SECTION 26

DRAINAGE CONTROL PLAN

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SECTION 26

DRAINAGE CONTROL PLAN

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26.2-1	Drainage Control Structures

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SECTION 26

DRAINAGE CONTROL PLAN

LIST OF EXHIBITS

EXHIBIT NUMBER	EXHIBIT TITLE
26.1-1	Drainage Control Plan - Control Structures and Watersheds
26.3-1	Pond 415 Design
26.3-2	Pond 416 Design

Field Code Changed

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SECTION 26

DRAINAGE CONTROL PLAN

LIST OF APPENDICES

APPENDIX NUMBER	**APPENDIX TITLE**
26.A	Pond 415 Hydrologic Analysis and Design
26.B	Pond 416 Hydrologic Analysis and Design

Field Code Changed

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SECTION 26

DRAINAGE CONTROL PLAN

LIST OF REVISIONS DURING PERMIT TERM

REV. NUMBER	REVISION DESCRIPTION	DATE APPROVED

SECTION 26 DRAINAGE CONTROL PLAN

Drainage control structures will be designed to meet the applicable performance standards of 30 CFR Subchapter K and the Mine Safety and Health Administration (MSHA) standards and requirements for impoundments.

26.1 Drainage Control Watersheds

The watersheds for drainage control structures were delineated using aerial mapping on 10-ft contours inside the permit area and U.S. Geologic Survey (USGS) quadrangle sheets on 10- or 20-feet contours outside the Pinabete Mine Plan permit area (permit area). The watersheds are presented on Exhibit 26.1-1. The curve numbers were determined using data from a detailed soil survey conducted inside the permit area, presented in Section 14 (Soil), and data from the Natural Resources Conservation Service (NRCS) soil surveys, *Soil Survey of San Juan County New Mexico, Eastern Part* (Keetch 1980), for areas outside the permit area. The soil mapping units were classified into four groups based on the surface texture; fine, fine loamy, coarse loamy, and sandy. The four groups have a combination of different hydrologic groups: fine 100% hydrologic group D; fine loamy 3.9% hydrologic group B and 96.1% hydrologic group D; coarse loamy 65.4% hydrologic group B, 18.6% hydrologic group C, and 16.0% hydrologic group D; sandy 96.0% hydrologic group A, 3.5% hydrologic group B, and 0.5% hydrologic group D. The curve numbers assigned to the hydrologic groups are: A 65, B 78, C 87, and D 93. Using this data, a weighted curve number was determined for each soil texture group. The weighted curve numbers for the four soil texture groups are: fine 93, fine loamy 92.4, coarse loamy 81.9, and sandy 65.6. Using this data, a weighted curve number was calculated for the watersheds.

Field Code Changed

26.2 Drainage Control Structures

The locations of the drainage control structures and their associated watersheds are presented on Exhibit 26.1-1. Table 26.2-1 identifies each structure and provides references for locating the supporting design data, design drawing, and the as-built drawing. The data referenced in the table for each respective structure provide the information required for demonstrating that the structures comply with applicable performance standards of 30 CFR Subchapter K and MSHA standards and requirements.

Field Code Changed

Field Code Changed

26.2.1 Existing Drainage Control Structures

Existing Area 4 North drainage structures will be utilized to facilitate the mining and reclamation operations along the northern permit boundary. These drainage control structures are identified on Exhibit 11-13F in the Navajo Mine Permit-0004F (BNCC 2009).

26.2.2 Impoundments and Siltation Structures General Plans

There will be no general plans for impoundments and siltation structures; a site-specific design will be developed for each structure.

26.3 Drainage Control Structures Design Plans

26.3.1 Perennial and Intermittent Stream Diversions

Currently there is no plan to construct any diversions of perennial or intermittent stream diversions to facilitate mining operations in permit area. Should a need arise in the future; this section will be revised accordingly.

