HYDROLOGY STUDY FOR
BIRMINGHAM COAL & COKE CO., INC.

BEAR CREEK MINE

P-3831 / REVISION R-7

FRANKLIN COUNTY, ALABAMA

BY

PERC ENGINEERING CO., INC.

P.O. BOX 1712

JASPER, ALABAMA 35502

DETAILED DESIGN PLANS

BASIN 019

ATTACHMENT III-B-2(a)

MAY 10, 2011

PERC
ENGINEERING CO., INC.

Telephone: (205) 384-5553
Facsimile: (205) 295-3114 - Main Building
(205) 295-3115 - Water Lab
Web Address: www.percengineering.com

May 10, 2011

Mr. Gary Heaton, P.E.
Alabama Surface Mining Commission
Post Office Box 2390
Jasper, Alabama 35502-2390

RE: Birmingham Coal & Coke Co., Inc.
Bear Creek Mine
P- 3831 / Revision R-7

Dear Gary:

I hereby certify the attached detailed design plans for Basin 019 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 amended to date, and are true and correct to the best of my knowledge and belief.

If you have any questions or required additional information, please feel free to call.

Sincerely,
PERC Engineering Co., Inc.

Leslie G. Stephens, P.E., P.L.S.
Alabama Registration No. 14117-E

ALABAMA PROFESSIONAL ENGINEER AND LAND SURVEYOR REGISTERED No. 14117 LESLIE G. STEPHENS

Pond Construction Criteria

The embankment for sediment basins (temporary and permanent) shall be designed and built using the following as minimum criteria:

1. The top of the dam shall be no less than 12 feet wide.

2. See design sheet for maximum and minimum embankment slopes.

3. The foundation and abutments for the impounding structure shall be designed to be stable under all conditions of construction and operation of the impoundments, with a minimum static safety factor of 1.3 for the normal pool with steady seepage saturation conditions.

4. The dam shall be constructed with a cutoff trench based upon prudent engineering practices for the site. The cutoff shall be located on the dam centerline and be of sufficient depth to extend into a relatively impervious material from which the core of the dam shall also be constructed.

5. The embankment foundation area shall be cleared of all organic matter, all surfaces sloped to no steeper than lv:lh, and the entire foundation surface scarified.

6. The entire embankment and cutoff trench shall be compacted to 95 percent density, based on standard proctor as outlined in ASTM.

7. The material placed in the embankment shall be free of sod, roots, stones over 6 inches in diameter, and other objectionable materials. The fill material shall be placed and spread over the entire fill area, starting at the lowest point of the foundation, in layers not to exceed 12 inches in thickness. Construction of the fill shall be undertaken only at such times that the moisture content of the fill material will permit satisfactory compaction in accordance with paragraph 5.

8. The pool area of all basins will be cleared of timber and large undergrowth.

9. The primary decant system when consisting of a pipe shall be installed according to Class C pipe installation for embankment bedding.

10. The primary decant system shall be equipped with a device, or constructed, such as to insure that subsurface withdrawal is accomplished to prevent discharge of floating solids. If a channel is used as the primary decant a skimmer shall be installed to prevent floating solids from discharging.

11. A splash pad or riprap may be required under the discharge of the primary decant system where necessary to insure that the discharge does not erode the embankment.

12. The combination primary and secondary decant system shall be designed to safely carry the expected peak flow from a 25 year - 6 hour storm. The entire emergency overflow spillway channel will be a stabilized channel and will be stabilized upon completion of construction as specified within the detailed design plans using prudent engineering measures. These measures may consist of lining the spillway with concrete or a durable rock riprap, or the spillway being constructed in consolidated non-erodible material and planted with a mixture or both annual and perennial grasses, or a combination of any or all of the above.

13. Sediment basins using a single spillway system shall be an open channel of non-erodible construction consisting of concrete, durable rock riprap or its being constructed in consolidated non-erodible material as specified in the detailed design plans.

14. The settled embankment for temporary impoundments shall be a minimum of 1.0 foot above the maximum water elevation for the runoff from a 25 year - 6 hour, or a 10 year - 24 hour precipitation event (whichever has the greatest runoff). The settled embankment for permanent impoundments shall be a minimum of 1.0 foot above the maximum water elevation for the runoff from a 25 year - 6 hour, or a 10 year - 24 hour precipitation event or greater event as specified by the Regulatory Authority.(whichever has the greatest runoff).

15. If basins are built in series, then the combined decant system for each shall be designed to accommodate the entire contributing drainage area.

16. The dam and all disturbed areas shall be seeded with both perennial and annual grasses, fertilized and mulched in order to insure erosion is minimized. Hay bales or riprap may be placed at the toe of the dam immediately upon completion of construction.

17. The constructed height of the dam shall be increased a minimum of 5 percent over the design height to allow for settlement over the life of the embankment.

18. Final graded slopes of the entire permanent water impoundment area shall not exceed 2.5H-1.0V to provide for adequate safety and access for proposed water users.

19. Prior to Phase II bond release, additional data concerning water quality, water quantity, depth, size, configuration, postmining land use, etc., for each proposed permanent water impoundment, shall be submitted to the Regulatory Authority for permanent water impoundment approval.

20. All sediment basins will be inspected for stability, erosion, etc. two (2) times a month until removal of the structure or release of the reclamation bond.

21. The embankment and spillway will be maintained by repairing any damage such as erosion, slope failure or spillway damage until removal of the structure or release of the performance bond.

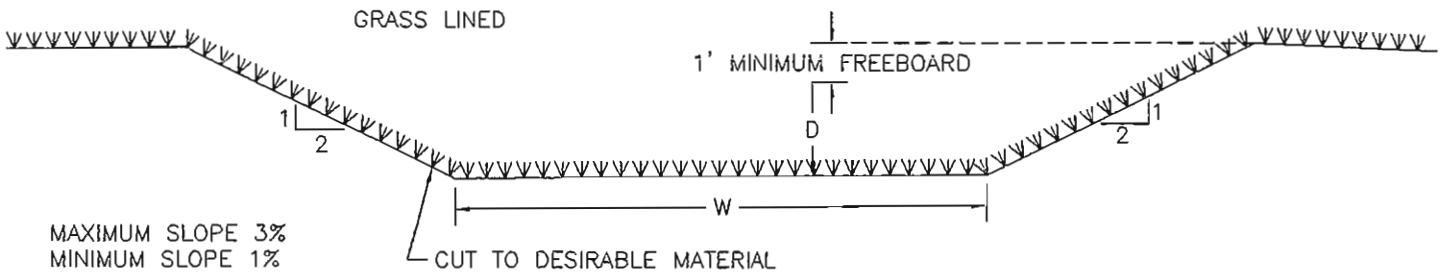
22. All ponds shall be examined quarterly for structural weakness, instability, erosion, or other hazardous conditions and maintenance performed as necessary. Formal inspections shall be made on an annual basis, including any reports or modifications, in accordance with 880-X-10C-.20[1(j)] of the Alabama Surface Mining Commission Regulations.

23. Sediment will be removed from each pond when the accumulated sediment reaches the sediment storage volume as shown on the detailed design sheet.

24. Upon completion of mining, successful reclamation and effluent standards being met, each sediment basin not remaining as a permanent water impoundment will be dewatered in an environmentally safe manner (such as siphoning, pumping, etc.) and reclaimed to approximate original contours by the following procedure: A permanent diversion channel (designed for a 10 year - 24 hour precipitation event) shall be cut along the outer edge of the basin to re-route drainage around the basin and back through the stabilized spillway to allow reclamation of the sediment basin. The diversion channel shall be designed and grassed as per enclosed information. (See permanent diversion for basin disposal).Upon completion of the diversion channel the back slope of the dam shall be graded to a minimum 3H to 1V slope. The dewatered sediment basin area shall be seeded with some combination of the following: Fescue, Bermuda, rye grass, canary grass and willows. After seeding the area shall be mulched. Any additional sediment or embankment material not used to meet original contour, if non-toxic, shall be spread in thin layers within the permit area and vegetated as stated in the approved reclamation plan. All toxic material encountered in the basin disposal shall be buried and covered with 4 feet of non-toxic material and vegetated as stated in the approved reclamation plan.

