

November 19, 2024

Via email

Tanya MacIntosh
Chair
Mackenzie Valley Land and Water Board
P.O. Box 2130 4922
48th Street 7th Floor YK Centre Mall
Yellowknife, NT X1A 2P6

Re: MV2021L2-0004: Annual Geotechnical Inspection Report Submission, Prairie Creek Mine, NT

Canadian Zinc Corporation (CZN) is pleased to submit the attached Annual Geotechnical Inspection Report as per Part F Condition 17 of Water Licence [MV2021L2-0004](#) (the WL). This condition states:

The Licensee shall ensure that geotechnical inspections of all Engineered Structures, the Active Tailings Stockpile, and Waste Rock Pile are conducted annually, and following any events that exceed design criteria, by a Professional Engineer. The Licensee shall:

- a) A minimum of two weeks prior to the annual geotechnical inspection, and when events that exceed design criteria occur, provide written notification to an Inspector; and
- b) Within 90 days of completing the annual geotechnical inspection, submit the Professional Engineer's full Geotechnical Inspection Report to the Board and an Inspector. The Report shall include, but not be limited to, the following information:
 - i. a covering letter from the Licensee outlining an implementation plan to respond to any recommendations made by the Professional Engineer, including rationale for any decisions that deviate from the Professional Engineer's recommendations; and
 - ii. a summary of any actions taken by the Licensee to address the recommendations made following the previous year's inspection.

Notification of the annual inspection was provided on [August 2, 2024](#). The Engineer's full report is attached. Note that the file has been divided into 2 parts to meet the Mackenzie Valley Land and Water Board's (MVLWB) [Document Submission Standards](#) (2023).

Within this report, CZN would particularly like to draw your attention to the information provided in Section 4.0 and 5.3 regarding the 930 and 970 Rock Piles¹. Although CZN did not create this “Waste Rock Pile(s)” and has not disturbed the area, during this years annual inspection both levels were observed by the Engineer.

Also please note that in previous years, recommendations were made to CZN, however the information was not provided in line with the WL requirements. The following is submitted to satisfy Part F Condition 17 b) i. and ii.

FLOOD PROTECTION BERM

Recommended remedial measures:

- Repair and regrade the creek side slope of the berm between Monitoring Sites NHC-02 and NHC-05, where erosion and oversteepening have occurred, to a slope gradient of 1.5H:1V or flatter. It is recommended that any suitable riprap along the upper bank of the berm be removed and reused after correcting the slope;
 - Repair and regrade of the creek side slope of the berm between Monitoring Sites NHC-02 and NHC-05 was completed in 2024 in areas where erosion and oversteepening was identified.
- Place additional riprap on the creek side slope of the berm, where armouring is sparse and low, for the 38 m long section identified between Monitoring Site NHC-05 and the WSP (i.e., NHC 2009, Repair Site “C”). Riprap is recommended to meet the elevation and gradation requirements that are outlined in the *Flood Protection Berm and Water Storage Pond Southern Dyke Evaluation Report* (Tetra Tech 2023a).
 - Additional riprap placement on the creek side slope of the berm was completed in 2024.

¹ Defined in the Water Licence as “Waste Rock Pile – the storage area(s) containing Waste Rock below the 930- and 970-metre level portals”.

Recommended performance monitoring:

- Annual inspections (i.e., subsequent AGIs) of the FPB should continue to be performed by a Geotechnical Engineer to confirm ongoing performance and identify any change in conditions, with a particular focus on
 - Erosion and subsidence of riprap along the creek side slope between Monitoring Sites NHC-02 and NHC-05; and
 - Cracking and subsidence along the crest of the creek side slope between Monitoring Sites NHC-03 and NHC-04.
- Annual inspections will continue as per the WL Part F Condition 17.
- If there is a significant flood event in Prairie Creek, the FPB [*Flood Protection Berm*] should immediately be inspected for erosion by Mine personnel to determine if any repairs are required.
 - CZN will inspect the FPB if there is any significant flood event(s) in Prairie Creek for erosion to determine if any repairs are required.
- If there is an earthquake event at the Mine, the FPB should immediately be inspected for deformation by Mine personnel to determine if any repairs are required.
 - CZN will inspect the FPB immediately after an earthquake (when safe to do so) to determine if any repairs are required.

WATER STORAGE POND

Recommended remedial measures:

- Repair and regrade the creek side slopes of Side 3B, where erosion and oversteepening have occurred, to a slope gradient of 2H:1V or flatter
 - CZN will repair and regrade the creek side slopes of Side 3B in 2025 when riprap material becomes available.

- Replace or reuse (where suitable) the existing riprap along the creek side slopes of Sides 2, 3A, and 3B to meet the gradation, elevation, and thickness requirements that are outlined in the *Flood Protection Berm and Water Storage Pond Southern Dyke Evaluation Report* (Tetra Tech 2023a)
 - CZN will repair the creek side slopes of Sides 2, 3A, and 3B with existing riprap in 2025.
- Remediate the existing rapid drawdown failure scarps that have occurred on the pond side slopes of Sides 3A, 3B, and 4
 - CZN will remediate the failure scarps that have occurred on the pond side slopes of Sides 3A, 3B, and 4 with existing riprap in 2025.
- Repair cracking in the road at the crest of Side 1B by grading, adding fill, or other methods to prevent loss of utility
 - CZN will repair the cracking in the road at the crest of Side 1B with existing riprap in 2025.
- Repair damage to clay core of embankments caused by animal burrows.
 - CZN will address damage caused by animal burrows by filling the holes with available rock from the quarry. This is a temporary solution as CZN would not dig up or repair these borrows until a new design and/or start of Construction commenced.

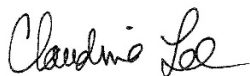
Recommended performance monitoring:

- As noted in the 2019 AGI (Tetra Tech 2019), the WSP [*Water Storage Pond*] has experienced rapid drawdown failures at several locations on the pond side slopes of Sides 2, 3A, and 3B. Until repairs are completed, it is recommended that water levels in the pond be monitored and maintained below the existing rapid drawdown failure scarps to maintain stability of the existing embankments. The slumped embankment material needs to be kept dry and allowed to drain to prevent further instabilities from occurring;

- Water levels in the WSP will be maintained below the existing rapid drawdown failure scarp.
- The creek side slopes of the WSP (Sides 2, 3A, and 3B) should be inspected weekly by Mine personnel for erosion during periods of high flow (i.e., spring freshet) and immediately following any significant storm events
 - CZN will continue to inspect the WSP on a weekly basis when Prairie Creek Mine is open.
- The pond side slopes of the WSP (Sides 1A, 1B, 1C, 2, 3A, 3B, and 4) should be inspected monthly by Mine personnel, when the WSP is in an unfrozen condition, for new signs of instability including bulging, cracking, slumping, and subsidence as well as any signs of seepage including wet patches on the creek side slopes and whirlpools in the pond
 - CZN will continue to inspect the WSP on a weekly basis when Prairie Creek Mine is open.
- Annual inspections (i.e., subsequent AGIs) of the WSP should continue to be performed by a Geotechnical Engineer to confirm ongoing performance and identify any change in conditions, with a particular focus on:
 - Erosion protection (i.e., riprap) along creek side slopes of Sides 2, 3A, and 3B;
 - Slumping along pond side slopes of Sides 3A, 3B, and 4; and
 - Cracking and subsidence along the Side 3B creek side access road.
 - Annual inspections will continue as per Part F Condition 17 of the WL.

