Beaverdell Mine
2016 Geotechnical Annual Report

March 31, 2017

Teck

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1.0 INTRODUCTION

This report summarizes the information in accordance with Section 10.4.4 (Annual Reporting) of the Health, Safety and Reclamation Code for Mines in British Columbia (HSRC, 2016) for Beaverdell Mine.

1.1 Facility Description

The Beaverdell Mine is located adjacent to the unincorporated community of Beaverdell, approximately 70 kilometers east of Kelowna, BC on Highway 33. The mine operated from the 1900's until permanent closure in 1991. Teck Resources Limited operated the mine from 1970 until final closure.

All of the mining activity occurred on Mount Wallace, east of the town of Beaverdell, BC. The mine area consists of 38 crown granted claims within which are located five separate vein systems, all containing silver and other recoverable minerals. All mining was conducted underground using open stoping methods. In 1950, a mill was constructed on Fee Simple Lands west of the community. The mill began production at 50 tons per day, ultimately increasing to 120 tons per day. Tailings were deposited in a series of ponds (7 in total).

Over the life of the mine, the operation produced approximately 34.6 million ounces of silver, 16,725 ounces of gold, 25.5 million pounds of lead, 30.6 million pounds of zinc and 25,699 pounds of copper.

The mine and mill areas are connected by a 6.3 km Forest Service access road to the east of town. The current mine includes closed underground workings and waste rock storage facilities lying east of the town on Mount Wallace, as well as the former mill site and tailings storage facilities located west of the town. The tailings storage facilities (TSF), located east of the mill and west of the West Kettle River, are divided into the South TSF and the North TSF. The South TSF includes five tailings deposition cells (Cells 1 to 5) and the North TSF includes two cells (Cells 6 and 7).

In 2009, responsibility for the care and maintenance of the site was transferred to Teck's Legacy Properties office in Kimberley. The Legacy Properties office is responsible for ensuring that all of Teck's closed mines are managed according to Provincial regulations and permits, Health and Safety Concerns as well as ensuring that Teck's Corporate Standards are maintained.

1.2 Mines Act Permit

The Beaverdell Mine is regulated under Mines Act Permit M-71.

2.0 ANNUAL REPORT

2.1 Reclamation and Environmental Monitoring

As per Section 10.4.4 (a), the reclamation and environmental monitoring work performed under Section 10.1.3 (e) is described in the report entitled "*Beaverdell Mine, Annual Reclamation Report for 2016, Permit M-71"*, dated March 27, 2017, submitted under separate cover.

2.2 Annual Dam Safety Inspection

As per Section 10.4.4 (b), the annual dam safety inspection performed under Section 10.5.3 is detailed in the report entitled "*Beaverdell Tailings Storage Facilities 2016 Annual Dam Safety Inspection"*, dated March 2017, prepared by Golder Associates, submitted under separate cover.

2.3 Independent Tailings Review Board

As per Section 10.4.4 (c), the Independent Tailings Review Board was established, however, no reviews were conducted in 2016. The terms of reference and qualifications of Board members are being submitted under separate cover. A report on activities of the Board will be included in future annual reports.

2.4 Recommendations from Annual Dam Safety Inspection

As per Section 10.4.4 (d), a summary of the recommendations from the annual dam safety inspection is provided in Appendix I.

2.5 Performance of High-Risk Dumps

There are nine external dumps located at the Beaverdell Mine plus numerous very small dumps that were constructed at the site of various smaller portals. All of the larger dumps were constructed during the early development of the site from the 1950's through to the 1960's. All of the dumps were constructed during the course of portal tunnel development and were built on steep slopes. Visual examination of the dumps 50-60 years following construction shows no indication of failure or erosion.

2.6 Updates on Tailings Storage Facilities Register

Teck Legacy Properties maintains a tailings storage facilities register, which will be updated annually. The Beaverdell Mine Dam Inventory is included in Appendix II.

As per the letter dated September 30, 2016 to the Chief Inspector, the Engineer of Record for the inactive tailings storage facilities at the closed Beaverdell Mine is Mr. John Cunning, P.Eng, of Golder Associates Ltd.

2.7 Other Information as Directed by the Chief Inspector

As per Section 10.4.4 (g), additional information noted in Section 4.1 (Annual Manager's Report) of "*Guidance Document, Health, Safety and Reclamation Code for Mines in British Columbia*", Version 1.0, July 2016 is provided in the following section for TSFs.

2.7.1 Summary of Design and Construction Works from the Year

The 2012 Dam Safety Review (DSR) of the closed tailings facilities recommended that riprap armoring be re-established to provide additional erosion protection on the exposed bank of the West Kettle River below the South TSF. Following up on this recommendation, a hydrological analysis was conducted and a design plan developed. The design involved the placement of riprap along a portion of the South TSF in a trench set back from the riverbank to minimize disturbance to the West Kettle River. With this in place, in the event of a major flood, the river would be expected to naturally erode the riverbank until it reached the riprap trench.

Excavation of the trench and riprap backfill was completed for a section approximately 45 m in length (construction station 0+193 to 0+150) in 2015 and final construction of the riprap trench was completed in August 2016, which included an additional 148 m section.

Pursuant to recommendations from the 2015 Dam Safety Inspection (DSI), construction of a berm along the south edge of Cell 1 of the South TSF was completed in August 2016 to reinstate the minimum freeboard requirements of Cell 1. The berm was constructed using an excavator and non-tailings material from the site to an elevation consistent with that of the adjacent existing berms along the west and east portions of the cell. A surface water trench was constructed on the north side of the berm to facilitate the drainage of surface water runoff towards Cell 5. Additionally, the decant inlet and pipe in Cell 5 were filled.

2.7.2 Planned Design and Construction Works for Following Year

No construction works are planned for the Beaverdell tailings storage facilities in 2017. Activities are expected to be focused on the recommendations from the 2016 DSI, including:

- Geochemical testing of the tailings to quantify the hazard if tailings are mobilized out of the TSF during a flood event.
- Review of existing Cell 3 spillway dimensions and riprap armoring to make recommendations to allow for safe passage of the IDF, raise the Cell 3 embankment to contain the IDF, or incorporate water management plan into closure plan.
- Assessment of stability under seismic loading in accordance with HSRC Guidance Document (Government of BC 2016b) for appropriate consequence classification.

2.7.3 Schedule for the Following Year

The schedule for the following year is not applicable as the Beaverdell Mine is a closed facility.

2.7.4 Update on Life of Mine Operation and Construction Plans/Schedule

The update on life of mine operation and construction plans and schedule is not applicable as the Beaverdell Mine is a closed facility.

2.7.5 Summary of OMS/ERP Updates

The Operations, Maintenance and Surveillance (OMS) Manual and Emergency Response Plan (ERP) are reviewed and updated as required annually as part of the Dam Safety Inspection. The key updates made in the previous year included:

- Addition of historic information on the mine, operations and as-built records;
- Addition of work completed on site since the previous revision;
- Update of contact information; and
- Revision to meet Teck's internal document guidelines.

The updated OMS Manual and ERP are submitted as part of this report,

2.7.6 Open Engineering Recommendations, Regulatory Orders and Permit Conditions

Recommendations arising from the annual Dam Safety Inspection are provided in Appendix I. There are no other open engineering recommendations, regulatory orders and permit conditions associated with the Beaverdell Mine TSFs.

2.7.7 Dangerous Occurrences during the Year

There were no dangerous occurrences during the previous year associated with the Beaverdell Mine TSFs during the preceding year.

On September 10, 2016 a Magnitude 4.2 earthquake occurred approximately 32 km south of Beaverdell (49.170N 119.252W). Teck immediately conducted a site inspection on September 11, 2016 to assess the condition of the dikes and overall TMF condition. No noticeable changes were observed.

2.7.8 Updated Dam Inventory

The Beaverdell Mine Dam Inventory is included in Appendix II.

2.7.9 Tailings Facility and Dam Inspection Report

As noted in Section 2.2, the annual dam safety inspection is detailed in the report entitled "*Beaverdell Tailings Storage Facilities 2016 Annual Dam Safety Inspection"*, dated March 2017, prepared by Golder Associates, submitted under separate cover.

A summary of recommendations, including scheduled completion date, is provided in Appendix I.

2.7.10 Update on Risk Management Activities

The Teck Legacy Properties group use a risk register to manage risks and prioritize activities at our closed facilities. The risk register is reviewed at least once/year.

3.0 CLOSING

I trust this reports meets the requirements under Section 10.4.4 of the HSRC. Please contact Gerry Murdoch at 250-427-8408 gerry.murdoch@teck.com if you have any questions regarding this report.

Gerry Murdoch
Project Manager, Beaverdell Mine Manager
Teck Legacy Properties

APPENDIX I
TABLE OF RECOMMENDATIONS FROM DAM SAFETY INSPECTION

APPENDIX I – TABLE OF RECOMMENDATIONS FROM DAM SAFETY INSPECTION

Table 1: Table of Recommendations from Dam Safety Inspection

Structure	ID No.	Deficiency or Non-Conformance	Applicable Regulation or OMS Reference	Recommended Action	Priority (see Table 2)	Recommended Deadline /Status
South TSF	2016-01	The South TSF would discharge through the Cell 3 spillway during a 24-hour IDF event. The consequence of potential tailings migration due to flood transport is not quantified.	HSRC §10.1.3 & 10.1.12	Conduct geochemical testing of the tailings to quantify the hazard if tailings are mobilized out of the TSF during a flood event.	2	Q4-2017
South TSF	2016-02	Cell 3 cannot contain the IDF; flood water will leave the South TSF via the spillway in Cell 3. The spillway's ability to pass the IDF is uncertain.	HSRC §10.1.8	Review existing Cell 3 spillway dimensions and riprap armoring; make recommendations to allow for safe passage of the IDF, raise Cell 3 embankment to contain the IDF, OR incorporate water management plan into closure plan.	2	Q4-2017
South and North TSFs	2016-03	Existing standpipe piezometers are not suitable for future monitoring.	CDA 2013 §6.6	Replace piezometers, either for closure purposes or dam monitoring, to be determined based on development of closure plan.	3	2018
South and North TSFs	2016-04	Seismic stability assessment is out of date.	HSRC §10.1.8	Assess stability under seismic loading in accordance with HSRC Guidance Document (MEN 2016) for appropriate consequence classification.	2	Q4-2017
South and North TSFs	2016-05	No closure Plan	HSRC §10.4.1	Start development of closure plan. This could include: • Piezometer installation • Vegetation plans • Surface water routing plan	4	Q1-2018

Table 2: General Description of Priority Rankings

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.

Source: HSRC Guidance Document (HSRC, 2016. §10.5.3)

APPENDIX II
BEAVERDELL MINE DAM INVENTORY

Teck Legacy Properties Dam Inventory

Site	Facility Name	Structure Name	Type	Location	Maximum Height of Embankment (m)	Crest Length (m)	Impoundment Footprint Area (m2)	CDA Consequence Classification	OMS	EPRP	Surveillance/Inspection				Dam Safety Inspection			Dam Safety Review			EOR Details					Latitude	Longitude
				Province / State					Date	Date	Daily	Weekly	Monthly	Quarterly	Required Frequency	Latest	By	Required Frequency	Latest	By	Firm	EOR	Phone #	Mobile #	Email		
BEAVERDELL																											
Beaverdell	North Tailings Management Facility	North Dam (Ponds 6-7)	Tailings	BC	12	840	25,700	Significant	2017	2017	N	End of Freshet and in fall prior to Winter	N	N	Annually	2016	Golder	5 years	2012	Golder	Golder Associates	John Cunning	(604) 296-4294	(604) 839-9600	jcunning@golder.com	49° 26' 31.24"N	119° 05' 47.77" W
Beaverdell	South Tailings Management Facility	South Dam (Ponds 1-5)	Tailings	BC	14	1010	116,500	Significant	2017	2017	N	End of Freshet and in fall prior to Winter	N	N	Annually	2016	Golder	5 years	2012	Golder	Golder Associates	John Cunning	(604) 296-4294	(604) 839-9600	jcunning@golder.com	49° 26' 09.85"N	119° 05' 51.97" W

APPENDIX III – BEAVEDELL MINE TAILINGS OMS MANUAL

The single most important factor in the prevention of incidents is a positive attitude towards safety. Before any task commences, make it a habit to assess the hazards so they can be mitigated and/or controlled. It only takes one at-risk behavior to result in a serious incident.

Any employee who is asked to participate in an unfamiliar work process must inform his/her supervisor of such before proceeding. Necessary training will then be provided.

OPERATION, MAINTENANCE AND SURVEILLANCE MANUAL FOR BEAVERDELL TAILINGS STORAGE FACILITIES

The review protocol for the Operation, Maintenance and Surveillance (OMS) Manual is shown in Table A-1.

Table A-1: OMS Manual Review Protocol

	Name	Company	Position	Signature	Date
Prepared by	John Cunning	Golder Associates Ltd.	Engineer of Record		16 Feb 2017
Prepared by	Julia Steele	Golder Associates Ltd.	Senior Geotechnical Engineer		16 Feb 2017
Approved by	Kathleen Willman	Teck Resources Limited	Manager, Engineering and Remediation		2016-02-17
Reviewed by	Gerry Murdoch	Teck Resources Limited	Mine Manager		2016-02-17

RECORD OF REVISIONS

Revisions to the OMS Manual are made, as and when required, by re-issuing a complete section, table or appendix so that the outdated section, table or appendix can be removed and replaced. Official electronic copy of the OMS Manual is also updated at the same time and should be the primary reference document. The version history of the OMS Manual is shown in Table A-2. The last revision of the OMS Manual supersedes all previous versions.

Table A-2: OMS Manual Revision Summary

Revision Number	SP&P Number	Details of Revision	Date of Issue
Version 2014-01	n/a	Updated Document by Golder	November 2014
Version 2016-02	n/a	Updated Document by Golder	February 2016
Version 2017-03	BEA-OMS-001.V001	Updated Document by Golder	February 2017

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1.0 ROLES AND RESPONSIBILITIES

1.1 Formally Assigned

The roles and responsibilities of personnel formally assigned involved in the operation, maintenance, and surveillance of the Beaverdell Tailings Storage Facilities (TSFs) are defined in Table 1.

Table 1: Individuals Responsible

Role	Name	Company	Responsibilities	Phone #
Mine Manager	Gerry Murdoch	Teck Resources Limited	Complete routine and event driven/special inspections as outline by surveillance.	Office: 1-250-427-8408 Mobile: 1-250-432-9943
Site Caretaker	Tex Hewitt	KB traplines	Assist with routine and event driven/special maintenance as outlined by maintenance.	Mobile: 1-250-484-5522
Manager, Engineering and Remediation	Kathleen Willman	Teck Resources Limited	Be available for consultation.	Office: 1-250-427-8401 Mobile: 1-250-432-9563
Engineer of Record (EoR)	John Cunning	Golder Associates Ltd.	Be available for consultation, complete annual dam safety inspection and submittal, participate in dam safety reviews and risk assessments.	Office: 1-604-296-4294 Mobile: 1-604-839-9600
Geotechnical Engineer	Julia Steele	Golder Associates Ltd.	Support the EoR and Teck when necessary, help complete annual dam safety inspection and submittal.	Office: 1-604-297-2051 Mobile: 1-604-309-6973

1.2 Organization Chart

An organization chart has been prepared identifying the individuals indicated in Table 1 and their chain of command (Chart 1). Key internal staff (Teck) and external advisors are included.

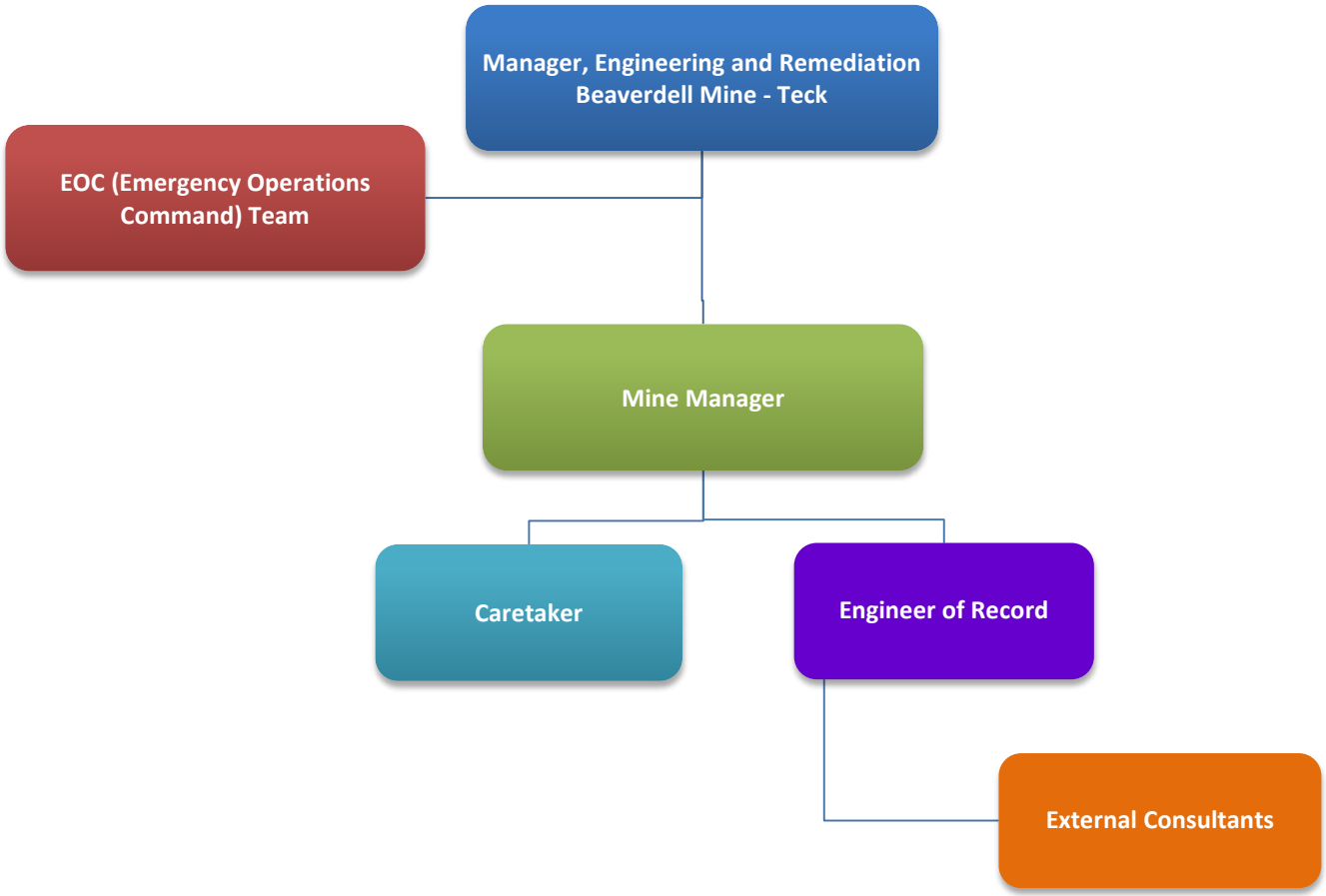

Chart 1: Beaverdell TSFs Chain of Command

1.3 Responsibilities and Requirements for Competency and Training

The specific training completed by the Mine Manager for the Beaverdell Mine includes:

- Province of British Columbia – Water Management Branch –Inspection and Maintenance of Dams – Dam Safety Guidelines
- FEMA – The National Dam Safety Program – A Self Instructional Study Course in Dam Safety Practices
- Review of specific documentation related to the Beaverdell Mine.