26.3.2 Miscellaneous Flow Diversions Design Plans

All miscellaneous flow diversion will meet the applicable performance standards described in 30 CFR Subchapter K and, in particular, §816.43.

The drainage plan associated with a site-specific design may require miscellaneous flow diversions to control drainage. These structures are an integral part of a site-specific design, thus, their design will be incorporated into the site-specific design package of the diversions that they are associated with.

Miscellaneous flow diversions need a smooth transition to prevent erosion issues. The NRCS (1977), formerly the Soil Conservation Service, has provided some general ~~rules~~principles to follow in designing transitions between constructed diversions and native channels. These principles include:

- ~~T~~the water surface should be smoothly transitioned to meet end conditions~~.~~;
- ~~T~~the water surface edges should not at any section converge at an angle greater than 28º with the center line, nor diverge at an angle greater than 25º~~.~~;
- ~~I~~in wells designed transitions, losses in addition to friction should not exceed 0.10*h_v for converges and 0.2*h_v for divergence, where h_v is the velocity head~~.~~;
- ~~I~~in general it is desirable to have bottom grades and side slopes meet end conditions tangentially~~.~~; and
- ~~C~~channel ~~C~~conjunctions: The natural angle of juncture between tributary streams and main streams has been observed to be in a range of 45 to 55 degrees should provide for reasonable transition and assimilation of diverted flows into stream channels.

For additional diversion design and principles refer to the OSM Surface Mining Water Diversion Design Manual (OSM 1982 section 7.1-7.6).

All miscellaneous flow diversions will be classified as temporary diversions and will be designed to safely pass the peak flow from the 2 year 6 hour (2yr-6hr) storm event or greater. The watersheds for the diversion channels will be delineated, soil curve numbers determined, and precipitation values for the design storm obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas IV-New Mexico (NOAA 2006). The watersheds and channel or ditch will be modeled in SEDCAD to determine the peak flow and the required channel size. If the results from the hydraulic analysis indicate potential for erosion to occur, riprap rock or other forms of protective lining will be installed.

26.3.3 Sedimentation Ponds

The sediment ponds required to retain the runoff and sediment from a disturbed area will be constructed prior to commencing any type of surface disturbance upstream of the pond. They will be located as close as possible to the upstream area that will be disturbed. Construction of a pond will not commence until the engineering drawings and supporting design data have been reviewed and approved by OSM. After completion of construction, an as-built drawing of the pond will be developed and kept on file at the mine site; it will be made available upon request. A registered professional engineer will certify both the design and as-built drawings.

Table 26.2-1 identifies each sediment pond and provides references for locating the supporting design data, design drawing, and the as-built drawing for each pond. The data referenced in the table for each respective pond provides the information required to demonstrate that the ponds comply with 30 CFR Sections 816.46, 816.47, and 816.49. The hazard classification for each pond is also specified on the table. The locations of the ponds are shown on Exhibit 26.1-1.

Field Code Changed

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A site-specific design will be developed for each sediment pond. They will be designed to meet the applicable performance standards of 30 CFR Subchapter K. The design criteria for the sediment ponds will be as follows:

- The design storm will be 10yr-24hr or the 100yr-6hr precipitation event.
- The design capacity will be the design storm runoff volume plus at least 15% to ensure there is adequate storage volume for sediment.
- Ponds designed to retain the 10yr-24hr runoff will have a spillway.
- Ponds designed to retain the 100yr-6hr runoff will not have a spillway.
- The spillway will safely pass the peak discharge from the 25yr-6hr storm event.
- The pond is assumed to be full when sizing the spillway.
- The pond will have a 1-foot freeboard with the spillway flowing.
- The design capacity will be less than 20 acre-feet (ac-ft).
- Riprap will be placed at the pond inlets and spillways if hydraulic analysis indicates that a protective lining is required to minimize and control erosion.
- Embankments will have a minimum static safety factor of 1.3.

