APPENDIX V

CDF AND DIKE DESIGNS

Technical Design Brief - Dikes

Springpole Gold Project

First Mining Gold Corp.

ONS2104

Prepared by:
WSP Canada Inc.

October 2024

Technical Design Brief - Dikes
Springpole Gold Project

Red Lake District, Northwest Ontario
Project #ONS2104

Prepared for:

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1.0 INTRODUCTION

First Mining Gold Corp. proposes to develop, operate and eventually decommission and close an open pit gold and silver mine and ore process plant with supporting facilities known as the Springpole Gold Project (Project). The Project is located in a remote area of northwestern Ontario, approximately 110 kilometres (km) northeast of the Municipality of Red Lake and 145 km north of the Municipality of Sioux Lookout.

An environmental assessment (EA) pursuant to the Canadian Environmental Assessment Act, 2012 (SC 2012, c. 19, s. 52) and the Ontario Environmental Assessment Act (RSO 1990, c. E.18) is required to be completed for the Project. This report is one of a series of Technical Support Documents prepared by WSP Canada Inc. (WSP)on behalf of First Mining Gold Corp.

The proposed open pit is located partly within a portion of the north basin of Springpole Lake. As such, two dikes are proposed to be constructed to isolate that portion of the lake in order to safely access the mining area.

FMG has retained WSP Canada Inc. (WSP) to provide engineering services for the dikes and to prepare a technical design brief for the dikes.

2.0 BACKGROUND

Dike Design Consideration Alternate locations for the dikes were assessed as described in Section 5 of the draft EIS/EA (Wood, 2022). The dike locations were selected in consideration of:

- Lakebed geotechnical foundation conditions;
- Minimizing the required area to be isolated from Springpole Lake;
- Ensuring sufficient safety distance from the open pit;
- Minimizing the dam length and height as well as overall footprint; and
- Minimizing fisheries impacts.

As a result of the alternatives assessment, the west and east dike locations were selected as presented in Figure 2-1.

2.1 Geotechnical Subsurface Condition

Two investigation programs were carried out along the proposed dike alignment to understand and assess foundation conditions. In 2018, 11 boreholes were advanced through the ice layer (Tetra Tech, 2019). Subsequently, an additional eight (8) boreholes were advanced in 2022 (Knight Piesold, 2022). Borehole location layouts for both the west and east dikes are shown in Attachment A along with lake bathymetry.

The subsurface of the dikes footprint is comprised of thin overburden about 1.8 m on average, typically ranging from zero to 3 m. One exception is the borehole DH22-AI which encountered overburden in the order of 8.3 m thick. The overburden typically consists of lakebed sediment underlain by glacial till. The lakebed sediment contains organics, clay and silt. The glacial till is a mixture of sand and gravel, possibly with cobble and boulders with a thickness of 1.7 m on average.

- Bedrock hydraulic conductivity ranged from 1.5×10^{-5} to less than 1.6×10^{-7} m/s;
- Some boreholes potentially encountered highly fractured bedrock in top 1 m to 3 m; these were described as cobbles/boulders in the borehole logs; and
- Some boreholes encountered a surficial low RQD[1] (<50%) zone, which is about 2.5 m thick on average, typically ranging from 1 to 6 m, up to 9 m.

