UNSTABLE AREAS DEMONSTRATION

ASH LANDFILL AREA

SPRINGERVILLE GENERATING STATION

SPRINGERVILLE, ARIZONA

Prepared for

Tucson Electric Power Company

October 17, 2018

Prepared by

AMTECH Associates, L.L.C.
8666 E. San Alberto Drive
Scottsdale, Arizona 85258

Project No. 1004.06

Unstable Areas Demonstration
Ash Landfill Area
Springerville Generating Station
Springerville, Arizona

I hereby certify that the unstable areas demonstration identified herein meets the requirements of 40 CFR §257.64 as included in 40 CFR 257, Subpart D, Disposal of Coal Combustion Residuals from Electric Utilities. The material and data in this report were prepared by me or under my supervision, and I am a duly Professional Engineer under the laws of the State of Arizona.

AMTECH Associates, L.L.C.

Tamara M. Jim, Engineer

Registered Professional Engineer (Civil)
CERTIFICATE NO.
26301
SYED SHAH
AMANATULLAH
Date Signed: 10/17/2018
ARIZONA, U.S.A.

Syed S. Amanatullah, P.E.
Managing Member

CONTENTS

1 UNSTABLE AREAS DEMONSTRATION REPORT

1.1 Introduction

AMTECH Associates L.L.C. (AMTECH) has prepared this Unstable Areas Demonstration report for the Ash Landfill area associated with Tucson Electric Power Company's (TEP) Springerville Generating Station (SGS). This report was prepared to comply with the unstable areas demonstration requirements as per the U.S. Environmental Protection Agency's Standards for the Disposal of Coal Combustion Residuals (CCR), 40 CFR Part §257.64. These standards are applicable to the facility's Ash Landfill as an "Existing CCR landfill" as defined in CFR §257.53.

1.1.1 Site Description and Location

The SGS is a four-unit, pulverized coal-fired, steam electric generating facility, operated by TEP, that began operations in 1985 and consists of a combined net generating output of approximately 1600-megawatts.

SGS is located approximately 15 miles northeast of Springerville, in Apache County, Arizona, See **Figure 1**. The power plant area of SGS is located in Sections 27, 28, 33, and 34, of Township 11 North, Range 30 East of the Salt and Gila River Baseline and Meridian. The SGS site occupies 14,355 acres, which includes the power plant area, ash landfill area and the east and west production well fields.

The Ash Landfill, located southwest of the power plant area, is primarily used for the disposal of fly and bottom ash, products of the coal-fired units at the plant. The ash, which is dry, is mixed with water in the ash unloading facility for dust control. The ash is then loaded into haul trucks for transfer to the Ash Landfill.

A delineated portion of the Ash Landfill is used for the disposal of other items in lesser quantities, (i.e. reactivator sludge, construction debris and power plant outage refuse, sump sludges, demineralizer resins, PCS, cooling tower sludge, lime, soda ash, sewage pond sludge, evaporation pond solids, miscellaneous pond clean-outs, cooling tower treated lumber, and other inert and non-hazardous materials). A site map showing the locations of the power plant area and the ash landfill is presented in **Figure 1**.

The ground surface at the Ash Landfill slopes down moderately to the west. The site is bounded on the north by a mesa cresting at an elevation of 6960 ft. and is bounded on the east by a shallow ridge line at an elevation of 6950 ft. A site map of the Ash Landfill is presented in **Figure 2**.

1.2 Regulatory Requirements

As per CFR Part §257.64(a), an existing CCR landfill must be not be located in an unstable area unless the owner or operator demonstrates that "recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted."

As per CFR Part §257.64(b), the owner or operator must consider all of the following factors, at a minimum, when determining whether an area is unstable: (1) onsite or local soil conditions that may result in significant differential settling; (2) onsite or local geologic or geomorphologic features; and (3) onsite or local human-made features or events (both surface and subsurface).

1.2.1 Factors of Consideration §257.64(b)

An evaluation of information from previous investigations was performed to determine that the SGS Ash Landfill area is not located in an unstable area and that good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted. The following documents were reviewed:

- The original Aquifer Protection Permit (APP) application, dated April 13, 1998 [1998 EMCON] that contains site-specific information on soils, geology, borehole information, landfill design, operations, and slope stability modeling. The SGS was issued APP No. P-101448 by the Arizona Department of Environmental Quality (ADEQ).

- A Geotechnical Investigation contained in Appendix B of the Ash Disposal Facility Expansion Design Report, dated November 2011 [2011 TETRATECH], contains additional information on site-specific sub-surface investigations, laboratory testing, seepage and stability analyses.

- A Groundwater Sampling and Analysis Program for the groundwater monitoring system at the Ash Landfill, dated June 20, 2016 [2016 Montgomery & Associates], contains additional information on site-specific hydrogeology for the site.

Below is a discussion of the factors of considerations the owner or operator must consider all of the following factors, at a minimum, when determining whether an area is unstable as part of this evaluation:

(1) On-site or local soil conditions that may result in significant differential settling.

AMTECH reviewed the soils and geologic information from previous investigations. Geologic units exposed in the general site vicinity and/or encountered in previous subsurface investigations include, from oldest to youngest [1998 EMCON]: Permian Upper Supai Formation, Permian Coconino Sandstone, Permian Kaibab Limestone, Triassic Moenkopi Formation, Triassic Chinle Formation, Tertiary Bidahochi Formation, Quaternary to Tertiary travertine deposits, and Quaternary alluvium. The Chinle Formation, which occurs at shallow depths in the Ash Landfill area, acts as a liner. The Chinle Formation is a low-permeability formation and consists of siltstone, claystone, mudstone, and limestone, which, in places, contains sandstone and conglomerate beds. The clay portion of the Chinle Formation is rich in montmorillonite and appears to form an effective barrier to the downward flow of water in the Ash Landfill area. In addition, AMTECH's previous annual inspections did not reveal any noticeable differential settlement around the Ash Landfill area. Also, TETRATECH's geotechnical investigation did not document the likelihood of differential settlement at the Ash Landfill area [2011 TETRATECH]. ***Based on the onsite soil conditions and previous geotechnical investigations, there is no evidence that indicates the onsite soil may result in significant differential settlement***.

(2) Onsite or local geologic or geomorphologic features.

The SGS site is located in the southern portion of the Colorado Plateau Physiographic Province (Province) of Arizona. The Province is characterized by steep-walled canyons, high isolated mesas, and volcanic peaks. A thick sequence of well-lithified, flat-lying sedimentary rocks underlie nearly the entire Province and consist of a sequence of alternating beds of resistant sandstone and limestone and less resistant shale. As mentioned above, the Chinle Formation is a low-permeability formation.

The most prominent structural features in the area of the Ash Landfill include a regional dip toward the northeast [2011 TETRATECH]. The general trend of principal faults and folds is toward the northwest. The most prominent structural geologic features in the area of the Ash Landfill include a regional northwest-trending anticline/fault (Cedar Mesa anticline fault), the axis of which passes beneath the eastern part of the Ash Landfill (inactive portion) and a fault zone that occurs west of the anticline and beneath much of the Coyote Wash fault. A groundwater elevation map showing the locations of the Cedar Mesa Anticline and the Coyote Wash fault is presented in **Appendix A** (note: the Ash Landfill boundary shown in this map is approximate and does not represent the actual extents/boundary of the Ash Landfill)**.** Geologic units on the west side of the anticline are down-dropped relative to the east side, and vertical offset along the fault zone is a few hundred feet or more. Because no movement along either of these fault zones are believed to have occurred during Holocene time, the location of the faults are not considered to be an issue with respect to the location of the Ash Landfill unit.

Based on the onsite geologic features, the Ash Landfill site is not located in an area of known geologic instability.

(3) Onsite or local human-made features or events (both surface and subsurface).

AMTECH reviewed the landfilled material characteristics and the slope stability analysis results from previous investigations. As mentioned in Section 1.1.1 above, the materials landfilled are for the most part, inert, dry materials.

There were no historic mines within the existing footprint of the Ash Landfill. In 1998, TEP closed an approximate 14-acre construction debris landfill, located on the eastern side of the (now inactive) Ash Landfill area. The construction debris landfill was closed and capped with up to 55 feet of ash and 2 feet of native soil material. In the active portion of Ash Landfill, landfill operations proceed (in general) from east to west and requires minimal cut or fill of native material as it is constructed upwards in a step-wise bench configuration. No visible settlement of the inactive or active portions of the Ash Landfill were observed during the most recent annual inspection conducted in January of 2018.

Located west of the Ash Landfill are production wells for the power plant that undergo continuous drawdown of groundwater. These activities have also not shown any observable settlement in the Ash Landfill.

As part of the 1998 APP Application, an investigation utilizing the PCSTABL5 computer model was used to analyze the proposed final grades of the Ash Landfill to compute safety factors meeting the criteria for static and pseudostatic conditions [1998 EMCON]. A factor of safety of 1.0 indicates impending instability, while a factor of safety ranging from 1.25 (special cases) to 2.0 is generally accepted as adequate for static and pseudostatic stability conditions. The scenario of the Ash Landfill area under static conditions yielded factors ranging from 2.31 to 2.66. The use of earthquake coefficients allows for a pseudostatic representation of earthquake effects within the PCSTABL5 model. Modeling of pseudostatic conditions is particularly significant when the slopes are exposed for a longer period of time. Slopes exposed for a minimum time period, such as the Ash Landfill area, are not subject to dynamic instability. However, to achieve conservative results, pseudostatic conditions were modeled at the Ash Landfill. The model yielded factor of safety values ranging from 1.71 to 1.95 for that scenario.

The computed minimum safety factors meet the criteria for static and pseudostatic conditions, respectively. ***Based on the results of the PCSTABL5 modeling, the proposed final grades of the ash disposal area of the landfill are stable*** [1998 EMCON]. A copy of the PCSTABL5 results by EMCON is included in **Appendix B.**

Additional seepage and stability analyses were performed for the proposed ash disposal piles and for the retention structure [2011 TETRATECH]. The stability analyses were conducted for the estimated maximum section for each scenario. The results of the seepage analysis indicate that the retention structure will only have minimal seepage through the embankment if maximum water level with the basin reaches steady state downstream. Steady state seepage conditions are unlikely to develop because of infrequent precipitation events in the area and because the maximum water level will only last several days. The model for the retention structure scenario yielded factor of safety values of 1.9 for static and 1.5 for seismic conditions. The models for the Ash

Landfill disposal area scenarios yielded factor of safety values of 1.9 for static and 1.4 for seismic conditions. ***Based on the model results, the retention structure and Ash Landfill Disposal areas are stable***. A copy of the results from the seepage and stability analyses by TETRATECH is included in **Appendix C.**

1.2.2 Certification by a Qualified Professional Engineer §257.64(c)

This report was certified by a qualified professional engineer (See Page ii of this report) stating that the demonstration meets the requirements as stipulated in §257.64(a).

