HYDROLOGY STUDY FOR
BLACK WARRIOR MINERALS, INC.

MANCHESTER EAST MINE
P-3922 / REVISION R-3
WALKER COUNTY, ALABAMA

BY

PERC ENGINEERING CO., INC.
1606 HWY. 78 WEST
JASPER, ALABAMA 35501

BASINS 043
DETAILED DESIGN PLANS
ATTACHMENT III-B-2(a)

MARCH 7, 2012

PERC
ENGINEERING CO., INC.

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March 7, 2012

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

RE: Black Warrior Minerals, Inc.
Manchester East Mine
P-3922 Revision R-3

Dear Michael:

I hereby certify the attached detailed design plans for Basin 043 for the above referenced location 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

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 the basin 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 (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, post mining 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.

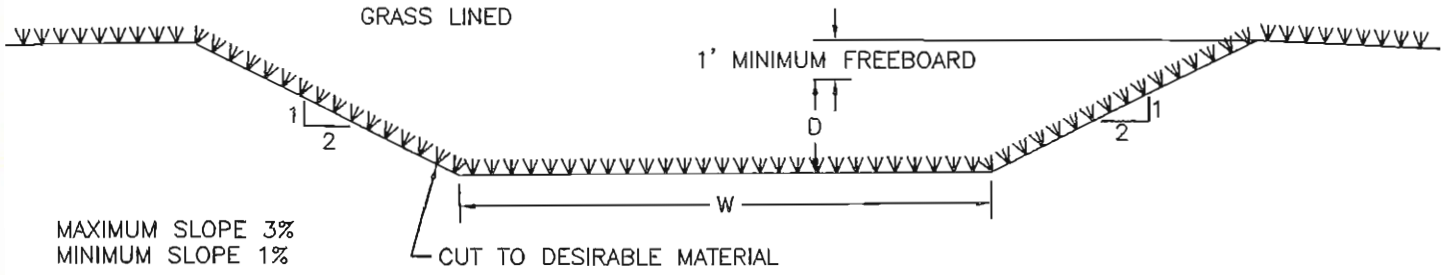
22. All ponds shall be examined quarterly for structural weakness, instability, erosion, or other hazardous conditions and maintenance performed as necessary. Formal inspections shall be made on an annual basis, including any reports or modifications, in accordance with 880-X-10C-.20[l(j)] of the Alabama 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)
1–15	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)
0–20	0.5
20–90	1.0
90–180	1.5
180–300	2.0
300–450	2.5

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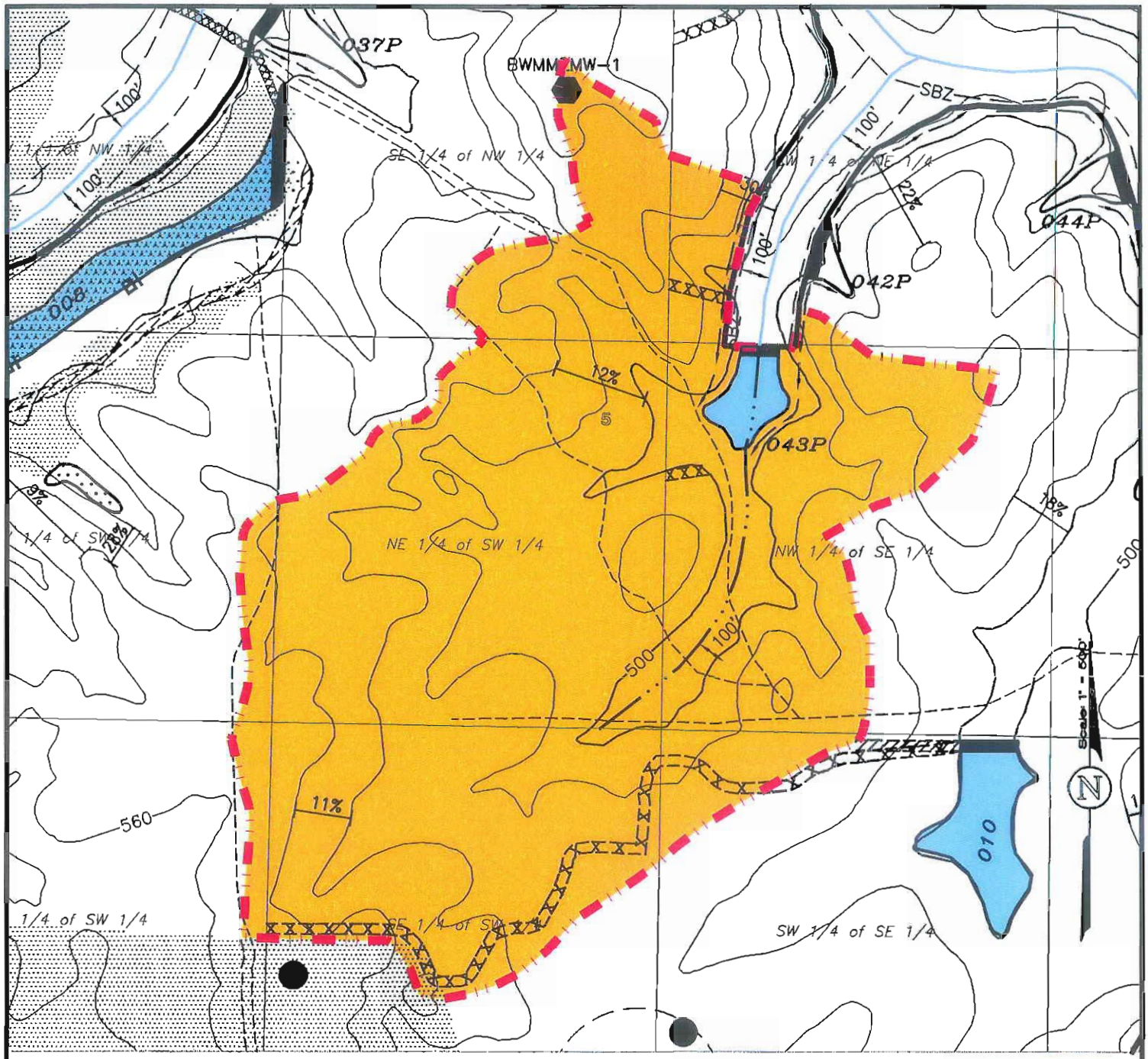
(205) 384-4880 Office (205) 221-7114 Fax

TYPICAL PERMANENT DIVERSION FOR BASIN DISPOSAL

DRAWN BY: J.W.T. DWG. NAME: TYPICALS	DATE: 04–16–2009
APPROVED BY: L.G.S.	SCALE: NONE

ATTACHMENT III–B–2–A



LEGEND

- Permit Boundary/Increment Boundary
- Drainage Divide
- 600 — Surface Contour
- 011P — Sediment Basin
- Natural Drainage Course
- Land Slope Measurement
- Primary Road
- Ancillary Road
- County Road (Paved unless otherwise designated)
- Road (Private unless otherwise shown)
- Trail
- Previously Surface Mined
- Intermittent Stream
- Perennial Stream
- Diversion Ditch
- B — Berm

LAND USE & CURVE NUMBER INFORMATION

- GRADED & BARE, CURVE NUMBER 81
- SEDIMENT BASIN, CURVE NUMBER 100

PERC ENGINEERING CO., INC.