If you have any further questions, please feel free to contact me at Claudine.Lee@norzinc.com or Lynn Boettger, Permitting Manager at lynn.boettger@norzinc.com.

Sincerely,



Claudine Lee
VP Corporate Social Responsibility

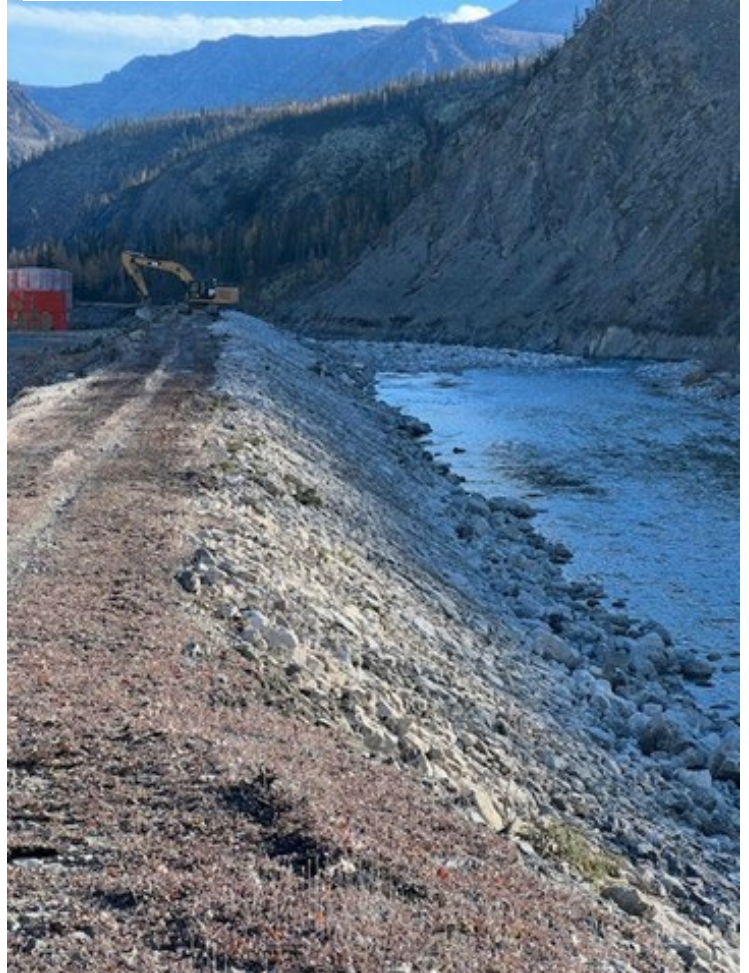
Attachments:

- Photos of 2024 repair work

Photo 1



Photo 2



Flood Protection Berm repair and regrade work between Monitoring Sites NHC-02 and NHC-05, 2024.

Photo 1 – South view of the berm.

Photo 2 – South view closer up to show berm repair work.

Photo 3 – North view (taken near the catchment pond looking towards the airport location).



Photo 3

November 13, 2024

Canadian Zinc Corporation (NorZinc Ltd.)
907 – 510 Burrard Street
Vancouver, BC V6C 3A8

ISSUED FOR USE
FILE: 704-ENG.EARC03183-06
Via Email: Claudine.Lee@NorZinc.com

Attention: Claudine Lee, M.Sc., P.Geo.
Vice President, Corporate Social Responsibility

Subject: 2024 Annual Geotechnical Inspection of Flood Protection Works and Rock Piles
Prairie Creek Mine, Northwest Territories

1.0 INTRODUCTION

Tetra Tech Canada Inc. (Tetra Tech) was retained by Canadian Zinc Corporation (CZN), a subsidiary of NorZinc Ltd., to conduct an annual geotechnical inspection (AGI) of the flood protection works and rock piles at the Prairie Creek Mine (the Mine), Northwest Territories. The Mine is located on traditional Dene territory and is adjacent to Prairie Creek, a tributary of the South Nahanni River, in the southwest corner of the Northwest Territories.

An AGI of the Mine's flood protection works and rock piles is required per Part F (Waste and Water Management), Condition 17 of the Mine's current Water Licence (MV2021L2-0004, the Water Licence), issued by the Mackenzie Valley Land and Water Board (MVLWB), which states:

"The Licensee shall ensure that geotechnical inspections of all Engineered Structures, the Active Tailings Stockpile, and Waste Rock Pile are conducted, and following any events that exceed design criteria, by a Professional Engineer."

The 2024 AGI was completed between August 20 to 22, 2024 by Thomas Bradshaw, P.Eng., of Tetra Tech. The AGI included a visual inspection of the existing Flood Protection Berm (FPB), Water Storage Pond (WSP), +930 Level Rock Pile, and +970 Level Rock Pile for signs of animal burrows, bulging, cracking, displacement, erosion, ponding, rutting, seepage, settlement, sinkholes, sloughing, and any other notable distresses. Observations and features of interest, noted at the time of the inspection, were documented with field notes and photographs while the locations were recorded with a handheld global positioning system (GPS) unit.

This report presents Tetra Tech's observations and recommendations for the Mine's flood protection works and rock piles. The previous AGI at the Mine was completed by Tetra Tech in June 2023 (Tetra Tech 2023b).

2.0 FLOOD PROTECTION BERM

The FPB is a flood protection berm that extends downstream from the south corner of the WSP between Prairie Creek (west of the berm) and the Mine (east of the berm), as shown on Figure 1 (see Figures section). It was constructed to protect the Mine from flooding during high water events in Prairie Creek. The berm is armoured with riprap on the creek side slope and is approximately 6 m wide (crest-to-crest), 5 m high, and 700 m long. Previously in a 2009 armour inspection, Northwest Hydraulics Consultants, Ltd. (NHC 2009) established five reference monitoring sites along the FPB (Monitoring Sites NHC-01 through NHC-05) which are referenced in this report and shown on Figure 2.

Visual inspection of the FPB was undertaken on August 20, 2024. The scope of the visual assessment included inspecting the berm's top surface, crests, sideslopes, and toe areas. Weather conditions during the inspection were light rain with light winds and air temperatures ranging from 5°C (low) to 20°C (high).

FPB observations made during the 2024 AGI were largely consistent with those from the 2023 AGI (Tetra Tech 2023b). The berm appears to be performing as intended; however, several areas of distress were noted along the creek side slope and top of the embankment. Appendix A presents photographs and observations from Tetra Tech's 2024 inspection of the FPB. The locations of each inspection issue, monitoring site, and photograph are illustrated on Figure 2.