All personnel visiting the Beaverdell Mine Site should review the specific documentation related to the Beaverdell Mine including the OMS Manual and the ERP.

Table 2 summarizes minimum knowledge and competency, and training requirements of personnel involved in the operation, maintenance, and surveillance of the Beaverdell TSFs.

Table 2: Required Proficiencies and Training

Roles	Minimum Knowledge and Competency Requirements	Training / Document Review
Mine Manager	■ Awareness of the responsibilities related to the dam, its safety, and applicable regulations. ■ An understanding of the significance of hazard and risk. ■ Detailed understanding of Emergency Response Plan (ERP) in relation to the Beaverdell TSFs dam failure. ■ Detailed understanding of regulatory requirements for various regulatory bodies in relation to Dam Safety Inspections (DSIs) and Dam Safety Reviews (DSRs).	■ OMS Manual (SP&P BEA-OMS-001.V001) ■ ERP (SP&P BEA-ERP-001.V001) ■ DSI Report (most recent, Golder 2016b) ■ DSR Report (Golder 2013)
Environmental Specialist	■ Detailed understanding of dam safety regulatory responsibilities. ■ Detailed understanding of surveillance and maintenance procedures for the Beaverdell TSFs. ■ Understanding of abnormal and non-compliance conditions and protocol. ■ Detailed understanding of environmental issues that could arise on site and permitting processes.	■ OMS Manual (SP&P BEA-OMS-001.V001) ■ ERP (SP&P BEA-ERP-001.V001)
Caretaker	■ Detailed understanding of dam safety regulatory responsibilities. ■ Detailed understanding of Beaverdell TSFs operations, maintenance, and surveillance procedures in relation to OMS Manual.	■ OMS Manual (SP&P BEA-OMS-001.V001) ■ ERP (SP&P BEA-ERP-001.V001)

Roles	Minimum Knowledge and Competency Requirements	Training / Document Review
	■ Detailed understanding of Emergency Response Plan (ERP) in relation to the Beaverdell TSFs dam failure. ■ Understanding of dam design principles and construction techniques. ■ Understanding of abnormal and non-compliance conditions and protocol.	
Engineer of Record (EoR)	■ Experience commensurate with the consequence classification and complexity of the facility. ■ Detailed understanding of dam safety regulatory responsibilities. ■ Detailed understanding of design, construction history, as well as applicable standards, criteria, and guidelines.	■ OMS Manual (SP&P BEA-OMS-001.V001) ■ ERP (SP&P BEA-ERP-001.V001)
Teck Employees	■ Understanding of contents of the OMS Manual. ■ Knowledge of specific risks as they apply to work areas in and around the pond.	■ OMS Manual (SP&P BEA-OMS-001.V001)
Contractors	■ Knowledge of specific risks as they apply to work areas in and around the pond.	
External Consultants	■ Experience with specific role relevant to the Beaverdell TSFs.	■ OMS Manual (SP&P BEA-OMS-001.V001) ■ ERP (SP&P BEA-ERP-001.V001)

1.4 Responsibilities for Managing Change

There are no procedures in place for making changes to design or operating plans since Beaverdell Mine is closed and non-operational.

The OMS Manual and all associated documents shall be kept current with appropriate practices and procedures and at minimum, be reviewed annually by the required personnel (Table A-1). The Mine Manager will be responsible for ensuring that any change imposed on the facility or within management is reflected in the OMS Manual, approved, and distributed accordingly.

2.0 FACILITY DESCRIPTION

2.1 Facility Overview

Beaverdell Mine is now a closed facility under active care and maintenance, with no current or planned mining activities. The Beaverdell TSFs are located in the valley of the West Kettle River, near the town of Beaverdell, 87 km southeast of Kelowna on Highway 33 (Figure 1). The TSFs are divided into two major components, the South TSF and the North TSF (Figure 2). The South and North TSFs Dams act as retention structures to contain tailings within the South and North TSFs, respectively.

Available records indicated ongoing exploration activities in the Beaverdell area as early as 1898 by various companies, each exploring individual veins or vein systems. The first shipment of ore from the development was directed to the Hall Mines smelter at Nelson (BC) in 1900. In 1936, the Bell and the Highland Lass mines merged to form Highland Bell Limited, which soon added the Beaver mines to its holdings. Leith Gold Mines Limited acquired a controlling interest in Highland Bell Limited and the Sally mine property in 1946. This company continued ore shipping to the smelter at Trail (BC), and undertook an exploration and development program that led to new ore discoveries and the decision to build a mill at Beaverdell. The mill was inaugurated in the 1950s, with an initial capacity of 50 tons-per-day that was later increased to 85 tons-per-day in 1964, 110 tons-per-day in 1967. The mill was located to the west of the community of Beaverdell, across the West Kettle River (Verzosa and Goetting 1972).

Beaverdell Mine was acquired by Teck Corporation Limited in 1969 or 1970, and continued production until 1991, when the mining development was permanently closed (Teck 2012). The mine is permitted under the *Mines Act* of British Columbia (Government of BC 1996).

2.2 Regulatory Requirements

A list of applicable Codes, Guidelines, and regulatory bodies governing the Beaverdell North and South TSFs are listed below:

- HSRC for Mines in BC (Government of BC 2016a)
- HSRC Guidance Document (Government of BC 2016b)
- CDA Dam Safety Guidelines (CDA 2013)
- Geotechnical, Hydrotechnical, and Application of Dam Safety Guidelines to Mining Dams bulletins (CDA 2007, 2014)
- MAC Guidelines (MAC 2011)

2.3 Site Conditions

Beaverdell Mine is a closed site which has not been in operation since 1991. The mine is permitted under Water Licence No. PE-444 (Ministry of Environment 1990).

The Beaverdell TSFs are situated on the flood plain of the West Kettle River. The surficial geology in the area is generally understood to be alluvial deposits with interpreted discrete interlayered fine grained deposits, most likely related to ancient abandoned meanders of the West Kettle River.

The long-term monthly statistics of precipitation (i.e., climate normal from 1975 to 2005) at Beaverdell North Environmental Station (EC 2016) are presented in Chart 2.

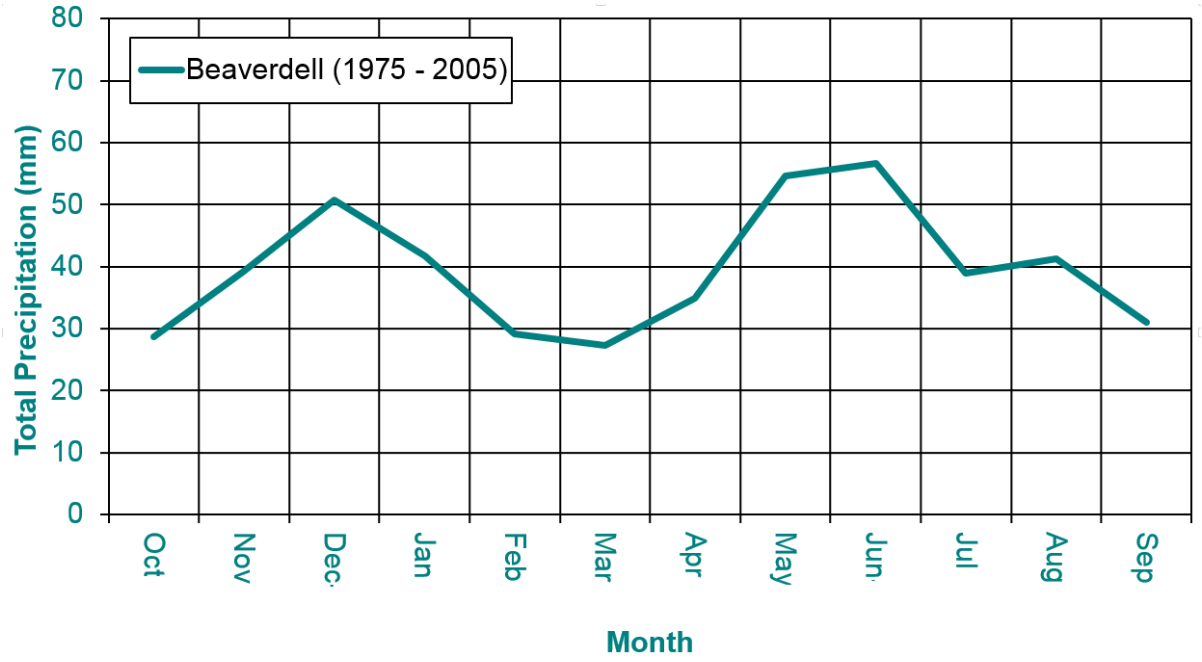

Chart 2: Monthly Precipitation Climate Normals (1975 to 2005)

2.4 Facility Components

2.4.1 Dams

The South TSF consists of five cells (Cells 1 to 5) (Photograph A-1 to A-5). The South TSF Dam lies to the south of Cells 1 and 5, and east of Cells 3 to 5 (Figure 2). The South TSF is a closed or isolated catchment area, where accumulated surface water is conveyed to the receiving environment through percolation (seepage) or is lost to the atmosphere by evaporation.

The North TSF consists of two cells (Cells 6 to 7) (Photograph A-6 and A-7). The North TSF Dam is to the west of Cell 7, north and south of Cells 6 and 7, and east of Cell 6 (Figure 2). The North TSF is a closed or isolated catchment area, where accumulated surface water is conveyed to the receiving environment through percolation (seepage) or is lost to the atmosphere by evaporation.

2.4.2 Water Management Infrastructure

2.4.2.1 South TSF

A ditch along the road to the west of the South TSF area (Beaverdell Station Road, Figure 2) collects water runoff from the Cranberry Ridge.

A trapezoidal, riprap-armored spillway through the Cell 3/4 divider dike allows conveyance of surface water from Cell 4 to Cell 3 (Photograph A-8, location on Figure 2).

A small partially riprap-armored spillway through the Cell 4/5 divider dike allows conveyance of surface water from Cell 5 to Cell 4 (Photograph A-9, location on Figure 2).

There are two known decant towers / tunnels in the South TSF in Cell 4 and 5. These towers originally managed pond water in the cell. The decant tower in Cell 4 could not be located. The decant tower in Cell 5 is shown in Photograph A-10 and its location is approximately shown in Figure 2. This decant tower was filled with a foam substance to plug it in 2016.

2.4.2.2 North TSF

The dam and the Cell 7 spillway channel to the west of Cell 7 prevents water runoff from Cranberry Ridge from entering the North TSF area. The watershed of the North TSF area therefore consists only of the surface area of that facility.

There is no constructed channel in the divider dike between Cell 6 and 7. There is a low point which will enable conveyance of surface water between Cell 6 and 7.

The location of the two decant towers / tunnels in each cell of the North TSF are shown in Figure 2. These towers have been sealed (Golder 2014). Photograph A-11 shows the current status of the Cell 7 decant tower. The diameter of each of the decant tunnel pipe was estimated at 0.2 m (i.e., 8 inches). The decant outlets for Cells 6 and 7 are shown in Photographs A-12 and A-13 with approximately locations shown on Figure 2.

The spillway built on the west side of Cell 7 discharges water from that cell to the receiving environment.

2.4.3 Piezometers

There are 13 documented standpipe piezometers around Cells 5, 6, and 7 (Binnie 1973, 1983, 1988). Of the 13 piezometers, 9 were located in 2016. The piezometers that were located are all dry with the exception of one piezometer that exceeded the length of the water level reader. A typical piezometer is shown in Photograph A-14.

2.5 Regulatory Compliance Points

The Beaverdell Mine is permitted under Water Licence No. PE-444 (Ministry of Environment 1990).

The Beaverdell TSFs are annually inspected as required by HSRC (Government of BC 2016a). A dam safety review (DSR) is completed every five years as required by HSRC (Government of BC 2016a). The last DSR was completed in 2012 and it is understood Teck plans to complete a DSR in 2017.

2.6 Basis of Design and Design Criteria

HSRC (Government of BC 2016a) has the following design criteria related to floods, seismic and static stability, and geometry applicable to the South and North TSFs:

Table 3: Minimum Design Criteria for Tailings Dams (after Government of BC 2016b)

Dam Class	Annual Exceedance Probability – Floods	Annual Exceedance Probability – Earthquakes	Minimum Static Factors of Safety			Downstream Slope no Steeper Than
			End of Construction	Long Term	Full or Partial Drawdown	
Significant	1/3 between 1/975 and PMF	1/2,745	1.5	1.5	1.5	2H:1V, or justification by EoR

Notes:

1. Adapted from CDA Dam Safety Guidelines, 2013. Further context and guidance provided there.
2. The Code requires that a facility that stores the inflow design flood use a minimum event duration of 72 hours.
3. PMF=Probably Maximum Flood; MCE=Maximum Credible Earthquake

The annual exceedance probability for floods is used for both inflow floods within the facility and floods of creeks or rivers located in the vicinity of the facility.

CDA (2013) provides two calculations for freeboard; the most 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 1,000 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 10 years (for Significant consequence structures), with the pond at the maximum level during the passage of the IDF

2.6.1 Flood Design

2.6.1.1 Original Design Intent

The TSFs were designed with the intent to not contain the inflow design flood (IDF) as there are spillways exiting Cell 3 and Cell 7 for the South TSF and North TSF, respectively.

There are no design records or construction as-builts for these spillways. Appendix A includes photographs of Cell 3 (Photograph A-15) and Cell 7 (Photograph A-16).

No clear design intent for freeboard was documented in the historic reports.

No riprap design or other erosion protection design to protect the toe of the dams from the Kettle River was documented in the historic reports.

2.6.1.2 Existing Conditions and Current Design Status

2.6.1.2.1 TSFs Criteria for Inflow Floods

The storage of the Beaverdell South TSFs was checked against the 24 and 72 hour inflow design flood (IDF) of 1/3 between the 1,000 year event and the PMF (Golder 2016d). The effect of waves due to wind was estimated to be minor due to sheltering effects from surrounding trees (Golder 2013).

The South TSF cannot store the IDF and excess flood water is expected to exit via the Cell 3 spillway.

The North TSF can store the IDF without discharge through the Cell 7 spillway.

2.6.1.2.2 Flood Protection for TSFs from West Kettle River

Erosion protection was designed for the right bank of the West Kettle River below the South TSF based on CDA (2013). The erosion protection was designed for a 24 hour flood event 1/3 between the 1,000 year flood and the PMF.

2.6.1.2.3 Freeboard

The freeboard for a water-containing structure can be defined as the minimum vertical distance between the still pool reservoir level and the crest of the containing structure (CDA 2013). This distance needs to be maintained at all times (including during the IDF) to prevent overtopping of the containing structure by large waves resulting from the sum of wind, and wave set-up and run-up.

An initial evaluation of freeboard conditions was completed for the DSR in 2012 (Golder 2013) and a freeboard of 0.5 m was recommended based on typical design criterion for small mining dams (BC MELP 2001). This is not consistent with the CDA recommendations.

The current condition of the TSFs is dry with occasional, temporary ponding away from the dam crest. In the South TSF the tailings are often beached to the same elevation as the crest. The North TSF generally has a vertical difference of at least 0.5 m between the crest and the top of tailings at the dam upstream. Due to dry conditions the freeboard is not measured directly.

A flood routing exercise in the South TSF is required to confirm the elevation difference between the potential flood pond level and the dam crest. This will be used to clarify the freeboard in accordance with CDA Dam Safety Guidelines (CDA 2013, 2014).

2.6.2 Seismic and Static Stability

2.6.2.1 Foundation Conditions

Known site investigations for each cell include the following:

- Cell 1: no known site investigations, conditions inferred
- Cell 2: no known site investigations, conditions inferred
- Cell 3: no known site investigations, conditions inferred
- Cell 4: samples taken from existing dam, conditions as described by site personnel (Binnie 1971)
- Cell 5: surface and subsurface soil samples for gradation testing (Binnie 1973)
- Cell 6: surface soil samples for gradation testing (Binnie 1980a)
- Cell 7: three test pits, samples taken for gradation testing (Binnie 1988a)

The foundation conditions for Cells 4, 5, 6 and 7, are reported to be sandy gravel alluvial deposits typical of river valleys in central BC (Binnie 1971, 1973, 1980a, 1988). The foundation conditions for Cells 1, 2, and 3 are unconfirmed, but are assumed to be similar to the rest of the site (sand and gravel alluvial deposits). Soil units under the sand and gravel are unknown. Bedrock outcrops are present west of Cell 7.

2.6.2.2 Embankment Fill Materials

Based on the design documents, construction of Cells 5, 6, and 7 consisted of excavation of the center of the cell area to source material for construction of the dams. Therefore, the embankment fills are generally sandy gravel alluvial materials. The material placed for the embankment may be slightly more compacted than the original alluvial material based on construction methods but there is no testing to confirm.

