August 12, 2021

Ms. Kimberly Dennis
Aggregate Industries-WCR
301 Centennial Drive
Milliken, CO 80543

Re: Stability Analysis, Tucson South Amendment, Clay Liner at the Aurora Challenger Pond

Dear Ms. Dennis:

This letter has been prepared to address the Mined Land Reclamation Board (MLRB) Construction Materials Rule 6, Section 4, Subsection 19, Exhibit S - Permanent Man-Made Structures (6.4.19, Exhibit S) for the proposed Tucson South Amendment of the Tucson South Mine located in Weld and Adams Counties, Colorado. Previous analyses regarding structure offsets were performed by Tetra Tech (2019). The analyses performed herein address the stability of the clay liner constructed at the City of Aurora Challenger Reservoir. Specifically, the analyses address surcharge loads anticipated during construction and maintenance of the conveyor to be constructed along the Challenger Reservoir.

The site is located south and west of the intersection of 168th Street and Tucson Street in Adams County, Colorado. More specifically, the mine is within part of Section 1, Township 1 South, Range 67 West of the 6th Principal Meridian. The site is approximately 2,600 feet west of the South Platte River. Land uses in the area include agricultural, oil and gas production, active gravel mines, gravel mines reclaimed as below grade reservoirs, and residential housing.

The site will be mined in two cells referred to as West and East areas. A conveyor will transfer mine products from the mine to the Wattenberg Lakes Mine located approximately 1.5 miles north of the Tucson South Mine. The majority of the conveyor route passes along unmined, nearly flat land. However, part of the conveyor will be located near the top of the clay liner which was constructed at the below grade Challenger Reservoir. Review of the final grades of the reservoir, indicates the liner slopes approximately 3 horizontal to 1 vertical (3h:1v) and is approximately 30 feet in height.

Based on the stability analyses discussed herein, the clay liner will be stable when subjected to the anticipated surcharge loads.

GEOLOGY

The Site is located approximately 25 miles east of the eastern flank of the Rocky Mountain Front Range. Younger sedimentary strata dip eastward off the Pre-Cambrian igneous and metamorphic rocks that form the core of the Front Range into the Denver Structural Basin. The Denver Basin is an asymmetrical downwarp of sedimentary strata with a steeply dipping west limb and a gently dipping east limb.

Bedrock does not crop out at the site, however regional geologic mapping of the area (Trimble and Machette, 1979) indicates the near surface bedrock at the site is most likely the Denver Formation. Trimble and Machette (1979) describes the Denver Formation as claystone, siltstone, and sandstone. The regional mapping indicates the bedrock is overlain by the Post Piney Creek and Piney Creek Alluviums. Trimble and Machette (1979) describes these alluvial deposits as sandy to gravelly alluvium.

GEOTECHNICAL CONDITIONS

Based on the site investigations, the natural site stratigraphy generally consists of four main units: 1) Overburden generally consisting of sandy clay and clayey and silty sands; 2) sand and gravel alluvial deposits that underlie the overburden and overlie the bedrock; 3) a mud lens locally interbedded within the sand and gravel; and 4) bedrock usually consisting of claystone, sandy claystone with local areas of sandstone. These units are described in more detail below.

Overburden Unit
The overburden at the site typically ranges from sandy clay to clayey sand locally grading to silty sand. This unit ranges from approximately 0.5 to 6 feet in thickness. This unit is usually slightly moist to moist, very stiff to hard or medium dense to dense with the top 6 inches containing significant organics. Of the samples tested, the percent passing the No. 200 sieve ranged from 29.0% to 88.2%. Atterberg Limits testing resulted in Liquid Limits of 22 to 68 and Plasticity Indices of 4 to 47.

Sand & Gravel Unit
The sand and gravel is present throughout the site usually underlying the overburden and overlying the bedrock. Locally, this unit is present at the ground surface on the west part of the west cell. This unit typically consists of gravelly, fine to coarse grained sand locally grading to sandy gravel. Where gravels were encountered, the size was typically ¼ to 3 inches. This unit is typically medium dense to dense but is also locally loose. This deposit ranges in thickness from approximately 8 feet to 50 feet. The sands are clean with fines content (silt and clay) generally considered to be on the order of approximately 2 to 6 percent. Local clay to clayey lenses were also logged within the deposit.

Mud Lens Unit
The mud lens typically ranges from fine silty sand to sandy clayey silt, to silty clay. This unit is most common west of Tucson Street but also is found on the east side of the street. It is commonly interbedded within the sand and gravel unit.

Bedrock
The bedrock encountered in the exploratory borings was generally weathered in the upper one to two feet typically becoming harder in unweathered zones. The bedrock consisted of sandy claystone locally grading to silty, fine to medium grained, sandstone with local claystone seams. For the claystone samples, the percent passing the 200-sieve ranged from 51.7 to 95 percent. For the sandstone samples, the percent passing the minus No. 200 sieve ranges from approximately 11.4% to 29.2%.

Groundwater
Groundwater was encountered in all the borings at approximately 5 to 13 feet below ground surface at the time of drilling. The groundwater levels will vary seasonally and will typically rise during the irrigation season. Groundwater will be controlled with the proposed below grade slurry wall. After slurry wall construction, groundwater mounding is anticipated on the upgradient (west and south) side of the site, and a groundwater shadow (deeper water table) is anticipated on the downgradient (north and east) side the site. An underdrain has been designed around the west slurry wall to mitigate mounding and shadowing effects.

