



DESIGN GROUP, LLC
ENGINEERING/SURVEYING

April 4, 2013

Permit Engineer
ALABAMA SURFACE MINING COMMISSION
P. O. Box 2390
Jasper, AL 35502-2390

RE: **BIRMINGHAM COAL & COKE CO., INC.**
Gooden Creek No. 2 Mine, P-39--

Dear Permit Engineer:

I, J. David McGehee, a qualified registered professional engineer, hereby certify that the information, cross-sections, data, maps, etc., contained in the design of Primary Road No. 3 are true and accurate to the best of my knowledge and belief. I also certify that this design is in accordance with current, prudent mining engineering practices, and meets or exceeds the applicable parts of 880-X-8F-.17, 880-X-10C-.67, and 880-X-10C-.68 pertaining to the construction, use, and/or maintenance of primary roads.

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

Sincerely,

DSM Design Group, LLC

J. David McGehee, P.E.
Alabama Reg. No. 18496

BIRMINGHAM COAL & COKE CO., INC.

GOODEN CREEK NO. 2 MINE, P-39--

DETAILED DESIGN FOR

PRIMARY ROAD NO. 3

ATTACHMENT III-B-5 (a)

Prepared by:

DSM Design Group, LLC

P. O. Box 690

Jasper, Alabama 35502

Telephone: (205) 221-6262

Fax: (205) 221-6850

Email: david@[dsmdg.com](mailto:david@dsmdg.com)



BIRMINGHAM COAL AND COKE CO., INC.
GOODEN CREEK NO. 2 MINE, P-39—
PRIMARY ROAD NO. 3

INTRODUCTION

Primary Road No. 3 is proposed for transportation purposes during the mining of Gooden Creek No. 2 Mine. This road will provide access from the area of Increment No. 3 to Increment No. 4 in order to continue the mining operation in Increment No. 4. The location of this road can be seen on the Primary Road Map in Part III.B.5 of the permit application as well as on the enclosed plan view drawings within this detailed design plan. All referenced [Specifications](#), enclosures and attachments can be found in the [Appendix](#) towards end of this document. This road is proposed as permanent and is to be left after the mine project as desired by the mine company and land owner for access throughout the property for Land Energy, LTD.

Primary Road No. 3 is approximately two hundred and eighty two (282) feet in length. There is one (1) drainage structure proposed (DS3P) for the road and a safety berm on both sides. Drainage structure DS3P is to be located at station 1+37 and is discussed in further detail within this detailed design plan. The road will be used for the haulage of recovered coal and spoil material and is not to be considered an ancillary roadway. The location and differentiation between primary and ancillary roads may be found in Part III.B.5 of the permit application.

DRAINAGE DITCHES

Due to the primary road drainage ditches having small drainage areas, an anticipated peak runoff of less than 3.0 cfs is expected for a design storm of a 10-year, 6-hour precipitation event. The slopes encountered in this particular design were greater than the slope ranges provided



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throughout the Typical Drainage Ditch drawing options. Drainage ditch slopes on this site are as high as 45.0% and a site specific cross-section is proposed. This cross-section and design information can be found in the [Appendix](#).

A riprap liner material consisting of Class III riprap is proposed along all ditches. Specification for Class III riprap can be found in the [Appendix](#). These ditches are at the toe of the fill section along the entire roadway until they reach a 10' x 15' x 3' sediment trap and ultimately the drainage course as shown on the plan view drawings within this plan. The location and specifications for the sediment trap can be found in the [Appendix](#) as well. All riprap will be limestone or sandstone material and underlain with Mirafi 500X or equivalent filter blanket.

DRAINAGE STRUCTURES

Primary Road No. 3 contains one drainage structure, DS3P, at station 1+37. This structure consists of four (4) – 42'' corrugated metal pipes (CMP). These structures are necessary to provide adequate drainage for the 10 - year, 6 - hour precipitation event. The watershed map and hydrologic model can be found in the [Appendix](#). Each pipe is proposed as 200' in length and will lay in the natural drainage course without any alteration to the upstream and downstream banks. There are also two (2) – 12'' Schedule 40 PVC pipes proposed at the sag of the road to provide drainage control trapped between the safety berms. These pipes tie into the sediment traps as shown on the plan view drawing.



