mcgehee engineering corp

April 23, 2013

J. Michael Harrison, P.E.
Alabama Surface Mining Commission
P. O. Box 2390
Jasper, AL 35502-2390

RE: Jesse Creek Mining, LLC
Gurnee Mine, P-39--

Dear Mr. Harrison:

I hereby certify the enclosed re-evaluation plans for Sediment Basin 018 and the detail design plans for Sediment Basin 018A for the above referenced Mine are in accordance with the Regulations of the Alabama Surface Mining Commission as adopted by Act 81-435 of December 18, 1981 and as amended to date and that the information used in the enclosed basin design plans is true and correct to the best of my knowledge and belief.

If you have any questions or need additional information, please do not hesitate to contact our office.

Sincerely,

McGehee Engineering Corp.

Robert W. Usher, P.E.
Alabama Reg. No. 15917

ALABAMA LICENSED PROFESSIONAL No. 15917 ENGINEER ROBERT W. USHER

Post Office Box 3431 • 450 19th Street West • Jasper, Alabama 35502-3431 • 205-221-0686 • Fax 205-221-7721 • staff@mcgehee.org

INTRODUCTION

The Jesse Creek Mining, LLC, Gurnee Mine proposes to utilize Sediment Basin 018 as part of the drainage control plan. This basin was added to the New Century Mining, Inc., Gholson Mine, P-3663 by Revision No. 10, constructed and certified on April 6, 1998. Since that time the Kodiak Mining, Coke Mine No. 1, P-3887 permitted the basin. Re-evaluation plans prepared by PERC Engineering that included the addition of Sediment Basin 018A were approved October 3, 2006. The plans routed proposed disturbed runoff through Sediment Basins 012, 013, 018A and 018. They stated that Basin 018A would not be constructed until the bond was posted on the increment associated with the proposed coarse refuse facilities.

These plans evaluate the watershed of Sediment Basin 018 with the disturbances associated with the Gurnee Mine, which includes the addition of Sediment Basin 018A. Sediment Basin 018A design differs somewhat from those in P-3887. Listed below is a comparison of the two designs.

	Fixed Siphon	Inlet Elev.	Crest Elev.	Spillway Elev.	Sediment Storage Volume (ac-ft)	25 year, 6 hour Peak Elev.	Top of Dam Elev.
New 018A	6"	410.5'	412'	412.5'	13	415.69'	417.8'
PERC Plan R--	3"	410'	412'	413'	9.1	415.4'	418'

There is very little change to the design plans.

The watershed for Sediment Basin 018 includes Sediment Basins 012 and 013. To properly evaluate Sediment Basin 018 these structures are included in the evaluation. The Gurnee Mine does not have disturbed drainage passing through either of these structures. The information for these structures along with Sediment Basin 018, such as spillway elevations and stage-areas was taken from the PERC plans submitted in P-3887. The individual watersheds were routed through these structures to determine peak stages for Sediment Basins 018A and 018.
Listed below is a comparison of the two designs of Sediment Basin 018.

	Fixed Siphon	Inlet Elev.	Crest Elev.	Spillway Elev.	Sediment Storage Volume (ac-ft)	25year, 6 hour Peak Elev.	Top of Dam Elev.
MEC 018 evaluation	6"	379'	380'	381'	7.2	383.78'	385'
PERC Plan R---	6"	379'	380'	381'	7.2	383.5'	385'

From this comparison the peak stage increased only 0.19’ during the 25 year, 6 hour rainfall event. This increase is an insignificant increase. No modifications are necessary for Sediment Basin 018.

The watershed breakdown for this evaluation and design used all area disturbed within the P-3887 permit area. Some of the permitted area has been shown in the past to be used for coarse refuse disposal. Due to the closure of the Coke Mine No.1 at this time, this evaluation did not show all of this as disturbed. The reason for this is due to the small amount of existing coarse refuse currently at the Coke Mine No. 1. It is obvious that during operations this mine produced a small amount of the refuse and there is a significant amount of volume remaining at that site. The proposed disturbances for the Coke Mine No. 1 future refuse facilities would be somewhere in the future after Gurnee Mine disturbances were completed and reclaimed for an extended time.

