SECTION 50

BONDING

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SECTION 50

BONDING

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50-1	Reclamation Bond Schedule-not in Text
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SECTION 50

BONDING

LIST OF FIGURES

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SECTION 50

BONDING

LIST OF EXHIBITS

EXHIBIT NUMBER	EXHIBIT TITLE
50-1	Area 2 Hosteen Yazzie Area Post Mining
50-2	Area 2 Mason Barber Areas Post Mining
50-3	Area 3 Lowe Dixon Post Mining Configuration
50-4	Area 4N Post Mining Configuration
50-5	Area 1 Pinto Post Mining Configuration
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50-7	Area 2 Mason Barber South Bond Surface Configuration
50-8	Area 3 Lowe Dixon Bond Surface Configuration
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50-10	Area 1 Pinto Bond Surface Configuration
50-11	Area 2 Hosteen Yazzie Cut Fill Contours
50-12	Area 2 Mason Barber Cut Fill Contours
50-13	Area 3 Lowe Dixon Cut Fill Contours
50-14	Area 1 Pinto Cut Fill Contours
50-15	Area 2 Hosteen Yazzie Cut Fill Contours
50-16	Area 2 Mason Barber Cut Fill Contours
50-17	Open
50-18	Area 2 Hosteen Yazzie Topdressing Replacement
50-19	Area 4N Cut Fill Contours
50-20	Open
50-21	Area 2 Mason Barber Topdressing Replacement
50-22	Area 3 Lowe Dixon Topdressing Replacement
50-23	Area 2 Hosteen Yazzie Bond Spoil Mitigation
50-24	Area 2 Mason Barber Bond Spoil Mitigation
50-25	Area 3 Lowe Dixon Bond Spoil Mitigation
50-26	Area 4N Topsoil Replacement Bond
50-27	Area 4N Bond Spoil Mitigation
50-28	Area 1 Topdressing Replacement

50-29 Area 1Bond Spoil Mitigation

SECTION 50

BONDING

LIST OF APPENDICES

APPENDIX NUMBER	APPENDIX TITLE
50.A	Topography Channel Stabilization for Bond Reclamation Bond Scenario 2014

SECTION 50

BONDING

LIST OF REVISIONS DURING PERMIT TERM

REV. NUMBER	REVISION DESCRIPTION	DATE APPROVED

50 BONDING

50.1 Determination of Bond

The determination of the bond is an estimation of the maximum reclamation cost that the Regulatory Authority would incur in the event of bond forfeiture by Navajo Mine during the permit term ending in 2014. Areas bonded include those areas which will be disturbed in the process of recovering coal from the Permit Area and those facilities that support the mine. The following costs and procedures apply only for determining the bond dollar figure at year 2014 and are not necessarily meant to represent current or future operational practices. Direct costs are calculated in Worksheets 2 through 15 and are totaled in Worksheet 16 in Appendix 32.A. Indirect costs are applied as percentages of the direct cost in Worksheet 16 to achieve a total bond cost.

50.1.1 Maximum Reclamation Requirements

The point at which reclamation liabilities will be greatest occurs during the first year of the five-year term ending in 2014 (see Worksheet 1, Appendix 32.A). The open volume of North and South Barber are at the maximum during year 1. As Hosteen and Yazzie pits progress, the final pit associated continually decreases in length.

For the purposes of this calculation, the disturbed areas have been updated with aerial flight topography and merged with the bond post mining configuration. NTEC will evaluate, and adjust if necessary, the bond amount based on significant permit revisions, mid-term renewals, and permit renewal periods.

The amount of disturbance taking place during the permit term is primarily controlled by strip progression, which is shown on Exhibits 2-1 and 2-2.

Mining activities will continue in Dixon, Lowe, Barber, Hosteen and Yazzie pits. Additionally, a box-cut and strip progression will commence in Area 4 North as seen in Exhibit 2-2. Pinto pit will be reclaimed during the permit term. Consequently Areas 2 and 3 are the primary areas for reclamation during this permit term.

50.2 Reclamation Cost Estimate

50.2.1 Reclamation Costs

Reclamation costs are calculated as shown in Appendix 32.A, Worksheets 1 through 16. Reclamation liabilities for Permit Areas will occur in Areas 1, 2, 3, and 4. It is assumed that all final bond pits will progress as scheduled as noted in Exhibits 2-1 and 2-2 and will be stripped to their lowest recoverable coal seam. Reclamation activities will consist of the following:

1. Facility Demolition and Removal

2. Earthmoving
3. Revegetation
4. Miscellaneous

50.2.2 Earthmoving

A post-mining "snapshot" of each Area was projected for year 2014, as shown in the Bond Post-Mining Configuration (PMC) Maps, Exhibit 50-1, Exhibit 50-2, Exhibit 50-3, Exhibit 50-4, and Exhibit 50-5. The bond post mining configuration is the surface that represents the planned disturbance based on the current mine plan and has the existing disturbance area updated with aerial topography, which was designed using Earth Technology's 3D-Dig software.

To achieve Bond Final Surface Configuration (BSC) (Exhibits 50-6, Exhibit 50-7, Exhibit 50-8, Exhibit 50-9 and Exhibit 50-10), PMC topography in these areas was altered to create reclaimed surfaces. The BSC surfaces maintain 6.5h: 1v maximum final interior slopes, 4h: 1v maximum outslopes, minimize backfill volumes, and ensure positive drainage as similar as possible to the Final Surface Configurations' (FSC) drainage schemes, Exhibits 34-1 through 34-6.

The next design step was to subtract a computerized grid of the PMC from the BSC using Maptek's Vulcan software. The result is a Cut-Fill Contours map (Exhibit 50-11, Exhibit 50-12, Exhibit 50-13, and Exhibit 50-14) with the cut areas shown as red contours, and the fill areas shown as blue contours. The cut and fill areas are then subdivided into polygons and the cut and fills are balanced by taking extra cut to polygons that require fill. The result is the Cut-Fill Blocks map (Exhibit 50-15, Exhibit 50-16, Exhibit 50-17, Exhibit 50-18, Exhibit 50-19 and Exhibit 50-20).

The Vulcan software gives the volume and centroid of each block. The centroids are used to calculate haulage distances and grades, except in the case of deep pits and ramps where haulage is assumed to be to the crest where the material can be pushed over the edge. The haulage profiles and grades are weight averaged by volume to give an average distance and grade for each equipment type for each of Areas 2 and 3.

All bond earthmoving activities are tabulated in Worksheet 3 as follows:

- Worksheet 3A Dozers
- Worksheet 3B Trucks and Loaders
- Worksheet 3C Scrapers
- Worksheet 3D Graders
- Worksheet 3E Drilling and Blasting of Highwalls

Quantities from these worksheets are used as input to Worksheets 5 through 12 where equipment hours are calculated. Worksheet 13 uses these hours to calculate earthmoving costs. The earthmoving costs are totaled in Worksheet 16, Item 2 (see Figure 12-B-1, Worksheet Flow). In addition to regrade activities, earthmoving includes spoil mitigation, topsoil placement, and concrete disposal.

Once regrading and/or facilities removal activities have been completed in an area, required suitable root zone mitigation and/or topsoil material is placed on these areas. The Industrial Complexes will support all bond activities and will be reclaimed as near to the end of the project as possible.

Suitable spoil and regolith/topdressing material (either stockpiled or in situ) is used to complete the four (4) feet suitable root zone material requirements on spoil surfaces. Stockpiled and/or in-situ regolith/topdressing material is used to complete the topsoil and regolith depth requirement on all reclaimed surfaces as outlined in Table 36-1, (Exhibit 50-18 and Exhibit 50-21, Exhibit 50-22, Exhibit 50-23, Exhibit 50-24, Exhibit 50-25, Exhibit 50-26, Exhibit 50-27, Exhibit 50-28, and Exhibit 50-29).

50.2.2.1 Equipment Selection

Large earthmoving equipment was selected assuming that a large contractor will be doing the reclamation work using their own equipment.

50.2.2.2 Equipment Productivity and Costs

Reclamation activities will take place with a 20-shift per week schedule. Equipment ownership and operating costs are tabulated in Table 12-B-23 taken from CRG-PRIMEDIA Equipment watch, "Cost Reference Guide for Construction Equipment", 1st half - 2009 Edition. Equipment operator wage rates are listed in Table 12-B-24 and were taken from the ACME Inc. Navajo Mine reclamation contract in force for 2008. The wage rates found in the aforementioned Table are greater than suggested wage rates provided by the Office of Navajo Labor Relations, as well as wages found for contracts for similar labor in Davis-Bacon data (1993). To model a conservative approach, the wage rates from the previous Bond calculation (higher than such found labor rates) were unchanged and used for calculation in the total bond cost.

For haul routes greater than 500 ft, scrapers are more economical than dozers. For haul routes greater than 3,000 ft, dump trucks are more economical than scrapers. Dozers are assumed to work alone with no support equipment other than a lowboy for transport. Truck fleets require load and dump dozers, and half-time water truck and grader for haul road maintenance. Scraper fleets require one-eighth time water truck and grader for haul road maintenance. All fleets are assigned light plants for night work. Fuel and lube trucks are included in the fuel costs (TABLE 12-B-23).

Productivities for each particular activity are calculated in Worksheets 5 through 12 (Appendix 32.A) using the material properties and haulage profile pertaining to the task.

50.2.2.3 Area 1

Earthmoving activities for Area 1 will consist of those required for facilities reclamation. During the permit term, Pinto Pit will be completely regraded according to the Area 1 Final Surface Configuration, Exhibit 34-2.

Stockpiled topsoil will be placed on disturbed areas at a depth of 8.7 inches, as outlined in Table 36-1 with 5 percent spoil mitigation. Exhibit 50-5, Exhibit 50-10, Exhibit 50-14, Exhibit 50-20, Exhibit 50-28 and Exhibit 50-29 detail the reclamation plan for Area 1.

50.2.2.4 Area 2

Ramps and pits are used as drainages and spoil material is hauled from South Barber, North Barber, and Hosteen pit and overlook to backfill open pits. In South Barber, CCB may be used to backfill the final pit as a means of contingency for the Four Corners Power Plant CCB disposal. Yazzie Pit requires additional material from the Big Fill railroad embankment and Hosteen for pit backfill. Earthmoving costs for fill material required to develop positive drainage in Permit lands is not included in the bond. Cut and Fill contours for Area 2 are shown on Exhibits 50-11 and Exhibit 50-12. Area 2 regrade material movement is shown on Exhibit 50-15 and Exhibit 50-16.

Material to achieve the required four (4) feet of suitable root zone material/topdressing is available in stockpiled and in-situ reserves within Area 2. Additional material will be hauled as needed from Regolith stockpile(s) in Area 3.

The suitable rootzone and topsoil movement consists of the mitigation of four (4) feet of suitable rootzone material over 2 percent of the surface area, with this four (4) foot total inclusive of the required 5.6 inches of topsoil as outlined in Table 36-1.

Area 2 suitable rootzone material movement is shown on Exhibit 50-23 and Exhibit 50-24.

Topsoil required to achieve the 5.6 inch depth is placed over the remaining (unmitigated) disturbed surfaces in Area 2. This is available in stockpile and in-situ reserves. Area 2 topdressing material movement is shown on Exhibit 50-18 and Exhibit 50-21.

50.2.2.5 Area 3

Generally, ramps and pits are used as drainages, spoil material is required from the Dixon Pit area for pit backfill in North Lowe, and Lowe boxcut material is graded to the west. Calculations for material movement and scheduling were performed without the inclusion of Dixon Box-cut Exchange. Pending negotiations with the Navajo Nation, an update will be submitted including the Dixon Box-cut Exchange.

As seen in Exhibit 50-3, a considerable volume of material is to be pre-stripped, or truck stripped, before dragline progression into strip DX74. For calculation purposes, this pre-strip volume was removed from the Post Mining Configuration and added to balance the Bond Surface Configuration (BSC) using Microsoft Excel. The pre-strip volume is accounted for in spreadsheet calculations: however, the cut block "Dixon PS" is not shown in exhibits.

Cut and Fill contours for Area 3 are shown on Exhibits 50-13. Area 3 regrade material movement is shown on Exhibit 50-17.

Area 3 topdressing and spoil mitigation material movement required to achieve four (4) feet of rootzone (including 9.7 inches of topsoil) is shown on Exhibit 50-22 and Exhibit 50-25. As with Areas 1 and 2 it is assumed that 10.8 percent of the disturbed surface areas will require mitigation. The remaining surface areas will receive only the 9.7 inches of topdressing.

50.2.2.6 Area 4

Ramps and pits are used as drainages and spoil material is used to backfill designed open pits and ramps using dozer and front end loader operations. Cut and Fill contours for Area 4 North are shown on Exhibit 50-19. Area 4 North regrade material movement is shown on Exhibit 50-19.

Material to achieve the required four (4) feet of suitable root zone material/topdressing is available in stockpile reserves in southern Area 3. It should be noted that in realistic scenarios, NTEC will remove topsoil material prior to mining, and stockpile such materials for use in reclamation activities. The Bond calculations however, represent a "Worst Case Scenario", where NTEC strips without removing topsoil material. In this "Worst Case Scenario", topsoil would be hauled using trucks from Area 3.

The suitable rootzone and topsoil movement consists of the mitigation of four (4) feet of suitable rootzone material over 10.8 percent of the surface area, with this four (4) foot total inclusive of the required 5.7 inches of topsoil as outlined in Table 36-1.

Area 4 North suitable rootzone material movement is shown on Exhibit 50-27. Topsoil required to achieve the 5.7 inch depth is placed over the remaining (unmitigated) disturbed surfaces in Area 4 North. This is

available in stockpile reserves in Area 3. Area 4 North topdressing material movement is shown on Exhibit 50-19. It should be noted that in realistic scenarios, NTEC will remove regolith material prior to mining, and stockpile such material for use in reclamation activities. The Bond calculations however, represent a "Worst Case Scenario", where NTEC strips without removing regolith material. In this "Worst Case Scenario", mitigation material would be hauled using trucks from Area 3.

50.2.3 Revegetation

After backfilling the pits and ramps the bonded areas will be graded with graders and then these areas and facilities areas will be topsoiled as noted in previous sections. After topsoiling, revegetation activities will initiate. This involves seeding, crimping, mulching and irrigation. Costs are noted on Appendix 32.A, Worksheet 14(A-C).

50.2.4 Miscellaneous

A cost estimate for the riprap necessary to stabilize the reestablished drainage channels associated with the Bond Reclamation Topography was developed in Appendix 50.A. Channel dimensions, riprap sizes and riprap quantities were determined for channel reaches at the mine. Hydrology and channel designs are based on procedures outlined in Reclamation Surface Stabilization Design Handbook for the Navajo Mine (1999).

50.2.5 Indirect Reclamation Costs

Mobilization and demobilization costs are assumed to be 1% of the direct costs, since the reclamation project would be very large. Contingencies are 2% of the direct costs; the engineering redesign fee, the contractor profit and overhead, and the reclamation fee are set at 1.8%, 15.0% and 3.9% of direct costs respectively, per discussed agreement with OSM staff.

50.2.6 Total Performance Bond Cost

The total performance bond cost is the sum of the direct and indirect costs and is shown in Worksheet 16, Appendix 32.A.

References

BHP Minerals - Navajo Mine. 1992. Reclamation Surface Stabilization Handbook.

Davis-Bacon. 1993. Wage Rates. U.S., Department of Labor, Superintendent of Documents, Government Printing Office, Washington, DC.

Table 50-1 Reclamation Bond Summary

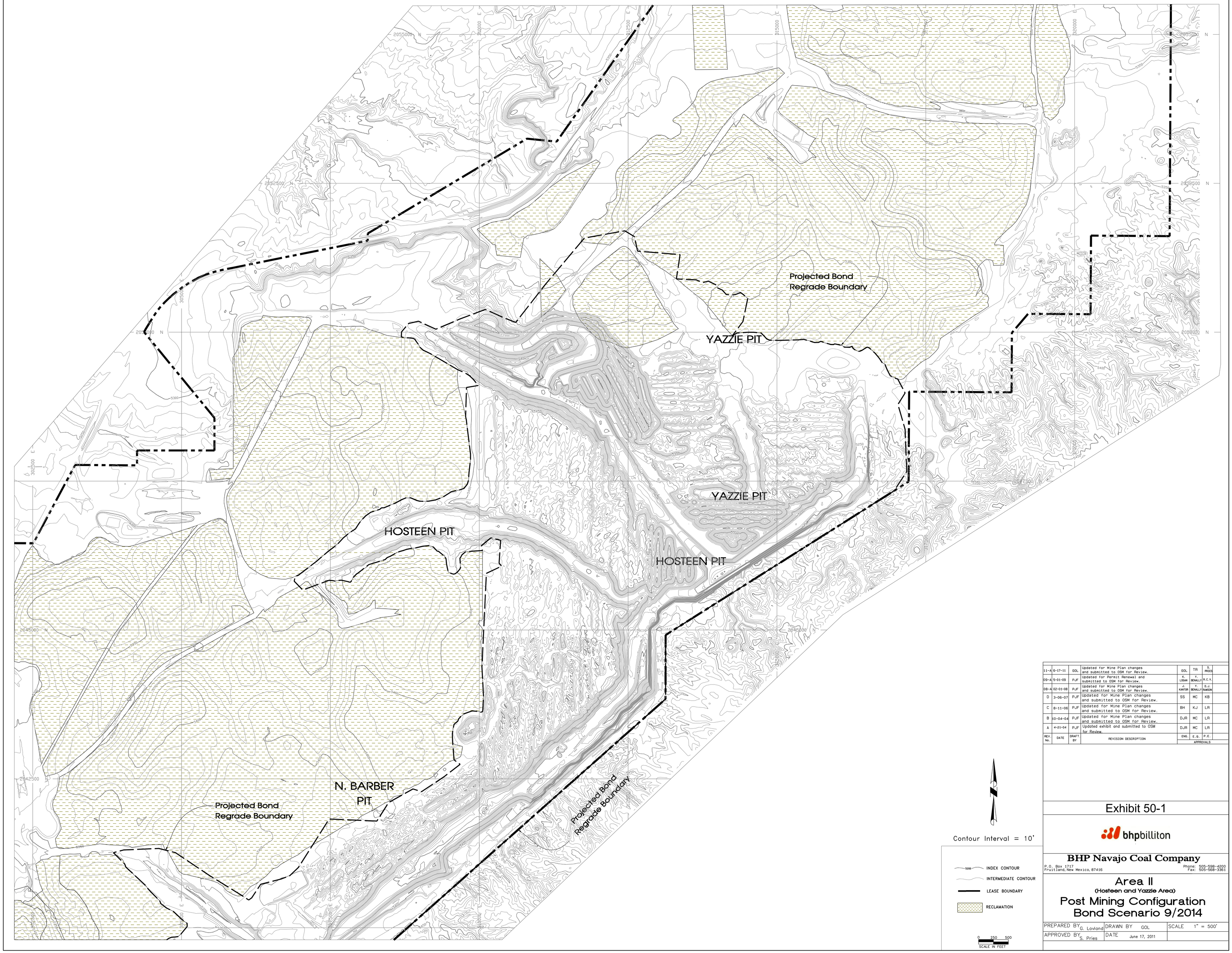
Item	Source	Amount
Total Facility and Structure Removal	Appendix 32.A Worksheet 2	$ 6,122,910
Total Earthmoving Costs	Appendix 32.A Worksheet 13	$104,470,964
Total Revegetation Costs	Appendix 32.A Worksheet 14	$ 14,272,846
Total Other Reclamation Activities Costs	Appendix 32.A Worksheet 15	$ 2,333,203
Subtotal: Direct Costs		**$127,199,924**
Mobilization and Demobilization	1.00%	$ 1,271,999
Contingencies	2.00%	$ 2,543,998
Engineering Redesign Fee	1.80%	$ 2,289,599
Contractor Profit and Overhead	15.00%	$ 19,079,989
Reclamation Management Fee	3.90%	$ 4,960,797
Subtotal: Indirect Costs		**$ 30,146,382**
Grand Total Bond Amount		**$157,346,306**

[1]Bond summary information can also be found in Appendix 32.A Worksheet No. 16 and Appendix 50.A.

Table 50-2 Reclamation Bond Adjustment Summary

Item #	Item	OSM Project ID	ADJ Sum [1]	ADJ Amount
1	Bond Cost Estimate in Approved PAP (Permit Renewal)	NM0003F	1, 2	$157,346,306
				$157,346,306

[1] The BHP initial reclamation bond adjustments summary sheets and worksheets are found in Appendix 32.A.
[2] Section 50 and Appendix 32.A established the base reclamation cost estimate in the permit renewal application.



REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.G.	P.E.
11-A	6-17-11	GOL	Updated for Mine Plan changes and submitted to OSM for Review.	GOL	TR	S. PRIES
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	K. LOGAN	Y. BENALLY	R.C.V.
08-A	02-01-08	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	J. KANTOR	Y. BENALLY	D.J. RAMON
D	3-06-07	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	SS	MC	KB
C	8-11-06	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	BH	KJ	LR
B	10-04-04	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	DJR	MC	LR
A	4-21-04	PJF	Updated exhibit and submitted to OSM for Review.	DJR	MC	LR
					APPROVALS	

Exhibit 50-1

bhpbilliton

BHP Navajo Coal Company

P.O. Box 1717
Fruitland, New Mexico, 87416

Phone: 505-598-4200
Fax: 505-568-3361

Area II

(Hosteen and Yazzie Area)

Post Mining Configuration Bond Scenario 9/2014

PREPARED BY G. Lovland	DRAWN BY GOL	SCALE 1" = 500'
APPROVED BY S. Pries	DATE June 17, 2011	

HOSTEEN PIT

N. BARBER PIT

S. BARBER PIT

Projected Bond Regrade Boundary

Projected Bond Regrade Boundary

Projected Bond Regrade Boundary

Contour Interval = 10'

LEGEND

- INDEX CONTOUR
- INTERMEDIATE CONTOUR
- LEASE BOUNDARY
- RECLAMATION

0 250 500
SCALE IN FEET

REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.G.	P.E.
				APPROVALS		
11-A	6-17-11	GOL	Updated for Mine Plan changes and submitted to OSM for Review.	GOL	TR	S. PRIES
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	K. LOGAN	T. BENALLY	R.C.V.
08-A	02-01-08	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	J. KANTOR	T. BENALLY	D.J. RANSON
D	3-06-07	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	SS	MC	KB
C	8-11-06	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	BH	KJ	LR
B	10-04-04	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	DJR	MC	LR
A	4-21-04	PJF	Updated exhibit and submitted to OSM for Review.	DJR	MC	LR

Exhibit 50-2

bhpbilliton

BHP Navajo Coal Company

P.O. Box 1717
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Fax: 505-568-3361

Area II

(Mason and Barber Area)

Post Mining Configuration Bond Scenario 9/2014

PREPARED BY G. Lovland	DRAWN BY GOL	SCALE 1" = 500'
APPROVED BY S. Pries	DATE June 17, 2011	

Exhibit 50-3

bhpbilliton

BHP Navajo Coal Company

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Fruitland, New Mexico, 87416
Phone: 505-598-4200
Fax: 505-568-3361

Area III
(Lowe/Dixon Area)
Post Mining Configuration
Bond Scenario 9/2014

PREPARED BY G. Lovland	DRAWN BY GOL	SCALE 1" = 500'
APPROVED BY S. Pries	DATE June 17, 2011	

Original Certified signed exhibits are maintained at the Mine Site and OSM

REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.Q.	P.E.
11-A	6-17-11	GOL	Updated exhibit and submitted OSM for Review.	GOL	TR	S. Pries
09-B	7-12-09	PJF	ADDED 1BR EASTSIDE OF LOWE PIT AND SUBMITTED TO OSM FOR REVIEW.	KA/ SSmith	YB	KAB
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	K. Logan	Y. Benally	R.C.V
08-A	09-05-08	PJF	Updated exhibit and submitted OSM for Review.	BH/ KL	YB	RCVV
A	4-21-04	PJF	Updated exhibit and submitted OSM for Review.	DJR	MC	LR