25. A qualified registered professional engineer or other qualified professional specialist, under the direction of the professional engineer shall conduct regular inspections during construction and upon completion shall inspect each basin for certification purposes.

26. Point source discharge embankments shall be constructed and abutments keyed into desirable material if at all possible. In the event that undesirable material is encountered, addition design and construction criteria shall be submitted prior to certification.



$$Q = \frac{1.49}{N} A R^{2/3} S^{1/2}$$

N(LOOSE STONE OR GRASS LINED) = 0.035

A = AREA

R = AREA/WETTED PERIMETER

S = SLOPE

* GRASS LINING: FESCUE, BERMUDA, RYE GRASS

DIVERSION CHANNEL DEPTH (D) FOR WIDTH (W) 8.0 FT.	
PEAK FLOW Q (CFS)	DEPTH D (FT)
0–15	0.5
15–50	1.0
50–100	1.5
100–180	2.0
180–270	2.5

DIVERSION CHANNEL DEPTH (D) FOR WIDTH (W) 10.0 FT.	
PEAK FLOW Q (CFS)	DEPTH D (FT)
0–15	0.5
15–60	1.0
60–120	1.5
120–210	2.0
210–320	2.5

DIVERSION CHANNEL DEPTH (D) FOR WIDTH (W) 12.0 FT.	
PEAK FLOW Q (CFS)	DEPTH D (FT)
0–20	0.5
20–70	1.0
70–150	1.5
150–250	2.0
250–383	2.5

DIVERSION CHANNEL DEPTH (D) FOR WIDTH (W) 15.0 FT.	
PEAK FLOW Q (CFS)	DEPTH D (FT)
0–25	0.5
25–90	1.0
90–180	1.5
180–300	2.0
300–450	2.5

PERC ENGINEERING CO., INC.
1809 Highway 78 West Jasper, Alabama 35501
P.O. Box 1712 Jasper, Alabama 35502
(205) 384-8810 Office (205) 384-8114 fax

TYPICAL PERMANENT DIVERSION FOR BASIN DISPOSAL

DRAWN BY: S.D.M. DWG. NAME: TYPICALS	DATE: 1/4/2011
APPROVED BY: L.G.S.	SCALE: NONE

NOTES

1) The primary spillway of Basin 019 consists of a 30-inch diameter corrugated metal pipe and will extend through and down the downstream slope of the embankment back to the original drainage course. The joints of the discharge pipe will be sealed using rubber "boots" type gaskets. To prevent the movement of the discharge pipe, the portions of the discharge pipe that are exposed along the downstream slope of the embankment will be covered with a minimum of 2 feet as measured from the top of the pipe.

2) A 8' x 15' x 16" thick splash pad consisting of durable, non-erodible sandstone or limestone class II riprap, concrete pad, or consolidated non-erodible bedrock will be located at the discharge point of the primary spillway of Basin 019 to prevent erosion.

3) The emergency spillway channel of Basin 019 will be cut along the side of the embankment and carried into natural ground. The channel lining will consist of a grass mixture of but not limited to Fescue, Bermuda, and, Sericea. The channel will be seeded with the mixture, fertilized, and mulched.

RIP-RAP CLASSIFICATION SPECIFICATIONS

CLASS 1 RIP-RAP

No more than 10% of the stone will have a diameter greater than twelve (12) inches; no more than 50% of the stone will have a diameter less than ten (10) inches; and no more than 10% of the stone will have a diameter of less than six (6) inches. The thickness of the rip-rap liner will be no less than twelve (12) inches.

CLASS 2 RIP-RAP

No more than 10% of the stone will have a diameter greater than sixteen (16) inches; no more than 50% of the stone will have a diameter less than twelve (12) inches; and no more than 10% of the stone will have a diameter of less than six (6) inches. The thickness of the rip-rap liner will be no less than sixteen (16) inches.

CLASS 3 RIP-RAP

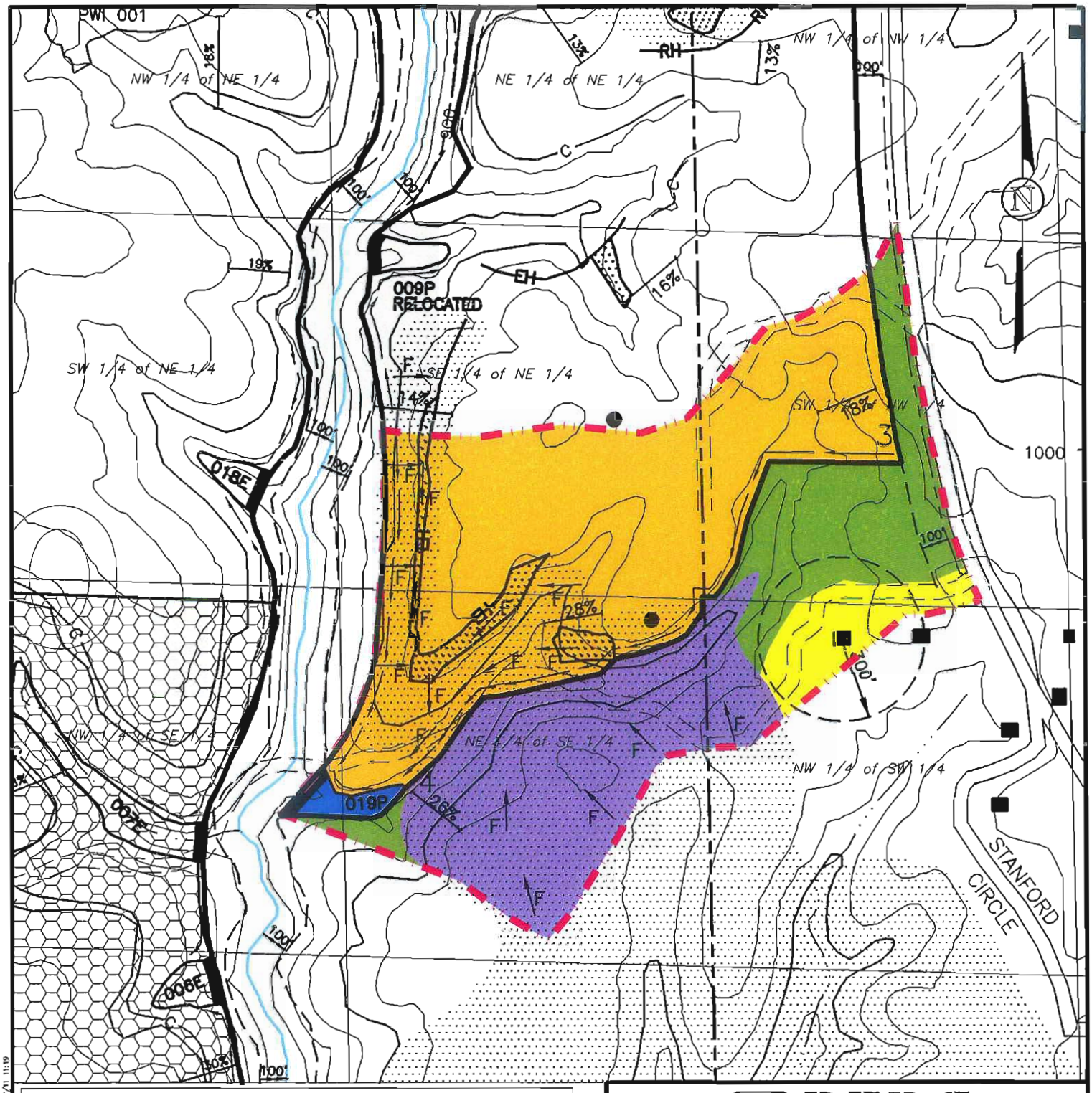
No more than 10% of the stone will have a diameter greater than twenty two (22) inches; no more than 50% of the stone will have a diameter less than sixteen (16) inches; and no more than 10% of the stone will have a diameter of less than eight (8) inches. The thickness of the rip-rap liner will be no less than twenty two (22) inches.

CLASS 4 RIP-RAP

No more than 10% of the stone will have a diameter greater than twenty seven (27) inches; no more than 50% of the stone will have a diameter less than twenty two (22) inches; and no more than 10% of the stone will have a diameter of less than ten (10) inches. The thickness of the rip-rap liner will be no less than twenty seven (27) inches.