Drawings Included.

MEC WATERSHED MAP

PERC PLAN VIEW FOR SEDIMENT BASIN 018

PERC CROSS SECTION VIEW FOR SEDIMENT BASIN 018

PERC PLAN VIEW FOR SEDIMENT BASIN 013

PERC CROSS SECTION VIEW FOR SEDIMENT BASIN 013

PERC PLAN VIEW FOR SEDIMENT BASIN 012

PERC CROSS SECTION VIEW FOR SEDIEMNT BASIN 012

MEC PLAN VIEW FOR SEDIMENT BASIN 018A

MEC CROSS SECTION VIEW FOR SEDIMENT BASIN 018A

MEC PROFILE VIEW FOR SPILLWAY DETAIL

SEDIMENT BASIN CONSTRUCTION SPECIFICATIONS

Sediment basins (temporary or permanent) will be designed and constructed using the following as minimum specifications:

1. EMBANKMENT REQUIREMENTS

A) The minimum width of the top of the embankment will under no circumstance be less than twelve (12) feet.

B) The embankment will have a minimum front and back slope no steeper than the slopes listed on the detailed design sheet.

C) The foundation area of the embankment will be cleared and grubbed of all organic matter with no surface slope steeper than 1 horizontal to 1 vertical. The entire wet area, as measured from the upstream toe of the embankment to the normal pool level, will be cleared of trees and large brush.

D) A core will be constructed in a cutoff trench along the centerline of the embankment. The cutoff trench will be of suitable depth and width to attain relatively impervious material.

E) The embankment construction material will be free of sod, roots, stumps, rocks, etc., which exceed six (6") inches in diameter. The embankment material will be placed in layers of twelve (12") inches or less and compacted to ninety five (95%) percent of the standard proctor density, as set forth in ASTM.

F) The embankment, foundation and abutments will be designed and constructed to be stable under normal construction and operating conditions, with a minimum static safety factor of 1.3 at normal pool level with steady seepage saturation conditions.

G) The actual constructed height of the embankment will be a minimum of five (5%) percent higher than the design height to allow for settling over the life of the embankment.

H) The design embankment height for temporary impoundments will be a minimum of one (1) foot above the maximum water level anticipated from a 10 Year - 24 Hour or a 25 Year - 6 Hour precipitation event (whichever is greater). The design embankment height for permanent impoundments will be a minimum of one (1) foot above the maximum water level anticipated from a 10 Year - 24 Hour or a 25 Year - 6 Hour precipitation event (whichever is greater).

I) For embankments constructed as point source discharges, the embankment will be constructed and abutments keyed into undisturbed, virgin, ground if at all possible. In the event that this can not be achieved, additional design and construction specifications will be submitted in the detailed design plans.

J) The embankment and all areas disturbed in the construction of the embankment will be seeded with a mixture of perennial and annual grasses, fertilized and mulched to prevent erosion and ensure restabilization. Hay dams, silt fences, rock check dams, etc. will be installed, where deemed necessary, as additional erosion prevention methods.

2. DISCHARGE STRUCTURE REQUIREMENTS

A) The primary spillway will be designed to adequately carry the anticipated peak runoff from a 10 Year - 24 Hour precipitation event. The combination primary and secondary (emergency) spillway system will be designed to safely carry the anticipated peak runoff from a 25 Year - 6 Hour precipitation event. When sediment basins are proposed in the drainage course of a public water supply, the spillway system will be designed and constructed to adequately carry the runoff from a 50 Year - 24 Hour precipitation event.

B) Channel linings, for secondary (emergency) spillways will be a trapezoidal open channel constructed in natural ground and planted with a mixture of both annual and perennial grasses being predominantly fescue and bermuda. In the event that the spillway can not be constructed in natural ground the spillway will be lined with riprap, concrete, asphalt or durable rock (See Detailed Design Plans for Spillway Lining).