STRUCTURES WITHIN 200 FEET OF MINED AEAS
Structures within 200 feet of the mine limits are listed in Exhibit S of the DRMS Amendment. As mentioned above, stability analyses addressing off set from the mining were performed by Tetra Tech (2019) in the previous amendment. The purpose of this analysis is to evaluate the stability of the Challenger Reservoir clay liner with anticipated surcharge loads during construction and maintenance of the off-site conveyor.

STABILITY ANALYSES
Recently, Division of Reclamation and Mining Safety (DRMS) staff drafted a policy regarding stability analyses of neighboring structures. The draft summarizes adequate factors of safety (FOS) for non-critical and critical structures. The Challenger Reservoir Clay liner is considered a critical structure. Discussions with the author of the memo, Mr. Tim Cazier, indicate the FOS will be adopted by the Mined Land Reclamation Board (MLRB). The FOS are for both static and seismic (from an earthquake) stability analyses. For generalized strength assumptions and critical structures, a FOS of 1.5 is considered sufficient for static conditions and a FOS of 1.3 is considered suitable for seismic conditions.

The stability of Challenger Clay Liner was analyzed on one (1) section considered to be the maximum section. The section was analyzed under anticipated loading conditions as discussed below. The computer program XSTABL was used for the analysis. The method for selecting the critical failure surface for each analyzed loading condition is the following. The Modified Bishop's Method of Analysis is used to find the critical failure surface by randomly searching with 20 termination points and 20 initiation points (400 failure circles) with 7-foot line segments over the slope surface and at the structure in question to determine the lowest factor of safety. Both static stability under anticipated conditions and seismic stability under peak ground acceleration loads were performed. A maximum horizontal acceleration of 0.067g was used at the site.

The cross-section location was selected and analyzed as described below. The section met adequate FOS as summarized below in Table 1. The section locations are shown on Figure 1.

- <u>Challenger Clay Liner:</u>
  This section is on the east side of the reservoir considers the tallest section adjacent to the conveyor. The stability analysis for this section assumes a mine highwall sloped at 0.5 horizontal to 1 vertical (0.5h:1v). The clay liver slopes 3h:1v. The overburden was modeled at 4 feet thick. The underlying sand and gravel was modeled at 26 feet thick with a 4 feet thick interlensed mud lens. One foot of residual strength bedrock was modeled over unweathered bedrock. A 3,000 psf surcharge was modeled at the top of the liner near the conveyor.

<u>MATERIAL PROPERTIES</u>

The material index and engineering strengths assumed in this slope stability report match those used in the Tetra Tech (2019) analyses and are discussed below.

Overburden

The strength properties for the in situ sandy clay to silty to clayey sand overburden were based on field testing data and on our engineering judgment; the following parameters have been used to model the overburden.

Moist Unit Weight (pcf)	*Saturated Unit Weight (pcf)*	*Cohesion C' psf*	*Friction Angle Φ'*
114	126	50	28

Alluvial Sand and Gravel

The sand and gravel is generally a medium to coarse-grained sand that is medium dense to dense and locally gravelly. The alluvial sand and gravel was modeled as follows:

Moist Unit Weight (pcf)	*Saturated Unit Weight (pcf)*	*Cohesion C' psf*	*Friction Angle Φ'*
130	137	0	35

Mud Lens

The strength properties for the mud lens was based on field testing data and on our engineering judgment; the following parameters have been used to model the overburden.

Moist Unit Weight (pcf)	*Saturated Unit Weight (pcf)*	*Cohesion C' psf*	*Friction Angle Φ'*
114	126	50	28

Bedrock
Bedrock below the alluvium is predominately sandy claystone with local sandstone. Sandstone is typically stronger than claystone. Claystone is generally a weak bedrock. To be conservative, we modeled the bedrock as claystone. For the claystone bedrock, two potential strength conditions were considered. These strength conditions are referred to as: 1) peak strength, and 2) residual strength.

Peak strength is the maximum shear strength the claystone bedrock exhibits. The shear strength is made up of both cohesion (diagenetic bonding) and internal friction. Under short-term conditions for unsheared claystone, peak strength governs behavior. If a sheared surface or sheared zone is present within claystone as a result of faulting, slippage between beds due to folding, past shrink-swell behavior, stress relief, weathering, or from a landslide, the cohesion along the sheared surface is reduced to zero, and the angle of internal friction is decreased, due to alignment of clay minerals parallel to the shear plane. Under these conditions a claystone exhibits its lowest strength known as residual strength. Residual strength bedrock occurs in discrete zones, parallel with the sheared surface or zone, whereas fully softened strength occurs over a broader area (not used in this modeling). Based on data from other recent projects and engineering judgment, the residual strength claystone was modeled in a one-foot-thick layer overlying the peak strength bedrock as follows:

Moist Unit Weight (pcf)	***Saturated Unit Weight (pcf)***	***Cohesion C' psf***	***Friction Angle Φ'***
Peak = 124 Residual = 124	Peak = 134 Residual = 134	Peak = 100 Residual = 0	Peak = 28 Residual = 14

<u>STABILITY ANALYSES RESULTS</u>

The factor of safety shown below in Table 1 is the minimum factor of safety of the conditions listed above.

TABLE 1 - SLOPE STABILITY RESULTS AND SETBACKS

Section	Critical Structure	Static Factor of Safety at Structure	Seismic Factor of Safety at Structure (0.067g horizontal)	DRMS Draft FOS Requirement Static/Quake
1	Clay Liner	1.6	1.3	1.5/1.3

<u>CONCLUSIONS</u>
Based on the Factors of Safety listed in the table above, the conveyor will not be a hazard to the clay liner provided the surcharges and subsurface conditions are as modeled.