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NOTES

1. Drainage Structure DS3P 1+37 is a permanent drainage course crossing used to transport personnel, equipment, supplies, spoil, coal and as general access for Gooden Creek No. 2 Mine. The crossing will primarily be used during the operation as the mining progresses from Increment No. 3 to Increment No. 4.

2. The drainage area for Drainage Structure DS3P 1+37 was calculated to be 440 acres (0.69 square miles). The U.S.G.S. Quadrangle map of the area shows the drainage course as a “blue line” stream. DSM Design Group, LLC has contacted the United States Army Corps of Engineers (USACE) and approval for the stream crossing will be provided with the issuance of the Corps permit for the entire project.

3. The flow rate used in the design of Drainage Structure DS3P 1+37, 522.4 cfs, was based on the results from the SEDCAD4 model of the 10 year, 6 hour precipitation event. It was determined that 4-42 inch diameter corrugated metal pipes will be used to carry the flow with 11 feet of headwater. The “bankfull” flow was also determined to assess any potential adverse changes to the bankfull characteristics. Based on regional curve data collected by DSM Design Group, LLC for the Cumberland Plateau physiographic province, the bankfull discharge was determined to be 38.7 cfs (For more information regarding this regional curve data, please contact DSM Design Group, LLC). In this case with a discharge of 38.7 cfs, the water level within the pipes will be 0.76 feet which reaches an elevation of 489.3 MSL.



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It should be noted that the bankfull water level noted in the field by survey data was determined to be at 490.0 MSL. With this information in mind and the fact that the elevation of the water stage during a bankfull event is not higher than the elevation noted in the field, Drainage Structure DS3P 1+37 will not result in an increase in the existing bankfull level of the drainage course.

4. Storm water runoff from Primary Roads No. 3 will be controlled by roadside ditches that will discharge into 10' x 15' x 3' sump type sediment traps. Overflow from the sediment trap outlet ditch will be received by the drainage course. Silt fences will also be utilized to control or prevent additional contributions of suspended solids to stream flow. The plan view drawing illustrates the location of these controls. See [Appendix](#) for specifications on these controls. The sediment traps will be inspected weekly. Maintenance will be performed as necessary to ensure that the sediment traps and silt fencing are functioning properly. When the sumps or silt fencing fill with sediment, the sediment will be removed and transported back to the permit area within drainage control.
5. Any debris, mud, or dust, accumulated upon the roadway surface along Drainage Structure DS3P 1+37 will be periodically removed and transported back to the permit area within drainage control to prevent it entering the drainage course during periods of inundation.
6. Roadway safety berms will be placed along the side slopes of the embankment of Drainage Structure DS3P 1+37 as per Mine Safety and Health Administration (MSHA) regulations.



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The safety berms will consist of 2.5:1 side slopes with a 2' top width at a height equal to the height of the axle of the largest vehicle traveling the roadway. The height is anticipated to be approximately 4 feet. These berms are to be faced with a minimum of 16" of durable non-toxic & non-acid forming sandstone or limestone rip-rap tying into the same facing for the embankment on the outslope sides.

7. Drainage Structure DS3P 1+37 will affect less than 440 linear feet (11 feet of headwater over a 2.5% slope) of stream channel during the peak flow of the 10 year, 6 hour precipitation event. This is very small as compared to the large total length of the channel, and due to there being no floodplains associated with the channel along the impacted section, and the fact that there are no structures located along the impacted area, and the fact that property along the impacted area is control by Land Energy, LTD (the same as the location of the roadway) there will be no adverse impacted to the stream channel or adjacent properties either upstream or downstream of the proposed crossing as a result of construction.
8. Due to Drainage Structure DS3P 1+37 having a fill section of substantial height a stability analysis was performed to prove its safety.