CLASS 5 RIP-RAP

No more than 10% of the stone will have a diameter greater than thirty four (34) inches; no more than 50% of the stone will have a diameter less than twenty seven (27) inches; and no more than 10% of the stone will have a diameter of less than sixteen (16) inches. The thickness of the rip-rap liner will be no less than thirty four (34) inches.



LEGEND

- Permit Boundary
- Drainage Divide
- Diversion
- Perennial Stream
- 018E Sediment Basin
- F Flow Direction on Previously Mined Area

LANDUSE & CURVE NUMBER INFORMATION

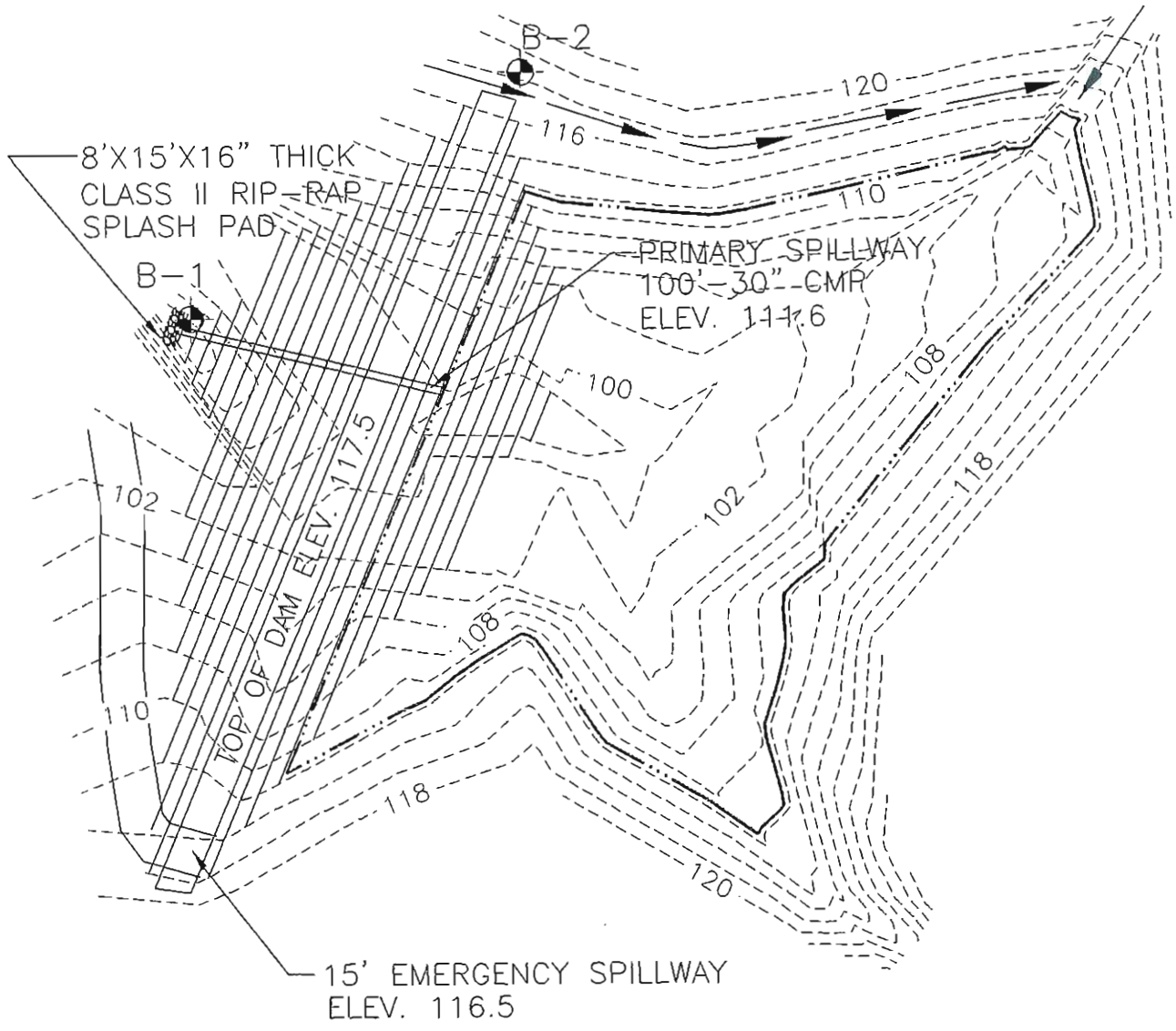
- Previously Mined, Curve Number, 68
- Unmanaged Timberland, Curve Number, 70
- Open Spaces, Curve Number, 75
- Graded & Bare, Curve Number, 81
- Sediment Basin, Curve Number, 100

PERC ENGINEERING CO., INC.
1505 Highway 78 West Jasper, Alabama 35501
P.O. Box 1712 Jasper, Alabama 35502
(205) 384-3553 Office (205) 295-3114 Fax

ATTACHMENT III-B-2(a)
BIRMINGHAM COAL & COKE CO., INC.
BEAR CREEK MINE
P-3831 / REVISION R-7
BASIN 019 WATERSHED MAP

DRAWN BY: S.D.M.	DATE: 9/7/2011
DWG. NAME: BCCBC019WS	
APPROVED BY: L.G.S.	SCALE: 1"=500'

V:\Steve Miles\Steve Docs\Mines\Bear Creek\R-7\Basin 019\BCCBC019WS.dwg 09/07/11 11:19



LEGEND

- MAJOR INFLOW
- NORMAL POOL LEVEL ELEV. 111.6
- 110 PROPOSED CONTOURS
- 112 EXISTING CONTOURS
- B-1 FOUNDATION MATERIAL
- B-2 DAM MATERIAL

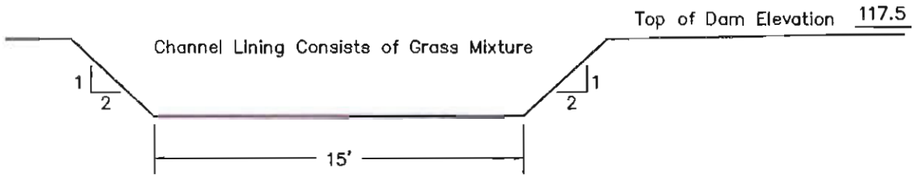
Scale 1"=60'

N

PERC
ENGINEERING CO., INC.
1606 Highway 78 West Jasper, Alabama 35501
P.O. Box 1712 Jasper, Alabama 35502
(205) 384-6363 Office (205) 384-3114 Fax

BIRMINGHAM COAL & COKE CO., INC.
BEAR CREEK MINE
P-3831 / REVISION R-7
BASIN 019 PLANVIEW

DRAWN BY: S.D.M. DWG. NAME: BCCBC019PV	DATE: 9/6/2011
APPROVED BY: L.G.S.	SCALE: 1" = 60'



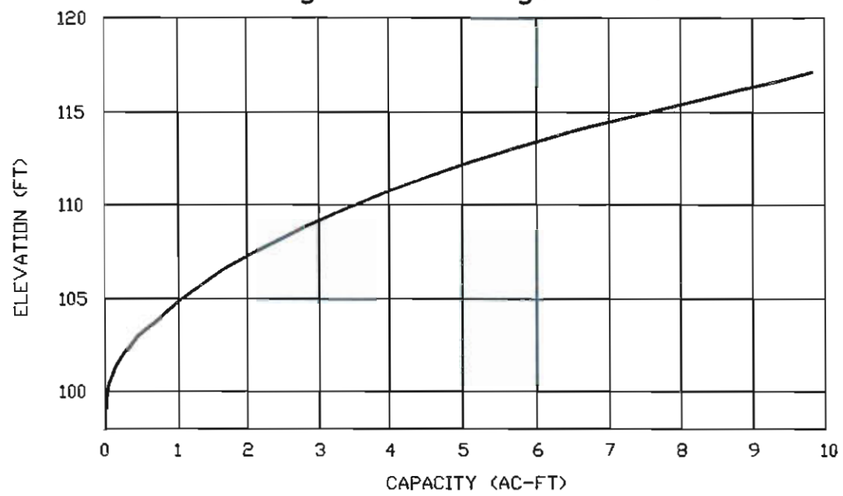
Crest of Emergency Spillway Elevation 116.5
Maximum Spillway Gradient 2.0% (Control Section)
Maximum Spillway Gradient 5.0% (Tail Ditch Section)
Minimum Spillway Gradient 2.0% (Tail Ditch Section)

Emergency Spillway

Notes:

1. The sediment shall be removed from the basin when the accumulated sediment reaches the sediment storage volume.
2. Outer slopes of embankment shall be grassed.
3. Fill material shall be placed in 12" lifts and compacted to 95% of standard proctor.
4. The surface beneath the embankment shall be stripped of undesirable material.
5. Upon completion of mining, reclamation and maintenance of water quality standards the pond will be de-watered and reclaimed.
6. See the attached pond construction criteria.
7. See the attached drawings and specifications for diversions.
8. Elevations are based on assumed datum.