Observations from the 2024 AGI of the FPB included:

- The creek side slope was armoured with riprap in most areas and was generally free of vegetation between the WSP and the berm's deflection point (Photo A1);
- The creek side slope was armoured with riprap and well-graded in most areas between the berm's deflection point and the Harrison Creek culverts. Ground vegetation and trees up to 8 m high were observed on the slope (Photo A2);
- No new flood debris was observed along the floodplain between the berm's deflection point and the Harrison Creek culverts (Photo A3);
- The mine side slope was lightly vegetated with grasses, lichens, and spruce treelings (Photos A4, A6, A10, and A13);
- Minor rutting was observed along the top of the berm which was lightly vegetated with grasses and lichens (Photos A5 and A20);
- Minor riprap settlement was observed along the creek side crest of the berm for approximately 35 m between the berm's deflection point and the Harrison Creek culverts;
- Riprap settlement was observed along the crest of the creek side slope near Monitoring Site NHC-01 for approximately 23 m. This localized area appeared to be stable and in similar condition to what was previously noted in the 2023 AGI (Photo A7);
- Animal burrow was observed along the mine side slope near Monitoring Site NHC-02;
- Riprap on the creek side slope was eroded and oversteepened from toe to midslope between Monitoring Sites NHC-03 and NHC-05. No exposed berm core material was observed along eroded segments of the berm (Photos A8, A12, A14, and A17);

- Riprap settlement was observed along the crest of the creek side slope near Monitoring Site NHC-03 for approximately 25 m. This localized area appeared to be stable and in similar condition to what was previously noted in the 2023 AGI (Photo A9);
- Old animal burrow and tension crack between Monitoring Sites NHC-03 and NHC-04 appeared to be inactive and were infilled with ground vegetation (Photo A11);
- Riprap settlement was observed along the crest of the creek side slope near Monitoring Site NHC-05 for approximately 12 m. This localized area appeared to be stable and in similar condition to what was previously noted in the 2023 AGI (Photo A15); and
- Riprap on the creek side slope was sparse and low along a 38 m-long section of the slope between Monitoring Site NHC-05 and the WSP. This area was previously identified in 2009 as a location where riprap repairs were undertaken (NHC 2009, Repair Site “C”). At the time of inspection, suitable armouring only covered the lower quarter (i.e., 1/4th) of the creek side slope in this section. The remainder of the slope was observed to have exposed berm core material with limited riprap coverage (Photos A16, A18, and A19).

3.0 WATER STORAGE POND

The WSP was constructed in 1981 and is located northwest of the main Mine area, as shown on Figure 1 (see Figures section). It was originally constructed as a tailings containment facility; however, no tailings have been deposited in it and it has not been used since construction. The facility comprises three back-sloped embankments constructed into the natural slope to the north (Sides 1A, 1B, and 1C) and four continuous, containment embankments (Sides 2, 3A, 3B, and 4) running parallel to Prairie Creek and the Mine. Material for the embankments was excavated from the north backslope and from within the impoundment area. An access road between the Mine and the airstrip runs along the top of the embankments on the north side (Sides 1A, 1B, and 1C). Historically, the embankments of the WSP have been named as Sides 1 through 4 and this nomenclature has been retained.

Previous AGIs of the facility (Golder 2014, 2021), reported that the WSP was excavated into a clay layer creating a low permeable barrier in the base of the pond. A geomembrane liner system (Hypalon) was installed over the interior slopes of Sides 1A, 1B, and 1C, as well as a portion of Side 4; however, the liner ruptured along the western portion of Side 1B in 1982. The liner has been progressively removed over the last two decades where exposed above the WSP's water level. The remaining embankments (Sides 2, 3A, and 3B, as well as a portion of Side 4) were constructed with a low permeability, clay core sourced from the pond's excavation. The excavated clay was used to line the pond side embankments of Sides 2, 3A, 3B, and 4 and was keyed into the base of the pond. A covering layer of aggregate material was placed over the clay core.

The creek side slopes of Sides 2, 3A, and 3B (i.e., along Prairie Creek) are armoured with riprap approximately one-quarter of the way up the slope. The riprap along the creek side slopes of the WSP is continuous and connects with the riprap of the FPB at the south corner of the facility. In 2009, an access road was constructed midslope along the creek side slope of Side 3B to allow for riprap repair and placement following high water events in Prairie Creek.

Previous WSP issues identified in the 2019 AGI (Tetra Tech 2019), 2020 AGI (Golder 2021), and 2021 AGI (Tetra Tech 2021) have included:

- The geomembrane liner system ruptured in 1982 and has been progressively removed over the last two decades. The rupture was attributed to a build-up of excess porewater pressure from melting of permafrost, infiltration of surface runoff, inadequate drainage, and instability in the upper clay layer underlying the north slope of the pond. The natural slope in the area of the instability has exhibited creep behaviour (i.e., moving slowly under constant loading);

- The clay cores of the four continuous, containment embankments (Sides 2, 3A, 3B, and 4) have been subject to disturbance since construction in 1982, including shallow slope instabilities, intrusive investigations (e.g., borehole drilling), freeze-thaw, tree roots, animal burrows, and from dewatering of the WSP in 2019. The pond side slopes of Sides 2, 3A, 3B, and 4 feature multiple slumps with scarps up to 1.0 m high by 1.2 m wide in the surficial layers, exposing the clay core;
- A groundwater spring was observed in 2019 near the toe of Side 1A in the base of the WSP, as identified on Figure 3; and
- Evidence of a high water event in Prairie Creek was observed in 2021 on the riprap of the WSP, particularly on Side 2 where flood levels were estimated to have risen within 0.3 m of the top of the erosion protection. Areas of riprap erosion and subsidence were also noted, particularly along Side 3B of the WSP to the FPB.

In Summer 2023, CZN dewatered the WSP and began grubbing sediments from the base of the pond in preparation for reconstruction of the facility. At the time of the 2024 AGI inspection, pond sediments were piled along the toe of Sides 1A and 1B for future removal (Photo B1). The WSP was retaining some water from surface runoff and groundwater infiltration (e.g., Side 1A spring); however, the base of the pond was largely dewatered (Photo B2). It should be noted that updated satellite imagery was not available for the WSP; therefore, the base of the pond and its water level shown in the Figures are not representative of its current condition.

Visual inspection of the WSP was conducted on August 21, 2024. The weather onsite during the inspection was cloudy with light winds and temperatures ranging between 4°C and 16°C. Observations made for the WSP during the 2024 AGI were largely consistent with those from the 2023 AGI (Tetra Tech 2023b). Appendix B presents photographs and observations from Tetra Tech's 2024 inspection of the WSP. The locations of each inspection issue and photograph are illustrated on Figure 3 (see Figures section).

Results from the 2024 AGI for the WSP are discussed in the following subsections.

3.1 Side 1

Side 1 comprises three interior slopes (Sides 1A, 1B, and 1C) that are graded back to tie into the surrounding mountainside. The tops of the slopes along Side 1 are used as the main access road between the Mine and the airstrip. As previously noted, the geomembrane liner system along Side 1 was removed above the water level at the time. The WSP has since been dewatered and portions of old liner are now exposed along the toes of the slopes.

3.1.1 Side 1A

Side 1A is an interior slope graded back into the surrounding mountainside, located in the northwest corner of the WSP between Sides 1B and 2. It features a single-lane access ramp down to the base of the pond at its connection with Side 2 (Photo B3).

The slope of Side 1A was generally in good condition with no significant signs of deformation. Observations from the 2024 AGI of Side 1A included:

- The slope is sparsely vegetated with willow trees up to 4.6 m in height;
- The access road along the top of the slope appeared level and no areas of subsidence were observed;
- An animal burrow was observed in the slope near the corner with Side 1B (Photo B4);
- Gabions are in place along the crest of the slope and appear to be in good condition (Photo B5);

- Exposed liner and minor ponding were observed along the toe of the slope (Photo B6);
- Grubbed pond sediments were stockpiled along the base of the pond near Side 1A (Photos B7 and B8); and
- Groundwater seepage was observed in two locations at the base of the dewatered pond near the spring previously identified in the 2019 AGI (Tetra Tech 2019).

