W1	> 1,623.146 m
	SP-W3	> 1,623.046 m
	TH15-04	> 1,603.546 m

Table 6 provides updated QPOs for the prism and GPS units on the NTP and STP dams. These QPOs should be considered draft.

Table 6: Draft Prism and GPS Instrumentation Trigger Levels for NTP and STP

Dam	Monitoring Instrument	Survey Data	Warning	Alarm
NTP	Prisms	SD displacement	> 15 mm	> 20 mm
		3D displacement	> 100 mm	> 150 mm
	GPS	3D displacement	> 100 mm	> 150 mm
		3D velocity with 12 point averaging	> 50 mm/day	> 100 mm/day
STP	GPS	3D displacement	> 100 mm	> 150 mm
		3D velocity with 12 point averaging	> 50 mm/day	> 100 mm/day

SD=slope distance or two dimensional; 3D is three dimensional.

Note: Discuss with engineer of record prior to zeroing displacement data

The warning and alarm triggers shown in Table 7 are currently used by FRO for the NTP and STP pond elevations. The freeboard levels are expected to increase based on the updated consequence classification. The hydraulic assessment is under review by Teck at the time of writing this report. It is anticipated that FRO and the EoR will need to develop an action plan and schedule to address the expected changes in freeboard requirements once the revised hydraulic assessment for the Very High dam class is complete.

Table 7: Freeboard Trigger Levels for NTP and STP

Dam	Survey Data	Warning	Alarm
NTP	Pond freeboard	> 1,651.4 m	none
STP	Pond freeboard	> 1,636.8 m	> 1,636.9 m

In total, there are seven inclinometers (Table 8): 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).

Table 8: 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

Summary table provided by email (Roseingrave R. 2017.)

The inclinometers were first read in December 2015, and to date, the readings have not shown any indication of significant deformations. Maximum total downstream displacements (from the initial reading) of 3 mm have been observed in TH15-02, TH15-03, and TH15-07 during the period from December 2015 to July 2017.

Based on the information available, with a monthly data gathering frequency, the following TARP for the inclinometers is recommended:

Table 9: Draft QPO and Trigger-Action-Response Plan for Inclinometers

Item	Threshold Criteria		
	Acceptable	**Warning**	**Alarm**
Inclinometer QPO	downstream displacement < 5 mm	downstream displacement > 5 mm and < 15 mm	downstream displacement > 15 mm
Action Required	■ Record monitoring results	■ Increase frequency of monitoring of GPS and inclinometers to weekly and record results ■ Inspection of embankment in area of concern; document inspection	■ Suspend activities in area of concern ■ Increase frequency of monitoring of GPS and inclinometers to daily and record results ■ Inspection TSF by EoR or designate ■ Daily inspection of embankment in area of concern; document inspection
Personnel Notified	■ Engineering of Record receives a copy of the monitor annually with DSI data ■ Tailings Engineer	■ Engineer of Record ■ Tailings Engineer	■ Ministry of Energy, Mines and Petroleum Resources ■ Teck's Tailings Working Group ■ Engineer of Record

3.0 OPERATIONS, MAINTENANCE, AND CONSTRUCTION DURING 2017

A TSF risk assessment for both facilities was undertaken in 2017, with reporting of the results currently in progress.

Changes at the NTP and STP since the September 2016 DSI are discussed in the following sections.

3.1 North Tailings Pond

3.1.1 Operations and Capacity

The NTP was not operational in 2017 and there was no tailings deposition.

The NTP has an available volume of about 175,000 m^3 to the current freeboard elevation (1,651.4 m); about 12,000 m^3 of the available volume is occupied by the existing pond. However, the required freeboard is expected to increase based on the change to the NTP consequence classification to Very High.

For planning purposes, the NTP should be considered as having no available tailings capacity.

3.1.2 Inspections

The dam is inspected monthly by FRO geotechnical personnel, and water quality testing is completed quarterly. Dam inspection forms are provided in Appendix D. Water quality testing results are provided in Appendix E.

3.1.3 Liverpool Sediment Pond System

The Liverpool outlet channel and fish barrier at the north abutment area of the NTP facility were completed in late 2016. They are not considered part of the NTP facility, but as part of the Liverpool Sediment Pond system. However the Liverpool Sediment Pond outlet channel was constructed over the NTP tailing beach at the north end of the facility and the fish barrier structure was constructed through the NTP dam's north abutment. The area should continue to be inspected during both of the monthly NTP and Liverpool Sediment Pond. A figure outlining the NTP facility boundary has been prepared and should be included in the OMS manual for each facility. Discussions between Engineers of Record for each facility and FRO should be held to review the boundary.

3.1.4 Future Use and Analyses

The future use of the NTP is under review. Golder completed a flowability assessment for the NTP in 2016 (Golder 2017f) 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 (MEM 2017). A prefeasibility design was completed for the facility (Golder 2017d, e).

3.1.5 Riprap Improvements

Riprap upgrade works to accommodate the revised Q200 design flow plus 0.5 m were completed in 2017 at the NTP under the direction of KWL. In 2017, the setback riprap between Sta. 0+165 and 0+205 was constructed to complete the riprap revetment and the riprap elevation between Sta. 0+205 and 0+930 was increased to meet the 2016 design basis, however, there remains areas that are about 0.1 to 0.2 m below the design elevation (KWL 2017c). Riprap has been placed along a section approximately 1,030 m long, from the Fording River Multiplate haul road along the Fording River to approximately Sta. 1+080 (KWL 2017c).

3.2 South Tailings Pond

3.2.1 Operations and Capacity

The STP was active over the reporting period and received tailings and site run off.

Bathymetric surveys are completed by FRO twice a year to confirm remaining capacity in the STP. Based on the 11 September 2017 survey, there were 537,900 m^3 of tailings deposited since 4 October 2016, with a projected annual deposited volume of 628,000 m^3 (FRO 2017b).

The remaining storage in the STP as of September 2017 was approximately 389,000 m^3, assuming the water elevation is at the minimum freeboard elevation (1,636.6 m). This volume does not allow for the typical pond volume of 500,000 m^3 to support the plant operations (FRO 2017b) which has resulted in tailings solids depositing around the reclaim barge. The available storage is typically occupied by pond water as the STP has been operated near, but below, the freeboard elevation over the reporting period (Section 5.4.1.2).

Based on the change to the consequence classification, the inflow design flood (IDF) will increase which will increase the required freeboard unless the catchment area is decreased.

3.2.2 Inspections

The STP dams are inspected monthly by FRO geotechnical personnel (Appendix D), and water quality testing is completed quarterly (Appendix E).

3.2.3 Dredging

Dredging from the STP to the Turnbull TSF began in 2016. FRO has a plan to transfer up to 1 million dry metric tonnes of tailings each year by dredging between about May and October. An estimated 850,076 dry metric tonnes of tailings were dredged from STP and sent to the Turnbull TSF between 24 May and 8 October 2017. A total of just over 1 million dry metric tonnes have been transfer by dredging operations over two years of operations, which is behind the planned schedule.

3.2.4 Construction and Maintenance

There was a potential tailings water discharge event in late June 2017 when FRO Environmental personnel noticed water seeping back into the STP dam in the area of the north abutment. Water was seeping into an incomplete section of the dam embankment, presumably into granular fill around the FortisBC gas line. No seepage was observed exiting the downstream slope of the north abutment and no soft spots were found on the crest of the north abutment. A sandbag berm was constructed near the STP discharge as a temporary measure to exclude tailings water from the area, and a till berm was later constructed directly behind the sandbag berm (Golder 2017e). Golder does not characterize this event as a "spill" as no tailings water was discharged to the environment, although FRO personnel pre-emptively reported to Emergency Management BC as a precautionary measure. In response the Golder's recommendations, FRO has extended the tailings line out further into the tailings pond and filled in the low area around the previous end of the tailings pipe to reduce the seepage rate reaching the unfinished north abutment. Golder recommends FRO complete the north abutment tie-in as soon as feasible but recognizes the removal of the high pressure gas pipeline is not likely to be completed in 2018. More details are provided under separate cover (Golder 2017c).

The berms along the West Dam of the STP's lower access road were repaired in the area adjacent to the Fording River bank. The ditches along the base of the West Dam were also cleaned out and regraded. This work was completed in August 2017.

Riprap was placed along the upstream slope of STP between Sta. 0+700 and 1+700 from 20 to 29 September 2017 to address DSI recommendation 2015-11.

An emergency riprap stockpile is typically maintained at the south end of the STP with an approximate volume of 4,500 m^3. The stockpile was removed to be used in a rock drain project for the Swift expansion. The riprap stockpile was replaced with better quality material (as confirmed by KWL personnel) in late 2017. The removal of the stockpile was completed in consultation with the tailings engineer and replaced within a timely manner to ensure material was in place prior to the 2018 freshet.

3.3 North and South Tailings Pond

A probable maximum flood assessment was completed for the Fording River watershed above the NTP and STP facilities by KWL (2017b). The probable maximum flood peak Fording River flow estimate is 790 m^3/s for the Fording River watershed with consideration of planned future mining activities. Additional details are available in the KWL report (2017b).

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

4.1 Climatic Review

Precipitation data are available from regional stations operated by Environment Canada and local stations operated by FRO.

Regional climate data were compiled from climate monitoring stations operated by Environment Canada. Six stations have historical year-round daily data, with periods of record ranging from 11 to 40 years. Some of the data years are incomplete or missing. Fording River Cominco (Climate Station 1152899) and Sparwood (Climate Station 1157630) are the only stations that are still active and have year-round daily data. The Fording River Cominco station is the closest Environment Canada station with long-term climate data. A third active station, Sparwood CS (Climate Station 1157631), has seasonal daily data.

The Fording River Cominco station is the closest regional station to the FRO site with long-term climate data. As part of the ongoing hydrology baseline analysis conducted for the Turnbull Project, a continuous record of daily precipitation using data from 1970 to 2017 was derived for the Fording River Cominco climate station by infilling data gaps (~9% missing). Missing precipitation data were infilled with data from regional stations, after adjusting for elevation differences using regression equations, in the following order of preference (depending on the availability of data at the station): Elkford, Sparwood, Sparwood CS, and Line Creek Operations Mine Services Area. Data from the local stations at FRO were not used in the development of the regression relationship because of their short data records.

The local climate data are available from three local climate monitoring stations operated by FRO: the Brownie Spoil, waste water treatment plant, and A Spoil stations. The available records include the period of interest for the DSI evaluation (i.e., from 1 September 2016 to 31 August 2017). It is noted that the A Spoil station record has several periods with missing data likely resulting in underestimation of monthly precipitation.

The monthly precipitation data from 1 September 2016 to 31 August 2017 at the Brownie Spoil, waste water treatment plant, and A Spoil climate stations are plotted in Chart 1 along with the derived precipitation for the Fording River Cominco climate station (infilled data) for the same period. The average precipitation for the period 1970 to 2016 from the regional station is also plotted in Chart 1.

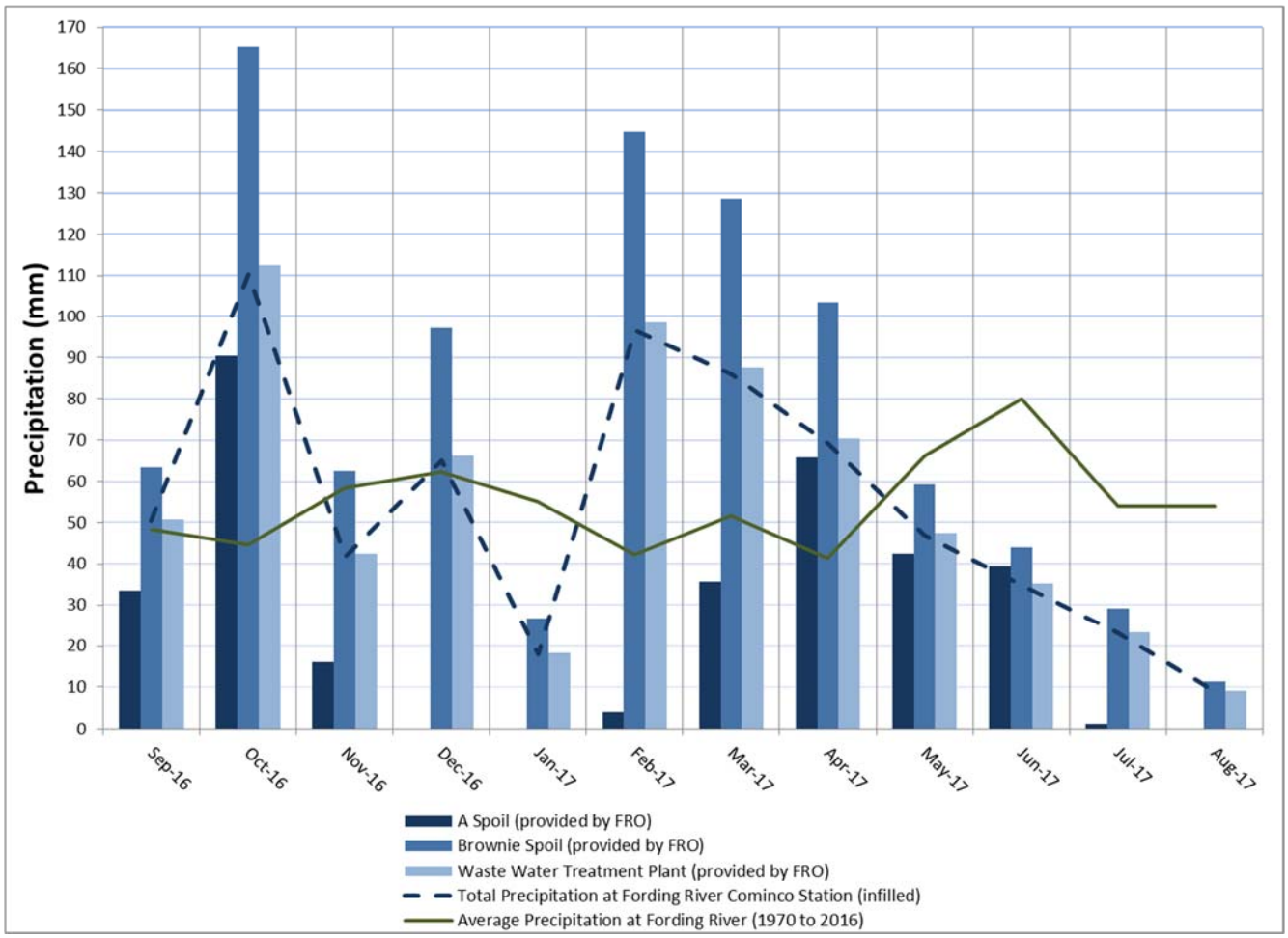

Chart 1: 1 September 2016 to 31 August 2017 Precipitation Data

The monthly precipitation values from the waste water treatment plant local station and the Fording River Cominco regional station are comparable as shown in Chart 1. This is consistent with the fact that both stations are located at similar elevations. The Brownie Spoil station is located at a higher elevation and consistently shows higher precipitation values.

Several storm events occurred in October 2016 in the Elk Valley, resulting in a high monthly precipitation for October as can be observed in Chart 1.

Winter snowfall accumulation typically runs off starting in April to May at FRO, and the higher flow events are expected to occur as a result of combined rainfall and freshet (snowmelt) events.

The total precipitation received between 1 September 2016 and 31 August 2017 is shown in Table 10 and compared with the average precipitation at Fording River for the period of 1970 to 2016.

Table 10: Precipitation from 1 September 2016 to 31 August 2017

Weather Station Location	Total Precipitation (mm)
Brownie Spoil Weather Station	936
Waste Water Treatment Plant Weather Station	662
A Spoil Weather Station	329
Fording River Cominco Station (infilled)	651
Long-Term Average Precipitation at Fording River Cominco (1970 to 2016)	659

The climate data in Table 10 indicate the annual precipitation received at FRO from 1 September 2016 to 31 August 2017 was average when compared to the long-term historical average (based on the available data).

4.2 Water Balance

4.2.1 North Tailings Pond Water Balance

The annual NTP water balance is summarized in Table 11.

Table 11: 2017 North Tailings Pond Water Balance (1 September 2016 to 31 August 2017)

IN	Annual Volume (Flows ×1,000 m^3/ 12 month)	OUT/LOSSES	Annual Volume (Flows ×1,000 m^3/ 12 month)	Total Inventory Change (Flows ×1,000 m^3/ 12 month)
Surface water	353	Evaporation	41	-
Precipitation	29	Seepage loss	349	
Sum	**382**	**Sum**	**390**	**-9**

Note: Total inventory change may not exactly equal the sum of inflow minus the sum of outflow due to rounding errors.

The water balance for the NTP was updated using a revised storage-elevation-area curve and catchment area. The revised catchment area is about three times the previous estimate in the water balance model, which has resulted in an increase to the estimated the total surface water runoff inflows to and seepage losses from the NTP.

The water balance model for the NTP estimates a seepage loss of 349,000 m^3 from 1 September 2016 through 31 August 2017. The total seepage volume is higher than previous years, which is attributed to the change in catchment area and corresponding increase in surface water inflows to the NTP.

4.2.2 South Tailings Pond Water Balance

Teck identified the need for model improvements for the STP water balance during the 2016 DSI, specifically related to its ability to (i) model water levels in the STP, and (ii) account for movement of solids (i.e., tailings) through deposition and dredging activities. Based on these needs, the STP water balance was updated in 2017 as follows:

- Incorporated dynamic storage elevation and storage area curves for the STP based on historical bathymetric surveys, to improve the ability of the model to predict pond water elevations.
- Incorporated updated dredging rates from the STP to Turnbull TSF.
- Incorporated dredge line inputs to facilitate tracking of solids and water within the STP and from the STP to Turnbull TSF.
- Incorporated a new dashboard to present the tailings solids mass balance, i.e., inflows and outflows within the STP, and accumulated tailings mass in 3 Pit and Turnbull TSF.

The September 2016 to August 2017 STP water balance, based on the updated version of the model, is summarized in Table 12.

Table 12: 2017 South Tailings Pond Water Balance (1 September 2016 to 31 August 2017)

IN	Annual Volume (Flows ×1,000 m^3/ 12 months)	OUT/LOSSES	Annual Volume (Flows ×1,000 m^3/ 12 months)	Total Inventory Change (Flows ×1,000 m^3/ 12 months)
Runoff water	400	Retained in Tailings	0	
Process make-up water	3,530	Dredge slurry to Turnbull TSF	901	
Precipitation	110	Evaporation	149	-
Miscellaneous	432	Clarified water return	22,774	
Tailings slurry	22,080	Seepage loss	2,637	
Sum	**26,552**	**Sum**	**26,461**	91

Note: Total inventory change may not exactly equal the sum of inflow minus the sum of outflow due to rounding errors.

3PS = 3 Pit South; Turnbull TSF = Turnbull Tailings Storage Facility.

The water balance assessment included a comparison of modelled and monitored water levels for calibration. The water balance model indicates a seepage loss estimation of 2,637,000 m^3 from 1 September 2016 through 31 August 2017.

The STP mass balance is approximately neutral, based on the volume of deposited tailings and the volume of dredged tailings being nearly equal over the reporting period. As a result, the volume of retained water in the net new tailings is negligible. Note that the dredging continued past the end of the reporting period, and the annual volume of dredged tailings exceeded the estimated volume of deposited tailings by October 2017 (Section3.2).

4.3 Water Quality Monitoring

Teck monitors water quality monitoring in and around the NTP and STP facilities as follows:

- NTP at discharge line
- STP north seep (at culverts)
- STP southwest corner (pond at toe of dam)
- STP west seep (embankment below West Dam)
- STP barge
- STP northwest pond (pond west of wastewater cells)
- STP groundwater wells (northwest of STP)
- STP at discharge line

Water quality monitoring data is submitted to the BC Ministry of Environment for compliance reporting. Water quality testing results are provided in Appendix E for completeness, but assessment of the water quality results are beyond the scope of this DSI.

4.4 Tailings Storage Facility Registry

The tailings storage facility registry for the NTP and STP are included in Appendix F.

5.0 TAILINGS FACILITY DAM SAFETY ASSESSMENT

This section presents the dam safety assessment of the NTP and STP 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

A site inspection was carried out on 3 to 5 October 2017 by Mr. John Cunning, P.Eng., and M[redacted], E.I.T., of Golder, accompanied by Ms. Heather Brickner, P.Eng., of FRO.

The temperature during the visit was between approximately 0°C and 10°C and the weather was clear and sunny.

Appendix A presents a summary of photographs of NTP and STP from the site inspection. The location, direction, and number for each photograph are noted in Figures 2 and 5.

A summary of the observations is included in the inspection reports in Appendix B and C for the NTP and STP, respectively. In general, the NTP and STP were observed to be in good condition at the time of the 2017 annual inspection. Details of the site inspection are discussed in Sections 5.3 and 5.4.

5.1.2 Review of Background Information

FRO provided the following information for this DSI:

- 2017 FRO site LiDAR survey data
- 2017 FRO site air photo
- 2017 tailings pond bathymetric survey data for the STP
- 2016 and 2017 FRO site climate data
- vibrating wire (VW) piezometer and pond water level data
- dam movement data: prism survey on the NTP, GPS monitoring data and slope inclinometers on the NTP and STP
- records of visual inspections
- records of construction completed

5.2 Review of Operational Documents

5.2.1 Operation, Maintenance and Surveillance Manual

The most recent update of the operation, maintenance, and surveillance (OMS) manual was completed by FRO in 2015 (FRO 2015b). As required by HSRC Section 10.5.2 (MEM 2017), FRO is currently completing a review and update of the OMS manual for the NTP and STP which is expected to be issued in Q2 2018.

Updates to the OMS manual should include:

- Update all references to consequence classification of structures—change from High to Very High.
- Include design criteria.
- Review the manual using the updated HSRC and Guidance Document (MEM 2017, 2016).
- Review the manual using most recent MAC guidelines
- QPOs to be included for surveillance.
- The dredging section needs to be updated to identify that dredging is currently operating to the Turnbull Tailings Storage Facility.
- Include safe work plans.
- Include incident reporting procedures.
- Include non-compliance reporting procedures.
- Include animal burrow inspection and procedures
- Include NTP pipe inspections
- Include hydroseeding records
- Include Liverpool and NTP boundaries

5.2.2 Emergency Preparedness Plan / Emergency Response Plan

An update to the 2015 version of the emergency response plan (ERP) is in draft for the NTP and STP (SP&P EP.009) (FRO 2017a). The updated ERP now includes the in pit tailings storage facilities on site. This document was updated to meet the guidelines provided by the HSRC (MEM 2016, 2017), the CDA (2013), the Mining Association of Canada (MAC 2011, 2017), and Teck Resources Limited standard guidelines (Teck 2014).

FRO has also developed a *Tailings Impoundment Flood Response Protocol for the Fording River*. This document was issued on 26 September 2017 (FRO 2017c).

The emergency preparedness plan (EP.008.R1) was last updated on 15 December 2015 (FRO 2015a). FRO plans to update the emergency preparedness plan once the ERP is finalized as the document will outline the warnings FRO will issue and the expected actions of local authorities and other responders for dam breach flood emergencies.

The emergency planning documents should continue to be reviewed at least annually, with updates incorporated when required. The ERP should be tested annually. FRO plans to tabletop test the ERP in 2018.

5.2.3 Dam Safety Review

The most recent DSR of the NTP and STP was completed in 2014 (KCB 2014). A DSR is required every five years for all water and tailings storage facilities regardless of dam consequence classification according to HSRC Section 10.5.4 (MEM 2017). The next DSR is required in 2019.

5.3 North Tailings Pond

The record of inspection for FRO's NTP is included in Appendix B. A plan of the NTP with the location of the monitoring points is shown in Figure 3, and a typical section of the NTP retaining dam is shown in Figure 4.

This section presents an assessment of dam safety for the NTP dam based on observations and data review and includes a review of the 2016 recommendations for the facility.

5.3.1 Assessment of Dam Safety Relative to Potential Failure Modes

A summary of the assessment and potential failure modes is presented in Table 13.

Table 13: Assessment of Dam Safety Relative to Potential Failure Modes

Potential Failure Mode	Observations/Data	Comments
Internal erosion (suffusion and piping)	Filter compatibility is generally met between materials except for the tailings and the foundation flood plain sand and gravel	The potential filter inadequacy between the tailings and foundation is considered a low risk. Portions of the NTP tailings deposit is drained with no driving head for seepage will not impact the stability of the dam, and the stability is not reliant on the tailings Migration of the tailings through the sand and gravel is considered a low risk.
Overtopping	Within acceptable range based on pond elevations over reporting period	Draft IDF and freeboard assessment complete, in review with Teck. Anticipated changes in freeboard requirements expected to be manageable.
Instability	No evident instability	Draft seismic stability assessment complete, in review with Teck. No anticipated changes to stability management.

HSRC = Health, Safety and Reclamation Code.

5.3.1.1 Internal Erosion (Suffusion and Piping)

Internal instability 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 towards an outside environment until a continuous pipe is formed. Suffusion is the migration of soil particles through the soil matrix.

Design Basis

Filter compatibility was reviewed using the internal stability criteria based on grain size distributions of till and CR or CCFR as part of the NTP flood repairs. Tailings grain size distribution testing was completed during an investigation of the existing coal tailings in 2 Pit, 3 Pit, and the NTP (Golder 2012b). The review indicates that the filter compatibility criteria are met between the till and the CR or CCFR, and between tailings and till.

Another filter compatibility assessment was completed by Golder in 2015 in response to a February 2015 MEM order to undertake an assessment to determine if the dams associated with the tailings facilities on site may be at risk due to filter inadequacy (Golder 2015a). The following filter relationships were checked:

- compatibility between the upstream till blanket (base soil) and CR shell (filter)
- compatibility between the till cut-off (base soil) and flood plain sand and gravel foundation (filter)
- internal stability of the CR shell (filter)

The compatibility between the till (base soil) and the CR shell or flood plain sand and gravel (filter) met the filter compatibility criteria for two of the three methods checked. The internal stability of the CR shell was confirmed. Based on the performance of the dam over the last 45 years, piping due to filter incompatible material is not expected to be an issue.

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 compatibility during design and construction.

It is noted that 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.

The filter compatibility of the underlying flood plain sands and gravels (filter) was assessed against the CR/CCFR, till, and tailings (bases) by Golder based on the 2015 investigation results (FRO 2016). Filter compatibility was checked using the Sherard and Dunnigan 1989 criteria, as recommended by the CDA (2007). The results showed that the filter compatibility is generally met between the sands and gravels and the CR/CCFR, as well as with the sands and gravels and till. However, filter compatibility between the tailings and the flood plain sand and gravel is not generally met. 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.

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 any sinkholes were observed that would indicate voids due to either suffusion or piping.

5.3.1.2 Overtopping

Design Basis

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 (2017 survey completed by FRO).

The HSRC Guidance Document (MEM 2016) recommends that the IDF be designed to 2/3 between the 1,000-year flood/storm event and the probable maximum flood for a structure classified as Very High consequence. The HSRC also requires that a facility that stores the IDF use a minimum event duration of 72 hours plus snowmelt. The current minimum freeboard is 1.2 m (elev. 1,651.4 m). An updated IDF and freeboard assessment has been completed in draft and updates to the maximum normal operating water level and freeboard are expected in 2018.

The NTP currently has no inputs of water except direct precipitation and some runoff from a small local catchment area. The water levels are generally maintained with over 2 m of freeboard and pumping and dewatering is not required under normal annual conditions. In the event that critical water levels in the pond are approached, FRO's contingency plan includes installing a diesel pump to transfer excess water to the Shandley Pond. The pump will be set up in the southwest corner of the NTP and connected to the nearby T fixture on the Shandley pipeline. This pump is to be inspected and refuelled daily while needed (FRO 2017a). The pump should be tested annually. The NTP is not equipped with an emergency spillway because a normal minimum freeboard of 1.2 m (as assessed for High consequence) will be maintained with emergency pumping as necessary. A draft IDF and freeboard assessment for Very High consequence classification is complete and in review with Teck. Anticipated changes in freeboard requirements are expected to be manageable, FRO personnel and the EoR will develop an action plan for the updated freeboard requirements once final.

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 as 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 run out analyses, failure of the reconfigured CR spoil and subsequent wave generation is considered unlikely.

Instrumentation

Pond elevation data for the NTP were received from FRO, and Chart 2 presents the variation in pond elevation from 1 September 2016 to 31 August 2017 based on this information.

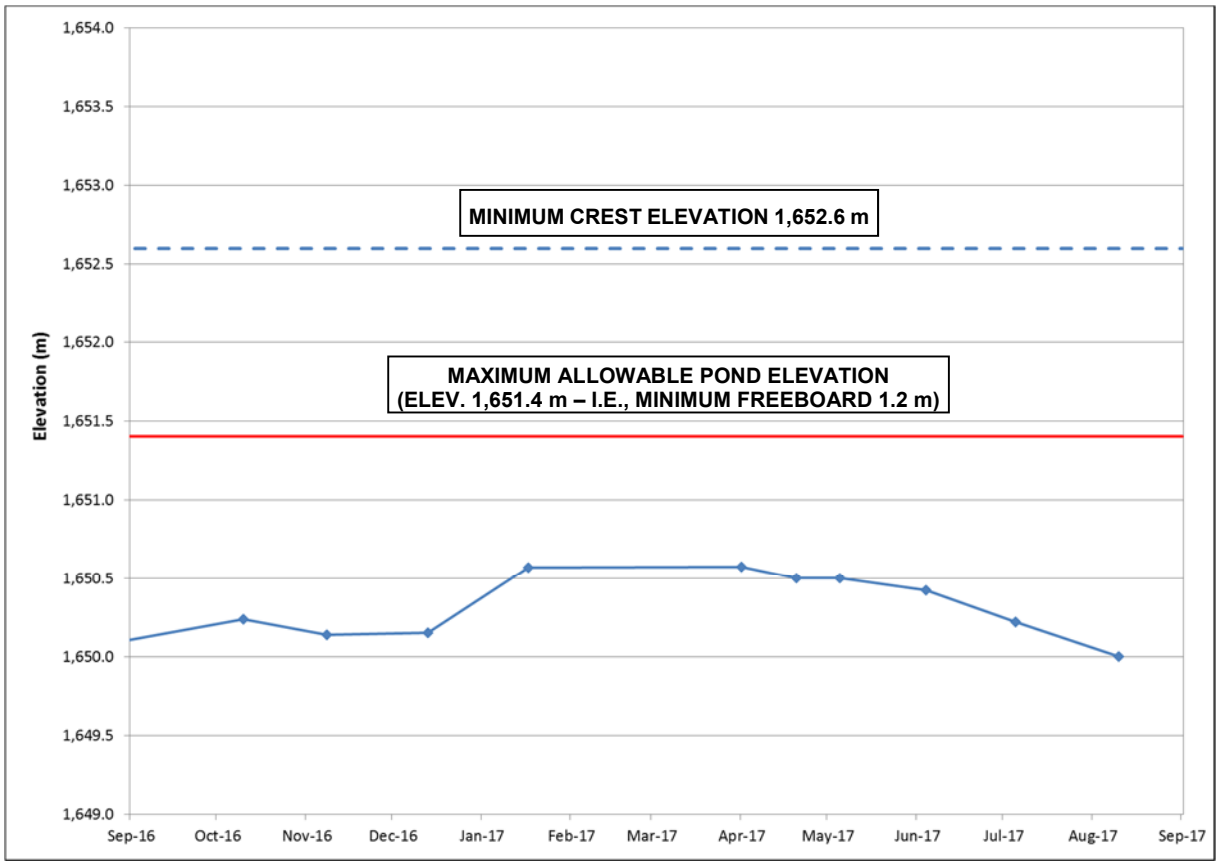

Chart 2: North Tailings Pond Water Elevation from 1 September 2016 to 31 August 2017

Note: Pond elevations reported in Elk Valley Elevation Datum.

The NTP water level is shown to be maintained below the maximum allowable water level. A total of 10 readings were taken during the period between 1 September 2016 and 31 August 2017, with readings missing in September 2016 and February 2017. FRO should survey the pond elevation monthly, and this is reflected in the OMS manual (FRO 2015b).

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 be inspected as part of the monthly NTP inspections until removed or grouted or until the NTP is decommissioned.

5.3.1.3 Instability

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

Design Basis

The drained 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).

In situ and laboratory results were used by Golder to assess the liquefaction potential of the floodplain foundation soils, per the recommendations from the 2014 DSR (KCB 2014). Results indicated that alluvial soils downstream of the dams are not likely to liquefy, and removes the requirement for any further work related to the DSR recommendation for stability analysis of the liquefied foundation condition. A detailed discussion of the results is provided in Golder (2016d).

A dam stability update for the NTP was completed by Golder (2016e) based on the drilling program conducted by FRO in 2015 (FRO 2016) in accordance with the CDA (2013) guidelines and related technical bulletins (CDA 2007, 2014). The 2,475-year earthquake event was selected (2% exceedance probability in 50 years) for long-term stability analyses under pseudo-static loading conditions as recommended by the CDA (2013), and a peak ground acceleration of 0.158 g was used in the pseudo-static analyses based on the site-specific seismic hazard assessment completed by Golder (2016a). Based on the HSRC, this assessment is out of date since a return period ½ between the 2,475-year and 10,000-year seismic event or the maximum credible earthquake should be used for a facility with a consequence classification of Very High. A draft seismic stability assessment has been completed and is in review with Teck. There are no anticipated changes to stability management based on the Very High consequence seismic stability assessment. The NTP is also 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 and 2017 (KWL 2017c) to mitigate against erosion.

Instrumentation Data – Crest Displacement Monitoring

Seven survey prisms (NT1 to NT7) and a GPS monitor (NTP-GPS 01) are installed along the crest of the NTP dam, and one reference prism is located at the wash plant location (NT10), as shown in Figure 3. FRO has improved the prism reading accuracy by installing a back site prism for the NTP (Prism M102).

Prism data were provided by FRO and the GPS data was downloaded from GeoExplorer. The grid system was updated in October 2016, therefore data for the prisms is shown from October 2016 through August 2017 (no historical data). The GPS data were downloaded for the reporting period, 1 September 2016 to 31 August 2017. The survey data are summarized in Appendix G.

Table 14 lists the prism and GPS units in use at the NTP.

Table 14: Instrument Monitoring Locations

Instrument Identification	Instrument	Northing (m)	Easting (m)	Elevation (m)
NT1	Prism	5,562,034.0	651,126.3	1,654.3
NT2	Prism	5,561,884.1	651,130.1	1,653.9
NT3	Prism	5,561,735.3	651,087.4	1,653.8
NT4	Prism	5,561,597.1	651,028.4	1,654.4
NT5	Prism	5,561,462.6	650,957.7	1,654.2
NT6	Prism	5,561,326.9	650,876.2	1,654.1
NT7	Prism	5,561,225.1	650,766.9	1,653.7
NT10	Prism	5,561,586.7	651,257.6	1,655.5
NTP-GPS 01	GPS	5,562,143.7	651,102.6	1,645.5

Note: Northing and Easting reported in FRO UTM, Elevations reported in NAD83. Sensor locations downloaded from GeoExplorer.

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

NT10 is a reference prism.

The total movement (3D displacement) measured for each survey prism relative to the original installation position is shown in Chart 3. The total displacement presented is the vector sum of the horizontal and vertical displacements.

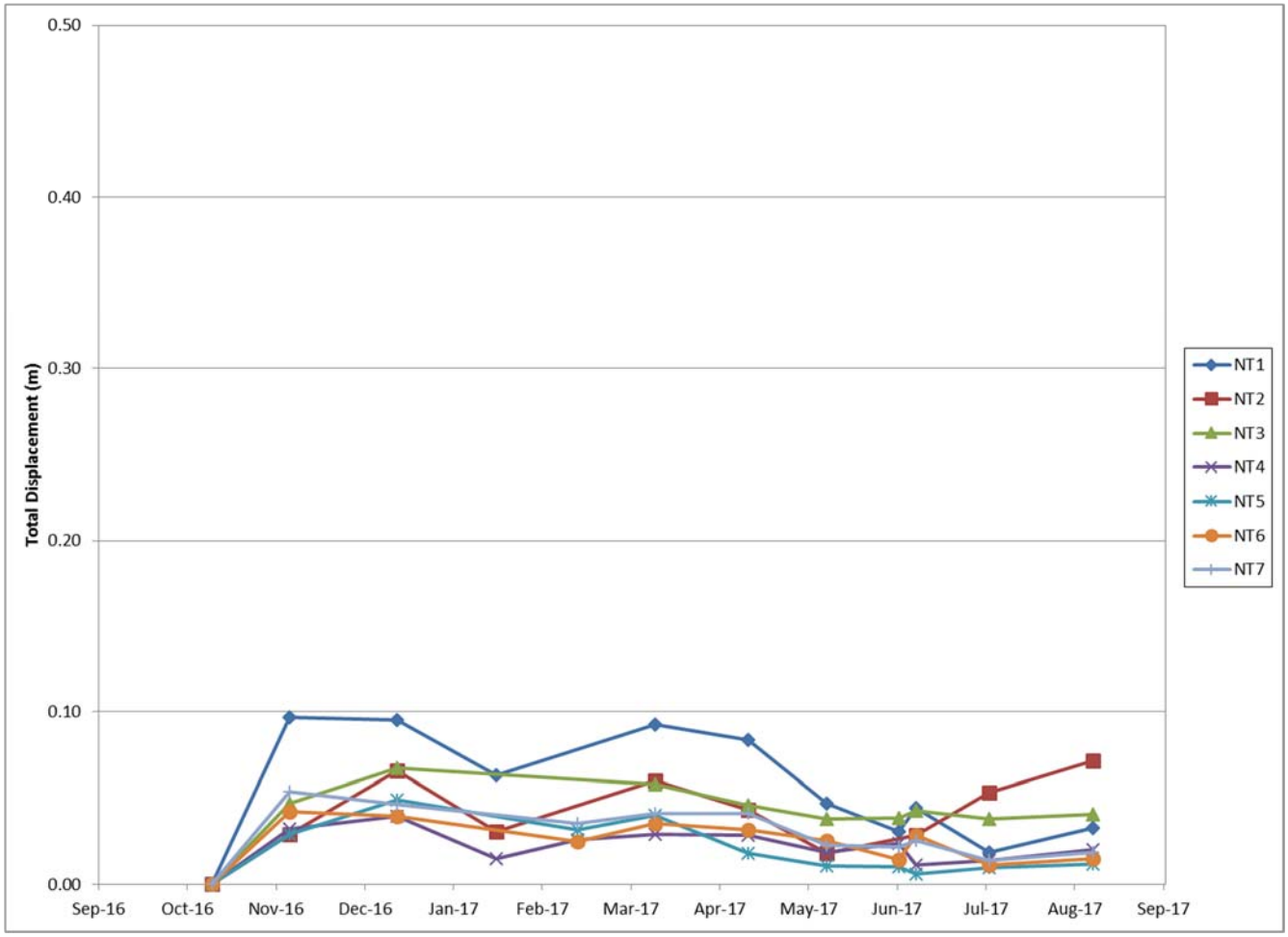

Chart 3: North Tailings Pond Prism Total 3D Displacement from 1 September 2016 to 31 August 2017

Note: Elevations reported in NAD 83.

Displacements have been zeroed at the start of the reporting period to assess annual trends.

Generally, the prism data are surveyed once a month. The survey data indicate little crest displacement during the reporting period. Increase in movement from October to November 2016 could be related to the large storm that was experienced in the Elk Valley in October 2016. As well, the majority of the prisms show a slight increase in movement during the spring freshet (March to April 2017) but they appear to have settled throughout the remainder of the reporting period. Movements are well below the GeoExplorer trigger for 3D movement (200 mm, GeoExplorer warning and the updated QPOs provided by Golder (Section 2.6).

The OMS manual outlines that the prisms should be shot once a month, three times each, to ensure accuracy. FRO followed this practice for the reporting period.

The 3D point velocity for GPS unit NTP-GPS 01 is presented in Chart 4.

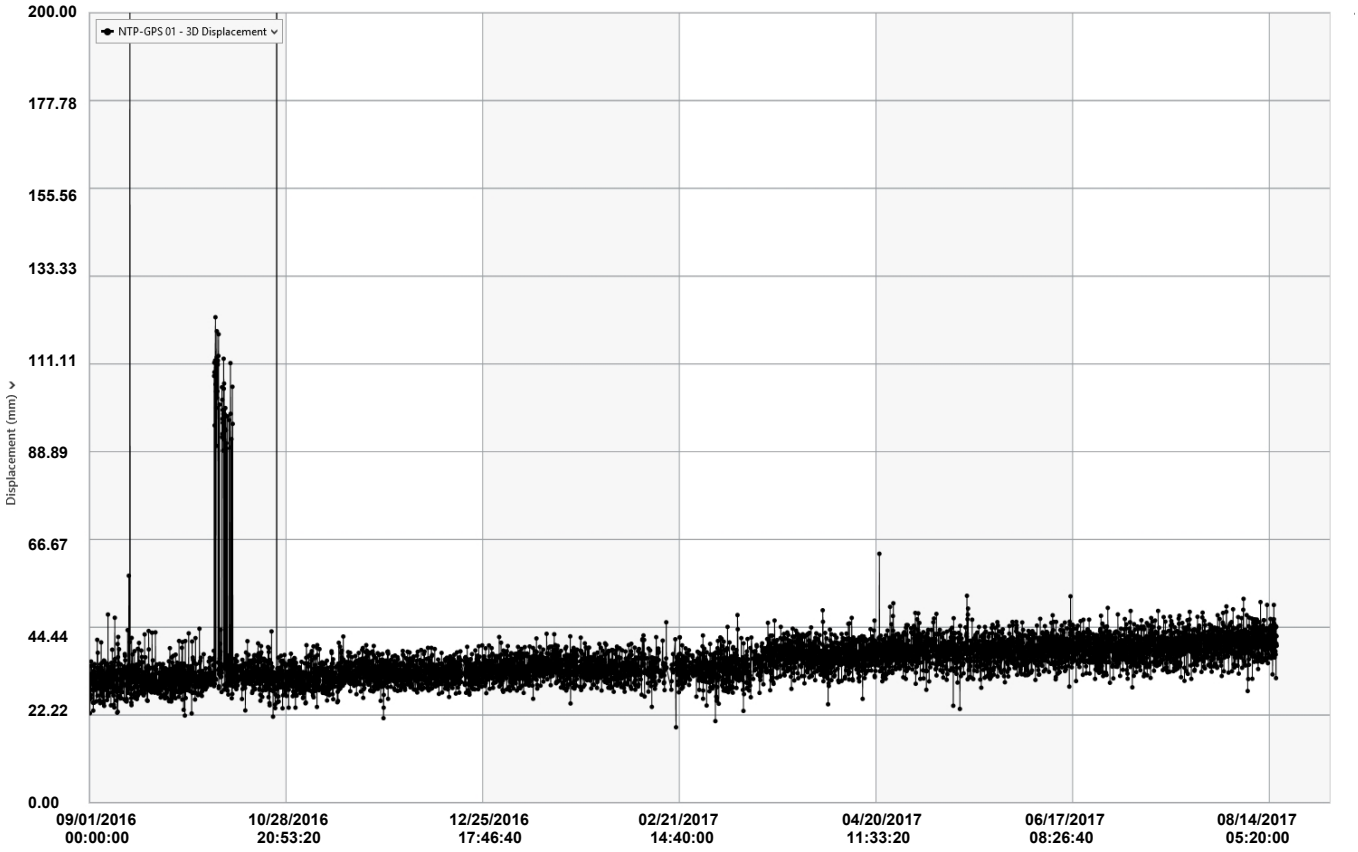

Chart 4: North Tailings Pond 3D Displacement from 1 September 2016 to 31 August 2017

Generally, the GPS device NTP-GPS 01 records on an hourly frequency. The survey data indicate little crest displacement during the reporting period. Minor spikes in NTP-GPS 01 are most likely noise in the system and are not a concern. Movements are well below the GeoExplorer alarm trigger for 3D point velocity (300 mm/day, GeoExplorer alarm) and the updated QPOs provided by Golder (Section 2.6), with the exception of some noise. The warning in GeoExplorer was triggered in September and October 2016. All warnings were investigated by FRO personnel and determined to be erroneous data.

A latent alarm is triggered in GeoExplorer when the measurement age of the GPS unit is greater than a day and the prisms is greater than five days on the NTP. Any offline monitors will be inspected and repaired within one week (FRO 2015b).

Instrumentation Data – Slope Inclinometers

Slope inclinometers were installed at three locations in 2015 along the NTP crest (Figure 3) 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 15.

Table 15: 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 for the first set of readings.

Elevations reported in Elk Valley Elevation Datum.

TH = test hole.

Raw inclinometer data were supplied to Golder by FRO. Readings have been taken approximately quarterly at the NTP inclinometers since December 2015. A total of three readings were taken at each of the three inclinometers between August 2016 and August 2017. Once received, the inclinometer data were interpreted by Golder (Appendix H). Data readings are from 23 January 2016 to 19 July 2017, and include the initial reading from 18 December 2015 as a reference line.

The maximum deflection observed in both direction A and B does not exceed approximately 4 mm for inclinometer TH15-05, which is an acceptable range (Appendix H, Figure H-1).

The maximum deflection observed in both direction A and B reaches a maximum of approximately 6 mm for inclinometer TH15-06, which can likely be attributed to a section of exposed casing above the dam crest which is experiencing movement during data acquisition. Below the first metre of casing, direction A and B appear not to experience more than 4 mm of deflection (Appendix H, Figure H-2).

The maximum deflection observed in both direction A and B does not exceed approximately 6 mm for inclinometer TH15-07 (Appendix H, Figure H-3).

The inclinometer readings do not indicated any significant trends in deformation.

Instrumentation Data – Piezometers

VW piezometers were installed in 2015 at three locations along the NTP crest (Figure 3) to monitor water levels in and below the dam; each location includes sensors at two or three depths. The piezometers located in the NTP are listed in Table 16. Data for the piezometers was provided to Golder by FRO. Chart 5 presents the piezometer readings from 1 September 2016 to 31 August 2017, as well as the NTP pond elevation over the same time period. Readings have been taken at the NTP piezometers since August 2015.

Table 16: North Tailings Pond Piezometer Installation Details

Piezometer ID	Northing (m)	Easting (m)	Elevation (m)	Data Logger Serial No.	Piezometer Serial No.	Piezometer Elevation (m)
TH15-05	5,561,992.0	651,130.8	1,653.6	DT09633	VW33222	1,641.3
				DT09636	VW33223	1,638.7
				DT09638	VW33241	1,635.6
TH15-06	5,561,641.0	651,047.2	1,653.7	DT09641	VW33240	1,628.5
				DT09643	VW33239	1,626.3
TH15-07	5,561,379.7	650,904.4	1,653.4	DT094501	VW33231	1,630.0
					VW33230	1,624.0
					VW33242	1,614.7

Note: Coordinates reported in UTM and elevations reported in Elk Valley Elevation Datum.

TH = test hole.

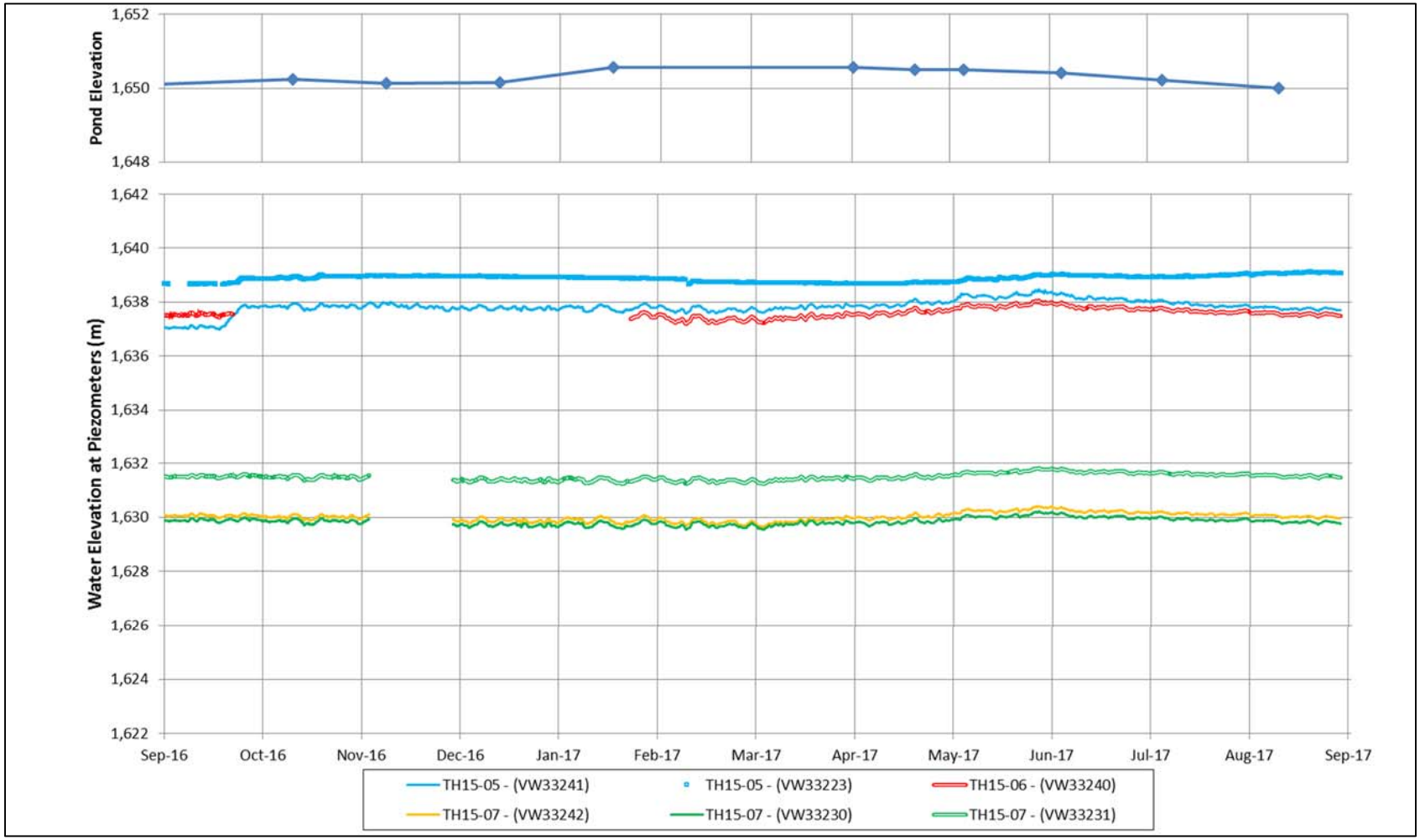

Chart 5: North Tailings Pond Vibrating Wire Piezometers and Pond Elevation from 1 September 2016 to 31 August 2017

Note: Elevations reported in Elk Valley Elevation Datum. TH15-05 (VW33222) and TH15-06 (VW33239) are dry and not presented in Chart 5.

The piezometers' performance was assessed and is summarized in Table 17.

Table 17: North Tailings Pond Piezometer Performance Summary

Piezometer ID	Piezometer Serial No.	Piezometer Elevation (m)	Minimum (2016/2017)	Maximum (2016/2017)	Upward Gradient	Exceed Alarm	Comments
TH15-05	VW33222	1,641.3	n/a	n/a	n/a	No	Negative water level (dry).
	VW33223	1,638.7	1,638.6	1,639.1	No	No	Missing data in September 2016, and January 2017.
	VW33241	1,635.6	1,637.0	1,638.4	No	No	Jump of nearly 1 m in September 2016.
TH15-06	VW33240	1,628.5	1,637.1	1,637.9	No	No	Erroneous data from end of September 2016 to January 2017 due to logger malfunction. Data removed from plot and battery replaced.
	VW33239	1,626.3	n/a	n/a	n/a	No	Likely malfunctioning, negative water level, still see freshet trend in piezometer data.
TH15-07	VW33231	1,630.0	1,631.2	1,631.8	No	No	Missing data in November 2016due to the data logger for TH15-07 being damaged by water.
	VW33230	1,624.0	1,629.6	1,630.2	No	No	Missing data in November 2016 due to the data logger for TH15-07 being damaged by water.
	VW33242	1,614.7	1,629.6	1,630.4	Yes	No	Missing data in November 2016 due to the data logger for TH15-07 being damaged by water.

Note: Elevations reported in Elk Valley Elevation Datum.

Alarms from GeoExplorer TH = test hole; n/a = not applicable.

The phreatic level readings for the time period were generally stable with trends related to spring freshet seen in most sensors in April and May 2017. No warnings were triggered in GeoExplorer for these piezometers.

TH15-05 (VW33241) had a sharp increase of approximately 1 m in head in September 2016. The readings settle out after this increase and show consistent trends with the other piezometers.

The upper VW sensor in TH15-05 (VW33222) was above the phreatic surface and was dry (negative water level readings). The piezometer readings for TH15-06 were reviewed because the lower piezometer (VW33239) was reading a negative water level while the upper piezometer was reading approximately 9 m of water above the piezometer. The sensor is still showing similar trends in water elevation as the other piezometers even though a negative water level is being read. After reviewing FRO installation records and checking the data logger in the field, it was determined that VW33239 is likely malfunctioning.

TH15-05 (V33223) shows the spring freshet trend similar to other sensors in the NTP, but the head does not decrease in the summer months, and continues to trend upward throughout August 2017. Data past August 2017 was reviewed in GeoExplorer and the water elevation reduces through September 2017.

There is an upward gradient in TH15-07 between VW33242 and VW33230. These piezometers are located in differing stratigraphic units, VW33242 is in glacial till and VW33230 is in fluvial material (Golder 2016e). Because the Fording River is close to this area of the NTP toe, there is the possibility that the piezometers may be influenced by the river. The gradient is small and is not a concern at this time. The piezometers should continue to be monitored on a regular basis as outlined in the OMS manual and the gradients should be checked as good practice.

At multiple times over the reporting period missing data was reported. To avoid this in the future, GeoExplorer has been updated to show “No Communication” and “No Frequency” alarms that alert FRO when the piezometers are not reading data. FRO will use these alarms as an indication that the piezometers are malfunctioning and will send someone to check on the instrument in question.

Observed Performance

No evidence of major slope instability was observed during the 2017 DSI. The key observations made during the NTP dam inspection were as follows:

- Minor surficial stepped erosion was noted on the north and central sections of the downstream slope (Appendix A, Photograph 7). This is considered to be cosmetic and will not affect the overall stability of the dam.
- Minor erosion created by surface water runoff was noted near the south end of the tailings pond in the 2015 DSI, but has since been repaired and appears stable (Appendix A, Photograph 3).
- A wet area with previous evidence of ponding was noted below the highest point of the NTP dam in 2016. Most likely due to freezing conditions during the site visit, this wet area was not observed in 2017.

5.3.1.4 River Erosion Protection (KWL)

KWL completed an inspection of the riprap at the toe of NTP in 2017 and the inspection report is provided in Appendix I (KWL 2018).

5.3.2 Review of Previous Deficiencies and Non-conformances

The deficiencies and non-conformances presented in Table 18 were noted in the previous DSI (Golder 2017b). Table 18 provides the current status of the 2016 DSI recommendations for the NTP. Items from the 2016 DSI that are incomplete have been brought forward into the 2017 DSI recommendations (Table 29).

There are a number of recommendations that are in progress and some that are incomplete, however Golder feels the work is being appropriately prioritized based on good communication between the EoR team and the FRO engineer teams.

Table 18: Current Status of 2016 Dam Safety Inspection Recommended Actions for North Tailings Pond Facility

ID Number	Deficiency or Non-conformance	Recommended Action	Updated Status as of March 2018
2015-05a,b	No passive emergency system against overtopping; emergency system requires active response	Assess the need for spillway after finalizing the closure plan NTP.	**Incomplete –** see Table 29 for updated recommended action and deadline
		If required, determine a construction schedule.	**Incomplete –** see Table 29 for updated recommended action and deadline
2015-06a,b,c	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 Fording River and timeline to implement.	**Incomplete –** see Table 29for updated recommended action and deadline
		Implement required protection measures for the operational phase according to the as-defined schedule.	**Incomplete–-** see Table 29for updated recommended action and deadline
		Execute the flood risk mitigation plan until the flood protection requirements defined by the risk-informed assessment are in place.	**Ongoing**
2015-07a,b	Buried pipes passing through crest locations	Complete review of pipe abandonment timeline as part of feasibility investigation into NTP decommissioning.	**Complete** – Golder provided recommendations for pipe abandonment in November 2017, pipes are currently capped on upstream side and are inspected regularly
		If required, execute abandonment plan.	**Incomplete –** see Table 29 for updated recommended action and deadline
2016-05	North abutment excavated without input or approvals from Engineer of Record or Qualified Person	Assess and revise required internal and external communication for work and construction activities carried out near the site TSFs.	**In Progress –** to be included in OMS manual; see Table 29 for updated recommended action and deadline
		Sediment pond designer to sign off on reconstruction of NTP dam north abutment.	**Complete (AMEC 2017)**
		Engineer of Record to review final NTP dam re-construction summary.	**Complete** – Liverpool outlet channel and fish barrier should now be considered outside of NTP facility and part of Liverpool Sediment Pond System.
2016-06	No closure plan for NTP	Develop closure plan for NTP based on results of feasibility investigation into NTP decommissioning.	**In Progress** – prefeasibility design completed; see Table 29 for updated recommended action and deadline
2016-7a,b	Additional animal burrows in toe of south abutment	Fill voids in downstream slope created by burrows.	**Complete**
		Perform regular inspection for new burrows. Burrows to be marked or identified by GPS during inspection to improve tracking of ongoing efforts.	**Ongoing**, include in OMS manual update
2016-11	Discrepancy within the documentation regarding the minimum elevation of the NTP crest. The lower elevation value has been reported here (i.e., more conservative)	The NTP dam, particularly the dam crest, be surveyed to confirm the minimum dam elevation.	**Complete**
2015-03	Roles of Geotechnical and Hydraulics Engineers of Record undocumented	Golder, FRO, and KWL to document the roles of the Engineer of Record for the geotechnical and hydraulics related works in the OMS manual.	**In Progress –** to be included in OMS manual; see Table 29 for updated recommended action and deadline
2016-01a,b	Seismic design criteria for stability out of date due to dam reclassification from High to Very High	Complete updated seismic stability assessment and liquefaction based on revised design criteria.	**In Progress** – draft assessment complete, seismic stability meets or exceeds new design criteria; see Table 29 for updated recommended action and deadline
		Update QPOs based on revised stability assessment.	**In Progress** – pending completion by Golder, updated GPS & prism QPOs in this DSI report; updated piezometer QPOs pending completion by Golder
2016-02	IDF and freeboard out of date due to dam reclassification from High to Very High	Update the IDF and freeboard assessment for the NTP and STP.	**In Progress** – draft assessment complete; see Table 29 for updated recommended action and deadline

ID Number	Deficiency or Non-conformance	Recommended Action	Updated Status as of March 2018
2016-03	OMS manual requires updating	Update OMS manual as follows: ■ Update all references to consequence classification of structures—change from High to Very High. ■ Include design criteria. ■ Review the manual using the updated HSRC and Guidance Document (MEM 2017, 2016). ■ QPOs to be included for surveillance. ■ The dredging section needs to be updated to identify that dredging is currently operating to the Turnbull Tailings Storage Facility. ■ Include safe work plans. ■ Include incident reporting procedures. ■ Include non-compliance reporting procedures. Complete minor updates identified in the 2015 DSI report (Golder 2016b).	**In Progress –** under review by FRO, QPO update pending completion by Golder; see Table 29 for updated recommended action and deadline
2016-04	EPP & ERP require updating	Reference to the QPOs needs to be included for actions required based on instrumentation warnings and alarms.	**In Progress** – pending completion by FRO; see Table 29 for updated recommended action and deadline
2016-09	No QPOs set for inclinometers	QPOs and frequency of readings should be set for the inclinometers.	**In Progress** – draft complete; see Table 29 for updated recommended action and deadline
2016-10	Warning level QPO for piezometers exceeded. Based on review of data, this is not a failure concern	Update warning level QPOs for piezometers based on review of data all available data (2014 to present).	**In Progress** – pending completion by Golder, recommendation incorporated in 2017-06

IDF = inflow design flood; FRO = Fording River Operations; KWL = Kerr Wood Leidal Associates Ltd.; NTP = North Tailings Pond; STP = South Tailings Pond; HSRC = Health, Safety and Reclamation Code; DSI = dam safety inspection; TSF = tailings storage facility; OMS = operation, maintenance and surveillance; EPP = Emergency Preparedness Plan; ERP = Emergency Response Plan; QPO = quantitative performance objectives.

5.4 South Tailings Pond

The record of inspection for the FRO STP is included in Appendix C. A plan of the STP with the location of the monitoring points is shown in Figure 6, and typical sections of the STP dams are shown in Figures 7 and 8.

This section presents an assessment of dam safety for the STP dam based on observations and data review and includes a review of the 2016 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 19.

Table 19: Assessment of Dam Safety Relative to Potential Failure Modes

Potential Failure Mode	Observations/Data	Comments
Internal erosion (suffusion and piping)	Filter compatibility is generally met between materials except for the tailings and the flood plain sand and gravel Ongoing seepage monitoring since 2015	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 considered low risk. Seasonal trends evident in seepage data collected.
Overtopping	Within acceptable range based on pond elevations over reporting period	Draft freeboard assessment complete, in review with Teck. FRO and EoR to develop action plan and schedule to address expected changes in freeboard requirements.
Instability	No evident instability	Draft seismic stability assessment complete, in review with Teck. No anticipated changes to stability management.

HSRC = Health, Safety and Reclamation Code.

5.4.1.1 Internal Erosion (Suffusion and Piping)

Design Basis

Filter compatibility was reviewed using the internal stability (piping) criteria based on grain size distributions of till and CR or CCFR in the design review (Golder 2011). The review indicates that the filter compatibility criteria are met between the till and the CR or CCFR and between tailings and till.

Another filter compatibility assessment was completed by Golder in 2015 in response to the MEM (Golder 2015a). The STP is constructed with an upstream till blanket and a CR (lower portion) or CCFR (upper portion) shell, which also acts as the filter. A till cut-off was constructed through the flood plain sand and gravel foundation of the STP.

The following filter relationships were checked:

- compatibility between the upstream till blanket (base soil) and CR/CCFR shell (filter)
- compatibility between the till cut-off (base soil) and flood plain sand and gravel foundation (filter)
- internal stability of the CR/CCFR shell (filter)

The compatibility between the till (base soil) and the CR/CCFR shell or flood plain sand and gravel (filter) met the filter compatibility criteria for two of the three methods checked. The internal stability of the CR/CCFR shell was confirmed.

The filter compatibility of the underlying flood plain sands and gravels (filter) was assessed against the CR/CCFR, till, and tailings (bases) by Golder in 2016 per the recommendations made by CDA (2007) to use the Sherard and Dunnigan (1989) criteria. The results showed that the filter compatibility is generally met between the sands and gravels and the CR/CCFR, as well as with the sands and gravels and till. However, filter compatibility between the tailings and the flood plain sand and gravel is not generally met. The potential filter inadequacy between the foundation and tailings will not impact the stability of the dam, and 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. No tailings have been observed downstream to date.

It is noted that 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 from the 1970s to present day (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 not expected to be an issue. 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.

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 has 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 modeling, such as not accounting for the mass balance.

The 1 September 2016 through 31 August 2017 water balance model indicates a seepage loss estimate of 2,637,000 m^3 or a seepage rate of 5 m^3/min. This rate is consistent with estimated historic seepage rates at the STP.

Seepage losses from the STP from 1989, 2000, 2003, and 2006 through 2017 are shown in Table 20. A graphical representation of the observed increase in seepage rate for recent years is provided in Chart 6.

Table 20: 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

Note: Pond elevations reported in Elk Valley Elevation Datum.

FRO = Fording River Operations; n/a = not applicable.

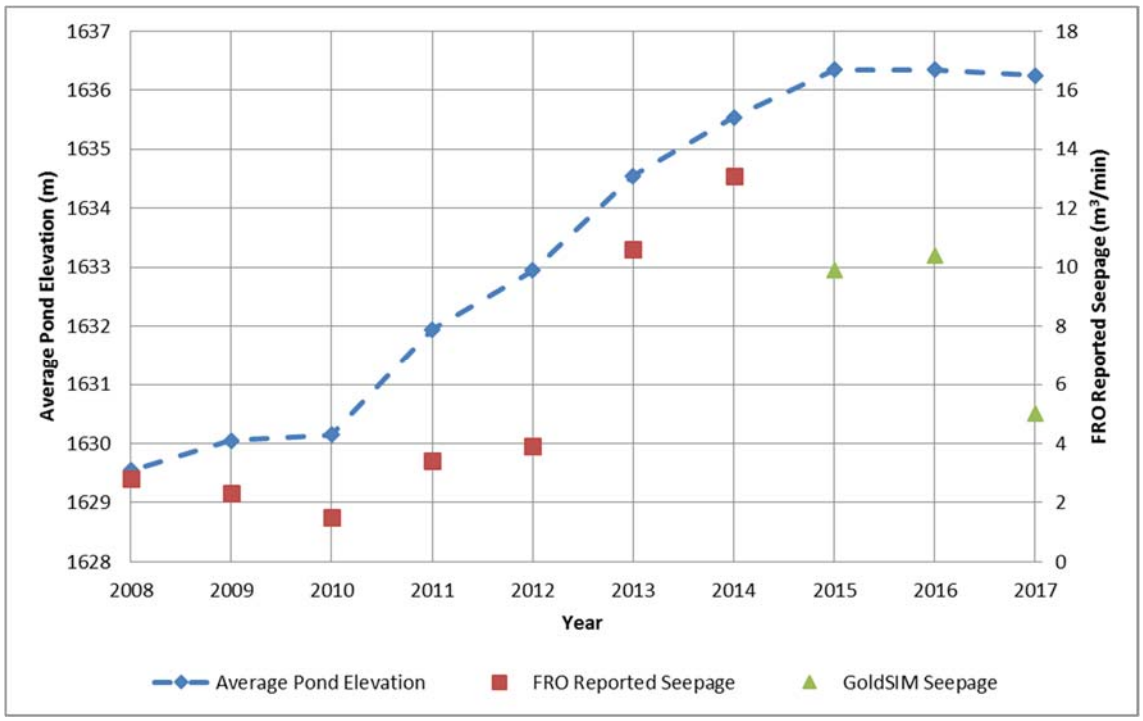

Chart 6: South Tailings Pond Seepage and Pond Elevation, 2008 through 2017

Note: Pond Elevations reported in Elk Valley Elevation Datum.

In response to an increase in the observed seepage below the West Dam, FRO installed two seepage collection pipes within the seepage area in 2015 and has started to collect seepage data. These data should be collected regularly to develop long-term trending of seepage rates in this area. Chart 7 displays the existing seepage and culvert measurement data collected for the STP in 2017.

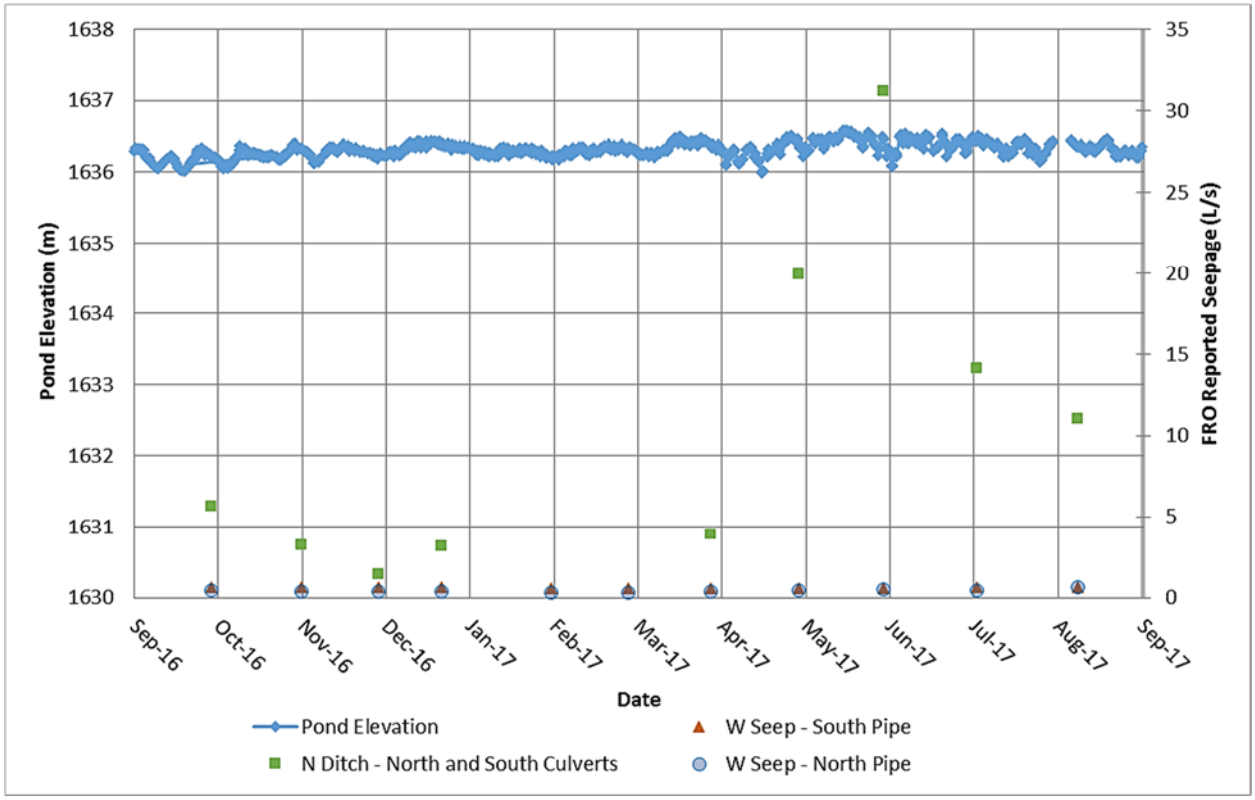

Chart 7: Seepage from West Seep and North Ditch from 29 September 2016 to 11 August 2017

Note: N Ditch North and South culverts include surface flows from Maxam Creek and are not solely seepage measurements.
Pond elevations reported in Elk Valley Elevation Datum.

Observed Performance

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

- Seepage continues along the presumed till/bedrock contact below the West Dam (Appendix A, Photograph 39). The seepage has pushed up mats of organics and created a hummocky, broken surface area. This is consistent with previous years. Seepage from the collection pipes at the time of the site visit was approximately 1.5 L/s from each the W Seep North and South pipes. Red staining was noted in some areas of seepage along the bedrock contact (Appendix A, Photograph 39).
- External seepage water was observed to be clear.
- The ditch that captures runoff or seepage at the toe of the West Dam was reinstated (Appendix A, Photograph 37).
- Water flow has been seen in previous years in the ditch along the downstream toe of the north end of the West Dam (Golder 2017b). Due to the cold conditions during the site visit, very little water was observed; however, vegetation growth patterns at the toe of the West Dam indicate some seepage is exiting the dam (Appendix A, Photograph 51). Some of the water is presumed to be surface flow as well.

- No zones of subsidence or any sinkholes were observed that would indicate voids due to either suffusion or piping.
- A pond is present at the north end of the West Dam near Stn. -0+050 (Appendix A, Photograph 33). This pond is assumed to be due to surface water from the Maxam Yard.
- An old river channel is present past the downstream toe of the Main Dam (Appendix A, Photograph 34). This is consistent with previous years.