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PRIMARY ROAD NO. 3

STABILITY ANALYSIS

The software 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 of Drainage Structure DS3P 1+37 is SM type material. The depth to the stiff base (2.5 feet) was measured by personnel of DSM Design Group, LLC. The soil type to be used in the construction of the embankment structure of Drainage Structure DS3P 1+37 is SM-SC type material which was sampled, analyzed and by personnel of DSM Design Group, LLC. The soil properties used in the stability analysis was taken from the U.S. Department of the Interior Bureau of Reclamation Design of Small Dams.* The pore pressure ratio approach was utilized during the analysis to account for some degree of saturation in the fill. A ratio of 1.0 (which assumed 20% of the fill as being saturated) was conservatively used during the analysis.

SOIL PROPERTIES

<u>USAGE</u>	<u>TYPE</u>	<u>COHESION (psf)</u>	<u>INTERNAL ANGLE OF FRICTION</u>	<u>EFFECTIVE DENSITY (pcf)</u>
FOUND.	SM	270.0	33.02	132.14
DAM	SM-SC	180.0	30.54	135.96

ANALYSIS RESULTS

<u>FILL</u>	<u>STATIC SAFETY FACTOR</u>
DS3P 1+37	1.940

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



BIRMINGHAM COAL AND COKE CO., INC.
GOODEN CREEK NO. 2 MINE, P-39—
ROADWAY SPECIFICATIONS

**DESIGN, CONSTRUCTION, MAINTENANCE, AND
RECLAMATION SPECIFICATIONS FOR PRIMARY ROADS**

1. LOCATION

- A) Primary roads will be located on ridges or high areas or on the most stable available slopes so as to control and prevent erosion, siltation, flooding, and adverse impacts to fish and wildlife, or their habitat and related environmental values, to the extent possible.
- B) No part of any primary road will be located in the channel of an intermittent or perennial stream without written approval from the Regulatory Authority, in accordance with 880-X-10C-.12 through 880-X-10C-.14 and 880-X-10C-.28.
- C) If at all possible, all primary roads will be located upstream of sediment basins to prevent, control and minimize additional contributions of suspended solids to stream flow or runoff outside the permit area, the violation of applicable State or Federal water quality standards, seriously altering the normal flow of water in stream-beds or drainage channels, and damage to all public or private property.
- D) In instances where it is not possible to locate primary roads in the above manner, sediment control will be achieved by the use of silt fences, rock check dams, hay bale berms, etc.

2. DESIGN REQUIREMENTS

- A) Primary roads will be designed by or under the direct supervision of a qualified registered Professional Engineer experienced in the design and construction of roads, in accordance with the ASMC rules and regulations, and current, prudent engineering practices. No Primary Road grade will be steeper than seventeen (17) percent.
- B) All primary roadway embankments will be designed and constructed to be stable under normal construction and operating conditions, with a minimum static safety factor of 1.3.
- C) All primary roads will be designed, constructed, reconstructed and maintained to have adequate drainage control structures to safely pass the peak runoff anticipated from a 10 year, 6 hour precipitation event.



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ROADWAY SPECIFICATIONS

3. CONSTRUCTION REQUIREMENTS

- A) The foundation area of the roadbed will be cleared and grubbed of all organic material and the topsoil will be removed. The disturbed area will be kept to the minimum necessary to accommodate the roadbed and/or associated drainage ditch construction.
- B) The road construction material will be suitable subgrade material, free of sod, roots, stumps, etc., and will not contain rocks which exceed twelve (12) inches in diameter. The road construction material will be placed in layers (12 inch maximum thickness) and compacted to ninety five (95%) percent of the standard proctor density, as set forth in ASTM.
- C) The minimum top width of primary roads will under no circumstance be less than eighteen (18) feet and will be of maximum width necessary to facilitate the largest equipment using the road.
- D) All slopes (cut and fill) will be no steeper than 2 horizontal to 1 vertical, unless specified otherwise in the detailed design.
- E) Roadbeds will be cut into consolidated, non-erodible material or will be surfaced with durable, non-toxic, non-acid forming material. In most instances, durable sandstone overburden material from the mine site will be used for surfacing material. In instances where durable sandstone overburden material from the site is not available or suitable, then durable, non-toxic, non-acid forming material, such as chert, crushed limestone, redrock, and/or crushed sandstone will be hauled in from off site, placed and compacted on the roadbed surface a minimum depth of four (4) inches.
- F) Primary roads will be constructed with grades as shown on the Detailed Primary Road Design Plans. No Primary Road grade will be steeper than seventeen (17) percent.