Stage vs. Storage Curve



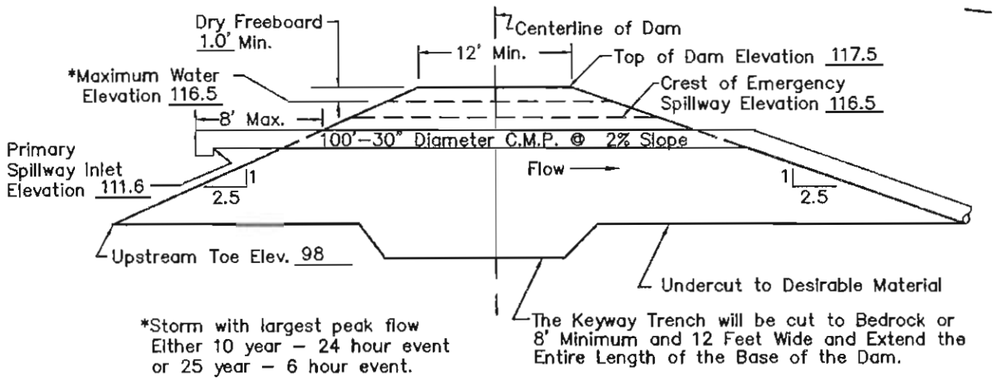
Storage Computation

Elevation (feet)	Area (acres)	Avg. Area (acres)	Interval (feet)	Storage (ac.-ft.)	Acc. Storage (ac.-ft.)
98	0.009				0.000
100	0.048	0.029	2	0.052	0.052
102	0.183	0.116	2	0.216	0.268
104	0.301	0.242	2	0.479	0.747
106	0.404	0.353	2	0.703	1.450
108	0.520	0.462	2	0.922	2.372
110	0.652	0.586	2	1.169	3.541
112	0.787	0.720	2	1.437	4.978
114	0.934	0.861	2	1.719	6.697
116	1.097	1.016	2	2.029	8.726
117	1.160	1.129	1	1.125	9.851

Key Basin Parameters

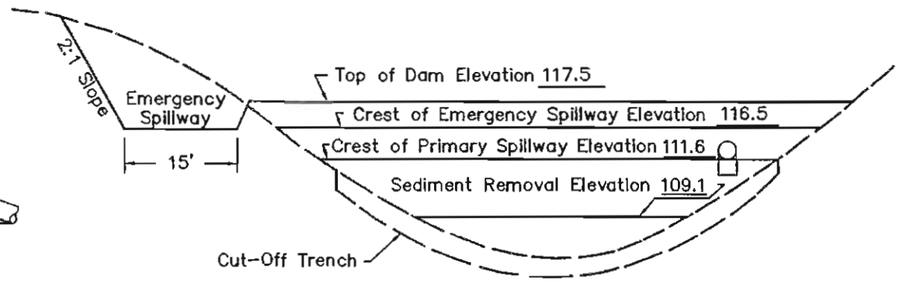
Drainage Area ____ 71.0 Acres
Disturbed Area ____ 36.5 Acres
Sediment Storage ____ 3.0 Ac. Ft.
Detention Storage ____ 1.7 Ac. Ft.
Permanent Pool Capacity ____ 4.7 Ac. Ft.
Total Basin Capacity ____ 9.3 Ac. Ft.
Peak Inflow ____ 124.8 C.F.S.
Peak Outflow ____ 38.1 C.F.S.

Leslie G. Stephens, P.E., P.L.S. 09/06/2011
Leslie G. Stephens, P.E., P.L.S. Date
AL Registration. #14117-E



*Storm with largest peak flow
Either 10 year - 24 hour event
or 25 year - 6 hour event.

Typical Cross Section Along Primary Spillway

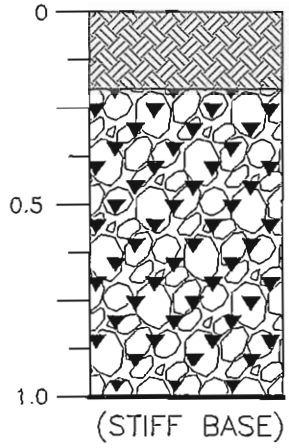


Typical Profile Looking Downstream

PERC ENGINEERING CO., INC.
1808 Highway 78 West Jasper, Alabama 35501
P.O. Box 1712 Jasper, Alabama 35502
(205) 384-8863 Office (205) 390-3114 Fax

BIRMINGHAM COAL & COKE CO., INC.
BEAR CREEK MINE
P-3831 / REVISION R-7
BASIN 019

DRAWN BY:	S.D.M.	DATE:	9/6/2011
DWG. NAME:	BCCBC019DT		
APPROVED BY:	L.G.S.	SCALE:	NONE



INTERVAL:	DESCRIPTION:
0 – 0.2'	Surface Material
0.2' – 1.0'	Silty Sand
	Stiff Base

DRILL HOLE: B-1
SAMPLED BY: GREG WADE
SAMPLED DATE: 10/6/2009

PERC
ENGINEERING CO., INC.
1606 Highway 78 West Jasper, Alabama 35501
P.O. Box 1712 Jasper, Alabama 35502
(205) 384-5363 Office (205) 384-8491 Fax

BIRMINGHAM COAL & COKE CO., INC.
BEAR CREEK MINE
P-3831 / REVISION R-7
BASIN 019
FOUNDATION INVESTIGATION

DRAWN BY: S.D.M. DWG. NAME: BCCBC019FI	DATE: 5/6/2011
APPROVED BY: L.G.S.	SCALE: 1" = 1'

Birmingham Coal & Coke Company, Inc.

Bear Creek Mine

P-3831 / Revision R-7

Basin 019

5.8 Inches, 10 Year-24 Hour,

DRN 58

SDM

PERC Engineering Co., Inc.
1606 Highway 78 West
Jasper, AL 35501

Phone: (205) 384-5553
Email: smiles@percengineering.com

General Information

Storm Information:

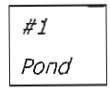
Storm Type:	DRN58
Design Storm:	10 yr - 24 hr
Rainfall Depth:	5.900 inches

Particle Size Distribution:

Size (mm)	Topsoil	Spoil
3.0000	100.000%	100.000%
2.0000	98.000%	92.000%
1.0000	96.000%	78.000%
0.5000	94.000%	54.000%
0.3000	88.000%	43.000%
0.2000	80.000%	34.000%
0.1000	68.000%	22.000%
0.0500	49.000%	15.000%
0.0300	36.000%	9.000%
0.0200	28.000%	5.000%
0.0100	14.000%	4.000%
0.0050	5.000%	3.000%
0.0030	4.000%	2.500%
0.0010	2.000%	2.000%
0.0001	0.001%	0.001%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Basin 019



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	In	71.000	71.000	74.60	18.60	5,124.8	363,591	278.06	141.14
	Out			38.11	18.60	192.4	11,879	0.15	0.11

Particle Size Distribution(s) at Each Structure

Structure #1:

Size (mm)	In	Out
3.0000	100.000%	100.000%
2.0000	94.813%	100.000%
1.0000	80.398%	100.000%
0.5000	55.687%	100.000%
0.3000	44.359%	100.000%
0.2000	35.085%	100.000%
0.1000	22.718%	100.000%
0.0500	15.492%	100.000%
0.0300	9.302%	100.000%
0.0200	5.176%	100.000%
0.0100	4.132%	100.000%
0.0050	3.094%	82.418%
0.0030	2.578%	68.677%
0.0010	2.061%	54.910%
0.0001	0.001%	0.027%