LIMITATIONS

Our review is based on regional geologic mapping, present mining plans, and in part borehole data by others. Stability analyses were performed using typical strength parameters for the various strata in the critical sections. Should the mining or conveyor plans change, or subsurface conditions vary from those portrayed in this letter, we should be contacted to re-evaluate the potential affects on permanent man-made structures.

Please call with any questions or comments.

Sincerely,

Civil Resources, LLC

Gary Linden, P.G.
Senior Engineering Geologist

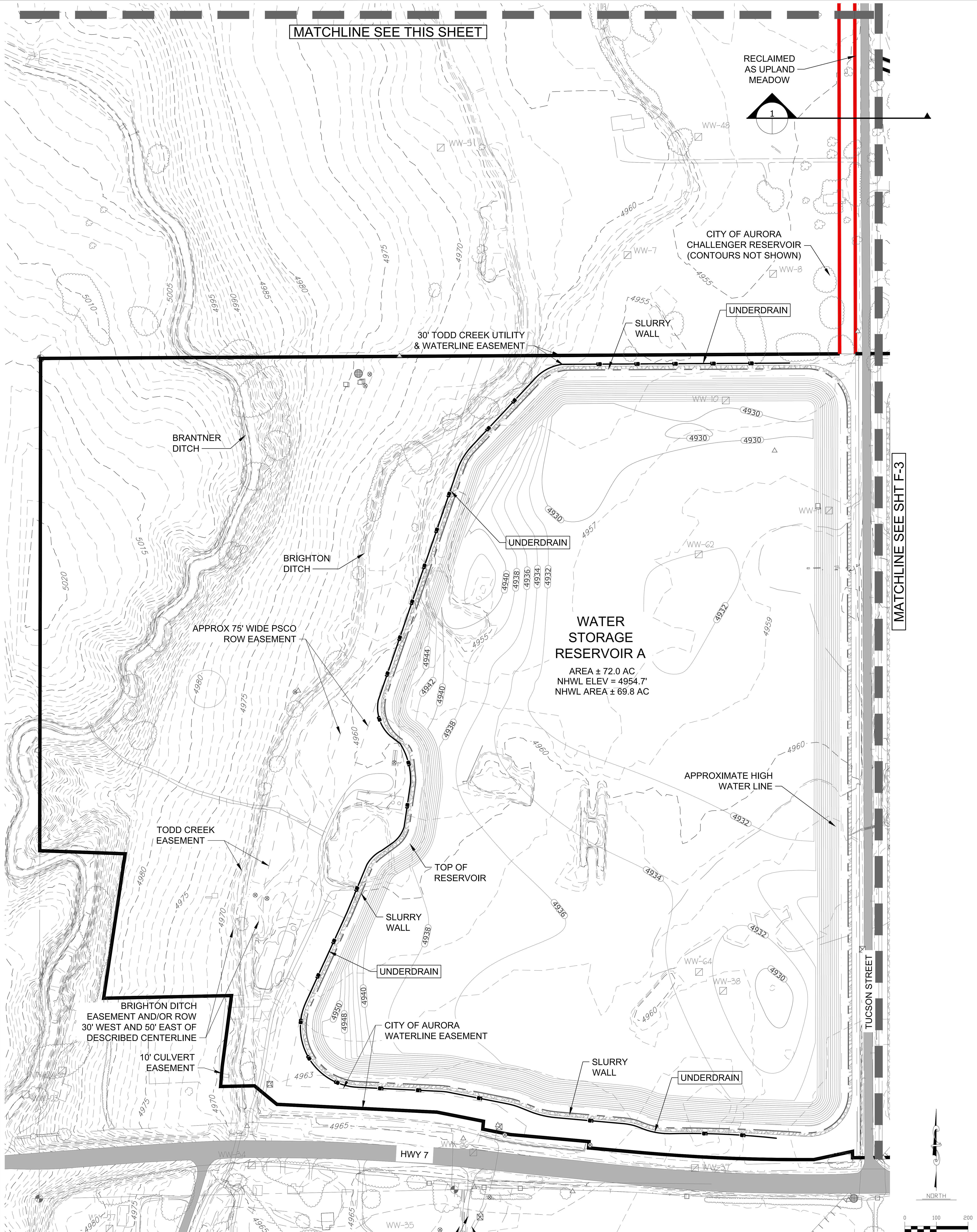
Attachments: Figure – Reclamation Plan showing section used.
XSTABL Model Outputs: Section 1

Reference:

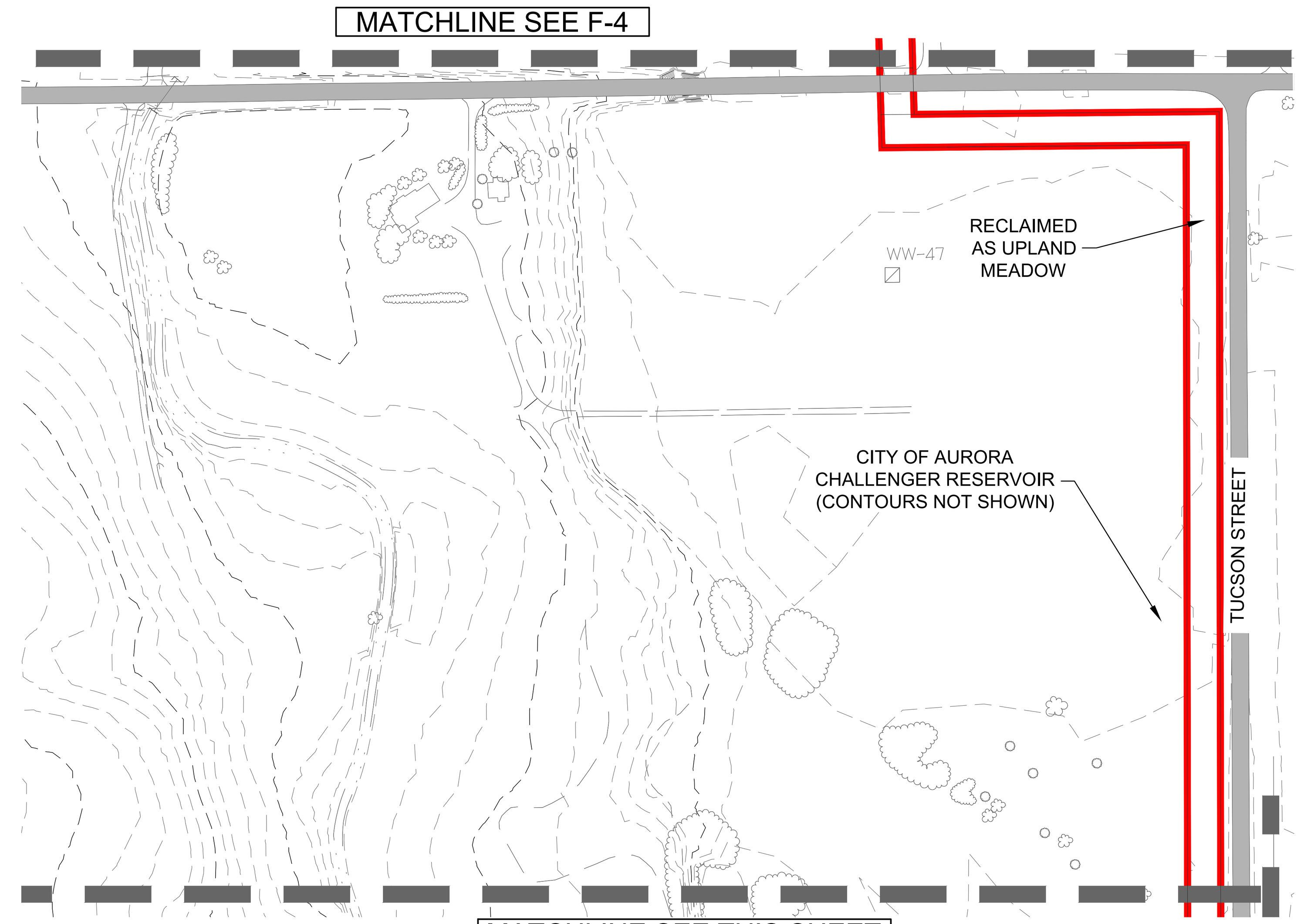
Tetra Tech, 2019. Slope Stability and Setback Updates, July 3, 2019: Tetra Tech Job No. 200-23514-18004

Trimble, D.E. and Machette, M.N.; "Geologic Map of the Greater Denver Area, Front Range Urban Corridor, Colorado"; U.S.G.S. Map I-856-H.

J:\Aggregate Industries-297\Tucson South Permit Support\2021 amendment\Exhibit S\Stability Analysis\Tucson South Stability analysis.doc



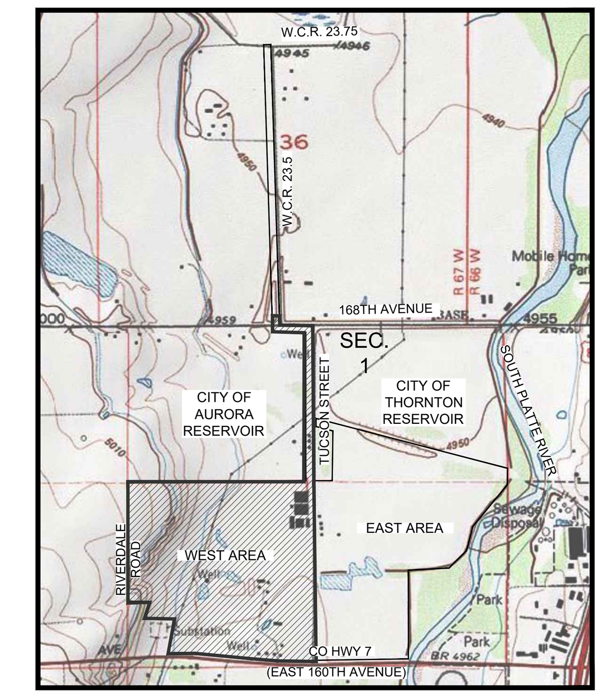
VIEW 1



VIEW 2

LEGEND:

	MINE PERMIT BOUNDARY
	TRACT BOUNDARY
	EFFECTIVE FLOODWAY
	EFFECTIVE ZONE AE
	EFFECTIVE ZONE X
	PRE-PROJECT/MINING CONDITIONS 100-YR FLOODPLAIN
	EXISTING EDGE OF WATER
4900	EXISTING 2' CONTOURS
x x x x	EXISTING FENCE
	EXISTING EDGE OF ROAD
UE	EXISTING ELECTRIC LINE
OE	EXISTING OVERHEAD ELECTRIC LINE
G	EXISTING GAS LINE
W	EXISTING WATER LINE
OT	EXISTING TELEPHONE LINE
UD UD	PROPOSED UNDERDRAIN
	PROPOSED SLURRY WALL
4900	PROPOSED 2' CONTOURS
	RESERVOIR ACCESS ROAD
	EXISTING ASPHALT ROAD
	EXISTING SOUTH PLATTE RIVER
	RESERVOIR ACCESS ROAD
NHWL	NORMAL HIGH WATER LINE



PERMIT KEY MAP
NTS

Know what's below. Call before you dig.