Attachment III-B-2(a)
Black Warrior Minerals, Inc.
Manchester East Mine
P-3922 Revision R-3
Basin 043 Watershed Map

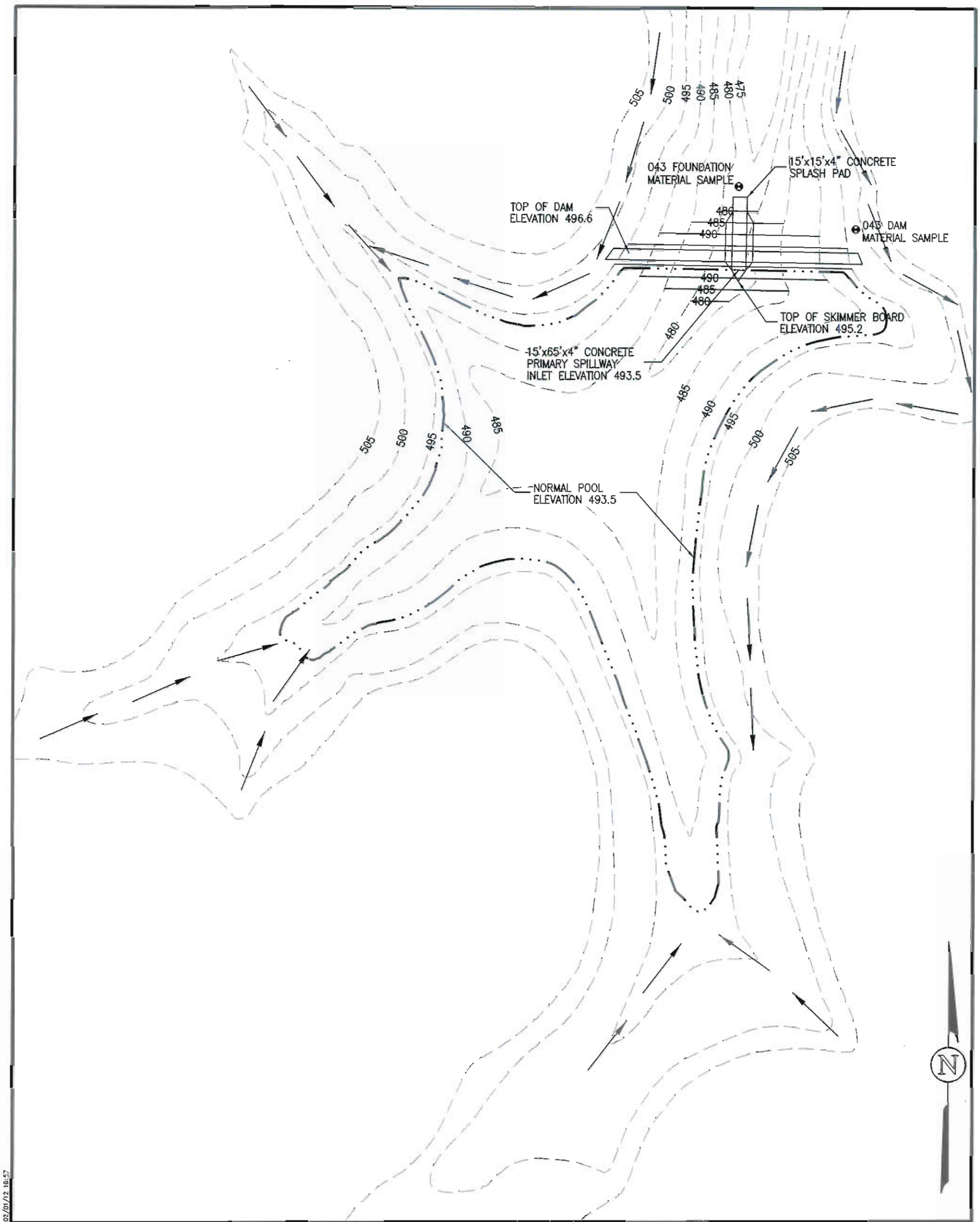
DRAWN BY: J.W.T.	DATE: 01/20/2011
DWG. NAME: BWMMEB043WSM	
APPROVED BY: L.G.S.	SCALE: 1"=500'

NOTES

Basin 043

1) The primary spillway of Basin 043 will consist of a 15 foot wide open channel lined with 4 inches of concrete reinforced with 6X6–W2.9XW2.9 concrete reinforcement wire. The channel lining will extend back to the existing drainage course. A 15' X 15' X 4" concrete splash pad reinforced with 6X6-W2.9XW2.9 welded wire fabric will be located at the exit point of the tail section of the channel.

2) Any coal that is located within the proposed pool area of Basin 043 will be excavated during the time of construction.



LEGEND

- Exisiting Natural Contours
- Proposed Finished Contours
- Normal Pool Elevation
- Major Inflow/Diversion

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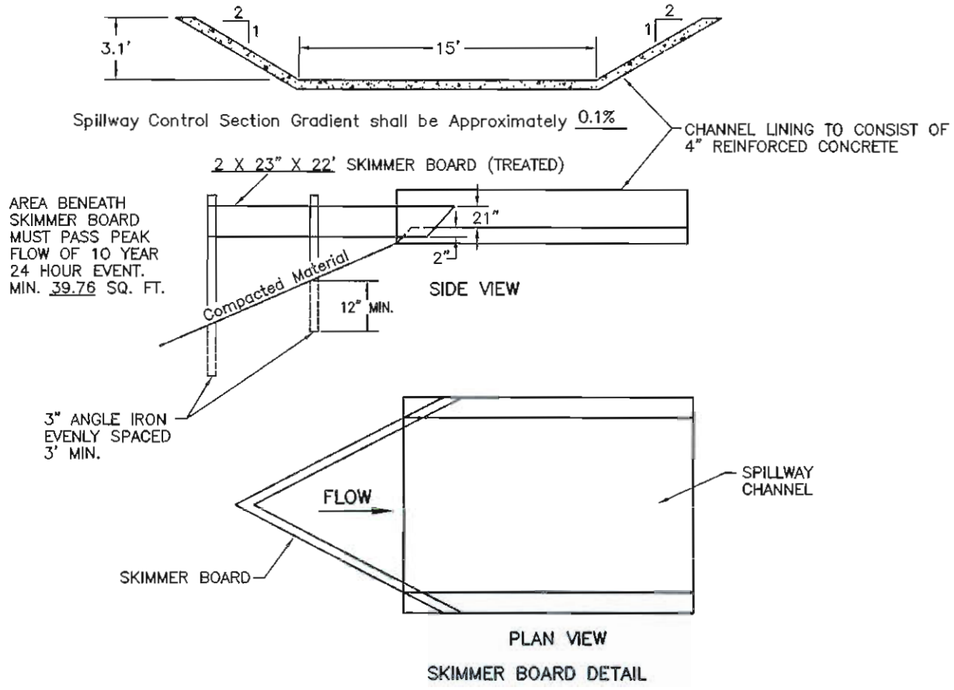
Black Warrior Minerals Inc.
Manchester East Mine
P-3922 Revision R-3
Basin 043 Plan View Map