3.1.2 Side 1B

Side 1B is an interior slope graded back into the former mountainside excavation area (i.e., north backslope). It features several single-lane access ramps near the middle of the slope length-wise that were established to access pumps stationed at the base of the WSP. Several monitoring wells are located along the crest of the slope between the access ramps.

The slope of Side 1B was in reasonably good condition with no significant signs of deformation. The 2024 AGI observations for Side 1B included:

- The access road along the top of the slope is undulating with several areas of subsidence up to 0.5 m deep with ponding water (Photos B9 and B14). As noted in the 2020 AGI (Golder 2021), cracking was observed along the access road near the corner of Sides 1A and 1B. The cracking traverses the access road for approximately 10 m and is up to 20 mm wide;
- The slope is moderately vegetated with willow trees up to 7 m in height;
- Grubbed pond sediments were stockpiled along the base of the pond near Side 1B (Photos B10 and B13);
- Exposed liner was observed along the toe of the slope (Photo B11);
- Groundwater seepage was observed flowing from the toe of the slope and base of the dewatered pond near the corner with Side 1A (Photo B12); and
- An erosion gully, initially observed during the 2019 AGI (Tetra Tech 2019), has formed downslope from an area of subsidence along the access road near the mid-point of Side 1B. The section of road is prone to rutting and ponding which has caused the adjacent erosion gully and is exposing a portion of the liner and gabions along the slope. The gully extends from the road crest to halfway down the slope and is up to 0.8 m wide and 0.3 m deep.

3.1.3 Side 1C

Side 1C is an interior slope graded back into the surrounding mountainside, located in the northeast corner of the WSP between Sides 1B and 4. It features a single-lane access ramp down to the base of the pond at its connection with Side 4.

The slope of Side 1C was generally in good condition with no significant signs of deformation. Side 1C observations from the 2024 AGI included:

- The slope is sparsely vegetated with grasses as well as several aspen and willow trees up to 4.5 m in height which were recently felled (Photos B15 and B16);
- Subsidence was observed on the access road along the top of the slope (Photo B17);
- Minor rutting was observed down the access ramp near the corner of Sides 1C and 4 (Photo B18); and
- A minor erosion gully was noted down the upper half of the slope near the corner with Side 4.

3.2 Side 2

Side 2 is an exterior containment embankment that runs parallel to Prairie Creek and impounds the west side of the WSP. The top of the embankment serves as an access road around the facility and connects Side 1A, including the main access road, with Side 3A. A single-lane access ramp down to the base of the pond is located on the pond side slope at its connection with Side 1A. A monitoring well is installed along the crest of the slope near the centre of the embankment.

Both the pond side (upstream) and creek side (downstream) slopes of Side 2 are generally in good condition. In late August 2021, a high water event occurred in Prairie Creek and it is estimated that water levels were within 0.3 m of the top of the creek side riprap; however, during the 2024 AGI, no new evidence of flooding was observed along Side 2. Other observations from the 2024 AGI of Side 2 included:

- Old creek debris was observed along the top of the creek side riprap from the 2021 high water event in Prairie Creek; however, no new evidence of flooding was observed along the creek side slope (Photo B19);
- The creek side slope was moderately vegetated above the riprap, with grasses and willow trees up to 5 m in height (Photo B20);
- The pond side slope was densely vegetated with grasses, mosses, saplings, and willow trees up to 5 m in height (Photo B21);
- Rutting and ponding water were observed along the access road on top of the embankment (Photos B22 and B23);
- An animal burrow was observed in the pond side slope near the corner with Side 1A;
- A minor erosion gully was observed beside the access ramp near Side 1A; and
- As noted in the 2020 AGI (Golder 2021), portions of the creek side slope appear to be oversteepened above the riprap armouring.

3.3 Side 3

Side 3 comprises two exterior containment berms (Sides 3A and 3B) that run parallel to Prairie Creek and impound the WSP to the south and southeast. The top of the embankments also serves as an access road around the perimeter of the facility, connecting Side 2 to Side 4 and the FPB. The creek side (downstream) slopes of Sides 3A and 3B (i.e., along Prairie Creek) are armoured with continuous riprap approximately one-quarter up the slope. Larger vegetation on the upper half of the creek side slopes have been cut down and left in place.

The pond side (upstream) slopes of Sides 3A and 3B have both experienced shallow slumping and scarping. As noted in the 2019 AGI (Tetra Tech 2019), these failures were likely a result of rapid dewatering of the WSP that was undertaken in August 2019. The rapid drawdown of water caused slumping of the saturated embankment soils that were below the WSP water level prior to dewatering.

3.3.1 Side 3A

Side 3A is an exterior containment berm that runs roughly parallel to Prairie Creek and directly adjacent to one of its channel braids. It impounds the WSP to the north and is connected to Side 2 to the west and Side 3B to the east. A monitoring well is located along the creek side crest of Side 3A, near the corner with Side 2.

The creek side slope of Side 3A is generally in good condition; however, the pond side slope is in poor condition due to the slumping that previously occurred in 2019. As described in the 2019 AGI (Tetra Tech 2019), two main slumps were observed along the pond side slope of Side 3A: a larger slump (approximately 80 m long) along the toe in the middle of Side 3A and a smaller one (approximately 20 m long) two-thirds up the slope near Side 3B. Saturated, grey clay was exposed along the faces of both slumps. An older, localized area of slumping near the crest and midway along the pond side slope of Side 3A was noted in previous AGIs. Further movement does not appear to have occurred as the slump scarp is now vegetated.

Other Side 3A observations from the 2024 AGI included:

- The creek side slope is moderately vegetated with grasses, saplings, and willows up to 2 m in height (Photos B24 and B30);
- Old creek debris were observed near the top of the riprap along the creek side slope and within a channel braid of Prairie Creek from the 2021 high water event; however, no new evidence of flooding was observed (Photo B25);
- Rutting and ponding water were observed along the access road on top of the embankment (Photo B26);
- The pond side slope is densely vegetated with grasses, horsetails, and mosses as well as spruce and willow trees up to 4 m in height;
- Slumping and scarps on the lower third of the pond side slope were measured up to 0.8 m in height near the middle of Side 3A. The WSP's water level was below the lower slumping and scarps identified on the pond side slope (Photos B27 and B28);
- Slumping and scarps on the upper half of the pond side slope were measured at up to 1.1 m in height near Side 3B;
- A minor erosion gully was observed down the pond side slope near Borehole BH23-WSP-05 (Photo B29); and
- Two animal burrows were observed along the creek and pond side slopes crests near Standpipe STP4.

3.3.2 Side 3B

Side 3B is an exterior containment berm that runs parallel to Prairie Creek and impounds the WSP to the northeast, along with Side 4. In 2009, an access road was constructed into the creek side (downstream) slope of Side 3B to access a riprap repair area at the corner near Side 3A. Additional riprap was placed along the toe of the area; however, there was insufficient material to match the riprap with the surrounding armour elevation and the area remains low and unfinished. Slumping of the riprap has also occurred in recent years due to Prairie Creek high water events.

No new signs of deformation were observed on the creek side slope of Side 3B. The pond side slope has experienced slumping along the entire berm length due to the rapid drawdown failures in 2019, similar to Side 3A. The exposed faces were predominantly saturated, greyish brown clay with a thin layer of dry gravel along the top of the scarp.