CIVIL RESOURCES
8308 COLORADO BLVD
SUITE 200
FIRESTONE, CO 80504
303.833.1416
WWW.CIVILRESOURCES.COM

AGGREGATE INDUSTRIES
1687 COLE BLVD, STE 300
GOLDEN, COLORADO 80401
303-648-1175(P)

TUCSON SOUTH RESOURCE
EXHIBIT F WEST AREA
RECLAMATION PLAN

REVISIONS

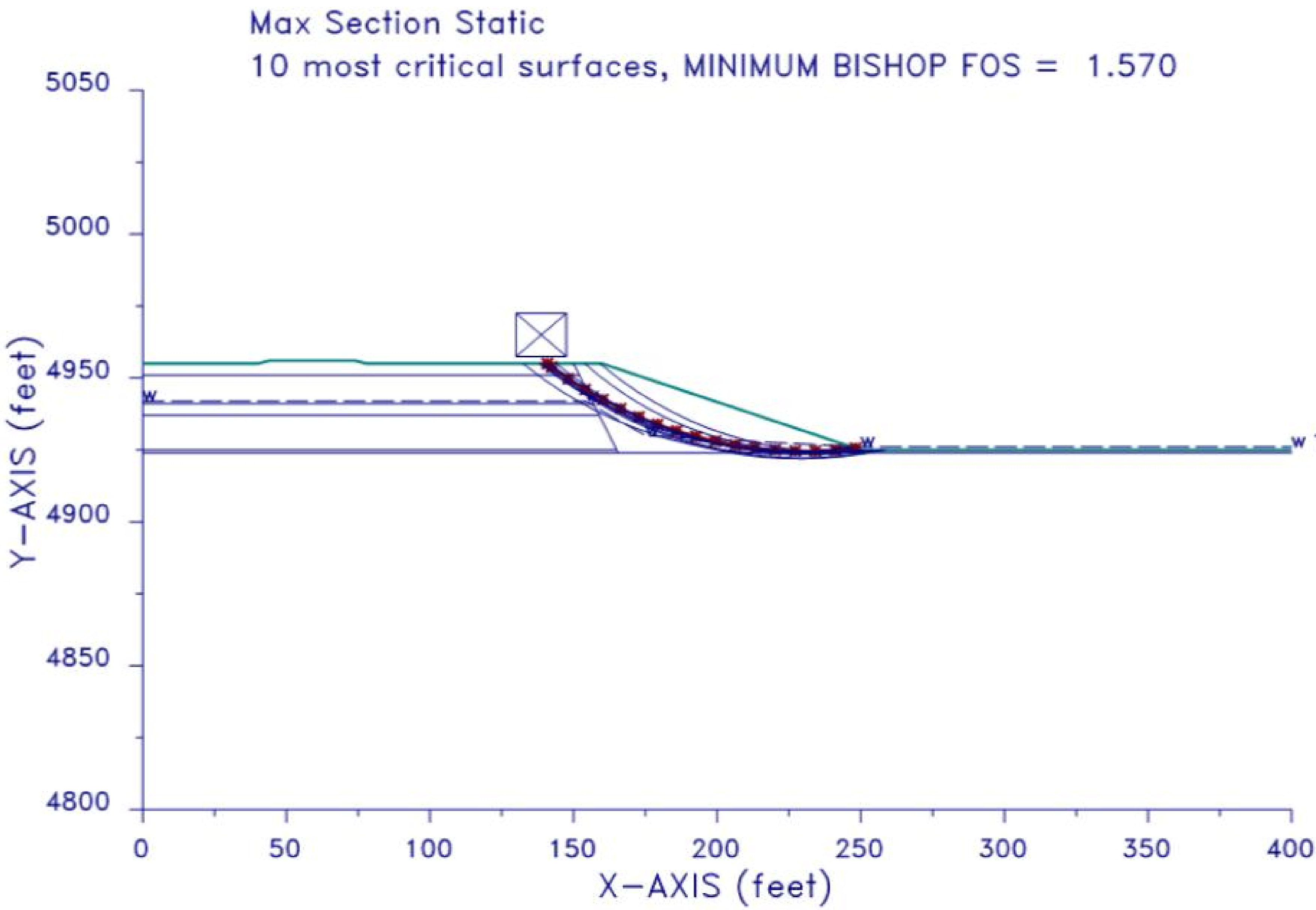
NO.	DESCRIPTION	DATE

DRAWN BY: CAI DATE: AUGUST 21
CHECKED BY: GL SCALE: AS NOTED
AS NOTED
JOB NO.: 297.001.09
DWG NAME: EXHIBIT F EAST AREA SECT.dwg