DRAWN BY: J.W.T. DWG. NAME: BWMMEBO43PV	DATE: 02/01/2012
APPROVED BY: L.G.S.	SCALE: 1" = 100'

Skimmer Board Elev. 495.2
Spillway Elev. 493.5
Q Out 118.31 C.F.S.
V Out 2.98 FT/S



Spillway Tail Section Gradient shall be Approximately 40%

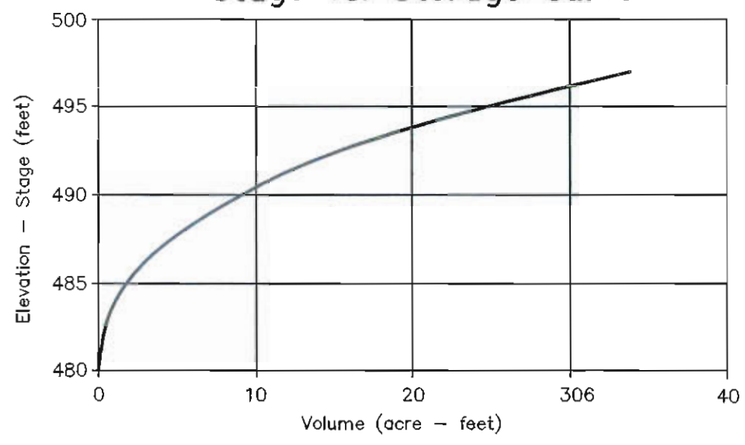
Notes:

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. Upan 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.
9. Channel lining within the control section of the spillway channel will extend to the maximum water elevation.

Storage Computation

Elevation (feet)	Area (acres)	Avg. Area (acres)	Interval (feet)	Storage (ac.–ft.)	Acc. Storage (ac.–ft.)
480	0.044				0.000
485	0.865	0.455	5.0	1,840	1.840
490	2.109	1.487	5.0	7.208	9.048
495	4.208	3.159	5.0	15.493	24.541
497	5.205	4.707	2.0	9.396	33.937

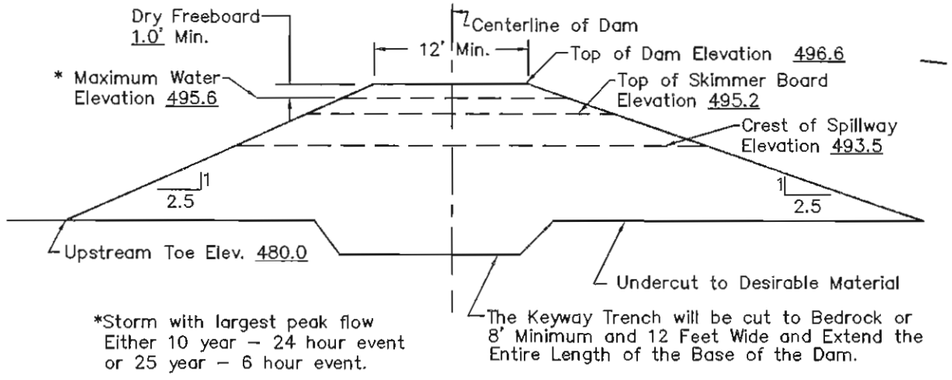
Stage vs. Storage Curve



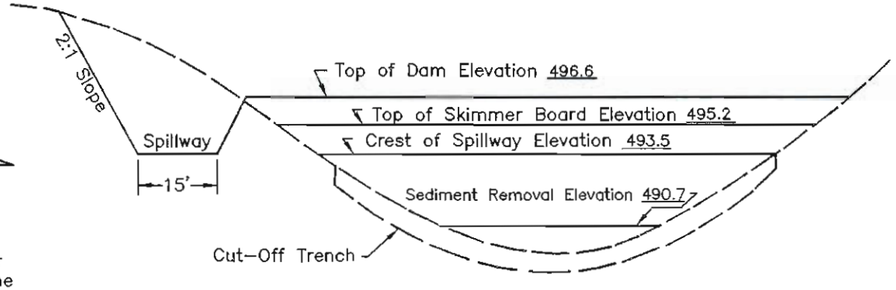
Key Basin Parameters

Drainage Area	101.0 Acres
Disturbed Area	100.0 Acres
Sediment Storage	10.5 Ac.–Ft.
Detention Storage	8.3 Ac.–Ft.
Normeal Pool Capacity	18.8 Ac.–Ft.
Total Basin Capacity	27.4 Ac.–Ft.
Peak Inflow	235.6 C.F.S.
Peak Outflow	118.3 C.F.S.

Leslie G. Stephens 03/07/2012
Leslie G Stephens, P.E., P.L.S.
AL Registration #14117–E



Typical Cross Section Along Spillway



Typical Profile Looking Downstream

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Black Warrior Minerals, Inc.
Manchester East Mine
P-3922 Revision R-3
Basin 043 Design Details