The capacity of all sediment ponds will be less than 20 ac-ft. These are small ponds located in a rural area and in the event of a failure they will not constitute a hazard to the general public, mine employees, mine equipment, and public transportation or utilities. The potential for loss of life and property damage is very low. They will all be classified as low-hazard-potential dams.

To demonstrate that the pond embankments will have a minimum static safety factor of 1.3, a slope stability analysis has been performed on a worst-case scenario, i.e., maximum embankment height. Because the embankments are to be constructed with similar type soils, a worst-case analysis should be sufficient. The slope stability analysis is presented in Appendix 23.A.

To ensure that the design storm runoff volume is maintained, the maximum permissible gauge reading for the water or sediment level is provided. The volume above the maximum permissible water or sediment level is equal to the design storm runoff volume, and the volume below it is the excess volume. If the water or sediment level should exceed the maximum permissible gauge reading, then the impoundment will be either pumped or cleaned out down to an acceptable level. This will ensure that the design storm runoff volume is maintained at all times. The maximum permissible gauge reading for the water or sediment level is provided for each impoundment, except for the sewer ponds, raw water storage ponds, and highwall impoundments. The maximum permissible gauge reading for each pond is provided on Table 26.2-1.

Field Code Changed

The watershed sizes and curve numbers can change due to areas being mined and reclaimed. This can result in changes in the volume of surface runoff that needs to be retained by the ponds. The supporting hydrology data and the maximum permissible gauge reading will be updated annually to account for these changes.

After a runoff event, 90% of the design capacity will be restored within 10 days, provided the ponds are accessible. Weather and ground conditions may limit access to some ponds, particularly those in the reclaimed and undisturbed areas. Accessing these ponds with dewatering equipment during muddy conditions can cause excessive damage to adjacent undisturbed or reclaimed lands. In such a case, dewatering will occur as soon as conditions improve.

Prior to commencing construction of the ponds, the topsoil will be removed and placed in a stockpile. To prevent excessive settlement, the pond will be located on stable ground and the embankment will be adequately compacted. The fill area will be cleared of trees, stumps, roots, boulders, vegetation, and rubbish prior to beginning placement of fill material. The sedimentation pond foundations shall be stable during all phases of construction and operation and shall be designed adequate and accurate information on the foundation conditions. Most sedimentation pond embankments will be classified as low hazard dams. However, should BNCC construct a sedimentation pond embankment meeting the Class B (significant hazard class) or C (high hazard class) criteria for dams in Natural Resource Conservation Service Technical Release (TR) 60 (NRCS 1985) or the size or other criteria of 30 CFR 77.216(a), BNCC will conduct a foundation investigation, as well as any necessary laboratory testing of foundation material to determine the design requirements for foundation stability. Only suitable fill material free of debris, organic material, frozen matter, and excessive moisture or dryness will be used to construct the embankments. The fill material will be properly compacted. To keep surface disturbance to a minimum, excavation and placement of fill will be limited to the lines and grades indicated on the design drawings.

Inspection and maintenance will be conducted on a periodic basis to ensure that sedimentation ponds are functional and in good condition. Inspections will be performed on a quarterly basis; the fourth quarter inspection will be an annual inspection, the results of which will be submitted to OSM. The quarterly inspections will be kept on file at the mine site. Any maintenance items identified from the inspections will be promptly repaired or corrected. Further discussion on the inspection and maintenance of ponds is provided in Section 42 (Monitoring, Maintenance, Inspections, and Examinations).

26.3.4 Siltation Structures Design Plans

Currently there is no plan to construct any siltation structures that do not impound water. Should the need arise in the future; this section will be revised accordingly.

26.3.5 Impoundments Design Plans

There will be no typical design or general plans for impoundments; a site-specific design will be developed of each impoundment.

26.3.5.1 Highwall Impoundments

When the mining pit is advancing in the upstream direction this may create a need to construct highwall impoundments to minimize the inflows into the pit and the immediate mining area (IMA). Highwall iImpoundments will be located upstream of the IMA on the highwall side of the pit. The primary intent is to retain all or a portion of the smaller intensity but more frequently occurring precipitation events, thereby enhancing the safety of work areas in the IMA (e.g., topsoil removal, truck/loader operation, blasting, and mining operations).

