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November 5, 2018

Robert Holmes, Director, Mineral Resources
Government of Yukon
Department of Energy, Mines & Resources
P.O. Box 2703
Whitehorse, Yukon Y1A 2C6

Dear Mr. Holmes:

Regarding: Dry Stack Tailings Facility Construction and Operation Plan Revision 4, QML-0009

This submission (revision 4) of the Dry Stack Tailings Facility (DSTF) Construction and Operation Plan incorporates the deposition of tailings generated by milling Bermingham ore. Ore from the Bermingham, Flame and Moth, Onek, Lucky Queen and Bellekeno deposits will be processed through the District Mill generating composite tailings to be deposited in the existing DSTF.

The previously submitted and approved *Detailed Design Dry-Stacked Tailings Facility Report* and the approved *Operations, Maintenance, and Surveillance Manual for the DSTF,* prepared for Alexco by EBA Engineering Consultants Ltd, outline the detailed design and operations of the DSTF phase I (existing). The preliminary design was provided in the previous version of this plan, *Dry Stacked Tailings Facility Phase II Expansion Preliminary Design – Revision 1 Keno Hill District Mill Site, YT (Attachment A)*. As required by schedule C clause 1.5 of the QML, additional investigation will be completed for Phase II prior to providing a final design. The DSTF construction and operation plan will be subsequently revised as required. There are no changes proposed to the construction and operations of the DSTF for the processing of Bermingham Ore.

Attachment B provides geochemical characterization of the Bermingham tailings, showing they are geochemically similar to the Flame and Moth, Bellekeno, Onek and Lucky Queen tailings. Attachment C provides the Tailings Characterization Plan outlining how tailings will be characterized during operations of the DSTF.

Sincerely,
ALEXCO KENO HILL MINING CORP.

Kai Woloshyn
Environmental Manager

Attachments:

A. Dry Stacked Tailings Facility Phase II Expansion Preliminary Design – Revision 1 Keno Hill District Mill Site, YT.
B. Geochemical Characterization of Bermingham Tailings
C. Tailings Characterization Plan

Attachment A

Dry Stacked Tailings Facility Phase II Expsansion Preliminary Design - Revision 1

Keno Hill District Mill Site, EBA 2015

June 2, 2015

FILE: W14103548-01
Via Email: kwoloshyn@alexcoresource.com

Alexco Resource Corp
3 Calcite Business Centre
151 Industrial Road
Whitehorse, YT Y1A 2V3

Attention: Kai Woloshyn, Environmental Manager

Subject: Dry Stacked Tailings Facility Phase II Expansion Preliminary Design – Revision 1
Keno Hill District Mill Site, YT

NND EBA Land Protection Corp. operating as NELPCo Limited Partnership (NELPCo) is pleased to submit the enclosed Dry Stacked Tailings Facility Phase II Expansion Preliminary Design Report, prepared by our exclusive service provider Tetra Tech EBA Inc. (Tetra Tech EBA)

NELPCo is a limited partnership corporation owned by NND Development Corporation (NNDDC) and Tetra Tech EBA. The partnership aims to develop business and employment opportunities associated with providing Environmental and Engineering Services in the Traditional Territory of the Na-Cho Nyak Dun First Nation (NND). The NELPCo partnership serves to further working relationships between Tetra Tech EBA, NND, and companies operating in NND Traditional Territory.

Thank you for selecting NELPCo to assist with your project, we look forward to supporting you on future projects in NND Traditional Territory. If you have any questions or comments about the NELPCo partnership please contact the undersigned.

Respectfully,

Pat Titus
NELPCo Director
Direct Line: 867.336.4340
coo@nnddc.ca

NELPCo Limited Partnership
61 Wasson Place
Whitehorse, YT Y1A 0H7 CANADA
Tel 867.668.3068 Fax 867.668.4349

TETRA TECH EBA

June 2, 2015

ISSUED FOR USE
FILE: W14103548-01
Via Email: kwoloshyn@alexcoresource.com

Alexco Resource Corp.
3 – 151 Industrial Road
Whitehorse, YT Y1A 2V3

Attention: Kai Woloshyn, Environmental Manager

Subject: Dry Stacked Tailings Facility Phase II Expansion Preliminary Design – Revision I
Keno Hill District Mill Site, YT

1.0 INTRODUCTION

Alexco Resource Corp. (Alexco) retained Tetra Tech EBA Inc. (Tetra Tech EBA) to complete a geotechnical investigation and provide a preliminary design for expansion of the existing Dry Stacked Tailings Facility (DSTF) at the Keno Hill District Mill Site, YT.

This report presents some background information related to the DSTF, a summary of the subsurface conditions encountered during the DSTF Phase II Expansion preliminary geotechnical investigation, and the preliminary design for the DSTF Phase II Expansion. For additional conditions regarding the use of this report, please refer to Tetra Tech EBA's General Conditions in Appendix A.

2.0 BACKGROUND

Tetra Tech EBA conducted geotechnical investigations on the subject site in 2009 and 2010 to determine the subsurface soil and permafrost conditions for design of the DSTF. Tetra Tech EBA submitted the current DSTF detailed design in 2011 and has been monitoring construction and performance of the facility since then. Recommendations for the DSTF Phase II Expansion presented in this letter are based on subsurface soil conditions encountered during the DSTF Phase II Expansion preliminary geotechnical investigation and the following DSTF documentation:

- "DSTF Instrumentation and Construction Monitoring" (EBA Memos, June 2011 – November 2013)
- "Dry Stacked Tailings Facility – Risk Assessment Stability Model Update Letter" (EBA Letter, February 2013)
- "Dry Stacked Tailings Facility – Detailed Design" (EBA Report, May 2011)
- "Dry Stacked Tailings Facility – Operation, Maintenance, and Surveillance Manual" (EBA Report, September 2010)
- "Dry Stacked Tailings Facility – Runoff Diversion Specifications" (EBA Report, September 2010)
- "Dry Stacked Tailings Facility – Preliminary Engineering Design and Management Plan" (EBA Report, January 2010)

Tetra Tech EBA Inc.
61 Wasson Place
Whitehorse, YT Y1A 0H7 CANADA
Tel 867.668.3068 Fax 867.668.4349

3.0 GEOTECHNICAL INVESTIGATION

Tetra Tech EBA completed a preliminary geotechnical investigation for the DSTF Phase II Expansion consisting of twelve testpits excavated to varying depths within the proposed expansion footprint. The investigation was completed on September 11, 2013 using a Hitachi 270 excavator supplied by Alexco. Tetra Tech EBA's representative on site was Mr. Justin Pigage, P.Eng.

The approximate testpit locations are shown on Figure 1. Disturbed samples collected from the testpit walls and excavator bucket were collected and returned to Tetra Tech EBA's Whitehorse laboratory for index property testing. A summary of the test results is shown on the testpit logs in Appendix B. The UTM (NAD 83 datum) coordinates noted on the testpit logs were obtained using a handheld GPS unit accurate to within 5 m.

3.1 Surface Conditions

The proposed DSTF Phase II Expansion area lies immediately south of the existing facility and is bound by the Keno City Dump and access road to the north and east, the Duncan Creek Road to the south, and the Keno Hill District Mill to the west. The proposed footprint is shown on Figure 1. The ground surface within the proposed footprint generally slopes down from east to west at approximately 10 to 15%. Vegetation in the area consists of moss cover and small spruce trees and willow shrubs. The existing Bellekeno Haul Road alignment crosses the proposed footprint in an east-west direction.

3.2 Subsurface Conditions

The subsurface conditions within the proposed DSTF Phase II Expansion footprint observed during the preliminary geotechnical investigation consist of ice-rich frozen silt till or unfrozen silty sand and gravel. The ice-rich silt till was observed in testpits excavated throughout the proposed footprint except for the south western extent (TP40 – TP43) in which the unfrozen silty sand and gravel was encountered. The thickness of the ice-rich frozen silt till is unknown as excavation of this material was not practical with the supplied equipment. The unfrozen silty sand and gravel along the south western extent extends at least 4.5 m (maximum reach of equipment) below the existing ground surface. Detailed testpit logs are included in Appendix B.

3.3 Groundwater

No groundwater was encountered during the preliminary geotechnical investigation.

3.4 Permafrost

Permafrost was encountered in the silt till throughout most of the proposed DSTF Phase II Expansion area. The frozen silt till contains a combination of randomly oriented ice inclusions, and non-visible excess ice. Observations in the field indicate an overall ice content of approximately 5 to 25% by volume.

3.5 Bedrock

Bedrock was not encountered during the preliminary geotechnical investigation. Bedrock depth information was provided by Alexco indicating between 10 and 40 m of overburden within the proposed expansion footprint.

4.0 DSTF PHASE II EXPANSION PRELIMINARY DESIGN

The preliminary design for the DSTF Phase II Expansion is based on the design of the existing facility, laboratory and field data collected from site, and the performance of the current DSTF. Visual inspections and compaction test results confirm the DSTF is being constructed and operated as specified in the design. Slope indicator and ground temperature data indicate there is no lateral movement of the foundation soils and that they have remained frozen. The following sections summarize design assumptions specific to the DSTF Phase II Expansion, the geometry of the expansion, and the stability modelling completed.

Prior to detailed design and construction of the DSTF Phase II Expansion, a detailed geotechnical drill investigation will be required to confirm subsurface assumptions in this preliminary design.

4.1 Design Assumptions

4.1.1 Subsurface Conditions

The preliminary geotechnical investigation consisted of shallow testpits terminated due to refusal in frozen ice-rich silt, at an average depth of about 0.5 m below the existing ground surface. Moisture content testing on samples collected from the shallow testpits indicate properties similar to the frozen ice-rich silt till encountered during design of the existing DSTF.

Alexco provided 57 bedrock contact locations recorded during previous drilling activities around the proposed expansion footprint. Tetra Tech EBA used this bedrock contact information to create an approximate bedrock surface.

For the purpose of the DSTF Phase II Expansion preliminary design, Tetra Tech EBA has assumed the frozen ice-rich silt till encountered in the shallow testpits extends down to bedrock. This is considered a conservative assumption because the ice-content in the subsurface soils likely decreases with depth (as is the case under the existing DSTF).

4.1.2 Ice-Rich Frozen Silt Strength Properties

The DSTF design relies on a conservative approach for determining the shear strength of the frozen ice-rich silt of assuming an internal angle of friction equal to zero, and relying solely on the cohesive properties of the frozen soil.

The existing DSTF was designed using long term shear strength of 50 kPa derived from a published relationship between shear strength and ground temperature (Johnston 1981). This relationship was chosen because it is considered very conservative and limited ground temperature data for the DSTF was available at the time of design.

The DSTF Phase II Expansion is designed using a similar relationship (Weaver and Morgenstern 1981). This relationship was chosen because Tetra Tech EBA has been collecting site specific ground temperature data since 2009, furthering our understanding of the condition of the foundation soils.

The frozen ice-rich silt has been assigned a long term shear strength value of 70 kPa for the purpose of the preliminary design.

4.1.3 DSTF Phase II Expansion Foundation

The foundation for the existing DSTF consists of a gravel drainage blanket, geosynthetic clay liner (GCL), and geocomposite drain. Waste rock sourced during the development of Flame and Moth can be used for gravel drainage blanket, provided it conforms to the particle size distribution specifications. It was assumed that 10% of

the porewater in the DSTF would drain from the facility after tailings placement. The GCL and geocomposite drain were included to provide containment and a pathway for this assumed excess porewater to safely drain from the toe of the facility. However, no seepage water has been observed in the geocomposite drain of the existing DSTF facility. In August 2012, a piezometer was installed in the completed lower bench of the DSTF to determine if any free water exists within the tailings. No water from tailings porewater has been observed in the piezometer.

Based on the above observations, the DSTF Phase II Expansion Preliminary Design was originally completed without the inclusion of the GCL and geocomposite drain. The GCL and geocomposite drain have been included in this Revision I report in response to the Yukon Water Board's request (dated January 15, 2015) to provide an updated preliminary design document, which includes the GCL and geocomposite drain.

The DSTF foundation stability analysis relies on modelling the synthetic foundation components as a frictional material. Based on review of relevant literature, an internal angle of friction of 16^{o} and a unit weight of 24.0 kN/m^{3} was used in the original DSTF design. These values are considered very conservative, the reported internal friction angle in the literature reviewed ranged from 16^{o} to 25^{o} for similar synthetic materials. For the DSTF Phase II Expansion Preliminary Design the unit weight of 24.0 kN/m^{3} was maintained but the internal angle of friction was increased to 18^{o}. Shear box testing of the site specific synthetic foundation components and tailings will be undertaken as part of detailed design to confirm the internal friction angle.

4.2 DSTF Phase II Expansion Geometry

The location and geometry of the DSTF Phase II Expansion are shown on Figure 1. The two sections used to conduct the slope stability assessment are shown on Figure 2. Slopes and bench elevations were carried over from the existing DSTF where possible. The approximate total storage within the expansion is 295,000 m^{3} (including a 22,000 m^{3} toe structure).

The toe structure is required to obtain the recommended factor of safety against deep rotational failures through the ice-rich silt foundation soils. It provides mass to counter the driving weight of the tailings placed further upslope. The toe structure can be constructed of waste rock or compacted tailings, both materials were analysed in the stability assessment. The toe structure must be fully constructed before placing tailings above the 936 m bench.

4.3 DSTF Phase II Expansion Stability Assessment

The stability of the DSTF Phase II Expansion was determined using Geostudio 2007 – Slope/W module, which is software that uses limit equilibrium theory to compute the factor of safety of slopes. The slopes were analyzed in several different conditions, including short term (during construction) and long term (after closure) in both static and pseudo-static scenarios.

Minimum factors of safety are suggested by the BC Mine Waste Rock Pile Research Committee (Piteau 1991). The results of the stability assessment for two sections in the DSTF Phase II Expansion were compared with the recommended minimums. A summary of the stability results is presented in the following sections.

4.3.1 Fully Frozen Case

This scenario is intended to model the condition where the tailings have been placed and the underlying soils have remained frozen (the current state of the DSTF). A summary of the computed factors of safety and the recommended minimums for this scenario are presented below in Table 1. Detailed slope stability results are presented in Appendix C.

Table 1: DSTF Phase II Expansion Slope Stability Results– Fully Frozen Case

Stability Conditions	Suggested Minimum Factor of Safety (Piteau 1991)	Calculated Factor of Safety Phase II Expansion	
		Section A-A'	Section B-B'
Stability of Surface			
Short-term (during construction – static)	1.0	1.4	2.6
Long-term (after construction – static)	1.1	1.1	1.7
Deep Seated Stability			
Short-term (during construction – static)	1.3	1.9	2.4
Short-term (during construction – pseudo-static)	1.0	1.3	1.6
Long-term (after closure – static)	1.3	1.3	2.5
Long-term (after closure – pseudo-static)	1.0	1.3	1.7

4.3.2 Fully Thawed Case

This scenario is intended to model the anticipated long-term condition where the tailings are placed and the underlying soils have fully thawed and consolidated. A summary of the factors of safety and the recommended minimums for this scenario are presented in Table 2 on the following page. Detailed slope stability results are presented in Appendix D.

Table 2: DSTF Phase II Expansion Slope Stability Results– Fully Thawed Case

Stability Conditions	Suggested Minimum Factor of Safety (Piteau 1991)	Calculated Factor of Safety Phase II Expansion	
		Section A-A'	Section B-B'
Stability of Surface			
Short-term (during construction – static)	1.0	N/A[1]	
Long-term (after construction – static)	1.1	1.3	1.7
Deep Seated Stability			
Short-term (during construction – static)	1.3	N/A[1]	
Short-term (during construction – pseudo-static)	1.0	N/A[1]	
Long-term (after closure – static)	1.3	2.0	2.6
Long-term (after closure – pseudo-static)	1.0	1.4	1.7

[1]Foundation will not be fully thawed during construction of the facility.

4.3.3 Stability of the DSTF Foundation

This scenario is intended to model the anticipated short and long-term conditions where the tailings are placed over the GCL and geocomposite drain. Failures in both static and pseudo-static conditions are then forced through the material layer representing the synthetic foundation components. A summary of the factors of safety and the recommended minimums for this scenario are presented below in Table 3. Detailed slope stability results are presented in Appendix E.

Table 3: DSTF Phase II Expansion Slope Stability Results– Foundation Materials

Stability Conditions	Suggested Minimum Factor of Safety (Piteau 1991)	Calculated Factor of Safety Phase II Expansion	
		Section A-A'	Section B-B'
Deep Seated Stability			
Short-term (during construction – static)	1.3	1.6	1.7
Short-term (during construction – pseudo-static)	1.0	1.0	1.1
Long-term (after closure – static)	1.3	1.6	1.8
Long-term (after closure – pseudo-static)	1.0	1.0	1.1

4.4 Surface Water Management

The surface water structures currently in place around the DSTF can be extended to provide surface water management for the DSTF Phase II Expansion. The following sections provide a preliminary design for the uphill runoff diversion berm, toe runoff collection ditch and sump, and the conveyance pipe.

4.4.1 Uphill Runoff Diversion Berm

The uphill runoff diversion berm is intended to redirect surface water away from the DSTF. The berm should be constructed in accordance with the *Runoff Diversion Structures Specs DSTF, Keno Hill District Mill, YT* (Section 1005) report issued September 2010. Construction should be completed to the dimensions and alignments shown on Figure 3.

4.4.2 Toe Runoff Collection Ditch

The toe runoff collection ditch should be constructed in accordance with the *Runoff Diversion Structures Specifications DSTF, Keno Hill District Mill, YT* (Section 1008) report issued September 2010. Construction should be completed to the dimensions and alignments indicated on Figure 3. The size of the ditch was determined from the maximum estimated 200-year flood discharges for Bellekeno Mine Project Area provided by Clearwater Consultants Ltd. (August 20, 2009).

4.4.3 Collection Sump and Conveyance Pipe

A conveyance pipe, shown in Figure 1, is required to direct water from the DSTF Phase II Expansion toe runoff collection sump to the existing surface water collection pond. The collection sump should be constructed according to the dimensions on Figure 3. The conveyance pipe was sized to match the existing 150 mm PVC pipe used for the runoff from the existing DSTF.

5.0 ADDITIONAL RECOMMENDATIONS

The DSTF Phase II Expansion preliminary design presents a physically stable geometry for the purposes of permitting. There are several components associated with a more detailed design that have not been included in the DSTF Phase II Expansion preliminary design. The following subjects should be addressed during the detailed design of the DSTF Phase II Expansion:

- **Synthetic Foundation Materials Strength Testing** - The DSTF foundation stability analysis relies on modelling the synthetic foundation components as a frictional material. Shear box testing of the site specific synthetic foundation components and tailings is required as part of detailed design to confirm the internal friction angle assumed in this preliminary design.

- **Construction schedule** – Construction of the DSTF Phase II Expansion will likely occur over several years. Recommendations with respect to timelines for clearing and placing foundation materials and tailings should be considered as part of the detailed design. A construction plan should be developed to limit the potential for permafrost degradation in the sensitive foundation soils beneath the expansion.

- **Closure** – A 0.5 m loose gravel cover material was assumed in the long-term stability assessment of the DSTF Phase II Expansion; cover performance is currently being evaluated on the existing DSTF and the overall cover thickness may change as a result of this testing. A detailed closure plan and schedule was not included in this preliminary design and should be addressed in the detailed design.

- **Future underground workings** – Alexco intends to develop underground workings beneath the proposed expansion footprint. Tetra Tech EBA understands the DSTF Phase II Expansion was considered and included in the preliminary mine design. If the overall footprint of the DSTF Phase II Expansion changes significantly during detailed design, the mine design should be updated accordingly.

This DSTF Phase II Expansion preliminary design was completed based on subsurface information gathered from several shallow testpits within the proposed footprint, and depth to bedrock information provided by Alexco. Prior to detailed design and construction of the DSTF Phase II Expansion, a geotechnical drill investigation to confirm the assumptions in this preliminary design is necessary.

Tetra Tech EBA recommends the drill investigation consist of at least a dozen holes advanced to bedrock within the footprint of the proposed expansion. The boreholes should be advanced with a drill capable of recovering undisturbed frozen overburden samples for the purpose of laboratory based strength testing. Instrumentation consisting of several slope indicator and ground temperature cable installations to monitor performance of the proposed expansion should be completed during the investigation. Tetra Tech EBA would be pleased to provide a proposal to complete the investigation, if requested.

6.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Alexco Resource Corp. and their agents. Tetra Tech EBA Inc. 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 Alexco Resource Corp., or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech EBA's Services Agreement. Tetra Tech EBA's General Conditions are provided in Appendix A of this report.

7.0 CLOSURE

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

Respectfully submitted,
Tetra Tech EBA Inc.

Justin Pigage, P.Eng.
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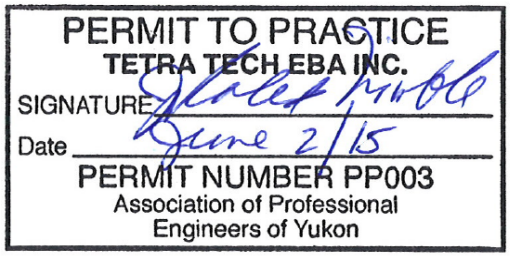
J. Richard Trimble, P.Eng., FEC
Principal Consultant, Arctic Region
Direct Line: 867.668.9216
Richard.Trimble@tetratech.com

Attachments: Figures (3)

Appendix A	Tetra Tech EBA's General Conditions
Appendix B	Testpit Logs
Appendix C	Slope Stability Results – Fully Frozen
Appendix D	Slope Stability Results – Fully Thawed
Appendix E	Slope Stability Results – Foundation Materials



REVISION I SUMMARY:

Added synthetic foundation components to stability analysis
Added preliminary design of surface water management structures

REFERENCES

Johnston G.H., 1981. *Permafrost Engineering Design and Construction.* Hunter Rose Company Ltd., Toronto, Ontario, Canada.

McCreath P.S., 2009. "Bellekeno Mine Project – Freshet Runoff Assessment." Clearwater Consultants Ltd., August 20, 2009.

Piteau Associates Engineering Ltd. 1991. "Investigation and Design of Mine Dumps – Interim Guidelines." Prepared for British Columbia Mine Waste Rock Pile Research Committee, May 1991.

Weaver J.S. and Morgenstern N.R., 1981. "Pile Design in Permafrost." Canadian Geotechnical Journal Vol 18 (1981): 357-370.

FIGURES

KENO CITY DUMP AREA

UPHILL RUN-OFF DIVERSION BERM

TOE RUN-OFF COLLECTION DITCH

TOE RUN-OFF COLLECTION SUMP

EXISTING DSTF ULTIMATE DESIGN FOOTPRINT

CONVEYANCE PIPE

MILL BUILDING

TOE RUN-OFF COLLECTION DITCH

UPHILL RUN-OFF DIVERSION BERM

TP36

SURFACE WATER COLLECTION POND

CONVEYOR

A

TP37

A

PHASE II EXPANSION ULTIMATE DESIGN FOOTPRINT STORAGE VOLUME: 295,000 m³

2H:1V

3H:1V

3H:1V

B

ELEV = 940 m

ORE BIN

TP35

TP38

CONVEYANCE PIPE

TOE RUN-OFF COLLECTION SUMP

3H:1V

TOE STRUCTURE

ELEV = 920 m

ELEV = 936 m

TP43

TP33

CRUSHER

COARSE ORE STOCKPILE CEMENT PADS

TP32

TP39

TP41

TP34

TP40

TP42

B

TOE RUN-OFF COLLECTION DITCH

DUNCAN CREEK ROAD

EXISTING BELLEKENO HAUL ROAD

RE-ROUTED BELKENO HAUL ROAD

LEGEND:

- TESTPIT LOCATION (PHASE II EXPANSION)

- DSTF PHASE II EXPANSION FOOTPRINT

0 100

Scale: 1 : 1750 (metres)

CLIENT

ALEXCO

DRY-STACKED TAILINGS FACILITY EXPANSION - PHASE II
KENO HILL DISTRICT MILL SITE, YUKON

SITE PLAN SHOWING PROPOSED EXPANSION FOOTPRINT

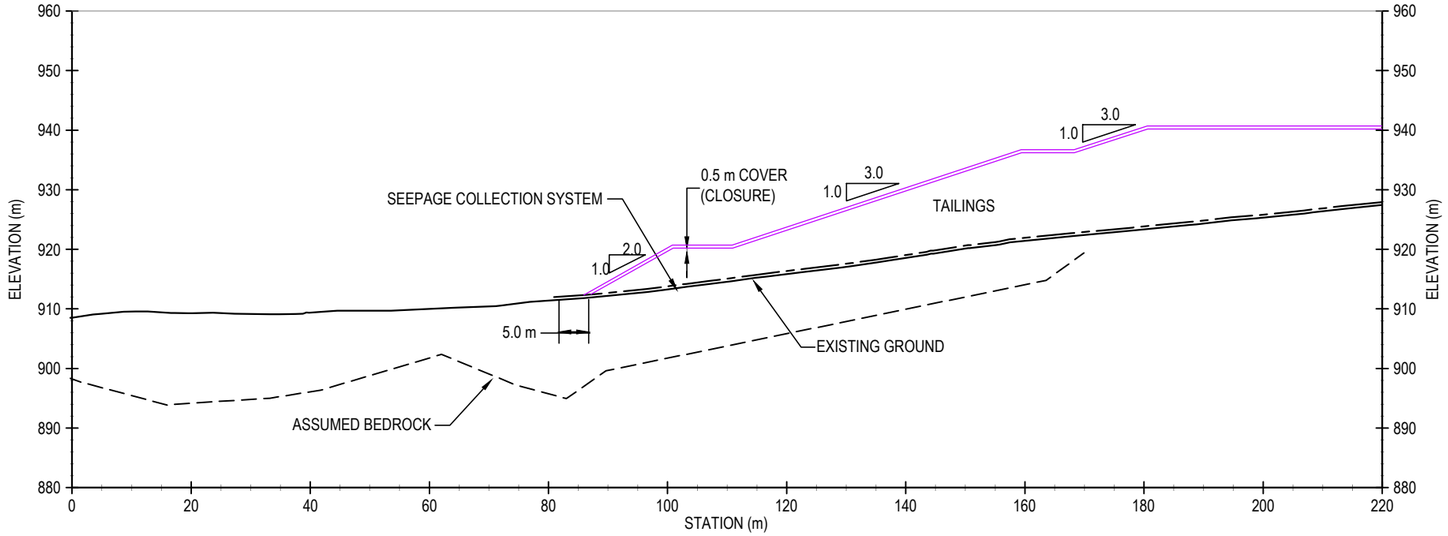
TETRA TECH EBA

PROJECT NO.	DWN	CKD	REV
W14103548-01	CB	JTP	1

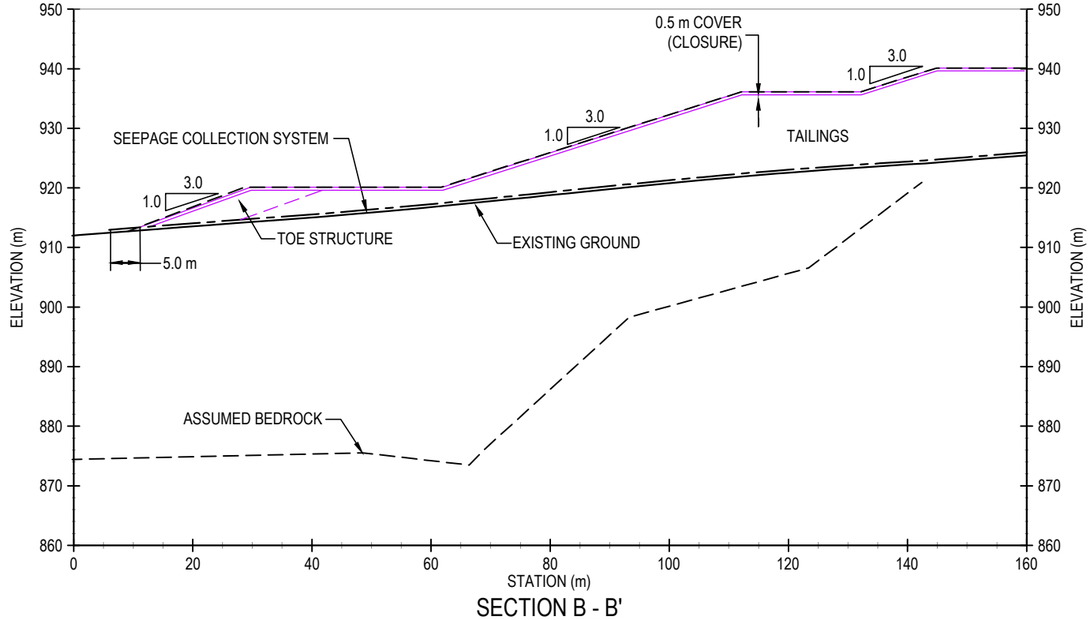
OFFICE	DATE
EBA-WHSE	May 15, 2015

Figure 1

Q:\Whitehorse\Data\0201drawings\Keno\W14103548-01 DSTF Phase II Liner Stability\W14103548-01 Figs 1-3 R0.dwg [FIGURE 1] May 20, 2015 - 3:25:16 pm (BY: BUCHAN, CAMERON)