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ROADWAY SPECIFICATIONS

4. DRAINAGE AND SEDIMENT CONTROL REQUIREMENTS

- A) Primary roads will be constructed, reconstructed, and maintained to have adequate drainage control, using structures such as, but not limited to bridges, culverts, drainage pipes, ditches, cross drains, and ditch relief drains designed to safely pass the peak runoff anticipated from a 10 year, 6 hour precipitation event. All drainage control structures will be designed and constructed in such a manner whereas, to allow free and operating conditions to prevent, control, and minimize erosion at the inlets and outlets.
- B) Culverts and drainage pipes will be designed and installed to provide adequate support for the load of the largest equipment using the road. For design purposes, "H-20" (live load + impact) was used. All culverts or drainage pipes with diameters of forty-eight (48) inches or less will be covered with a minimum of one (1) foot and the maximum cover will not exceed fifty-seven (57) feet of desirable compacted material. All culverts or drainage pipes with diameters greater than forty- eight (48) inches will be covered with a minimum of two (2) feet and the maximum cover will not exceed forty-one (41) feet of desirable compacted material. See Detailed Primary Road Design Plans for actual depth of material proposed above each culvert or drainage pipe.
- C) Culverts and drainage pipes will be designed and installed to allow adequate freeboard to prevent overtopping of the embankment.
- D) Drainage ditches, cross drains, and ditch relief drains will be constructed and maintained to prevent uncontrolled surface drainage over the road surface and roadway embankment.
- E) Drainage ditches will be constructed with no sustained grades greater than five (5%) percent, unless unavoidable. If ditches must be constructed with grades in excess of five (5%) percent, drainage ditches will be lined as shown on the Primary Road Detailed Design Plans.
- F) Sediment control will be achieved by the use of silt fences, rock check dams, hay bale berms, etc. in strategic locations, to prevent excessive siltation to the receiving streams.
- G) Upon completion of construction of all roads, the side slopes of the roadway cut and fill sections, including all borrow areas formed in the construction, areas used for disposal of excess material, ditches, etc. will be seeded with a mixture of perennial and annual grasses, fertilized and mulched to prevent erosion and ensure restabilization. Grass mixtures will include, but not be limited to, fescue, bermuda, rye grass, browntop millet, clover and sericea.



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ROADWAY SPECIFICATIONS

5. INSPECTION AND MAINTENANCE REQUIREMENTS

- A) Routine inspections and maintenance (such as regrading, resurfacing, maintenance of sediment control structures, spot replanting, and dust control) will be conducted regularly during the life of each road to assure that each road continually meets design and performance standards.
- B) Dust control will be achieved by the periodic application of water, chemical binders and/or other dust suppressants.
- C) Any road damaged by a catastrophic event, such as a flood, or earthquake, will be repaired as soon as it is practicable after the damage has occurred.

6. CERTIFICATION REQUIREMENTS

- A) Primary roads will be designed by or under the direct supervision of a qualified registered Professional Engineer experienced in the design and construction of roads, in accordance with the ASMC rules and regulations, and current, prudent engineering practices. Each design will be certified by a registered Professional Engineer as being designed in accordance with the Regulations of the Alabama Surface Mining Commission, Chapter 880-X-10.
- B) Upon the completion of the construction of each section of the primary road, as set forth in the detailed design plans, the construction will be certified by a registered Professional Engineer, to the Alabama Surface Mining Commission, as being constructed in accordance with the approved detailed design plans.
- C) In the event that a primary road is mined through in the mining process and must be reconstructed, the newly constructed primary road will be reconstructed to the minimum design criteria within the detailed design plans and the construction will be certified by a registered Professional Engineer, to the Alabama Surface Mining Commission, as being constructed in accordance with the approved detailed design plans.