5.4.1.2 Overtopping

Design Basis

The calculated freeboard and maximum allowable pond levels for the STP were previously calculated as per the CDA design guidelines for High consequence classification (Section 5.4.1.2). The HSRC Guidance Document (MEM 2016) recommends that the IDF be designed to 2/3 between the 1,000-year flood/storm event and the probable maximum flood for a structure classified as Very High consequence. The HSRC also requires that a facility that stores the IDF use a minimum event duration of 72 hours plus snowmelt. The current minimum freeboard for High consequence classification is 1.2 m (elev. 1,636.6 m). A draft IDF and freeboard assessment for Very High consequence classification is complete and in review with Teck. FRO personnel and the EoR will develop an action plan and schedule to address expected changes in the minimum freeboard requirements. The technical bulletin *Application of Dam Safety Guidelines to Mining Dams* (CDA 2014) recommends examination of the condition where the high water level (IDF) occurs at a similar time as a high wind event for calculation of the minimum freeboard.

Instrumentation Data

Pond elevation data for 1 September 2016 to 31 August 2017 at the STP were received from FRO (Chart 8).

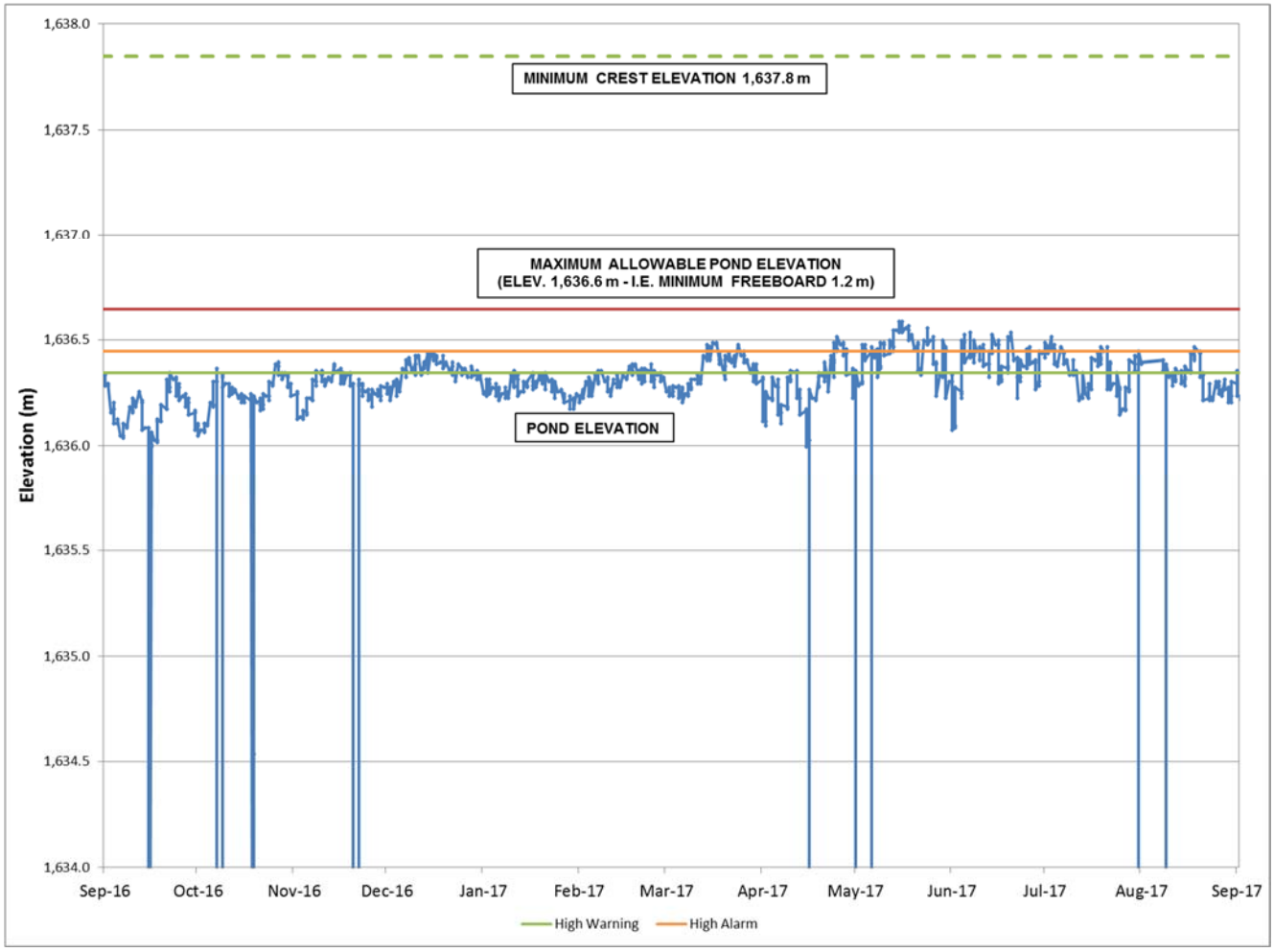

Chart 8: South Tailings Pond Water Elevation from September 2016 to August 2017

Note: Pond elevations reported in Elk Valley Elevation Datum.

Rapid decrease in pond elevation due to plant shut down and not actual pond elevation change

The STP water level is shown to have been maintained below the maximum allowable water elevation from 1 September 2016 to 31 August 2017. In February 2015, a meter was installed at the pond that takes continuous elevation readings which are then fed into the wash plant monitoring system and are thus accessible in real time to anyone with access to that system. The high alarm was triggered several times throughout the reporting period, particularly in November and December 2016, and from March to August 2017. The alarms were investigated by FRO staff and determined that the high readings in winter were due to ice build-up and the increasing water elevation in the spring was due to spring freshet.

Observed Performance

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

- The pond was clear and free of major debris.
- Water from the seepage return wells was being pumped back to the STP. The return line from Kilmarnock Pond was being pumped into the pond at the time of inspection (Appendix A, Photographs 27 and 28).

In an emergency, the following measures could be initiated to control the rise of the water surface in the STP:

- Most inputs to the pond could be turned off. Runoff from the plant site could be redirected to the North Loop Pond. The tailings discharge stream from the plant could be shut down.
- The water reclaim system could be operated to remove water from the pond.
- Water could be pumped from the STP or NLP to Shandley Pit, the NTP , or to the Turnbull TSF, subject to approval of the Ministry of Environment.

The STP is not equipped with an overflow emergency spillway, as the High consequence classification design storm volume can be stored within the facility provided adequate freeboard is maintained. This practice may need to be reassessed as part of the Very High freeboard assessment.

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). Golder has prepared a conceptual design for an emergency spillway. Spillway location options along with the spillway design criteria and preliminary details are presented in Golder (2012a).

5.4.1.3 Instability

Design Basis

A dam stability update for the STP was completed by Golder (2016e) based on the drilling program conducted by FRO in 2015 (FRO 2016) in accordance with the CDA (2013) guidelines and related technical bulletins (CDA 2007, 2014). The 2,475-year earthquake event was selected (2% exceedance probability in 50 years) for long-term stability analyses under pseudo-static loading conditions as recommended by the CDA (2013), and a peak ground acceleration of 0.158 g was used in the pseudo-static analyses based on the site-specific seismic hazard assessment completed by Golder (2016a). Based on the HSRC, this assessment is out of date since a return period ½ between the 2,475-year and 10,000-year seismic event or the maximum credible earthquake should be used for a facility with a consequence classification of Very High. A draft seismic stability assessment has been completed and is in review with Teck. There are no anticipated changes to stability management based on the Very High consequence seismic stability assessment.

The STP West Dam is also 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 2017c). The south section of the West Dam from the pipe bridge southward does not have any erosion protection but consists partially of bedrock, which provides erosion protection.

Instrumentation Data– Dam Displacement Monitoring

There are 11 operational GPS units on the STP West and Main Dams. Hourly readings from 1 September 2016 to 31 August 2017 were downloaded from GeoExplorer. The initial readings of the GPS units were used for locations of the GPS monitors and are shown in Figure 6.

A summary of the GPS units in use for the 2017 DSI reporting period is presented in Table 21.

Table 21: GPS Monitoring Locations on South Tailings Pond

GPS Identification	Reading Start Date	Northing (m)	Easting (m)	Location Description
STP-GPS 01	December 2013	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	February 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	August 2015	5,560,152.6	651,659.4	West Dam – crest
STP-GPS 09	April 2016	5,560,081.3	651,844.4	Main Dam – crest
STP-GPS 10	April 2016	5,560,022.7	652,029.4	Main Dam – toe
STP-GPS 11	April 2016	5,560,089.4	652,051.2	Main Dam – crest

Note: Northings and Eastings reported in UTM.

Table 22 summarizes the GPS units at STP, whether they have been relocated at any point in time, and any other comments provided by FRO. No GPS units were reset during the reporting period.

Table 22: South Tailings Pond GPS Unit Activities (Based on FRO Records)

GPS Monitor ID	Colour in Chart 9	Relocated	Comments
STP-GPS 01		No	21 April 2017 erroneous data 17 May 2017 erroneous data, deleted
STP-GPS 02		No	No activity
STP-GPS 03		No	No activity
STP-GPS 04		No	First readings, replaced STP349
STP349		n/a	Readings discontinued, replaced by STP-GPS 04
STP-GPS 05		No	No activity
STP-GPS 06		Yes	16 September 2016 GPS was moved for rip rap construction 9 November 2016 GPS was moved after rip rap construction 7 February 2017 dead battery 5 March 2017 erroneous data observed 10 April 2017 erroneous data observed 1 April 2017 erroneous data observed, deleted
STP-GPS 07		No	16 April 2017 erroneous data, deleted 5 May 2017 erroneous data, deleted
STP-GPS 08		No	23 May 2017 erroneous data, deleted
STP-GPS 09		No	23 April 2017 erroneous data, deleted
STP-GPS 10		No	11 November 2016 erroneous data observed 14 November 2016 erroneous data observed 13 March 2017 erroneous data observed 14 April 2017 erroneous data observed, deleted 18 April 2017 erroneous data observed, deleted 14 June 2017 erroneous data observed, deleted 3 July 2017 erroneous data observed, deleted
STP-GPS 11		No	No activity

Note: GPS considered “relocated” when unit moved more than 1 m in any direction.

n/a = not applicable.

The 3D displacement for each GPS monitor were downloaded from GeoExplorer and are presented in Chart 9. The cumulative horizontal displacement, cumulative vertical displacement, cumulative relative displacement, and 3D point velocity for the GPS monitors were downloaded from GeoExplorer and are presented in Appendix G.

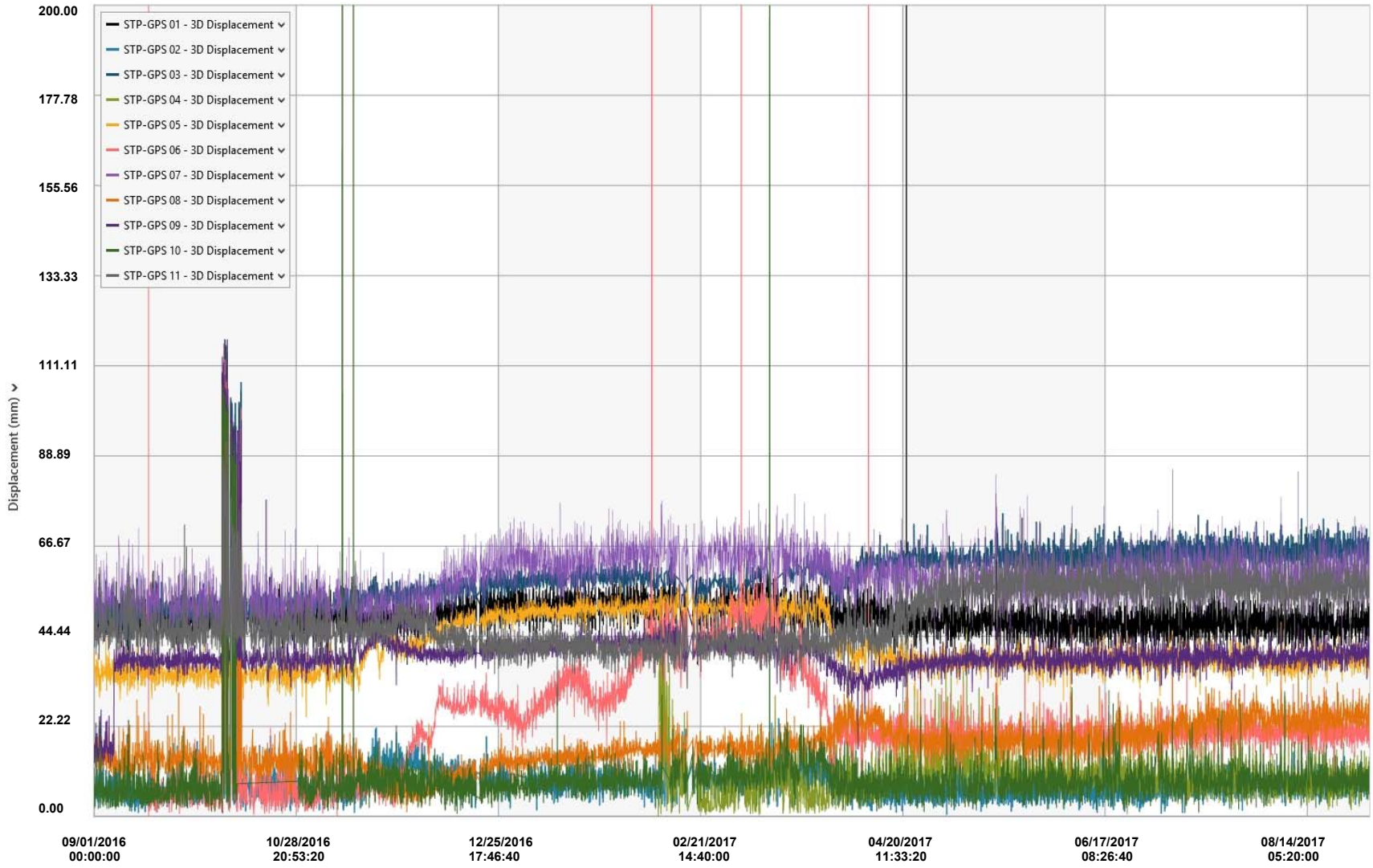

Chart 9: South Tailings Pond GPS Monitors 3D Displacement

The GPS units record on an hourly frequency. The survey data indicate little crest displacement during the reporting period. Spikes in the data, particularly in October 2016, are most likely noise in the system and are not a concern. The overall trend of the data is consistent with little increase over the reporting period. Movements are below the GeoExplorer trigger for 3D displacement (100 mm, updated QPO warning).

Any offline monitors will be inspected and repaired within one week (FRO 2015b).

It is noted that STP-GPS 06 was relocated due to rip rap construction. As best practice, relocating the monitoring points should be avoided as it does not allow long-term trend monitoring of displacement.

Instrumentation Data – Slope Inclinometers

Slope inclinometers were installed at four locations in 2015 along the STP crest (Figure 6) 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 Table 23.

Table 23: 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 reported in UTM and elevations reported in Elk Valley Elevation Datum.

TH = test hole.

Inclinometer data were supplied to Golder by FRO. Readings have been taken approximately quarterly at the STP inclinometers since December 2015. A total of three readings were taken at inclinometers TH15-02, TH15-03, and TH15-04 between August 2016 and August 2017. A total of four readings were taken at inclinometer TH15-01 between August 2016 and August 2017. Results from 5 March 2017 showed very large deflections in TH15-01; therefore, FRO took a second set of readings on this date. The second set of results trends within the expected range.

Once the inclinometer data were received, they were interpreted by Golder (Appendix H). Data readings are from 10 January 2017 to 6 July 2017, including the initial reading from 18 December 2015 as a reference line.

The maximum deflection observed in direction A does not exceed approximately 4 mm for inclinometer TH15-01. Direction B appears to deflect approximately 4 to 3 mm to a depth of about 20 m below the top of inclinometer casing (Appendix H, Figure H-4).

The maximum deflection observed in direction A does not exceed approximately 4 mm for inclinometer TH15-02. Direction B appears to deflect approximately 5 mm from an elevation of about 1,615 to 1,605 m (Appendix H, Figure H-5).

The maximum deflection observed in direction A does not exceed approximately 4 mm for inclinometer TH15-03. Direction B appears to deflect approximately 5 mm to a depth of about 14 m below the top of inclinometer casing (Appendix H, Figure H-6).

TH15-04 shows a deflection of approximately 4 mm at the top of the casing, which is likely due to movement of the casing exposed above the dam crest (Appendix H, Figure H-7).

The inclinometer readings do not indicated any significant trends in deformation.

Instrumentation Data – Piezometers on Main Dam

A summary of the VW piezometer locations and sensor depths on the Main Dam is shown in Table 24.

Table 24: South Tailings Pond Main Dam Piezometer Installation Details

Piezometer ID	Northing (m)	Easting (m)	Top of Well Elevation (m)	Data Logger Serial	Piezometer Serial No.	Piezometer Elevation (m)
VW-4	5,560,100.6	651,758.7	1,639.2	DT08079	VW27921	1,617.2
				DT08082	VW27920	1,615.0
VW-5	5,560,106.2	652,102.4	1,639.2	DT08073	VW27929	1,615.5
				DT08075	VW27930	1,610.4
TH15-01	5,560,086.2	652,037.3	1,638.2	DT04498	VW33227	1,611.1
					VW33229	1,604.8
					VW33244	1,600.9
TH15-02	5,560,093.0	651,786.4	1,638.3	DT04499	VW33238	1,612.2
					VW33233	1,605.5
					VW33243	1,601.6
TH15-04	5,559,997.8	652,003.4	1,604.6	DT09637	VW33224	1,599.6
SP-3	5,560,032.4	652,043.8	1,610.4	DT08083	VW27931	1,600.6
SP-5	5,560,057.5	652,163.7	1,605.0	DT08074	VW27918	1,595.9

Note: Northings and Eastings reported in UTM and elevations reported in Elk Valley Elevation Datum.

TH = test hole; VW = vibrating wire; SP = retrofitted standpipe.

The VW piezometers and standpipes locations are shown in plan in Figure 6. Chart 10 presents the piezometer readings for 1 September 2016 to 31 August 2017, as well as the pond elevation over the same time period. Data for the piezometers was provided by FRO and supplemented with data downloaded from GeoExplorer to fill in any gaps as necessary.

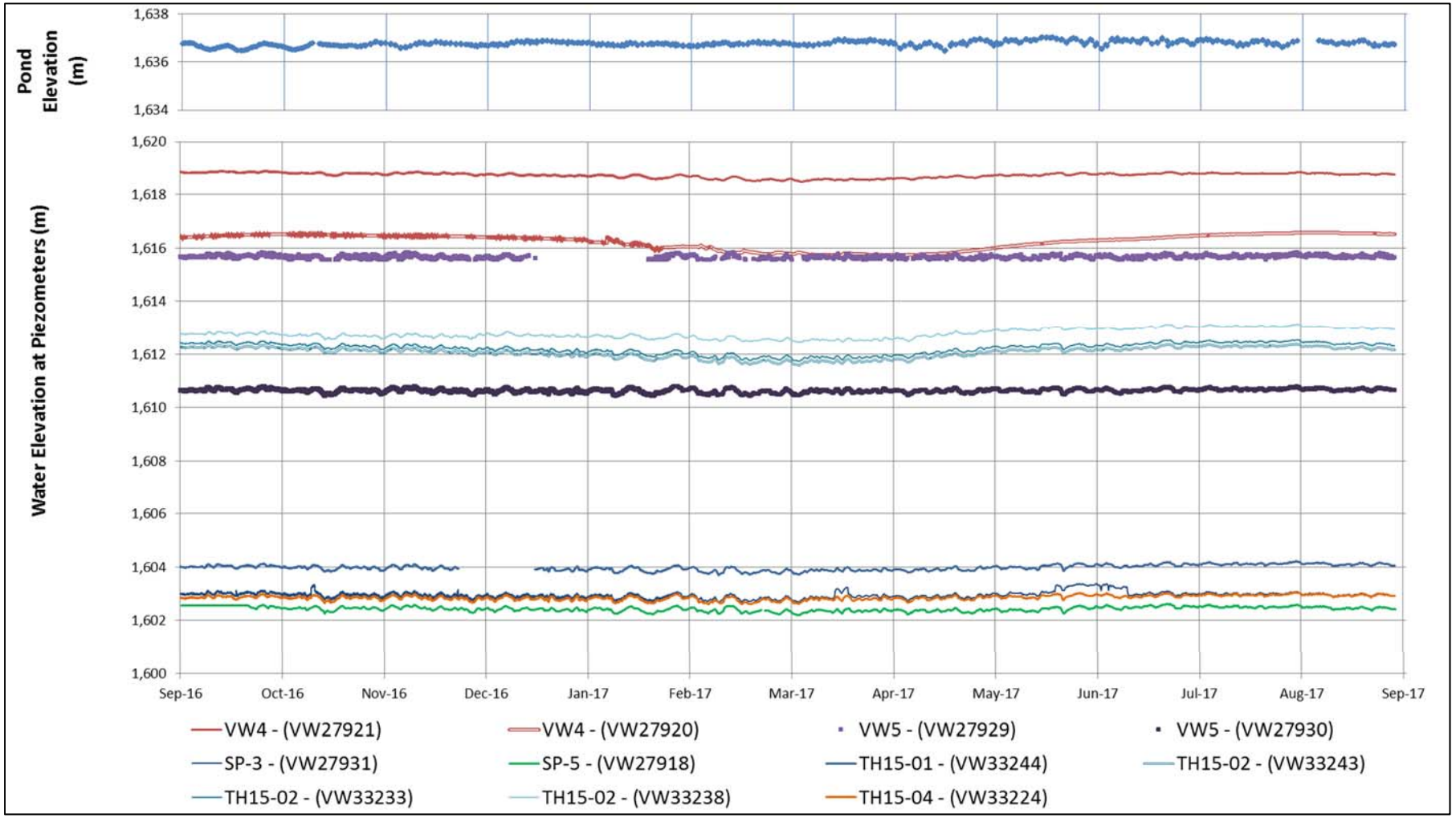

Chart 10: Main Dam Vibrating Wire Piezometer and Standpipe Water Elevations and South Tailings Pond Elevation

Note: Elevations reported in Elk Valley Elevation Datum.

The Main Dam piezometers' performance was assessed and is summarized in Table 25.

Table 25: South Tailings Pond Main Dam Piezometer Performance Summary

Piezometer ID	Piezometer Serial No.	GeoExplorer Sensor No.	Piezometer Elevation (m)	Minimum (2016/2017)	Maximum (2016/2017)	Upward Gradient	Exceed Alarm	Comments
VW-4	VW27921	2	1,617.2	1,618.3	1,618.7	n/a	No	No concerns.
	VW27920	1	1,615.0	1,615.6	1,616.5	No	No	Trending upwards from April to June 2017.
VW-5	VW27929	2	1,615.5	1,615.5	1,615.9	No	No	Missing data from December 2016 to January 2017.
	VW27930	1	1,610.4	1,610.4	1,610.9	n/a	No	No concerns.
TH15-01	VW33227	1	1,611.1	n/a	n/a	n/a	No	Negative water level (dry).
	VW33229	2	1,604.9	n/a	n/a	n/a	No	Negative water level (dry). Missing data from November to December 2016 due to dead battery (subsequently replaced).
	VW33244	3	1,600.9	1,603.7	1,604.2	n/a	No	Missing data from November to December 2016.
TH15-02	VW33238	3	1,612.2	1,612.9	1,613.6	n/a	No	Trending upwards from April to June 2017.
	VW33233	2	1,605.5	1,611.7	1,612.5	No	No	Trending upwards from April to June 2017.
	VW33243	1	1,601.5	1,611.5	1,612.3	No	No	Trending upwards from April to June 2017.
TH15-04	VW33224	-	1,599.5	1,602.5	1,603.0	n/a	No	No concerns.
SP-3	VW27931	-	1,600.6	1,602.8	1,603.5	n/a	No	Small increase of 0.2 m in water level from May to June 2017.
SP-5	VW27918	-	1,595.9	1,602.1	1,602.6	n/a	No	No concerns.

Note: Elevations reported in Elk Valley Elevation Datum.

Alarms from GeoExplorer.

TH = test hole; VW = vibrating wire; SP = retrofitted standpipe; n/a = not applicable.

The phreatic level readings for the time period were generally stable very little to no reaction to spring freshet. No warnings were triggered in GeoExplorer for these piezometers.

VW-4 (VW27920) and TH15-02 sensors all show slight increases in water elevation from April to about June 2017. This trend may be attributed to spring freshet. The trend does not seem to persist, and the piezometer water elevations seem to flatten after June.

At multiple times over the reporting period missing data was reported. GeoExplorer has been updated to show "No Communication" and "No Frequency" alarms that alert FRO when the piezometers are not reading data. FRO will use these alarms as an indication that the piezometers are malfunctioning and will send someone to check on the instrument in question.

Instrumentation Data – Piezometers on West Dam

A summary of the VW piezometer locations and sensor depths on the West Dam is shown in Table 26.

No data were available from GeoExplorer for VW-3 (VW27917); therefore, it is not reported on. FRO personnel noted that the output from the cable is very low and the piezometer is likely not functional.

Table 26: South Tailings Pond West Dam Piezometers Installation Details

Piezometer ID	Northing (m)	Easting (m)	Elevation (m)	Data Logger Serial	Piezometer Serial No.	Piezometer Elevation (m)
VW-1	5,560,710.9	651,118.1	1,640.0	DT08070	VW27922	1,620.4
				DT08078	VW27923	1,606.4
VW-2	5,560,494.1	651,310.0	1,639.3	DT08076	VW27926	1,616.9
				DT08077	VW27928	1,610.5
VW-3	5,560,278.9	651,509.5	1,638.9	DT08071	VW27925	1,622.3
				DT08072	VW27924	1,611.4
TH15-03	5,560,550.6	651,227.5	1,638.7	DT04500	VW33225	1,618.2
					VW33228	1,614.2
					VW33226	1,612.1
SP-W1	5,560,273.7	651,497.3	1,633.9	DT08081	VW27927	1,613.4
SP-W3	5,560,255.0	651,481.4	1,624.5	DT08080	VW27919	1,615.0

Note: Northings and Eastings reported in UTM and elevations reported in Elk Valley Elevation Datum.

TH = test hole; VW = vibrating wire; SP = retrofitted standpipe.

The VW piezometers and standpipes are presented in plan in Figure 6. Chart 11 presents the piezometer readings for 1 September 2016 to 31 August 2017, as well as the pond elevation over the same time period. Data for the piezometers was provided by FRO personnel and supplemented with data downloaded from GeoExplorer to fill in any gaps as necessary.

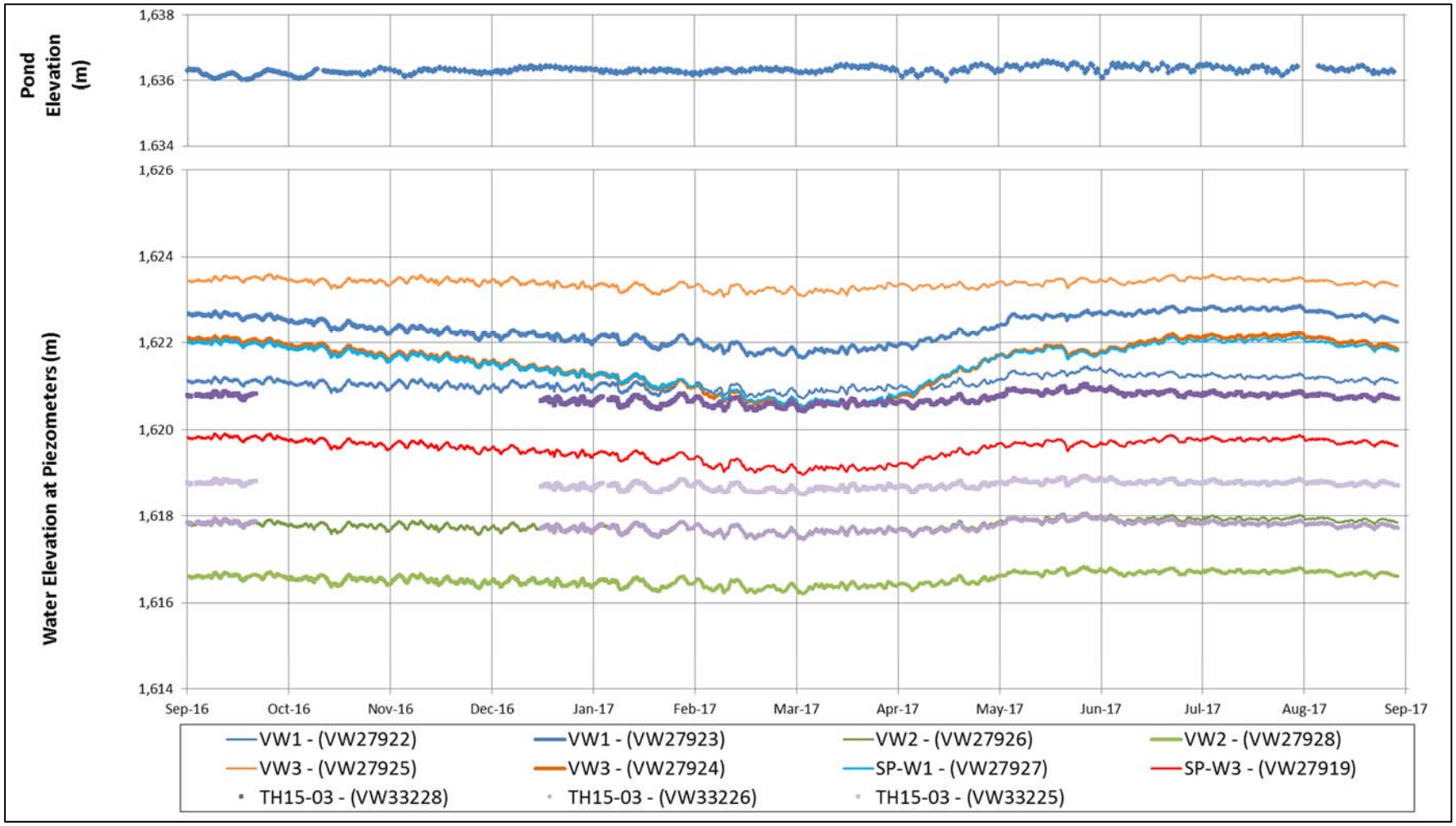

Chart 11: West Dam Vibrating Wire Piezometer and Standpipe Water Elevations and South Tailings Pond Elevation

Note: Elevations reported in Elk Valley Elevation Datum.

The West Dam piezometers' performance was assessed and is summarized in Table 27.

Table 27: South Tailings Pond West Dam Piezometer Performance Summary

Piezometer ID	Piezometer Serial No.	Piezometer Elevation (m)	Minimum (2016/2017)	Maximum (2016/2017)	Upward Gradient	Exceed Alarm	Comments
VW-1	VW27922	1,620.4	1,620.7	1,621.5	n/a	No	No concerns.
	VW27923	1,606.4	1,621.6	1,622.9	Yes	No	Larger freshet trend as compared to other piezometers, still within range of expected water elevations for piezometer.
VW-2	VW27926	1,616.9	1,617.6	1,618.2	n/a	No	No concerns.
	VW27928	1,610.5	1,616.2	1,616.8	No	No	No concerns.
VW-3	VW27925	1,622.3	1,623.2	1,623.7	n/a	No	No concerns.
	VW27924	1,611.4	1,620.5	1,622.3	No	No	Larger freshet trend as compared to other piezometers, still within range of expected water elevations for piezometer
TH15-03	VW33225	1,618.2	1,618.5	1,618.9	n/a	No	Missing data from September to December 2016, except for a few sporadic readings. TH15-03 data logger damaged by water and needs to be replaced.
	VW33228	1,614.2	1,620.4	1,621.0	Yes	No	Missing data from September to December 2016 except for a few sporadic readings. TH15-03 data logger damaged by water and needs to be replaced.
	VW33226	1,612.2	1,617.5	1,618.1	No	No	Missing data from September to December 2016 except for a few sporadic readings. TH15-03 data logger damaged by water and needs to be replaced.
SP-W1	VW27927	1,613.4	1,620.5	1,622.1	n/a	No	Larger freshet trend as compared to other piezometers, still within range of expected water elevations for piezometer.
SP-W3	VW27919	1,615.0	1,618.9	1,619.9	n/a	No	Larger freshet trend as compared to other piezometers, still within range of expected water elevations for piezometer

Note: Elevations reported in Elk Valley Elevation Datum.

Alarms from GeoExplorer

TH = test hole; VW = vibrating wire; SP = retrofitted standpipe; n/a = not applicable.

The phreatic level readings for the time period were generally stable with trends related to spring freshet seen in most sensors in April and May 2017. No warnings were triggered in GeoExplorer for these piezometers.

VW-1 (VW27923), VW-3 (VW27924), SP-W1 (VW27927), and SP-W3 (VW27919) all show stronger trends related to spring freshet as compared to the other piezometers in the West Dam. VW-1 (VW27923) and VW-3 (VW27924) are both installed in bedrock so the trend could be related to the water table within the unit. SP-W1 (VW27927) and SP-W3 (VW27919) installation geologic units are unknown. After the increase in water elevation in the piezometers during spring freshet, the water elevations tend to stay higher for these piezometers but it appears the water elevations trend down due to freezing conditions from October onwards. These trends are considered consistent with previous years.

Upward gradients are noted in TH15-03 and VW-1. In TH15-03, both piezometers are within the foundation fluvial sand and gravel unit. In VW-1 the lower piezometer is in bedrock and the upper piezometer is in the fluvial sand and gravel. The fluvial unit is not confined in both borehole location, and the piezometer readings are likely influenced by groundwater flow through the previous river channel.

Teck note that the data logger for TH15-03 has been damaged by water and a replacement is required.

At multiple times over the reporting period missing data was reported. GeoExplorer has been updated to show “No Communication” and “No Frequency” alarms that alert FRO when the piezometers are not reading data. FRO will use these alarms as an indication that the piezometers are malfunctioning and will send someone to check on the instrument in question.

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 2017 DSI.
- The upstream slope was regraded and riprap protection was installed on the upstream side of the Main Dam (Appendix A, Photographs 29 and 36). It was noted that tailings were pushed into the pond to place the riprap and there is a buildup of water between the tailings and riprap. The tailings should be regraded with an excavator so that water will preferentially flow into the pond.
- Minor erosion has been noted on the downstream slope over the years, generally in the CCFR material. 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 repaired in a similar or equivalent manner as part of ongoing maintenance.
- The downstream slope has sections steeper than 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)

KWL completed an inspection of the riprap at the toe of STP in 2017 and the inspection report is provided in Appendix I.

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 (Golder 2017b). Table 28 provides the current status of the 2016 DSI recommendations for the STP. Items from the 2016 DSI that are incomplete have been brought forward into the 2017 DSI recommendations (Table 29).

There are a number of recommendations that are in progress and some that are incomplete, however Golder feels the work is being appropriately prioritized based on good communication between the EoR team and the FRO engineer teams.

Table 28: Current Status of 2016 Dam Safety Inspection Recommended Actions for South Tailings Pond Facility

ID Number	Deficiency or Non-conformance	Recommended Action	Updated Status as of March 2018
2013-16	No passive emergency system against overtopping; emergency system requires active response	Assess the best combination of active and passive emergency systems during various stages of the pond life cycle. If the assessment determines that passive systems are warranted, then develop a construction schedule for the selected system(s).	**Incomplete** – see Table 29 for updated recommended action and deadline
2015-11	Over-steepened relative to design and susceptible to erosion from wave action	Regrade upstream slope to design (1.75H:1V) and place riprap on regraded slope.	**Complete**
2015-12a,b,c	Riprap erosion protection along downstream toe north of STP Stn. 0+680, no riprap south of STP Stn. 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.	**In Progress** – completed drilling program for widening of Fording River channel
		Implement required protection measures for the operational phase according to the as-defined schedule.	**Incomplete** – see Table 29 for updated recommended action and deadline
		Execute flood risk mitigation plan until flood protection requirements defined by the risk-informed assessment are in place.	**Ongoing**
2016-08	Ditch adjacent road on West Dam bench filled in by haul truck traffic	Reinstate ditch to functional condition.	**Complete**
2016-12	Hydroseeding in the repaired sections of the STP downstream slope did not root. No records available	Hydroseeding should be incorporated into the tailing management system and records of hydroseeding, including the success rate, should be kept.	**Incomplete** – recommendation moved to OMS manual updates (2016-03)
2016-13	The GoldSIM water balance model is not accurately accounting for the change in available volume in the STP due to dredging (increase in available volume) and tailings depositions (decrease in available volume)	The change in available volume be included in future water balances to improve the STP water balance.	**Complete**
2015-03	Roles of Geotechnical and Hydraulics Engineers of Record undocumented	Golder, FRO, and KWL to document the roles of the Engineer of Record for the geotechnical and hydraulics related works in the OMS manual.	**In Progress –** to be included in OMS manual; see Table 29 for updated recommended action and deadline
2016-01a,b	Seismic design criteria for stability out of date due to dam reclassification from High to Very High	Complete updated seismic stability assessment and liquefaction based on revised design criteria.	**In Progress** – draft assessment complete, seismic stability meets or exceeds new design criteria; see Table 29 for updated recommended action and deadline
		Update QPOs based on revised stability assessment.	**In Progress** – pending completion by Golder, updated GPS & prism QPOs in this DSI report; updated piezometer QPOs pending completion by Golder; see Table 29 for updated recommended action and deadline
2016-02	IDF and freeboard out of date due to dam reclassification from High to Very High	Update the IDF and freeboard assessment for the NTP and STP.	**In Progress** – draft assessment complete; see Table 29 for updated recommended action and deadline
2016-03	OMS manual requires updating	Update OMS manual as follows: ■ Update all references to consequence classification of structures—change from High to Very High. ■ Include design criteria. ■ Review the manual using the updated HSRC and Guidance Document (MEM 2017, 2016). ■ QPOs to be included for surveillance. ■ The dredging section needs to be updated to identify that dredging is currently operating to the Turnbull Tailings Storage Facility. ■ Include safe work plans. ■ Include incident reporting procedures. ■ Include non-compliance reporting procedures. Complete minor updates identified in the 2015 DSI report (Golder 2016b).	**In Progress** – under review by FRO, QPO update pending completion by Golder; see Table 29 for updated recommended action and deadline

ID Number	Deficiency or Non-conformance	Recommended Action	Updated Status as of March 2018
2016-04	EPP & ERP require updating	Reference to the QPOs needs to be included for actions required based on instrumentation warnings and alarms.	**In Progress** – pending completion by FRO; see Table 29 for updated recommended action and deadline
2016-09	No QPOs set for inclinometers	QPOs and frequency of readings should be set for the inclinometers.	**In Progress** – draft complete; see Table 29 for updated recommended action and deadline
2016-10	Warning level QPO for piezometers exceeded. Based on review of data, this is not a failure concern	Update warning level QPOs for piezometers based on review of data all available data (2014 to present).	**In Progress** – pending completion by Golder, recommendation incorporated in 2017-06

IDF = inflow design flood; FRO = Fording River Operations; KWL = Kerr Wood Leidal Associates Ltd.; NTP = North Tailings Pond; STP = South Tailings Pond; HSRC = Health, Safety and Reclamation Code; DSI = dam safety inspection; TSF = tailings storage facility; OMS = operation, maintenance and surveillance; EPP = Emergency Preparedness Plan; ERP = Emergency Response Plan; QPO = quantitative performance objectives.

6.0 SUMMARY AND RECOMMENDATIONS

6.1 Summary of Activities

Activities completed for the NTP during the reporting period were:

- Monthly inspections by FRO geotechnical personnel
- Quarterly water quality testing
- Completion of Liverpool Sediment Pond system
- Prefeasibility design of NTP revision from tailings dam to mine waste facility or “landform”
- Completion of riprap upgrade works to Q200 design flow plus 0.5 m
- Completion of a probable maximum flood assessment for the Fording River watershed

Activities completed for the STP during the reporting period were:

- Two bathymetric surveys
- Monthly inspections by FRO geotechnical personnel
- Quarterly water quality testing
- Dredging of an estimated 850,076 dry metric tonnes of tailings to the Turnbull TSF
- Potential tailings water discharge event and related response including:
  - Inspection by Golder personnel
  - Construction of a till berm to exclude pond water near north abutment
  - Extended tailings line further into the pond
  - Filled in low area around previous end of tailings line
- Cleaned out ditches, regraded, and repaired berms along the lower access road of the West Dam
- Placed riprap along the upstream slope between Sta. 0+700 and 1+700
- Replaced the riprap emergency stockpile
- Completion of a probable maximum flood assessment for the Fording River watershed (same report as noted for NTP)

6.2 Summary of Climate and Water Balance

The climate data indicates the annual precipitation received at FRO from 1 September 2016 to 31 August 2017 was average as compared to the long-term historical average.

The NTP has a negative to neutral water balance. The pond was generally the same size throughout the year and no pumping was necessary.

The STP has a positive to neutral water balance. The pond capacity is reduced due to tailings deposition. The water levels are closely monitored and managed since the levels are near, but below, the maximum freeboard level.

6.3 Summary of Performance and Changes

The STP and NTP facilities were observed to be in good condition at the time of the 2017 DSI field inspection. No significant changes in instrumentation and 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 (MEM 2016).

An incremental inundation assessment was completed to assess the consequence of failure of the NTP and STP during a major flood event of the Fording River (Golder 2017g). The assessment concluded that the consequence of a failure occurring coincident with a major river flood event was High.

6.5 Current Deficiencies and Non-conformances

Table 29 summarizes the recommended actions for both the STP and NTP facilities.

Table 29: 2017 Dam Safety Inspection Recommended Actions for the North and South Tailings Pond Facilities

Structure	ID Number	Deficiency or Non-conformance	Applicable Guideline or OMS 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 finalizing the closure plan NTP.	4	Q3 2018
				If required, determine a construction schedule.	4	Q4 2018
	2015-06a,b,c	Risk-informed criteria for flood erosion protection along toe of dams not defined	CDA 2013 §6.2	Perform risk-informed assessment to determine appropriate flood protection requirements for downstream toe of dam along the Fording River and the timeline to implement.	2	Q3 2018
				Implement required protection measures for the operational phase according to the as-defined schedule.	2	2019
				Execute the flood risk mitigation plan until the flood protection requirements defined by the risk-informed assessment are in place.	1	Ongoing
	2015-07a,b,c	Buried pipes passing through crest locations	n/a	Inspect steel pipes as part of regular dam inspections until NTP closure plans are finalized. Include inspections in OMS manual update.	3	Q2 2018 (tentatively complete since December 2017, pending final OMS revision)
				Execute abandonment plan for PVC pipes.	3	Q4 2018
	2016-05a	North abutment excavated without input or approvals from Engineer of Record or Qualified Person	n/a	Assess and revise required internal and external communication for work and construction activities carried out near the site TSFs	1	Q2 2018 (tentatively complete since March 2018, pending final OMS revision)
	2016-06	No closure plan for NTP	n/a	Develop closure plan for NTP based on results of feasibility investigation into NTP decommissioning.	4	Q4 2018
STP	2013-16	No passive emergency system against overtopping; emergency system requires active response	n/a	Assess the best combination of active and passive emergency systems during various stages of the pond life cycle. If the assessment determines that passive systems are warranted, then develop a construction schedule for the selected system(s).	4	Q4 2018
	2015-12a,b,c	Riprap erosion protection along downstream toe north of STP Stn. 0+680, no riprap south of STP Stn. 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	Q3 2018
				Implement required protection measures for the operational phase according to the as-defined schedule.	2	2019 or as determined by schedule
				Execute flood risk mitigation plan until flood protection requirements defined by the risk-informed assessment are in place.	1	Ongoing
	2017-01	North abutment construction deficiencies	HSRC §10.5.1(3)	Address construction deficiency, finish dam construction.	2	2019
	2017-02	Tailings that were excavated along upstream slope to place the riprap zone impede water flow towards main pond	n/a	The tailings should be regraded with an excavator so that water will preferentially flow into the pond.	4	Q3 2018
	2017-03	Inspection frequency inadequate for active, Very High consequence facility	HSRC §10.1.12	Increase geotechnical inspections to weekly from April to October and twice per month from November to March for STP	3	Q2 2018 (in progress, pending final OMS revision)
	2017-04	Planned dredging of Tailings to Turnbull TSF is behind schedule and the result is a very high level of tailings in STP which is causing operational issues (e.g., disposition line backing up and reclaimed process water with too much sediment)	n/a	Dredging to Turnbull TSF should be started as soon as possible with an increased annual dredging target.	2	Q2 2018
NTP/STP	2015-03	Roles of Geotechnical and Hydraulics Engineers of Record undocumented	HSRC §10.1.5	Golder, FRO, and KWL to document the roles of the Engineer of Record for the geotechnical and hydraulics related works in the OMS manual.	4	Q2 2018
	2016-01	Seismic design criteria for stability out of date due to dam reclassification from High to Very High	HSRC §10.1.4 & 8	Complete updated seismic stability assessment and liquefaction based on revised design criteria. Check effects of upward gradient noted in STP piezometers.	2	Q2 2018 (draft in review)
	2016-02	IDF and freeboard out of date due to dam reclassification from High to Very High	HSRC §10.1.4 & 8	Update the IDF and freeboard assessment for the NTP and STP.	2	Q2 2018 (draft in review)

Structure	ID Number	Deficiency or Non-conformance	Applicable Guideline or OMS Reference	Recommended Action	Priority Level	Recommended Timing for the Action
	2016-03	OMS manual requires updating	HSRC §10.5.2(4)	Update OMS manual as follows: ■ Update all references to consequence classification of structures—change from High to Very High. ■ Include design criteria. ■ Review the manual using the updated HSRC and Guidance Document (MEM 2017, 2016). ■ Review the manual using most recent MAC guidelines ■ QPOs to be included for surveillance. ■ The dredging section needs to be updated to identify that dredging is currently operating to the Turnbull Tailings Storage Facility. ■ Include safe work plans. ■ Include incident reporting procedures. ■ Include non-compliance reporting procedures. ■ Include animal burrow inspection and procedures ■ Include NTP pipe inspections ■ Include hydroseeding records ■ Include Liverpool and NTP boundaries Complete minor updates identified in the 2015 DSI report (Golder 2016b).	4	Q2 2018 (draft in progress)
	2016-04	EPP & ERP require updating	HSRC §10.4.2(1)	Reference to the QPOs needs to be included for actions required based on instrumentation warnings and alarms.	4	Q3 2018
	2016-09	No QPOs set for inclinometers	HSRC §10.1.13	QPOs and frequency of readings should be set for the inclinometers.	3	Q2 2018 (draft in this document)
	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	Q4 2018
	2017-06 (supersedes 2016-01b and 2016-10)	Trigger-action-response plans (TARPs) and related QPOs not strongly tied to risk assessment results	HSRC §10.5.2	TARPs with related monitoring plans and QPOs should be reviewed with consideration of the results from the 2017 TSF risk assessment	3	Q3 2018

STP = South Tailings Pond; NTP = North Tailings Pond; FRO = Fording River Operations; KWL = Kerr Wood Leidal Associates Ltd.; OMS = operation, maintenance and surveillance; CDA = Canadian Dam Association; HSRC = Health, Safety and Reclamation Code; QPO = quantitative performance objectives; EPP = Emergency Preparedness Plan; ERP = Emergency Response Plan; Stn. = Station; n/a = not applicable; DSI = dam safety inspection; TSF = tailings storage facility.

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 (MEM 2016).

7.0 OPPORTUNITIES FOR IMPROVEMENT

Some opportunities for improvement were identified during the DSI:

- The downstream slopes of the STP West Dam could be revegetated to reduce erosion and reduce the required maintenance.
- The STP West and Main dams could be resloped to remove the bench. This could reduce the amount of erosion on the dam and could increase the overall factor of safety against instability.

8.0 CLOSURE

The reader is referred to the Study Limitations, 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.

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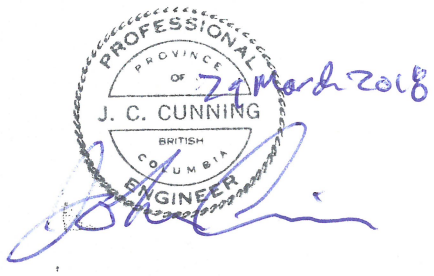

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https://golderassociates.sharepoint.com/sites/16299g/deliverables/issued/2017-129-r-rev0-1000_ntp-stp_dsi_2017/1784573-2017-129-r-rev0-1000-2017 dsi of ntp and stp 29mar_18.docx

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STUDY LIMITATIONS

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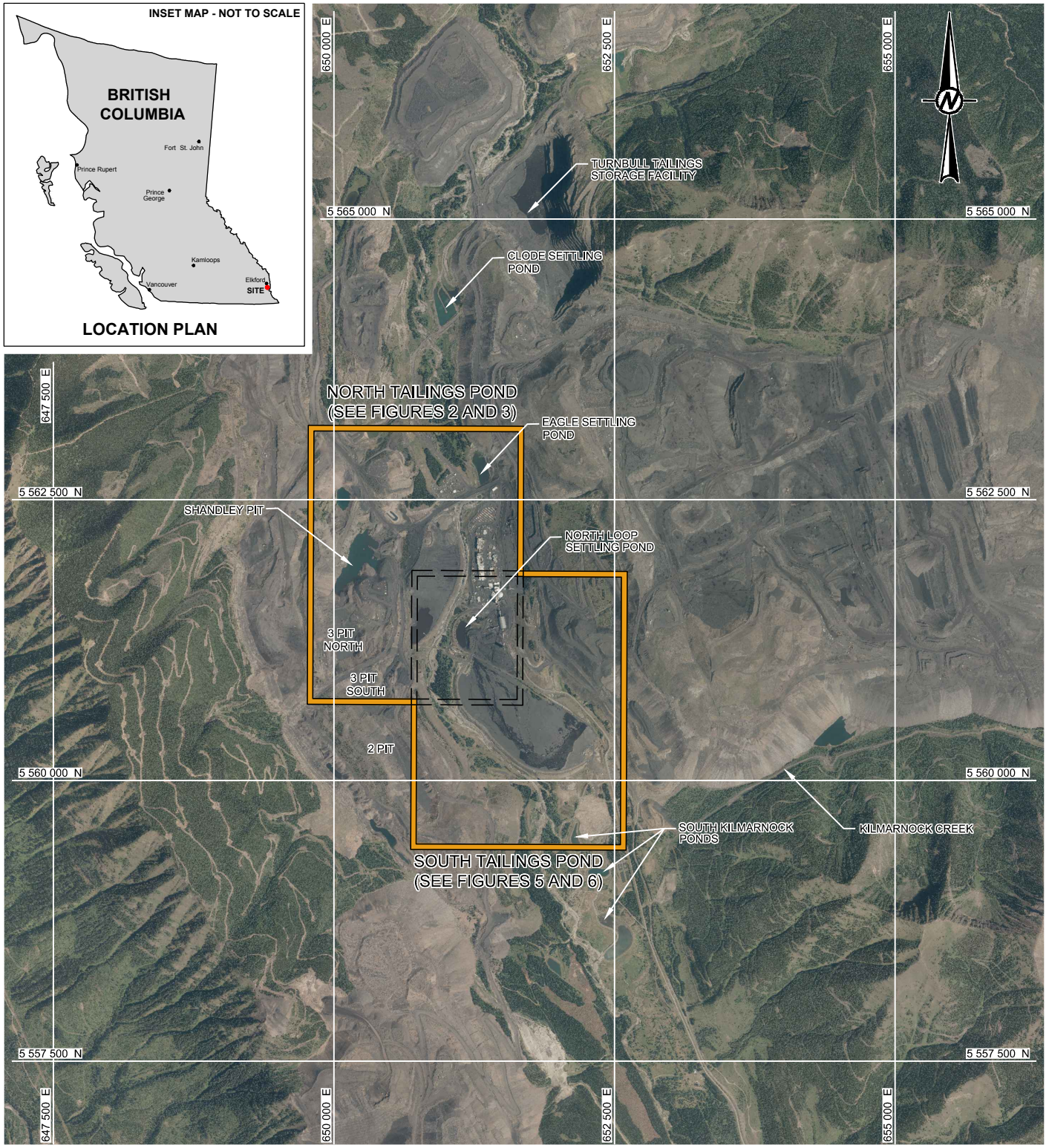

REFERENCE

1. 2017 AERIAL PHOTO PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS.

NOTES

1. ALL UNITS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATES ARE IN UTM, 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.

PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

CONSULTANT
Golder Associates

YYYY-MM-DD	2018-03-21
DESIGNED	NC
PREPARED	TAK
REVIEWED	JMS
APPROVED	JCC

TITLE
FORDING RIVER OPERATIONS SITE PLAN

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
1784573	1000/1008/2017-129	0	1

LEGEND

- TOPOGRAPHIC CONTOURS
- TAILINGS CONTOURS
- 2017 NTP CREST SURVEY
- EXTENT OF NTP DOWNSTREAM RIPRAP
- (#) 2017 SITE VISIT PHOTOGRAPH LOCATION

NOTES

1. ALL UNITS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATES ARE IN UTM, 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. TAILINGS CONTOURS SHOWN AT 1.0 m MINOR AND 5.0 m MAJOR INTERVAL.

REFERENCES

1. 2017 AERIAL PHOTO AND TOPOGRAPHY PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS. FLOWN 25 TO 27 JULY 2017.
2. 2016 TAILINGS SURVEY PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS. RECEIVED: 24 OCTOBER 2016.
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

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DESIGNED	NC
PREPARED	TAK
REVIEWED	JMS
APPROVED	JCC

PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND
PHOTOGRAPH LOCATIONS

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
1784573	1000/1008/2017-129	0	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
0 25 mm

LEGEND

- TOPOGRAPHIC CONTOURS
- TAILINGS CONTOURS
- 2017 NTP CREST SURVEY
- EXTENT OF NTP DOWNSTREAM RIPRAP
- VIBRATING WIRE PIEZOMETER AND INCLINOMETER LOCATION
- GPS MONITORING LOCATION
- PRISM LOCATION
- REFERENCE PRISM LOCATION

0 125 250
1:7,500 METRES

NOTES

1. ALL UNITS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
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3. TOPOGRAPHIC CONTOURS SHOWN AT 5.0 m MINOR AND 25.0 m MAJOR INTERVAL.
4. TAILINGS CONTOURS SHOWN AT 1.0 m MINOR AND 5.0 m MAJOR INTERVAL.

REFERENCES

1. 2017 AERIAL PHOTO AND TOPOGRAPHY PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS, FLOWN ON 25 TO 27 AUGUST 2016.
2. 2016 TAILINGS SURVEY PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS. RECEIVED: 24 OCTOBER 2016.
3. GPS AND PRISM MONITORING LOCATIONS BASED ON INITIAL READINGS OF DATA FROM GEOEXPLORER, ACCESSED: 13 DECEMBER 2017.
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6. 2017 NTP CREST SURVEY PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS. RECEIVED 8 JANUARY 2018. FILE NAME: NTP CREST SURVEY - 171121C.xls

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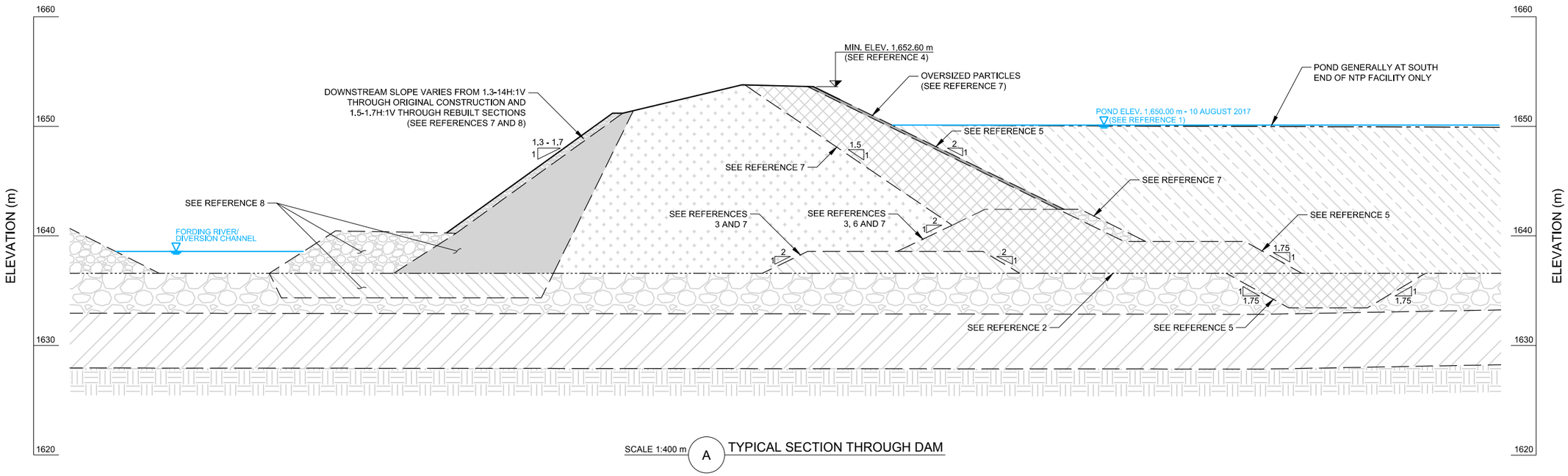
YYYY-MM-DD	2018-03-21
DESIGNED	NC
PREPARED	TAK
REVIEWED	JMS
APPROVED	JCC

PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND MONITORING LOCATIONS

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
1784573	1000/1008/2017-129	0	3



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
- APPROXIMATE TAILINGS 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. ELEVATION DATUM WAS ADJUSTED TO THE ELK VALLEY ELEVATION DATUM BY SUBTRACTING 0.454 m AS PER AIRBORNE IMAGING (2017)

REFERENCES

1. POND ELEVATION IS LAST RECORDED READING FROM DATA PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS, RECEIVED: 26 SEPTEMBER 2017.
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.
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5. GOLDER BRAWNER (GOLDER BRAWNER ASSOCIATES). 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.
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7. GOLDER (GOLDER ASSOCIATES). 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. 2014. 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 Associates

YYYY-MM-DD	2018-03-21
DESIGNED	NC
PREPARED	TAK
REVIEWED	JMS
APPROVED	JCC

PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND
TYPICAL SECTION THROUGH DAM

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
1784573	1000/1008/2017-129	0	4

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

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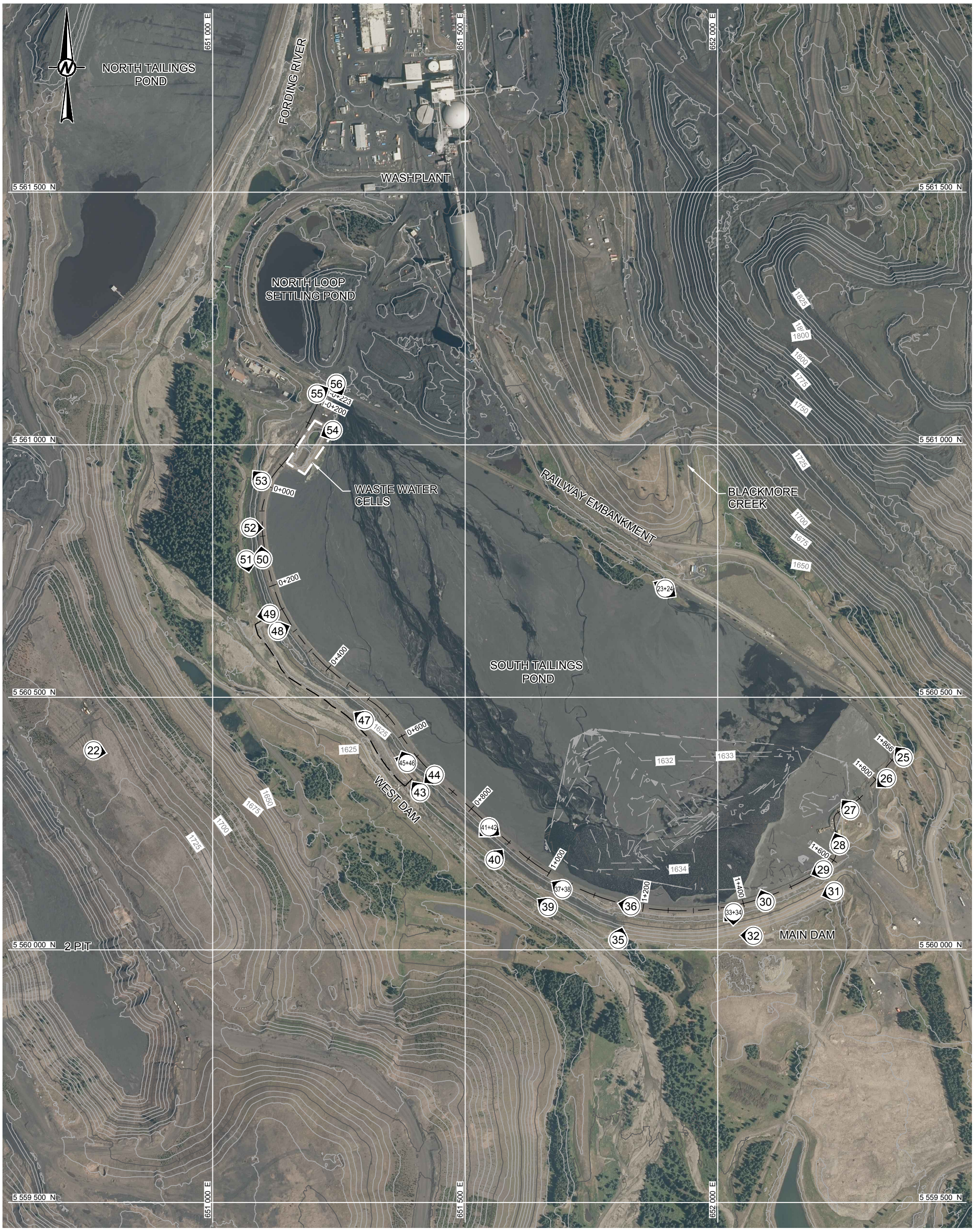


LEGEND

- TOPOGRAPHIC CONTOURS
- TAILINGS CONTOURS
- EXTENT OF STP DOWNSTREAM RIPRAP
- # 2017 SITE VISIT PHOTOGRAPH LOCATION

NOTES

1. ALL UNITS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATES ARE IN UTM, 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. TAILINGS CONTOURS SHOWN AT 1.0 m MINOR AND 5.0 m MAJOR INTERVAL.

REFERENCES

1. 2017 AERIAL PHOTO AND TOPOGRAPHY PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS. FLOWN 25 TO 27 JULY 2017.
2. 2017 BATHYMETRY DATA PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS. FILE NAME: Combined Surface (good).msr RECEIVED: 13 DECEMBER 2017.
3. STP 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.

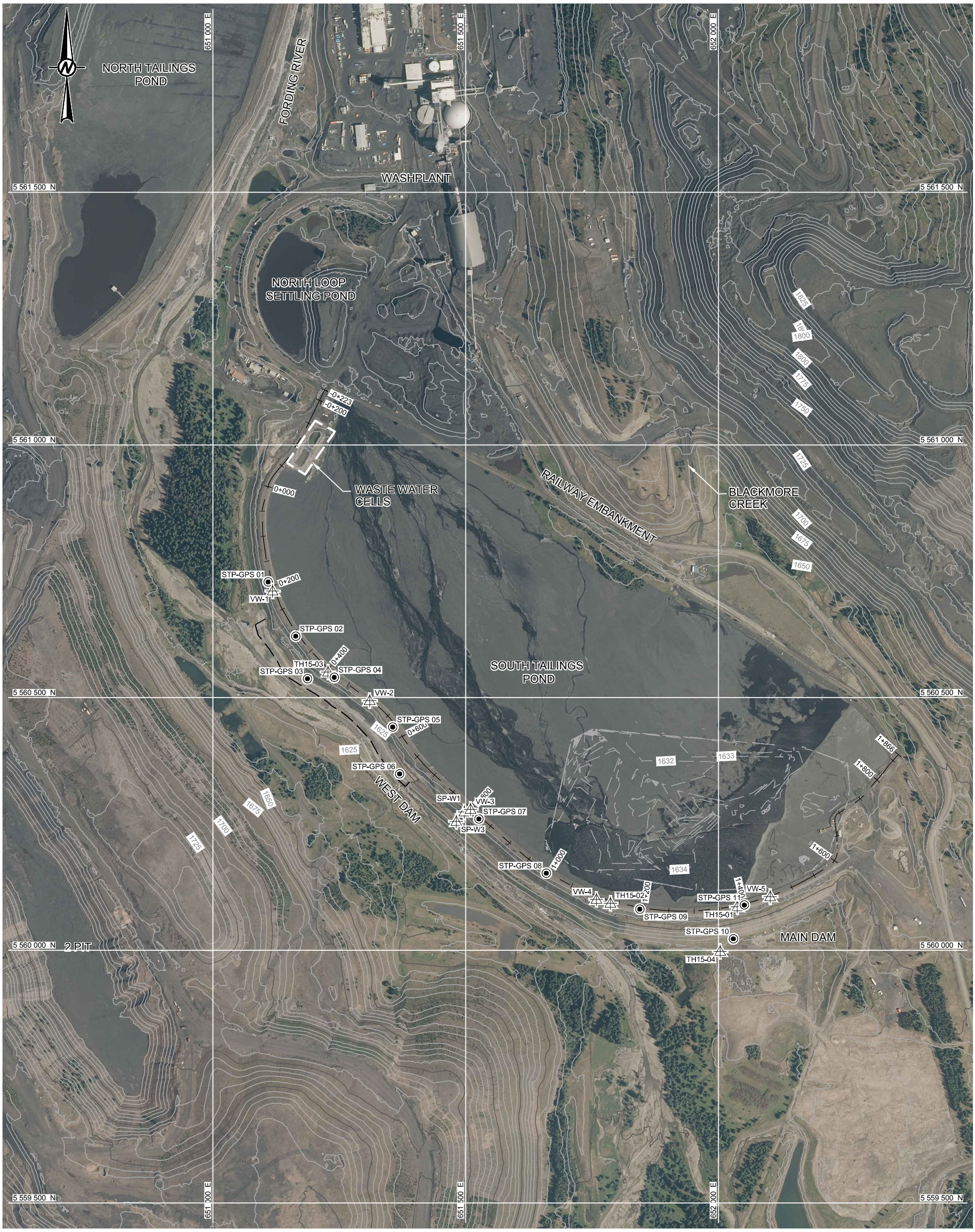
CONSULTANT
Golder Associates

YYYY-MM-DD	2018-03-21
DESIGNED	NC
PREPARED	TAK
REVIEWED	JMS
APPROVED	JCC

PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND
PHOTOGRAPH LOCATIONS

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
1784573	1000/1008/2017-129	0	5



LEGEND

- TOPOGRAPHIC CONTOURS
- TAILINGS CONTOURS
- EXTENT OF STP DOWNSTREAM RIPRAP
- GPS MONITORING LOCATION
- VIBRATING WIRE PIEZOMETER AND INCLINOMETER LOCATION
- STANDPIPE PIEZOMETER LOCATION
- RETROFIT STANDPIPE WITH VIBRATING WIRE PIEZOMETER LOCATION
- SEEPAGE RETURN WELL LOCATION

NOTES

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4. TAILINGS CONTOURS SHOWN AT 1.0 m MINOR AND 5.0 m MAJOR INTERVAL.

REFERENCES

1. 2017 AERIAL PHOTO AND TOPOGRAPHY PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS, FLOWN ON 25 TO 27 JULY 2017.
2. 2017 BATHYMETRY DATA PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS. FILE NAME: COMBINED SURFACE (GOOD).MSR RECEIVED: 13 DECEMBER 2017.
3. STP RIPRAP EXTENTS PROVIDED BY KERR WOOD LEIDAL ASSOCIATES LTD. RECEIVED: 17 JANUARY 2018
4. GPS MONITORING LOCATIONS BASED ON INITIAL READINGS OF DATA PROVIDED FROM GEOEXPLORER ACCESSED 13 DECEMBER 2017.
5. LOCATIONS OF STANDPIPE PIEZOMETERS AND SEEPAGE RETURN WELLS BASED ON SURVEY DATA FROM GEOEXPLORER, ACCESSED 13 DECEMBER 2017.
6. LOCATIONS OF 2014 VIBRATING WIRE PIEZOMETERS BASED ON SURVEY DATA FROM GEOEXPLORER, ACCESSED 13 DECEMBER 2017.
7. LOCATIONS OF 2015 VIBRATING WIRE PIEZOMETERS AND INCLINOMETERS BASED ON SURVEY DATA FROM GEOEXPLORER, ACCESSED 13 DECEMBER 2017.
8. 2017 BATHYMETRY DATA PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS. FILE NAME: Combined Surface (good).msr RECEIVED: 13 DECEMBER 2017.