DRAWN BY: J.W.T. DWG. NAME: BWMMEB043DT	DATE: 02/02/2012
APPROVED BY: L.G.S.	SCALE: NONE

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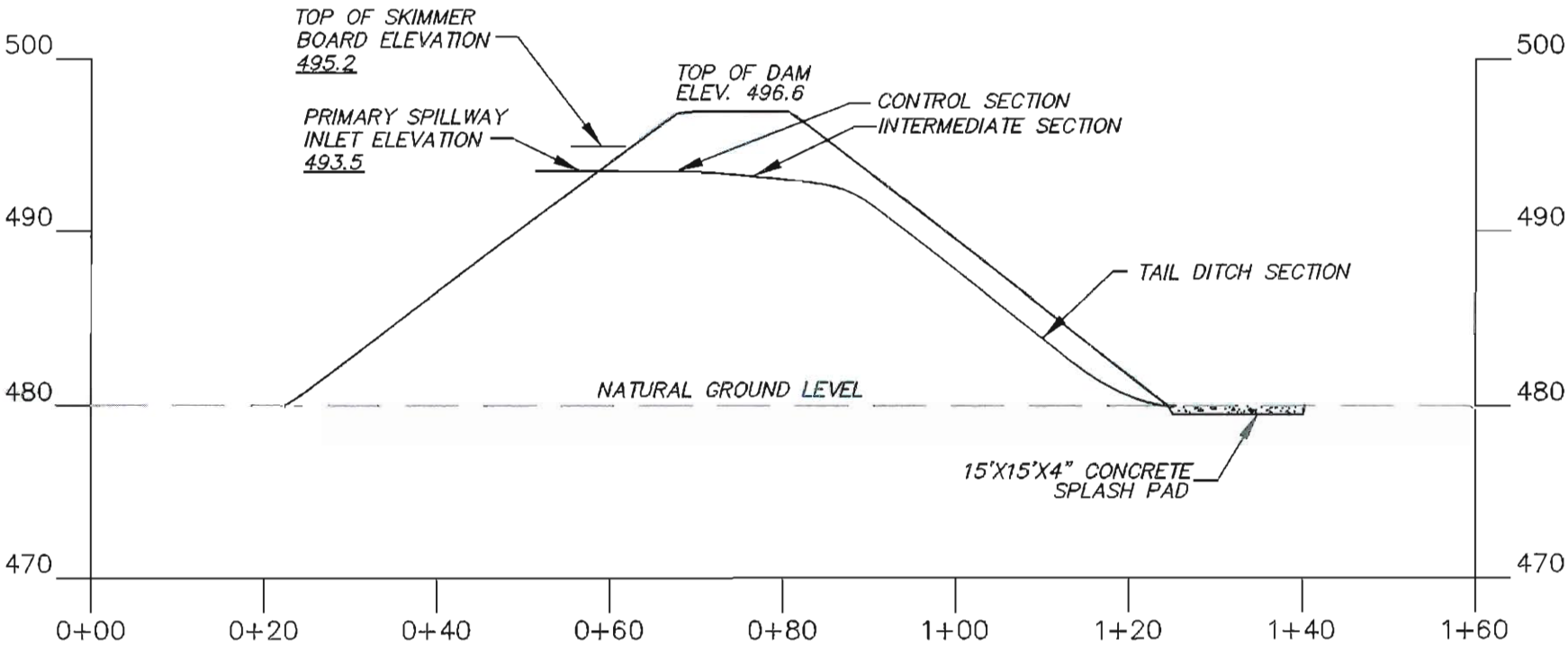
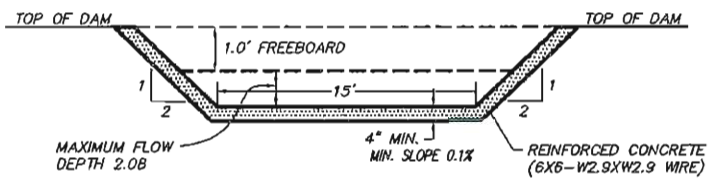
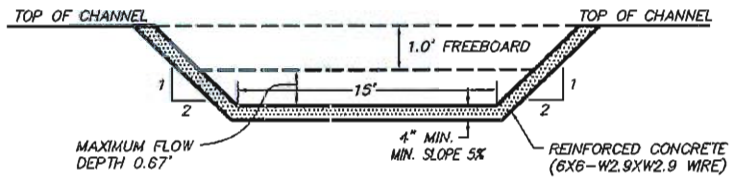
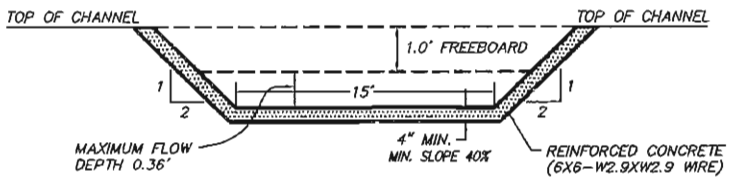




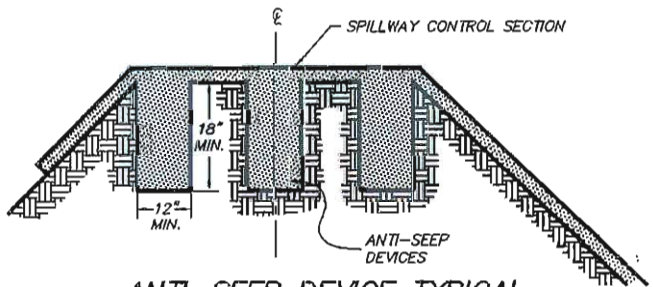
SPILLWAY CONTROL SECTION TYPICAL
N.T.S.



SPILLWAY INTERMEDIATE SECTION TYPICAL
N.T.S.



SPILLWAY TAIL SECTION TYPICAL
N.T.S.



ANTI-SEEP DEVICE TYPICAL
N.T.S.

PERC ENGINEERING CO., INC.

Black Warrior Minerals, Inc.
Manchester East Mine
P-3922 Revision R-3
Basin 043 Dam Details

DRAWN BY: J.W.T. DWG. NAME: BWMMEB043DD	DATE: 02/02/2012
APPROVED BY: L.G.S.	SCALE: AS SHOWN

P-3922 Revision R-3 Basin 043 Spillway 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	0.1	0.0220	1.00		

	w/o Freeboard	w/ Freeboard
Design Discharge:	118.31 cfs	
Depth:	2.08 ft	3.08 ft
Top Width:	23.30 ft	27.30 ft
Velocity:	2.98 fps	
X-Section Area:	39.76 sq ft	
Hydraulic Radius:	1.637 ft	
Froude Number:	0.40	

P-3922 Revision R-3 Basin 043 Spillway Intermediate 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	5.0	0.0220	1.00		

	w/o Freeboard	w/ Freeboard
Design Discharge:	118.31 cfs	
Depth:	0.67 ft	1.67 ft
Top Width:	17.67 ft	21.67 ft
Velocity:	10.85 fps	
X-Section Area:	10.91 sq ft	
Hydraulic Radius:	0.606 ft	
Froude Number:	2.43	

P-3922 Revision R-3 Basin 043 Spillway 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:	118.31 cfs	
Depth:	0.36 ft	1.36 ft
Top Width:	16.44 ft	20.44 ft
Velocity:	20.90 fps	
X-Section Area:	5.66 sq ft	
Hydraulic Radius:	0.341 ft	
Froude Number:	6.28	

Black Warrior Minerals, Inc.
Manchester East Mine
P-3922 Revision R-3
Basin 043

5.9 Inch, 10 Year-24 Hour

DRN 58

JWT

PERC Engineering Co., Inc.
PO BOX 1712
Jasper, AL 35503

Phone: 205-384-5553
Email: John.Taylor@percengineering.com

General Information

Storm Information:

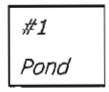
Storm Type:	DRN58
Design Storm:	10 yr - 24 hr
Rainfall Depth:	5.900 inches

Particle Size Distribution:

Size (mm)	Topsoil	Spoil
3.0000	96.000%	80.000%
2.0000	95.000%	73.000%
1.0000	94.000%	55.000%
0.5000	87.000%	42.000%
0.3000	60.000%	37.000%
0.2000	45.000%	34.000%
0.1000	32.000%	31.000%
0.0500	27.000%	29.000%
0.0300	24.000%	27.500%
0.0200	22.000%	25.000%
0.0100	18.000%	21.000%
0.0050	15.000%	16.000%
0.0030	14.000%	11.000%
0.0010	13.000%	5.000%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Basin 043



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	101.000	101.000	121.01	30.94	9,329.1	342,232	212.09	124.28
	Out			100.32	30.89	1,489.6	52,303	0.03	0.02

Particle Size Distribution(s) at Each Structure

Structure #1:

Size (mm)	In	Out
3.0000	82.483%	100.000%
2.0000	75.265%	100.000%
1.0000	56.707%	100.000%
0.5000	43.303%	100.000%
0.3000	38.148%	100.000%
0.2000	35.055%	100.000%
0.1000	31.962%	100.000%
0.0500	29.900%	100.000%
0.0300	28.353%	100.000%
0.0200	25.776%	100.000%
0.0100	21.652%	100.000%
0.0050	16.497%	100.000%
0.0030	11.341%	71.027%
0.0010	5.155%	32.285%

Structure Detail:

Structure #1 (Pond)

Basin 043

Pond Inputs:

Initial Pool Elev:	493.50 ft
Initial Pool:	8.28 ac-ft
*Sediment Storage:	10.50 ac-ft
Dead Space:	20.00 %

**Sediment capacity was entered by user*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
493.50	12.00	2.00:1	2.00:1	15.00

Pond Results:

Peak Elevation:	495.14 ft
H'graph Detention Time:	1.84 hrs
Pond Model:	CSTRS
Dewater Time:	0.81 days
Trap Efficiency:	84.03 %

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)	
490.65	2.341	0.000	0.000		Top of Sed. Storage
491.00	2.472	0.848	0.000		
491.50	2.664	2.132	0.000		
492.00	2.863	3.513	0.000		
492.50	3.069	4.996	0.000		
493.00	3.283	6.583	0.000		
493.50	3.503	8.279	0.000		Spillway #1
494.00	3.731	10.087	3.027	7.23*	
494.50	3.966	12.011	40.393	11.00	
495.00	4.208	14.055	84.486	1.05	
495.14	4.276	14.673	100.316	0.25	Peak Stage
495.50	4.447	16.218	139.844		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
496.00	4.693	18.503	207.093	
496.50	4.946	20.913	286.254	
497.00	5.205	23.450	377.481	

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
490.65	0.000	0.000
491.00	0.000	0.000
491.50	0.000	0.000
492.00	0.000	0.000
492.50	0.000	0.000
493.00	0.000	0.000
493.50	0.000	0.000
494.00	3.027	3.027
494.50	40.393	40.393
495.00	84.486	84.486
495.50	139.844	139.844
496.00	207.093	207.093
496.50	286.254	286.254
497.00	377.481	377.481

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	100.000	0.159	0.000	0.000	81.000	F	120.31	30.451
	2	1.000	0.001	0.000	0.000	100.000	F	1.55	0.491
	Σ	**101.000**						**121.01**	**30.943**

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	0.240	200.00	17.70	0.9000	1.0000	2	9,329.1	343,692	212.99	125.78
	2	0.001	100.00	0.01	0.0010	1.0000	1	0.0	0	0.00	0.00
	Σ							**9,329.1**	**342,232**	**212.09**	**124.28**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	5.00	10.00	200.00	2.230	0.024
		8. Large gullies, diversions, and low flowing streams	2.84	70.00	2,463.00	5.050	0.135
#1	**1**	**Time of Concentration:**					**0.159**

Black Warrior Minerals, Inc.
Manchester East Mine
P-3922 Revision R-3
Basin 043

4.8 Inch, 25 Year-6 Hour

SCS 6 Hour

JWT

PERC Engineering Co., Inc.
PO BOX 1712
Jasper, AL 35503

Phone: 205-384-5553
Email: John.Taylor@percengineering.com

General Information

Storm Information:

Storm Type:	Rainfall Event

Accumulated Time (hrs)	Accumulated Depth (in)
0.00	0.0000
0.50	0.1680
1.00	0.3840
1.50	0.6480
2.00	1.1040
2.50	2.8800
3.00	3.3600
3.50	3.7440
4.00	4.0080
4.50	4.2480
5.00	4.4400
5.50	4.6320
6.00	4.8000

Peak 30-minute Intensity: 3.552 in/hr

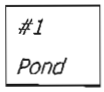
Particle Size Distribution:

Size (mm)	Topsoil	Spoil
3.0000	96.000%	80.000%
2.0000	95.000%	73.000%
1.0000	94.000%	55.000%
0.5000	87.000%	42.000%
0.3000	60.000%	37.000%
0.2000	45.000%	34.000%
0.1000	32.000%	31.000%
0.0500	27.000%	29.000%
0.0300	24.000%	27.500%
0.0200	22.000%	25.000%
0.0100	18.000%	21.000%
0.0050	15.000%	16.000%
0.0030	14.000%	11.000%

Size (mm)	Topsoil	Spoil
0.0010	13.000%	5.000%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Basin 043



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	101.000	101.000	235.55	22.95	11,461.6	484,262	296.35	192.66
	Out			118.31	22.95	1,927.6	72,703	0.04	0.03

Particle Size Distribution(s) at Each Structure

Structure #1:

Size (mm)	In	Out
3.0000	86.137%	100.000%
2.0000	78.600%	100.000%
1.0000	59.219%	100.000%
0.5000	45.222%	100.000%
0.3000	39.839%	100.000%
0.2000	36.608%	100.000%
0.1000	33.378%	100.000%
0.0500	31.225%	100.000%
0.0300	29.610%	100.000%
0.0200	26.918%	100.000%
0.0100	22.611%	100.000%
0.0050	17.227%	100.000%
0.0030	11.844%	70.425%
0.0010	5.384%	32.011%

Structure Detail:

Structure #1 (Pond)

Basin 043

Pond Inputs:

Initial Pool Elev:	493.50 ft
Initial Pool:	8.28 ac-ft
*Sediment Storage:	10.50 ac-ft
Dead Space:	20.00 %

**Sediment capacity was entered by user*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
493.50	12.00	2.00:1	2.00:1	15.00

Pond Results:

Peak Elevation:	495.31 ft
H'graph Detention Time:	1.52 hrs
Pond Model:	CSTRS
Dewater Time:	0.51 days
Trap Efficiency:	83.18 %

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)	
490.65	2.341	0.000	0.000		Top of Sed. Storage
491.00	2.472	0.848	0.000		
491.50	2.664	2.132	0.000		
492.00	2.863	3.513	0.000		
492.50	3.069	4.996	0.000		
493.00	3.283	6.583	0.000		
493.50	3.503	8.279	0.000		Spillway #1
494.00	3.731	10.087	3.027	7.23*	
494.50	3.966	12.011	40.393	2.65	
495.00	4.208	14.055	84.486	1.65	
495.31	4.354	15.377	118.311	0.60	Peak Stage
495.50	4.447	16.218	139.844		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
496.00	4.693	18.503	207.093	
496.50	4.946	20.913	286.254	
497.00	5.205	23.450	377.481	

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
490.65	0.000	0.000
491.00	0.000	0.000
491.50	0.000	0.000
492.00	0.000	0.000
492.50	0.000	0.000
493.00	0.000	0.000
493.50	0.000	0.000
494.00	3.027	3.027
494.50	40.393	40.393
495.00	84.486	84.486
495.50	139.844	139.844
496.00	207.093	207.093
496.50	286.254	286.254
497.00	377.481	377.481