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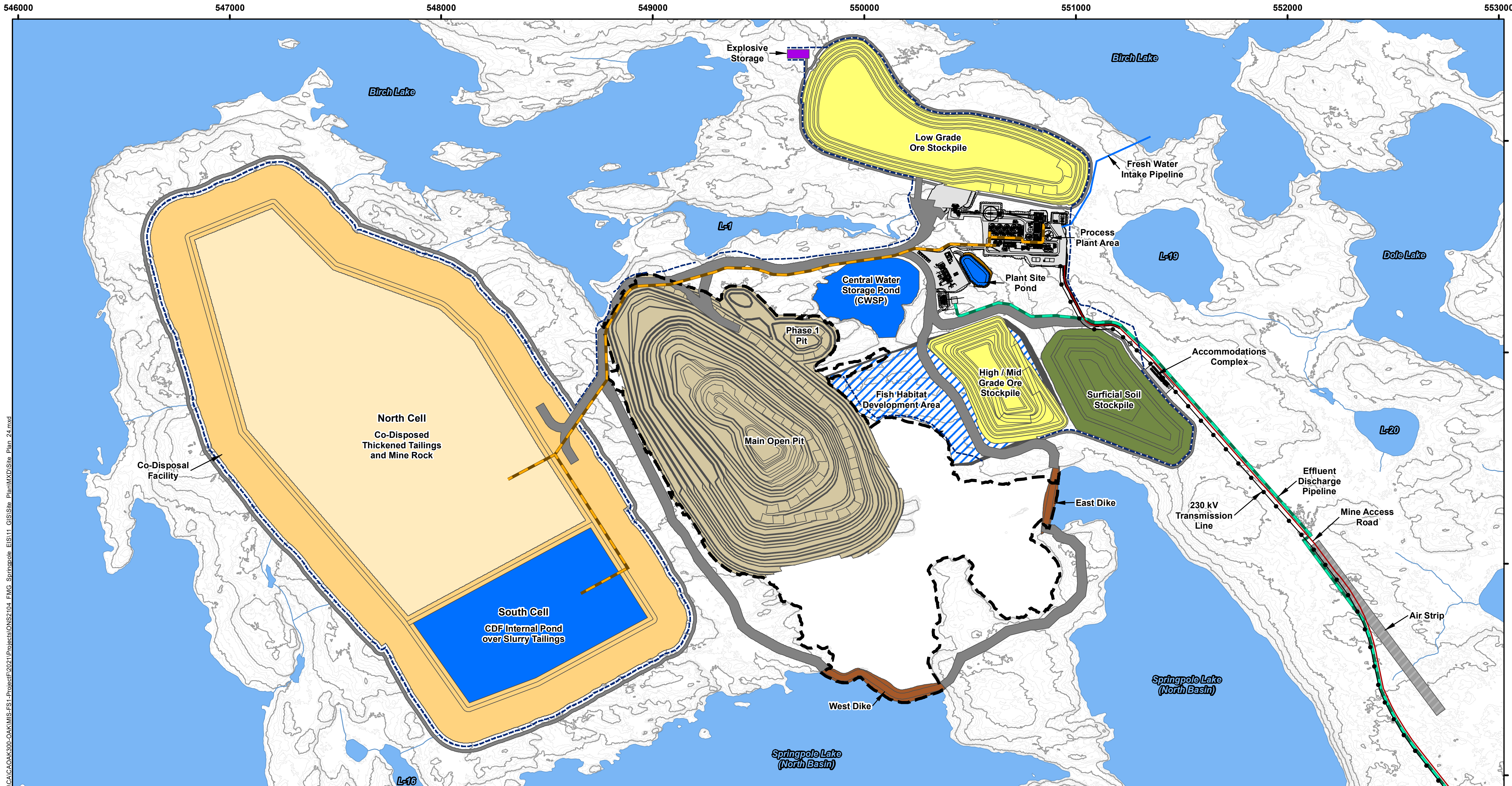
1 Rock Quality Designation.



LEGEND

- Watercourse
- Waterbody
- Major Contours (5 m interval)
- Minor Contours (1 m interval)

Proposed Mine Features

- Open Pit
- Open Pit Basin
- Ore Stockpile
- Surficial Soil Stockpile
- Co-Disposal Facility
- Co-Disposed Thickened Tailings and Mine Rock
- Process Plant Area
- Dike
- Pond
- Haul / Access Road
- Explosives Storage
- Air Strip
- Mine Access Road
- Seepage / Runoff Collection System
- 230 kV Transmission Line
- Fresh Water Intake Pipeline
- Effluent Discharge Pipeline
- Tailings Pipeline Corridor
- Fish Habitat Development Area

NOTES:
- Contours extracted from 2020 LiDAR survey.
- Proposed site plan provided by Ausenco, drawing number 104496-GX-03000-31344-003, Rev 1. 26 June 2023 and modified by WSP July 2023.
- 230 kV transmission line provided by First Mining Gold, April 2024.

Datum: NAD83
Projection: UTM Zone 15N

0 0.5 1 2 3 4 5 Kilometres

FIRST MINING GOLD

wsp

SPRINGPOLE GOLD PROJECT

EIS / EA Site Plan

PROJECT N°: ONS2104

FIGURE: 2-1

SCALE: 1:17,000

DATE: April 2024

3.0 SEEPAGE CUT-OFF WALL OF DIKES

The proposed dikes were initially designed during the pre-feasibility study (PFS) to include a homogeneous embankment with a grout curtain and seepage cut-off wall (secant pile wall) installed in the centre to minimize seepage through and under the structure (AGP, 2021). WSP carried out a trade-off study for the seepage cut-off wall of the dikes and recommended a slurry wall replacing the secant pile wall. The trade off study considered three dike seepage cut-off wall options listed as follows:

- Option A Secant Pile Wall. This option was the recommended solution from the PFS study.
- Option B Slurry Wall.
- Option C Sheet Pile Wall.

For all of the options, fundamental engineering considerations were evaluated such as the constructability, deformation compatibility with the surrounding soil, acceptable strain, effectiveness in ensuring continuity (with treated bedrock and between panels), and performance on seepage control. Considerations were also given to cost, schedule, and risks.