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1:7,500 METRES

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

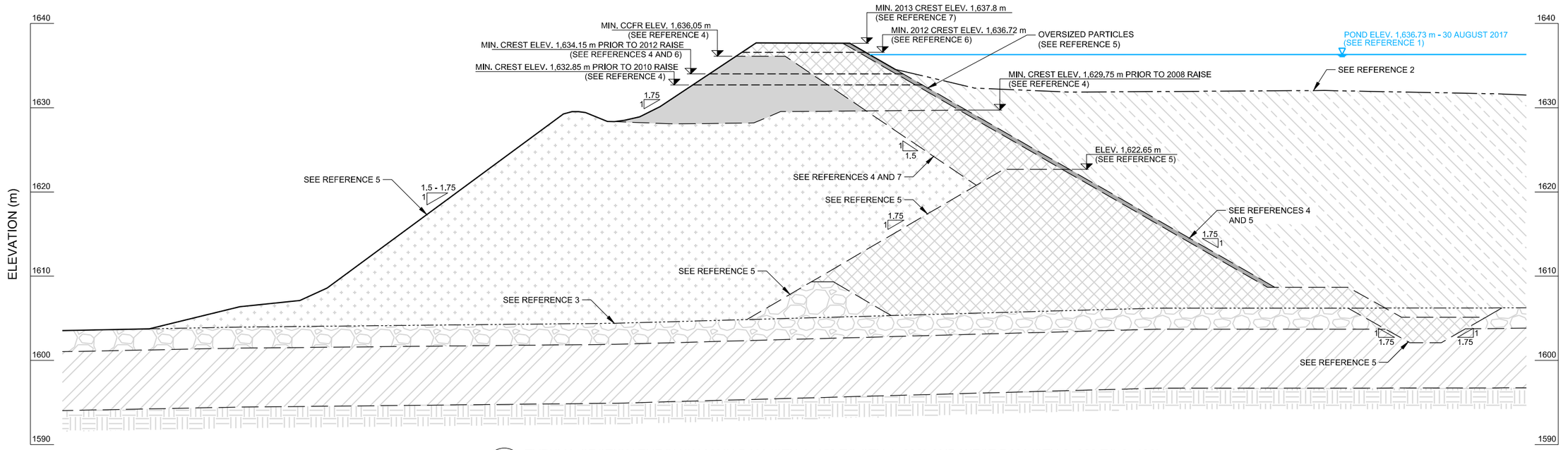
CONSULTANT
Golder Associates

YYYY-MM-DD	2018-03-21
DESIGNED	NC
PREPARED	TAK
REVIEWED	JMS
APPROVED	JCC

PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND MONITORING LOCATIONS

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
1784573	1000/1008/2017-129	0	6



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. ELEVATION DATUM WAS ADJUSTED TO THE ELK VALLEY ELEVATION DATUM BY SUBTRACTING 0.454 m AS PER AIRBORNE IMAGING (2017)

REFERENCES

1. POND ELEVATION IS LAST RECORDED READING FROM DATA PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS, RECEIVED: 26 SEPTEMBER 2017.
2. TAILINGS SURFACE 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 (TECK COAL LIMITED FORDING RIVER OPERATIONS). 2010. SOUTH TAILINGS POND DESIGN AND CONSTRUCTION REPORT JULY-SEPTEMBER 2010. SUBMITTED NOVEMBER 2010.
5. GOLDER (GOLDER ASSOCIATES). 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 (GOLDER ASSOCIATES LTD.). 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. 2014. 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
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2018-03-21
DESIGNED	NC
PREPARED	TAK
REVIEWED	JMS
APPROVED	JCC

PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL 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
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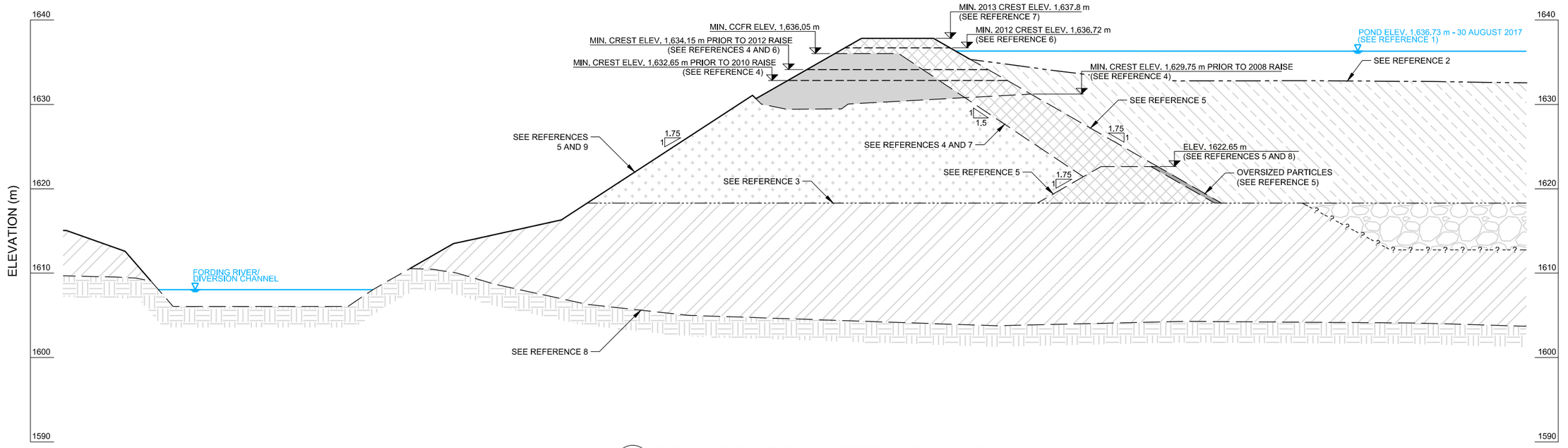

SCALE 1:500 m C TYPICAL SECTION THROUGH WEST DAM (STN 0+400 TO 1+150)

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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2. MATERIALS SHOWN SCHEMATICALLY ONLY.
3. RIPRAP PRESENT FROM APPROXIMATELY 0+205 TO 0+680, NOT SHOWN ON SECTION.
4. ELEVATION DATUM WAS ADJUSTED TO THE ELK VALLEY ELEVATION DATUM BY SUBTRACTING 0.454 m AS PER AIRBORNE IMAGING (2017)

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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 (TECK COAL LIMITED FORDING RIVER OPERATIONS). 2010. SOUTH TAILINGS POND DESIGN AND CONSTRUCTION REPORT JULY-SEPTEMBER 2010. SUBMITTED NOVEMBER 2010.
5. GOLDER (GOLDER ASSOCIATES). 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 (GOLDER ASSOCIATES LTD.). 2013. SOUTH TAILINGS POND DAM 2012 CONSTRUCTION DAM RAISE AS-BUILT REPORT. REPORT PREPARED FOR TECK COAL LIMITED FORDING RIVER OPERATIONS. REFERENCE NO. 1214270098-2013-303-R-REV0-6400. SUBMITTED 1 APRIL 2013.
7. GOLDER. 2014. 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.
8. GOLDER (GOLDER ASSOCIATES LTD.). 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 (KERR WOOD LEIDAL ASSOCIATES LTD.). 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 Associates

YYYY-MM-DD	2018-03-21
DESIGNED	NC
PREPARED	TAK
REVIEWED	JMS
APPROVED	JCC

PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL 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
1784573	1000/1008/2017-129	0	8

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

25 mm 0

APPENDIX A

Site Photographs

Photograph 1: North Tailings Pond (NTP) overview from south abutment, looking north. 4 October 2017.

Photograph 2: NTP dam downstream slope overview from south abutment, looking northeast. 4 October 2017.

Photograph 3: NTP dam downstream slope at south abutment with filled erosion channel, looking northwest. 4 October 2017.

Photograph 4: NTP downstream toe, animal burrows near south abutment, looking northwest. 4 October 2017.

Photograph 5: NTP barge on small pond, looking northwest. 4 October 2017.

Photograph 6: NTP dam upstream slope with small trees and vegetation growing, and unused reclaim pipes, looking northeast. 4 October 2017.

Photograph 7: NTP dam downstream slope with stepped erosion, looking northwest. 4 October 2017.

Photograph 8: NTP dam downstream slope and toe with riprap staging area, looking east. 4 October 2017.

Photograph 9: NTP dam downstream slope with unused pipe along surface of slope, looking northeast. 4 October 2017.

Photograph 10: NTP dam downstream slope and riprap overview from North Loop Pond, looking northwest. 3 October 2017.

Photograph 11 : NTP crest, looking southwest. 4 October 2017.

Photograph 12 : NTP toe, riprap along Fording River, looking northeast. 4 October 2017.

Photograph 13 : NTP unused dual reclaim pipes on upstream slope and crossing under crest, looking north. 4 October 2017.

Photograph 14 : NTP crest, looking north. 4 October 2017.

Photograph 15: NTP downstream slope and riprap along Fording River, looking north. 4 October 2017.

Photograph 16: NTP, tailings surface with silt fencing for dust control, looking southwest. 5 October 2017.

Photograph 17: NTP near north abutment, dozed till material and unused steel tailings pipe, looking north. 5 October 2017.

Photograph 18: NTP, surface runoff from haul road ditch reporting to tailings beach, looking west. 5 October 2017.

Photograph 19: Liverpool Pond outlet channel north of NTP, looking west. 5 October 2017.

Photograph 20: Liverpool Pond outlet north of NTP, fish control structure, looking north. 5 October 2017.

Photograph 21: NTP dam toe, downstream riprap recently raised, looking north. 4 October 2017.

Photograph 22: South Tailings Pond (STP) overview from west side of Fording River, looking southeast. 5 October 2017.

Photograph 23: STP buttress adjacent to railway line, twin culvert outlets from Blackmore Creek, and dredge pipeline to the Turnbull South Tailings Storage Facility, looking southeast. 4 October 2017.

Photograph 24: Natural ground adjacent to railway line and emergency tailings dredge bypass, looking northwest. 4 October 2017.

Photograph 25: STP south abutment till blanket area and gas line crossing location, looking northeast. 4 October 2017.

Photograph 26: STP south abutment till blanket area and upstream slope, looking southwest. 4 October 2017.

Photograph 27: STP south abutment till blanket area, makeup water lines from Kilmarnock Ponds with riprap protection on blanket, looking northwest. 4 October 2017.

Photograph 28: STP Main Dam, barge at south end of pond and reclaim from seepage return wells, looking north. 4 October 2017.

Photograph 29: STP Main Dam, new upstream constructed riprap 1.4H:1V, looking west. 4 October 2017.

Photograph 30: STP, dredge in tailings pond, looking north. 4 October 2017.

Photograph 31: STP Main Dam, downstream slope at mid-slope bench (approximately elev. 1,630 m), looking west. 4 October 2017.

Photograph 32: STP Main Dam, downstream slope and toe at seepage return well, looking west. 4 October 2017.

Photograph 33: STP Main Dam, riprap emergency stockpile removed, and Fording River floodplain, looking south. 4 October 2017.

The riprap stockpile was replaced late 2017.

Photograph 34: STP Main Dam, persistent ponding downstream of toe in old river channel, looking southwest. 4 October 2017.

Photograph 35: STP corner of West and Main dams, looking northeast. Note vegetation not taking root in CCFR. 4 October 2017.

Photograph 36: STP West Dam, upstream slope with new riprap, looking northwest. Note tailings were pushed into pond to place riprap. 4 October 2017.

Photograph 37: STP West Dam, access road used for riprap haulage, ditch re-established along bench, looking northwest. 4 October 2017.

Photograph 38: STP West Dam, downstream slope, looking northwest. 4 October 2017.

Photograph 39: STP West Dam, major seepage point at the downstream slope toe (Stn. 1+000). Seepage collection pipes monitor flow. Note discolouration. The flow rate at the time of inspection was approximately 3 L/sec from both pipes. Looking northwest. 4 October 2017.

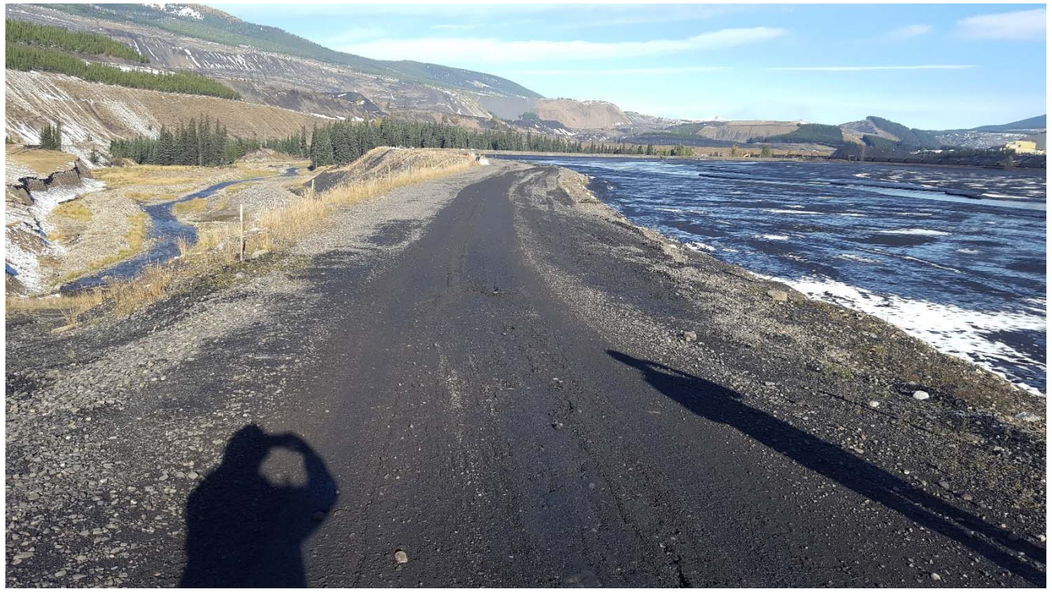
Photograph 40: STP West Dam, seepage along the downstream toe, looking northeast. 4 October 2017.

Photograph 41: STP West Dam crest overview, looking southeast. Note crest regraded. 4 October 2017.

Photograph 42: STP West Dam, downstream slope and Fording River, looking southwest. 4 October 2017.

Photograph 43: STP West Dam, seepage at riprap at downstream toe, looking northwest. 4 October 2017.

Photograph 44: STP unused dredge line to 2P-3P Tailings Storage Area on pipe bridge, looking southwest. 4 October 2017.



Photograph 45: STP West Dam crest and tailings pond overview, looking northwest. 4 October 2017.

Photograph 46: STP West Dam, downstream slope overview and Fording River, looking northwest. 4 October 2017.

Photograph 47: STP West Dam, riprap placed at toe of dam for erosion protection from Fording River, looking northwest. 4 October 2017.

Photograph 48: STP West Dam, erosion gully and infilled depression, looking northeast. 4 October 2017.

Photograph 49: STP West Dam, twin culverts beneath access road at toe, looking east. 4 October 2017.

Photograph 50: STP upstream slope and crest, looking north. 4 October 2017.

Photograph 51: STP West Dam downstream slope with vegetation and ditch at downstream toe, looking south.

4 October 2017.

Photograph 52: STP West Dam, erosion gully, looking east. 4 October 2017.

Photograph 53: STP West Dam, pond at downstream toe near Stn.-0+050, looking northwest. 4 October 2017.

Photograph 54: STP north abutment, waste water cells, looking southwest. 4 October 2017.

Photograph 55: STP north abutment, recently constructed upstream till berm, looking northeast. 4 October 2017.

Photograph 56: STP north abutment, outlet of tailings pipe and water return pipe, looking southeast. 3 October 2017.

APPENDIX B

North Tailings Pond Inspection Report

Client:	**Teck Coal Limited, Fording River Operations**	**By:**	**John Cunning, P.Eng., [redacted], E.I.T.**
Project:	**FRO Dam Safety Inspection**	**Date:**	**4 to 5 October 2017**
Location:	**North Tailings Pond**	**Reviewed:**	**John Cunning, P.Eng.**

GENERAL INFORMATION

Dam Type: Zoned Earth Fill

Weather Conditions:	Clear and Sunny	**Temp:**	0 to 10°C

Inspection Item	Observations/Data	Photo	Comments & Other Data
1.0 DAM CREST		6, 11, 13, 14	
1.1 Crest Elevation	Elev. 1,652.6 m (minimum)		2017 NTP crest survey provided by FRO confirms minimum elevation (Elk Valley Elevation Datum).
1.2 Reservoir Level/ Freeboard	Elev. 1,650.0 m (10 August 2017) 2.8 m freeboard	1, 5	From 2017 pond elevation survey data provided by FRO (Elk Valley Elevation Datum).
1.3 Distance to Tailings Pond (if applicable)	**0 m (south end)** Approx. Stn. 1+200 to 1+400; **Full beach** Approx. Stn 0+000 to 1+200	1, 5 16	Usually no beach at south end
1.4 Surface Cracking	None		
1.5 Unexpected Settlement	None		
1.6 Lateral Movement	None		
1.7 Other Unusual Conditions	Yes	9, 13, 17	■ pipe crossings under the crest: - dual steel pipes - steel pipe to culvert on downstream face - shallow PVC pipes - old tailings delivery pipe at former bridge abutment

Inspection Item	Observations/Data	Photo	Comments & Other Data
2.0 UPSTREAM SLOPE		1, 6, 13	
2.1 Slope Angle	1.4 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	6, 13	
3.0 DOWNSTREAM SLOPE		2, 3, 7, 8, 9, 10, 15	
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 1.75 H:1 V due to 2013 flood.
3.2 Signs of Erosion	Minor surficial erosion, not stability concern	7 3	Minor stepped erosion throughout downstream slope. Vertical channel at south abutment appears stable since repairs in 2016.
3.3 Signs of Movement (Deformation)	None		
3.4 Cracks	None		
3.5 Seepage or Wet Areas	Dry		
3.6 Vegetation Growth	Variable	2, 7, 15	Grasses appropriate on old slopes. Good grass growth on soil cover placed on rebuilt slopes.
3.7 Other Unusual Conditions	Yes		Vertical culvert in downstream slope
4.0 DOWNSTREAM TOE AREA		8, 12, 15	
4.1 Seepage from Dam	None		
4.2 Signs of Erosion	No	12, 15	Riprap placed to protect from Fording River erosion, in good condition.

Inspection Item	Observations/Data	Photo	Comments & Other Data
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	None		
5.0 ABUTMENTS		2, 17, 20	
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	4	Animal burrows in toe near south abutment.
5.5 Other Unusual Conditions	Yes	18 20	Surface runoff from haul road reports to north end of tailings beach. Liverpool outlet channel and fish barrier at north end of NTP.
6.0 RESERVOIR		16	
6.1 Stability of Slopes	Spoils west of tailings storage facility	16	Spoils resloped in March 2015
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	5	Barge is crooked from being stuck in tailings, barge not in use.
7.0 EMERGENCY SPILLWAY/ OUTLET STRUCTURE	None		No spillway or emergency outlet.
7.1 Surface Condition	N/A		
7.2 Signs of Erosion	N/A		

Inspection Item	Observations/Data	Photo	Comments & Other Data
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		
8.0 INSTRUMENTATION			
8.1 Piezometers	Yes		Three piezometers installed in 2015, see Section 5.3.1.3. Locations shown in plan in Figure 3.
8.2 Settlement Cells	None		
8.3 Thermistors	None		
8.4 Settlement Monuments	Yes		Prisms and GPS unit monitor crest movements - see Appendix H. Locations shown in plan in Figure 3.
8.5 Accelerograph	None		
8.6 Inclinometer	Yes		Three inclinometers installed in 2015 – see Appendix I. Locations shown in plan in Figure 3.
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	None		

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	Yes		SP&P GN.029A.R5, 17 December 2015.
9.1.2 OMS Manual Reflects Current Dam Conditions	No		
9.1.3 Date of Last Revision	OMS manual in draft		Under review by FRO, NTP to be included in NTP-STP OMS manual. Updated revision pending.
9.2 Emergency Preparedness Plan (ERP) 9.2.1 ERP Exists	Yes ERP: Internal to Teck EPP: External to Teck		NTP included in site tailings facilities ERP (SP&P EP.009) (FRO 2017). EPP SP&P EP.008.R1
9.2.2 ERP Reflects Current Conditions	ERP reflects current conditions on site, EPP to be updated based on ERP once finalized.		
9.2.3 Date of Last Revision	**ERP**: September 2017, in draft **EPP**: 15 December 2015		

10. NOTES

Currently, no active deposition of tailings into the NTP. Barge is not being operated and pipes are not connected. Ability to pump water from the pond is part of storm water management; temporary pumps need to be available in the event pumping is necessary. The temporary pipeline that crosses the Fording River from Shandley Pit to the STP would be used in an emergency pumping event.

Upgrades to erosion protection along the downstream toe was completed at the time of the site inspection.

The future use of the facility is currently under review by FRO.

Inspectors	[redacted], E.I.T.	**Date:**	4 October 2017

APPENDIX C

South Tailings Pond Inspection Report

Client:	**Teck Coal Limited, Fording River Operations**	**By:**	**John Cunning, P.Eng., [redacted], E.I.T.**
Project:	**FRO Dam Safety Inspection**	**Date:**	**4 to 5 October 2017**
Location:	**South Tailings Pond**	**Reviewed:**	**John Cunning, P.Eng.**

GENERAL INFORMATION

Dam Type: Zoned Earth Fill

Weather Conditions:	Clear and Sunny	**Temp:**	0 to 10°C

Inspection Item	Observations/Data	Photo	Comments & Other Data
1.0 DAM CREST		29, 36, 41, 45, 50	
1.1 Crest Elevation	Elev. 1,637.8 m (minimum)		From FRO survey of last raise in 2013. Confirmed with 2017 LiDAR survey (Elk Valley Elevation Datum).
1.2 Reservoir Level / Freeboard	Elev.1,636.28 m (30 August 2017) 1.52 m freeboard	26, 28, 29	From 2017 pond elevation survey data provided by FRO (Elk Valley Elevation Datum).
1.3 Distance To Tailings Pond (if applicable)	0 m at south along Main Dam. Variable beach along West Dam	29, 30 45, 50	
1.4 Surface Cracking	None		
1.5 Unexpected Settlement	None		
1.6 Lateral Movement	None		
1.7 Other Unusual Conditions or Structures	No		Crest was regraded in 2017
2.0 UPSTREAM SLOPE		26, 29, 36, 50	
2.1 Slope Angle	Generally 1.4 H to 1.75 H : 1 V	26, 29	■ Till crest graded to drain upstream. ■ Riprap placed along upstream slope of Main Dam in 2017
2.2 Signs of Erosion	None		

Inspection Item	Observations/Data	Photo	Comments & Other Data
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	No		
3.0 DOWNSTREAM SLOPE		31, 32, 38, 42, 46, 47, 48, 51, 52	
3.1 Slope Angle	± 1.5 to 1.75 H : 1 V	31, 32	■ Oversteepened with respect to Main Dam design which calls for 1.75 H : 1 V. ■ Not re-graded over whole slope height, local sections of oversteep slope with benches.
3.2 Signs of Erosion	Minor channels Repaired old channels	35, 48, 52	■ Old CCFR benches have surface erosion channels. ■ Repaired erosion channels are performing well. ■ Erosion channels in Main and West Dam should continue to be monitored and be filled with coarse rock fill as per previously repaired channels.
3.3 Signs of Movement (Deformation)	None		
3.4 Cracks	None		
3.5 Seepage or Wet Areas	None		
3.6 Vegetation Growth	Good on Main Dam Poor on West Dam	35	West Dam south end vegetation not rooting, improve growth on dam.
3.7 Other Unusual Conditions	None		

Inspection Item	Observations/Data	Photo	Comments & Other Data
4.0 DOWNSTREAM TOE AREA		32, 33, 34, 39, 40, 43, 47, 51	
4.1 Seepage from Dam	Yes on West and Main Dams	53 39, 40 43 34	West Dam - Pond at toe at north end. - Persistent seepage from West Dam areas at north end and on bench above Fording River diversion channel. - Saturated ground observed in cut slope at toe of West Dam above area of new riprap. Main Dam - Pond south of dam toe.
4.2 Signs of Erosion	None	22	
4.3 Signs of Turbidity in Seepage Water	None		
4.4 Discoloration/Staining	Yes (green, red)	39 40	■ Green mineral (possible calcite) deposits from seepage water. ■ Some minor areas with red colored staining in seepage from bedrock contact.
4.5 Outlet Operating Problem (if applicable)	N/A		
4.6 Other Unusual Conditions	None		
5.0 ABUTMENTS			
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	55	■ Gas main pipeline in north abutment area did not allow for abutment section of dam to tie into interim berm built. ■ Till berm constructed near north abutment in 2017.
6.0 RESERVOIR		22, 30	
6.1 Stability of Slopes	Stable	23	■ Railway embankment on east side of impoundment has a buttress berm. ■ 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)	Adjacent to impoundment		■ Slide from railway embankment would impact tailings beach and/or pond water. Potential for generation of small waves from slide into water. ■ Slide from small slope would impact tailings beach. Little to no potential for wave generation.
6.3 Estimate of Slide Volume (if applicable)	Minor		■ Potential slide volume from railway embankment or small slope would be small.
6.4 Floating Debris	None		
6.5 Other Unusual Conditions	Yes	56 23 30 54	■ Tailings beach is nearing elevation of plant discharge pipe outlet. ■ Tailings beach in nearing elevation of Blackmore Creek culverts outlet. ■ Tailings being dredged to Turnbull TSF May to October 2017. Dredge operations active at time of inspection. ■ Waste water cells in operation near the north abutment.
7.0 EMERGENCY SPILLWAY/ OUTLET STRUCTURE	None		■ No spillway or emergency outlet.

Inspection Item	Observations/Data	Photo	Comments & Other Data
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		
8.0 INSTRUMENTATION			
8.1 Piezometers	Yes		West Dam (see Section 5.4.1.3) - 2 standpipes (not read) - 2 retrofit standpipes with vibrating wire - 4 VW piezometers Main Dam (see Section 5.4.1.3) - 1 standpipe (not read) - 2 retrofit standpipes with vibrating wire - 5 VW piezometers Locations shown in plan in Figure 5
8.2 Settlement Cells	None		
8.3 Thermistors	None		
8.4 Settlement Monuments	Yes		GPS units monitor crest and toe movements - see Appendix H. Locations shown in plan in Figure 5.
8.5 Accelerograph	None		

Inspection Item	Observations/Data	Photo	Comments & Other Data
8.6 Inclinometer	Yes		West Dam - 1 location Main Dam - 3 locations See Appendix I. Locations shown in plan in Figure 5.
8.7 Weirs and Flow Monitors	None		
8.8 Data Logger(s)	Yes		On piezometers and GPS units, all instrumentation connected to GeoExplorer system.
8.9 Other	None		
9.0 DOCUMENTATION			
9.1 Operation, Maintenance and Surveillance (OMS) Manual			SP&P GN.029A.R5, 17 December 2015
9.1.1 OMS Manual Exists	Yes		
9.1.2 OMS Plan Reflects Current Dam Conditions	No		
9.1.3 Date of Last Revision	OMS manual in draft		Under review by FRO, STP to be included in in NTP-STP OMS manual. Updated revision pending.
9.2 Emergency Preparedness Plan (EPP)	Yes		STP included in site tailings facilities ERP (SP&P EP.009) (FRO 2017).
9.2.1 EPP Exists	ERP: Internal to Teck EPP: External to Teck		EPP SP&P EP.008.R1
9.2.2 EPP Reflects Current Conditions	ERP reflects current conditions on site, EPP to be updated based on ERP once finalized.		
9.2.3 Date of Last Revision	**ERP**: September 2017, in draft **EPP**: 15 December 2015		

Inspection Item	Observations/Data	Photo	Comments & Other Data

10. NOTES

North abutment final alignment on hold since 2013 due to gas main pipeline; interim berm in place until gas main relocated or north abutment redesigned.

Erosion channels in CCFR benches should continue to be monitored and to be repaired as required similar to previous repairs.

Continue to monitor seepage including measuring flows where possible along downstream toe of West Dam.

Inspectors	[redacted], E.I.T.	**Date:**	4 October 2017

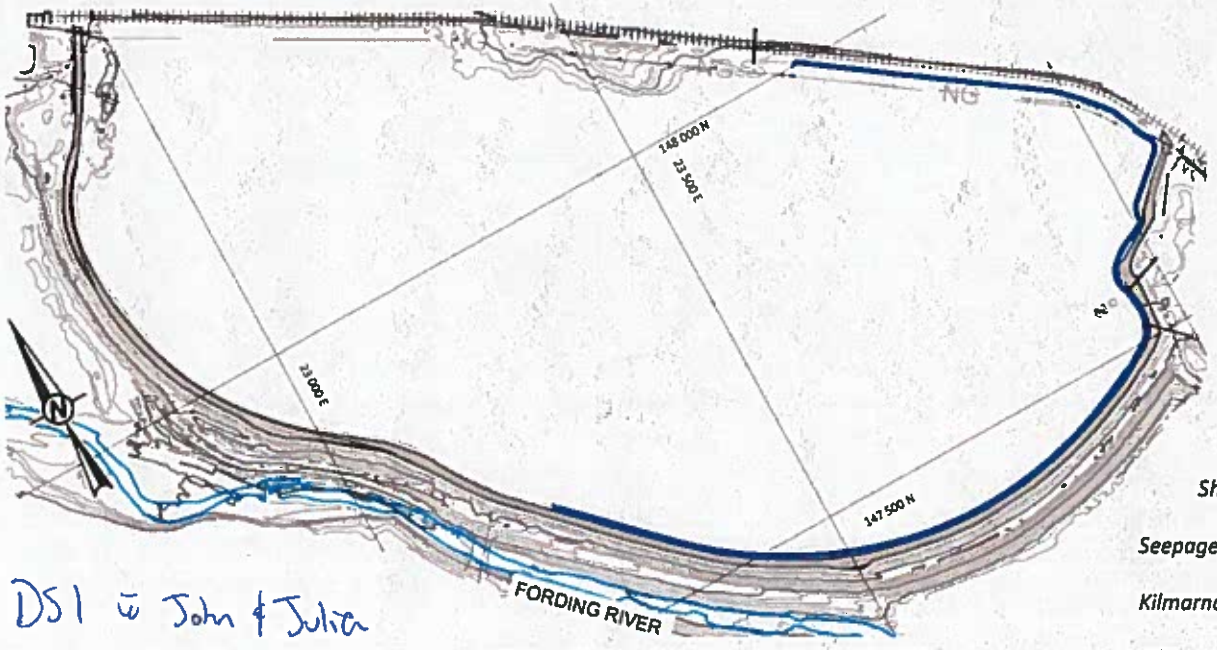
https://golderassociates.sharepoint.com/sites/16299g/deliverables/issued/2017-129-r-rev0-1000_ntp-stp_dsi_2017/appendix c - south tailings pond inspection report/appendix c - stp insp rep.docx

APPENDIX D

Fording River Operations Personnel Tailings Pond Inspections

Fording River Operations: South Tailings Pond Inspection Sheet rev2e **Monthly**

Inspected By: BRIAN GEOGHEGAN Date: Sept. 27. 2016



DS1 w John & Julia

1636.68 (Sept 29)
Pond El.

1.62 m
Freeboard (min 1.2m)

1.1 L/s
W Seep
Sept 29.

0.4 L/s / 5.3 L/s
N Seep (N culv/S culv)

dried reads 100 cm through pipe empty

Flowrate / Totalizers

Shandley 0 / 520355

Seepage Return 150 / 334764

Kilmarnock W. 0 / 279889

Kilmarnock E. 0 / 341582

Use above map to mark up observations incl wetted perimeter

U: Upstream D: Downstream C: Crest F: Face T: Toe B: Lower Bench

Are the following components in SATISFACTORY CONDITION?

South Abutment			Comment
Kilmarnock W	Y	(N)	Blocked
Kilmarnock E	(Y)	N	
Gasline	(Y)	N	
Clarified Line	(Y)	N	
Barge+anchors	(Y)	N	
Seepage Return Line	(Y)	N	
Railway Embankment			**Comment**
Blackmore Culverts	Y	(N)	Blocked
South Loop Culverts	Y	N	—
West & Main Dam			**Comment**
S. Seep	(Y)	N	
W.Seep	(Y)	N	
N.Seep	(Y)	N	
Dredge line	Y	N	—
Rip Rap	Y	N	—
Instruments			**Comment**
Piezometers	(Y)	N	
GPS Units	(Y)	N	
Slope Inclinometers	(Y)	N	
Reservoir			**Comment**
Tailings surface	(Y)	N	
Dust Fences	Y	N	—
Wetted Perimeter	(Y)	N	
Other			

Were any of the below POTENTIAL PROBLEM INDICATORS found?

	Problem? Y	Problem? N	Location (s) (M. Dam, W. Dam, N.Ab., S.Ab., Rail Emb.)	Comments
Piping		✓		
Sinkholes		✓		
Seepage		✓		
External Erosion		✓	M. Emb	Monitor
Cracks		✓		
Settlement		✓		
Sloughing/Slides		✓		
Animal Activity		✓	M. Emb	Badger hole near toe
Excessive growth		✓		
Excessive Debris		✓		
Standing Water		✓		
Over-steepened Slope	✓		M. Emb	U/S slope

Comments

Piezo Data Collected?

- Some ponding on haul road. Photos of depths.
- Seepage return line @ toe of main dam, not double walled. Could this be a concern in case of pipe burst & resulting erosion?
- Obtain photos M. Dam erosion (main face & curve)
- Haul traffic ~~causing~~ ponding on bench road, obstructing flow in ditch
- Looked @ different W-Dam Seepage points
- STP Rip Rap project underway
- White fine from Maxam
- Mat'l dumped on dredge line @ N End.

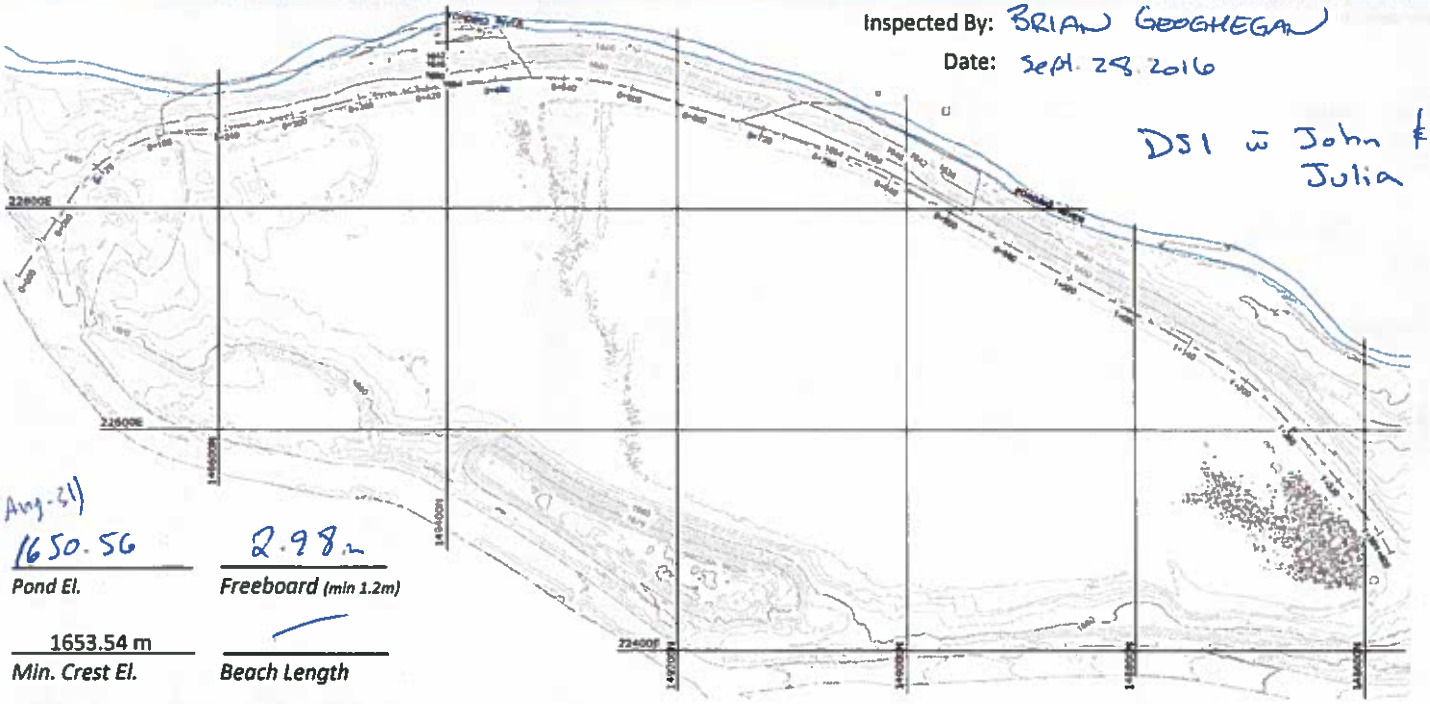
⇒ See Notebook for more detailed notes.

Fording River Operations: North Tailings Pond Inspection Sheet rev2c *Monthly*

Inspected By: BRIAN GEOGHEGAN

Date: Sept. 28. 2016

DSI w John & Julia



(Aug-31)

1650.56 *Pond El.*

2.98 m *Freeboard (min 1.2m)*

1653.54 m *Min. Crest El.*

Beach Length

Use above map to mark up observations incl wetted perimeter

U: Upstream D: Downstream C: Crest F: Face T: Toe B: Lower Bench

Are the following components in SATISFACTORY CONDITION?

Main Embankment			Comment
Rip Rap	Y	N	Upgrade
Old Tailings Line	Y	N	
2013 Main Failure Area	Y	N	
2013 South Failure Area	Y	N	
Old Scraper Crossing	Y	N	
FRNTP2	Y	N	
Clarified Lines River Crossing	Y	N	
Clarified Lines inside Pond	Y	N	
Steel Pipe Crossing	Y	N	
Black PVC Pipe Crossing	Y	N	
Barge Infrastructure	Y	N	
Shandley Bridge	Y	N	
West Abutment			**Comment**
Facilities Dump	Y	N	
Pond Coal Stockpile	Y	N	
Shandley Line	Y	N	
Reservoir			**Comment**
North Abutment Area	Y	N	MDG
Tailings surface	Y	N	MTC
Dust Fences	Y	N	dam
Wetted Perimeter	Y	N	

Were any of the below POTENTIAL PROBLEM INDICATORS found?

	Main Embankment		West Abutment		Comments
	Y	N	Y	N	
Piping					MDG dump & excavation to Liverpool pad
Sinkholes					
Seepage					
External Erosion					
Cracks					
Settlement					
Sloughing/Slides					
Animal Activity					
Excessive growth					
Excessive Debris					
Standing Water					
Over-steepened Slope	✓				

Unauthorized Activity ✓

Comments

Piezo Data Collected?

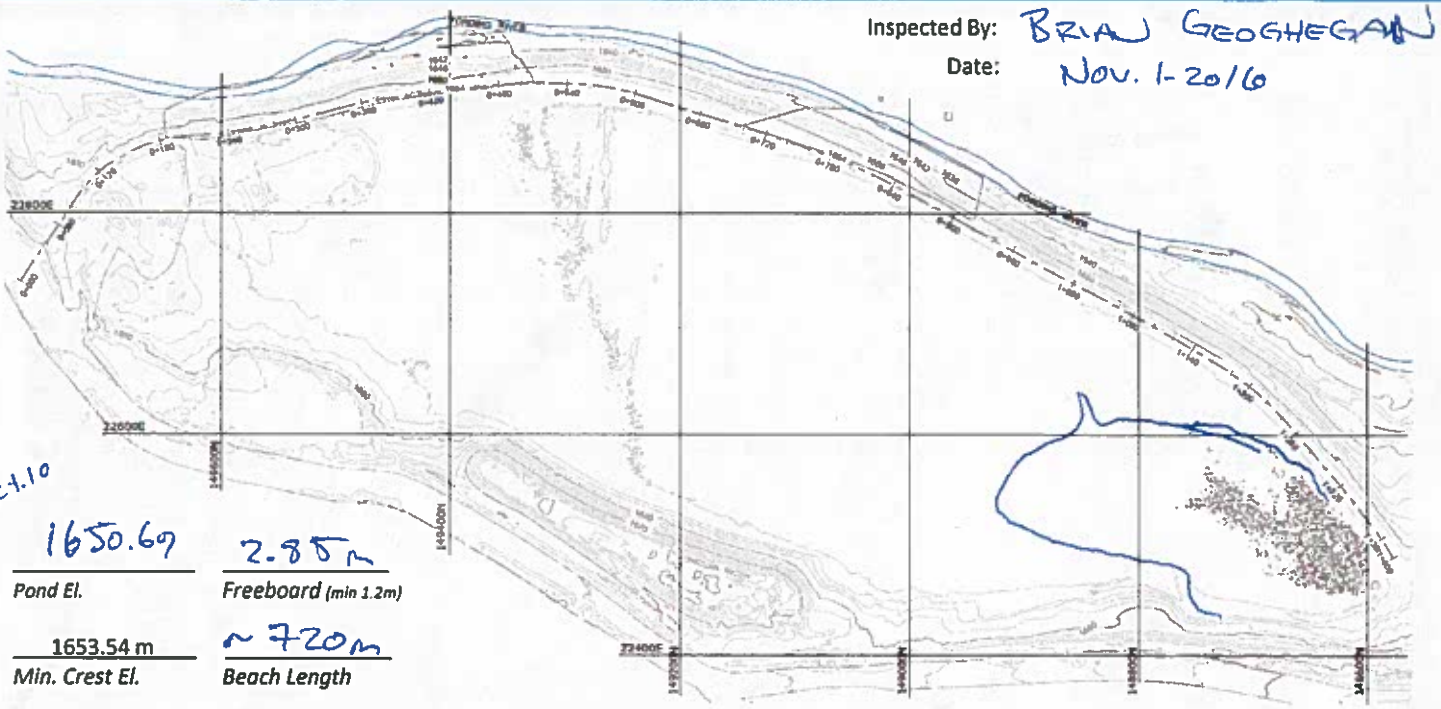
- Pipe in ground @ SW corner
- Animal burrow? SW d/s face
- fish ~~rest~~ riffles construction occurs? (ie any impact to dam?)
- MDG waste dump @ North end
- MDG excavation through dike @ N. end
- New facilities/enviro dump reviewed. No concerns.

See notebook for further detail

Fording River Operations: North Tailings Pond Inspection Sheet rev2c *Monthly*

Inspected By: BRIAN GEOGHEGAN

Date: NOV. 1-2016



oct. 10

1650.69 *Pond El.*

2.85m *Freeboard (min 1.2m)*

1653.54 m *Min. Crest El.*

~720m *Beach Length*

Use above map to mark up observations incl wetted perimeter

U: Upstream D: Downstream C: Crest F: Face T: Toe B: Lower Bench

Are the following components in SATISFACTORY CONDITION?

Main Embankment			Comment
Rip Rap	(Y)	N	upgrade
Old Tailings Line	(Y)	N	
2013 Main Failure Area	(Y)	N	
2013 South Failure Area	(Y)	N	
Old Scraper Crossing	(Y)	N	
FRNTP2	(Y)	N	
Clarified Lines River Crossing	(Y)	N	
Clarified Lines inside Pond	(Y)	N	
Steel Pipe Crossing	(Y)	N	
Black PVC Pipe Crossing	(Y)	N	
Barge Infrastructure	(Y)	N	
Shandley Bridge	(Y)	N	
West Abutment			**Comment**
Facilities Dump	(Y)	N	NEW
Pond Coal Stockpile	(Y)	N	
Shandley Line	(Y)	N	
Reservoir			**Comment**
North Abutment Area	Y	N	Repairs
Tailings surface	(Y)	N	
Dust Fences	Y	N	
Wetted Perimeter	(Y)	N	

Were any of the below POTENTIAL PROBLEM INDICATORS found?

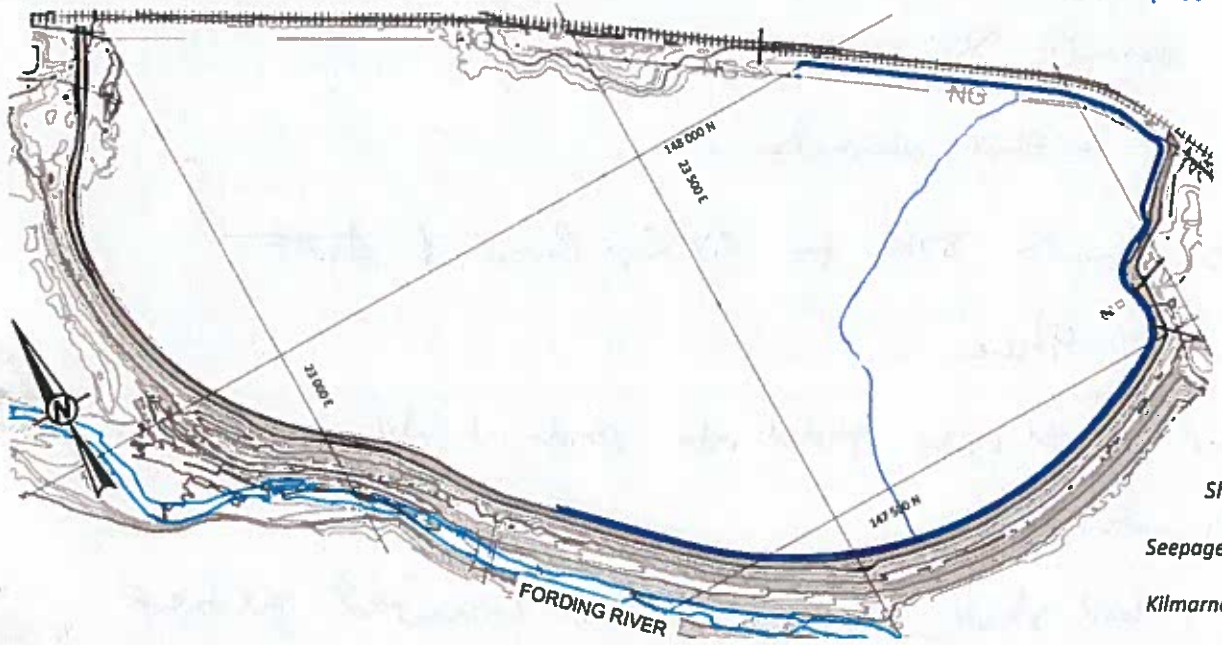
	Main Embankment		West Abutment		
	Y	N	Y	N	Comments
Piping		✓		✓	see notes below.
Sinkholes		✓		✓	
Seepage		✓		✓	
External Erosion		✓		✓	
Cracks		✓		✓	
Settlement		✓		✓	
Sloughing/Slides		✓		✓	
Animal Activity		✓		✓	
Excessive growth		✓		✓	
Excessive Debris		✓		✓	
Standing Water		✓		✓	
Over-steepened Slope		✓		✓	

Comments

- NTP rip rap upgrades underway (NW dump, & South toe)
- Moving MDG stockpile - Spoke to TMM (contractor), made sure they don't over-steepen the stockpile in the process - will use hoe to haul back from edge & feed a dozer.
- LVP discharge channel seems complete
- New sediment dump in use. Sloppy entrance, no safety berm @ dump location
- Surface crush looks good
- Stockpiling Rip Rap materials @ parking area, toe W of Berm (across from Maxam)

Fording River Operations: South Tailings Pond Inspection Sheet rev2e **Monthly**

Inspected By: ~~AMEC~~ BRIAN GEOGHEGAN Date: Nov. 1. 2016



1636.78
Pond El.

1.52m
Freeboard (min 1.2m)

6.1 L/s
W Seep

3.3 L/s
N Seep (N culv/S culv)

Flowrate / Totalizers

Shandley ———

Seepage Return 150 / 432400

Kilmarnock W. ∅ / 291082

Kilmarnock E. ∅ / 341582

Use above map to mark up observations incl wetted perimeter

U: Upstream D: Downstream C: Crest F: Face T: Toe B: Lower Bench

Are the following components in SATISFACTORY CONDITION?

South Abutment			Comment
Kilmarnock W	(Y)	N	
Kilmarnock E	(Y)	N	
Gasline	(Y)	N	
Clarified Line	(Y)	N	
Barge+anchors	(Y)	N	
Seepage Return Line	(Y)	N	
Railway Embankment			**Comment**
Blackmore Culverts	~~Y~~	~~N~~	
South Loop Culverts	~~Y~~	~~N~~	
West & Main Dam			**Comment**
S. Seep	(Y)	N	
W.Seep	(Y)	N	
N.Seep	(Y)	N	
Dredge line	(Y)	N	
Rip Rap	(Y)	N	
Instruments			**Comment**
Piezometers	(Y)	N	
GPS Units	(Y)	N	
Slope Inclinometers	~~Y~~	~~N~~	
Reservoir			**Comment**
Tailings surface	Y	(N)	Floc
Dust Fences	(Y)	N	
Wetted Perimeter	(Y)	N	
Other			

Were any of the below POTENTIAL PROBLEM INDICATORS found?

	Problem? Y	Problem? N	Location (s) (M. Dam, W. Dam, N.Ab., S.Ab., Rail Emb.)	Comments
Piping		✓		
Sinkholes		✓		
Seepage		✓		
External Erosion		✓		
Cracks		✓		
Settlement		✓		
Sloughing/Slides		✓		
Animal Activity		✓		ELK @ SCW's
Excessive growth		✓		
Excessive Debris	✓			Dredge debris around pond various locations
Standing Water	✓			
Over-steepened Slope	—	—		

Comments

- Floc @ N Ab, near animal tracks
- Debris on dike crest from dredging operation (cables
- Pics taken from Connector road - good for labeling old version repairs
- STP Rip Rap upgrades complete.
- Relocate GPS (229) back to toe
- Ponding @ Facilities discharge
- Flow along u/s toe
- Ponding on dike crest → regrade crush before winter? Crest uneven in places
- Bad rutting on bench road, Bad ponding above STP cut (Rip Rap project)

S by Piezo's & old erosion structures

Additional Comments

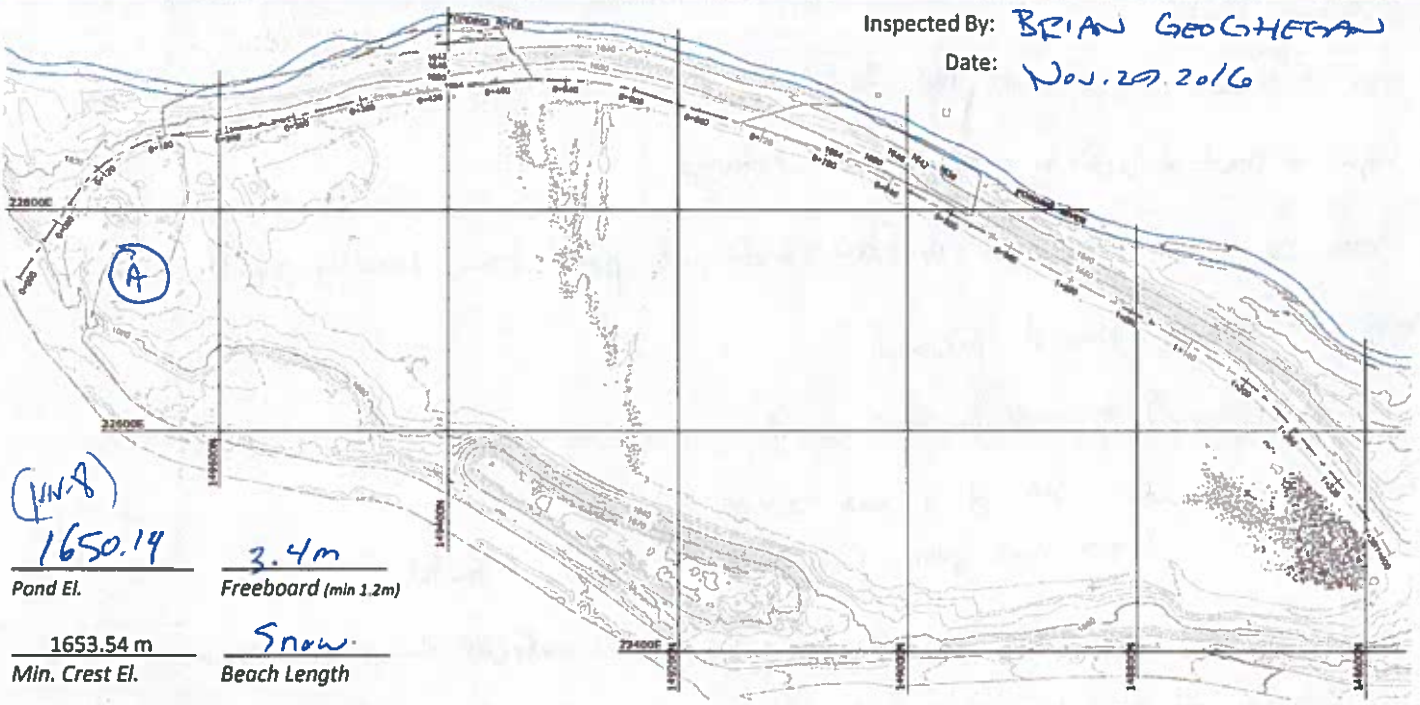
Follow-up Items from previous Inspection:

- Status pit, erosion @ SW corner
- u/s stake @ wetted perimeter
- Stockpiling beneath SPB for Rip Rap Project & AWTF
- Badger hole still there
- Road @ toe of M. Embo graded into ponds of old river channel (dirty water?)
- Bench road in bad shape, adjacent ditch not connected end to end
- Need berm @ STP cut

Fording River Operations: North Tailings Pond Inspection Sheet rev2c *Monthly*

Inspected By: BRIAN GEOGHEGAN

Date: Nov. 29 2016



(N/A)

1650.14 *Pond El.*

3.4m *Freeboard (min 1.2m)*

1653.54 m *Min. Crest El.*

Snow *Beach Length*

Use above map to mark up observations incl wetted perimeter

Are the following components in SATISFACTORY CONDITION?

Main Embankment			Comment
Rip Rap	Y	N	Construct
Old Tailings Line	Y	N	check
2013 Main Failure Area	Y	N	
2013 South Failure Area	Y	N	
Old Scraper Crossing	Y	N	
FRNTP2	Y	N	
Clarified Lines River Crossing	Y	N	
Clarified Lines Inside Pond	Y	N	
Steel Pipe Crossing	Y	N	
Black PVC Pipe Crossing	Y	N	
Barge Infrastructure	Y	N	
Shandley Bridge Pipe Cradle	Y	N	
West Abutment			**Comment**
Facilities Dump	Y	N	check
Pond Coal Stockpile	Y	N	
Shandley Line	Y	N	
Reservoir			**Comment**
North Abutment Area	Y	N	Confirm
Tailings surface	Y	N	Confirm
Dust Fences	Y	N	
Wetted Perimeter	Y	N	

Were any of the below POTENTIAL PROBLEM INDICATORS found?

U: Upstream D: Downstream C: Crest F: Face T: Toe B: Lower Bench

	Main Embankment		West Abutment		Comments
	Y	N	Y	N	
Piping		✓		✓	
Sinkholes		✓		✓	
Seepage		✓		✓	
External Erosion		✓		✓	
Cracks		✓		✓	
Settlement		✓		✓	
Sloughing/Slides		✓		✓	
Animal Activity	✓			✓	Coyote
Excessive growth		✓		✓	
Excessive Debris		✓		✓	
Standing Water	✓			✓	Water on beach from Swift
Over-steepened Slope		✓		✓	

Comments

Swift Construction: berm + ditch along LVP channel to keep mud from old MDO stockpile from flowing into channel. To report to Boating sump in TSF.

Discuss w LPock - a) stay away from dike b) don't truck ~~right of~~ ridge (re IDF containment)

Gravel mat: not doing anything until Golder OK'd

Pump to go in tomorrow - connect cont & tee @ N. end where Swift cut access

Water from Lee's Lake system currently reporting to NTP (since Sat.) - water Balance short

S. Culvert from box structure is to feature LVP connection - blow concrete plug, but plug was removed on recommendation of decision by G. Sword - water flowing in Lees Lake system needed to go somewhere, GF dike ? want it diverted to river ~~until some final details cleaned up (berm around channel)~~

b/c of tailings release concern — ~~averted~~ incident: water from Lk. reported to box structure, went out S. Culvert, topo in that area was such that water swirled around back to the discharge channel. It picked up tails & deposited that tails into the LVP channel. No water through channel now until tails cleaned up. Topo d/s of S. Culvert has already been corrected, water now collecting in pond @ N. end of NTP (re (A) on Map)

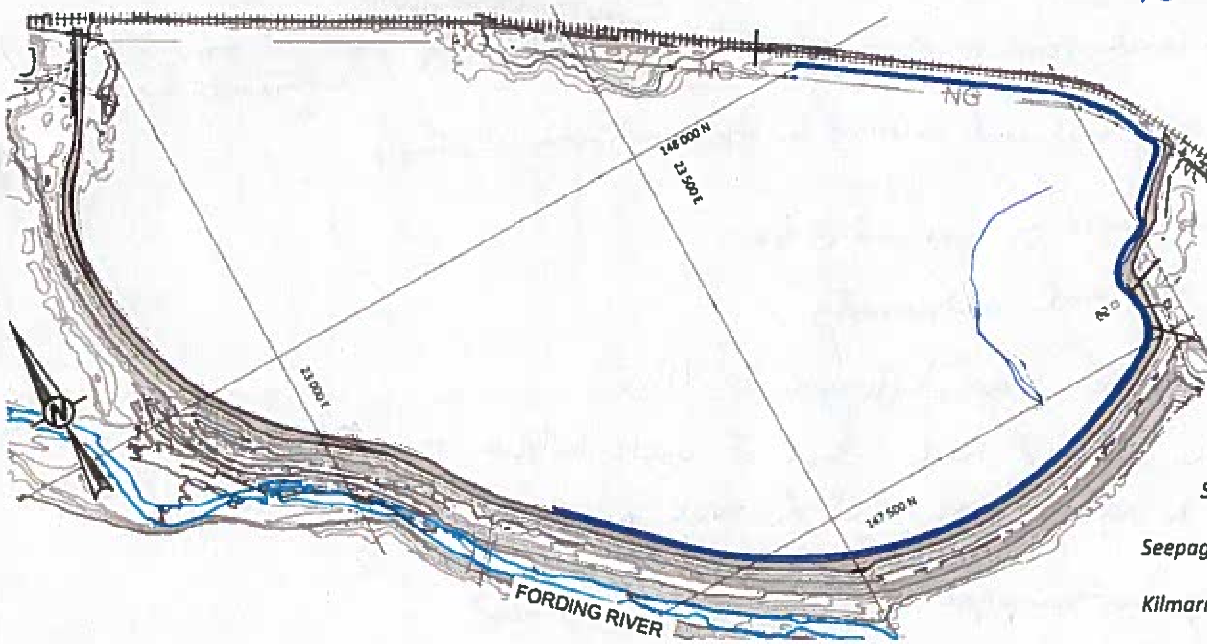
Dozer/Trucks on top of MDO (thawed) stockpile - not working around recently ditch construction? Hwy → note made establishing a turnaround spot

Additional Comments

Follow-up items from previous inspection:

- No sign of any recent activity at sed dump
- No sign of stat of activity at NTP Snow dump
- Area snow covered. No sign of surface runoff into pond from Shadley pipeline road
- Jersey barriers w/ around piezo's
- Snow clearing (grader) occurred on dike crest recent
- Lip Rap project inactive b/c of recent TMM incident
  ↳ if can't place filter materials, then can't build
- Check old photos to make sure dozer tracks / small material dump around new (bgside old tails like stub rd, dk face & dam)
- Coyote, dark water from flow out of LC drop box structure
- Sump created by MDG stockpile push, immediately W of dike crest @ N. end (Stable to fill as well.)
- Sed dump - any noted concern/mitigation needed for already built steep side face?
- Hazard: coming out onto Connector road from NTP. High speed haul road, used to be inactive
- Shadley Flowmeter - needs a buggy whip for ID when snow covered.
  totalize = 533538
  flow = 0, but did read 100

Inspected By: BRIAN GEOGHEGAN **Date:** Nov. 29 2016



1636.71
Pond El.

1.59
Freeboard (min 1.2m)

1.0 L/s
W Seep

1.4 L/s
N Seep (N culv/S culv)

reads 100 the pipe is empty

Flowrate / Totalizers

Shandley Ø / 535538

Seepage Return 130 / 511128

Kilmarnock W. —

Kilmarnock E. —

Use above map to mark up observations incl wetted perimeter

U: Upstream D: Downstream C: Crest F: Face T: Toe B: Lower Bench

Are the following components in SATISFACTORY CONDITION?

South Abutment	Y	N	Comment
Kilmarnock W	Y	N	Gone
Kilmarnock E	Y	N	Gone
Gasline	Y ✓	N	
Clarified Line	Y ✓	N	
Barge+anchors	Y	N	
Seepage Return Line	Y ✓	N	
Railway Embankment			**Comment**
Blackmore Culverts	Y	N ✓	obstructed
South Loop Culverts	~~Y~~	~~N~~	
West & Main Dam			**Comment**
S. Seep	Y ✓	N	
W.Seep	Y ✓	N	
N.Seep	Y ✓	N	
Dredge line	Y ✓	N	
Rip Rap	Y ✓	N	
Instruments			**Comment**
Piezometers	~~Y~~ (circled)	~~N~~	
GPS Units	Y (circled)	N	
Slope Inclinometers	~~Y~~	~~N~~	
Reservoir			**Comment**
Tailings surface	Y (circled)	N	
Dust Fences	~~Y~~	N	
Wetted Perimeter	Y (circled)	N	
Other			

Were any of the below POTENTIAL PROBLEM INDICATORS found?

	Problem? Y	Problem? N	Location (s) (M. Dam, W. Dam, N.Ab., S.Ab., Rail Emb.)	Comments
Piping		✓		
Sinkholes		✓		
Seepage		✓		
External Erosion		✓		
Cracks		✓		
Settlement		✓		
Sloughing/Slides		✓		
Animal Activity	✓		N	coyote
Excessive growth		✓		
Excessive Debris		✓		
Standing Water	—	—	Bench road	
Over-steepened Slope	+		u/s	not a concern for winter

Comments

- Environmental collected Sample from N. Abutment pond yesterday.
- Berm from tails beach modification will cause ponding of water should the WWC's ever decant. Not a concern.
- Beach is snow covered
- Env. did water sampling @ N. Seep yesterday – should also have done N Seep flow measurement. Need to coordinate ~~tails~~ monitoring schedule/tasks (BG should get site-wide notification when sampling coming up)
- Coyote ~~howling across the river~~ Yipping from woods by Maxam. (live item) – proximity to N seep flow reading & howling from across river
- Should rip rap road have a berm?

- Need Berm above STP cut slope w/ snow-covered driving surface
- Bench road still needs work. Spring said Jersey barrier delivery truck almost got stuck on the way out
  ↳ pretty deep rut holding water by bench piezo's & another spot is deeper – almost 1st stuck in 4 high

Additional Comments

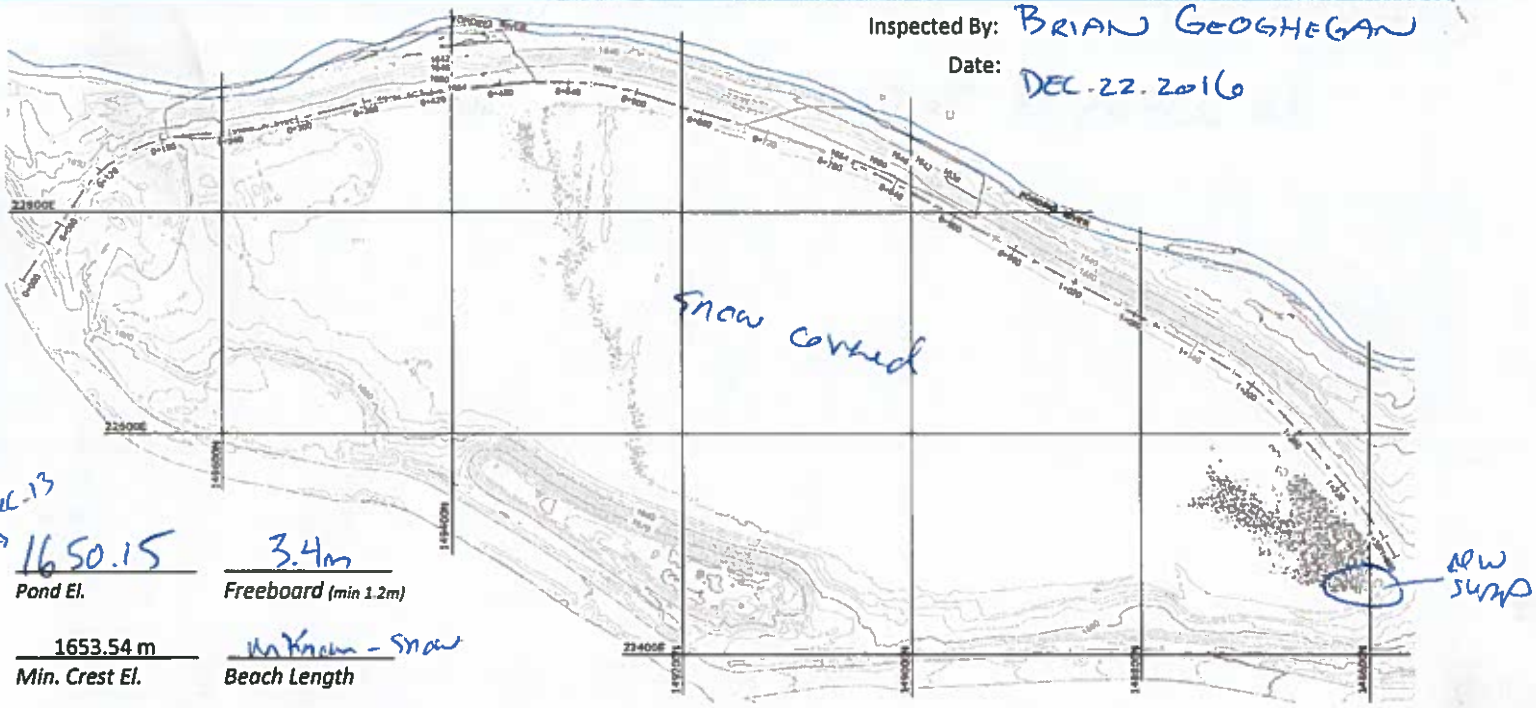
Follow-up items from previous inspection:

- should clean up bench road as soon as possible in early spring. (any work now would start deteriorate anyway)
  - ↳ access along bench road necessary for flood mitigation strategy
- SW seep still flowing based on wet road @ toe
- Jersey barriers up around instruments
- Flowmeters removed from Kilmanock Lites
  - ↳ BG should have control of water balance so can have authority to require notification of such activities/items
- Obstructed dredge overflow pipe still needs to be addressed
  - ↳ spring cleanup item. pick to start of next dredging season
- Pond starting to ice up. Barge de-icing is ~~effective~~
- U/s slope snow-covered. ~~wave action concern~~ has
  } wave action concern has passed. U/s slope cutting can now wait until 2017 spring
- Maxam froth area now snow-covered/ not an issue. Pick up in spring

Fording River Operations: North Tailings Pond Inspection Sheet rev2c *Monthly*

Inspected By: BRIAN GEOGHEGAN

Date: DEC. 22. 2016



DEC. 13 → 1650.15 *Pond El.*

3.4m *Freeboard (min 1.2m)*

1653.54 m *Min. Crest El.*

Unknown - Snow *Beach Length*

Use above map to mark up observations incl wetted perimeter

Are the following components in SATISFACTORY CONDITION?

Main Embankment		Comment
Rip Rap	(Y) N	
Old Tailings Line	Y — N	
2013 Main Failure Area	(Y) N	
2013 South Failure Area	(Y) N	
Old Scraper Crossing	(Y) N	
FRNTP2	(Y) N	
Clarified Lines River Crossing	(Y) N	
Clarified Lines Inside Pond	Y — N	
Steel Pipe Crossing	Y — N	
Black PVC Pipe Crossing	Y — N	
Barge Infrastructure	Y — N	
Shandley Bridge	(Y) N	
West Abutment		**Comment**
Facilities Dump	(Y) N	
Pond Coal Stockpile	(Y) N	
Shandley Line	Y — N	
Reservoir		**Comment**
North Abutment Area	Y (N)	water
Tailings surface	Y — N	
Dust Fences	Y (N)	
Wetted Perimeter	(Y) N	

U: Upstream D: Downstream C: Crest F: Face T: Toe B: Lower Bench

Were any of the below POTENTIAL PROBLEM INDICATORS found?

	Main Embankment		West Abutment		Comments
	Y	N	Y	N	
Piping		X		X	
Sinkholes		X		X	
Seepage		X		X	
External Erosion		X		X	
Cracks		X		X	
Settlement		X		X	
Sloughing/Slides		X		X	
Animal Activity		X		X	
Excessive growth		X		X	
Excessive Debris		X		X	
Standing Water		X		X	
Over-steepened Slope		X		X	

Comments

- TMM Rip Rap project shut down on Dec. 19.
- river not ice-covered. Ducks/birds around
- LVP flow being directed to NTP
  - ↳ Pump new pump on site, not in use
    - ↳ BPI on site doing hydrovac/steaming?
- Rip Rap upgrade to ~ 5+875
- Crest not snow ploughed
- Sump @ NE corner where pump crew did some dewatering. dug up some of the old pipe that had been there
- Noticed pipe sticking out of U/S slope by Barge. Debris?

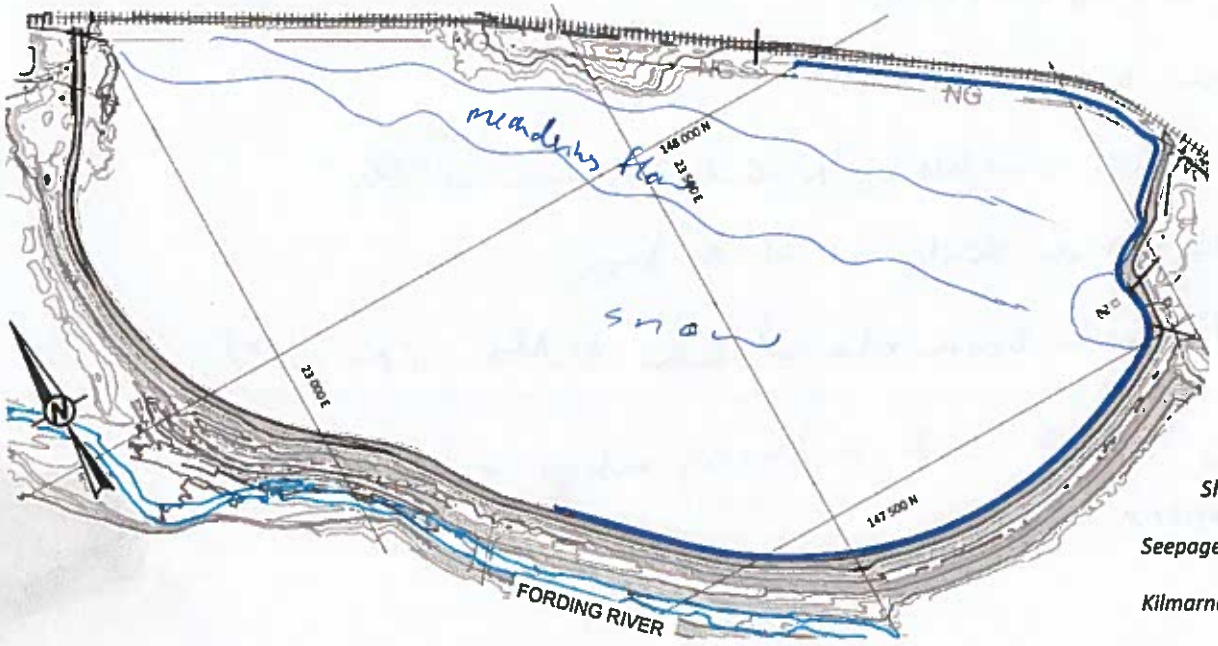
Additional Comments

Follow-up items from previous inspection:

No activity at Sediment Dump or Slag Dump

Fording River Operations: South Tailings Pond Inspection Sheet rev2e *Monthly*

Inspected By: BRIAN GEOGHEGAN Date: Dec. 22/2016



1636.85
Pond El.

1.45m
Freeboard (min 1.2m)

1.0 L/s
W Seep

3.2 L/s
N Seep (N culv/S culv)

Flowrate / Totalizers

Shandley 0 / 554241

Seepage Return 180 / 576539

Kilmarnock W. removed

Kilmarnock E. removed

Use above map to mark up observations incl wetted perimeter

U: Upstream D: Downstream C: Crest F: Face T: Toe B: Lower Bench

Are the following components in SATISFACTORY CONDITION?

South Abutment		Comment
Kilmarnock W	Y (N)	F/m
Kilmarnock E	Y (N)	F/m
Gasline	Y — N	
Clarified Line	(Y) N	
Barge+anchors	(Y) N	
Seepage Return Line	(Y) N	
Railway Embankment		**Comment**
Blackmore Culverts	~~Y~~ ~~N~~	
South Loop Culverts	~~Y~~ ~~N~~	
West & Main Dam		**Comment**
S. Seep	(Y) N	
W.Seep	(Y) N	
N.Seep	(Y) N	
Dredge line	Y — N	
Rip Rap	(Y) N	
Instruments		**Comment**
Piezometers	(Y) N	
GPS Units	(Y) N	
Slope Inclinometers	(Y) N	
Reservoir		**Comment**
Tailings surface	Y — N	Snow
Dust Fences	Y (N)	
Wetted Perimeter	(Y) N	
Other		

Were any of the below POTENTIAL PROBLEM INDICATORS found?