C) When consisting of pipe, the primary spillway will be installed according to Class "C" pipe installation for embankment bedding.

D) Sediment basins with a single spillway system, such as a skimmer board, will be a trapezoidal open channel constructed in consolidated, nonerodible material and lined with rip-rap, concrete, asphalt or durable rock (See Detailed Design Plans for Spillway Lining).

E) The primary spillway will be designed and constructed with device to eliminate floating solids from leaving the impoundment. This device will consist of a turned down elbow when using pipe or a skimmer system when using an open channel spillway.

F) When necessary, to prevent erosion of the embankment or discharge area, a splash pad of rip-rap, durable rock, sacrete, etc. will be installed at the discharge end of the primary spillway.

G) The combined spillway systems, for sediment basins constructed in series, will be designed to adequately accommodate the entire drainage area.

3. INSPECTION, MAINTENANCE AND CERTIFICATION REQUIREMENTS

A) Inspections will be conducted regularly during construction of the sediment basin by a qualified registered professional engineer or other qualified person under the direction of a professional engineer. Upon completion of construction, the sediment basin will be

certified, by a qualified registered professional engineer, to the Regulatory Authority as having been constructed in accordance with the approved detailed design plans.

B) Sediment basins will be inspected semi-monthly for erosion, instability, etc., with maintenance performed as necessary, until the removal of the structure or until a Phase III Bond Release is granted.

C) Sediment basins will be examined quarterly for structural weakness, instability, erosion, slope failure, or other hazardous conditions with maintenance performed as necessary.

D) Formal inspections will be made annually, by a qualified registered professional engineer or other qualified person under the direction of a professional engineer, including any reports or modifications, in accordance with 880-X- 10C- .20[1(j)] of the Alabama Surface Mining Regulations.

E) Retained sediment will be removed from each sediment basin when the accumulated sediment reaches the maximum allowable sediment volume as set forth in the detailed design plans.

4. BASIN REMOVAL REQUIREMENTS

A) Upon completion of mining, reclamation, restabilization and effluent standards being met, each sediment basin not proposed as a permanent water impoundment will be dewatered in a controlled manner by either pumping or siphoning. Upon successful dewatering, a determination will be made as to the retained sediment level in the basin. After determining the retained sediment level, a channel will be cut into the embankment down to the retained sediment level on the side of the embankment deemed most suitable to reach natural ground without encountering prohibiting rock. The embankment material removed from this newly constructed channel will be spread and compacted over the previous impoundment (wet area) area to prevent erosion and ensure restabilization. The newly constructed channel will be of adequate width (minimum 30 feet) and sloped to a grade (approximately 1% to 3%) which will cause all surface drainage to travel across this area in sheet flow, minimizing the possibility of erosion. Also, where necessary, hay dams will be installed in strategic locations across the width of the channel to retain sediment and slow the water velocity to a favorable rate. Upon removal of the embankment section, all disturbed areas will be graded in such a manner to ensure slope stability, successful restabilization and to minimize erosion. All disturbed areas will be seeded with a mixture of annual and perennial grasses, fertilized and mulched. No slope, existing or created in the removal of the sediment basin, will be left on a grade that will slip or slough.

5. PERMANENT WATER IMPOUNDMENT REQUIREMENTS

A) Prior to a request for a Phase II Bond Release, all sediment basins being left as permanent water impoundments will have supplemental data submitted to the Regulatory Authority concerning water quality, water quantity, size, depth, configuration, postmining land use, etc.

B) Final grading slopes of the entire permanent water impoundment area will not exceed a slope of 2 Horizontal to 1 Vertical to provide for safety and access for future water users.

SPILLWAY CHANNEL SPECIFICATIONS
SEDIMENT BASIN 018A

The entire control section, transition section and tail ditch section of the emergency spillway (extending from the entrance of the control section through the tail ditch section down to the original drainage course) has been cut along the centerline of the embankment into compacted fill material and lined as follows:

The entire control section of the emergency spillway is lined with a minimum of four (4") inches of 3,000 psi concrete extending up the channel side a minimum of 4.19 feet as measured vertically at the control entrance tapering down to 2.57 feet at the end of the control section. The transition section is lined similarly up the channel side a minimum of 2.57 feet at the beginning of the transition section tapering down to 1.65 feet at the end of the transition section. The entire tail ditch section is lined similarly up the channel side a minimum of 1.63 feet as measured vertically. All concrete is reinforced with 10 gauge, 6" x 6" welded wire mesh.