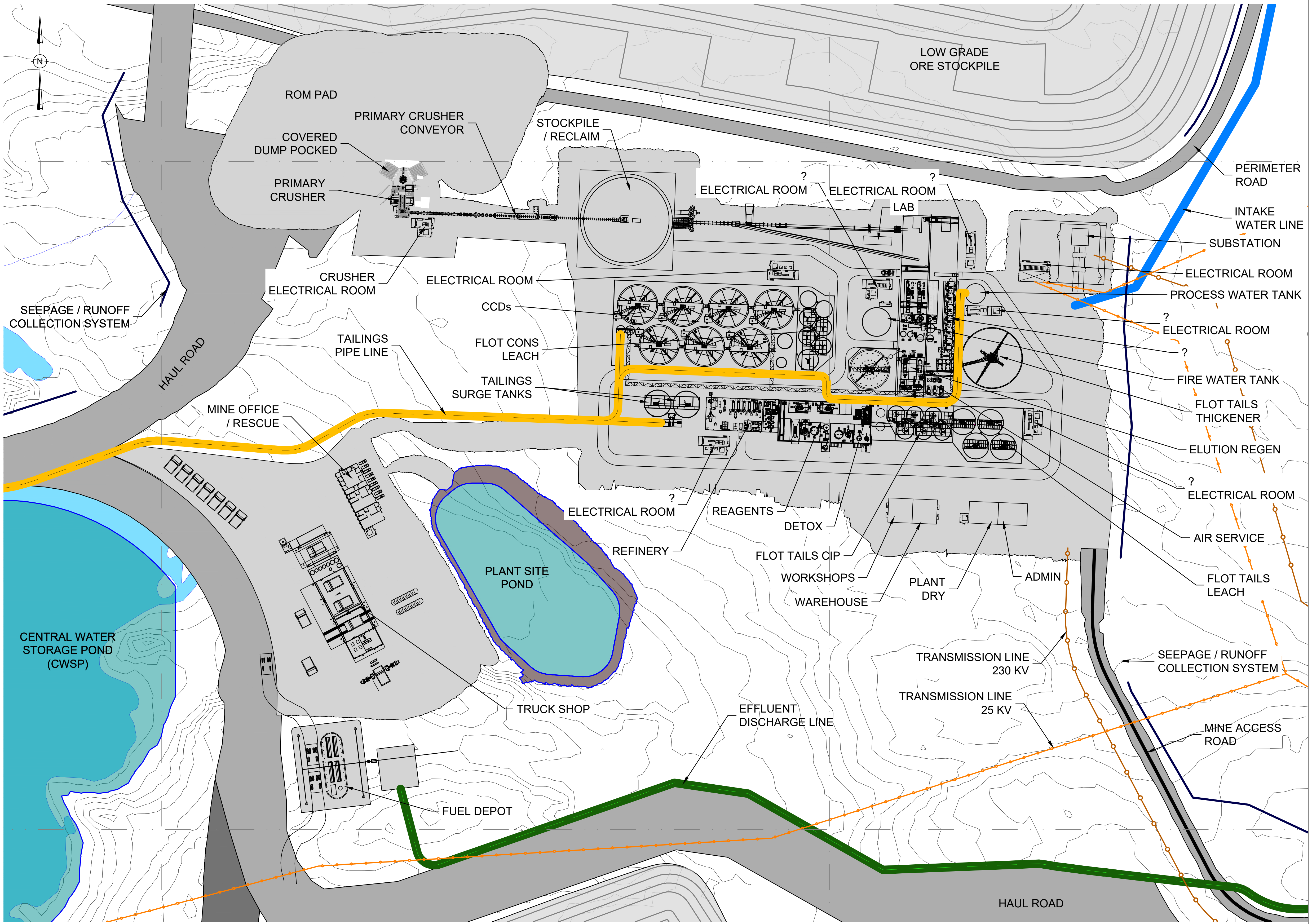
Option A (secant pile wall) was less preferred considering the higher cost and longer construction schedule in comparison with the slurry wall option, and the risk of tie-in defects between adjacent piles. Option C (sheet pile wall) was less favourable considering the performance risk of potential seepage and piping through the windows/gaps below sheet piles to bedrock. Based on the assessment the slurry wall option (Option B) was selected as the new base-case option. This option presents opportunities to decrease the risk of seepage, a lower cost, and a more favourable construction schedule). Further assessment will be carried out during the feasibility study to assess the preferred type of slurry wall (i.e., Cement-Bentonite slurry wall or Plastic Concrete slurry wall).

4.0 SEEPAGE CUT OFF WALL OF DIKES

Figure 4-1 shows a sketch of a typical dike cross-section as per the pre-feasibility study (AGP, 2021). The pertinent dike dimensions are summarised in Table 4-1.

The dikes will have 28 m crest width to allow for bulk rockfill placement by the mine fleet. The upstream and downstream slopes will be at the angle of repose and will not be controlled. Zone 1 (25 mm minus crushed rock) will be placed as the central core to facilitate installation of the seepage cut-off wall, and 100 mm minus crushed rock fill material (Zone 2) will be used as embankment shells. Dikes will be provided with two seepage control elements as follows:

- A seepage cut-off wall (Slurry Wall) will be installed within the embankment zone 1 crushed rockfill to minimize seepage from Springpole Lake through the structure into the dewatered open pit basin; and
- A foundation grout curtain - will also be installed through the zone 1 rockfill to minimize seepage through the shallow bedrock zone and low RQD zone.



NOTES:

1. THIS FIGURE ILLUSTRATES THE CO-DISPOSAL FACILITY CONCEPTUAL DESIGN PLAN VIEW OF ULTIMATE CONFIGURATION.
2. ALL DIMENSIONS AND ELEVATIONS ARE IN METERS. GRID COORDINATES ARE IN NAD 1983 UTM ZONE 15N.