BIRMINGHAM COAL AND COKE CO., INC.
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ROADWAY SPECIFICATIONS

7. REMOVAL AND RECLAMATION REQUIREMENTS

- A) All primary roads which are not mined through and remain after the completion of mining may be left as permanent roads for landowner access, if there is no opposition by said landowner.
- B) All primary roads which are not mined through and remain after the completion of mining which are not to be retained as permanent for landowner access will be removed and reclaimed in accordance with the approved grading and reclamation plans as soon as practicable after it is no longer needed for mining and reclamation purposes. This removal and reclamation will include:
1. Closing the road to traffic;
 2. Removing all bridges, culverts, drainage pipes, and other drainage control structures, unless otherwise approved as part of the post mining land use;
 3. Removing and/or otherwise disposing of road surfacing materials, that are not compatible with the post mining land use and revegetation requirements, onsite or removed and stored for re-use;
 4. Reshaping and regrading cut and fill slopes as necessary to be compatible with the post mining land use and to compliment the natural drainage pattern of the surrounding terrain;
 5. Protecting the natural drainage patterns by installing dikes or cross drains as necessary to control surface runoff and erosion;
 6. Scarifying or ripping the roadbed, replacing topsoil or substitute material, and revegetating the entire disturbed area in accordance with the approved reclamation plan.



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[SITE LOCATION & WATERSHED MAP](#)



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DETAILED DESIGN DRAWING



**BIRMINGHAM COAL AND COKE CO., INC.
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10 – YEAR, 6 – HOUR DESIGN SEDCAD OUTPUT



**BIRMINGHAM COAL AND COKE CO., INC.
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STABILITY ANALYSIS DATA

(BORE HOLE DESCRIPTIONS, SIEVE ANALYSIS & ATTERBURG LIMITS)



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REAME STABILITY ANALYSIS OUTPUT
REAME DRAWINGS



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**REAME (ROTATIONAL EQUILIBRIUM ANALYSIS OF MULTILAYERED
EARTHWORKS)**

INPUT FILE NAME -M:\REAME\Birmingham Coal and Coke\Gooden Creek No. 2
Mine\Primary Road No. 3 DS3P 1+37.DAT

TITLE -Primary Road No. 3 Drainage Structure DS3P 1+37

NO. OF STATIC AND SEISMIC CASES (NCASE) = 1

NO. OF NONCIRCULAR FAILURE SURFACES (NNS) = 0

TWO-DIMENSIONAL ANALYSIS (THREED = 0)

ANALYSIS BY DETERMINISTIC METHOD (PROB = 0)

CASE NO. 1 SEISMIC COEFFICIENT (SEIC) = 0.000

NO. OF BOUNDARY LINES (NBL) = 3

NO. OF POINTS ON BOUNDARY LINE 1 = 2

1 X COORD.= 297.437 Y COORD.= 5.0641
2 X COORD.= 500 Y COORD.= 0

NO. OF POINTS ON BOUNDARY LINE 2 = 2

1 X COORD.= 297.437 Y COORD.= 7.5641
2 X COORD.= 500 Y COORD.= 2.5

NO. OF POINTS ON BOUNDARY LINE 3 = 9

1 X COORD.= 297.437 Y COORD.= 7.5641
2 X COORD.= 368.092 Y COORD.= 36.2184
3 X COORD.= 370.0939 Y COORD.= 36.2283
4 X COORD.= 380.1037 Y COORD.= 32.2777
5 X COORD.= 392.1154 Y COORD.= 32.6971
6 X COORD.= 404.1271 Y COORD.= 32.3978
7 X COORD.= 414.1369 Y COORD.= 36.4511
8 X COORD.= 416.1388 Y COORD.= 36.4618
9 X COORD.= 500 Y COORD.= 2.5



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LINE NO. AND SLOPE OF EACH SEGMENT ARE:

1 -0.025
2 -0.025
3 0.406 0.005 -0.395 0.035 -0.025 0.405
0.005 -0.405

MIN. DEPTH OF TALLEST SLICE (DMIN) = 0
NO. OF RADIUS CONTROL ZONES (NRCZ) = 1

RADIUS DECREMENT (RDEC) FOR ZONE 1 = 0
NO. OF CIRCLES (NCIR) FOR ZONE 1 = 5
NO. OF BOTTOM LINES (NOL) FOR ZONE 1 = 1
LINE NO. (LINO) BEG. NO. (NBP) END NO. (NEP)
1 1 2

ENGLISH UNITS ARE USED WITH DISTANCE IN FEET AND FORCE IN POUND.