The gradient of the control section of the emergency spillway will not exceed two (2.0%) percent. The gradient of the tail ditch section of the emergency spillway will not exceed forty (40%) percent.

See enclosed SEDCAD 4.0 spillway tail ditch section design, Plan Sheet cross-section and Spillway Profile Sheet for the minimum and maximum emergency spillway construction requirements.

No subsurface withdrawal device is required for this structure due to it being an upstream structure.

BASIN 018A 2% CONTROL SECTION

Material: Concrete, Rubble

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
15.00	2.0:1	2.0:1	2.0	0.0220	1.00		

	w/o Freeboard	w/ Freeboard
Design Discharge:	323.00 cfs	
Depth:	1.57 ft	2.57 ft
Top Width:	21.27 ft	25.27 ft
Velocity:	11.36 fps	
X-Section Area:	28.43 sq ft	
Hydraulic Radius:	1.292 ft	
Froude Number:	1.73	

BASIN 018A 40% TAIL DITCH SECTION

Material: Concrete, Rubble

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
15.00	2.0:1	2.0:1	40.0	0.0220	1.00		

	w/o Freeboard	w/ Freeboard
Design Discharge:	323.00 cfs	
Depth:	0.65 ft	1.65 ft
Top Width:	17.62 ft	21.62 ft
Velocity:	30.30 fps	
X-Section Area:	10.66 sq ft	
Hydraulic Radius:	0.595 ft	
Froude Number:	6.86	

Sediment Basin 018A

Elevation-Area-Capacity Table

Elevation (ft)	Area (ac)	Capacity (ac-ft)
393.00	0.000	0.000
394.00	0.035	0.012
395.00	0.140	0.093
396.00	0.205	0.265
397.00	0.282	0.507
398.00	0.370	0.832
399.00	0.441	1.237
400.00	0.518	1.716
401.00	0.600	2.274
402.00	0.723	2.935
403.00	0.856	3.723
404.00	1.000	4.650
405.00	1.168	5.733
406.00	1.348	6.990
407.00	1.540	8.433
408.00	1.715	10.059
409.00	1.898	11.865
410.00	2.090	13.858
411.00	2.239	16.022
412.00	2.392	18.337
413.00	2.550	20.807
414.00	2.690	23.427
415.00	2.833	26.188
416.00	2.980	29.094

HYDROLOGY AND SEDIMENTOLOGY PREDICTION
10 YEAR - 24 HOUR PRECIPITATION EVENT
SEDIMENT BASINS 018, 018A

HYDROLOGY AND SEDIMENTOLOGY PREDICTION
25 YEAR - 6 HOUR PRECIPITATION EVENT
SEDIMENT BASIN 018, 018A

STABILITY ANALYSIS

The computer program used to analyze the slope stability was the REAME Slope Stability Program as developed by Dr. Yang H. Huang, P.E. of the University of Kentucky.

The soil type of the foundation material beneath the proposed embankment structure of Sediment Basin 018A was sampled, analyzed and classified by personnel of McGehee Engineering Corp. The depth to the stiff base of Sediment Basin 018A (5.1') was measured by personnel of McGehee Engineering Corp.