Structure Detail:

Structure #1 (Pond)

Basin 019

Pond Inputs:

Initial Pool Elev:	111.60 ft
Initial Pool:	1.67 ac-ft
*Sediment Storage:	3.00 ac-ft
Dead Space:	20.00 %

**Sediment capacity was entered by user*

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
30.00	100.00	2.00	0.0240	111.60	0.90	0.00

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
116.50	12.00	2.00:1	2.00:1	15.00

Pond Results:

Peak Elevation:	116.45 ft
H'graph Detention Time:	1.47 hrs
Pond Model:	CSTRS
Dewater Time:	1.04 days
Trap Efficiency:	96.25 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
109.13	0.593	0.000	0.000		Top of Sed. Storage
109.50	0.618	0.225	0.000		
110.00	0.652	0.543	0.000		
110.50	0.685	0.877	0.000		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
111.00	0.718	1.227	0.000		
111.50	0.752	1.595	0.000		
111.60	0.759	1.671	0.000		Spillway #1
111.70	0.766	1.747	0.568	7.70	
111.90	0.780	1.901	0.873	2.65	
112.00	0.787	1.980	1.332	0.85	
112.10	0.794	2.059	1.856	0.60	
112.50	0.823	2.382	4.471	1.35	
112.60	0.830	2.465	5.242	0.20	
113.00	0.859	2.803	8.672	4.95	
113.50	0.896	3.241	13.710	3.15	
114.00	0.934	3.699	19.471	1.15	
114.50	0.974	4.176	24.990	0.60	
115.00	1.014	4.673	30.885	0.40	
115.50	1.055	5.190	34.059	0.45	
115.80	1.080	5.510	35.386	0.25	
116.00	1.097	5.728	36.250	0.15	
116.10	1.100	5.838	36.677	0.05	
116.20	1.103	5.948	37.086	0.10	
116.30	1.110	6.058	37.495	0.10	
116.45	1.121	6.225	38.106	0.30	Peak Stage
116.50	1.124	6.282	38.313		Spillway #2
117.00	1.160	6.853	43.295		

Detailed Discharge Table

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
109.13	0.000	0.000	0.000
109.50	0.000	0.000	0.000
110.00	0.000	0.000	0.000
110.50	0.000	0.000	0.000
111.00	0.000	0.000	0.000
111.50	0.000	0.000	0.000
111.60	0.000	0.000	0.000
111.70	(3)>0.568	0.000	0.568
111.90	(3)>0.873	0.000	0.873
112.00	(3)>1.332	0.000	1.332
112.10	(3)>1.856	0.000	1.856

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
112.50	(3)>4.471	0.000	4.471
112.60	(3)>5.242	0.000	5.242
113.00	(3)>8.672	0.000	8.672
113.50	(3)>13.710	0.000	13.710
114.00	(3)>19.471	0.000	19.471
114.50	(3)>24.990	0.000	24.990
115.00	(5)>30.885	0.000	30.885
115.50	(6)>34.059	0.000	34.059
115.80	(6)>35.386	0.000	35.386
116.00	(6)>36.250	0.000	36.250
116.10	(6)>36.677	0.000	36.677
116.20	(6)>37.086	0.000	37.086
116.30	(6)>37.495	0.000	37.495
116.50	(6)>38.313	0.000	38.313
117.00	(6)>40.269	3.027	43.295

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	1.000	0.001	0.000	0.000	100.000	F	1.55	0.491
	2	36.500	0.130	0.000	0.000	81.000	F	43.91	11.115
	3	11.500	0.149	0.117	0.397	70.000	M	8.75	2.123
	4	3.900	0.065	0.021	0.463	75.000	M	4.37	1.037
	5	18.100	0.082	0.000	0.000	68.000	M	16.80	3.831
	$\sum$	**71.000**						**74.60**	**18.597**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.001	200.00	0.01	0.0010	1.0000	1	0.0	0	0.00	0.00
	2	0.240	200.00	28.00	0.9000	1.0000	2	5,038.5	477,072	364.88	219.50
	3	0.300	200.00	18.00	0.0030	1.0000	1	2.3	1,384	0.92	0.52
	4	0.240	200.00	18.00	0.0100	1.0000	1	2.4	3,059	2.08	1.17
	5	0.240	200.00	26.00	0.0500	1.0000	2	81.6	27,675	21.20	11.90
	$\sum$							**5,124.8**	**363,591**	**278.06**	**141.14**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	2	5. Nearly bare and untilled, and alluvial valley fans	10.00	20.00	200.00	3.160	0.017
		8. Large gullies, diversions, and low flowing streams	4.31	110.00	2,550.00	6.230	0.113
#1	**2**	**Time of Concentration:**					**0.130**
#1	3	1. Forest with heavy ground litter	2.38	5.00	210.00	0.390	0.149
#1	**3**	**Time of Concentration:**					**0.149**
#1	4	3. Short grass pasture	1.92	5.00	260.00	1.100	0.065
#1	**4**	**Time of Concentration:**					**0.065**
#1	5	3. Short grass pasture	5.00	10.00	200.00	1.780	0.031
		8. Large gullies, diversions, and low flowing streams	6.38	90.00	1,410.00	7.570	0.051
#1	**5**	**Time of Concentration:**					**0.082**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	3	8. Large gullies, diversions, and low flowing streams	4.73	130.00	2,750.00	6.520	0.117
#1	**3**	**Muskingum K:**					**0.117**
#1	4	9. Small streams flowing bankfull	5.56	90.00	1,620.00	21.210	0.021
#1	**4**	**Muskingum K:**					**0.021**

Birmingham Coal & Coke Company, Inc.
Bear Creek Mine
P-3831 / Revision R-7
Basin 019

4.6 Inches, 25 Year-6 Hour,

SCS 6 Hour

SDM

PERC Engineering Co., Inc.
1606 Highway 78 West
Jasper, AL 35501

Phone: (205) 384-5553
Email: smiles@percengineering.com

General Information

Storm Information:

Storm Type:	Rainfall Event

Accumulated Time (hrs)	Accumulated Depth (in)
0.00	0.0000
0.50	0.1610
1.00	0.3680
1.50	0.6210
2.00	1.0580
2.50	2.7600
3.00	3.2200
3.50	3.5880
4.00	3.8410
4.50	4.0710
5.00	4.2550
5.50	4.4390
6.00	4.6000

Peak 30-minute Intensity: 3.404 in/hr

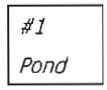
Particle Size Distribution:

Size (mm)	Topsoil	Spoil
3.0000	100.000%	100.000%
2.0000	98.000%	92.000%
1.0000	96.000%	78.000%
0.5000	94.000%	54.000%
0.3000	88.000%	43.000%
0.2000	80.000%	34.000%
0.1000	68.000%	22.000%
0.0500	49.000%	15.000%
0.0300	36.000%	9.000%
0.0200	28.000%	5.000%
0.0100	14.000%	4.000%
0.0050	5.000%	3.000%
0.0030	4.000%	2.500%

Size (mm)	Topsoil	Spoil
0.0010	2.000%	2.000%
0.0001	0.001%	0.001%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Basin 019



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	In	71.000	71.000	124.82	12.55	5,849.2	550,687	420.24	224.92
	Out			37.18	12.55	232.3	21,594	0.30	0.19

Particle Size Distribution(s) at Each Structure

Structure #1:

Size (mm)	In	Out
3.0000	100.000%	100.000%
2.0000	99.207%	100.000%
1.0000	84.122%	100.000%
0.5000	58.262%	100.000%
0.3000	46.408%	100.000%
0.2000	36.707%	100.000%
0.1000	23.768%	100.000%
0.0500	16.208%	100.000%
0.0300	9.731%	100.000%
0.0200	5.414%	100.000%
0.0100	4.323%	100.000%
0.0050	3.237%	81.512%
0.0030	2.697%	67.922%
0.0010	2.157%	54.309%
0.0001	0.001%	0.027%

Structure Detail:

Structure #1 (Pond)

Basin 019

Pond Inputs:

Initial Pool Elev:	111.60 ft
Initial Pool:	1.67 ac-ft
*Sediment Storage:	3.00 ac-ft
Dead Space:	20.00 %

**Sediment capacity was entered by user*

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
30.00	100.00	2.00	0.0240	111.60	0.90	0.00