1.2.3 Demonstration Completion Date §257.64(d)

This report was completed prior to October 17, 2018, as stipulated in §257.64(d)(1) for an existing CCR landfill.

1.2.4 Recordkeeping, Notification, and Posting §257.64(e)

In accordance with §257.105(e), the Unstable Areas Demonstration will be placed in the facility operating record.

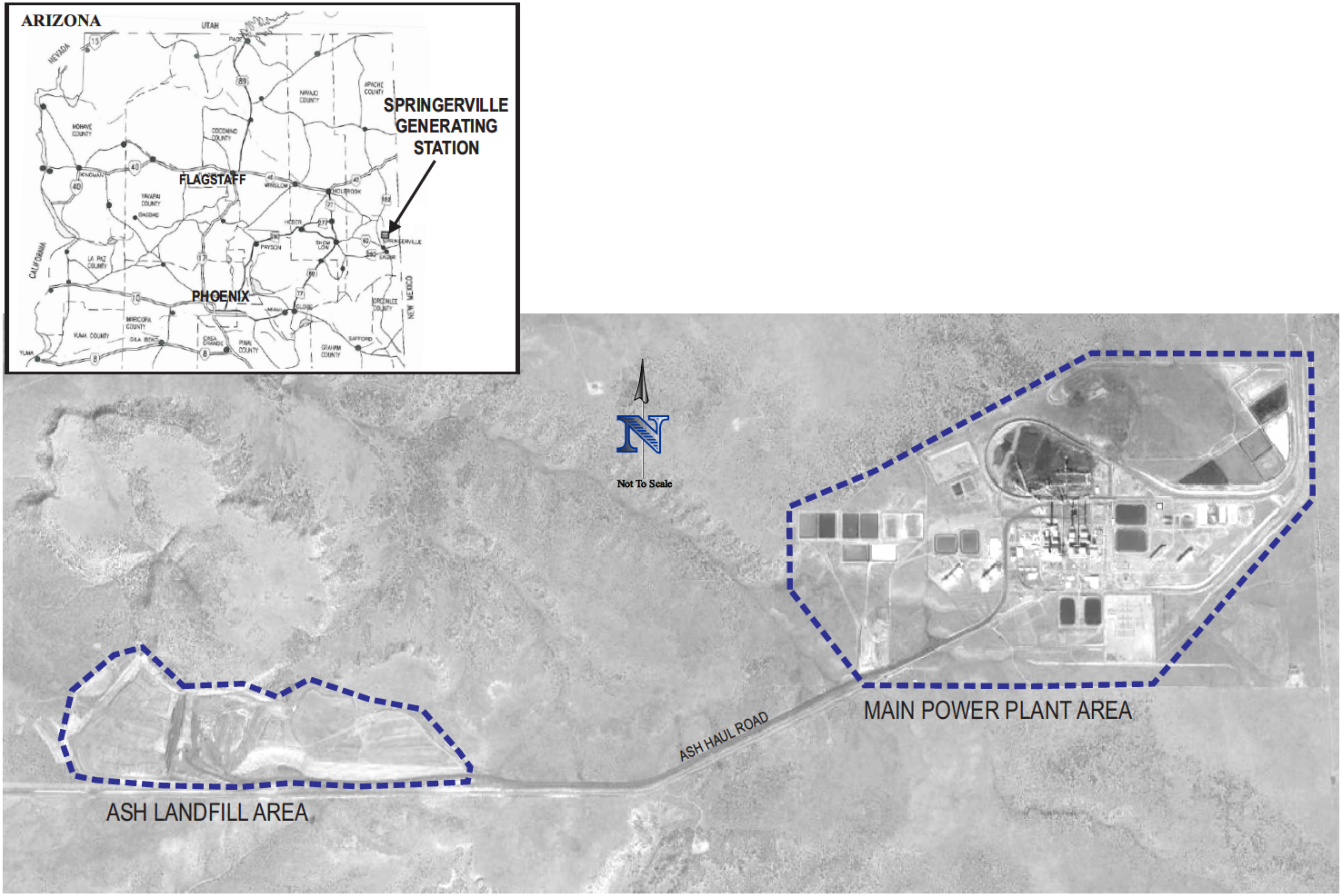
In accordance with §257.106(e), TEP will provide notification to the relevant State Director and/or Tribal authority that the Unstable Areas Demonstration was placed in the facility operating record and on TEP's CCR Web site.

TEP will place the Unstable Areas Demonstration on TEP's CCR Web site in accordance with §257.107(e).

1.3 Conclusion

Based on AMTECH's review of the facility's previous site investigations, the SGS Ash Landfill area is not located in an unstable area and good engineering practices have been incorporated into the design of the Ash Landfill to ensure that the integrity of the structural components of the CCR unit will not be disrupted. Based on the information contained in this evaluation, the demonstration requirements for the CCR unit have been completed as per CFR Part §257.64.

FIGURES



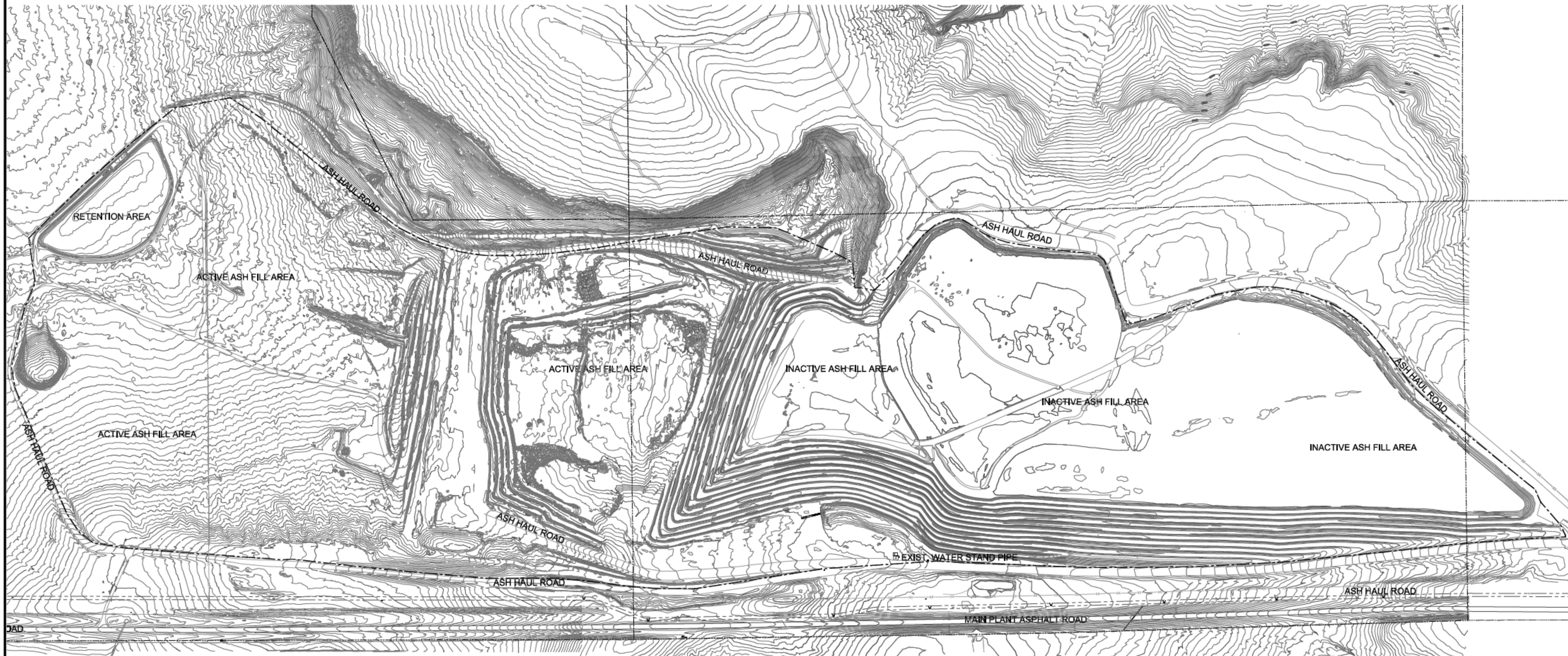
AMTECH Associates, L.L.C.
8666 E.San Alberto Drive, Scottsdale, AZ 85258
Tel: (480) 705 6494 Fax: (480) 362 6133

Project Number: 1010.01 Date: October 2018

SITE LOCATION MAP
MAIN PLANT AND ASH LANDFILL AREA

Springerville Generating Station
Tucson Electric Power Company
Springerville, Arizona

Figure
1



LEGEND

EXIST. CONTOUR ELEVATIONS
EXIST. SECTION LINE
EXIST. INERT LANDFILL BOUNDARY
EXIST. ROADWAY/HAUL ROADS
EXIST. FENCE LINE

N

0 650 1300
SCALE FEET

AMTECH Associates, L.L.C.
8666 E San Alberto Drive, Scottsdale, Arizona 85258
Office: (480) 705-6494 Fax: (480) 362-6133