APPROVALS

LEGEND

- INDEX CONTOUR
- INTERMEDIATE CONTOUR
- LEASE BOUNDARY
- TOPSOIL REMOVAL
- RECLAMATION

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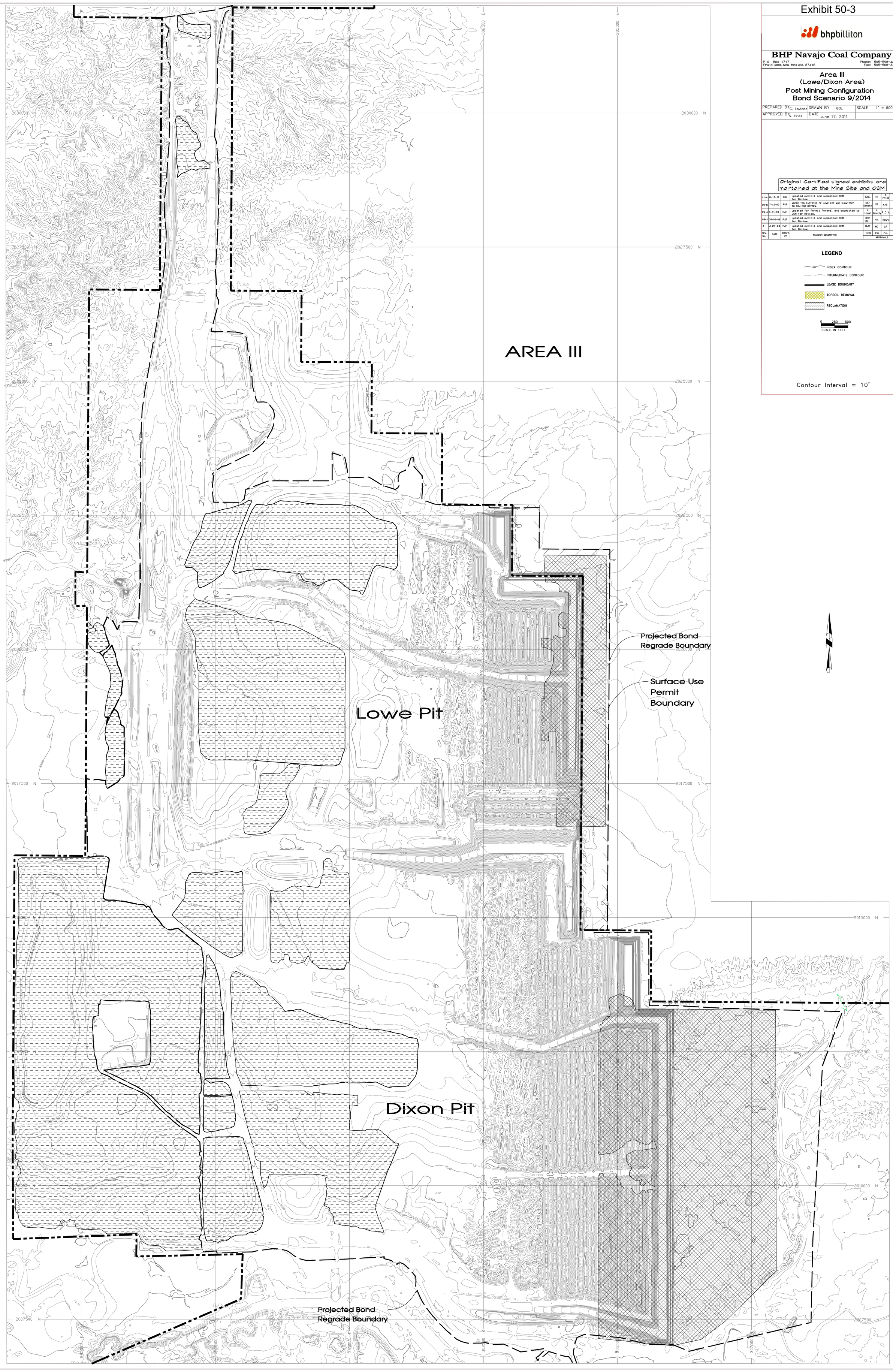
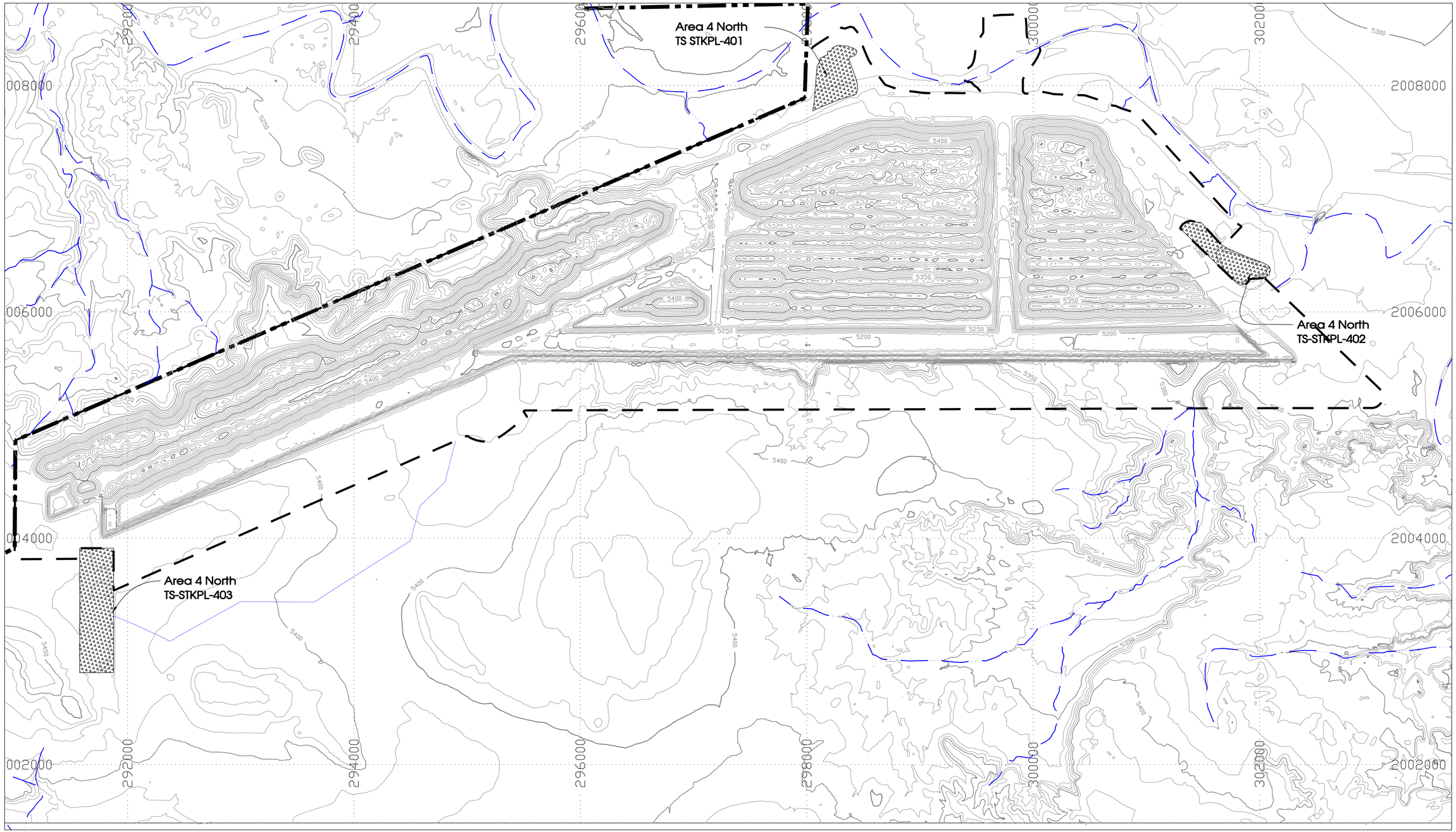
SCALE IN FEET

Contour Interval = 10'





LOCATION MAP

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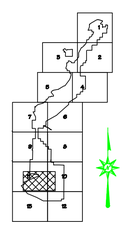


LEGEND

- 5300 — INDEX CONTOUR (50 Ft.)
- INTERMEDIATE CONTOUR (10 Ft.)
- LEASE BOUNDARY
- TOPSOIL REMOVAL
- DRAINAGE PATTERNS

REVISION		DATE
Submitted to CDR for Review	1	Oct. 27, 2004
Updated for Permit Revision and Submitted to CDR for Review.	2	May 15, 2009
Updated for Permit Revision and submitted	3	April 01, 2011

PROJECT MANAGER: George Loveland
CHAR. of RECORD: Stephen Pries
REG. NO: 20425

PROJECT: AAN Permitting
DATE:
DESIGNED BY: Fred Busche
DRAWN BY: Fred Busche
CHECKED BY: George Loveland
APPROVED BY: Stephen Pries

bhpbilliton

BHP NAVAJO COAL COMPANY
NAVAJO MINE

PO BOX 1717, FRUITLAND, NEW MEXICO, 87416 / PHONE 505-598-4200/FAX 505-598-3361

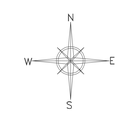
LOCATION MAP

Exhibit 50-4 AREA-4N

POST-MINE CONFIGURATION
BOND SCENARIO 9/2014

DRAWING

SHEET 0
OF 0



5200 INDEX CONTOUR

INTERMEDIATE CONTOUR

LEASE BOUNDARY

-1000 -500 0 500 1000

Scale: 1" = 500'

Contour Interval = 10'

REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.G.	P.E.
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	F. GORMAN	Y. BENALLY	R.C.V.
B	9-26-06	PJF	Updated Mine Plan changes. Pinto Pit with June 2006 aerial flight and submitted to OSM for Review.	BH	KJ	LR
A	4-21-04	PJF	Updated exhibit and submitted to OSM for Review.	DJR	MC	LR

APPROVALS

CERTIFICATION STATEMENT

I, Ron C. Van Valkenburg, hereby certify that this drawing has reviewed by me and that the information shown is complete and accurate to the best of my knowledge.

RON C. VAN VALKENBURG NEW MEXICO 9263 LICENSED PROFESSIONAL ENGINEER

EXHIBIT 50-5

BHP NAVAJO COAL COMPANY

NAVAJO MINE

P.O. BOX 1717 FRUITLAND, NEW MEXICO 87416

Area I
(Pinto Area)
Post Mining Configuration
Bond Scenario 9/2014

PREPARED BY F.Gorman	DRAWN BY PJF	SCALE 1" = 500'
APPROVED BY	DATE May 01, 2009	

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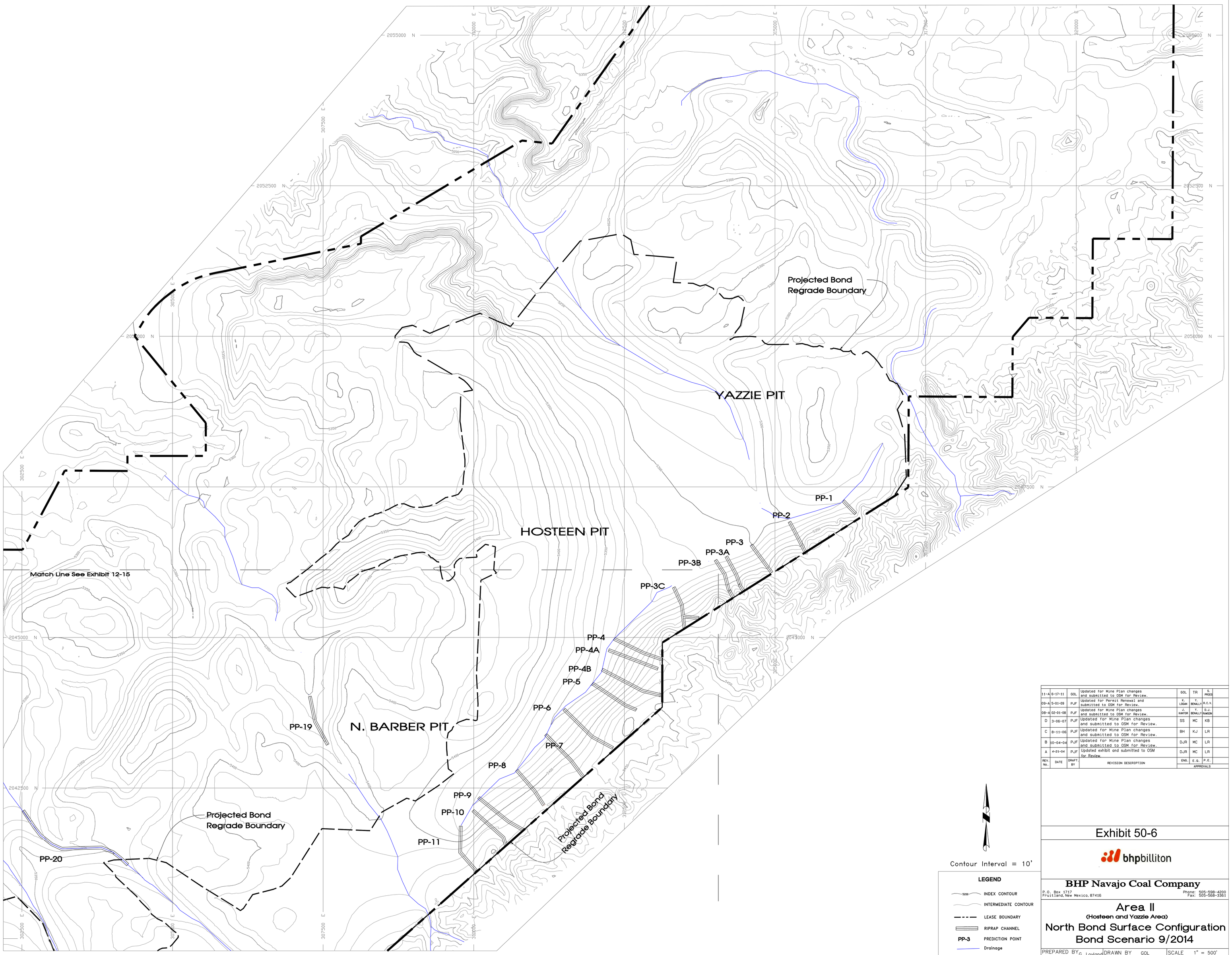
Fri Apr 24 10:47:37 2009



REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.G.	P.E.
11-A	6-17-11	GOL	Updated for Mine Plan changes and submitted to OSM for Review.	GOL	TR	S. PRIES
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	K. LOGAN	Y. BENALLY	R.C.V.
08-A	02-01-08	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	J. KANTOR	Y. BENALLY	D.J. RAMSON
D	3-06-07	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	SS	MC	KB
C	8-11-06	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	BH	KJ	LR
B	10-04-04	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	DJR	MC	LR
A	4-21-04	PJF	Updated exhibit and submitted to OSM for Review.	DJR	MC	LR

APPROVALS

Exhibit 50-6

bhpbilliton

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Area II

(Hosteen and Yazzie Area)

North Bond Surface Configuration
Bond Scenario 9/2014

PREPARED BY G. Lovland	DRAWN BY GOL	SCALE 1" = 500'
APPROVED BY S. Pries	DATE June 17, 2011	

N. BARBER PIT

S. BARBER PIT

Projected Bond Regrade Boundary

Projected Bond Regrade Boundary

PP-3A
PP-3B
PP-3C
PP-4
PP-4A
PP-4B
PP-5
PP-6
PP-7
PP-8
PP-9
PP-10
PP-11
PP-14
PP-15
PP-16
PP-18
PP-19
PP-20

Match Line See Exhibit 12-14

Contour Interval = 10'

LEGEND

- INDEX CONTOUR
- INTERMEDIATE CONTOUR
- LEASE BOUNDARY
- RIPRAP CHANNEL
- PP-13 PREDICTION POINT
- Drainage

0 250 500
SCALE IN FEET

REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.G.	P.E.
11-A	6-17-11	GOL	Updated for Mine Plan changes and submitted to OSM for Review.	GOL	TR	S. PRIES
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	A LOGAN	A BENALLY	R.C.Y.
08-A	02-01-08	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	J. KANTOR	Y. BENALLY	D.J. RAMON
D	3-06-07	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	SS	MC	KB
C	8-11-06	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	BH	KJ	LR
B	10-04-04	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	DJR	MC	LR
A	4-21-04	PJF	Updated exhibit and submitted to OSM for Review.	DJR	MC	LR

APPROVALS

Exhibit 50-7

bhpbilliton

BHP Navajo Coal Company

P.O. Box 1717
Fruitland, New Mexico, 87416

Phone: 505-598-4200
Fax: 505-568-3361

Area II

(Mason and Barber Area)

South Bond Surface Configuration
Bond Scenario 9/2014

PREPARED BY C. Loviano	DRAWN BY GOL	SCALE 1" = 500'
APPROVED BY S. Pries	DATE June 17, 2011	

Exhibit 50-8

bhpbilliton

BHP Navajo Coal Company

P.O. Box 1717
Fruitland, New Mexico, 87416
Phone: 505-598-4200
Fax: 505-568-3361

Area III
(Lowe/Dixon Area)
Bond Surface Configuration
Bond Scenario 9/2014

PREPARED BY G. Lovland	DRAWN BY GOL	SCALE 1" = 500'	
APPROVED BY S. Pries	DATE June 17, 2011		

Original Certified signed exhibits are maintained at the Mine Site and OSM

REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.Q.	P.E.
11-A	6-17-11	GOL	Updated exhibit and submitted OSM for Review.	GOL	TR	S. Pries
09-B	7-12-09	PJF	ADDED IBR EASTSIDE OF LOWE PIT AND SUBMITTED TO OSM FOR REVIEW.	KA/ SSmith	YB	KAB
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	K. Logan	Y. Benally	R.C.Y
08-A	09-05-08	PJF	Updated exhibit and submitted OSM for Review.	BH/ KL	YB	RCVV
A	4-21-04	PJF	Updated exhibit and submitted OSM for Review.	DJR	MC	LR

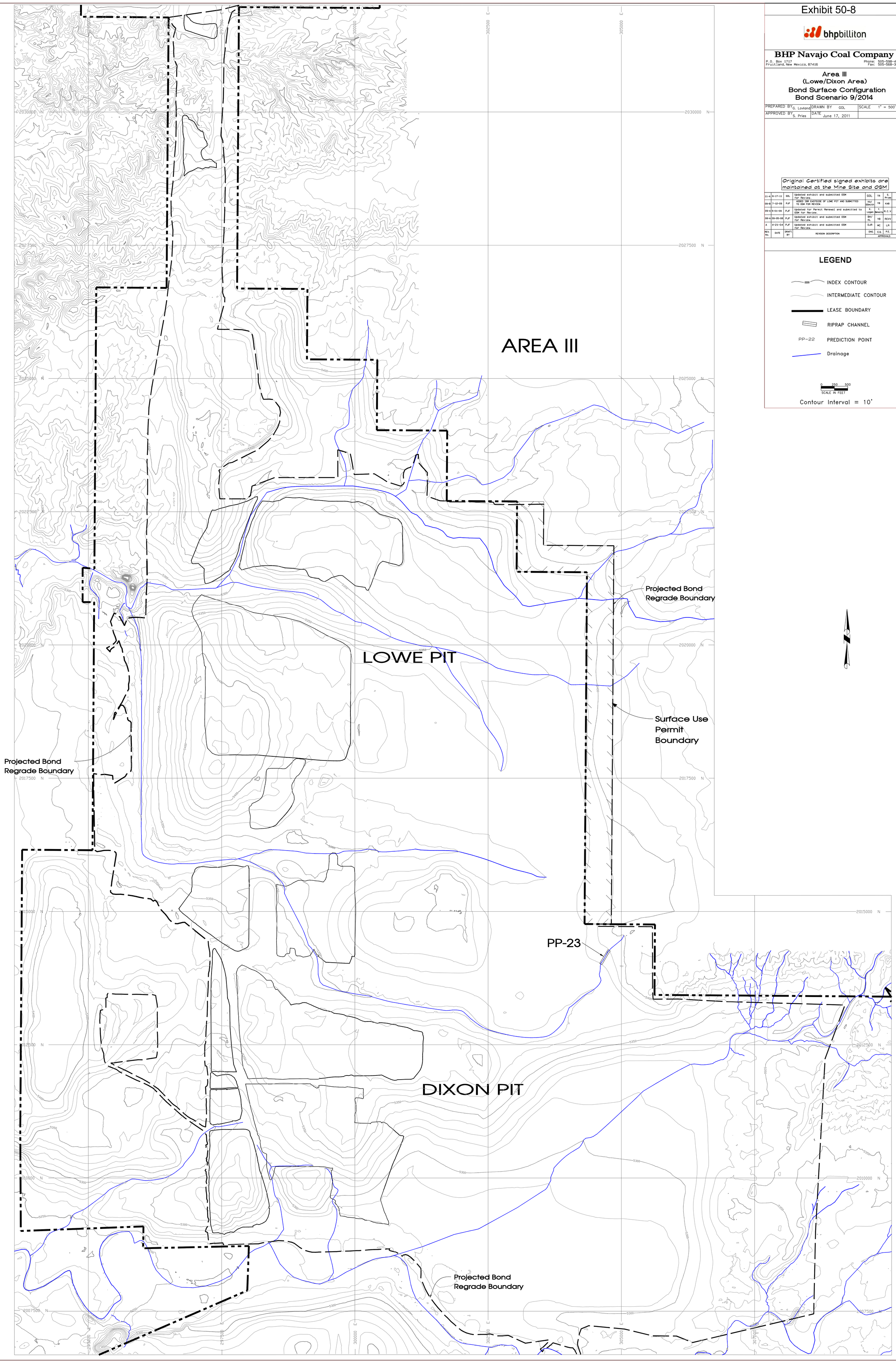
APPROVALS

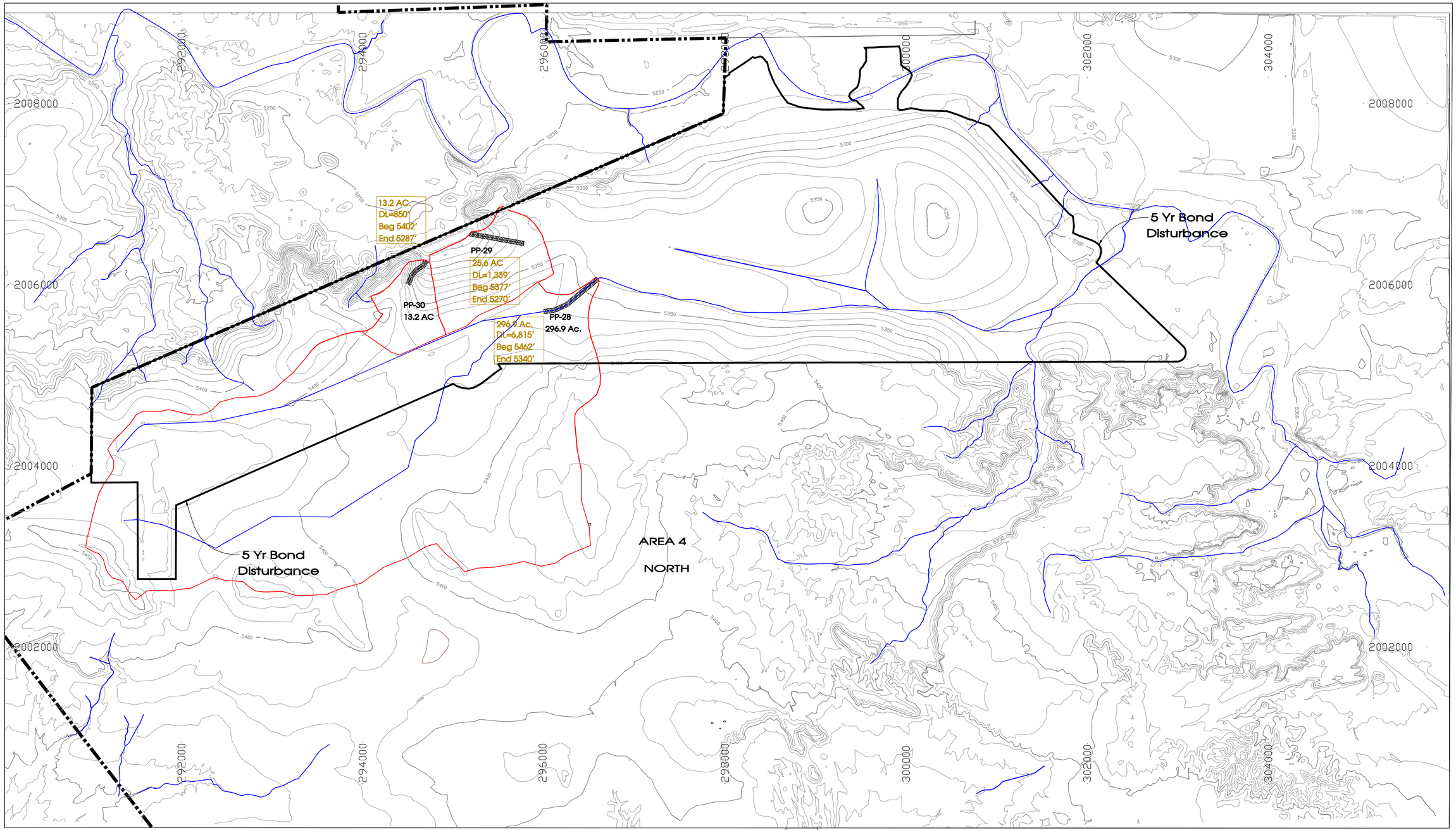
LEGEND

- INDEX CONTOUR
- INTERMEDIATE CONTOUR
- LEASE BOUNDARY
- RIPRAP CHANNEL
- PP-22 PREDICTION POINT
- Drainage

0 250 500
SCALE IN FEET

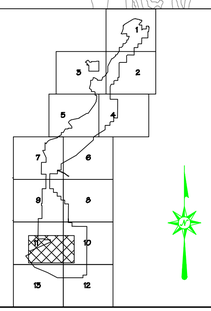
Contour Interval = 10'





LOCATION MAP

SCALE: 1" = 500'



LEGEND

- 5300 — INDEX CONTOUR (50 Ft)
- INTERMEDIATE CONTOUR (10 Ft)
- LEASE BOUNDARY
- RIP-RAP CHANNEL
- PP-3 — PREDICTION POINT
- WATERSHED BOUNDARIES
- DRAINAGE PATTERNS

REVISION		DATE
1	Submitted to OSM for Review.	Oct.12.2004
2	Updated for Permit Renewal and Submitted to OSM for Review.	Nov.01.2009
3	Updated for Permit Revision and submitted to OSM for Review.	April 01,2011

PROJECT MANAGER: George Loveland
CHIEF of RECORD: Stephen Pries
REG. NO: 20425
SHVIN of RECORD:
REG. NO:

PROJECT: AM Permitting
DATE:
DESIGNED BY: Fred Busche
DRAWN BY: Fred Busche
CHECKED BY: George Loveland
APPROVED BY: Stephen Pries

bhpbilliton

BHP NAVAJO COAL COMPANY
NAVAJO MINE

PO BOX 1717, FRUITLAND, NEW MEXICO, 87416 / PHONE 505-598-4200/FAX 505-598-3361

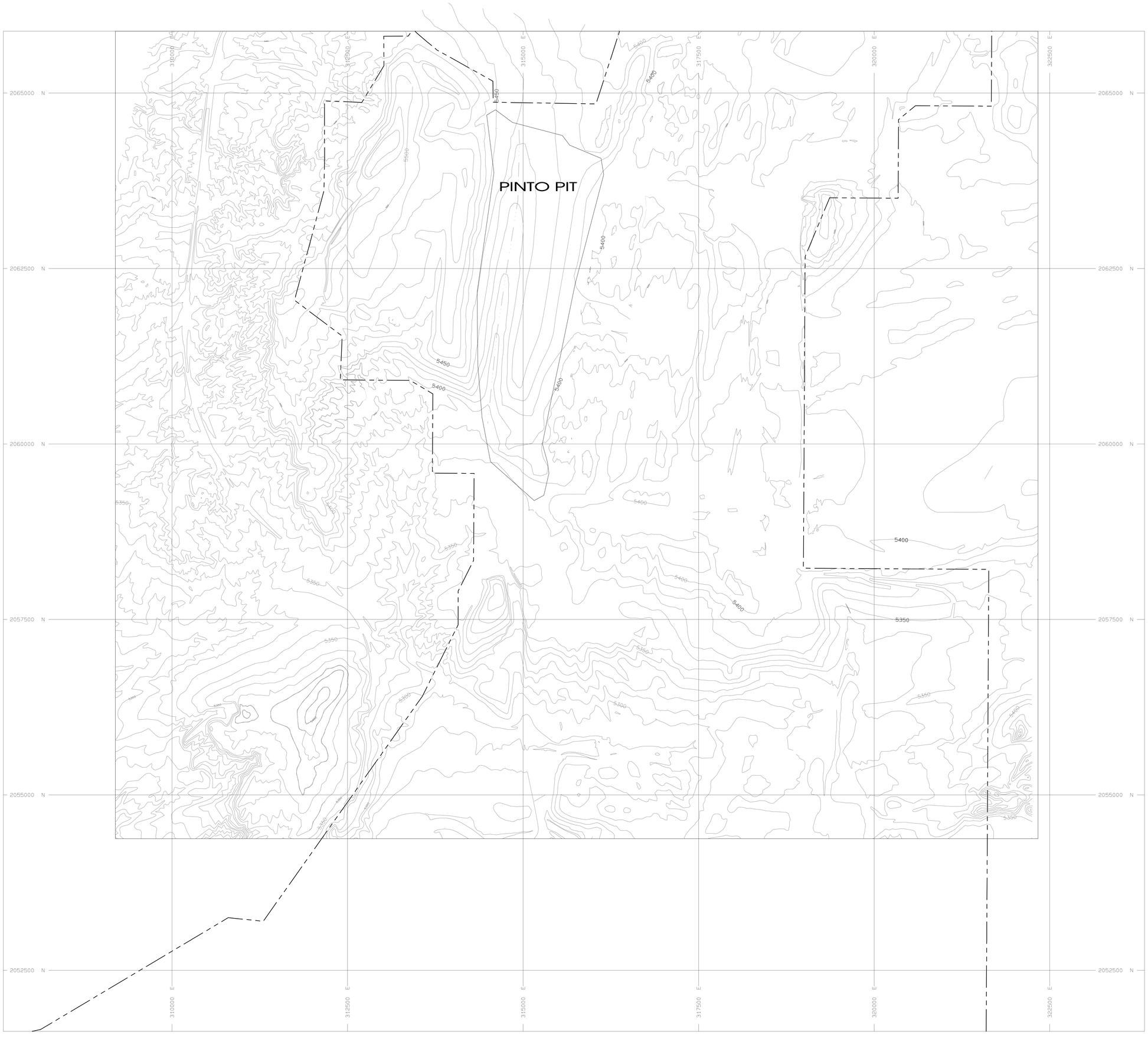
LOCATION MAP

Exhibit 50-9 AREA-4N

BOND SURFACE CONFIGURATION
AND DROP STRUCTURE
W/WATERSHED BOUNDARY
BOND SCENARIO 9/2014

DRAWING

SHEET 0
OF 0



N
W E
S

5200 CUT CONTOUR

FILL CONTOUR

LEASE BOUNDARY

-1000 -500 0 500 1000

Scale: 1" = 500'

Contour Interval = 10'

REV. NO.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.G.	P.E.
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	K. LOGAN	Y. BENALLY	R.C.V.
C	1-11-07	PJF	REVISED PINTO PSC, REMOVED RP-32 AND SUBMITTED TO OSM FOR REVIEW AND APPROVAL.	LR	KJ	LR
B	9-26-06	PJF	Updated Mine Plan changes, and submitted to OSM for Review.	BH	KJ	LR
A	4-21-04	PJF	Updated exhibit and submitted to OSM for Review.	DJR	MC	LR

APPROVALS

CERTIFICATION STATEMENT

I, Ron C. Van Valkenburg, hereby certify that this drawing was reviewed by me and that the information shown is complete and accurate to the best of my knowledge.

RON C. VAN VALKENBURG
NEW MEXICO
9263
LICENSED PROFESSIONAL ENGINEER

EXHIBIT 50-10

BHP NAVAJO COAL COMPANY

NAVAJO MINE
SAFETY PEOPLE PRIDE

P.O. BOX 1717 FRUITLAND, NEW MEXICO 87416

Area I
(Pinto Area)
Bond Surface Configuration
Bond Scenario 9/2014

PREPARED BY F.Gorman	DRAWN BY PJF	SCALE 1" = 500'
APPROVED BY	DATE May 01, 2009	

G:\Departments\Ge\OSM_SUBM\PER_PROG\CH_12_PAP EXHIBITS\BOND-2009\A1 BOND DATA\R9-EXH_12-40_BSC.pro
PJFOSTER Fri Apr 24 10:57:29 2009

YAZZIE PIT

Projected Bond
Regrade Boundary

HOSTEEN PIT

HOSTEEN PIT

Match Line See Exhibit 12-18

N. BARBER
PIT

Projected Bond
Regrade Boundary

Projected Bond
Regrade Boundary

Contour Interval = 10'

LEGEND

CUT CONTOUR

FILL CONTOUR

LEASE BOUNDARY

0 250 500

REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.G.	P.E.
				APPROVALS		
11-A	6-17-11	GOL	Updated for Mine Plan changes and submitted to OSM for Review.	GOL	TR	S. PRIES
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	K LOGAN	Y. BENALLY	R.C.Y.
08-A	02-01-08	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	V. KANTOR	Y. BENALLY	D.J. RAMSON
D	3-06-07	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	SS	MC	KB
C	8-11-06	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	BH	KJ	LR
B	10-04-04	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	DJR	MC	LR
A	4-21-04	PJF	Updated exhibit and submitted to OSM for Review.	DJR	MC	LR

Exhibit 50-11

bhpbilliton

BHP Navajo Coal Company

P.O. Box 1717
Fruitland, New Mexico, 87416

Phone: 505-598-4200
Fax: 505-568-3361

Area II

(Hosteen and Yazzie Area)

Cut Fill Contours
Bond Scenario 9/2014

PREPARED BY G. Lovland	DRAWN BY GOL	SCALE 1" = 500'
APPROVED BY S. Pries	DATE June 17, 2011	

HOSTEEN PIT

N. BARBER PIT

S. BARBER PIT

Projected Bond Regrade Boundary

Projected Bond Regrade Boundary

Match Line See Exhibit 12-17

295000 E
297500 E
300000 E
302500 E
305000 E
307500 E
310000 E
312500 E

2045000 N
2042500 N
2040000 N
2037500 N
2035000 N
2032500 N

Contour Interval = 10'

LEGEND

CUT CONTOUR

FILL CONTOUR

LEASE BOUNDARY

0 250 500
SCALE IN FEET

REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.G.	P.E.
11-A	6-17-11	GOL	Updated for Mine Plan changes and submitted to OSM for Review.	GOL	TR	S. PRIES
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	K. LOGAN	T. BENALLY	R.C.Y.
08-A	02-01-08	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	J. KANTOR	T. BENALLY	D.J. MASON
D	3-06-07	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	SS	MC	KB
C	8-11-06	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	BH	KJ	LR
B	10-04-04	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	DJR	MC	LR
A	4-21-04	PJF	Updated exhibit and submitted to OSM for Review.	DJR	MC	LR

APPROVALS

Exhibit 50-12

bhpbilliton

BHP Navajo Coal Company

P.O. Box 1717
Fruitland, New Mexico, 87416

Phone: 505-598-4200
Fax: 505-568-3361

Area II

(Mason and Barber Area)

Cut Fill Contours
Bond Scenario 9/2014

PREPARED BY G. Lovland	DRAWN BY GOL	SCALE 1" = 500'	
APPROVED BY S. Pries	DATE June 17, 2011		

Exhibit 50-13

bhpbilliton

BHP Navajo Coal Company

P.O. Box 1717
Fruitland, New Mexico, 87416

Phone: 505-598-4200
Fax: 505-568-3361

Area III
(Lowe/Dixon Area)
Cut Fill Contours
Bond Scenario 9/2014

PREPARED BY G. Lovland	DRAWN BY GOL	SCALE 1" = 500'
APPROVED BY S. Pries	DATE June 16, 2011	

Original Certified signed exhibits are maintained at the Mine Site and OSM

REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.Q.	P.E.
11-A	6-17-11	GOL	Updated exhibit and submitted OSM for Review.	GOL	TR	S. Pries
09-B	7-12-09	PJF	ADDED 1BR EASTSIDE OF LOWE PIT AND SUBMITTED TO OSM FOR REVIEW.	KA/ SSmith	YB	KAB
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	K. Logan	T. Benally	R.C.V.
08-A	09-05-08	PJF	Updated exhibit and submitted OSM for Review.	BH/ KL	YB	RCVV
A	4-21-04	PJF	Updated exhibit and submitted OSM for Review.	DJR	MC	LR

APPROVALS

LEGEND

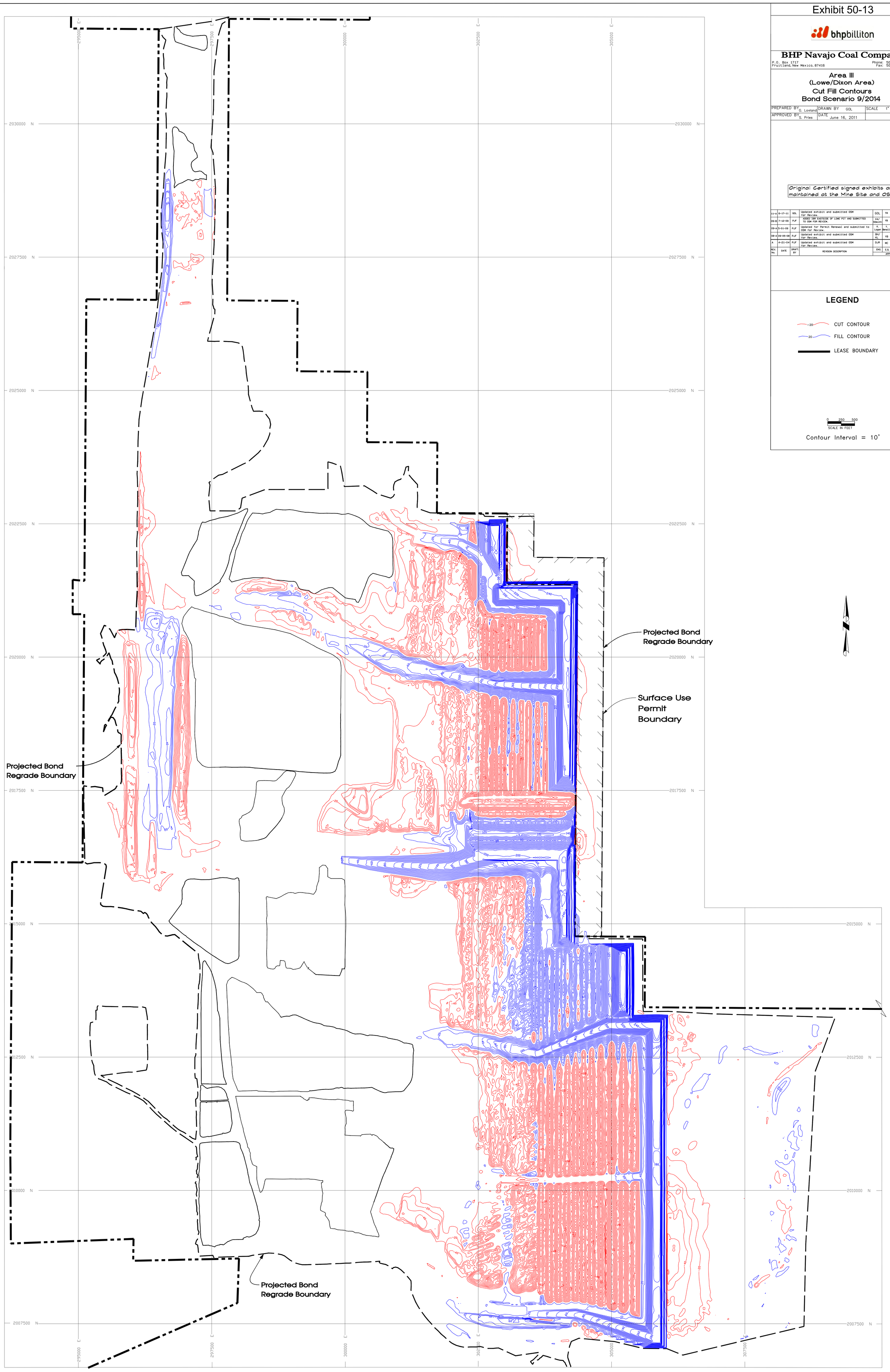
CUT CONTOUR

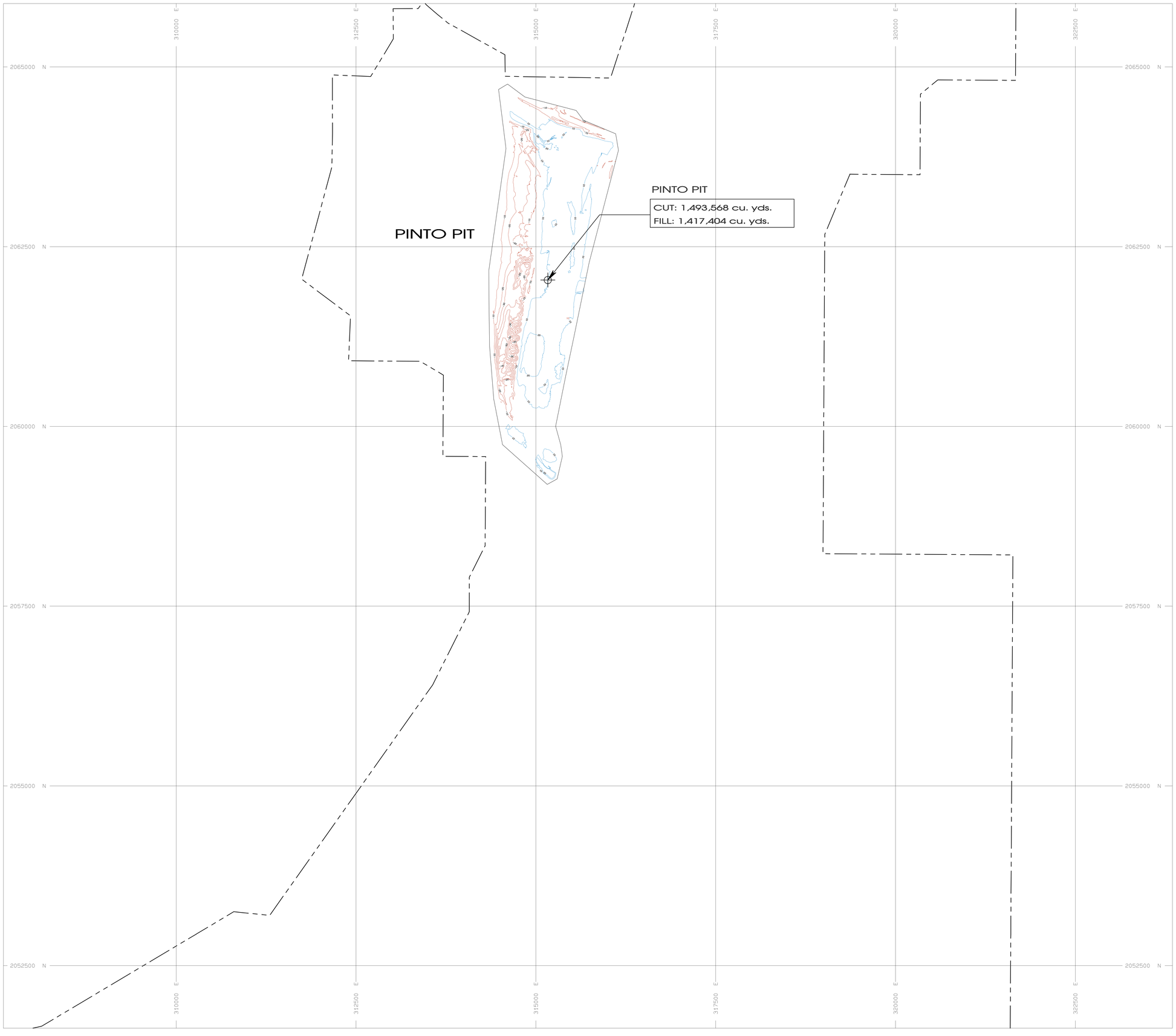
FILL CONTOUR

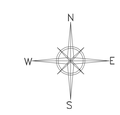
LEASE BOUNDARY

0 250 500
SCALE IN FEET

Contour Interval = 10'







-20 CUT CONTOUR

20 FILL CONTOUR

LEASE BOUNDARY

-1000 -500 0 500 1000

Scale: 1" = 500'

Contour Interval = 10'

REV. NO.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.G.	P.E.
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	F. GORMAN	Y. BENALLY	R.C.V.
B	9-26-06	PJF	Updated Mine Plan changes, and submitted to OSM for Review.	BH	KJ	LR
A	4-21-04	PJF	Updated exhibit and submitted to OSM for Review.	DJR	WC	LR

APPROVALS

CERTIFICATION STATEMENT

I, Ron C. Van Valkenburg, hereby certify that this drawing was reviewed by me and that the information shown is complete and accurate to the best of my knowledge.

RON C. VAN VALKENBURG NEW MEXICO 9263 LICENSED PROFESSIONAL ENGINEER

EXHIBIT 50-14

BHP NAVAJO COAL COMPANY

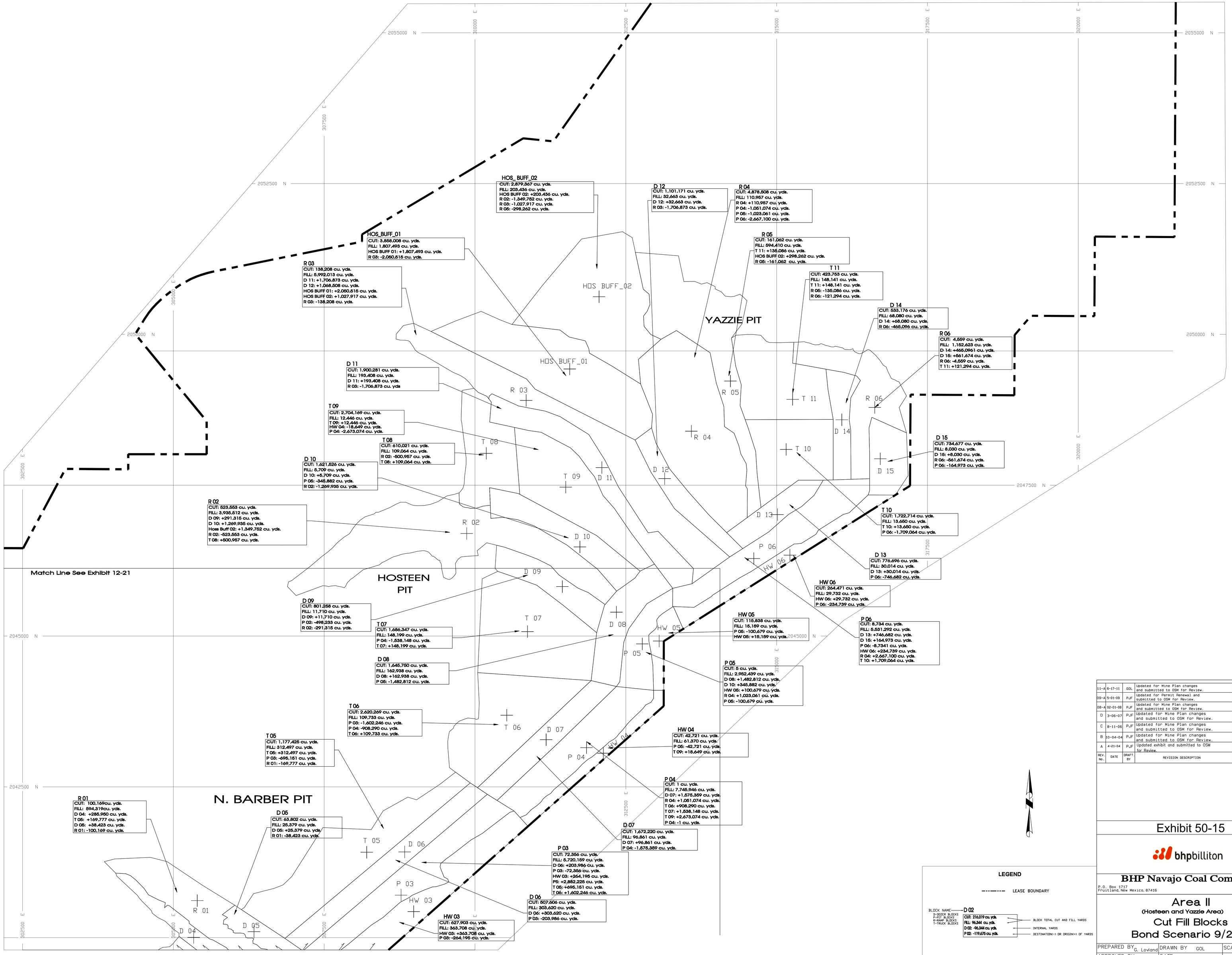
NAVAJO MINE SAFETY PRIDE

P.O. BOX 1717 FRUITLAND, NEW MEXICO 87416

Area I
(Pinto Area)
Cut Fill Contours
Bond Scenario 9/2014

PREPARED BY F. Gorman	DRAWN BY PJF	SCALE 1" = 500'
APPROVED BY	DATE May 01, 2009	

G:\Departments\Ge\OSM_SUBM\PER_PROG\CH_12_PAP EXHIBITS\BOND-2009\A1 BOND DATA\RG-EXH_12-41_CFC.pro
PJFOSTER Fri Apr 24 10:59:29 2009



REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.G.	P.E.
				APPROVALS		
11-A	6-17-11	GOL	Updated for Mine Plan changes and submitted to OSM for Review.	GOL	TR	S. PRIES
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	K. LOGAN	Y. BENALLY	R.C.Y.
08-A	02-01-08	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	J. KANTOR	Y. BENALLY	D.J. RAMSON
D	3-06-07	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	SS	MC	KB
C	8-11-06	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	BH	KJ	LR
B	10-04-04	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	DJR	MC	LR
A	4-21-04	PJF	Updated exhibit and submitted to OSM for Review.	DJR	MC	LR