SECTION A - A'



SECTION B - B'

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Q:\Whitehorse\Data\02\01drawings\Keno\W14103548-01 DSTF Phase II Liner Stability\W14103548-01 Figs 1-3 R0.dwg [FIGURE 2] May 20, 2015 - 3:12:41 pm (BY: BUCHAN, CAMERON)

CLIENT

ALEXCO

TETRA TECH EBA

DRY-STACKED TAILINGS FACILITY EXPANSION - PHASE II
KENO HILL DISTRICT MILL SITE, YUKON

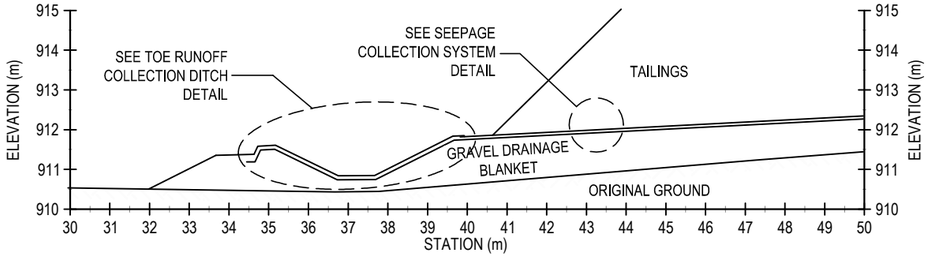
DSTF SECTIONS

PROJECT NO.	DWN	CKD	REV
W14103548-01	CB	JTP	1

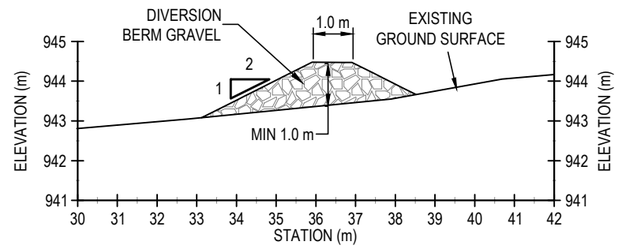
OFFICE: EBA-WHSE

DATE: May 15, 2015

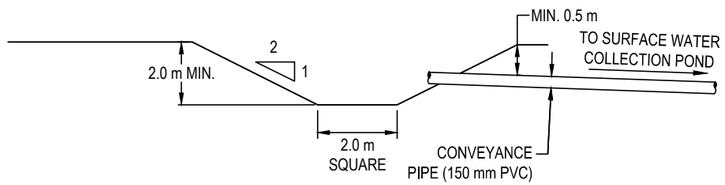
Figure 2



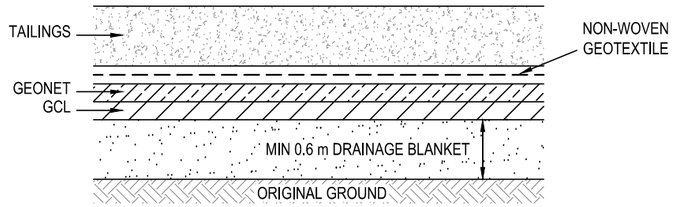
TOE RUNOFF COLLECTION DITCH - TYPICAL SECTION



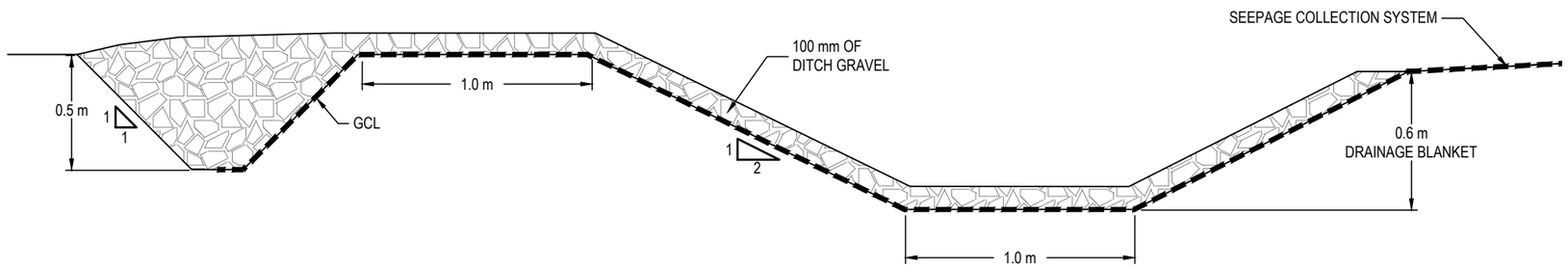
UPHILL DIVERSION BERM DETAIL



COLLECTION SUMP & CONVEYANCE PIPE



SEEPAGE COLLECTION SYSTEM DETAIL



TOE RUNOFF COLLECTION DITCH DETAIL

0 100
Scale: 1 : 1750 (metres)

CLIENT: ALEXCO	DRY-STACKED TAILINGS FACILITY EXPANSION - PHASE II KENO HILL DISTRICT MILL SITE, YUKON				
	SURFACE WATER MANAGEMENT STRUCTURES				
TETRA TECH EBA	PROJECT NO. W14103303-01	DWN CB	CKD JTP	REV 1	Figure 3
	OFFICE EBA-WHSE	DATE May 15, 2015			

APPENDIX A
TETRA TECH EBA'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOTECHNICAL REPORT

This report incorporates and is subject to these “General Conditions”.

1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of Tetra Tech EBA’s Client. Tetra Tech EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than Tetra Tech EBA’s Client unless otherwise authorized in writing by Tetra Tech EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of Tetra Tech EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where Tetra Tech EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed Tetra Tech EBA’s instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by Tetra Tech EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of Tetra Tech EBA’s instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Tetra Tech EBA. Tetra Tech EBA’s instruments of professional service will be used only and exactly as submitted by Tetra Tech EBA.

Electronic files submitted by Tetra Tech EBA have been prepared and submitted using specific software and hardware systems. Tetra Tech EBA makes no representation about the compatibility of these files with the Client’s current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, Tetra Tech EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. Tetra Tech EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. Tetra Tech EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

7.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

8.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

9.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

10.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

11.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

12.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

13.0 SAMPLES

Tetra Tech EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

14.0 INFORMATION PROVIDED TO TETRA TECH EBA BY OTHERS

During the performance of the work and the preparation of the report, Tetra Tech EBA may rely on information provided by persons other than the Client. While Tetra Tech EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, Tetra Tech EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

APPENDIX B
TESTPIT LOGS

Dry Stack Tailings Facility Phase II Expansion	CLIENT: Alexco Keno Hill Mining Corp	TESTPIT NO: W14103303-TP32
Keno Hill District Mill Site	EXCAVATOR: Hitachi 270 Excavator	PROJECT NO: W14103303-01
Keno City, YT	7086670N; 483945E; Zone 8	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	GROUND ICE DESCRIPTION AND COMMENTS	SPT (N) 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	CLAY (%) 20 40 60 80 / SILT (%) 20 40 60 80 / SAND (%) 20 40 60 80 / GRAVEL (%) 20 40 60 80	Depth (ft)
0	PEAT - woody, roots, organics		FROZEN, Nbe			0
	END OF TESTPIT @ 0.3 m (refusal in permafrost)					
1						5
2						
3						10
4						
5						16

eba A TETRA TECH COMPANY	LOGGED BY: JTP	COMPLETION DEPTH: 0.3m
	REVIEWED BY: CPC	COMPLETE: 9/11/2013
	DRAWING NO:	Page 1 of 1

Dry Stack Tailings Facility Phase II Expansion	CLIENT: Alexco Keno Hill Mining Corp	TESTPIT NO: W14103303-TP33
Keno Hill District Mill Site	EXCAVATOR: Hitachi 270 Excavator	PROJECT NO: W14103303-01
Keno City, YT	7086688N; 783971E; Zone 8	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	GROUND ICE DESCRIPTION AND COMMENTS	SPT (N) 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	CLAY (%) 20 40 60 80 / SILT (%) 20 40 60 80 / SAND (%) 20 40 60 80 / GRAVEL (%) 20 40 60 80	Depth (ft)
0	PEAT - woody, roots, organics		FROZEN, Nbe			0
	END OF TESTPIT @ 0.4 m (refusal in permafrost)					
1						5
2						
3						10
4						
5						16

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LOGGED BY: JTP	COMPLETION DEPTH: 0.4m
REVIEWED BY: CPC	COMPLETE: 9/11/2013
DRAWING NO:	Page 1 of 1

Dry Stack Tailings Facility Phase II Expansion	CLIENT: Alexco Keno Hill Mining Corp	TESTPIT NO: W14103303-TP34
Keno Hill District Mill Site	EXCAVATOR: Hitachi 270 Excavator	PROJECT NO: W14103303-01
Keno City, YT	7086656N; 484041E; Zone 8	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION AND COMMENTS	SPT (N) 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	CLAY (%) 20 40 60 80 / SILT (%) 20 40 60 80 / SAND (%) 20 40 60 80 / GRAVEL (%) 20 40 60 80	Depth (ft)
0	PEAT - woody, roots, organics			FROZEN, Nbe			0
	SILT - some gravel, some sand, non-plastic, olive grey, cobbles throughout			FROZEN, Vr, Vc, 5%			
1			SA01		●		5
	END OF TESTPIT @ 1.0 m (refusal in permafrost)						
2							
3							10
4							
							15
5							16

eba A TETRA TECH COMPANY	LOGGED BY: JTP	COMPLETION DEPTH: 1m
	REVIEWED BY: CPC	COMPLETE: 9/11/2013
	DRAWING NO:	Page 1 of 1

Dry Stack Tailings Facility Phase II Expansion	CLIENT: Alexco Keno Hill Mining Corp	TESTPIT NO: W14103303-TP35
Keno Hill District Mill Site	EXCAVATOR: Hitachi 270 Excavator	PROJECT NO: W14103303-01
Keno City, YT	7086717N; 484118E; Zone 8	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION AND COMMENTS	SPT (N) 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	CLAY (%) 20 40 60 80 / SILT (%) 20 40 60 80 / SAND (%) 20 40 60 80 / GRAVEL (%) 20 40 60 80	Depth (ft)
0	PEAT - woody, roots, organics			FROZEN, Nbe			0
	SILT - some gravel, some sand, non-plastic, olive grey, cobbles throughout			FROZEN, Vr, Vc, 25%			
			SA02		●		
	END OF TESTPIT @ 0.6 m (refusal in permafrost)						
1							5
2							
3							10
4							
							15
5							16

eba A TETRA TECH COMPANY	LOGGED BY: JTP	COMPLETION DEPTH: 0.6m
	REVIEWED BY: CPC	COMPLETE: 9/11/2013
	DRAWING NO:	Page 1 of 1

Dry Stack Tailings Facility Phase II Expansion	CLIENT: Alexco Keno Hill Mining Corp	TESTPIT NO: W14103303-TP36
Keno Hill District Mill Site	EXCAVATOR: Hitachi 270 Excavator	PROJECT NO: W14103303-01
Keno City, YT	7086820N; 484131E; Zone 8	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	GROUND ICE DESCRIPTION AND COMMENTS	SPT (N) 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	CLAY (%) 20 40 60 80 / SILT (%) 20 40 60 80 / SAND (%) 20 40 60 80 / GRAVEL (%) 20 40 60 80	Depth (ft)
0	PEAT - woody, roots, organics		FROZEN, Nbe			0
	SILT - some gravel, some sand, non-plastic, olive grey, cobbles throughout		FROZEN, Vr, Vc, 25%			
	END OF TESTPIT @ 0.5 m (refusal in permafrost)					
1						5
2						
3						10
4						
						15
5						16

eba A TETRA TECH COMPANY

LOGGED BY: JTP	COMPLETION DEPTH: 0.5m
REVIEWED BY: CPC	COMPLETE: 9/11/2013
DRAWING NO:	Page 1 of 1

Dry Stack Tailings Facility Phase II Expansion	CLIENT: Alexco Keno Hill Mining Corp	TESTPIT NO: W14103303-TP37
Keno Hill District Mill Site	EXCAVATOR: Hitachi 270 Excavator	PROJECT NO: W14103303-01
Keno City, YT	7086772N; 484206E; Zone 8	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	GROUND ICE DESCRIPTION AND COMMENTS	SPT (N) 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	CLAY (%) 20 40 60 80 / SILT (%) 20 40 60 80 / SAND (%) 20 40 60 80 / GRAVEL (%) 20 40 60 80	Depth (ft)
0	PEAT - woody, roots, organics		FROZEN, Nbe			0
	SILT - some gravel, some sand, non-plastic, olive grey, cobbles throughout		FROZEN, Vr, Vc, 25%			
	END OF TESTPIT @ 0.5 m (refusal in permafrost)					
1						5
2						
3						10
4						
						15
5						16

eba A TETRA TECH COMPANY	LOGGED BY: JTP	COMPLETION DEPTH: 0.5m
	REVIEWED BY: CPC	COMPLETE: 9/11/2013
	DRAWING NO:	Page 1 of 1

Dry Stack Tailings Facility Phase II Expansion	CLIENT: Alexco Keno Hill Mining Corp	TESTPIT NO: W14103303-TP38
Keno Hill District Mill Site	EXCAVATOR: Hitachi 270 Excavator	PROJECT NO: W14103303-01
Keno City, YT	7086712N; 484238E; Zone 8	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION AND COMMENTS	SPT (N) 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	CLAY (%) 20 40 60 80 / SILT (%) 20 40 60 80 / SAND (%) 20 40 60 80 / GRAVEL (%) 20 40 60 80	Depth (ft)
0	PEAT - woody, roots, organics			FROZEN, Nbe			0
	SILT - some gravel, trace sand, non-plastic, olive grey, cobbles and boulders throughout		SA03	FROZEN, Vr, Vc, 10%	●		
	END OF TESTPIT @ 0.4 m (refusal in permafrost)						
1							5
2							
3							10
4							
							15
5							16

eba A TETRA TECH COMPANY

LOGGED BY: JTP	COMPLETION DEPTH: 0.4m
REVIEWED BY: CPC	COMPLETE: 9/11/2013
DRAWING NO:	Page 1 of 1

Dry Stack Tailings Facility Phase II Expansion	CLIENT: Alexco Keno Hill Mining Corp	TESTPIT NO: W14103303-TP39
Keno Hill District Mill Site	EXCAVATOR: Hitachi 270 Excavator	PROJECT NO: W14103303-01
Keno City, YT	7086668N; 484114E; Zone 8	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION AND COMMENTS	SPT (N) 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	CLAY (%) 20 40 60 80 / SILT (%) 20 40 60 80 / SAND (%) 20 40 60 80 / GRAVEL (%) 20 40 60 80	Depth (ft)
0	PEAT - woody, roots, organics			FROZEN, Nbe			0
	SILT - some gravel, trace sand, non-plastic, olive grey, cobbles throughout			FROZEN, Vr, Vc, 10%			
			SA04		●		
	END OF TESTPIT @ 0.6 m (refusal in permafrost)						
1							5
2							
3							10
4							
							15
5							16

LOGGED BY: JTP	COMPLETION DEPTH: 0.6m
REVIEWED BY: CPC	COMPLETE: 9/11/2013
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Dry Stack Tailings Facility Phase II Expansion	CLIENT: Alexco Keno Hill Mining Corp	TESTPIT NO: W14103303-TP40
Keno Hill District Mill Site	EXCAVATOR: Hitachi 270 Excavator	PROJECT NO: W14103303-01
Keno City, YT	7086655N; 484135E; Zone 8	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION AND COMMENTS	SPT (N) 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	CLAY (%) 20 40 60 80 / SILT (%) 20 40 60 80 / SAND (%) 20 40 60 80 / GRAVEL (%) 20 40 60 80	Depth (ft)
0	ORGANIC COVER						0
	SILT - some gravel, trace sand, firm (est.), damp, non-plastic, olive grey, cobbles throughout						
1			SA05		●		
	SAND and GRAVEL - trace silt, well graded, medium grained, sub-rounded, loose (est.), damp, brown, cobbles throughout						5
2			SA06		●		
3							10
4							
	END OF TESTPIT @ 4.5 m (machine extent)						15
5							16

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LOGGED BY: JTP	COMPLETION DEPTH: 4.5m
REVIEWED BY: CPC	COMPLETE: 9/11/2013
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Dry Stack Tailings Facility Phase II Expansion	CLIENT: Alexco Keno Hill Mining Corp	TESTPIT NO: W14103303-TP41
Keno Hill District Mill Site	EXCAVATOR: Hitachi 270 Excavator	PROJECT NO: W14103303-01
Keno City, YT	7086670N; 484145E; Zone 8	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION AND COMMENTS	SPT (N) 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	CLAY (%) 20 40 60 80 / SILT (%) 20 40 60 80 / SAND (%) 20 40 60 80 / GRAVEL (%) 20 40 60 80	Depth (ft)
0	ORGANIC COVER						0
	SILT - some gravel, trace sand, firm (est.), damp, non-plastic, olive grey, cobbles throughout						
1							
							5
2		DISTURBED	SA07		●		
	SAND and GRAVEL - trace silt, well graded, medium grained, sub-rounded, loose (est.), damp, brown, cobbles throughout						
3							10
4		DISTURBED	SA08		●		
	END OF TESTPIT @ 4.5 m (machine extent)						15
5							16

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	REVIEWED BY: CPC	COMPLETE: 9/11/2013
	DRAWING NO:	Page 1 of 1

Dry Stack Tailings Facility Phase II Expansion	CLIENT: Alexco Keno Hill Mining Corp	TESTPIT NO: W14103303-TP42
Keno Hill District Mill Site	EXCAVATOR: Hitachi 270 Excavator	PROJECT NO: W14103303-01
Keno City, YT	7086655N; 484180E; Zone 8	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	GROUND ICE DESCRIPTION AND COMMENTS	SPT (N) 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	CLAY (%) 20 40 60 80 / SILT (%) 20 40 60 80 / SAND (%) 20 40 60 80 / GRAVEL (%) 20 40 60 80	Depth (ft)
0	ORGANIC COVER					0
	SILT - sandy, some gravel, firm (est.), damp, non-plastic, olive grey, cobbles throughout					
1						
	- becomes some sand, some gravel, cobbles and boulders throughout					5
2						
3	END OF TESTPIT @ 3.0 m (desired depth)					10
4						
						15
5						16

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	REVIEWED BY: CPC	COMPLETE: 9/11/2013
	DRAWING NO:	Page 1 of 1

Dry Stack Tailings Facility Phase II Expansion	CLIENT: Alexco Keno Hill Mining Corp	TESTPIT NO: W14103303-TP43
Keno Hill District Mill Site	EXCAVATOR: Hitachi 270 Excavator	PROJECT NO: W14103303-01
Keno City, YT	7086695N; 484241E; Zone 8	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION AND COMMENTS	SPT (N) 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	CLAY (%) 20 40 60 80 / SILT (%) 20 40 60 80 / SAND (%) 20 40 60 80 / GRAVEL (%) 20 40 60 80	Depth (ft)
0	ORGANIC COVER						0
	SAND and GRAVEL - silty, well graded, medium grained, sub-rounded, compact (est.), damp, brown, cobbles throughout						
1							5
2			SA09		●		
3	END OF TESTPIT @ 3.0 m (desired depth)						10
4							15
5							16

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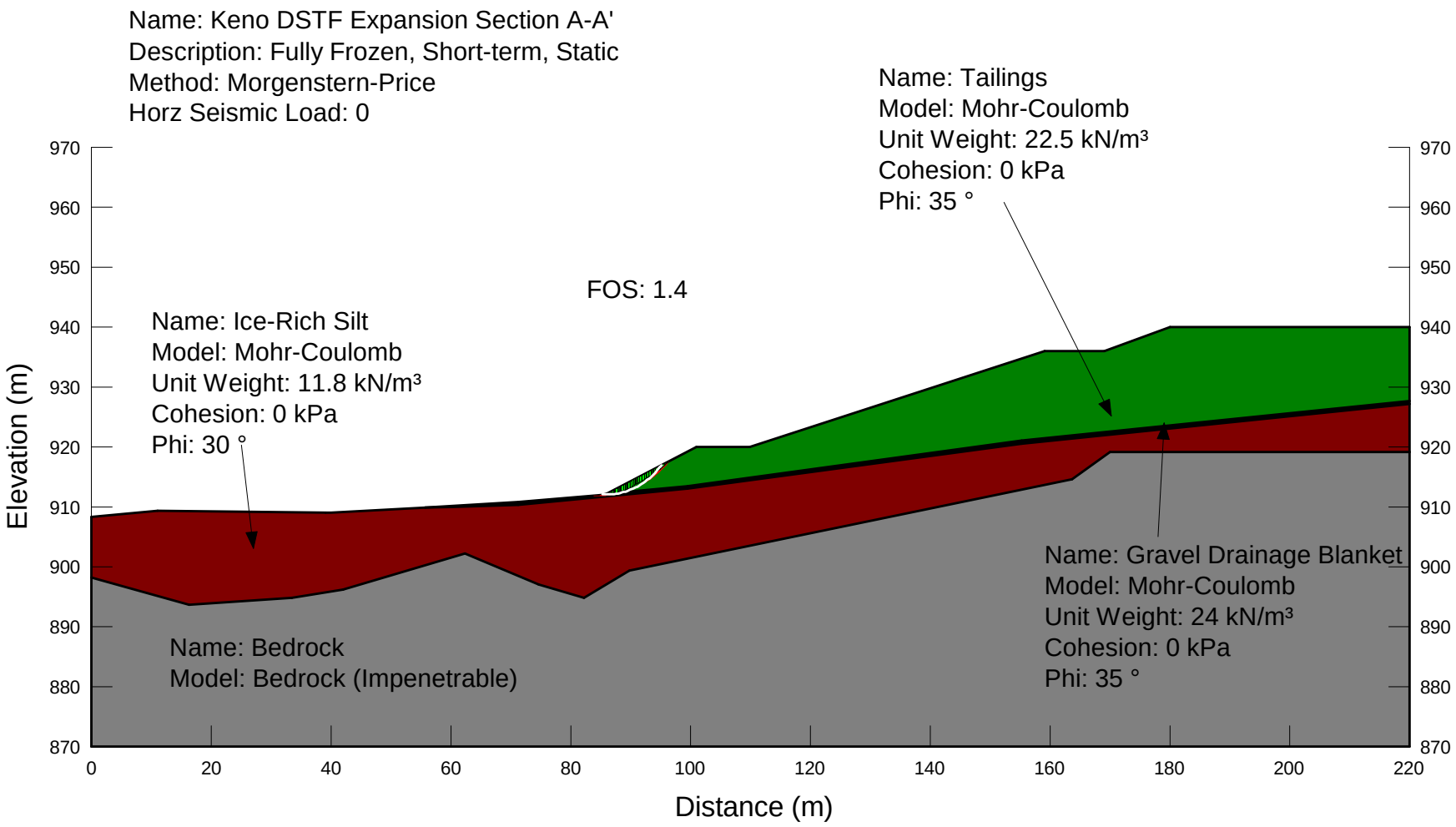
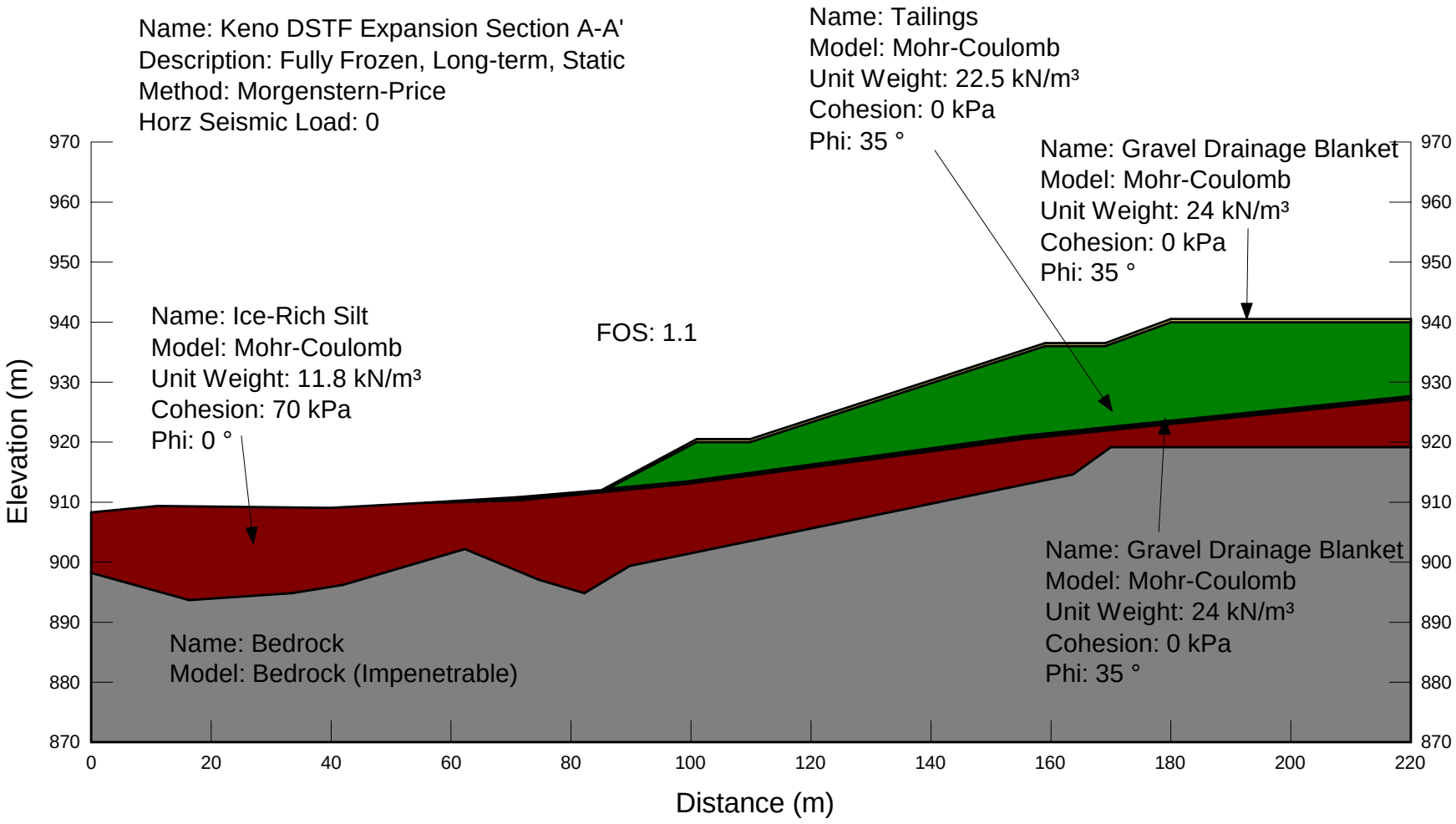
LOGGED BY: JTP	COMPLETION DEPTH: 3m
REVIEWED BY: CPC	COMPLETE: 9/11/2013
DRAWING NO:	Page 1 of 1