REV	ISSUE	DWG	DES	CHK	APP

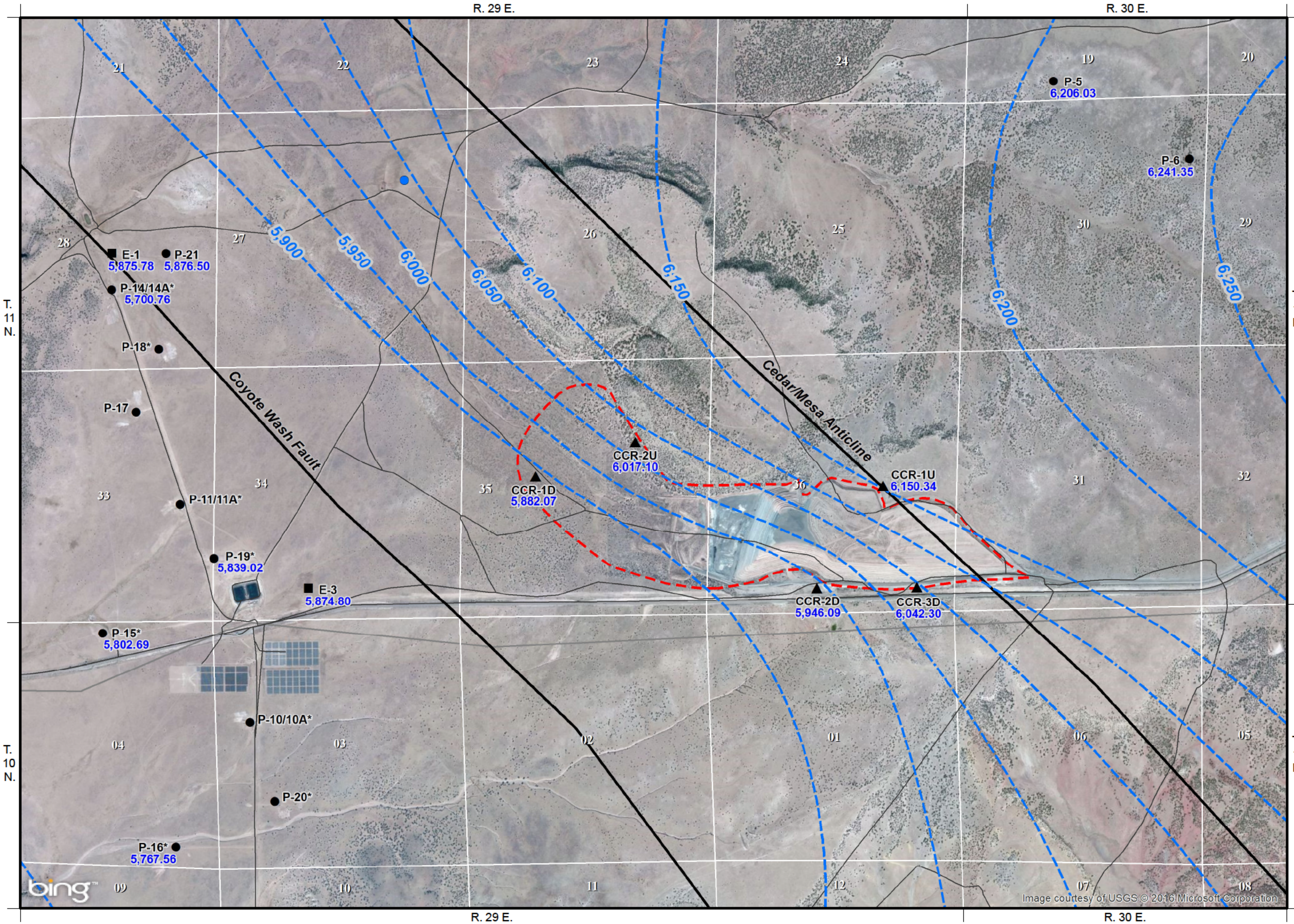
DWN. BMK CHK. TMJ
DES. BMK APPR. SSA
ISSUE DATE OCTOBER 2018
PROJECT NO. 1062.03

TUCSON ELECTRIC POWER COMPANY
SPRINGERVILLE GENERATING STATION
ASH DISPOSAL LANDFILL
EXISTING FEATURES

FIGURE:
2

APPENDIX A

Groundwater Elevation, Montgomery & Associates 2016



EXPLANATION

- **P-5** ● Springerville Generating Station Production Water Well and Identifier
- **E-3** ■ Springerville Generating Station Monitor Well and Identifier
- ● Other Water Well
- **CCR-1D** 5,882.07 ▲ Monitor Well Location and Identifier; Groundwater Elevation, in feet above mean sea level; * = pumping
- *6,100* Estimated Water Level Contour, Kaibab-Coconino Aquifer, in feet above mean sea level
- Ash Disposal Facility

DRAFT

N

0 2,000

Feet

TEP Tucson Electric Power

GROUNDWATER ELEVATION JUNE 2016

MONTGOMERY & ASSOCIATES Water Resource Consultants

2016

FIGURE 3

GIS-Tuc\934 5302\CCR_GWelev_June2016\14July2016 UTM27 meters Zn12

APPENDIX B

PCSTABL5 Results EMCON 1998

** PCSTABL5 **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date:	01-09-98
Time of Run:	1:35pm
Run By:	robin
Input Data Filename:	H:TEP3.DAT
Output Filename:	H:TEP3.OUT
Plotted Output Filename:	H:TEP3.PLT

PROBLEM DESCRIPTION TEP - ash disposal area
actual elev. and distance

BOUNDARY COORDINATES

35 Top Boundaries
37 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	32.00	10.00	32.00	2
2	10.00	32.00	32.00	44.00	1
3	32.00	44.00	54.00	42.30	1
4	54.00	42.30	76.00	54.30	1
5	76.00	54.30	98.00	52.60	1
6	98.00	52.60	120.00	64.60	1
7	120.00	64.60	142.00	62.90	1
8	142.00	62.90	164.00	74.90	1
9	164.00	74.90	186.00	73.20	1
10	186.00	73.20	208.00	85.20	1
11	208.00	85.20	230.00	83.50	1
12	230.00	83.50	252.00	95.50	1
13	252.00	95.50	274.00	93.80	1
14	274.00	93.80	296.00	105.80	1
15	296.00	105.80	318.00	104.10	1
16	318.00	104.10	340.00	116.10	1
17	340.00	116.10	362.00	114.40	1
18	362.00	114.40	384.00	126.40	1
19	384.00	126.40	406.00	124.70	1
20	406.00	124.70	428.00	136.70	1
21	428.00	136.70	450.00	135.00	1
22	450.00	135.00	472.00	147.00	1

23	472.00	147.00	494.00	145.30	1
24	494.00	145.30	516.00	157.30	1
25	516.00	157.30	538.00	155.60	1
26	538.00	155.60	560.00	167.60	1
27	560.00	167.60	582.00	165.90	1
28	582.00	165.90	604.00	177.90	1
29	604.00	177.90	626.00	176.20	1
30	626.00	176.20	648.00	188.20	1
31	648.00	188.20	670.00	186.50	1
32	670.00	186.50	692.00	198.50	1
33	692.00	198.50	714.00	196.80	1
34	714.00	196.80	736.00	208.80	1
35	736.00	208.80	750.00	208.80	1
36	10.00	32.00	750.00	32.00	2
37	750.00	32.00	750.10	208.80	1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	72.5	72.5	800.0	10.0	.00	.0	0
2	115.0	115.0	400.0	35.0	.00	.0	0

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

40 Trial Surfaces Have Been Generated.

20 Surfaces Initiate From Each Of 2 Points Equally Spaced Along The Ground Surface Between X = .00 ft.
and X = 10.00 ft.

Each Surface Terminates Between X = 736.00 ft.
and X = 745.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

44.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.00	32.00
2	53.94	29.67
3	97.93	28.90
4	141.92	29.70
5	185.86	32.07
6	229.68	36.00
7	273.34	41.49
8	316.77	48.53
9	359.93	57.12
10	402.75	67.23
11	445.18	78.87
12	487.18	92.01
13	528.67	106.63
14	569.62	122.73
15	609.98	140.27
16	649.68	159.24
17	688.68	179.62
18	726.93	201.36
19	738.98	208.80

Circle Center At X = 97.4 ; Y = 1264.0 and Radius, 1235.1

*** 2.305 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.00	32.00
2	54.00	32.04
3	97.98	33.35
4	141.90	35.94
5	185.73	39.81
6	229.43	44.94
7	272.97	51.35
8	316.29	59.01
9	359.38	67.93
10	402.19	78.10
11	444.68	89.50

12	486.83	102.14
13	528.59	115.99
14	569.94	131.05
15	610.82	147.30
16	651.22	164.74
17	691.10	183.34
18	730.42	203.09
19	741.01	208.80

Circle Center At X = 30.7 ; Y = 1547.0 and Radius, 1515.2

*** 2.317 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.00	32.00
2	53.81	27.96
3	97.75	25.66
4	141.75	25.12
5	185.73	26.34
6	229.63	29.30
7	273.38	34.01
8	316.91	40.46
9	360.14	48.64
10	403.01	58.53
11	445.46	70.13
12	487.41	83.40
13	528.79	98.34
14	569.55	114.91
15	609.62	133.10
16	648.93	152.86
17	687.42	174.18
18	725.03	197.02
19	742.81	208.80

Circle Center At X = 133.3 ; Y = 1129.3 and Radius, 1104.2

*** 2.433 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	.00	32.00
2	43.75	27.35

3	87.66	24.46
4	131.65	23.36
5	175.64	24.03
6	219.57	26.48
7	263.37	30.71
8	306.96	36.70
9	350.27	44.45
10	393.23	53.94
11	435.78	65.17
12	477.84	78.10
13	519.34	92.72
14	560.21	109.01
15	600.39	126.93
16	639.82	146.47
17	678.42	167.58
18	716.14	190.24
19	744.39	208.80

Circle Center At X = 137.0 ; Y = 1111.7 and Radius, 1088.4

*** 2.502 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.00	32.00
2	53.98	33.42
3	97.91	35.94
4	141.76	39.55
5	185.50	44.27
6	229.12	50.07
7	272.58	56.96
8	315.85	64.94
9	358.90	74.00
10	401.72	84.14
11	444.27	95.34
12	486.53	107.60
13	528.46	120.91
14	570.06	135.27
15	611.27	150.67
16	652.09	167.09
17	692.49	184.53
18	732.44	202.97
19	744.27	208.80

Circle Center At X = -24.7 ; Y = 1790.5 and Radius, 1758.8

*** 2.511 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.00	32.00
2	53.71	26.99
3	97.60	23.83
4	141.58	22.53
5	185.58	23.09
6	229.51	25.51
7	273.30	29.78
8	316.88	35.89
9	360.15	43.85
10	403.05	53.62
11	445.50	65.20
12	487.42	78.56
13	528.74	93.68
14	569.39	110.54
15	609.28	129.09
16	648.36	149.32
17	686.55	171.17
18	723.78	194.63
19	744.30	208.80

Circle Center At X = 150.4 ; Y = 1063.6 and Radius, 1041.1

*** 2.533 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	.00	32.00
2	43.70	26.91
3	87.58	23.66
4	131.56	22.25
5	175.56	22.70
6	219.50	25.00
7	263.30	29.15
8	306.89	35.14
9	350.20	42.95
10	393.13	52.58
11	435.62	64.01
12	477.59	77.21
13	518.97	92.17
14	559.68	108.86
15	599.66	127.24
16	638.83	147.29
17	677.11	168.97

18	714.46	192.24
19	738.70	208.80

Circle Center At X = 142.9 ; Y = 1067.9 and Radius, 1045.7

*** 2.567 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	.00	32.00
2	43.68	26.66
3	87.54	23.18
4	131.51	21.58
5	175.51	21.86
6	219.46	24.00
7	263.27	28.02
8	306.88	33.91
9	350.19	41.64
10	393.14	51.22
11	435.63	62.61
12	477.61	75.81
13	518.98	90.78
14	559.68	107.51
15	599.63	125.95
16	638.75	146.08
17	676.99	167.86
18	714.26	191.25
19	739.75	208.80

Circle Center At X = 147.1 ; Y = 1053.6 and Radius, 1032.2

*** 2.592 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.00	32.00
2	53.61	26.16
3	97.44	22.27
4	141.40	20.33
5	185.40	20.34
6	229.35	22.31
7	273.18	26.23
8	316.78	32.09