LEGEND:

- ROAD
- INTAKE WATER LINE
- EFFLUENT DISCHARGE LINE
- TAILINGS LINE
- 230 KV TRANSMISSION LINE
- 25 KV TRANSMISSION LINE
- SEEPAGE / RUNOFF COLLECTION SYSTEM
- POND

0 50 100 150m

1:3000 SCALE

CLIENT LOGO: FIRST MINING GOLD	CLIENT: FIRST MINING GOLD	DWN BY: KJ	COMPANY LOGO: WSP	PROJECT: SPRINGPOLE GOLD PROJECT	DATE: JUNE 2024
	WSP Canada Inc. 6925 Century Avenue Mississauga, Ontario, Canada, L5N 7K2	CHK'D BY:			PROJECT NO: ONS2104
		DATUM: UTM NAD 83		TITLE: PROCESSING AREA SITE PLAN	REV. NO.: A
		PROJECTION: ZONE 15			FIGURE No. 4-1
		SCALE: 1:3000			

X:\CA\CAOAK300-OAK\MIS-FS1-ProjectF\2021\Projects\ONS2104_FMG_Springpole_EIS\13_CAD\02_DWG\-AA – Springpole Site\Site Plan_23.dwg – Plant Site Area – Jun. 12, 2024 3:20pm – wds_nadine.rondon

Table 4-1: Summary of Dike Dimensions

Item	Value, m	Notes
Total Dike Length	**1100**	
West Dike	700	Water depth < 10 m; Dike height < 15 m
East Dike	400	Water depth < 8 m; Dike height < 13 m
Dike Height	Varies, up to about 15 m	
Lake Water Depth	Varies, up to about 10 m	
Dike Crest Elevation	396	
Lake Water Elevation (max. see note 2)	391	
Freeboard	5	

Notes:
1. The data was based on the currently available information to WSP.
2. Information is based on available site data (391.28 m as per WSP, 2023).

5.0 CONSTRUCTION SEQUENCE

An overview of the current planned dike construction sequence is provided below:

1. Install turbidity barriers upstream and downstream of the proposed dikes. to control sediments within the work area, and to isolate the dike areas from fish.
2. Remove fish from the internal work area between the turbidity barriers. The barriers will be installed in a manner to minimize fish within the isolated area by installing the barriers at the centreline of the dike, and slowly moving the weighted barriers to their respective upstream and downstream locations.
3. Foundation preparation within the footprint of dikes and tie-in abutments. This step is to prepare the tie-in abutments and foundations for the dike embankments.
    a. For the embankment segments on land, it will include the removal of organics and trees (if applicable) within the footprint of embankments.
    b. For the embankment segments in water, the weak / soft material at the lakebed under the proposed embankment will be removed using a long-reach excavator or by dredging.
4. Zone 1 and Zone 2 fill materials will be placed in the wet for the embankment segment in water using end-dump trucks and dozers. The embankment will be placed at a working elevation for the construction of the slurry wall, as shown by the dash line in Figure 4–1. The working elevation is approximately 2 m above the average lake water level.
5. Vibro-compaction of Zone 1 material near the cut-off wall. This step is to compact and densify the Zone 1 material to improve the stability of the slurry trench (see the step - construction of slurry wall).
6. Bedrock grouting. The surficial fractured bedrock is to be grouted to control the seepage through dike foundation. The grout holes will be drilled through the Zone 1 material down into fractured bedrock. The grout will be pressured into the fractured bedrock from the drilled hole(s) to minimize the potential seepage through shallow bedrock.
7. Construction of slurry wall.
    a. Install a guide wall along the slurry wall alignment to guide slurry trench excavation.
    b. Excavate the slurry trench. Keep the slurry level above the lake water level to maintain the stability of the trench side walls during the operation. The slurry will be mixed at a specified ratio to form a filter cake along the side wall of the trench so as to minimize the filtration of slurry into Zone 1.
    c. Backfill the trench with cement-bentonite slurry or plastic concrete.
8. Dike embankment construction, including the following:
    a. Placement of riprap upstream for wave protection.
    b. Raise the dike embankment to the target final crest level.
9. Controlled dewatering. Initially the open pit basin area is to be dewatered by the controlled pumping of lake water over the upstream face of the dikes. When the water quality becomes unsuitable for direct discharge, (due to total suspended solids) the remaining water will be directed to the central water storage pond for treatment prior to being discharged.
10. Toe berm construction (if needed). A downstream toe-berm may be required to improve the overall stability of the dike embankment, depending on the findings from the future feasibility study.

6.0 MATERIAL TAKE OFF

Table 6-1 summarizes a high-level estimate of the material take-off for the dike construction.

Table 6-1: Dike Material Take-Off

Items	Unit	Quantity
Zone 1 (1" minus Rockfill)	m^3	110,000
Zone 2 (4" minus Rockfill)	m^3	175,000
Riprap	m^3	26,000
Cutoff Wall Volume	m^3	3,800
Foundation Prep. Area (Dike Footprint)	m^2	50,000
Bedrock Grouting	m^2	8,400

Notes:

1. The data was estimated using Civil 3D model based on the typical configuration and alignment layout (See Attachment A).
2. Quantities in this table are in-place to neat lines.
3. A fish habitat development area will be near the shoreline, including the upstream of the dikes. The materials required for the fish habitat development area were estimated in the environmental assessment. These are excluded from the MTO estimation in this memo.
4. The grout injection depth into the bedrock is assumed to be 8 m.