	Problem? Y	Problem? N	Location (s) (M. Dam, W. Dam, N.Ab., S.Ab., Rail Emb.)	Comments
Piping		X		
Sinkholes		X		
Seepage		X		
External Erosion		X		
Cracks		X		
Settlement		X		
Sloughing/Slides		X		
Animal Activity		X		
Excessive growth		X		
Excessive Debris		X		
Standing Water		X		
Over-steepened Slope		X		

Comments

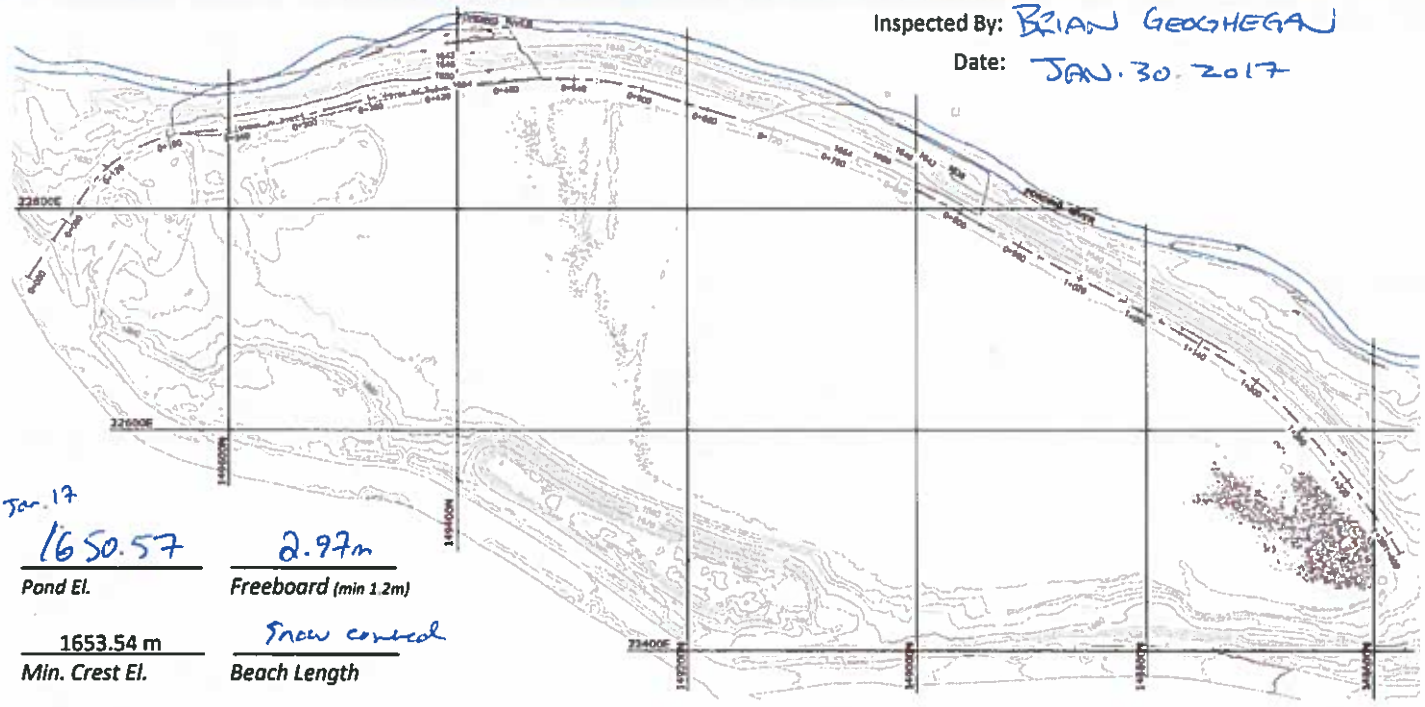
- Water Balance spreadsheet should be updated monthly.
- Need better flow monitoring system @ N. Seep.
  - Dive instrument & manual are not producing similar enough results. - Dig down so can use bucket? too sensitive to depth reading, where is difficult to get
- No recent activity @ facilitation diversion or WWC's
- Investigated N seep to see if could identify it's entry point
  - Low road needs ploughing, almost completely travel
  - "Badger hole" no activity, but plenty animal tracks below M. Dam

- Dredge sitting on N. Ab
- u/s slope snow covered
- S. end of dike windblown. N. end has snow drifts
- Looks like animals drink out of N. seep
- Photo of bench basin channel near N. Ab (0+100?)
- Shadley flagmate needs a buggy whip or it will get buried in snow.

Fording River Operations: North Tailings Pond Inspection Sheet rev2c *Monthly*

Inspected By: BRIAN GEOGHEGAN

Date: JAN. 30. 2017



Jan. 17

1650.57 *Pond El.*

2.97m *Freeboard (min 1.2m)*

1653.54 m *Min. Crest El.*

Snow covered *Beach Length*

Use above map to mark up observations incl wetted perimeter

U: Upstream D: Downstream C: Crest F: Face T: Toe B: Lower Bench

Are the following components in SATISFACTORY CONDITION?

Main Embankment			Comment
Rip Rap	Y	N	
Old Tailings Line	Y	N	
2013 Main Failure Area	Y	N	
2013 South Failure Area	Y	N	
Old Scraper Crossing	Y	N	
FRNTP2	Y	N	
Clarified Lines River Crossing	Y	N	
Clarified Lines inside Pond	Y	N	Damaged at toe
Steel Pipe Crossing	Y	N	
Black PVC Pipe Crossing	Y	N	
Barge Infrastructure	Y	N	
Shandley Bridge	Y	N	
West Abutment			Comment
Facilities Dump	Y	N	
Pond Coal Stockpile	Y	N	
Shandley Line	Y	N	
Reservoir			Comment
North Abutment Area	Y	N	
Tailings surface	Y	N	
Dust Fences	Y	N	check
Wetted Perimeter	Y	N	None

Were any of the below POTENTIAL PROBLEM INDICATORS found?

	Main Embankment		West Abutment		Comments
	Y	N	Y	N	
Piping		x		x	Main Emb. Snow covered - Nothing visible ~~from~~ on snow surface
Sinkholes		x		x	
Seepage		x		x	
External Erosion		x		x	
Cracks		x		x	
Settlement		x		x	
Sloughing/Slides		x		x	
Animal Activity		x		x	
Excessive growth		x		x	
Excessive Debris		x		x	
Standing Water		x		x	
Over-steepened Slope		x		x	

Comments

Sediment dump - are Env. getting regular scans for volume reconciliation? - Field where?

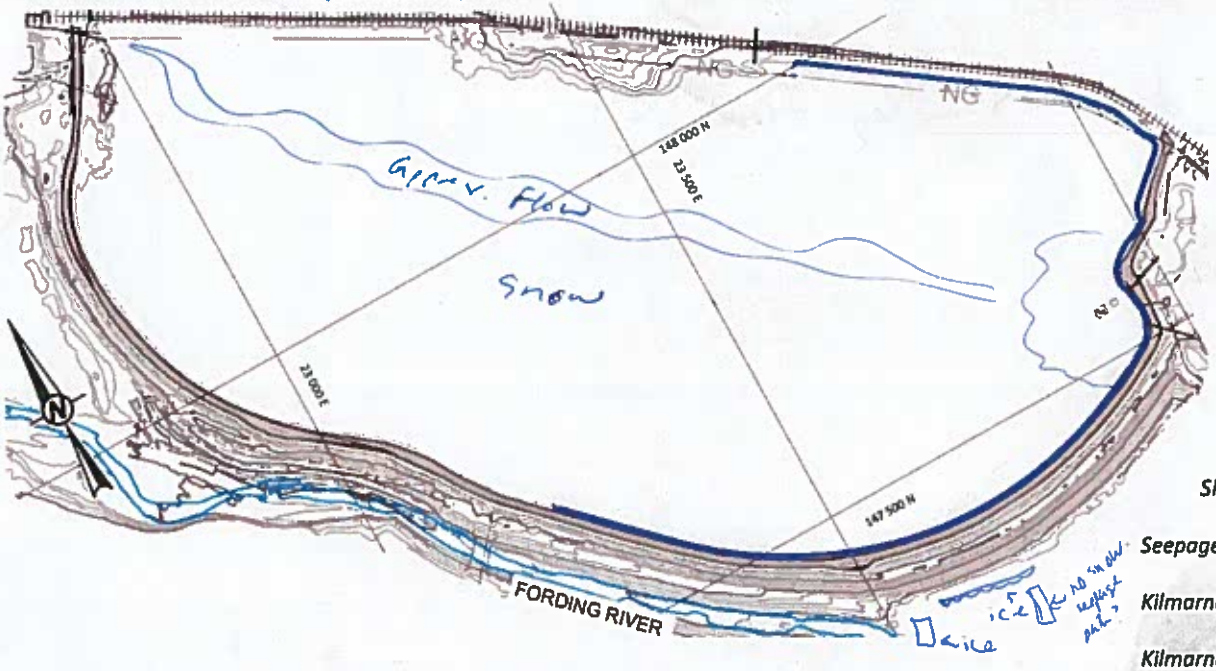
Risk of damaging clarified pipes during snow removal

training for snow removal operators! cable stands @ narrow points / sharp turns

- CVP marked to NTP recently
- Elk @ d/s toe across from Maxam

Fording River Operations: South Tailings Pond Inspection Sheet rev2e **Monthly**

Inspected By: BRIAN GEOGHEGAN Date: Jan.30/2017



1636.66
Pond El.

1.64
Freeboard (min 1.2m)

0.9 L/S
W Seep

Snow covered
N Seep (N culv/S culv)

Flowrate / Totalizers

Shandley 0 (150) / 5504108

Seepage Return 6180 / 693850

Kilmarnock W. ∅

Kilmarnock E. ∅

Use above map to mark up observations incl wetted perimeter

U: Upstream D: Downstream C: Crest F: Face T: Toe B: Lower Bench

Are the following components in SATISFACTORY CONDITION?

South Abutment			Comment
Kilmarnock W	Y	N	OFF
Kilmarnock E	Y	N	OFF
Gasline	(Y)	N	
Clarified Line	(Y)	N	
Barge+anchors	(Y)	N	
Seepage Return Line	(Y)	N	ON
Railway Embankment			**Comment**
Blackmore Culverts	~~Y~~	~~N~~	no access
South Loop Culverts	~~Y~~	~~N~~	
West & Main Dam			**Comment**
S. Seep	(Y)	N	
W.Seep	(Y)	N	
N.Seep	(Y)	N	
Dredge line	~~Y~~	~~N~~	inactive
Rip Rap	~~Y~~	~~N~~	snow covered
Instruments			**Comment**
Piezometers	(Y)	N	
GPS Units	(Y)	N	
Slope Inclinometers	~~Y~~	~~N~~	
Reservoir			**Comment**
Tailings surface	Y	N	Snow
Dust Fences	Y	N	"
Wetted Perimeter	Y	N	"
Other			

Were any of the below POTENTIAL PROBLEM INDICATORS found?

	Problem? Y	Problem? N	Location (s) (M. Dam, W. Dam, N.Ab., S.Ab., Rail Emb.)	Comments
Piping		X		
Sinkholes		X		
Seepage		X		
External Erosion	X	~~X~~	M. Dam	Erosion looks like it getting worse
Cracks		X		
Settlement		X		
Sloughing/Slides		X		
Animal Activity		X		
Excessive growth		X		
Excessive Debris		X		
Standing Water		X		At SW seep, toe end of M. Dam
Over-steepened Slope		X		

Comments

- If seepage return line burst, it could erode out the toe of M. Dam
- Kiln flumeters still out
- N. Seep culverts frozen (North one) & snow covered (South one)
  - ↳ could not get measurement, but was flowing nicely in S.
- facilities trails + dump point accessible, WWC dump pit inactive
- Jan road not plowed – asked TMM to plow for Jan. 31. to access seeps

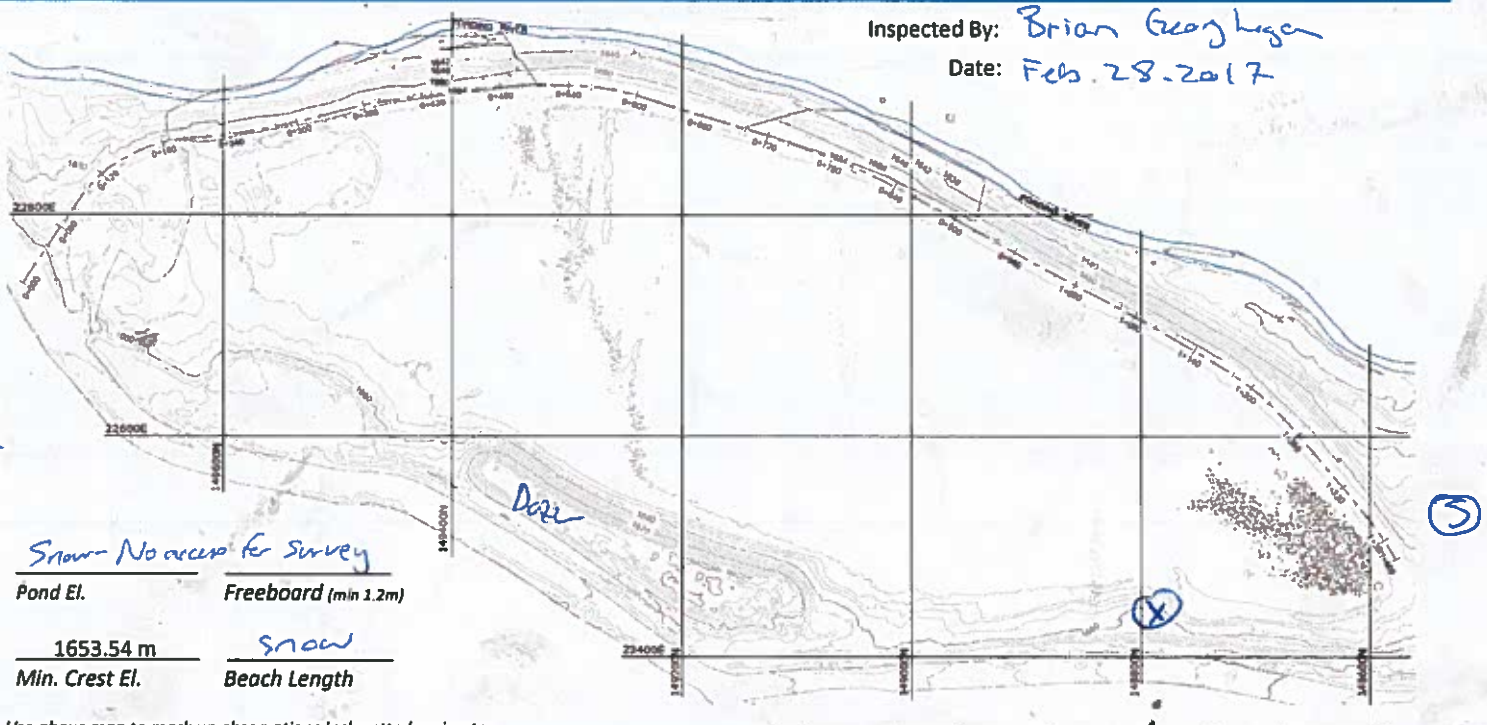
- SNP MW pond (debris dam) – snow covered. G.t test results back from Env, need to monitor
- U/s face snow covered (thick drift)
- d/s face has no snow only on road/surface & u/s bench

- Ice at toe of main dam, above from a snow-less section by old river channel. → sign of seepage pathway?
- cable stand above Shalley flowmeter

Fording River Operations: North Tailings Pond Inspection Sheet rev2c *Monthly*

Inspected By: Brian Greg Logan

Date: Feb. 28. 2017



Snow - No access for survey
Pond El.

Freeboard (min 1.2m)

1653.54 m
Min. Crest El.

Snow
Beach Length

Use above map to mark up observations incl wetted perimeter

U: Upstream D: Downstream C: Crest F: Face T: Toe B: Lower Bench

Are the following components in SATISFACTORY CONDITION?

Main Embankment			Comment
Rip Rap	(Y)	N	
Old Tailings Line	(Y)	N	
2013 Main Failure Area	(Y)	N	
2013 South Failure Area	(Y)	N	
Old Scraper Crossing	(Y)	N	
FRNTP2	(Y)	N	
Clarified Lines River Crossing	(Y)	N	
Clarified Lines Inside Pond	(Y)	N	
Steel Pipe Crossing	(Y)	N	
Black PVC Pipe Crossing	(Y)	N	
Barge Infrastructure	(Y)	N	
Shandley Bridge	(Y)	N	
West Abutment			**Comment**
Facilities Dump	(Y)	N	
Pond Coal Stockpile	(Y)	N	Dozer
Shandley Line	Y	(N)	Break
Reservoir			**Comment**
North Abutment Area	(Y)	N	
Tailings surface	(Y)	N	
Dust Fences	Y	N	
Wetted Perimeter	Y	N	

Were any of the below POTENTIAL PROBLEM INDICATORS found?

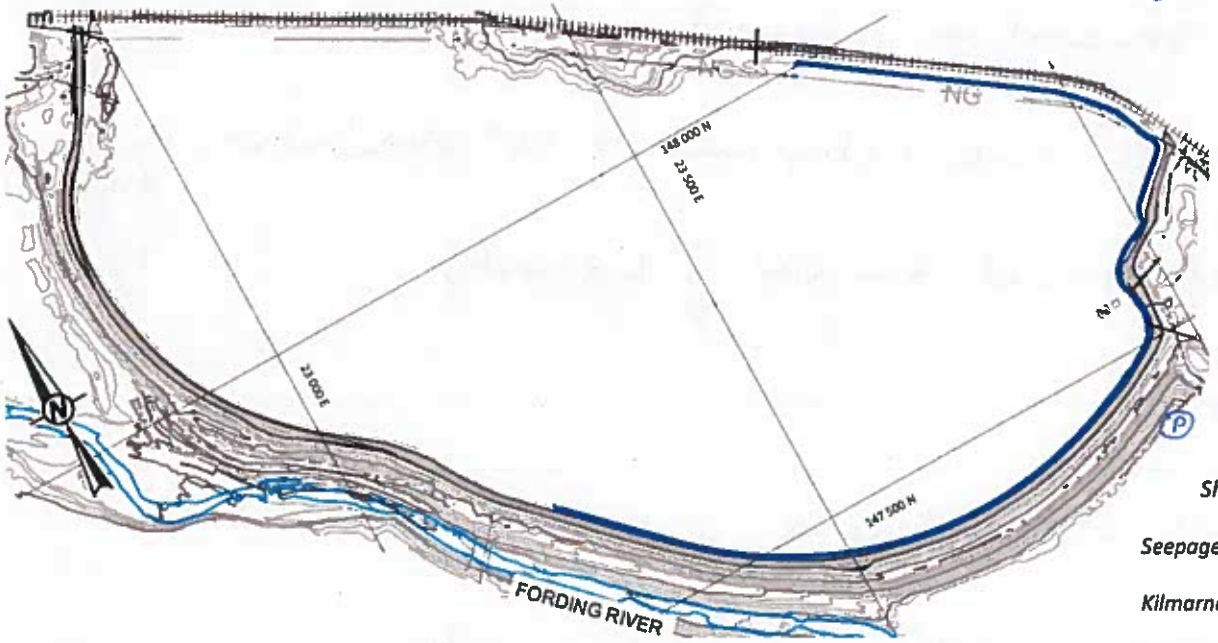
	Main Embankment		West Abutment		Comments
	Y	N	Y	N	
Piping		X		X	Significant snow coverage
Sinkholes		X		X	
Seepage		X		X	
External Erosion		X		X	
Cracks		X		X	
Settlement		X		X	
Sloughing/Slides		X		X	
Animal Activity		X		X	
Excessive growth		X		X	
Excessive Debris		X		X	
Standing Water		X		X	
Over-steepened Slope		X		X	

Comments

- Deep puddle at (X). Travel/access concern
- Break in Shandley line @ (5). Too far from NTP to be concern, only snow affected.
- No access to dike crest from S. side b/c no snow removal. Couldn't get over windrow from snow removal to Shandley levee
- Dozer operating on pond coal stockpile. Assuming this is part of summit/ snow removal for timely access to near powerlines.
- N/D recent activity evident @ Sed. pond.
- Deep lake system flowing to river. Looks like still a pond @ head of NTP
- No access to NTP for survey level reading, but pictures taken to visually confirm freeboard

Fording River Operations: South Tailings Pond Inspection Sheet rev2e *Monthly*

Inspected By: BRIAN GEOGHEGAN Date: Feb 28. 2017



1636.80
Pond El.

1.50m
Freeboard (min 1.2m)

0.93 L/s
W Seep

no access
N Seep (N culv/S culv)

Flowrate / Totalizers

Shandley off / no access

Seepage Return 120 / 774963

Kilmarnock W. missing

Kilmarnock E. " "

Use above map to mark up observations incl wetted perimeter

U: Upstream D: Downstream C: Crest F: Face T: Toe B: Lower Bench

Are the following components in SATISFACTORY CONDITION?

South Abutment		Comment
Kilmarnock W	Y (N)	
Kilmarnock E	Y (N)	
Gasline	(Y) N	
Clarified Line	(Y) N	
Barge+anchors	(Y) N	
Seepage Return Line	(Y) N	
Railway Embankment		**Comment**
Blackmore Culverts	Y — N	
South Loop Culverts	Y — N	
West & Main Dam		**Comment**
S. Seep	(Y) N	
W.Seep	(Y) N	
N.Seep	Y — N	
Dredge line	Y — N	
Rip Rap	(Y) N	
Instruments		**Comment**
Piezometers	Y — N	
GPS Units	Y — N	
Slope Inclinometers	Y — N	
Reservoir		**Comment**
Tailings surface	(Y) N	
Dust Fences	(Y) N	
Wetted Perimeter	(Y) N	
Other		

Were any of the below POTENTIAL PROBLEM INDICATORS found?

	Problem? Y	Problem? N	Location (s) (M. Dam, W. Dam, N.Ab., S.Ab., Rail Emb.)	Comments
Piping		X		
Sinkholes		X		
Seepage		X		
External Erosion		X		
Cracks		X		
Settlement		X		
Sloughing/Slides		X		
Animal Activity		X		
Excessive growth		X		
Excessive Debris		X		
Standing Water		X		
Over-steepened Slope		X		

Comments

Shandley pipeline leak near NTP. Line off, snow removal to line. damage likely from previous snow removal (ie Pump crew must be aware)
↳ need pump crew foreman @ monthly mtgs so can report on this type of activity rather than just discovering in field
esp. since water mgmt mtgs re large happening in environmental

Kelsa - find out where Env keeps their flowrate records, merge in ours

- Add E.Niemi remote flowrate monitoring project to Action log for monthly updates
- N. seep: melted snow indicates possible standing area - need survey pickup. See pics. Should compare in observations from summer

N. Keep Calvert snow covered - no measurement

Seepage return well = only makeup water to STP at the moment, other than rainfall

Wheels dredge removed from site (last week)

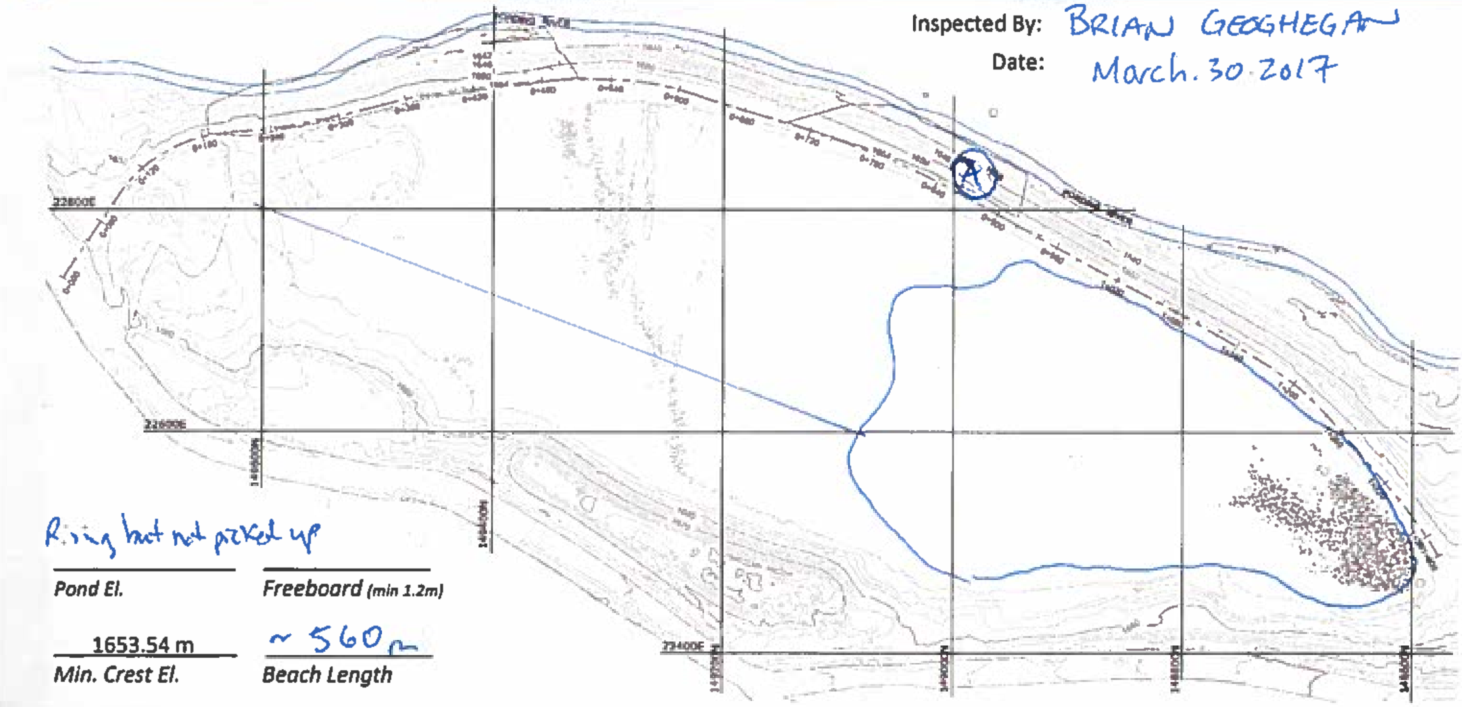
U/s snow covered.

Bench road clear / driveable

New datalogger + antenna @ t piezo (P)

Good photos of d/s face

Inspected By: BRIAN GEOGHEGAN
Date: March. 30. 2017



Rising but not picked up
Pond El.

Freeboard (min 1.2m)

1653.54 m
Min. Crest El.

~ 560 m
Beach Length

Use above map to mark up observations incl wetted perimeter

Are the following components in SATISFACTORY CONDITION?

Main Embankment		Comment
Rip Rap	(Y) N	
Old Tailings Line	Y—N	
2013 Main Failure Area	(Y) N	
2013 South Failure Area	(Y) N	
Old Scraper Crossing	(Y) N	(A)
FRNTP2	(Y) N	
Clarified Lines River Crossing	(Y) N	
Clarified Lines inside Pond	Y—N	
Steel Pipe Crossing	Y—N	
Black PVC Pipe Crossing	Y—N	
Barge Infrastructure	Y—N	
Shandley Bridge	Y—N	
West Abutment		Comment
Facilities Dump	(Y) N	
Pond Coal Stockpile	(Y) N	
Shandley Line	(Y) N	
Reservoir		Comment
North Abutment Area	(Y) N	
Tailings surface	(Y) N	
Dust Fences	Y—N	
Wetted Perimeter	Y—N	

U: Upstream D: Downstream C: Crest F: Face T: Toe B: Lower Bench

Were any of the below POTENTIAL PROBLEM INDICATORS found?

	Main Embankment		West Abutment		Comments
	Y	N	Y	N	
Piping		x		x	
Sinkholes	?			x	investigate previous pics
Seepage		x		x	
External Erosion		x		x	
Cracks		x		x	
Settlement		x		x	
Sloughing/Slides		x		x	
Animal Activity	x			x	d/s
Excessive growth		x		x	
Excessive Debris		x		x	
Standing Water		x		x	
Over-steepened Slope		x		x	

Comments

- is the Lees Lake ditch lined? Significant flow through it. is this flow seeping into NTP?
- No signs of hydrovac dumping (operation)
- investigated area with geos where Lee's Lake discharge to NTP → becomes standing water u/s of obsolete tails input line, but no signs of seepage along d/s face or toe
- Standing water on tails beach b/w NT2 & TH15-05
- Small excavated hole (old?) just south of by TH15-06? from 2013 rip rap works? right across from old demolition pump discharge
- seperated pond has increased in size noticeably
- burst pipe fixed. Need pipe crew to re-establish access to toe.
- Animal Burrow d/s of Barge. Lakes first. Env. to do their spring check (operations) & also all but the find
- Spring runoff entering pond, rockfall on W. road

Additional Comments

Follow-up items from previous inspection:

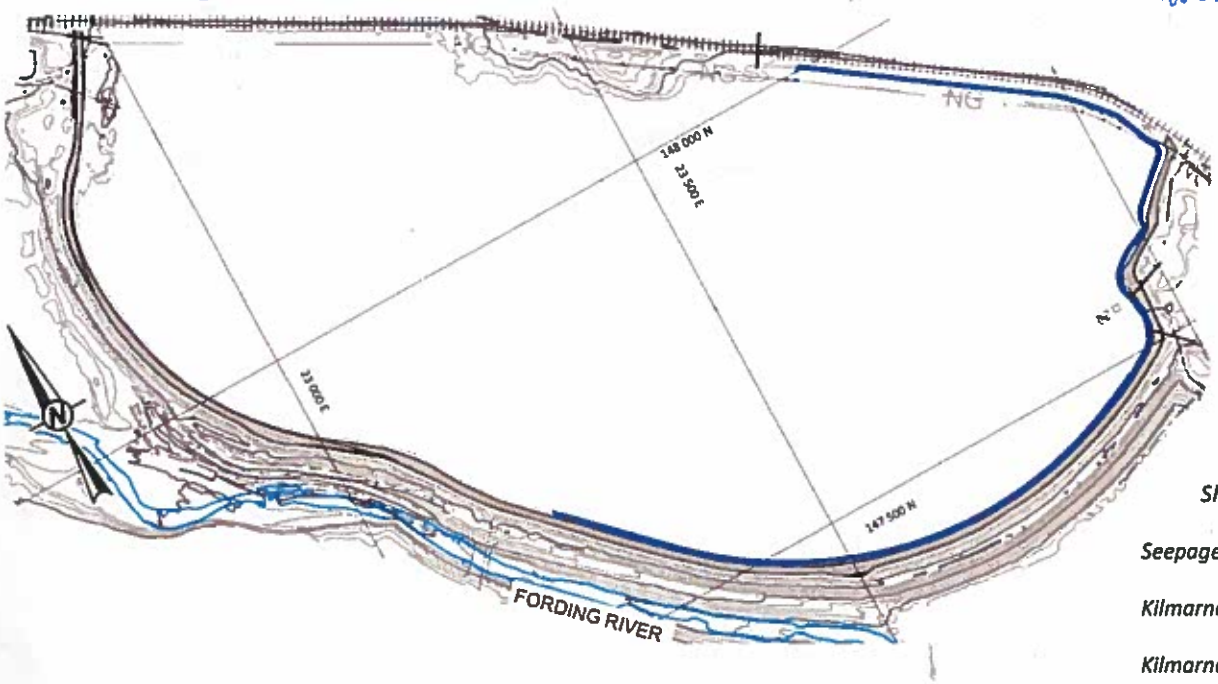
Old snow dump (MDS former laydown) inactive - dumping along haul road has granted any access for operations (would need doze to cut in new access)

No signed boom by obsolete culvert across from MS Pond → is it Elk Pond?

- Environmental notified of seepage through bank of haul road by Multiplate (c/o of NTP)

Fording River Operations: South Tailings Pond Inspection Sheet rev2e *Monthly*

Inspected By: BRIAN GEOGHEGAN Date: March. 31. 2017



1636.84
Pond El.

1.46
Freeboard (min 1.2m)

0.91
W Seep ~~l/s~~ L/s

3.9 L/s
N Seep (~~N culv/S culv~~)

Flowrate / Totalizers

Shandley 0* / 557005

Seepage Return 110 / 839807

Kilmarnock W. N/A

Kilmarnock E. N/A

Use above map to mark up observations incl wetted perimeter

U: Upstream D: Downstream C: Crest F: Face T: Toe B: Lower Bench

Are the following components in SATISFACTORY CONDITION?

South Abutment			Comment
Kilmarnock W	Y	N	~~GC~~
Kilmarnock E	Y	N	~~GC~~
Gasline	Y	N	—
Clarified Line	(Y)	N	
Barge+anchors	(Y)	N	
Seepage Return Line	(Y)	N	
Railway Embankment			**Comment**
Blackmore Culverts	(Y)	N	
South Loop Culverts	~~Y~~	~~N~~	
West & Main Dam			**Comment**
S. Seep	(Y)	N	
W.Seep	(Y)	N	
N.Seep	(Y)	N	
Dredge line	Y	N	off
Rip Rap	(Y)	N	
Instruments			**Comment**
Piezometers	(Y)	N	
GPS Units	(Y)	N	
Slope Inclinometers	Y	N	
Reservoir			**Comment**
Tailings surface	(Y)	N	
Dust Fences	Y	N	
Wetted Perimeter	(Y)	N	
Other			

Were any of the below POTENTIAL PROBLEM INDICATORS found?

	Problem? Y	Problem? N	Location (s) (M. Dam, W. Dam, N.Ab., S.Ab., Rail Emb.)	Comments
Piping		X		
Sinkholes		X		
Seepage		X		
External Erosion		X		
Cracks		X		
Settlement		X		
Sloughing/Slides		X		
Animal Activity		X		
Excessive growth		X		
Excessive Debris		X		
Standing Water		X		
Over-steepened Slope		X		

Comments

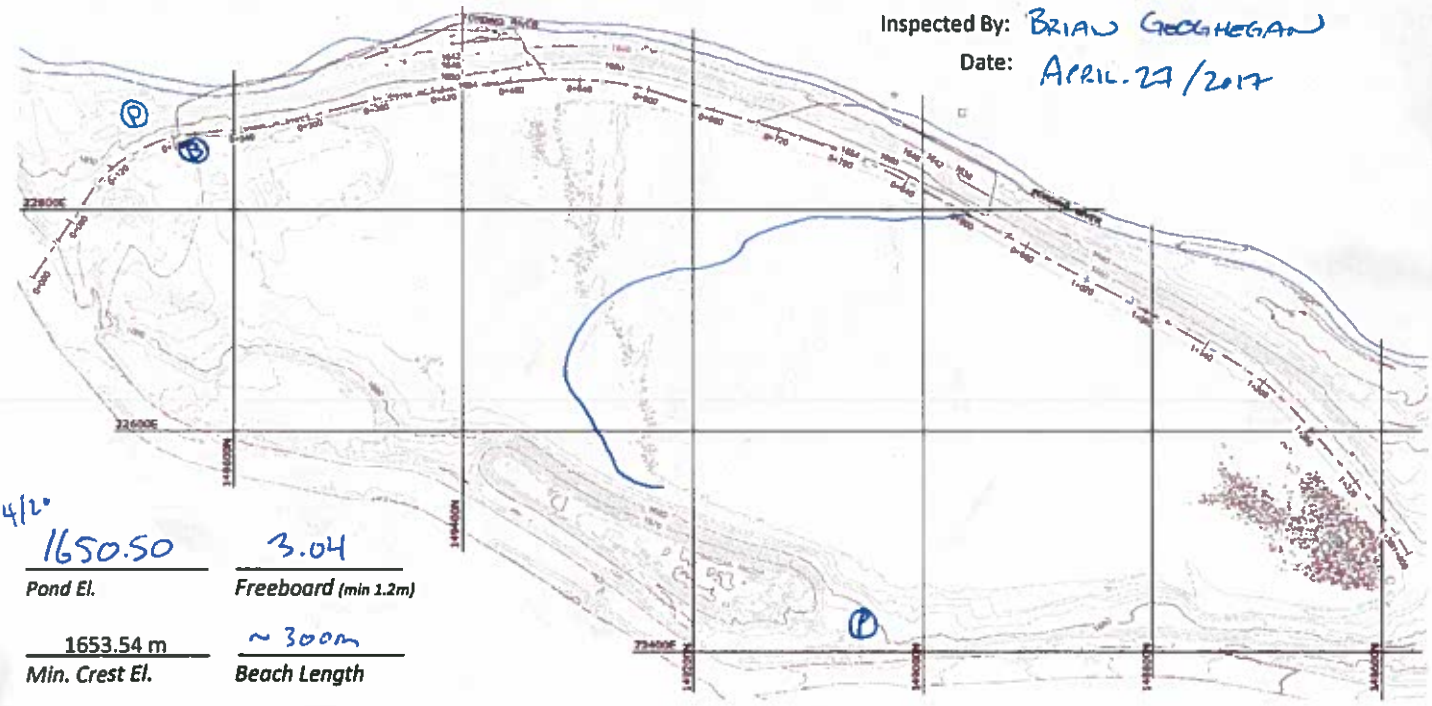
- Shandley FM - shows 150 usgpm even though no actual flow
- TMA moved a D6 along the Dike this morning
- Tails Beach is obstructing overall discharge from traveling towards Base
  - GPS downstream for feedback. No flow identified/needed
- Significant flow through blackmore culverts
  - ↳ do flow measurements there as well? (note to below operations)
- Looked at N. Ditch, see if any signs of increased flow from NLP decant. Review possibility & erosion @ toe of SDP if heavy discharge from NLP
  - (No evidence of erosion, or high flow.
  - clean up inlet around
  - ~~Blackmore culverts~~ dredge culverts ope/flow, put up cross ties

- Rail bed cracking to SDP
- Minor erosion above N-Ditch
- Piezo standpipe height addressed (by S.P. well)
- M. Dam erosion ~~fixed~~ developed a bit?

Fording River Operations: North Tailings Pond Inspection Sheet rev2c *Monthly*

Inspected By: BRIAN GEOGHEGAN

Date: APRIL. 27 / 2017



4/12

1650.50 *Pond El.*

3.04 *Freeboard (min 1.2m)*

1653.54 m *Min. Crest El.*

~ 300m *Beach Length*

Use above map to mark up observations incl wetted perimeter

U: Upstream D: Downstream C: Crest F: Face T: Toe B: Lower Bench

Are the following components in SATISFACTORY CONDITION?

Main Embankment			Comment
Rip Rap	(Y)	N	
Old Tailings Line	Y	(N)	
2013 Main Failure Area	(Y)	N	
2013 South Failure Area	(Y)	N	
Old Scraper Crossing	Y	(N)	
FRNTP2	(Y)	N	
Clarified Lines River Crossing	Y	(N)	
Clarified Lines inside Pond	(Y)	N	
Steel Pipe Crossing	Y	(N)	
Black PVC Pipe Crossing	Y	(N)	
Barge Infrastructure	Y	(N)	
Shandley Bridge	(Y)	N	
West Abutment			**Comment**
Facilities Dump	(Y)	N	
Pond Coal Stockpile	(Y)	N	
Shandley Line	(Y)	N	
Reservoir			**Comment**
North Abutment Area	(Y)	N	
Tailings surface	(Y)	N	
Dust Fences	(Y)	N	
Wetted Perimeter	(Y)	N	

Were any of the below POTENTIAL PROBLEM INDICATORS found?

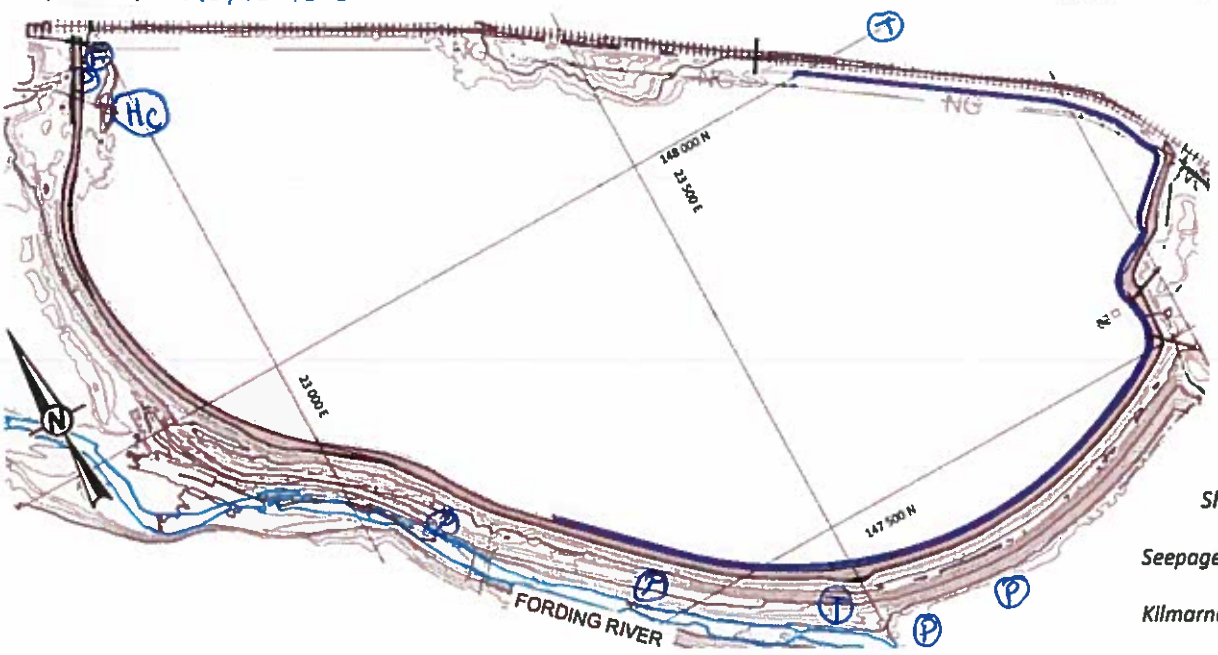
	Main Embankment		West Abutment		Comments
	Y	N	Y	N	
Piping		X		X	
Sinkholes		X		X	
Seepage		X		X	
External Erosion		X		X	
Cracks		X		X	
Settlement		X		X	
Sloughing/Slides		X		X	
Animal Activity		X		X	E/K
Excessive growth		X		X	
Excessive Debris		X		X	
Standing Water		X		X	
Over-steepened Slope		X		X	

Comments

- Lees Lake decanting through WTP channel
- Ponding water in some locations (snow melt) - (P) above
- Should add safety berm at top of access ramp - (B) above
- Took representative photos of couple very minor erosion/slough features.

Fording River Operations: South Tailings Pond Inspection Sheet rev2e **Monthly**

Inspected By: BRIAN GEOGHEGAN Date: APR. 27. 2017



1636.91
Pond El.

1.39
Freeboard (min 1.2m)

1.06 Us
W Seep

7.3 Us
N Seep (N culv/S culv)

Flowrate / Totalizers

Shandley 100 (est) / 557203

Seepage Return 100 / 908125

Kilmarnock W. 50 (est) / 4994

Kilmarnock E. 0 / 2894

Use above map to mark up observations incl wetted perimeter

U: Upstream D: Downstream C: Crest F: Face T: Toe B: Lower Bench

Are the following components in SATISFACTORY CONDITION?

		Comment
South Abutment		
Kilmarnock W	(Y) N	
Kilmarnock E	(Y) N	
Gasline	~~Y~~ ~~N~~	
Clarified Line	(Y) N	
Barge+anchors	(Y) N	
Seepage Return Line	(Y) N	
Railway Embankment		Comment
Blackmore Culverts	~~Y~~ ~~N~~	
South Loop Culverts	~~Y~~ ~~N~~	
West & Main Dam		Comment
S. Seep	(Y) N	
W.Seep	(Y) N	
N.Seep	(Y) N	
Dredge line	~~Y~~ ~~N~~	
Rip Rap	(Y) N	
Instruments		Comment
Piezometers	~~Y~~ N	
GPS Units	(Y) N	
Slope Inclinometers	~~Y~~ N	
Reservoir		Comment
Tailings surface	(Y) N	
Dust Fences	(Y) N	
Wetted Perimeter	(Y) N	
Other		

Were any of the below POTENTIAL PROBLEM INDICATORS found?

	Problem? Y	Problem? N	Location (s) (M. Dam, W. Dam, N.Ab., S.Ab., Rail Emb.)	Comments
Piping		X		
Sinkholes		X		
Seepage		X		
External Erosion		X		
Cracks		X		
Settlement		X		
Sloughing/Slides		X		
Animal Activity		X		
Excessive growth		X		
Excessive Debris		X		
Standing Water		X		
Over-steepened Slope		X		

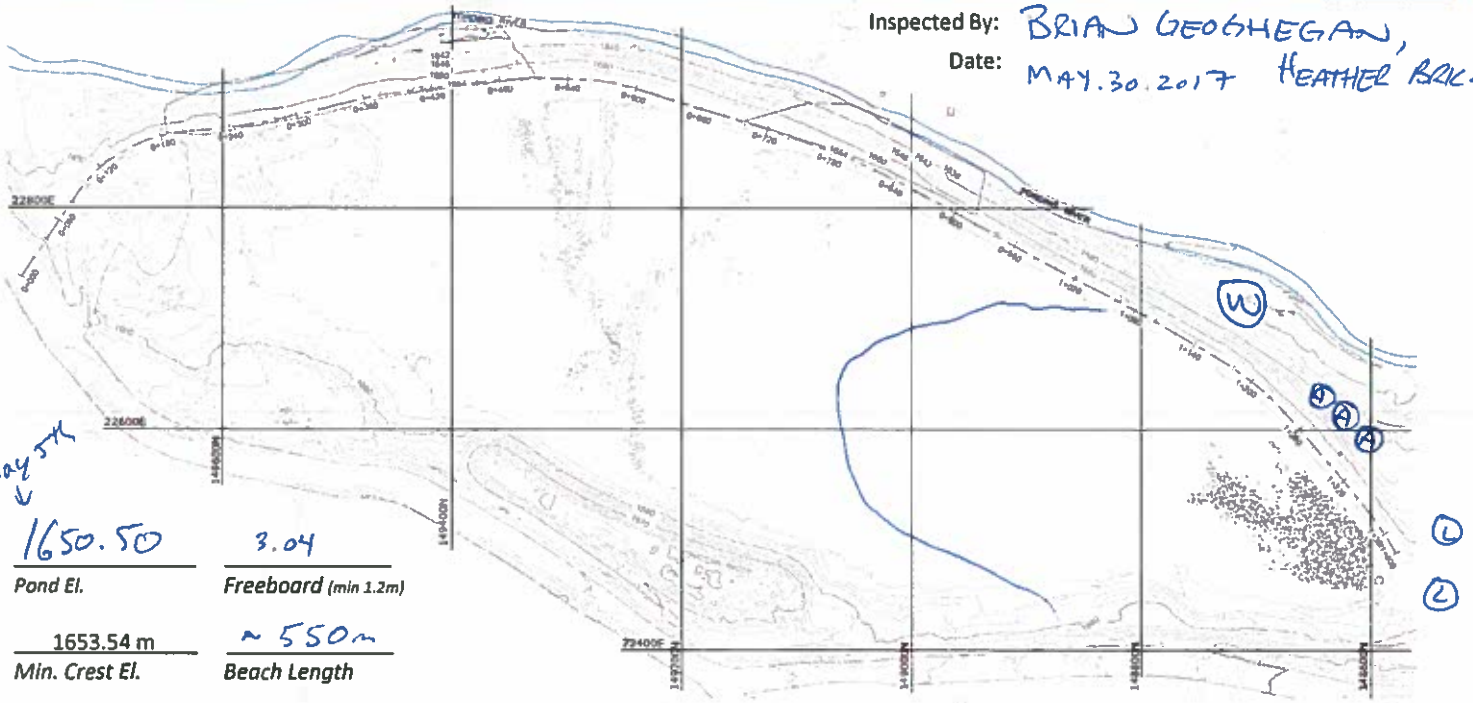
Comments

- Terrapine working on booster pump - (T), Tires put up on dike (Anchors)
- Flowmeters installed, Kil. E ordered under PO 478345
- Lots of froth on pond
- Ponding water (P)
- "N. Seep" flowing well, visibly dry close to marsh - coming up at usual spot.
- Unusual discharge @ facilities location (F)

- Hydrocarbons visible in pond by WWC's (Hc). Suspect runoff from land rather than leakage from WWC's
- Bedspray racing up WWC's
- Surface starting to need crush grading.

Fording River Operations: North Tailings Pond Inspection Sheet rev2c *Monthly*

Inspected By: BRIAN GEOGHEGAN, HEATHER BRICKNER
Date: MAY.30.2017



May 5th

1650.50	3.04
Pond El.	*Freeboard (min 1.2m)*
1653.54 m	~ 550m
Min. Crest El.	*Beach Length*

Use above map to mark up observations incl wetted perimeter

U: Upstream D: Downstream C: Crest F: Face T: Toe B: Lower Bench

Are the following components in SATISFACTORY CONDITION?			
Main Embankment			Comment
Rip Rap	(Y)	N	in progress
Old Tailings Line	Y	~~N~~	
2013 Main Failure Area	(Y)	N	
2013 South Failure Area	(Y)	N	
Old Scraper Crossing	(Y)	N	
FRNTP2	(Y)	N	
Clarified Lines River Crossing	Y	N	
Clarified Lines inside Pond	(Y)	N	
Steel Pipe Crossing	(Y)	N	
Black PVC Pipe Crossing	Y	N	
Barge Infrastructure	Y	N	
Shandley Bridge	(Y)	N	
West Abutment			Comment
Facilities Dump	(Y)	N	
Pond Coal Stockpile	(Y)	N	
Shandley Line	(Y)	N	
Reservoir			Comment
North Abutment Area	Y	N	
Tailings surface	(Y)	N	
Dust Fences	(Y)	N	
Wetted Perimeter	(Y)	N	

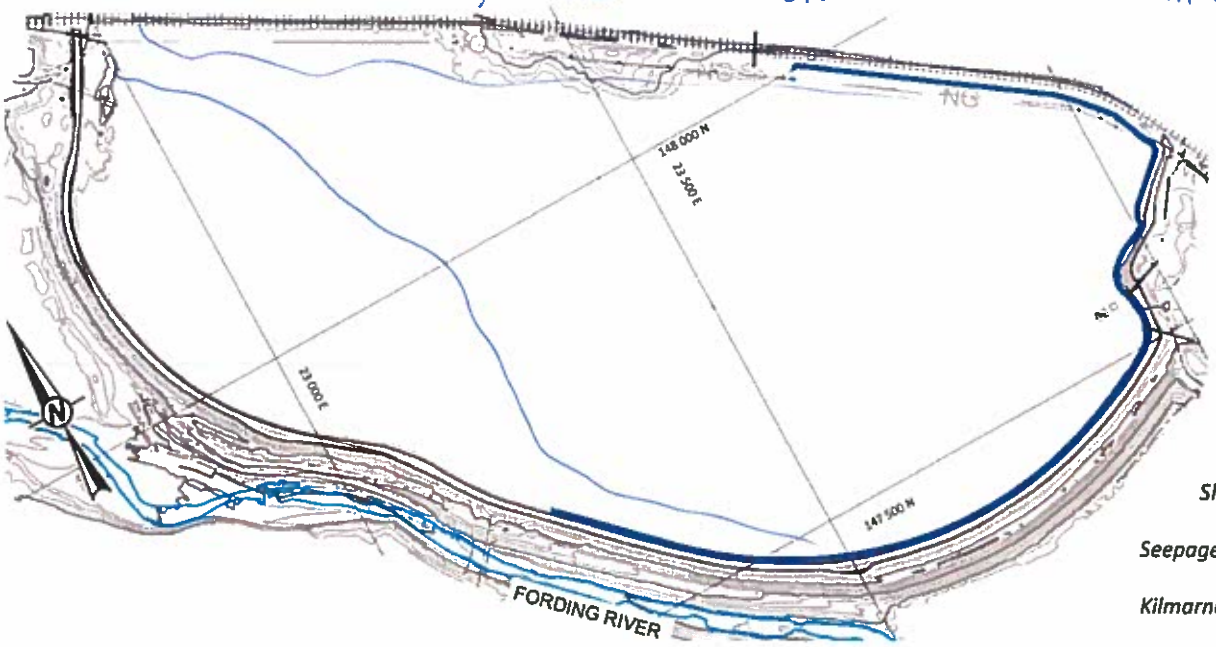
Were any of the below POTENTIAL PROBLEM INDICATORS found?	Main Embankment		West Abutment		Comments
	Y	N	Y	N	
Piping		X		X	
Sinkholes		X		X	
Seepage		X		X	
External Erosion		X		X	
Cracks		X		X	
Settlement		X		X	
Sloughing/Slides		X		X	
Animal Activity	✓			X	Animal Burrows - environment annual check required
Excessive growth		X		X	
Excessive Debris		X		X	
Standing Water		X		X	
Over-steepened Slope		X		X	

Comments

- Lees Lake system draining to river via LVP channel (good flow)
- Surface crush in good condition
- River looks high
- Network of animal burrows on d/s bench (starting) by barge. Looks like bears may have been digging at some of them see (A) on map.
- water ponding at toe (W), in usual area (not stability concern)
- Leaks in Shandley line (L), one is at location of previous repair, one is leaking flange @ Y. Not stability concern, should be addressed before winter, water leak (drips) toward toe of dam
- Osprey's nesting on gantry/pole again this year.
- Looks like new material have been placed at sediment dump.
- Should investigate location survey instrument setup (verify)

Fording River Operations: South Tailings Pond Inspection Sheet rev2e *Monthly*

Inspected By: BRIAN GEOGHEGAN, HEATHER BRICKNER Date: MAY. 30. 2017



1636.82
Pond El.

1.48
Freeboard (min 1.2m)

unsafe - high water
W Seep

60 L/s
N Seep (N culv/S culv)
Ø to be checked

Flowrate / Totalizers

Shandley Ø (150) / 557654

Seepage Return Ø / 966410

Kilmarnock W. Ø / 21251

Kilmarnock E. Ø / 30595

Use above map to mark up observations incl wetted perimeter

U: Upstream D: Downstream C: Crest F: Face T: Toe B: Lower Bench

Are the following components in SATISFACTORY CONDITION?

South Abutment		Comment
Kilmarnock W	Y N	
Kilmarnock E	Y N	
Gasline	Y N	
Clarified Line	Y N	
Barge+anchors	Y N	
Seepage Return Line	Y N	
Railway Embankment		**Comment**
Blackmore Culverts	Y N	
South Loop Culverts	Y N	
West & Main Dam		**Comment**
S. Seep	Y N	
W.Seep	Y N	
N.Seep	Y N	
Dredge line	Y N	Culverts
Rip Rap	Y N	
Instruments		**Comment**
Piezometers	Y N	
GPS Units	Y N	
Slope Inclinometers	Y N	
Reservoir		**Comment**
Tailings surface	Y N	
Dust Fences	Y N	
Wetted Perimeter	Y N	
Other		

Were any of the below POTENTIAL PROBLEM INDICATORS found?

	Problem? Y	Problem? N	Location (s) (M. Dam, W. Dam, N.Ab., S.Ab., Rail Emb.)	Comments
Piping		X		
Sinkholes		X		
Seepage		X		
External Erosion		X		
Cracks		X		
Settlement		X		
Sloughing/Slides		X		
Animal Activity		X		
Excessive growth		X		
Excessive Debris		X		
Standing Water		X		
Over-steepened Slope		X		

Comments

- Tailings discharge partially submerged
- High flow in river - overtopping bank south of STP
- Vegetation clumping @ toe indicate higher seepage? (d/s of STP 242) by SP-WS
  - ↳ could lead to topsoil sloughing?
- Culverts beneath railway buried @ ~~intersection~~ dredge line working? overflow
- Lots of froth in pond.

- No ponding water @ toe of M.Dam, still ponding water on back of W. Dam
- N Seep Heavy flow, flow starting much further up than usual

Additional Comments

Follow-up items from previous inspection:

- WWC looking scummy
- Dust coming off STP - WWC's acting to catch some of it
- Facilities discharge area heavily rutted
- Surface needs regrading & crush
- N/S slope to be cut back
- ~~Material~~ Pedge line - surface runoff from coal stockpiles clogging up culverts at and above potable water tank (looks like tailings)

Inspected By: Heather Bruckner
Inspection Date: June 27-28, 2017
Weather & Temperature: sunny ~23°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 tailings discharge	Water from STP flowing into the dam near FortisBC gasline location. See Note 4	2	
All	Flowmeter locations → unsure where these are located, map would be useful.	n/a	Locate by next insp.
STP	Implement weekly inspections from May-Sept.	4	start week of July 3 2017.
STP/ NLP	Request access to daily tailings line inspections (Processing Supervisors)	4	by next monthly insp. See Note 8

INSPECTION ITEMS

The dam crests, downstream slope, upstream slope, abutments, pipelines, instruments, culverts and other relevant structures shall be inspected. This form does not provide a complete list of potential issues. Details around observations and any other concerns should be noted in the "Additional Comments" section.

Photographs of all structures are required as part of the monthly inspection. The following brief description of areas to inspect. During the inspection, checking "Condition Acceptable" indicates that the relevant items in this section have been reviewed for each structure, and were found to be acceptable.

Item Description	Potential Problems
Piping	Uncontrolled internal erosion of the embankment, resulting in rapid failure of the dam Any signs of piping should be reported immediately, as this is a serious risk to the structural integrity of the dam
Seepage	Increase in volume of flow Turbidity or sediment in the seepage indicates a potential piping issue (internal erosion) Seepage boils – check for sediment transport and flow rates. An increase in the number of boils indicates poor drainage conditions through the embankment
Sinkholes	Generally occurring on the dam crest or slopes, can indicate internal settlement of the embankment
External Erosion	Around, overtop or at the toe of the embankment Heavy rainfall events typically cause substantial erosion on the downstream slopes of earthen/tailings embankments
Cracks	Longitudinal (along the length of the dam) Transverse (across the dam) Cracks should be marked with paint/stakes along the length and survey pins on either side of the crack. These should be surveyed and monitored for
Settlement	Excessive settlement Survey pins should be installed in any new settled areas so that settlement can be tracked over time.
Sloughing / Slides	Heavy rainfall events can cause sloughing of material
Animal Activity	Burrowing vectors can potentially damage the dam Large animal activity (bears, elk, etc.) can pose a safety concern to those working in the area
Excessive growth	Vegetation can hide potential problems on the crest, slopes and toes of the dams. Excessive root infiltration due to vegetation also has the potential of damaging the structural integrity of the dam.
General housekeeping	Excessive debris / waste materials Dusting concerns from the tailings pond or embankment materials Access to the dams (due to snow, poor road conditions, etc.)
Standing water	On the crest or at the toe of the dam. Excessive water can cause increases in the saturation of the embankment fills, reducing the soil strength
Over-steepened slope	Steep slopes can lead to sloughing of material and general dam stability issues
Pipeline conditions	Leaks or holes / tears in the line Damage to the pipelines from passing equipment / snow removal Pipeline leaks on dam crests or slopes will begin to erode the embankment material very quickly, with the potential to develop into a dam breach scenario

NORTH TAILINGS POND

- Minimum crest elevation = 1653.54 m (mine grid UTM)

NORTH TAILINGS POND

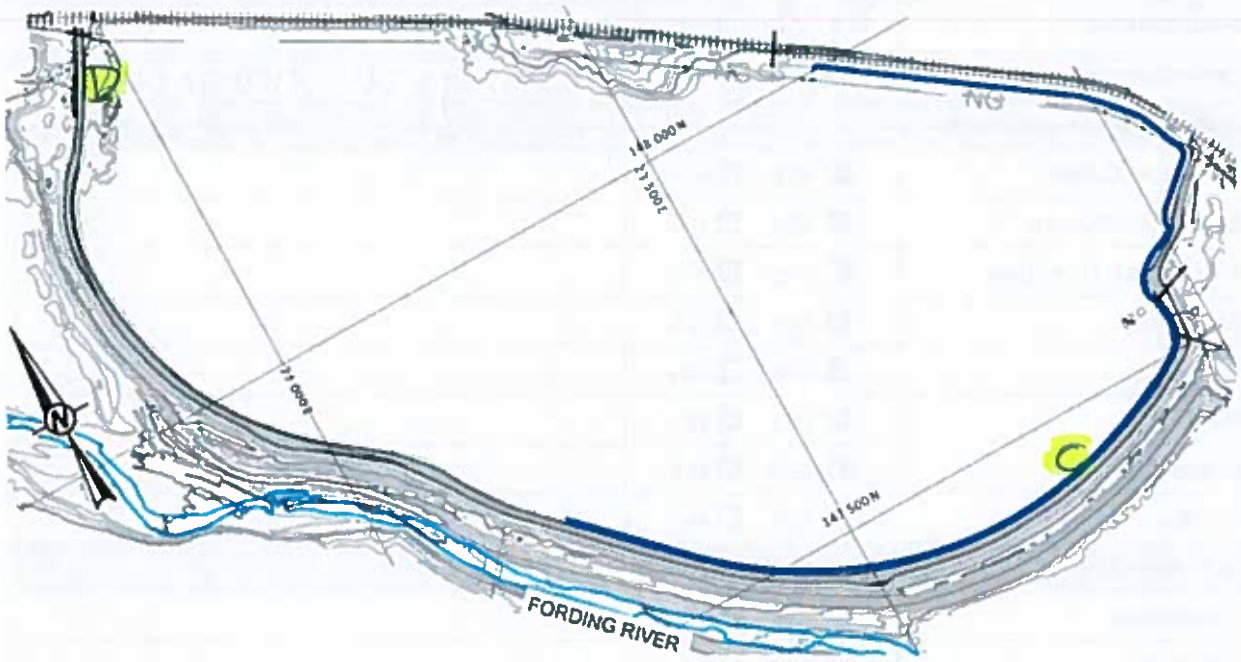
- Minimum crest elevation = 1653.54 m (mine grid UTM)
- Minimum Freeboard = 1.2 m
- Mark any issues on the map below, including tailings wetted perimeter

Structure	Condition Acceptable	Comments
North Tailings Pond – Main Embankment		
Access	☐ YES ☑ NO	2
Downstream Toe	☑ YES ☐ NO	
Downstream Slope	☑ YES ☐ NO	
Dam Crest	☑ YES ☐ NO	
East Abutment	☑ YES ☐ NO	
West Abutment	☑ YES ☐ NO	
Rip Rap	☑ YES ☐ NO	
Old Tailings Line	☑ YES ☐ NO	
2013 Main Failure Area	☑ YES ☐ NO	
2013 South Failure Area	☑ YES ☐ NO	
Old Scraper Crossing	☑ YES ☐ NO	
FRNTP2	☑ YES ☐ NO	

Cl. Lines River Crossing	☑ YES ☐ NO	
Cl. Lines inside Pond	☑ YES ☐ NO	
Steep Pipe Crossing	☑ YES ☐ NO	
Black PVC Pipe Crossing	☑ YES ☐ NO	
Barge Infrastructure	☑ YES ☐ NO	
Shandley Bridge	☑ YES ☐ NO	1
General Housekeeping	☑ YES ☐ NO	
Water Level Elevation		
Freeboard (m)		
Other Concerns	☑ YES ☐ NO	none
West Abutment Area		
Facilities Dump	☑ YES ☐ NO	
Pond Coal Stockpile	☑ YES ☐ NO	
Shandley Line	☑ YES ☐ NO	
Other Concerns	☑ YES ☐ NO	none
Reservoir Area		
North Abutment Area	☑ YES ☐ NO	
Tailings Surface	☑ YES ☐ NO	
Dust Fences	☑ YES ☐ NO	
Tailings Wetted Perimeter	☑ YES ☐ NO	
Other Concerns	☑ YES ☐ NO	none
Additional On-going Monitoring (add as required)		

SOUTH TAILINGS POND

- Minimum crest elevation = 1638.30 masl (mine grid UTM)
- Minimum Freeboard = 1.2 m
- Mark any issues on the map below, including tailings wetted perimeter



Structure	Condition Acceptable	Comments
South Tailings Pond – Main Embankment		
Access	☑ YES ☐ NO	
Downstream Toe	☑ YES ☐ NO	
Downstream Slope	☑ YES ☐ NO	3
Dam Crest	☑ YES ☐ NO	
South Abutment	☑ YES ☐ NO	
North Abutment	☑ YES ☐ NO	
South Abutment Area		
Kilmarnock W	☑ YES ☐ NO	
Kilmarnock E	☑ YES ☐ NO	
Fortis Gasline	☐ YES ☑ NO	4
Clarified Line	☑ YES ☐ NO	

Barge & anchors	☑ YES ☐ NO	
Seepage Return Line	☑ YES ☐ NO	
General Housekeeping	☑ YES ☐ NO	
Water Level Elevation	1636.90 m	from Trend.
Freeboard (m)	1.40 m	
Other Concerns	☐ YES ☑ NO	tailings discharge area, 4
Railway Embankment Area		
Blackmore Culverts	☑ YES ☐ NO	
South Loop Culverts	☑ YES ☐ NO	
West & Main Dam Area	☑ YES ☐ NO	
South Seep	☑ YES ☐ NO	
West Seep	☑ YES ☐ NO	
North Seep	☑ YES ☐ NO	
Dredge Line	☑ YES ☐ NO	
Rip Rap	☑ YES ☐ NO	
Instrumentation		
Piezometers	☑ YES ☐ NO	
GPS Units	☑ YES ☐ NO	
Slope Inclinometers	☑ YES ☐ NO	
Reservoir Area		
Tailings Surface	☑ YES ☐ NO	
~~Dust Fences~~ n/a	~~☐ YES ☑ NO~~	
Tailings Wetted Perimeter	☑ YES ☐ NO	
Flowrates & Totalizers		
Shandley Flowrate		
Seepage Return Flowrate		
Kilmarnock West		
Kilmarnock East		
Additional On-going Monitoring (add as required)		

ADDITIONAL COMMENTS:

1) Leak at location "A" on Standley line has been repaired.

2) Access road on west side (approx. location B) requires repair, lots of evidence of erosion along side of road.

3) Erosion gully (approximate location C) was checked, no concerns noted.

4) At the tailings discharge on June 26, Environment personnel reported that water was flowing back underneath the embankment near the FortisBC gasline (where it goes beneath the embankment). Water levels in the tailings pond were lower on June 27, this was not observed. It is likely the water was using the gasline as a "conduit" through the dam. Will continue to check the area, but it is recommended that some remediative measures wrt the gasline be investigated & implemented. * next page

5) Checked the TBS TSF and the Henretta culvert crossing, no issues were noted. Water seemed to be flowing well at Henretta.

*Note 4 (contd). Notified Robin & Andrew Bidwell. Discussed with Julia Steele (Golder). Turns out the STP North Abutment area was not completed as part of 2012 dam raise, underlying material is sandy-gravel covered by coarse rejects fill. Julia will be on site for an inspection July 3.

6) Turnbull South Pit TSF + Henretta Culvert:
- no issues noted. Will continue to check these areas during the monthly dam inspection.

7) Flowmeters - locations of flowmeters is not known, will need to ask (eg. Brian or Erika) where these are located.

8) Talked to Andrea Murland, she said she would be able to put me on the email list for daily supervisor inspections (which includes tailings line and discharge).

Fording River Operations

Weekly STP Dam Inspection Form

Teck

Inspected By: Heather Brickner

Inspection Date: July 7/2017

Weather & Temperature: Sunny ~27°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 end, DS slope	Animal burrows at point "A" on map. Continue to monitor, email Environment personnel	4	emailed Environment on July 7/17.

INSPECTION ITEMS

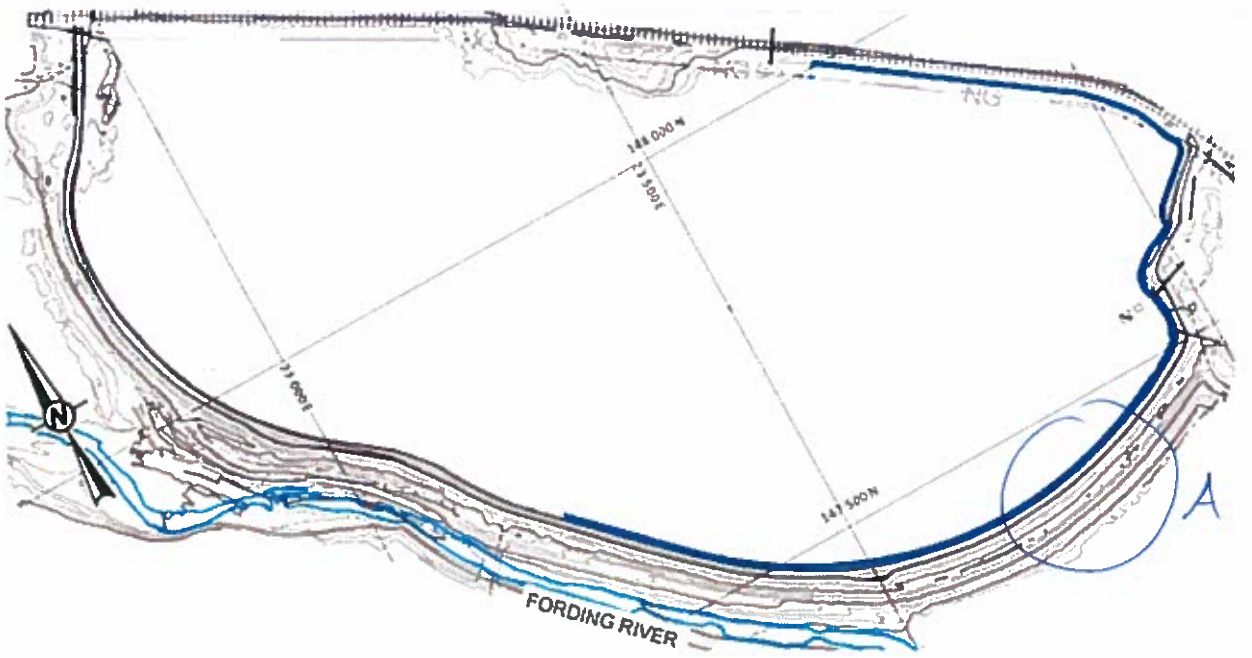
The dam crests, downstream slope, upstream slope, abutments, pipelines, instruments, culverts and other relevant structures shall be inspected. This form does not provide a complete list of potential issues. Details around observations and any other concerns should be noted in the "Additional Comments" section.

Photographs of all structures are required as part of the weekly inspection. The following brief description of areas to inspect. During the inspection, checking "Condition Acceptable" indicates that the relevant items in this section have been reviewed for each structure, and were found to be acceptable.