9	360.09	39.89
10	403.00	49.60
11	445.44	61.21
12	487.33	74.69
13	528.57	90.03
14	569.09	107.18
15	608.80	126.11
16	647.64	146.79
17	685.52	169.18
18	722.37	193.23
19	744.05	208.80

Circle Center At X = 163.1 ; Y = 1009.9 and Radius, 989.8

*** 2.636 ***

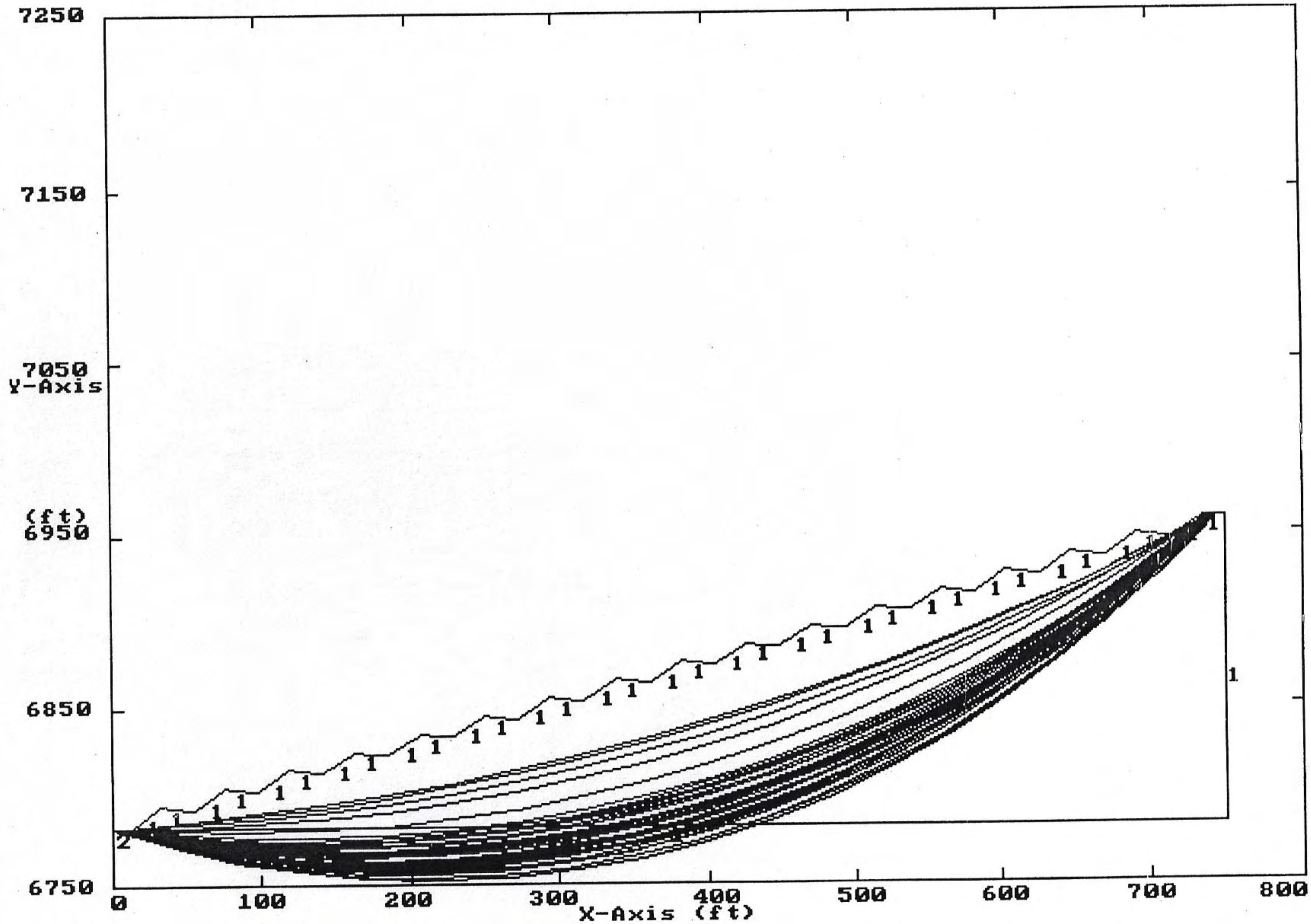
Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	.00	32.00
2	43.58	25.94
3	87.39	21.80
4	131.33	19.60
5	175.33	19.33
6	219.30	21.00
7	263.15	24.61
8	306.80	30.14
9	350.17	37.59
10	393.16	46.94
11	435.70	58.17
12	477.71	71.27
13	519.10	86.20
14	559.79	102.95
15	599.70	121.46
16	638.76	141.72
17	676.89	163.68
18	714.02	187.29
19	744.76	208.80

Circle Center At X = 159.4 ; Y = 1018.3 and Radius, 999.1

*** 2.663 ***

TEP - ash disposal area actual elev. and distance
All surfaces evaluated.   H:TEP3.PLT   By: robin   01-09-98   1:35pm



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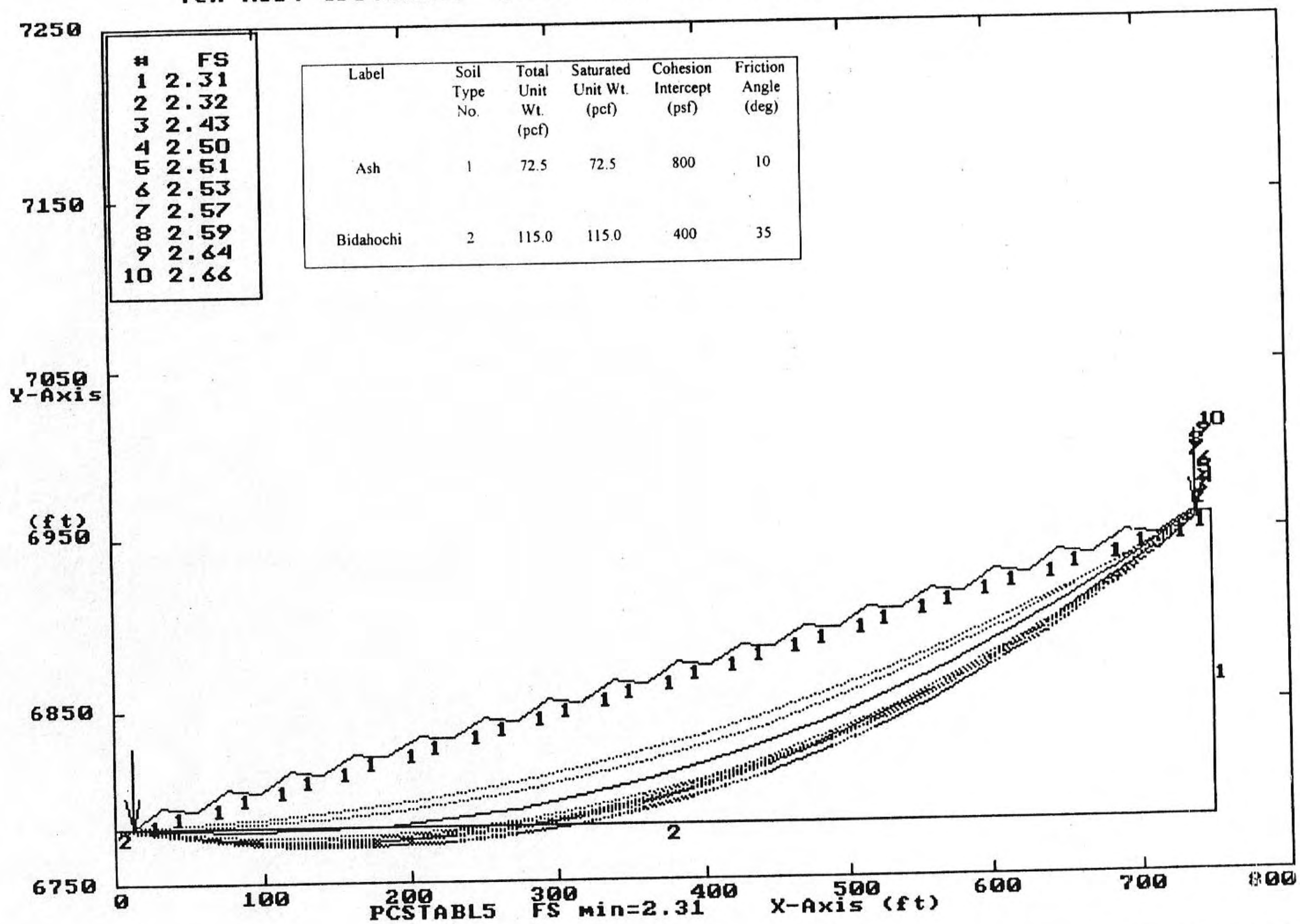
TEP - ash disposal area actual elev. and distance
Ten Most Critical. H:TEP3.PLT By: robin 01-09-98 1:35pm



#	FS
1	2.31
2	2.32
3	2.43
4	2.50
5	2.51
6	2.53
7	2.57
8	2.59
9	2.64
10	2.66

Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
Ash	1	72.5	72.5	800	10
Bidahochi	2	115.0	115.0	400	35

EMCON

DATE 12/16/97
DWN GL
APP SA
REV
PROJECT NO.
92097-030.051

TUCSON ELECTRIC COMPANY
SPRINGERVILLE POWER PLANT
SPRINGERVILLE, ARIZONA

PCSTABL5 PLOTS

** PCSTABL5 **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 01-09-98
Time of Run: 1:40pm
Run By: robin
Input Data Filename: H:TEP3.DAT
Output Filename: H:TEP3.OUT
Plotted Output Filename: H:TEP3.PLT

PROBLEM DESCRIPTION TEP - ash disposal area
actual elev. and distance

BOUNDARY COORDINATES

35 Top Boundaries
37 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	32.00	10.00	32.00	2
2	10.00	32.00	32.00	44.00	1
3	32.00	44.00	54.00	42.30	1
4	54.00	42.30	76.00	54.30	1
5	76.00	54.30	98.00	52.60	1
6	98.00	52.60	120.00	64.60	1
7	120.00	64.60	142.00	62.90	1
8	142.00	62.90	164.00	74.90	1
9	164.00	74.90	186.00	73.20	1
10	186.00	73.20	208.00	85.20	1
11	208.00	85.20	230.00	83.50	1
12	230.00	83.50	252.00	95.50	1
13	252.00	95.50	274.00	93.80	1
14	274.00	93.80	296.00	105.80	1
15	296.00	105.80	318.00	104.10	1
16	318.00	104.10	340.00	116.10	1
17	340.00	116.10	362.00	114.40	1
18	362.00	114.40	384.00	126.40	1
19	384.00	126.40	406.00	124.70	1
20	406.00	124.70	428.00	136.70	1
21	428.00	136.70	450.00	135.00	1
22	450.00	135.00	472.00	147.00	1