Based on observations of the facility during several site visits, the embankment construction materials appear to be consistent for all South TSF dams.

Cells 4 and 5 have a waste rock or alluvial cobbles protective layer on the downstream face (Binnie 1971, 1973). Based on the design drawings, this layer is approximately 1.8 m (6 feet) at the crest and 3.0 m (10 feet) at the base of the embankment (Binnie 1971, 1973).

2.6.2.3 Seismicity

Seismic information from the seismic hazard maps developed by Natural Resources Canada was used to determine the peak horizontal ground acceleration (PGA) for use in the stability reassessment. Earthquake ground motions calculated for the Beaverdell site (49.4423 north latitude and -119.0968 west longitude) from Natural Resources Canada (2015) are presented in Table 4.

Table 4: Peak Ground Acceleration by Return Period for the Beaverdell Site

Exceedance Probability	Return Period	Peak Ground Acceleration (PGA)
40% in 50 years	100 years	0.0085 g
10% in 50 years	475 years	0.026 g
5% in 50 years	1,000 years	0.040 g
2% in 50 years	2,475 years	0.065 g

Note: Spectral and peak hazard values are determined for soil site class C

Return periods are not exact representations of annual exceedance probabilities, rounding as per CDA is shown

2.6.2.4 Original Design Intent

The historic reports do not include any details of static or seismic stability calculations or assessments.

2.6.2.5 Existing Conditions and Current Design Status

HSRC (Government of BC 2016a) recommends a return period 2,475 year seismic event be used for Significant consequence structures.

Golder has assessed the static and pseudo-static stability of the TSF dams, prior to the 2016 HSRC update. The static stability meets the required factor of safety. The pseudo-static stability analyses used a PGA of 0.040 g, equivalent to the 1,000 year return period. The pseudo-static stability assessment is out of date due to the recently changed HRSC.

2.6.3 Geometry

2.6.3.1 Original Design Intent

2.6.3.1.1 South TSF Dams

The South TSF area intersects with the natural up slope of the West Kettle River valley and as a result no dam was required on the north and west sides of Cell 3, the west side of Cell 2, and parts of the west side of Cell 1. The main perimeter dam of the South TSF is to the south of Cells 1 and 5 and east of Cells 3, 4, and 5 (Figure 2). A summary of the original design and references for the South TSF dams is shown below in Table 5 and original design cross sections are in Appendix B.

Table 5: Original Design Dam Geometry for Cells in the South TSF

Cell	Downstream Slopes	Upstream Slopes	Crest Width (m)	Embankment Height (m)	References	Figure
Cell 1	Unknown					
Cell 2						
Cell 3						
Cell 4	2H:1V	1.5H:1V (if drawn to scale)	3.2 to 5.1	3.8 to 4.6	Binnie 1971, 1973	Figure B-1
Cell 5	2H:1V	1.5H:1V	5.1	7	Binnie 1973, 1980c	Figure B-2

There are no original design or construction summaries of Cells 1 through 3 in the South TSF. The original design dimensions of these cells is unknown.

2.6.3.1.2 North TSF Dams

The North TSF consists of two cells (Cells 6 and 7) contained by the North TSF Dam and separated by a divider dike. The North TSF area intersects with the natural up slope of the West Kettle River valley and consequently no dam was required on parts of the west side of Cell 7. The main perimeter dam for the North TSF surrounds Cells 6 and 7, expect for a portion to the west of Cell 7 where the topography has sufficient elevation to contain the facility (Figure 2). A summary of the original design and references for the North TSF dams is shown below in Table 6 and original design cross sections are in Appendix B.

Table 6: Original Design Dam Geometry for Cells in the North TSF

Cell	Downstream Slopes	Upstream Slopes	Crest Width (m)	Embankment Height (m)	References	Figure
Cell 6	2H:1V	1.5H:1V	4	9.5	Binnie1980a	Figure B-3
Cell 7	2H:1V	1.5H:1V	4	8	Binnie 1988	Figure B-4

2.6.3.2 Existing Conditions and Current Design Status

2.6.3.2.1 South TSF Dams

There are no construction summaries for Cells 1 through 5.

Cell 2 and the western side of Cell 1 appears may have been constructed by dry stack method. There is not clear embankment around Cell 2 or the western side of Cell 1.

The geometry of the south side of Cell 1 and the exterior perimeter dams of Cells 3 to 5 are summarized in Table 7.

Table 7: Surveyed Dam Geometry for Cells in the South TSF

Cell	Downstream Slopes	Upstream Slopes	Crest Width (m)	Embankment Height (m)	Figure
Cell 1	2.0 to 4.0H:1V	unknown	2 to 3	3 to 4	Figure 2
Cell 2	N/A	unknown	N/A	N/A	Figure 2
Cell 3	1.5 to 2.4H:1V	unknown	2.5 to 3.5	2 to 3	Figure 2
Cell 4	1.2 to 1.4H:1V	design of 1.5H:1V (unconfirmed)	3 to 3.5	14	Figure 2
Cell 5	1.3 to 2.5H:1V	design of 1.5H:1V (unconfirmed)	3 to 6	7 to 8	Figure 3

2.6.3.2.2 North TSF Dams

There are no construction summaries for Cells 6 and 7.

The geometry of the exterior perimeter dams of Cells 6 and 7 are summarized in Table 8.

Table 8: Surveyed Dam Geometry for Cells in the North TSF

Cell	Downstream Slopes	Upstream Slopes	Crest Width (m)	Embankment Height (m)	Figure
Cell 6	1.4 to 1.9H:1V	design of 1.5H:1V (unconfirmed)	3 to 4	10 to 12	Figure 3
Cell 7	1.6 to 2.6H:1V	1.5H:1V	3 to 4	8 to 10	Figure 3

2.6.4 Dam Breach and Inundation Study

No dam breach and inundation study has been completed for the Beaverdell TSFs.

2.6.5 Dam Consequence Classification

Table 9 presents the dam classification criteria by the CDA (2013).

Table 9: Dam Classification in Terms of Consequences of Failure

Dam Class	Population at Risk[a]	Incremental Losses		
		Loss of Life [b]	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	Unspecified	No significant loss or deterioration of fish or wildlife habitat. 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	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	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	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: CDA (2013), Table 2-1

(a) Definition for population at risk:

None – There is no identifiable population at risk, so there is no possibility of loss of life other than through unforeseeable misadventure.

Temporary – People are only temporarily in the dam-breach inundation zone (e.g., seasonal cottage use, passing through on transportation routes, participating in recreational activities).

Permanent – The population at risk is ordinarily located in the dam-breach inundation zone (e.g., as permanent residents); three consequence classes (high, very high, extreme) are proposed to allow for more detailed estimates of potential loss of life (to assist in decision-making if the appropriate analysis is carried out).

(b) Implications for loss of life:

Unspecified – The appropriate level of safety required a dam where people are temporarily at risk depends on the number of people, the exposure time, the nature of their activity, and other conditions. A higher class could be appropriate, depending on the requirements. However, the design flood requirement, for example, might not be higher if the temporary population is not likely to be present during the flood season.

The CDA guidelines were used to assign a dam class to the Beaverdell TSF dams (CDA 2013). A screening level assessment of the classification of the TSF dams was previously completed for the DSR carried out in 2012 (Golder 2013). The rational applied for the DSR for assigning the consequence level for each attribute can be found in Golder (2013). A summary of the classification is provided in Table 10.

Table 10: Dam Failure Consequence Classification for the South and North TSF Dams

Dam	Dam Class	Population at Risk	Consequences of Failure		
			Loss of Life	Environment and Cultural Values	Infrastructure and Economics
South TSF Dam	Significant	Significant	Low	Low to Significant	Low
North TSF Dam	Significant	Significant	Low	Low	Low

Note: The class assigned to a dam is the highest rank determined among the four attributes (i.e., population at risk, loss of life, environmental and cultural values, and infrastructure and economics).

CDA Technical Bulletin – Application of Dam Safety Guidelines to Mining Dams (2014) discusses the phases of a mining dam as follows:

- Site selection
- Operation
- Transition
- Closure – Active Care
- Closure – Passive Care

The Closure – Active Care phase is often referred to as “care and maintenance”. It involves the active care of a mining dam including monitoring, inspection, water management, operation of a water treatment system, etc. The mine owner will typically have staff monitoring the site on a regular basis and the dam should achieve a steady state condition during this phase.

Beaverdell is currently considered to be in Closure – Active Care.

2.6.5.1 Structures and Receptors Downstream of Dams Considered for Consequence Classification

Structures and receptors downstream of the South TSF Dam include:

1) A baseball playing field (east of the dam)

2) The Beaverdell Station Road (east of the dam)

3) West Kettle River (east of dam)

Structures and receptors downstream of the North TSF Dam include:

1) The Kettle Valley Trail (north and east of the dam)
2) One private property (south of the dam)
3) West Kettle River (east of dam)

These structures and receptors are shown in Figure 2.

2.6.6 Design Criteria Summary

Table 11 summarizes all design criteria for the TSFs.

Table 11: South and North TSFs Closure-Active Care and Design Criteria

Design Feature	Criteria	Source	Original Assessment	Updated Assessment	Meets Criteria	Comments
Dam Safety Inspection	Required to be completed annually	HSRC	N/A	Golder 2016b	Y	
Dam Safety Review	Required to be completed every 5 years	HSRC	Golder 2013	N/A	Y	To be completed in 2017
Emergency Response Plan	N/A	HSRC and CDA	Teck 2013	Golder updated February 2017	Y	SP&P BEA-ERP-001.V001
Operations, Maintenance, and Surveillance Manual	N/A	HSRC and CDA	Teck 2013	Golder updated February 2017	Y	SP&P BEA-OMS-001.V001
Freeboard	Two calculations for freeboard with the more critical of the two cases setting the minimum freeboard	CDA	N/A	Golder 2016b	Out of date	Minimum freeboard requires reassessment due to new HSRC
Inflow Design Flood	1/3 Between 1/1,000 year return period and PMF; 72 hour IDF if contained	HSRC	Golder 2013	Golder 2016b	Partially	Cell 3 cannot contain IDF with 24 or 72 hour event
River Flood	1/3 Between 1/1,000 year return period and PMF	HSRC	N/A	Golder 2015	Y	West Kettle River evaluated
EDGM	1/2,475	HSRC	Golder 2014	Golder 2016a	N	PGA of 0.040 g (1/1,000)
Factory of Safety	Long Term – 1.5	HSRC	N/A	Golder 2016a	Y	Laboratory testing completed on sample to confirm strength parameters (Golder 2016c). Post-earthquake not analysed. New HSRC criteria
	Pseudo-static – 1.0	HSRC	Golder 2016a	Required	Out of date	
	Post-earthquake – 1.2	CDA	N/A	Required	Out of date	
Downstream Slope	No Steeper than 2H:1V	HSRC	N/A	N/A	N	Requires justification from EoR

Note: PMF = Probable Maximum Flood; EDGM = Earthquake Design Ground Motion; PGA = Peak Horizontal Ground Acceleration

2.7 Site Reference Data

2.7.1 Grid System and Maps

Beaverdell uses UTM NAD 83 Zone 11 grid. Figure 2 shows a contoured plan map of the Beaverdell TSFs in UTM.

2.7.2 Instrumentation

There are 13 documented standpipe piezometers around Cells 5, 6, and 7 (Binnie 1973, 1983, 1988). Locations of the 13 piezometers are shown in Figure 2. No installation records are available.

2.7.3 Subsoil Characteristics

The foundation conditions for Cells 4, 5, 6 and 7, are reported to be sandy gravel alluvial deposits typical of river valleys in central BC (Binnie 1971, 1973, 1980a, 1988). Laboratory testing was completed on a sample from in front of Cell 5 to confirm the strength of the material (Golder 2016c). The foundation conditions for Cells 1, 2, and 3 are unconfirmed, but are assumed to be similar to the rest of the site (sand and gravel alluvial deposits). Soil units under the sand and gravel are unknown. Bedrock outcrops are present west of Cell 7.

2.7.4 Surface Water Sampling Points

Water quality testing results are submitted to the Ministry of the Environment in accordance with Water Licence No. PE-444 (Ministry of Environment 1990). Data is managed by Teck.

2.7.5 Weather

Site weather data is collected by Environment Canada and made available online. The data is reviewed annually.

2.8 Construction History

Initial construction of the South TSF was presumably concurrent with the opening of the Beaverdell mill in the 1950s. At the time, the site was owned by Highland Bell Limited and Leith Gold Mines Limited.

The South and North TSFs are understood to have been developed using a downstream construction technique.

2.8.1 South TSF

2.8.1.1 Cell 1

No construction records are available.

2.8.1.2 Cell 2

No construction records are available.

2.8.1.3 Cell 3

No construction records are available.

2.8.1.4 Cell 4

No initial construction records are available. Binnie provided site observations and recommendations for remedial actions in 1971.

Binnie (1971) indicates that Cell 4 experienced tailings migration through the dam section during the winter of 1970/1971. In response to this event, coarse rock was placed on the downstream slope of a section of the Cell 4 dam and operations were change to spigotted deposition to deposit coarse tailings against the upstream slope and push the slimes toward the centre of the facility (Binnie 1971). The tailings against the upstream face were found to contain less fines than the unsegregated tailings, which confirmed a wedge of coarse tailings was being successfully developed to act as a filter. The remedial measures directed in Binnie (1971) were determined to have been successful (Binnie 1973).

2.8.1.5 Cell 5

Cell 5 of the South TSF was constructed after Teck Corporation Limited obtained the property. Cell 5 was designed by Robert F. Binnie Ltd. (Binnie 1973).

Available records indicate that design reports for Cell 5 required that operations create a wedge of coarse tailings against the upstream slope of the TSF dams to act as a filter for the slimes. Samples of the tailings were taken once deposited to confirm the coarse tailings wedge (beach) was being created and spigotting methods were observed (Binnie 1980a).

Construction of Cell 5 consisted of excavation of the center of the cell area to source material for construction of the dam.

2.8.2 North TSF

2.8.2.1 Cell 6

Cell 6 of the North TSF was constructed after Teck Corporation Limited obtained the property. Cell 6 was designed by Robert F. Binnie Ltd. (Binnie1980a, b).

Available records indicate that design reports for Cell 6 required that operations create a wedge of coarse tailings against the upstream slope of the TSF dams to act as a filter for the slimes and samples of the tailings were to confirm the coarse tailings wedge (beach) was being created and spigotting methods were observed (Binnie 1983, 1988a).

Construction of Cell 6 consisted of excavation of the center of the cell area to source material for construction of the dam.

2.8.2.2 Cell 7

Cell 7 was designed by Robert F. Binnie Ltd. (Binnie 1988a). Cell 7 of the North TSF is only partially filled with tailings.

Available records indicate that design reports for Cell 7 required that operations create a wedge of coarse tailings against the upstream slope of the TSF dams to act as a filter for the slimes and samples of the tailings were to confirm the coarse tailings wedge (beach) was being created and spigotting methods were observed (Binnie 1988a).

Construction of Cell 7 consisted of excavation of the center of the cell area to source material for construction of the dam.

2.9 Training Requirements

Teck Site Inspectors Training Courses:

- Province of British Columbia – Water Management Branch –Inspection and Maintenance of Dams – Dam Safety Guidelines
- FEMA – The National Dam Safety Program – A Self Instructional Study Course in Dam Safety Practices

2.10 Documentation and Document Control

Teck has set up procedures for the retention of information. Once a document has been revised, the version number is updated, at which time, the revised procedure is flagged as necessary training to all applicable employees.

Historic reports on the Beaverdell TSFs and reports from external consultants conducting work on the Beaverdell TSFs are kept by Teck at its administrative office in Kimberley and electronically on its server in Kimberley.

Electronic data from water quality sampling as outlined by Water Licence No. PE-444 (Ministry of Environment 1990) is stored in EQWin Database on the Kimberley Server.

3.0 OPERATIONS

3.1 Objectives

The objective of this section is to define operating standards and procedures in accordance with design criteria, regulatory requirements, company policies and sound operating practices.

3.2 Tailings Transport and Deposition

Not applicable, Beaverdell is a closed site.

3.3 Equipment Operating Instructions

Not applicable. There is no operational equipment on site.

3.4 Dam and Impoundment Raising

Not applicable, Beaverdell is a closed site.

3.5 Surface Water Management and Water Balance

The cells act as un-regulated landforms, and the South and North TSF are therefore self-contained or isolated systems. The only sources of inflow to the cells are direct precipitation in the cells and runoff from limited drainage areas. Discharge from any of the cells is controlled by water level within the cells. Water levels in the cells are expected to have seasonal fluctuations that are similar to those of a natural pond, with high levels reached during the freshet period and extreme rainfall events. However, minor water ponding has only been observed during the freshet period at Cell 4, and this water accumulation has never reached the inside slope of the dam crest section.

The cells in the South TSF area are connected by a system of spillways, meaning that overflow from upstream cells is discharged to downstream cells. Cell 1 has no capacity and its berms were raised in August 2016 to facilitate the movement of water from Cell 1 to Cell 5. Cell 2 has not capacity and runoff overflow reports to Cell 4. Excess runoff from Cell 3 would discharge via the spillway to the area downstream of the Cell 3 dam.

The storage of the Beaverdell South TSFs was checked against the 24 and 72 hour IDF of 1/3 between the 1,000 year event and the PMF (Golder 2016d). The effect of waves due to wind was estimated to be minor due to sheltering effects from surrounding trees (Golder 2013).

The South TSF cannot store the full IDF and excess water is expected to exit via the Cell 3 spillway during an IDF event.

The TSF cells in the north TSF area are connected by a low point that can act as a spillway, meaning that overflow from Cell 6 would discharge to Cell 7, and Cell 7 would discharge through the spillway to the area downstream of Cell 7.

The storage of the Beaverdell North TSFs was checked against the 24 and 72 hour IDF of 1/3 between the 1,000 year and PMF (Golder 2016d). The effect of waves due to wind was estimated to be minor due to sheltering effects from surrounding trees (Golder 2013).

The North TSF can store the IDF without discharge through the Cell 7 spillway.

