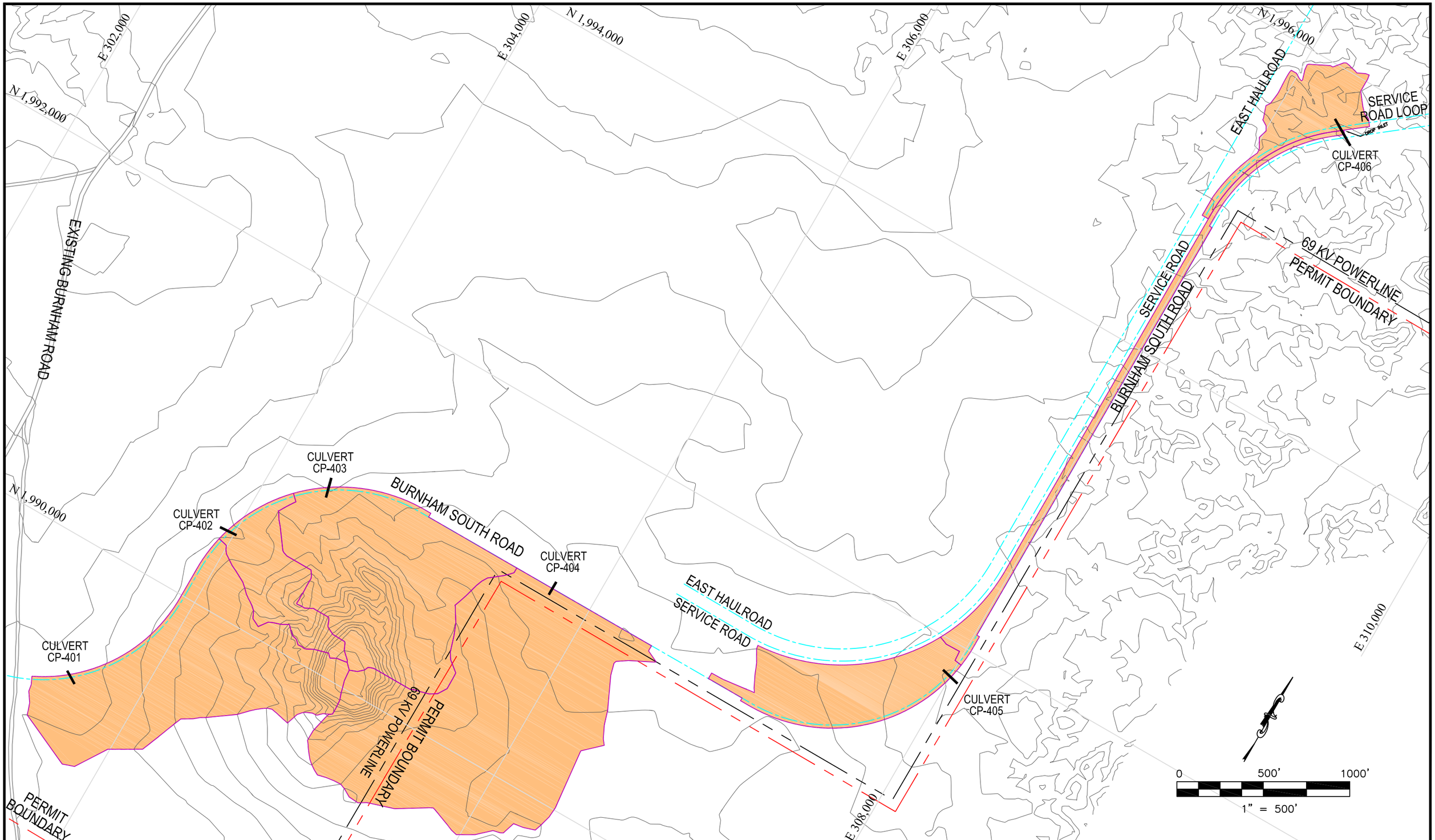
Appendix 40.A

Burnham South Road Supporting Design Data for Drainage Control Structures

AREA 4 ROADS ENGINEERING - BURNHAM SOUTH ROAD																		
CULVERT TABLE																		
Culvert No.	Road	Station	Area (Ac)	Discharge (cfs)	Size (ft-in)	Corrugation (in)	Corner Radius (in)	Gage	Minimum Cover (in)	Inlet Invert Elev.	Outlet Invert Elev.	Headwater Elev.	Barrels	Skew Angle	Run Length (ft)	Total Length (ft)	Outlet Velocity (ft/sec)	Outflow Protection
CP-401	B.S.R.	16+77	23.948	38.11	3 - 6	2-2/3 X 1/2	N/A	16	24	5424.08	5422.58	5426.85	1	71	89	89	7.47	RIPRAP
CP-402	B.S.R.	29+71	6.330	10.07	2	2-2/3 X 1/2	N/A	16	24	5438.94	5435.51	5440.59	1	68	107	107	6.84	RIPRAP
CP-403	B.S.R.	35+98	21.778	34.66	3	2-2/3 X 1/2	N/A	16	24	5441.76	5437.08	5444.64	1	109	119	119	10.06	RIPRAP
CP-404	B.S.R.	50+38	38.909	61.92	3	2-2/3 X 1/2	N/A	16	24	5450.91	5450.45	5453.97	2	90	88	176	6.98	RIPRAP
CP-405	B.S.R.	76+10	9.491	15.10	2	2-2/3 X 1/2	N/A	16	24	5430.87	5426.75	5433.09	1	90	117	117	7.82	RIPRAP
CP-406	B.S.R.	115+90	9.629	12.36	2 - 6	2-2/3 X 1/2	N/A	16	24	5380.95	5380.00	5382.89	1	68	180	180	5.42	N/A



GEOMAT INC.
915 Malta Avenue ◆ Farmington, NM 87401 ◆ (505) 327-7928

NAVAJO COAL COMPANY
BURNHAM SOUTH ROAD DESIGN

BURNHAM SOUTH ROAD
WATERSHEDS

DRAWN BY: PR & BT	PLATE 1
PREPARED BY: PR & BT	REVISED:
	DATE: JAN. 27, 2012

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BURNHAM SOUTH ROAD
25-YR 24-HR STORM

CULVERT CP-401

STATION 16+77

BHP Billiton

GEOMAT Inc.
915 Malta Avenue
Farmingrton, NM 87401

Phone: (505) 327-7928

General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	25 yr - 24 hr
Rainfall Depth:	2.060 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	CULVERT CP-401

#1
Null