Exhibit 50-15

bhpbilliton

BHP Navajo Coal Company

P.O. Box 1717
Fruitland, New Mexico, 87416

Phone: 505-598-4200
Fax: 505-568-3361

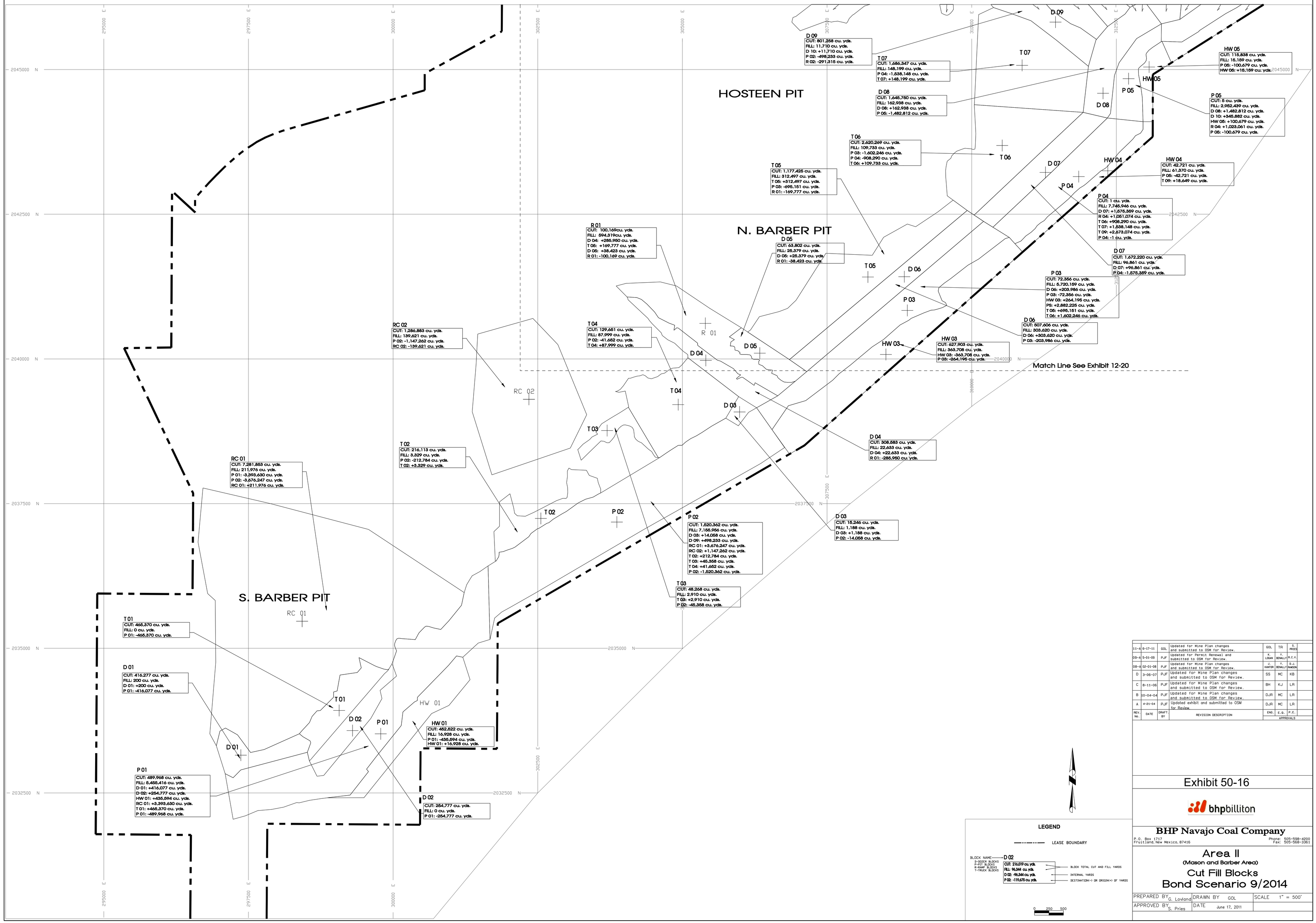
Area II

(Hosteen and Yazzie Area)

Cut Fill Blocks

Bond Scenario 9/2014

PREPARED BY G. Lovland	DRAWN BY GOL	SCALE 1" = 500'	
APPROVED BY S. Pries	DATE June 17, 2011		



REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.G.	P.E.
11-A	6-17-11	GOL	Updated for Mine Plan changes and submitted to OSM for Review.	GOL	TR	S. PRIES
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	K. LOGAN	Y. BENALLY	R.C.Y.
08-A	02-01-08	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	J. KANTOR	Y. BENALLY	D.J. RAMON
D	3-06-07	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	SS	MC	KB
C	8-11-06	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	BH	KJ	LR
B	10-04-04	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	DJR	MC	LR
A	4-21-04	PJF	Updated exhibit and submitted to OSM for Review.	DJR	MC	LR

APPROVALS

Exhibit 50-16

bhpbilliton

BHP Navajo Coal Company

P.O. Box 1717
Fruitland, New Mexico, 87416

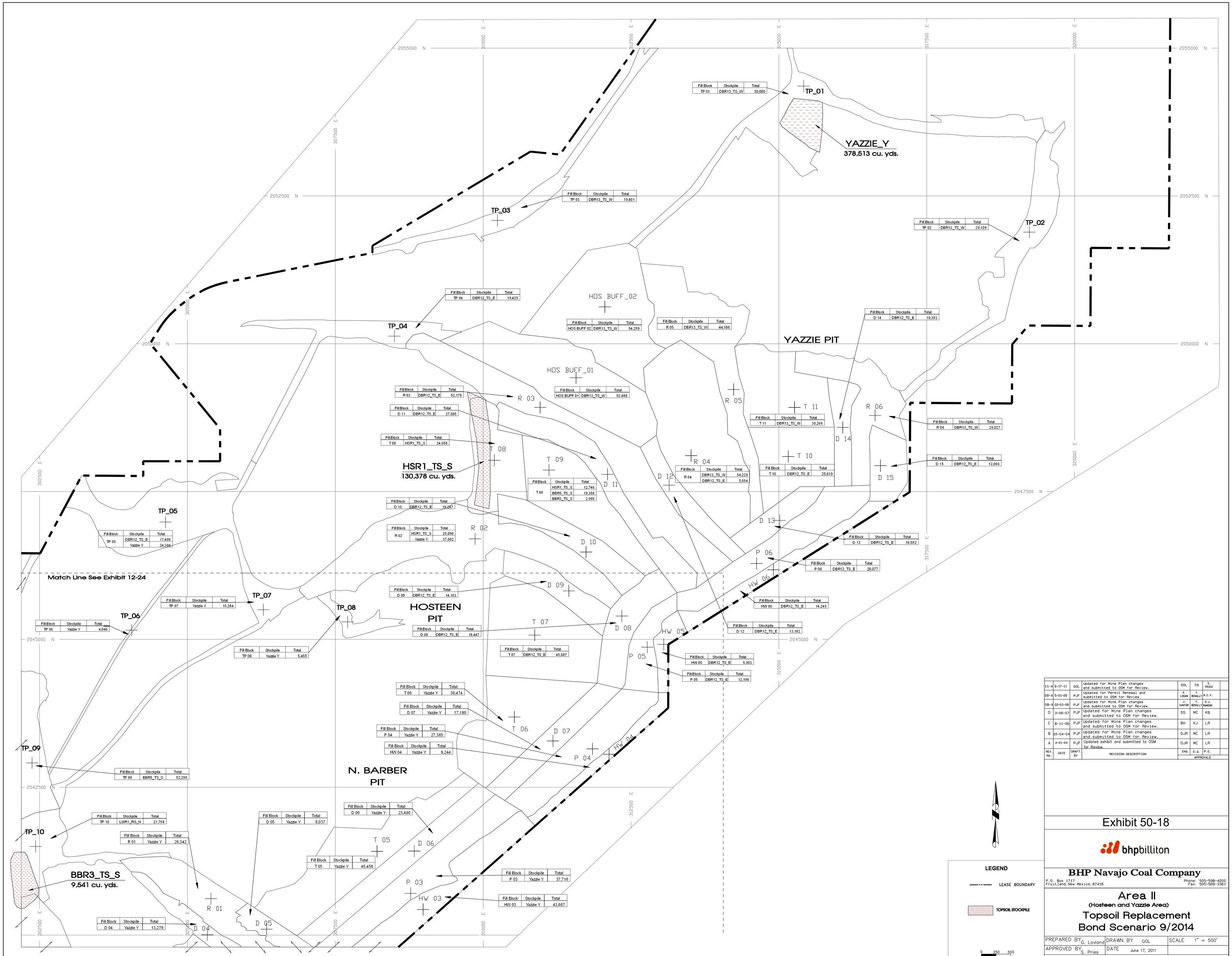
Phone: 505-598-4200
Fax: 505-568-3361

Area II

(Mason and Barber Area)

Cut Fill Blocks
Bond Scenario 9/2014

PREPARED BY C. Lovland	DRAWN BY GOL	SCALE 1" = 500'
APPROVED BY S. Pries	DATE June 17, 2011	



Fill Block	Stockpile	Total
TP 01	DBR13_TS_W	39,680
TP 03	DBR13_TS_W	19,801
TP 02	DBR13_TS_W	29,109
TP 04	DBR12_TS_E	19,425
HOS BUFF 02	DBR13_TS_W	54,259
R 05	DBR13_TS_W	44,186
D 14	DBR12_TS_E	10,393
HOS BUFF 01	DBR13_TS_W	52,488
R 03	DBR12_TS_E	52,178
D 11	DBR12_TS_E	27,085
T 08	HSR1_TS_S	24,658
T 11	DBR13_TS_W	30,266
R 06	DBR13_TS_W	26,027
D 15	DBR12_TS_E	12,066
R 04	DBR13_TS_W	54,229
	DBR12_TS_E	5,554
T 10	DBR12_TS_E	25,619
T 09	HSR1_TS_S	12,746
	BBR5_TS_S	19,358
	BBR3_TS_S	2,995
D 10	DBR12_TS_E	19,247
R 02	HSR1_TS_S	25,090
	Yazzie Y	37,002
D 13	DBR12_TS_E	10,592
P 06	DBR12_TS_E	28,077
TP 05	DBR12_TS_E	17,406
	Yazzie Y	24,304
TP 07	Yazzie Y	15,284
TP 06	Yazzie Y	4,046
D 09	DBR12_TS_E	14,163
D 08	DBR12_TS_E	18,447
HW 06	DBR12_TS_E	14,245
D 12	DBR12_TS_E	13,182
TP 08	Yazzie Y	5,455
T 07	DBR12_TS_E	45,687
HW 05	DBR12_TS_E	5,903
P 05	DBR12_TS_E	12,198
T 06	Yazzie Y	38,474
D 07	Yazzie Y	17,180
P 04	Yazzie Y	27,385
HW 04	Yazzie Y	9,244
TP 09	BBR5_TS_S	52,295
D 06	Yazzie Y	23,490
TP 10	LWR1_RG_N	21,758
D 05	Yazzie Y	8,037
R 01	Yazzie Y	26,342
T 05	Yazzie Y	45,458
P 03	Yazzie Y	37,716
HW 03	Yazzie Y	43,667
D 04	Yazzie Y	13,278

REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.G.	P.E.
11-A	6-17-11	GOL	Updated for Mine Plan changes and submitted to OSM for Review.	GOL	TR	S. PRIES
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	K. LOGAN	Y. BENALLY	R.C.V.
08-A	02-01-08	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	J. KANTOR	Y. BENALLY	D.J. HAWKIN
D	3-06-07	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	SS	MC	KB
C	8-11-06	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	BH	KJ	LR
B	10-04-04	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	DJR	MC	LR
A	4-21-04	PJF	Updated exhibit and submitted to OSM for Review.	DJR	MC	LR

APPROVALS

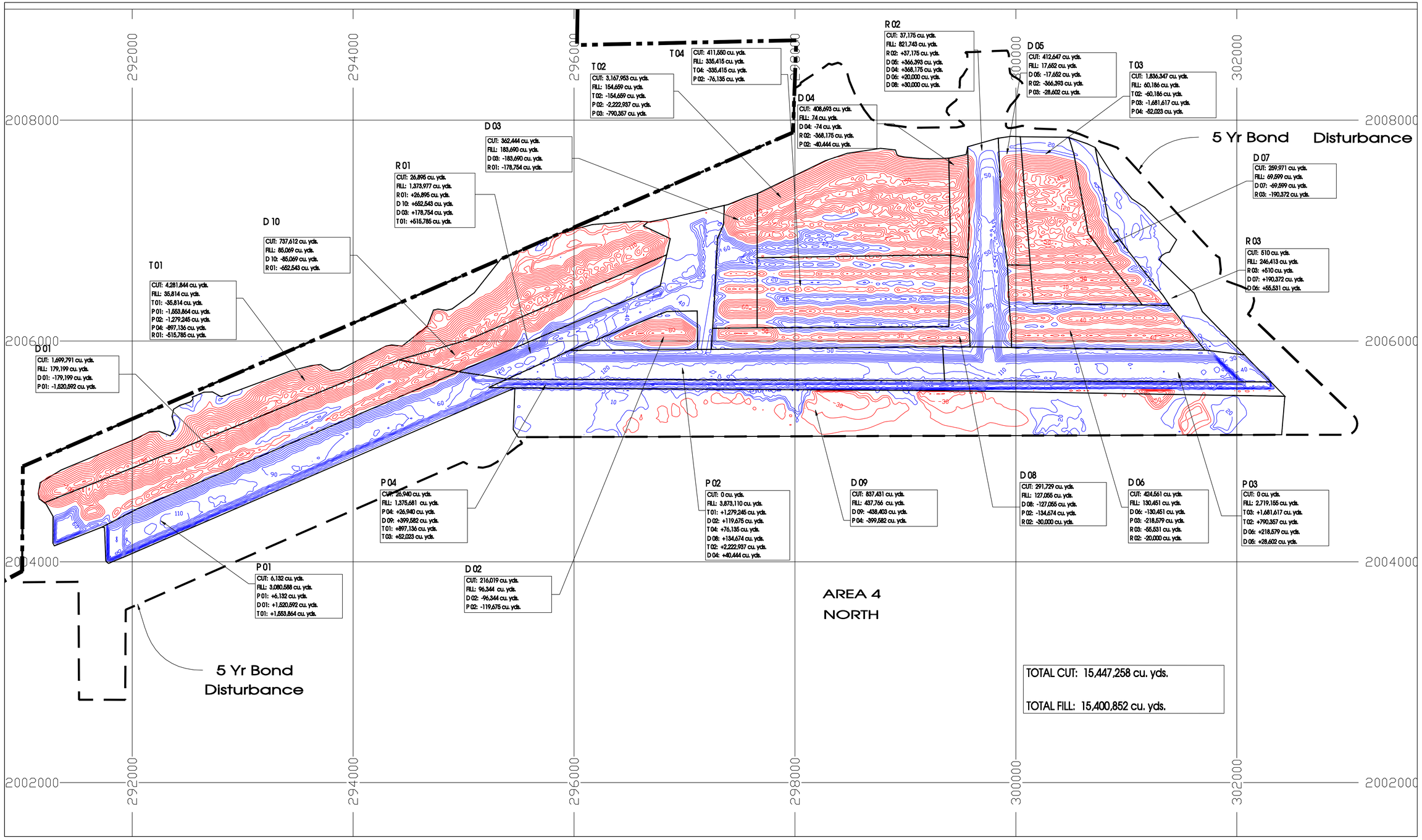
Exhibit 50-18

bhpbilliton

BHP Navajo Coal Company
P.O. Box 1717
Fruitland, New Mexico, 87416
Phone: 505-598-4200
Fax: 505-568-3361

Area II
(Hosteen and Yazzie Area)
Topsoil Replacement Bond Scenario 9/2014

PREPARED BY G. Lovland	DRAWN BY GOL	SCALE 1" = 500'
APPROVED BY S. Pries	DATE June 17, 2011	



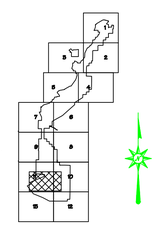
BLOCK NAME → D 02

D-DOZER BLOCKS
P-PIT BLOCKS
R-RAMP BLOCKS
T-TRUCK BLOCKS

CUT: 216,019 cu. yds.	BLOCK TOTAL CUT AND FILL YARDS
FILL: 96,344 cu. yds.	
D 02: -96,344 cu. yds.	INTERNAL YARDS
P 02: -119,675 cu. yds.	DESTINATION(-) OR ORIGIN(+) OF YARDS

LOCATION MAP

SCALE: 1"=400'



LEGEND

-10 CUT CONTOUR

10 FILL CONTOUR

LEASE BOUNDARY

DATE	REVISION	
Oct. 12, 2004	1	Submitted to OSM for Review.
Nov. 01, 2009	2	Updated for Permit Renewal and Submitted to OSM for Review.
April 01, 2011	3	Updated for Permit Revision and Submitted to OSM for Review.

PROJECT MANAGER: George Loveland
CHIEF of RECORD: Stephen Priles
REG. NO: 20425
DESIGNED BY: Fred Busche
DRAWN BY: Fred Busche
SHVR of RECORD:
REG. NO:
CHECKED BY: George Loveland
APPROVED BY: Stephen Priles

PROJECT: AM Permitting
DATE:

bhpbilliton

BHP NAVAJO COAL COMPANY
NAVAJO MINE

PO BOX 1717, FRUITLAND, NEW MEXICO, 87416 / PHONE 505-598-4200/FAX 505-598-3361

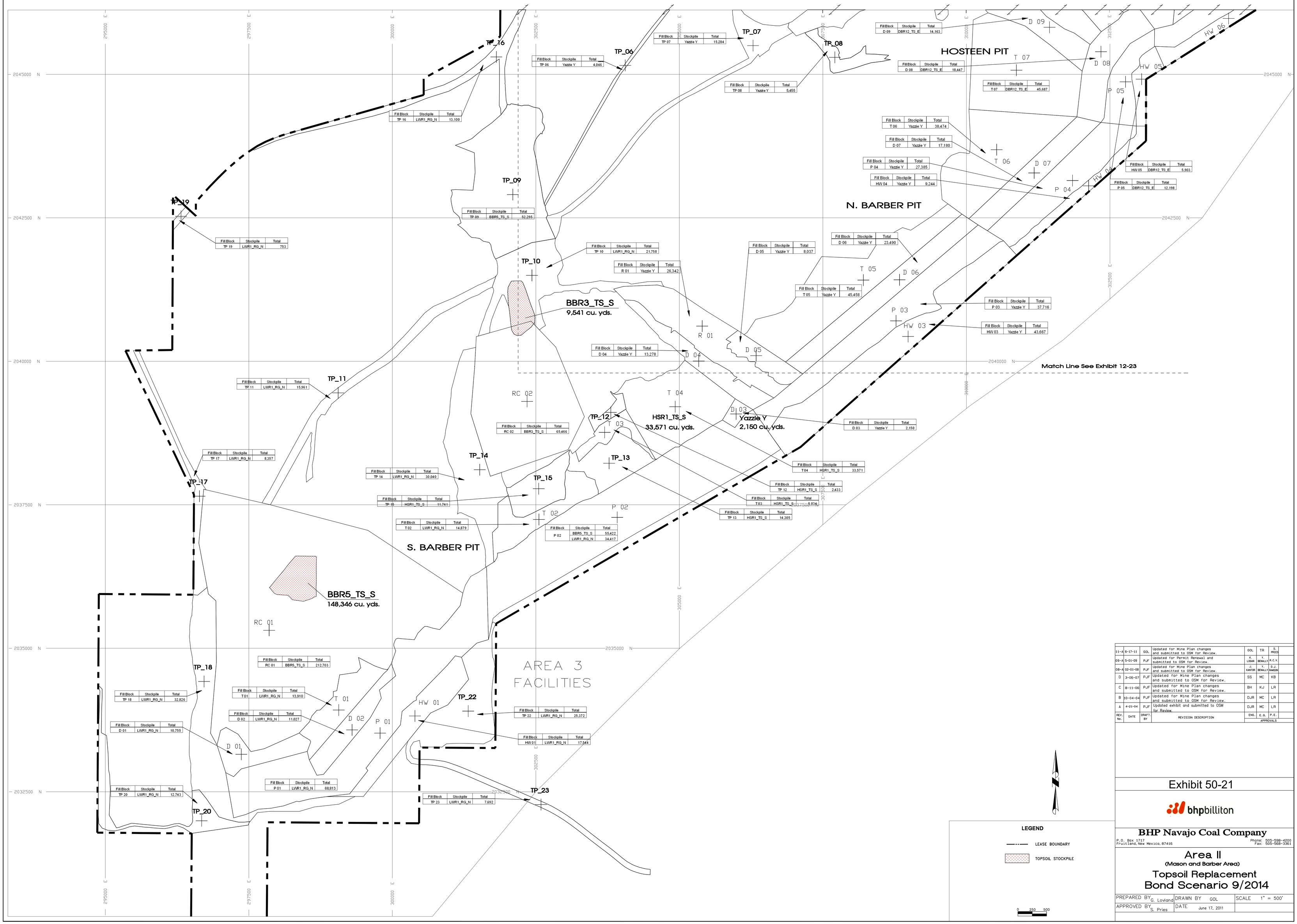
LOCATION MAP

Exhibit 50-19 AREA-4N

CUT/FILL CONTOURS
AND BLOCKS
BOND SCENARIO 9/2014

DRAWING

SHEET 0
OF 0



Fill Block	Stockpile	Total
TP 06	Yazzie Y	4,046
TP 07	Yazzie Y	15,284
TP 08	Yazzie Y	5,455
D 09	DBR12_TS_E	14,163
D 08	DBR12_TS_E	18,447
T 07	DBR12_TS_E	45,687
TP 16	LWR1_RG_N	13,100
T 06	Yazzie Y	38,474
D 07	Yazzie Y	17,180
P 04	Yazzie Y	27,385
HW 04	Yazzie Y	9,244
HW 05	DBR12_TS_E	5,903
P 05	DBR12_TS_E	12,198
TP 09	BBR3_TS_S	52,295
TP 19	LWR1_RG_N	753
TP 10	LWR1_RG_N	21,758
R 01	Yazzie Y	26,342
D 05	Yazzie Y	8,037
D 06	Yazzie Y	23,490
T 05	Yazzie Y	45,458
P 03	Yazzie Y	37,716
HW 03	Yazzie Y	43,667
D 04	Yazzie Y	13,278
TP 11	LWR1_RG_N	15,961
RC 02	BBR3_TS_S	65,466
D 03	Yazzie Y	2,150
T 04	HSR1_TS_S	33,571
TP 12	HSR1_TS_S	2,433
T 03	HSR1_TS_S	6,834
TP 13	HSR1_TS_S	14,305
TP 17	LWR1_RG_N	8,357
TP 14	LWR1_RG_N	30,040
TP 15	HSR1_TS_S	11,741
T 02	LWR1_RG_N	14,879
P 02	BBR5_TS_S	55,422
	LWR1_RG_N	34,417
RC 01	BBR5_TS_S	212,703
TP 18	LWR1_RG_N	32,826
T 01	LWR1_RG_N	13,910
D 02	LWR1_RG_N	11,027
D 01	LWR1_RG_N	10,755
P 01	LWR1_RG_N	68,813
TP 20	LWR1_RG_N	12,743
TP 22	LWR1_RG_N	25,372
HW 01	LWR1_RG_N	17,544
TP 23	LWR1_RG_N	7,692

REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.G.	P.E.
11-A	6-17-11	GOL	Updated for Mine Plan changes and submitted to OSM for Review.	GOL	TR	S. PRIES
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	K. LOGAN	T. BENALLY	R.C.V.
08-A	02-01-08	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	J. KANTOR	T. BENALLY	D.J. RAMSON
D	3-06-07	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	SS	MC	KB
C	8-11-06	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	BH	KJ	LR
B	10-04-04	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	DJR	MC	LR
A	4-21-04	PJF	Updated exhibit and submitted to OSM for Review.	DJR	MC	LR

APPROVALS

Exhibit 50-21

bhpbilliton

BHP Navajo Coal Company

P.O. Box 1717
Fruitland, New Mexico, 87416

Phone: 505-598-4200
Fax: 505-568-3361

Area II
(Mason and Barber Area)

Topsoil Replacement
Bond Scenario 9/2014

PREPARED BY G. Lovland	DRAWN BY GOL	SCALE 1" = 500'	
APPROVED BY S. Pries	DATE June 17, 2011		

Exhibit 50-22

bhpbilliton

BHP Navajo Coal Company

P.O. Box 1717
Fruitland, New Mexico, 87416

Phone: 505-598-4200
Fax: 505-568-3361

Area III
(Lowe/Dixon Area)
Topsoil Replacement
Bond Scenario 9/2014

PREPARED BY G. Loviano	DRAWN BY GOL	SCALE 1" = 500'	
APPROVED BY S. Pries	DATE July 29, 2011		

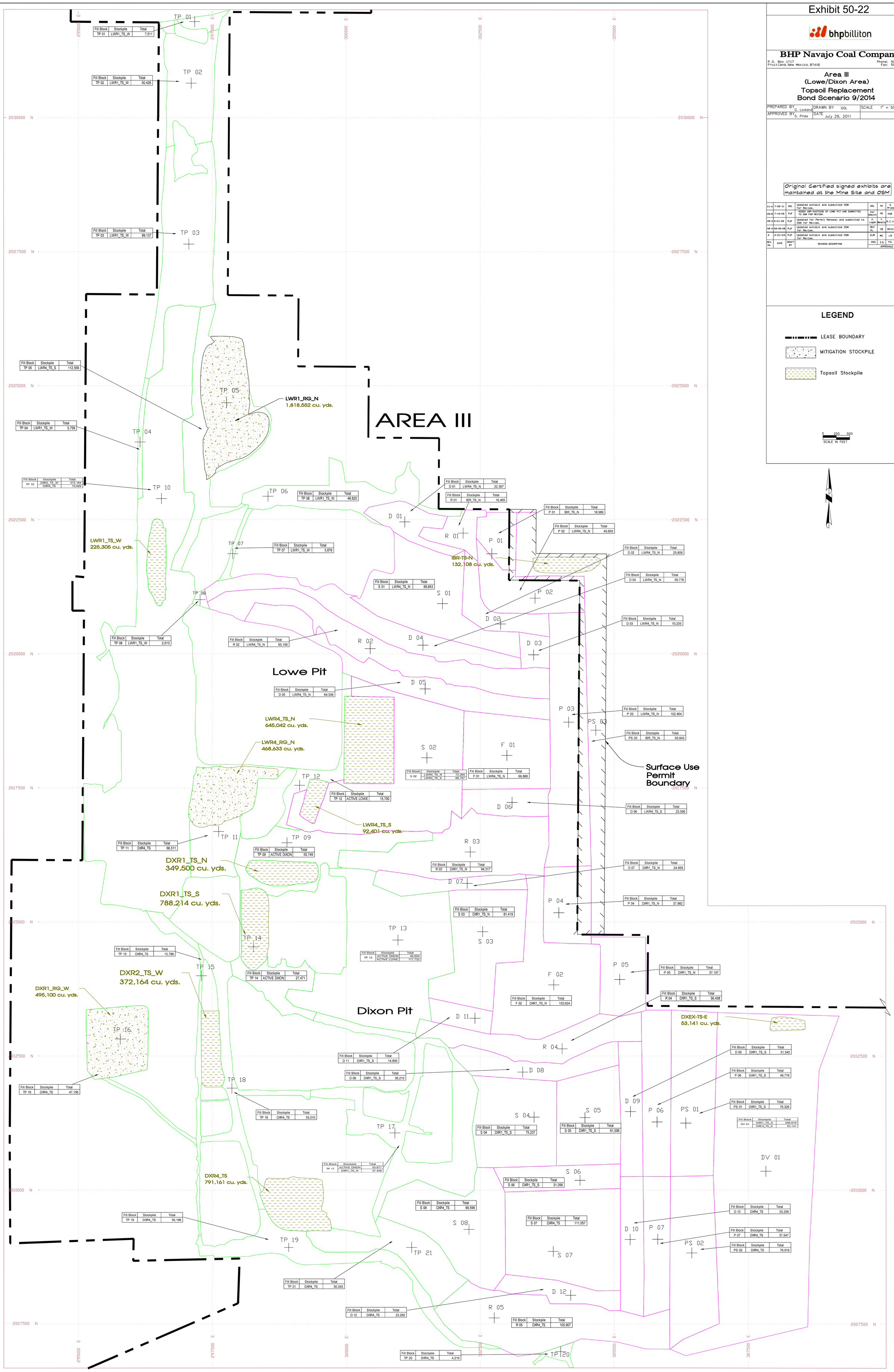
Original Certified signed exhibits are maintained at the Mine Site and OSM

