APPENDIX 11-E

SPUR D DRAINAGE/SEDIMENT CONTROL

MAY 2004

NAVAJO MINE RAILROAD

DRAINAGE/SEDIMENT CONTROL AT SPUR D

The drainage and erosion control structures for the railroad at Spur D consist of a diversion berm on the east side and riprap lined channels on both the east and west side. The watershed subdivisions are presented on Exhibit 11-53. The location and details of the drainage control structures are presented on Exhibits 11-14P and 11-14T.

A diversion berm was constructed at the top of the slope that is directly east of culvert CP-16. The berm will divert the surface runoff from watershed "B1" into drop-structure "DS-484L" as presented on Exhibit 11-53 and 11-14P. The diversion berm will prevent formation of gullies and rills on the slope, thus reducing the sediment load to the downstream flow. The diversion berm is design for the peak discharge from the 10 year-24 hour storm event. Typical section of the diversion berm is shown on Exhibit 11-14S.

Drop-structures DS-481+50L, DS-484L, and DS-484R are design for the peak discharge from the 10 year-6 hour storm event. Refer to the schedule on Exhibit 11-14T for the channel dimensions and the riprap size placed.

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Railroad Drainage/Sediment Control at Spur D - East Side

The watershed subdivisions are presented on Exhibit 11-53. The location and details of the drainage control structures are presented on Exhibits 11-14P and 11-14T.

LR

BHP Navajo Coal Company
Navajo Mine
PO Box 1717
Fruitland, NM 87415

Phone: 505-598-5861

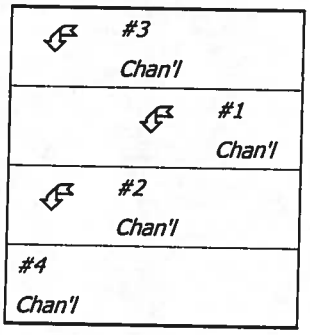
General Information

Storm Information:

Storm Type:	NRCS Type II-60
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	==>	#2	0.000	0.000	Diversion Berm
Channel	#2	==>	#4	0.000	0.000	Dropstructure DS-484L
Channel	#3	==>	#4	0.000	0.000	Dropstructure DS-481+50L
Channel	#4	==>	End	0.000	0.000	Dropstructure DS-484



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#3	39.000	39.000	8.02	0.63
#1	104.000	104.000	19.45	1.68
#2	21.000	125.000	28.54	2.53
#4	0.000	164.000	36.39	3.16

Structure Detail:

Structure #3 (Riprap Channel)

Dropstructure DS-481+50L

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	20.0	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	8.02 cfs	
Depth:	0.10 ft	1.10 ft
Top Width:	6.57 ft	12.57 ft
Velocity*:		
X-Section Area:	0.60 sq ft	
Hydraulic Radius:	0.091	
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 #1 (Erodible Channel)

Diversion Berm

Trapezoidal Erodible Channel Inputs:

Material: Ordinary firm loam

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
4.00	6.0:1	2.0:1	1.0	0.0300	1.00			3.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	19.45 cfs	
Depth:	0.81 ft	1.81 ft
Top Width:	10.47 ft	18.47 ft
Velocity:	3.33 fps	
X-Section Area:	5.85 sq ft	
Hydraulic Radius:	0.548	
Froude Number:	0.78	

Structure #2 (Riprap Channel)

Dropstructure DS-484L

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	9.0	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	28.54 cfs	
Depth:	0.28 ft	1.28 ft
Top Width:	11.70 ft	17.70 ft
Velocity*:		
X-Section Area:	3.07 sq ft	
Hydraulic Radius:	0.260	
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 #4 (Riprap Channel)

Dropstructure DS-484

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	10.0	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	36.39 cfs	
Depth:	0.34 ft	1.34 ft
Top Width:	12.04 ft	18.04 ft
Velocity*:		
X-Section Area:	3.74 sq ft	
Hydraulic Radius:	0.308	
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	39.000	0.244	0.000	0.000	80.000	M	8.02	0.630
	Σ	**39.000**						**8.02**	**0.630**
#1	1	104.000	0.292	0.000	0.000	80.000	M	19.45	1.681
	Σ	**104.000**						**19.45**	**1.681**
#2	1	21.000	0.409	0.000	0.000	89.000	M	9.10	0.847
	Σ	**125.000**						**28.54**	**2.528**
#4	Σ	**164.000**						**36.39**	**3.159**

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	4.41	75.00	1,700.00	2.100	0.224
		8. Large gullies, diversions, and low flowing streams	3.57	50.00	1,400.00	5.660	0.068
#1	**1**	**Time of Concentration:**					**0.292**
#2	1	8. Large gullies, diversions, and low flowing streams	1.67	95.00	5,700.00	3.870	0.409
#2	**1**	**Time of Concentration:**					**0.409**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	3.59	52.00	1,450.00	1.890	0.213
		8. Large gullies, diversions, and low flowing streams	4.29	30.00	700.00	6.210	0.031
#3	**1**	**Time of Concentration:**					**0.244**

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Railroad Drainage/Sediment Control at Spur D - West Side

The watershed subdivisions are presented on Exhibit 11-53. The location and details of the drainage control structures are presented on Exhibits 11-14P and 11-14T.

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PO Box 1717
Fruitland, NM 87415

Phone: 505-598-5861

General Information

Storm Information:

Storm Type:	NRCS Type II-60
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	Dropsturcture DS-484R

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	31.000	31.000	10.60	1.25

Structure Detail:

Structure #1 (Riprap Channel)

Dropsturcture DS-484R

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)
3.00	3.0:1	3.0:1	7.0	1.00		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	10.60 cfs	
Depth:	0.30 ft	1.30 ft
Top Width:	4.82 ft	10.82 ft
Velocity*:		
X-Section Area:	1.19 sq ft	
Hydraulic Radius:	0.241	
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	25.000	0.523	0.000	0.000	89.000	M	9.50	1.009
	2	6.000	0.058	0.000	0.000	89.000	M	6.11	0.242
	Σ	**31.000**						**10.60**	**1.251**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.36	90.00	6,600.00	3.500	0.523
#1	**1**	**Time of Concentration:**					**0.523**
#1	2	5. Nearly bare and untilled, and alluvial valley fans	20.00	30.00	150.00	4.470	0.009
		8. Large gullies, diversions, and low flowing streams	3.81	40.00	1,050.00	5.850	0.049
#1	**2**	**Time of Concentration:**					**0.058**