STABILITY ANALYSIS SECTION

SHEET: 1

STATIC 8-10-21 16:36



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Max Section Static
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       .0     4955.0       40.0     4955.0   1
     40.0     4955.0       44.0     4956.0   1
     44.0     4956.0       74.0     4956.0   1
     74.0     4956.0       78.0     4955.0   1
     78.0     4955.0      150.0     4955.0   1
    150.0     4955.0      160.0     4955.0   6
    160.0     4955.0      250.0     4925.0   6
    250.0     4925.0      400.0     4925.0   4
    150.0     4955.0      152.0     4951.0   1
       .0     4951.0      152.0     4951.0   2
    152.0     4951.0      157.0     4941.0   2
       .0     4941.0      157.0     4941.0   3
    157.0     4941.0      159.0     4937.0   3
       .0     4937.0      159.0     4937.0   2
    159.0     4937.0      165.0     4925.0   2
       .0     4925.0      165.0     4925.0   4
    165.0     4925.0      165.5     4924.0   4
       .0     4924.0      400.0     4924.0   5
SOIL
  6
  114.0    126.0      50.0    28.00     .000        .0    1
  130.0    137.0        .0    35.00     .000        .0    1
  114.0    126.0      50.0    28.00     .000        .0    1
  124.0    134.0        .0    14.00     .000        .0    1
  124.0    134.0     100.0    28.00     .000        .0    1
  119.0    126.0      25.0    26.00     .000        .0    1
WATER
  1       62.40
     5
          .0      4942.0
       154.0      4942.0
       175.0      4930.0
       250.0      4926.0
       400.0      4926.0
LOADS
  1
       130.0       147.5      3000.0          .0
CIRCL2
    20      20
    245.0      265.0      130.0      160.0
   4900.0        7.0       -5.0      -45.0
```

XSTABL File: STATIC   8-10-21   16:36

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*        Copyright (C) 1992 - 2002       *
*   Interactive Software Designs, Inc.   *
*        Moscow, ID 83843, U.S.A.        *
*                                        *
*          All Rights Reserved           *
*                                        *
*  Ver. 5.206                96 - 1952   *
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Problem Description : Max Section Static

SEGMENT BOUNDARY COORDINATES
----

8 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	4955.0	40.0	4955.0	1
2	40.0	4955.0	44.0	4956.0	1
3	44.0	4956.0	74.0	4956.0	1
4	74.0	4956.0	78.0	4955.0	1
5	78.0	4955.0	150.0	4955.0	1
6	150.0	4955.0	160.0	4955.0	6
7	160.0	4955.0	250.0	4925.0	6
8	250.0	4925.0	400.0	4925.0	4

10 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	150.0	4955.0	152.0	4951.0	1
2	.0	4951.0	152.0	4951.0	2
3	152.0	4951.0	157.0	4941.0	2
4	.0	4941.0	157.0	4941.0	3
5	157.0	4941.0	159.0	4937.0	3
6	.0	4937.0	159.0	4937.0	2
7	159.0	4937.0	165.0	4925.0	2
8	.0	4925.0	165.0	4925.0	4
9	165.0	4925.0	165.5	4924.0	4
10	.0	4924.0	400.0	4924.0	5

ISOTROPIC Soil Parameters
----

6 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Parameter Ru	Pressure Constant (psf)	Water Surface No.
1	114.0	126.0	50.0	28.00	.000	.0	1
2	130.0	137.0	.0	35.00	.000	.0	1
3	114.0	126.0	50.0	28.00	.000	.0	1
4	124.0	134.0	.0	14.00	.000	.0	1
5	124.0	134.0	100.0				

28.00	.000		.0	1
	6	119.0	126.0	25.0
26.00	.000		.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 5 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	4942.00
2	154.00	4942.00
3	175.00	4930.00
4	250.00	4926.00
5	400.00	4926.00

BOUNDARY LOADS
----

1 load(s) specified

Load No.	x-left (ft)	x-right (ft)	Intensity (psf)	Direction (deg)
1	130.0	147.5	3000.0	.0

NOTE - Intensity is specified as a uniformly distributed force acting on a HORIZONTALLY projected surface.

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

400 trial surfaces will be generated and analyzed.

20 Surfaces initiate from each of 20 points equally spaced

along the ground surface between x = 245.0 ft
and x = 265.0 ft

Each surface terminates between x = 130.0 ft
and x = 160.0 ft

Unless further limitations were imposed, the minimum elevation

at which a surface extends is y = 4900.0 ft

7.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined

within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface
is specified by 18 coordinate points

Point x-surf y-surf

No.	(ft)	(ft)
1	248.16	4925.61
2	241.19	4924.98
3	234.19	4924.68
4	227.19	4924.70
5	220.20	4925.05
6	213.23	4925.73
7	206.31	4926.73
8	199.43	4928.06
9	192.63	4929.70
10	185.91	4931.66
11	179.29	4933.93
12	172.78	4936.51
13	166.40	4939.39
14	160.16	4942.57
15	154.08	4946.03
16	148.16	4949.78
17	142.43	4953.79
18	140.87	4955.00

**** Simplified BISHOP FOS = 1.570 ****

The following is a summary of the TEN most critical surfaces

Problem Description : Max Section Static

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.570	231.19	5074.54	149.89	248.16	140.87	1.093E+07
2.	1.583	226.66	5068.47	143.96	247.11	138.13	1.225E+07
3.	1.584	232.54	5071.34	147.54	251.32	141.91	1.082E+07
4.	1.590	243.05	5053.08	129.03	258.68	159.30	4.684E+06
5.	1.602	233.14	5081.17	157.62	254.47	138.77	1.343E+07
6.	1.609	229.92	5058.18	134.31	249.21	144.00	9.147E+06