Item Description	Potential Problems
Piping	Uncontrolled internal erosion of the embankment, resulting in rapid failure of the dam Any signs of piping should be reported immediately, as this is a serious risk to the structural integrity of the dam
Seepage	Increase in volume of flow Turbidity or sediment in the seepage indicates a potential piping issue (internal erosion) Seepage boils – check for sediment transport and flow rates. An increase in the number of boils indicates poor drainage conditions through the embankment
Sinkholes	Generally occurring on the dam crest or slopes, can indicate internal settlement of the embankment
External Erosion	Around, overtop or at the toe of the embankment Heavy rainfall events typically cause substantial erosion on the downstream slopes of earthen/tailings embankments
Cracks	Longitudinal (along the length of the dam) Transverse (across the dam) Cracks should be marked with paint/stakes along the length and survey pins on either side of the crack. These should be surveyed and monitored for
Settlement	Excessive settlement Survey pins should be installed in any new settled areas so that settlement can be tracked over time.
Sloughing / Slides	Heavy rainfall events can cause sloughing of material
Animal Activity	Burrowing vectors can potentially damage the dam Large animal activity (bears, elk, etc.) can pose a safety concern to those working in the area
Excessive growth	Vegetation can hide potential problems on the crest, slopes and toes of the dams. Excessive root infiltration due to vegetation also has the potential of damaging the structural integrity of the dam.
General housekeeping	Excessive debris / waste materials Dusting concerns from the tailings pond or embankment materials Access to the dams (due to snow, poor road conditions, etc.)
Standing water	On the crest or at the toe of the dam. Excessive water can cause increases in the saturation of the embankment fills, reducing the soil strength
Over-steepened slope	Steep slopes can lead to sloughing of material and general dam stability issues
Pipeline conditions	Leaks or holes / tears in the line Damage to the pipelines from passing equipment / snow removal Pipeline leaks on dam crests or slopes will begin to erode the embankment material very quickly, with the potential to develop into a dam breach scenario

SOUTH TAILINGS POND

- Minimum crest elevation = 1638.30 masl (mine grid UTM)
- Minimum Freeboard = 1.2 m
- Mark any issues on the map below, including tailings wetted perimeter



Structure	Condition Acceptable	Comments
South Tailings Pond – Main Embankment		
Access	☑ YES ☐ NO	
Downstream Toe	☑ YES ☐ NO	
Downstream Slope	☑ YES ☐ NO	see Note 7, 8
Dam Crest	☑ YES ☐ NO	
South Abutment	☑ YES ☐ NO	
North Abutment	☑ YES ☐ NO	
South Abutment Area		
Kilmarnock W	☑ YES ☐ NO	not running
Kilmarnock E	☑ YES ☐ NO	not running
Fortis Gasline	☑ YES ☐ NO	
Clarified Line	☑ YES ☐ NO	

Barge & anchors	☑ YES ☐ NO	
Seepage Return Line	☑ YES ☐ NO	
General Housekeeping	☑ YES ☐ NO	
Water Level Elevation	1636.84m	
Freeboard (m)	1.46m.	
Other Concerns	☐ YES ☐ NO	
Railway Embankment Area		
Blackmore Culverts	☑ YES ☐ NO	
South Loop Culverts	☑ YES ☐ NO	
West & Main Dam Area	☑ YES ☐ NO	
South Seep	☑ YES ☐ NO	
West Seep	☑ YES ☐ NO	
North Seep	☑ YES ☐ NO	
Dredge Line	☑ YES ☐ NO	
Rip Rap	☑ YES ☐ NO	
Instrumentation		
Piezometers	☑ YES ☐ NO	
GPS Units	☑ YES ☐ NO	
Slope Inclinometers	☑ YES ☐ NO	
Reservoir Area		
Tailings Surface	☑ YES ☐ NO	
~~Dust Fences~~	☐ YES ☐ NO	n/a
Tailings Wetted Perimeter	☑ YES ☐ NO	
Flowrates & Totalizers		
Shandley Flowrate		
Seepage Return Flowrate		n/a not running
Kilmarnock West		
Kilmarnock East		
Additional On-going Monitoring (add as required)		
Tails discharge area		no concerns noted. More details on pg. 5

ADDITIONAL COMMENTS:

1) Berm just west of STP tailings discharge was filled in with till from near wastewater cells. Tailings/water had been very close to flowing onto the road.
2) Sand (for sandbags) stockpiled near tailings discharge, ready to be put in sandbags for sandbag berm
3) North Abutment seep area checked, no signs of water/settling or erosion on road surface and DS in maxam site. Water level in STP at tailings discharge is lower than yesterday. Hot weather/evaporation is helping remove water, plant is also running.
4) Dredge is still down.
5) Shandley and 1-Pit line into STP are not running.
6) Lots of animal tracks in tailings beach (near north end). See photos.
7) Noticed some animal burrows near "A", close to the 3 seepage collection wells. Continue to monitor, inform Environment personnel.
8) No changes noted on erosion gully at south end (near "A").

Fording River Operations

Weekly STP Dam Inspection Form

Teck

Inspected By: Heather Brickner

Inspection Date: July 14, 2017

Weather & Temperature: sunny, 26°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 downstream toe (south end)	Continue to monitor animal burrows at STP DS toe (south end). Sparwood Environment personnel to assess.	4	monitor weekly/ monthly.

INSPECTION ITEMS

The dam crests, downstream slope, upstream slope, abutments, pipelines, instruments, culverts and other relevant structures shall be inspected. This form does not provide a complete list of potential issues. Details around observations and any other concerns should be noted in the "Additional Comments" section.

Photographs of all structures are required as part of the weekly inspection. The following brief description of areas to inspect. During the inspection, checking "Condition Acceptable" indicates that the relevant items in this section have been reviewed for each structure, and were found to be acceptable.

Item Description	Potential Problems
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Sinkholes	Generally occurring on the dam crest or slopes, can indicate internal settlement of the embankment
External Erosion	Around, overtop or at the toe of the embankment Heavy rainfall events typically cause substantial erosion on the downstream slopes of earthen/tailings embankments
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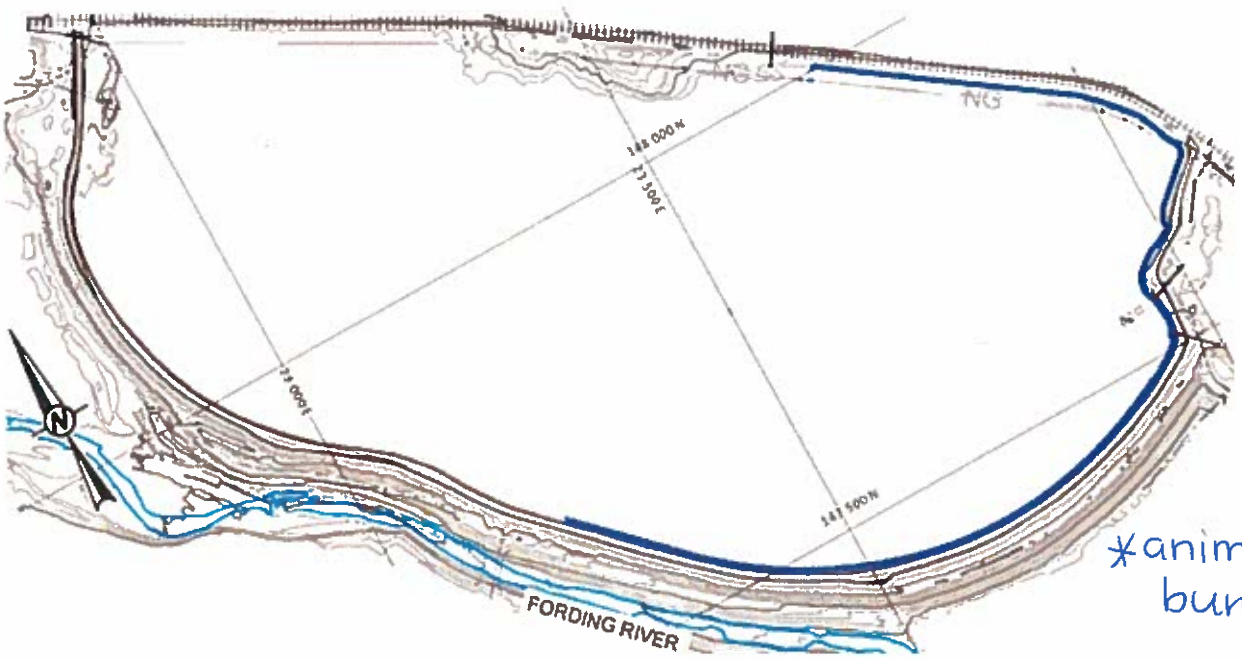
Settlement	Excessive settlement Survey pins should be installed in any new settled areas so that settlement can be tracked over time.
Sloughing / Slides	Heavy rainfall events can cause sloughing of material
Animal Activity	Burrowing vectors can potentially damage the dam Large animal activity (bears, elk, etc.) can pose a safety concern to those working in the area
Excessive growth	Vegetation can hide potential problems on the crest, slopes and toes of the dams. Excessive root infiltration due to vegetation also has the potential of damaging the structural integrity of the dam.
General housekeeping	Excessive debris / waste materials Dusting concerns from the tailings pond or embankment materials Access to the dams (due to snow, poor road conditions, etc.)
Standing water	On the crest or at the toe of the dam. Excessive water can cause increases in the saturation of the embankment fills, reducing the soil strength
Over-steepened slope	Steep slopes can lead to sloughing of material and general dam stability issues
Pipeline conditions	Leaks or holes / tears in the line Damage to the pipelines from passing equipment / snow removal Pipeline leaks on dam crests or slopes will begin to erode the embankment material very quickly, with the potential to develop into a dam breach scenario

SOUTH TAILINGS POND

- Minimum crest elevation = 1638.30 masl (mine grid UTM)
- Minimum Freeboard = 1.2 m
- Mark any issues on the map below, including tailings wetted perimeter



*animal burrows.

Structure	Condition Acceptable	Comments
South Tailings Pond – Main Embankment		
Access	☑ YES ☐ NO	
Downstream Toe	☑ YES ☐ NO	3
Downstream Slope	☑ YES ☐ NO	
Dam Crest	☑ YES ☐ NO	
South Abutment	☑ YES ☐ NO	
North Abutment	☑ YES ☐ NO	4
South Abutment Area		
Kilmamock W	☑ YES ☐ NO	
Kilmamock E	☑ YES ☐ NO	
Fortis Gasline	☑ YES ☐ NO	
Clarified Line	☑ YES ☐ NO	

Barge & anchors	☑ YES ☐ NO	
Seepage Return Line	☑ YES ☐ NO	
General Housekeeping	☑ YES ☐ NO	
Water Level Elevation		
Freeboard (m)		
Other Concerns	☐ YES ☑ NO	1, 2
Railway Embankment Area		
Blackmore Culverts	☑ YES ☐ NO	
South Loop Culverts	☑ YES ☐ NO	
West & Main Dam Area	☑ YES ☐ NO	
South Seep	☑ YES ☐ NO	
West Seep	☑ YES ☐ NO	
North Seep	☑ YES ☐ NO	
Dredge Line	☑ YES ☐ NO	
Rip Rap	☑ YES ☐ NO	
Instrumentation		
Piezometers	☑ YES ☐ NO	
GPS Units	☑ YES ☐ NO	
Slope Inclinometers	☑ YES ☐ NO	
Reservoir Area		
Tailings Surface	☐ YES ☐ NO	
~~Dust Fences~~	☐ YES ☐ NO	n/a
Tailings Wetted Perimeter	☐ YES ☐ NO	
Flowrates & Totalizers		
Shandley Flowrate		leak in 1-Pit line, see ① ⑤
Seepage Return Flowrate		
Kilmarnock West		
Kilmarnock East		
Additional On-going Monitoring (add as required)		

ADDITIONAL COMMENTS:

1) Checked NTP, there was a leak at at clamp in the line, approx. 0.5 L/s. Called LPO, Martin Wilson. Spill was reported to appropriate regulators by LPO([redacted] was with me during inspection. Water seeping to Fording River.
2) Noted bear tracks at base of NTP.
3) [redacted] checked animal burrows at south end of STP by seepage collection wells. Burrows are definitely bigger than ground squirrel. Will have someone from Sparwood Environment group assess (potentially badgers). Burrows are not close to STP embankment, on far side of wells. Will continue to monitor.
4) Checked tailings discharge area, water level low again, not back-flooding to area of concern. Sandbags in place (3 high x 3 wide). Permits for till berm construction are in place (Fortis, EHSC/EPWP). Waiting for PO.
5) Pipe crew came and replaced clamp within an hour of spill reporting. Line from I-Pit was shut down within 30 minutes.

Fording River Operations

Weekly STP Dam Inspection Form

Teck

Inspected By: [redacted]

Inspection Date: July 20th, 2017

Weather & Temperature: Partly cloudy; 23°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
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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
STP downstream toe (south end)	Animal burrows still present - under investigation by environment (perhaps badger burrows)	4	monitor weekly/ monthly
Waste water cell	Area unkept → responsibility of environment?	4	n/a

INSPECTION ITEMS

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Photographs of all structures are required as part of the weekly inspection. The following brief description of areas to inspect. During the inspection, checking "Condition Acceptable" indicates that the relevant items in this section have been reviewed for each structure, and were found to be acceptable.

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Settlement	Excessive settlement Survey pins should be installed in any new settled areas so that settlement can be tracked over time.
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Pipeline conditions	Leaks or holes / tears in the line Damage to the pipelines from passing equipment / snow removal Pipeline leaks on dam crests or slopes will begin to erode the embankment material very quickly, with the potential to develop into a dam breach scenario

SOUTH TAILINGS POND

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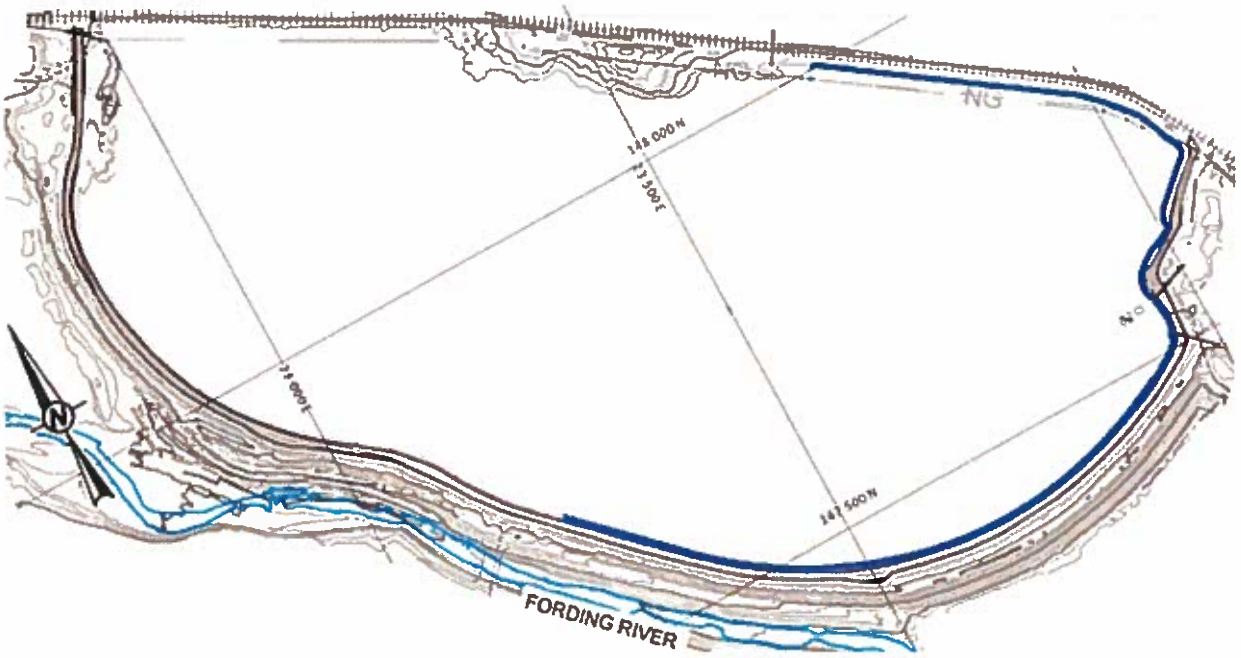

Structure	Condition Acceptable	Comments
South Tailings Pond – Main Embankment		
Access	☑ YES ☐ NO	
Downstream Toe	☑ YES ☐ NO	
Downstream Slope	☑ YES ☐ NO	
Dam Crest	☑ YES ☐ NO	
South Abutment	☑ YES ☐ NO	
North Abutment	☑ YES ☐ NO	
South Abutment Area		
Kilmamock W	☐ YES ☐ NO	
Kilmamock E	☐ YES ☐ NO	
Fortis Gasline	☑ YES ☐ NO	loads of hauled to gasline area
Clarified Line	☑ YES ☐ NO	

Barge & anchors	☑ YES ☐ NO	
Seepage Return Line	☑ YES ☐ NO	
General Housekeeping	☑ YES ☐ NO	dyke roads need new gravel
Water Level Elevation		
Freeboard (m)		
Other Concerns	☐ YES ☑ NO	
Railway Embankment Area		
Blackmore Culverts	☑ YES ☐ NO	
South Loop Culverts	☑ YES ☐ NO	
West & Main Dam Area	☑ YES ☐ NO	
South Seep	☑ YES ☐ NO	
West Seep	☑ YES ☐ NO	
North Seep	☑ YES ☐ NO	
Dredge Line	☑ YES ☐ NO	
Rip Rap	☑ YES ☐ NO	
Instrumentation		
Piezometers	☑ YES ☐ NO	some piezos have animal chew marks
GPS Units	☑ YES ☐ NO	
Slope Inclinometers	☑ YES ☐ NO	data collected this month
Reservoir Area		
Tailings Surface	☑ YES ☐ NO	
Tailings Wetted Perimeter	☑ YES ☐ NO	
Flowrates & Totalizers		
Shandley Flowrate		not taken
Seepage Return Flowrate		
Kilmarnock West		
Kilmarnock East		
Additional On-going Monitoring (add as required)		

ADDITIONAL COMMENTS:

1) Dust in tailings pond significant due to windy weather
2) Tailings discharge berm completed by Transcendint. No issues with berm construction. Berm built in front of pre-existing sand bags on the road side → 1m high by 1m wide. Water level was increasing but still not near the area of concern. Hoe to do 1hr of clean-up work (moving pipes and distributing Kilmamock Till)
3) Dredge contractors using some sort of forklift on dyke.

Fording River Operations

Weekly STP Dam Inspection Form

Teck

Inspected By: Heather Brickner

Inspection Date: July 25, 2017

Weather & Temperature: sunny 26°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 (lower road)	Build up STP berms (lower road) and place fill in wet spot/low spot near wastewater cells	3	Aug. 25, 2017 *
STP	monitor GBRS 341 weekly (check GE displacement data), send weekly email	4	weekly

* Inspection item from MEM, complete within 30 days.

INSPECTION ITEMS

The dam crests, downstream slope, upstream slope, abutments, pipelines, instruments, culverts and other relevant structures shall be inspected. This form does not provide a complete list of potential issues. Details around observations and any other concerns should be noted in the "Additional Comments" section.

Photographs of all structures are required as part of the weekly inspection. The following brief description of areas to inspect. During the inspection, checking "Condition Acceptable" indicates that the relevant items in this section have been reviewed for each structure, and were found to be acceptable.

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Pipeline conditions	Leaks or holes / tears in the line Damage to the pipelines from passing equipment / snow removal Pipeline leaks on dam crests or slopes will begin to erode the embankment material very quickly, with the potential to develop into a dam breach scenario

SOUTH TAILINGS POND

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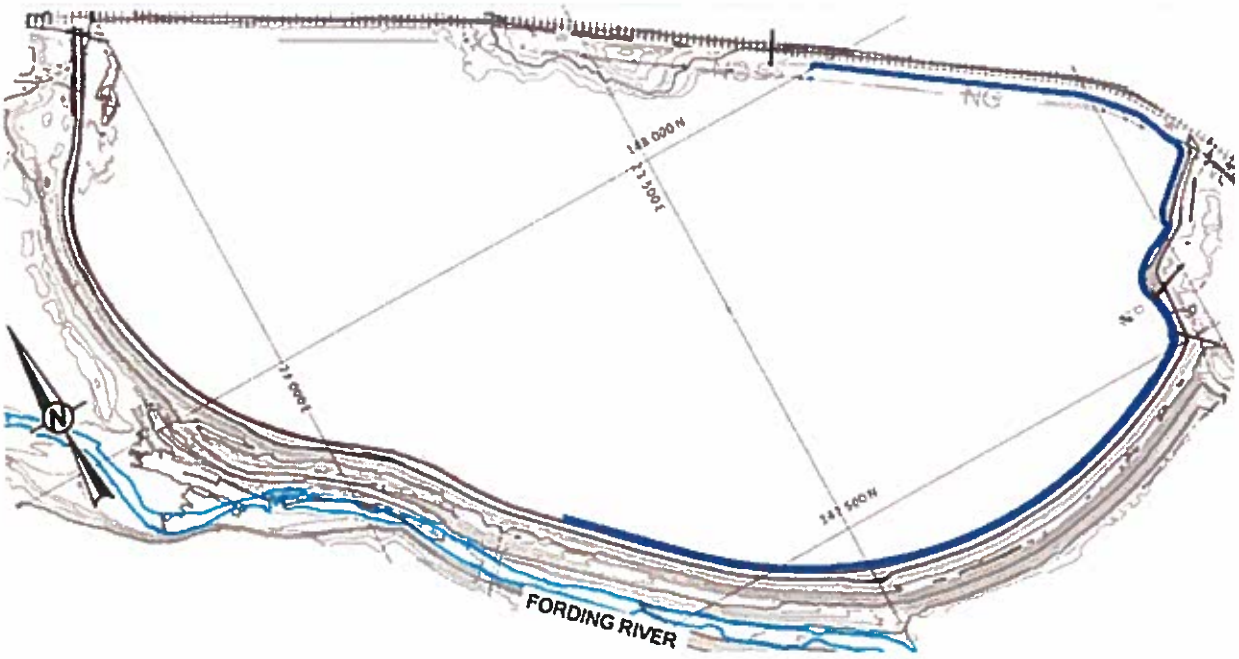


Structure	Condition Acceptable	Comments
South Tailings Pond – Main Embankment		
Access	☑ YES ☐ NO	
Downstream Toe	☑ YES ☐ NO	7
Downstream Slope	☑ YES ☐ NO	4
Dam Crest	☑ YES ☐ NO	
Upstream Slope	☑ YES ☐ NO	6
South Abutment	☑ YES ☐ NO	8
North Abutment	☑ YES ☐ NO	3
STP Tailings Discharge	☑ YES ☐ NO	
Fortis Gasline	☑ YES ☐ NO	
Till Berm / Sandbag Berm	☑ YES ☐ NO	(1)
South Abutment Area		

Kilmamock W	☑ YES ☐ NO	
Kilmamock E	☑ YES ☐ NO	
Fortis Gasline	☑ YES ☐ NO	
Clarified Line	☑ YES ☐ NO	
Barge & anchors	☑ YES ☐ NO	
Seepage Return Line	☑ YES ☐ NO	
General Housekeeping	☑ YES ☐ NO	2 4
Water Level Elevation		
Freeboard (m)		
Other Concerns	☑ YES ☑ NO	no other concerns
Railway Embankment Area		
Blackmore Culverts	☑ YES ☐ NO	
South Loop Culverts	☑ YES ☐ NO	
West & Main Dam Area	☑ YES ☐ NO	
South Seep	☑ YES ☐ NO	
West Seep	☑ YES ☐ NO	
North Seep	☑ YES ☐ NO	
Dredge Line	☑ YES ☐ NO	
Rip Rap	☑ YES ☐ NO	
Instrumentation		
Piezometers	☑ YES ☐ NO	
GPS Units	☑ YES ☐ NO	8
Slope Inclinometers	☑ YES ☐ NO	
Reservoir Area		
Tailings Surface	☑ YES ☐ NO	5
Tailings Wetted Perimeter	☑ YES ☐ NO	dredging on-going
Additional On-going Monitoring (add as required)		

ADDITIONAL COMMENTS:

1) Till berm at STP discharge/north abutment area was constructed July 20. Built directly behind the sandbag berm, temporary only. WL was not encroaching in this area

2) MEM Geotech inspection completed at the same time as this weekly.

3) No issues with road in this area (no low spots, etc) Downstream slope (Maxam yard) was checked, no issues, no signs of ~~excess~~ any seepage on surface.

4) Wet spot near the wastewater cells, likely formed after thunderstorm over weekend. Fill material needed to stop water from ponding.

5) Elk tracks were again noted in the tailings near the northwest corner of the pond.

6) Upstream slope is oversteepened and susceptible to further erosion from wave action. Item was brought up by the inspectors. This work is planned for September.

7) Riprap along Fording River looked fine, inspectors had no concerns about it.

8) Check GPS Unit 341 (weekly on-going monitoring)

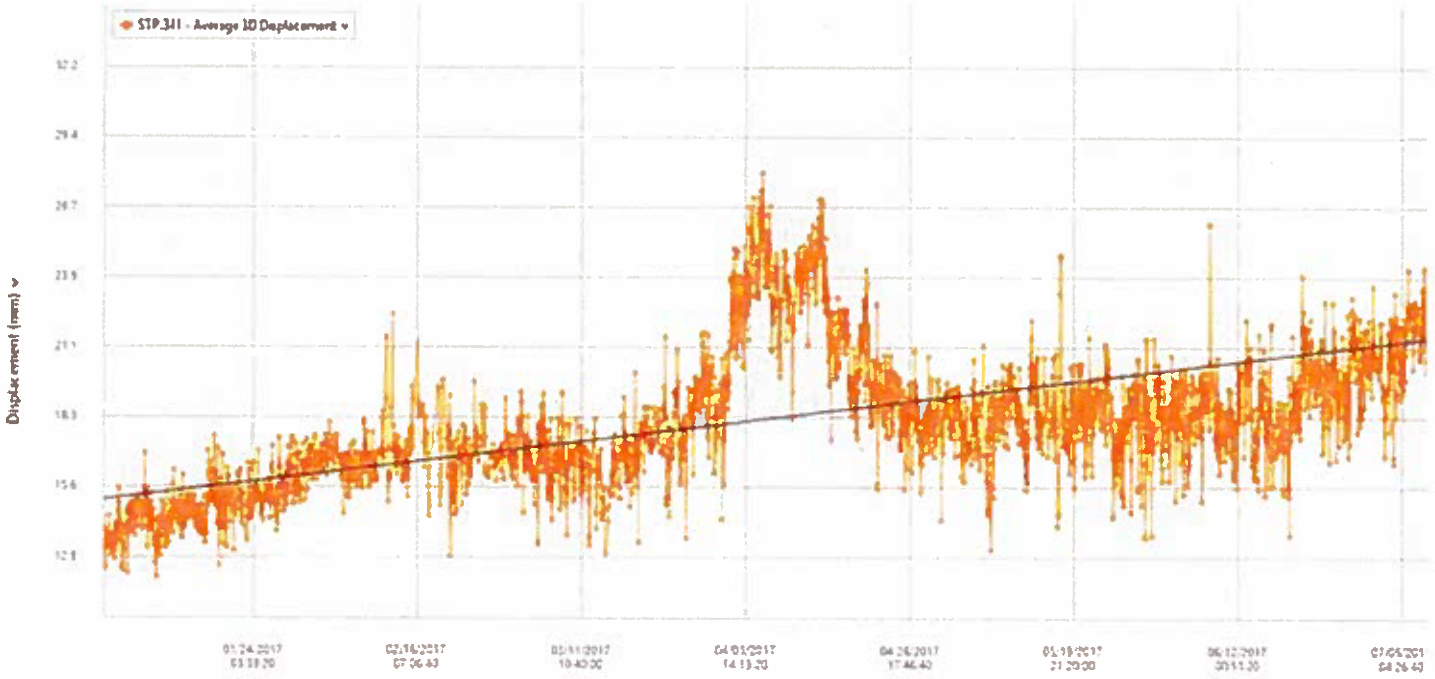
Brickner Heather FRO

From: Brickner Heather FRO
Sent: Friday, July 28, 2017 9:22 AM
To: Langer Adam FRO (Adam.Langer@teck.com)
Cc: [redacted] FRO; [redacted] FRO [redacted]@teck.com)
Subject: GPS Unit 341

Hi Adam,

I have checked the displacement data for GPS Unit 341 on the STP, which was the GPS flagged at the last tailings meeting due to the displacement data showing a slow rise. It looks like this trend is continuing although it may be starting to level off the past couple weeks. The linear trendline is still showing the upward trend we noticed before.

Heather



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Heather Brickner, M.Sc., P.Eng.
Tailings Engineer
Fording River Operations
Teck Resources Limited
Direct: 250-865-6537
Mobile: 250-425-3852
Email: heather.brickner@teck.com

Fording River Operations

Monthly Tailings Dam Inspection Form

Teck

Inspected By: Heather Brickner

Inspection Date: July 31, 2017

Weather & Temperature: mostly sunny, 24°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.
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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
STP	Ponded water - STP near wastewater cells	3	Aug 31, 2017
NTP	Boulders on access road, could damage vehicles (Transcendent to look at this next week)	3	Aug 31, 2017

INSPECTION ITEMS

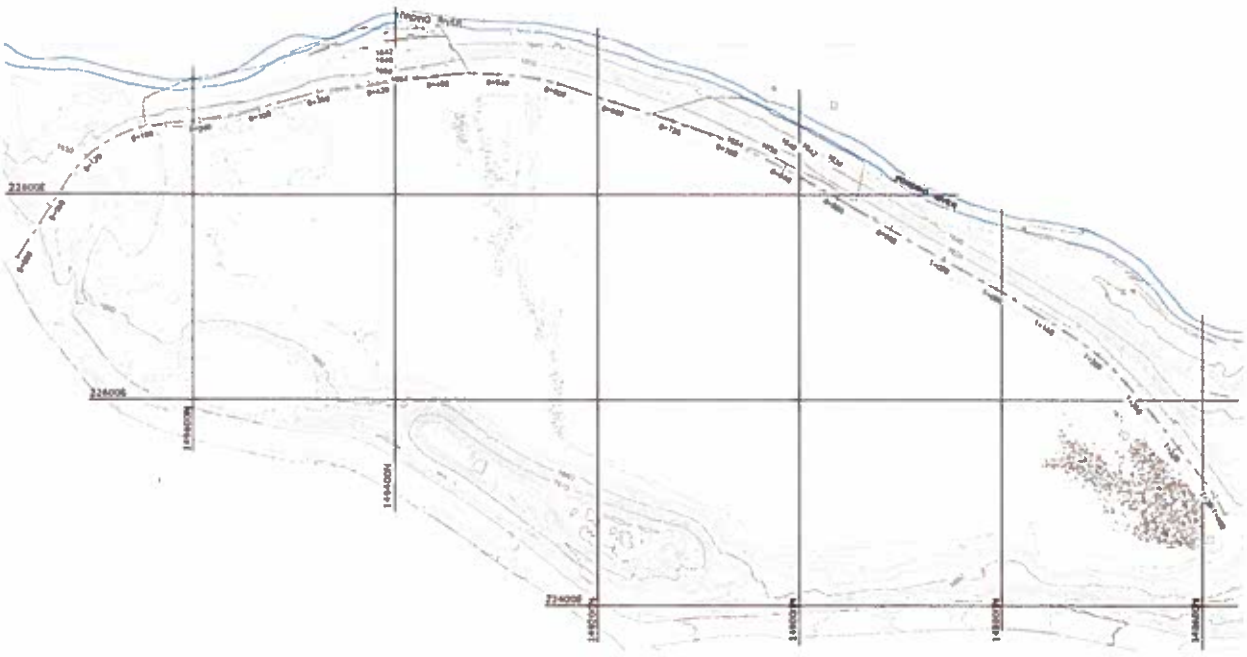
The dam crests, downstream slope, upstream slope, abutments, pipelines, instruments, culverts and other relevant structures shall be inspected. This form does not provide a complete list of potential issues. Details around observations and any other concerns should be noted in the "Additional Comments" section.

Photographs of all structures are required as part of the monthly inspection. The following brief description of areas to inspect. During the inspection, checking "Condition Acceptable" indicates that the relevant items in this section have been reviewed for each structure, and were found to be acceptable.

Item Description	Potential Problems
Piping	Uncontrolled internal erosion of the embankment, resulting in rapid failure of the dam Any signs of piping should be reported immediately, as this is a serious risk to the structural integrity of the dam
Seepage	Increase in volume of flow Turbidity or sediment in the seepage indicates a potential piping issue (internal erosion) Seepage boils – check for sediment transport and flow rates. An increase in the number of boils indicates poor drainage conditions through the embankment
Sinkholes	Generally occurring on the dam crest or slopes, can indicate internal settlement of the embankment
External Erosion	Around, overtop or at the toe of the embankment Heavy rainfall events typically cause substantial erosion on the downstream slopes of earthen/tailings embankments
Cracks	Longitudinal (along the length of the dam) Transverse (across the dam) Cracks should be marked with paint/stakes along the length and survey pins on either side of the crack. These should be surveyed and monitored for
Settlement	Excessive settlement Survey pins should be installed in any new settled areas so that settlement can be tracked over time.
Sloughing / Slides	Heavy rainfall events can cause sloughing of material
Animal Activity	Burrowing vectors can potentially damage the dam Large animal activity (bears, elk, etc.) can pose a safety concern to those working in the area
Excessive growth	Vegetation can hide potential problems on the crest, slopes and toes of the dams. Excessive root infiltration due to vegetation also has the potential of damaging the structural integrity of the dam.
General housekeeping	Excessive debris / waste materials Dusting concerns from the tailings pond or embankment materials Access to the dams (due to snow, poor road conditions, etc.)
Standing water	On the crest or at the toe of the dam. Excessive water can cause increases in the saturation of the embankment fills, reducing the soil strength
Over-steepened slope	Steep slopes can lead to sloughing of material and general dam stability issues
Pipeline conditions	Leaks or holes / tears in the line Damage to the pipelines from passing equipment / snow removal Pipeline leaks on dam crests or slopes will begin to erode the embankment material very quickly, with the potential to develop into a dam breach scenario

NORTH TAILINGS POND

- Minimum crest elevation = 1653.54 m (mine grid UTM)
- Minimum Freeboard = 1.2 m
- Mark any issues on the map below, including tailings wetted perimeter

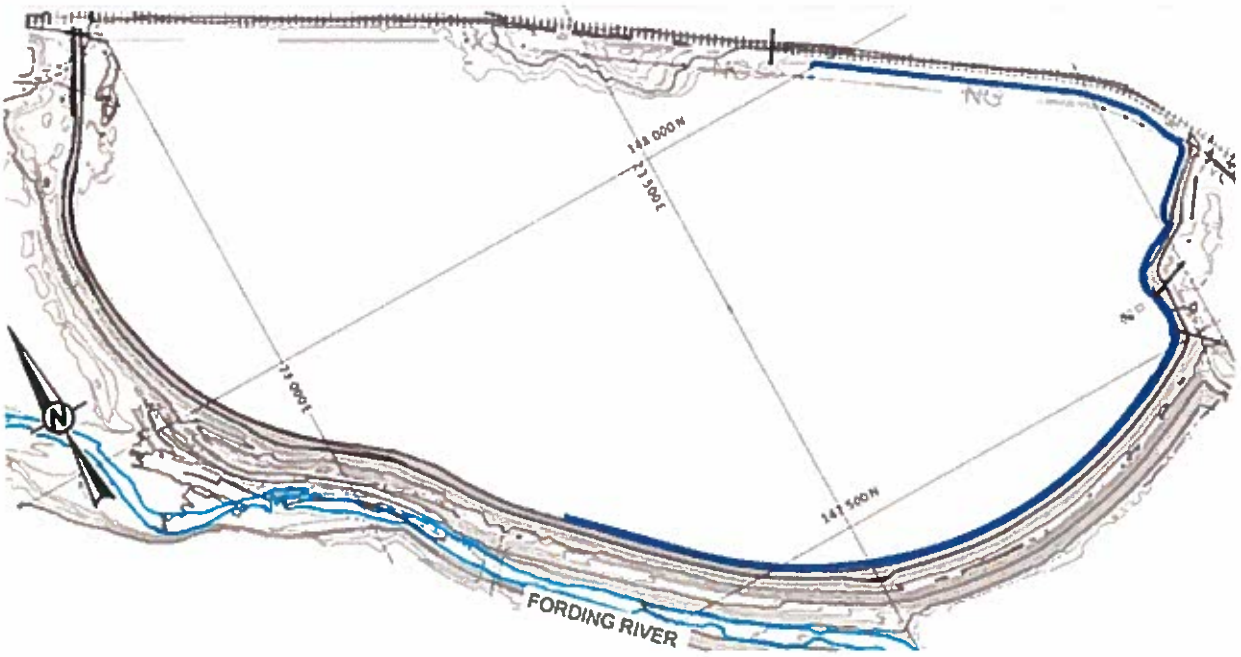


Structure	Condition Acceptable	Comments
North Tailings Pond – Main Embankment		
Access	☐ YES ☑ NO	5
Downstream Toe	☑ YES ☐ NO	
Downstream Slope	☑ YES ☐ NO	
Dam Crest	☑ YES ☐ NO	
East Abutment	☑ YES ☐ NO	
West Abutment	☑ YES ☐ NO	
Rip Rap	☑ YES ☐ NO	
Old Tailings Line	☑ YES ☐ NO	
2013 Main Failure Area	☑ YES ☐ NO	
2013 South Failure Area	☑ YES ☐ NO	
Old Scraper Crossing	☑ YES ☐ NO	
FRNTP2	☑ YES ☐ NO	

Cl. Lines River Crossing	☑ YES ☐ NO	
Cl. Lines inside Pond	☑ YES ☐ NO	
Steep Pipe Crossing	☑ YES ☐ NO	
Black PVC Pipe Crossing	☑ YES ☐ NO	
Barge Infrastructure	☑ YES ☐ NO	
Shandley Bridge	☑ YES ☐ NO	
Prisms (+ take photo)	☑ YES ☐ NO	
General Housekeeping	☑ YES ☐ NO	
Water Level Elevation	1650.22m	surveyed July 5, 2017
Freeboard (m)	3.32 m	
Other Concerns	☐ YES ☑ NO	4
West Abutment Area		
Facilities Dump	☑ YES ☐ NO	
Pond Coal Stockpile	☑ YES ☐ NO	
Shandley Line	☑ YES ☐ NO	
Other Concerns	☑ YES ☐ NO	
Reservoir Area		
North Abutment Area	☑ YES ☐ NO	
Tailings Surface	☑ YES ☐ NO	
Dust Fences	☑ YES ☐ NO	
Tailings Wetted Perimeter	☑ YES ☐ NO	
Other Concerns	☑ YES ☐ NO	
Additional On-going Monitoring (add as required)		

SOUTH TAILINGS POND

- Minimum crest elevation = 1638.30 masl (mine grid UTM)
- Minimum Freeboard = 1.2 m
- Mark any issues on the map below, including tailings wetted perimeter



Structure	Condition Acceptable	Comments
South Tailings Pond – Main Embankment		
Access	☑ YES ☐ NO	
Downstream Toe	☑ YES ☐ NO	1
Downstream Slope	☑ YES ☐ NO	
Dam Crest	☑ YES ☐ NO	
South Abutment	☑ YES ☐ NO	
North Abutment	☑ YES ☐ NO	2
South Abutment Area		
Kilmarnock W	☑ YES ☐ NO	
Kilmarnock E	☑ YES ☐ NO	
Fortis Gasline	☑ YES ☐ NO	
Clarified Line	☑ YES ☐ NO	

Barge & anchors	☑ YES ☐ NO	
Seepage Return Line	☑ YES ☐ NO	
General Housekeeping	☑ YES ☐ NO	6
Water Level Elevation	1636.839m	(~2pm)
Freeboard (m)	1.46m	
Other Concerns	☑ YES ☐ NO	1
Railway Embankment Area		
Blackmore Culverts	☑ YES ☐ NO	
South Loop Culverts	☑ YES ☐ NO	
West & Main Dam Area	☑ YES ☐ NO	
South Seep	☑ YES ☐ NO	
West Seep	☑ YES ☐ NO	7
North Seep	☑ YES ☐ NO	
Dredge Line	☑ YES ☐ NO	
Rip Rap	☑ YES ☐ NO	
Instrumentation		
Piezometers	☑ YES ☐ NO	
GPS Units	☑ YES ☐ NO	3
Slope Inclinometers	☑ YES ☐ NO	
Reservoir Area		
Tailings Surface	☑ YES ☐ NO	1
Tailings Wetted Perimeter	☑ YES ☐ NO	
Flowrates & Totalizers	pump crew/Environment monitors these	
Shandley Flowrate		
Seepage Return Flowrate		
Kilmarnock West		
Kilmarnock East		
Additional On-going Monitoring (add as required)		

ADDITIONAL COMMENTS:

1) Froth on STP is pretty extensive, Environment has already commented they are concerned with birds getting stuck in it.
2) No issues at STP tailings discharge, till berm and sandbags looked fine. No concerns noted on embankment crest or downstream. ML was below the sandbag/berm area
3) Checked GPS 341, no issues noted around the unit or base
4) A large volume of material has been stockpiled on the Liverpool Pad at the north end of NTP. Will inspect with John Cunning (EOR) later this week (he is on site Thursday).
5) Access road to NTP has a lot of large boulders, needs to be cleaned up.
6) Water had ponded in low spot by wastewater cells. Area will be filled in when STP lower road berms are repaired.
7) Red staining observed on rocks by west seep from STP. Check with Environment about water sampler.

8) Coal stockpile is blocking access to 3Pit North, dam can only be viewed from above. However, there is no water in this facility, not a major concern at this time.

9) Seeds have not yet sprouted from the hydroseeding done earlier in the month.

Fording River Operations

Weekly STP Dam Inspection Form

Teck

Inspected By: [redacted]

Inspection Date: August 11, 2017

Weather & Temperature: Partly cloudy, smokey, 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
STP lower access road	Repair berms to 1m and fill hole near wastewater cells (construction in progress today)	3	IN PROGRESS TARGET: AUG 25, 2017
STP	weekly monitoring of GPS 341 ▷send weekly email	4	weekly

as per last week's inspection: inspection item from MEM. complete within 30 days

INSPECTION ITEMS

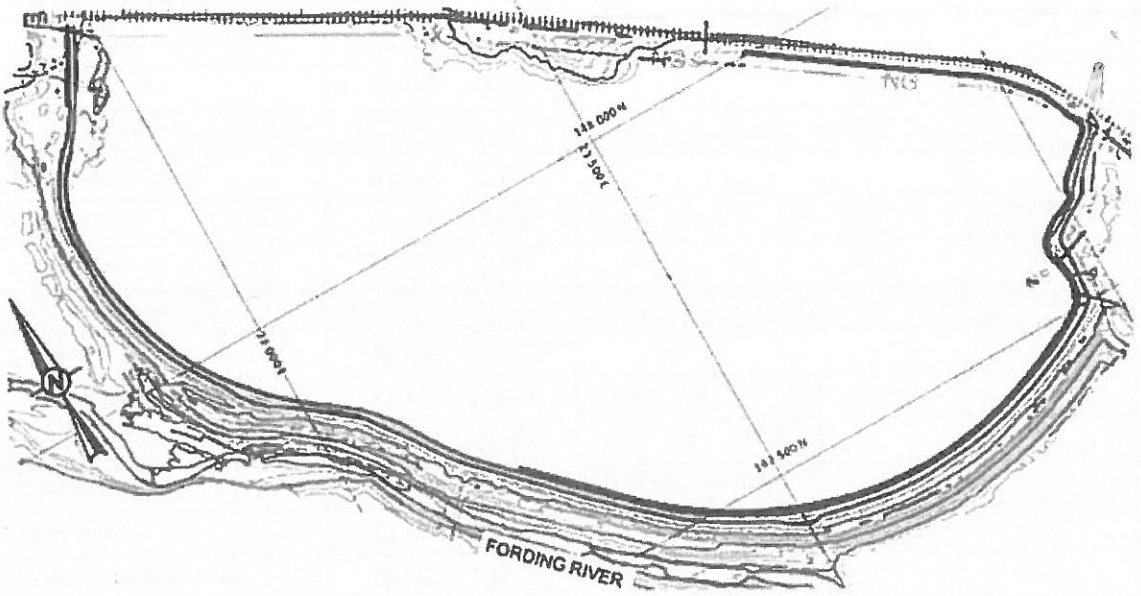
The dam crests, downstream slope, upstream slope, abutments, pipelines, instruments, culverts and other relevant structures shall be inspected. This form does not provide a complete list of potential issues. Details around observations and any other concerns should be noted in the "Additional Comments" section.

Photographs of all structures are required as part of the weekly inspection. The following brief description of areas to inspect. During the inspection, checking "Condition Acceptable" indicates that the relevant items in this section have been reviewed for each structure, and were found to be acceptable.

Item Description	Potential Problems
Piping	Uncontrolled internal erosion of the embankment, resulting in rapid failure of the dam Any signs of piping should be reported immediately, as this is a serious risk to the structural integrity of the dam
Seepage	Increase in volume of flow Turbidity or sediment in the seepage indicates a potential piping issue (internal erosion) Seepage boils – check for sediment transport and flow rates. An increase in the number of boils indicates poor drainage conditions through the embankment
Sinkholes	Generally occurring on the dam crest or slopes, can indicate internal settlement of the embankment
External Erosion	Around, overtop or at the toe of the embankment Heavy rainfall events typically cause substantial erosion on the downstream slopes of earthen/tailings embankments
Cracks	Longitudinal (along the length of the dam) Transverse (across the dam) Cracks should be marked with paint/stakes along the length and survey pins on either side of the crack. These should be surveyed and monitored for
Settlement	Excessive settlement Survey pins should be installed in any new settled areas so that settlement can be tracked over time.
Sloughing / Slides	Heavy rainfall events can cause sloughing of material
Animal Activity	Burrowing vectors can potentially damage the dam Large animal activity (bears, elk, etc.) can pose a safety concern to those working in the area
Excessive growth	Vegetation can hide potential problems on the crest, slopes and toes of the dams. Excessive root infiltration due to vegetation also has the potential of damaging the structural integrity of the dam.
General housekeeping	Excessive debris / waste materials Dusting concerns from the tailings pond or embankment materials Access to the dams (due to snow, poor road conditions, etc.)
Standing water	On the crest or at the toe of the dam. Excessive water can cause increases in the saturation of the embankment fills, reducing the soil strength
Over-steepened slope	Steep slopes can lead to sloughing of material and general dam stability issues
Pipeline conditions	Leaks or holes / tears in the line Damage to the pipelines from passing equipment / snow removal Pipeline leaks on dam crests or slopes will begin to erode the embankment material very quickly, with the potential to develop into a dam breach scenario

SOUTH TAILINGS POND

- Minimum crest elevation = 1638.30 masl (mine grid UTM)
- Minimum Freeboard = 1.2 m
- Mark any issues on the map below, including tailings wetted perimeter



Structure	Condition Acceptable	Comments
South Tailings Pond – Main Embankment		
Access	☑ YES ☐ NO	
Downstream Toe	☑ YES ☐ NO	
Downstream Slope	☑ YES ☐ NO	
Dam Crest	☑ YES ☐ NO	
Upstream Slope	☑ YES ☐ NO	
South Abutment	☑ YES ☐ NO	
North Abutment	☐ YES ☐ NO	
STP Tailings Discharge	☑ YES ☐ NO	
Fortis Gasline	☑ YES ☐ NO	puddle filled in
Till Berm / Sandbag Berm	☑ YES ☐ NO	
South Abutment Area		

Kilmarnock W	☐ YES ☐ NO	not checked
Kilmarnock E	☐ YES ☐ NO	not checked
Fortis Gasline	☑ YES ☐ NO	
Clarified Line	☑ YES ☐ NO	
Barge & anchors	☑ YES ☐ NO	
Seepage Return Line	☑ YES ☐ NO	
General Housekeeping	☑ YES ☐ NO	
Water Level Elevation	~~1637m~~ 1636.8m	
Freeboard (m)	1.5m	
Other Concerns	☐ YES ☑ NO	
Railway Embankment Area		
Blackmore Culverts	☐ YES ☐ NO	not checked
South Loop Culverts	☐ YES ☐ NO	
West & Main Dam Area	☐ YES ☐ NO	
South Seep	☐ YES ☐ NO	✓
West Seep	☑ YES ☐ NO	data taken
North Seep	☑ YES ☐ NO	data taken
Dredge Line	☐ YES ☐ NO	not checked
Rip Rap	☑ YES ☐ NO	
Instrumentation		
Piezometers	☑ YES ☐ NO	
GPS Units	☑ YES ☐ NO	GPS 341 no sign of change
Slope Inclinometers	☑ YES ☐ NO	
Reservoir Area		
Tailings Surface	☑ YES ☐ NO	
Tailings Wetted Perimeter	☑ YES ☐ NO	
Additional On-going Monitoring (add as required)		

ADDITIONAL COMMENTS:

- GPS 341 continues to trend upward in average 3D displacement; however over the last few days displacement has decreased - GPS appears to be unchanged
- water still collected near waste water cells
- signs of erosion / water movement near NLP
- ditches along lower access road containing small amounts of still water
- access road updated by 12:50 from southern end of pond to pipe bride → surface of road is dirt
- seepage and growth by West seep
- embankment of tailings used for ditch work at angle of repose → ditches re-established on toe side of road

Fording River Operations

Weekly STP Dam Inspection Form

Teck

Inspected By: H. Brickner

Inspection Date: Aug. 17/2017

Weather & Temperature: Sunny. 26°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 north abutment area	Water ponded near wastewater cells (north end) No drainage from area	3	

INSPECTION ITEMS

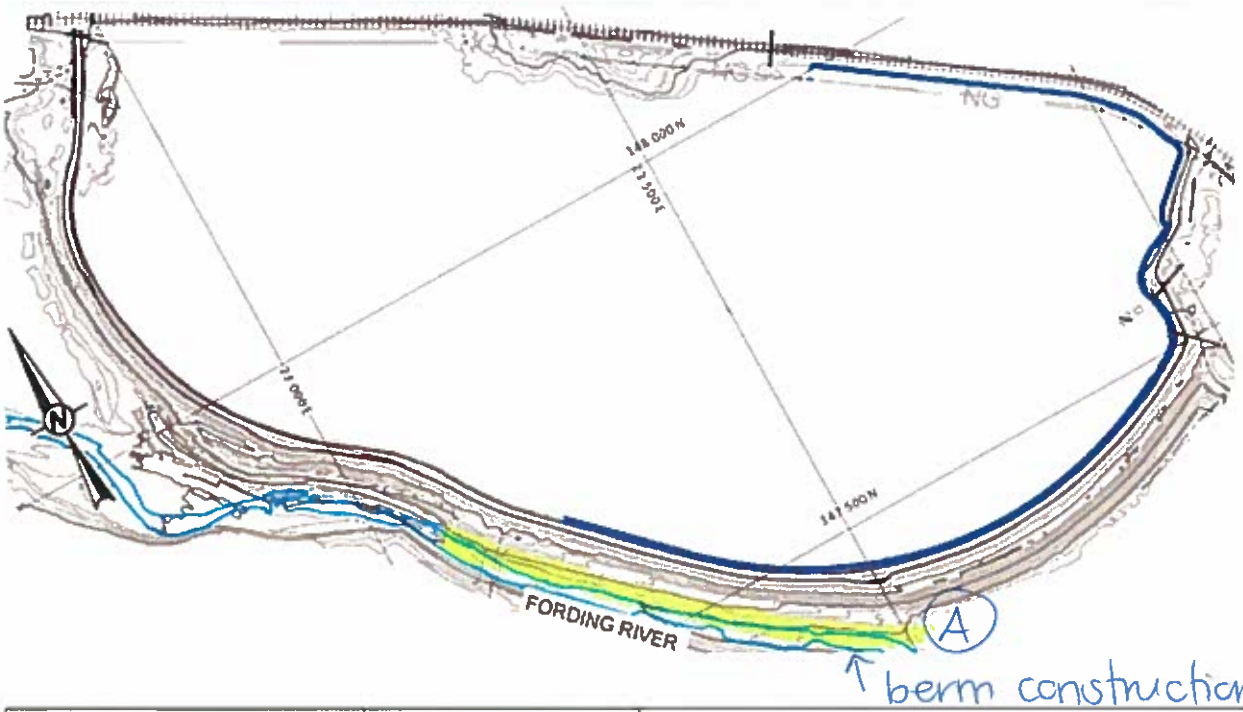
The dam crests, downstream slope, upstream slope, abutments, pipelines, instruments, culverts and other relevant structures shall be inspected. This form does not provide a complete list of potential issues. Details around observations and any other concerns should be noted in the "Additional Comments" section.

Photographs of all structures are required as part of the weekly inspection. The following brief description of areas to inspect. During the inspection, checking "Condition Acceptable" indicates that the relevant items in this section have been reviewed for each structure, and were found to be acceptable.

Item Description	Potential Problems
Piping	Uncontrolled internal erosion of the embankment, resulting in rapid failure of the dam Any signs of piping should be reported immediately, as this is a serious risk to the structural integrity of the dam
Seepage	Increase in volume of flow Turbidity or sediment in the seepage indicates a potential piping issue (internal erosion) Seepage boils – check for sediment transport and flow rates. An increase in the number of boils indicates poor drainage conditions through the embankment
Sinkholes	Generally occurring on the dam crest or slopes, can indicate internal settlement of the embankment
External Erosion	Around, overtop or at the toe of the embankment Heavy rainfall events typically cause substantial erosion on the downstream slopes of earthen/tailings embankments
Cracks	Longitudinal (along the length of the dam) Transverse (across the dam) Cracks should be marked with paint/stakes along the length and survey pins on either side of the crack. These should be surveyed and monitored for
Settlement	Excessive settlement Survey pins should be installed in any new settled areas so that settlement can be tracked over time.
Sloughing / Slides	Heavy rainfall events can cause sloughing of material
Animal Activity	Burrowing vectors can potentially damage the dam Large animal activity (bears, elk, etc.) can pose a safety concern to those working in the area
Excessive growth	Vegetation can hide potential problems on the crest, slopes and toes of the dams. Excessive root infiltration due to vegetation also has the potential of damaging the structural integrity of the dam.
General housekeeping	Excessive debris / waste materials Dusting concerns from the tailings pond or embankment materials Access to the dams (due to snow, poor road conditions, etc.)
Standing water	On the crest or at the toe of the dam. Excessive water can cause increases in the saturation of the embankment fills, reducing the soil strength
Over-steepened slope	Steep slopes can lead to sloughing of material and general dam stability issues
Pipeline conditions	Leaks or holes / tears in the line Damage to the pipelines from passing equipment / snow removal Pipeline leaks on dam crests or slopes will begin to erode the embankment material very quickly, with the potential to develop into a dam breach scenario

SOUTH TAILINGS POND

- Minimum crest elevation = 1638.30 masl (mine grid UTM)
- Minimum Freeboard = 1.2 m
- Mark any issues on the map below, including tailings wetted perimeter



Structure	Condition Acceptable	Comments
South Tailings Pond – Main Embankment		
Access	☑ YES ☐ NO	
Downstream Toe	☑ YES ☐ NO	
Downstream Slope	☑ YES ☐ NO	1, 2
Dam Crest	☑ YES ☐ NO	4 Concern noted.
Upstream Slope	☑ YES ☐ NO	
South Abutment	☑ YES ☐ NO	
North Abutment	☑ YES ☐ NO	
STP Tailings Discharge	☑ YES ☐ NO	
Fortis Gasline	☑ YES ☐ NO	
Till Berm / Sandbag Berm	☑ YES ☐ NO	3
South Abutment Area		

Kilmarnock W	☑ YES ☐ NO	
Kilmarnock E	☑ YES ☐ NO	
Fortis Gasline	☑ YES ☐ NO	
Clarified Line	☑ YES ☐ NO	
Barge & anchors	☑ YES ☐ NO	
Seepage Return Line	☑ YES ☐ NO	
General Housekeeping	☑ YES ☐ NO	
Water Level Elevation	1636.78 m	
Freeboard (m)	1.52m	
Other Concerns	☑ YES ☐ NO	
Railway Embankment Area		
Blackmore Culverts	☑ YES ☐ NO	
South Loop Culverts	☑ YES ☐ NO	
West & Main Dam Area	☑ YES ☐ NO	
South Seep	☑ YES ☐ NO	
West Seep	☑ YES ☐ NO	
North Seep	☑ YES ☐ NO	
Dredge Line	☑ YES ☐ NO	
Rip Rap	☑ YES ☐ NO	
Instrumentation		
Piezometers	☑ YES ☐ NO	
GPS Units	☑ YES ☐ NO	
Slope Inclinometers	☑ YES ☐ NO	
Reservoir Area		
Tailings Surface	☑ YES ☐ NO	
Tailings Wetted Perimeter	☑ YES ☐ NO	
Additional On-going Monitoring (add as required)		
none.		
GPS 341 data		

ADDITIONAL COMMENTS:

1) Ditches along the lower road on the west embankment/West Dam have been cleared out and re-graded. A small swale was constructed at southwest corner to facilitate drainage from the ditches (allow it to run-off and not pond). Refer to approximate location at "A"

2) Berms alongouter edge of West Dam lower road (STP) were also completed. This was a request by MEM geotechnical inspectors (on site July 25). Berm construction shown in yellow on map (approx.)

3) Till berm and tailings discharge area inspected, no issues noted. Road/crest and DS slope (maxam side) had no issues. Water at discharge location was below "lip" of tailings, not against sandbag/till berm. Refer to photos.

4) Some water (more than has been seen previously) was ponded in the low area near WW cells and STP tailings discharge. Transcendent had been asked to fill this area in, but drainage still an issue. Water accumulation likely due to precip, will check area again early next week.

Fording River Operations

Weekly STP Dam Inspection Form

Teck

Inspected By: H. Brickner

Inspection Date: Aug. 24/2017

Weather & Temperature: 21°C, mostly 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
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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 end)	Inspect emergency riprap stockpile to determine if it's usable (w/ KWL)	2	Aug. 31, 2017

INSPECTION ITEMS

The dam crests, downstream slope, upstream slope, abutments, pipelines, instruments, culverts and other relevant structures shall be inspected. This form does not provide a complete list of potential issues. Details around observations and any other concerns should be noted in the "Additional Comments" section.

Photographs of all structures are required as part of the weekly inspection. The following brief description of areas to inspect. During the inspection, checking "Condition Acceptable" indicates that the relevant items in this section have been reviewed for each structure, and were found to be acceptable.

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Pipeline conditions	Leaks or holes / tears in the line Damage to the pipelines from passing equipment / snow removal Pipeline leaks on dam crests or slopes will begin to erode the embankment material very quickly, with the potential to develop into a dam breach scenario

SOUTH TAILINGS POND

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- Minimum Freeboard = 1.2 m
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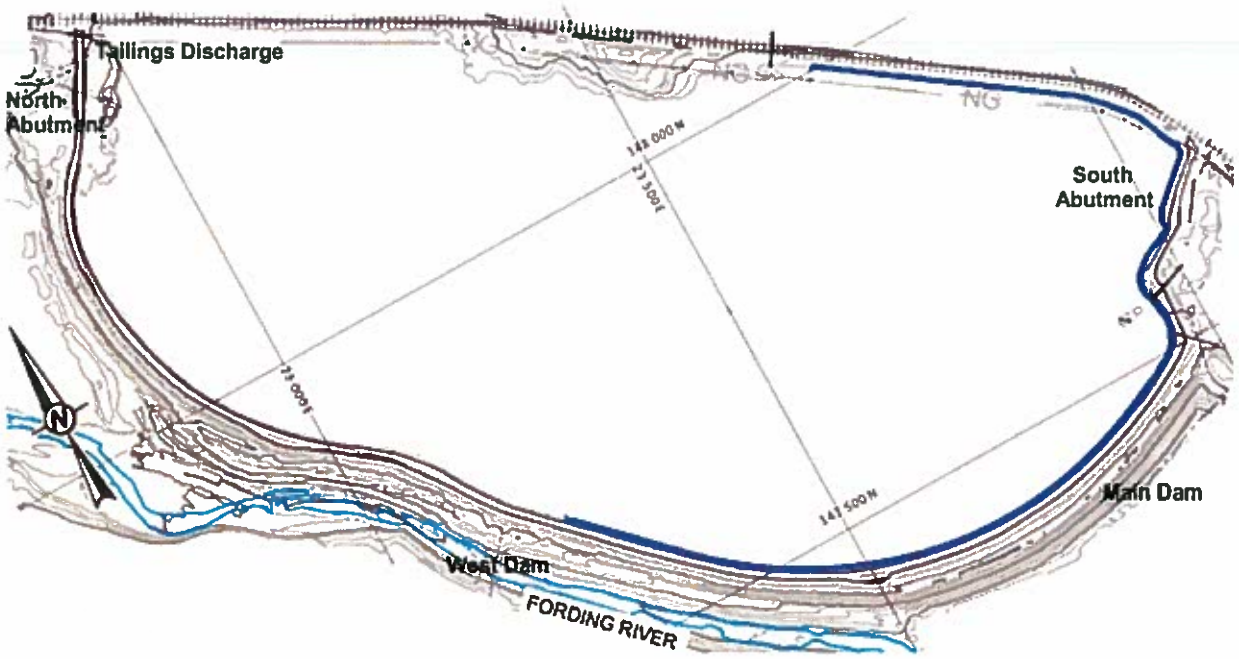


Structure	Condition Acceptable	Comments
West Dam & North Abutment Area		
Access	☑ YES ☐ NO	train in the loop
Downstream Toe	☑ YES ☐ NO	
Downstream Slope	☑ YES ☐ NO	
Dam Crest	☑ YES ☐ NO	
Upstream Slope	☑ YES ☐ NO	
West Seep	☑ YES ☐ NO	
North Seep	☑ YES ☐ NO	
Lower Road (ditches/berms)	☑ YES ☐ NO	
North Abutment	☑ YES ☐ NO	1, 4, 5
STP Tailings Discharge	☑ YES ☐ NO	
FortisBC Gasline	☑ YES ☐ NO	
Tailings Line	☑ YES ☐ NO	
Shandley Line	☑ YES ☐ NO	
Till Berm / Sandbag Berm	☑ YES ☐ NO	

General Housekeeping	☑ YES ☐ NO	
Main Embankment & South Abutment Area		
Access	☑ YES ☐ NO	
Downstream Toe	☑ YES ☐ NO	
Downstream Slope	☑ YES ☐ NO	
Dam Crest	☑ YES ☐ NO	
Upstream Slope	☑ YES ☐ NO	
South Seep	☑ YES ☐ NO	
Kilmarnock W Line	☑ YES ☐ NO	
Kilmarnock E Line	☑ YES ☐ NO	
South Abutment	☑ YES ☐ NO	
FortisBC Gasline	☑ YES ☐ NO	
Clarified Line	☑ YES ☐ NO	
Barge & anchors	☑ YES ☐ NO	
Seepage Return Line	☑ YES ☐ NO	
General Housekeeping	☑ YES ☐ NO	4
Water Level Elevation	1636.94m	
Freeboard (m)	1.36m	good.
Railway Embankment Area		
Blackmore Culverts	☑ YES ☐ NO	
South Loop Culverts	☑ YES ☐ NO	
Dredge Line	☑ YES ☐ NO	
Rip Rap	☑ YES ☐ NO	
Instrumentation		
Piezometers	☑ YES ☐ NO	
GPS Units	☑ YES ☐ NO	3
Slope Inclinometers	☑ YES ☐ NO	
Reservoir Area		
Tailings Surface	☑ YES ☐ NO	
Tailings Wetted Perimeter	☑ YES ☐ NO	
Additional On-going Monitoring (add as required)		
check GPS 341	✓	see comment 3, attached data

ADDITIONAL COMMENTS:

1) Some fairly extensive dusting was seen at the STP tailings discharge, wind was strong with lots of gusts. Refer to photos and videos.
2) Inspected emergency riprap stockpile at the south end of STP (nr. Main Dam), as I had been told by a contractor (Transcendent) that it was no longer suitable to put in river due to weathering. I could not see evidence of weathering, will inspect with Jason Miller from KWL when he's on site next week.
3) Checked GPS 341 (it had been the unit with the upward trend). Could not see any evidence of movement on the unit or in the surrounding area. Will check data for trends again (see attached).
4) Noticed that Environment has installed a propane banger at south abutment. Received no notification from them. Checked with Erika and they told her they plan to install 3 additional bangers. Will I email and ask that they notify me if they are doing any work on the dams.*
5) Wet area near WW cells was much drier than earlier in the week. Still need drainage plan.

* Update Aug 25/2017: [redacted] said he'd installed in 2 more on Main Dam and one near WW cells. Said he would notify me in future of any work.

Fording River Operations

Monthly Tailings Dam Inspection Form

Teck

Inspected By: H. Brickner

Inspection Date: Aug. 29/2017 & Aug 31/2017

Weather & Temperature: sunny/smokey, 30°C & 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
	no items.		

INSPECTION ITEMS

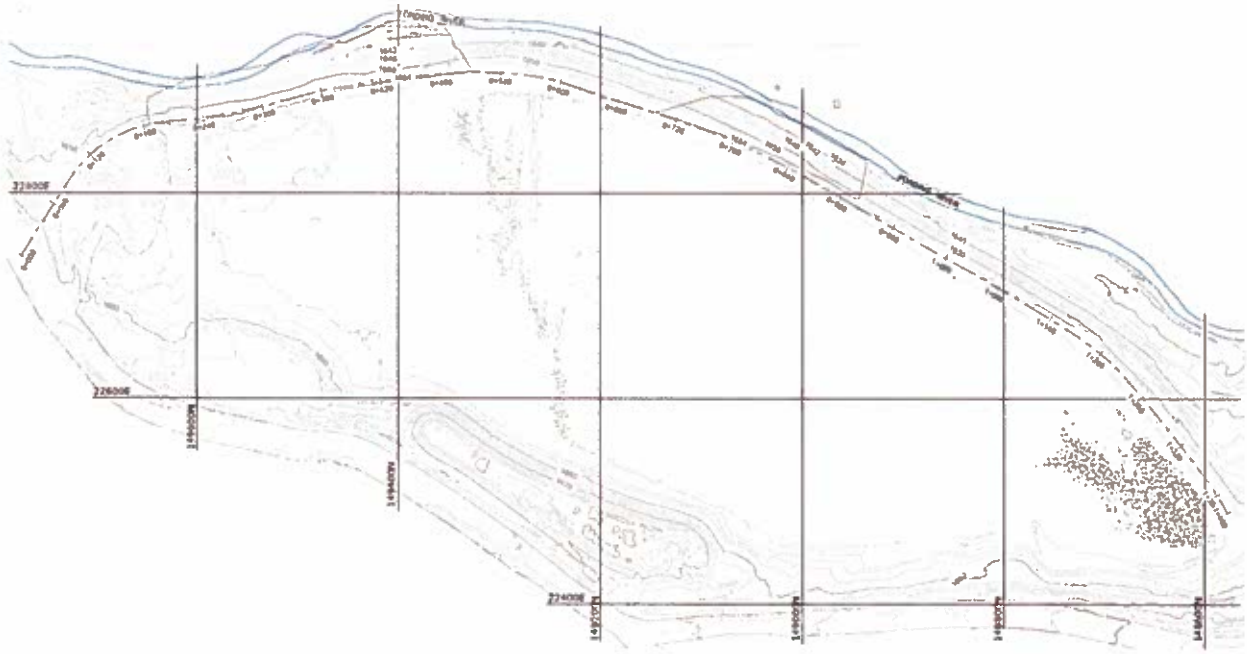
The dam crests, downstream slope, upstream slope, abutments, pipelines, instruments, culverts and other relevant structures shall be inspected. This form does not provide a complete list of potential issues. Details around observations and any other concerns should be noted in the "Additional Comments" section.

Photographs of all structures are required as part of the monthly inspection. The following brief description of areas to inspect. During the inspection, checking "Condition Acceptable" indicates that the relevant items in this section have been reviewed for each structure, and were found to be acceptable.

Item Description	Potential Problems
Piping	Uncontrolled internal erosion of the embankment, resulting in rapid failure of the dam Any signs of piping should be reported immediately, as this is a serious risk to the structural integrity of the dam
Seepage	Increase in volume of flow Turbidity or sediment in the seepage indicates a potential piping issue (internal erosion) Seepage boils – check for sediment transport and flow rates. An increase in the number of boils indicates poor drainage conditions through the embankment
Sinkholes	Generally occurring on the dam crest or slopes, can indicate internal settlement of the embankment
External Erosion	Around, overtop or at the toe of the embankment Heavy rainfall events typically cause substantial erosion on the downstream slopes of earthen/tailings embankments
Cracks	Longitudinal (along the length of the dam) Transverse (across the dam) Cracks should be marked with paint/stakes along the length and survey pins on either side of the crack. These should be surveyed and monitored for
Settlement	Excessive settlement Survey pins should be installed in any new settled areas so that settlement can be tracked over time.
Sloughing / Slides	Heavy rainfall events can cause sloughing of material
Animal Activity	Burrowing vectors can potentially damage the dam Large animal activity (bears, elk, etc.) can pose a safety concern to those working in the area
Excessive growth	Vegetation can hide potential problems on the crest, slopes and toes of the dams. Excessive root infiltration due to vegetation also has the potential of damaging the structural integrity of the dam.
General housekeeping	Excessive debris / waste materials Dusting concerns from the tailings pond or embankment materials Access to the dams (due to snow, poor road conditions, etc.)
Standing water	On the crest or at the toe of the dam. Excessive water can cause increases in the saturation of the embankment fills, reducing the soil strength
Over-steepened slope	Steep slopes can lead to sloughing of material and general dam stability issues
Pipeline conditions	Leaks or holes / tears in the line Damage to the pipelines from passing equipment / snow removal Pipeline leaks on dam crests or slopes will begin to erode the embankment material very quickly, with the potential to develop into a dam breach scenario

NORTH TAILINGS POND

- Minimum crest elevation = 1653.54 m (mine grid UTM)
- Minimum Freeboard = 1.2 m
- Mark any issues on the map below, including tailings wetted perimeter

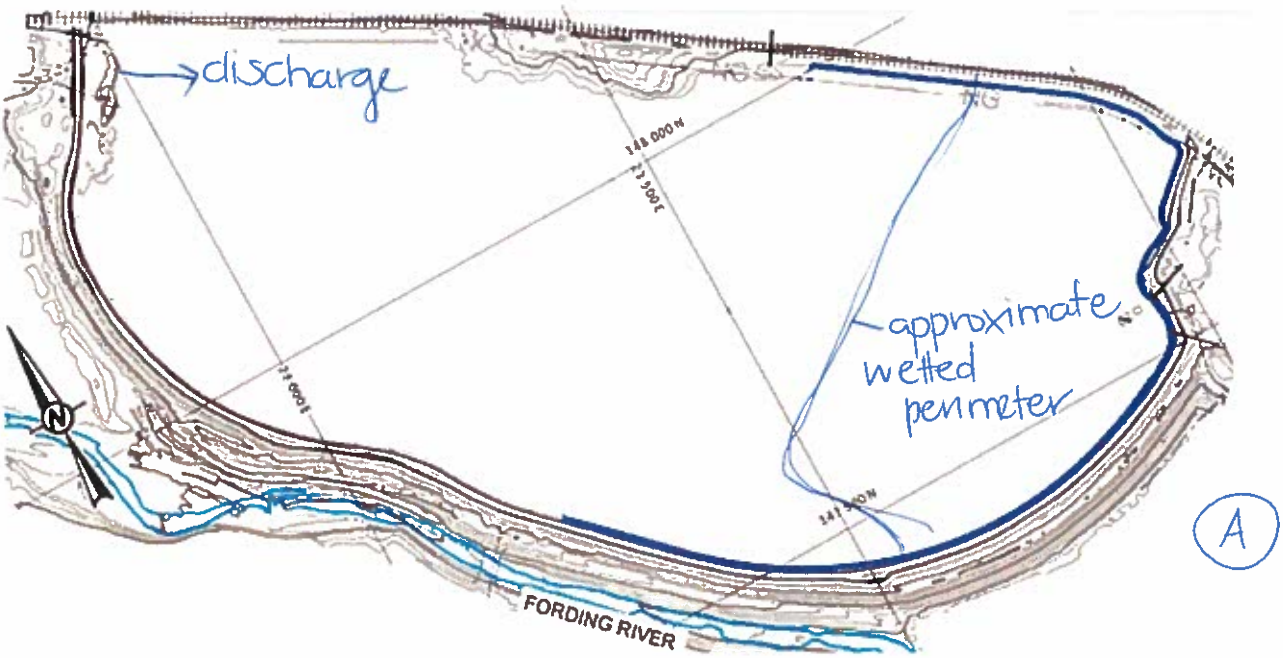


Structure	Condition Acceptable	Comments
North Tailings Pond – Main Embankment		
Access	☑ YES ☐ NO	
Downstream Toe	☑ YES ☐ NO	
Downstream Slope	☑ YES ☐ NO	
Dam Crest	☑ YES ☐ NO	
East Abutment	☑ YES ☐ NO	
West Abutment	☑ YES ☐ NO	
Rip Rap	☑ YES ☐ NO	
Old Tailings Line	☑ YES ☐ NO	
2013 Main Failure Area	☑ YES ☐ NO	
2013 South Failure Area	☑ YES ☐ NO	
Old Scraper Crossing	☑ YES ☐ NO	
FRNTP2	☑ YES ☐ NO	

Cl. Lines River Crossing	☑ YES ☐ NO	
Cl. Lines inside Pond	☑ YES ☐ NO	
Steep Pipe Crossing	☑ YES ☐ NO	
Black PVC Pipe Crossing	☑ YES ☐ NO	
Barge Infrastructure	☑ YES ☐ NO	
Shandley Bridge	☑ YES ☐ NO	
Prisms (+ take photo)	☑ YES ☐ NO	
General Housekeeping	☑ YES ☐ NO	~~10~~ 11.
Water Level Elevation	1650.0m	monthly survey Aug. 10
Freeboard (m)	3.54m	
Other Concerns	☑ YES ☐ NO	6
West Abutment Area		
Facilities Dump	☑ YES ☐ NO	
Pond Coal Stockpile	☑ YES ☐ NO	
Shandley Line	☑ YES ☐ NO	
Other Concerns	☑ YES ☐ NO	
Reservoir Area		
North Abutment Area	☑ YES ☐ NO	
Tailings Surface	☑ YES ☐ NO	
Dust Fences	☑ YES ☐ NO	
Tailings Wetted Perimeter	☑ YES ☐ NO	
Other Concerns	☑ YES ☐ NO	
Additional On-going Monitoring (add as required)		
Monitor drainage to NTP from Liverpool Pond system	✓	no concerns.