The water balances for the South and North TSF areas were based on the watershed areas of each facility, summarized in Table 12 (Golder 2016g). The total watershed of the South TSF area is limited by the South TSF Dam and the Beaverdell Station Road (the road ditching diverts runoff from Cranberry Ridge away from the TSF). The total watershed of the North TSF is limited to the areas of Cells 6 and 7 (ditching to the west of the North TSF, including the emergency spillway, diverts runoff from Cranberry Ridge away from the TSF).

Table 12: TSF Catchment Areas

TSF	Cell	Catchment Area (km^2)	TSF Catchment Area (km^2)
South TSF	1	0.029	0.188
	2	0.020	
	3	0.086	
	4	0.027	
	5	0.026	
North TSF	6	0.031	0.081
	7	0.050	

The water balance is limited to surface water contributions. It is assumed that all groundwater flows (if any) exit the TSFs. The only surface inflow to the TSFs is the contribution from direct precipitation on the cells and a small external catchment between Beaverdell Station Road and the South TSF cells. An annual combined runoff coefficient for the cells and external catchment area was assumed at 0.4. The inflow volume each year is therefore the total annual precipitation multiplied by the watershed areas and the annual runoff coefficient (0.4). Based on the long-term average annual precipitation depth of 476 mm, the total average net annual inflow volume is:

- 35,800 m^3 for the South TSF area
- 15,430 m^3 for the North TSF area

There is no long-term surface water accumulation in the TSF cells and no surface or seepage discharge to the environment has been observed. Therefore, outflows (losses) from the TSFs are due to the following processes:

- Evaporation: loss of water to the atmosphere occurs in the TSFs from temporary water ponding and from the soil near the surface.
- Transpiration: a vegetation cover is present at the TSFs on the tailings surface and on the dams slopes, and this cover captures water that is released to the atmosphere in the form of transpiration.

- Sublimation: a fraction of the snow cover on the TSFs during the winter is lost to the atmosphere through sublimation (the transition from solid to water vapour).
- Infiltration to ground: surface water percolates through the tailings deposits and infiltrates the underlying ground.

There is no persistent surface water accumulation at the TSF on an annual basis (i.e., no surface water storage). All precipitation inflows are conveyed out of the TSF through the outflow processes listed above. The distribution of the inflows to these outflows processes cannot be assessed. It is assumed that sublimation is negligible, and therefore all outflows are in the form of evaporation, transpiration and infiltration to ground. No seepage through the North and South TSF dams has been observed.

Table 13 and Table 14 summarize the annual water balances for the South and North TSFs, respectively.

Table 13: South TSF Annual Water Balance

IN	Annual Volume (m^3)	OUT	Annual Volume (m^3)	Total Inventory Change (m^3)
Surface water	0	Evaporation	35,800 (distribution of volume cannot be assumed)	
Precipitation	35,800	Transpiration		
Tailings slurry water	0	Seepage as Infiltration to groundwater		
		Seepage through dam to surface	0 (none observed)	
		Sublimation	0 (negligible)	
Sum	35,800	Sum	35,800	0

Table 14: North TSF Annual Water Balance

IN	Annual Volume (m^3)	OUT	Annual Volume (m^3)	Total Inventory Change (m^3)
Surface water	0	Evaporation	15,430 (distribution of volume cannot be assumed)	
Precipitation	15,430	Transpiration		
Tailings slurry water	0	Seepage as Infiltration to groundwater		
		Seepage through dam	0 (none observed)	
		Sublimation	0 (negligible)	
Sum	15,430	Sum	15,430	0

A total inventory change of 0 indicates there is no change to volume of surface water being held in the facility (dry condition unchanged).

3.6 Environmental Protection

Beaverdell water sampling occurs in accordance with the locations and frequencies listed in Section 8 of the Ministry of Environment Effluent Permit PE-444. Water samples are collected quarterly from the West Kettle River, upstream (WK U/S) and downstream (WK D/S) of the tailings area near Beaverdell, BC. Both permitted water sampling locations are shown in PE-444. In addition, Teck has been sampling another location on the West Kettle River, further downstream than the permitted sample location WK D/S for due diligence. This location (KR FAR) is also sampled quarterly, with its coordinates listed within Teck's EQWin database.

3.7 Safety and Security

The Beaverdell TSF is located adjacent to the town of Beaverdell, 87 km from Kelowna on BC Highway 33 (Figure 1). The TSF can be accessed from the Beaverdell Station Road, which crosses Highway 33 within the town (Figure 2). The North TSF is 200 m to the north of Beaverdell Station Road, accessible from the Kettle Valley Trail. The South TSF is located immediately south and west of the Beaverdell Station Road. There is a "No Trespassing" sign between the Beaverdell TSF and the Kettle Valley Trail (Photograph A-17). Fencing has been installed around the embankments (Photograph A-17).

3.8 Change Management

Not applicable, there are no operations at the Beaverdell TSFs.

3.9 Documentation

Not applicable.

3.10 Reporting

Not applicable.

4.0 SURVEILLANCE

4.1 Objectives

A surveillance program is a fundamental part of determining the current performance of a facility relative to its intended design parameters.

The objective of a surveillance program is to provide positive confirmation of adequate performance of the facility including containment, stability, and operational function by observing, measuring, and recording data relative to potential failure modes.

A visual inspection checklist is included in Appendix A.

4.2 Surveillance Parameters

4.2.1 Identify Potential Failure Modes

The following list outlines the different failure modes applicable to the Beaverdell TSFs:

- Overtopping
- Instability
- Contaminated seepage
- Piping
- Flooding (of TSFs)
- Flooding (of West Kettle River)

4.2.2 Visual Parameters

The following table outlines the different failure modes applicable to the Beaverdell TSFs and visual observations which may indicate potential failure.

Table 15: Failure Modes and Identification

Failure Mode	Conditions to Identify Potential Failure Mode
Overtopping	■ Seepage ■ Meteorological event ■ Landslide
Instability	■ Cracking ■ Settlement ■ Bulging ■ Seepage ■ Erosion ■ Seismic event
Contaminated Seepage	■ Increased contaminants indicated by water quality testing
Piping	■ Seepage ■ Wet spots downstream of dam toe ■ Sinkholes, depressions
Flooding (of TSFs)	■ Meteorological event ■ Landslide
Flooding (of West Kettle River)	■ Meteorological event ■ Landslide

4.2.3 Instrumentation Installation Details

There are no installation details regarding the piezometers on the Beaverdell TSFs.

4.2.4 Instrumentation Parameters and Thresholds

There are no instrument parameters and thresholds for the piezometers on the Beaverdell TSFs.

4.2.5 Sampling and Testing Location Details

Water samples are collected from the West Kettle River and sent for water quality testing. The results are submitted to the Ministry of the Environment in accordance with Water Licence No. PE-444 (Ministry of Environment 1990).

4.2.6 Sampling and Testing Parameters and Thresholds

Samples are collected for total suspended solids (TSS), pH, total cyanide, dissolved arsenic, copper, lead, zinc, iron, manganese and silver as per requirements listed in PE-444. The MOE permit does not list maximum allowable concentrations for these parameters, in the receiving environment, so the British Columbia Water Quality Guidelines Aquatic Life (Ministry of Environment 2017) are used to screen the data.

4.3 Surveillance Procedures

4.3.1 Defined Frequency, Schedule and Procedures

Based on the dam classification (Significant), frequency of routine visual inspections can be selected based on the conditions of the dam site. The dams are part of a closed mine. The cells act as natural (un-regulated) water bodies. Routine visual inspection should therefore be conducted during or toward the end of the freshet period, and in the fall prior to winter (semi-annually). Visual inspections should also be conducted following a significant earthquake or storm event (described in Section 4.3.8.1). A visual inspection checklist for the South and North TSFs is included in Appendix C.

4.3.2 Visual Monitoring

The following should be visually inspected during routine and special inspections:

1) The inlets (cells 5, 6, and 7) and outlets (cells 6 and 7) of the known decant pipes should be checked to identify that the seal is in place and functioning.

2) The spillways should be checked for blockage by vegetation or debris.

3) The spillway channels should be checked for sloughing, sliding or erosion.

4) The crests and faces of the dams should be checked for cracks and slumps.

5) The crests and faces of the dams should be checked for any damage caused by vegetation, as well as any burrows or other disturbance caused by animal presence.

6) The dam crests should be checked for settlement or sinkholes.

7) Both the upstream and downstream slopes of the dams should be checked for sinkholes, sloughing, sliding or bulges.

8) The downstream slope/toe of the dams should be checked for wet areas or seepage, in addition to any celled water. If any seepage or celling is observed, the quantity should be estimated.

9) The height from the water level to the dam crest in Cells 3 to 7 should be estimated and noted, if water celling is observed at any of these cells. The height must be more than the 0.5 m freeboard.

There is no instrumentation that requires to be inspected or monitored.

4.3.3 Survey and Bathymetry

The last survey of the Beaverdell TSFs was July 2013 and is shown in Figure 2. Surveys of Cells 1 and 3 were completed in August 2016 and are shown in Figure 2. There is no ponded water on the TSFs so bathymetry is not applicable.

4.3.4 Instrumentation Measurements

There is no operating instrumentation on the Beaverdell TSFs.

4.3.5 Sampling and Testing

Water quality samples are collected and tested quarterly.

4.3.6 Weather Stations

The following Environment Canada weather stations are within the vicinity of the Beaverdell site:

- Kelowna
- Penticton
- Billings

They are reviewed annually and reported in the DSI.

4.3.7 Triggers for Change of Operations

The Beaverdell TSFs are not in operation, however, unusual conditions, (i.e., any conditions not noted on previous inspections, conditions that may cause hazards or indicate potential issues with the care and maintenance of the dams) may be observed during care of the facility. These could potentially lead to dam instability if not addressed in a timely manner. Such conditions can be identified from visual inspections of the dam, whether it's a routine or special inspection. There is no instrumentation to aid in identifying an unusual condition.

If any unusual conditions are observed, the Mine Manger must be informed immediately. Depending on the nature and severity of the condition observed, the EoR may be contacted or the Emergency Response Plan (ERP) may be initiated. The decision to execute the ERP shall only be made once an incident exists (i.e., possible failure or failure of the dam) and that there is a serious risk to facilities and/or downstream stakeholders. The ERP is under separate cover (Teck 2017).

4.3.8 Event Driven Procedures

4.3.8.1 Special Inspections

In addition to the routine and periodic inspections, special inspections may be required during, if possible, and after unusual or significant seismic or climatic events. Significant climatic events include heavy rainfall and spring freshet floods.

Teck staff should carry out the special inspections after significant events and the EoR should be notified. If there are any concerns with areas of the dam, then the Mine Manager would arrange to bring in the EoR for further inspections and review.

4.3.8.1.1 Earthquake Event

The United States Society on Dams (USSD 2003) provides guidelines for inspection of dams after earthquakes, and recommends that an inspection should be carried out after an earthquake within the following distances from the dam, under corresponding Richter earthquake magnitudes (M). These guidelines have been adopted for this OMS:

- M < 4.0 no special inspection required, inspect dam during next routine inspection
- M > 4.0 within 40 km
- 6.0 > M ≥ 5.0 within 80 km
- 7.0 > M ≥ 6.0 within 120 km
- 8.0 > M ≥ 7.0 within 200 km
- M >8.0 within 320 km

Dam crest and outer slopes require immediate inspection by the site caretaker. The site manager and geotechnical consultant are to be called if damage is noted.

4.3.8.1.2 Storm Event

Guidelines for special inspection following a significant or unusual storm event are as follows:

- <50 mm in 24 hours (~1 in 100 year rainfall event) requires no action
- >50 mm in 24 hours requires an inspection of the facility

Dam faces to be checked for erosion. Seepage through the dam toe (if any) to be checked daily for next 5 days. The decant pipes should be checked to identify that the seal is still in place and functioning. The spillways and downstream channels should be checked for debris and damage to riprap lining. The site manager and geotechnical consultant are to be called if damage is noted.

4.3.9 Data Collection, Analysis and Documentation

Inspection reports and water quality results are maintained by Teck at its administrative office in Kimberley and electronically on its server in Kimberley.

4.3.10 Periodic Inspections and Review

4.3.10.1 Annual Dam Safety Inspection

A comprehensive review of the Beaverdell TSFs and its management should be undertaken annually by the EoR or designate. This review shall be submitted to the Ministry of Energy and Mines (MEM) as required by the HSRC Section 10.5.3 (Government of BC 2016a).

The inspection shall consist of a geotechnical assessment of the conditions of the dams, spillways, drainage pipe outlets and would typically be conducted following the freshet period.

All annual dam safety inspections reports are stored electronically on the Dam Owner's computer network.

4.3.10.2 Dam Safety Review

An independent dam safety review of the Beaverdell TSFs should be undertaken by an external consultant/third party. The last DSR for the facility was completed in 2012. Based on the HSRC Section 10.5.4, DSRs need to be completed every 5 years. Beaverdell is scheduled to complete a DSR in 2017.

All dam safety review reports are stored electronically on Teck's computer network.

5.0 MAINTENANCE

5.1 Objectives

Maintenance of the Beaverdell TSFs is important to ensure integrity of the facility.

The objective of the maintenance program is to:

- identify and describe critical parts of the facility
- address routine, predictive/preventative, and event-driven maintenance
- address operating and surveillance observations for all components of the facility

5.2 Inventory of Components Requiring Maintenance

The following components of the Beaverdell TSFs may require maintenance over the facilities lifetime:

- Embankments
- Spillways
- Riprap

5.3 Maintenance Schedule and Triggers

Maintenance should be carried out as needed and may be triggered by visual observations from routine inspections, an emergency/hazard potential (reference the ERP, Golder 2016d), or failure mode.

5.4 Maintenance Parameters

There are no maintenance parameters.

5.5 Routine and Preventative Maintenance

Routine/preventative maintenance typically includes the following tasks:

1) Removal of dead trees ≥ 75 mm in diameters from the dam crest and outer dam slopes. Removal should occur within a year of the observation of dead tree(s) being made.

2) Repair of gullies or rills formed by erosion along the dam crest, using angular, granular backfill. To be performed as required.

3) Investigation of any large sized cracks on the crest or slope. To be performed as required.

4) Re-establishing dam crests, as needed, if significant settlement is observed. A crest repair would be needed if settlement exceeds 0.075 m, and should be performed only as required.

5) Removal of debris from the spillways. To be done twice a year (Spring / Fall).

6) Repair of sloughing on the channel slopes. To be done annually (if observed).

7) Repair of riprap erosion protection. To be done as required.

8) Checking of decant pipe inlet and outlet. It must be confirmed that the seal is still in place and functioning. No water should seep from the outlet. To be done twice a year (Spring / Fall).

A log of maintenance activities is kept by the Teck at its administrative office in Kimberley and electronically on its server in Kimberley.

5.6 Event Driven Maintenance

After a special inspection due to an event driven inspection, event driven maintenance may be required. The maintenance should be completed as soon as possible.

5.7 Documentation

Maintenance logs and summaries are maintained by Teck at its administrative office in Kimberley and electronically on its server in Kimberley.

6.0 REPORTING AND COMMUNICATION

6.1 Communications

The posted contact number on the signage at the Beaverdell site is monitored 24 hours per day. All in-coming call are received at 250-427-9700 are directed to the Mine Manager.

6.2 Operations Reporting

Not applicable.

6.3 Surveillance Reporting

Surveillance reporting must be completed as follows:

- Bi-annually for routine inspection
- Annually for the DSI
- Any time a special inspection is carried out

Reporting must be maintained on Teck's Kimberley server.

6.4 Maintenance Reporting

Maintenance logs and summaries must be completed immediately after works are carried out and maintained on Teck's Kimberly server.

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NOTE

1. COORDINATES ARE IN UTM ZONE 11 NAD83.

REFERENCE

1. 2013 ORTHOPHOTO RECEIVED FROM TECK RESOURCES LIMITED.

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-02-06
DESIGNED	AGH
PREPARED	JY
REVIEWED	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATION, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
BEAVERDELL SITE PLAN

PROJECT NO.	PHASE/DOC.	REV.	FIGURE
12-1428-0022	16100/033	0	01

LEGEND

- 2013 TOPOGRAPHIC CONTOURS
- 2016 TOPOGRAPHIC CONTOURS
- RIP-RAP ARMOURING A
- RIP-RAP ARMOURING B
- APPROXIMATE STANDPIPE PIEZOMETER LOCATION
- APPROXIMATE DECANT TOWER LOCATION
- APPROXIMATE OUTLET LOCATION
- APPROXIMATE SPILLWAY LOCATION AND FLOW DIRECTION

NOTES

1. ALL UNITS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATES ARE IN UTM ZONE 11 NAD83.
3. 2013 TOPOGRAPHIC CONTOURS SHOWN AT 1.0 m MINOR AND 5.0 m MAJOR INTERVAL.
4. 2016 TOPOGRAPHIC CONTOURS SHOWN AT 0.1 m MINOR AND 0.5 m MAJOR INTERVAL.