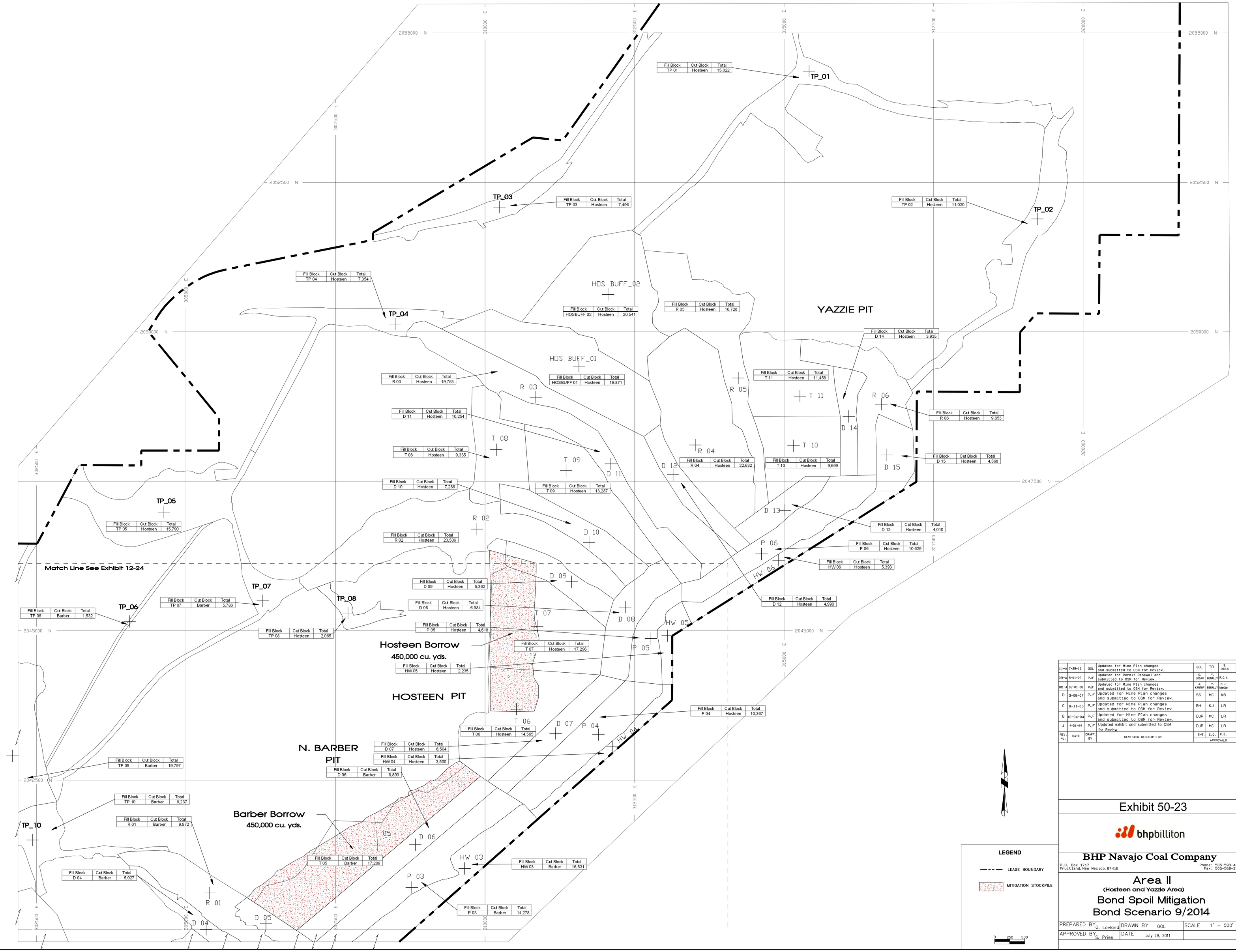
REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.Q.	P.E.	
11-A	7-29-11	GOL	Updated exhibit and submitted OSM for Review.	GOL	TR	S. Pries	
09-B	7-12-09	PJF	ADDED IBR EASTSIDE OF LOWE PIT AND SUBMITTED TO OSM FOR REVIEW.	KA/ SSmith	YB	KAB	
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	K. Logan	Y. Benally	R.C.V	
08-A	09-05-08	PJF	Updated exhibit and submitted OSM for Review.	BH/ KL	YB	RCVV	
A	4-21-04	PJF	Updated exhibit and submitted OSM for Review.	DJR	MC	LR	
				APPROVALS			

LEGEND

- LEASE BOUNDARY
- MITIGATION STOCKPILE
- Topsoil Stockpile

0 250 500
SCALE IN FEET





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11-A	7-29-11	GOL	Updated for Mine Plan changes and submitted to OSM for Review.	GOL	TR	S. PRIES
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	K. LOGAN	Y. BENALLY	R.C.V.
08-A	02-01-08	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	J. KANTOR	Y. BENALLY	D.J. RANKIN
D	3-06-07	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	SS	MC	KB
C	8-11-06	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	BH	KJ	LR
B	10-04-04	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	DJR	MC	LR
A	4-21-04	PJF	Updated exhibit and submitted to OSM for Review.	DJR	MC	LR

APPROVALS

Exhibit 50-23

bhpbilliton

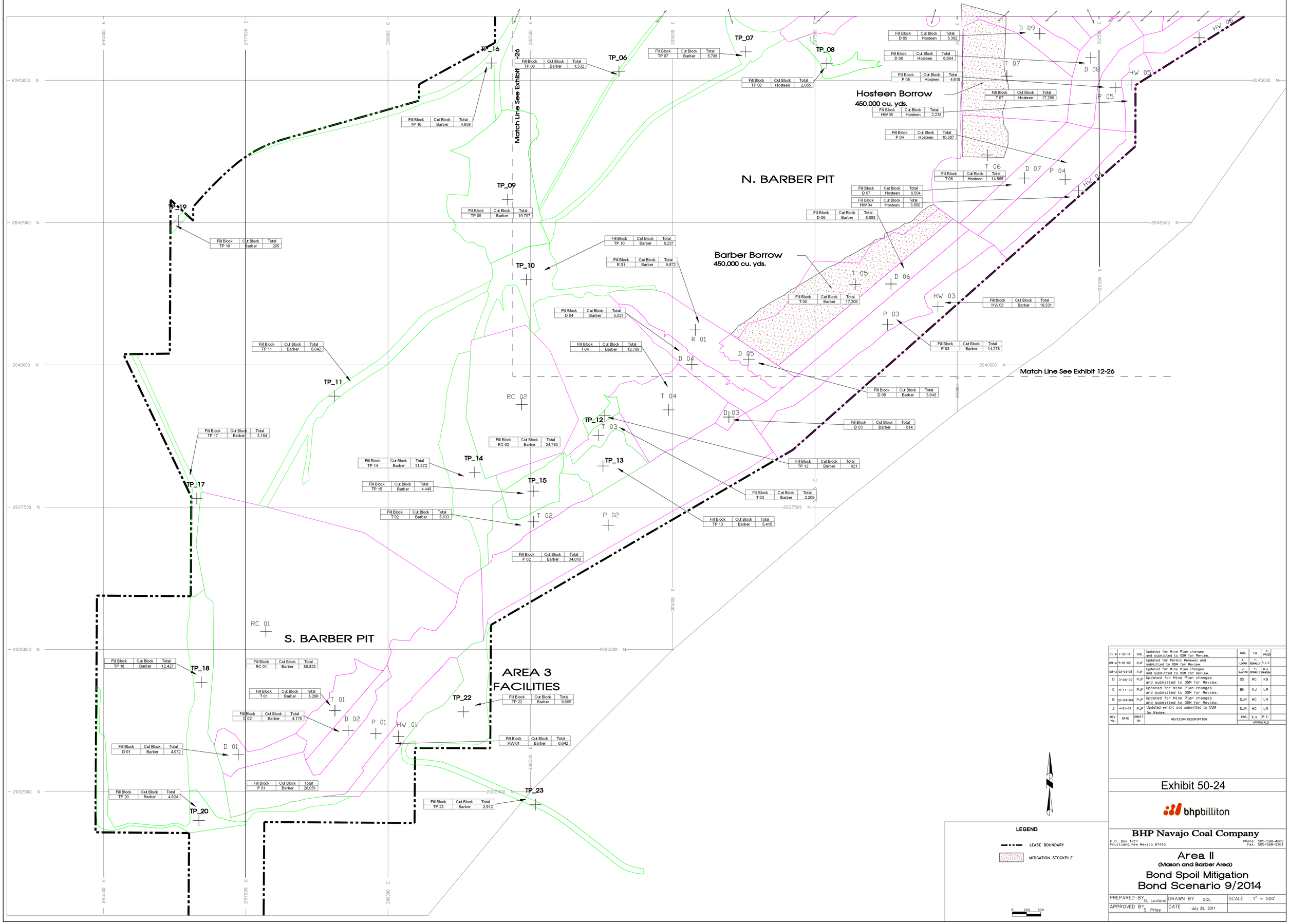
BHP Navajo Coal Company

P.O. Box 1717
Fruitland, New Mexico, 87416

Phone: 505-598-4200
Fax: 505-568-3361

Area II
(Hosteen and Yazzie Area)
Bond Spoil Mitigation
Bond Scenario 9/2014

PREPARED BY G. Lovland	DRAWN BY GOL	SCALE 1" = 500'	
APPROVED BY S. Pries	DATE July 29, 2011		



REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.G.	P.E.
11-A	7-29-11	GOL	Updated for Mine Plan changes and submitted to OSM for Review.	GOL	TR	S. PRIES
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	K. LOGAN	Y. BENALLY	R.C.V.
08-A	02-01-08	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	J. KANTOR	Y. BENALLY	D.J. HAWKIN
D	3-06-07	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	SS	MC	KB
C	8-11-06	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	BH	KJ	LR
B	10-04-04	PJF	Updated for Mine Plan changes and submitted to OSM for Review.	DJR	MC	LR
A	4-21-04	PJF	Updated exhibit and submitted to OSM for Review.	DJR	MC	LR

APPROVALS

Exhibit 50-24

bhpbilliton

BHP Navajo Coal Company

P.O. Box 1717
Fruitland, New Mexico. 87416

Phone: 505-598-4200
Fax: 505-568-3361

Area II

(Mason and Barber Area)

Bond Spoil Mitigation
Bond Scenario 9/2014

PREPARED BY G. Lovland	DRAWN BY GOL	SCALE 1" = 500'	
APPROVED BY S. Pries	DATE July 29, 2011		

Exhibit 50-25

bhpbilliton

BHP Navajo Coal Company

P.O. Box 1717
Fruitland, New Mexico, 87416

Phone: 505-598-4200
Fax: 505-568-3361

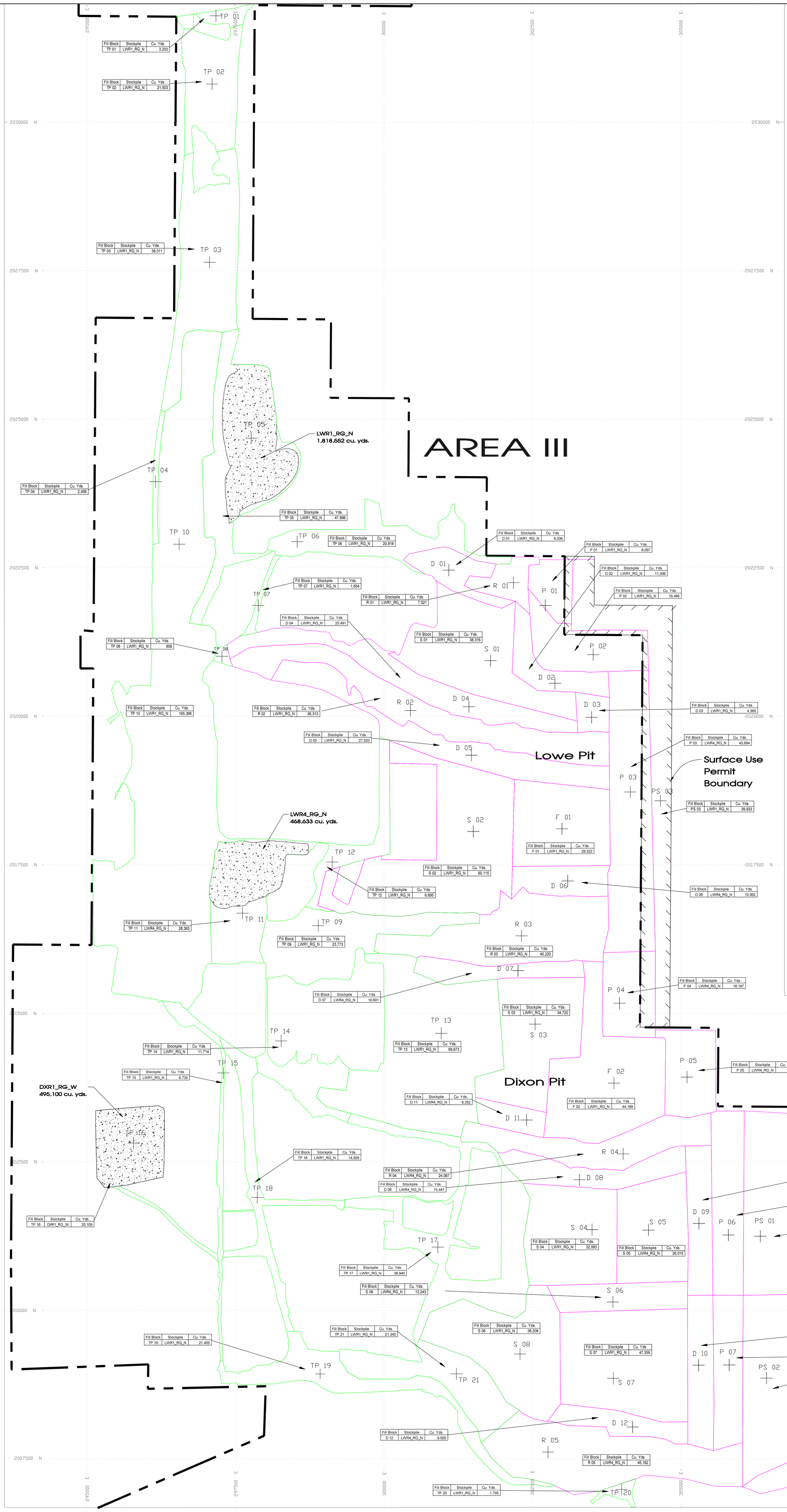
Area III
(Lowe/Dixon Area)
Bond Spoil Mitigation
Bond Scenario 9/2014

PREPARED BY G. Lovland	DRAWN BY GOL	SCALE 1" = 500'
APPROVED BY S. Pries	DATE July 29, 2011	

Original Certified signed exhibits are maintained at the Mine Site and OSM

REV. No.	DATE	DRAFT. BY	REVISION DESCRIPTION	ENG.	E.G.	P.E.
11-A	7-29-11	GOL	Updated exhibit and submitted OSM for Review.	GOL	TR	S. Pries
09-B	7-12-09	PJF	ADDED IBR EASTSIDE OF LOWE PIT AND SUBMITTED TO OSM FOR REVIEW.	KA/ SSmith	YB	KAB
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	K. Logan	T. Benally	R.C.V.
08-A	09-05-08	PJF	Updated exhibit and submitted OSM for Review.	BH/ KL	YB	RCVV
A	4-21-04	PJF	Updated exhibit and submitted OSM for Review.	DJR	MC	LR

APPROVALS



LEGEND

LEASE BOUNDARY

MITIGATION STOCKPILE

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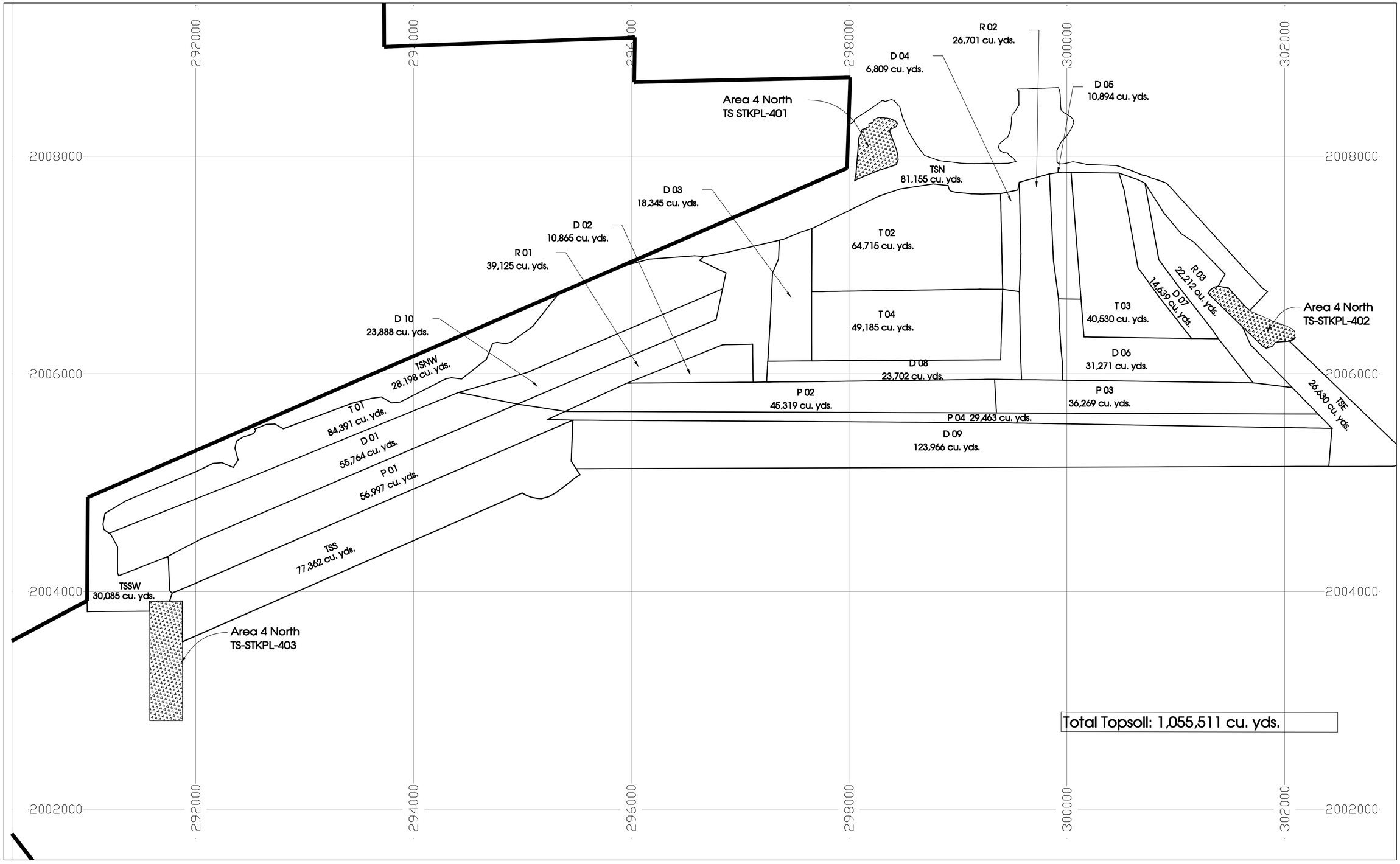
SCALE IN FEET



LOCATION MAP

SCALE: 1" = 400'

LEGEND

TOPSPOIL STOCKPILE

LEASE BOUNDARY

REVISION		DATE
Submitted to OSM for Review.	1	Oct. 17, 2004
Submitted for Permit and Submitted to OSM for Review.	2	May 01, 2009
Submitted for Permit Revision and submitted to OSM for Review.	3	April 11, 2011
11-A		

PROJECT MANAGER: George Loveland

DRAWN w/ RECORD: Stephen Priest

REG. NO: 20425

SHVYR w/ RECORD:

REG. NO:

PROJECT: AAN Permitting

DATE:

DESIGNED BY: Fred Busche

DRAWN BY: Fred Busche

CHECKED BY: George Loveland

APPROVED BY: Stephen Priest

bhpbilliton

BHP NAVAJO COAL COMPANY
NAVAJO MINE

PO BOX 1717, FRUITLAND, NEW MEXICO, 87416 / PHONE 505-598-4200/FAX 505-598-3361

LOCATION MAP

Exhibit 50-26 AREA-4N

TOPSOIL REPLACEMENT
BOND SCENARIO 9/2014

DRAWING

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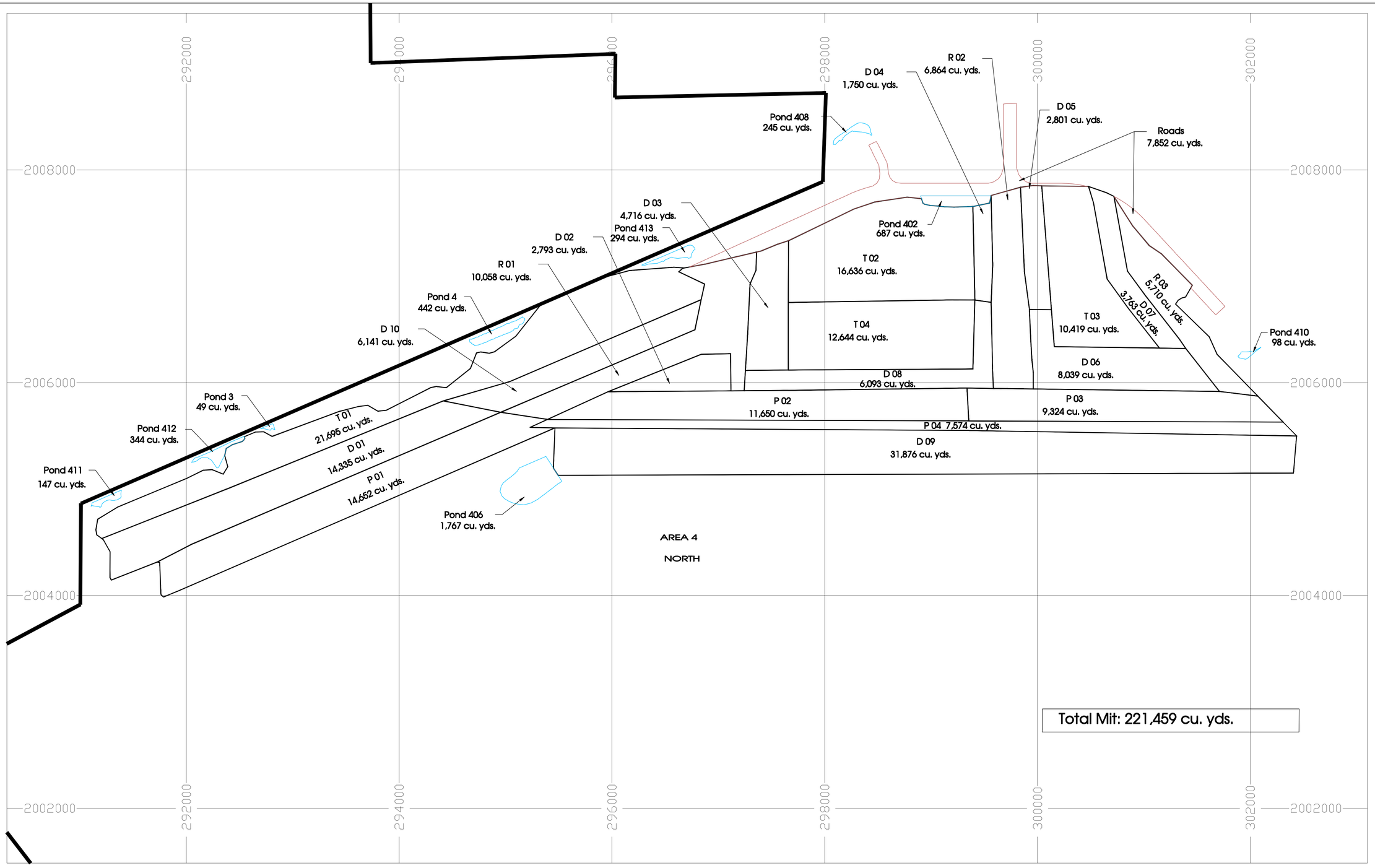
OF 0