SOIL PROPERTIES

USAGE	TYPE	COHESION (psf)	INTERNAL ANGLE OF FRICTION	EFFECTIVE DENSITY (pcf)
018A FOUND.	SC	100	27.92	133.52
018A DAM	SM-SC	180	30.54	135.96

ANALYSIS RESULTS

BASIN	STATIC SAFETY FACTOR
018A	1.56

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SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Jesse Creek Mining, LLC
Location: Gurnee
Sample I.D.: Basin 018A
Description: Dam Material

Sample Date: 2/22/13
Analyzed By: JWW
Date Analyzed: 2/27/13
Requested By: R. Usher

Weight of Oven Dry Sample (W): 1003.0 Grams

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	564.0	540.0	24.0	2.4	2.4	2.4	97.6
4	625.0	513.0	112.0	11.2	13.6	13.6	86.4
10	598.0	462.0	136.0	13.6	27.1	27.1	72.9
40	641.0	383.0	258.0	25.7	52.8	52.8	47.2
200	618.3	333.0	285.3	28.4	81.3	81.3	18.7
Pan	567.7	380.0	187.7	18.7	100.0	100.0	0.0
		Total Weight (W1):	1003.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit: 25.4
Plastic Limit: 20.4
Plasticity Index: 5.0

Soil Classification: SM-SC

Coarse Grained
Silty, Clayey Sand

Effective Cohesion: 1.2500 psi
Total Cohesion: 1.940 psi
Permeability: 1.40 ft/yr
Maximum Dry Density: 120.0 pcf
Optimum Moisture: 13.3 %
Effective Cohesion: 180.0 psf
Angle of Internal Friction: 30.54 degrees
Mass Unit Weight: 135.96 pcf

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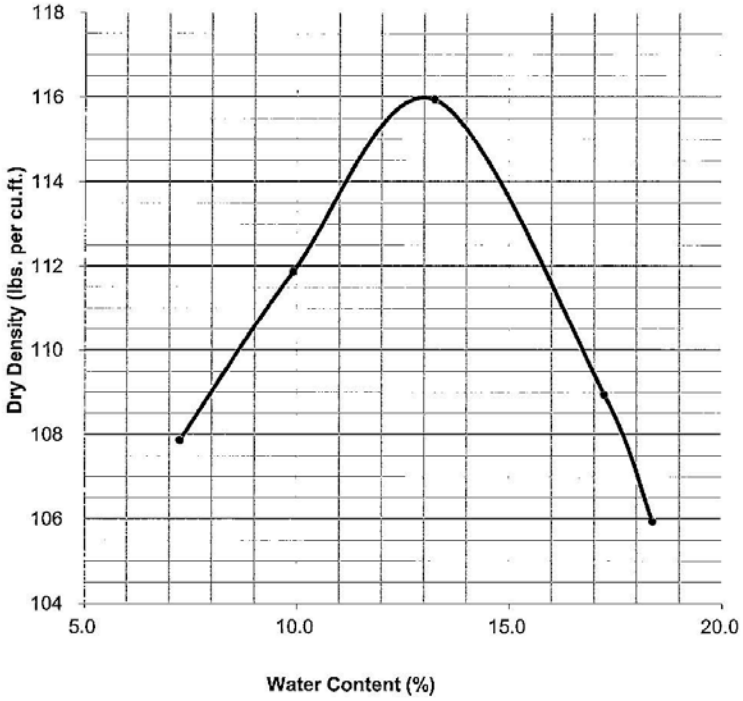
Jesse Creek Mining, LLC
Gurnee, Basin 018A, Dam Material
Moisture Density Relationship
(Proctor Method)



ASTM D-698 Method A	Water Content %	Specific Gravity	%> No. 4	%< No. 200	LL %	PL %	PI %
			13.6	18.7	25.4	20.4	5.0
Sample Description, Classification and Location				Sample No.:			Basin 018A Dam Material
Coarse Grained Silty, Clayey Sand				Optimum Moisture Content=			13.0
				Maximum Dry Density =			116.0

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STANDARD PROCTOR COMPACTION TEST (ASTM D-698)

Company Name: Jesse Creek Mining, LLC
Location: Gurnee
Sample I.D.: Basin 018A
Description: Dam Material

Sampled By: D. Clark
Sample Date: 2/22/13
Analyzed By: JWW
Date Analyzed: 2/27/13
Requested By: R. Usher