APPENDIX C

SLOPE STABILITY RESULTS – FULLY FROZEN


Name: Keno DSTF Expansion Section A-A'
Description: Fully Frozen, Short-term, Static
Method: Morgenstern-Price
Horz Seismic Load: 0
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
FOS: 1.4
Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
Distance (m)
970
960
950
940
930
920
910
900
890
880
870
0
20
40
60
80
100
120
140
160
180
200
220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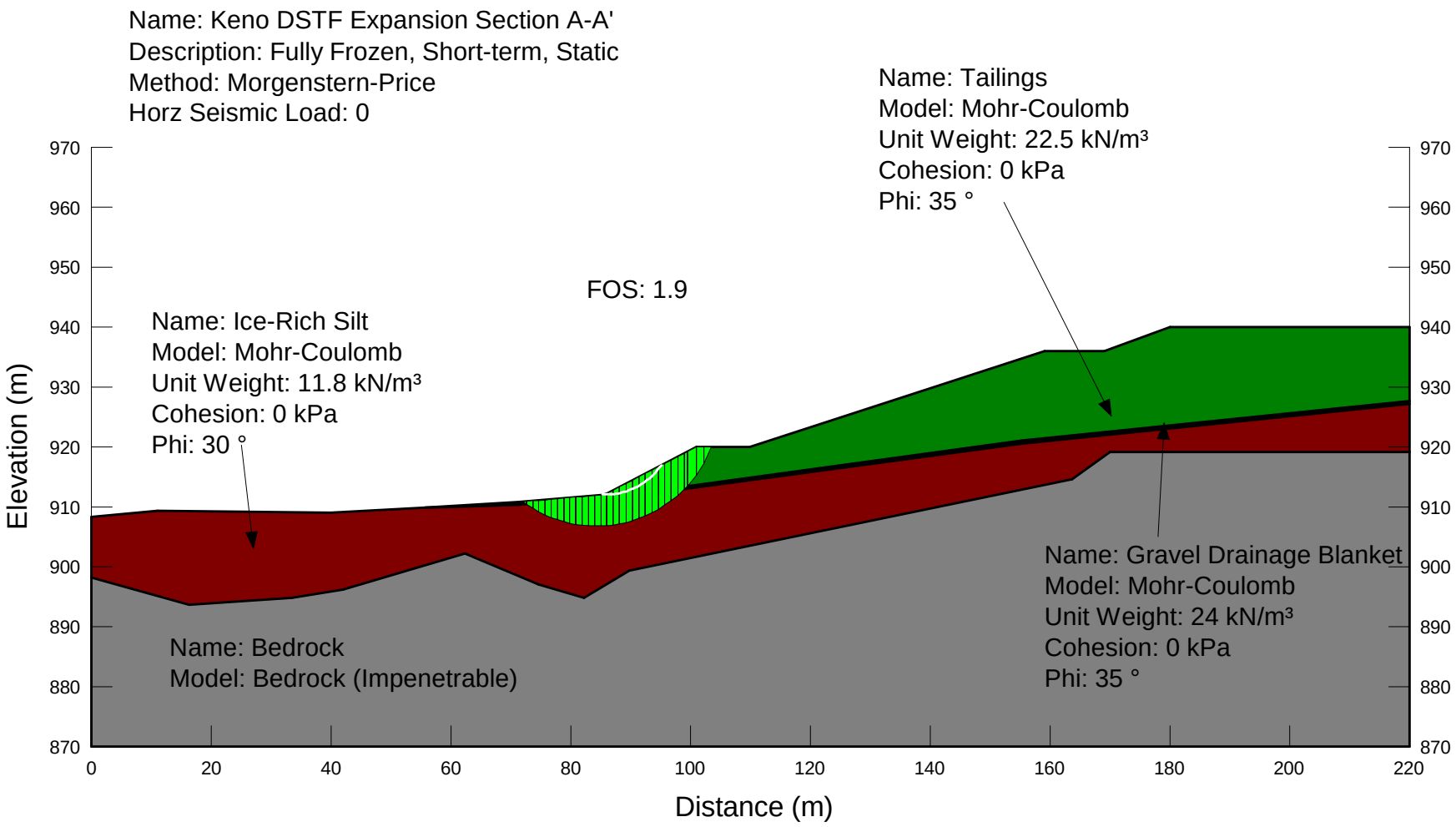
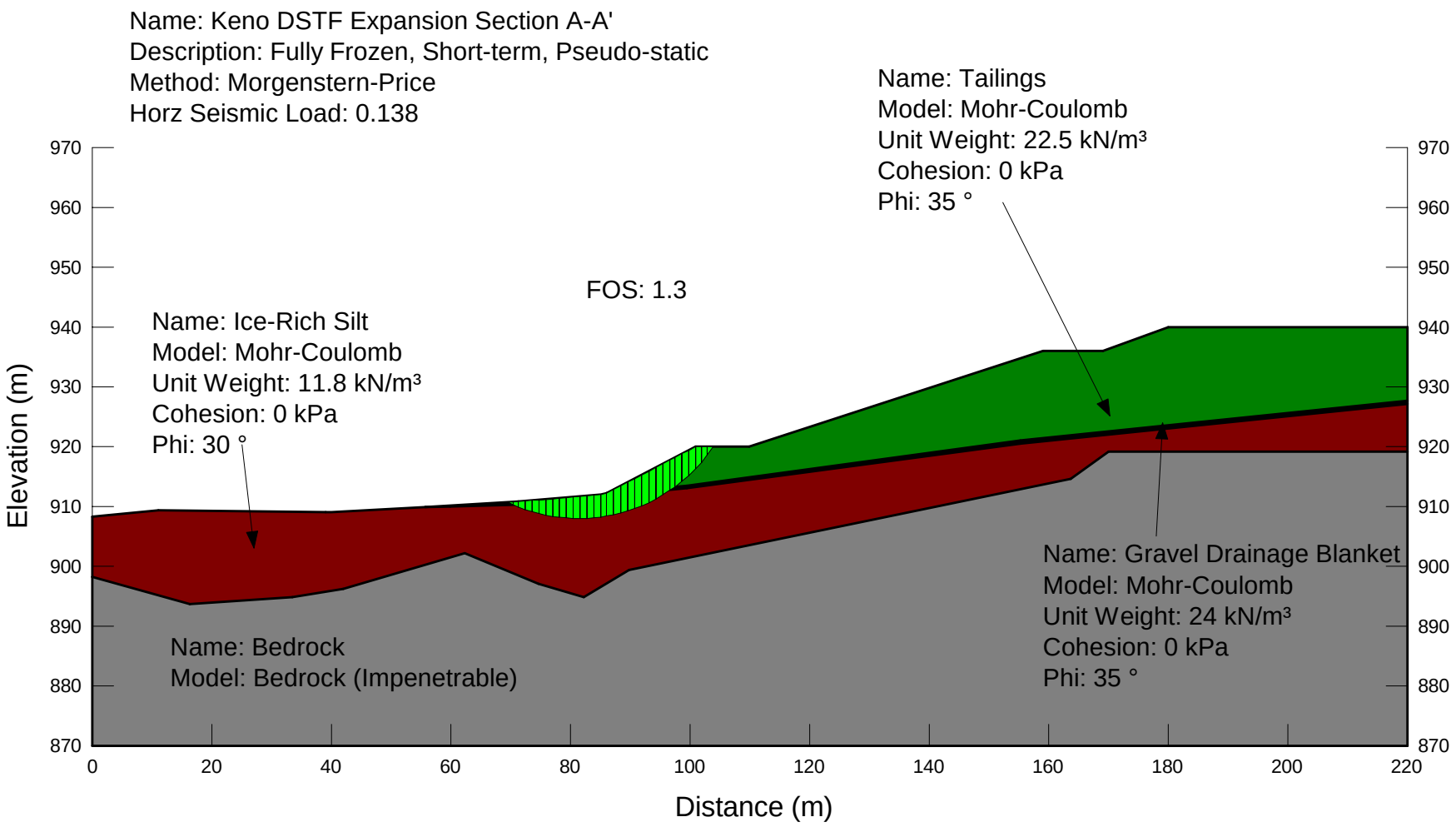
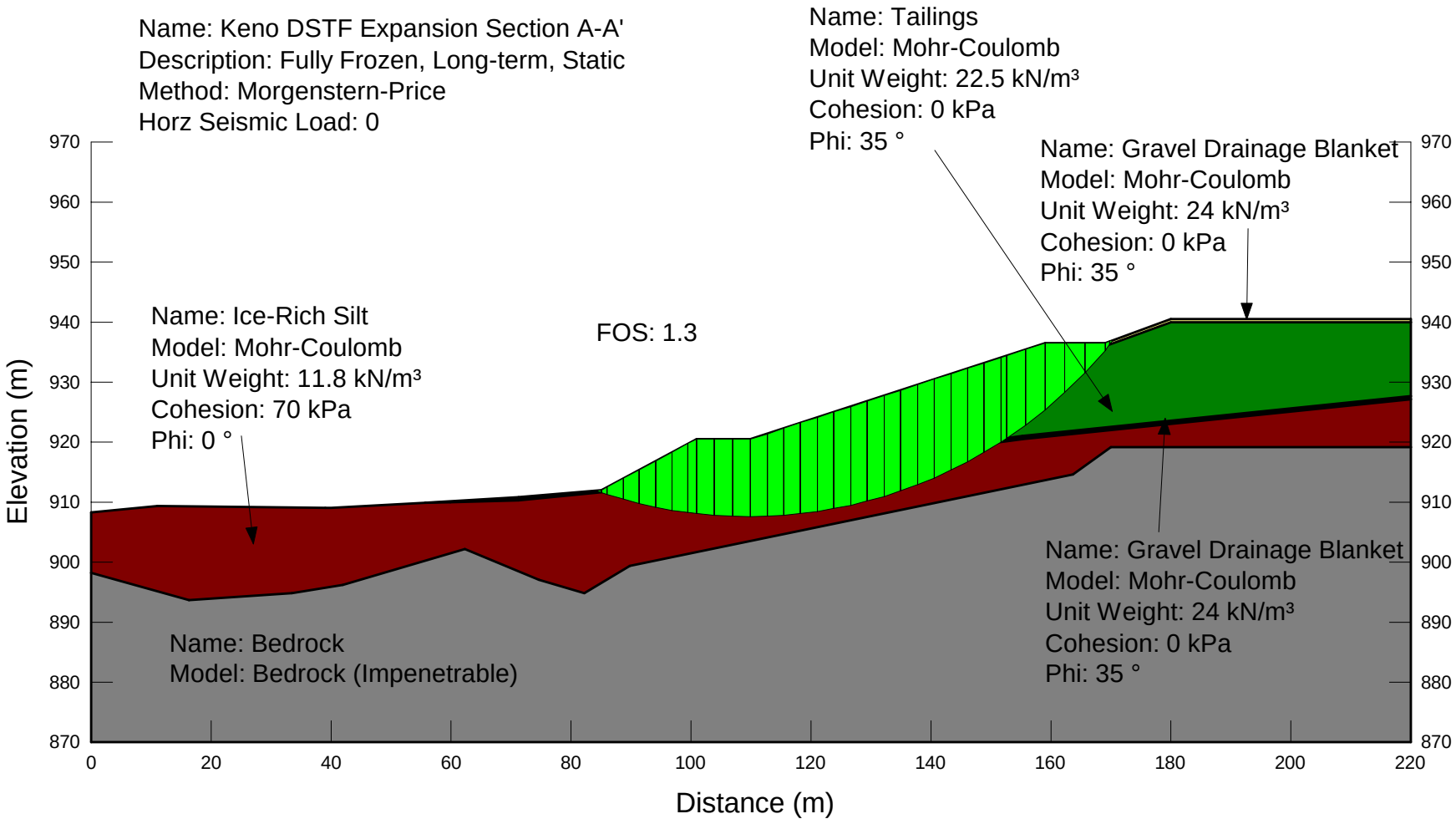
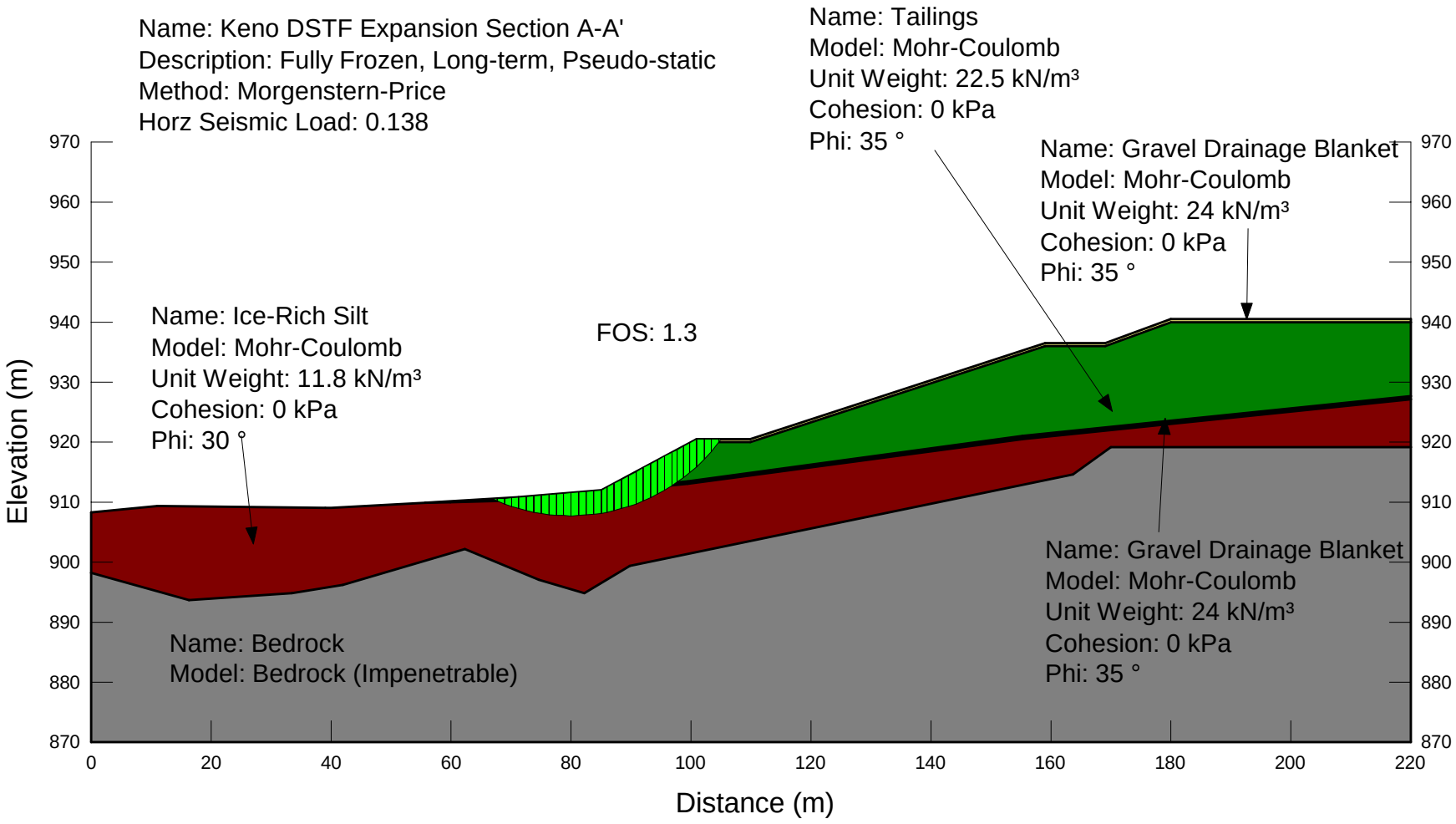
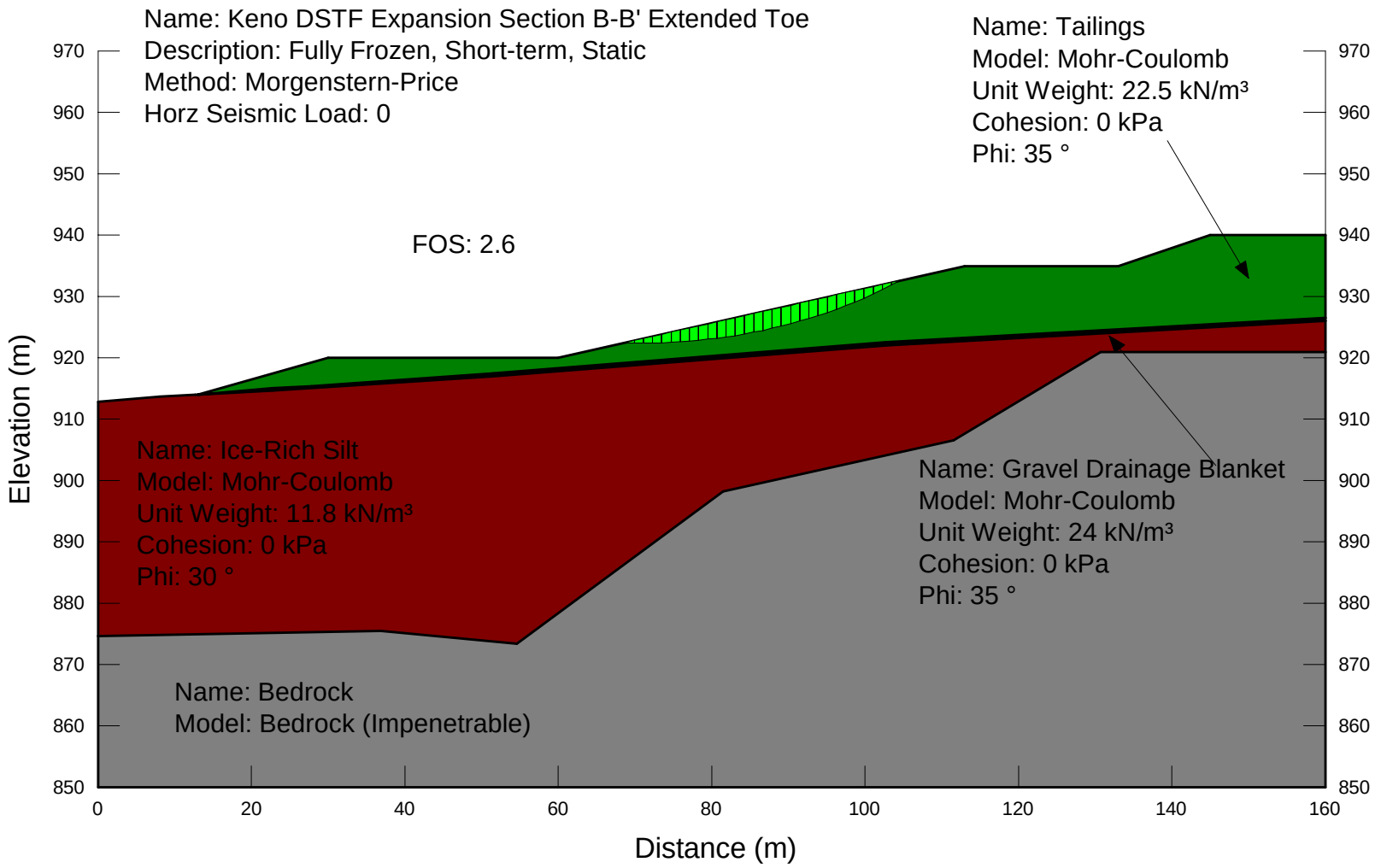
Description: Fully Frozen, Long-term, Static
Method: Morgenstern-Price
Horz Seismic Load: 0
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 70 kPa
Phi: 0 °
FOS: 1.1
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
970
960
950
940
930
920
910
900
890
880
870
0
20
40
60
80
100
120
140
160
180
200
220
Distance (m)

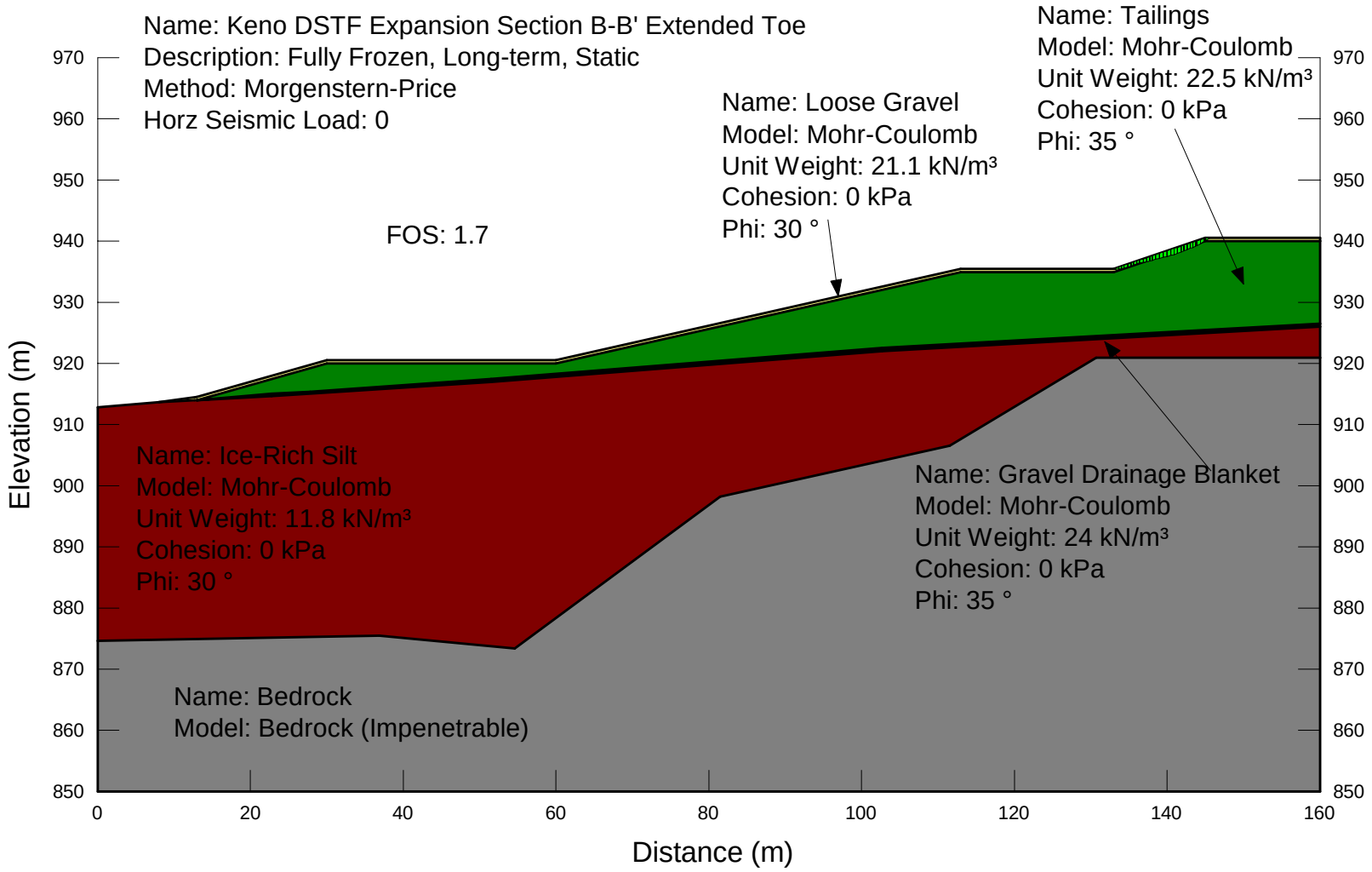

Name: Keno DSTF Expansion Section A-A'
Description: Fully Frozen, Short-term, Static
Method: Morgenstern-Price
Horz Seismic Load: 0
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
FOS: 1.9
Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
970
960
950
940
930
920
910
900
890
880
870
0
20
40
60
80
100
120
140
160
180
200
220
Distance (m)

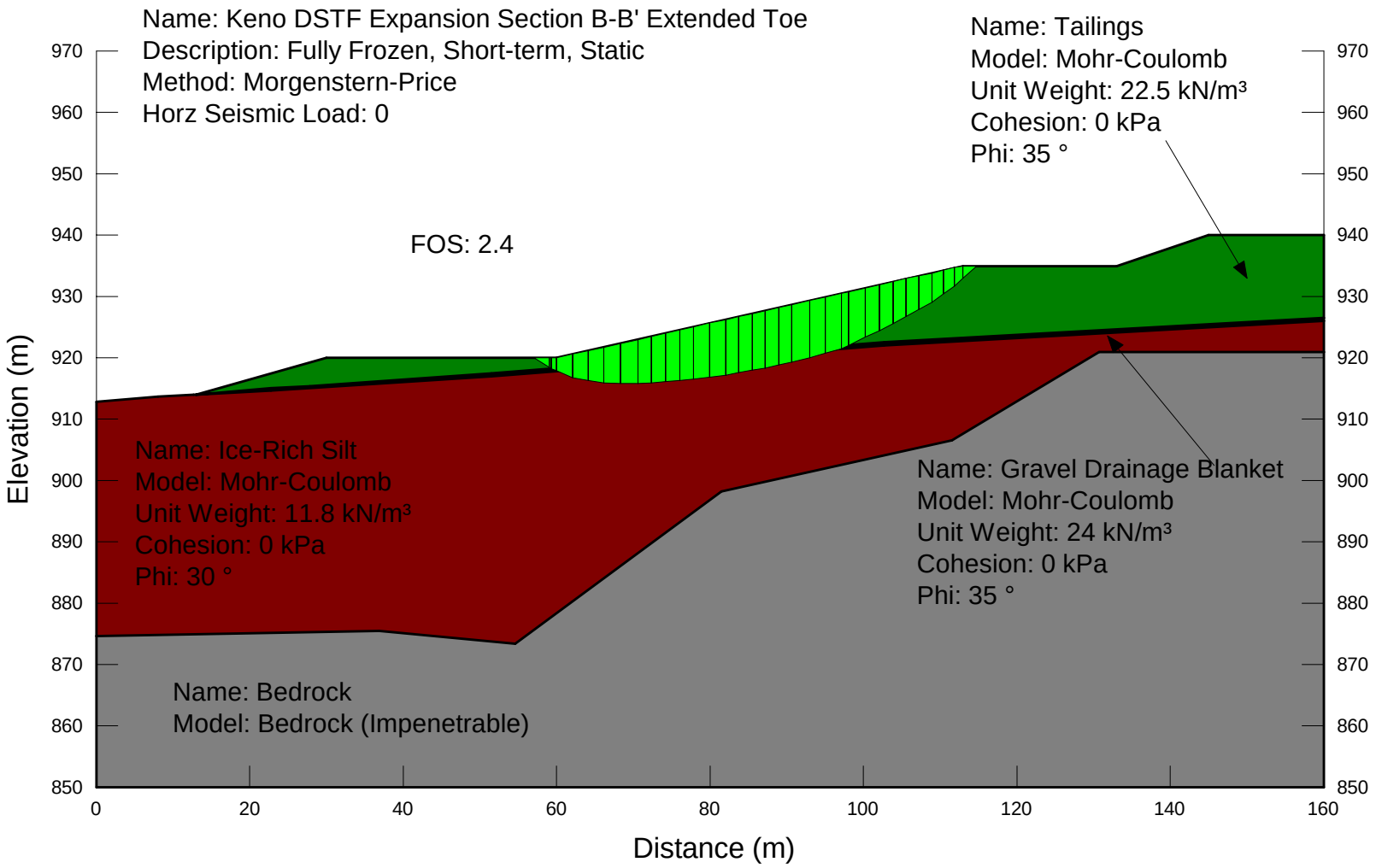

Name: Keno DSTF Expansion Section A-A'
Description: Fully Frozen, Short-term, Pseudo-static
Method: Morgenstern-Price
Horz Seismic Load: 0.138
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
FOS: 1.3
Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
970
960
950
940
930
920
910
900
890
880
870
0
20
40
60
80
100
120
140
160
180
200
220
Distance (m)