LOCATION MAP

SCALE: 1" = 400'

LEGEND

LEASE BOUNDARY

REVISION		DATE
Submitted to OSM for Review.	1	July 26, 2011
Updated for Permit Renewal and Submitted to OSM for Review.	2	July 26, 2011
Updated for Permit Revision and submitted to OSM for Review.	3	July 26, 2011
	11-A	

PROJECT MANAGER: George Loveland
DRAWN w/ RECORD: Stephen Pries
REG. NO: 20425

PROJECT: AAN Permitting
DATE:
DESIGNED BY: Fred Busche
DRAWN BY: Fred Busche
CHECKED BY: George Loveland
APPROVED BY: Stephen Pries

SHWM w/ RECORD:
REG. NO:

bhpbilliton

BHP NAVAJO COAL COMPANY
NAVAJO MINE

PO BOX 1717, FRUITLAND, NEW MEXICO, 87416 / PHONE 505-598-4200/FAX 505-598-3361

LOCATION MAP

Exhibit 50-27 AREA-4N

BOND SPOIL MITIGATION
BOND SCENARIO 9/2014

DRAWING

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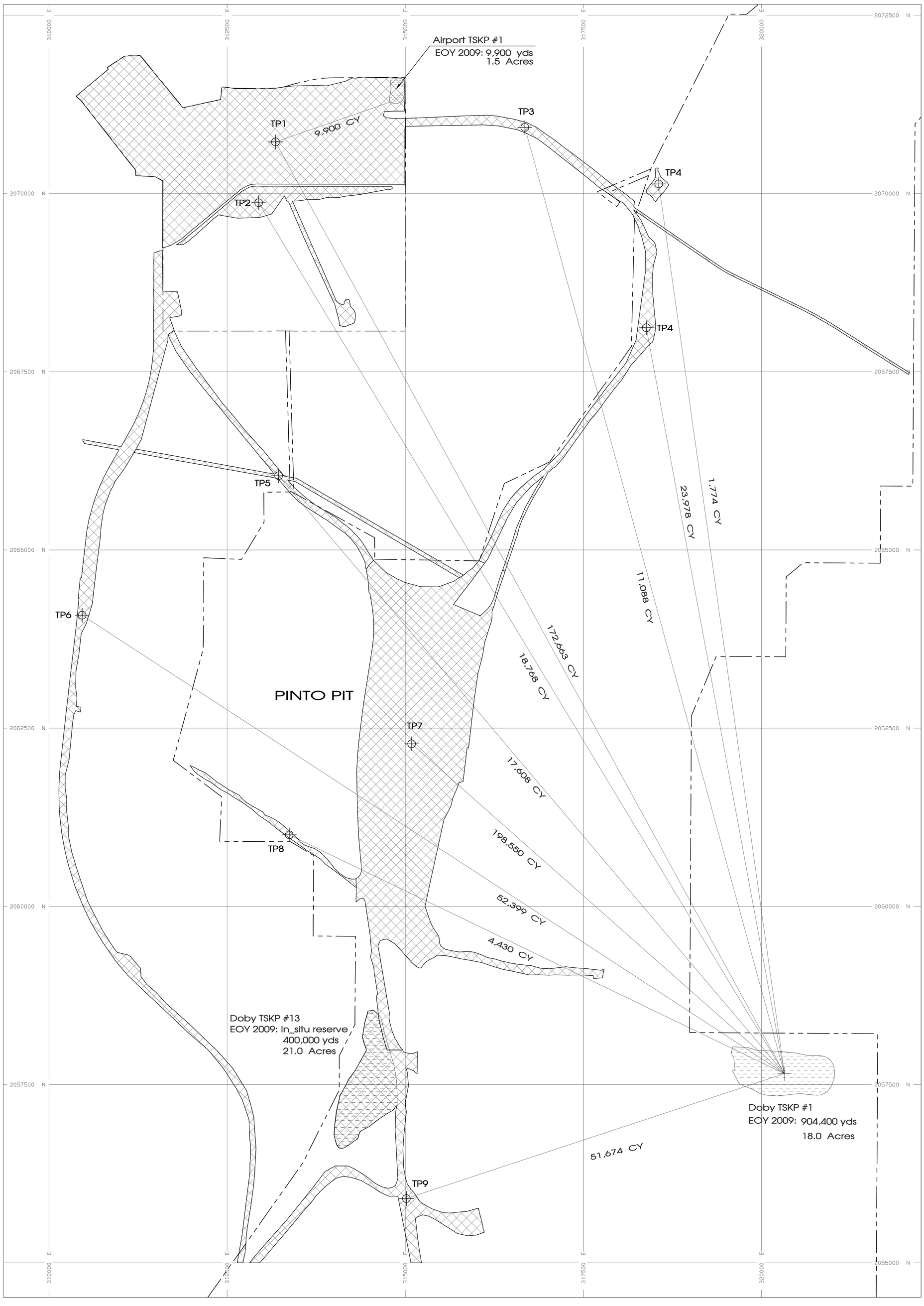
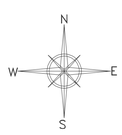
OF 0





TOPSOIL STOCKPILE

LEASE BOUNDARY

-1000 -500 0 500 1000

Scale: 1" = 500'

REV. NO.	DATE	DRAFT BY	REVISION DESCRIPTION	ENG.	E.G.	P.E.
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	F. GORMAN	Y. BENALLY	R.C.V.
B	9-26-06	PJF	Updated Mine Plan changes, and submitted to OSM for Review.	BH	KJ	LR
A	4-21-04	PJF	Updated exhibit and submitted to OSM for Review.	DJR	MC	LR

APPROVALS

CERTIFICATION STATEMENT

I, Ron C. Van Valkenburg, hereby certify that this drawing was reviewed by me and that the information shown is complete and accurate to the best of my knowledge.

RON C. VAN VALKENBURG NEW MEXICO 9263 LICENSED PROFESSIONAL ENGINEER

EXHIBIT 50-28

BHP NAVAJO COAL COMPANY

NAVAJO SAFETY MINE PRIDE

P.O. BOX 1717 FRUITLAND, NEW MEXICO 87416

Area I
Topdressing Replacement
Bond Scenario 9/2014

PREPARED BY F. Gorman	DRAWN BY PJF	SCALE 1" = 500'
APPROVED BY	DATE May 01, 2009	

G:\Departments\Gs\OSM_SUBM\PER_PROG\CH_12_PAP EXHIBITS\BOND-2009\A1 BOND DATA\R9-EXH_12-37_TRB.pro
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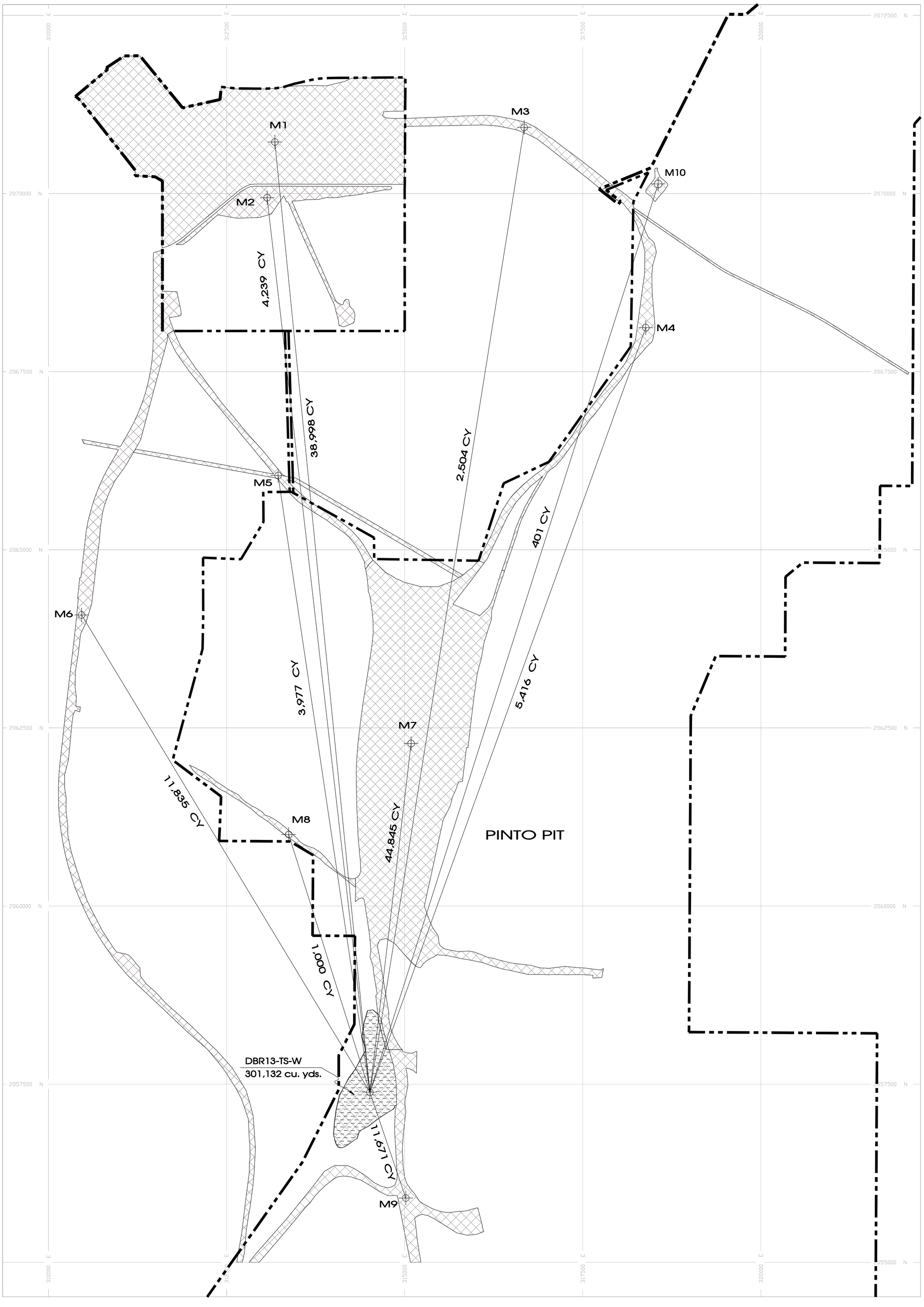

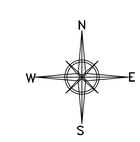

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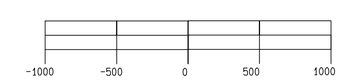


Scale: 1" = 500'

REV. No.	DATE	DRAFT BY	REVISION DESCRIPTION	ENG.	E.G.	P.E.
11-A	8-26-11	PJF	Updated exhibit and submitted to OSM for Review.	LR	SD	LR
09-A	5-01-09	PJF	Updated for Permit Renewal and submitted to OSM for Review.	F. GORMAN	T. BENALLY	R.C.V.
B	9-26-06	PJF	Updated Mine Plan changes, and submitted to OSM for Review.	BH	KJ	LR
A	4-21-04	PJF	Updated exhibit and submitted to OSM for Review.	DJR	MC	LR

APPROVALS

CERTIFICATION STATEMENT

I, Leonard Raymond, hereby certify that this drawing was reviewed by me and that the information shown is complete and accurate to the best of my knowledge.

LEONARD RAYMOND NEW MEXICO 6600 REGISTERED PROFESSIONAL ENGINEER

Exhibit 50-29

bhpbilliton

BHP Navajo Coal Company

P.O. Box 1717
Fruitland, New Mexico, 87416

Phone: 505-598-4200
Fax: 505-568-3361

Area I

Bond Spoil Mitigation

Bond Scenario 9/2014

PREPARED BY F.Gorman	DRAWN BY PJF	SCALE 1" = 500'
APPROVED BY	DATE May 01,2009	

Appendix 50.A

Topography Channel Stabilization
for Bond Reclamation
Bond Scenario 2014

BHP Navajo Coal Company
Navajo Mine
Fruitland, New Mexico
April 2009

TOPOGRAPHY CHANNEL STABILIZATION
FOR BOND RECLAMATION
BOND SCENARIO 2014

Introduction

Protective lining requirements were developed for the stabilization of the drainage channels associated with Bond Reclamation Topography at the Navajo Mine. A cost estimate for the materials and installation is also provided for use in reclamation bond determination.

Hydrology and channel designs are based on procedures outlined in Reclamation Surface Stabilization Design Handbook for the Navajo Mine (Navajo Mine, 1992). Peak flow estimates were developed at prediction points within the Area II, Area III and Area IV North mining areas (see EXHIBITS 12C-1, 12C-2, and 12-30B). Prediction Points 1 through 20 are located in Area II, 23 is located in Area III, and prediction points 28 through 30 are in Area IV North. Prediction Points 0, 12, 13, 21, 22, 24, 25, 26, 27 and 31 were removed, they are not required due to changes in the bond surface and drainage patterns. The peak discharges were used to evaluate the channel stability at each prediction point. Protective lining requirements were developed based on channel slope, expected peak flow rates and channel dimensions. The cost estimates for materials and installation were developed using unit costs associated with recent placement of riprap and gabions at Navajo Mine.

Hydrology

Peak flow estimates were developed using the SEDCAD 4.0 computer model. The estimates are based on the 100 yr–6 hr storm event for intermittent and perennial streams (watersheds > 640 acres); and the 10 yr–6 hr storm event for ephemeral streams (watersheds < 640 acres). Each lined channel was designed to be stable and to safely pass the peak discharge during the applicable design storm event.

Watersheds were developed and measured from USGS topographic quad sheets and topography of the bond reclamation areas. Soil types and the associated hydrologic soil group classification for the undisturbed portions of the watersheds were taken from the San Juan County Soil Survey, Eastern Part (USDA-SCS, 1980). The watershed data for each prediction point is presented in TABLE A. The watershed areas are on drawings in this Appendix.

Curve numbers for the undisturbed soils were taken from Table 11-16 in the Navajo Mine PAP. Curve numbers for the reclaimed areas were taken from Table 11-16B (Area II), Table 11-16C (Area III), and Table 11-16D (Area IV) in the Navajo Mine PAP.

Hydrologic curve numbers were developed as an aerially weighted average of the curve numbers for undisturbed and disturbed soils occurring within the watersheds.

The time of concentration (T_c) for each prediction point was determined by the Modified Kirpich method. The SEDCAD 4.0 hydrology data sheets are located in this Appendix.

Channel Proportioning

The prediction points were located at the drainages entering the reclaimed areas along the highwall and on channel slopes greater than 2% for watersheds within the reclaimed area. The main channels with slopes less than 2% will be constructed using an earth channel design. Channel slopes and lengths were measured from the bond reclamation topography.

The SEDCAD 4.0 computer model was used to proportion the channels and compute the riprap sizes. Channel side slopes of 3:1 were used in the designs. A minimum freeboard of 1.0 foot was used. FIGURE 1 shows a typical riprap/gabion channel section listing the hydraulic dimensions. The lengths of entrance and exit aprons were calculated as 5 times the exit channel flow depth with a minimum length of 15 feet. Riprap layer thickness was designed as 1.5 times the D_{50} of the riprap. A minimum riprap size of D_{50} equal to 0.5 feet was used. A filter fabric was utilized

in lieu of a graded sand and gravel filter beneath the riprap. Channel hydraulic dimensions for each prediction point are presented in TABLE B for Area II and TABLE C for Area III and Area IV North. The SEDCAD 4.0 channel proportioning sheets are located in this Appendix.

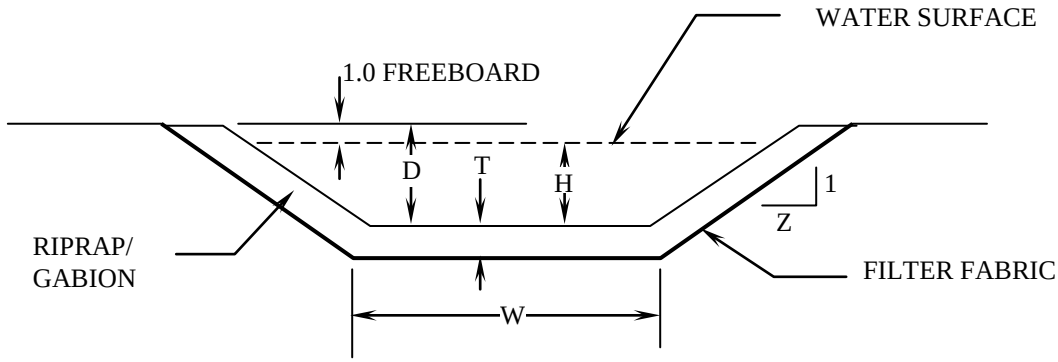
The availability of rock size greater than D_{50} equal to 9-inch is very limited in the local area. Therefore, if results from the hydraulic analysis specifies rip-rap size of D_{50} equal to 12-inch or greater, gabions filled with either D_{50} equal 4-inch or 6-inch rock will be used in lieu of the size specified. If a gabion structure is required the design of the structure is attach to the Sedcad output reports.

Cost Estimate

The riprap and gabion cost are based on the cost of material, labor, and equipment associated with recent riprap/gabion placement at the Navajo Mine. The cost for placing the filter fabric was developed by using the cost of geotextile fabric (200-lb tensile strength) from RS Means "Heavy Construction Cost Data – 2009". The unit costs used are presented on Table D and E.

The cost for placing the filter fabric was developed by using the cost of geotextile fabric (200-lb tensile strength) from RS Means "Heavy Construction Cost Data – 2009".

The estimated material and installation costs for each reach of riprap or gabion lined channel are presented in TABLE D for Area II and TABLE E for Area III and Area IV North. Channel lengths include apron lengths.



D = Channel Depth

H = Flow Depth

T = Riprap/Gabion Layer Thickness

W = Channel Bottom Width

Z = Side Slope (Z:1)

FIGURE 1

TYPICAL CHANNEL SECTION

TABLE A
WATERSHED DATA

						Soil Classification, Hydrologic Soil Group, and Curve Number (CN)			
Predicition Point	Watershed Area (ac)	Drainage Length (ft)	High Pt. Elev. (ft)	Low Pt. Elev. (ft)	Delta Elev. (ft)	Soil Type	% of Area	Hydrologic Gp.	CN
PP-0	NOT REQUIRED - REMOVED								
PP-1	340.8	11,235.0	5,655	5,311	344	Ba	100	D	91
PP-1A	27,705.5	62,720.0	5,890	5,190	700	Refer to Appendix 11-BB			
PP-2	8.6	963.0	5,403	5,300	103	Ba	100	D	91
PP-3	14.0	1,291.0	5,435	5,322	113	Ba	100	D	91
PP-3A	7.2	1,141.0	5,435	5,330	105	Ba	100	D	91
PP-3B	64.5	3,522.0	5,530	5,332	198	Ba	100	D	91
PP-BC	12.9	1,186.0	5,465	5,345	120	Ba	100	D	91
PP-4	6.1	1,269.0	5,463	5,368	95	Ba	100	D	91
PP-4A	9.8	1,580.0	5,473	5,372	101	Ba	100	D	91
PP-4B	9.1	1,680.0	5,482	5,394	88	Ba	100	D	91
PP-5	60.6	3,306.0	5,575	5,360	215	Ba	100	D	91
PP-6	23.2	2,230.0	5,525	5,410	115	Ba	100	D	91
PP-7	152.8	4,976.0	5,645	5,407	238	Ba	100	D	91
PP-8	34.5	2,459.0	5,605	5,407	198	Ba	100	D	91
PP-9	9.8	1,679.0	5,515	5,415	100	Ba	100	D	91
PP-10	56.0	3,508.0	5,620	5,422	198	Ba	100	D	91
PP-11	12.4	1,819.0	5,512	5,420	92	Ba	100	D	91
PP-12	NOT REQUIRED - REMOVED								
PP-13	NOT REQUIRED - REMOVED								
PP-14	330.4	9,091.0	5,645	5,383	262	Ba	100	D	91
PP-15	77.0	3,600.0	5,542	5,410	132	Ba	100	D	91
PP-16	677.3	14,649.0	5,655	5,432	223	Ba	100	D	91
PP-17	NOT REQUIRED - REMOVED								
PP-18	113.2	4,222.0	5,465	5,320	145	Reclaimed	100	n/a	76
PP-19	403.3	5,251	5,655	5,350	305	Reclaimed	100	n/a	76
PP-20	1,561.4	15,255	5,642	5,308	334	Reclaimed/Ba	31/69	n/a	86.4

TABLE A (Cont'd)

WATERSHED DATA

						Soil Classification, Hydrologic Soil Group, and Curve Number (CN)			
Predicition Point	Watershed Area (ac)	Drainage Length (ft)	High Pt. Elev. (ft)	Low Pt. Elev. (ft)	Delta Elev. (ft)	Soil Type	% of Area	Hydrologic Gp.	CN
PP21	NOT REQUIRED - REMOVED								
PP22	NOT REQUIRED - REMOVED								
PP23	26.7	2,016	5,530	5,355	175		100	D	87
PP24	NOT REQUIRED - REMOVED								
PP25	NOT REQUIRED - REMOVED								
PP26	NOT REQUIRED - REMOVED								
PP27	NOT REQUIRED - REMOVED								
PP28	296.9	6815	5,462	5,340	122	Reclaimed			80
PP29	25.6	1339	5,377	5,270	107	Reclaimed			80
PP30	13.2	850	5,402	5,287	115	Reclaimed			80
PP31	NOT REQUIRED - REMOVED								

TABLE B

AREA II CHANNEL HYDRAULIC DIMENSIONS

Prediction Point	Q_{10} (cfs) * Q_{25}	Slope (%)	Bottom Width (ft)	Side Slope (Z:1)	Flow Depth (ft)	D_{50} (ft)	Riprap/ Gabion Thickness (ft)
PP0	Not	required	-removed				
PP1(1)	139.2	8.6	10	3.0	0.85	0.33	0.5
PP1A(1)	1820.0	3.1	50.0	3.0	2.15	0.33	0.5
PP2	10.8	10.9	6.0	3.0	0.17	0.50	0.8
PP3	17.6	10.9	6.0	3.0	0.25	0.50	0.8
PP3A	9.0	9.6	6.0	3.0	0.17	0.50	0.8
PP3B	50.0	8.6	6.0	3.0	0.40	0.50	0.8
PP3C	16.8	10.8	6.0	3.0	0.24	0.50	0.8
PP4	7.7	9.9	6.0	3.0	0.14	0.50	0.8
PP4A	12.3	9.0	6.0	3.0	0.20	0.50	0.8
PP4B	11.4	9.3	6.0	3.0	0.19	0.50	0.8
PP5	47.0	12.4	9.0	3.0	0.42	0.75	1.2
PP6	29.1	8.2	6.0	3.0	0.40	0.75	1.2
PP7	107.6	7.7	12.0	3.0	0.75	0.75	1.2
PP8	43.3	8.8	6.0	3.0	0.53	0.75	1.2
PP9	12.3	6.9	6.0	3.0	0.22	0.6	0.8
PP10	43.4	7.2	9.0	3.0	0.44	0.50	0.8
PP11	15.6	6.8	6.0	3.0	0.26	0.50	0.8
PP12	Not	required	-removed				
PP13(1)	Not	required	-removed				
PP14	155.5	4.4	14.0	3.0	1.04	0.75	1.2
PP15	53.8	4.0	12.0	3.0	0.50	0.50	0.8
PP16(1)	358.1	2.2	10.0	3.0	2.04	0.33	0.5
PP17	Not	required	- removed				
PP18	12.8	2.4	6.0	3.0	0.24	0.50	0.8
PP19	48.4	2.3	6.0	3.0	0.64	0.75	1.2
PP20(1)	772.7	1.9	12.0	3.0	2.94	0.33	0.5

(1) Gabion structure

TABLE C

AREA III AND AREA IV NORTH CHANNEL HYDRAULIC DIMENSIONS

Prediction Point	Q_{10} (cfs) * Q_{25}	Slope (%)	Bottom Width (ft)	Side Slope (Z:1)	Flow Depth (ft)	D_{50} (ft)	Riprap Thickness (ft)
PP21	Not	required	-removed				
PP22	Not	required	-removed				
PP23	64.57	7.0	12.0	3.0	0.53	0.50	0.8
PP24	Not	required	-removed				
PP25	Not	required	-removed				
PP26 – Removed 04/11 Revision	Not	required	-removed				
PP27 – Removed 04/11 Revision	Not	required	-removed				
PP28	23.6	3.5	7.0	3.0	0.34	0.50	0.8
PP29	7.8	10.7	7.0	3.0	0.13	0.50	0.8
PP30	8.2	18.3	7.0	3.0	0.1	0.75	1.2
PP31 - Removed 04/11 Revision	Not	required	-removed				