23	472.00	147.00	494.00	145.30	1
24	494.00	145.30	516.00	157.30	1
25	516.00	157.30	538.00	155.60	1
26	538.00	155.60	560.00	167.60	1
27	560.00	167.60	582.00	165.90	1
28	582.00	165.90	604.00	177.90	1
29	604.00	177.90	626.00	176.20	1
30	626.00	176.20	648.00	188.20	1
31	648.00	188.20	670.00	186.50	1
32	670.00	186.50	692.00	198.50	1
33	692.00	198.50	714.00	196.80	1
34	714.00	196.80	736.00	208.80	1
35	736.00	208.80	750.00	208.80	1
36	10.00	32.00	750.00	32.00	2
37	750.00	32.00	750.10	208.80	1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	72.5	72.5	800.0	10.0	.00	.0	0
2	115.0	115.0	400.0	35.0	.00	.0	0

A Horizontal Earthquake Loading Coefficient
Of .080 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

40 Trial Surfaces Have Been Generated.

20 Surfaces Initiate From Each Of 2 Points Equally Spaced
Along The Ground Surface Between X = .00 ft.
and X = 10.00 ft.

Each Surface Terminates Between X = 736.00 ft.
and X = 745.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

44.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.00	32.00
2	53.94	29.67
3	97.93	28.90
4	141.92	29.70
5	185.86	32.07
6	229.68	36.00
7	273.34	41.49
8	316.77	48.53
9	359.93	57.12
10	402.75	67.23
11	445.18	78.87
12	487.18	92.01
13	528.67	106.63
14	569.62	122.73
15	609.98	140.27
16	649.68	159.24
17	688.68	179.62
18	726.93	201.36
19	738.98	208.80

Circle Center At X = 97.4 ; Y = 1264.0 and Radius, 1235.1

*** 1.705 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.00	32.00

2	54.00	32.04
3	97.98	33.35
4	141.90	35.94
5	185.73	39.81
6	229.43	44.94
7	272.97	51.35
8	316.29	59.01
9	359.38	67.93
10	402.19	78.10
11	444.68	89.50
12	486.83	102.14
13	528.59	115.99
14	569.94	131.05
15	610.82	147.30
16	651.22	164.74
17	691.10	183.34
18	730.42	203.09
19	741.01	208.80

Circle Center At X = 30.7 ; Y = 1547.0 and Radius, 1515.2

*** 1.716 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.00	32.00
2	53.81	27.96
3	97.75	25.66
4	141.75	25.12
5	185.73	26.34
6	229.63	29.30
7	273.38	34.01
8	316.91	40.46
9	360.14	48.64
10	403.01	58.53
11	445.46	70.13
12	487.41	83.40
13	528.79	98.34
14	569.55	114.91
15	609.62	133.10
16	648.93	152.86
17	687.42	174.18
18	725.03	197.02
19	742.81	208.80

Circle Center At X = 133.3 ; Y = 1129.3 and Radius, 1104.2

*** 1.794 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	.00	32.00
2	43.75	27.35
3	87.66	24.46
4	131.65	23.36
5	175.64	24.03
6	219.57	26.48
7	263.37	30.71
8	306.96	36.70
9	350.27	44.45
10	393.23	53.94
11	435.78	65.17
12	477.84	78.10
13	519.34	92.72
14	560.21	109.01
15	600.39	126.93
16	639.82	146.47
17	678.42	167.58
18	716.14	190.24
19	744.39	208.80

Circle Center At X = 137.0 ; Y = 1111.7 and Radius, 1088.4

*** 1.842 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.00	32.00
2	53.98	33.42
3	97.91	35.94
4	141.76	39.55
5	185.50	44.27
6	229.12	50.07
7	272.58	56.96
8	315.85	64.94
9	358.90	74.00
10	401.72	84.14
11	444.27	95.34
12	486.53	107.60
13	528.46	120.91
14	570.06	135.27
15	611.27	150.67
16	652.09	167.09

17	692.49	184.53
18	732.44	202.97
19	744.27	208.80

Circle Center At X = -24.7 ; Y = 1790.5 and Radius, 1758.8

*** 1.861 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.00	32.00
2	53.71	26.99
3	97.60	23.83
4	141.58	22.53
5	185.58	23.09
6	229.51	25.51
7	273.30	29.78
8	316.88	35.89
9	360.15	43.85
10	403.05	53.62
11	445.50	65.20
12	487.42	78.56
13	528.74	93.68
14	569.39	110.54
15	609.28	129.09
16	648.36	149.32
17	686.55	171.17
18	723.78	194.63
19	744.30	208.80

Circle Center At X = 150.4 ; Y = 1063.6 and Radius, 1041.1

*** 1.864 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	.00	32.00
2	43.70	26.91
3	87.58	23.66
4	131.56	22.25
5	175.56	22.70
6	219.50	25.00
7	263.30	29.15

8	306.89	35.14
9	350.20	42.95
10	393.13	52.58
11	435.62	64.01
12	477.59	77.21
13	518.97	92.17
14	559.68	108.86
15	599.66	127.24
16	638.83	147.29
17	677.11	168.97
18	714.46	192.24
19	738.70	208.80

Circle Center At X = 142.9 ; Y = 1067.9 and Radius, 1045.7

*** 1.887 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	.00	32.00
2	43.68	26.66
3	87.54	23.18
4	131.51	21.58
5	175.51	21.86
6	219.46	24.00
7	263.27	28.02
8	306.88	33.91
9	350.19	41.64
10	393.14	51.22
11	435.63	62.61
12	477.61	75.81
13	518.98	90.78
14	559.68	107.51
15	599.63	125.95
16	638.75	146.08
17	676.99	167.86
18	714.26	191.25
19	739.75	208.80

Circle Center At X = 147.1 ; Y = 1053.6 and Radius, 1032.2

*** 1.905 ***

Failure Surface Specified By 19 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	10.00	32.00
2	53.61	26.16
3	97.44	22.27
4	141.40	20.33
5	185.40	20.34
6	229.35	22.31
7	273.18	26.23
8	316.78	32.09
9	360.09	39.89
10	403.00	49.60
11	445.44	61.21
12	487.33	74.69
13	528.57	90.03
14	569.09	107.18
15	608.80	126.11
16	647.64	146.79
17	685.52	169.18
18	722.37	193.23
19	744.05	208.80

Circle Center At X = 163.1 ; Y = 1009.9 and Radius, 989.8

*** 1.936 ***

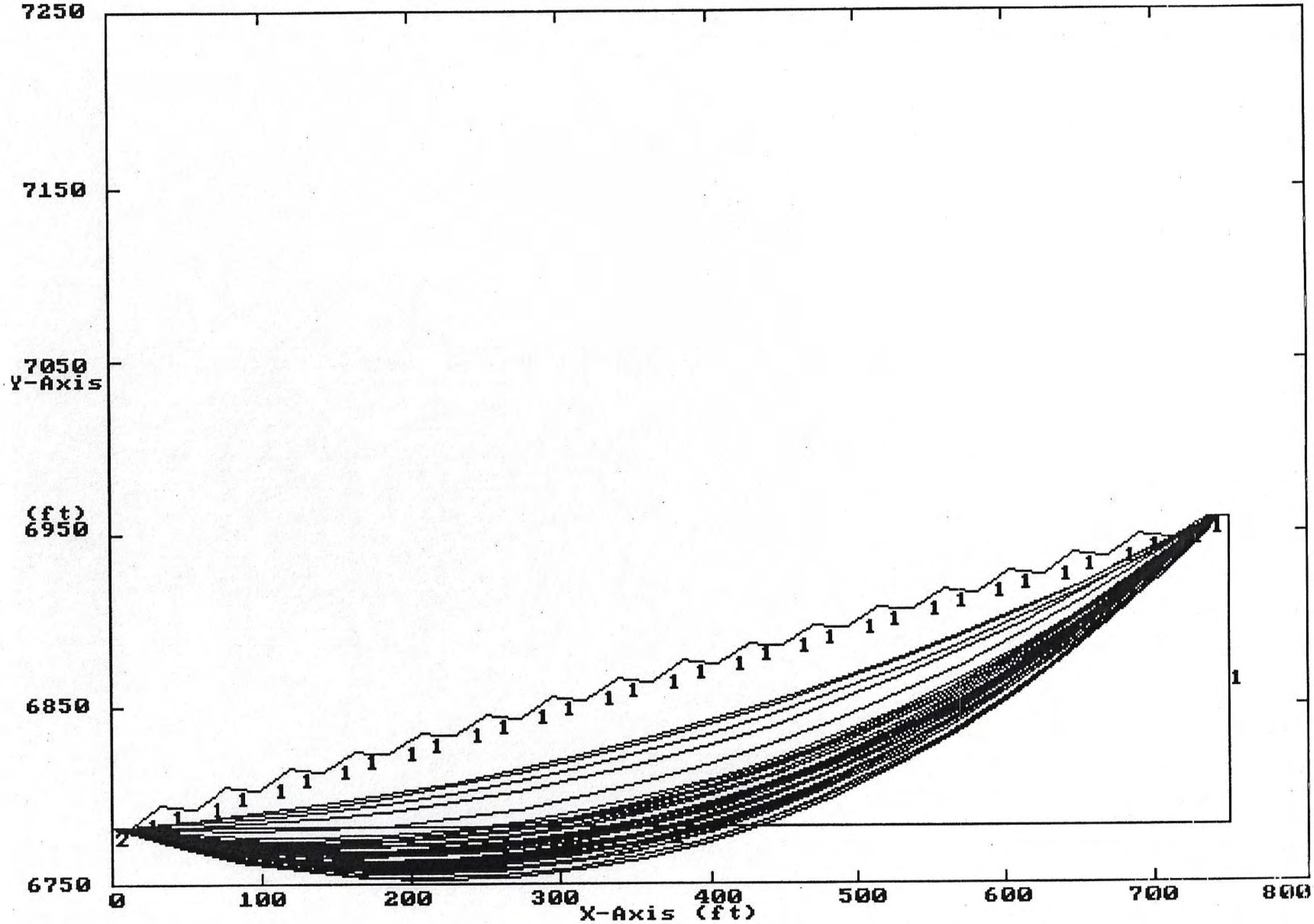
Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	.00	32.00
2	43.58	25.94
3	87.39	21.80
4	131.33	19.60
5	175.33	19.33
6	219.30	21.00
7	263.15	24.61
8	306.80	30.14
9	350.17	37.59
10	393.16	46.94
11	435.70	58.17
12	477.71	71.27
13	519.10	86.20
14	559.79	102.95
15	599.70	121.46
16	638.76	141.72
17	676.89	163.68
18	714.02	187.29
19	744.76	208.80

Circle Center At X = 159.4 ; Y = 1018.3 and Radius, 999.1

*** 1.953 ***

TEP - ash disposal area actual elev. and distance
All surfaces evaluated. H:TEP3.PLT By: robin 01-09-98 1:40pm