These highwall impoundments, although not intended to comply with surface runoff standards, will retain some sediment. In the event of a discharge or failure, the water released along with any sediment generated will be retained in the pit downstream. Discharges from these impoundments will not leave the permit area. Discharge through the spillways would be very infrequent since the annual rainfall for the area is approximately 6 in and generates infrequent surface runoff. These impoundments would be dry and empty a majority of the time.

Field Code Changed

Field Code Changed

Table 26.2-1 identifies each highwall impoundment and provides references for locating the supporting design data, design drawing, and as-built drawing. The hazard classification for each impoundment is also specified on the table. The locations of the impoundments are shown on Exhibit 26.1-1.

A site-specific design will be developed for each highwall impoundment and submitted to OSM for approval. Construction will not commence until approval has been obtained. After completion of construction, an as-built drawing will be developed and kept on file at the mine site; it will be made available upon request. A registered professional engineer will certify both the design and as-built drawings.

The design criteria for the highwall impoundments will be as follows:

- They will not be designed for a specific storm event, but will be capable of retaining the more frequently occurring storm events, i.e., between the 2yr-6hr and 5yr-6hr storm event.
- The spillway will safely pass the peak discharge from the 25yr-6hr storm event.
- The impoundment is assumed to be full when sizing the spillway.
- The impoundment will have a 1-foot freeboard with the spillway flowing.
- Capacity will be less than 20 ac-ft.
- A protective lining will be installed in the spillway if the hydraulic analysis indicates that it is required to control erosion.
- Embankments will have a minimum static safety factor of 1.3 (see Appendix 23.A).

The capacity of highwall impoundments will be less than 20 ac-ft. These are small impoundments located in a rural area and in the event of a failure they will not constitute a hazard to the general public, mine employees, mine equipment, and public transportation or utilities. The potential for loss of life and property damage is very low. They will all be classified as low-hazard-potential dams.

Prior to commencing construction of the pond, the topsoil will be removed and placed in a stockpile. To prevent excessive settlement, the highwall impoundment will be located on stable ground and the embankment will be adequately compacted. The fill area will be cleared of trees, stumps, roots, boulders, vegetation, and rubbish prior to beginning placement of fill material. The highwall impoundment foundations shall be stable during all phases of construction and operation and shall be designed adequate and accurate information on the foundation conditions. Most highwall impoundment embankments will be classified as low hazard dams. However, should BNCC construct a highwall impoundment embankment meeting the Class B (significant hazard class) or C (high hazard class) criteria for dams in Natural Resource Conservation Service Technical Release (TR) 60 (NRCS 1985) or the size or other criteria of 30 CFR 77.216(a), BNCC will conduct a foundation investigation, as well as any necessary laboratory testing of foundation material to determine the design requirements for foundation stability. Only suitable fill material free of debris, organic material, frozen matter, and excessive moisture or dryness will be used to construct the embankments. The fill material will be properly compacted. To keep surface disturbance to a minimum, excavation and placement of fill will be limited to the lines and grades indicated on design drawings.

Inspection and maintenance will be conducted on a periodic basis to ensure that highwall impoundments are functional and in good condition. Inspections will be performed on a quarterly basis; the fourth quarter inspection will be an annual inspection, the results of which will be submitted to OSM. The quarterly inspections will be kept on file at the mine site. Any maintenance items identified from the inspections will be promptly repaired or corrected. Further discussion on the inspection and maintenance of high wall impoundments is provided in Section 42 (Monitoring, Maintenance, Inspections, and Examinations).

26.3.6 Other Drainage Control Structures Design Plans

Refer to Section 25 (Sediment Control Plan) for diversion berms and other structures or methods utilized to control drainage, erosion, and sediment.