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	100.000	0.159	0.000	0.000	81.000	F	234.58	22.556
	2	1.000	0.001	0.000	0.000	100.000	F	3.58	0.399
	Σ	**101.000**						**235.55**	**22.954**

Subwatershed Sedimentology Detail:

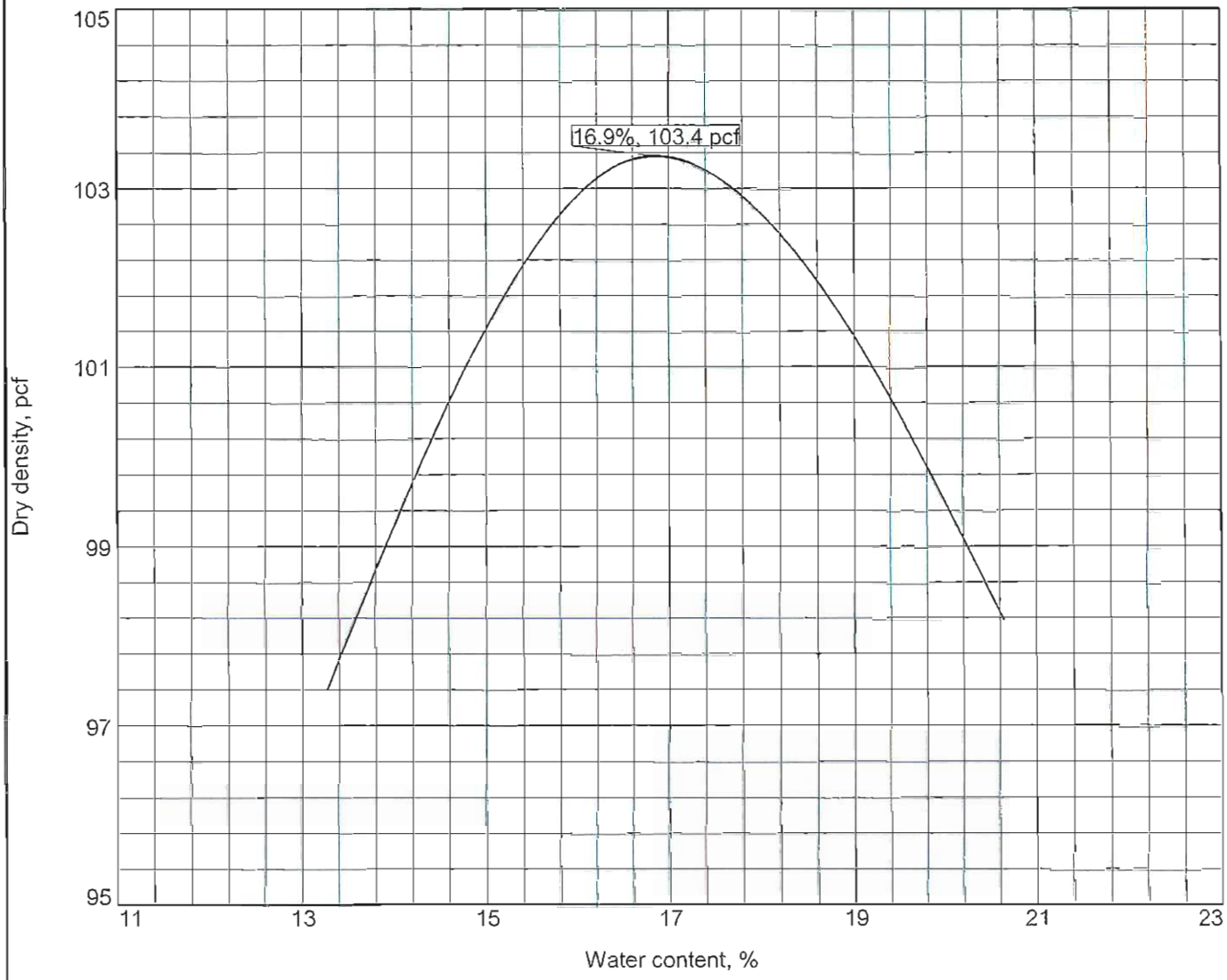
Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.240	200.00	17.70	0.9000	1.0000	2	11,461.6	485,872	297.33	195.58
	2	0.001	100.00	0.01	0.0010	1.0000	1	0.0	0	0.00	0.00
	Σ							**11,461.6**	**484,262**	**296.35**	**192.66**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	5.00	10.00	200.00	2.230	0.024
		8. Large gullies, diversions, and low flowing streams	2.84	70.00	2,463.00	5.050	0.135
#1	**1**	**Time of Concentration:**					**0.159**

Black Warrior Minerals, Inc.
Manchester East Mine
P-3922 Revision R-3
Basin 043
Soil Classification

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						
	ML				30	1		80.00

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 103.4 pcf Optimum moisture = 16.9 %	Silt with sand

Project No. **Client:** Black Warrior Minerals

Project: Basin 043

Date: 1-26-12

○ **Location:** B043 - Dam

PERC ENGINEERING CO., INC.