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
116.50	12.00	2.00:1	2.00:1	15.00

Pond Results:

Peak Elevation:	116.22 ft
H'graph Detention Time:	1.38 hrs
Pond Model:	CSTRS
Dewater Time:	0.74 days
Trap Efficiency:	96.03 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
109.13	0.593	0.000	0.000		Top of Sed. Storage
109.50	0.618	0.225	0.000		
110.00	0.652	0.543	0.000		
110.50	0.685	0.877	0.000		
111.00	0.718	1.227	0.000		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
111.50	0.752	1.595	0.000		
111.60	0.759	1.671	0.000		Spillway #1
111.70	0.766	1.747	0.568	7.70	
111.90	0.780	1.901	0.873	2.65	
112.00	0.787	1.980	1.332	0.85	
112.10	0.794	2.059	1.856	0.60	
112.50	0.823	2.382	4.471	1.35	
112.60	0.830	2.465	5.242	0.20	
113.00	0.859	2.803	8.672	0.60	
113.50	0.896	3.241	13.710	0.45	
114.00	0.934	3.699	19.471	0.35	
114.50	0.974	4.176	24.990	0.60	
115.00	1.014	4.673	30.885	0.70	
115.50	1.055	5.190	34.059	0.50	
115.80	1.080	5.510	35.386	0.40	
116.00	1.097	5.728	36.250	0.25	
116.10	1.100	5.838	36.677	0.10	
116.20	1.103	5.948	37.086	0.25	
116.22	1.106	5.972	37.175	0.25	Peak Stage
116.30	1.110	6.058	37.495		
116.50	1.124	6.282	38.313		Spillway #2
117.00	1.160	6.853	43.295		

Detailed Discharge Table

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
109.13	0.000	0.000	0.000
109.50	0.000	0.000	0.000
110.00	0.000	0.000	0.000
110.50	0.000	0.000	0.000
111.00	0.000	0.000	0.000
111.50	0.000	0.000	0.000
111.60	0.000	0.000	0.000
111.70	(3)>0.568	0.000	0.568
111.90	(3)>0.873	0.000	0.873
112.00	(3)>1.332	0.000	1.332
112.10	(3)>1.856	0.000	1.856
112.50	(3)>4.471	0.000	4.471
112.60	(3)>5.242	0.000	5.242

Elevation (ft)	Straight Pipe (cfs)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
113.00	(3)>8.672	0.000	8.672
113.50	(3)>13.710	0.000	13.710
114.00	(3)>19.471	0.000	19.471
114.50	(3)>24.990	0.000	24.990
115.00	(5)>30.885	0.000	30.885
115.50	(6)>34.059	0.000	34.059
115.80	(6)>35.386	0.000	35.386
116.00	(6)>36.250	0.000	36.250
116.10	(6)>36.677	0.000	36.677
116.20	(6)>37.086	0.000	37.086
116.30	(6)>37.495	0.000	37.495
116.50	(6)>38.313	0.000	38.313
117.00	(6)>40.269	3.027	43.295

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	1.000	0.001	0.000	0.000	100.000	F	3.43	0.382
	2	36.500	0.130	0.000	0.000	81.000	F	80.25	7.721
	3	11.500	0.149	0.117	0.397	70.000	M	12.66	1.359
	4	3.900	0.065	0.021	0.463	75.000	M	8.17	0.688
	5	18.100	0.082	0.000	0.000	68.000	M	28.94	2.397
	$\sum$	**71.000**						**124.82**	**12.547**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.001	200.00	0.01	0.0010	1.0000	1	0.0	0	0.00	0.00
	2	0.240	200.00	28.00	0.9000	1.0000	2	5,759.0	653,751	498.93	335.85
	3	0.300	200.00	18.00	0.0030	1.0000	1	2.2	1,853	1.21	0.77
	4	0.240	200.00	18.00	0.0100	1.0000	1	2.8	4,921	3.34	2.00
	5	0.240	200.00	26.00	0.0500	1.0000	2	85.3	44,141	33.81	19.81
	$\sum$							**5,849.2**	**550,687**	**420.24**	**224.92**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	2	5. Nearly bare and untilled, and alluvial valley fans	10.00	20.00	200.00	3.160	0.017
		8. Large gullies, diversions, and low flowing streams	4.31	110.00	2,550.00	6.230	0.113
#1	**2**	**Time of Concentration:**					**0.130**
#1	3	1. Forest with heavy ground litter	2.38	5.00	210.00	0.390	0.149
#1	**3**	**Time of Concentration:**					**0.149**
#1	4	3. Short grass pasture	1.92	5.00	260.00	1.100	0.065
#1	**4**	**Time of Concentration:**					**0.065**
#1	5	3. Short grass pasture	5.00	10.00	200.00	1.780	0.031
		8. Large gullies, diversions, and low flowing streams	6.38	90.00	1,410.00	7.570	0.051
#1	**5**	**Time of Concentration:**					**0.082**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	3	8. Large gullies, diversions, and low flowing streams	4.73	130.00	2,750.00	6.520	0.117
#1	**3**	**Muskingum K:**					**0.117**
#1	4	9. Small streams flowing bankfull	5.56	90.00	1,620.00	21.210	0.021
#1	**4**	**Muskingum K:**					**0.021**

Birmingham Coal & Coke Co., Inc
Bear Creek Mine
P-3831 / Revision R-7
Basin 019
Soil Classification

Birmingham Coal &
Coke Co., Inc.
Bear Creek Mine
P-3831 / Revision R-7

STABILITY ANALYSIS DATA

METHODOLOGY

The static and dynamic loading stability analyses were performed using the Simplified Bishop Method. The computer program used was the REAME Slope Stability Program as developed by Dr. Yang H. Haung, P.E. of the University of Kentucky.

SOIL CLASSIFICATION UNITS

The soil type (soil classification) to be used in the construction of the embankment structure of Basin 019 (SM) and the soil type (soil classification) of the material between the proposed embankment and stiff base of Basin 019 was sampled and analyzed by PERC Engineering Co., Inc. The soil properties used in the stability analysis (SM) type soils, was taken from the U.S. Department of the Interior Bureau of Reclamation Design of Small Dams.*

SOIL PROPERTIES

	UNIFIED CLASS	COHESION (PSF)	ANGLE OF INT. FRC.	DESIGN DENSITY (PCF)
Dam Material Basin 019	SM	273.6	33.0	132.1
Foundation Basin 019	SM	273.6	33.0	132.1

*United States Department of Interior Bureau of Reclamation Design of Small Dams Second Edition 1973, Revised Reprint 1974 page 137 and United States Department of Interior Bureau of Reclamation Design of Small Dams Third Edition 1987 page 96 and 97.

STABILITY ANALYSIS DATA

(Continued)

DESIGN DATA

1) Design Density = 95% of the standard proctor maximum density.
2) Embankment top width: 12.0'.
3) Freeboard minimum = 10% of structure (from top of embankment to normal pool level).
4) Safety factors for embankments with 2.5H:1V slopes, front and back.
5) Basin 019 design height = 19.5 ft.
6) DMIN = 0.00
7) All design heights are measured from the top of the embankment to the toe of the upstream slope.