```
           7.   1.611    235.28  5046.65   122.56   250.26
153.98  5.673E+06
           8.   1.625    220.00  5062.27   138.43   246.05
132.57  1.532E+07
           9.   1.630    229.43  5058.00   135.75   256.58
141.02  1.187E+07
          10.   1.634    228.80  5058.54   136.62   257.63
139.69  1.285E+07
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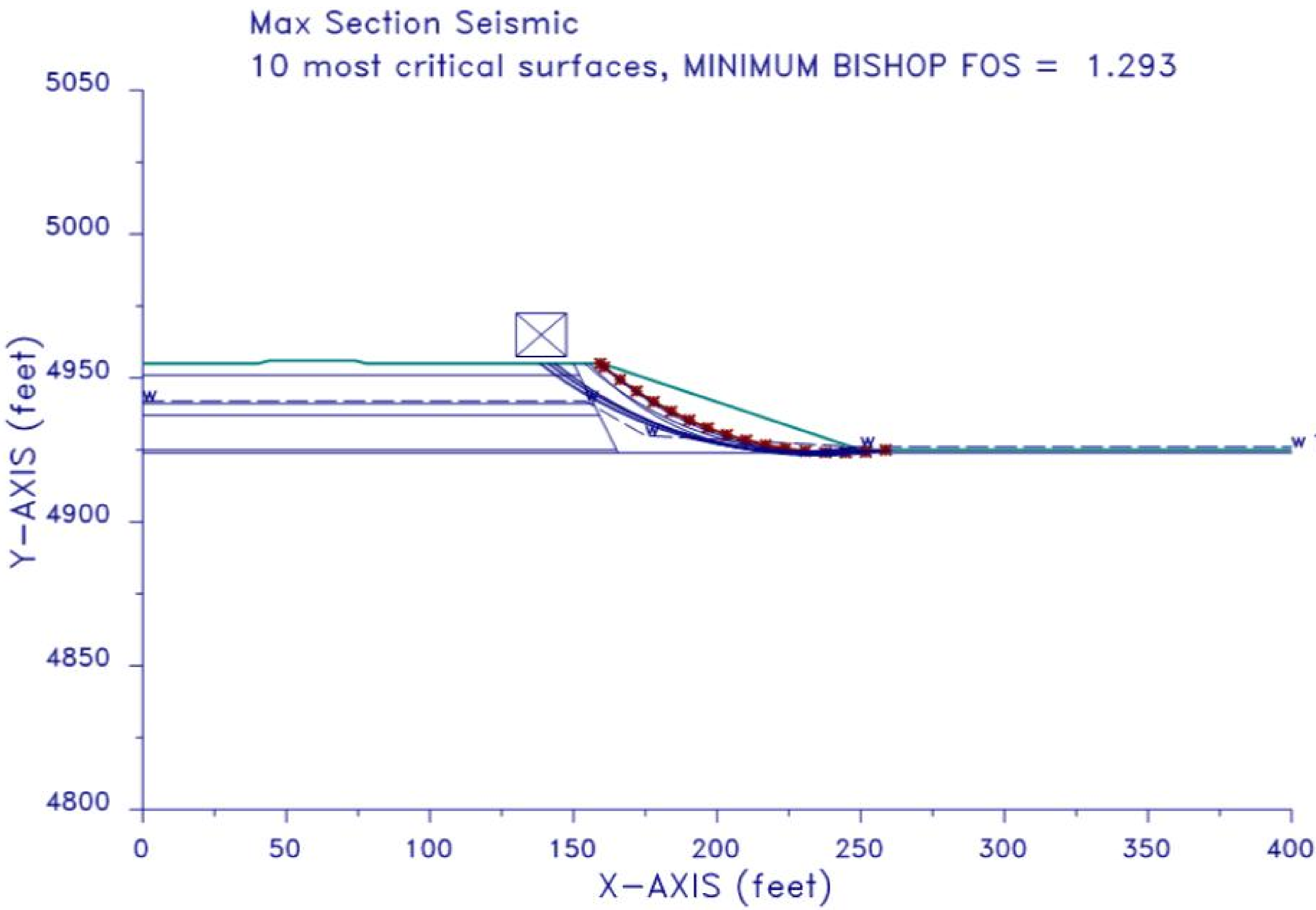