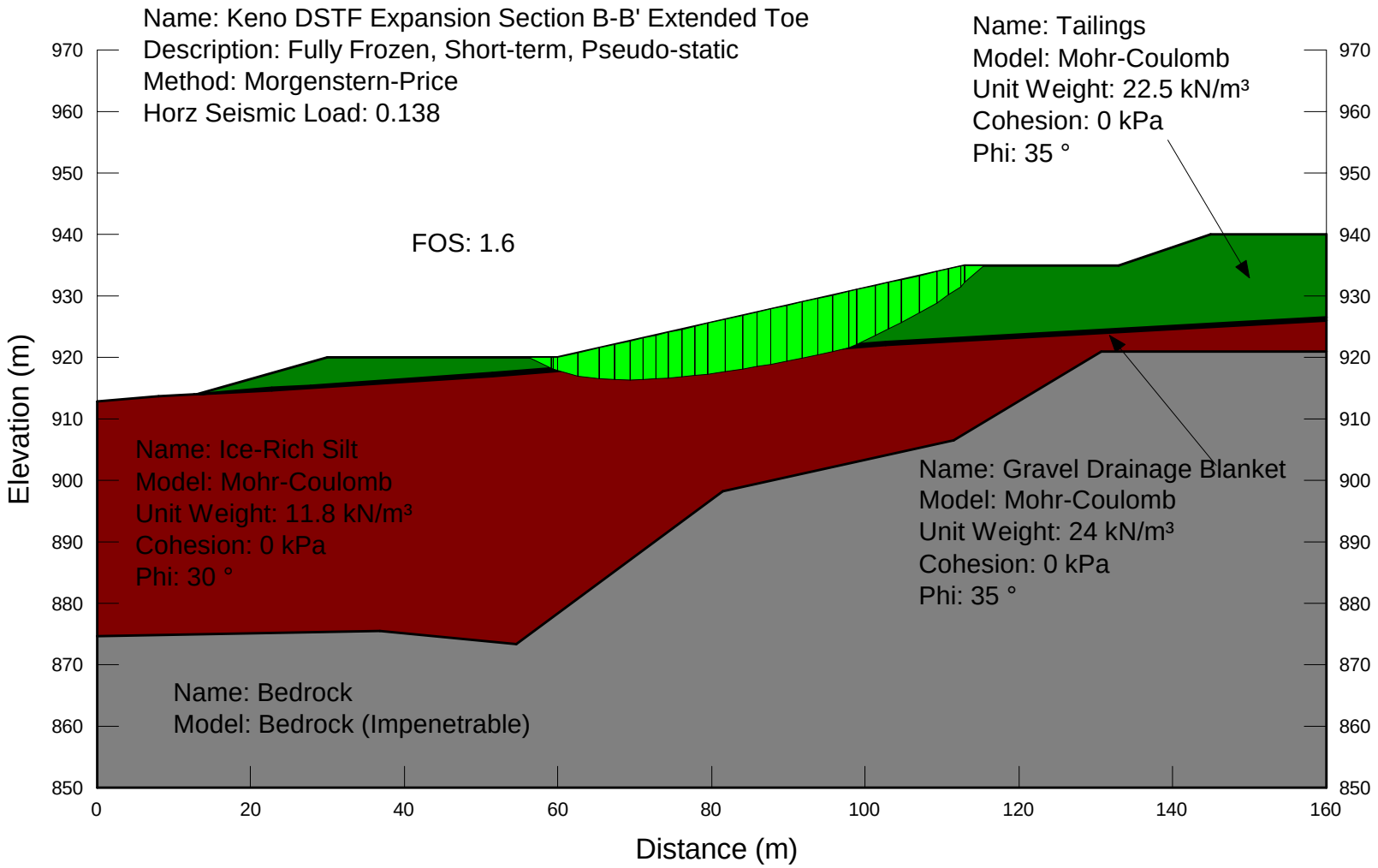

Name: Keno DSTF Expansion Section A-A'
Description: Fully Frozen, Long-term, Static
Method: Morgenstern-Price
Horz Seismic Load: 0
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 70 kPa
Phi: 0 °
FOS: 1.3
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
970
960
950
940
930
920
910
900
890
880
870
0
20
40
60
80
100
120
140
160
180
200
220
Distance (m)

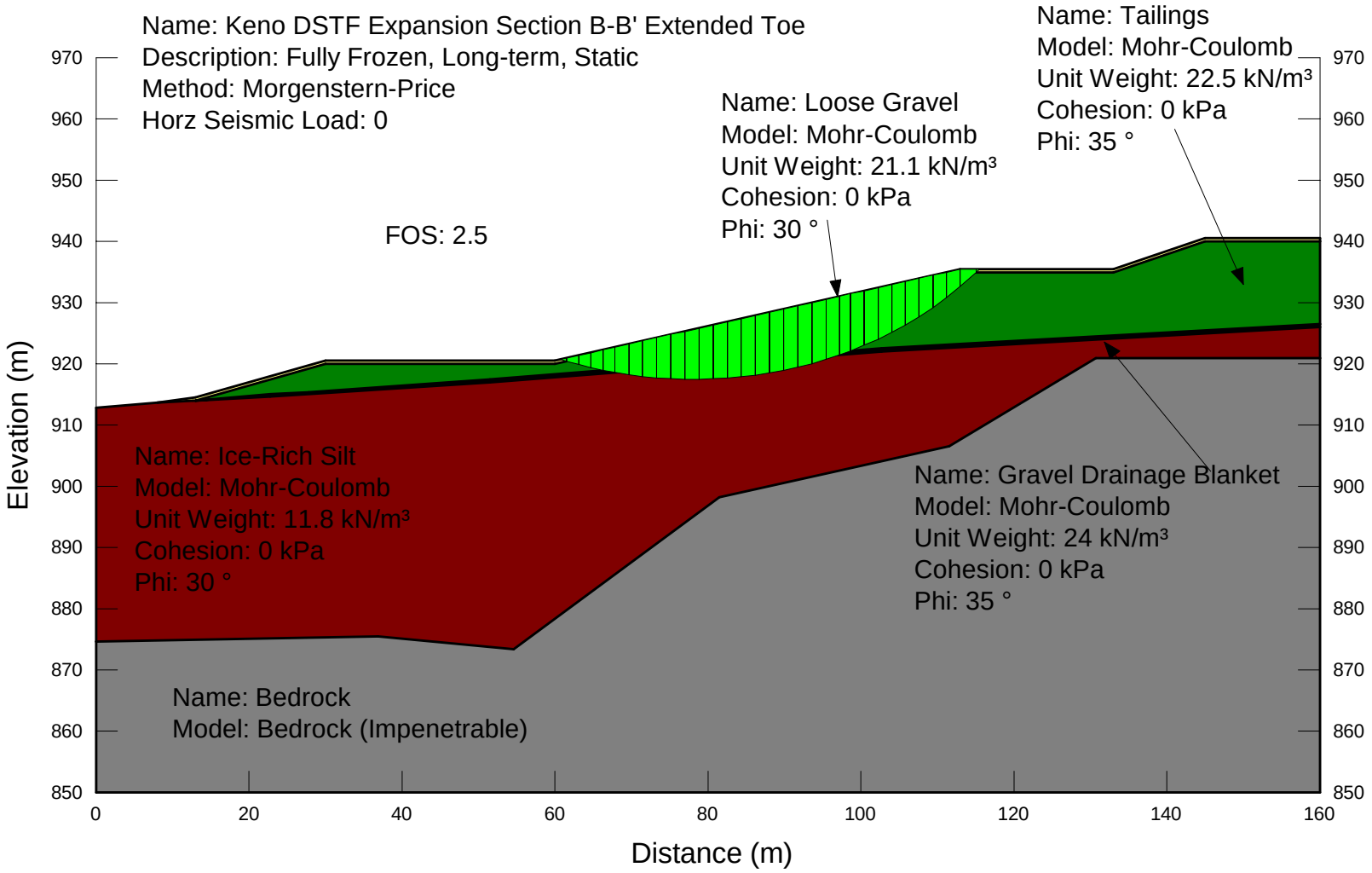

Name: Keno DSTF Expansion Section A-A'
Description: Fully Frozen, Long-term, Pseudo-static
Method: Morgenstern-Price
Horz Seismic Load: 0.138
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 0 kPa
Phi: 30 °
FOS: 1.3
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
970
960
950
940
930
920
910
900
890
880
870
0
20
40
60
80
100
120
140
160
180
200
220
Distance (m)

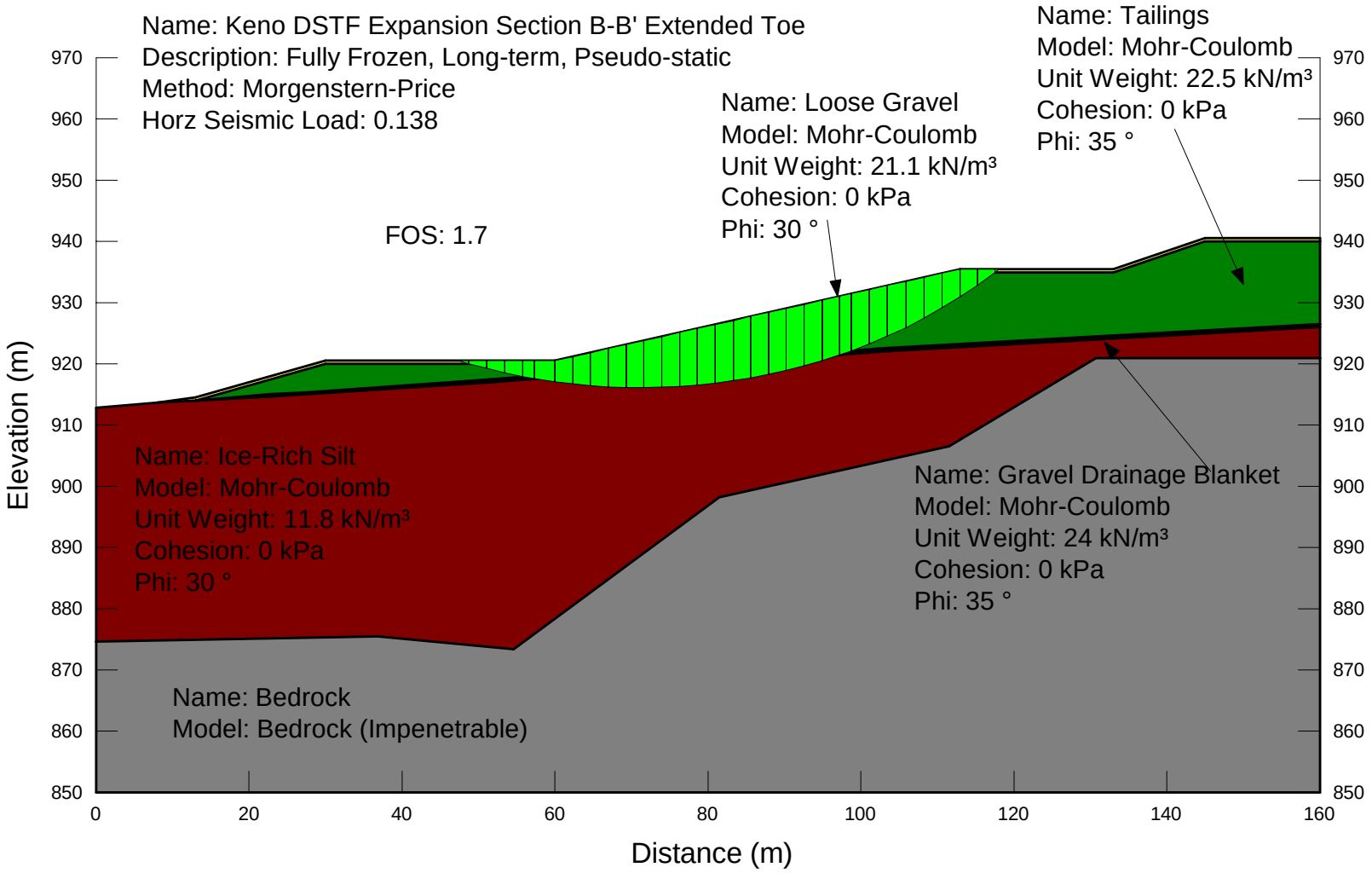

Name: Keno DSTF Expansion Section B-B' Extended Toe
Description: Fully Frozen, Short-term, Static
Method: Morgenstern-Price
Horz Seismic Load: 0
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
FOS: 2.6
Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
Distance (m)
970
960
950
940
930
920
910
900
890
880
870
860
850
0
20
40
60
80
100
120
140
160


Name: Keno DSTF Expansion Section B-B' Extended Toe
Description: Fully Frozen, Long-term, Static
Method: Morgenstern-Price
Horz Seismic Load: 0
FOS: 1.7
Name: Loose Gravel
Model: Mohr-Coulomb
Unit Weight: 21.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
970
960
950
940
930
920
910
900
890
880
870
860
850
0
20
40
60
80
100
120
140
160
Distance (m)


Name: Keno DSTF Expansion Section B-B' Extended Toe
Description: Fully Frozen, Short-term, Static
Method: Morgenstern-Price
Horz Seismic Load: 0
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
FOS: 2.4
Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
970
960
950
940
930
920
910
900
890
880
870
860
850
0
20
40
60
80
100
120
140
160
Distance (m)

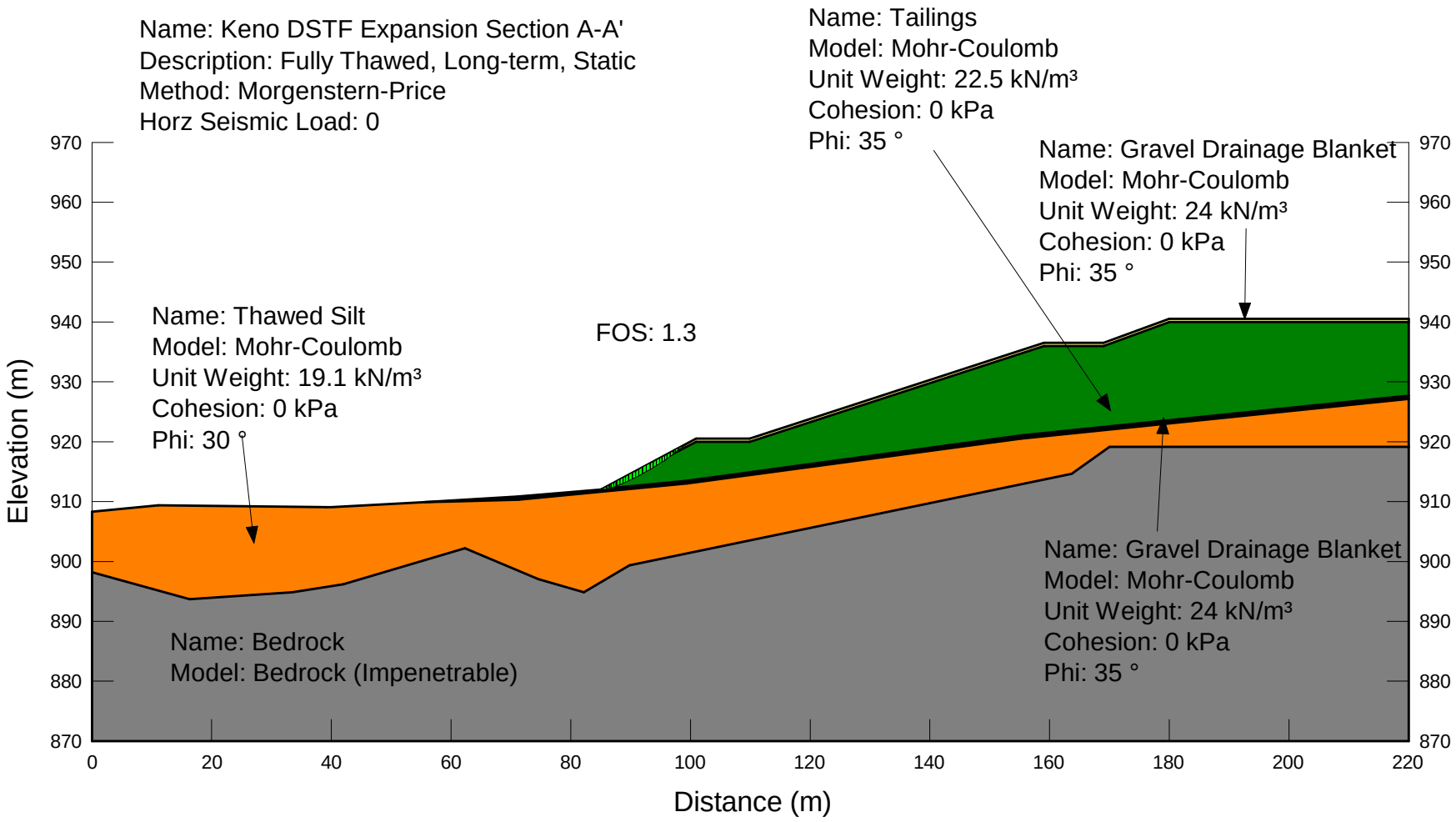

Name: Keno DSTF Expansion Section B-B' Extended Toe
Description: Fully Frozen, Short-term, Pseudo-static
Method: Morgenstern-Price
Horz Seismic Load: 0.138
FOS: 1.6
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
970
960
950
940
930
920
910
900
890
880
870
860
850
0
20
40
60
80
100
120
140
160
Distance (m)

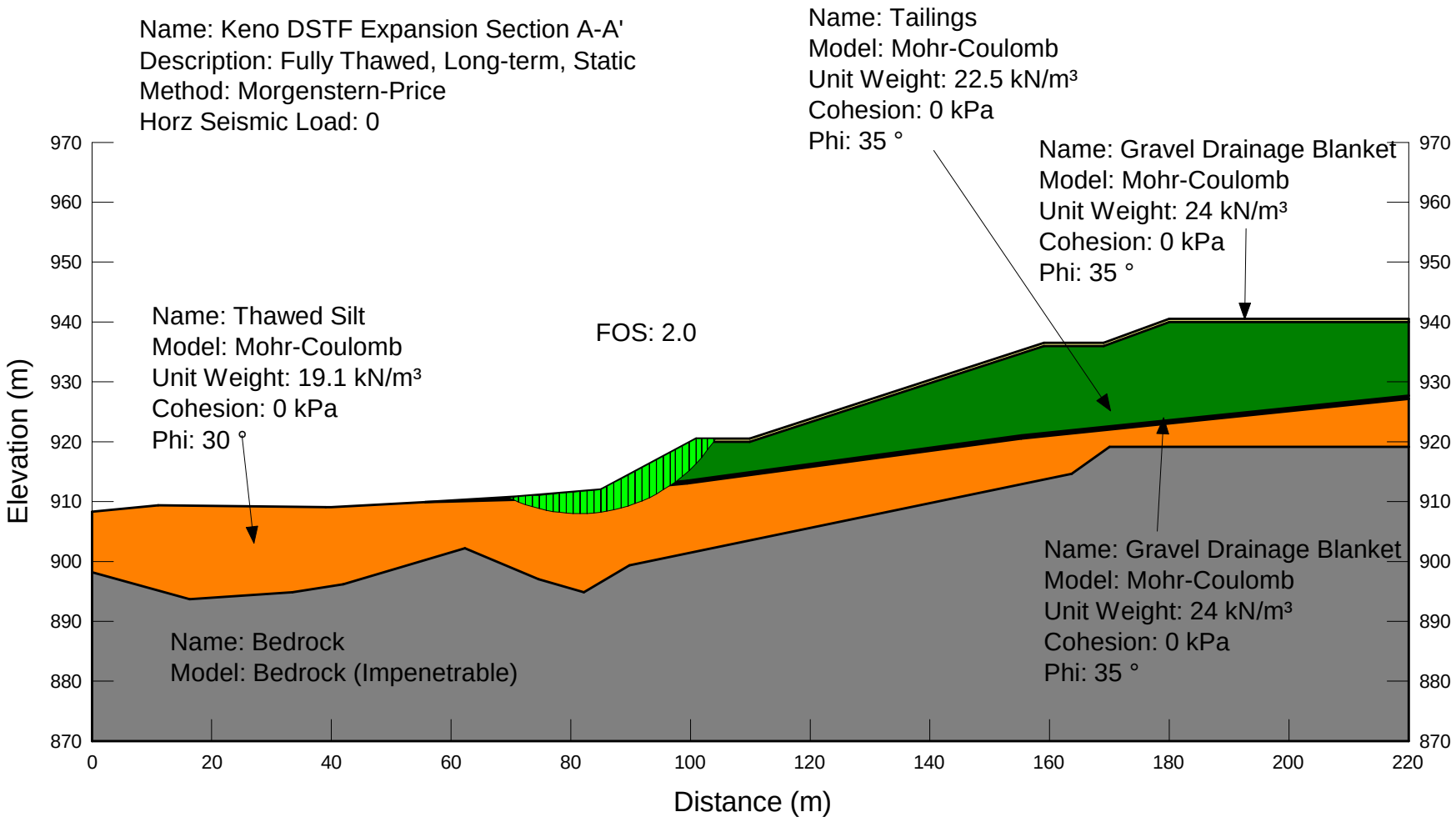

Name: Keno DSTF Expansion Section B-B' Extended Toe
Description: Fully Frozen, Long-term, Static
Method: Morgenstern-Price
Horz Seismic Load: 0
FOS: 2.5
Name: Loose Gravel
Model: Mohr-Coulomb
Unit Weight: 21.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
970
960
950
940
930
920
910
900
890
880
870
860
850
0
20
40
60
80
100
120
140
160
Distance (m)

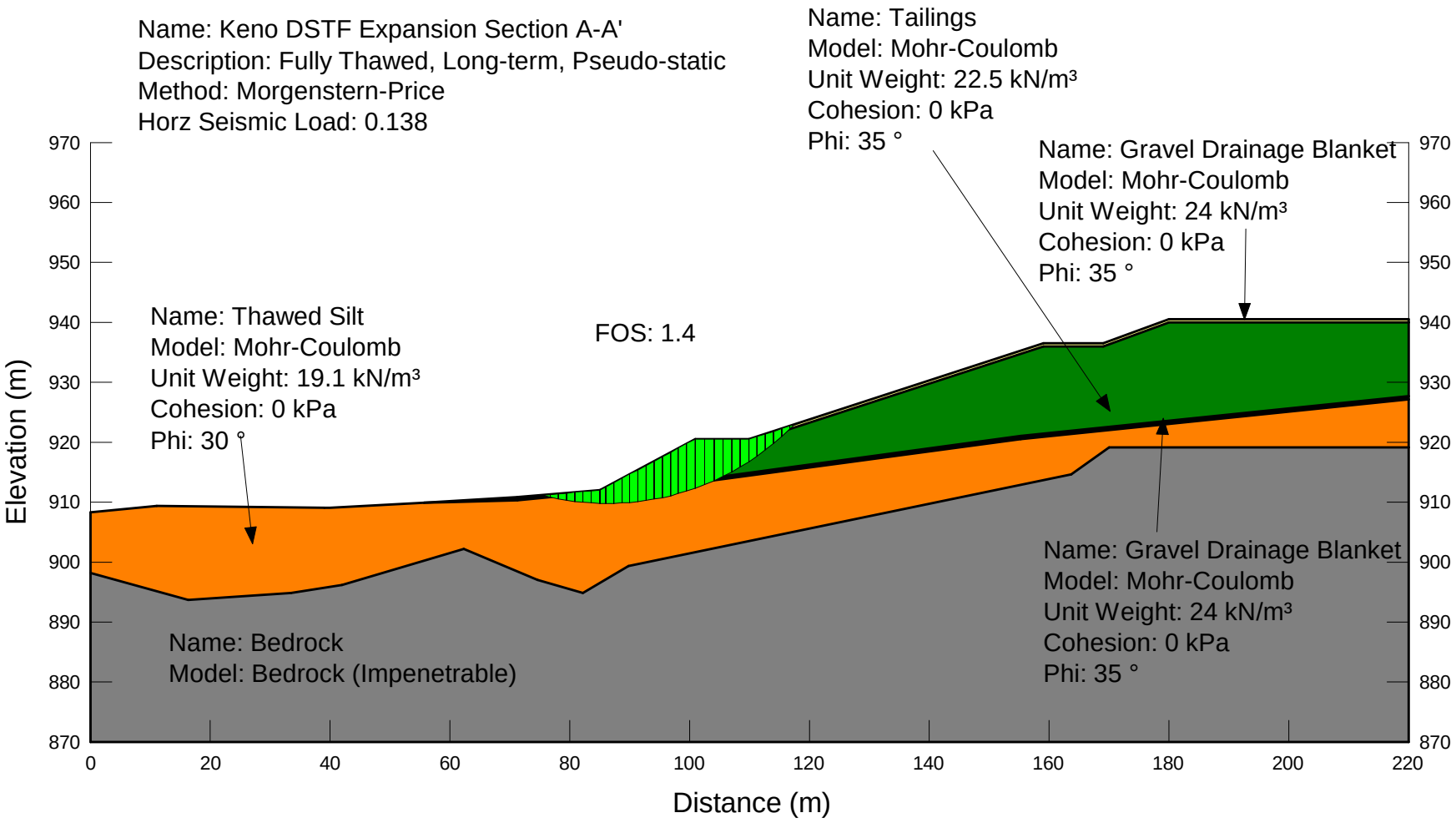

Name: Keno DSTF Expansion Section B-B' Extended Toe
Description: Fully Frozen, Long-term, Pseudo-static
Method: Morgenstern-Price
Horz Seismic Load: 0.138
FOS: 1.7
Name: Loose Gravel
Model: Mohr-Coulomb
Unit Weight: 21.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
970
960
950
940
930
920
910
900
890
880
870
860
850
0
20
40
60
80
100
120
140
160
Distance (m)