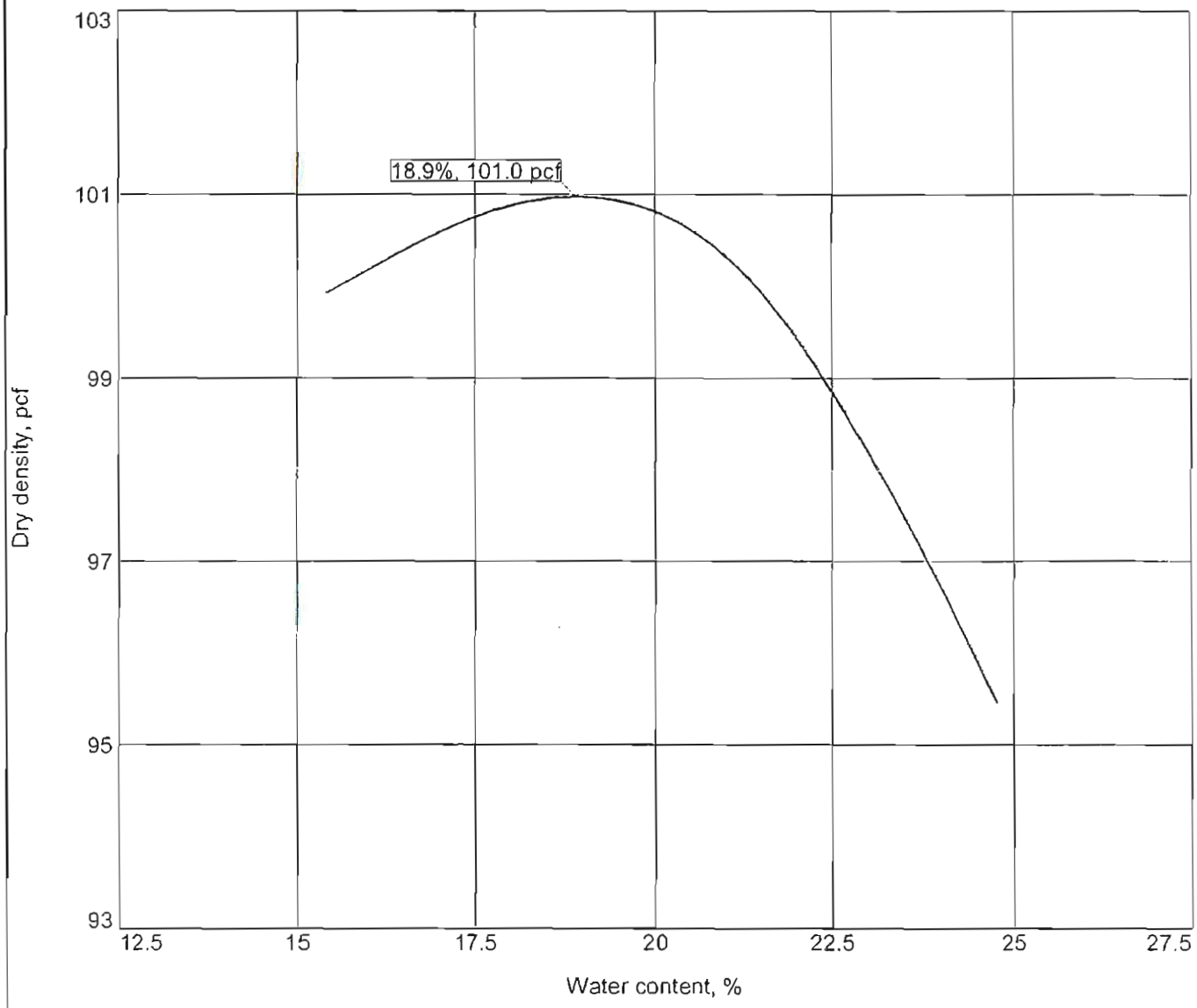
SAFETY FACTORS

BASIN NUMBER	STATIC SAFETY FACTOR
019	2.3

FOUNDATIONS AND ABUTMENTS

The foundation and abutments area will be inspected for visible structural deficiencies after clearing and grubbing, and if found they will be treated using sound engineering practices.

COMPACTION TEST REPORT



Test specification: ASTM D 698-91 Procedure B Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
	SM				25	3		44.24

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 101.0 pcf Optimum moisture = 18.9 %	Dam Material Silty sand with gravel

Project No. **Client:** Birmingham Coal & Coke

Project: Basin 019

Date:

Location: Bear Creek Mine

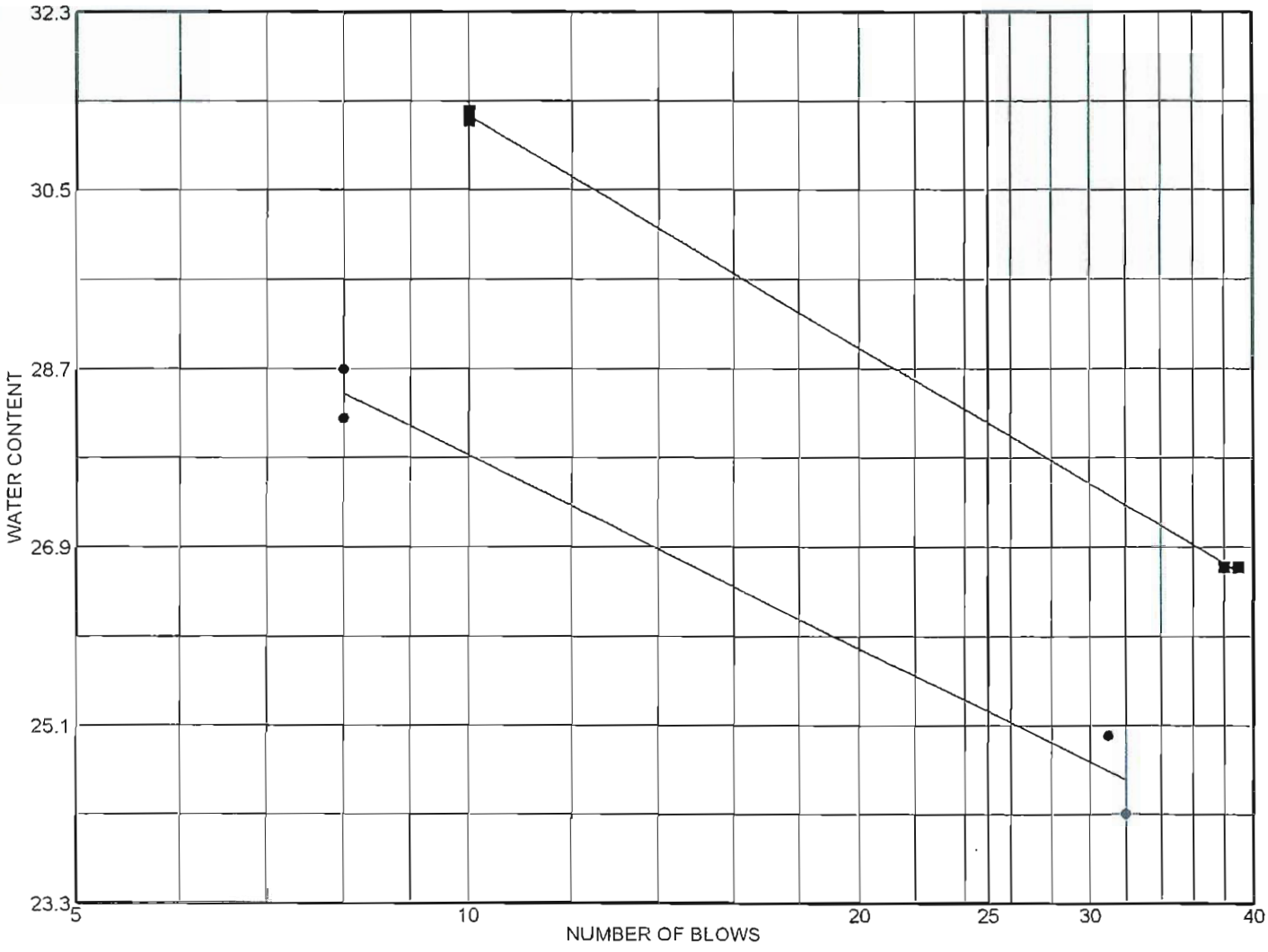
Remarks:

PERC ENGINEERING CO., INC.

Jasper, Alabama

Date 10/12/2009

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dam Material Silty sand with gravel	25	22	3	65.56	44.24	SM
■	Foundation Material Silty sand	28	25	3	66.13	36.43	SM

Project No. **Client:** Birmingham Coal & Coke

Project: Basin 019

Basin 019

● **Location:** Bear Creek Mine

■ **Location:** Bear Creek Mine

Remarks:

●

■

PERC ENGINEERING CO., INC.