Other observations from the 2024 AGI of Side 3B included:

- The creek side slope, with the access road at midslope, is sparsely vegetated with grasses and willow treeplings (Photo B31);
- Riprap along the toe of the creek side slope has slumped and remains low near the corner with Side 3A, as noted in previous AGIs (Photo B32);

- Riprap along the toe of the creek side slope has eroded and settled from the 2021 high water event in Prairie Creek. Two erosion cavities, approximately 3 m wide by 4 m high, have developed at the point of deflection with Prairie Creek near the corner with Side 3A, as noted in the 2021 AGI (Tetra Tech 2021). The erosion cavities have expanded since the 2023 AGI and some material loss was observed from along the Side 3B access road (Photo B33);
- Subsidence and old longitudinal tension cracks were observed at several locations along the creek side access road and appeared consistent with previous AGIs. The largest cracks, approximately 100 mm deep by 250 mm wide, were observed along the centre of the access road and have begun to self-heal and infill (Photo B34);
- Minor rutting and ponding water were observed along the access road on top of the embankment (Photo B35);
- The pond side slope is sparsely vegetated with grasses, mosses, and saplings (Photo B36);
- New slumping was observed on the upper half of the pond side slope between Side 4 and Standpipe STP6. The slumping is likely a retrogressive failure as it is above the older slumping and scarps on the lower half of the pond side slope (Photo B37);
- Old slumping and scarps on the lower half of the pond side slope were measured up to 2.0 m in height near the mid-point of the embankment. Most of the scarps have infilled with eroded sediments and vegetation (Photo B38); and
- Two animal burrows were observed along the pond side slope, including one towards the middle of the embankment length and one near the corner with Side 4 (Photo B39).

3.4 Side 4

Side 4 is an exterior containment embankment adjacent to the Mine that impounds the east side of the WSP. There is an embedded culvert at the mid-point of the embankment near the crest which extends down most of the pond side slope. It also shares an access ramp from the crest to the base of the pond in the corner with Side 1C. A monitoring well is located along the crest of the pond side slope near Side 3B.

The mine side (downstream) slope of Side 4 is in good condition and no concerns were noted. The pond side (upstream) slope of Side 4 had also experienced significant slumping due to rapid drawdown of the water level, similar to Sides 3A and 3B. Slumping and scarps have formed along the lower two-thirds of the pond side slope and extend nearly two-thirds the length of the embankment from the corner with Side 3B.

Other observations from the 2024 AGI of Side 4 included:

- Several animal burrows were observed along the crests of the pond and mine side slopes, approximately one-half along the embankment's length from Side 1C (Photo B40);
- Old slumping and scarps, measuring up to 1.2 m high and 1.0 m wide, were observed along the lower half of the pond side slope (Photo B41);
- Cobbles, roots, and ponded water were observed in scarp depressions along pond side slope (Photo B42);
- The pond side slope was sparsely vegetated with spruce treelings and had pipe and wood debris along the toe (Photos B43 and B44); and
- The mine side slope was moderately vegetated with grasses and willow trees up to 1.8 m in height.

4.0 ROCK PILES

The +930 Level and +970 Level Rock Piles were formed during development of the Mine's upper underground adits which started in 1966 (KPA 1980). Further development of the underground adits and their associated rock piles continued until the early 1980s. It is understood that no changes to the rock piles have occurred since the early 1980s and they have remained dormant for over 40 years. Both rock piles are located on the southeast-facing mountainside to the northeast of the Mine within the Harrison Creek valley, as shown on Figure 1 (see Figures section).

Both rock piles do not appear to be engineered structures and predominantly consist of colluvium granular materials (e.g., shale and talus materials) pushed downslope to establish access to each underground portal. No design or construction documentation are available for either rock pile.

Visual inspection of the +930 Level and +970 Level Rock Piles was undertaken on August 22, 2024. The scope of the visual assessment included inspection the rock pile's top surface, crest, slope, and toe areas. Weather conditions during the inspection were overcast with light winds and air temperatures ranging from 4°C (low) to 12°C (high).

4.1 +930 Level Rock Pile

The +930 Level Rock Pile is located directly downslope of its associated portal at an approximate elevation of +930 m, as shown on Figure 4. The rock pile was generally in good condition with no significant signs of instability.

Appendix C presents photographs and observations from Tetra Tech's 2024 inspection of the +930 Level Rock Pile. The locations of each inspection issue and photograph are illustrated on Figure 4. Observations from the 2024 AGI of the +930 Level Rock Pile included:

- The rock pile does not appear to be an engineered structure and was likely formed during development of the +930 Level Portal by heavy equipment (e.g., bulldozers) cutting into the mountainside to establish a bench for drift mining (Photo C1);
- Two large yellow, propane storage tanks are located at the top of the rock pile near the crest (Photos C2 and C3);
- The rock pile appeared to predominantly consist of colluvium granular materials (e.g., shale and talus materials less than 25 mm in diameter) with little evidence of mined waste rock (Photo C4);
- Minor erosion gullies have been established down the slope of the rock pile from surface water runoff;
- Metal and wood debris were observed near the toe of the rock pile (Photo C5);
- Slope angles of the rock pile were estimated to range from 40° to 50°, which likely corresponds to the angle of repose of the rock pile's material (Photos C6 and C7); and
- An access trail is established along the toe of the rock pile which connects the Mine with the proposed Waste Rock Pile area (Photo C8).

4.2 +970 Level Rock Pile

The +970 Level Rock Pile is located directly downslope of its associated portal at an approximate elevation of +970 m, as shown on Figure 4. The rock pile was generally in good condition with no significant signs of instability.

Appendix D presents photographs and observations from Tetra Tech's 2024 inspection of the +970 Level Rock Pile. The locations of each inspection issue and photograph are illustrated on Figure 4. Observations from the 2024 AGI of the +970 Level Rock Pile included:

- The rock pile does not appear to be an engineered structure and was likely formed during development of the +970 Level Portal by heavy equipment (e.g., bulldozers) cutting into the mountainside to establish a bench for drift mining (Photo D1);
- The rock pile appeared to predominantly consist of colluvium granular materials (e.g., shale and talus materials less than 25 mm in diameter) with little evidence of mined waste rock (Photos D2 and D3);
- Safety berms were established along the crest of the rock pile (Photo D4);
- Minor erosion gullies have been established down the central slope of the rock pile from surface water runoff;
- Several tree stumps were observed near the centre of the rock pile indicating the pile's granular materials are not overly thick;
- Metal, plastic, and wood debris were observed near the toe of the rock pile;
- Slope angles of the rock pile were estimated to range from 35° to 40°, which likely corresponds to the angle of repose of the rock pile's material (Photo D5);
- An access trail is established along the toe of the rock pile which connects the Mine to the +930 Level Portal (Photo D6).

5.0 RECOMMENDATIONS

The 2024 AGI identified inspection issues, for both the FPB and the WSP, that were largely consistent with those from the 2023 AGI (Tetra Tech 2023b). Primarily, the issues relate to the riprap and erosion protection requirements along Prairie Creek as a result of the August 2021 high water event. Areas of riprap erosion and subsidence were noted for on the creek side of both flood protection works from Side 3B of the WSP to Monitoring Site NHC-03 of the FPB.