26.4 Discharges to Underground Mines

There will be no discharge of water, coal-mine waste, coal combustion by-products, or other wastes into underground mine workings.

26.5 Information Collection and Analysis

Certified exhibits for Section 26 are available for review upon request at either the BNCC offices or the OSM, Western Region, technical office in Denver, Colorado. Certified as-built drawings will be kept on file at the mine site and made available upon request.

Personnel

Persons or organizations responsible for data collection, analysis, and preparation of this permit application package section:

Ron Van Valkenburg	GEOMAT, Inc.
Kent Applegate	Farmington, NM
BHP Navajo Coal Company	

References

BHP Navajo Coal Company (BNCC). 2009. Navajo Mine Permit Application Package. OSM Permit No. NM-0003F. On file at Office of Surface Mining Reclamation and Enforcement- Western Region Technical Office. Denver, Colorado.

Keetch, C. Wesley. 1980. Soil Survey of San Juan County, New Mexico, Eastern Part. U.S. Department of Agriculture, Soil Conservation Service, Washington, D.C.

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Natural Resources Conservation Service. 2005. Earth Dams and Reservoirs. Construction Engineering Division. Technical Release 60 (TR 60). http://directives.sc.egov.usda.gov/24937.wba (verified December 4, 2013).

Office of Surface Mining Reclamation and Enforcement (OSM). 1982. Surface Mining Water Diversion Design Manual. OSM/TR-82/2. http://www.techtransfer.osmre.gov/nttmainsite/Library/hbmanual/smwddm/smwddm.pdf (Verified Dec 11, 2013).

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Table 26.2-1 Drainage Control Structures

Structure type	Structure identification	Hazard class	Watershed (ac)	Curve number	Design slope (%)	Maximum permissible gauge reading	Purpose	Design and as-built data	Const. date	Removal or recl. date	Reclamation plan
Sediment pond	Pond 415	Low	3.8	See Appendix 26.A	NA	4.7 ft or El. 5310.7	Retains runoff and sediment from disturbed area	Exhibit 26.3-1 and Appendix 26.A	2017	2036	Section 35.1
Sediment pond	Pond 416	Low	125.9	See Appendix 26.B	NA	5.2 or El. 5303.2	Retains runoff and sediment from disturbed area	Exhibit 26.3-2 and Appendix 26.B	2017	2036	Section 35.1
Sediment pond	Pond 417	Low	261.8	NA	NA	NA	Retains runoff and sediment from disturbed area	To be designed prior to the end of first 5-year permit term	NA	NA	NA
Sediment pond	Pond 418	Low	233.5	NA	NA	NA	Retains runoff and sediment from disturbed area	To be designed prior to the end of first 5-year permit term	NA	NA	NA
Sediment pond	Pond 419	Low	199.3	NA	NA	NA	Retains runoff and sediment from disturbed area	To be designed prior to the end of first 5-year permit term	NA	NA	NA
Sediment pond	Pond 420	Low	387.4	NA	NA	NA	Retains runoff and sediment from disturbed area	To be designed prior to the end of first 5-year permit term	NA	NA	NA
Sediment pond	Pond 421	Low	148.8	NA	NA	NA	Retains runoff and sediment from disturbed area	To be designed prior to the end of first 5-year permit term	NA	NA	NA
Sediment pond	Pond 422	Low	476.7	NA	NA	NA	Retains runoff and sediment from disturbed area	To be designed prior to the end of first 5-year permit term	NA	NA	NA
Sediment pond	Pond 423	Low	949.3	NA	NA	NA	Retains runoff and sediment from disturbed area	To be designed prior to the end of first 5-year permit term	NA	NA	NA
Sediment pond	Pond 424	Low	45.0	NA	NA	NA	Retains runoff and sediment from disturbed area	To be designed prior to the end of first 5-year permit term	NA	NA	NA
Sediment pond	Pond 425	Low	218.2	NA	NA	NA	Retains runoff and sediment from disturbed area	To be designed prior to the end of first 5-year permit term	NA	NA	NA
Sediment pond	Pond 426	Low	81.5	NA	NA	NA	Retains runoff and sediment from disturbed area	To be designed prior to the end of first 5-year permit term	NA	NA	NA
Sediment pond	Pond 427	Low	23.1	NA	NA	NA	Retains runoff and sediment from topdressing stockpile	To be designed prior to the end of first 5-year permit term	NA	NA	NA
Sediment pond	Pond 428	Low	5.4	NA	NA	NA	Retains runoff and sediment from topdressing stockpile	To be designed prior to the end of first 5-year permit term	NA	NA	NA