Weight of Mold (W1): 4,235 Grams

Test No.	Wt. of Mold & Wet Soil (w2) grams	Wt. of wet Soil (w2-w1) grams	Wet Unit Wt. (w2-w1)/c lb/cu-ft	Moisture Content (w) %	Dry Unit Weight lb/cu-ft
1	5,984	1,749	115.7	7.2	107.9
2	6,094	1,859	122.9	9.9	111.9
3	6,220	1,985	131.3	13.2	115.9
4	6,166	1,931	127.7	17.2	108.9
5	6,131	1,896	125.4	18.4	105.9
6					
7					

Constant C = 15.12 (conversion factor)

MOISTURE CONTENT DETERMINATION

Test No.	1	2	3	4	5	6	7
Can No.	1	2	3	4	5		
Wt. of Can, a, (g)	20.47	20.42	20.58	20.46	20.59		
Wt. of Can + Wet Soil, b, (g)	90.33	82.88	88.65	94.32	98.16		
Wt. of Can + Dry Soil, c, (g)	85.61	77.25	80.69	83.46	86.12		
* Moisture Content, w, (%)	7.25	9.91	13.24	17.24	18.37		

* Moisture Content, w = (b - c)/(c - a) x 100

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SIEVE ANALYSIS

(ASTM C136-96a)

Company Name: Jesse Creek Mining, LLC
Location: Gurnee
Sample I.D.: Basin 018A
Description: Foundation

Sample Date: 2/22/13
Analyzed By: JWW
Date Analyzed: 2/27/13
Requested By: R. Usher

Weight of Oven Dry Sample (W): **1001.0 Grams**

Sieve No.	Sieve + Sample Weight	Sieve Weight	Sample Weight Retained	Percent of Total Retained	Cumulative Weight Percent	Percent Retained	Percent Finer
1"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
3/4"	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1/2"	547.0	540.0	7.0	0.7	0.7	0.7	99.3
4	555.0	513.0	42.0	4.2	4.9	4.9	95.1
10	584.0	462.0	122.0	12.2	17.1	17.1	82.9
40	631.0	383.0	248.0	24.8	41.9	41.9	58.1
200	502.9	333.0	169.9	17.0	58.8	58.8	41.2
Pan	792.1	380.0	412.1	41.2	100.0	100.0	0.0
		Total Weight (W1):	1001.0				

SOIL CLASSIFICATION

Unified System (ASTM D-2487)

Liquid Limit:	35.5
Plastic Limit:	25.6
Plasticity Index:	9.9

Soil Classification: **SC**

Coarse Grained
Clayey Sand

Effective Cohesion:	0.6940	psi
Total Cohesion:	8.610	psi
Permeability:	0.50	ft/yr
Maximum Dry Density:	116.0	pcf
Optimum Moisture:	15.1	%
Effective Cohesion:	99.9	psf
Angle of Internal Friction:	27.92	degrees
Mass Unit Weight:	133.52	pcf

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STABILITY ANALYSIS - COMPUTER OUTPUT
SEDIMENT BASIN 018A - STATIC

REAME
(Rotational Equilibrium Analysis of Multilayered Embankments)

Jesse Creek Mining, LLC
Gurnee Mine, P-39--
Sediment Basin 018A
Static Case

Jesse Creek Mining, LLC Sediment Basin 018A
Number of cases to be analyzed 1

Case Number 1
Number of boundary lines= 4
Number of points on boundary lines are: 2 2 3 7

On boundary line no. 1 Point no. and coordinates are:
1 .000 5.000 2 500.000 .000

On boundary line no. 2 Point no. and coordinates are:
1 200.000 8.100 2 338.974 6.710

On boundary line no. 3 Point no. and coordinates are:
1 .000 10.100 2 200.000 8.100 3 243.750 25.600

On boundary line no. 4 Point no. and coordinates are:
1 .000 25.600 2 243.750 25.600 3 261.750 32.800 4 273.750 32.800 5 329.057 10.677
6 338.974 6.710 7 500.000 5.100

Line no. and slope of each segment are:
1 -.010
2 -.010
3 -.010 .400
4 .000 .400 .000 -.400 -.400 -.010