Previously in the 2023 AGI, Tetra Tech noted that a geotechnical and hydrological flood evaluation of the FPB and WSP Southern Dyke structures (i.e., along Prairie Creek) was completed to determine the recommended design flood event for Prairie Creek. This evaluation was issued to the MVLWB under a separate report titled *Flood Protection Berm and Water Storage Pond Southern Dyke Evaluation Report* (Tetra Tech 2023a) and should be read in conjunction with this 2024 AGI report. The results of this evaluation provide estimates of water depths and flow velocities to inform riprap requirements for the FPB and the creek side embankments of the WSP. Estimated water depths were then used to recommend suitable elevations for riprap placement along the FPB and WSP Southern Dyke that account for high water levels and freeboard. Estimated flow velocities for Prairie Creek were then used to inform the sizing and gradation requirements for the riprap.

Recommendations as a result of the 2024 AGI are provided in the following subsections.

5.1 Flood Protection Berm

No new remedial measures are recommended for the FPB as a result of the 2024 AGI. Observations were largely consistent with those from the 2023 AGI (Tetra Tech 2023b) which previously identified several signs of distress along the berm including riprap erosion and settlement.

Two remedial measures for the FPB were recommended in previous AGIs and remain outstanding, including:

- Repair and regrade the creek side slope of the berm between Monitoring Sites NHC-02 and NHC-05, where erosion and oversteepening have occurred, to a slope gradient of 1.5H:1V or flatter. It is recommended that any suitable riprap along the upper bank of the berm be removed and reused after correcting the slope; and
- Place additional riprap on the creek side slope of the berm, where armouring is sparse and low, for the 38 m-long section identified between Monitoring Site NHC-05 and the WSP (i.e., NHC 2009, Repair Site “C”). Riprap is recommended to meet the elevation and gradation requirements that are outlined in the *Flood Protection Berm and Water Storage Pond Southern Dyke Evaluation Report* (Tetra Tech 2023a).

Following the 2024 AGI in October 2024, Tetra Tech understands that CZN began remedial works to address both of the above FPB issues. It is also recommended that the following performance monitoring continue to be undertaken for the FPB:

- Annual inspections (i.e., subsequent AGIs) of the FPB should continue to be performed by a Geotechnical Engineer to confirm ongoing performance and identify any change in conditions, with a particular focus on:
 - Erosion and subsidence of riprap along the creek side slope between Monitoring Sites NHC-02 and NHC-05; and
 - Cracking and subsidence along the crest of the creek side slope between Monitoring Sites NHC-03 and NHC-04.
- If there is a significant flood event in Prairie Creek, the FPB should immediately be inspected for erosion by Mine personnel to determine if any repairs are required; and
- If there is an earthquake event at the Mine, the FPB should immediately be inspected for deformation by Mine personnel to determine if any repairs are required.

5.2 Water Storage Pond

No new remedial measures are recommended for the WSP as a result of the 2024 AGI. Observations were largely consistent with those from the 2023 AGI (Tetra Tech 2023b) which previously identified several distresses around the pond including animal burrows, cracking, erosion gullies, riprap erosion, and slumping. Additionally, several riprap areas along the creek side slopes of Sides 2, 3A, and 3B were previously found to be oversteepened, sparsely armoured, or too low.

Based on recommendations from previous AGIs, the following remedial measures for the WSP remain outstanding and should be addressed in a timely manner:

- Repair and regrade the creek side slopes of Side 3B, where erosion and oversteepening have occurred, to a slope gradient of 2H:1V or flatter;
- Replace or reuse (where suitable) the existing riprap along the creek side slopes of Sides 2, 3A, and 3B to meet the gradation, elevation, and thickness requirements that are outlined in the *Flood Protection Berm and Water Storage Pond Southern Dyke Evaluation Report* (Tetra Tech 2023a);
- Remediate the existing rapid drawdown failure scarps that have occurred on the pond side slopes of Sides 3A, 3B, and 4;
- Repair cracking in the road at the crest of Side 1B by grading, adding fill, or other methods to prevent loss of utility; and

- Repair damage to clay core of embankments caused by animal burrows.

Additionally, it is recommended that the following performance monitoring continue to be undertaken for the WSP:

- As noted in the 2019 AGI (Tetra Tech 2019), the WSP has experienced rapid drawdown failures at several locations on the pond side slopes of Sides 2, 3A, and 3B. Until repairs are completed, it is recommended that water levels in the pond be monitored and maintained below the existing rapid drawdown failure scarps to maintain stability of the existing embankments. The slumped embankment material needs to be kept dry and allowed to drain to prevent further instabilities from occurring;
- The creek side slopes of the WSP (Sides 2, 3A, and 3B) should be inspected weekly by Mine personnel for erosion during periods of high flow (i.e., spring freshet) and immediately following any significant storm events;
- The pond side slopes of the WSP (Sides 1A, 1B, 1C, 2, 3A, 3B, and 4) should be inspected monthly by Mine personnel, when the WSP is in an unfrozen condition, for new signs of instability including bulging, cracking, slumping, and subsidence as well as any signs of seepage including wet patches on the creek side slopes and whirlpools in the pond;
- Annual inspections (i.e., subsequent AGIs) of the WSP should continue to be performed by a Geotechnical Engineer to confirm ongoing performance and identify any change in conditions, with a particular focus on:
 - Erosion protection (i.e., riprap) along creek side slopes of Sides 2, 3A, and 3B;
 - Slumping along pond side slopes of Sides 3A, 3B, and 4; and
 - Cracking and subsidence along the Side 3B creek side access road.

Tetra Tech understands that CZN intend to redesign and remediate the WSP for future use. Therefore, the above inspection issues should be addressed in any redesign of the facility and prior to its operation.

5.3 Rock Piles

The +930 Level and +970 Level Rock Piles do not appear to be engineered structures and predominantly consist of colluvium granular materials (e.g., shale and talus materials) pushed downslope to establish access to each underground portal. No changes to the rock piles have occurred since the early 1980s and they have remained dormant for over 40 years. Currently, Tetra Tech understands that CZN do not plan to develop or modify the existing rock piles as part of the Mine's development.

Based on this, no remedial measures or further performance monitoring are recommended for the +930 Level and +970 Level Rock Piles. Performance monitoring is recommended to be reconsidered if any development activities or modifications are planned for either rock pile.

6.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of CZN and their agents. Tetra Tech does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than CZN, or for any Project other than the proposed development at the Mine. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on Use of this Document attached in Appendix E.

7.0 CLOSURE

We trust this document meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

FILE: 704-ENG.EARC03183-06
FILE: 704-ENG.EARC03183-06
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**PERMIT TO PRACTICE
TETRA TECH CANADA INC.**