REFERENCES

1. 2013 ORTHOPHOTO PROVIDED BY TECK RESOURCES LIMITED.
2. GROUND SURVEY BY MCELHANNEY (JULY 2013) PROVIDED BY TECK RESOURCES LIMITED.
3. 2016 TOPOGRAPHIC CONTOURS FOR CELL 1 AND 3 SURVEYED 10 AUGUST 2016 BY ALLTERRA LAND SURVEYING LTD. AND PROVIDED ON 30 AUGUST 2016.
4. CELL 5 STANDPIPE PIEZOMETER APPROXIMATE LOCATIONS FROM BINNIE (ROBERT F. BINNIE LTD.). 1973. *REPORT ON PROPOSED NEW TAILINGS POND.* REPORT PREPARED FOR TECK CORPORATION LTD., BEAVERDELL, BC. SUBMITTED AUGUST 27, 1973.
5. CELL 6 STANDPIPE PIEZOMETER APPROXIMATE LOCATIONS FROM BINNIE (R.F. BINNIE & ASSOCIATES LTD.). 1983. *1982 REPORT ON TAILINGS DISPOSAL, PONDS NO. 5 AND 4.* REPORT PREPARED FOR TECK CORPORATION LTD. SUBMITTED FEBRUARY 11, 1983.
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CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-02-06
DESIGNED	AGH
PREPARED	JY
REVIEWED	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATION, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
DETAIL PLAN

PROJECT NO.	PHASE/DOC.	REV.	FIGURE
12-1428-0022	16100/033	0	02

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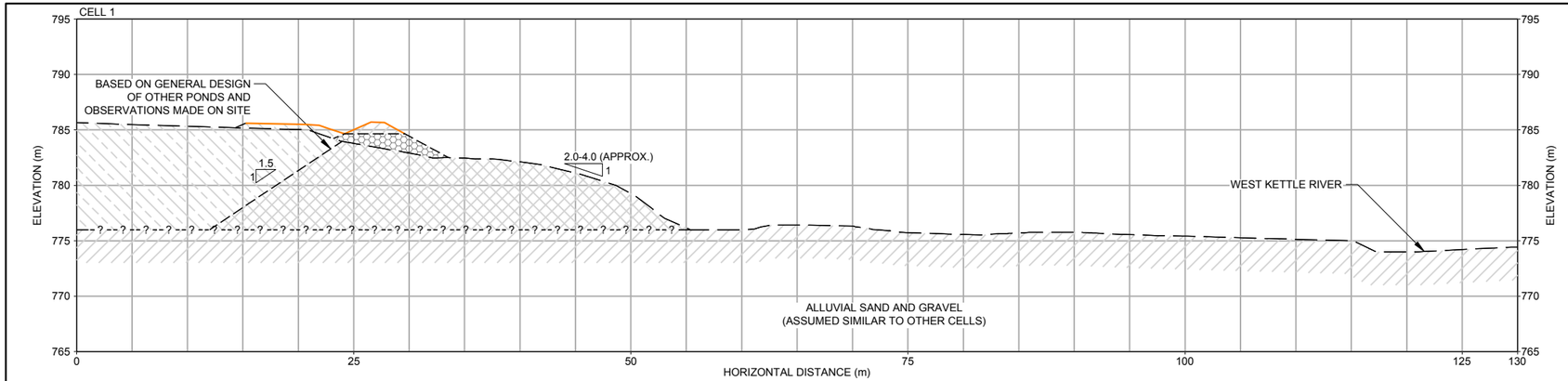

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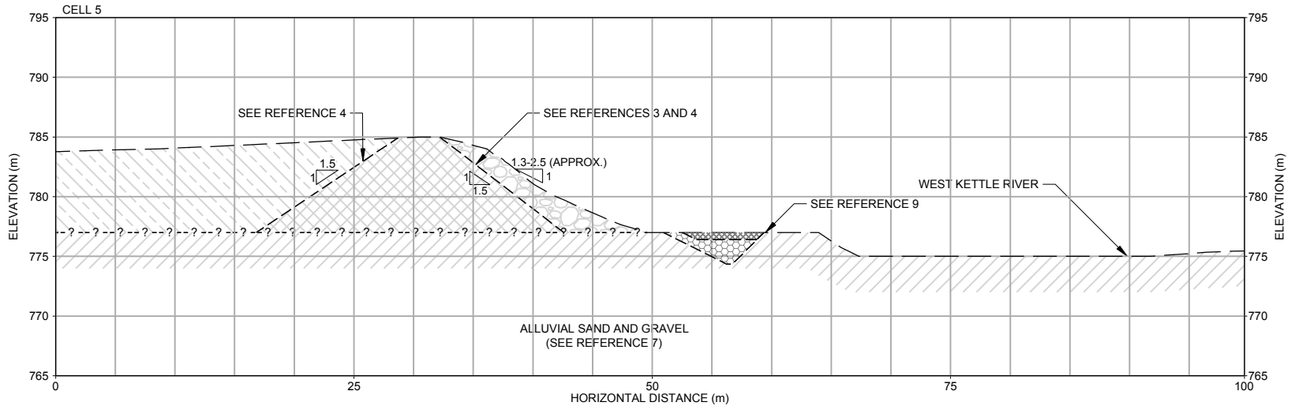

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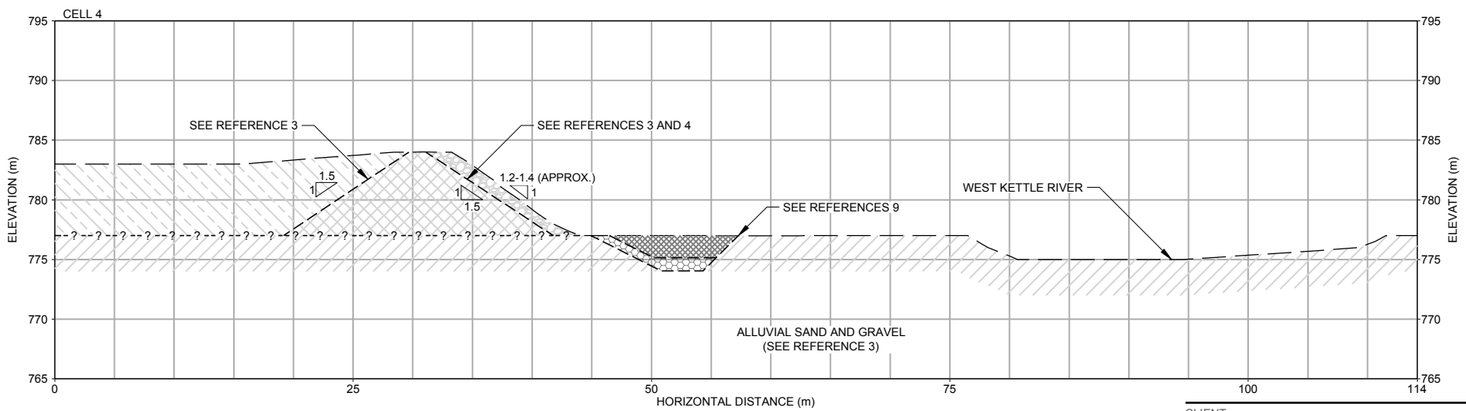

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LEGEND

- EXISTING GROUND SURFACE (JULY 2013)
- ESTIMATED ORIGINAL GROUND SURFACE
- 2016 TOPOGRAPHIC SURFACE (AUGUST 2016)
- INFERRED MATERIAL BOUNDARY
- TAILINGS
- EMBANKMENT FILL
- ALLUVIAL SAND AND GRAVEL
- ALLUVIAL COBBLE COVER
- WASTE ROCK/ALLUVIAL COBBLES
- RIPRAP MIXED WITH GRANULAR FILL
- BACKFILLED EXCAVATED MATERIAL

NOTES

1. ALL UNITS ARE SHOWN IN METERS UNLESS OTHERWISE NOTED.
2. STRATIGRAPHY BENEATH ALLUVIAL SAND AND GRAVEL IS UNKNOWN.
3. ESTIMATED ORIGINAL GROUND SURFACE BASED ON SURVEYED TOPOGRAPHY.

REFERENCES

1. GROUND SURVEY BY MCELHANNEY (JULY 2013) PROVIDED BY TECK RESOURCES LIMITED.
2. 2016 TOPOGRAPHIC CONTOURS FOR CELL 1, 3 AND 5 SURVEYED: 10 AUGUST 2016 BY ALLTERRA LAND SURVEYING LTD. AND PROVIDED ON 30 AUGUST 2016.
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CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-02-06
DESIGNED	AGH
PREPARED	JY
REVIEWED	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATION, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
CROSS-SECTIONS (1 OF 2)

PROJECT NO.	PHASE/DOC.	REV.	FIGURE
12-1428-0022	16100/033	0	03

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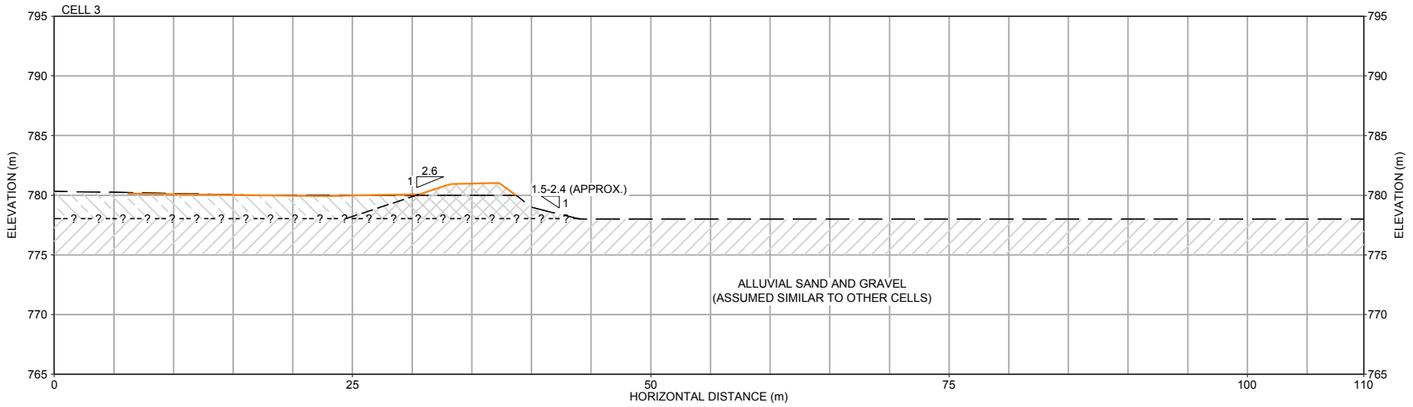

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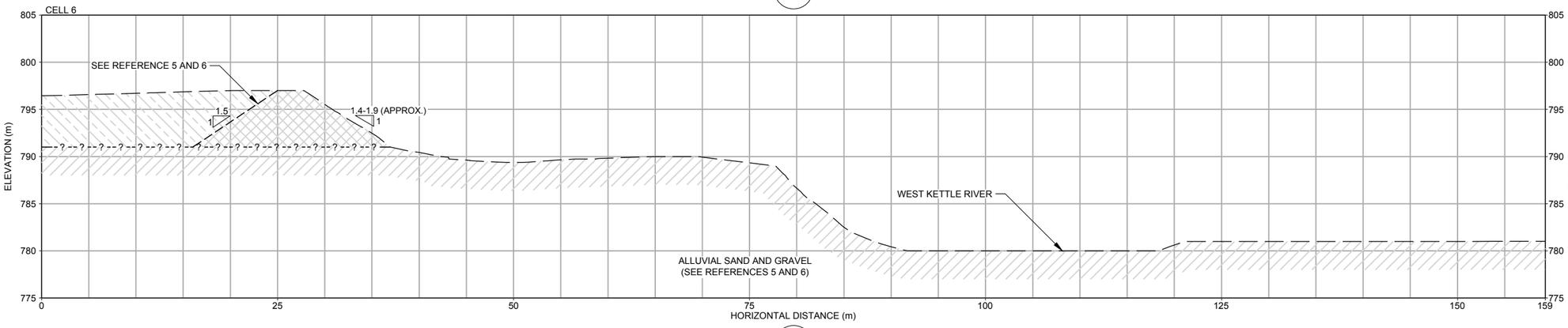
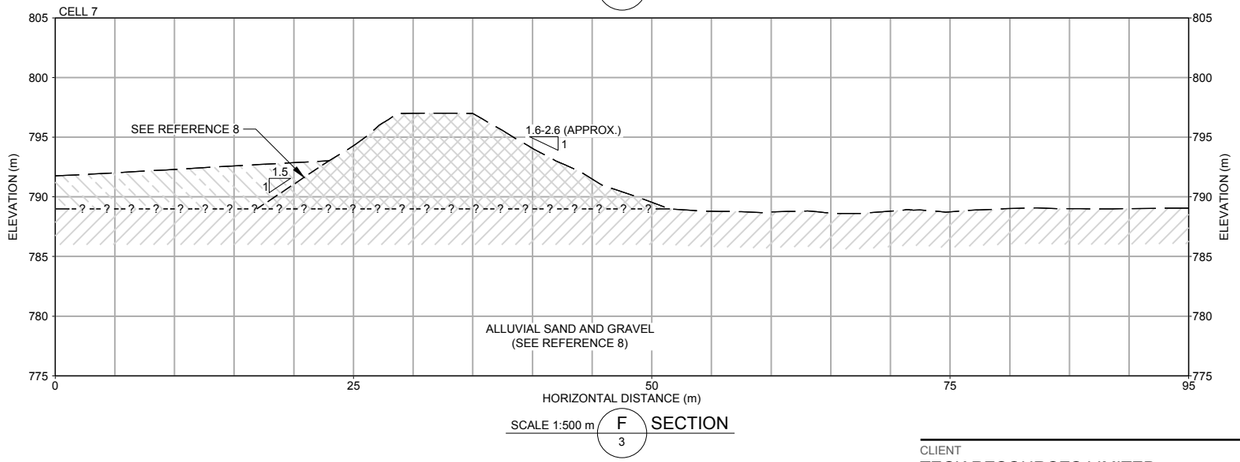


SCALE 1:500 m — E / 3 — SECTION



SCALE 1:500 m — F / 3 — SECTION

LEGEND

- EXISTING GROUND SURFACE (JULY 2013)
- ESTIMATED ORIGINAL GROUND SURFACE
- 2016 TOPOGRAPHIC SURFACE (AUGUST 2016)
- INFERRED MATERIAL BOUNDARY
- TAILINGS
- EMBANKMENT FILL
- ALLUVIAL SAND AND GRAVEL

NOTES

1. ALL UNITS ARE SHOWN IN METERS UNLESS OTHERWISE NOTED.
2. STRATIGRAPHY BENEATH ALLUVIAL SAND AND GRAVEL IS UNKNOWN.
3. ESTIMATED ORIGINAL GROUND SURFACE BASED ON SURVEYED TOPOGRAPHY.

REFERENCES

1. GROUND SURVEY BY MCELHANNEY (JULY 2013) PROVIDED BY TECK RESOURCES LIMITED.
2. 2016 TOPOGRAPHIC CONTOURS FOR CELL 1, 3, AND 5 SURVEYED: 10 AUGUST 2016 BY ALLTERRA LAND SURVEYING LTD. AND PROVIDED ON 30 AUGUST 2016.
3. BINNIE (ROBERT F. BINNIE LTD.). 1971. *REPORT ON STABILITY OF TAILINGS DAM*. REPORT PREPARED FOR TECK CORPORATION LTD., BEAVERDELL, BC. SUBMITTED JUNE 8, 1971.
4. BINNIE. 1973. *REPORT ON PROPOSED NEW TAILINGS POND*. REPORT PREPARED FOR TECK CORPORATION LTD., BEAVERDELL, BC. SUBMITTED AUGUST 27, 1973.
5. BINNIE. 1980A. *REPORT ON TAILINGS DISPOSAL POND NO. 5 AND PROPOSED POND NO. 6*. REPORT PREPARED FOR TECK CORPORATION LTD., BEAVERDELL, BC. SUBMITTED FEBRUARY 20, 1980.
6. BINNIE. 1980B. *SUPPLEMENTARY REPORT ON PROPOSED POND NO. 6*. REPORT PREPARED FOR TECK CORPORATION LTD., BEAVERDELL, BC. SUBMITTED MARCH 31, 1980.
7. BINNIE. 1980C. *REPORT ON STABILITY OF ABANDONED POND NO. 5*. REPORT PREPARED FOR TECK CORPORATION LTD., BEAVERDELL, BC. SUBMITTED DECEMBER 9, 1980.
8. BINNIE (R.F. BINNIE & ASSOCIATES LTD.). 1988. *REPORT ON PROPOSED POND NO. 7*. REPORT PREPARED FOR TECK CORPORATION, BEAVERDELL, BC. SUBMITTED APRIL 1988.