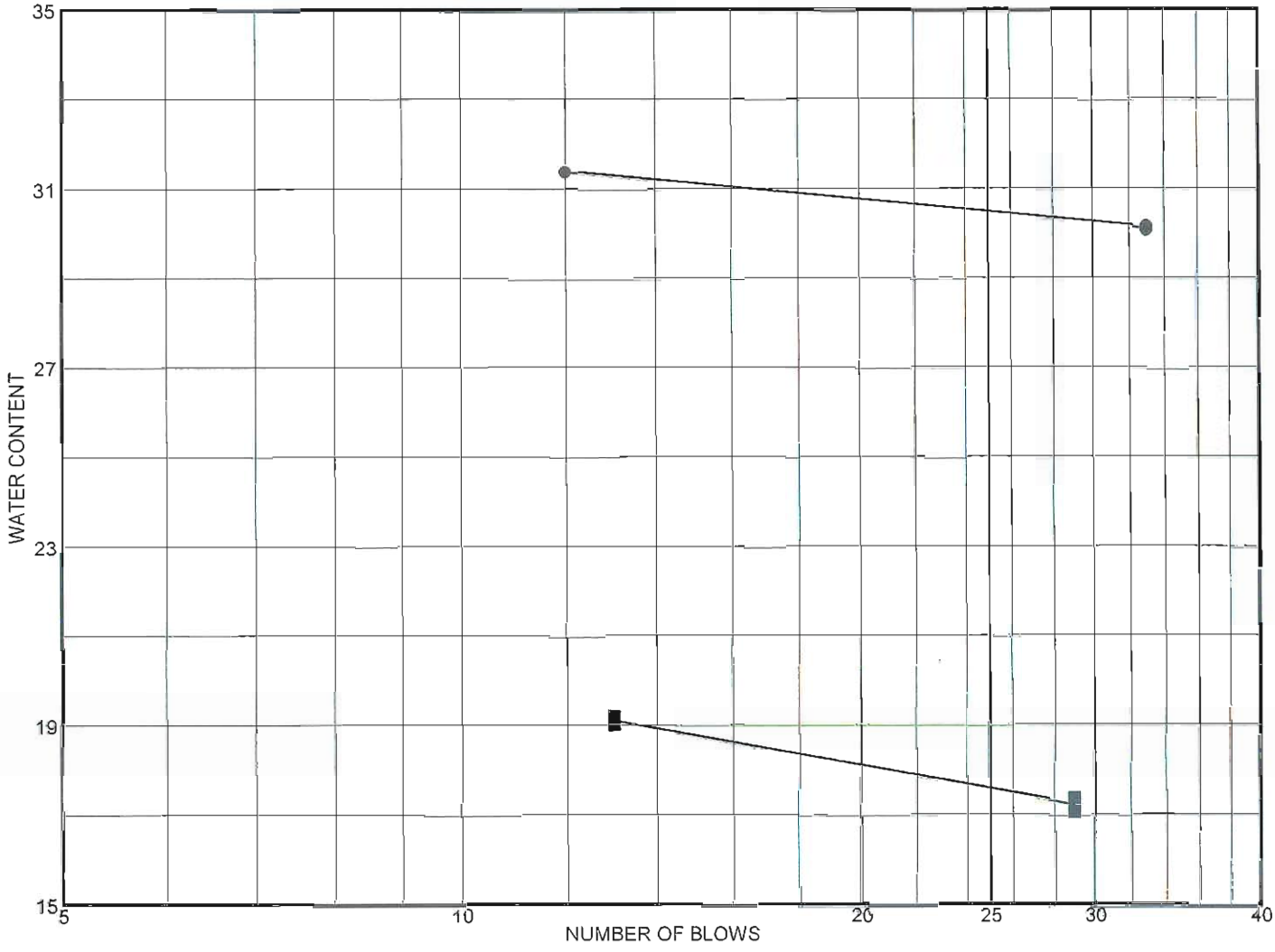
Jasper, Alabama

Remarks:

Date 1-30-12

Tested By: SWR **Checked By:** LS

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silt with sand	30	29	1	95.47	80.00	ML
■	Sandy silt	18	20	NP	98.26	61.27	ML

Project No. **Client:** Black Warrior Minerals

Project: Basin 043

Basin 043

● **Location:** B043 - Dam

■ **Location:** B043 - Foundation

Remarks:

●

■

PERC ENGINEERING CO., INC.

Jasper, Alabama

Date 1-30-12

Black Warrior Minerals, Inc.
Manchester East Mine
P-3922 Revision R-3
Basin 043
Stability Analysis

Black Warrior Minerals, Inc.
Manchester East Mine
P-3922 Revision R-3

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 and the foundation material for Basin 043 is (ML). The soil properties used in the stability analysis (ML) type soil, 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 043	ML	100.8	29.7	129.5
Foundation Basin 043	ML	100.8	29.7	129.5

*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 043 design height = 16.6 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
043	1.5

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.

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

Black Warrior Minerals Manchester East Mine P-3922 Basin 043

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 10.000 2 500.000 .000

On boundary line no. 2 Point no. and coordinates are:
1 200.000 9.500 2 300.000 7.500

On boundary line no. 3 Point no. and coordinates are:
1 .000 13.500 2 200.000 9.500 3 233.750 23.000

On boundary line no. 4 Point no. and coordinates are:
1 .000 23.000 2 233.750 23.000 3 241.500 26.100 4
253.500 26.100 5 289.925 11.530
6 300.000 7.500 7 500.000 3.500

Line no. and slope of each segment are:
1 -.020
2 -.020
3 -.020 .400
4 .000 .400 .000 -.400 -.400 -.020

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	29.700	129.500
2	100.800	29.700	129.500
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    23.000    2   233.750    23.000    3   256.775    18.660    4
289.925    11.530    5   300.000     7.500
    6   500.000     3.500

 point1=(   255.000,    47.000) point2=(   255.000,    27.000) point3=(
301.000,    27.000) NJ=    2 NI=    2
     Automatic search will follow after grid with XINC=    10.000 and YINC=
10.000

 At point (   255.000,    47.000) under seepage    1,the radius and the
corresponding factor of safety are:
         42.092     5.622         37.864     5.669         33.636     5.724
29.409     5.932         25.181     6.531
     Lowest factor of safety=     5.622 and occurs at radius  =     42.092


 At point (   255.000,    37.000) under seepage    1,the radius and the
corresponding factor of safety are:
         32.094     5.605         27.875     5.456         23.657     5.236
19.439     5.327         15.221     5.938
         26.469     5.374         25.063     5.260         22.251     5.240
20.845     5.229
     Lowest factor of safety=     5.229 and occurs at radius  =     20.845


 At point (   255.000,    27.000) under seepage    1,the radius and the
corresponding factor of safety are:
         22.096     5.986         17.955     5.709         13.814     5.858
9.674     6.381          5.533     6.406
         20.715     5.818         19.335     5.769         16.575     5.669
15.195     5.809
     Lowest factor of safety=     5.669 and occurs at radius  =     16.575


 At point (   278.000,    47.000) under seepage    1,the radius and the
corresponding factor of safety are:
         42.551     1.765         39.742     1.788         36.933     1.892
34.123     2.139         31.314     2.746
     Lowest factor of safety=     1.765 and occurs at radius  =     42.551