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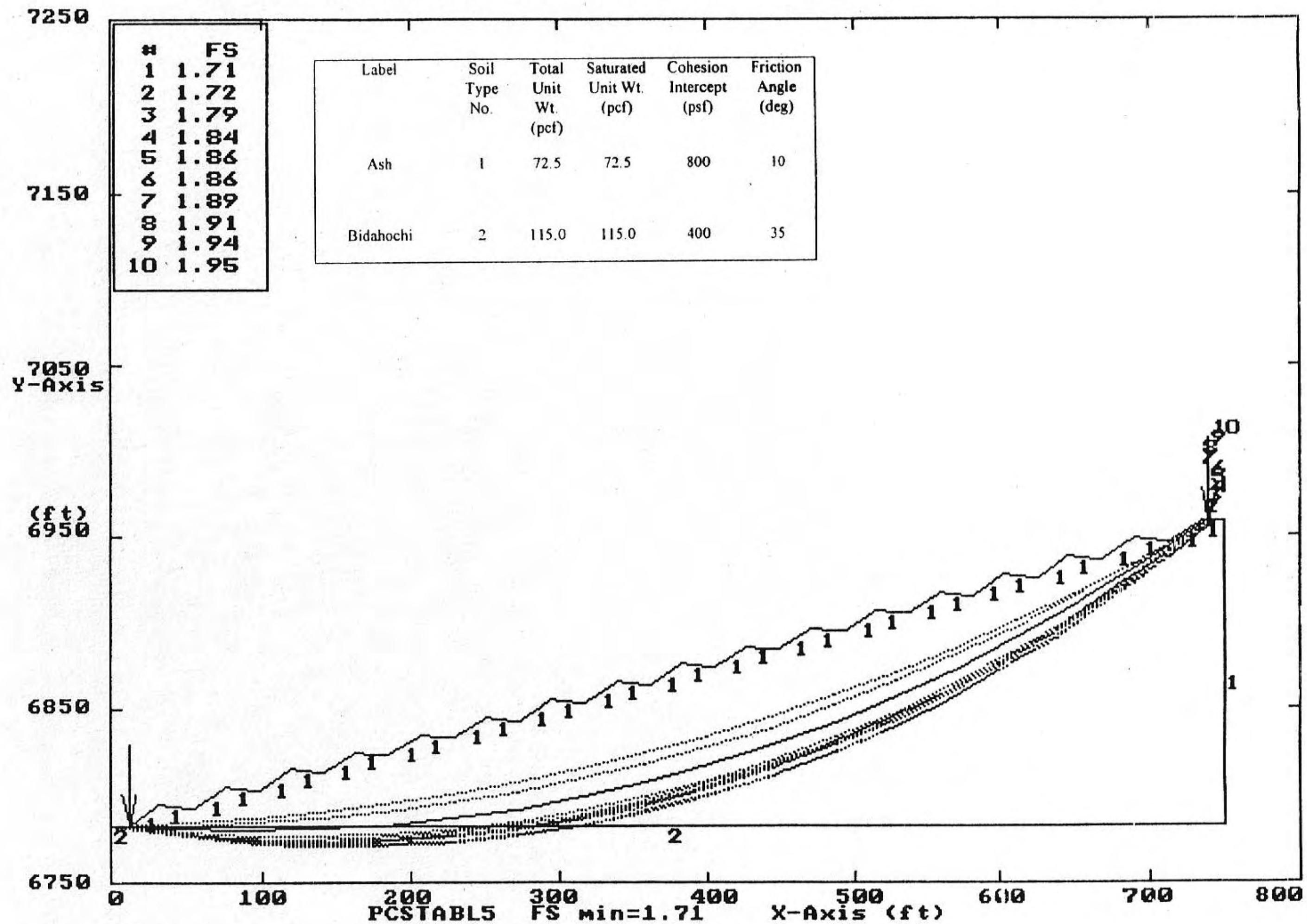
TEP - ash disposal area actual elev. and distance
Ten Most Critical. H:TEP3.PLT By: robin 01-09-98 1:40pm



#	FS
1	1.71
2	1.72
3	1.79
4	1.84
5	1.86
6	1.86
7	1.89
8	1.91
9	1.94
10	1.95

Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
Ash	1	72.5	72.5	800	10
Bidahochi	2	115.0	115.0	400	35

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DATE	12/16/97
DWN	GL
APP	SA
REV	
PROJECT NO.	92097-030.051

TUCSON ELECTRIC COMPANY
SPRINGERVILLE POWER PLANT
SPRINGERVILLE, ARIZONA

PCSTABL5 PLOTS

APPENDIX C

Seepage and Static Stability Results TETRATECH 2011

9.2 Seepage Results

Steady state seepage conditions are unlikely to develop because of the infrequent precipitation events in the area and because the maximum water level will only last several days. Steady state conditions typically take on the order of many months to many years. The results of the seepage analysis indicate that the retention structure will only have minimal seepage through the embankment (approximately 5.7E-6 ft^3/sec/ft) if maximum water level within the basin reaches steady state downstream.

Conservative steady state groundwater conditions were utilized in the stability analyses.

9.3 Static Stability Results

Results of these analyses are summarized on Table 3. The cross sections modeled are presented in Appendix C.

Table 3: Results of Static Stability Analyses

Scenario	Factor Of Safety	
	Static	Seismic (0.1g)
Retention Structure 3	1.9	1.5
Ash Disposal Phase 4	1.9	1.4
Ash Disposal Phase 7	1.9	1.4

10.0 CONCLUSIONS AND RECOMMENDATIONS

10.1 Retention Structure 3

The embankment material unit should be composed of onsite borrow material and onsite fly ash. A key trench should be excavated along the center line of the embankment. The key trench should be excavated a minimum of 2 feet into the claystone bedrock and have a minimum 10-foot wide bottom with 1:1 (H:V) side slopes extending to the existing grade. Ripping of hard shale bedrock may be necessary. Following the excavation, the exposed subgrade should be evaluated by a representative of the project engineer. The engineer may require deeper cutoff excavation in areas where sandstone, sandy claystone and/or excessive groundwater seepage are encountered. The subgrade may need to be proof rolled with a heavily-loaded pneumatic-tired vehicle or a tamping roller. Any excessively soft areas encountered or deleterious material discovered should be removed and replaced with compacted earthfill. After excavation a sheepsfoot compactor should be used to compact the bottom and sides of the cutoff trench before embankment fly ash and soil placement.

The embankment will utilize onsite fly ash as a core and onsite sandy clay utilized in the remainder of the embankment. A typical section can be found in Figure 4. The embankment materials should be placed in maximum 12-inch loose lifts, be compacted to at least 95% of maximum Standard Proctor density (ASTM D698), and be moisture conditioned to within +/- 2% of optimum moisture content.

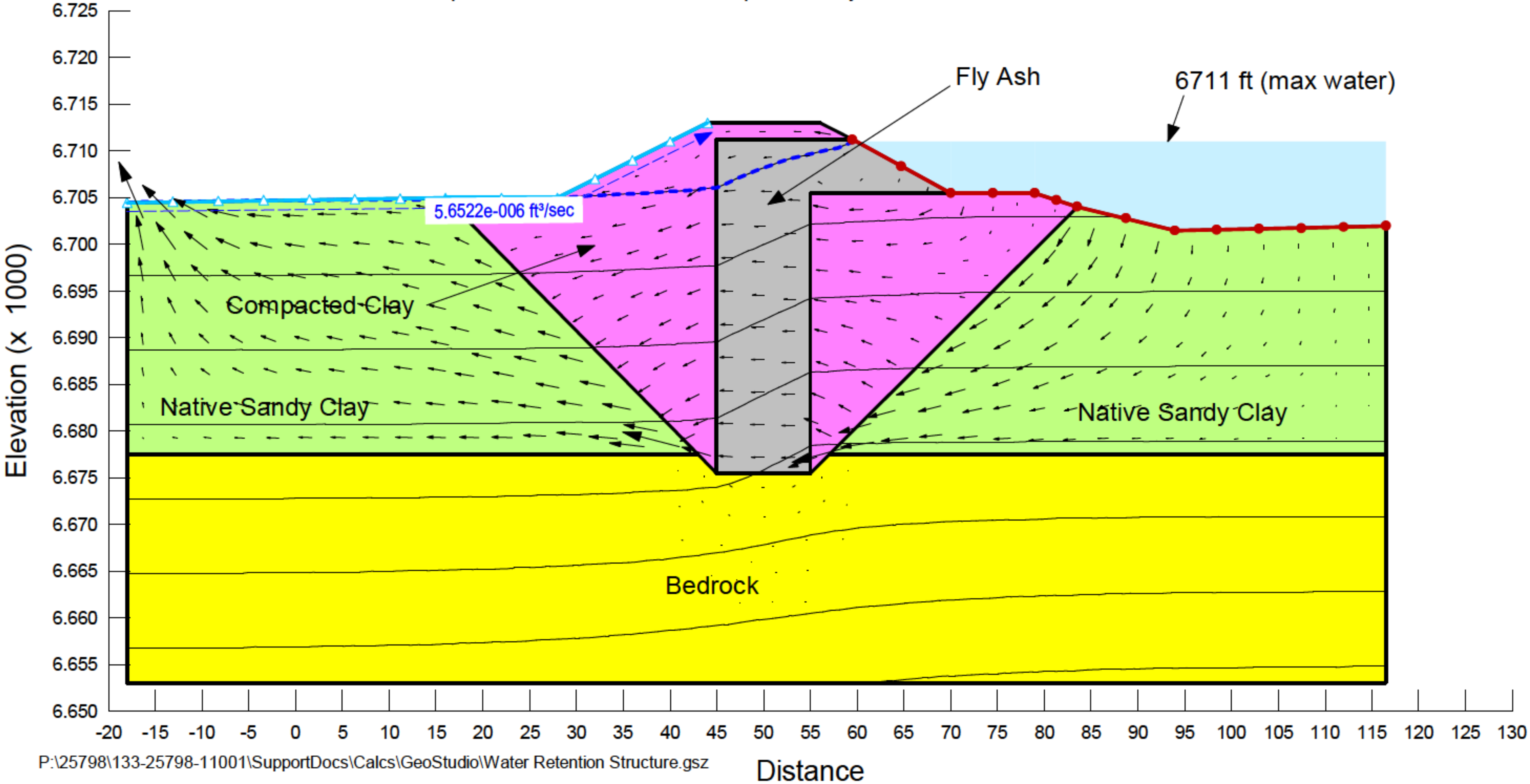
APPENDIX C

STABILITY ANALYSES

Springerville Generating Station

Retention Structure Seepage

Name: Bedrock K-Function: Bedrock Ksat = 8.28e-008 ft/sec
Name: Sandy Clay K-Function: Sandy Clay Ksat = 3.28e-05ft/s
Name: Fly Ash K-Function: Fly Ash = 3.28e-07ft/s
Name: Compacted Fill K-Function: Compacted Clay Fill Ksat = 3.028e-06ft/s