0 10 20
1:500 METRES

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-02-06
DESIGNED	AGH
PREPARED	JY
REVIEWED	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATION, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
CROSS-SECTIONS (2 OF 2)

PROJECT NO.	PHASE/DOC.	REV.	FIGURE
12-1428-0022	16100/033	0	04

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

25 mm

0

APPENDIX A

Photographs

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
SOUTH TAILINGS STORAGE FACILITY
OVERVIEW OF CELL 1
PHOTOGRAPH LOOKING NORTHEAST

PHOTOGRAPH TAKEN BY GOLDER 10 JUNE 2015

PROJECT No.	PHASE	Rev.	PHOTOGRAPH
1214280022	**16100**	**0**	**A-1**

PHOTOGRAPH TAKEN BY GOLDER 8 AUGUST 2016

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
SOUTH TAILINGS STORAGE FACILITY
OVERVIEW OF CELL 2
PHOTOGRAPH LOOKING SOUTHEAST

PROJECT No.	PHASE	Rev.	PHOTOGRAPH
1214280022	**16100**	**0**	**A-2**

PHOTOGRAPH TAKEN BY GOLDER 10 JUNE 2015

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
SOUTH TAILINGS STORAGE FACILITY
OVERVIEW OF CELL 3
PHOTOGRAPH LOOKING NORTHWEST

PROJECT No.	PHASE	Rev.	PHOTOGRAPH
1214280022	**16100**	**0**	**A-3**

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

PHOTOGRAPH TAKEN BY GOLDER 10 JUNE 2015

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
SOUTH TAILINGS STORAGE FACILITY
OVERVIEW OF CELL 4
PHOTOGRAPH LOOKING NORTH

PROJECT No.	PHASE	Rev.	PHOTOGRAPH
1214280022	**16100**	**0**	**A-4**

PHOTOGRAPH TAKEN BY GOLDER 10 JUNE 2015

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
SOUTH TAILINGS STORAGE FACILITY
OVERVIEW OF CELL 5
PHOTOGRAPH LOOKING NORTH

PROJECT No.	PHASE	Rev.	PHOTOGRAPH
1214280022	**16100**	**0**	**A-5**

PHOTOGRAPH TAKEN BY GOLDER 10 JUNE 2015

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
NORTH TAILINGS STORAGE FACILITY
OVERVIEW OF CELL 6
PHOTOGRAPH LOOKING NORTH

PROJECT No.	PHASE	Rev.	PHOTOGRAPH
1214280022	**16100**	**0**	**A-6**

PHOTOGRAPH TAKEN BY GOLDER 10 JUNE 2015

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
NORTH TAILINGS STORAGE FACILITY
OVERVIEW OF CELL 7
PHOTOGRAPH LOOKING SOUTH

PROJECT No.	PHASE	Rev.	PHOTOGRAPH
1214280022	**16100**	**0**	**A-7**

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

TITLE
SOUTH TAILINGS STORAGE FACILITY
SPILLWAY FROM CELL 4 TO CELL 3
PHOTOGRAPH LOOKING NORTH

PHOTOGRAPH TAKEN BY GOLDER 10 JUNE 2015

PROJECT No.	PHASE	Rev.	PHOTOGRAPH
1214280022	**16100**	**0**	**A-8**

PHOTOGRAPH TAKEN BY GOLDER 10 JUNE 2015

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
SOUTH TAILINGS STORAGE FACILITY
SPILLWAY AND INTERNAL DIVIDER EMBANKMENT BETWEEN CELL 4 AND CELL 5, PHOTOGRAPH LOOKING NORTHWEST

PROJECT No.	PHASE	Rev.	PHOTOGRAPH
1214280022	**16100**	**0**	**A-9**

DECANT TOWER FILLED WITH FOAM - PLUGGED

PHOTOGRAPH TAKEN BY GOLDER 10 JUNE 2015

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
SOUTH TAILINGS STORAGE FACILITY
CELL 5 DECANT TOWER INTAKE STRUCTURE

PROJECT No.	PHASE	Rev.	PHOTOGRAPH
1214280022	**16100**	**0**	**A-10**

DECANT TOWER FILLED WITH FOAM - PLUGGED

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
NORTH TAILINGS STORAGE FACILITY
CELL 7 DECANT TOWER

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT No.	PHASE	Rev.	PHOTOGRAPH
1214280022	**16100**	**0**	**A-11**

PHOTOGRAPH TAKEN BY GOLDER 8 AUGUST 2016

PHOTOGRAPH TAKEN BY GOLDER 10 JUNE 2015

PHOTOGRAPH TAKEN BY GOLDER 8 AUGUST 2016

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
NORTH TAILINGS STORAGE FACILITY
CELL 6 DECANT TOWER OUTLET

PROJECT No.	PHASE	Rev.	PHOTOGRAPH
1214280022	**16100**	**0**	**A-12**

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

TITLE
NORTH TAILINGS STORAGE FACILITY
CELL 7 DECANT TOWER OUTLET

PHOTOGRAPH TAKEN BY GOLDER 8 AUGUST 2016

PROJECT No.	PHASE	Rev.	PHOTOGRAPH
1214280022	**16100**	**0**	**A-13**

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

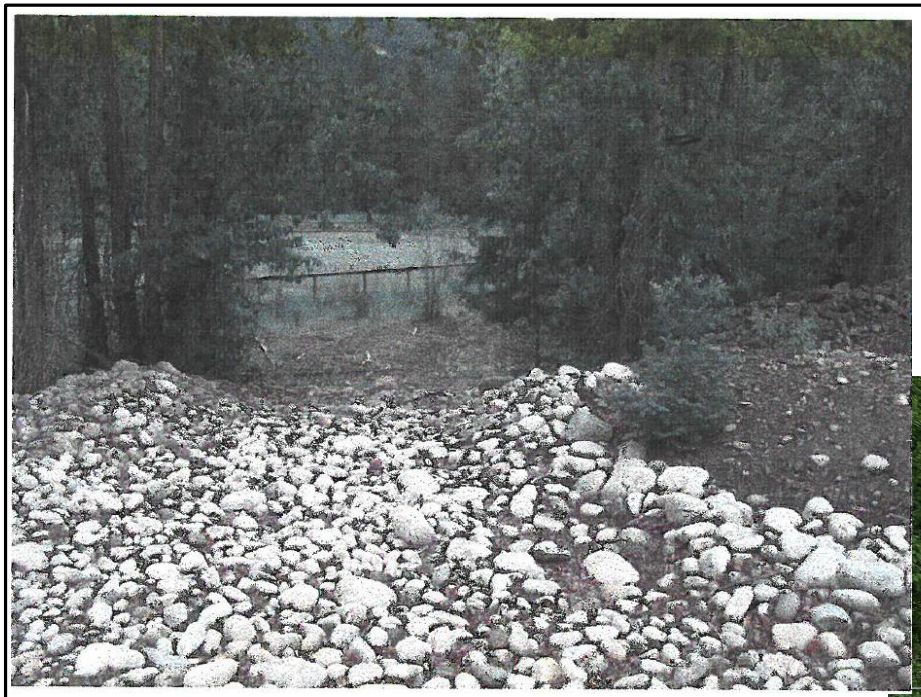
PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

TITLE
TYPICAL STANDPIPE PIEZOMETER

PHOTOGRAPH TAKEN BY GOLDER 8 AUGUST 2016

PROJECT No.	PHASE	Rev.	PHOTOGRAPH
1214280022	**16100**	**0**	**A-14**



PHOTOGRAPH TAKEN BY TECK COMINCO 2004

PHOTOGRAPH TAKEN BY GOLDER 8 AUGUST 2016

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
SOUTH TAILINGS STORAGE FACILITY
CELL 3 SPILLWAY
PHOTOGRAPHS LOOKING SOUTH

PROJECT No.	PHASE	Rev.	PHOTOGRAPH
1214280022	**16100**	**0**	**A-15**

PHOTOGRAPH TAKEN BY TECK COMINCO 2004

PHOTOGRAPH TAKEN BY GOLDER 10 JUNE 2015

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
NORTH TAILINGS STORAGE FACILITY
CELL 7 OVERFLOW SPILLWAY
PHOTOS LOOKING SOUTH

PROJECT No.	PHASE	Rev.	PHOTOGRAPH
1214280022	**16100**	**0**	**A-16**

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
SECURITY AROUND BEAVERDELL TAILINGS STORAGE FACILITIES

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PHOTOGRAPHS TAKEN BY GOLDER 8 AUGUST 2016

PROJECT No.	PHASE	Rev.	PHOTOGRAPH
1214280022	**16100**	**0**	**A-17**

APPENDIX B

Original Design Cross Sections

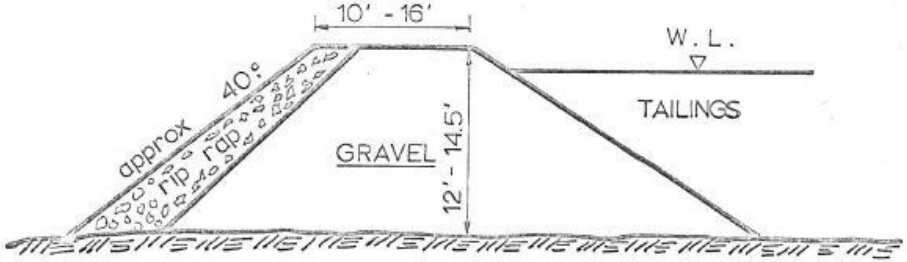


FIG. A

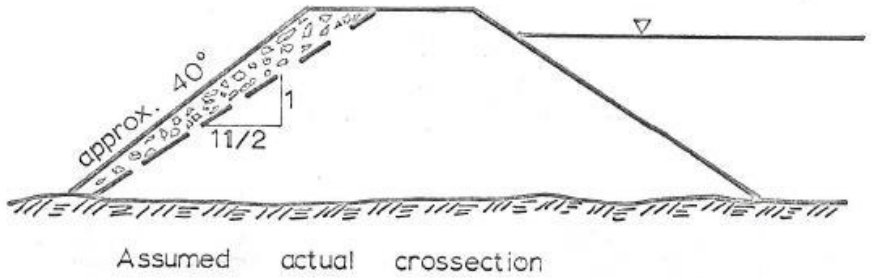
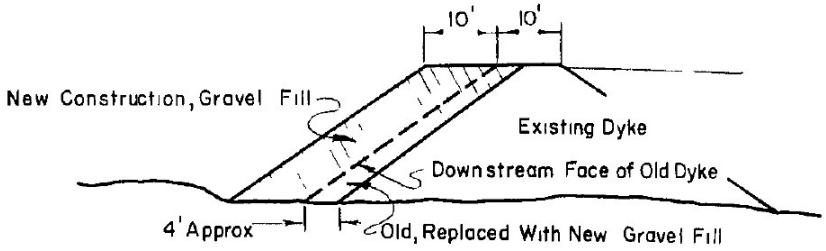


FIG. B

REFERENCE: BINNIE (ROBERT F. BINNIE LTD.). 1971. REPORT ON STABILITY OF TAILINGS DAM. REPORT PREPARED FOR TECK CORPORATION LTD., BEAVERDELL, BC. SUBMITTED 8 JUNE 1971.

TYPICAL SECTION Y-Y

SCALE 1" = 20' Approx



REFERENCE: BINNIE (ROBERT F. BINNIE LTD.). 1973. REPORT ON PROPOSED NEW TAILINGS CELL. REPORT PREPARED FOR TECK CORPORATION LTD., BEAVERDELL

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
DAM DESIGN FOR CELL 4
CROSS SECTIONS

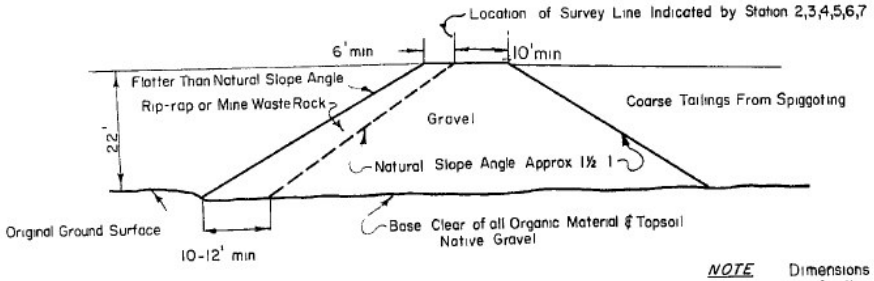
PROJECT No.	PHASE	Rev.	FIGURE
1214280022	**16100**	**0**	**B-1**

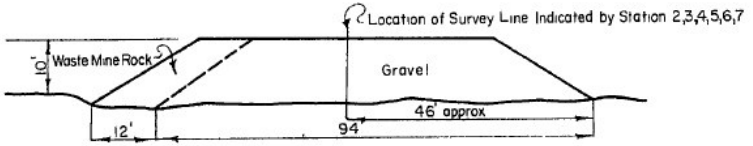
TYPICAL SECTION X-X AT FINAL HEIGHT & INITIAL CONSTRUCTION STAGE

FINAL HEIGHT

SCALE 1" = 20' Approx

INITIAL STAGE





NOTE Dimensions are APPROXIMATE and are only for the highest section Dimensions should be decreased accordingly where the ultimate height will be less Slopes remain constant

REFERENCE: BINNIE (ROBERT F. BINNIE LTD.). 1973. REPORT ON PROPOSED NEW TAILINGS CELL. REPORT PREPARED FOR TECK CORPORATION LTD., BEAVERDELL

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

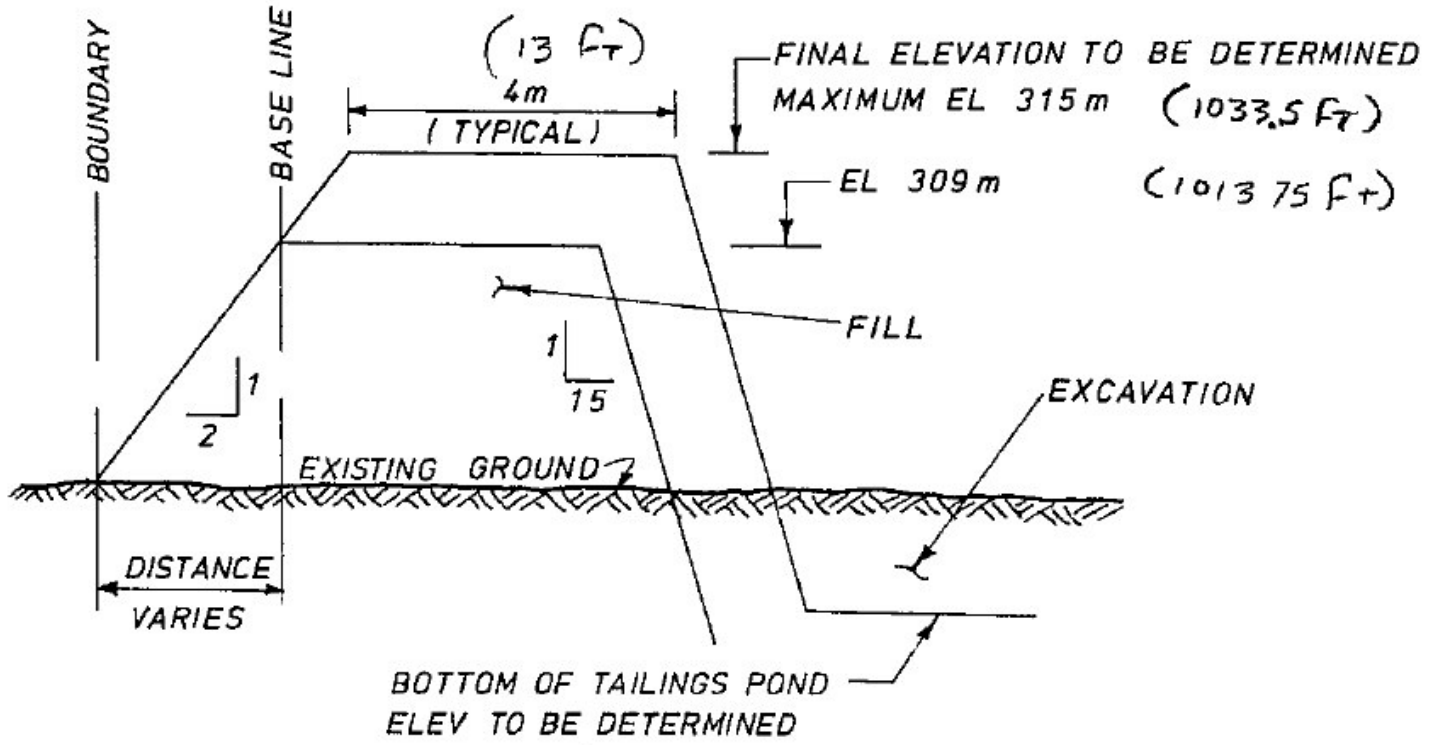
CONSULTANT
Golder Associates

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
DAM DESIGN FOR CELL 5
CROSS SECTIONS

PROJECT No.	PHASE	Rev.	FIGURE
1214280022	**16100**	**0**	**B-2**



TYPICAL DAM CROSS-SECTION

NOT TO SCALE

REFERENCE: BINNIE (ROBERT F. BINNIE LTD.). 1980A. REPORT ON TAILINGS DISPOSAL POND NO. 5 AND PROPOSED POND NO. 6. REPORT PREPARED FOR TECK CORPORATION LTD., BEAVERDELL, BC. SUBMITTED 20 FEBRUARY 1980.

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

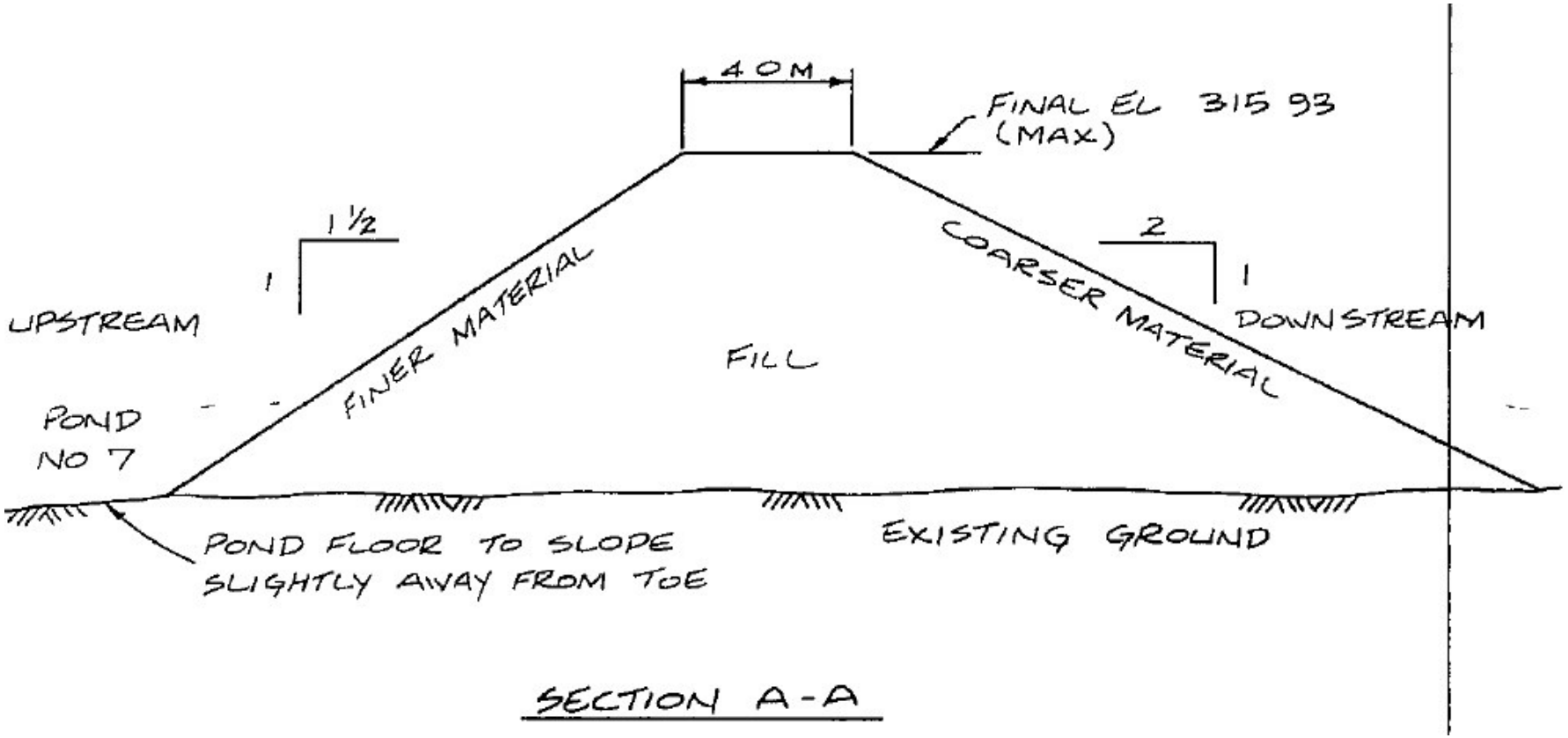
CONSULTANT
Golder Associates

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
DAM DESIGN FOR CELL 6
CROSS SECTION

PROJECT No.	PHASE	Rev.	FIGURE
1214280022	**16100**	**0**	**B-3**



SECTION A-A

REFERENCE: BINNIE (R.F. BINNIE & ASSOCIATES LTD). 1988. REPORT ON PROPOSED POND NO. 7. REPORT PREPARED FOR TECK CORPORATION, BEAVERDELL, BC. SUBMITTED APRIL 1988.