TABLE D
AREA II RIPRAP COST ESTIMATE

Prediction Point	Riprap Channel Length (ft)	D_{50} (ft)	Riprap/Gabion Thickness (ft)	Channel Depth (ft)	Bottom Width (ft)	Side Slopes (Z:1)	Filter Fabric (SF)	Riprap/Gabion (CY)	Cost ($)
PP-0	NOT REQUIRED - REMOVED								
PP-1[(1)]	385	0.33	0.5	2.0	8.0	3.0	7,893	146	$ 18,892
PP-1A[(1)]	1010	0.33	0.5	3.5	50.0	3.0	73,503	1,361	$ 175,944
PP-2	600	0.50	0.8	1.5	6.0	3.0	9,225	273	$ 20,298
PP-3	570	0.50	0.8	1.5	6.0	3.0	8,764	260	$ 19,283
PP-3A	645	0.50	0.8	1.5	6.0	3.0	9,917	294	$ 21,821
PP-3B	695	0.50	0.8	1.5	6.0	3.0	10,686	317	$ 23,512
PP-3C	695	0.50	0.8	1.5	6.0	3.0	10,686	317	$ 23,512
PP-4	855	0.50	0.8	1.5	6.0	3.0	13,146	390	$ 28,925
PP-4A	875	0.50	0.8	1.5	6.0	3.0	13,453	399	$ 29,602
PP-4B	1085	0.50	0.8	1.5	6.0	3.0	16,682	494	$ 36,706
PP-5	845	0.75	1.2	2.0	9.0	3.0	18,189	808	$ 58,305
PP-6	1042	0.75	1.2	1.5	6.0	3.0	16,021	712	$ 51,355
PP-7	940	0.75	1.2	2.0	12.0	3.0	23,124	1,028	$ 74,125
PP-8	740	0.75	1.2	1.5	6.0	3.0	11,378	506	$ 36,471
PP-9	910	0.50	0.8	1.5	6.0	3.0	13,991	415	$ 30,786
PP-10	810	0.50	0.8	1.5	9.0	3.0	14,945	443	$ 32,883
PP-11	840	0.50	0.8	1.5	6.0	3.0	12,915	383	$ 28,418
PP-12	NOT REQUIRED - REMOVED								
PP-13[(1)]	NOT REQUIRED - REMOVED								
PP-14	850	0.75	1.2	2.0	14.0	3.0	22,653	1,007	$ 72,614
PP-15	710	0.50	0.8	1.5	12.0	3.0	15,283	453	$ 33,628
PP-16[(1)]	690	0.33	0.5	3.0	10.0	3.0	19,803	367	$ 47,403
PP-17	NOT REQUIRED - REMOVED								
PP-18	2530	0.50	0.8	1.5	6.0	3.0	38,899	1,153	$ 85,592
PP-19	870	0.75	1.2	1.5	6.0	3.0	13,376	595	$ 42,878
PP-20[(1)]	2110	0.33	0.5	4.0	12.0	3.0	77,859	1,442	$ 186,371
						Totals	**472,387**	**13,559**	**$ 1,179,326**

(1) Gabion Structure

Unit Cost Installed

	Unit	$/Unit	
Riprap	CY	$ 67.85	
Filter Fabric	SF	$ 0.19	RS Means cost data inflated from September 2009 to May 2011; inflation rate of 4.63% based on http://inflationdata.com

TABLE E

AREA III AND AREA IV NORTH RIPRAP COST ESTIMATE

Prediction Point	Riprap Channel Length (ft)	D50 (ft)	Riprap Thickness (ft)	Channel Depth (ft)	Bottom Width (ft)	Side Slopes (Z:1)	Filter Fabric (SF)	Riprap (CY)	Cost ($)
Area III									
PP 21	NOT REQUIRED - REMOVED								
PP 22	NOT REQUIRED - REMOVED								
PP 23	680	0.50	0.8	1.5	6.0	3.0	10,455	310	$ 23,005
PP 24	NOT REQUIRED - REMOVED								
PP 25	NOT REQUIRED - REMOVED								
						Subtotals	**10,455**	**310**	**$ 23,005**
Area IV North									
PP26	NOT REQUIRED - REMOVED								
PP27	NOT REQUIRED - REMOVED								
PP28	715	0.50	0.8	1.8	7.0	3.0	13,045	387	$ 28,704
PP29	608	0.50	0.8	1.3	7.0	3.0	9,223	273	$ 20,295
PP30	344	0.75	1.0	1.2	7.0	3.0	5,007	185	$ 13,534
PP31	NOT REQUIRED - REMOVED								
						Subtotals	**27,275**	**845**	**$ 62,533**
						Totals	**37,730**	**1,155**	**$ 85,537**

Unit Cost Installed

	Unit	$/Unit	
Riprap	CY	$ 67.85	
Filter Fabric	SF	$ 0.19	RS Means cost data inflated from September 2009 to May 2011; inflation rate of 4.63% based on http://inflationdata.com

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Bond Scenario 9/2014

Prediction Point PP-1, for watershed data see Appendix 12C, Exhibit 12C-1.

Revised Aug 2011

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General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-1

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	340.800	340.800	139.15	11.93

Structure Detail:

Structure #1 (Riprap Channel)

PP-1

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
10.00	3.0:1	3.0:1	8.6	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	139.15 cfs	
Depth:	0.90 ft	1.90 ft
Top Width:	15.43 ft	21.43 ft
Velocity*:		
X-Section Area:	11.50 sq ft	
Hydraulic Radius:	0.731 ft	
Froude Number*:		
Manning's n*:		
Dmin:	4.00 in	
D50:	12.00 in	
Dmax:	15.00 in	

Velocity and Manning's n calculations may not apply for this method.

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	340.800	0.663	0.000	0.000	91.000	M	139.15	11.935
	Σ	**340.800**						**139.15**	**11.935**

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	3.56	25.00	703.00	1.880	0.103
		8. Large gullies, diversions, and low flowing streams	3.03	319.00	10,532.00	5.220	0.560
#1	**1**	**Time of Concentration:**					**0.663**

Title: A2 Bond Scenario 2014
Description: Prediction Point PP-1

Folder:
Date: 26/08/2011

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Run n.1

Gradient [%]	8.60	Froude number	2.73
Discharge [ft3/s]	139.20	Cross section [ft2]	10.70
Water level [ft]	0.85	Wetted perimeter [ft]	15.39
Average velocity [ft/s]	13.01	Hydraulic radius [ft]	0.70

Stretch	Length [ft]	V [ft/s]	K	Vadm [ft/s]	Vb [ft/s]	Material	V	tau max [lb/ft2]	tau adm [lb/ft2]	GeoFil
2	6.00	0.00	1.00							
2.1	6.00			-	-	Stiff Clay (cohesive)	N	-	-	N
3	6.33	8.60	1.00							
3.1	6.33			5.00	2.18	Reno mattress 6"	N	3.55	4.36	Y
4	10.00	14.14	1.00							
4.1	10.00			5.00	2.18	Reno mattress 6"	N	4.66	4.68	Y
5	6.33	8.60	1.00							
5.1	6.33			5.00	2.18	Reno mattress 6"	N	3.55	4.36	Y
6	6.00	0.00	1.00							
6.1	6.00			-	-	Stiff Clay (cohesive)	N	-	-	N

1

Title: A2 Bond Scenario 2014
Description: Prediction Point PP-1

Folder:
Date: 26/08/2011

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Materials used

Description	Roughness	Allow. shear stress [lb/ft2]	V	Rock d50 [inch]	Thickness [ft]	Rockfill unit we [lb/ft3]	Time [h]	C Shields
Stiff Clay (cohesive)	0.0250	0.46	Y					
GabionMats 12"	0.0301	7.01	N	5.90	0.98	165.51		0.140
Reno mattress 6"	0.0277	4.68	N	3.94	0.56	165.51		0.140

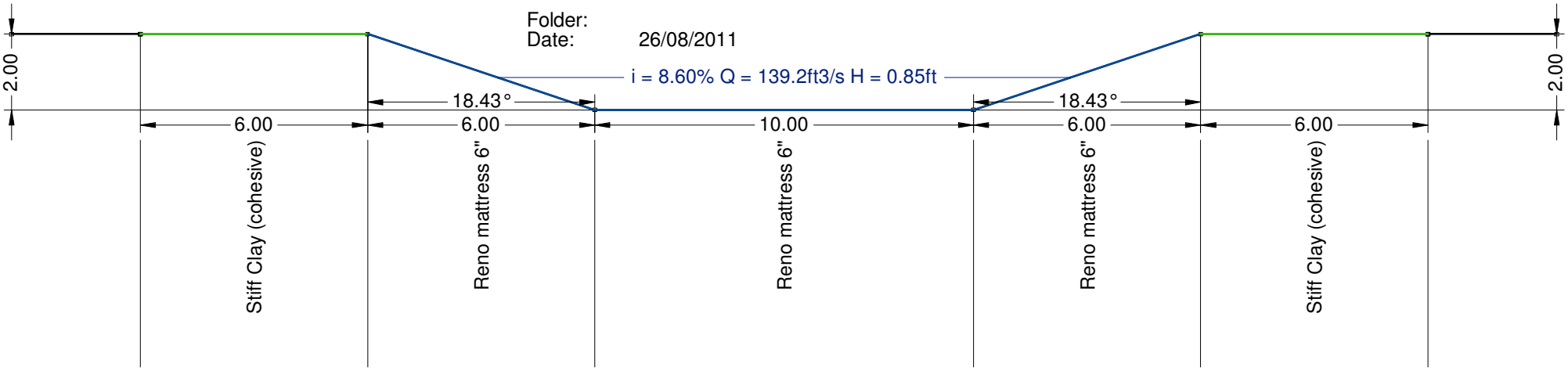
2

Macra1 2006

Maccaferri River Analysis
Bank Protections

Title: A2 Bond Scenario 2014
Description: Prediction Point PP-1

Folder:
Date: 26/08/2011



Bond Scenario 9/2014

Prediction Point PP 1A (Chinde Arroyo)

The 100 yr - 6 hour peak flow from the Chinde Arroyo post-mine hydrology model at Structure 23 was used to design the drop structure at PP-1A. The summary report is attach, the full report is presented in Appendix 11-BB. The hydrology model and drainage subdivisions are presented on Exhibit 11-75.

Revised Aug 2011

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General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	100 yr - 6 hr
Rainfall Depth:	1.970 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#42	1.386	0.156	
Null	#3	==>	#5	0.000	0.000	
Null	#4	==>	#5	0.000	0.000	
Null	#5	==>	#6	0.778	0.334	
Null	#6	==>	#40	1.118	0.289	
Null	#7	==>	#12	0.389	0.341	
Null	#8	==>	#12	0.213	0.373	
Null	#9	==>	#12	0.203	0.370	
Null	#10	==>	#12	0.122	0.381	
Null	#11	==>	#12	0.071	0.392	
Null	#12	==>	#25	0.584	0.301	
Null	#13	==>	#25	0.320	0.368	
Null	#14	==>	#38	0.749	0.206	
Null	#15	==>	#41	0.000	0.000	
Null	#16	==>	#38	0.043	0.404	
Null	#17	==>	#32	0.000	0.000	
Null	#18	==>	#41	0.076	0.313	
Null	#19	==>	#33	0.000	0.000	
Null	#21	==>	#25	0.188	0.334	
Null	#22	==>	#30	0.621	0.218	
Null	#23	==>	#24	0.494	0.312	Prediction Point PP-1A
Null	#24	==>	End	0.000	0.000	
Null	#25	==>	#27	0.354	0.297	
Null	#26	==>	#29	0.144	0.211	
Null	#27	==>	#28	0.450	0.301	
Null	#28	==>	#23	0.101	0.361	
Null	#29	==>	#40	0.653	0.305	
Null	#30	==>	#33	0.000	0.000	
Null	#31	==>	#32	0.274	0.297	
Null	#32	==>	#23	0.403	0.327	
Null	#33	==>	#18	0.349	0.315	
Null	#34	==>	#38	0.601	0.202	
Null	#35	==>	#23	0.080	0.367	
Null	#36	==>	#25	0.212	0.367	
Null	#37	==>	#4	1.717	0.316	
Null	#38	==>	#39	0.165	0.329	Doby Channel
Null	#39	==>	#15	0.342	0.321	Doby Permanent Imp.
Null	#40	==>	#41	0.000	0.000	
Null	#41	==>	#32	0.307	0.299	
Null	#42	==>	#3	1.479	0.221	
Null	#43	==>	#30	0.479	0.208	

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#35	105.000	105.000	87.92	4.54
#26	217.200	217.200	287.43	16.46
#29	90.200	307.400	344.35	23.38
#37	3,024.600	3,024.600	204.72	94.54
#4	2,965.700	5,990.300	729.12	200.23
#1	755.100	755.100	120.62	24.72
#42	2,360.600	3,115.700	232.09	107.00
#3	1,550.000	4,665.700	331.42	178.79
#5	0.000	10,656.000	944.96	379.02
#6	2,008.700	12,664.700	1,189.30	470.40
#40	155.400	13,127.500	1,178.49	497.79
#43	817.400	817.400	139.97	33.14
#22	163.500	163.500	181.57	11.85
#30	138.800	1,119.700	220.63	55.07
#19	452.600	452.600	223.90	25.65
#33	0.000	1,572.300	420.50	80.72
#18	119.500	1,691.800	421.70	83.80
#34	235.300	235.300	21.86	5.43
#16	1,570.700	1,570.700	136.03	38.49
#14	6,695.200	6,695.200	324.85	224.27
#38	0.000	8,501.199	394.09	268.19
#39	0.000	8,501.199	392.98	268.19
#15	600.300	9,101.499	417.17	283.66
#41	0.000	23,920.800	1,685.72	865.26
#31	120.200	120.200	52.49	3.12
#17	939.500	939.500	184.77	27.18
#32	168.000	25,148.500	1,716.62	899.89
#36	14.200	14.200	34.19	1.34
#21	90.300	90.300	135.69	6.83
#13	23.300	23.300	36.86	1.79
#11	154.900	154.900	231.87	11.71
#10	32.500	32.500	45.82	2.47
#9	15.000	15.000	36.11	1.42
#8	58.800	58.800	141.56	5.56
#7	204.800	204.800	237.30	14.93
#12	75.500	541.500	567.85	41.90
#25	359.300	1,028.600	722.39	73.33
#27	696.910	1,725.510	792.31	91.29
#28	534.300	2,259.810	799.81	105.08
#23	192.200	27,705.510	1,819.95	1,014.47

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#24	548.700	28,254.210	1,805.17	1,045.11

Title: A2 Bond Scenario 2014
Description: Prediction Point PP-1A

Folder:
Date: 30/08/2011

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Run n.1

Gradient [%]	3.10	Froude number	1.91
Discharge [ft3/s]	1820.00	Cross section [ft2]	121.19
Water level [ft]	2.15	Wetted perimeter [ft]	63.58
Average velocity [ft/s]	15.02	Hydraulic radius [ft]	1.91

Stretch	Length [ft]	V [ft/s]	K	Vadm [ft/s]	Vb [ft/s]	Material	V	tau max [lb/ft2]	tau adm [lb/ft2]	GeoFil
2	6.00	0.00	1.00							
2.1	6.00			-	-	Stiff Clay (cohesive)	N	-	-	N
3	11.07	9.56	1.00							
3.1	11.07			5.00	1.31	Reno mattress 6"	N	3.23	4.36	Y
4	50.00	15.72	1.00							
4.1	50.00			5.00	1.31	Reno mattress 6"	N	4.24	4.68	Y
5	11.07	9.56	1.00							
5.1	11.07			5.00	1.31	Reno mattress 6"	N	3.23	4.36	Y
6	6.00	0.00	1.00							
6.1	6.00			-	-	Stiff Clay (cohesive)	N	-	-	N

1

Title: A2 Bond Scenario 2014
Description: Prediction Point PP-1A

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Date: 30/08/2011

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Materials used

Description	Roughness	Allow. shear stress [lb/ft2]	V	Rock d50 [inch]	Thickness [ft]	Rockfill unit we [lb/ft3]	Time [h]	C Shields
Stiff Clay (cohesive)	0.0250	0.46	Y					
Reno mattress 6"	0.0277	4.68	N	3.94	0.56	165.51		0.140

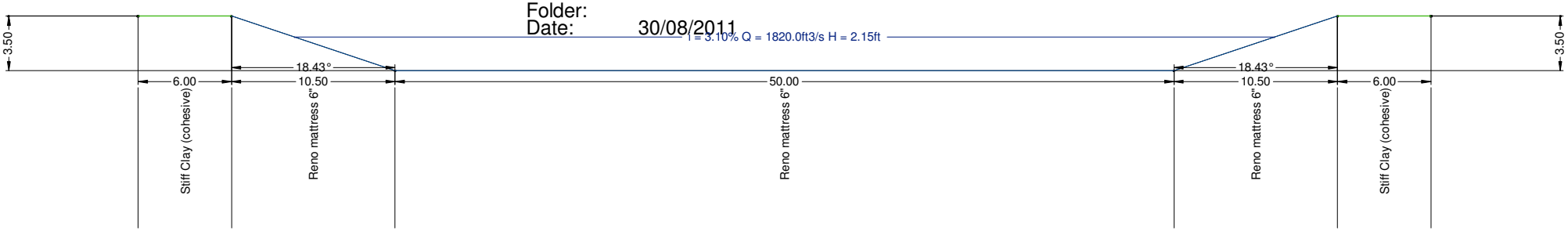
2

Macra1 2006

Maccaferri River Analysis
Bank Protections

Title: A2 Bond Scenario 2014
Description: Prediction Point PP-1A

Folder:
Date: 30/08/2011



Bond Scenario 9/2014

Prediction Point PP-2, for watershed data see Appendix 12C, Exhibit 12C-1.

Revised Aug 2011

LR

BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-2

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	8.600	8.600	10.79	0.38

Structure Detail:

Structure #1 (Riprap Channel)

PP-2

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
6.00	3.0:1	3.0:1	10.9	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	10.79 cfs	
Depth:	0.17 ft	1.17 ft
Top Width:	7.04 ft	13.04 ft
Velocity*:		
X-Section Area:	1.13 sq ft	
Hydraulic Radius:	0.160 ft	
Froude Number*:		
Manning's n*:		
Dmin:	2.00 in	
D50:	6.00 in	
Dmax:	7.50 in	

Velocity and Manning's n calculations may not apply for this method.

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	8.600	0.031	0.000	0.000	91.000	M	10.79	0.377
	Σ	**8.600**						**10.79**	**0.377**

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	12.74	13.00	102.00	3.570	0.007
		8. Large gullies, diversions, and low flowing streams	10.45	90.00	861.00	9.690	0.024
#1	**1**	**Time of Concentration:**					**0.031**

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Prediction Point PP-3,for watershed data see Appendix 12C, Exhibit 12C-1.

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BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-3

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	14.000	14.000	17.56	0.61

Structure Detail:

Structure #1 (Riprap Channel)

PP-3

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
6.00	3.0:1	3.0:1	10.9	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	17.56 cfs	
Depth:	0.25 ft	1.25 ft
Top Width:	7.51 ft	13.51 ft
Velocity*:		
X-Section Area:	1.70 sq ft	
Hydraulic Radius:	0.224 ft	
Froude Number*:		
Manning's n*:		
Dmin:	2.00 in	
D50:	6.00 in	
Dmax:	7.50 in	

Velocity and Manning's n calculations may not apply for this method.

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	14.000	0.051	0.000	0.000	91.000	M	17.56	0.614
	Σ	**14.000**						**17.56**	**0.614**

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	8.33	15.00	180.00	2.880	0.017
		8. Large gullies, diversions, and low flowing streams	8.82	98.00	1,111.00	8.900	0.034
#1	**1**	**Time of Concentration:**					**0.051**

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Prediction Point PP-3A, for watershed data see Appendix 12C, Exhibit 12C-1.

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BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-3A

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	7.200	7.200	9.03	0.32

Structure Detail:

Structure #1 (Riprap Channel)

PP-3A

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
6.00	3.0:1	3.0:1	9.6	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	9.03 cfs	
Depth:	0.16 ft	1.16 ft
Top Width:	6.96 ft	12.96 ft
Velocity*:		
X-Section Area:	1.03 sq ft	
Hydraulic Radius:	0.147 ft	
Froude Number*:		
Manning's n*:		
Dmin:	2.00 in	
D50:	6.00 in	
Dmax:	7.50 in	

Velocity and Manning's n calculations may not apply for this method.

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	7.200	0.040	0.000	0.000	91.000	M	9.03	0.316
	Σ	**7.200**						**9.03**	**0.316**

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	12.30	15.00	122.00	3.500	0.009
		8. Large gullies, diversions, and low flowing streams	8.83	90.00	1,019.00	8.910	0.031
#1	**1**	**Time of Concentration:**					**0.040**

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Prediction Point PP-3B, for watershed data see Appendix 12C, Exhibit 12C-1.

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BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-3B

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	64.500	64.500	49.98	2.30

Structure Detail:

Structure #1 (Riprap Channel)

PP-3B

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
12.00	3.0:1	3.0:1	8.7	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	49.98 cfs	
Depth:	0.40 ft	1.40 ft
Top Width:	14.42 ft	20.42 ft
Velocity*:		
X-Section Area:	5.32 sq ft	
Hydraulic Radius:	0.366 ft	
Froude Number*:		
Manning's n*:		
Dmin:	2.00 in	
D50:	6.00 in	
Dmax:	7.50 in	

Velocity and Manning's n calculations may not apply for this method.

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	64.500	0.155	0.000	0.000	91.000	M	49.98	2.302
	Σ	**64.500**						**49.98**	**2.302**

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	10.49	30.00	286.00	3.230	0.024
		8. Large gullies, diversions, and low flowing streams	5.19	168.00	3,236.00	6.830	0.131
#1	**1**	**Time of Concentration:**					**0.155**

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Prediction Point PP-3C, for watershed data see Appendix 12C, Exhibit 12C-1.

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BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-3C

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	12.900	12.900	16.18	0.57

Structure Detail:

Structure #1 (Riprap Channel)

PP-3C

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
6.00	3.0:1	3.0:1	10.8	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	16.18 cfs	
Depth:	0.24 ft	1.24 ft
Top Width:	7.42 ft	13.42 ft
Velocity*:		
X-Section Area:	1.59 sq ft	
Hydraulic Radius:	0.212 ft	
Froude Number*:		
Manning's n*:		
Dmin:	2.00 in	
D50:	6.00 in	
Dmax:	7.50 in	

Velocity and Manning's n calculations may not apply for this method.

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	12.900	0.045	0.000	0.000	91.000	M	16.18	0.566
	Σ	**12.900**						**16.18**	**0.566**

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	12.22	27.00	221.00	3.490	0.017
		8. Large gullies, diversions, and low flowing streams	9.64	93.00	965.01	9.310	0.028
#1	**1**	**Time of Concentration:**					**0.045**

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Prediction Point PP-4, for watershed data see Appendix 12C, Exhibit 12C-1.

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General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-4

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	6.100	6.100	7.65	0.27

Structure Detail:

Structure #1 (Riprap Channel)

PP-4

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
6.00	3.0:1	3.0:1	9.9	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	7.65 cfs	
Depth:	0.14 ft	1.14 ft
Top Width:	6.84 ft	12.84 ft
Velocity*:		
X-Section Area:	0.90 sq ft	
Hydraulic Radius:	0.131 ft	
Froude Number*:		
Manning's n*:		
Dmin:	2.00 in	
D50:	6.00 in	
Dmax:	7.50 in	

Velocity and Manning's n calculations may not apply for this method.

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	6.100	0.054	0.000	0.000	91.000	M	7.65	0.267
	Σ	**6.100**						**7.65**	**0.267**

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	8.33	16.00	192.00	2.880	0.018
		8. Large gullies, diversions, and low flowing streams	7.34	79.00	1,077.00	8.120	0.036
#1	**1**	**Time of Concentration:**					**0.054**

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Prediction Point PP-4A, for watershed data see Appendix 12C, Exhibit 12C-1.

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BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-4A

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	9.800	9.800	12.30	0.43

Structure Detail:

Structure #1 (Riprap Channel)

PP-4A

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
6.00	3.0:1	3.0:1	9.0	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	12.30 cfs	
Depth:	0.20 ft	1.20 ft
Top Width:	7.22 ft	13.22 ft
Velocity*:		
X-Section Area:	1.35 sq ft	
Hydraulic Radius:	0.185 ft	
Froude Number*:		
Manning's n*:		
Dmin:	2.00 in	
D50:	6.00 in	
Dmax:	7.50 in	

Velocity and Manning's n calculations may not apply for this method.

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	9.800	0.071	0.000	0.000	91.000	M	12.30	0.430
	Σ	**9.800**						**12.30**	**0.430**

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	6.63	13.00	196.00	2.570	0.021
		8. Large gullies, diversions, and low flowing streams	6.36	88.00	1,384.00	7.560	0.050
#1	**1**	**Time of Concentration:**					**0.071**

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Prediction Point PP-4B, for watershed data see Appendix 12C, Exhibit 12C-1.

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BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-4B

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	9.100	9.100	11.42	0.40

Structure Detail:

Structure #1 (Riprap Channel)

PP-4B

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
6.00	3.0:1	3.0:1	9.3	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	11.42 cfs	
Depth:	0.19 ft	1.19 ft
Top Width:	7.15 ft	13.15 ft
Velocity*:		
X-Section Area:	1.26 sq ft	
Hydraulic Radius:	0.174 ft	
Froude Number*:		
Manning's n*:		
Dmin:	2.00 in	
D50:	6.00 in	
Dmax:	7.50 in	

Velocity and Manning's n calculations may not apply for this method.