7.0 REFERENCES

AGP Mining Consultants (AGP). 2021. NI 43-101 Technical Report and Pre-Feasibility Study on the Springpole Gold Project, Ontario, Canada. Report Date: February 26, 2021.

Tetra Tech, 2019, Winter 2018 Geotechnical Site Investigation Data Report, ENG.EARC03100-01, July 2, 2019.

Knight Piesold, 2021, Pre-Feasibility Design of Cofferdams, VA101-567/2-1, Rev.0, March 5, 2021.

Knight Piesold, 2021, Springpole Gold Project Cofferdam Alternative Trade-off Study, November 5, 2021.

Knight Piesold, 2022, 2022 Cofferdam Geotechnical Site Investigation, Rev.A, VA101-567/4-1, September 8, 2022.

Wood, 2021; Springpole Gold Project, Draft Environmental Impact Statement / Environmental Assessment

WSP, 2022, Dyke Cut-off Wall Trade-off Study for Springpole Gold Project, SP-EM-MEM-0006 A, November. 18, 2022.

WSP, 2023. Springpole Gold Project, 2022 Hydrology Baseline Report.

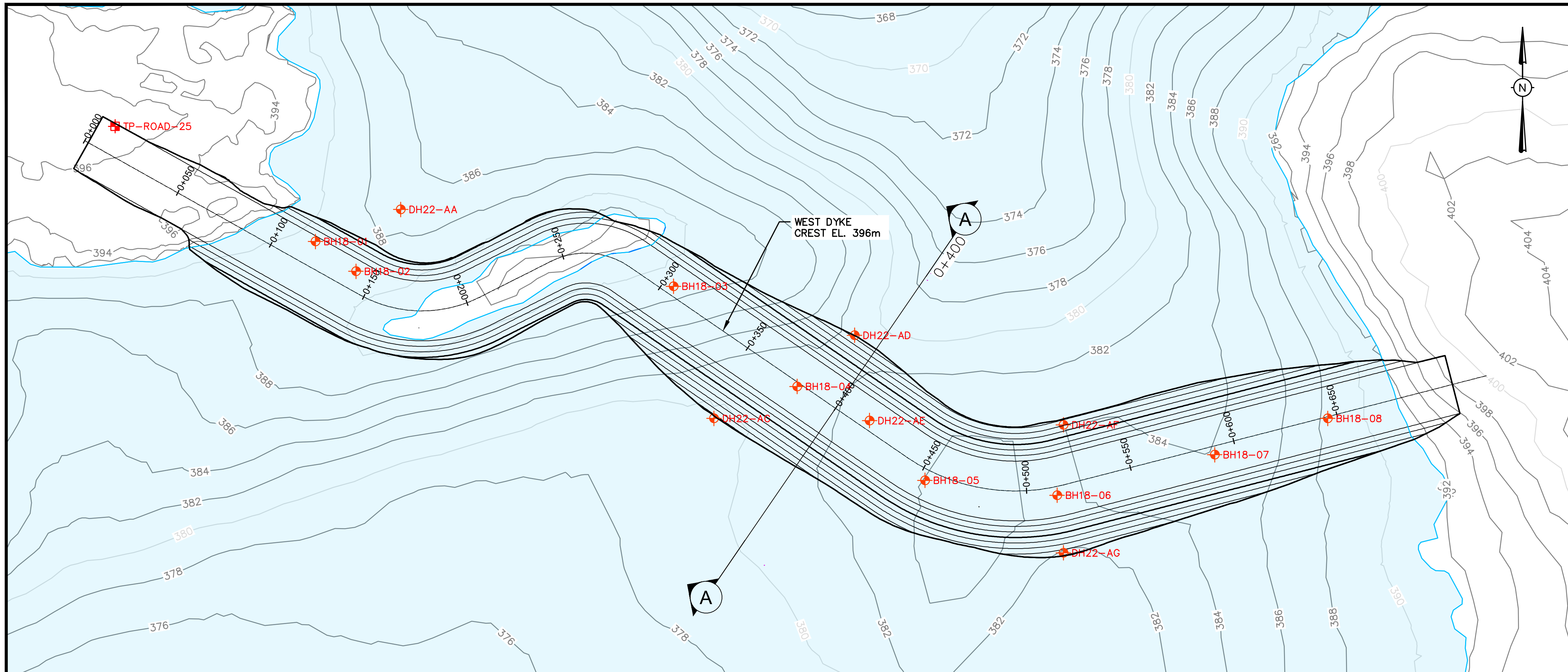
Attachment A
Figures

NOTES:

1. THE TOPOGRAPHY SHOWN ON THIS DRAWING WAS OBTAINED FROM 2022-06-27 LIDAR CONTOURS & INDEX FOR KP AND SPRINGPOLE_LAKE_2019_BATHYMETRY.