.

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-11-02
PREPARED	AGH
DESIGN	AGH
REVIEW	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

TITLE
DAM DESIGN FOR CELL 7
CROSS SECTION

PROJECT No.	PHASE	Rev.	FIGURE
1214280022	**16100**	**0**	**B-4**

APPENDIX C

Inspection Checklists

Teck Beaverdell North TMF Dam INSPECTION CHECKLIST (Page 1 of 2)

Inspected by: _____
Inspection Date: _____
Inspection Time: _____
Reviewed by: _____
Review Date _____

Inspection Type:
☐ Routine ☐ Event Driven
Weather/Visibility:
_____
_____

Are any of the following conditions apparent?	YES	NO	N/A
Cracking on the crest?	☐	☐	☐
Cracking on the upstream slope?	☐	☐	☐
Cracking on the downstream slope?	☐	☐	☐

VEGETATION AND WILDLIFE	YES	NO	N/A
Vegetation or debris blocking spillway?	☐	☐	☐
Significant vegetation damaging the dam (crest and/or faces)?	☐	☐	☐
Animal presence (burrows or disturbance on the dam)?	☐	☐	☐

STRUCTURAL PROBLEMS	YES	NO	N/A
Water flowing from decant pipes (broken seal)?	☐	☐	☐
Settlement on crest?	☐	☐	☐
Slough, slides or bulges on upstream slope?	☐	☐	☐
Slough, slides or bulges on downstream slope?	☐	☐	☐
Slough, slide or erosion of spillway channel?	☐	☐	☐
Sinkhole on crest?	☐	☐	☐
Sinkhole on upstream slope?	☐	☐	☐
Sinkhole on downstream slope?	☐	☐	☐

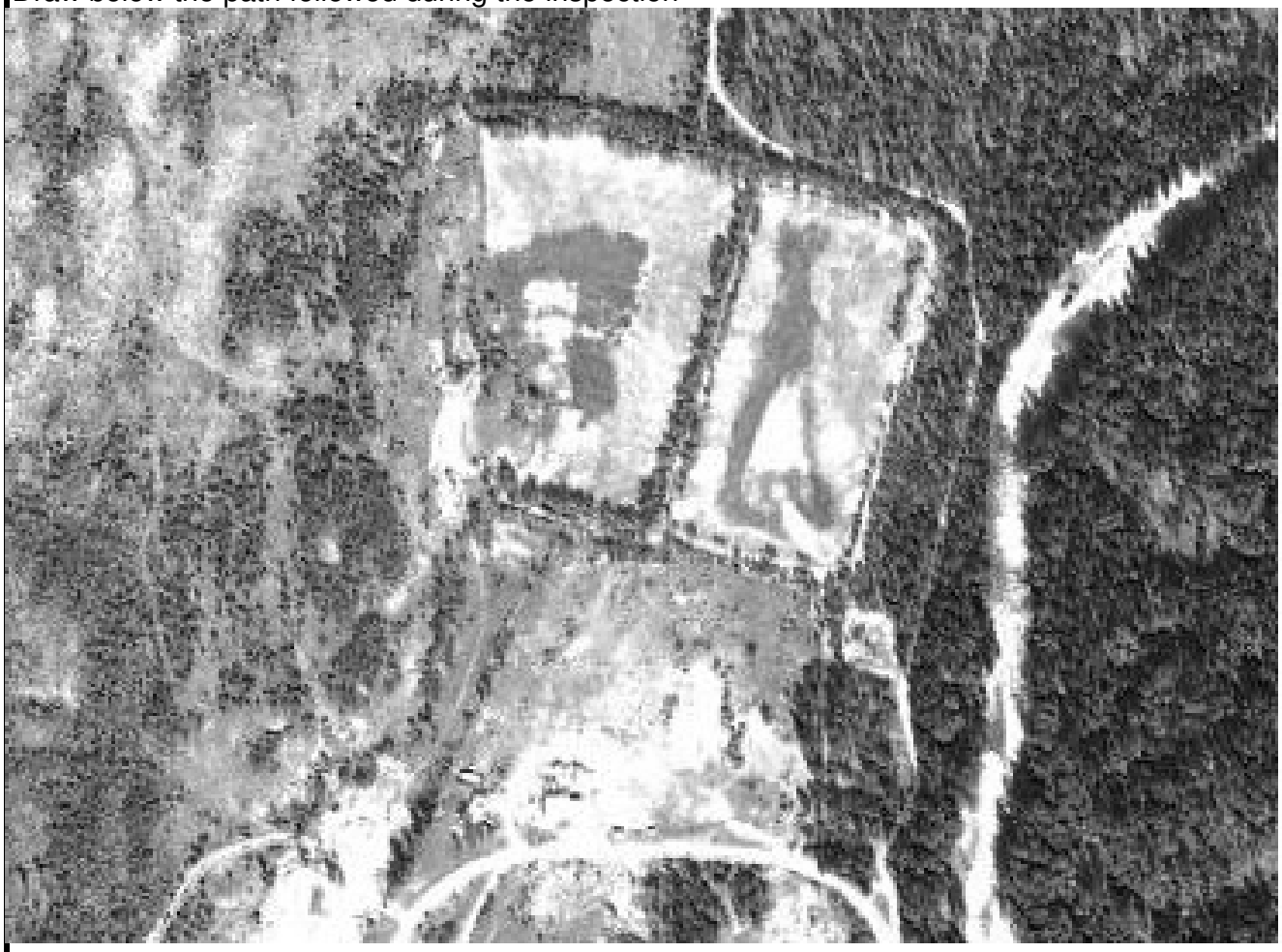
SEEPAGE	YES	NO	N/A
Wet areas or seepage on downstream slope/toe?	☐	☐	☐
Ponded water at the downstream toe?	☐	☐	☐
If seepage is observed - estimated or measured quantity? _____			
If seepage is observed - Quality / appearance, sampled? _____			

Estimate of height between water surface and dam crest at Cell 6 (in metres) _____
Estimate of height between water surface and dam crest at Cell 7 (in metres) _____
Height estimate to be made if water is present in the cell, otherwise indicate no water.

	YES	NO	N/A
Crest and slopes SNOW COVERED?	☐	☐	☐

INSPECTION ITINERARY

Draw below the path followed during the inspection



Comments on Deficiencies Found:

Teck Beaverdell South TMF Dam INSPECTION CHECKLIST (Page 1 of 2)

Inspected by: _____
Inspection Date: _____
Inspection Time: _____
Reviewed by: _____
Review Date _____

Inspection Type:
☐ Routine ☐ Event Driven
Weather/Visibility:
_____
_____

Are any of the following conditions apparent?	YES	NO	N/A
Cracking on the crest?	☐	☐	☐
Cracking on the upstream slope?	☐	☐	☐
Cracking on the downstream slope?	☐	☐	☐

VEGETATION AND WILDLIFE	YES	NO	N/A
Vegetation or debris blocking spillway?	☐	☐	☐
Significant vegetation damaging the dam (crest and/or faces)?	☐	☐	☐
Animal presence (burrows or disturbance on the dam)?	☐	☐	☐

STRUCTURAL PROBLEMS	YES	NO	N/A
Settlement on crest?	☐	☐	☐
Slough, slides or bulges on upstream slope?	☐	☐	☐
Slough, slides or bulges on downstream slope?	☐	☐	☐
Slough, slide or erosion of spillway channel?	☐	☐	☐
Sinkhole on crest?	☐	☐	☐
Sinkhole on upstream slope?	☐	☐	☐
Sinkhole on downstream slope?	☐	☐	☐

SEEPAGE	YES	NO	N/A
Wet areas or seepage on downstream slope/toe?	☐	☐	☐
Ponded water at the downstream toe?	☐	☐	☐
If seepage is observed - estimated or measured quantity? _____			
If seepage is observed - Quality / appearance, sampled? _____			

Estimate of height between water surface and dam crest at Cell 5 (in metres) _____
Estimate of height between water surface and dam crest at Cell 4 (in metres) _____
Estimate of height between water surface and dam crest at Cell 3 (in metres) _____
Height estimate to be made if water is present in the cell, otherwise indicate no water.

	YES	NO	N/A
Crest and slopes SNOW COVERED?	☐	☐	☐

INSPECTION ITINERARY

Draw below the path followed during the inspection

Comments on Deficiencies Found:

APPENDIX IV
BEAVERDELL MINE TAILINGS EMERGENCY RESPONSE PLAN (ERP)

EMERGENCY RESPONSE PLAN FOR BEAVERDELL TAILINGS STORAGE FACILITIES

The review protocol for the Emergency Response Plan (ERP) is shown in Table A-1.

Table A-1: ERP Review Protocol

	Name	Company	Position	Signature	Date
Prepared by	John Cunning	Golder Associates Ltd.	Engineer of Record		16 February 2017
Prepared by	Julia Steele	Golder Associates Ltd.	Geotechnical Engineer		16 February 2017
Approved by	Kathleen Willman	Teck Resources Limited	Manager, Engineering and Remediation	KWillman	2017-02-17
Reviewed by	Gerry Murdoch	Teck Resources Limited	Mine Manager		2017-02-17

RECORD OF REVISIONS

Revisions to the ERP are made, as and when required, by re-issuing a complete section, table or appendix so that the outdated section, table or appendix can be removed and replaced. Official electronic copy of the ERP is also updated at the same time and should be the primary reference document. The version history of the ERP is shown in Table A-2. The last revision of the ERP supersedes all previous versions.

Table A-2: ERP Manual Revision Summary

Revision Number	SP&P Number	Details of Revision	Date of Issue
Version 2014-01	n/a	Updated Document by Golder	November 2014
Version 2016-02	n/a	Updated Document by Golder	February 2016
Version 2017-03	BEA-ERP-001.V001	Updated Document by Golder	February 2017

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APPENDIX A

Teck Legacy Properties - Reporting of Accident or Dangerous Occurrence - 2016

1.0 ROLES AND RESPONSIBILITIES

The roles and responsibilities of personnel involved in the emergency procedures related to the Beaverdell Tailings Storage Facilities (TSFs) are defined in Table 1.

Table 1: Individuals Responsible

Role	Name	Company	Responsibilities	Phone #
Mine Manager	Gerry Murdoch	Teck Resources Limited	Complete routine and event driven/special maintenance as outlined by maintenance and surveillance. Be available for consultation.	Office: 1-250-427-8408 Mobile: 1-250-432-9943
Site Caretaker	Tex Hewitt	KB Traplines	Assist in routine and event driven/special maintenance as outlined by maintenance.	Mobile: 1-250-484-5522
Manager, Engineering and Remediation	Kathleen Willman	Teck Resources Limited	Be available for consultation	Office: 1-250-427-8401 Mobile: 1-250-432-9563
Engineer of Record (EoR)	John Cunning	Golder Associates Ltd.	Be available for consultation, complete annual dam safety inspection and submittal, participate in dam safety reviews and risk assessments.	Office: 1-604-296-4294 Mobile: 1-604-839-9600
Geotechnical Engineer	Julia Steele	Golder Associates Ltd.	Support the EoR and Teck when necessary, help complete annual dam safety inspection and submittal.	Office: 1-604-297-2051 Mobile: 1-604-309-6973
External Contractor	Shawn McIver	Lime Creek Logging	Aid in remedial actions related to emergency response to an alert level failure mode.	Office 1-250-442-5536 Mobile 1-250-442-7467

2.0 EMERGENCY RESPONSE PLAN

2.1 Site Access

The Beaverdell TSFs are located adjacent to the town of Beaverdell, 87 km from Kelowna on BC Highway 33. The TSFs can be accessed from the Beaverdell Station Road, which crosses Highway 33 within the town. The North TSF is 200 m to the north of Beaverdell Station Road, accessible from the Kettle Valley Trail. The South TSF is located immediately south and west of the Beaverdell Station Road (Figure 1). There is a "No Trespassing" sign between the Beaverdell TSF and the Kettle Valley Trail. The phones numbers on the sign should be:

1-250-427-9700

The emergency numbers on the sign should be updated.

A continuous fence has been installed around the perimeter of each the South TSF and North TSF, generally located at the crest of the dam.

2.2 Warning Systems

Beaverdell Mine is now a closed facility under active care and maintenance, with no current or planned mining activities and there are no automated warning systems in place at the site. No instrumentation is installed on or around the TSFs that can trigger an automated warning to Teck. The warning system in place is based on visual inspections carried out by the Mine Manager semi-annually. If a potential emergency or hazard is identified by:

- The caretaker – the Teck mine manager should be informed to determine the level of concern and appropriate course of action
- The public – signs around the TSFs have a phone number for Teck to call to report any potential emergencies or hazards

2.3 Alert Levels

The alert levels for hazards is described in Table 2.

Table 2: Responsibilities for Unusual Events and Hazards

Contact	Earthquake Event	Storm Event	Warning Level	Alarm Level
Hazard	Within distance (earthquake magnitude): ■ M>4.0 within 40 km ■ 6.0>M≥ 5.0 within 80 km ■ 7.0>M≥ 6.0 within 120 km ■ 8.0>M≥ 7.0 within 200 km ■ M>8.0 within 320 km	>37 mm in 24 hours (1 in 10 year storm event)	Examples: cracking, settlement, bulging, erosion, water seeping out of dam, vandalism	Examples: major new cracks, large landslide, sink holes, overtopping, vandalism
Care Taker	■ Perform visual special inspection ■ Inform Senior Mine Manager of findings	■ Perform visual special inspection ■ Inform Mine Manager of findings	■ Perform visual inspection ■ Determine extent of potential hazard or failure mode ■ Inform Mine Manager of findings	■ Perform visual inspection ■ Determine extent of potential imminent hazard or failure mode ■ Inform Mine Manager of findings
Manager, Engineering and Remediation	■ Be available for consultations	■ Be available for consultation	■ Be available for consultation	■ Be available for consultation
Mine Manager	■ Notify Engineer of Record for guidance ■ Perform visual special inspection ■ Be available for consultation ■ Be prepared to notify downstream stakeholders and communities	■ Notify Engineer of Record for guidance ■ Perform visual inspection ■ Be available for consultation ■ Be prepared to notify downstream stakeholders and communities	■ Notify Engineer of Record for guidance ■ Perform visual inspection ■ Be available for consultation ■ Be prepared to notify downstream stakeholders and communities	■ Notify Engineer of Record for guidance ■ Perform visual inspection ■ Be available for consultation ■ Notify downstream stakeholders and communities ■ Close Beaverdell Station Road

2.4 Communication System & Procedures

The Beaverdell site has cell phone capabilities and calls can be made from site. There are no automated systems in place on site.

If a potential emergency or hazard is observed on site, Teck must be notified immediately.

Once Teck has determined the warning or alert level associated with the emergency, the following contacts may need to be informed or as determined by the emergency response leader or designate:

Table 3: Official Contacts

Contact	Phone Number	Comments
Emergency Management BC (EMBC)	1-800-663-3456	
Local Authority (Regional District of Kootenay Boundary)	1-250-368-9148	Phone numbers listed are for general inquiries. Chief Administrative Officer: John MacLean Director of Environmental Services: Alan Stanley
	1-800-355-7352	
RCMP Office (Midway Detachment)	1-250-449-2244	
Local Radio Station (Mountain FM)	1-877-560-1010	
Local Highways Office (Grand Fork Area)	1-250-442-4384	
Local Highway Contractor (Emcon Services Inc.)	1-866-353-3136	Contractor for the Kootenay Boundary area
Ministry of Energy and Mines Geotechnical Engineer (Lowell Constable)	1-250-952-0914	
Regional FLNRO Dam Safety Officer (Mike Noseworthy)	1-250-490-2291	
Water Stewardship Division (Penticton Office)	1-250-490-8200	
Regional EMBC Office (Central Region – Kamloops)	1-250-371-5240	
Local Helicopter Company: Alpine Helicopters - Kelowna	1-250-769-4111	

2.5 Response Flow Chart for Each Alert Level

The two alert levels determined applicable to the Beaverdell site are a warning level and alarm level. The flowcharts below connect discovery of a potential hazard or emergency to informing downstream stakeholders and communities.