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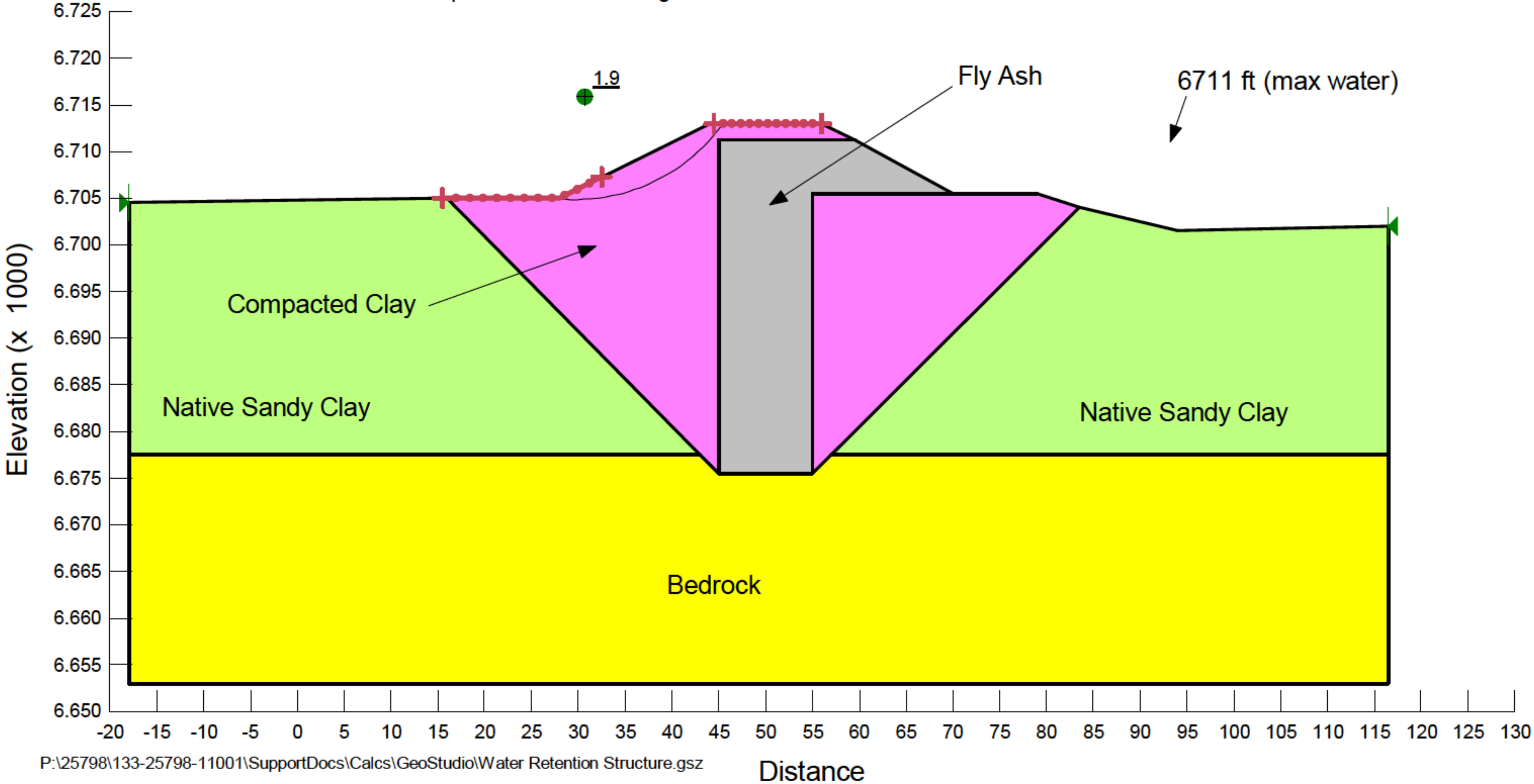
Springerville Generating Station

Retention Structure Stability

Name: Bedrock Unit Weight: 122 Cohesion: 100 Phi: 26
Name: Sandy Clay Unit Weight: 118 Cohesion: 50 Phi: 20
Name: Fly Ash Unit Weight: 60 Cohesion: 250 Phi: 28
Name: Compacted Fill Unit Weight: 122 Cohesion: 50 Phi: 30



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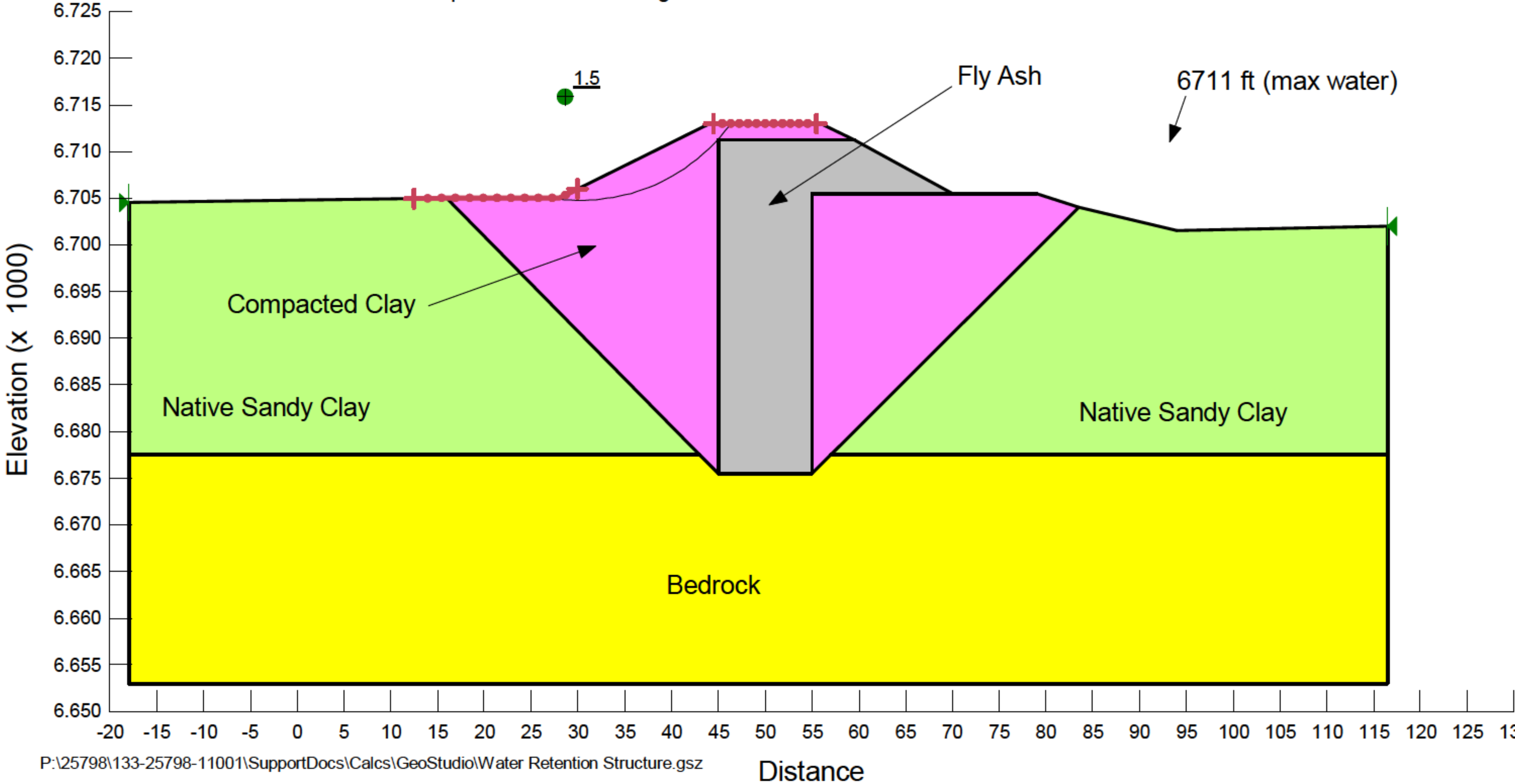
Springerville Generating Station

Retention Stucture Stabilty (seismic)

Name: Bedrock   Unit Weight: 122   Cohesion: 100   Phi: 26
Name: Sandy Clay   Unit Weight: 118   Cohesion: 50   Phi: 20
Name: Fly Ash   Unit Weight: 60   Cohesion: 250   Phi: 28
Name: Compacted Fill   Unit Weight: 122   Cohesion: 50   Phi: 30



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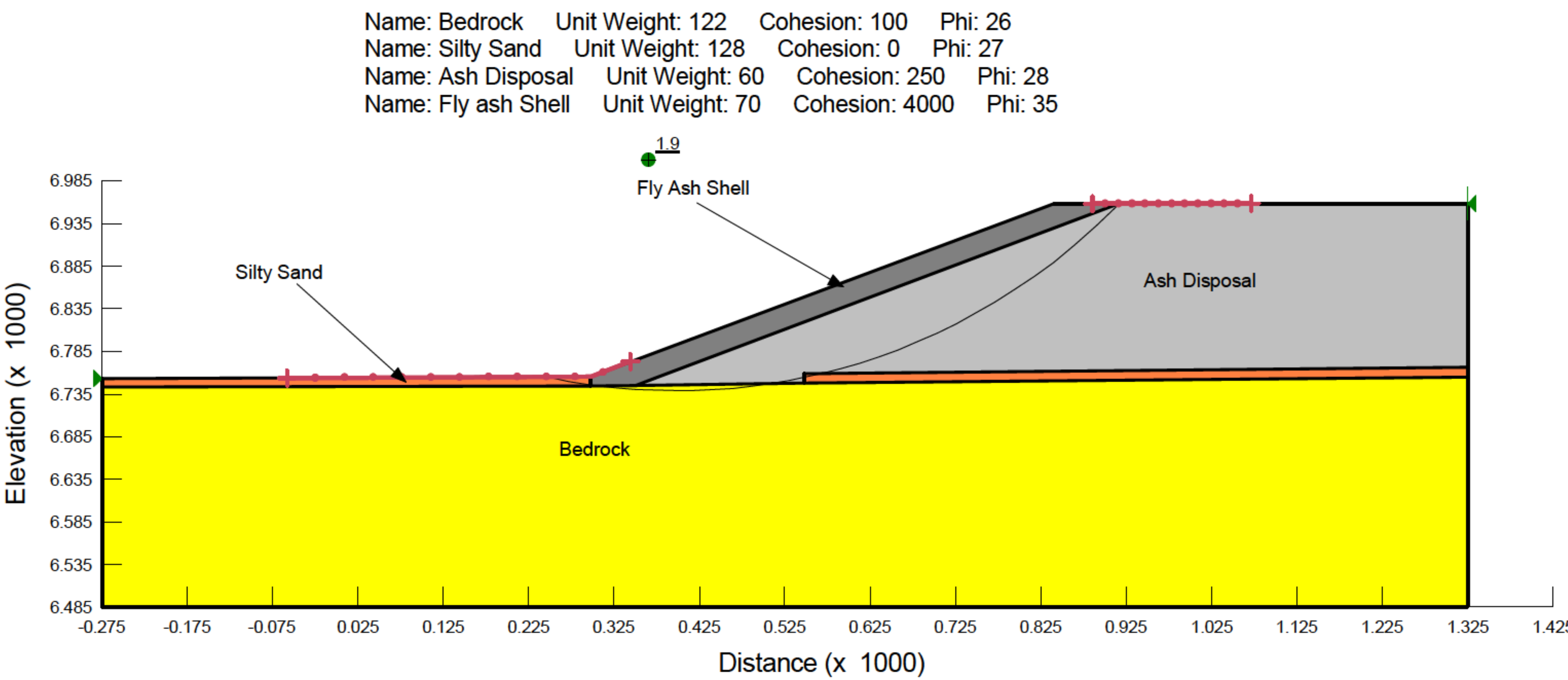
Springerville Generating Station
Ash Disposal Phase 4