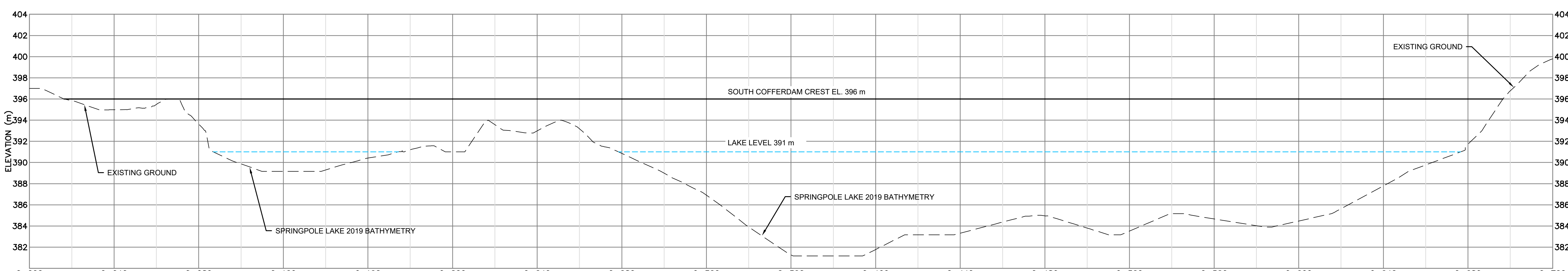
LEGEND:

	CONTOUR (MASL)
	STREAM WATER COURSE
	WATER
	PROPOSED DAM CENTERLINE
BH-XX	BOREHOLE FROM PREVIOUS INVESTIGATIONS
TP-XX	TEST PIT FROM PREVIOUS INVESTIGATIONS



PLAN

0 20 50 100m
1:1250 SCALE



PROFILE (1) ALONG SOUTH COFFERDAM CENTRELINE
SCALE: 1:1000 H
1:200 V

0 20 40 100m
1:1000 SCALE
0 5 10 20m
1:200 SCALE

DRAFT

CLIENT LOGO	CLIENT:	DWN BY: SC	COMPANY LOGO	PROJECT: FIRST MINING GOLD CORPORATION SPRINGPOLE GOLD PROJECT	DATE: DECEMBER 2023
		CHK'D BY: GQ			PROJECT NO: OMGS20021
	WSP E&I Canada Limited 6925 Century Avenue. Mississauga, Ontario L5N 7K2	DATUM: UTM		TITLE: WEST DYKE PLAN AND PROFILE	REV. NO.: A
		PROJECTION: NAD 83			FIGURE No. 1
		SCALE: AS SHOWN			

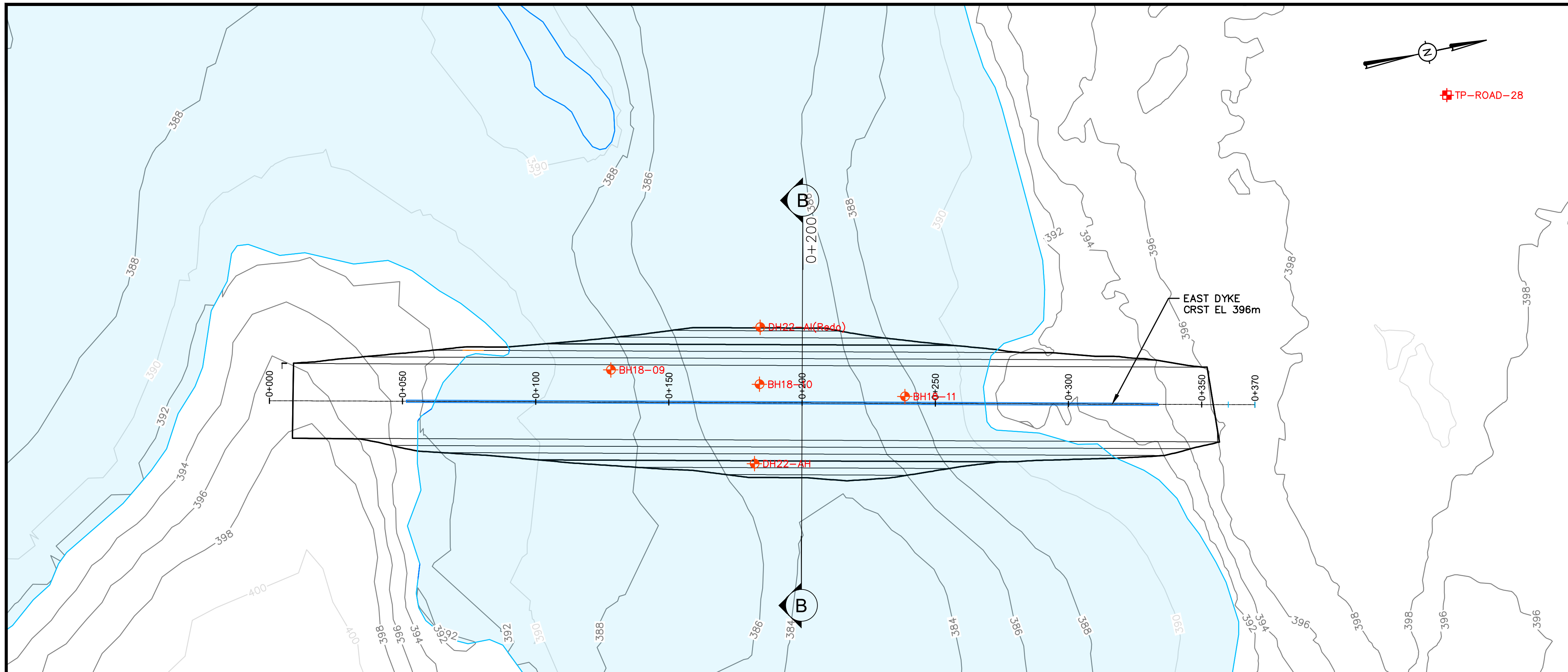
C:\Users\USSC714811\OneDrive - WSP O365\Documents\WORKING\01-PROJECTS\Gold_Springpole Tradeoff Studies\02-DWG\Springpole_PFS Cofferdam Volumes.dwg - Layout1 - Dec. 15, 2023 2:18pm - USSC714811