Signature _____

Date _____

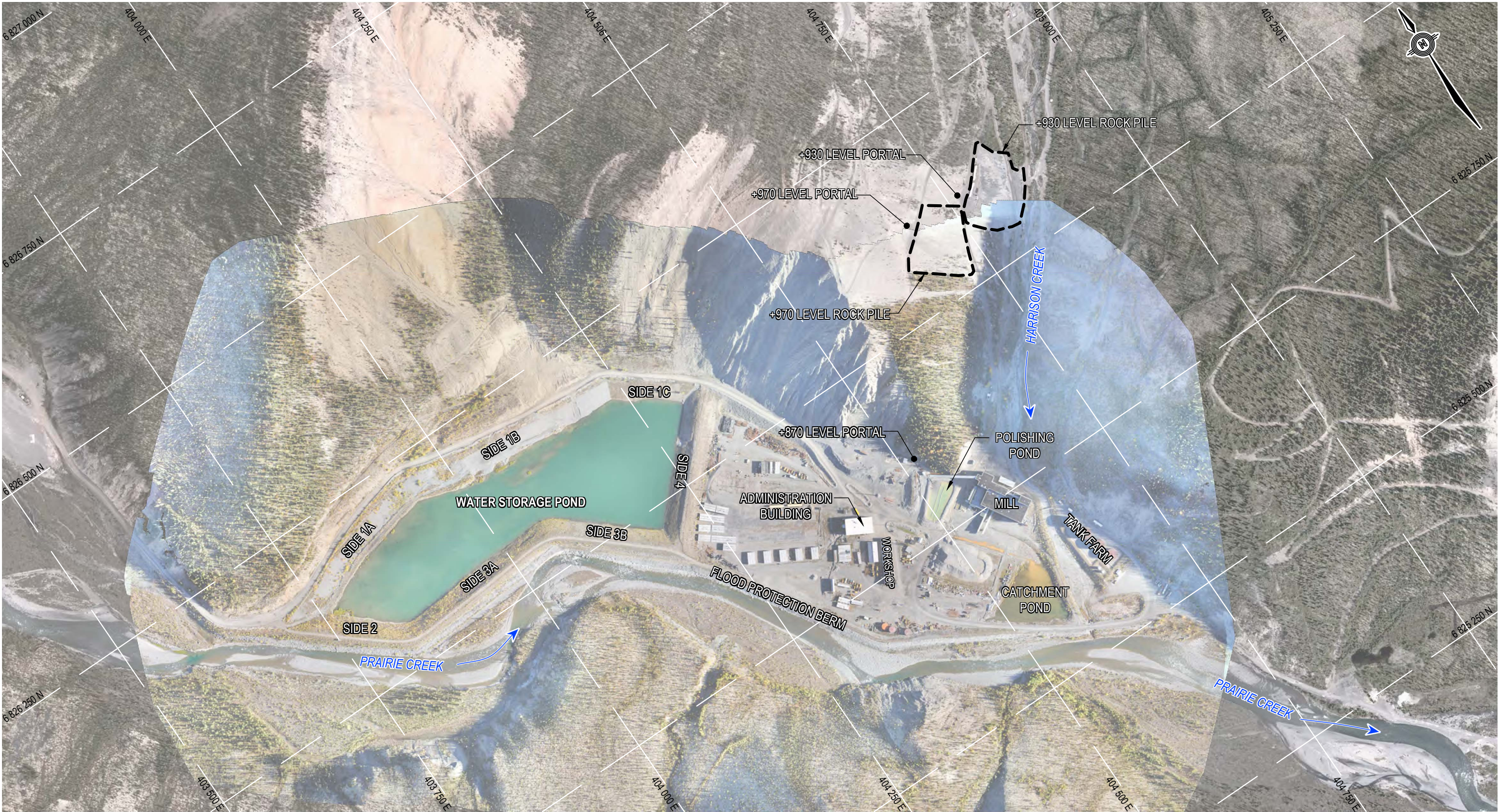
PERMIT NUMBER: P 018
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REFERENCES

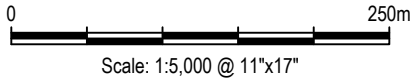
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FIGURES

Figure 1	Mine Plan
Figure 2	Flood Protection Berm Plan
Figure 3	Water Storage Pond Plan
Figure 4	+930 Level and +970 Level Rock Pile Plan



- NOTES:
1. LIDAR DATA AND AERIAL IMAGERY COLLECTED BY OLLERHEAD & ASSOCIATES LTD. IN SEPTEMBER 2022 AND PROVIDED TO TETRA TECH BY NORZINC LTD. ON OCTOBER 4, 2022.
 2. UTM WITH NAD83 DATUM, ZONE 10, METER; CENTRAL MERIDIAN 123D W



2024 ANNUAL GEOTECHNICAL INSPECTION
PRAIRIE CREEK MINE, NORTHWEST TERRITORIES

MINE PLAN





PROJECT NO.	DWN	CKD	REV
ENG.EARC03183-06	EL	TB	IFU
OFFICE	DATE		
EDMONTON	NOVEMBER 2024		

FIGURE 1

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LEGEND

-  HISTORICAL MONITORING LOCATION (NHC 2009)
-  2009 RIPRAP REPAIR (NHC 2009, REPAIR SITE "C")
-  RIPRAP SETTLEMENT
-  PHOTO LOCATION

NOTES:

- AERIAL IMAGERY COLLECTED BY OLLERHEAD & ASSOCIATES LTD. IN SEPTEMBER 2022 AND PROVIDED TO TETRA TECH BY NORZINC LTD. ON OCTOBER 4, 2022.
- UTM WITH NAD83 DATUM, ZONE 10, METER; CENTRAL MERIDIAN 123D W