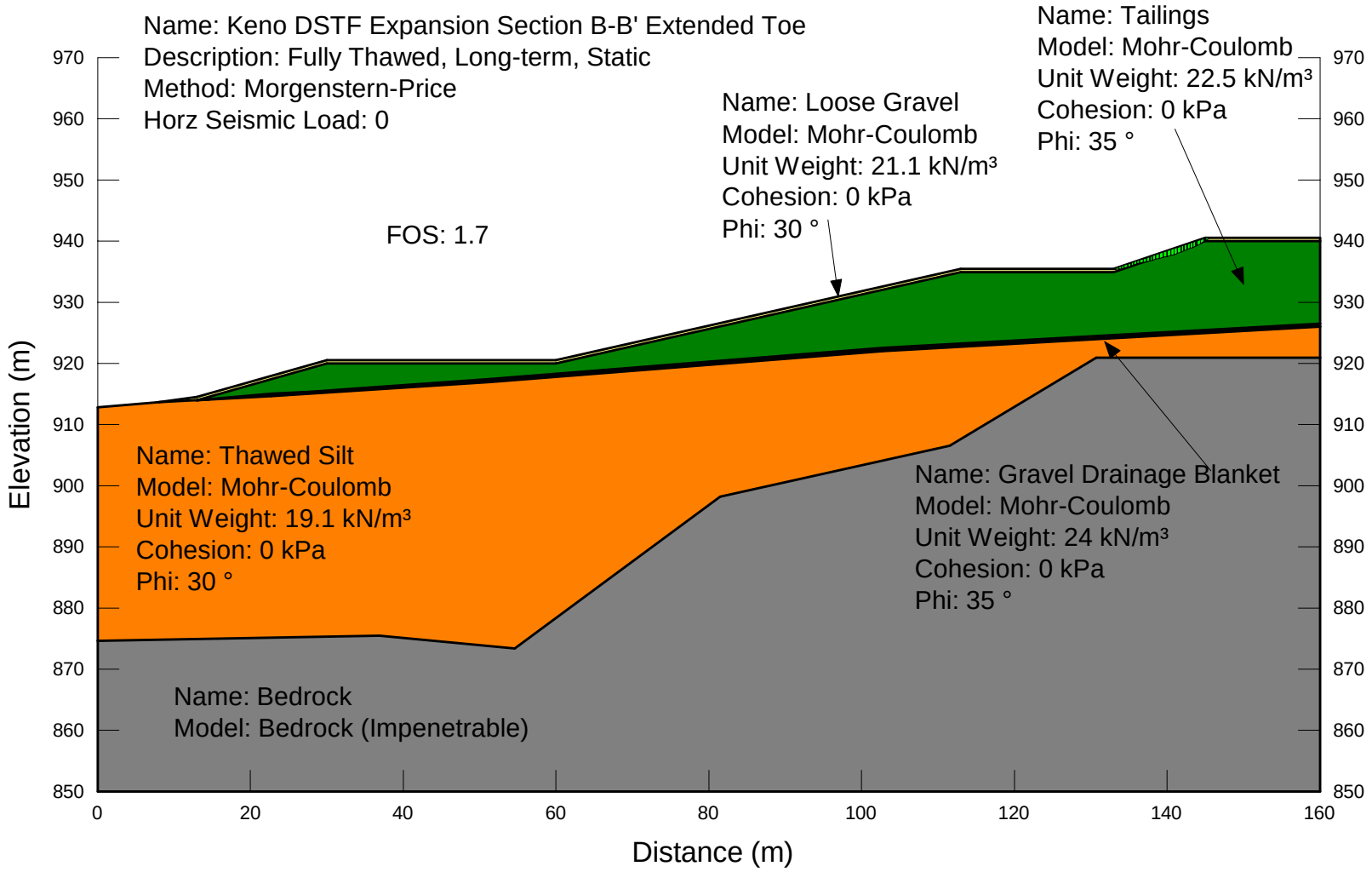
APPENDIX D

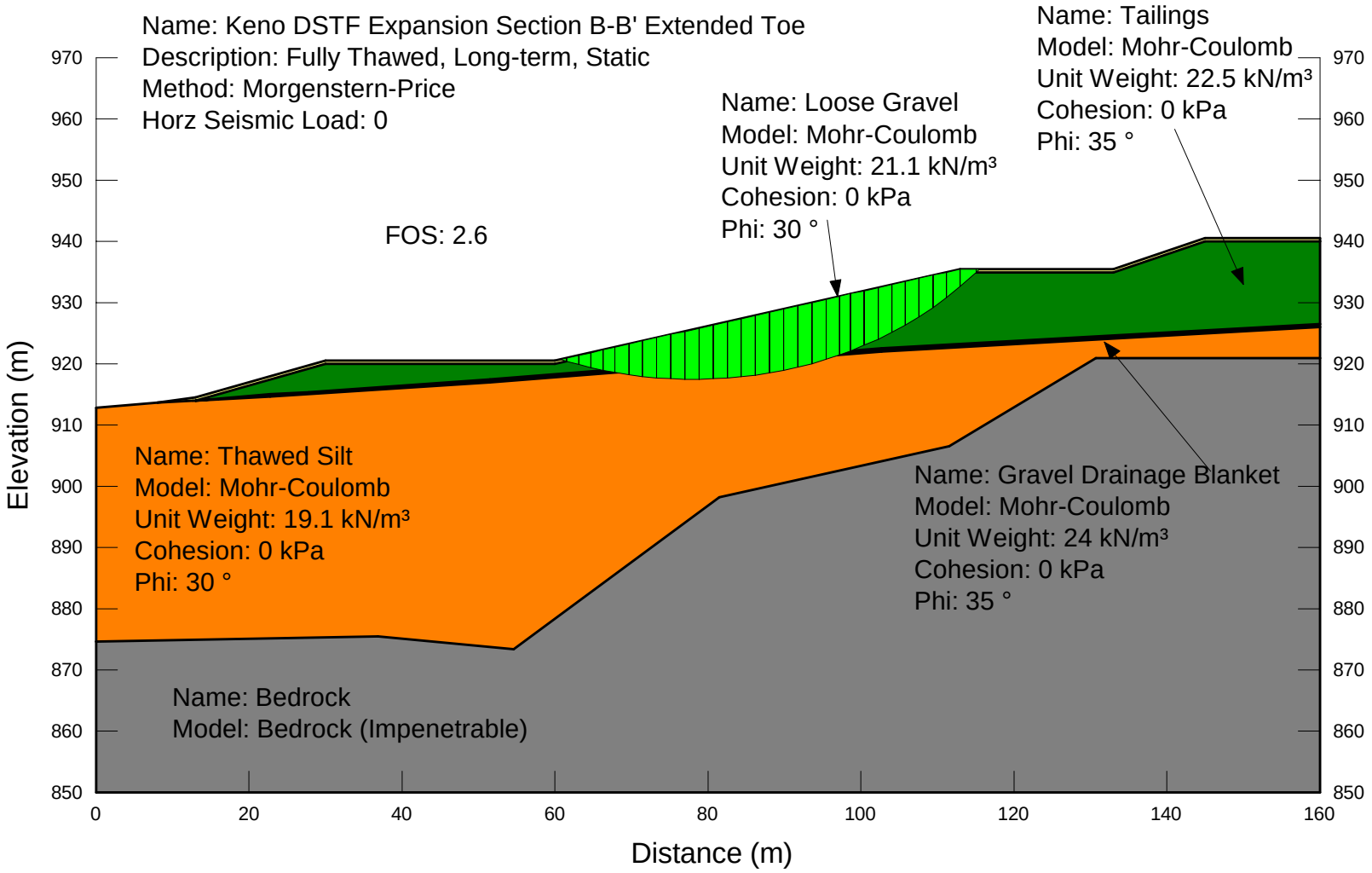
SLOPE STABILITY RESULTS – FULLY THAWED

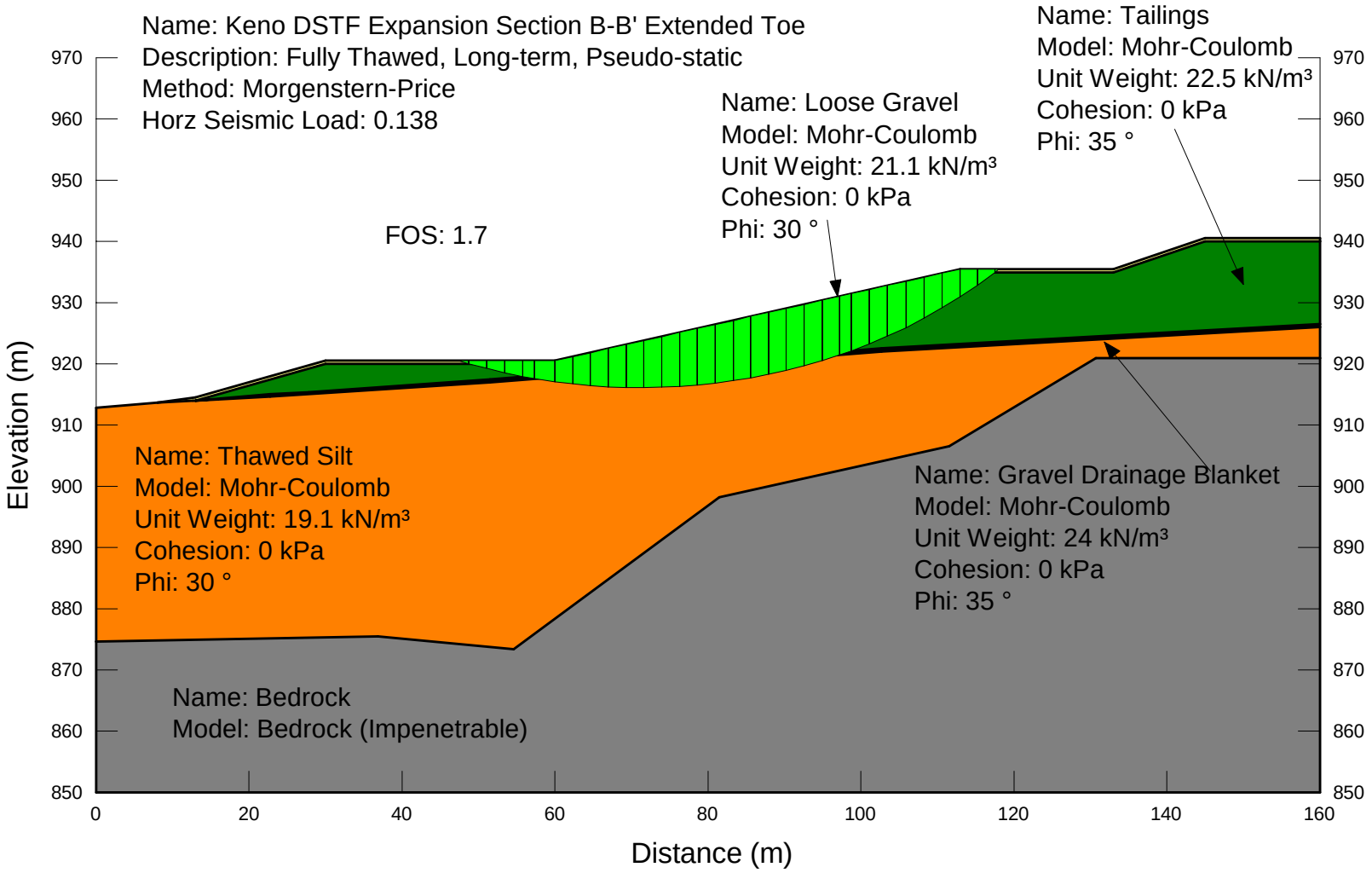

Name: Keno DSTF Expansion Section A-A'
Description: Fully Thawed, Long-term, Static
Method: Morgenstern-Price
Horz Seismic Load: 0
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Thawed Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
FOS: 1.3
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
970
960
950
940
930
920
910
900
890
880
870
0
20
40
60
80
100
120
140
160
180
200
220
Distance (m)


Name: Keno DSTF Expansion Section A-A'
Description: Fully Thawed, Long-term, Static
Method: Morgenstern-Price
Horz Seismic Load: 0
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Thawed Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
FOS: 2.0
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
970
960
950
940
930
920
910
900
890
880
870
0
20
40
60
80
100
120
140
160
180
200
220
Distance (m)


Name: Keno DSTF Expansion Section A-A'
Description: Fully Thawed, Long-term, Pseudo-static
Method: Morgenstern-Price
Horz Seismic Load: 0.138
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Thawed Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
FOS: 1.4
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
970
960
950
940
930
920
910
900
890
880
870
0
20
40
60
80
100
120
140
160
180
200
220
Distance (m)


Name: Keno DSTF Expansion Section B-B' Extended Toe
Description: Fully Thawed, Long-term, Static
Method: Morgenstern-Price
Horz Seismic Load: 0
FOS: 1.7
Name: Loose Gravel
Model: Mohr-Coulomb
Unit Weight: 21.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Thawed Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
970
960
950
940
930
920
910
900
890
880
870
860
850
0
20
40
60
80
100
120
140
160
Distance (m)

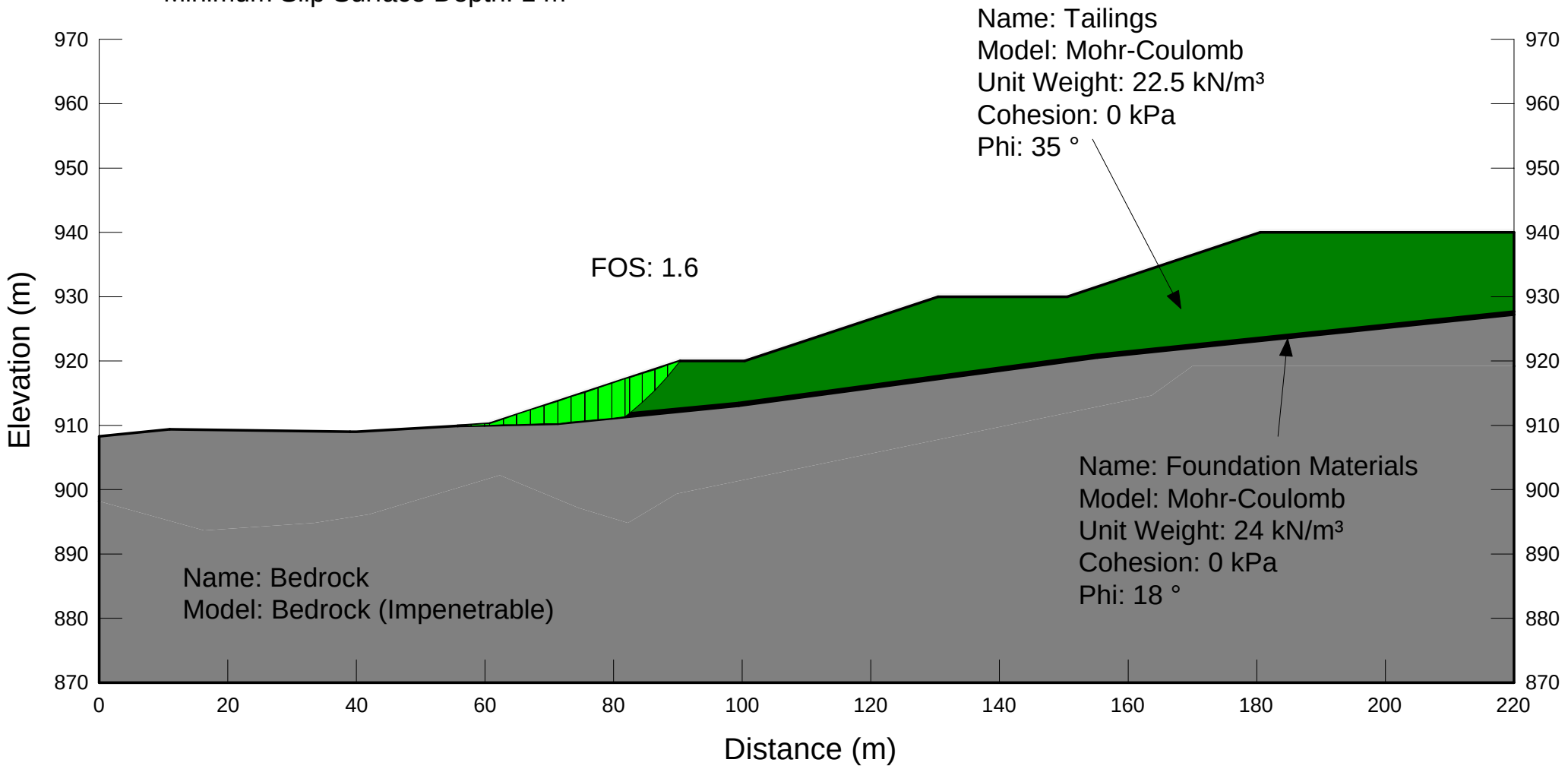

Name: Keno DSTF Expansion Section B-B' Extended Toe
Description: Fully Thawed, Long-term, Static
Method: Morgenstern-Price
Horz Seismic Load: 0
FOS: 2.6
Name: Loose Gravel
Model: Mohr-Coulomb
Unit Weight: 21.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Thawed Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
970
960
950
940
930
920
910
900
890
880
870
860
850
0
20
40
60
80
100
120
140
160
Distance (m)


Name: Keno DSTF Expansion Section B-B' Extended Toe
Description: Fully Thawed, Long-term, Pseudo-static
Method: Morgenstern-Price
Horz Seismic Load: 0.138
FOS: 1.7
Name: Loose Gravel
Model: Mohr-Coulomb
Unit Weight: 21.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Thawed Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Gravel Drainage Blanket
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
970
960
950
940
930
920
910
900
890
880
870
860
850
0
20
40
60
80
100
120
140
160
Distance (m)

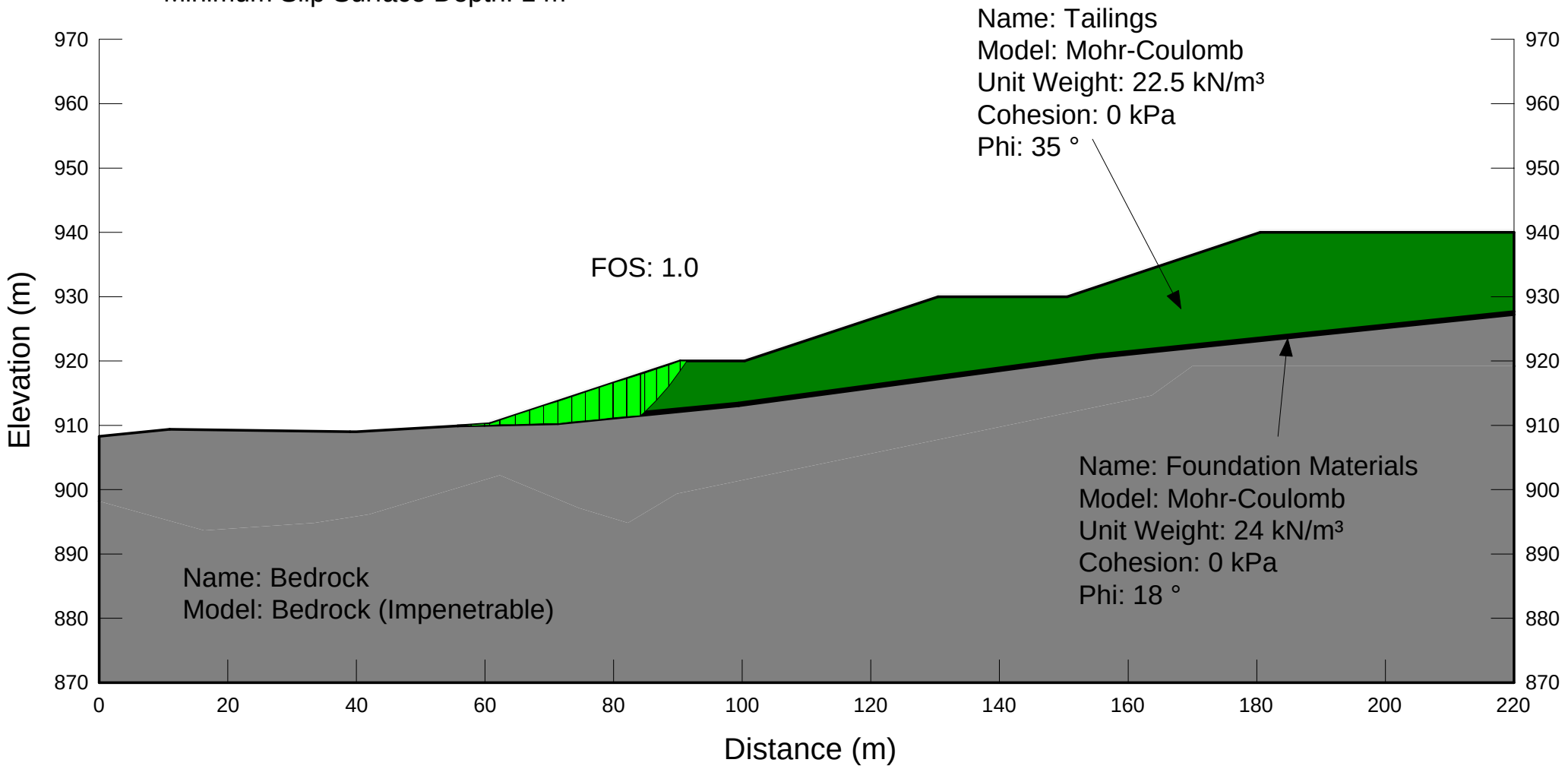
APPENDIX E

SLOPE STABILITY RESULTS – FOUNDATION MATERIALS

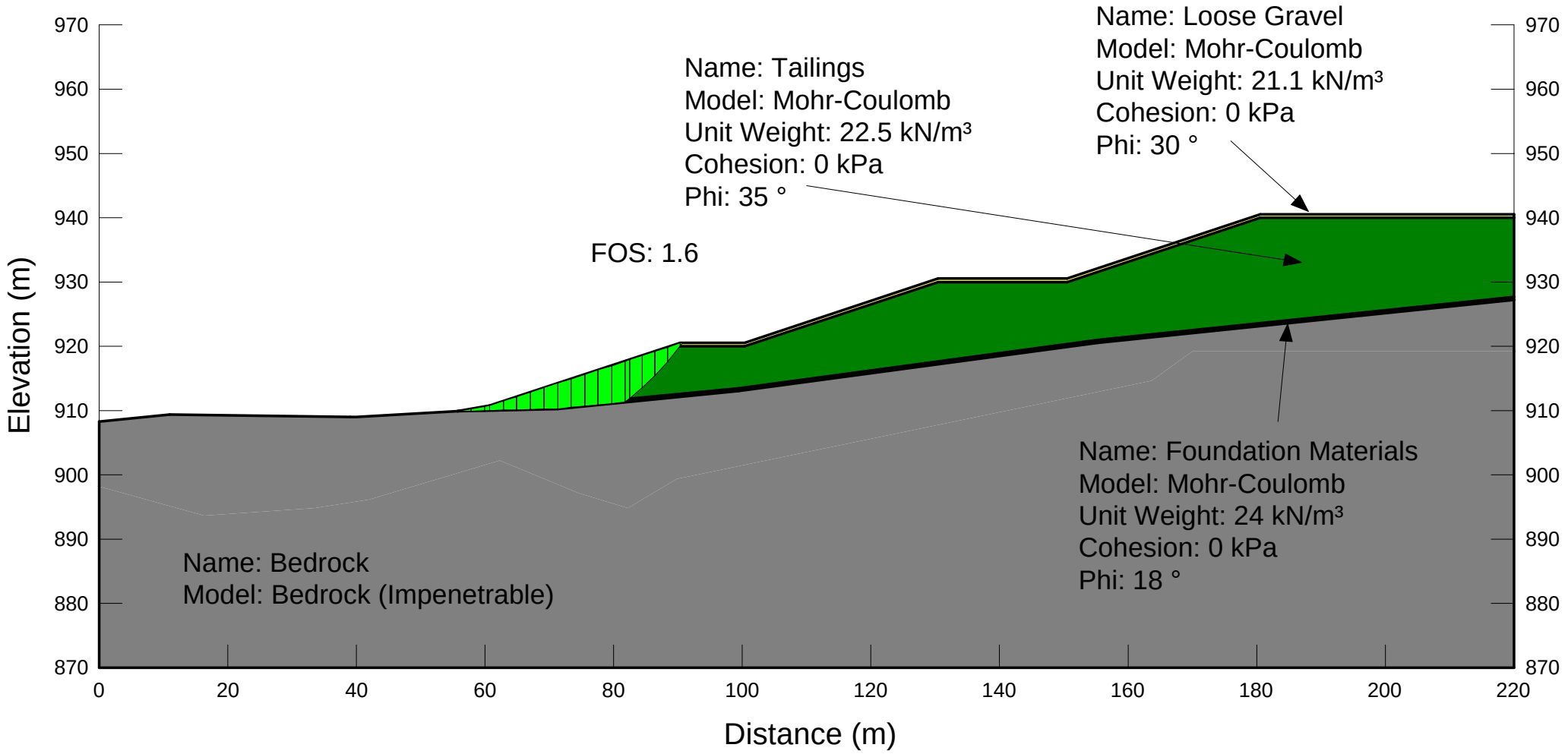
File Name: Section A-A'.gsz
Name: Keno DSTF Expansion With Geosynthetic Clay Liner Short Term
Description: Short Term Static
Method: Morgenstern-Price
Horz Seismic Load: 0
Minimum Slip Surface Depth: 1 m