SOIL	ENVELOPE	COHESION	FRIC. ANGLE	UNIT WEIGHT
No.	(TSSE)	(C)	(PHID)	(G)
1	1	270.000	33.020	132.140
2	1	180.000	30.540	135.960

USE PORE PRESSURE RATIO
USE GRID
NO. OF SLICES (NSLI) = 10
NO. OF ADD. CIRCLES (NAC) = 3
ANALYSIS BY SIMPLIFIED BISHOP METHOD (MTHD=2)
NUMBER OF FORCES (NFO)= 0
SOFT SOIL NUMBER (SSN)= 0

PORE PRESSURE RATIO (RU) = 0.1

NO. OF SOILS WITH DIFFERENT PORE PRESSURE RATIO (NSDP) = 0
INPUT COORD. OF GRID POINTS 1,2,AND 3

POINT 1 X COORD. = 440 Y COORD. = 120
POINT 2 X COORD. = 440 Y COORD. = 20
POINT 3 X COORD. = 520 Y COORD. = 20

X INCREMENT (XINC) = 8 Y INCREMENT (YINC) = 8



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NO. OF DIVISIONS BETWEEN POINTS 1 AND 2 (ND12) = 5
 NO. OF DIVISIONS BETWEEN POINTS 2 AND 3 (ND23) = 4
 ONLY A SUMMARY TABLE IS PRINTED (NPRT = 0)
 SLICES WILL BE SUBDIVIDED

AUTOMATIC SEARCH WILL FOLLOW AFTER GRID

FACTORS OF SAFETY BASED ON GRID

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
 MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	NO. OF CIRCLE CRITIC.	LOWEST RADIUS	WARNING F.S.
440.0	120.0	11	7	115.305	3.650 0
440.0	100.0	11	10	83.170	3.586 0
440.0	80.0	8	5	55.144	3.045 0
440.0	60.0	8	5	36.315	2.633 0
440.0	40.0	11	4	22.737	2.782 0
440.0	20.0	8	8	6.911	5.008 0
460.0	120.0	11	4	103.921	2.573 0
460.0	100.0	11	4	84.801	2.328 0
460.0	80.0	11	7	67.897	2.157 0
460.0	60.0	11	8	51.736	2.153 0
460.0	40.0	11	8	32.252	2.471 0
460.0	20.0	11	8	16.326	4.419 0
480.0	120.0	11	8	112.964	2.062 1
480.0	100.0	11	2	96.148	1.972 0
480.0	80.0	11	2	76.445	1.992 0
480.0	60.0	11	2	56.743	2.112 0
480.0	40.0	11	9	36.428	2.349 0
480.0	20.0	11	6	16.799	3.061 0
500.0	120.0	5	1	117.500	2.053 1
500.0	100.0	5	1	97.500	2.191 1
500.0	80.0	5	1	77.500	2.399 1
500.0	60.0	5	1	57.500	2.753 1
500.0	40.0	5	1	37.500	3.485 1
500.0	20.0	5	1	17.500	5.889 1
520.0	120.0	5	1	119.190	3.248 1
520.0	100.0	5	1	99.530	4.536 1



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520.0	80.0	5	1	80.039	8.885	1
520.0	60.0	1	1	60.879	1000.000	1
520.0	40.0	1	1	42.500	1000.000	1
520.0	20.0	1	1	26.575	1000.000	1

LOWEST FACTOR OF SAFETY AT EACH GRID POINT IS TABULATED BELOW

COORDINATE	440.000	460.000	480.000	500.000	520.000
120.000	3.650	2.573	2.062	2.053	3.248
100.000	3.586	2.328	1.972	2.191	4.536
80.000	3.045	2.157	1.992	2.399	8.885
60.000	2.633	2.153	2.112	2.753	1000.000
40.000	2.782	2.471	2.349	3.485	1000.000
20.000	5.008	4.419	3.061	5.889	1000.000

MINIMUM FACTORS OF SAFETY OCCUR AT THE FOLLOWING 2 CENTERS

FACTOR OF SAFETY = 2.053 AT (500.000,120.000)

FACTOR OF SAFETY = 1.972 AT (480.000,100.000)

AUTOMATIC SEARCH WILL BE MADE ONLY ON THE CENTER WITH THE SMALLEST F.S.