I, Ron C. Van Valkenburg, [Mining Engineer]
certify that BNCC will submit detailed design plans according to the above general schedule
and prior to mining disturbance within the sediment pond watershed presented on Exhibit 26.1-1.

Appendix 26.A

Pond 415

Hydrologic Analysis and Design

NAVAJO MINE PINABETE PERMIT POND 415

The location of the pond and the associated watershed are presented on Exhibit 26.1-1.

Ron Van Valkenburg, PE

BHP Billiton
Navajo Mine
PO Box 1717
Fruitland, NM 87416

Phone: 505 598 2007

General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	100 yr - 6 hr
Rainfall Depth:	2.000 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	POND 415

#1
Null

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	3.800	3.800	8.68	0.32

Structure Detail:

Structure #1 (Null)

POND 415

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	3.800	0.018	0.000	0.000	89.000	M	8.68	0.325
	Σ	**3.800**						**8.68**	**0.325**

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	9.90	20.00	202.00	3.140	0.017
		8. Large gullies, diversions, and low flowing streams	42.11	40.00	95.00	19.460	0.001
#1	**1**	**Time of Concentration:**					**0.018**

Appendix 26.B

Pond 416

Hydrologic Analysis and Design

NAVAJO MINE PINABETE PERMIT
POND 416

The location of the pond and the associated watershed are presented on Exhibit 26.1-1.

Ron Van Valkenburg, PE

BHP Billiton
Navajo Mine
PO Box 1717
Fruitland, NM 87416

Phone: 505 598 2007

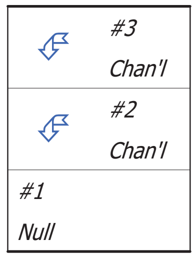
General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	100 yr - 6 hr
Rainfall Depth:	2.000 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	POND 416
Channel	#2	==>	#1	0.002	0.422	North Inlet
Channel	#3	==>	#1	0.002	0.426	South Inlet



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	8. Large gullies, diversions, and low flowing streams	9.41	8.00	85.00	9.20	0.002
#2	**Muskingum K:**					**0.002**
#3	8. Large gullies, diversions, and low flowing streams	10.67	8.00	75.00	9.79	0.002
#3	**Muskingum K:**					**0.002**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#3	94.000	94.000	115.00	6.43
#2	27.100	27.100	61.93	2.32
#1	4.800	125.900	156.21	9.16

Structure Detail:

Structure #3 (Riprap Channel)

South Inlet

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)
16.00	2.0:1	2.0:1	10.6	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	115.00 cfs	
Depth:	0.62 ft	1.62 ft
Top Width:	18.49 ft	22.49 ft
Velocity*:		
X-Section Area:	10.71 sq ft	
Hydraulic Radius:	0.570 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.

Structure #2 (Riprap Channel)

North Inlet

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	2.0:1	2.0:1	9.4	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	61.93 cfs	
Depth:	0.46 ft	1.46 ft
Top Width:	13.85 ft	17.85 ft
Velocity*:		
X-Section Area:	5.97 sq ft	
Hydraulic Radius:	0.425 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.