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PROFIL                                   FILE: SEISMIC    8-10-21   16:34    ft
Max Section Seismic
    18       8
       .0     4955.0       40.0     4955.0   1
     40.0     4955.0       44.0     4956.0   1
     44.0     4956.0       74.0     4956.0   1
     74.0     4956.0       78.0     4955.0   1
     78.0     4955.0      150.0     4955.0   1
    150.0     4955.0      160.0     4955.0   6
    160.0     4955.0      250.0     4925.0   6
    250.0     4925.0      400.0     4925.0   4
    150.0     4955.0      152.0     4951.0   1
       .0     4951.0      152.0     4951.0   2
    152.0     4951.0      157.0     4941.0   2
       .0     4941.0      157.0     4941.0   3
    157.0     4941.0      159.0     4937.0   3
       .0     4937.0      159.0     4937.0   2
    159.0     4937.0      165.0     4925.0   2
       .0     4925.0      165.0     4925.0   4
    165.0     4925.0      165.5     4924.0   4
       .0     4924.0      400.0     4924.0   5
SOIL
  6
  114.0    126.0      50.0    28.00     .000        .0    1
  130.0    137.0        .0    35.00     .000        .0    1
  114.0    126.0      50.0    28.00     .000        .0    1
  124.0    134.0        .0    14.00     .000        .0    1
  124.0    134.0     100.0    28.00     .000        .0    1
  119.0    126.0      25.0    26.00     .000        .0    1
WATER
  1       62.40
     5
          .0      4942.0
       154.0      4942.0
       175.0      4930.0
       250.0      4926.0
       400.0      4926.0
EQUAKE
   .067     .000
LOADS
  1
       130.0       147.5      3000.0          .0
CIRCL2
    20      20
    245.0      265.0      130.0      160.0
   4900.0        7.0       -5.0      -45.0
```

XSTABL File: SEISMIC   8-10-21   16:34

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*                                         *
*        Slope Stability Analysis         *
*               using the                 *
*            Method of Slices             *
*                                         *
*        Copyright (C) 1992 - 2002        *
*   Interactive Software Designs, Inc.    *
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*                                         *
*          All Rights Reserved            *
*                                         *
*  Ver. 5.206                96 - 1952    *
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Problem Description : Max Section Seismic

SEGMENT BOUNDARY COORDINATES
----

8 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	4955.0	40.0	4955.0	1
2	40.0	4955.0	44.0	4956.0	1
3	44.0	4956.0	74.0	4956.0	1
4	74.0	4956.0	78.0	4955.0	1
5	78.0	4955.0	150.0	4955.0	1
6	150.0	4955.0	160.0	4955.0	6
7	160.0	4955.0	250.0	4925.0	6
8	250.0	4925.0	400.0	4925.0	4

10 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	150.0	4955.0	152.0	4951.0	1
2	.0	4951.0	152.0	4951.0	2
3	152.0	4951.0	157.0	4941.0	2
4	.0	4941.0	157.0	4941.0	3
5	157.0	4941.0	159.0	4937.0	3
6	.0	4937.0	159.0	4937.0	2
7	159.0	4937.0	165.0	4925.0	2
8	.0	4925.0	165.0	4925.0	4
9	165.0	4925.0	165.5	4924.0	4
10	.0	4924.0	400.0	4924.0	5

ISOTROPIC Soil Parameters
----

6 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Parameter Ru	Pressure Constant (psf)	Water Surface No.
1	114.0	126.0	50.0	28.00	.000	.0	1
2	130.0	137.0	.0	35.00	.000	.0	1
3	114.0	126.0	50.0	28.00	.000	.0	1
4	124.0	134.0	.0	14.00	.000	.0	1
5	124.0	134.0	100.0				

28.00 .000 .0 1
6 119.0 126.0 25.0
26.00 .000 .0 1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 5 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	4942.00
2	154.00	4942.00
3	175.00	4930.00
4	250.00	4926.00
5	400.00	4926.00

A horizontal earthquake loading coefficient
of .067 has been assigned

A vertical earthquake loading coefficient
of .000 has been assigned

BOUNDARY LOADS
----

1 load(s) specified

Load No.	x-left (ft)	x-right (ft)	Intensity (psf)	Direction (deg)
1	130.0	147.5	3000.0	.0

NOTE - Intensity is specified as a uniformly

distributed
force acting on a HORIZONTALLY projected
surface.

A critical failure surface searching method, using a
random
technique for generating CIRCULAR surfaces has been
specified.

400 trial surfaces will be generated and analyzed.

20 Surfaces initiate from each of 20 points equally
spaced
along the ground surface between x = 245.0 ft
and x = 265.0 ft

Each surface terminates between x = 130.0 ft
and x = 160.0 ft

Unless further limitations were imposed, the minimum
elevation
at which a surface extends is y = 4900.0 ft

7.0 ft line segments define each trial failure
surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be
inclined
within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := -5.0 degrees

Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED BISHOP METHOD   * * * * *

The most critical circular failure surface
is specified by 17 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	258.68	4925.00
2	251.72	4924.34
3	244.72	4924.06
4	237.72	4924.16
5	230.74	4924.64
6	223.79	4925.50
7	216.90	4926.73
8	210.09	4928.34
9	203.37	4930.31
10	196.77	4932.64
11	190.31	4935.33
12	184.00	4938.37
13	177.87	4941.74
14	171.93	4945.44
15	166.19	4949.46
16	160.69	4953.78
17	159.30	4955.00

**** Simplified BISHOP FOS =   1.293 ****

The following is a summary of the TEN most critical surfaces

Problem Description : Max Section Seismic

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.293	243.05	5053.08	129.03	258.68	159.30	4.586E+06
2.	1.309	235.28	5046.65	122.56	250.26	153.98	5.558E+06
3.	1.316	231.19	5074.54	149.89	248.16		

```
140.87  1.071E+07
           4.   1.322    232.54  5071.34   147.54   251.32
141.91  1.061E+07
           5.   1.330    229.92  5058.18   134.31   249.21
144.00  8.968E+06
           6.   1.336    226.66  5068.47   143.96   247.11
138.13  1.200E+07
           7.   1.341    239.08  5040.58   116.89   256.58
159.43  4.691E+06
           8.   1.347    227.21  5021.92    98.00   247.11
155.72  4.769E+06
           9.   1.349    233.14  5081.17   157.62   254.47
138.77  1.316E+07
          10.   1.355    236.29  5074.25   151.25   260.79
143.33  1.073E+07
```

* * * END OF FILE * * *