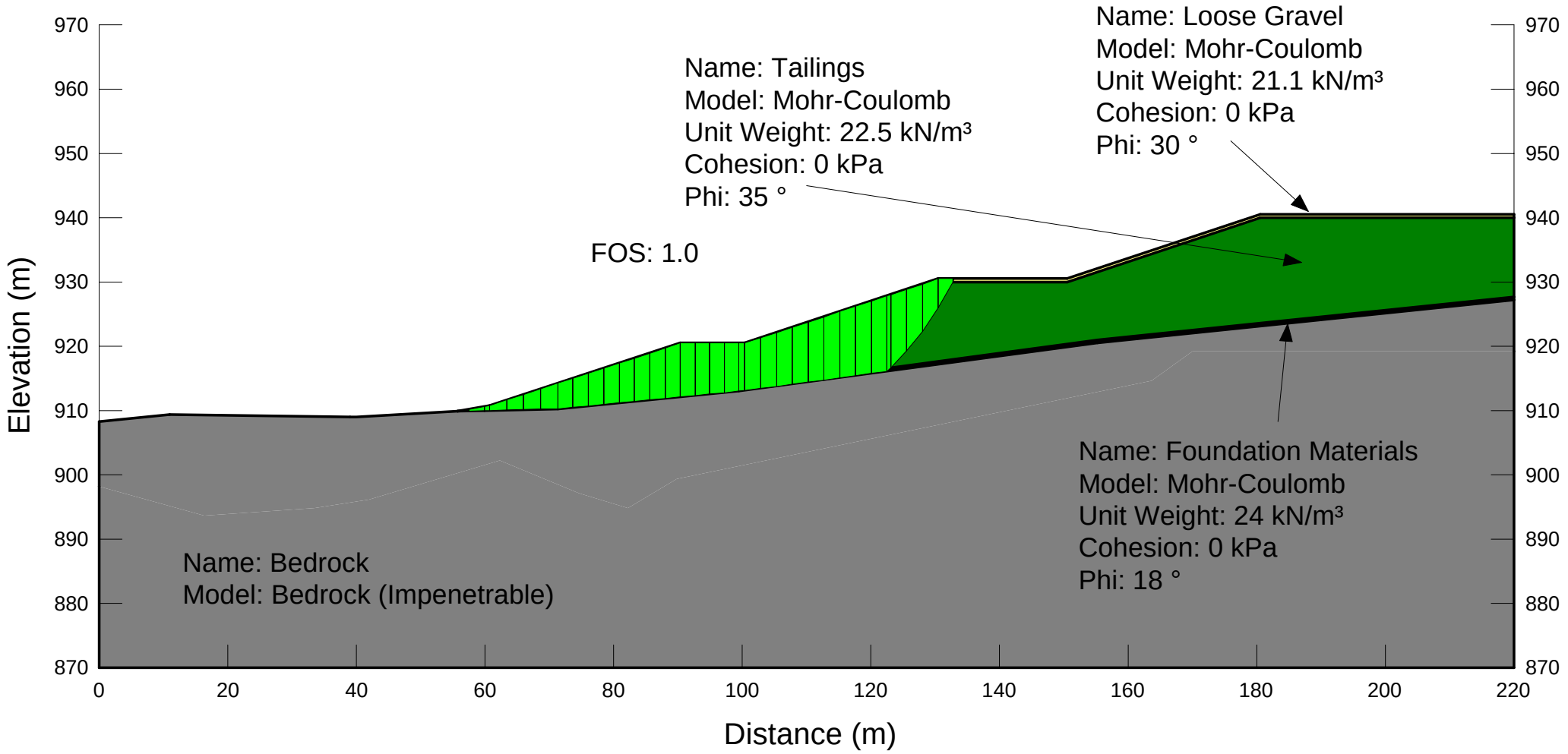
File Name: Section A-A'.gsz
Name: Keno DSTF Expansion With Geosynthetic Clay Liner Short Term
Description: Short Term Pseudo-static
Method: Morgenstern-Price
Horz Seismic Load: 0.138
Minimum Slip Surface Depth: 1 m

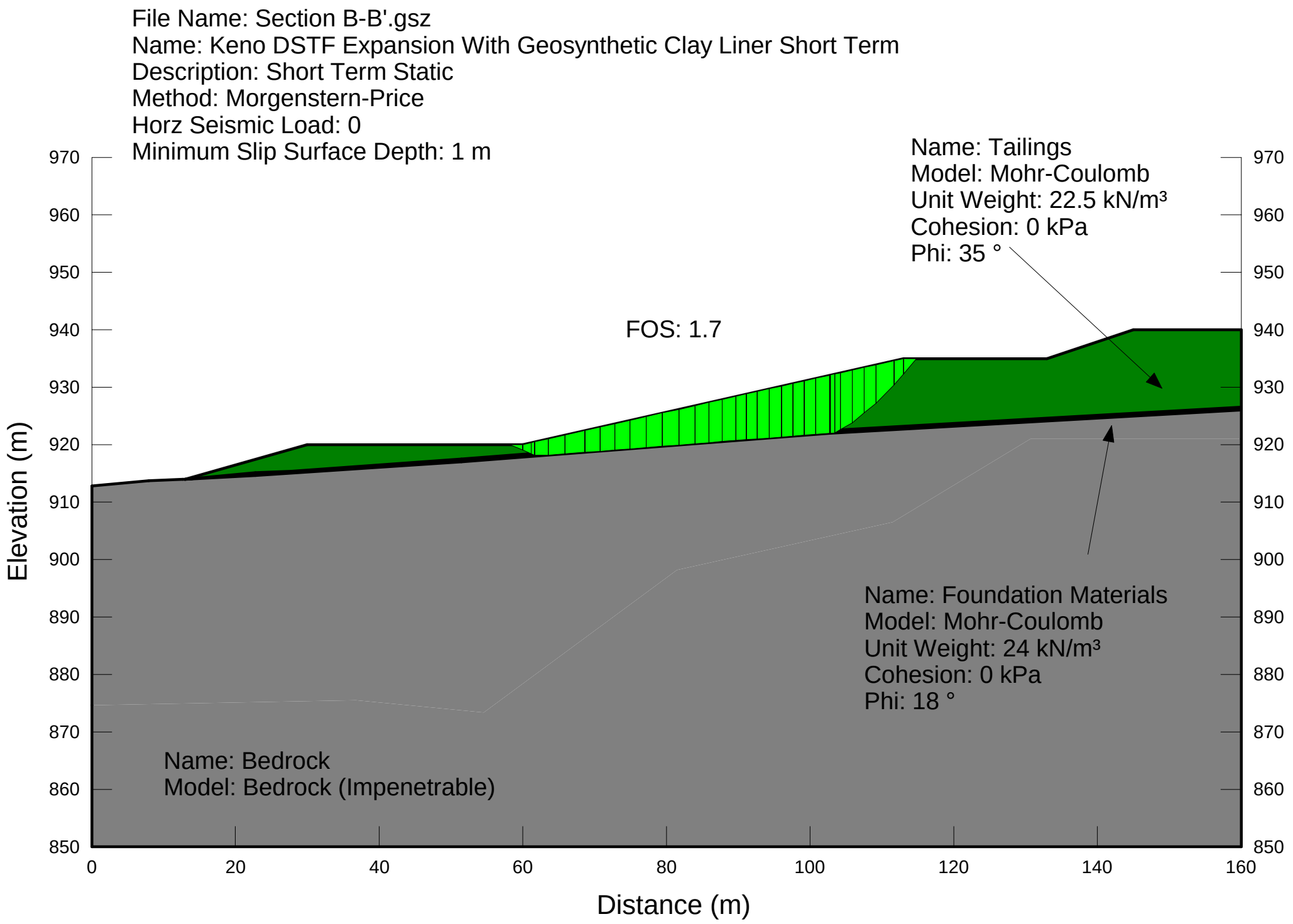


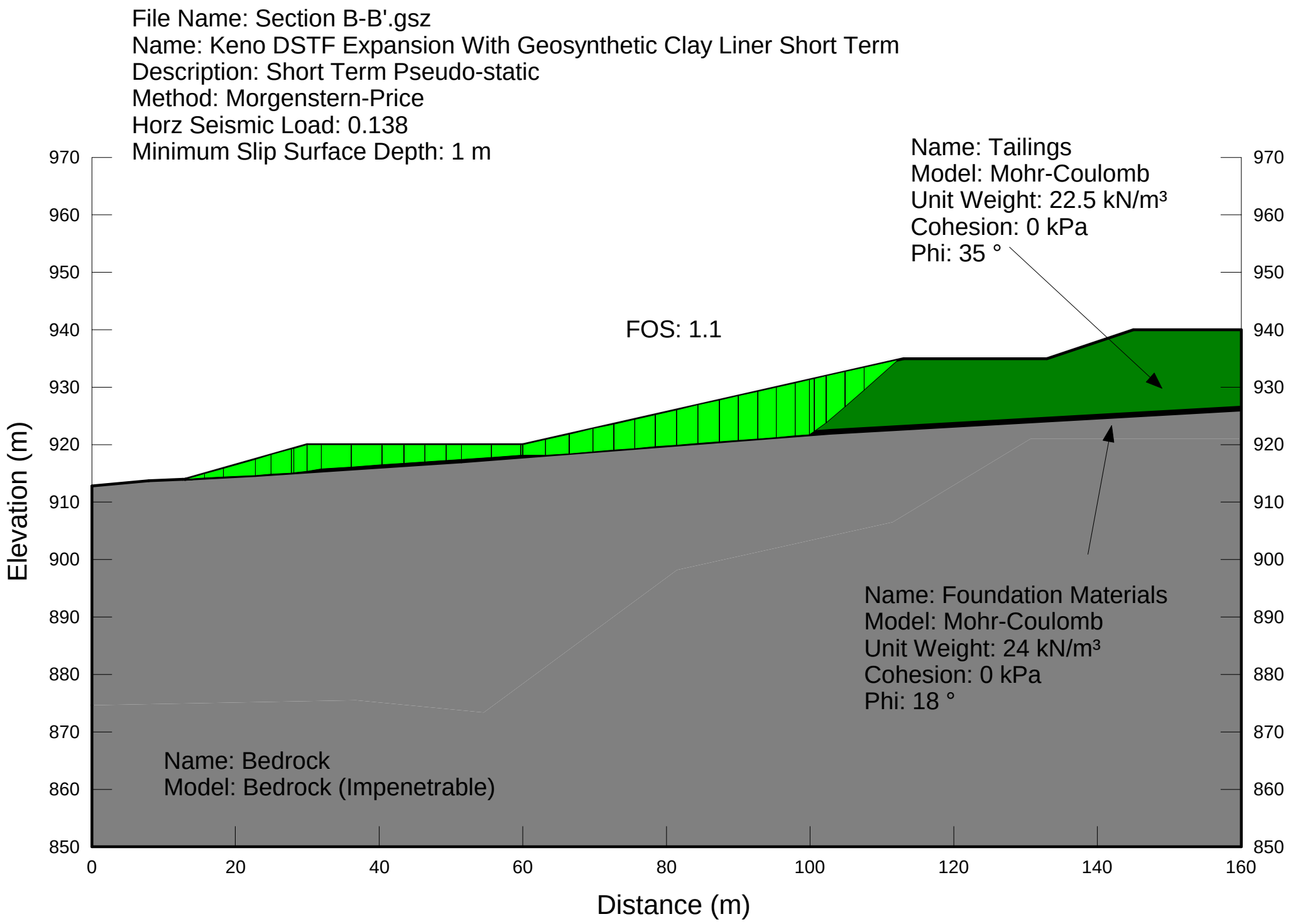
File Name: Section A-A'.gsz
Name: Keno DSTF Expansion With Geosynthetic Clay Liner Long Term
Description: Long Term Static
Method: Morgenstern-Price
Horz Seismic Load: 0
Minimum Slip Surface Depth: 1 m



File Name: Section A-A'.gsz
Name: Keno DSTF Expansion With Geosynthetic Clay Liner Long Term
Description: Long Term Pseudo-static
Method: Morgenstern-Price
Horz Seismic Load: 0.138
Minimum Slip Surface Depth: 1 m




File Name: Section B-B'.gsz
Name: Keno DSTF Expansion With Geosynthetic Clay Liner Short Term
Description: Short Term Static
Method: Morgenstern-Price
Horz Seismic Load: 0
Minimum Slip Surface Depth: 1 m
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
FOS: 1.7
Name: Foundation Materials
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 18 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
970
960
950
940
930
920
910
900
890
880
870
860
850
0
20
40
60
80
100
120
140
160
Distance (m)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Method: Morgenstern-Price
Horz Seismic Load: 0.138
Minimum Slip Surface Depth: 1 m
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
FOS: 1.1
Name: Foundation Materials
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 18 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation (m)
970
960
950
940
930
920
910
900
890
880
870
860
850
0
20
40
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120
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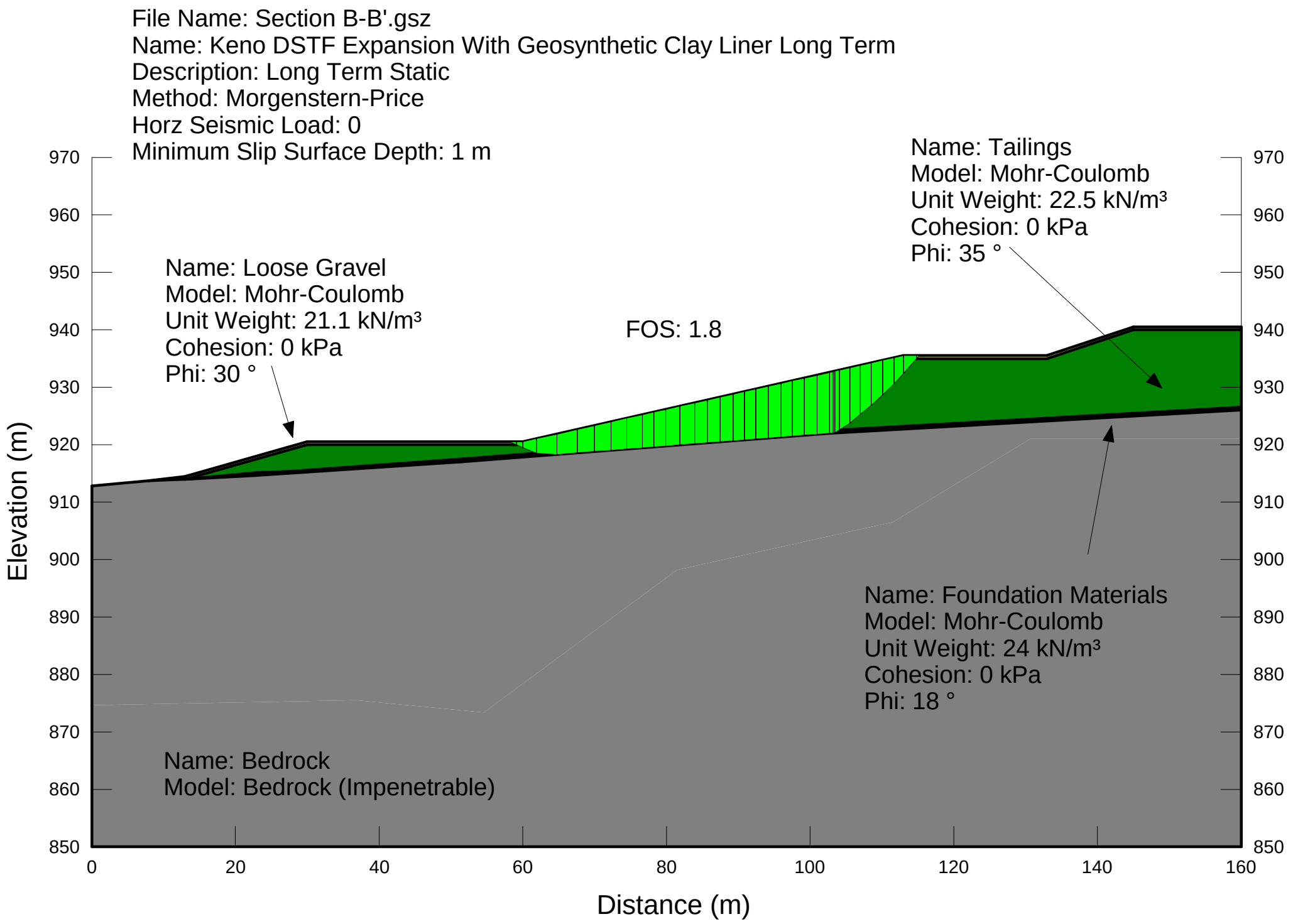
Distance (m)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Method: Morgenstern-Price
Horz Seismic Load: 0
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Model: Mohr-Coulomb
Unit Weight: 22.5 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Loose Gravel
Model: Mohr-Coulomb
Unit Weight: 21.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
FOS: 1.8
Name: Foundation Materials
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 18 °
Name: Bedrock
Model: Bedrock (Impenetrable)
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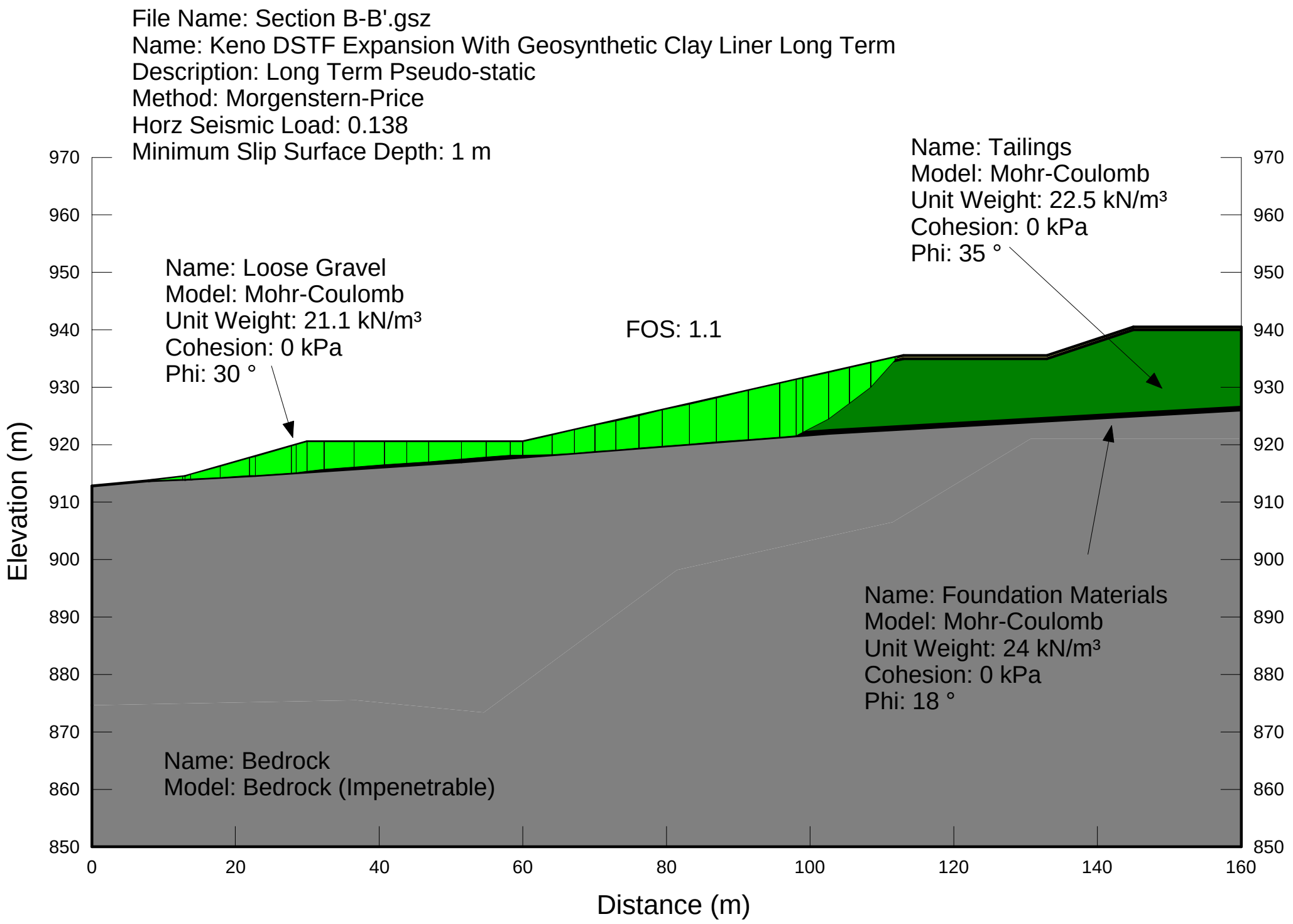
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140
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Distance (m)

Attachment B

Tailings Characterization Plan

3 Calcite Business Centre, 151 Industrial Road
Whitehorse, Yukon Y1A 2V3
Phone (867) 668-6463 Fax (867) 633-4882
www.alexcoenv.com

Memorandum

To: Kai Woloshyn, Alexco Resource Corp.

From: Cheibany Ould Elemine, P.Geo., Alexco Environmental Group Inc.

Date: October 25, 2018

Re: Summary of Geochemical Characterization of Bermingham Locked Cycle Tailings

1 INTRODUCTION

The Bermingham Mine Development and Production Project has received an Evaluation Report and Decision Document under the *Yukon Environmental and Socio-economic Assessment Act* (YESAA) at the Designated Office level (YESAB Project #2017-0176) and has recently applied for the renewal of Water Licence QZ09-092 and amend QML-0009 to authorize development and production of the deposit in addition to the previously authorised deposits.

The scope of the Bermingham Project includes the development of underground workings and ventilation/escape raise, construction of surface and underground infrastructure, underground definition drilling, development of ore accesses, mining and processing ore through the Keno District Mill, deposition of waste rock on surface, treatment and release of water and deposition of tailings in the licenced Dry Stack Tailings Facility (DSTF).

To characterize the acid rock drainage and metal leaching (ARD/ML) potential related to the tailings when exposed to oxidizing surface conditions, a large tailings sample was collected from the locked cycle (LC) metallurgical testing of Bermingham ore, and tested for their geochemical composition and properties. This technical memorandum summarizes the results of the geochemical static and kinetic tests conducted on this tailings material.

2 TAILINGS SAMPLE PREPARATION

One representative 5.5 kg tailings sample (Berm LCT2) was obtained from the LC metallurgical testing and sent to Maxxam Analytics, Burnaby, British Columbia for static and kinetic testing. The tailings sample was homogenized without any further crushing prior to shake flask extraction analysis and kinetic testing. One subsample of the tailings was crushed further to 85% passing 200 mesh (75 µm) for acid base accounting, elemental, and X-ray diffraction analyses.

3 LABORATORY GEOCHEMICAL TESTING

The acid base accounting (ABA) test included: paste pH, total inorganic carbon, bulk neutralization potential by the siderite-corrected method, and sulphur speciation with the sulphide sulphur determined by difference between total sulphur (Leco) and sulphate sulphur (HCl extraction). A sequential net acid generation (NAG) test was done as a cross-check on the ABA test work. The metal content of the tailings sample was determined by *aqua regia* digestion followed by inductively coupled plasma mass spectrometry (ICP-MS) analysis, and the mineralogical composition determined by X-ray diffraction (XRD) with Rietveld refinement. A standard shake flask extraction (MEND SFE) test was also performed using a 3:1 liquid to solid ratio using deionized water as leaching fluid. Kinetic testing using the standard humidity cell (HC) was also performed. The HC analysis was started in July, 2018 and is still in operation at the time of writing. Detailed descriptions of each of the above analytical methods can be found in Price (2009).

4 RESULTS

4.1 ACID BASE ACCOUNTING

The results of the ABA testing are presented Table 4-1. These results show that the Bermingham LC tailings have a slightly alkaline paste pH (8.15), a very high carbonate neutralization potential (carbonate-NP; 204 kg $CaCO_3$/t) and relatively low bulk neutralization potential (bulk NP; 56 kg $CaCO_3$/t)). The carbonate-NP was significantly (3.6 times) higher than the bulk NP due to the anticipated presence of a large proportion of iron and/or manganese carbonate such as siderite that do not contribute to the net acid neutralization under oxidizing conditions. The sulphate content of the tailings sample is extremely low (at the detection limit of 0.01 wt. %) indicating that the bulk of sulphur (1.39 wt.%) of the tailings consists of sulphide sulphur.

The neutralization potential ratio (NPR), defined as the ratio of the neutralization potential to the acid potential, provides an indication of acid generation over the long-term. A sample with an NPR less than one is termed "potentially acid generating (PAG)", whereas a sample with NPR greater than two is considered non-PAG. The Bermingham tailings returned an NPR of 1.3, which falls within the "uncertain" potential for acid generation (NPR between 1 and 2). This means that further tests are required to confirm the potential for ARD/ML classification.

Table 4-1 The results of ABA test of Bermingham locked cycle tailings

Sample ID	Paste pH	Total Sulphur	Sulphate-Sulphur	Sulphide-Sulphur	Total Inorganic Carbon (CO_2)	Carbonate -NP [a]	Siderite-Corrected NP [a]	Acid Potential	Neutralization Potential Ratio
	Unity	wt. %	wt.%	wt.%	wt.%	kg $CaCO_3$/t			Unity
Berm LCT2	8.15	1.39	0.01	1.38	8.96	204	56.3	43.1	1.3

[a] NP: neutralization potential

4.2 SEQUENTIAL NAG

The NAG test is often used as a cross check on the ABA results regarding potential for net acid generation. The NAG test rapidly oxidizes the sulphide in the sample by reacting it with an excess of hydrogen peroxide. In this

work, the NAG test was performed sequentially such that four successive NAG cycles were conducted on the same sample to ensure all of the available sulphide was oxidized. The pH of the NAG leachate after each cycle provides an indication of the capacity of the acid neutralizing minerals in the sample to buffer the acid produced from sulphide oxidation and therefore the overall net acid generation potential of the sample.

The results of the sequential NAG reported in Table 4-2 show that a negligible amount of acidity (i.e., 0.19 kg $CaCO_3$/t) was generated during the test and only during the first cycle suggesting a very low oxidation rate or that the sulphides content of the tailings is not reactive. The potential for acid generation is considered low because the NAG pH was circumneutral during the four cycles; the NAG test indicates a sample is non-PAG if the NAG pH is greater than 4.5. In short, the sequential NAG provides clarification regarding the "uncertain" acid generation potential indicated by the ABA work – that is, net acid generation is not expected from these tailings. Ongoing kinetic testing will also be used to provide further confirmation of the ARD potential of the Bermingham tailings.

Table 4-2 The Results of Sequential NAG Bermingham Locked Cycle Tailings

Sample ID	Cycle Number	NAG pH	NAG Volume to pH 4.5	NAG Volume to pH 7.0	NAG NaOH Conc.	NAG Acidity pH 4.5	NAG Acidity pH 7.0
		pH Units	mL	mL	N	kg $CaCO_3$/t	kg $CaCO_3$/t
Berm LCT2	Cycle 1	6.56	0.0	0.1	0.1	0.000	0.192
	Cycle 2	7.81	0.0	0.0	0.1	0.000	0.000
	Cycle 3	8.28	0.0	0.0	0.1	0.000	0.000
	Cycle 4	7.81	0.0	0.0	0.1	0.000	0.000

4.3 MINERALOGY

XRD was used to determine the mineralogical composition of the tailing and the results are reported in Table 4-3. These results show that the tailings are mainly composed of quartz (SiO_2; 59.3 wt. %) and calcium rich siderite ($FeCO_3$; 27.8 wt. % as calcian siderite). The tailings contain sulphide minerals, the main source of acidity, as pyrite (FeS_2; 2.2 wt. %), sphalerite (ZnS; 0.3 wt. %) and galena (PbS; 0.3 wt. %). In addition to calcian siderite, the tailings contain another carbonate mineral, ankerite ($Ca(Fe,Mg,Mn)(CO_3)2$; 1.0 wt. %), with no effective buffering capacity. These data indicate that the tailings consist predominantly of geochemically inert silica (~ 60 %) and iron and manganese carbonate minerals (28 %). Iron and manganese carbonates have a net neutral buffering capacity under aerobic conditions because the amount of acidity consumed during dissolution is subsequently generated during the oxidation and hydrolysis of ferrous iron. However, the XRD data indicates a calcium rich siderite where substitution of calcium for iron occurs which may result in some neutralization capacity of a portion of the siderite.

The potential AP estimated for the pyrite content of the tailings (AP = ~37 kg $CaCO_3$ /t) is slightly lower than the AP from the ABA meaning that the sulphide sulphur from galena and sphalerite, minerals that do not generate acid when oxygen is the only oxidant, may be the source of excess of AP in the ABA test.