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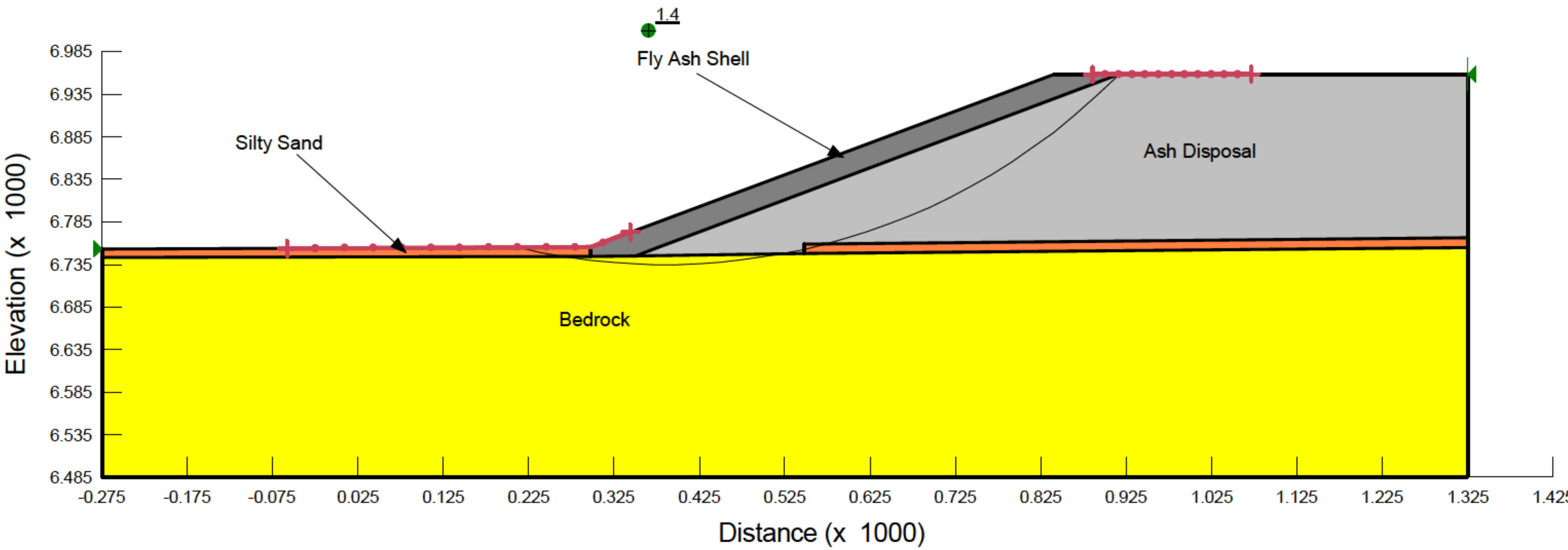
Springerville Generating Station

Ash Disposal Phase 4 (seismic)

Name: Bedrock Unit Weight: 122 Cohesion: 100 Phi: 26
Name: Silty Sand Unit Weight: 128 Cohesion: 0 Phi: 27
Name: Ash Disposal Unit Weight: 60 Cohesion: 250 Phi: 28
Name: Fly ash Shell Unit Weight: 70 Cohesion: 4000 Phi: 35



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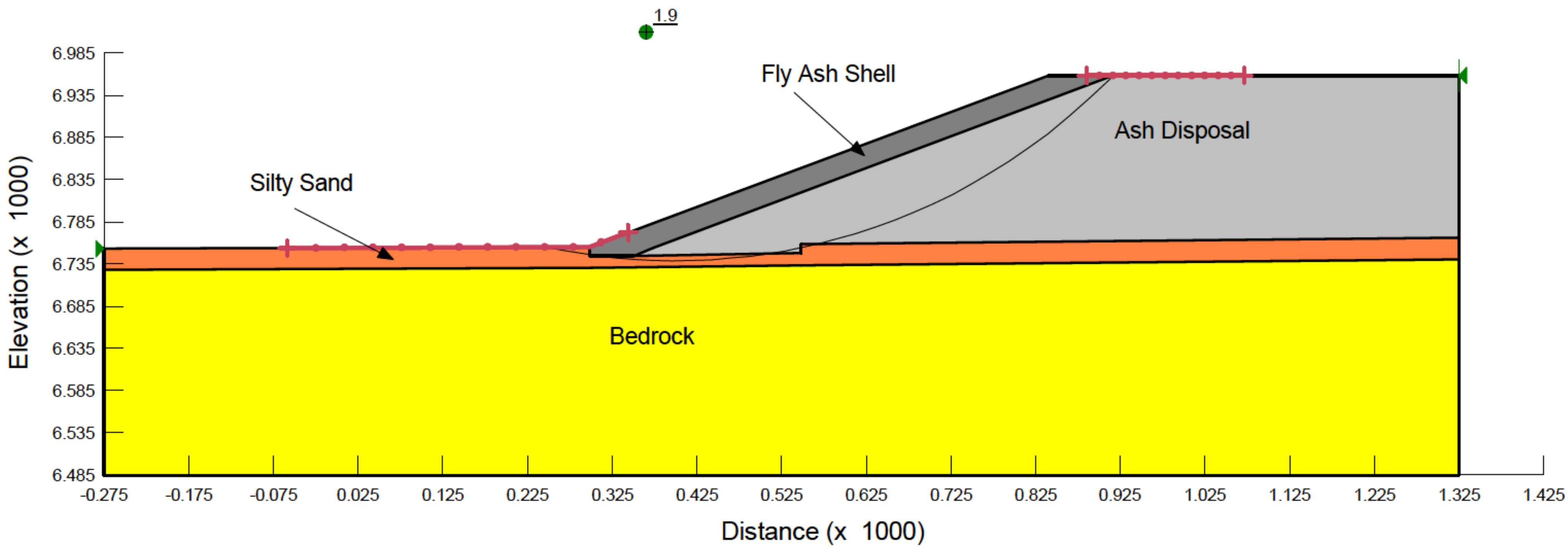
Springerville Generating Station
Ash Disposal Phase 7

Name: Bedrock Unit Weight: 122 Cohesion: 100 Phi: 26
Name: Silty Sand Unit Weight: 128 Cohesion: 0 Phi: 27
Name: Ash Disposal Unit Weight: 60 Cohesion: 250 Phi: 28
Name: Fly Ash Shell Unit Weight: 70 Cohesion: 4000 Phi: 35



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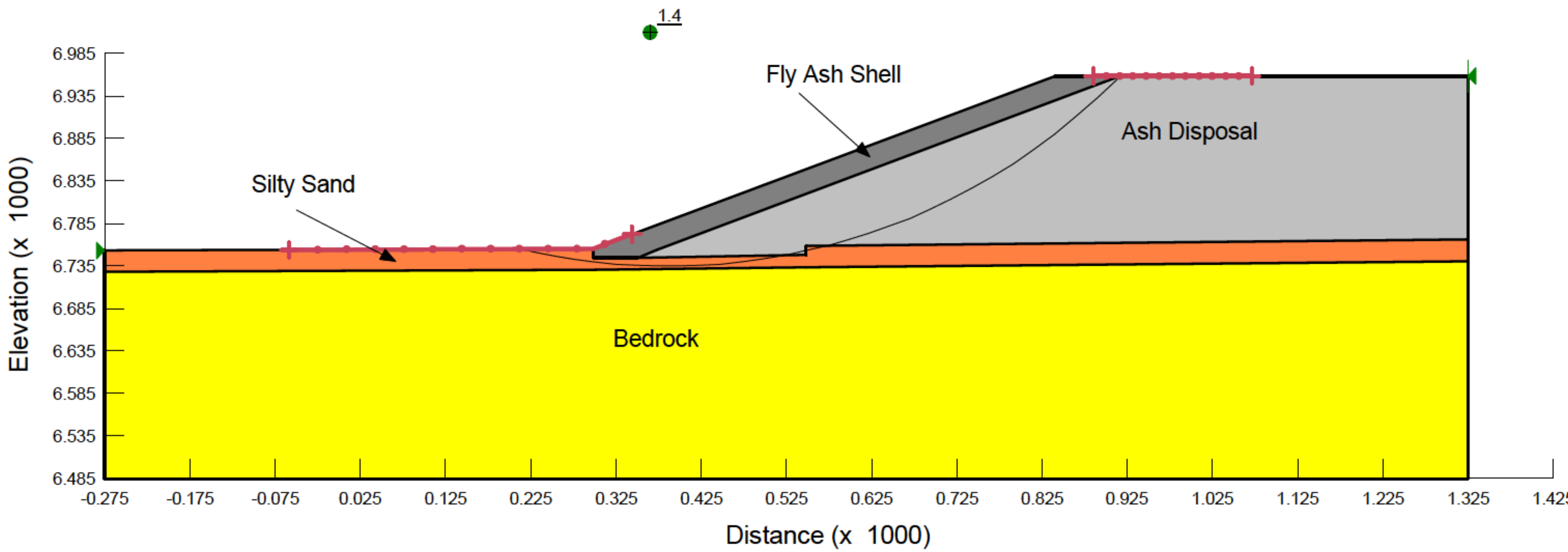
Springerville Generating Station
Ash Disposal Phase 7 (seismic)

Name: Bedrock Unit Weight: 122 Cohesion: 100 Phi: 26
Name: Silty Sand Unit Weight: 128 Cohesion: 0 Phi: 27
Name: Ash Disposal Unit Weight: 60 Cohesion: 250 Phi: 28
Name: Fly Ash Shell Unit Weight: 70 Cohesion: 4000 Phi: 35



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