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	23.948	23.948	38.11	1.46

Structure Detail:

Structure #1 (Null)

CULVERT CP-401

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	23.948	0.064	0.000	0.000	82.900	M	38.11	1.459
	Σ	**23.948**						**38.11**	**1.459**

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	8.04	159.66	1,985.05	8.500	0.064
#1	**1**	**Time of Concentration:**					**0.064**

HY-8 Culvert Analysis Report
CULVERT CP-401 - STATION 16+77

Culvert Data Summary - Culvert CP-401

Barrel Shape: Circular

Barrel Diameter: 3.50 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Square Edge with Headwall

Inlet Depression: None

Site Data - Culvert CP-401

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5424.08 ft

Outlet Station: 89.00 ft

Outlet Elevation: 5422.58 ft

Number of Barrels: 1

Table 1 - Culvert Summary Table: Culvert CP-401

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	5424.08	0.000	0.0*	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
3.81	3.81	5424.86	0.777	0.0*	1-S2n	0.523	0.559	0.549	0.178	3.826	1.044
7.62	7.62	5425.20	1.122	0.0*	1-S2n	0.764	0.817	0.767	0.231	4.849	1.241
11.43	11.43	5425.47	1.393	0.0*	1-S2n	0.938	1.021	0.941	0.269	5.452	1.374
15.24	15.24	5425.70	1.622	0.0*	1-S2n	1.098	1.178	1.098	0.299	5.923	1.476
19.06	19.06	5425.92	1.836	0.0*	1-S2n	1.231	1.328	1.237	0.325	6.244	1.561
22.87	22.87	5426.12	2.041	0.0*	1-S2n	1.364	1.463	1.372	0.348	6.535	1.633
26.68	26.68	5426.32	2.237	0.0*	1-S2n	1.484	1.582	1.491	0.369	6.820	1.698
30.49	30.49	5426.51	2.426	0.0*	1-S2n	1.600	1.702	1.601	0.388	7.101	1.755
34.30	34.30	5426.69	2.609	0.0*	1-S2n	1.715	1.810	1.719	0.406	7.292	1.808
38.11	37.75	5426.85	2.772	0.0*	1-S2n	1.816	1.901	1.820	0.422	7.470	1.856

* theoretical depth is impractical. Depth reported is corrected.