No. of radius control zones= 1 Plot or no plot= 1 No. of seepage cases= 1

Total no. of lines at bottom of radius control zones is: 1

For rad. cont. zone no. 1 Radius decrement= .000 No. of Circles= 5 Id no. for first circle=, 1
Line no.= 1 Begin pt. no.= 1 End pt. no.= 2

Soil no.	Cohesion	F. angle	Unit wt.
1	100.800	27.920	133.520
2	180.000	30.540	135.960
3	.000	.000	62.400

Seismic coefficient= .000 Min. depth of tallest slice= .000 Unit weight of water= 62.400

The factors of safety are determined by the SIMPLIFIED BISHOP method

NSPG= 1 NSRCH= 0 No. of slices= 10 No. of add. radii= 2

No. of points on water table for each case= 6

Under seepage condition 1point no. and coordinates of water table are:
1 .000 25.600 2 243.750 25.600 3 279.841 20.311 4 329.057 10.677 5 338.974 6.710

6 500.000 5.100

point1=(275.000, 54.000) point2=(275.000, 34.000) point3=(340.000, 34.000) NJ= 2 NI= 2
Automatic search will follow after grid with XINC= 10.000 and YINC= 10.000

At point (275.000, 54.000) under seepage 1,the radius and the corresponding factor of safety are:
51.747 8.204 45.645 8.915 39.543 8.494 33.441 8.178 27.339 7.646
25.305 8.692 23.271 13.788
Lowest factor of safety= 7.646 and occurs at radius = 27.339

At point (275.000, 44.000) under seepage 1,the radius and the corresponding factor of safety are:
41.748 8.187 35.652 8.392 29.557 7.873 23.461 7.303 17.365 6.938
15.333 7.936 13.301 11.533
Lowest factor of safety= 6.938 and occurs at radius = 17.365

At point (275.000, 34.000) under seepage 1,the radius and the corresponding factor of safety are:
31.748 8.322 25.714 8.488 19.680 7.967 13.646 7.935 7.612 8.083
17.669 7.823 15.658 7.838 11.635 7.880 9.624 7.951
Lowest factor of safety= 7.823 and occurs at radius = 17.669

At point (307.500, 54.000) under seepage 1,the radius and the corresponding factor of safety are:
52.072 1.813 48.102 1.945 44.131 2.177 40.160 2.470 36.189 3.096
Lowest factor of safety= 1.813 and occurs at radius = 52.072

At point (307.500, 44.000) under seepage 1,the radius and the corresponding factor of safety are:
42.073 1.843 38.245 1.998 34.417 2.277 30.589 2.595 26.761 3.245
Lowest factor of safety= 1.843 and occurs at radius = 42.073

At point (307.500, 34.000) under seepage 1,the radius and the corresponding factor of safety are:
32.073 2.049 28.388 2.221 24.704 2.546 21.019 2.861 17.334 3.520
Lowest factor of safety= 2.049 and occurs at radius = 32.073

At point (340.000, 54.000) under seepage 1,the radius and the corresponding factor of safety are:
52.397 2.028 50.776 2.119 49.154 2.328 47.532 2.863 45.910 4.587
Lowest factor of safety= 2.028 and occurs at radius = 52.397

At point (340.000, 44.000) under seepage 1,the radius and the corresponding factor of safety are:
42.398 2.153 40.919 2.236 39.440 2.439 37.961 2.980 36.483 4.776
Lowest factor of safety= 2.153 and occurs at radius = 42.398

At point (340.000, 34.000) under seepage 1,the radius and the corresponding factor of safety are:
32.398 2.356 31.063 2.441 29.727 2.637 28.391 3.167 27.055 5.036
Lowest factor of safety= 2.356 and occurs at radius = 32.398

For piezometric line No. 1

At point (307.500, 54.000) ,RADIUS 52.072
the minimum factor of safety is 1.813

At point (307.500, 54.000) under seepage 1,the radius and the corresponding factor of safety are:
52.072 1.813 48.102 1.945 44.131 2.177 40.160 2.470 36.189 3.096
Lowest factor of safety= 1.813 and occurs at radius = 52.072