Jasper, Alabama

Date 10/16/2009

Birmingham Coal & Coke Co., Inc
Bear Creek Mine
P-3831 / Revision R-7
Basin 019
Stability Analysis

REAME (Rotational Equilibrium Analysis of Multilayered Embankments)
Implemented on the 16-bit Microcomputers C. F. Hains, Jr. and D. M. Hains
2301 22nd Ave.
Northport, AL 35476
(205)-339-6536

BIRMINGHAM COAL & COKE CO., INC. BEAR CREEK MINE P-3831 / REVISION R-7
BASIN 019
STATIC

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 25.000 2 500.000 .000

On boundary line no. 2 Point no. and coordinates are:
1 200.000 16.000 2 325.143 9.743

On boundary line no. 3 Point no. and coordinates are:
1 .000 26.000 2 200.000 16.000 3 234.000 29.600

On boundary line no. 4 Point no. and coordinates are:
1 .000 29.600 2 234.000 29.600 3 248.750 35.500 4
260.750 35.500 5 312.732 14.707
6 325.143 9.743 7 500.000 1.000

Line no. and slope of each segment are:
1 -.050
2 -.050
3 -.050 .400
4 .000 .400 .000 -.400 -.400 -.050

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      273.600       33.000      132.100
         2      273.600       33.000      132.100
         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    29.600    2   234.000    29.600    3   268.266    24.139    4
312.732    14.707    5   325.143     9.743
    6   500.000     1.000

 point1=(   262.000,    57.000) point2=(   262.000,    37.000) point3=(
326.000,    37.000) NJ=    2 NI=    2
     Automatic search will follow after grid with XINC=    10.000 and YINC=
10.000

 At point (   262.000,    57.000) under seepage    1,the radius and the
corresponding factor of safety are:
         45.044     9.694         40.342     9.647         35.641     9.571
30.939     9.554         26.238    10.679
         34.074     9.598         32.506     9.622         29.372     9.514
27.805     9.725
     Lowest factor of safety=     9.514 and occurs at radius  =     29.372


 At point (   262.000,    47.000) under seepage    1,the radius and the
corresponding factor of safety are:
         35.056     9.399         30.359     8.944         25.661     8.627
20.963     8.437         16.265     9.834
         24.095     8.604         22.529     8.577         19.397     8.436
17.831     8.795
     Lowest factor of safety=     8.436 and occurs at radius  =     19.397


 At point (   262.000,    37.000) under seepage    1,the radius and the
corresponding factor of safety are:
         25.069     9.374         20.426     9.024         15.784     8.971
11.142     9.549          6.499    10.555
         18.879     8.965         17.331     8.889         14.237     9.245
12.689     9.309
     Lowest factor of safety=     8.889 and occurs at radius  =     17.331


 At point (   294.000,    57.000) under seepage    1,the radius and the
corresponding factor of safety are:
         46.642     2.434         43.776     2.582         40.909     2.876
38.043     3.480         35.177     4.851
     Lowest factor of safety=     2.434 and occurs at radius  =     46.642
```

```
 At point (   294.000,    47.000) under seepage    1,the radius and the
corresponding factor of safety are:
         36.654     2.533          33.929     2.719          31.203     3.043
28.477     3.673          25.752     5.117
     Lowest factor of safety=     2.533 and occurs at radius  =     36.654


 At point (   294.000,    37.000) under seepage    1,the radius and the
corresponding factor of safety are:
         26.667     2.844          24.082     3.045          21.497     3.384
18.912     4.032          16.327     5.546
     Lowest factor of safety=     2.844 and occurs at radius  =     26.667


 At point (   326.000,    57.000) under seepage    1,the radius and the
corresponding factor of safety are:
         48.240     3.715          47.431     4.011          46.622     4.707
45.813     6.471          45.004    11.735
     Lowest factor of safety=     3.715 and occurs at radius  =     48.240


 At point (   326.000,    47.000) under seepage    1,the radius and the
corresponding factor of safety are:
         38.252     4.250          37.584     4.705          36.916     5.347
36.247     7.426          35.579    13.681
     Lowest factor of safety=     4.250 and occurs at radius  =     38.252


 At point (   326.000,    37.000) under seepage    1,the radius and the
corresponding factor of safety are:
         28.265     5.165          27.737     5.833          27.209     6.374
26.681     8.974          26.154    16.820
     Lowest factor of safety=     5.165 and occurs at radius  =     28.265



 For piezometric line No.    1

 At point (   294.000,    57.000) ,RADIUS    46.642
     the minimum factor of safety is      2.434


 At point (   294.000,    57.000) under seepage    1,the radius and the
corresponding factor of safety are:
         46.642     2.434          43.776     2.582          40.909     2.876
38.043     3.480          35.177     4.851
     Lowest factor of safety=     2.434 and occurs at radius  =     46.642


 At point (   304.000,    57.000) under seepage    1,the radius and the
corresponding factor of safety are:
         47.141     2.350          44.918     2.572          42.695     2.978
40.471     3.753          38.248     5.635
```

```
     Lowest factor of safety=     2.350 and occurs at radius  =     47.141


 At point (   314.000,    57.000) under seepage    1,the radius and the
corresponding factor of safety are:
         47.640     2.492         46.060     2.787         44.480     3.294
42.900     4.302         41.319     7.113
     Lowest factor of safety=     2.492 and occurs at radius  =     47.640


 At point (   304.000,    67.000) under seepage    1,the radius and the
corresponding factor of safety are:
         57.129     2.281         54.765     2.481         52.401     2.873
50.037     3.619         47.674     5.363
     Lowest factor of safety=     2.281 and occurs at radius  =     57.129


 At point (   304.000,    77.000) under seepage    1,the radius and the
corresponding factor of safety are:
         67.116     2.279         64.612     2.454         62.108     2.799
59.603     3.505         57.099     5.132
     Lowest factor of safety=     2.279 and occurs at radius  =     67.116


 At point (   304.000,    87.000) under seepage    1,the radius and the
corresponding factor of safety are:
         77.104     2.326         74.459     2.496         71.814     2.810
69.169     3.402         66.524     4.932
     Lowest factor of safety=     2.326 and occurs at radius  =     77.104


 At point (   314.000,    77.000) under seepage    1,the radius and the
corresponding factor of safety are:
         67.616     2.318         65.754     2.597         63.893     3.054
62.031     3.965         60.170     6.254
     Lowest factor of safety=     2.318 and occurs at radius  =     67.616


 At point (   294.000,    77.000) under seepage    1,the radius and the
corresponding factor of safety are:
         66.617     2.526         63.470     2.669         60.322     2.924
57.175     3.378         54.028     4.438
     Lowest factor of safety=     2.526 and occurs at radius  =     66.617


 At point (   306.500,    77.000) under seepage    1,the radius and the
corresponding factor of safety are:
         67.241     2.259         64.897     2.456         62.554     2.835
60.210     3.594         57.867     5.353
     Lowest factor of safety=     2.259 and occurs at radius  =     67.241


 At point (   309.000,    77.000) under seepage    1,the radius and the
corresponding factor of safety are:
         67.366     2.255         65.183     2.482         63.000     2.895
60.817     3.699         58.634     5.608
     Lowest factor of safety=     2.255 and occurs at radius  =     67.366
```

```
 At point (   311.500,     77.000) under seepage    1,the radius and the
corresponding factor of safety are:
         67.491     2.273          65.469     2.535          63.446     2.965
61.424     3.823          59.402     5.905
     Lowest factor of safety=     2.273 and occurs at radius  =     67.491


 At point (   309.000,     79.500) under seepage    1,the radius and the
corresponding factor of safety are:
         69.863     2.252          67.645     2.471          65.427     2.875
63.209     3.669          60.991     5.542
     Lowest factor of safety=     2.252 and occurs at radius  =     69.863


 At point (   309.000,     82.000) under seepage    1,the radius and the
corresponding factor of safety are:
         72.360     2.252          70.106     2.463          67.853     2.851
65.600     3.641          63.347     5.478
     Lowest factor of safety=     2.252 and occurs at radius  =     72.360


 At point (   311.500,     79.500) under seepage    1,the radius and the
corresponding factor of safety are:
         69.988     2.264          67.930     2.514          65.873     2.945
63.816     3.790          61.758     5.829
     Lowest factor of safety=     2.264 and occurs at radius  =     69.988


 At point (   306.500,     79.500) under seepage    1,the radius and the
corresponding factor of safety are:
         69.738     2.263          67.359     2.452          64.980     2.818
62.602     3.567          60.223     5.295
     Lowest factor of safety=     2.263 and occurs at radius  =     69.738



 For piezometric line No.    1

 At point (   309.000,     79.500) ,RADIUS    69.863
     the minimum factor of safety is      2.252


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 2.252