SOUTH TAILINGS POND

- Minimum crest elevation = 1638.30 masl (mine grid UTM)
- Minimum Freeboard = 1.2 m
- Mark any issues on the map below, including tailings wetted perimeter



Structure	Condition Acceptable	Comments
West Dam & North Abutment Area		
Access	☑ YES ☐ NO	
Downstream Toe	☑ YES ☐ NO	
Downstream Slope	☑ YES ☐ NO	
Dam Crest	☑ YES ☐ NO	
Upstream Slope	☑ YES ☐ NO	
West Seep	☑ YES ☐ NO	
North Seep	☑ YES ☐ NO	
Lower Road (ditches/berms)	☑ YES ☐ NO	
North Abutment	☑ YES ☐ NO	
STP Tailings Discharge	☑ YES ☐ NO	2
FortisBC Gasline	☑ YES ☐ NO	
Tailings Line	☑ YES ☐ NO	4 3
Shandley Line	☑ YES ☐ NO	

A - emergency riprap stockpile

Till Berm / Sandbag Berm	☑ YES ☐ NO	2
General Housekeeping	☑ YES ☐ NO	12
Main Embankment & South Abutment Area		
Access	☑ YES ☐ NO	
Downstream Toe	☑ YES ☐ NO	
Downstream Slope	☑ YES ☐ NO	
Dam Crest	☑ YES ☐ NO	
Upstream Slope	☑ YES ☐ NO	
South Seep	☑ YES ☐ NO	
Kilmarnock W Line	☑ YES ☐ NO	
Kilmarnock E Line	☑ YES ☐ NO	
South Abutment	☑ YES ☐ NO	
FortisBC Gasline	☑ YES ☐ NO	
Clarified Line	☑ YES ☐ NO	
Barge & anchors	☑ YES ☐ NO	
Seepage Return Line	☑ YES ☐ NO	
General Housekeeping	☑ YES ☐ NO	5 3
Water Level Elevation	1636.70m	Aug. 31/2017
Freeboard (m)	1.6m	
Railway Embankment Area		
Blackmore Culverts	☑ YES ☐ NO	
South Loop Culverts	☑ YES ☐ NO	
Dredge Line	☑ YES ☐ NO	
Rip Rap	☑ YES ☐ NO	
Instrumentation		
Piezometers	☑ YES ☐ NO	
GPS Units	☑ YES ☐ NO	checked 341, 10.
Slope Inclinometers	☑ YES ☐ NO	
Reservoir Area		
Tailings Surface	☑ YES ☐ NO	
Tailings Wetted Perimeter	☑ YES ☐ NO	
Additional On-going Monitoring (add as required)		

ADDITIONAL COMMENTS:

6) No issues at NTP. Riprap construction along the river bank began Aug. 29, KWL on site for this work.
7) No issues at Turnbull TSF, dredging is on-going.
8) Inspected Henretta culvert crossing, water level remains low in the creek. Hydroseeding does not seem to have been successful, no vegetation.
9) No issues at 3Pit North and South embankments. Will have to consider how to access 3Pit South embankment for annual DSI. Accessible on foot only.
10) GPS unit 341 data was reviewed for the past 2 months, attached.
11) Liverpool Pad (NTP) - Swift project will be removing most of the good till material for other projects. Rass checked the area, it is too small (less than 30m) to be considered a spoil, no additional monitoring is required (as a spoil). Pile is ~10m
12) Area near WW cells has dried up. Will have Transcendent fix this when STP upstream riprap is done.

1) Pump secondary containment is slowly filling with water (one drip).
2) Area at STP discharge and till berm inspected, no issues. Water level is lower than the base of the berm.
3) Leak has been repaired (Standley line through South Embankment). No concerns noted with the tailings line.
4) Consulting engineers from Norwest are on site Aug. 31 to collect some samples from STP discharge and Turnbull TSF dredge line. Environment personnel will be assisting them with sampling (there are sampling ports in both lines). Project Engineering and Terrapure (dredge company) are also aware of the sampling.
5) Jason Miller (KWL) on site, provided comments on the quality/durability of the rock in the STP emergency riprap stockpile. He said it was not suitable for long-term use in Fording River. Swift project team is considering using it for a rock drain, and replacing the riprap with better quality material.

APPENDIX E

Water Quality Data

Appendix E:
Water Quality Data

		Location	FR_STPBARGE	FR_STPBARGE	FR_STPBARGE	FR_STPBARGE	FR_STPBARGE	FR_STPBARGE	FR_STPBARGE	FR_STPBARGE
		Date	15/09/2016	28/11/2016	28/11/2016	13/06/2017	04/07/2017	12/07/2017	18/07/2017	27/07/2017
		Sample Type	NP	NP	FD	NP	NP	N	N	N
Fraction	Analyte	Unit	Result	Result	Result	Result	Result	Result	Result	Result
D	ALUMINUM	mg/l	0.0045	0.0036	0.0034	0.0042	0.0047	0.0048	0.0040	0.0034
D	ANTIMONY	mg/l	0.00297	0.00454	0.00451	0.00332	0.00296	0.00413	0.00311	0.00315
D	ARSENIC	mg/l	0.00059	0.00054	0.00059	0.00095	0.00066	0.00080	0.00060	0.00068
D	BARIUM	mg/l	0.104	0.127	0.133	0.135	0.0819	0.103	0.0828	0.0707
D	BERYLLIUM	mg/l	< 0.000020	< 0.000020	< 0.000020	< 0.000020	< 0.000020	< 0.000020	< 0.000020	< 0.000020
D	BISMUTH	mg/l	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050
D	BORON	mg/l	0.028	0.026	0.026	0.026	0.026	0.030	0.025	0.028
D	BROMIDE	mg/l	< 0.25	< 0.25	< 0.25	< 0.050	0.051	0.083	< 0.25	< 0.25
D	CADMIUM	mg/l	0.000215	0.000678	0.000710	0.000549	0.000458	0.000587	0.000363	0.000300
D	CALCIUM	mg/l	121	141	143	95.1	109	104	108	112
D	CARBON, DISSOLV	mg/l	0.51	0.53	< 0.50	1.28	1.16	1.95	1.54	1.74
D	CHLORIDE	mg/l	3.69	5.00	5.02	2.35	4.49	6.00	2.8	3.4
D	CHROMIUM	mg/l	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
D	COBALT	mg/l	0.00161	0.00295	0.00305	0.00178	0.00145	0.00220	0.00147	0.00143
D	COPPER	mg/l	0.00063	0.00122	0.00106	0.00083	0.00061	0.00077	0.00070	0.00077
D	FLUORIDE	mg/l	0.43	0.48	0.49	0.427	0.526	0.649	0.32	0.37
D	IRON	mg/l	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
D	LEAD	mg/l	0.000050	0.000128	0.000130	0.000143	0.000110	0.000140	0.000080	0.000077
D	LITHIUM	mg/l	0.0713	0.0903	0.0932	0.0629	0.0602	0.0710	0.0632	0.0617
D	MAGNESIUM	mg/l	70.8	72.3	74.6	56.5	63.0	61.3	63.2	70.2
D	MANGANESE	mg/l	0.0548	0.109	0.114	0.0791	0.0539	0.0738	0.0414	0.0428
D	MERCURY	mg/l	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050
D	MOLYBDENUM	mg/l	0.0179	0.0304	0.0303	0.0203	0.0172	0.0282	0.0191	0.0179
D	NICKEL	mg/l	0.00820	0.0125	0.0131	0.00535	0.00591	0.00551	0.00737	0.00706
D	POTASSIUM	mg/l	6.32	7.19	7.51	5.25	5.39	6.95	5.71	5.35
D	SELENIUM	ug/l	73.6	81.3	82.7	54.8	59	55.5	65.6	73.5
D	SILICON	mg/l	2.06	1.95	2.02	1.86	1.86	2.07	2.04	1.96
D	SILVER	mg/l	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010
D	SODIUM	mg/l	4.98	7.00	7.34	4.71	3.98	4.42	3.66	4.10
D	STRONTIUM	mg/l	0.208	0.243	0.246	0.176	0.217	0.242	0.204	0.207
D	SULFATE (AS SO4)	mg/l	298	377	376	236	254	256	261	282
D	THALLIUM	mg/l	0.000042	0.000053	0.000051	0.000039	< 0.000010	0.000072	0.000049	0.000052
D	TIN	mg/l	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
D	TITANIUM	mg/l	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
D	URANIUM	mg/l	0.0111	0.0162	0.0161	0.00836	0.00952	0.0109	0.00929	0.00987
D	VANADIUM	mg/l	0.00143	0.00190	0.00202	0.00081	0.00108	0.00126	0.00092	0.00118
D	ZINC	mg/l	0.0032	0.0257	0.0281	0.0074	0.0054	0.0044	0.0055	0.0061
N	ACIDITY TO pH 8.3	mg/l	2.4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	2.2	1.8
N	ALKALINITY, BICAR	mg/l	243	243	254	220	237	261	340	256
N	ALKALINITY, CARB	mg/l	< 1.0	6.6	< 1.0	11.6	14.8	10.0	< 1.0	< 1.0
N	ALKALINITY, HYDR	mg/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N	ALKALINITY, TOTAI	mg/l	243	249	254	231	252	271	340	256
N	Cation - Anion Balan	%				-2.3	-1.7	-4.6	-10.3	-2.9
N	CONDUCTIVITY, FI	us/cm		1094						
N	CONDUCTIVITY, LA	us/cm	1100	1240	1240	876	987	949	1000	1010
N	DISSOLVED OXYGI	mg/l		9.21						
N	DISSOLVED OXYGI	%		67.0						
N	Hardness, Total or D	mg/l	595	650	663	470	532	511	531	570
N	ION BALANCE	%	-1.7	-3.8	-3.0					
N	MAJOR ANION SUM	meq/l	12.7	14.7	14.8	10.2	11.4	11.7	13.5	12.4
N	MAJOR CATION SU	meq/l	12.3	13.6	13.9	9.79	11.0	10.6	10.9	11.7
N	NITRATE NITROGE	mg/l	21.5	23.4	23.4	8.41	12.3	9.76	15.7	18.4
N	NITRITE NITROGEN	mg/l	0.266	0.421	0.418	0.275	0.200	0.446	0.316	0.292
N	NITROGEN, AMMO	mg/l	0.745	1.88	1.98	0.796	0.76	0.92	0.503	0.673
N	ORTHO-PHOSPHAT	mg/l	< 0.0010	< 0.0010	< 0.0010	0.0284	0.0183	0.0214	0.0076	< 0.0010
N	OXIDATION-REDUC	mv		-28.5						
N	OXIDATION-REDUC	mv	302	318	315	458	299	293	300	342
N	pH, Field	ph units		8.14						
N	pH, LAB	ph units	8.19	8.31	8.28	8.36	8.37	8.32	8.23	8.07
N	PHOSPHORUS	mg/l	0.0099	0.0185	0.0222	0.0871	0.0475	0.0387	0.0429	0.0322
N	TEMPERATURE, FI	deg c		2.4						
N	TOTAL DISSOLVED	mg/l	820	908	925	604	718	710	691	680
N	TOTAL KJELDAHL N	mg/l	1.22	2.44	2.77	2.03	1.97	1.37	1.18	1.56
N	TOTAL SUSPENDE	mg/l	17.5	22.0	20.9	22.3	47.4	28.5	45.3	144
N	TURBIDITY, LAB	ntu	10.8	15.9	14.9	12.8	31.2	27.4	32.3	129
T	ALUMINUM	mg/l	0.0287	0.0346	0.0285	0.0288	0.0409	0.0222	0.0405	0.051
T	ANTIMONY	mg/l	0.00309	0.00477	0.00464	0.00329	0.00289	0.00397	0.00306	0.00301
T	ARSENIC	mg/l	0.00057	0.00061	0.00061	0.00101	0.00073	0.00077	0.00078	0.00072
T	BARIUM	mg/l	0.107	0.138	0.137	0.135	0.0864	0.105	0.0867	0.0801
T	BERYLLIUM	mg/l	< 0.000020	< 0.000020	< 0.000020	< 0.000020	< 0.000020	< 0.000020	< 0.000020	< 0.00010
T	BISMUTH	mg/l	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.00025
T	BORON	mg/l	0.028	0.028	0.027	0.025	0.025	0.032	0.026	< 0.050
T	CADMIUM	mg/l	0.000252	0.000756	0.000763	0.000577	0.000442	0.000560	0.000473	0.000402
T	CALCIUM	mg/l	119	147	147	91.6	105	102	109	115
T	CHROMIUM	mg/l	0.00014	0.00067	0.00033	0.00010	0.00011	< 0.00010	0.00016	< 0.00050
T	COBALT	mg/l	0.00152	0.00321	0.00315	0.00183	0.00148	0.00223	0.00161	0.00158
T	COPPER	mg/l	0.00121	0.00169	0.00149	0.00121	0.00101	0.00112	0.00118	< 0.0025
T	IRON	mg/l	0.021	0.040	0.026	0.029	0.056	0.027	0.137	0.072
T	LEAD	mg/l	0.000111	0.000258	0.000208	0.000236	0.000264	0.000238	0.000319	0.00030
T	LITHIUM	mg/l	0.0735	0.0934	0.0929	0.0591	0.0594	0.0696	0.0619	0.0630
T	MAGNESIUM	mg/l	60.7	76.0	76.4	57.0	63.1	60.2	62.6	72.1
T	MANGANESE	mg/l	0.0518	0.120	0.118	0.0835	0.0526	0.0772	0.0499	0.0564
T	MERCURY	mg/l	< 0.000025	< 0.0000050	< 0.0000050	< 0.0000050	< 0.000025	< 0.000050	< 0.0000050	< 0.000025
T	MOLYBDENUM	mg/l	0.0172	0.0317	0.0314	0.0202	0.0176	0.0284	0.0192	0.0180
T	NICKEL	mg/l	0.00757	0.0134	0.0136	0.00651	0.00645	0.00574	0.00772	0.0076
T	POTASSIUM	mg/l	5.32	7.56	7.80	5.12	5.20	6.78	5.49	5.50
T	SELENIUM	ug/l	68.7	82.6	79.8	53.9	57.9	51	62.3	66.3
T	SILICON	mg/l	2.06	2.14	2.09	1.89	1.94	2.14	2.06	2.01
T	SILVER	mg/l	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000050
T	SODIUM	mg/l	4.59	7.44	7.53	4.72	3.83	4.37	3.58	3.99
T	STRONTIUM	mg/l	0.197	0.256	0.254	0.174	0.213	0.243	0.200	0.206
T	THALLIUM	mg/l	0.000044	0.000056	0.000054	0.000044	0.000050	0.000073	0.000052	0.000053
T	TIN	mg/l	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00050
T	TITANIUM	mg/l	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
T	TOTAL ORGANIC C	mg/l	5.89	8.58	8.57	9.99	28.7	6.81	31.3	28.6
T	URANIUM	mg/l	0.0100	0.0164	0.0162	0.00874	0.00968	0.0114	0.00909	0.00945
T	VANADIUM	mg/l	0.00169	0.00235	0.00232	0.00152	0.00155	0.00151	0.00167	< 0.0025
T	ZINC	mg/l	0.0056	0.0314	0.0236	0.0076	0.0065	0.0045	0.0095	< 0.015

Appendix E:
Water Quality Data

		Location	FR_STPNSEEP	FR_STPNSEEP	FR_STPNSEEP	FR_STPNSEEP	FR_STPNSEEP	FR_STPNSEEP	FR_STPNSEEP
		Date	15/09/2016	28/11/2016	12/06/2017	04/07/2017	12/07/2017	18/07/2017	27/07/2017
		Sample Type	NP	NP	NP	NP	N	N	N
Fraction	Analyte	Unit	Result	Result	Result	Result	Result	Result	Result
D	ALUMINUM	mg/l	< 0.0030	< 0.0030	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
D	ANTIMONY	mg/l	0.00015	0.00012	0.00016	0.00018	0.00014	0.00016	0.00016
D	ARSENIC	mg/l	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
D	BARIUM	mg/l	0.106	0.0919	0.0619	0.0820	0.0881	0.0960	0.103
D	BERYLLIUM	mg/l	< 0.000020	< 0.000020	< 0.000020	< 0.000020	< 0.000020	< 0.000020	< 0.000020
D	BISMUTH	mg/l	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050
D	BORON	mg/l	0.022	0.016	0.015	0.021	0.022	0.022	0.024
D	BROMIDE	mg/l	< 0.25	< 0.25	0.062	0.050	0.066	< 0.25	0.063
D	CADMIUM	mg/l	0.000109	0.0000475	0.000165	0.000235	0.000216	0.000230	0.000243
D	CALCIUM	mg/l	113	99.7	84.4	98.6	107	103	112
D	CARBON, DISSOLV	mg/l	1.01	0.85	1.38	2.28	1.62	1.29	1.79
D	CHLORIDE	mg/l	14.7	19.5	7.85	8.09	8.22	7.9	9.08
D	CHROMIUM	mg/l	0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
D	COBALT	mg/l	0.00049	0.00016	0.00029	0.00044	0.00045	0.00050	0.00055
D	COPPER	mg/l	< 0.00050	< 0.00050	< 0.00020	0.00024	< 0.00020	0.00023	< 0.00020
D	FLUORIDE	mg/l	0.22	0.20	0.219	0.180	0.195	0.16	0.204
D	IRON	mg/l	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
D	LEAD	mg/l	< 0.000050	0.000064	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050
D	LITHIUM	mg/l	0.0426	0.0293	0.0316	0.0407	0.0433	0.0456	0.0431
D	MAGNESIUM	mg/l	40.8	31.0	33.9	39.4	39.9	41.2	45.6
D	MANGANESE	mg/l	0.00398	0.00129	0.00459	0.00607	0.00691	0.00773	0.00744
D	MERCURY	mg/l	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050
D	MOLYBDENUM	mg/l	0.000901	0.00101	0.00107	0.00104	0.000977	0.000956	0.000947
D	NICKEL	mg/l	0.00194	0.00089	0.00097	0.00142	0.00153	0.00163	0.00190
D	POTASSIUM	mg/l	2.10	1.74	1.84	2.15	2.12	2.42	2.39
D	SELENIUM	ug/l	7.16	14.4	8.93	8.27	8.38	7.93	8.26
D	SILICON	mg/l	2.73	2.30	2.04	2.15	2.26	2.39	2.40
D	SILVER	mg/l	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010
D	SODIUM	mg/l	5.33	4.75	3.86	4.96	4.95	5.31	5.88
D	STRONTIUM	mg/l	0.197	0.168	0.138	0.175	0.183	0.189	0.197
D	SULFATE (AS SO4)	mg/l	185	135	124	174	177	186	196
D	THALLIUM	mg/l	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	0.000010	< 0.000010
D	TIN	mg/l	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
D	TITANIUM	mg/l	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
D	URANIUM	mg/l	0.00271	0.00176	0.00278	0.00326	0.00266	0.00309	0.00309
D	VANADIUM	mg/l	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050
D	ZINC	mg/l	< 0.0030	< 0.0030	0.0018	0.0019	0.0015	0.0015	0.0022
N	ACIDITY TO pH 8.3	mg/l	6.0	1.1	< 1.0	2.5	4.9	< 1.0	< 1.0
N	ALKALINITY, BICAF	mg/l	255	215	217	243	291	288	260
N	ALKALINITY, CARB	mg/l	< 1.0	< 1.0	10.4	< 1.0	< 1.0	18.0	< 1.0
N	ALKALINITY, HYDR	mg/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N	ALKALINITY, TOTA	mg/l	255	215	228	243	291	306	260
N	Cation - Anion Balar	%			-2.5	-3.2	-6.0	-8.6	-1.0
N	CONDUCTIVITY, FI	us/cm		644.1	576.2				
N	CONDUCTIVITY, LA	us/cm	843	736	652	788	811	831	840
N	DISSOLVED OXYG	mg/l		8.86	8.26				
N	DISSOLVED OXYG	%		71.5	66.4				
N	Hardness, Total or D	mg/l	451	377	350	408	431	428	467
N	ION BALANCE	%	-1.7	-2.6					
N	MAJOR ANION SUM	meq/l	9.63	8.20	7.58	8.99	10.0	10.5	9.84
N	MAJOR CATION SU	meq/l	9.30	7.78	7.22	8.43	8.89	8.84	9.65
N	NITRATE NITROGE	mg/l	3.39	7.44	3.06	3.82	3.97	4.19	4.22
N	NITRITE NITROGEI	mg/l	< 0.0050	< 0.0050	0.0017	0.0020	0.0029	0.0065	0.0020
N	NITROGEN, AMMO	mg/l	< 0.0050	< 0.0050	< 0.0050	0.0077	0.0100	0.0059	< 0.0050
N	ORTHO-PHOSPHAT	mg/l	< 0.0010	0.0012	< 0.0010	0.0016	0.0026	0.0020	< 0.0010
N	OXIDATION-REDUC	mv		-41.5	164.2				
N	OXIDATION-REDUC	mv	322	309	507	318	334	232	334
N	pH, Field	ph units		7.79	7.23				
N	pH, LAB	ph units	8.05	8.25	8.34	8.17	8.15	8.40	7.88
N	PHOSPHORUS	mg/l	0.0029	< 0.0020	0.0022	< 0.0020	0.0049	0.0055	0.0069
N	TEMPERATURE, FI	deg c		6.2	6.0				
N	TOTAL DISSOLVED	mg/l	597	444	409	548	520	539	598
N	TOTAL KJELDAHL I	mg/l	0.124	0.149	0.460	0.470	0.250	0.292	0.282
N	TOTAL SUSPENDE	mg/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N	TURBIDITY, LAB	ntu	0.29	0.28	0.25	0.51	0.18	0.26	0.29
T	ALUMINUM	mg/l	0.0040	0.0290	0.0046	0.0033	< 0.0030	< 0.0030	0.0034
T	ANTIMONY	mg/l	0.00017	0.00014	0.00015	0.00016	0.00016	0.00015	0.00016
T	ARSENIC	mg/l	< 0.00010	< 0.00010	0.00017	0.00014	0.00010	0.00014	< 0.00010
T	BARIUM	mg/l	0.109	0.0986	0.0595	0.0815	0.0815	0.0883	0.0978
T	BERYLLIUM	mg/l	< 0.000020	< 0.000020	< 0.000020	< 0.000020	< 0.000020	< 0.000020	< 0.000020
T	BISMUTH	mg/l	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050
T	BORON	mg/l	0.025	0.017	0.015	0.020	0.022	0.023	0.025
T	CADMIUM	mg/l	0.000120	0.0000647	0.000169	0.000219	0.000195	0.000214	0.000222
T	CALCIUM	mg/l	119	101	82.0	95.8	103	101	110
T	CHROMIUM	mg/l	0.00013	0.00015	0.00014	0.00011	0.00012	< 0.00010	0.00011
T	COBALT	mg/l	0.00055	0.00020	0.00029	0.00045	0.00045	0.00049	0.00055
T	COPPER	mg/l	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050
T	IRON	mg/l	< 0.010	0.014	< 0.010	< 0.010	< 0.010	< 0.010	0.011
T	LEAD	mg/l	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050
T	LITHIUM	mg/l	0.0466	0.0307	0.0301	0.0403	0.0409	0.0433	0.0436
T	MAGNESIUM	mg/l	37.0	32.9	33.9	39.5	39.5	38.9	44.8
T	MANGANESE	mg/l	0.00512	0.00225	0.00543	0.00645	0.00797	0.00751	0.00795
T	MERCURY	mg/l	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050
T	MOLYBDENUM	mg/l	0.000989	0.00109	0.00108	0.00104	0.000965	0.000899	0.000966
T	NICKEL	mg/l	0.00208	0.00105	0.00116	0.00151	0.00150	0.00162	0.00171
T	POTASSIUM	mg/l	2.21	1.88	1.76	2.08	2.11	2.22	2.25
T	SELENIUM	ug/l	7.16	14.9	8.7	7.73	7.59	7.55	7.48
T	SILICON	mg/l	2.86	2.41	1.99	2.18	2.32	2.31	2.39
T	SILVER	mg/l	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010
T	SODIUM	mg/l	5.66	5.11	3.83	4.82	4.89	4.97	5.62
T	STRONTIUM	mg/l	0.201	0.172	0.137	0.173	0.174	0.182	0.194
T	THALLIUM	mg/l	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010
T	TIN	mg/l	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
T	TITANIUM	mg/l	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
T	TOTAL ORGANIC C	mg/l	0.96	1.00	1.17	2.72	1.25	1.35	1.99
T	URANIUM	mg/l	0.00272	0.00180	0.00288	0.00343	0.00274	0.00310	0.00309
T	VANADIUM	mg/l	< 0.00050	< 0.00050	0.00064	< 0.00050	< 0.00050	0.00055	< 0.00050
T	ZINC	mg/l	< 0.0030	< 0.0030	< 0.0030	< 0.0030	< 0.0030	< 0.0030	< 0.0030

Appendix E:
Water Quality Data

*** This Location is the pooled water that we spoke of yesterday that is weest of the Wastewater Cells

		Location	FR_STPNWP
		Date	28/11/2016
		Sample Type	NP
Fraction	Analyte	Unit	Result
D	ALUMINUM	mg/l	0.0041
D	ANTIMONY	mg/l	0.00033
D	ARSENIC	mg/l	0.00014
D	BARIUM	mg/l	0.0895
D	BERYLLIUM	mg/l	< 0.000020
D	BISMUTH	mg/l	< 0.000050
D	BORON	mg/l	0.020
D	BROMIDE	mg/l	< 0.050
D	CADMIUM	mg/l	0.0000134
D	CALCIUM	mg/l	60.8
D	CARBON, DISSOLV	mg/l	2.21
D	CHLORIDE	mg/l	1.04
D	CHROMIUM	mg/l	< 0.00010
D	COBALT	mg/l	< 0.00010
D	COPPER	mg/l	0.00074
D	FLUORIDE	mg/l	0.259
D	IRON	mg/l	< 0.010
D	LEAD	mg/l	< 0.000050
D	LITHIUM	mg/l	0.0121
D	MAGNESIUM	mg/l	25.1
D	MANGANESE	mg/l	0.00021
D	MERCURY	mg/l	< 0.0000050
D	MOLYBDENUM	mg/l	0.00415
D	NICKEL	mg/l	0.00127
D	POTASSIUM	mg/l	2.70
D	SELENIUM	ug/l	4.91
D	SILICON	mg/l	0.633
D	SILVER	mg/l	< 0.000010
D	SODIUM	mg/l	1.20
D	STRONTIUM	mg/l	0.122
D	SULFATE (AS SO4)	mg/l	88.9
D	THALLIUM	mg/l	0.000012
D	TIN	mg/l	< 0.00010
D	TITANIUM	mg/l	< 0.010
D	URANIUM	mg/l	0.00122
D	VANADIUM	mg/l	< 0.00050
D	ZINC	mg/l	< 0.0030
N	ACIDITY TO pH 8.3	mg/l	< 1.0
N	ALKALINITY, BICAF	mg/l	174
N	ALKALINITY, CARB	mg/l	< 1.0
N	ALKALINITY, HYDR	mg/l	< 1.0
N	ALKALINITY, TOTA	mg/l	174
N	CONDUCTIVITY, FI	us/cm	427.5
N	CONDUCTIVITY, LA	us/cm	477
N	DISSOLVED OXYG	mg/l	8.20
N	DISSOLVED OXYG	%	60.0
N	Hardness, Total or D	mg/l	255
N	ION BALANCE	%	-1.4
N	MAJOR ANION SUM	meq/l	5.37
N	MAJOR CATION SU	meq/l	5.22
N	NITRATE NITROGE	mg/l	< 0.0050
N	NITRITE NITROGEI	mg/l	< 0.0010
N	NITROGEN, AMMO	mg/l	< 0.0050
N	ORTHO-PHOSPHA	mg/l	< 0.0010
N	OXIDATION-REDUC	mv	-42.6
N	OXIDATION-REDUC	mv	322
N	pH, Field	ph units	7.95
N	pH, LAB	ph units	8.28
N	PHOSPHORUS	mg/l	0.0063
N	TEMPERATURE, FI	deg c	2.4
N	TOTAL DISSOLVED	mg/l	282
N	TOTAL KJELDAHL I	mg/l	0.169
N	TOTAL SUSPENDE	mg/l	1.8
N	TURBIDITY, LAB	ntu	4.20
T	ALUMINUM	mg/l	0.0590
T	ANTIMONY	mg/l	0.00035
T	ARSENIC	mg/l	0.00018
T	BARIUM	mg/l	0.0865
T	BERYLLIUM	mg/l	< 0.000020
T	BISMUTH	mg/l	< 0.000050
T	BORON	mg/l	0.021
T	CADMIUM	mg/l	0.0000242
T	CALCIUM	mg/l	64.8
T	CHROMIUM	mg/l	0.00020
T	COBALT	mg/l	< 0.00010
T	COPPER	mg/l	0.00102
T	IRON	mg/l	0.036
T	LEAD	mg/l	0.000055
T	LITHIUM	mg/l	0.0130
T	MAGNESIUM	mg/l	24.9
T	MANGANESE	mg/l	0.00326
T	MERCURY	mg/l	< 0.0000050
T	MOLYBDENUM	mg/l	0.00426
T	NICKEL	mg/l	0.00142
T	POTASSIUM	mg/l	2.68
T	SELENIUM	ug/l	4.93
T	SILICON	mg/l	0.778
T	SILVER	mg/l	< 0.000010
T	SODIUM	mg/l	1.17
T	STRONTIUM	mg/l	0.129
T	THALLIUM	mg/l	0.000011
T	TIN	mg/l	< 0.00010
T	TITANIUM	mg/l	< 0.010
T	TOTAL ORGANIC C	mg/l	2.50
T	URANIUM	mg/l	0.00123
T	VANADIUM	mg/l	< 0.00050
T	ZINC	mg/l	< 0.0030

Appendix E:
Water Quality Data

		Location	FR_STPNWWELL4B	FR_STPNWWELL4B	FR_STPNWWELL4B	FR_STPNWWELL4B
		Date	04/07/2017	12/07/2017	18/07/2017	27/07/2017
		Sample Type	N	N	N	N
Fraction	Analyte	Unit	Result	Result	Result	Result
D	ALUMINUM	mg/l	< 0.0010	< 0.0010	< 0.0010	< 0.0010
D	ANTIMONY	mg/l	0.00021	0.00018	0.00021	0.00020
D	ARSENIC	mg/l	0.00012	< 0.00010	< 0.00010	0.00011
D	BARIUM	mg/l	0.0415	0.0336	0.0371	0.0362
D	BERYLLIUM	mg/l	< 0.000020	< 0.000020	< 0.000020	< 0.000020
D	BISMUTH	mg/l	< 0.000050	< 0.000050	< 0.000050	< 0.000050
D	BORON	mg/l	0.052	0.052	0.047	0.056
D	BROMIDE	mg/l	< 0.25	< 0.25	< 0.25	< 0.25
D	CADMIUM	mg/l	0.00112	0.00110	0.00114	0.00128
D	CALCIUM	mg/l	140	135	125	125
D	CARBON, DISSOLV	mg/l	0.84	0.96	1.21	1.72
D	CHLORIDE	mg/l	3.8	2.9	2.6	< 2.5
D	CHROMIUM	mg/l	< 0.00010	< 0.00010	< 0.00010	< 0.00010
D	COBALT	mg/l	0.00143	0.00142	0.00155	0.00146
D	COPPER	mg/l	0.00088	0.00070	0.00084	0.00086
D	FLUORIDE	mg/l	0.36	0.38	0.39	0.43
D	IRON	mg/l	< 0.010	< 0.010	< 0.010	< 0.010
D	LEAD	mg/l	0.000175	0.000144	0.000177	0.000205
D	LITHIUM	mg/l	0.121	0.122	0.112	0.112
D	MAGNESIUM	mg/l	86.4	81.2	78.8	82.4
D	MANGANESE	mg/l	0.00599	0.00472	0.0158	0.00711
D	MERCURY	mg/l	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050
D	MOLYBDENUM	mg/l	0.00126	0.00131	0.00133	0.00140
D	NICKEL	mg/l	0.00431	0.00411	0.00466	0.00424
D	POTASSIUM	mg/l	4.02	4.00	3.98	4.05
D	SELENIUM	ug/l	2.03	1.28	0.968	0.605
D	SILICON	mg/l	1.82	1.73	1.81	1.84
D	SILVER	mg/l	< 0.000010	< 0.000010	< 0.000010	< 0.000010
D	SODIUM	mg/l	6.74	6.80	7.12	7.73
D	STRONTIUM	mg/l	0.267	0.253	0.248	0.245
D	SULFATE (AS SO4)	mg/l	337	293	280	252
D	THALLIUM	mg/l	0.000041	0.000044	0.000042	0.000055
D	TIN	mg/l	< 0.00010	< 0.00010	< 0.00010	< 0.00010
D	TITANIUM	mg/l	< 0.010	< 0.010	< 0.010	< 0.010
D	URANIUM	mg/l	0.0136	0.0121	0.0110	0.0113
D	VANADIUM	mg/l	< 0.00050	< 0.00050	< 0.00050	< 0.00050
D	ZINC	mg/l	0.0083	0.0076	0.0075	0.0089
N	ACIDITY TO pH 8.3	mg/l	4.9	4.8	8.9	3.0
N	ALKALINITY, BICAR	mg/l	419	421	388	405
N	ALKALINITY, CARB	mg/l	< 1.0	< 1.0	< 1.0	< 1.0
N	ALKALINITY, HYDR	mg/l	< 1.0	< 1.0	< 1.0	< 1.0
N	ALKALINITY, TOTA	mg/l	419	421	388	405
N	Cation - Anion Balar	%	-3.8	-3.3	-2.3	0
N	CONDUCTIVITY, LA	us/cm	1230	1170	1120	1090
N	Hardness, Total or D	mg/l	707	671	637	651
N	MAJOR ANION SUM	meq/l	15.7	14.7	13.8	13.4
N	MAJOR CATION SU	meq/l	14.5	13.8	13.1	13.4
N	NITRATE NITROGE	mg/l	2.05	1.66	1.35	0.934
N	NITRITE NITROGEN	mg/l	< 0.0050	< 0.0050	< 0.0050	< 0.0050
N	NITROGEN, AMMO	mg/l	< 0.0050	0.0064	< 0.0050	< 0.0050
N	ORTHO-PHOSPHA	mg/l	< 0.0010	0.0021	0.0013	0.0012
N	OXIDATION-REDUC	mv	325	339	350	344
N	pH, LAB	ph units	7.62	8.06	8.25	7.72
N	PHOSPHORUS	mg/l	0.0034	0.0054	0.0056	0.0235
N	TOTAL DISSOLVED	mg/l	913	817	745	711
N	TOTAL KJELDAHL I	mg/l	0.193	0.250	0.123	0.102
N	TOTAL SUSPENDE	mg/l	1.5	< 1.0	< 1.0	1.5
N	TURBIDITY, LAB	ntu	0.66	0.59	0.46	0.94
T	ALUMINUM	mg/l	0.0056	0.0036	< 0.0030	0.0101
T	ANTIMONY	mg/l	0.00020	0.00021	0.00020	0.00020
T	ARSENIC	mg/l	0.00017	0.00017	0.00017	0.00013
T	BARIUM	mg/l	0.0396	0.0342	0.0357	0.0345
T	BERYLLIUM	mg/l	< 0.000020	< 0.000020	< 0.000020	< 0.000020
T	BISMUTH	mg/l	< 0.000050	< 0.000050	< 0.000050	< 0.000050
T	BORON	mg/l	0.053	0.054	0.051	0.058
T	CADMIUM	mg/l	0.00118	0.000989	0.00110	0.00122
T	CALCIUM	mg/l	138	133	124	123
T	CHROMIUM	mg/l	< 0.00010	< 0.00010	< 0.00010	< 0.00010
T	COBALT	mg/l	0.00170	0.00185	0.00164	0.00145
T	COPPER	mg/l	0.00083	0.00072	0.00084	0.00086
T	IRON	mg/l	0.016	< 0.010	< 0.010	0.019
T	LEAD	mg/l	0.000196	0.000194	0.000194	0.000222
T	LITHIUM	mg/l	0.118	0.118	0.110	0.113
T	MAGNESIUM	mg/l	80.6	83.9	79.5	80.5
T	MANGANESE	mg/l	0.0143	0.00968	0.0172	0.00962
T	MERCURY	mg/l	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050
T	MOLYBDENUM	mg/l	0.00122	0.00130	0.00140	0.00140
T	NICKEL	mg/l	0.00441	0.00426	0.00459	0.00414
T	POTASSIUM	mg/l	3.77	3.99	4.12	3.86
T	SELENIUM	ug/l	2	1.24	0.888	0.536
T	SILICON	mg/l	1.83	1.84	1.82	1.86
T	SILVER	mg/l	< 0.000010	< 0.000010	< 0.000010	< 0.000010
T	SODIUM	mg/l	6.41	6.96	7.05	7.28
T	STRONTIUM	mg/l	0.262	0.247	0.244	0.239
T	THALLIUM	mg/l	0.000035	0.000038	0.000042	0.000051
T	TIN	mg/l	< 0.00010	< 0.00010	< 0.00010	< 0.00010
T	TITANIUM	mg/l	< 0.010	< 0.010	< 0.010	< 0.010
T	TOTAL ORGANIC C	mg/l	1.00	1.12	1.41	1.61
T	URANIUM	mg/l	0.0141	0.0125	0.0113	0.0114
T	VANADIUM	mg/l	< 0.00050	< 0.00050	0.00058	< 0.00050
T	ZINC	mg/l	0.0089	0.0077	0.0078	0.0083

Appendix E:
Water Quality Data

		Location	FR_STPNWWELL5A	FR_STPNWWELL5A	FR_STPNWWELL5A	FR_STPNWWELL5A
		Date	04/07/2017	12/07/2017	18/07/2017	27/07/2017
		Sample Type	N	N	N	N
Fraction	Analyte	Unit	Result	Result	Result	Result
D	ALUMINUM	mg/l	0.0018	0.0018	0.0027	0.0036
D	ANTIMONY	mg/l	0.00024	0.00021	0.00023	0.00023
D	ARSENIC	mg/l	0.00023	0.00026	0.00031	0.00032
D	BARIUM	mg/l	0.143	0.137	0.182	0.167
D	BERYLLIUM	mg/l	< 0.000020	< 0.000020	< 0.000020	< 0.000020
D	BISMUTH	mg/l	< 0.000050	< 0.000050	< 0.000050	< 0.000050
D	BORON	mg/l	0.035	0.036	0.027	0.028
D	BROMIDE	mg/l	< 0.25	< 0.25	< 0.25	< 0.25
D	CADMIUM	mg/l	0.00106	0.000958	0.000798	0.000796
D	CALCIUM	mg/l	174	172	172	171
D	CARBON, DISSOLV	mg/l	3.80	4.04	6.10	6.89
D	CHLORIDE	mg/l	3.5	2.6	< 2.5	< 2.5
D	CHROMIUM	mg/l	< 0.00010	< 0.00010	< 0.00010	< 0.00010
D	COBALT	mg/l	0.00261	0.00280	0.00301	0.00294
D	COPPER	mg/l	0.00130	0.00115	0.00132	0.00129
D	FLUORIDE	mg/l	0.22	0.24	0.16	0.19
D	IRON	mg/l	0.016	0.017	0.037	0.037
D	LEAD	mg/l	0.000103	< 0.000050	0.000088	< 0.000050
D	LITHIUM	mg/l	0.0850	0.0874	0.0570	0.0526
D	MAGNESIUM	mg/l	75.2	74.0	59.7	58.8
D	MANGANESE	mg/l	0.963	1.30	1.31	1.26
D	MERCURY	mg/l	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050
D	MOLYBDENUM	mg/l	0.00186	0.00203	0.00197	0.00232
D	NICKEL	mg/l	0.0103	0.0104	0.00956	0.00964
D	POTASSIUM	mg/l	2.54	2.53	2.36	2.04
D	SELENIUM	ug/l	0.505	0.447	0.389	0.379
D	SILICON	mg/l	2.71	2.60	2.88	2.64
D	SILVER	mg/l	< 0.000010	< 0.000010	< 0.000010	< 0.000010
D	SODIUM	mg/l	5.96	5.91	5.28	5.38
D	STRONTIUM	mg/l	0.255	0.248	0.230	0.224
D	SULFATE (AS SO4)	mg/l	342	310	279	272
D	THALLIUM	mg/l	0.000036	0.000039	0.000032	0.000032
D	TIN	mg/l	< 0.00010	< 0.00010	< 0.00010	< 0.00010
D	TITANIUM	mg/l	< 0.010	< 0.010	< 0.010	< 0.010
D	URANIUM	mg/l	0.00721	0.00624	0.00456	0.00440
D	VANADIUM	mg/l	< 0.00050	< 0.00050	< 0.00050	< 0.00050
D	ZINC	mg/l	0.0142	0.0125	0.0121	0.0118
N	ACIDITY TO pH 8.3	mg/l	9.2	11.4	17.8	6.6
N	ALKALINITY, BICAR	mg/l	460	456	432	431
N	ALKALINITY, CARB	mg/l	< 1.0	< 1.0	< 1.0	< 1.0
N	ALKALINITY, HYDR	mg/l	< 1.0	< 1.0	< 1.0	< 1.0
N	ALKALINITY, TOTA	mg/l	460	456	432	431
N	Cation - Anion Balar	%	-3.9	-2.0	-2.2	-2.1
N	CONDUCTIVITY, LA	us/cm	1290	1260	1170	1130
N	Hardness, Total or D	mg/l	744	734	676	669
N	MAJOR ANION SUM	meq/l	16.5	15.7	14.5	14.3
N	MAJOR CATION SU	meq/l	15.2	15.0	13.8	13.7
N	NITRATE NITROGE	mg/l	0.515	0.355	0.422	0.130
N	NITRITE NITROGEN	mg/l	0.0058	0.0050	< 0.0050	< 0.0050
N	NITROGEN, AMMO	mg/l	0.0080	0.0111	0.0136	0.0082
N	ORTHO-PHOSPHA	mg/l	0.0016	0.0023	0.0034	0.0025
N	OXIDATION-REDUC	mv	255	276	350	288
N	pH, LAB	ph units	7.36	7.91	8.28	7.49
N	PHOSPHORUS	mg/l	0.0024	< 0.0040	0.0102	0.0143
N	TOTAL DISSOLVED	mg/l	926	904	820	797
N	TOTAL KJELDAHL I	mg/l	0.253	0.344	0.250	0.250
N	TOTAL SUSPENDE	mg/l	1.3	1.9	1.0	1.5
N	TURBIDITY, LAB	ntu	1.62	1.14	1.55	1.91
T	ALUMINUM	mg/l	0.0132	0.0132	0.0104	0.0188
T	ANTIMONY	mg/l	0.00024	0.00025	0.00024	0.00027
T	ARSENIC	mg/l	0.00040	0.00036	0.00038	0.00033
T	BARIUM	mg/l	0.138	0.138	0.157	0.166
T	BERYLLIUM	mg/l	< 0.000020	< 0.000020	< 0.000020	< 0.000020
T	BISMUTH	mg/l	< 0.000050	< 0.000050	< 0.000050	< 0.000050
T	BORON	mg/l	0.035	0.036	0.028	0.030
T	CADMIUM	mg/l	0.00102	0.000922	0.000813	0.000917
T	CALCIUM	mg/l	172	169	165	168
T	CHROMIUM	mg/l	0.133	< 0.00010	< 0.00010	0.00013
T	COBALT	mg/l	0.00316	0.00361	0.00282	0.00467
T	COPPER	mg/l	0.00703	0.00126	0.00136	0.00145
T	IRON	mg/l	2.10	0.083	0.074	0.106
T	LEAD	mg/l	0.000114	0.000116	0.000088	0.000108
T	LITHIUM	mg/l	0.0809	0.0824	0.0547	0.0543
T	MAGNESIUM	mg/l	68.6	72.7	54.6	58.1
T	MANGANESE	mg/l	0.990	1.38	1.17	1.69
T	MERCURY	mg/l	0.0000058	< 0.0000050	< 0.0000050	< 0.0000050
T	MOLYBDENUM	mg/l	0.00441	0.00214	0.00204	0.00239
T	NICKEL	mg/l	0.0122	0.0109	0.00923	0.0116
T	POTASSIUM	mg/l	2.37	2.41	2.10	1.98
T	SELENIUM	ug/l	0.483	0.377	0.385	0.37
T	SILICON	mg/l	2.75	2.71	2.78	2.76
T	SILVER	mg/l	< 0.000010	< 0.000010	< 0.000010	< 0.000010
T	SODIUM	mg/l	5.41	5.81	4.75	5.16
T	STRONTIUM	mg/l	0.245	0.240	0.222	0.223
T	THALLIUM	mg/l	0.000033	0.000041	0.000031	0.000048
T	TIN	mg/l	< 0.00010	< 0.00010	< 0.00010	< 0.00010
T	TITANIUM	mg/l	< 0.010	< 0.010	< 0.010	< 0.010
T	TOTAL ORGANIC C	mg/l	4.27	4.48	6.63	7.61
T	URANIUM	mg/l	0.00772	0.00645	0.00471	0.00462
T	VANADIUM	mg/l	0.00103	0.00051	0.00068	< 0.00050
T	ZINC	mg/l	0.0136	0.0134	0.0116	0.0137

Appendix E:
Water Quality Data

		Location	FR_STPNWWELL6A	FR_STPNWWELL6A	FR_STPNWWELL6A	FR_STPNWWELL6A
		Date	04/07/2017	12/07/2017	18/07/2017	27/07/2017
		Sample Type	N	N	N	N
Fraction	Analyte	Unit	Result	Result	Result	Result
D	ALUMINUM	mg/l	0.0015	0.0013	< 0.0010	0.0017
D	ANTIMONY	mg/l	0.00017	0.00017	0.00017	0.00018
D	ARSENIC	mg/l	0.00013	0.00015	0.00015	0.00013
D	BARIUM	mg/l	0.0766	0.0685	0.0591	0.0615
D	BERYLLIUM	mg/l	< 0.000020	< 0.000020	< 0.000020	< 0.000020
D	BISMUTH	mg/l	< 0.000050	< 0.000050	< 0.000050	< 0.000050
D	BORON	mg/l	0.050	0.049	0.047	0.052
D	BROMIDE	mg/l	< 0.25	< 0.25	< 0.25	< 0.25
D	CADMIUM	mg/l	0.00113	0.000965	0.00103	0.000973
D	CALCIUM	mg/l	143	142	129	128
D	CARBON, DISSOLV	mg/l	1.83	2.72	2.03	2.68
D	CHLORIDE	mg/l	3.4	2.5	< 2.5	< 2.5
D	CHROMIUM	mg/l	< 0.00010	< 0.00010	< 0.00010	< 0.00010
D	COBALT	mg/l	0.00168	0.00168	0.00166	0.00171
D	COPPER	mg/l	0.00069	0.00065	0.00055	0.00058
D	FLUORIDE	mg/l	0.35	0.40	0.40	0.48
D	IRON	mg/l	< 0.010	< 0.010	< 0.010	0.011
D	LEAD	mg/l	0.000118	0.000110	0.000150	0.000141
D	LITHIUM	mg/l	0.117	0.117	0.111	0.109
D	MAGNESIUM	mg/l	87.7	83.9	81.1	81.3
D	MANGANESE	mg/l	0.173	0.125	0.137	0.116
D	MERCURY	mg/l	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050
D	MOLYBDENUM	mg/l	0.00127	0.00132	0.00128	0.00139
D	NICKEL	mg/l	0.00425	0.00414	0.00359	0.00381
D	POTASSIUM	mg/l	3.63	3.76	4.10	3.68
D	SELENIUM	ug/l	0.727	0.625	0.598	0.571
D	SILICON	mg/l	1.93	1.84	1.97	1.89
D	SILVER	mg/l	< 0.000010	< 0.000010	< 0.000010	< 0.000010
D	SODIUM	mg/l	6.79	6.79	7.31	7.61
D	STRONTIUM	mg/l	0.274	0.263	0.255	0.248
D	SULFATE (AS SO4)	mg/l	345	316	274	268
D	THALLIUM	mg/l	0.000031	0.000034	0.000028	0.000033
D	TIN	mg/l	< 0.00010	< 0.00010	< 0.00010	< 0.00010
D	TITANIUM	mg/l	< 0.010	< 0.010	< 0.010	< 0.010
D	URANIUM	mg/l	0.0137	0.0123	0.0117	0.0121
D	VANADIUM	mg/l	< 0.00050	< 0.00050	< 0.00050	< 0.00050
D	ZINC	mg/l	0.0095	0.0081	0.0077	0.0082
N	ACIDITY TO pH 8.3	mg/l	3.5	7.7	9.0	1.6
N	ALKALINITY, BICAR	mg/l	426	399	383	421
N	ALKALINITY, CARB	mg/l	< 1.0	< 1.0	20.8	< 1.0
N	ALKALINITY, HYDR	mg/l	< 1.0	< 1.0	< 1.0	< 1.0
N	ALKALINITY, TOTA	mg/l	426	399	403	421
N	Cation - Anion Balar	%	-3.6	-1.1	-1.1	-2.0
N	CONDUCTIVITY, LA	us/cm	1270	1200	1150	1090
N	Hardness, Total or D	mg/l	720	699	656	654
N	MAJOR ANION SUM	meq/l	15.9	14.7	13.8	14.0
N	MAJOR CATION SU	meq/l	14.8	14.4	13.5	13.5
N	NITRATE NITROGE	mg/l	0.780	0.726	0.586	0.288
N	NITRITE NITROGEN	mg/l	< 0.0050	< 0.0050	< 0.0050	< 0.0050
N	NITROGEN, AMMO	mg/l	< 0.0050	0.0110	0.0089	< 0.0050
N	ORTHO-PHOSPHA	mg/l	0.0013	0.0021	0.0016	0.0019
N	OXIDATION-REDUC	mv	279	311	351	293
N	pH, LAB	ph units	7.59	7.72	8.37	7.66
N	PHOSPHORUS	mg/l	0.0065	0.0133	0.0083	0.0080
N	TOTAL DISSOLVED	mg/l	881	889	768	745
N	TOTAL KJELDAHL I	mg/l	0.192	0.250	0.118	0.090
N	TOTAL SUSPENDE	mg/l	1.9	< 1.0	< 1.0	< 1.0
N	TURBIDITY, LAB	ntu	1.19	0.93	0.50	0.74
T	ALUMINUM	mg/l	0.0080	0.0092	< 0.0030	0.0035
T	ANTIMONY	mg/l	0.00016	0.00018	0.00017	0.00018
T	ARSENIC	mg/l	0.00019	0.00018	0.00020	0.00016
T	BARIUM	mg/l	0.0748	0.0700	0.0571	0.0589
T	BERYLLIUM	mg/l	< 0.000020	< 0.000020	< 0.000020	< 0.000020
T	BISMUTH	mg/l	< 0.000050	< 0.000050	< 0.000050	< 0.000050
T	BORON	mg/l	0.049	0.050	0.048	0.054
T	CADMIUM	mg/l	0.00119	0.000974	0.00102	0.000969
T	CALCIUM	mg/l	145	140	123	125
T	CHROMIUM	mg/l	0.00010	< 0.00010	< 0.00010	< 0.00010
T	COBALT	mg/l	0.00180	0.00176	0.00161	0.00164
T	COPPER	mg/l	0.00060	0.00067	0.00057	0.00063
T	IRON	mg/l	0.020	0.018	0.013	0.014
T	LEAD	mg/l	0.000164	0.000148	0.000161	0.000149
T	LITHIUM	mg/l	0.113	0.114	0.106	0.109
T	MAGNESIUM	mg/l	81.2	84.6	76.9	80.7
T	MANGANESE	mg/l	0.194	0.141	0.120	0.110
T	MERCURY	mg/l	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050
T	MOLYBDENUM	mg/l	0.00133	0.00139	0.00131	0.00144
T	NICKEL	mg/l	0.00407	0.00420	0.00356	0.00364
T	POTASSIUM	mg/l	3.47	3.69	3.77	3.52
T	SELENIUM	ug/l	0.669	0.565	0.592	0.543
T	SILICON	mg/l	1.96	1.97	1.95	1.93
T	SILVER	mg/l	< 0.000010	< 0.000010	< 0.000010	< 0.000010
T	SODIUM	mg/l	6.25	6.78	6.90	7.37
T	STRONTIUM	mg/l	0.271	0.262	0.244	0.243
T	THALLIUM	mg/l	0.000030	0.000033	0.000028	0.000034
T	TIN	mg/l	< 0.00010	< 0.00010	< 0.00010	< 0.00010
T	TITANIUM	mg/l	< 0.010	< 0.010	< 0.010	< 0.010
T	TOTAL ORGANIC C	mg/l	2.17	3.32	2.44	2.68
T	URANIUM	mg/l	0.0147	0.0129	0.0123	0.0123
T	VANADIUM	mg/l	< 0.00050	< 0.00050	< 0.00050	< 0.00050
T	ZINC	mg/l	0.0089	0.0080	0.0070	0.0076

Appendix E:
Water Quality Data

		Location	FR_STPSWSEEP	FR_STPSWSEEP	FR_STPSWSEEP
		Date	15/09/2016	28/11/2016	12/06/2017
		Sample Type	NP	NP	NP
Fraction	Analyte	Unit	Result	Result	Result
D	ALUMINUM	mg/l	< 0.0030	< 0.0030	< 0.0010
D	ANTIMONY	mg/l	< 0.00010	< 0.00010	< 0.00010
D	ARSENIC	mg/l	< 0.00010	< 0.00010	< 0.00010
D	BARIUM	mg/l	0.0820	0.0771	0.0840
D	BERYLLIUM	mg/l	< 0.000020	< 0.000020	< 0.000020
D	BISMUTH	mg/l	< 0.000050	< 0.000050	< 0.000050
D	BORON	mg/l	0.027	0.027	0.030
D	BROMIDE	mg/l	< 0.25	< 0.25	< 0.25
D	CADMIUM	mg/l	0.000403	0.000411	0.000351
D	CALCIUM	mg/l	145	141	139
D	CARBON, DISSOLV	mg/l	1.01	1.00	1.05
D	CHLORIDE	mg/l	8.24	6.84	5.9
D	CHROMIUM	mg/l	< 0.00010	< 0.00010	< 0.00010
D	COBALT	mg/l	0.00102	0.00094	0.00091
D	COPPER	mg/l	< 0.00050	< 0.00050	< 0.00020
D	FLUORIDE	mg/l	0.35	0.30	0.23
D	IRON	mg/l	< 0.010	< 0.010	< 0.010
D	LEAD	mg/l	< 0.000050	< 0.000050	< 0.000050
D	LITHIUM	mg/l	0.0998	0.0952	0.0976
D	MAGNESIUM	mg/l	80.8	73.7	78.6
D	MANGANESE	mg/l	0.693	0.421	0.355
D	MERCURY	mg/l	< 0.0000050	< 0.0000050	< 0.0000050
D	MOLYBDENUM	mg/l	0.00226	0.00217	0.00211
D	NICKEL	mg/l	0.00558	0.00538	0.00483
D	POTASSIUM	mg/l	6.59	5.73	5.98
D	SELENIUM	ug/l	0.067	< 0.050	< 0.050
D	SILICON	mg/l	2.67	2.63	2.52
D	SILVER	mg/l	< 0.000010	< 0.000010	< 0.000010
D	SODIUM	mg/l	6.70	6.75	6.83
D	STRONTIUM	mg/l	0.224	0.217	0.220
D	SULFATE (AS SO4)	mg/l	386	358	353
D	THALLIUM	mg/l	0.000028	0.000021	0.000027
D	TIN	mg/l	< 0.00010	< 0.00010	< 0.00010
D	TITANIUM	mg/l	< 0.010	< 0.010	< 0.010
D	URANIUM	mg/l	0.00543	0.00562	0.00512
D	VANADIUM	mg/l	< 0.00050	< 0.00050	< 0.00050
D	ZINC	mg/l	< 0.0030	< 0.0030	0.0024
N	ACIDITY TO pH 8.3	mg/l	9.3	2.5	< 1.0
N	ALKALINITY, BICAR	mg/l	327	333	350
N	ALKALINITY, CARB	mg/l	< 1.0	< 1.0	6.4
N	ALKALINITY, HYDR	mg/l	< 1.0	< 1.0	< 1.0
N	ALKALINITY, TOTAL	mg/l	327	333	356
N	Cation - Anion Balan	%			-2.8
N	CONDUCTIVITY, FIE	us/cm		1000	1031
N	CONDUCTIVITY, LA	us/cm	1200	1150	1150
N	DISSOLVED OXYGE	mg/l		8.45	6.49
N	DISSOLVED OXYGE	%		67.1	62.7
N	Hardness, Total or D	mg/l	695	656	671
N	ION BALANCE	%	-1.5	-2.7	
N	MAJOR ANION SUM	meq/l	14.8	14.3	14.7
N	MAJOR CATION SU	meq/l	14.4	13.6	13.9
N	NITRATE NITROGE	mg/l	< 0.025	< 0.025	0.272
N	NITRITE NITROGEN	mg/l	< 0.0050	< 0.0050	< 0.0050
N	NITROGEN, AMMOI	mg/l	< 0.0050	< 0.0050	< 0.0050
N	ORTHO-PHOSPHAT	mg/l	< 0.0010	< 0.0010	< 0.0010
N	OXIDATION-REDUC	mv		-45.7	20.2
N	OXIDATION-REDUC	mv	326	331	493
N	pH, Field	ph units		7.61	7.41
N	pH, LAB	ph units	7.98	8.24	8.30
N	PHOSPHORUS	mg/l	< 0.0020	0.0029	< 0.0020
N	TEMPERATURE, FI	deg c		5.5	13.6
N	TOTAL DISSOLVED	mg/l	933	839	830
N	TOTAL KJELDAHL N	mg/l	0.082	0.135	< 0.050
N	TOTAL SUSPENDE	mg/l	3.4	2.7	< 1.0
N	TURBIDITY, LAB	ntu	0.23	0.36	0.20
T	ALUMINUM	mg/l	0.0058	0.139	< 0.0030
T	ANTIMONY	mg/l	< 0.00010	< 0.00010	< 0.00010
T	ARSENIC	mg/l	0.00011	0.00022	0.00018
T	BARIUM	mg/l	0.0857	0.0986	0.0842
T	BERYLLIUM	mg/l	< 0.000020	< 0.000020	< 0.000020
T	BISMUTH	mg/l	< 0.000050	< 0.000050	< 0.000050
T	BORON	mg/l	0.027	0.028	0.030
T	CADMIUM	mg/l	0.000478	0.000809	0.000409
T	CALCIUM	mg/l	142	150	136
T	CHROMIUM	mg/l	< 0.00010	0.00028	< 0.00010
T	COBALT	mg/l	0.00108	0.00116	0.00102
T	COPPER	mg/l	< 0.00050	< 0.00050	< 0.00050
T	IRON	mg/l	0.088	0.716	0.038
T	LEAD	mg/l	< 0.000050	0.000217	< 0.000050
T	LITHIUM	mg/l	0.101	0.0973	0.0942
T	MAGNESIUM	mg/l	74.2	77.7	79.3
T	MANGANESE	mg/l	0.792	1.02	0.369
T	MERCURY	mg/l	< 0.0000050	< 0.0000050	< 0.0000050
T	MOLYBDENUM	mg/l	0.00219	0.00250	0.00210
T	NICKEL	mg/l	0.00572	0.00667	0.00533
T	POTASSIUM	mg/l	6.01	5.99	5.82
T	SELENIUM	ug/l	0.082	0.198	0.067
T	SILICON	mg/l	2.72	2.91	2.50
T	SILVER	mg/l	< 0.000010	< 0.000010	< 0.000010
T	SODIUM	mg/l	6.52	7.13	7.00
T	STRONTIUM	mg/l	0.214	0.228	0.221
T	THALLIUM	mg/l	0.000029	0.000043	0.000027
T	TIN	mg/l	< 0.00010	< 0.00010	< 0.00010
T	TITANIUM	mg/l	< 0.010	< 0.010	< 0.010
T	TOTAL ORGANIC C	mg/l	1.23	1.62	1.15
T	URANIUM	mg/l	0.00540	0.00588	0.00535
T	VANADIUM	mg/l	< 0.00050	0.00084	0.00058
T	ZINC	mg/l	0.0031	0.0076	< 0.0030

Appendix E:
Water Quality Data

		Location	FR_STPWSEEP	FR_STPWSEEP	FR_STPWSEEP
		Date	15/09/2016	28/11/2016	12/06/2017
		Sample Type	NP	NP	NP
Fraction	Analyte	Unit	Result	Result	Result
D	ALUMINUM	mg/l	< 0.0030	< 0.0030	< 0.0010
D	ANTIMONY	mg/l	< 0.00010	< 0.00010	< 0.00010
D	ARSENIC	mg/l	< 0.00010	< 0.00010	< 0.00010
D	BARIUM	mg/l	0.0845	0.105	0.111
D	BERYLLIUM	mg/l	< 0.000020	< 0.000020	< 0.000020
D	BISMUTH	mg/l	< 0.000050	< 0.000050	< 0.000050
D	BORON	mg/l	0.026	0.028	0.030
D	BROMIDE	mg/l	< 0.25	< 0.25	< 0.25
D	CADMIUM	mg/l	0.000403	0.000677	0.000778
D	CALCIUM	mg/l	138	136	137
D	CARBON, DISSOLV	mg/l	1.01	0.79	0.91
D	CHLORIDE	mg/l	7.84	6.25	7.2
D	CHROMIUM	mg/l	< 0.00010	< 0.00010	< 0.00010
D	COBALT	mg/l	0.00127	0.00140	0.00143
D	COPPER	mg/l	< 0.00050	< 0.00050	< 0.00020
D	FLUORIDE	mg/l	0.38	0.35	0.14
D	IRON	mg/l	< 0.010	< 0.010	< 0.010
D	LEAD	mg/l	< 0.000050	< 0.000050	< 0.000050
D	LITHIUM	mg/l	0.0975	0.0990	0.0989
D	MAGNESIUM	mg/l	76.8	70.1	78.2
D	MANGANESE	mg/l	0.579	0.879	0.828
D	MERCURY	mg/l	< 0.0000050	< 0.0000050	< 0.0000050
D	MOLYBDENUM	mg/l	0.00264	0.00287	0.00259
D	NICKEL	mg/l	0.00562	0.00703	0.00654
D	POTASSIUM	mg/l	6.58	5.66	5.97
D	SELENIUM	ug/l	< 0.050	0.054	0.216
D	SILICON	mg/l	3.06	2.63	2.79
D	SILVER	mg/l	< 0.000010	< 0.000010	< 0.000010
D	SODIUM	mg/l	6.24	6.60	6.53
D	STRONTIUM	mg/l	0.214	0.212	0.212
D	SULFATE (AS SO4)	mg/l	355	317	206
D	THALLIUM	mg/l	0.000029	0.000058	0.000055
D	TIN	mg/l	< 0.00010	< 0.00010	< 0.00010
D	TITANIUM	mg/l	< 0.010	< 0.010	< 0.010
D	URANIUM	mg/l	0.00550	0.00646	0.00618
D	VANADIUM	mg/l	< 0.00050	< 0.00050	< 0.00050
D	ZINC	mg/l	< 0.0030	< 0.0030	0.0024
N	ACIDITY TO pH 8.3	mg/l	< 1.0	7.2	< 1.0
N	ALKALINITY, BICAR	mg/l	342	356	386
N	ALKALINITY, CARB	mg/l	< 1.0	< 1.0	< 1.0
N	ALKALINITY, HYDR	mg/l	< 1.0	< 1.0	< 1.0
N	ALKALINITY, TOTAL	mg/l	342	356	386
N	Cation - Anion Balan	%			4.4
N	CONDUCTIVITY, FIE	us/cm		979	1007
N	CONDUCTIVITY, LA	us/cm	1160	1130	1120
N	DISSOLVED OXYGE	mg/l		2.32	2.67
N	DISSOLVED OXYGE	%		19.7	23.1
N	Hardness, Total or D	mg/l	661	628	663
N	ION BALANCE	%	-2.8	-3.3	
N	MAJOR ANION SUM	meq/l	14.5	13.9	12.6
N	MAJOR CATION SU	meq/l	13.7	13.0	13.7
N	NITRATE NITROGE	mg/l	< 0.025	< 0.025	4.96
N	NITRITE NITROGEN	mg/l	< 0.0050	< 0.0050	0.0053
N	NITROGEN, AMMOI	mg/l	0.0132	0.0433	0.0432
N	ORTHO-PHOSPHAT	mg/l	< 0.0010	0.0014	< 0.0010
N	OXIDATION-REDUC	mv		-48.5	80.5
N	OXIDATION-REDUC	mv	307	336	464
N	pH, Field	ph units		7.35	7.19
N	pH, LAB	ph units	8.30	8.11	8.24
N	PHOSPHORUS	mg/l	< 0.0020	< 0.0020	< 0.0020
N	TEMPERATURE, FIE	deg c		8.0	8.5
N	TOTAL DISSOLVED	mg/l	891	777	790
N	TOTAL KJELDAHL N	mg/l	0.097	0.105	0.053
N	TOTAL SUSPENDEI	mg/l	< 1.0	2.8	< 1.0
N	TURBIDITY, LAB	ntu	0.14	0.21	0.13
T	ALUMINUM	mg/l	< 0.0030	0.0037	< 0.0030
T	ANTIMONY	mg/l	< 0.00010	< 0.00010	< 0.00010
T	ARSENIC	mg/l	0.00013	< 0.00010	0.00016
T	BARIUM	mg/l	0.0924	0.135	0.112
T	BERYLLIUM	mg/l	< 0.000020	< 0.000020	< 0.000020
T	BISMUTH	mg/l	< 0.000050	< 0.000050	< 0.000050
T	BORON	mg/l	0.027	0.029	0.029
T	CADMIUM	mg/l	0.000398	0.000973	0.000788
T	CALCIUM	mg/l	144	142	134
T	CHROMIUM	mg/l	< 0.00010	< 0.00010	< 0.00010
T	COBALT	mg/l	0.00144	0.00199	0.00145
T	COPPER	mg/l	< 0.00050	< 0.00050	< 0.00050
T	IRON	mg/l	0.034	0.021	< 0.010
T	LEAD	mg/l	< 0.000050	< 0.000050	< 0.000050
T	LITHIUM	mg/l	0.102	0.0993	0.0945
T	MAGNESIUM	mg/l	71.2	76.5	79.2
T	MANGANESE	mg/l	0.823	1.89	0.853
T	MERCURY	mg/l	< 0.0000050	< 0.0000050	< 0.0000050
T	MOLYBDENUM	mg/l	0.00275	0.00312	0.00264
T	NICKEL	mg/l	0.00613	0.0101	0.00699
T	POTASSIUM	mg/l	6.04	6.03	5.80
T	SELENIUM	ug/l	< 0.050	< 0.050	0.221
T	SILICON	mg/l	3.11	2.80	2.84
T	SILVER	mg/l	< 0.000010	< 0.000010	< 0.000010
T	SODIUM	mg/l	6.04	7.16	6.63
T	STRONTIUM	mg/l	0.215	0.220	0.212
T	THALLIUM	mg/l	0.000031	0.000081	0.000057
T	TIN	mg/l	< 0.00010	< 0.00010	< 0.00010
T	TITANIUM	mg/l	< 0.010	< 0.010	< 0.010
T	TOTAL ORGANIC C	mg/l	1.09	0.90	1.12
T	URANIUM	mg/l	0.00578	0.00660	0.00647
T	VANADIUM	mg/l	< 0.00050	< 0.00050	0.00069
T	ZINC	mg/l	< 0.0030	0.0031	< 0.0030

APPENDIX F

Tailings Storage Facility Registry

Appendix F:
TSF Registry

Mine Name: Fording River Operations
Permit No: No. C-3 (and amendments)

General Mine Information	
Owner/company	Teck Resources Ltd.
Nearest community	Elkford
Region	Elk Valley / East Kootenay
Ore(s) mined	Coal
Mine operational status	Operational
Number of tailings impoundments	4

TSF Documentation	
Date of last DSI	3 October 2017
Date of last DSR	November 2014
Date of next DSR	2019
Date of OMS update	December 2015, currently under review
Date of EPRP update	Draft September 2017, under review
Date of EPRP test	December 2015
Date of dam breach and inundation study	28 November 2014
Tailings Management system (name)	FRO Tailings Management System
Tailings management system (last audit)	Legal compliance audit Aug. 2016
TSF risk assessment last reviewed	To be completed by end of 2017
Water balance and water management plan (last update)	2017
Date of last as-built	2012 & 2013

TSF Information	
TSF name	South Tailings Pond
TSF operating status	Active, in use
Year facility was last used (if closed)	Currently in use
Number of dams	2
Engineer of record	John Cunning (Golder Associates Ltd.)
TSF qualified person	Heather Brickner
Spillway present	no
Spillway date of last maintenance	n/a
Quantitative Performance Objectives (QPOs)	yes
Volume of impoundment	12.1 million m^3

Dam Information	
Dam name	**Main Dam**
Height of dam	35 m
Consequence classification	Very High
Slope	1.5 to 1.75H : 1V
minimum factor of safety (long term steady state)	1.5
minimum factor of safety (pseudo-static)	1.2
Permitted elevation	1,637.85 m
Current elevation	1,637.85 m
Seismic design (AEP)	1/2 between 1/2,475 and 1/10,000 or Maximum Credible Earthquate
Flood design (AEP)	2/3 between 1/1,000 and PMF event
Type of dam construction (upstream, downstream, centre)	downstream
Type of dam core (till core, rock fill, cyclone sand, etc.)	till core

Dam Information	
Dam name	**West Dam**
Height of dam	35 m
Consequence classification	Very High
Slope	1.5 to 1.75H : 1V
minimum factor of safety (long term steady state)	1.6
minimum factor of safety (pseudo-static)	1.0
Permitted elevation	1,637.85 m to 1640 m
Current elevation	1,637.85 m to 1640 m
Seismic design (AEP)	1/2 between 1/2,475 and 1/10,000 or Maximum Credible Earthquate
Flood design (AEP)	2/3 between 1/1,000 and PMF event
Type of dam construction (upstream, downstream, centre)	downstream
Type of dam core (till core, rock fill, cyclone sand, etc.)	till core

TSF Information	
TSF name	North Tailings Pond
TSF operating status	Inactive
Year facility was last used (if closed)	2006
Number of dams	1
Engineer of record	John Cunning (Golder Associates Ltd.)
TSF qualified person	Heather Brickner
Spillway present	no
Spillway date of last maintenance	n/a
Quantitative Performance Objectives (QPOs)	yes
Volume of impoundment	3.8 million m^3

Dam Information	
Dam name	North Tailings Pond Dam
Height of dam	24 m
Consequence classification	Very High
Slope	1.5 to 1.75H : 1V
minimum factor of safety (long term steady state)	1.5
minimum factor of safety (pseudo-static)	1.2
Permitted elevation	1653.09 m
Current elevation	1,652.6 m
Seismic design (AEP)	1/2 between 1/2,475 and 1/10,000 or Maximum Credible Earthquate
Flood design (AEP)	2/3 between 1/1,000 and PMF event
Type of dam construction (upstream, downstream, centre)	downstream
Type of dam core (till core, rock fill, cyclone sand, etc.)	till core

Notes: Elevations reported in the Elk Valley Elevation Datum.