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	9.100	0.094	0.000	0.000	91.000	M	11.42	0.399
	Σ	**9.100**						**11.42**	**0.399**

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	4.17	12.00	288.00	2.040	0.039
		8. Large gullies, diversions, and low flowing streams	5.46	76.00	1,392.01	7.000	0.055
#1	**1**	**Time of Concentration:**					**0.094**

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Prediction Point PP-5, for watershed data see Appendix 12C, Exhibit 12C-1.

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BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-5

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	60.600	60.600	46.96	2.16

Structure Detail:

Structure #1 (Riprap Channel)

PP-5

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
9.00	3.0:1	3.0:1	12.4	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	46.96 cfs	
Depth:	0.42 ft	1.42 ft
Top Width:	11.49 ft	17.49 ft
Velocity*:		
X-Section Area:	4.26 sq ft	
Hydraulic Radius:	0.366 ft	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

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	60.600	0.138	0.000	0.000	91.000	M	46.96	2.163
	Σ	**60.600**						**46.96**	**2.163**

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	14.95	45.00	301.00	3.860	0.021
		8. Large gullies, diversions, and low flowing streams	5.66	170.00	3,005.02	7.130	0.117
#1	**1**	**Time of Concentration:**					**0.138**

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Prediction Point PP-6, for watershed data see Appendix 12C, Exhibit 12C-1.

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BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-6

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	23.200	23.200	29.11	1.02

Structure Detail:

Structure #1 (Riprap Channel)

PP-6

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
6.00	3.0:1	3.0:1	8.2	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	29.11 cfs	
Depth:	0.40 ft	1.40 ft
Top Width:	8.41 ft	14.41 ft
Velocity*:		
X-Section Area:	2.90 sq ft	
Hydraulic Radius:	0.339 ft	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

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	23.200	0.113	0.000	0.000	91.000	M	29.11	1.017
	Σ	**23.200**						**29.11**	**1.017**

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	10.48	35.00	334.00	3.230	0.028
		8. Large gullies, diversions, and low flowing streams	4.22	80.00	1,896.00	6.160	0.085
#1	**1**	**Time of Concentration:**					**0.113**

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Prediction Point PP-7, for watershed data see Apendix 12C, Exhibit 12C-1.

Revised Aug 2011

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BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-7

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	152.800	152.800	107.60	5.39

Structure Detail:

Structure #1 (Riprap Channel)

PP-7

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
12.00	3.0:1	3.0:1	7.7	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	107.60 cfs	
Depth:	0.75 ft	1.75 ft
Top Width:	16.48 ft	22.48 ft
Velocity*:		
X-Section Area:	10.64 sq ft	
Hydraulic Radius:	0.636 ft	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

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	152.800	0.221	0.000	0.000	91.000	M	107.60	5.389
	Σ	**152.800**						**107.60**	**5.389**

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	20.33	25.00	123.00	4.500	0.007
		8. Large gullies, diversions, and low flowing streams	4.39	213.00	4,853.00	6.280	0.214
#1	**1**	**Time of Concentration:**					**0.221**

Bond Scenario 9/2014

Prediction Point PP-8, for watershed data see Appendix 12C, Exhibit 12C-1.

Revised Aug 2011

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BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-8

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	34.500	34.500	43.28	1.51

Structure Detail:

Structure #1 (Riprap Channel)

PP-8

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
6.00	3.0:1	3.0:1	8.8	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	43.28 cfs	
Depth:	0.53 ft	1.53 ft
Top Width:	9.17 ft	15.17 ft
Velocity*:		
X-Section Area:	4.00 sq ft	
Hydraulic Radius:	0.429 ft	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

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	34.500	0.106	0.000	0.000	91.000	M	43.28	1.513
	Σ	**34.500**						**43.28**	**1.513**

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	29.87	95.00	318.00	5.460	0.016
		8. Large gullies, diversions, and low flowing streams	4.81	103.00	2,141.00	6.580	0.090
#1	**1**	**Time of Concentration:**					**0.106**

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Prediction Point PP-9, for watershed data see Appendix 12C, Exhibit 12C-1.

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BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-9

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	9.800	9.800	12.30	0.43

Structure Detail:

Structure #1 (Riprap Channel)

PP-9

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
6.00	3.0:1	3.0:1	6.9	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	12.30 cfs	
Depth:	0.22 ft	1.22 ft
Top Width:	7.31 ft	13.31 ft
Velocity*:		
X-Section Area:	1.45 sq ft	
Hydraulic Radius:	0.196 ft	
Froude Number*:		
Manning's n*:		
Dmin:	2.00 in	
D50:	6.00 in	
Dmax:	7.50 in	

Velocity and Manning's n calculations may not apply for this method.

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	9.800	0.079	0.000	0.000	91.000	M	12.30	0.430
	Σ	**9.800**						**12.30**	**0.430**

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	9.77	25.00	256.00	3.120	0.022
		8. Large gullies, diversions, and low flowing streams	5.27	75.00	1,423.00	6.880	0.057
#1	**1**	**Time of Concentration:**					**0.079**

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Bond Scenario 9/2014

Prediction Point PP-10, for watershed data see Appendix 12C, Exhibit 12C-1.

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BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-10

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	56.000	56.000	43.39	2.00

Structure Detail:

Structure #1 (Riprap Channel)

PP-10

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
9.00	3.0:1	3.0:1	7.2	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	43.39 cfs	
Depth:	0.44 ft	1.44 ft
Top Width:	11.63 ft	17.63 ft
Velocity*:		
X-Section Area:	4.52 sq ft	
Hydraulic Radius:	0.384 ft	
Froude Number*:		
Manning's n*:		
Dmin:	2.00 in	
D50:	6.00 in	
Dmax:	7.50 in	

Velocity and Manning's n calculations may not apply for this method.

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	56.000	0.155	0.000	0.000	91.000	M	43.39	1.999
	Σ	**56.000**						**43.39**	**1.999**

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	34.01	50.00	147.00	5.830	0.007
		8. Large gullies, diversions, and low flowing streams	4.40	148.00	3,361.00	6.290	0.148
#1	**1**	**Time of Concentration:**					**0.155**

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Bond Scenario 9/2014

Prediction Point PP-11, for watershed data see Appendix 12C, Exhibit 12C-1.

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BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-11

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	12.400	12.400	15.56	0.54

Structure Detail:

Structure #1 (Riprap Channel)

PP-11

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
6.00	3.0:1	3.0:1	6.8	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	15.56 cfs	
Depth:	0.26 ft	1.26 ft
Top Width:	7.56 ft	13.56 ft
Velocity*:		
X-Section Area:	1.76 sq ft	
Hydraulic Radius:	0.231 ft	
Froude Number*:		
Manning's n*:		
Dmin:	2.00 in	
D50:	6.00 in	
Dmax:	7.50 in	

Velocity and Manning's n calculations may not apply for this method.

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	12.400	0.024	0.000	0.000	91.000	M	15.56	0.544
	Σ	**12.400**						**15.56**	**0.544**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	9. Small streams flowing bankfull	5.06	92.00	1,819.00	20.240	0.024
#1	**1**	**Time of Concentration:**					**0.024**

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Bond Scenario 9/2014

Prediction Point PP-14, for watershed data see Appendix 12C, Exhibit 12C-1.

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BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-14

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	330.400	330.400	155.50	11.57

Structure Detail:

Structure #1 (Riprap Channel)

PP-14

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
14.00	3.0:1	3.0:1	4.4	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	155.50 cfs	
Depth:	1.04 ft	2.04 ft
Top Width:	20.21 ft	26.21 ft
Velocity*:		
X-Section Area:	17.72 sq ft	
Hydraulic Radius:	0.862 ft	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

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	330.400	0.532	0.000	0.000	91.000	M	155.50	11.570
	Σ	**330.400**						**155.50**	**11.570**

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	6.19	25.00	404.00	2.480	0.045
		8. Large gullies, diversions, and low flowing streams	2.73	237.00	8,687.00	4.950	0.487
#1	**1**	**Time of Concentration:**					**0.532**

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Bond Scenario 9/2014

Prediction Point PP-15, for watershed data see Appendix 12C, Exhibit 12C-1.

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BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-15

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	77.000	77.000	53.76	2.72

Structure Detail:

Structure #1 (Riprap Channel)

PP-15

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
12.00	3.0:1	3.0:1	4.0	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	53.76 cfs	
Depth:	0.50 ft	1.50 ft
Top Width:	15.01 ft	21.01 ft
Velocity*:		
X-Section Area:	6.77 sq ft	
Hydraulic Radius:	0.446 ft	
Froude Number*:		
Manning's n*:		
Dmin:	2.00 in	
D50:	6.00 in	
Dmax:	7.50 in	

Velocity and Manning's n calculations may not apply for this method.

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	77.000	0.228	0.000	0.000	91.000	M	53.76	2.719
	Σ	**77.000**						**53.76**	**2.719**

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	3.81	22.00	577.00	1.950	0.082
		8. Large gullies, diversions, and low flowing streams	3.64	110.00	3,023.00	5.720	0.146
#1	**1**	**Time of Concentration:**					**0.228**

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Bond Scenario 9/2014

Prediction Point PP-16, for watershed data see Appendix 12C, Exhibit 12C-1.

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BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	100 yr - 6 hr
Rainfall Depth:	1.970 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-16

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	677.300	677.300	358.13	51.10

Structure Detail:

Structure #1 (Riprap Channel)

PP-16

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
10.00	3.0:1	3.0:1	2.2	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	358.13 cfs	
Depth:	1.55 ft	2.55 ft
Top Width:	19.28 ft	25.28 ft
Velocity*:		
X-Section Area:	22.64 sq ft	
Hydraulic Radius:	1.145 ft	
Froude Number*:		
Manning's n*:		
Dmin:	8.00 in	
D50:	24.00 in	
Dmax:	30.00 in	

Velocity and Manning's n calculations may not apply for this method.

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	677.300	1.374	0.000	0.000	91.000	M	358.13	51.097
	Σ	**677.300**						**358.13**	**51.097**

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	1.03	15.00	1,457.01	1.010	0.400
		8. Large gullies, diversions, and low flowing streams	1.58	208.00	13,192.11	3.760	0.974
#1	**1**	**Time of Concentration:**					**1.374**

Title: A2 Bond Scenario 2014
Description: Prediction Point PP-16

Folder:
Date: 26/08/2011

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Run n.1

Gradient [%]	2.20	Froude number	1.58
Discharge [ft3/s]	358.10	Cross section [ft2]	32.87
Water level [ft]	2.04	Wetted perimeter [ft]	22.90
Average velocity [ft/s]	10.89	Hydraulic radius [ft]	1.44

Stretch	Length [ft]	V [ft/s]	K	Vadm [ft/s]	Vb [ft/s]	Material	V	tau max [lb/ft2]	tau adm [lb/ft2]	GeoFil
2	6.00	0.00	1.00							
2.1	6.00			-	-	Stiff Clay (cohesive)	N	-	-	N
3	9.49	7.78	1.00							
3.1	9.49			5.00	1.10	Reno mattress 6"	N	2.18	4.36	Y
4	10.00	12.80	1.00							
4.1	10.00			5.00	1.10	Reno mattress 6"	N	2.86	4.68	Y
5	9.49	7.78	1.00							
5.1	9.49			5.00	1.10	Reno mattress 6"	N	2.18	4.36	Y
6	6.00	0.00	1.00							
6.1	6.00			-	-	Stiff Clay (cohesive)	N	-	-	N

1

Title: A2 Bond Scenario 2014
Description: Prediction Point PP-16

Folder:
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Materials used

Description	Roughness	Allow. shear stress [lb/ft2]	V	Rock d50 [inch]	Thickness [ft]	Rockfill unit we [lb/ft3]	Time [h]	C Shields
Stiff Clay (cohesive)	0.0250	0.46	Y					
Reno mattress 6"	0.0277	4.68	N	3.94	0.56	165.51		0.140

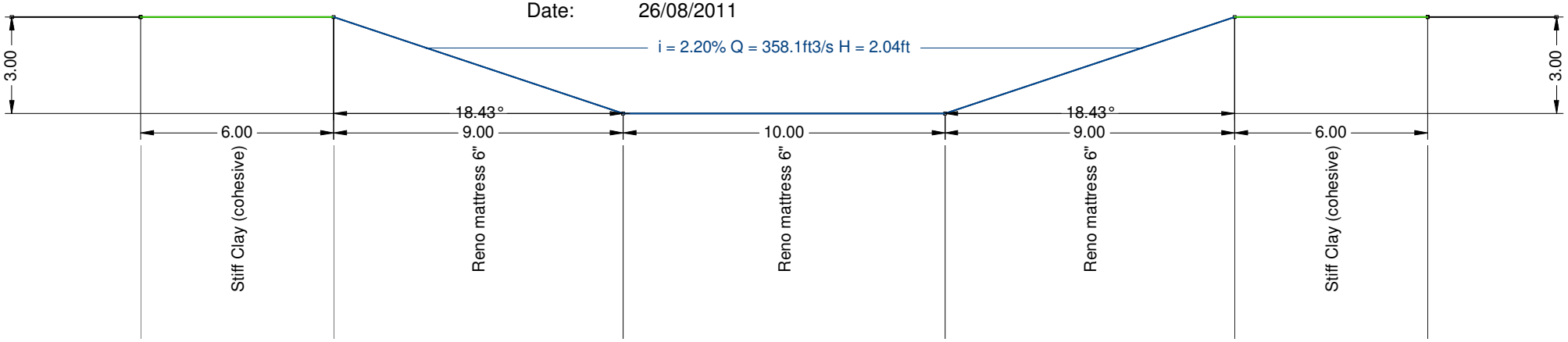
2

Macra1 2006

Maccaferri River Analysis
Bank Protections

Title: A2 Bond Scenario 2014
Description: Prediction Point PP-16

Folder:
Date: 26/08/2011



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Bond Scenario 9/2014

Prediction Point PP-18, for watershed data see Appendix 12C, Exhibit 12C-1.

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BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-18

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	113.200	113.200	12.75	0.72

Structure Detail:

Structure #1 (Riprap Channel)

PP-18

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
6.00	3.0:1	3.0:1	2.4	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	12.75 cfs	
Depth:	0.24 ft	1.24 ft
Top Width:	7.42 ft	13.42 ft
Velocity*:		
X-Section Area:	1.59 sq ft	
Hydraulic Radius:	0.212 ft	
Froude Number*:		
Manning's n*:		
Dmin:	1.00 in	
D50:	3.00 in	
Dmax:	3.75 in	

Velocity and Manning's n calculations may not apply for this method.

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	113.200	0.258	0.000	0.000	76.000	M	12.75	0.721
	Σ	**113.200**						**12.75**	**0.721**

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	8.41	45.00	535.00	2.900	0.051
		8. Large gullies, diversions, and low flowing streams	2.71	100.00	3,687.00	4.940	0.207
#1	**1**	**Time of Concentration:**					**0.258**

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Bond Scenario 9/2014

Prediction Point PP-19, for watershed data see Appendix 12C, Exhibit 12C-1.

Revised Aug 2011

LR

BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP19

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	403.300	403.300	48.41	2.58

Structure Detail:

Structure #1 (Riprap Channel)

PP19

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
6.00	3.0:1	3.0:1	2.3	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	48.41 cfs	
Depth:	0.64 ft	1.64 ft
Top Width:	9.84 ft	15.84 ft
Velocity*:		
X-Section Area:	5.07 sq ft	
Hydraulic Radius:	0.505 ft	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

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	403.300	0.231	0.000	0.000	76.000	M	48.41	2.576
	Σ	**403.300**						**48.41**	**2.576**

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	6.28	25.00	398.00	2.500	0.044
		8. Large gullies, diversions, and low flowing streams	5.77	280.00	4,853.00	7.200	0.187
#1	**1**	**Time of Concentration:**					**0.231**

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Bond Scenario 9/2014

Prediction Point PP-20, for watershed data see Appendix 12C, Exhibit 12C-1.

Revised Aug 2011

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BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	100 yr - 6 hr
Rainfall Depth:	1.970 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-20

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	1,561.400	1,561.400	772.70	87.91

Structure Detail:

Structure #1 (Riprap Channel)

PP-20

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
15.00	3.0:1	3.0:1	1.9	1.00		

Riprap Channel Results:

Simons/OSM Method - Mild Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	772.70 cfs	
Depth:	0.00 ft	
Top Width:	0.00 ft	
Velocity:	0.00 fps	
X-Section Area:	0.00 sq ft	
Hydraulic Radius:	0.000 ft	
Froude Number:	0.00	
Manning's n:	0.0000	
Dmin:	0.00 in	
D50:	0.00 in	
Dmax:	0.00 in	

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	1,561.400	0.999	0.000	0.000	86.400	M	772.70	87.907
	Σ	**1,561.400**						**772.70**	**87.907**

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	5.30	22.00	415.00	2.300	0.050
		8. Large gullies, diversions, and low flowing streams	2.10	312.00	14,840.00	4.340	0.949
#1	**1**	**Time of Concentration:**					**0.999**

Title: A2 Bond Scenario 2014
Description: Prediction Point PP-20

Folder:
Date: 30/08/2011

Notice
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Run n.1

Gradient [%]	1.90	Froude number	1.55
Discharge [ft3/s]	773.00	Cross section [ft2]	61.11
Water level [ft]	2.94	Wetted perimeter [ft]	30.58
Average velocity [ft/s]	12.65	Hydraulic radius [ft]	2.00

Stretch	Length [ft]	V [ft/s]	K	Vadm [ft/s]	Vb [ft/s]	Material	V	tau max [lb/ft2]	tau adm [lb/ft2]	GeoFil
2	2.00	0.00	1.00							
2.1	2.00			-	-	Stiff Clay (cohesive)	N	-	-	N
3	12.65	9.22	1.00							
3.1	12.65			5.00	1.02	Reno mattress 6"	N	2.71	4.36	Y
4	12.00	15.16	1.00							
4.1	12.00			5.00	1.02	Reno mattress 6"	N	3.55	4.68	Y
5	12.65	9.22	1.00							
5.1	12.65			5.00	1.02	Reno mattress 6"	N	2.71	4.36	Y
6	2.00	0.00	1.00							
6.1	2.00			-	-	Stiff Clay (cohesive)	N	-	-	N

1

Title: A2 Bond Scenario 2014
Description: Prediction Point PP-20

Folder:
Date: 30/08/2011

Notice
Maccaferri is not responsible for the drawings and the calculations trasmitted, since they should be intended as general design outlines and advice,aiming only to the best use of the products.

Materials used

Description	Roughness	Allow. shear stress [lb/ft2]	V	Rock d50 [inch]	Thickness [ft]	Rockfill unit we [lb/ft3]	Time [h]	C Shields
Stiff Clay (cohesive)	0.0250	0.46	Y					
Reno mattress 6"	0.0277	4.68	N	3.94	0.56	165.51		0.140

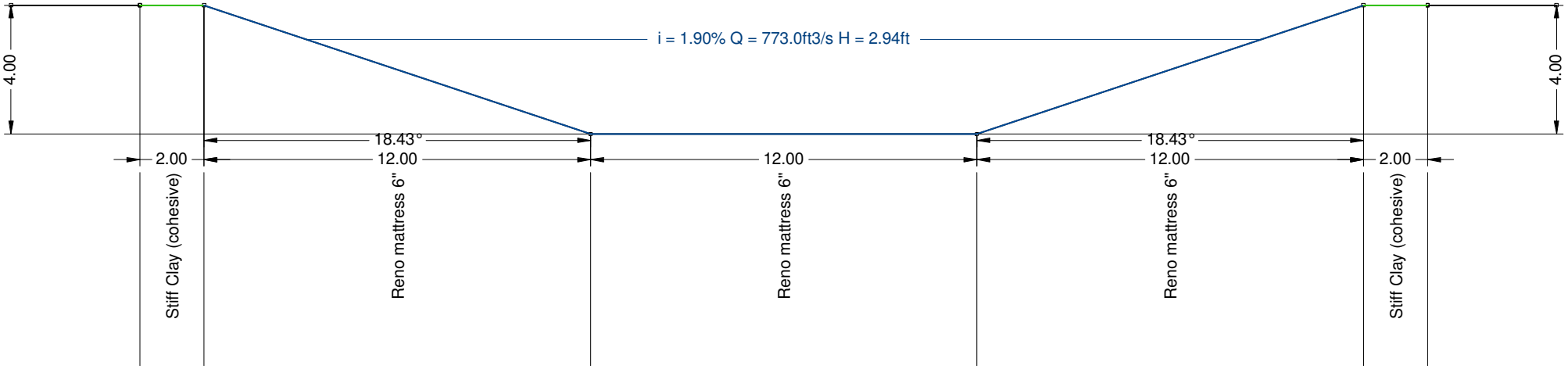
2

Macra1 2006

Maccaferri River Analysis
Bank Protections

Title: A2 Bond Scenario 2014
Description: Prediction Point PP-20

Folder:
Date: 30/08/2011



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Bond Scenario 9/2014

Prediction Point PP-23, for watershed data see Appendix 12C, Exhibit 12C-2.

Revised Aug 2011

LR

BHP Navajo Coal Company

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	PP-23

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	26.700	26.700	14.15	0.64

Structure Detail:

Structure #1 (Riprap Channel)

PP-23

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
6.00	3.0:1	3.0:1	2.9	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	14.15 cfs	
Depth:	0.26 ft	1.26 ft
Top Width:	7.53 ft	13.53 ft
Velocity*:		
X-Section Area:	1.73 sq ft	
Hydraulic Radius:	0.227 ft	
Froude Number*:		
Manning's n*:		
Dmin:	2.00 in	
D50:	6.00 in	
Dmax:	7.50 in	

Velocity and Manning's n calculations may not apply for this method.

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	26.700	0.185	0.000	0.000	87.000	M	14.15	0.642
	Σ	**26.700**						**14.15**	**0.642**

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	1.66	5.00	302.00	1.280	0.065
		8. Large gullies, diversions, and low flowing streams	1.75	30.00	1,714.00	3.960	0.120
#1	**1**	**Time of Concentration:**					**0.185**

Bond Scenario 9/2014

Area-4 North

Prediction Point PP-28

10-yr, 6-hr

BHP Billiton
Navajo Mine
PO Box 1717
Fruitland, NM 87416

Phone: 505 598 2007

General Information

Storm Information:

Storm Type:	NRCS TYPE II-70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.300 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#3	==>	End	0.000	0.000	Prediction Point PP-28

#3
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#3	296.900	296.900	23.55	3.82

Structure Detail:

Structure #3 (Riprap Channel)

Prediction Point PP-28

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
7.00	3.0:1	3.0:1	3.5	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	23.55 cfs	
Depth:	0.34 ft	1.34 ft
Top Width:	9.05 ft	15.05 ft
Velocity*:		
X-Section Area:	2.74 sq ft	
Hydraulic Radius:	0.300 ft	
Froude Number*:		
Manning's n*:		
Dmin:	2.00 in	
D50:	6.00 in	
Dmax:	7.50 in	

Velocity and Manning's n calculations may not apply for this method.

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)
#3	1	296.900	1.423	0.000	0.000	80.000	M	23.55	3.820
	Σ	**296.900**						**23.55**	**3.820**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#3	1	5. Nearly bare and untilled, and alluvial valley fans	1.79	122.00	6,815.26	1.330	1.423
#3	**1**	**Time of Concentration:**					**1.423**

Bond Scenario 9/2014

Area 4 North

Prediction Point PP-29

10-yr, 6-hr

BHP Billiton
Navajo Mine
PO Box 1717
Fruitland, NM 87416

Phone: 505 598 2007

General Information

Storm Information:

Storm Type:	NRCS TYPE II-70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.300 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	Prediction Point PP-29

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	25.600	25.600	7.81	0.34

Structure Detail:

Structure #1 (Riprap Channel)

Prediction Point PP-29

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
7.00	3.0:1	3.0:1	10.7	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	7.81 cfs	
Depth:	0.13 ft	1.13 ft
Top Width:	7.79 ft	13.79 ft
Velocity*:		
X-Section Area:	0.97 sq ft	
Hydraulic Radius:	0.124 ft	
Froude Number*:		
Manning's n*:		
Dmin:	2.00 in	
D50:	6.00 in	
Dmax:	7.50 in	

Velocity and Manning's n calculations may not apply for this method.

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	25.600	0.131	0.000	0.000	80.000	M	7.81	0.336
	Σ	**25.600**						**7.81**	**0.336**

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	7.99	107.00	1,339.00	2.820	0.131
#1	**1**	**Time of Concentration:**					**0.131**

Bond Scenario 9/2014

Area 4 North

Prediction Point PP-30

10-yr, 6-hr

BHP Billiton
Navajo Mine
PO Box 1717
Fruitland, NM 87416

Phone: 505 598 2007

General Information

Storm Information:

Storm Type:	NRCS TYPE II-70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.300 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	Prediction Point PP-30

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	13.200	13.200	8.17	0.21

Structure Detail:

Structure #1 (Riprap Channel)

Prediction Point PP-30

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
7.00	3.0:1	3.0:1	18.3	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	8.17 cfs	
Depth:	0.10 ft	1.10 ft
Top Width:	7.60 ft	13.60 ft
Velocity*:		
X-Section Area:	0.73 sq ft	
Hydraulic Radius:	0.096 ft	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

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	13.200	0.064	0.000	0.000	80.000	M	8.17	0.213
	Σ	**13.200**						**8.17**	**0.213**

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	13.53	115.00	850.00	3.670	0.064
#1	**1**	**Time of Concentration:**					**0.064**