Structure #1 (Null)

POND 416

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	94.000	0.301	0.000	0.000	89.000	M	115.00	6.435
	Σ	**94.000**						**115.00**	**6.435**
#2	1	27.100	0.114	0.000	0.000	89.000	M	61.93	2.318
	Σ	**27.100**						**61.93**	**2.318**
#1	1	4.800	0.026	0.000	0.000	89.000	M	10.97	0.411
	Σ	**125.900**						**156.21**	**9.163**

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	5.00	10.00	200.00	2.230	0.024
		8. Large gullies, diversions, and low flowing streams	32.31	42.00	130.00	17.050	0.002
#1	**1**	**Time of Concentration:**					**0.026**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	3.33	10.00	300.00	1.820	0.045
		8. Large gullies, diversions, and low flowing streams	3.62	52.00	1,435.00	5.710	0.069
#2	**1**	**Time of Concentration:**					**0.114**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	3.25	20.00	616.00	1.800	0.095
		8. Large gullies, diversions, and low flowing streams	2.57	92.00	3,576.00	4.810	0.206
#3	**1**	**Time of Concentration:**					**0.301**

NAVAJO MINE PINABETE PERMIT POND 416

The location of the pond and the associated watershed are presented on Exhibit 26.1-1.

Ron Van Valkenburg, PE

BHP Billiton
Navajo Mine
PO Box 1717
Fruitland, NM 87416

Phone: 505 598 2007

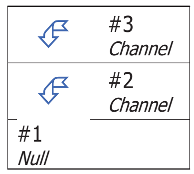
General Information

Storm Information:

Storm Type:	NM TYPE II 70
Design Storm:	25 yr - 6 hr
Rainfall Depth:	1.600 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	POND 416
Channel	#2	==>	#1	0.002	0.422	North Inlet
Channel	#3	==>	#1	0.002	0.426	South Inlet



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	8. Large gullies, diversions, and low flowing streams	9.41	8.00	85.00	9.20	0.002
#2	**Muskingum K:**					**0.002**
#3	8. Large gullies, diversions, and low flowing streams	10.67	8.00	75.00	9.79	0.002
#3	**Muskingum K:**					**0.002**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#3	94.000	94.000	79.72	5.54
#2	27.100	27.100	45.10	1.60
#1	4.800	125.900	106.82	7.42

Structure Detail:

Structure #3 (Riprap Channel)

South Inlet

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)
16.00	2.0:1	2.0:1	10.6	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Depth:	0.46 ft	1.46 ft
Top Width:	17.86 ft	21.86 ft
Velocity*:		
X-Section Area:	7.86 sq ft	
Hydraulic Radius:	0.435	
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.

Structure #2 (Riprap Channel)

North Inlet

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	2.0:1	2.0:1	9.4	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Depth:	0.36 ft	1.36 ft
Top Width:	13.43 ft	17.43 ft
Velocity*:		
X-Section Area:	4.56 sq ft	
Hydraulic Radius:	0.335	
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.

Structure #1 (Null)

POND 416

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	94.000	0.301	0.000	0.000	89.000	M	79.72	5.54
	S	**94.000**						**79.72**	**5.54**
#2	1	27.100	0.114	0.000	0.000	89.000	M	45.10	1.60
	S	**27.100**						**45.10**	**1.60**
#1	1	4.800	0.026	0.000	0.000	89.000	M	7.99	0.28
	S	**125.900**						**106.82**	**7.42**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	5.00	10.00	200.00	2.230	0.024
		8. Large gullies, diversions, and low flowing streams	32.31	42.00	130.00	17.050	0.002
#1	**1**	**Time of Concentration:**					**0.026**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	3.33	10.00	300.00	1.820	0.045
		8. Large gullies, diversions, and low flowing streams	3.62	52.00	1,435.00	5.710	0.069
#2	**1**	**Time of Concentration:**					**0.114**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	3.25	20.00	616.00	1.800	0.095
		8. Large gullies, diversions, and low flowing streams	2.57	92.00	3,576.00	4.810	0.206
#3	**1**	**Time of Concentration:**					**0.301**