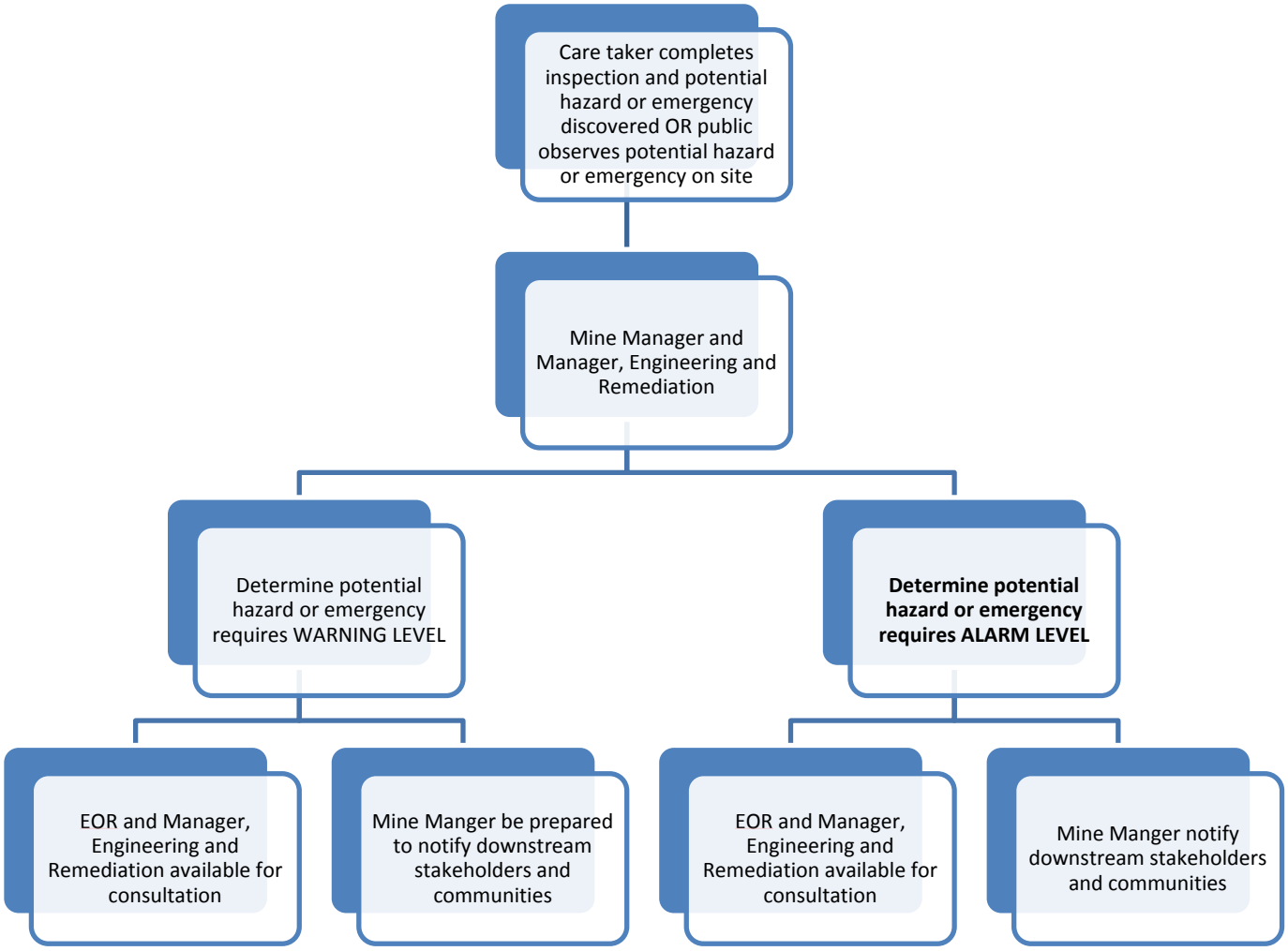

Chart 1: Response to Alert and Warning Levels

2.6 Call-out Procedure

If a potential emergency or hazard is identified by the public or the caretaker, Teck must be informed. The following external members must be informed:

- Patty Postin - 175A-Beaverdell Station Road – 1-250-484-5622
- Beaverdell Community - Tex Hewitt 1-250-718-9302

2.7 Preventive & Remedial Responses for Different Failure Modes

Preventive and remedial responses for different failure modes is described in Table 4.

Table 4: Preventive and Remedial Responses for Failure Modes

Failure Mode	Preventative Measures	Remedial Responses
Overtopping	■ Adequate storage ■ Regular inspections - functioning spillways	■ Earthworks to re-establish dam
Instability/Collapse	■ Regular inspections to assess embankment stability checking for cracks, settlement, bulging, rutting, etc.	■ Earthworks to re-establish dam
Contaminated Seepage	■ Regular water quality checks	■ Increase dam height to contain storm event
Piping	■ Regular inspections checking for seepage and pooled water at the toe of the embankment	■ Earthworks
Flooding (TSFs)	■ Monitor meteorological events and spillway performance	■ Repairs to spillways and potential breach in dam
Flooding (West Kettle River)	■ Riprap protection ■ Monitor river water levels	■ Repairs to riprap ■ Depending on storm event, special inspection
Instability due to Seismic Shaking	■ Appropriate downstream slopes	■ Special inspection

2.8 Available Resources

The resources available to Teck are included in Table 5.

Table 5: Available Resources

Role	Company	Contact	Comments
Contractor	Lime Creek Logging	1-250-442-5536	Shawn McIvor point of contact within company, previous experience on site.
Engineer of Record, John Cunning	Golder Associates Ltd.	Office: 1-604-296-4294 Cell:1-604-839-9600	Can be a point of contact for the following services that are available at Golder and can be utilized in the event of an emergency ■ physical stability ■ contaminated seep failure ■ flood hazard
Contractor	OK Excavating	1-250-765-4902	Kelowna based excavation contractor – specialize in earthworks and excavation
Contractor	A.G. Appel Enterprises Ltd.	1-250-860-1211	Kelowna based contractor company – one-call company for all earthwork needs
Contractor	Lake Excavating Ltd.	1-250-392-4063	Vancouver head office with satellites in Williams Lake and non-permanent in Penticton, remedial work at Mt. Polley. Specialize in earthworks and excavation.

2.9 Mutual Aid Agreements

Teck does not have any mutual aid agreements.

2.10 Flood Management Plan

There is no flood management or dam inundation plan for the Beaverdell TSF.

2.11 Contingency Plans

There are no contingency plans for the Beaverdell TSF.

2.12 Return to Operation Plan

Not applicable as there are no operations at the Beaverdell mine site.

2.13 Incident Investigation Procedure

The incident investigation procedure is presented in Appendix A.

3.0 EMERGENCY PREPAREDNESS

3.1 Identification of Conditions, Events & Warning Signs Indicating Failure

Below is a list of conditions, events, and warning signs which would identify a potential hazard or failure mode. Surveillance to identify these and routine maintenance to prevent failure is presented in the OMS Manual (SP&P BEA-OMS-001.V001, Teck 2017).

Conditions

- Water level in West Kettle River

Events

- Seismic event – triggers special inspections (see SP&P BEA-OMS-001.V001, Teck 2017)
- Flooding event – triggers special inspections (see SP&P BEA-OMS-001.V001, Teck 2017)
- Vandalism

Warning Signs

- Damage to spillways
- Damage to riprap
- Increased seepage
- Wet areas at toe
- Toe bulging
- Slumping
- Cracks
- Settlement
- Rutting
- Animal burrows

3.2 Requirements of Legislation, Codes of Practice, Commitments, Etc.

The requirements related to this ERP and its applicable Code is listed below:

- HSRC for Mines in BC (Government of BC 2016a)

  10.4.2 (1) The manager of a mine with one or more tailings storage facilities shall

  (e) maintain tailings storage facility emergency preparedness and response plans integrated into the Mine Emergency Response Plan required under section 3.7.1 of this code…

The following are guidelines followed as recommended by HSRC and as industry best practice:

- HSRC Guidance Document (Government of BC 2016b) (references industry standard of practice – CDA)

  Section 4.3 Emergency Preparedness and Response

- CDA Dam Safety Guidelines (CDA 2013)

  Section 4.0 Emergency Preparedness

- CDA Technical Bulletin: Dam Safety Analysis and Assessment (CDA 2007a)
- CDA Technical Bulletin: Surveillance of Dam Facilities (CDA 2007b)
- CDA Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams (CDA 2014)

  3.3 and 4.3 Emergency Preparedness and Response

- MAC Guidelines (MAC 2011)

  Chapter 8 – Emergency Planning and Response

3.3 Identification of all Jurisdictions, Agencies and Individuals Involved in Response

Depending on the emergency related to the Beaverdell TSFs, an emergency response could involve the following jurisdictions, agencies, and individuals:

- Emergency responders (fire/ambulance)
- Ministry of Environment
- Interior Health (Kelowna)
- Ministry of Energy and Mines (MEM)

- Government of BC
- Contractors

3.4 Identification of Failure Modes

Routine inspections are carried out by the Mine Manager as outlined in the OMS Manual (SP&P BEA-OMS-001.V00, Teck 2017). The following table outlines the different failure modes applicable to the Beaverdell TSFs and conditions which may indicate potential failure and emergency response.

Table 6: Failure Modes and Identification

Failure Mode	Conditions to Identify Potential Failure Mode
Overtopping	■ Seepage ■ Meteorological event ■ Landslide
Instability	■ Cracking ■ Settlement ■ Bulging ■ Seepage ■ Erosion ■ Seismic event
Contaminated Seepage	■ Increased contaminants indicated by water quality testing
Piping	■ Seepage ■ Wet spots downstream of dam toe ■ Sinkholes, depressions
Flooding (of TSFs)	■ Meteorological event ■ Landslide
Flooding (of West Kettle River)	■ Meteorological event ■ Landslide

3.5 Risk Analysis for On-site and Off-site Effects

The consequence of the Beaverdell TSFs was assessed in the 2012 Dam Safety Review (DSR). This is the closest assessment which involves risk that has been completed for the site and downstream stakeholders. A risk assessment has not been completed for the Beaverdell TSFs.

3.6 Training Requirements

The Mine Manager has read the following documents:

- Inspection & Maintenance of Dams, Dam Safety Guidelines, Province of British Columbia Waste Management Branch, Version 2, March 2011
- FEMA Dam Safety Publications and Resources (https://www.fema.gov/dam-safety-publications-resources)
- Beaverdell Tailings Management Facilities Operations, Maintenance and Surveillance Manual, SP&P BEA-OMS-001.V001 (Teck 2017)
- Beaverdell Tailings Management Facilities Emergency Response Plan, SP&P BEA-ERP-001.V001 (This document)

All personnel working on site should read the following documents:

- Beaverdell Tailings Management Facilities Operations, Maintenance and Surveillance Manual, SP&P BEA-OMS-001.V001 (Teck 2017)
- Beaverdell Tailings Management Facilities Emergency Response Plan, SP&P BEA-ERP-001.V001 (This document)

3.7 Public Relations Plan

There is no public relations plan.

3.8 COI Consultation

No consultation has been completed.

3.9 Emergency Preparedness and Response Plan Tested

The ERP has never been tested, table top or full-scale. The frequency of testing should be based on what is suitable for the structures consequence classification for response and recovery from specific incidents (Government of BC 2016b). Periodic testing of the emergency procedures with downstream agencies and stakeholders is an integral part of emergency preparedness.

REFERENCES

CDA (Canadian Dam Association). 2007a. Technical Bulletin: Dam Safety Analysis and Assessment.

CDA. 2007b. Technical Bulletin: Surveillance of Dam Facilities.

CDA. 2013. Dam Safety Guidelines. Original dated 2007, Revised 2013.

CDA. 2014. Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams.

Government of BC. 2016a. Revisions to Part 10 of the Health, Safety and Reclamation Code for Mines in British Columbia. Under the Mines Act. Effective as of 20 July 2016. Victoria, BC: British Columbia Ministry of Energy and Mines. http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/mineral-exploration-mining/documents/health-and-safety/code-review/hsrc_code_part_10_revisions_effective_july_20_2016.pdf.

Government of BC. 2016b. Guidance Document – Health, Safety and Reclamation Code for Mines in British Columbia. Version 1.0. Updated July 2016. Victoria, BC: British Columbia Ministry of Energy and Mines. http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/mineral-exploration-mining/documents/health-and-safety/part_10_guidance_doc_10_20july_2016.pdf.

MAC (The Mining Association of Canada). 2011. Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities. Ottawa, Ontario.

Teck (Teck Resources Limited). 2014. Guideline for Tailings and Water Retaining Structures. Version 4 Revised November 2014 and Effective January 2015.

Teck. 2017. Operations, Maintenance, and Surveillance Manual. SP&P Number BEA-OMS-001.V001. 16 February 2017.

LOCATION PLAN

0 500 1,000
1:20,000 METRES

NOTE

1. COORDINATES ARE IN UTM ZONE 11 NAD83.

REFERENCE

1. 2013 ORTHOPHOTO RECEIVED FROM TECK RESOURCES LIMITED.

CLIENT
TECK RESOURCES LIMITED
BEAVERDELL MINE
BEAVERDELL, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-02-06
DESIGNED	AGH
PREPARED	JY
REVIEWED	JMS
APPROVED	JCC

PROJECT
BEAVERDELL TAILINGS STORAGE FACILITIES
EMERGENCY RESPONSE PLAN

TITLE
BEAVERDELL SITE PLAN

PROJECT NO.	PHASE/DOC.	REV.	FIGURE
12-1428-0022	16100/034	0	01

APPENDIX A

Teck Legacy Properties - Reporting of Accident or Dangerous Occurrence - 2016

Teck Legacy Properties – Reporting of Accident or Dangerous Occurrence - 2016

July 21/2016

Teck

Document No.	Version No.	Date Revised	Revised By	Revision Made
TK-007	V1	December 15/11	W. Maluta	Initial doc
	V2	July 21/16	W. Maluta	Format changes and included procedures for all Legacy sites

ACCIDENT OR DANGEROUS OCCURRENCE – PROCEDURE FOR SUPERVISORS AND MANAGERS

1. INTRODUCTION

For BC, an Accident or Dangerous occurrence could include any of the following situations:

- An unexpected major ground fall or substances, whether on surface or underground, which endangers people or damages equipment or poses a threat to people or property
- Cracking or subsidence of a dam or impoundment dike; unexpected seepage or appearance of springs on the outer face of dam or dike; loss of adequate freeboard, washout or a significant erosion of a dam or dike, any of which might adversely affect the integrity of such structures
- An unexpected inrush of water, mud slurry, or debris
- Premature or unexpected explosion of explosives, gas or any dust,
- Significant inflow or release of explosive or other dangerous gas,
- Unplanned stoppage of the main underground ventilation system
- A mine vehicle going out of control
- An outbreak of fire if it endangers persons or threatens or damages equipment and all underground fires
- Electrical equipment failure or incident that causes or threatens to cause injury to persons or damage to equipment or property, and
- Any other unusual accident or unexpected event which had the potential to result in serious injury.

2. REQUIREMENT

2.1 For Mines in BC

HS&RC - Accident or Dangerous Occurrences

Section 1.7.1, 1.7.2 and 1.7.3 (Sections refer to HSRC code)

Manager's Responsibility
1.7.1

(1) In the event of

(a) any accident resulting in loss of life, or

(b) any dangerous occurrence as specified in section 1.7.3, the manager shall inform an inspector, the OHSC, and the local union or worker representative as soon as practicable, but no later than 4 hours after an event under paragraph (a) or 16 hours after an event under paragraph (b), and within one week send a written notification to an inspector for an event under paragraph (a) or (b).

(2) In the case of any accident resulting in a worker seeking medical aid, the manager shall provide a monthly report to an inspector, the OHSC, and the local union or worker representative.

(3) For an event under section 1.7.1(1)(a) or (b) the manager shall ensure that, except for the purpose of saving life or relieving human suffering, the scene of the accident or occurrence is not disturbed without approval of
(a) the OHSC,
(b) an inspector, or
(c) in the case of a fatal accident, the chief inspector.

(4) The manager shall ensure that the investigation is carried out by persons knowledgeable in the type of work involved as well as the co-chairpersons of the OHSC or their designates.

Accident Investigation

1.7.2 On completion of the investigation, the manager shall prepare a report that
(1) to the extent practicable identifies the causes of the accident, and
(2) identifies any unsafe conditions, acts, or procedures which contributed in any manner to the accident, and
(3) makes recommendations which may prevent similar accidents, and
(4) is forwarded to the OHSC and an inspector.

Dangerous Occurrences

1.7.3 Dangerous occurrences to be reported shall include

(1) unexpected major groundfall or subsidence, whether on surface or underground, which endangers people or damages equipment or poses a threat to people or property,

(2) cracking or subsidence of a dam or impoundment dike, unexpected seepage or appearance of springs on the outer face of a dam or dike; loss of adequate freeboard, washout or significant erosion of a dam or dike, any of which might adversely affect the integrity of such structures,

(3) any accident involving a mine hoisting plant and including sheaves, hoisting rope, shaft conveyance, shaft, shaft timber, or headframe structure,

(4) unexpected inrush of water, mud, slurry, or debris,

(5) premature or unexpected explosion of explosives, gas or any dust,

(6) significant inflow or release of explosive or other dangerous gas,

(7) unplanned stoppage of the main underground ventilation system,

(8) a mine vehicle going out of control,

(9) outbreak of fire if it endangers persons or threatens or damages equipment and all underground fires,

(10) electrical equipment failure or incident that causes or threatens to cause injury to persons or damage to equipment or property, and

(11) any other unusual accident or unexpected event which had the potential to result in serious injury.

3. PROCEDURE / RESPONSIBILITIES - SUPERVISORS

3.1 The supervisor responsible for the area where an accident or dangerous occurrence has taken place must notify the Manager immediately.

3.2 The supervisor shall document the accident investigation per the Supervisors Accident Investigation Report.

4. PROCEDURE / RESPONSIBILITIES – MANAGER OF BC MINES

4.1 The manager shall inform a Mine Inspector, relevant Contractor Representatives and the Worker Safety Representative in writing in the event of:

a) any accident resulting in loss of life - as soon as possible, but no later than **4 hours** after an event, followed by written notification within 1 week.

b) any dangerous occurrence as specified above and in HS&RC 1.7.3 – within **16 hours** after an event followed by written notification within 1 week.

4.2 For an event under HS&RC section 1.7.1 (a) or 1.7.1(b) the manager shall ensure that, except for the purpose of saving life, or relieving human suffering, the scene of the accident or occurrence is not disturbed without approval of

(a) the chief inspector in the event of a fatal accident, or

(b) the worker safety representative, or

(c) an inspector.

(d) owner representative

(e) contractor representative

4.3 In case of any accident resulting in a worker seeking medical aid, the manager shall provide a monthly report to the Mine Inspector, contractor representative and worker safety representative

4.4 The Manager shall ensure that the investigation is carried out by persons knowledgeable in the type of work involved and the worker safety representative or their designate.

4.5 The Manager shall ensure the supervisor has completed an accident investigation and documented it on the Supervisors Accident Investigation Report

TECK LEGACY PROPERTIES – ACCIDENT/DANGEROUS OCCURRENCE REPORTING

SIGN OFF

Employee acknowledges that he/she has read and understood the above procedure:

Employee Name:	Signature:	Date:
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

NOTES:

_____

_____

_____