Table 4-3 The results of XRD of Bermingham locked cycle tailings

Mineral	Berm LCT2 (wt. %)
Quartz	59.3
Siderite, calcian	27.8
Muscovite	8.2
Pyrite	2.2
Ankerite	1.0
Kaolinite	0.9
Sphalerite	0.3
Galena	0.3
Total	**100**

4.4 METALS CONTENT

The results of the solid-phase metals analysis of the Bermingham LC tailings are presented in Table 4-4. The enrichment or depletion of metals in the tailings was assessed by comparison with the ten (10) times the concentration of the same metals in the average crustal abundance compiled by CRC (CRC, 2005). The comparative analysis shows that a number of metals and metalloids that could be of potential environmental concern are enriched in the tailings compared to the reference crustal abundance. These are: antimony, arsenic, cadmium, lead, manganese, selenium, silver and zinc. The enrichment of these metals and metalloids in the tailings compared to the average crustal abundance is expected considering the source of the parent material (i.e., ore). The metal concentrations of lead and zinc are particularly elevated because they are the main base metal in sphalerite and galena remaining in the tailing after processing. The high concentration of arsenic is likely due to its known presence as trace element in sulphidic ore. The potential for leachability and solubility of these metals and metalloids is assessed in the SFE and HC tests.

Table 4-4 The results of metal analysis of the Bermingham locked cycle tailings

Element/Métal	Unit	Berm LCT2	Crustal Abondance [a]
Aluminum (Al)	%	0.16	8.23
Antimony (Sb)	ppm	44.6	0.2
Arsenic (As)	ppm	401	1.8
Barium (Ba)	ppm	30	425
Beryllium (Be)	ppm	0.25	2.8
Bismuth (Bi)	ppm	0.04	0.0085
Cadmium (Cd)	ppm	23.4	0.15
Calcium (Ca)	%	0.73	4.15
Chromium (Cr)	ppm	115	102
Cobalt (Co)	ppm	4.3	25
Copper (Cu)	ppm	57.5	60
Iron (Fe)	%	7.07	5.63
Lead (Pb)	ppm	2330	14
Lithium (Li)	ppm	1	20
Magnesium (Mg)	%	0.36	2.33
Manganese (Mn)	%	4.43	0.095
Mercury (Hg)	ppm	0.13	0.085
Molybdenum (Mo)	ppm	2.02	1.2
Nickel (Ni)	ppm	49.1	84
Phosphorus (P)	%	0.032	0.105
Potassium (K)	%	0.08	2.09
Selenium (Se)	ppm	0.8	0.05
Silver (Ag)	ppm	56.4	0.075
Sodium (Na)	%	<0.01	2.36
Strontium (Sr)	ppm	15	370
Thallium (Tl)	ppm	1.9	9.6
Tin (Sn)	ppm	2	2.3
Titanium (Ti)	%	<0.005	0.56
Uranium (U)	ppm	0.38	2.7
Vanadium (V)	ppm	5	120
Zinc (Zn)	ppm	2080	70

[a] Source: (CRC, 2005)

4.5 SHAKE FLASK EXTRACTION

SFE provides preliminary indication of the leachability, solubility and potential mobility of metals and metalloids during short-term leaching by meteoric water under oxidizing conditions. SFE is also used to screen for potential exceedances of water quality objectives, discharge standards or generic water quality guidelines.

The results of the SFE are reported in Table 4-5 alongside the District Mill pond effluent quality standards (EQS) at KV-83. Table 4-5 shows a circumneutral pH (pH= 8.17) consistent with the ABA paste pH and sequential NAG pH, low sulphate content (19.1 mg/L) and no measurable acidity (less than the method detection limit of 0.5 mg/L $CaCO_3$).

To screen for potential water quality exceedances, the SFE data were compared with the mill pond EQS as any seepage would report to the mill pond. No exceedance of the mill pond EQS were found. The solubility of metals and metalloids enriched in the tailings compared to the average crustal abundance did not generate exceedances despite the vigorous condition of the SFE test. Note that the comparison of result of SFE data with the EQS is not and should not be used as a measure of compliance with site water quality standards and objectives. Rather, the comparison provides a guide for potential constituents of concern in drainage from the tailings, which should be confirmed by kinetic testing.

Table 4-5 The results of SFE of the Bermingham locked cycle tailings

Leachable Metals	Unit	Berm LCT2	KHSD Mill Pond EQS (KV-83)
pH	pH units	8.17	6.5-9.5
EC	uS/cm	97.1	
SO4	mg/L	19.1	
Acidity to pH4.5	mg/L	<0.5	
Acidity to pH8.3	mg/L	<0.5	
Total Alkalinity	mg/L	14	
Bicarbonate	mg/L	18	
Carbonate	mg/L	<0.5	
Hydroxide	mg/L	<0.5	
Fluoride	mg/L	0.2	
Hardness CaCO3	mg/L	35	
Aluminum (Al)-Leachable	mg/L	0.0214	
Antimony (Sb)-Leachable	mg/L	0.0111	
Arsenic (As)-Leachable	mg/L	0.000331	0.1
Barium (Ba)-Leachable	mg/L	0.0134	
Beryllium (Be)-Leachable	mg/L	<0.000010	
Bismuth (Bi)-Leachable	mg/L	<0.0000050	
Boron (B)-Leachable	mg/L	<0.050	
Cadmium (Cd)-Leachable	mg/L	0.000309	0.01
Calcium (Ca)-Leachable	mg/L	12.4	

Leachable Metals	Unit	Berm LCT2	KHSD Mill Pond EQS (KV-83)
Chromium (Cr)-Leachable	mg/L	<0.00010	
Cobalt (Co)-Leachable	mg/L	0.000099	
Copper (Cu)-Leachable	mg/L	0.000334	0.1
Iron (Fe)-Leachable	mg/L	<0.0010	
Lead (Pb)-Leachable	mg/L	0.0188	0.2
Lithium (Li)-Leachable	mg/L	0.00294	
Magnesium (Mg)-Leachable	mg/L	0.988	
Manganese (Mn)-Leachable	mg/L	0.445	
Mercury (Hg)-Leachable	mg/L	<0.000050	
Molybdenum (Mo)-Leachable	mg/L	0.000928	
Nickel (Ni)-Leachable	mg/L	0.000368	0.5
Phosphorus (P)-Leachable	mg/L	0.0414	
Potassium (K)-Leachable	mg/L	1.7	
Selenium (Se)-Leachable	mg/L	0.000041	
Silicon (Si)-Leachable	mg/L	0.45	
Silver (Ag)-Leachable	mg/L	0.00003	0.02
Sodium (Na)-Leachable	mg/L	0.596	
Strontium (Sr)-Leachable	mg/L	0.0172	
Thallium (Tl)-Leachable	mg/L	0.000177	
Tin (Sn)-Leachable	mg/L	<0.00020	
Titanium (Ti)-Leachable	mg/L	<0.00050	
Uranium (U)-Leachable	mg/L	<0.0000020	
Vanadium (V)-Leachable	mg/L	<0.00020	
Zinc (Zn)-Leachable	mg/L	0.0172	0.5

Note: EQS: effluent discharge standards at KV-83

4.6 HUMIDITY CELL

The HC test provide an indication of the long-term rate of release of constituents (i.e., acidity, alkalinity, sulphate, major and trace elements) and provides robust evidence on the ARD/ML potential of a geologic material.

The Bermingham HC was started in July 2018 and the currently available 15 weeks (cycles) of data are reported and discussed herein. HC testing is still ongoing at the time of writing and will continue until a steady state release rate has been reached. Time series of selected constituents of interest are provided below and discussed in order to assess the rate of release and the ARD/ML potential of the tailings. Comparisons of HC data with the District Mill pond EQS were also done to determine if leachable constituent concentrations exceeding the EQS are observed.

The pH, acidity, alkalinity and sulphate released during the first 15 cycles are plotted in

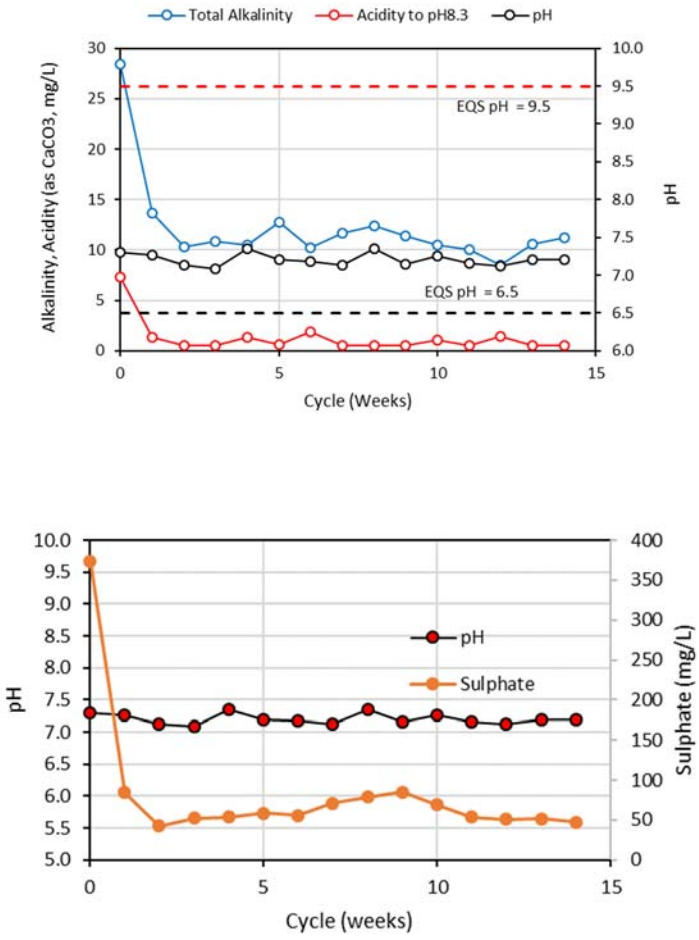

Figure 4-1 Figure 4-1. The plot shows a stable neutral pH of about 7.1-7.2, a very low acidity (maximum = 7.3 mg/L $CaCO_3$ during the first flush), an alkalinity high enough to buffer the acidify released, and sulphate concentration between 46 and 85 mg/L, excluding the first flush, indicating a low sulphide oxidation rate. The acidity, alkalinity and sulphate released show a first flush effect resulting from the release of readily soluble products followed by a decrease then stabilization of the rate during the following cycles for acidity and alkalinity. On the other hand, sulphate release gradually increased after the initial decrease, peaked at cycle 9 (84.9 mg/L) and has decreased since. Note that the HC pH is within the EQS range (6.5-9.5).

The times series of metals and metalloids of potential environmental concern are plotted in Figure 4-2 and Figure 4-3. The behaviour of arsenic, antimony, cadmium and copper are displayed in Figure 4-2 and lead, nickel, silver and zinc are shown in Figure 4-3. Analysis of the release show a similar pattern characterized by a flush effect during cycle 0 followed by a decrease of the concentration released then by a stabilization. However, sporadic fluctuations of concentration are visible in the plots of silver and copper. Copper and nickel concentrations show a slight increasing trend after cycle 2. Copper exhibits a generally weak increasing trend (increased from 0.00009 to 0.00075 mg/L between cycles 2 and 11) that peaked at cycle 11. It then declined and stabilized during the last three cycles. Nickel concentration is also decreasing after the increasing trend

noted between cycles two and nine. Zinc concentrations show a similar pattern as nickel. The leachate concentration of all these metals and metalloids are below the EQS.

Other important information derived from the analysis of the 10 cycles HC data include:

- The concentration of selenium in the HC leachate was low (average = 0.00009 mg/L);
- The concentration of ammonia was also very low (average = 0.03 mg/L) and well below the EQS of 0.5 mg/L; and
- The concentration of the following constituents was below the method of detection limit in all the cycles or at least in seven (7) of the 15 cycles: nitrate, nitrite, ammonia, beryllium, bismuth, boron, chromium, lanthanum, iron, mercury, silver, tellurium, thorium, tin, titanium, tungsten, uranium, vanadium and zirconium.

The neutral pH, alkalinity, low acidity and sulphate, and lower concentration of metal and metalloids compared to EQS are evidence of low potential for acid generation and metal release consistent with the sequential NAG and SFE results. However, the ARD/ML classification may change if an increase of oxidation rate generates an acidity greater than the buffering capacity. No evidence of such possible change is currently available, so the tailings are considered non-PAG.

Preliminary estimation of the lag time to acid generation using the current 15 cycles of data indicates that the times to sulphide and bulk NP depletion are approximately 26 and 34 years, respectively (Figure 4-4). Some bulk NP of the tailings will remain after the sulphide has been depleted, suggesting that net acid generation is not expected from the tailings. This preliminary lag time estimate will be updated after the HC has reached steady state conditions.

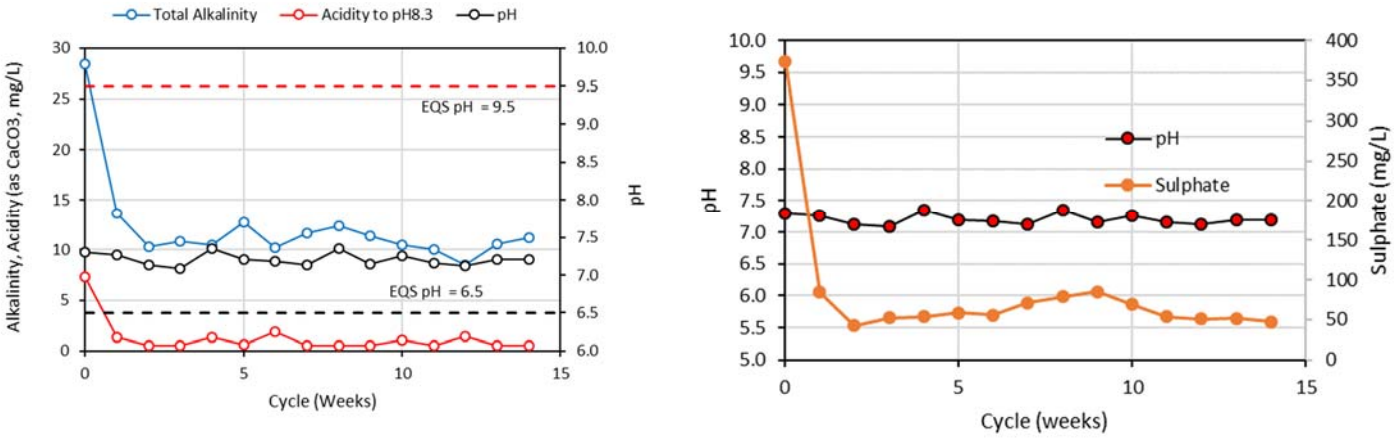

Figure 4-1 pH, alkalinity, acidity, (left), sulphate and pH (right) release in Bermingham tailing HC

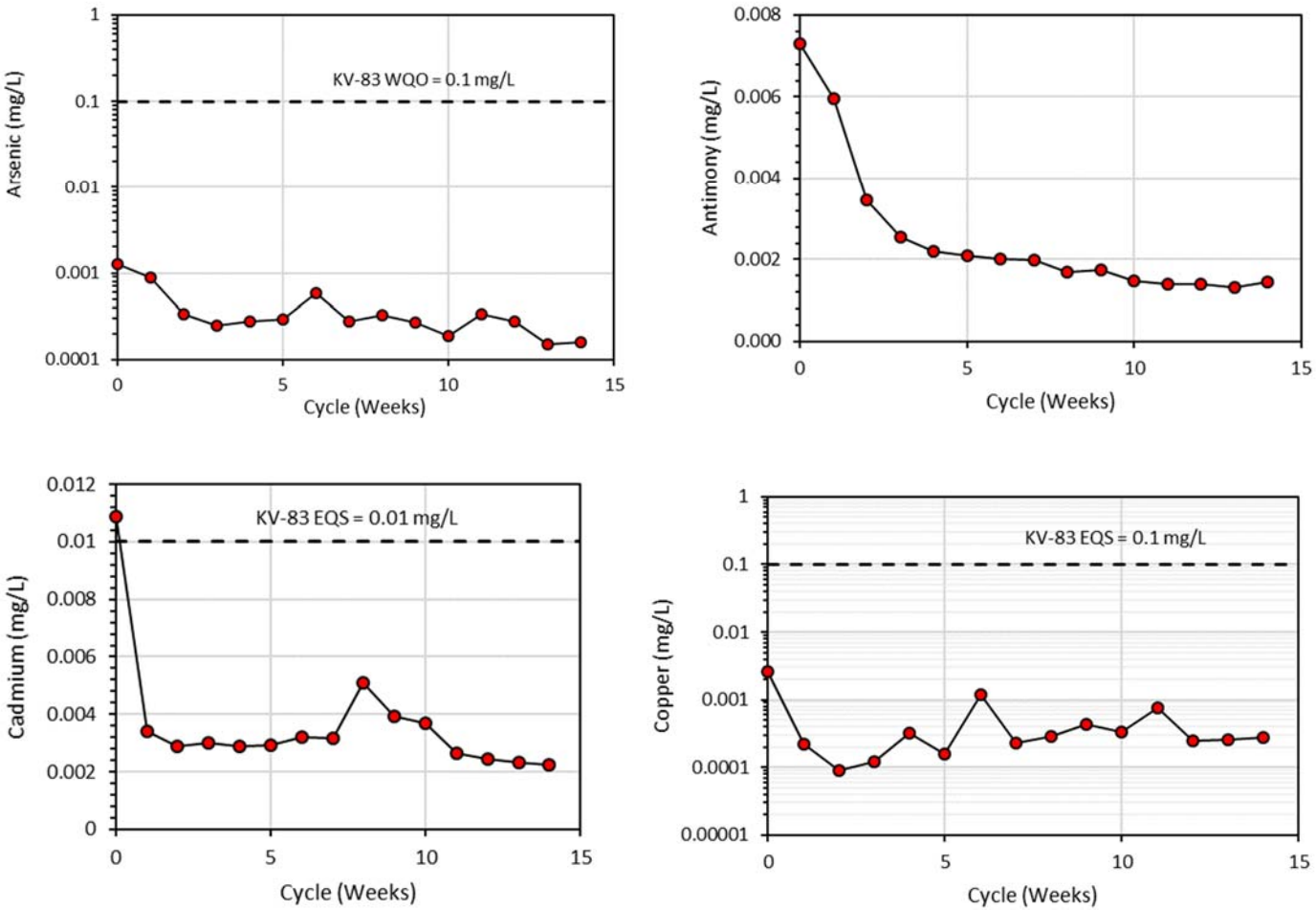

Figure 4-2 Arsenic (top left), cadmium (bottom left), antimony (top right), and copper (bottom right) release in Bermingham tailing HC. Note the log scale for copper

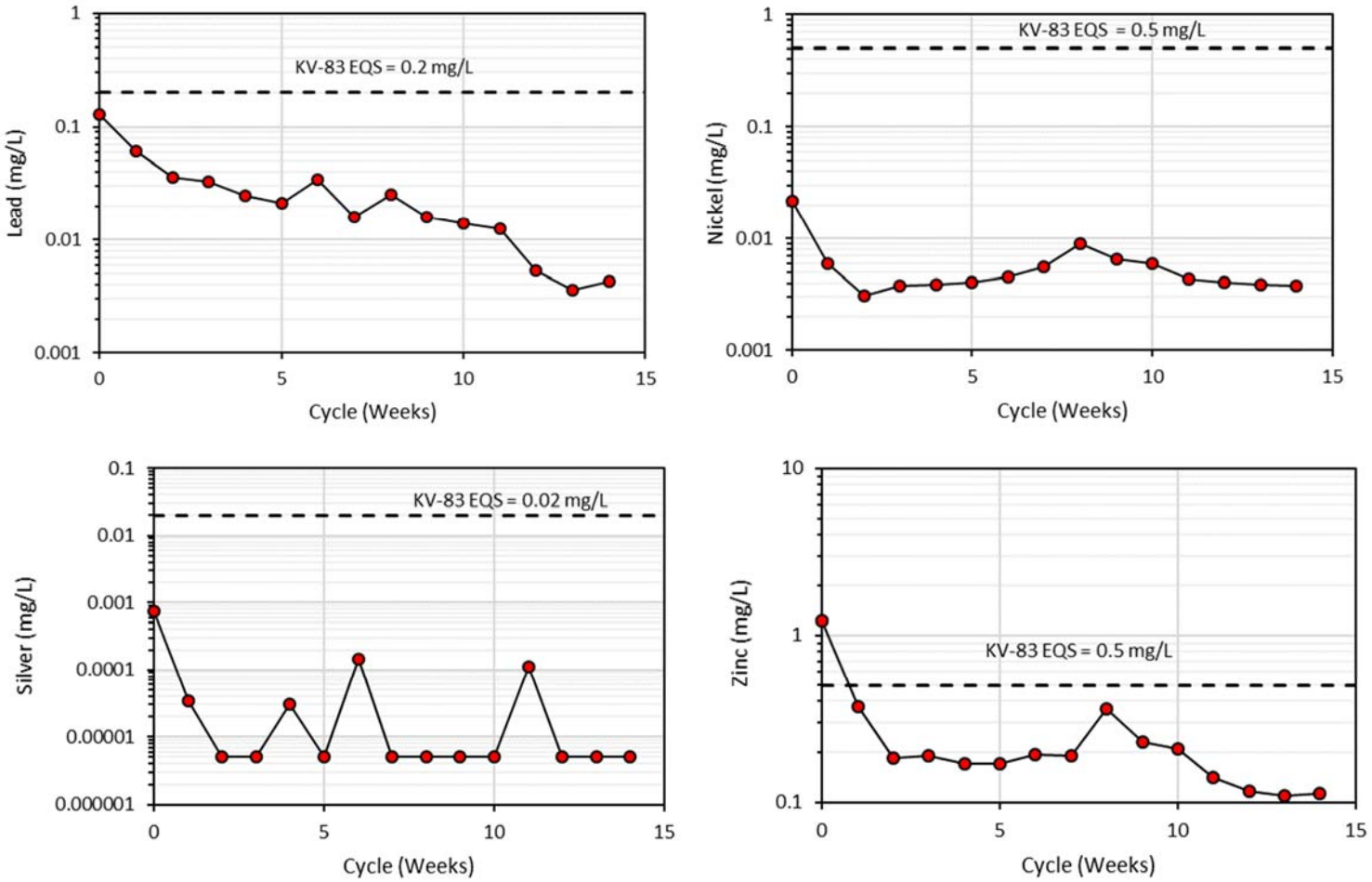

Figure 4-3 Lead (top left), silver (bottom left), nickel (top right), and zinc (bottom right) release in Bermingham tailing HC. Note the Log scale for all.

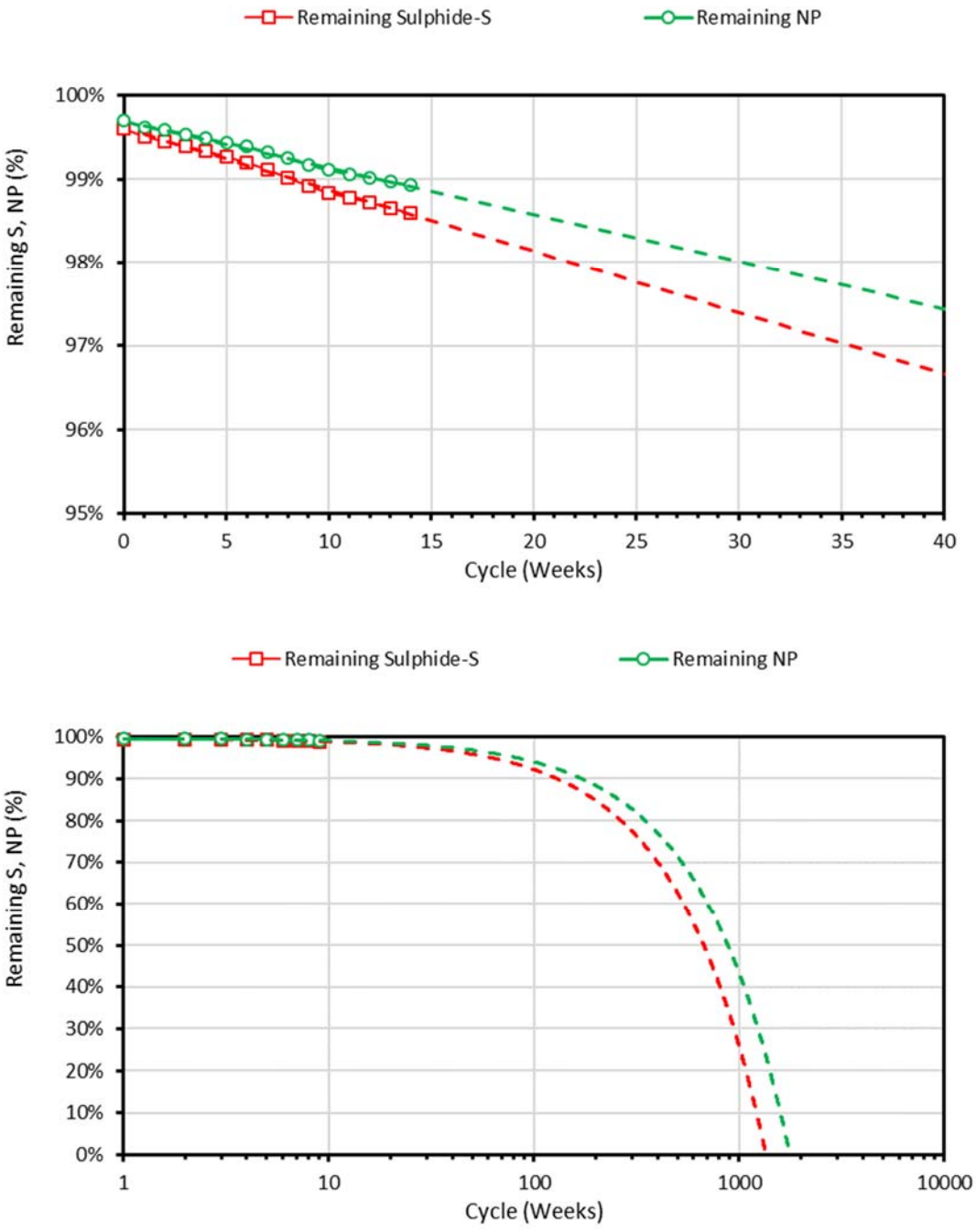

Figure 4-4 Preliminary Calculations of Sulphide Sulphur and NP Depletion in Bermingham Tailings Humidity Cell

5 SUMMARY

The results of static and kinetic tests conducted on the Bermingham LC tailings indicate that the tailings are mainly composed of silica, iron and manganese carbonates and minor sulphides. They have low potential for long-term acid generation due to an adequate NP buffering the acidity released from sulphide oxidation. The tailings have elevated bulk concentrations of several metals and metalloids but simulated short- and long-term leaching have shown that the water quality resulting from potential leaching by meteoric water is unlikely to exceed the EQS.

6 REFERENCES

CRC (2005). CRC *Handbook of Chemistry and Physics, 85th Edition.* CRC Press. Boca Raton, Florida.

Price, W.A. (2009) *Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials*. MEND Report 1.20.1. CANMET – Mining and Mineral Science Laboratories, Smithers, BC.

Attachment C

Geochemical Characterization of Bermingham Tailings

TAILINGS CHARACTERIZATION PLAN

REVISION 4

July 2018

ALEXCO KENO HILL MINING CORP.