CLIENT



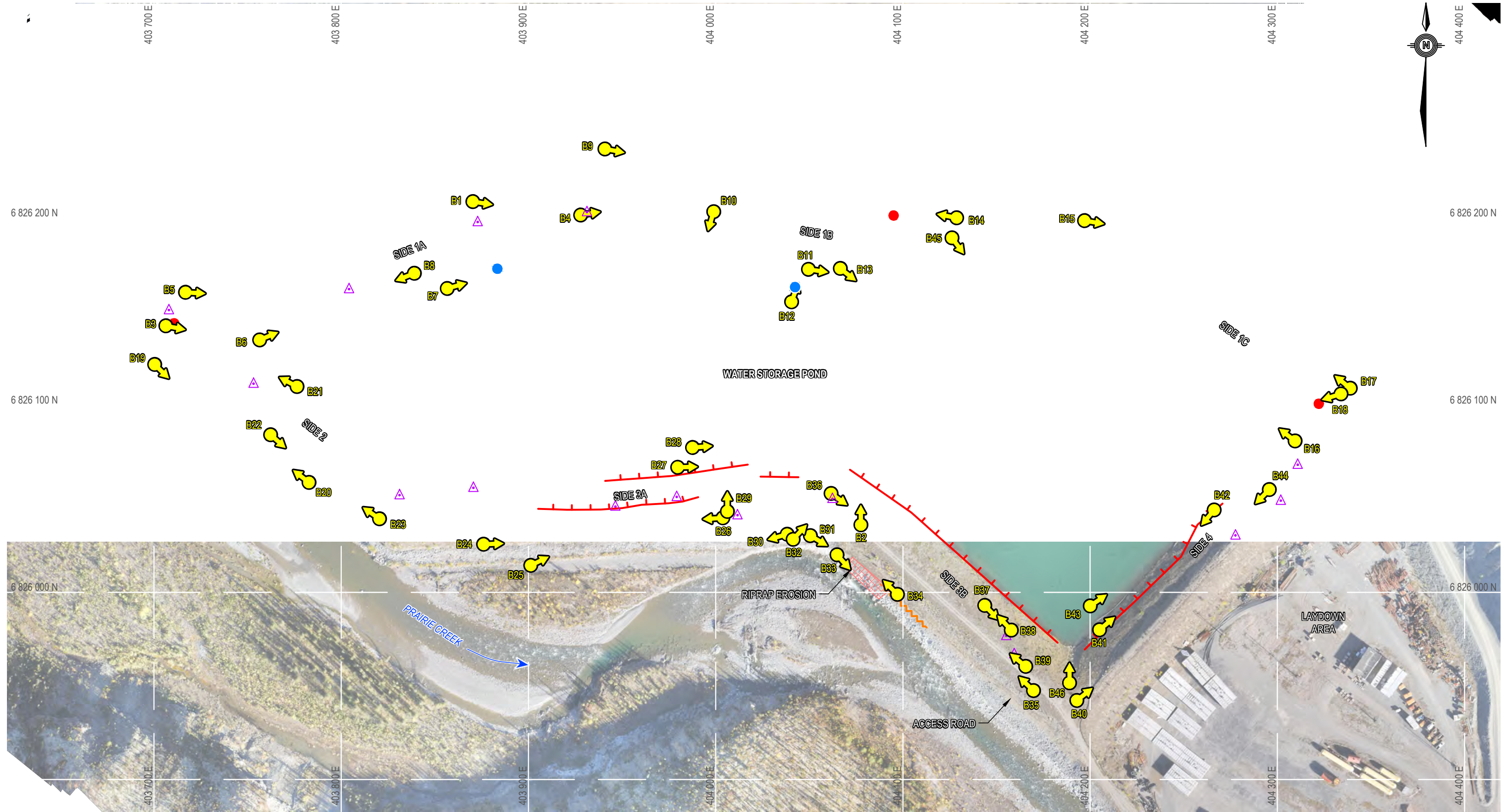
2024 ANNUAL GEOTECHNICAL INSPECTION PRAIRIE CREEK MINE, NORTHWEST TERRITORIES

FLOOD PROTECTION BERM PLAN

PROJECT NO.	DWN	CKD	REV	FIGURE 2
ENG.EARC03183-06	EL	TB	IFU	
OFFICE	DATE			
EDMONTON	NOVEMBER 2024			

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Scale: 1:2,000 @ 11"x17"

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- LEGEND**
- SLUMP
 - RIPRAP EROSION
 - CRACKING
 - PHOTO LOCATION

- SPRING
- ANIMAL BURROW
- EROSION GULLY

- NOTES:**
- AERIAL IMAGERY COLLECTED BY OLLERHEAD & ASSOCIATES LTD. IN SEPTEMBER 2022 AND PROVIDED TO TETRA TECH BY NORZINC LTD. ON OCTOBER 4, 2022.
 - UTM WITH NAD83 DATUM, ZONE 10, METER; CENTRAL MERIDIAN 123D W

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CLIENT

CANADIAN ZINC CORPORATION

TETRA TECH

2024 ANNUAL GEOTECHNICAL INSPECTION PRAIRIE CREEK MINE, NORTHWEST TERRITORIES					
WATER STORAGE POND PLAN					
PROJECT NO. ENG.EARC03183-06		DWN EL	CKD TB	REV IFU	FIGURE 3
OFFICE EDMONTON		DATE NOVEMBER 2024			

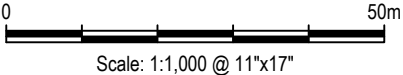
C:\Users\elvin.lee\OneDrive - Tetra Tech, Inc\Project Data\ENG\EARC03183-06\Production Drawings\ENG\EARC03183-06_Figure 4.dwg [FIGURE 4] November 13, 2024 - 8:32:14 am (BY: LEE, ELVIN)





LEGEND

 PHOTO LOCATION

- NOTES:
1. AERIAL IMAGERY COLLECTED BY OLLERHEAD & ASSOCIATES LTD. IN SEPTEMBER 2022 AND PROVIDED TO TETRA TECH BY NORZINC LTD. ON OCTOBER 4, 2022.
 2. UTM WITH NAD83 DATUM, ZONE 10, METER; CENTRAL MERIDIAN 123D W



CLIENT		2024 ANNUAL GEOTECHNICAL INSPECTION PRAIRIE CREEK MINE, NORTHWEST TERRITORIES			
		+930 LEVEL AND +970 LEVEL ROCK PILE PLAN			
	PROJECT NO. ENG.EARC03183-06	DWN EL	CKD TB	REV IFU	FIGURE 4
	OFFICE EDMONTON	DATE NOVEMBER 2024			

APPENDIX A

FLOOD PROTECTION BERM PHOTOGRAPHS



Photo A1: Flood Protection Berm
General view looking downstream from Water Storage Pond towards the Mine.
(photo taken August 20, 2024)



Photo A2: Flood Protection Berm
Crest of creek side slope looking upstream from Harrison Creek culverts.
(photo taken August 20, 2024)



Photo A3: Flood Protection Berm
Creek side floodplain looking upstream from near Harrison Creek culverts.
(photo taken August 20, 2024)



Photo A4: Flood Protection Berm
Crest of mine side slope looking downstream from near berm deflection point.
(photo taken August 20, 2024)



Photo A5: Flood Protection Berm
Top of berm looking upstream from near Monitoring Site NHC-01.
(photo taken August 20, 2024)



Photo A6: Flood Protection Berm
Crest of mine side slope looking upstream from near Monitoring Site NHC-02.
(photo taken August 20, 2024)



Photo A7: Flood Protection Berm, crest of creek side slope looking upstream from near Monitoring Site NHC-01. Riprap settlement shown along crest of berm.
(photo taken August 20, 2024)



Photo A8: Flood Protection Berm, toe of creek side slope looking upstream from near Monitoring Site NHC-03. Riprap erosion and oversteepening shown along slope.
(photo taken August 20, 2024)



Photo A9: Flood Protection Berm, crest of creek side slope looking downstream from near Monitoring Site NHC-03. Riprap settlement shown along crest of berm.
(photo taken August 20, 2024)



Photo A10: Flood Protection Berm, crest of mine side slope looking downstream from between Monitoring Sites NHC-03 and NHC-04.
(photo taken August 20, 2024)



Photo A11: Flood Protection Berm, crest of creek side slope looking upstream from between Monitoring Sites NHC-03 and NHC-04. Old animal burrow and tension crack shown. (photo taken August 20, 2024)



Photo A12: Flood Protection Berm, toe of creek side slope looking upstream from near Monitoring Site NHC-04. Riprap erosion and oversteepening shown along slope. (photo taken August 20, 2024)



Photo A13: Flood Protection Berm
Crest of mine side slope looking downstream from near Monitoring Site NHC-04.
(photo taken August 20, 2024)



Photo A14: Flood Protection Berm, toe of creek side slope looking upstream from between
Monitoring Sites NHC-04 and NHC-05. Riprap erosion and oversteepening shown.
(photo taken August 20, 2024)



Photo A15: Flood Protection Berm, crest of creek side slope looking upstream from near Monitoring Site NHC-05. Riprap settlement shown along crest of berm.
(photo taken August 20, 2024)



Photo A16: Flood Protection Berm, crest of creek side slope looking upstream from location of 2009 riprap repairs (NHC 2009, Repair Site "C").
(photo taken August 20, 2024)



Photo A17: Flood Protection Berm, middle of creek side slope looking downstream near Monitoring Site NHC-05. Riprap erosion and oversteepening shown.
(photo taken August 20, 2024)



Photo A18: Flood Protection Berm, toe of creek side slope looking upslope (camp to the right) from location of 2009 riprap repairs (NHC 2009, Repair Site "C").
(photo taken August 20, 2024)



Photo A19: Flood Protection Berm, toe of creek side slope looking downstream from location of 2009 riprap repairs (NHC 2009, Repair Site “C”).
(photo taken August 20, 2024)



Photo A20: Flood Protection Berm
Top of berm looking downstream from connection with Water Storage Pond.
(photo taken August 20, 2024)