 At point (   278.000,    37.000) under seepage    1,the radius and the
corresponding factor of safety are:
         32.553     1.776         29.887     1.798         27.220     1.922
24.553     2.212         21.886     2.891
     Lowest factor of safety=     1.776 and occurs at radius  =     32.553
```

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 At point (   278.000,    27.000) under seepage    1,the radius and the
corresponding factor of safety are:
         22.555     2.000         20.031     2.056         17.507     2.179
14.983     2.462         12.459     3.188
     Lowest factor of safety=     2.000 and occurs at radius  =     22.555


 At point (   301.000,    47.000) under seepage    1,the radius and the
corresponding factor of safety are:
         43.011     2.009         41.818     2.071         40.625     2.206
39.432     2.339         38.239     3.727
     Lowest factor of safety=     2.009 and occurs at radius  =     43.011


 At point (   301.000,    37.000) under seepage    1,the radius and the
corresponding factor of safety are:
         33.013     2.206         31.963     2.275         30.913     2.431
29.862     2.773         28.812     3.910
     Lowest factor of safety=     2.206 and occurs at radius  =     33.013


 At point (   301.000,    27.000) under seepage    1,the radius and the
corresponding factor of safety are:
         23.015     2.559         22.108     2.658         21.200     2.863
20.292     3.336         19.384     4.259
     Lowest factor of safety=     2.559 and occurs at radius  =     23.015



 For piezometric line No.    1

 At point (   278.000,    47.000) ,RADIUS    42.551
     the minimum factor of safety is      1.765



 At point (   278.000,    47.000) under seepage    1,the radius and the
corresponding factor of safety are:
         42.551     1.765         39.742     1.788         36.933     1.892
34.123     2.139         31.314     2.746
     Lowest factor of safety=     1.765 and occurs at radius  =     42.551


 At point (   288.000,    47.000) under seepage    1,the radius and the
corresponding factor of safety are:
         42.751     1.547         40.645     1.592         38.538     1.746
36.431     2.088         34.325     3.065
     Lowest factor of safety=     1.547 and occurs at radius  =     42.751


 At point (   298.000,    47.000) under seepage    1,the radius and the
corresponding factor of safety are:
         42.951     1.794         41.548     1.825         40.144     1.917
38.740     2.222         37.336     3.466
     Lowest factor of safety=     1.794 and occurs at radius  =     42.951
```

```
 At point (   288.000,    57.000) under seepage    1,the radius and the
corresponding factor of safety are:
         52.749     1.574         50.500     1.590         48.251     1.730
46.002     2.067         43.752     2.944
     Lowest factor of safety=     1.574 and occurs at radius  =     52.749


 At point (   288.000,    37.000) under seepage    1,the radius and the
corresponding factor of safety are:
         32.753     1.589         30.789     1.644         28.825     1.799
26.861     2.126         24.897     3.155
     Lowest factor of safety=     1.589 and occurs at radius  =     32.753


 At point (   290.500,    47.000) under seepage    1,the radius and the
corresponding factor of safety are:
         42.801     1.561         40.870     1.591         38.940     1.746
37.009     2.100         35.078     3.148
     Lowest factor of safety=     1.561 and occurs at radius  =     42.801


 At point (   285.500,    47.000) under seepage    1,the radius and the
corresponding factor of safety are:
         42.701     1.558         40.419     1.610         38.137     1.755
35.854     2.089         33.572     2.965
     Lowest factor of safety=     1.558 and occurs at radius  =     42.701


 At point (   288.000,    49.500) under seepage    1,the radius and the
corresponding factor of safety are:
         45.251     1.546         43.109     1.586         40.966     1.738
38.824     2.081         36.682     3.034
     Lowest factor of safety=     1.546 and occurs at radius  =     45.251


 At point (   288.000,    52.000) under seepage    1,the radius and the
corresponding factor of safety are:
         47.750     1.549         45.572     1.583         43.394     1.731
41.216     2.075         39.039     3.002
     Lowest factor of safety=     1.549 and occurs at radius  =     47.750


 At point (   290.500,    49.500) under seepage    1,the radius and the
corresponding factor of safety are:
         45.301     1.557         43.334     1.585         41.368     1.739
39.401     2.094         37.434     3.130
     Lowest factor of safety=     1.557 and occurs at radius  =     45.301

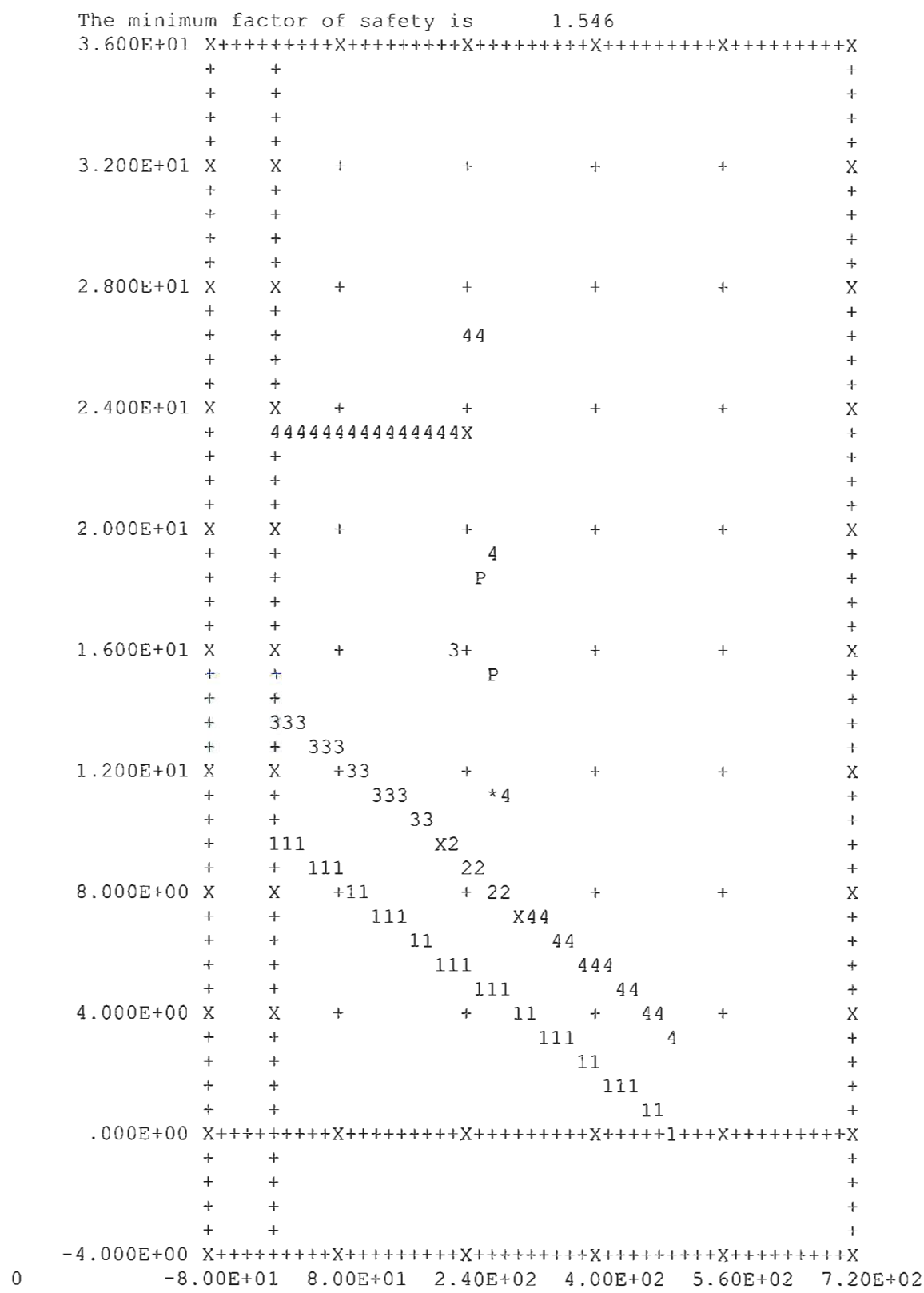

 At point (   285.500,    49.500) under seepage    1,the radius and the
corresponding factor of safety are:
         45.201     1.566         42.883     1.608         40.565     1.749
38.247     2.082         35.929     2.934
     Lowest factor of safety=     1.566 and occurs at radius  =     45.201
```

For piezometric line No. 1

At point (288.000, 49.500) ,RADIUS 45.251
the minimum factor of safety is 1.546

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 1.546
3.600E+01
3.200E+01
2.800E+01
2.400E+01
2.000E+01
1.600E+01
1.200E+01
8.000E+00
4.000E+00
.000E+00
-4.000E+00
0
-8.00E+01
8.00E+01
2.40E+02
4.00E+02
5.60E+02
7.20E+02