Sources: 2017 Dam Safety Inspection for North Tailings Pond and South Tailings Pond (Golder, March 2018)
C-3 Permit Amendments

General Mine Information	
Owner/company	
Nearest community	name of closest community
Region	mining region name - Southcoast, Northwest, Northeast, Kootenays, Okanagan
Ore(s) mined	
Mine operational status	Operating, Closed or Care and Maintenance
Number of tailings impoundments	

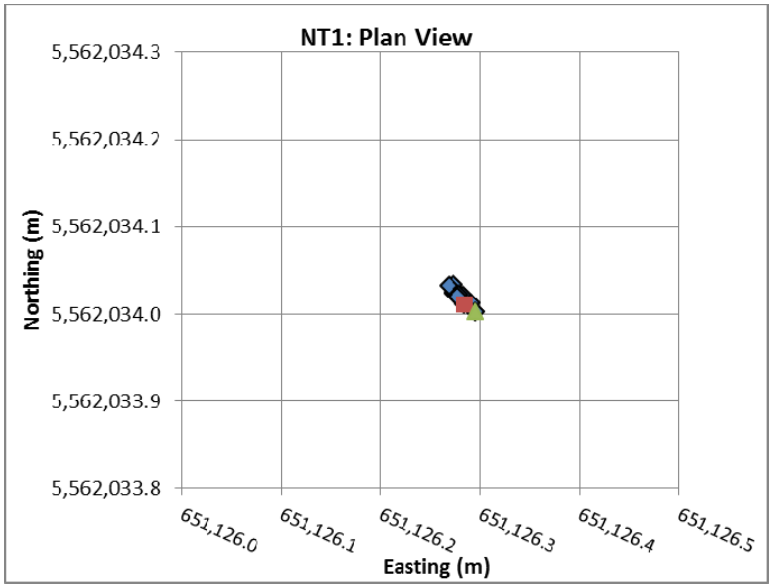
TSF Documentation	
Date of last DSI	dd/mm/yyyy of last inspection performed
Date of last DSR	dd/mm/yyyy of last inspection performed
Date of next DSR	yyyy of next DSR. NOTE DSRs now due every 5 years as per Code requirements
Date of OMS update	dd/mm/yyyy when OMS last updated
Date of EPRP update	dd/mm/yyyy when EPRP last updated
Date of EPRP test	dd/mm/yyyy when last EPRP test
Date of dam breach and inundation study	dd/mm/yyyy
Tailings management system (name)	name of system used (TSM, ISO, etc)
Tailings management system (last audit)	when last audit completed
TSF risk assessment last reviewed	dd/mm/yyyy when last risk assessment completed
Water balance and water management plan (last update)	dd/mm/yyyy last update
Date of last as-built	dd/mm/yyyy when as-built completed for TSF

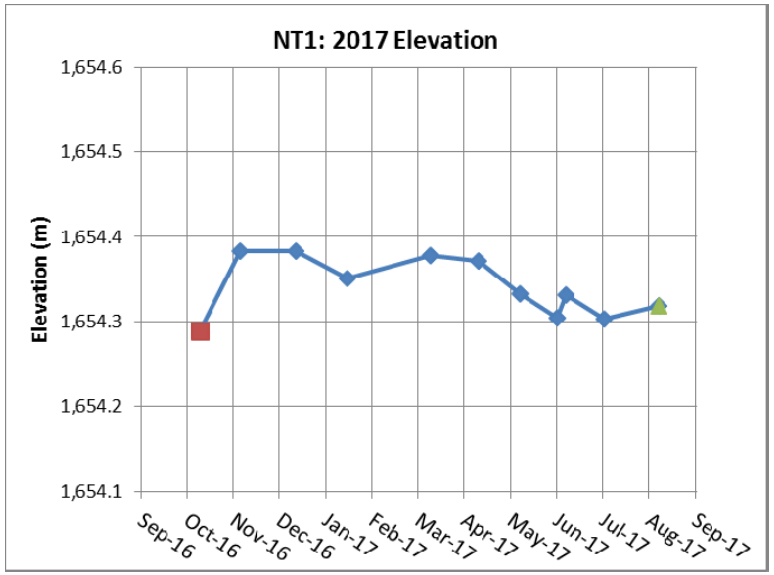
TSF Information	
TSF name	name of TSF please fill in one box per TSF on site
TSF operating status	current status of TSF - operating or closed. If intention is to use facility in future, please include projected date of re-start
Year facility was last used (if closed)	yyyy that TSF last received tailings
Number of dams	provide number of dams associated with the TSF
Engineer of record	name of Engineer of Record for the TSF
TSF qualified person	name of TSF qualified person
Spillway present	yes or no
Spillway date of last maintenance	dd/mm/yyyy of last maintenance
Quantitative Performance Objectives (QPOs)	yes or no (included in OMS manual and DSI)
Volume of impoundment	volume of impoundment in cubic meters

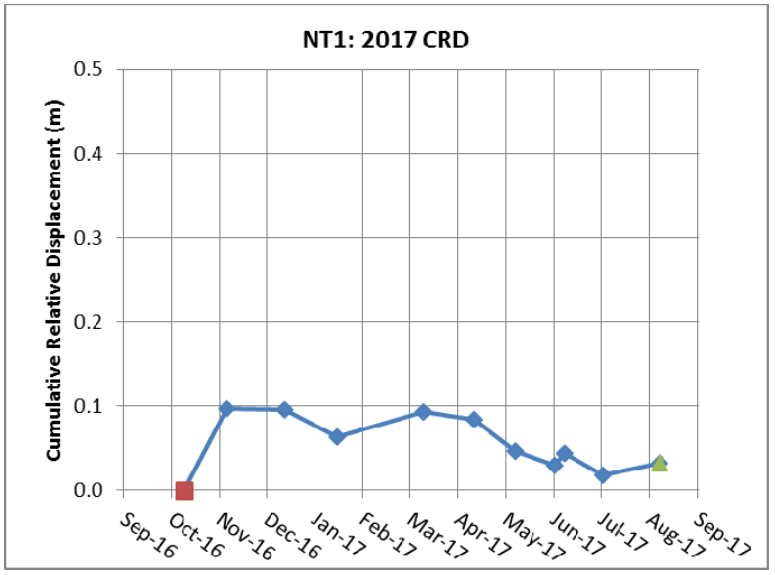
Dam Information	
Dam name	provide dam name if applicable - please fill in one box per dam on mine site
Height of dam	current height of dam in m (meaured toe of slope to crest of dam)
Consequence classification	consequence classification of the dam
Slope	Maximum slope angle (ex. 2H:1V)
minimum factor of safety (long-term steady state)	Minimum FOS (long term steady state analyses)
minimum factor of safety (pseudo-static)	Minimum FOS (psuedo-static analyses)
Permitted elevation	provide highest permitted elevation of the dam in m
Current elevation	provide current elevation of the dam in m
Seismic design (AEP)	Annual Exceedance Probability (Seismic design)
Flood design (AEP)	Annual Exceedance Probability (Flood design)
Type of dam construction (upstream, downstream, centre)	upstream, downstream or centre
Type of dam core (till core, rock fill, cyclone sand, etc.)	till core, rock fill, cyclone same or other

APPENDIX G

Tailings Pond Survey Data (Prisms and GPS)







LEGEND

- INITIAL READING (OCTOBER 2016)
- 2016/2017 READINGS
- LAST READING (AUGUST 2017)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN NOVEMBER 2017.

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

CONSULTANT
Golder Associates

YYYY-MM-DD	2018-03-09
PREPARED	NC
DESIGN	NC
REVIEW	JMS
APPROVED	JCC

PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND
PRISM NT1

PROJECT No.	Phase	Rev.	FIGURE
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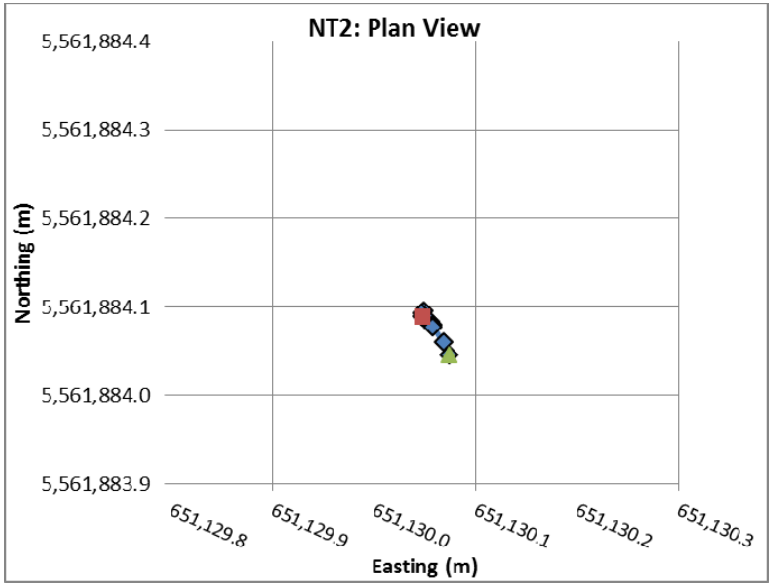

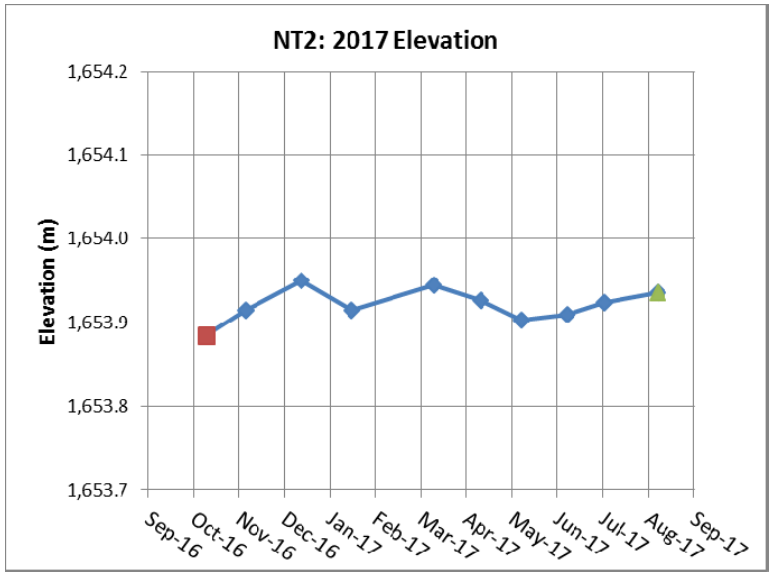

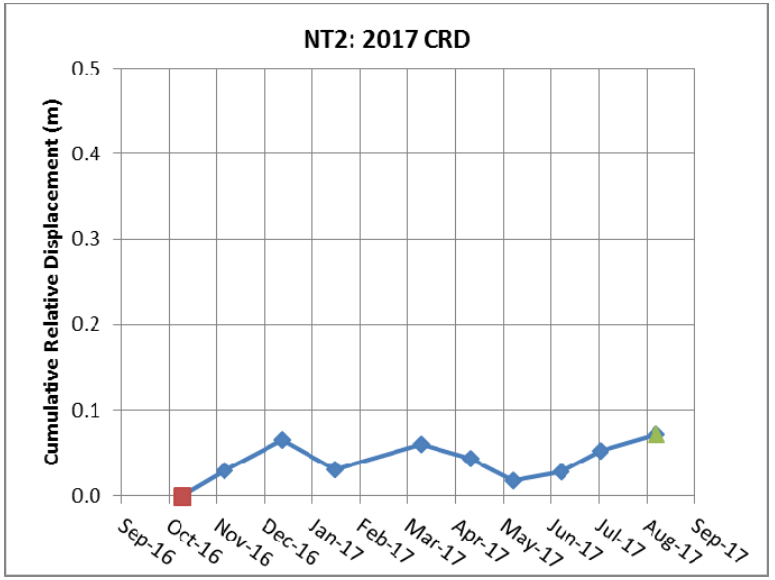

LEGEND

- INITIAL READING (OCTOBER 2016)
- 2016/2017 READINGS
- LAST READING (AUGUST 2017)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN NOVEMBER 2017.

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

CONSULTANT
Golder Associates

YYYY-MM-DD	2018-03-09
PREPARED	NC
DESIGN	NC
REVIEW	JMS
APPROVED	JCC

PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND
PRISM NT2

PROJECT No.	Phase	Rev.	FIGURE
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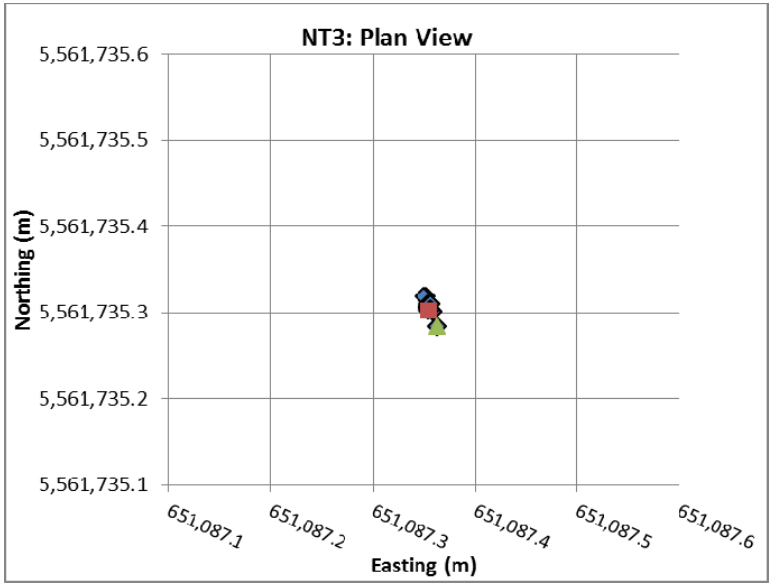

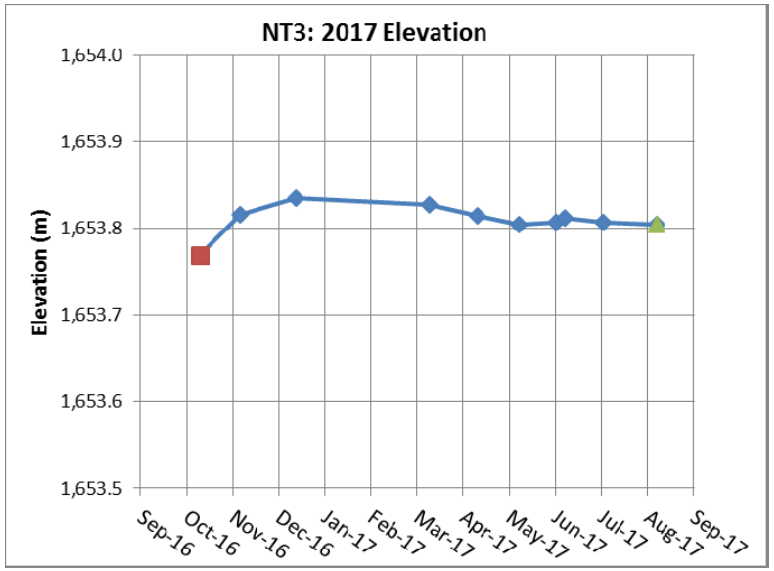

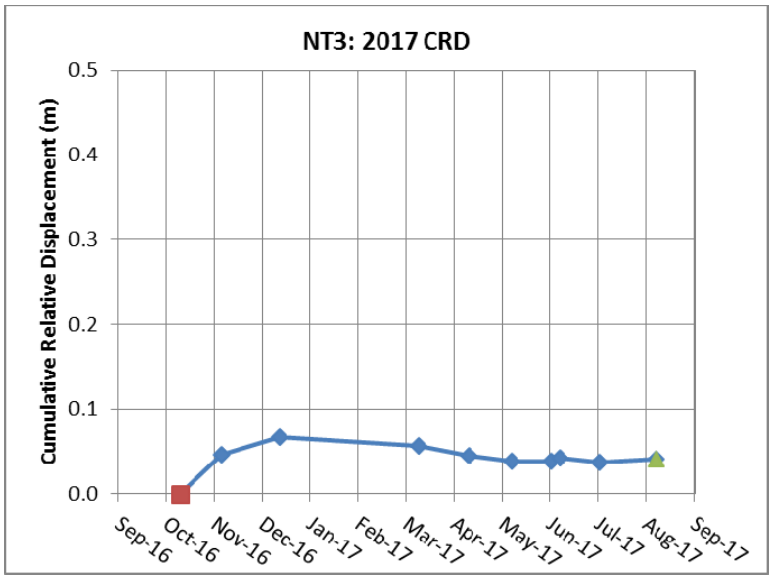

LEGEND

- INITIAL READING (OCTOBER 2016)
- 2016/2017 READINGS
- LAST READING (AUGUST 2017)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN NOVEMBER 2017.

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

CONSULTANT
Golder Associates

YYYY-MM-DD	2018-03-09
PREPARED	NC
DESIGN	NC
REVIEW	JMS
APPROVED	JCC

PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND
PRISM NT3

PROJECT No.	Phase	Rev.	FIGURE
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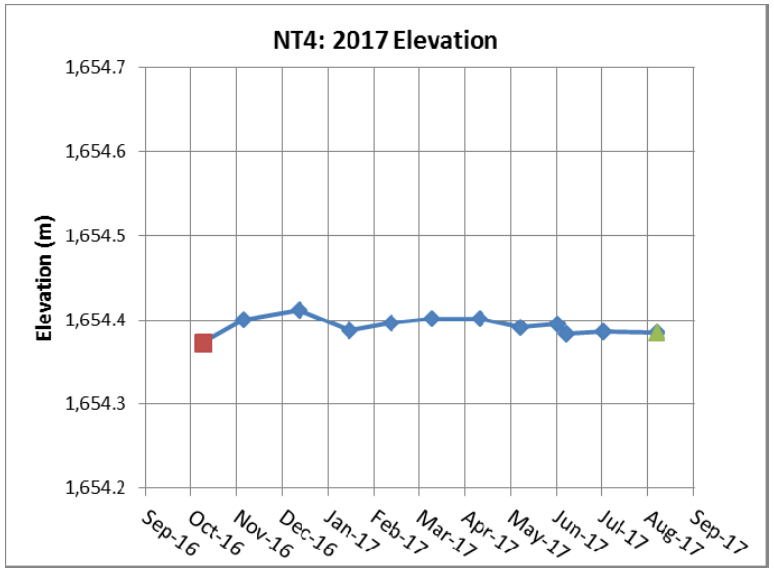

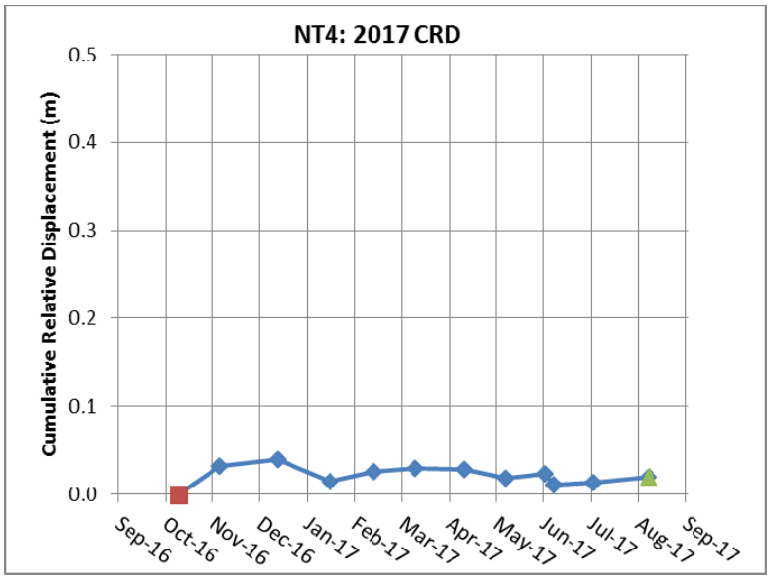

LEGEND

- INITIAL READING (OCTOBER 2016)
- 2016/2017 READINGS
- LAST READING (AUGUST 2017)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN NOVEMBER 2017.

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

CONSULTANT
Golder Associates

YYYY-MM-DD	2018-03-09
PREPARED	NC
DESIGN	NC
REVIEW	JMS
APPROVED	JCC

PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND
PRISM NT4

PROJECT No.	Phase	Rev.	FIGURE
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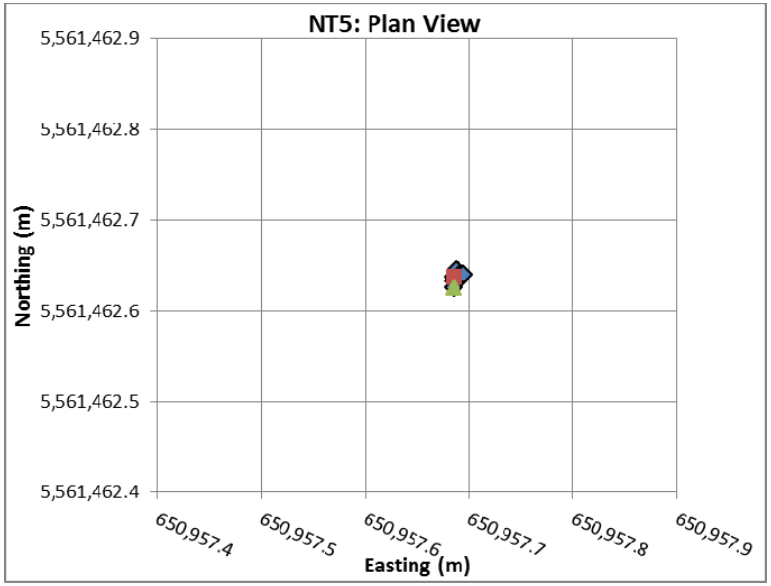
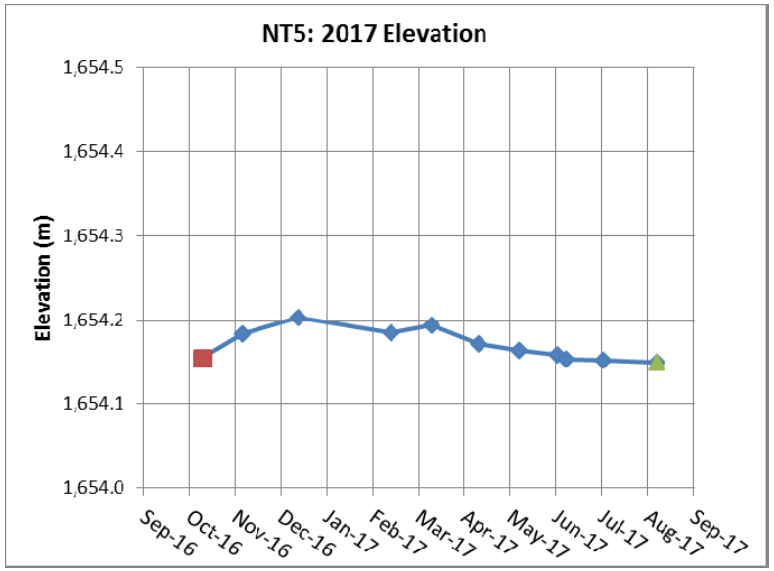
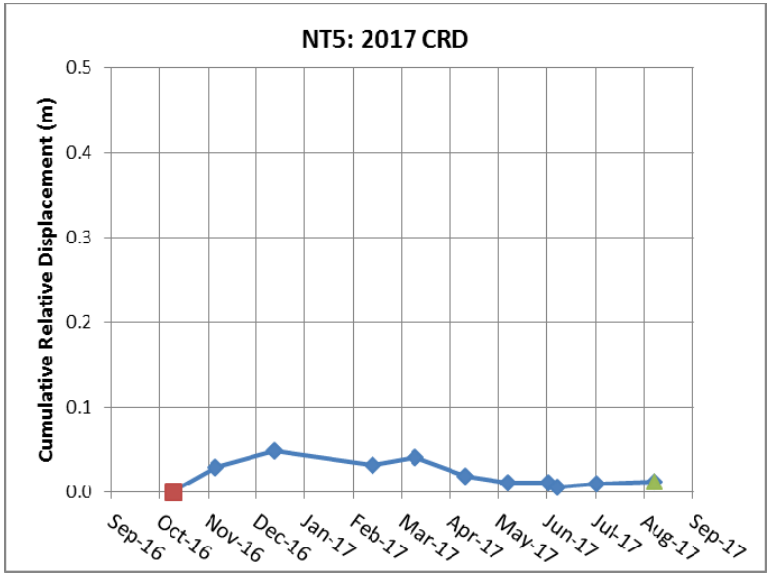






LEGEND

- INITIAL READING (OCTOBER 2016)
- 2016/2017 READINGS
- LAST READING (AUGUST 2017)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN NOVEMBER 2017.

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

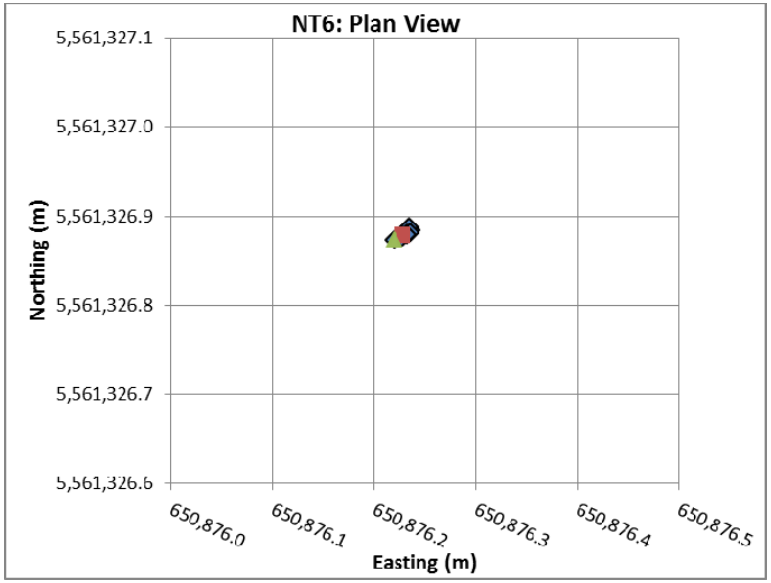
CONSULTANT
Golder Associates

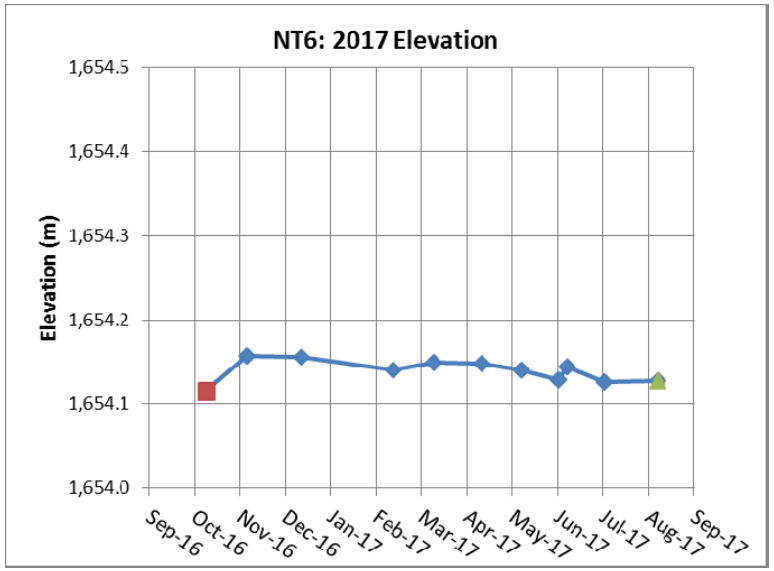
YYYY-MM-DD	2018-03-09
PREPARED	NC
DESIGN	NC
REVIEW	JMS
APPROVED	JCC

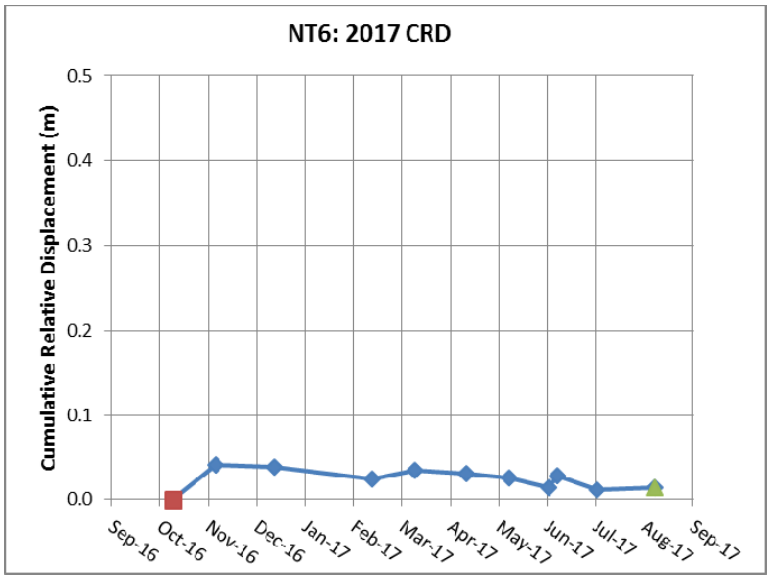
PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND
PRISM NT5

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**G-5**







LEGEND

- INITIAL READING (OCTOBER 2016)
- 2016/2017 READINGS
- LAST READING (AUGUST 2017)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN NOVEMBER 2017.

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

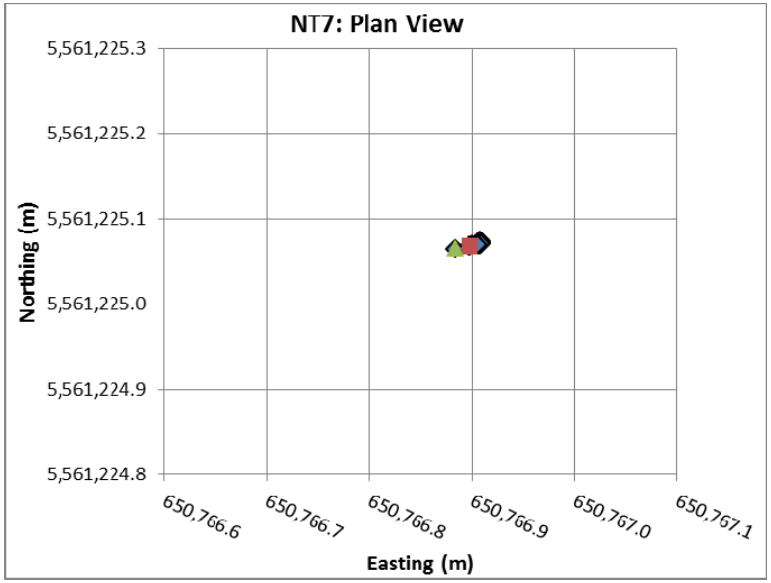
CONSULTANT
Golder Associates

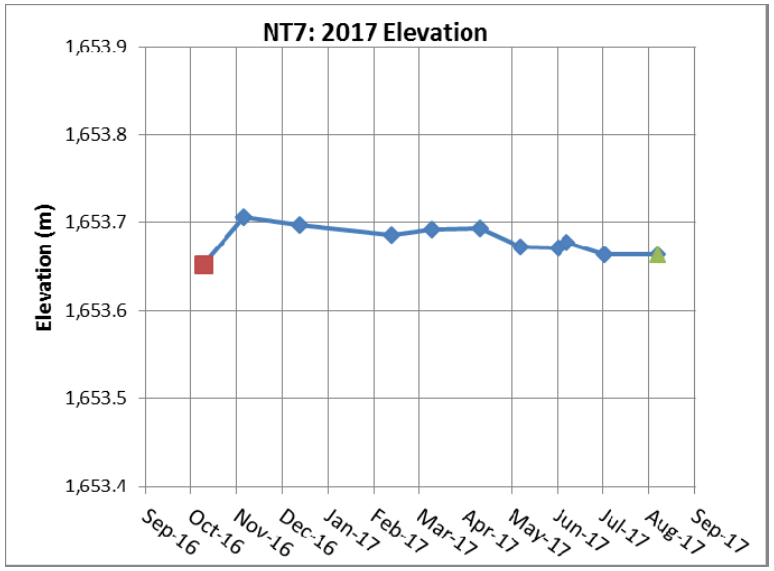
YYYY-MM-DD	2018-03-09
PREPARED	NC
DESIGN	NC
REVIEW	JMS
APPROVED	JCC

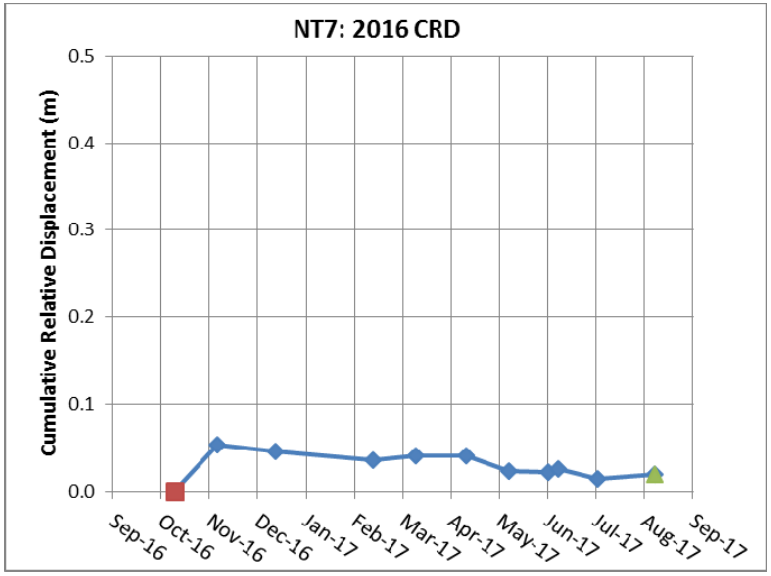
PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND
PRISM NT6

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**G-6**







LEGEND

- INITIAL READING (OCTOBER 2016)
- 2016/2017 READINGS
- LAST READING (AUGUST 2017)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN NOVEMBER 2017.

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

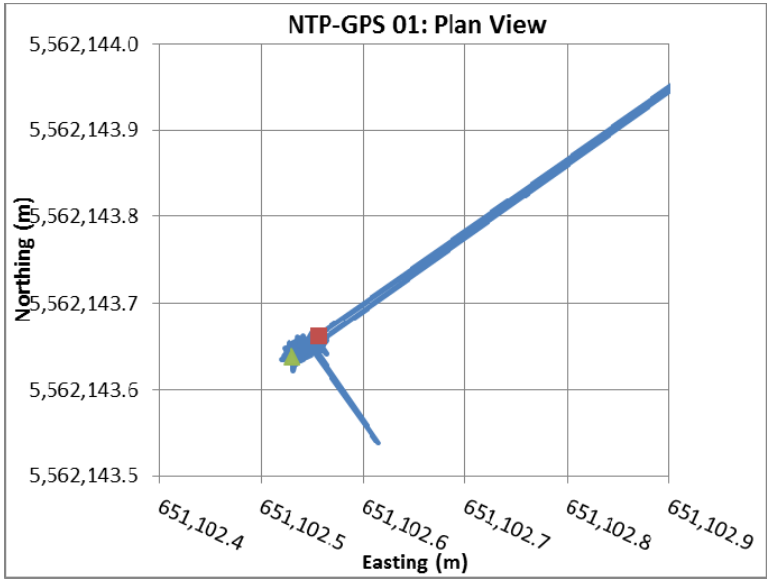
CONSULTANT
Golder Associates

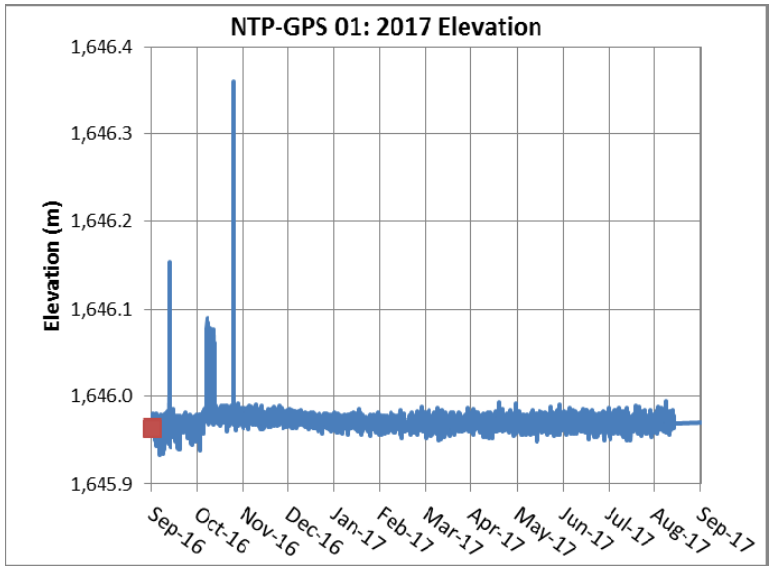
YYYY-MM-DD	2018-03-09
PREPARED	NC
DESIGN	NC
REVIEW	JMS
APPROVED	JCC

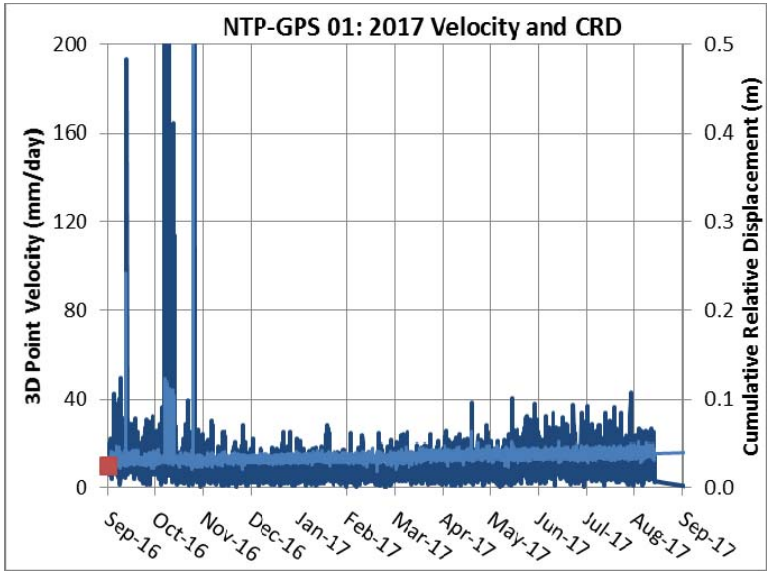
PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND
PRISM NT7

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**G-7**







LEGEND

- INITIAL READING (SEPTEMBER 2016)
- 2016/2017 READINGS
- LAST READING (AUGUST 2017)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN MARCH 2018.

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

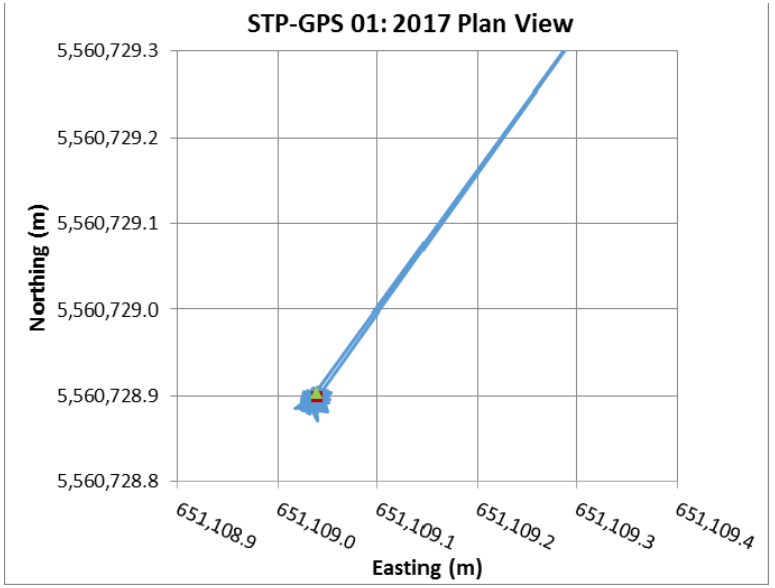
CONSULTANT
Golder Associates

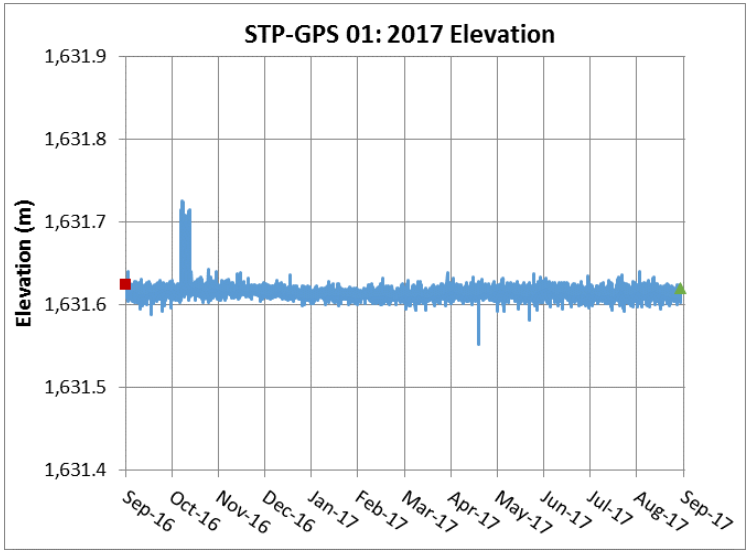
YYYY-MM-DD	2018-03-09
PREPARED	NC
DESIGN	NC
REVIEW	JMS
APPROVED	JCC

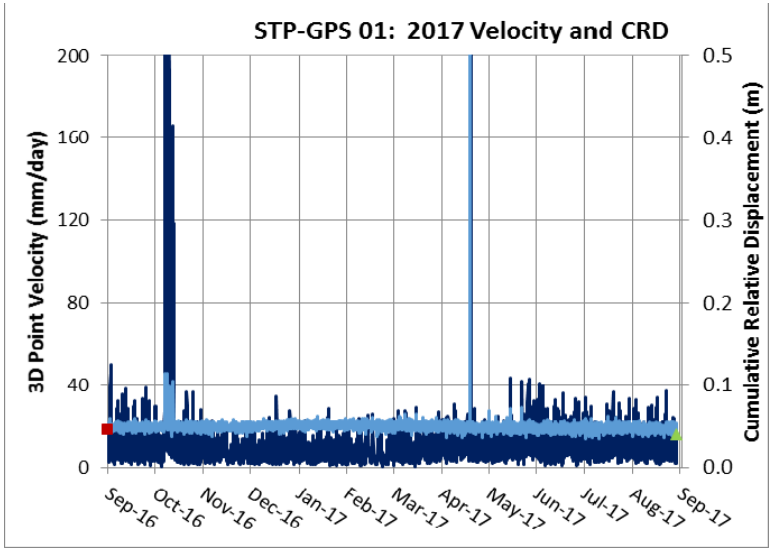
PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND
NTP-GPS 01

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**G-8**







LEGEND

- INITIAL READING (SEPTEMBER 2016)
- 2016/2017 READINGS
- LAST READING (AUGUST 2017)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN NOVEMBER 2017.

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

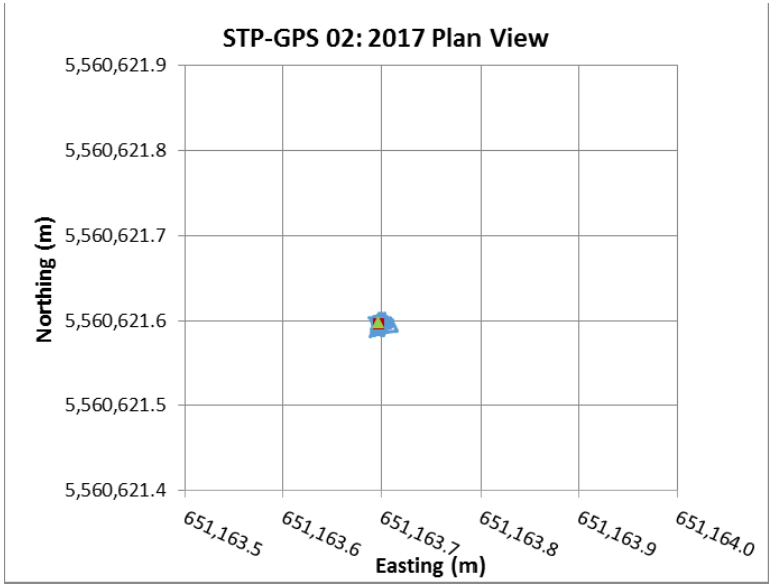
CONSULTANT
Golder Associates

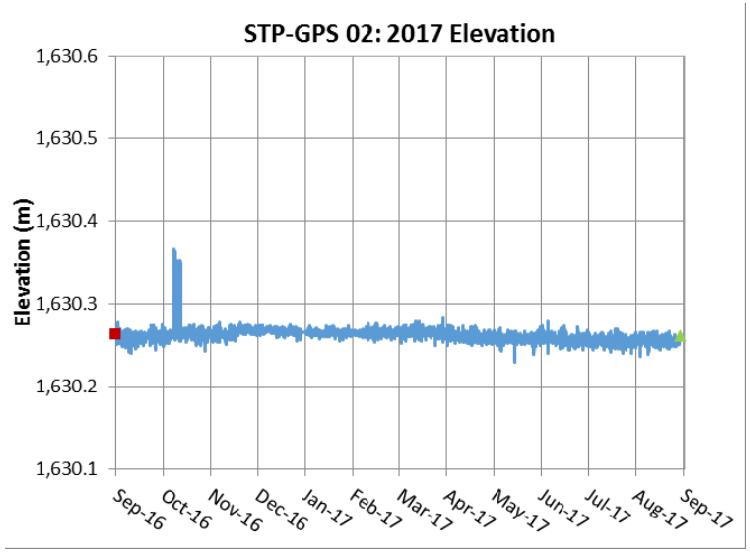
YYYY-MM-DD	2018-03-09
PREPARED	NC
DESIGN	NC
REVIEW	JMS
APPROVED	JCC

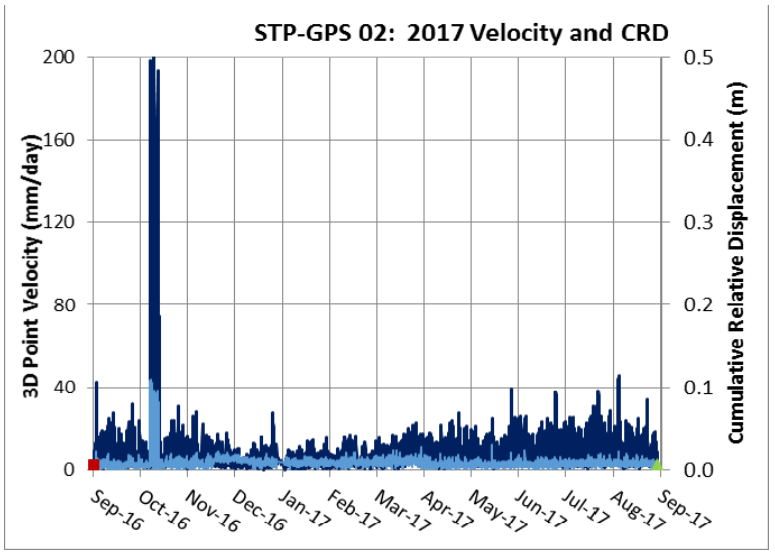
PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND
STP-GPS 01

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**G-9**







LEGEND

- INITIAL READING (SEPTEMBER 2016)
- 2016/2017 READINGS
- LAST READING (AUGUST 2017)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN NOVEMBER 2017.

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

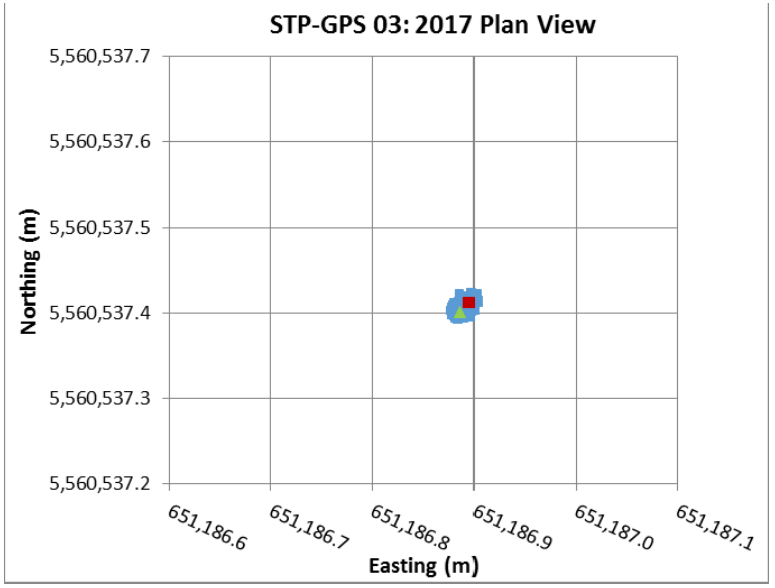
CONSULTANT
Golder Associates

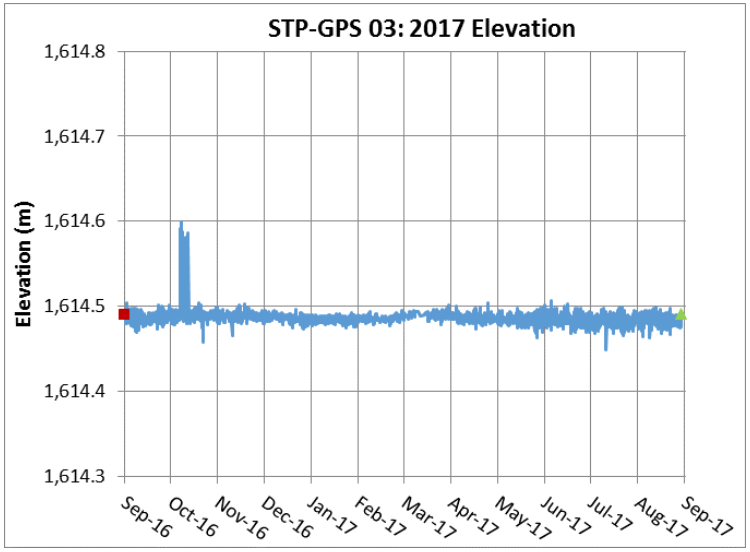
YYYY-MM-DD	2018-03-09
PREPARED	NC
DESIGN	NC
REVIEW	JMS
APPROVED	JCC

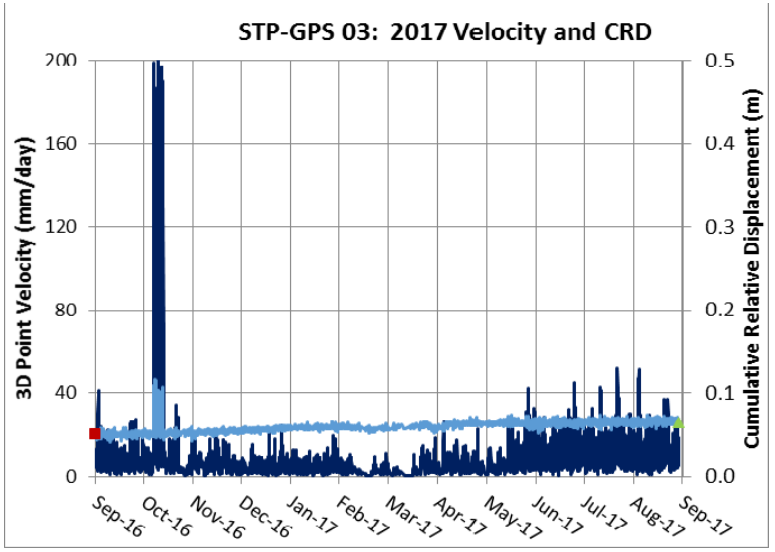
PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND
STP-GPS 02

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**G-10**







LEGEND

- INITIAL READING (SEPTEMBER 2016)
- 2016/2017 READINGS
- LAST READING (AUGUST 2017)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN NOVEMBER 2017.

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

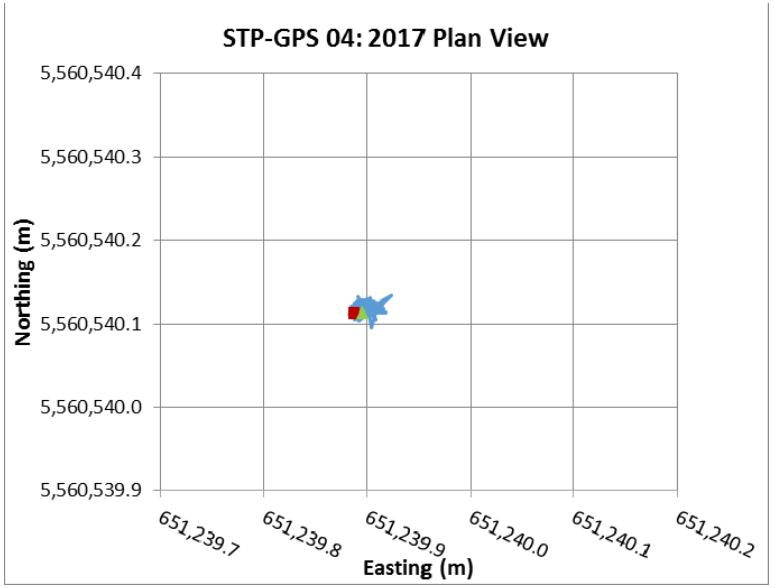
CONSULTANT
Golder Associates

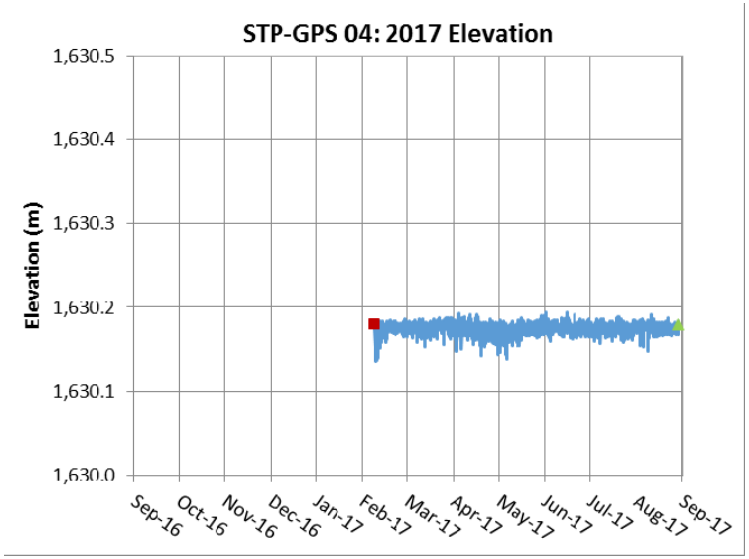
YYYY-MM-DD	2018-03-09
PREPARED	NC
DESIGN	NC
REVIEW	JMS
APPROVED	JCC

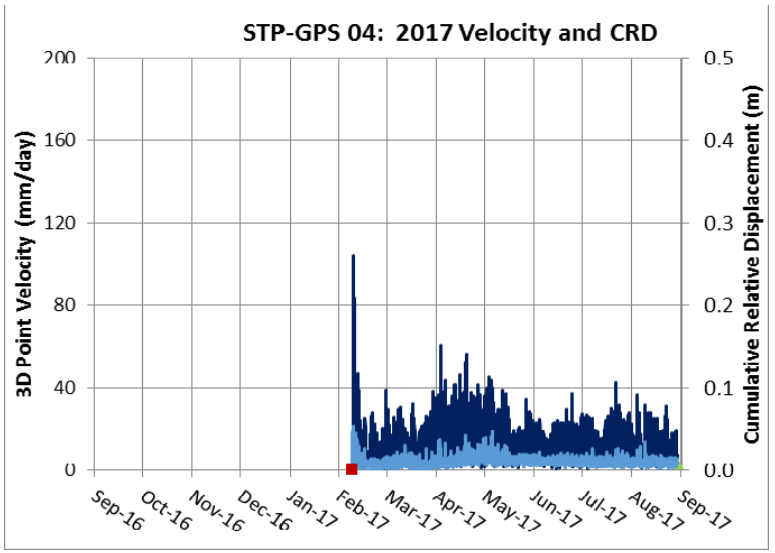
PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND
STP-GPS 03

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**G-11**







LEGEND

- INITIAL READING (FEBRUARY 2017)
- 2017 READINGS
- LAST READING (AUGUST 2017)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN NOVEMBER 2017.

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

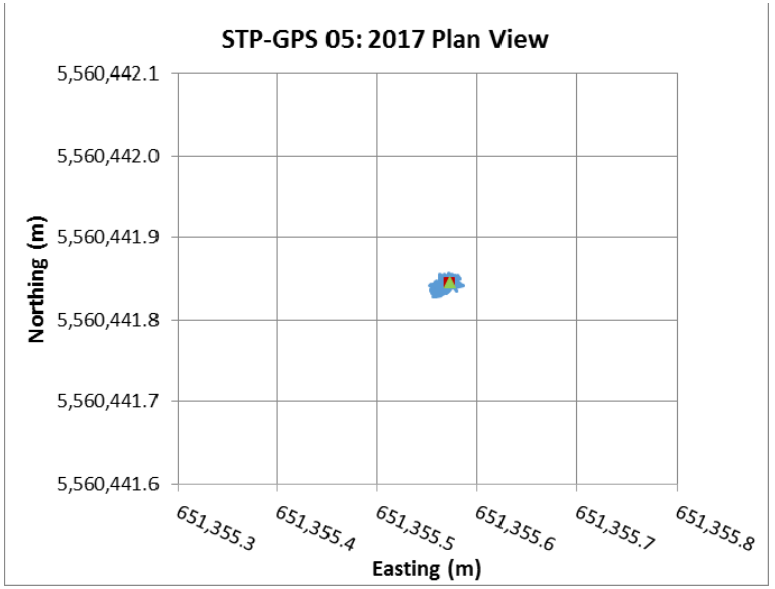
CONSULTANT
Golder Associates

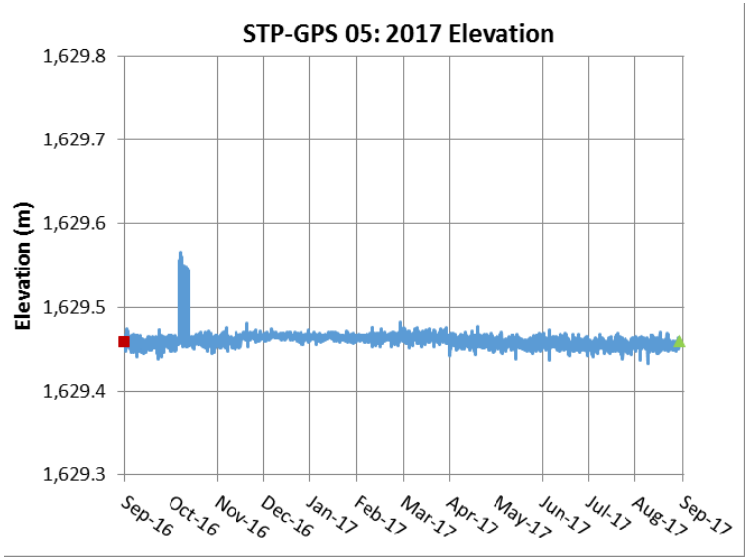
YYYY-MM-DD	2018-03-09
PREPARED	NC
DESIGN	NC
REVIEW	JMS
APPROVED	JCC

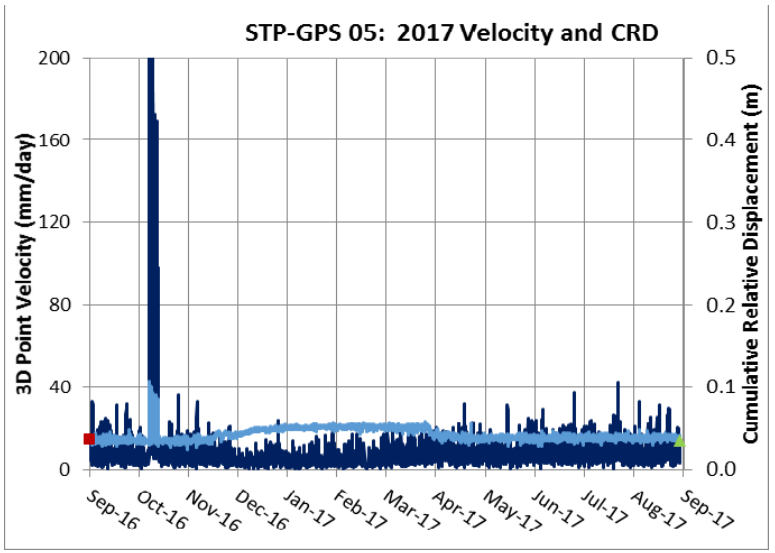
PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND
STP-GPS 04

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**G-12**







LEGEND

- INITIAL READING (SEPTEMBER 2016)
- 2016/2017 READINGS
- LAST READING (AUGUST 2017)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN NOVEMBER 2017.

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

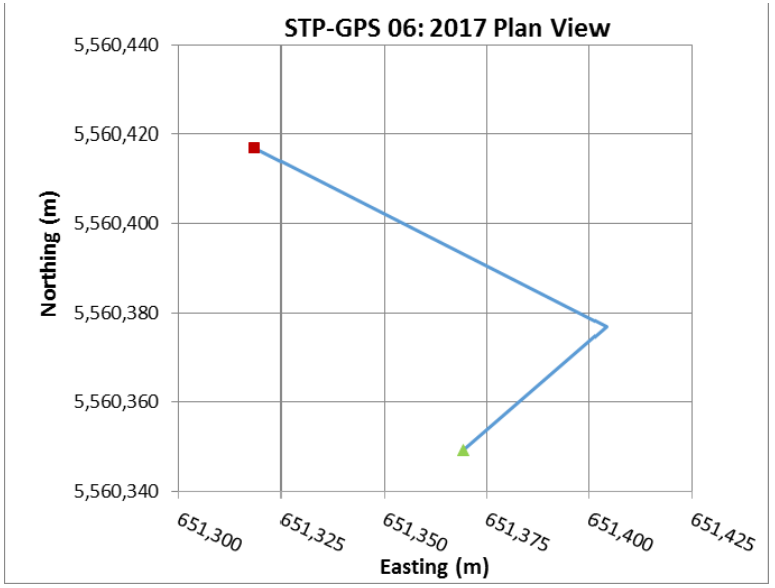
CONSULTANT
Golder Associates

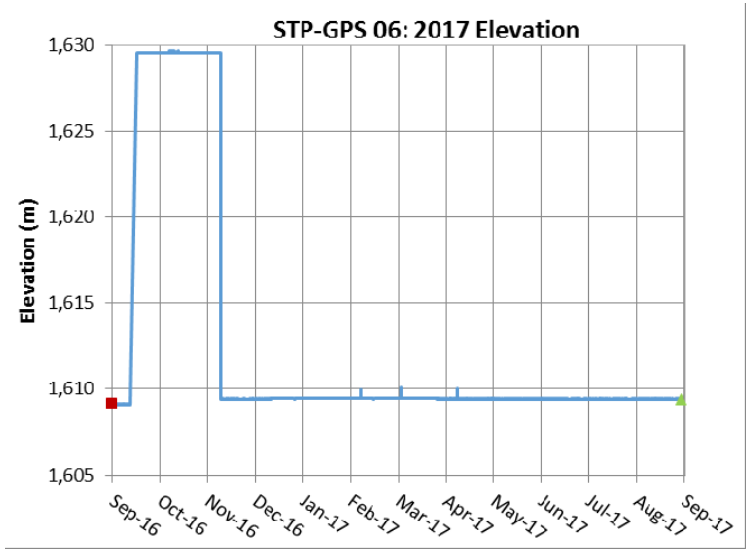
YYYY-MM-DD	2018-03-09
PREPARED	NC
DESIGN	NC
REVIEW	JMS
APPROVED	JCC

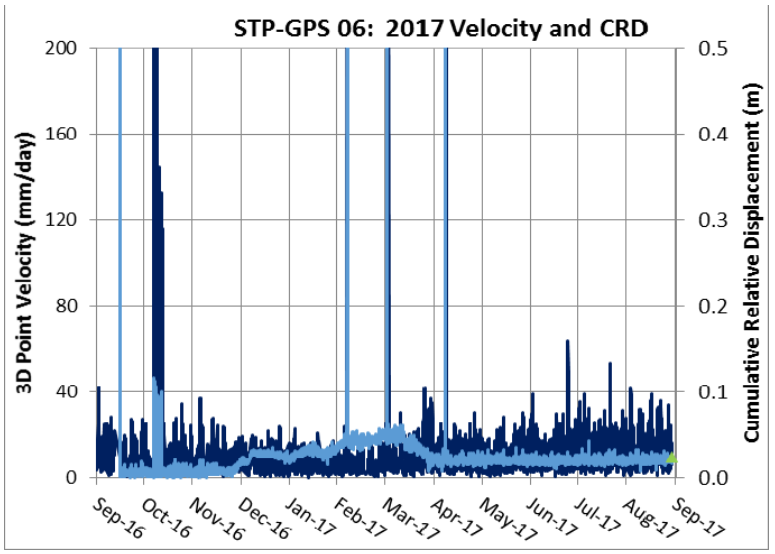
PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND
STP-GPS 05

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**G-13**







LEGEND

- INITIAL READING (SEPTEMBER 2016)
- 2016/2017 READINGS
- LAST READING (AUGUST 2017)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN NOVEMBER 2017.
2. SCALE OF PLAN VIEW AND ELEVATION PLOTS ENLARGED TO SHOW MOVEMENT OF GPS

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

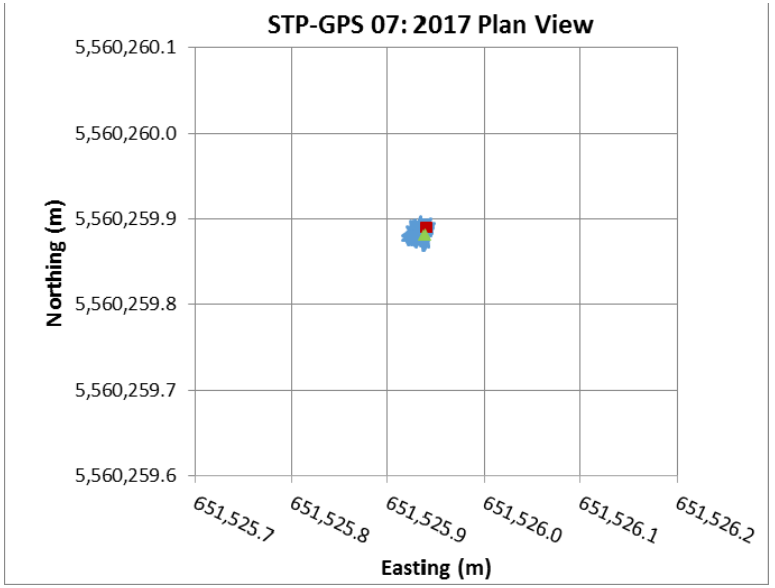
CONSULTANT
Golder Associates

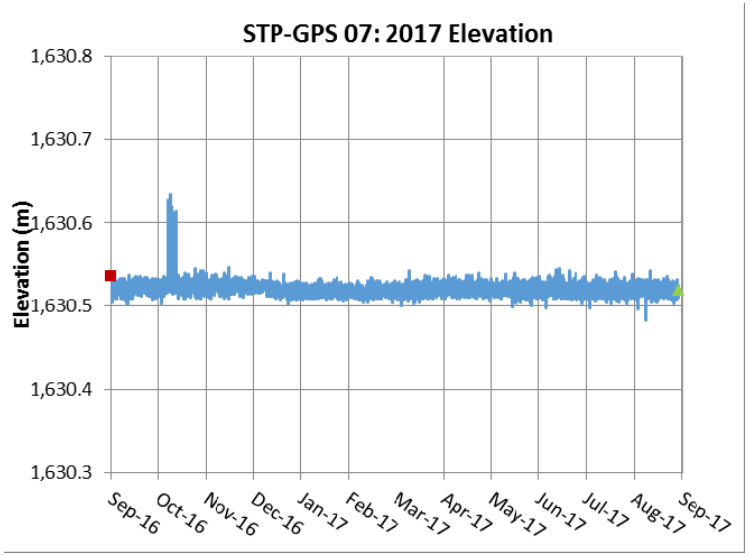
YYYY-MM-DD	2018-03-09
PREPARED	NC
DESIGN	NC
REVIEW	JMS
APPROVED	JCC

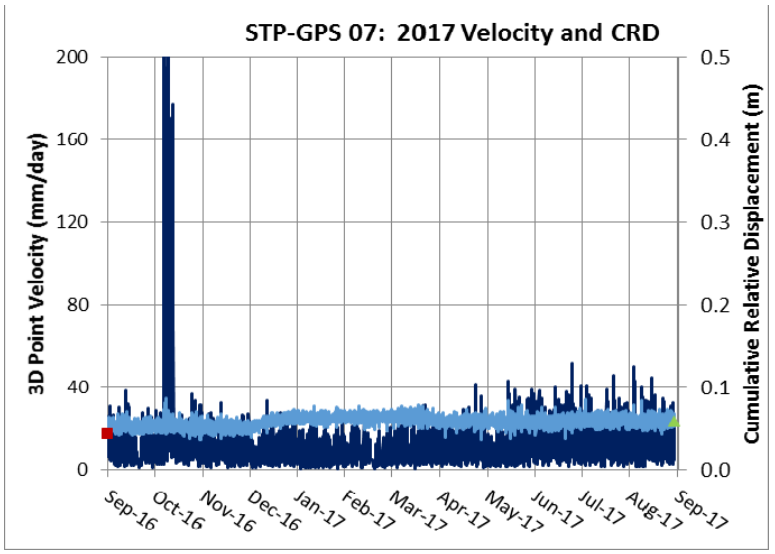
PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND
STP-GPS 06

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**G-14**







LEGEND

- INITIAL READING (SEPTEMBER 2016)
- 2016/2017 READINGS
- LAST READING (AUGUST 2017)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN NOVEMBER 2017.