FACTORS OF SAFETY BASED ON SEARCH

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	OF CIRCLE CRITIC.	LOWEST RADIUS	WARNING F.S.	
480.0	100.0	11	2	96.148	1.972	0
488.0	100.0	11	7	96.999	1.955	1
496.0	100.0	5	1	97.582	2.116	1
488.0	108.0	11	7	104.890	1.940	1
488.0	116.0	11	7	112.789	1.950	1
496.0	108.0	5	1	105.576	2.066	1
480.0	108.0	11	9	103.104	2.001	1
490.0	108.0	11	7	104.779	1.952	1
486.0	108.0	11	7	105.035	1.943	1



BIRMINGHAM COAL AND COKE CO., INC.
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488.0 110.0 11 7 106.864 1.940 1
 488.0 106.0 11 7 102.917 1.941 1
 AT POINT (488.0 , 108.0) RADIUS 104.890

THE MINIMUM FACTOR OF SAFETY IS 1.940

SUMMARY OF SLICE INFORMATION FOR MOST CRITICAL FAILURE SURFACE

SL. NO.	SOIL NO.	SLICE WIDTH	SLICE HEIGHT	WATER HEIGHT	BOTTOM SINE	TOTAL WEIGHT	EFFEC. WEIGHT	RESIS. MOMENT	DRIVING MOMENT
1	2	2.052	1.477	0.000	-.714	.412E+03	.371E+03	.714E+05	.309E+05
2	2	2.002	3.909	0.000	-.695	.106E+04	.958E+03	.952E+05	.775E+05
3	2	4.482	6.008	0.000	-.664	.366E+04	.329E+04	.266E+06	.255E+06
4	2	8.536	8.697	0.000	-.602	.101E+05	.908E+04	.651E+06	.637E+06
5	2	8.536	11.036	0.000	-.520	.128E+05	.115E+05	.798E+06	.699E+06
6	2	8.536	12.251	0.000	-.439	.142E+05	.128E+05	.891E+06	.655E+06
7	2	8.536	12.504	0.000	-.358	.145E+05	.131E+05	.927E+06	.544E+06
8	2	8.536	11.902	0.000	-.276	.138E+05	.124E+05	.907E+06	.400E+06
9	2	8.536	10.515	0.000	-.195	.122E+05	.110E+05	.831E+06	.249E+06
10	2	8.536	8.391	0.000	-.113	.974E+04	.876E+04	.701E+06	.116E+06
11	2	8.536	5.557	0.000	-.032	.645E+04	.580E+04	.520E+06	.217E+05
12	2	8.536	2.027	0.000	.049	.235E+04	.212E+04	.292E+06	-.122E+05
SUM						.695E+07	.367E+07		

AT CENTER (488.000 , 108.000) WITH RADIUS 104.890 AND SEIS. COEFF. 0.00
 FACTOR OF SAFETY BY NORMAL METHOD IS 1.892
 FACTOR OF SAFETY BY SIMPLIFIED BISHOP METHOD IS 1.940

SUMMARY OF STABILITY ANALYSIS

FACTOR OF SAFETY IS DETERMINED BY SIMPLIFIED BISHOP METHOD
 NUMBER OF CASES = 1

CASE 1 SEISMIC COEFFICIENT = 0
 FACTOR OF SAFETY BASED ON 2D ANALYSIS = **1.940**



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SITE-SPECIFIC DRAINAGE DITCH DESIGN OUTPUT



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SILT FENCING SPECIFICATIONS



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SEDIMENT TRAP SPECIFICATIONS



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TYPICAL PRIMARY ROAD CROSS-SECTION



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TYPICAL DIVERSION DITCH CROSS-SECTIONS



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RIPRAP SPECIFICATIONS