At point (317.500, 54.000) under seepage 1,the radius and the corresponding factor of safety are:
52.172 1.592 48.924 1.736 45.676 2.070 42.428 2.466 39.180 3.343

Lowest factor of safety= 1.592 and occurs at radius = 52.172

At point (327.500, 54.000) under seepage 1,the radius and the corresponding factor of safety are:
52.272 1.604 49.747 1.677 47.222 2.024 44.697 2.505 42.171 3.768
Lowest factor of safety= 1.604 and occurs at radius = 52.272

At point (317.500, 64.000) under seepage 1,the radius and the corresponding factor of safety are:
62.172 1.596 58.781 1.722 55.390 2.024 51.999 2.412 48.608 3.232
Lowest factor of safety= 1.596 and occurs at radius = 62.172

At point (317.500, 44.000) under seepage 1,the radius and the corresponding factor of safety are:
42.173 1.648 39.068 1.797 35.963 2.157 32.858 2.551 29.752 3.488
Lowest factor of safety= 1.648 and occurs at radius = 42.173

At point (320.000, 54.000) under seepage 1,the radius and the corresponding factor of safety are:
52.197 1.574 49.130 1.706 46.063 2.060 42.995 2.469 39.928 3.428
Lowest factor of safety= 1.574 and occurs at radius = 52.197

At point (322.500, 54.000) under seepage 1,the radius and the corresponding factor of safety are:
52.222 1.570 49.336 1.681 46.449 2.058 43.562 2.475 40.676 3.525
Lowest factor of safety= 1.570 and occurs at radius = 52.222

At point (325.000, 54.000) under seepage 1,the radius and the corresponding factor of safety are:
52.247 1.580 49.541 1.666 46.835 2.058 44.130 2.485 41.424 3.638
Lowest factor of safety= 1.580 and occurs at radius = 52.247

At point (322.500, 56.500) under seepage 1,the radius and the corresponding factor of safety are:
54.722 1.566 51.800 1.673 48.877 2.045 45.955 2.464 43.033 3.492
Lowest factor of safety= 1.566 and occurs at radius = 54.722

At point (322.500, 59.000) under seepage 1,the radius and the corresponding factor of safety are:
57.222 1.565 54.264 1.666 51.306 2.035 48.348 2.453 45.390 3.461
Lowest factor of safety= 1.565 and occurs at radius = 57.222

At point (322.500, 61.500) under seepage 1,the radius and the corresponding factor of safety are:
59.722 1.564 56.728 1.660 53.734 2.025 50.740 2.444 47.747 3.431
Lowest factor of safety= 1.564 and occurs at radius = 59.722

At point (322.500, 64.000) under seepage 1,the radius and the corresponding factor of safety are:
62.222 1.566 59.192 1.657 56.163 2.017 53.133 2.435 50.103 3.402
Lowest factor of safety= 1.566 and occurs at radius = 62.222

At point (325.000, 61.500) under seepage 1,the radius and the corresponding factor of safety are:
59.747 1.569 56.934 1.652 54.121 2.030 51.308 2.457 48.494 3.537
Lowest factor of safety= 1.569 and occurs at radius = 59.747

At point (320.000, 61.500) under seepage 1,the radius and the corresponding factor of safety are:
59.697 1.568 56.522 1.686 53.348 2.025 50.173 2.435 46.999 3.338
Lowest factor of safety= 1.568 and occurs at radius = 59.697

For piezometric line No. 1

At point (322.500, 61.500) ,RADIUS 59.722

the minimum factor of safety is 1.564

1

Cross section in distorted scale. Numerals indicate boundary line no.
If there area more than 10 bound. lines, alphabets will then be used. P indicates
Piezometric line. If a portion of Piezometric line coincides with
the ground or another boundary line, only the ground or boundary
line will be shown. X indicates intersection of two boundary
lines. * indicates failure surface.
The minimum factor of safety is 1.564