KENO HILL SILVER DISTRICT MINE OPERATIONS

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1 INTRODUCTION

1.1 PURPOSE OF PLAN

This plan was originally submitted to fulfill the conditions set out in Part H, Clauses 67 and 68 of Water Licence QZ09-092 issued to Alexco Keno Hill Mining Corp. on August 19th 2010:

67. As part of the Operations, Maintenance, and Surveillance Manual required for the DSTF under QML-0009, the Licensee shall develop and implement a Tailings Characterization Plan and submit the plan to the Board by December 31, 2010.

68. The Tailings Characterization Plan shall include:

a) testing procedures to confirm the physical, chemical, and mineralogical properties of the low sulphur tailings which will be deposited at the facility. The procedures are required to determine at least the following properties or characteristics of the low sulphur tailings:

i. soil water characteristic curve;

ii. tailings gradation;

iii. tailings specific gravity;

iv. drained and undrained shear strength;

v. tailings pore water chemistry; and

vi. tailings mineralogy and acid base accounting.

b) provisions for conducting long-term humidity cell tests of tailings. Such tests shall be initiated for each new ore body mined and shall be continued until a steady-state has been established; and

c) sampling frequencies for confirming the properties of deposited tailings such that the assumed long term chemical and physical behaviour of the tailings stack can be progressively confirmed during operation Bellekeno Mine, and the rationale to support the recommended frequencies.

Water licence QZ09-092 (Amendment 1) was amended on May 15, 2013 (Application QZ12-053-1) to include development and mine production from the Onek and Lucky Queen deposits. The amended licence contains replacement clauses pertaining to an update of the Tailings Characterization Plan:

71. Within six months of the effective date of the Licence, the Licensee shall submit to the Board an updated Tailings Characterization Plan.

72. The Tailings Characterization Plan shall include:

a) *the testing procedures to confirm the physical, chemical, and mineralogical properties of the low sulphur tailings which will be deposited at the facility. The procedures are required to determine at least the following properties or characteristics of the low sulphur tailings:*

   i. *soil water characteristic curve;*

   ii. *tailings gradation;*

   iii. *tailings specific gravity;*

   iv. *drained and undrained shear strength;*

   v. *tailings pore water chemistry; and*

   vi. *tailings mineralogy and acid base accounting;*

b) *provisions for conducting long-term humidity cell tests of the comingled tailings generated through the processing of ore from the Bellekeno, Lucky Queen and Onek mines. Such tests shall be initiated as required to ensure adequate representation of the comingled tailings deposited in the DSTF as each new ore body is mined, and shall be continued until the make up of the DSTF at the end of operations is known and a steady-state has been established; and*

c) *sampling frequencies for confirming the properties of deposited tailings such that the assumed long term chemical and physical behaviour of the tailings stack can be progressively confirmed during operation of the Keno Hill Silver District Mill, and the rationale to support the recommended frequencies.*

An amended TCP was submitted to the Yukon Water Board on January 23, 2013 in fulfillment of the requirements. Water licence QZ09-092-2 (Amendment 2) was amended on December 22, 2017 to include development and mine production from the Flame and Moth deposits. The amended licence contains replacement clauses pertaining to an update of the Tailings Characterization Plan:

79. *Within 90 days of the effective date of amendment #2 of this Licence and within 30 days of any subsequent modifications to the plan, the Licensee shall submit to the Board an updated Tailings Characterization Plan.*

80. *The Tailings Characterization Plan shall include:*

    a) *the testing procedures to confirm the physical, chemical, and mineralogical properties of the tailings which will be deposited at the facility. The procedures shall determine, at a minimum, the following properties or characteristics of the tailings:*
        i. *soil water characteristic curve;*

        ii. *tailings gradation;*

        iii. *tailings specific gravity;*

        iv. *drained and undrained shear strength;*

v. tailings pore water chemistry; and

vi. tailings mineralogy and acid base accounting.

b) provisions for conducting long-term humidity cell tests of the comingled tailings generated through the processing of ore from the Bellekeno, Lucky Queen, Onek and Flame and Moth mines. Such tests shall be initiated as required to ensure adequate representation of the comingled tailings deposited in the DSTF as each new ore body is mined, and shall be continued until the make up of the DSTF at the end of operations is known and a steady-state has been established;

c) sampling frequencies for confirming the properties of deposited tailings such that the assumed long term chemical and physical behaviour of the tailings stack can be progressively confirmed during operation of the Keno Hill Silver District Mill, and the rationale to support the recommended frequencies;

d) proposed modifying criteria to reduce or increase frequencies identified in sub-clause c) accompanied by a supporting rationale and examples of the application of the rationale to the results of testing; and

e) at a minimum, the analysis of one full suite of the identified properties and characteristics for each ore body brought into production.

This plan outlines the methodology that will be followed to comply with the requirements of these clauses within the broader Keno Hill Mining District and presents information supporting the application of the Tailings Characterization Plan for use on tailings sourced from ores from other mines within the District including Flame and Moth and Bermingham.

1.2 KENO DISTRICT MINE TAILINGS CHARACTERIZATION

Under the original tailing characterization plan, all tailing materials produced were the result of the operations occurring at the Bellekeno mine area. As a result of the advancements of the Flame and Moth, Onek, Lucky Queen, and Bermingham projects, additional tailing materials will be produced once these areas come online and become part of the production stream. Thus, the revised tailing characterization plan is to be called the Keno District Mine Tailings Characterization plan.

In the first amendment of the tailings characterization plan, the Onek and Lucky Queen tailings were inferred to be 1) physically and 2) chemically similar to the Bellekeno tailings which will be progressively demonstrated by testing described in this plan. Tailings from Flame & Moth and Bermingham are assumed to be physically and chemically similar, which will be progressively demonstrated by appropriate testing. Ongoing geochemical and geotechnical tailings characterization as described in this plan will provide verification of the properties of the tailings and the expected performance of the tailings facility and management plan.

The existing Dry Stack Storage Facility (DSTF) has been permitted under QML-0009 and Water Licence QZ09-092 to accommodate 907,000 tonnes of tailings. The existing DSTF is designed for 322,000 tonnes while the phase II design has a capacity of 585,000 tonnes.

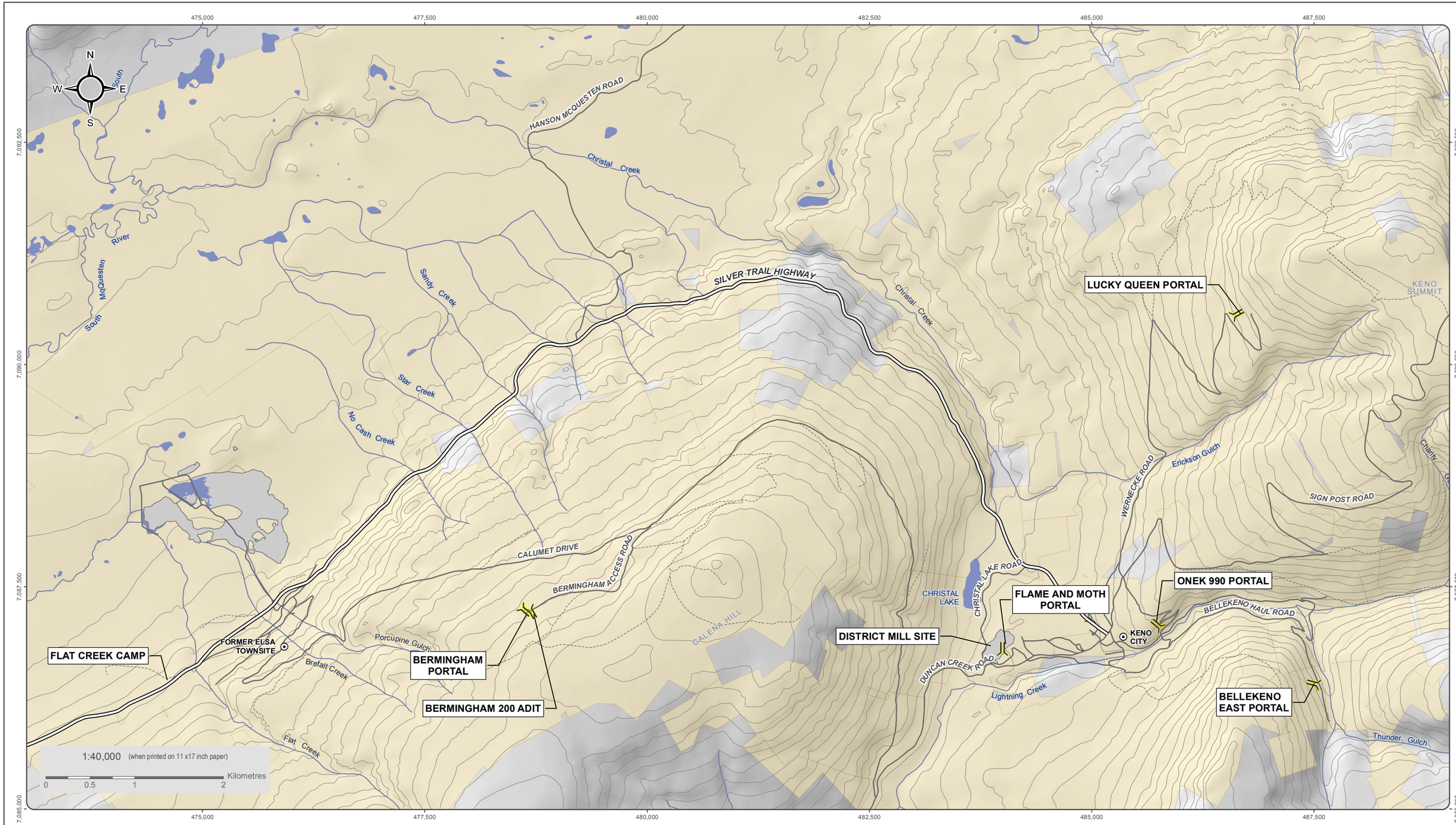
1.3 COMPATIBILITY OF TAILINGS WITH EXISTING TAILINGS MANAGEMENT

EBA was retained to undertake an assessment of the properties and suitability of incorporating tailings resulting from the milling of ores from Onek and Lucky Queen into the existing Dry Stack Tailings Facility, which currently consists of ores from Bellekeno only. This assessment by EBA is included as Attachment 1. Tailings from Flame & Moth and Bermingham are inferred to be suitably similar to tailings from the other deposits and will be incorporated into the existing DSTF (Phase 1) or used in Phase II of the DSTF.

2 MINE LOCATION AND DESCRIPTION

The Keno Hill Silver District is located in central Yukon Territory, 354 km (by air) due north of Whitehorse. The Bellekeno mine area is located approximately 3 km east of Keno City within the Keno Hill Silver District. Lucky Queen is located approximately 4 km northeast of Keno City and Onek is situated about 500 m northeast of Keno City. The mill site and Dry Stack Tailings Facility Phase 1 and Phase II (hereinafter referred to as the "DSTF") are located approximately 1 km west of Keno City. The Flame & Moth portal is located just to the east of the District Mill approximately 1 km west of Keno City (Figure 1). The Bermingham portal is situated on Galena Hill, close to the historical Bermingham 200 adit and approximately 6.5 km due west of Keno City.

The portal at Bellekeno East is located on a steep slope above Thunder Gulch, a narrow tributary of Lightning Creek, and the haul road access to the mill site is provided by an approximately 3 km access road which crosses Lightning Creek approximately 2,200 m downstream from the confluence of Thunder Gulch and Lightning Creek. Please see Figure 1 for the site map.



National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Cadastral data compiled by Natural Resources Canada. Reproduced underlicense from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on October 2017

Datum: NAD 83; Map Projection: UTM Zone 8N

- Place of Interest
- Adit
- Valley Tailings
- Alexco/ERDC Quartz Claims
- Waterbody
- Watercourse
- Silver Trail Highway
- Other Road
- Limited-Use Road

AKHM

ALEXCO ENVIRONMENTAL GROUP

ALEXCO KENO HILL MINING CORP.
BERMINGHAM

FIGURE 1

KENO HILL SILVER DISTRICT MINING OPERATIONS AREA OVERVIEW

JULY 2018

D:\Projects\All Projects\Keno_Area_Mines\BERM\Maps\01-Overview\03-Overview\SilverDistrict\Overview\Berm_overview_20170925.mxd
(Last edited by: amasliashevska;26/10/2017(8:41 AM))

3 TAILINGS CHARACTERIZATION PLAN FRAMEWORK

The tailings characterization plan provides methodology to characterize the physical and chemical and mineralogical properties of tailings produced at the Keno District mines. The Chief Assayer for Alexco Keno Hill Mining Corp. (AKHM) will be responsible for preparing the representative monthly composites that will form the basis for the proposed test work; except where alternative or additional samples are being collected.

3.1 PHYSICAL PROPERTY CHARACTERIZATION

Clause 80 (c) of the Licence states that sampling frequencies for confirming the properties of deposited tailings can be progressively confirmed during operation along with rationale supporting the recommended frequencies. Alexco retained EBA to undertake a review of the suite of physical property testing currently completed on tailings generated at the Keno District Mill and provide recommendations for ongoing testing requirements. This review from EBA is provided as Attachment 2 and recommends reducing or eliminating some of the routine physical testing parameters. The EBA review includes discussion and rationale for the recommended changes and provides triggers for additional physical property testing beyond the routine testing.

Following this advice, the following physical properties will be routinely determined as part of the ongoing characterization of physical parameters:

Table 1: Updated Routine Physical Testing Requirements

Test Description	Frequency
Tailings Gradation (hydrometer)	Monthly

The EBA review indicates that results from the full suite of physical property testing of tailings produced at the Keno Hill District Mill since 2011, including gradation, moisture (soil water characteristic curve), weight (specific gravity), and shear strength have remained consistent. In addition, routine inspections of the DSTF by EBA include field density and moisture content testing of the placed tailings. The recommended monthly laboratory testing (hydrometer) will confirm the gradation of the produced tailings. The shear strength of the tailings is controlled by the gradation, moisture, and weight of the material and will therefore be indirectly verified through the ongoing field and laboratory testing being completed. Triggers for additional physical property testing were recommended by EBA and were adopted as per below.

3.1.1 Triggers for Additional Physical Property Testing

The shear strength of the placed tailings within the DSTF will be verified indirectly through field and laboratory testing. The overall stability of the DSTF depends on the strength of the placed tailings. Quarterly direct shear testing will be resumed if gradation results indicate a deviation of 10% or greater from the results obtained to date.

3.1.2 Physical Property Testing Methods

The tailings grain-size distribution will be determined using ASTM approved methods for measuring coarse and fine-grained granular materials. A split of the monthly composite sample will be submitted for determination of the average monthly gradation. Tailings specific gravity will be determined using a split from the monthly tailings composite. The testing procedure will be conducted using ASTM approved methods.

Testing to determine the drained and undrained shear strength of the placed tailings will be conducted if required using quarterly composite samples created from the monthly composites.

The revised sampling frequencies for the physical behavior of the tailings Physical parameters of the placed tailings will be verified through a combination of physical monitoring results and laboratory testing programs and modified as necessary to ensure adequate physical characterization of the tailings.

3.2 MINERALOGICAL TESTING

While in operations, mineralogical testing of the tailings will be conducted quarterly. A quarterly composite will be submitted for quantitative Rietveld-XRD to determine the major mineral constituents of the tailings.

3.3 GEOCHEMICAL TESTING – STATIC TEST WORK

Tailings pore water chemistry will be determined through monthly monitoring of the Dry Stack Tailings Storage Facility (DSTF) collection sump. The DSTF collection sump is designed to collect runoff and seepage water from the tailings. This sump is located at the toe of the DSTF and seepage waters will be representative of water draining from the facility.

Chemical testing to characterize the placed tailings materials will be conducted in accordance with sampling guidance contained in MEND 2009. A spilt of the monthly composite will be submitted for acid-base accounting (ABA) (paste pH, Sobek neutralization potential with siderite correction, total inorganic carbon by HCl leach, total sulphur by Leco, sulphate-sulphur via HCl leach, and sulphide-sulphur by difference), standard 24-hour shake flask extraction shake flask testing and determination of the total metals content using aqua regia digestion and ICP-AES/MS analysis. The determination of the neutralization potential for these materials will be conducted using the siderite corrected method due to the elevated presence of this mineral in the tailings. If neutralization potential ratios for tailings are less than predicted, frequency of testing may be increased to determine variability.

3.4 GEOCHEMICAL TESTING – KINETIC TEST WORK

Humidity cell testing is an accepted method for identification of potential long term effects from geologic materials disturbed by mining activities. A humidity cell for geochemical characterization of the placed tailings was initiated at Bellekeno in August 2011 and was operated for 212 weeks. The humidity cell was a composite that comprised splits collected from representative monthly composites. The humidity cell composite comprised at least 10 splits collected during the first 16 months of operation. The use of monthly composites for an operational tailings characterization kinetic testing program is consistent with those

implemented as part of an operational geochemistry program for the Cantung Mine in the Northwest Territories.

A humidity cell containing Flame and Moth F4 and F5 size fraction tailings generated from metallurgical testing was also conducted (operated for 113 weeks) as part of the geochemical characterization work for the Flame and Moth project.

A humidity cell composed of tailings produced from metallurgical testing of the Bermingham mineralization was initiated in June 2018. An additional humidity cell with blended tailings from multiple deposits including Bermingham will be initiated in 2018 following the completion of the pending metallurgical testing.

As required by Clause 80 (b) of the Licence, additional long term humidity cell tests will be initiated from co-mingled tailings sourced from Bellekeno, Lucky Queen, Onek, Flame and Moth, and Bermingham ore. Similar to the Bellekeno tailings humidity cell, these humidity cells will be composed of splits collected from at least 10 representative monthly composites produced during initial production from each of these deposits. If production is resumed from multiple deposits concurrently, a representative humidity cell consisting of at least 10 monthly sample composites comingled from the deposits in production will be initiated. If one orebody is replaced with another in the mill feed stream, or if an additional orebody is added, a new humidity cell will be initiated based on a composite of the tailings splits produced. In this way, a humidity cell test will be initiated as required to ensure adequate representation of the comingled tailings deposited in the DSTF as each new ore body is mined. All humidity cells will be continued until the makeup of the DSTF at the end operations is known or a steady-state has been established.

4 IMPLEMENTATION SCHEDULE

AKHM commenced with the assembly monthly composites at the start of commercial production in Q1 2010. All routine physical and geochemical testing will continue as ores from Flame and Moth, Onek and Lucky Queen are added to the production stream and commercial production is resumed. Humidity cell testing on Bellekeno composites commenced in 2010 and were terminated after stability was achieved following 212 weeks. Once back into production new humidity cells will be initiated and will likely be a composite of Bellekeno and other ores, which as discussed above, will be conducted using combined tailings once ore from Flame and Moth, Onek, Lucky Queen, and Bermingham are added to the production stream in addition to Bellekeno.

To satisfy Clause 80 (e), the full suite of physical and geochemical testing described in Sections 3.1 to 3.3 will be conducted for tailings produced for each new ore body that is brought into production (i.e., Onek, Lucky Queen, Flame and Moth, and Bermingham).

5 REPORTING

The results of the tailings characterization program will be included with the annual report for Water Licence QZ09-092-092 according to Clause 25, 26 and 27:

25. *The Licensee shall provide to the Board one unbound, single-sided, paper copy of all reports required by this licence. All reports must be reproducible by standard photocopier.*

26. *The Licensee shall upload electronic copies of all reports required by this licence to the Board's online licensing registry, the WATERLINE. Electronic copies shall be submitted in one of the following formats: Word 97 - 2003, Excel 97 - 2003 workbooks, or Adobe .pdf format.*

27. *All water quality, water quantity and water level data shall also be submitted in Excel format. Water quality results must be uploaded to Waterline in the format outlined in the most recent version of Yukon's "Laboratory Data Submission Standards for Water Quality". This guide is available on the Board website.*

ATTACHMENT 1

EBA OPINION ON PROPERTIES OF LUCKY QUEEN AND ONEK TAILS: FOR USE IN EXISTING DRY STACK TAILINGS DISPOSAL FACILITY, NEAR BELLEKENO MILL, YT (EBA FILE: W14101178.011), WHITEHORSE, YT.

A TETRA TECH COMPANY

March 2, 2012

ISSUED FOR USE
EBA FILE: W14101178.011

Alexco Keno Hill Mining Corp.
#4 – 151 Industrial Road
Whitehorse, YT Y1A 2V3

Via Email: bthrall@alexcoresource.com

Attention: Brad Thrall

Subject: EBA Opinion on Properties of Lucky Queen and Onek Tails
For Use in Existing Dry Stack Tailings Disposal Facility, near Bellekeno Mill, YT

The physical and chemical properties of the tailings that will be produced from the two new ore zones are expected to be very similar to the geological and geotechnical properties of the Bellekeno ore zone tailings. Experience gained from thorough geological review of deposits throughout the Keno Hill Silver District indicates there are minor variations in ore mineralogy and deposit configuration, but all deposits discovered to date fall within a relatively narrow and well understood geological range, all hosted within the same geological terrain, age range and subjected to similar structural controls and ore genesis environments.

Within that range, the geotechnical properties of the tailings produced from milling these variations are expected to be very similar. As part of ongoing DSTF operations, maintenance and surveillance protocol and procedures, these assumptions will be confirmed through testing through the ongoing implementation of the Tailings Characterization Plan. Results of analytical testing presented in the YESAB Project Proposal indicate the similar geological nature of the three ore zones. All ore from each of the three deposits will be processed in the same mill, with the same mill process flow sheet, therefore producing a nearly identical particle size distribution.

If there are any minor variations in the nature of Lucky Queen and Onek tails from the Bellekeno tails, they are not expected to affect the geotechnical performance of the DSTF.

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

Sincerely,
EBA Engineering Consultants Ltd.

J. Richard Trimble, P.Eng., FEC
Principal Consultant, Arctic Engineering
Ph: 867-668-2071 x222 Email: rtrimble@eba.ca

EBA Engineering Consultants Ltd. operating as EBA, A Tetra Tech Company
Calcite Business Centre, Unit 6, 151 Industrial Road
Whitehorse, YT Y1A 2V3 CANADA
p. 867.668.3068 f. 867.668.4349

ATTACHMENT 2

TETRA TECH EBA OPINION ON TAILINGS CHARACTERIZATION PLAN PHYSICAL TESTING REQUIREMENTS, KENO HILL DISTRICT MILL, YUKON (EBA FILE: W14103144), WHITEHORSE, YT

TETRA TECH EBA

January 15, 2014

ISSUED FOR USE
FILE: W14103144

Access Consulting Group
3-151 Industrial Road
Whitehorse, YT Y1A 2V3

Via Email: eallen@accessconsulting.ca

Attention: Ethan Allen, M.Sc.- Environmental Geoscientist

Subject: Tailings Characterization Plan – Physical Testing Requirements
Keno Hill District Mill, Yukon

1.0 INTRODUCTION

In partial fulfillment of Alexco Resource Corporation's water license (QZ09-092), Access Consulting Group (Access) is preparing an updated Tailings Characterization Plan. Access retained Tetra Tech EBA Inc. (Tetra Tech EBA) to review the suite of physical property testing currently completed on the tailings generated at the Keno Hill District Mill and provide recommendations for ongoing testing requirements. This letter presents the current suite of testing being completed, Tetra Tech EBA's recommendation for ongoing testing, and rationale for the recommendation.

2.0 CURRENT PHYSICAL TESTING REQUIREMENTS

Laboratory tests to verify the physical properties of the tailings generated at the Keno Hill District Mill are completed on a regular basis. The following Table 1 summarizes the physical tests and testing frequencies stated in the current Tailings Characterization Plan.

Table 1: Current Physical Testing Requirements

Test Description	Frequency
Gradation (hydrometer)	Monthly
Soil water characteristic curve	Monthly
Specific gravity	Monthly
Shear strength	Quarterly

3.0 RECOMMENDED PHYSICAL TESTING REQUIREMENTS

Tetra Tech EBA recommends the physical property testing requirements in the Tailings Characterization Plan be updated as shown in the following Table 2.

Table 2: Recommended Physical Testing Requirements

Test Description	Frequency
Gradation (hydrometer)	Monthly

Tetra Tech EBA Inc.
61 Wasson Place
Whitehorse, YT Y1A 0H7 CANADA
Tel 867.668.3068 Fax 867.668.4349

3.1 Discussion

Tetra Tech EBA has been completing and reviewing the physical property testing for tailings produced at the Keno Hill District Mill since production began in 2011. In that time the results of the physical property testing for gradation, moisture, weight, and shear strength have remained consistent. Tetra Tech EBA also conducts routine inspections of the Dry Stack Tailings Facility (DSTF) which include field density and moisture content testing of the placed tailings.

The density (weight) and moisture content of placed tailings is verified in the field during routine DSTF inspections. The recommended monthly laboratory testing (hydrometer) will confirm the gradation of the produced tailings. The shear strength of the tailings is controlled by the gradation, moisture, and weight of the material and will therefore be indirectly verified through the ongoing field and laboratory testing being completed.

3.2 Triggers for Additional Physical Property Testing

The shear strength of the placed tailings within the DSTF will be verified indirectly through field and laboratory testing. The overall stability of the DSTF depends on the strength of the placed tailings. Tetra Tech EBA recommends quarterly direct shear testing be resumed if gradation results indicate a deviation of 10% or greater from the results obtained to date.

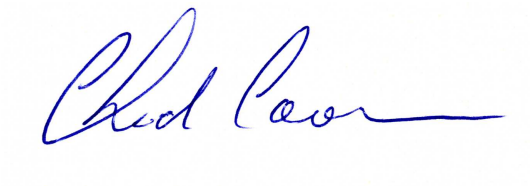
4.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Access Consulting Group and their agents. Tetra Tech EBA Inc. (Tetra Tech EBA) 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 Access Consulting Group, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech EBA's Services Agreement. Tetra Tech EBA's General Conditions are attached to this letter.

5.0 CLOSURE

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

Respectfully submitted,
Tetra Tech EBA Inc.



Justin Pigage, P.Eng.
Geotechnical Engineer, Arctic Region
Direct Line: 867.668.9213
justin.pigage@tetratech.com

Chad Cowan, P.Eng.
Project Director – Yukon, Arctic Region
Direct Line: 867.668.9214
chad.cowan@tetratech.com

GENERAL CONDITIONS

GEOTECHNICAL REPORT

This report incorporates and is subject to these “General Conditions”.

1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of Tetra Tech EBA’s Client. Tetra Tech EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than Tetra Tech EBA’s Client unless otherwise authorized in writing by Tetra Tech EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of Tetra Tech EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where Tetra Tech EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed Tetra Tech EBA’s instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by Tetra Tech EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of Tetra Tech EBA’s instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Tetra Tech EBA. Tetra Tech EBA’s instruments of professional service will be used only and exactly as submitted by Tetra Tech EBA.

Electronic files submitted by Tetra Tech EBA have been prepared and submitted using specific software and hardware systems. Tetra Tech EBA makes no representation about the compatibility of these files with the Client’s current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, Tetra Tech EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. Tetra Tech EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. Tetra Tech EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

7.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

8.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

9.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

10.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

11.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

12.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

13.0 SAMPLES

Tetra Tech EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

14.0 INFORMATION PROVIDED TO TETRA TECH EBA BY OTHERS

During the performance of the work and the preparation of the report, Tetra Tech EBA may rely on information provided by persons other than the Client. While Tetra Tech EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, Tetra Tech EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.