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

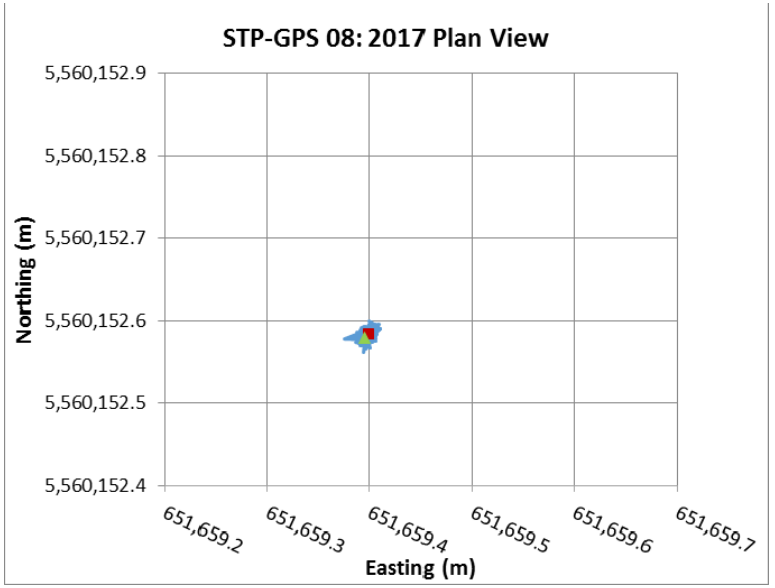
CONSULTANT
Golder Associates

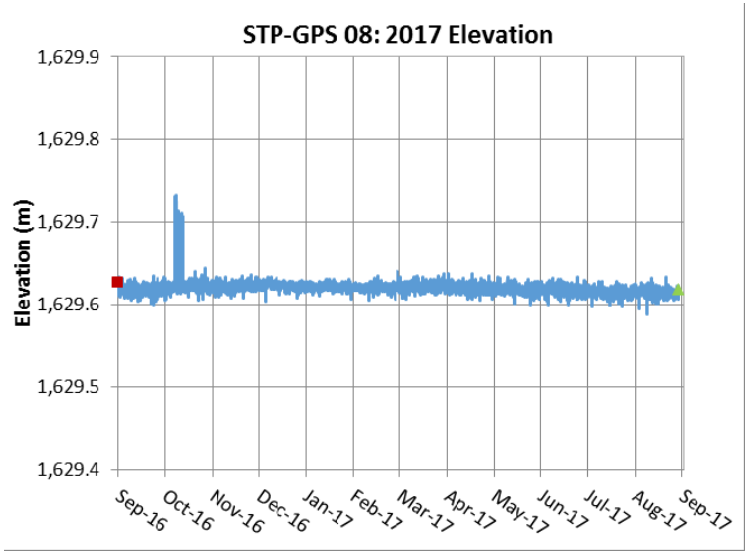
YYYY-MM-DD	2018-03-09
PREPARED	NC
DESIGN	NC
REVIEW	JMS
APPROVED	JCC

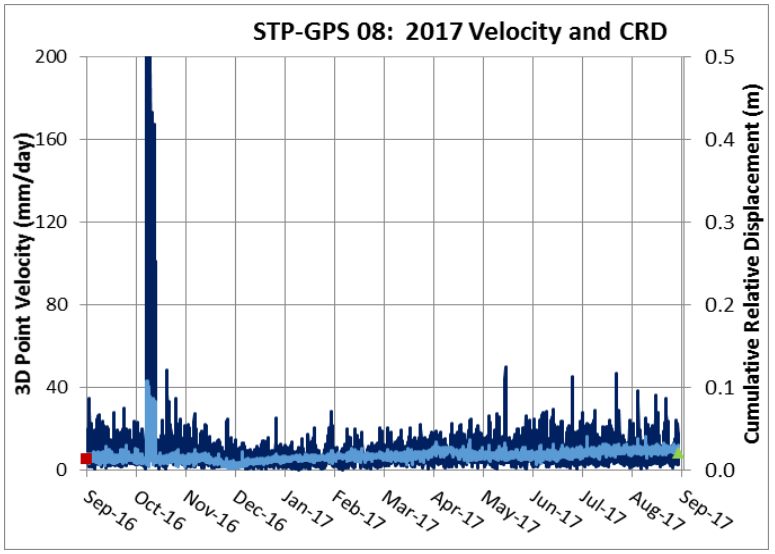
PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND
STP-GPS 07

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**G-15**







LEGEND

- INITIAL READING (SEPTEMBER 2016)
- 2016/2017 READINGS
- LAST READING (AUGUST 2017)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN NOVEMBER 2017.

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

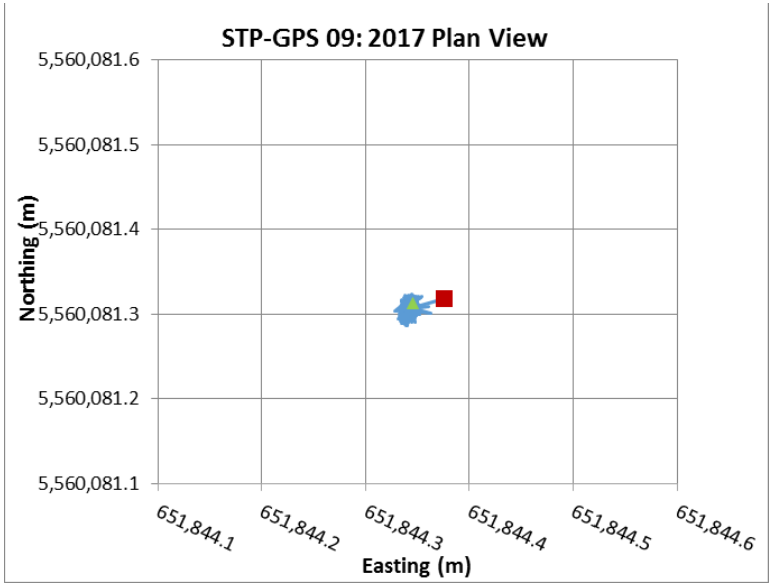
CONSULTANT
Golder Associates

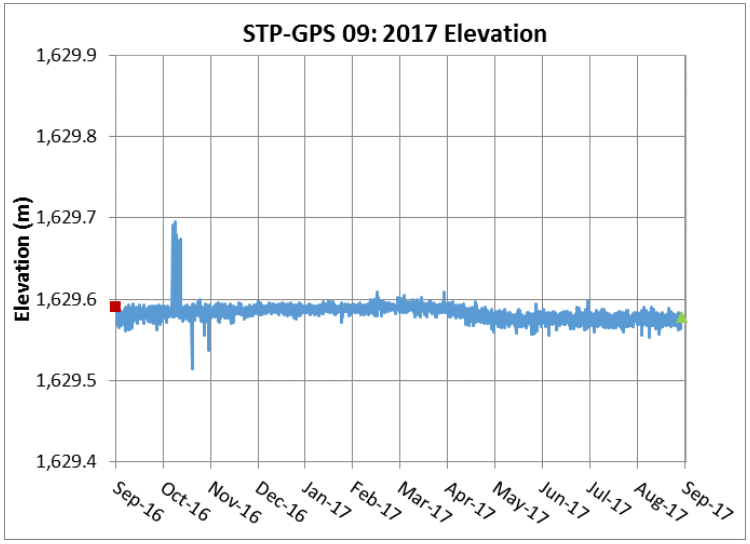
YYYY-MM-DD	2018-03-09
PREPARED	NC
DESIGN	NC
REVIEW	JMS
APPROVED	JCC

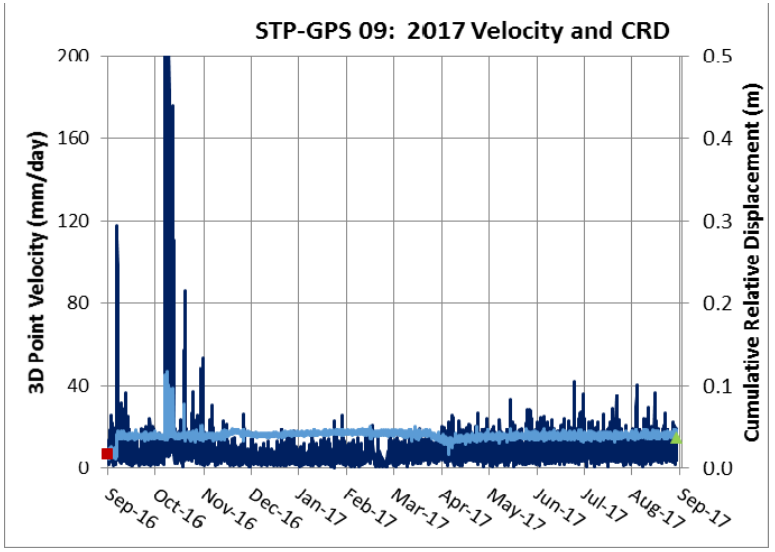
PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND
STP-GPS 08

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**G-16**







LEGEND

- INITIAL READING (SEPTEMBER 2016)
- 2016/2017 READINGS
- LAST READING (AUGUST 2017)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN NOVEMBER 2017.

CLIENT
TECK COAL LIMITED
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ELKFORD, B.C.

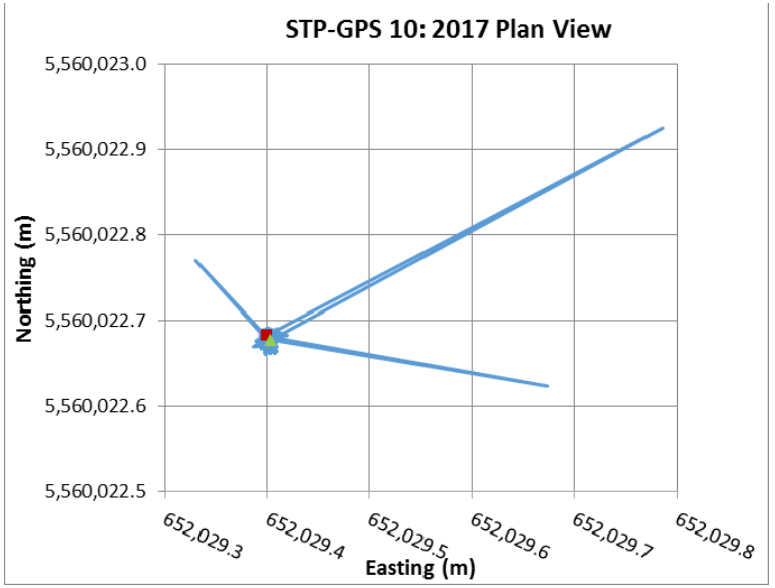
CONSULTANT
Golder Associates

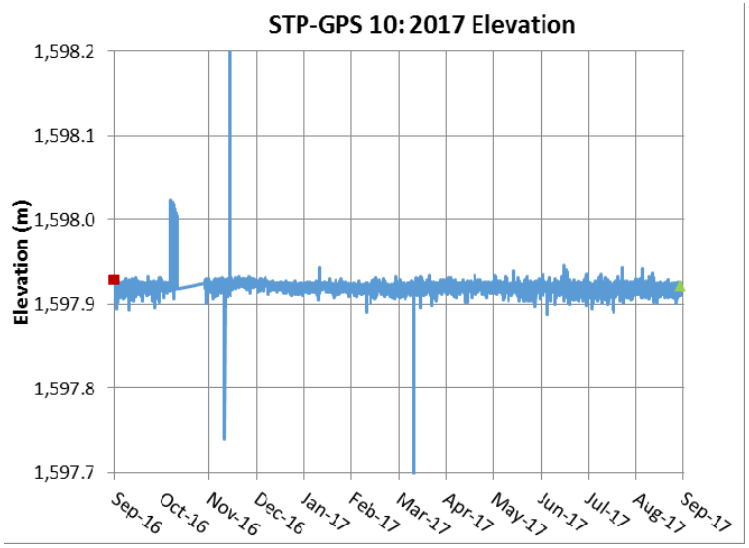
YYYY-MM-DD	2018-03-09
PREPARED	NC
DESIGN	NC
REVIEW	JMS
APPROVED	JCC

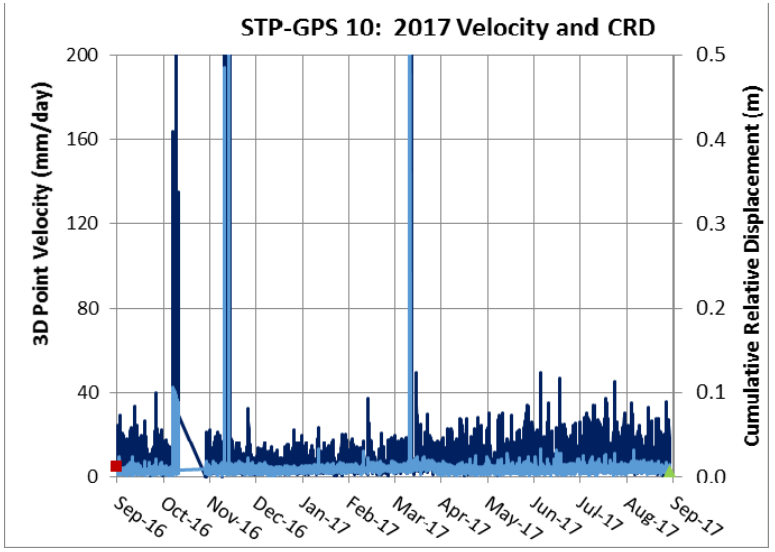
PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND
STP-GPS 09

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**G-17**







LEGEND

- INITIAL READING (SEPTEMBER 2016)
- 2016/2017 READINGS
- LAST READING (AUGUST 2017)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN NOVEMBER 2017.

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

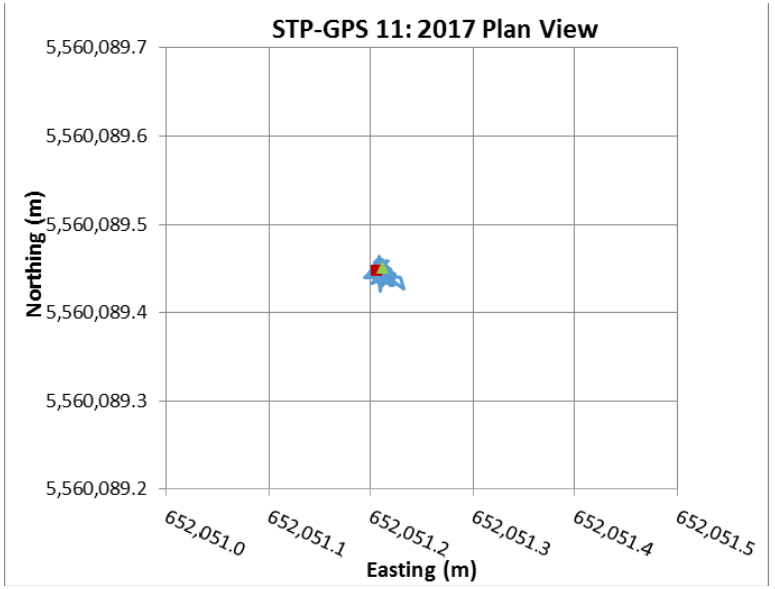
CONSULTANT
Golder Associates

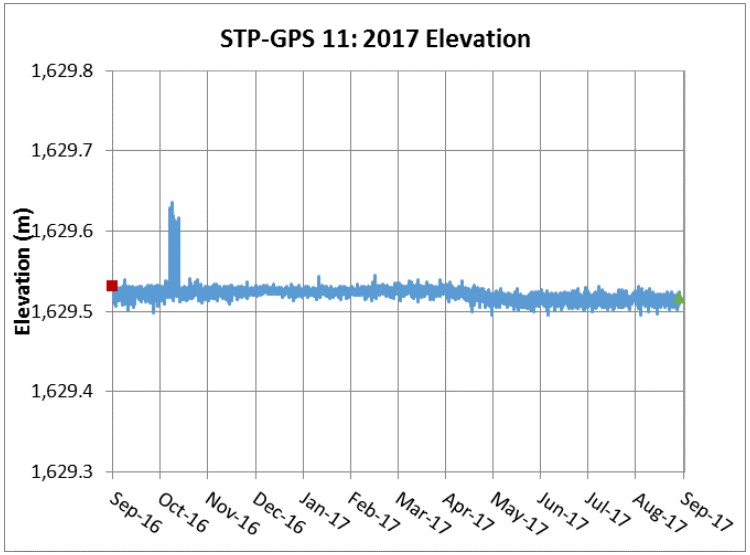
YYYY-MM-DD	2018-03-09
PREPARED	NC
DESIGN	NC
REVIEW	JMS
APPROVED	JCC

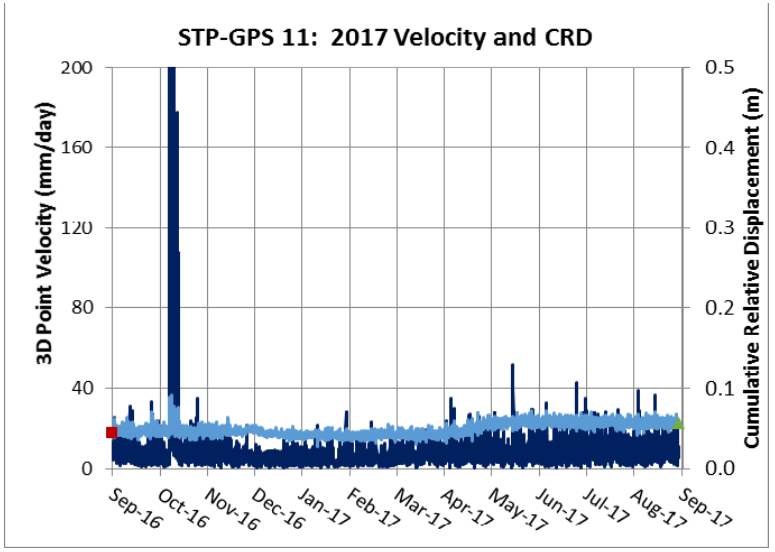
PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND
STP-GPS 10

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**G-18**







LEGEND

- INITIAL READING (SEPTEMBER 2016)
- 2016/2017 READINGS
- LAST READING (AUGUST 2017)

NOTES

1. DATA DOWNLOADED FROM GEOEXPLORER IN NOVEMBER 2017.

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

CONSULTANT
Golder Associates

YYYY-MM-DD	2018-03-09
PREPARED	NC
DESIGN	NC
REVIEW	JMS
APPROVED	JCC

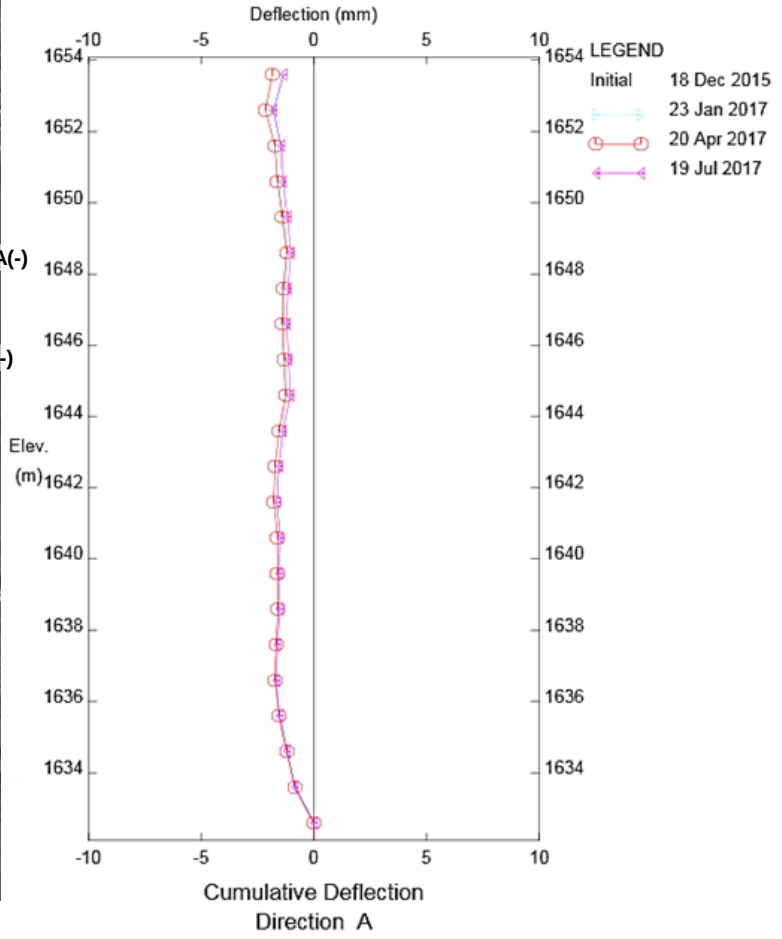
PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

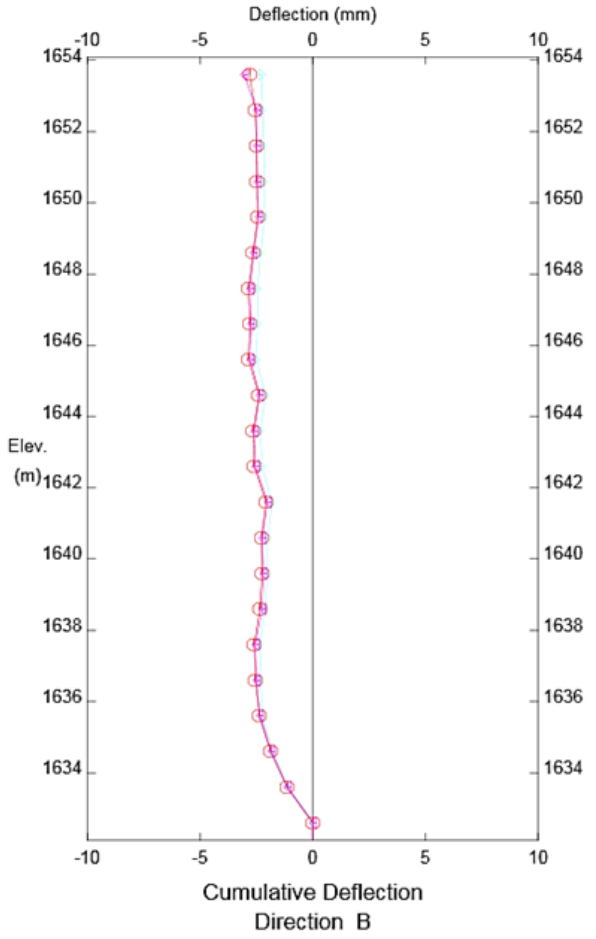
TITLE
SOUTH TAILINGS POND
STP-GPS 11

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**G-19**

APPENDIX H

Tailings Pond Inclinometer Data





North Tailings Pond, Inclinometer TH15-05
Fording River Operations

REFERENCES

1. DATA PROVIDED BY FRO OCTOBER 2017.
2. LOCATIONS FROM GEOEXPLORER.
3. SLOPE INCLINOMETER DATA FOR TH15-05 FROM 23 JANUARY 2017 TO 19 JULY 2017.
4. A-A AXIS AZIMUTH PROVIDED BY FRO 15 NOVEMBER 2017.

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

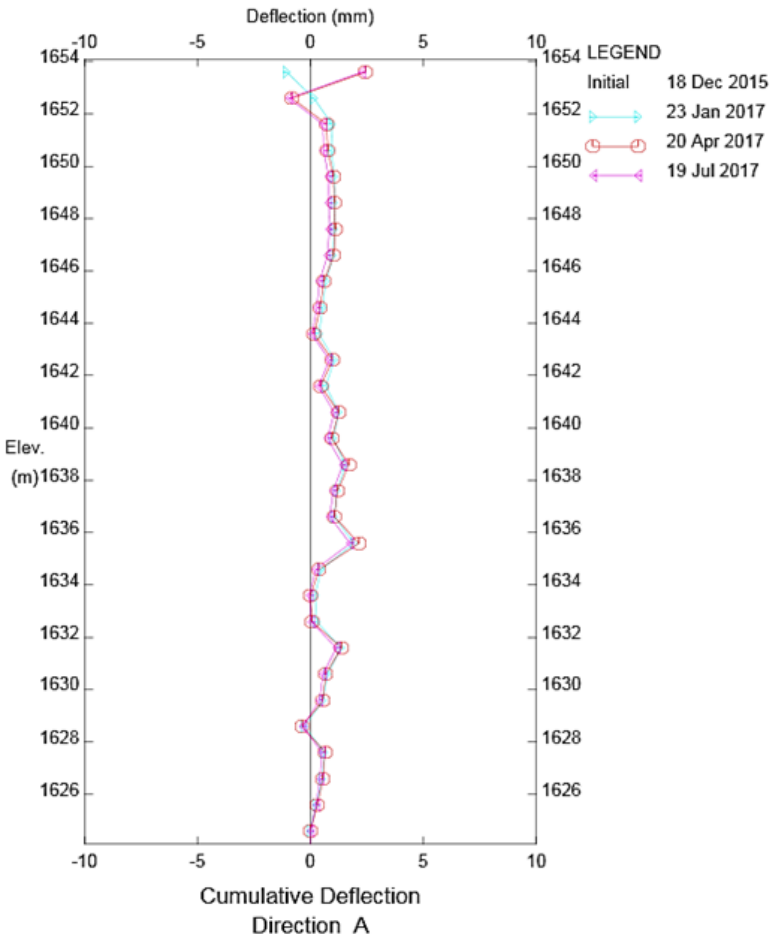
CONSULTANT
Golder Associates

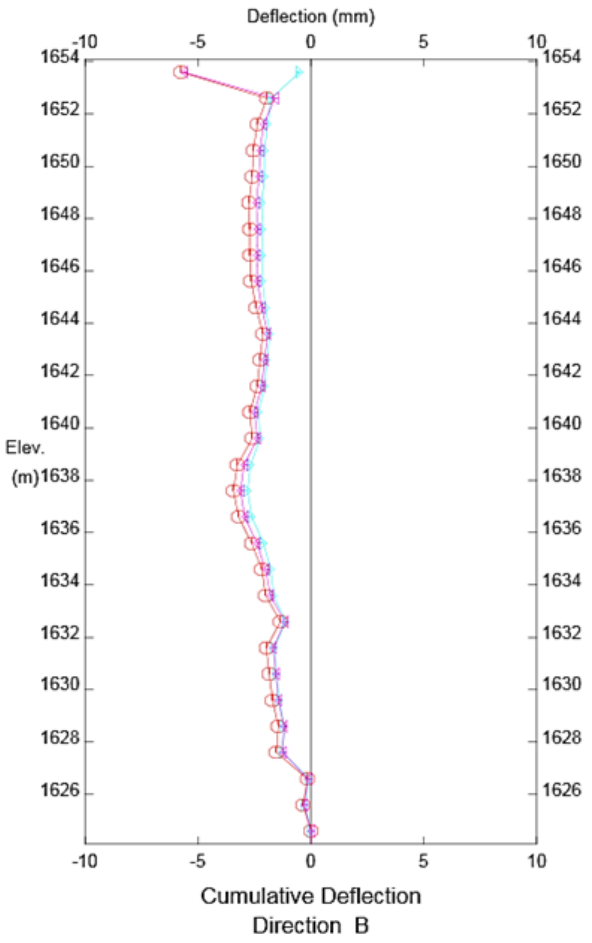
YYYY-MM-DD	2017-12-18
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND
TH15-05 INCLINOMETER

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**H-1**





North Tailings Pond, Inclinometer TH15-06
Fording River Operations

REFERENCES

1. DATA PROVIDED BY FRO OCTOBER 2017.
2. LOCATIONS FROM GEOEXPLORER.
3. SLOPE INCLINOMETER DATA FOR TH15-06 FROM 23 JANUARY 2017 TO 19 JULY 2017.
4. A-A AXIS AZIMUTH PROVIDED BY FRO 15 NOVEMBER 2017.

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

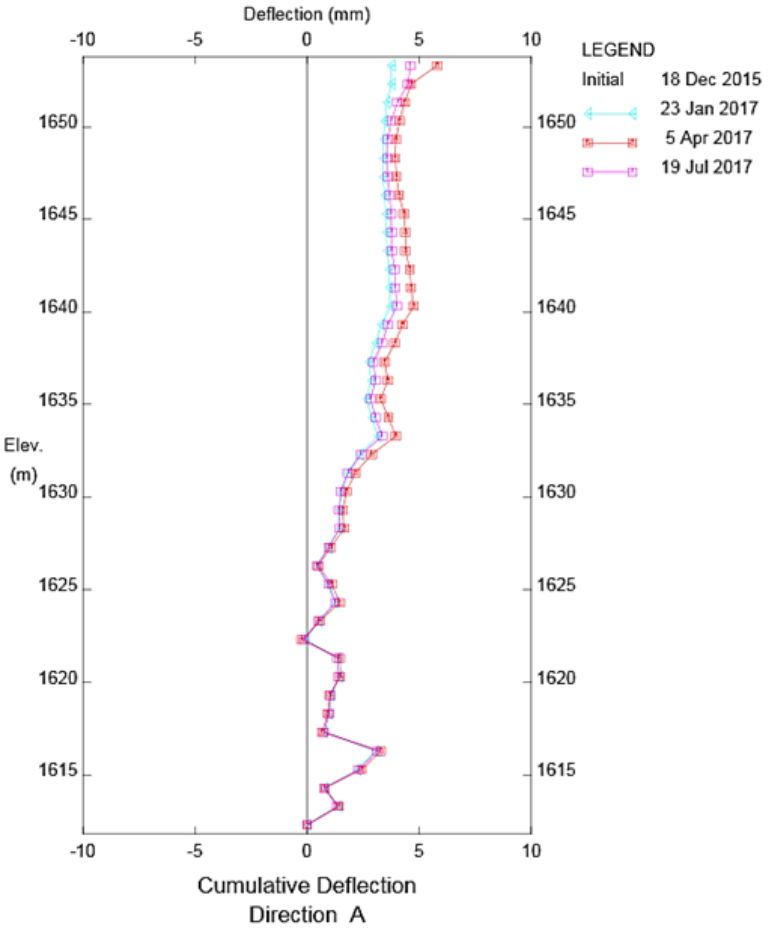
CONSULTANT
Golder Associates

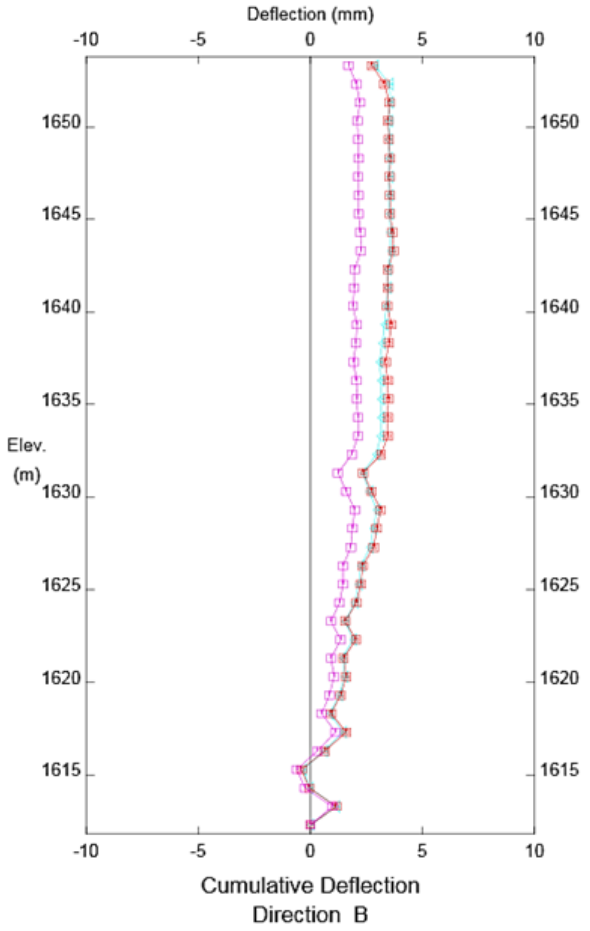
YYYY-MM-DD	2017-12-18
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND
TH15-06 INCLINOMETER

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**H-2**





North Tailings Pond, Inclinometer TH15-07
Fording River Operations

REFERENCES

1. DATA PROVIDED BY FRO OCTOBER 2017.
2. LOCATIONS FROM GEOEXPLORER.
3. SLOPE INCLINOMETER DATA FOR TH15-07 FROM 23 JANUARY 2017 TO 19 JULY 2017.
4. A-A AXIS AZIMUTH PROVIDED BY FRO 15 NOVEMBER 2017.

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

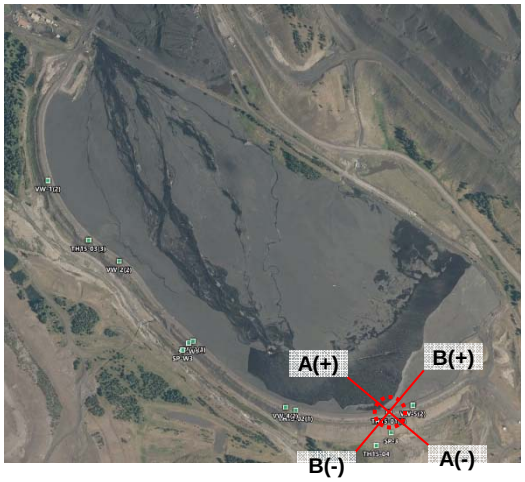
CONSULTANT
Golder Associates

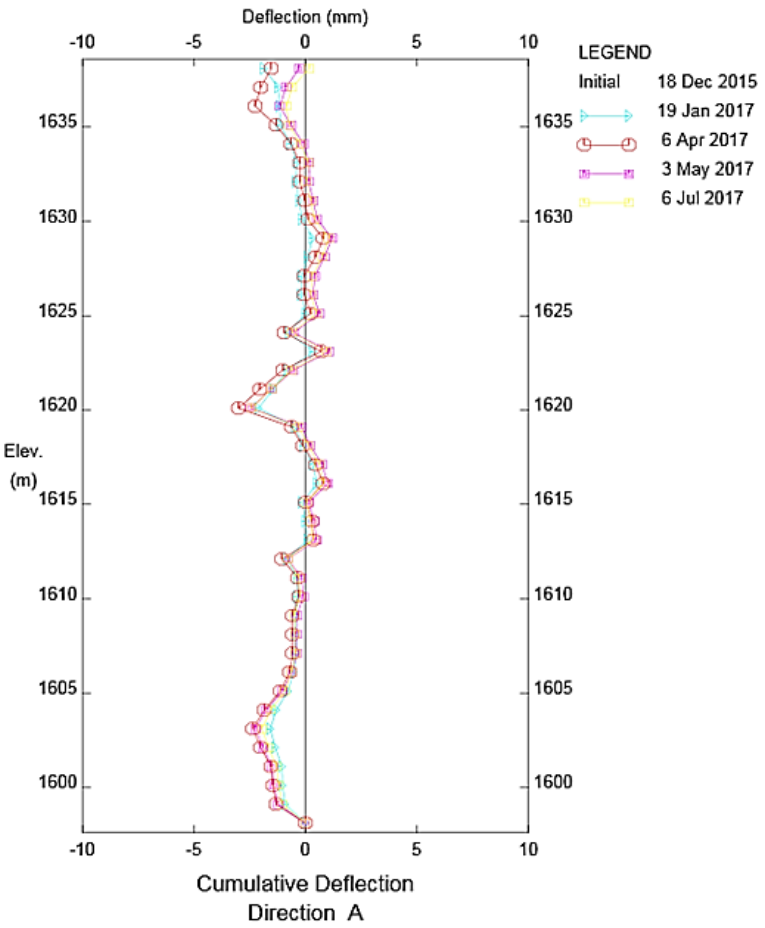
YYYY-MM-DD	2017-12-18
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

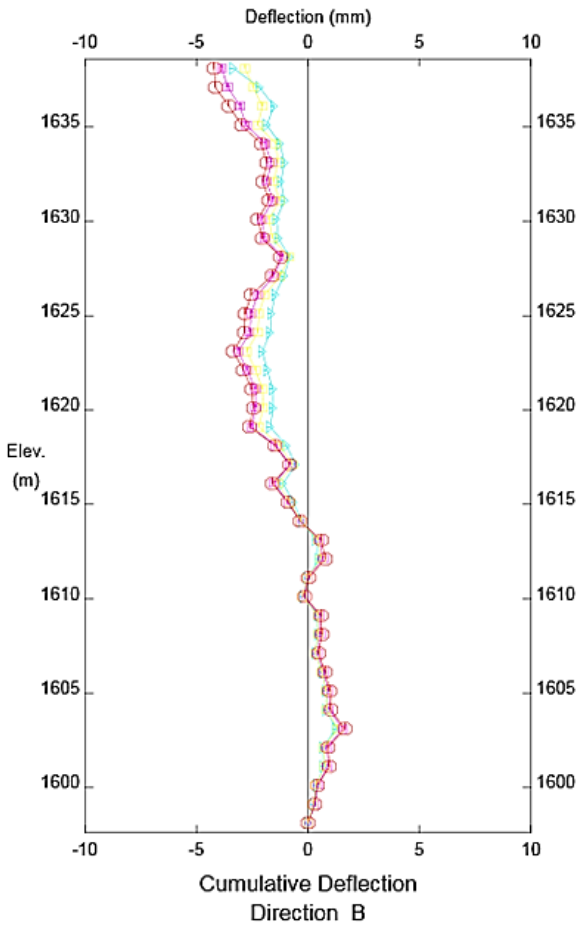
PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
NORTH TAILINGS POND
TH15-07 INCLINOMETER

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**H-3**







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

REFERENCES

1. DATA PROVIDED BY FRO OCTOBER 2017.
2. LOCATIONS FROM GEOEXPLORER.
3. SLOPE INCLINOMETER DATA FOR TH15-01 FROM 19 JANUARY 2017 TO 6 JULY 2017.
4. A-A AXIS AZIMUTH PROVIDED BY FRO 15 NOVEMBER 2017.

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

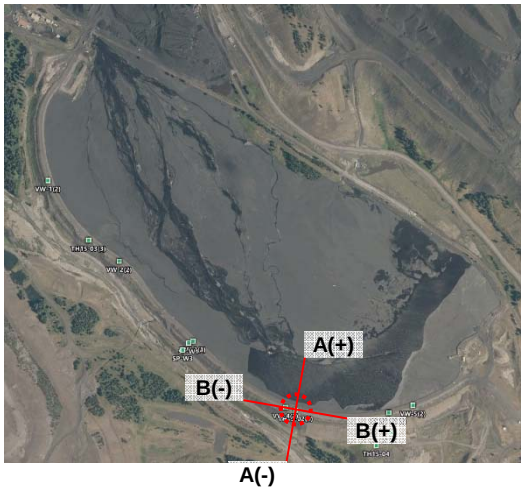
CONSULTANT
Golder Associates

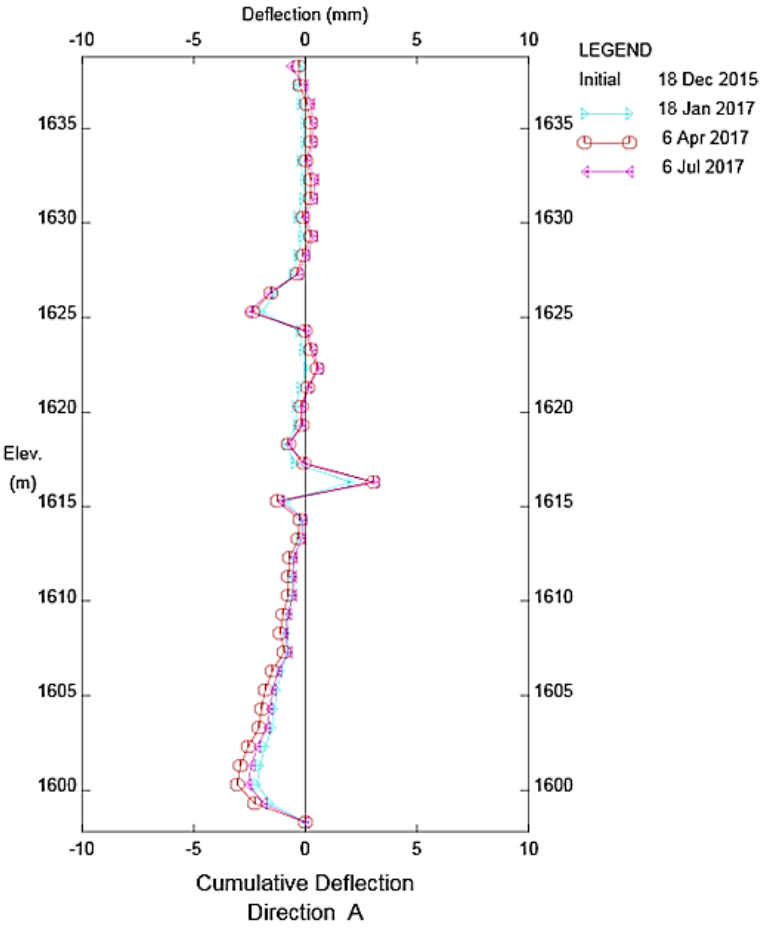
YYYY-MM-DD	2017-12-18
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

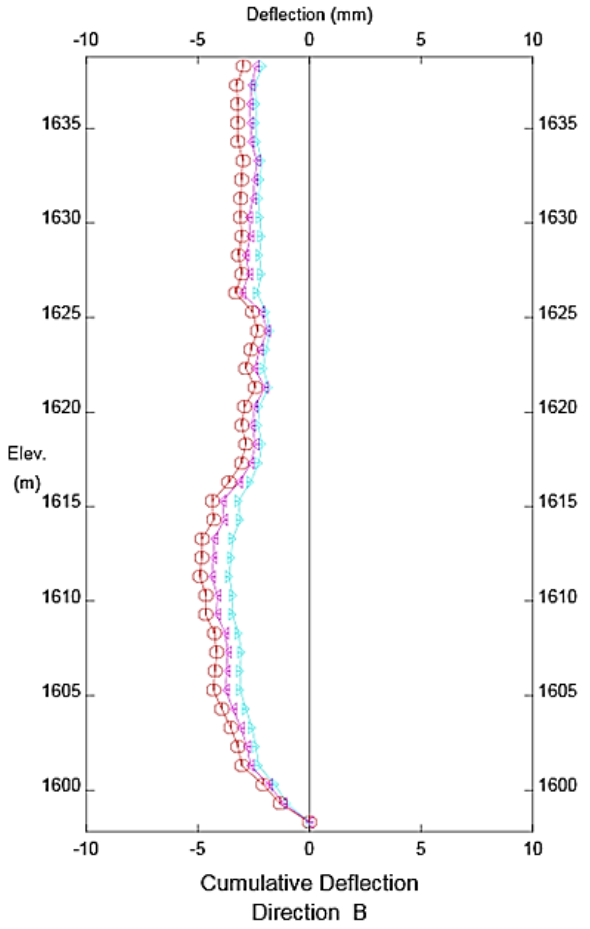
PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND
TH15-01 INCLINOMETER

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**H-4**







South Tailings Pond Main Dam, Inclinometer TH15-02
Fording River Operations

REFERENCES

1. DATA PROVIDED BY FRO OCTOBER 2017.
2. LOCATIONS FROM GEOEXPLORER.
3. SLOPE INCLINOMETER DATA FOR TH15-02 FROM 18 JANUARY 2017 TO 6 JULY 2017.
4. A-A AXIS AZIMUTH PROVIDED BY FRO 15 NOVEMBER 2017.

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

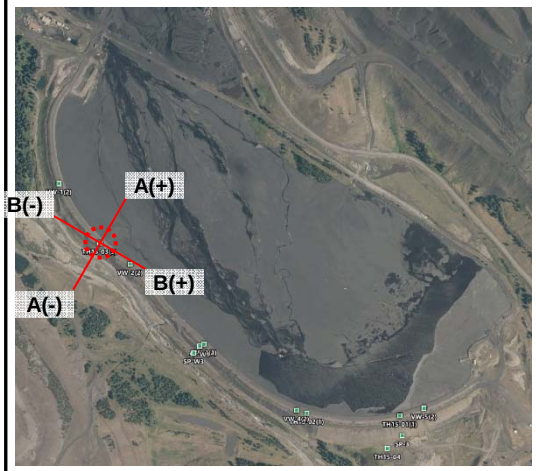
CONSULTANT
Golder Associates

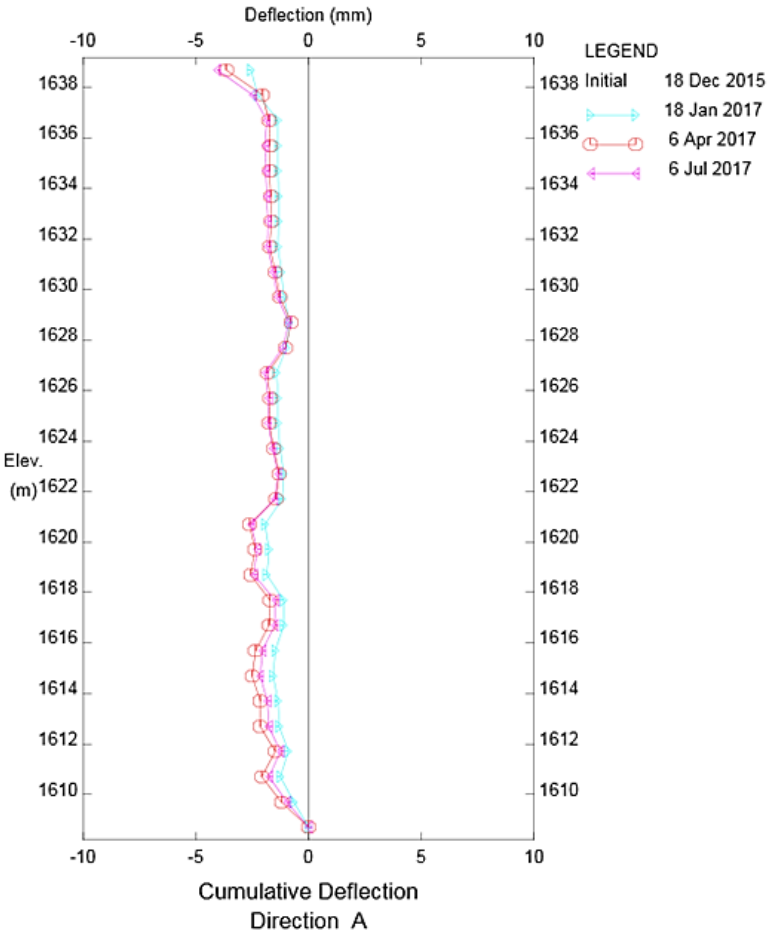
YYYY-MM-DD	2017-12-18
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

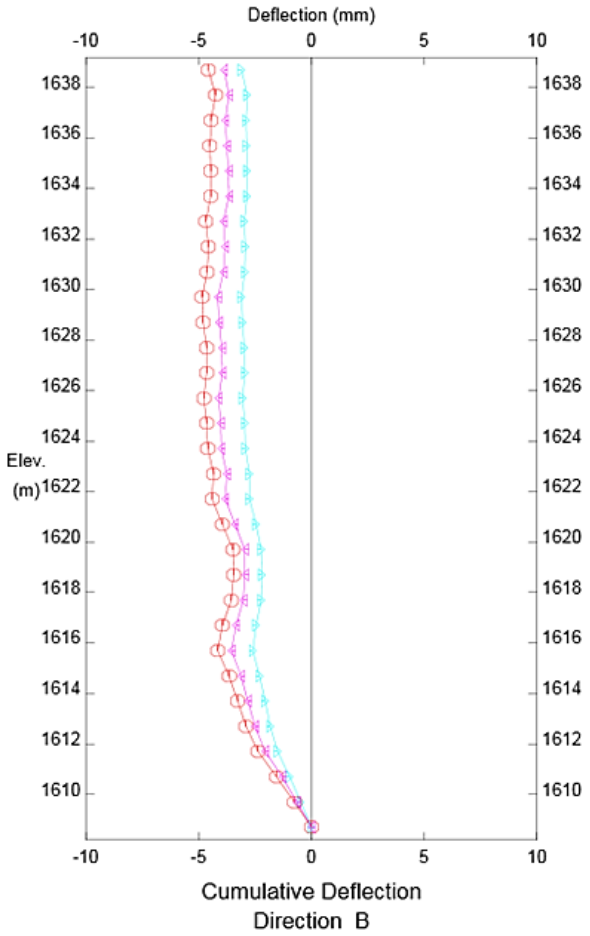
PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND
TH15-02 INCLINOMETER

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**H-5**







South Tailings Pond West Dam, Inclinometer TH15-03
Fording River Operations

REFERENCES

1. DATA PROVIDED BY FRO OCTOBER 2017.
2. LOCATIONS FROM GEOEXPLORER.
3. SLOPE INCLINOMETER DATA FOR TH15-03 FROM 18 JANUARY 2017 TO 6 JULY 2017.
4. A-A AXIS AZIMUTH PROVIDED BY FRO 15 NOVEMBER 2017.

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

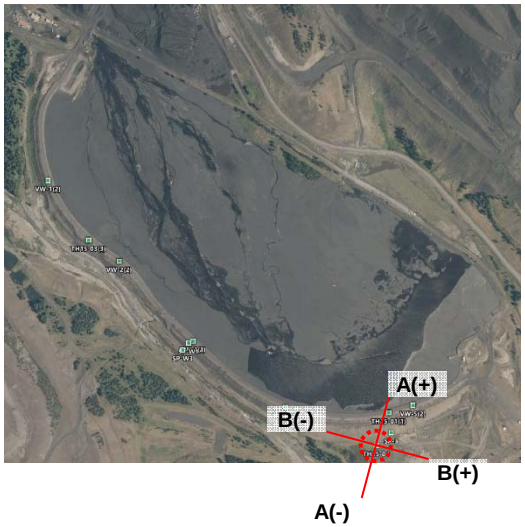
CONSULTANT
Golder Associates

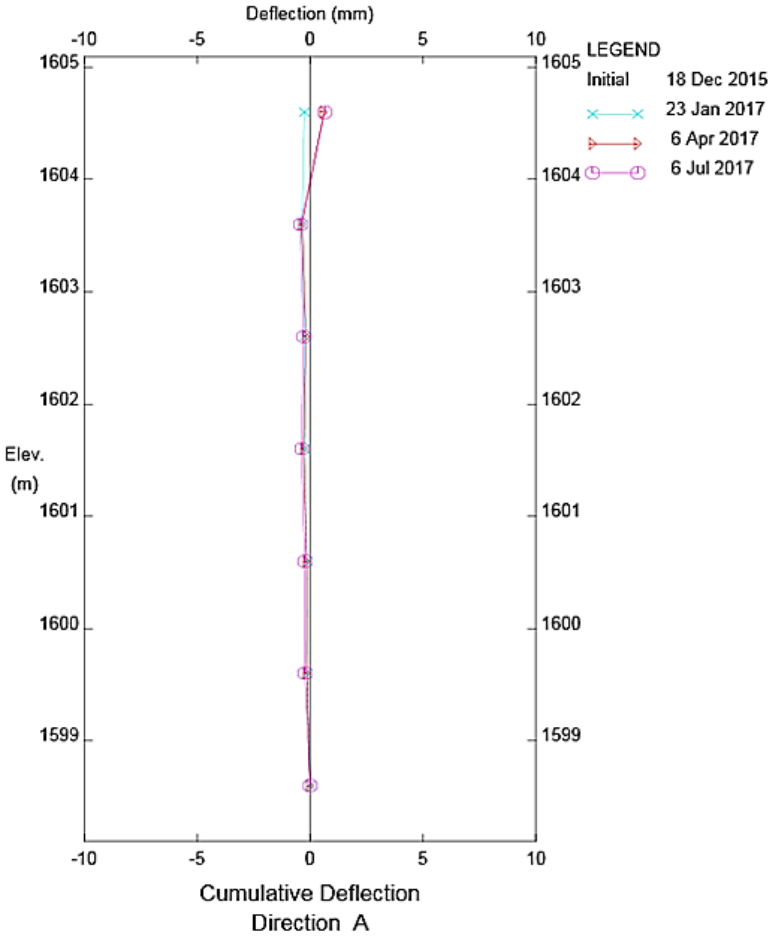
YYYY-MM-DD	2017-12-18
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

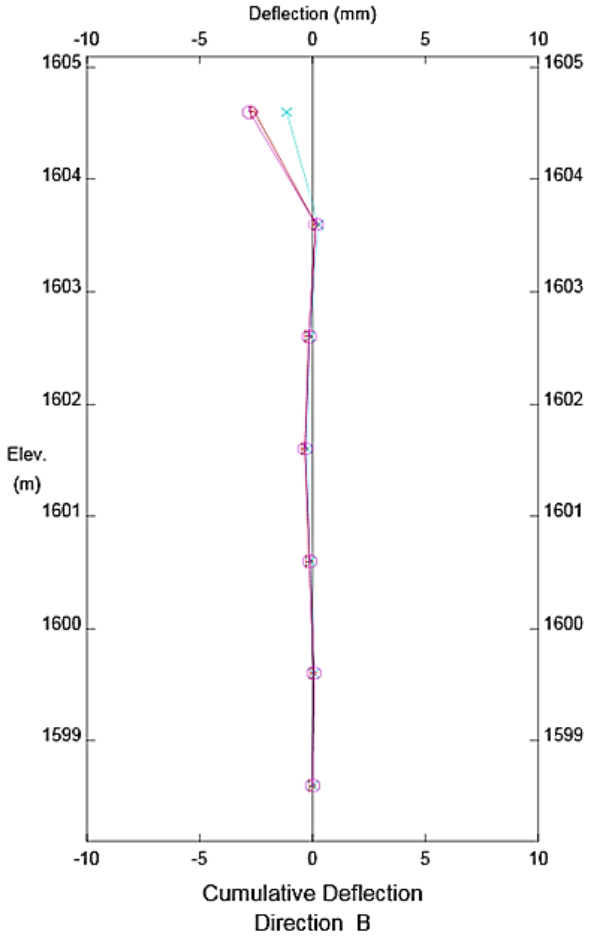
PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND
TH15-03 INCLINOMETER

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**H-6**







South Tailings Pond Main Dam, Inclinometer TH15-04
Fording River Operations

REFERENCES

1. DATA PROVIDED BY FRO OCTOBER 2017.
2. LOCATIONS FROM GEOEXPLORER.
3. SLOPE INCLINOMETER DATA FOR TH15-04 FROM 23 JANUARY 2017 TO 6 JULY 2017.
4. A-A AXIS AZIMUTH PROVIDED BY FRO 15 NOVEMBER 2017.

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

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-12-18
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT
NORTH AND SOUTH TAILINGS PONDS
2017 ANNUAL DAM SAFETY INSPECTION

TITLE
SOUTH TAILINGS POND
TH15-04 INCLINOMETER

PROJECT No.	Phase	Rev.	FIGURE
1784573	**1000**	**0**	**H-7**

APPENDIX I

2017 Riprap Inspection by Kerr Wood Leidal Associates Ltd.

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: March 25, 2018

TO: Heather Brickner
Teck Coal Limited

CC: Julia Steele, P.Eng.
Golder Associates Ltd.

FROM: Jason Miller, P.Eng.

RE: **TECK COAL LIMITED – FORDING RIVER OPERATIONS**
2017 NTP and STP Riprap Inspection
Our File 0008.245-300

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 facilities at FRO. This technical memorandum summarizes the findings of KWL's riprap inspection and will be appended to the Golder 2017 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 and 2014. 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.

In 2016, KWL updated the Fording River hydraulic model and designed upgrades to the 2013 bank protection works that would further protect the NTP and STP against high flows on the Fording River[1]. Based on the high priority assigned to these upgrades and feasibility constraints for 2016 construction, design proceeded using the 200-year return period flood. FRO is continuing a parallel process to establish an appropriate Fording River design flow for long-term upgrading and operation of its tailings dams.

The 2016 bank protection works for NTP and STP were constructed through two construction seasons, 2016 and 2017.

Activities Since 2016 Riprap Inspection

In August/September 2017, the remaining NTP bank protection works were completed as per the 2016 design (KWL, 2016). This work included:

- Excavating and placing riprap to scour depth from Sta. 0+165 to 0+205;
- Raising the existing riprap to design height and transitioning to existing ground between Sta. 0+930 and 1+075; and
- Raising a section of riprap to design height between Sta. 0+510 and 0+580.

Stationing cited above refers to the Golder Tailings Dam baseline shown in Figure 1.

The works were reviewed by KWL during construction to confirm general conformance with the design. The bank protection generally meets the design gradation with an average size of 1,200 mm and a thickness of 1.8 m to 2.4 m. The rock was sourced from mining operations at FRO and is expected to have similar quality as the rock placed in previous years. Rock that appeared to be weathering or broke easily when handled was discarded during riprap placement. The buried section of riprap is set back from the river and has a 2H:1V slope. Sections of the riprap that were raised in 2017 comprise the river bank and have a 1.5H:1V slope.

Field Inspection

An initial site visit was conducted on September 12, 2017 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 north end of the NTP and moved downstream to the STP. During the initial inspection, the 2017 riprap upgrades were in progress at the south end of the NTP. The initial assessment therefore focussed on the condition of the 2016 riprap works. A supplemental inspection was conducted on October 4, 2017 to review the completed 2017 riprap works.

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 was impeded by gravel placed over the riprap during 2013 construction. The upper riprap slope placed during 2016/2017 was visible and appears to be well-interlocked. The exposed toe of the revetment was also observed and appears to be in good condition with no visual signs of scour or displacement. Riprap was visible on the entire slope in one short section approximately between Sta. 0+750 and Sta. 0+830. The exposed riprap is in good condition and appears to remain well interlocked. The slope of the exposed riprap is about 1.5H:1V.

[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.

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. No visual signs of movement were observed over the length of the revetment.

The buried section of riprap (Sta. 0+100 to 0+200) is not visible. The ground covering the riprap was checked for signs of movement such as cracks or settlement. No visual signs of movement were observed over the length of the buried riprap.

Some of the locally-supplied rock is known to weather and degrade. This year's inspection did not include any test holes to review rock degradation below the visible rock layer. However, work completed on raising the riprap at the south end of the protection work (Sta. 0+930 to 1+075) required exposing the top of the riprap placed in 2013. The exposed riprap appeared to well-interlocked with smaller material filling the voids between the riprap and did not appear to show significant signs of weathering.

Generally, the NTP riprap has been constructed to +/- 0.1 m of the design elevation; however, there are a few areas where the riprap is up to 0.4 m lower than the design elevation (refer to profile on record drawings in in completion report[2]). 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 should be paid to these areas on regular inspection. Signs of settling or subsidence should be confirmed by survey and levels of protection should be raised if required. FRO should take advantage of future opportunities to cost-effectively 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 riprap). The riprap is well interlocked with smaller riprap filling the voids of the larger riprap. The riprap slope is about 2H:1V.

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 end where the floodplain narrows to the edge of the channel. The Fording River was not flowing directly against the riprap during the inspection.

There is some weathering (cracking and flaking) of individual riprap pieces along the entire length of the STP protection works. Currently, the degradation is intermittent and has not affected the overall integrity of the protection works; however, should additional rock continue to degrade, 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.

[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 monitoring 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. 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. There is the occasional riprap piece that has degraded from weathering. These pieces are located intermittently along the length of the STP. This is expected to be the case for NTP riprap as well. 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.

Inspections of the riprap should be completed at least annually. The riprap should continue to be monitored for weathering during these annual inspections. 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 be conducted after high water events on the Fording River, which could 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 a few areas along the NTP riprap where the riprap is up to 0.4 m lower than the design elevation. This reduces the freeboard in these areas to 0.6 m. Particular attention should be paid to these areas on regular inspection. 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).

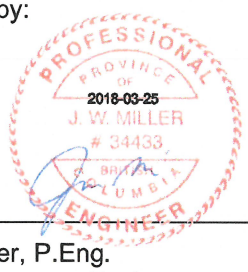
Design of the riprap erosion protection works is based on the 200-year return period flood, which is subject to numerous uncertainties. For example, the energy of the flood can significantly change channel conditions. In addition, larger floods are possible, including the breach of an upstream valley-spanning structure, 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 dams.

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.

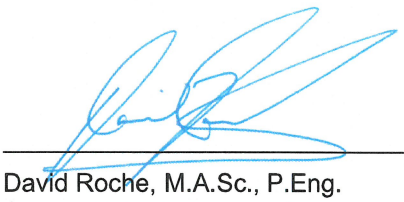
Prepared by:



Jason Miller, P.Eng.
Water Resources Engineer

JM/

Reviewed by:



David Roche, M.A.Sc., P.Eng.
Senior Water Resources Engineer

Encl.: Photos, Figure 1, Figure 2

Statement of Limitations

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Revision History

Revision #	Date	Status	Revision Description	Author
0	March 25, 2018	Original		JM

OQM | Organizational Quality Management Program

Photos

Photo 1: Looking downstream at NTP riprap (far bank) covered by gravel (approx. Sta. 0+100 to 0+200)

Photo 2: Looking downstream at NTP riprap (far bank) covered by gravel (approx. Sta. 0+200 to 0+320)

Photo 3: Looking downstream at NTP riprap (far bank) covered by gravel (approx. Sta. 0+340 to 0+450)

Photo 4: NTP riprap (far bank) with 2013 riprap covered by gravel on lower slope and 2016 riprap exposed on upper slope (approx. Sta. 0+500)

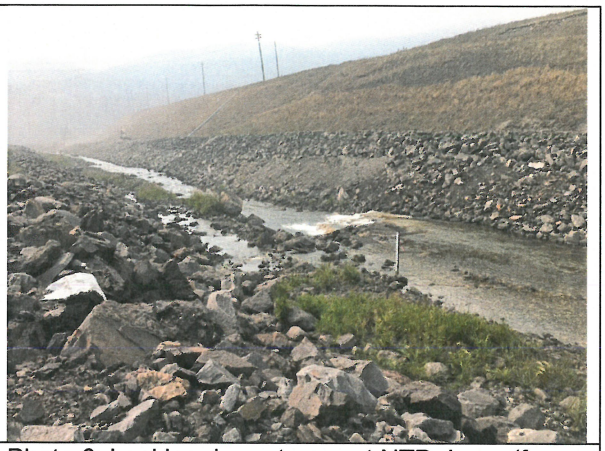
	
Photo 5: Looking downstream at NTP riprap (far bank) covered by gravel (approx. Sta. 0+620 to 0+800)	Photo 6: Looking downstream at NTP riprap (far bank) covered by gravel (approx. Sta. 0+840 to 0+940)
	
Photo 7: Looking upstream at NTP downstream tie-in of raised riprap (approx. Sta. 0+900 to 1+070)	Photo 8: Looking upstream at STP riprap and drainage culverts along Maxam Creek (approx. Sta. 0+240 to 0+250)

Photo 9: Looking downstream at STP riprap (approx. Sta. 0+280 to 0+360)

Photo 10: Riprap degradation due to weathering on a surface of a piece of riprap

Photo 11: Looking upstream at STP riprap (approx. Sta. 0+360 to 0+460)

Photo 12: Looking upstream at STP riprap (approx. Sta. 0+360 to 0+580)

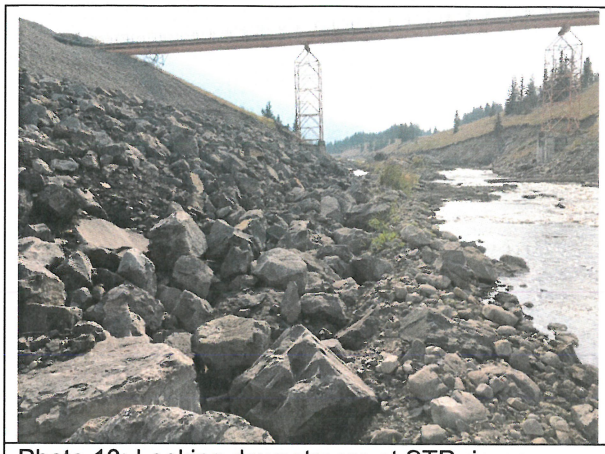


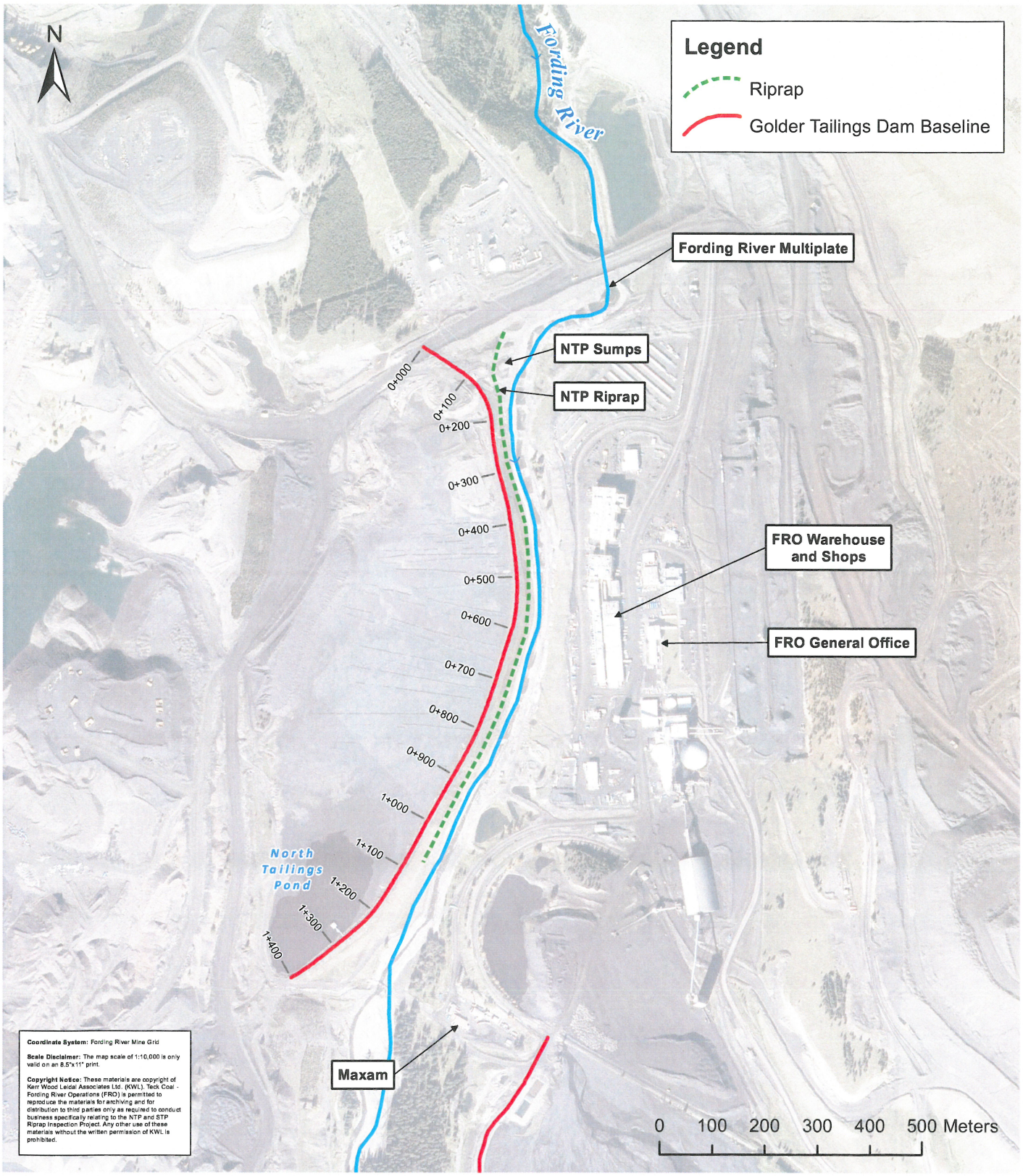
Photo 13: Looking downstream at STP riprap (approx. Sta. 0+580 to 0+680)

Photo 14: Looking at downstream extent of riprap (approx. Sta. 0+680)

Teck Coal - Fording River Operations (FRO)

NTP and STP Riprap Inspection

KERR WOOD LEIDAL consulting engineers



Coordinate System: Fording River Mine Grid

Scale Disclaimer: The map scale of 1:10,000 is only valid on an 8.5"x11" print.

Project No.	8-245
Date	March 2018
Scale	1:10,000

North Tailings Pond

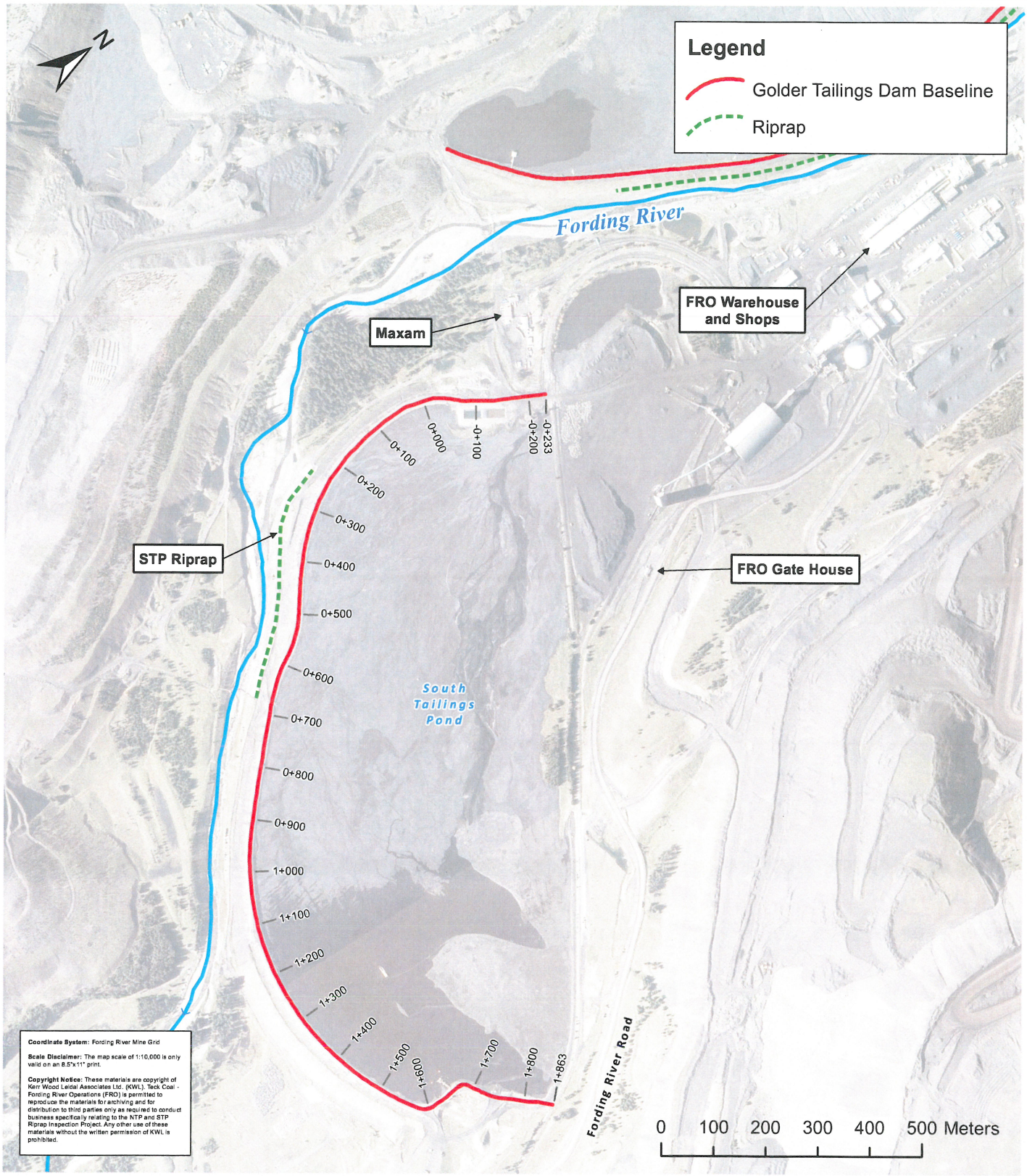
Figure 1

Path: O:\0000-0099\008-245\430-GIS\MXD-Rp\008245_Figure2_South.mxd Date Saved: 2018-03-07 9:58:23 AM | Author: RTaylor

Teck Coal - Fording River Operations (FRO)

NTP and STP Riprap Inspection

KERR WOOD LEIDAL consulting engineers



Coordinate System: Fording River Mine Grid

Scale Disclaimer: The map scale of 1:10,000 is only valid on an 8.5"x11" print.

Project No.	8-245
Date	March 2018
Scale	1:10,000

South Tailings Pond

Figure 2

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