NOTES:

1. THE TOPOGRAPHY SHOWN ON THIS DRAWING WAS OBTAINED FROM 2022-06-27 LIDAR CONTOURS & INDEX FOR KP AND SPRINGPOLE_LAKE_2019_BATHYMETRY.

LEGEND:

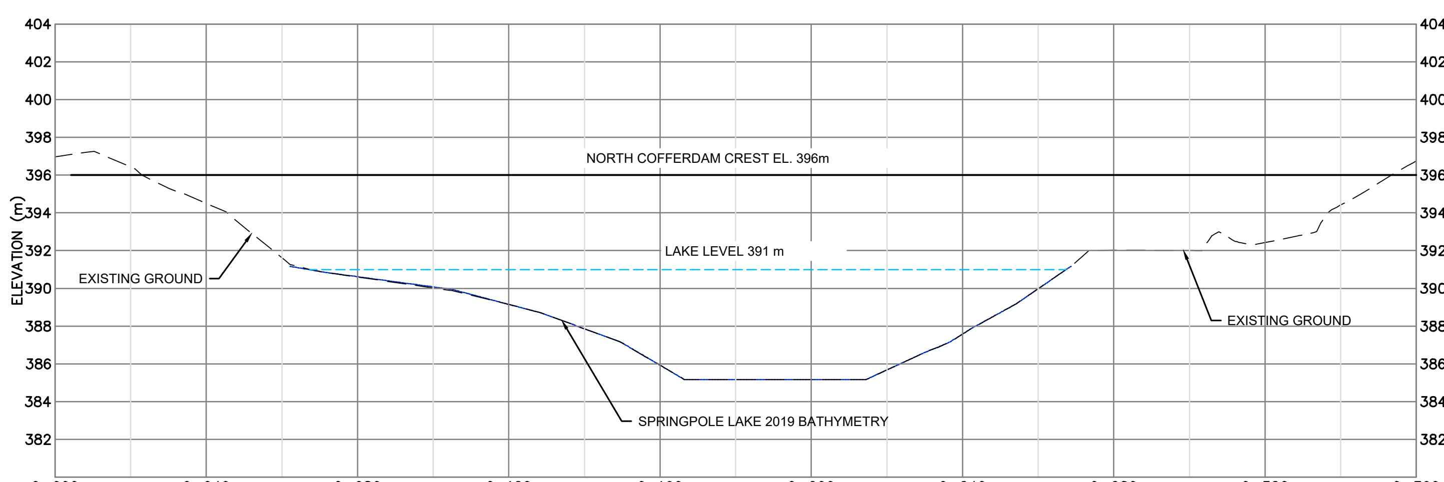
- CONTOUR (MASL)
- STREAM WATER COURSE
- WATER
- PROPOSED DAM CENTERLINE
- BH-XX BOREHOLE FROM PREVIOUS INVESTIGATIONS
- TP-XX TEST PIT FROM PREVIOUS INVESTIGATIONS



PLAN

0 20 40 100m

1:1000 SCALE



PROFILE 2 ALONG NORTH COFFERDAM CENTRELINE

SCALE: 1:1000 H
1:200 V

0 20 40 100m

1:1000 SCALE

0 5 10 20m

1:200 SCALE

DRAFT	CLIENT LOGO	CLIENT: WSP E&I Canada Limited, 6925 Century Avenue. Mississauga, Ontario L5N 7K2	DWN BY: SC; CHK'D BY: GQ; DATUM: UTM; PROJECTION: NAD 83; SCALE: AS SHOWN	COMPANY LOGO	PROJECT: FIRST MINING GOLD CORPORATION SPRINGPOLE GOLD PROJECT; TITLE: EAST DYKE PLAN AND PROFILE	DATE: DECEMBER 2023; PROJECT NO: OMGS20021; REV. NO.: A; FIGURE No. 2

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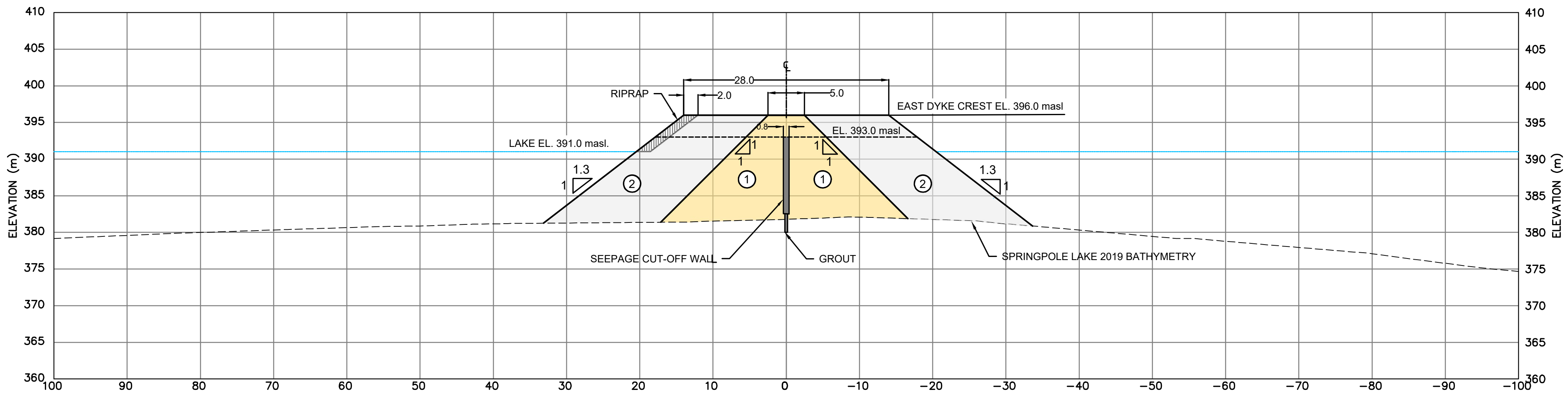
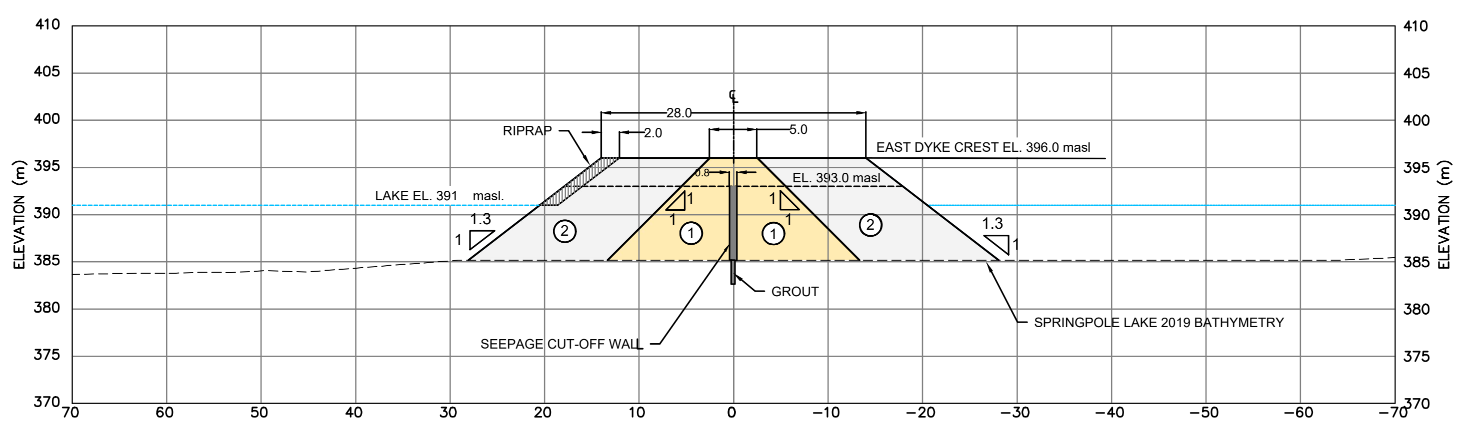


SECTION A WEST DYKE
SCALE: 1: 400



SECTION B EAST DYKE
SCALE: 1: 400

CONSTRUCTION MATERIALS:

1 ZONE 1A

2 ZONE 2 - COARSE ROCKFILL

RIPRAP

DRAFT

CLIENT LOGO

CLIENT:

WSP E&I Canada Limited

6925 Century Avenue. Mississauga, Ontario L5N 7K2

DWN BY: SC

CHK'D BY: GQ

DATUM: UTM

PROJECTION: NAD 83

SCALE: AS SHOWN

COMPANY LOGO

PROJECT

FIRST MINING GOLD CORPORATION

SPRINGPOLE GOLD PROJECT

TITLE

EAST & WEST DYKES SECTIONS

DATE: DECEMBER 2023

PROJECT NO: OMGS20021

REV. NO.: A

FIGURE No. 3