****

Inlet Elevation (invert): 5424.08 ft, Outlet Elevation (invert): 5422.58 ft

Culvert Length: 89.00 ft, Culvert Slope: 0.0169

****

Roadway Data for Crossing: Culvert CP-401

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section:

Coord No.	Station (ft)	Elevation (ft)
1	50.00	5426.72
2	100.00	5427.66
3	150.00	5428.48
4	200.00	5429.18
5	300.00	5430.82

Roadway Surface: Gravel

Roadway Top Width: 36.00 ft

Table 2 - Downstream Channel Rating Curve (Crossing: Culvert CP-401)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	5422.58	0.00	0.00	0.00	0.00
3.81	5422.76	0.18	1.04	0.19	0.62
7.62	5422.81	0.23	1.24	0.24	0.64
11.43	5422.85	0.27	1.37	0.29	0.66
15.24	5422.88	0.30	1.48	0.32	0.67
19.06	5422.91	0.33	1.56	0.35	0.68
22.87	5422.93	0.35	1.63	0.37	0.69
26.68	5422.95	0.37	1.70	0.39	0.70
30.49	5422.97	0.39	1.76	0.41	0.70
34.30	5422.99	0.41	1.81	0.43	0.71
38.11	5423.00	0.42	1.86	0.45	0.71

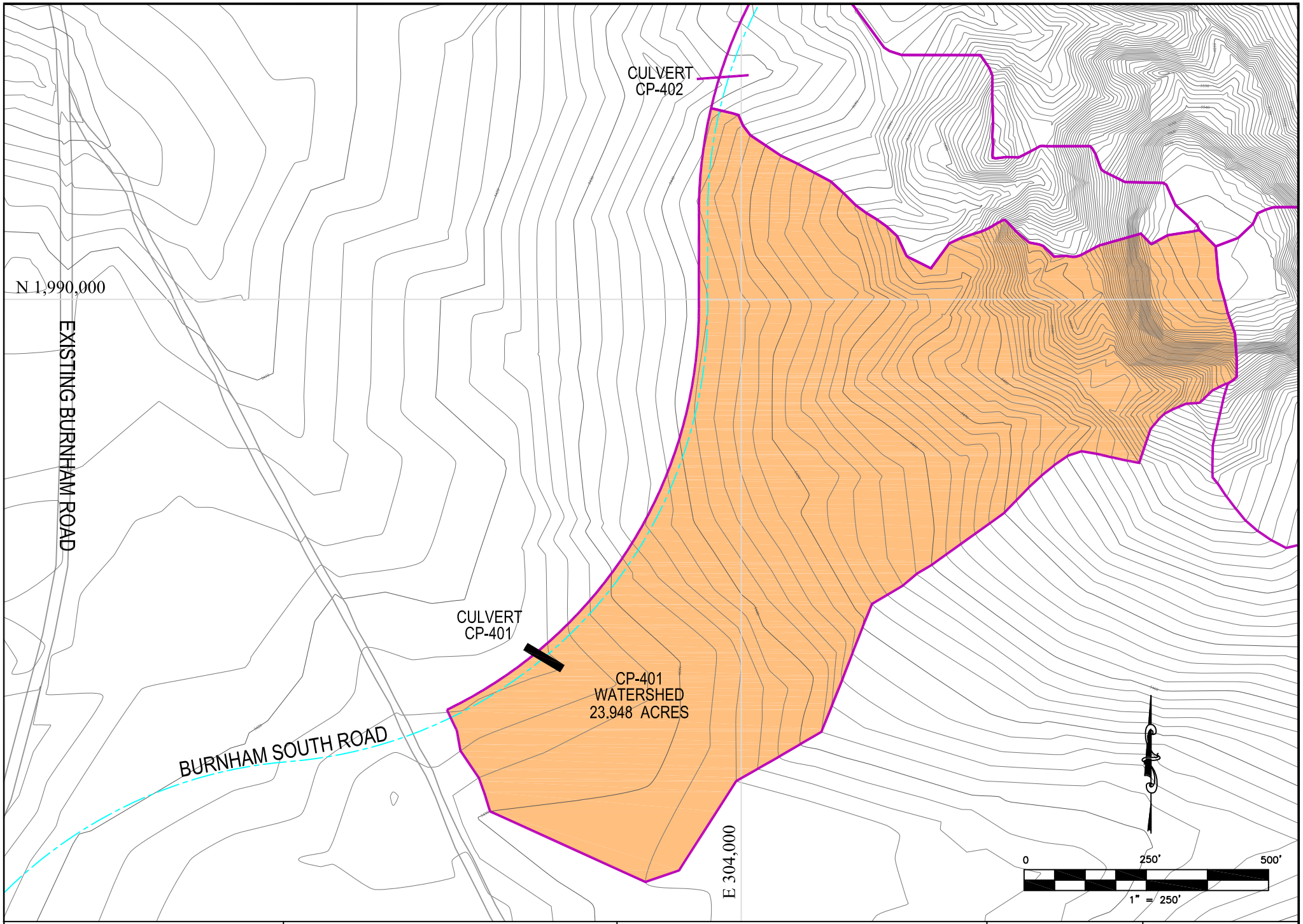
Tailwater Channel Data - Culvert CP-401

Tailwater Channel Option: Irregular Channel

Channel Slope: 0.0170

User Defined Channel Cross-Section:

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	5426.00	0.0370
2	52.62	5424.00	0.0370
3	69.06	5423.01	0.0370
4	150.00	5422.58	0.0370
5	209.45	5424.00	0.0370
6	265.40	5426.00	0.0370
7	300.00	5427.11	0.0000



GEOMAT INC.
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NAVAJO COAL COMPANY
BURNHAM SOUTH ROAD DESIGN

CULVERT CP-401 WATERSHED
BURNHAM SOUTH ROAD STA 16+77

DRAWN BY: PR & BT	PLATE 2
PREPARED BY: PR & BT	REVISED:
	DATE: JAN. 27, 2012

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BURNHAM SOUTH ROAD
25-YR 24-HR STORM

CULVERT CP-402

STATION 29+71

BHP Billiton

GEOMAT Inc.
915 Malta Avenue
Farmingrton, NM 87401

Phone: (505) 327-7928

General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	25 yr - 24 hr
Rainfall Depth:	2.060 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	CULVERT CP-402

#1
Null

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	6.330	6.330	10.07	0.39

Structure Detail:

Structure #1 (Null)

CULVERT CP-402

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	6.330	0.030	0.000	0.000	82.900	M	10.07	0.386
	Σ	**6.330**						**10.07**	**0.386**

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	12.61	145.89	1,157.02	10.650	0.030
#1	**1**	**Time of Concentration:**					**0.030**

HY-8 Culvert Analysis Report
CULVERT CP-402 - STATION 29+71

Culvert Data Summary - Culvert CP-402

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Square Edge with Headwall

Inlet Depression: None

Site Data - Culvert CP-402

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5438.94 ft

Outlet Station: 107.00 ft

Outlet Elevation: 5435.51 ft

Number of Barrels: 1

Table 1 - Culvert Summary Table: Culvert CP-402

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	5438.94	0.000	0.0*	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
1.01	1.01	5439.39	0.454	0.0*	1-S2n	0.275	0.333	0.282	0.136	3.599	1.667
2.01	2.01	5439.59	0.655	0.0*	1-S2n	0.407	0.483	0.412	0.176	4.335	1.982
3.02	3.02	5439.75	0.815	0.0*	1-S2n	0.492	0.606	0.496	0.205	4.931	2.194
4.03	4.03	5439.89	0.948	0.0*	1-S2n	0.577	0.697	0.577	0.228	5.345	2.357
5.04	5.04	5440.02	1.076	0.0*	1-S2n	0.647	0.789	0.648	0.248	5.748	2.493
6.04	6.04	5440.14	1.199	0.0*	1-S2n	0.712	0.865	0.714	0.265	5.987	2.609
7.05	7.05	5440.26	1.317	0.0*	1-S2n	0.777	0.938	0.777	0.281	6.239	2.711
8.06	8.06	5440.37	1.430	0.0*	1-S2n	0.836	1.010	0.839	0.296	6.461	2.803
9.06	9.06	5440.48	1.541	0.0*	1-S2n	0.892	1.071	0.900	0.309	6.608	2.887
10.07	10.07	5440.59	1.650	0.0*	1-S2n	0.949	1.132	0.951	0.321	6.836	2.964

* theoretical depth is impractical. Depth reported is corrected.

****

Inlet Elevation (invert): 5438.94 ft, Outlet Elevation (invert): 5435.51 ft

Culvert Length: 107.00 ft, Culvert Slope: 0.0321

****

Roadway Data for Crossing: Culvert CP-402

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section:

Coord No.	Station (ft)	Elevation (ft)
1	0.00	5441.32
2	50.00	5441.84
3	100.00	5442.31
4	150.00	5442.67
5	300.00	5443.57

Roadway Surface: Gravel

Roadway Top Width: 36.00 ft

Table 2 - Downstream Channel Rating Curve (Crossing: Culvert CP-402)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	5435.52	0.00	0.00	0.00	0.00
1.01	5435.65	0.14	1.67	0.53	1.13
2.01	5435.69	0.18	1.98	0.68	1.18
3.02	5435.72	0.20	2.19	0.80	1.21
4.03	5435.74	0.23	2.36	0.89	1.23
5.04	5435.76	0.25	2.49	0.96	1.25
6.04	5435.78	0.27	2.61	1.03	1.26
7.05	5435.80	0.28	2.71	1.09	1.27
8.06	5435.81	0.30	2.80	1.15	1.29
9.06	5435.82	0.31	2.89	1.20	1.29
10.07	5435.84	0.32	2.96	1.25	1.30

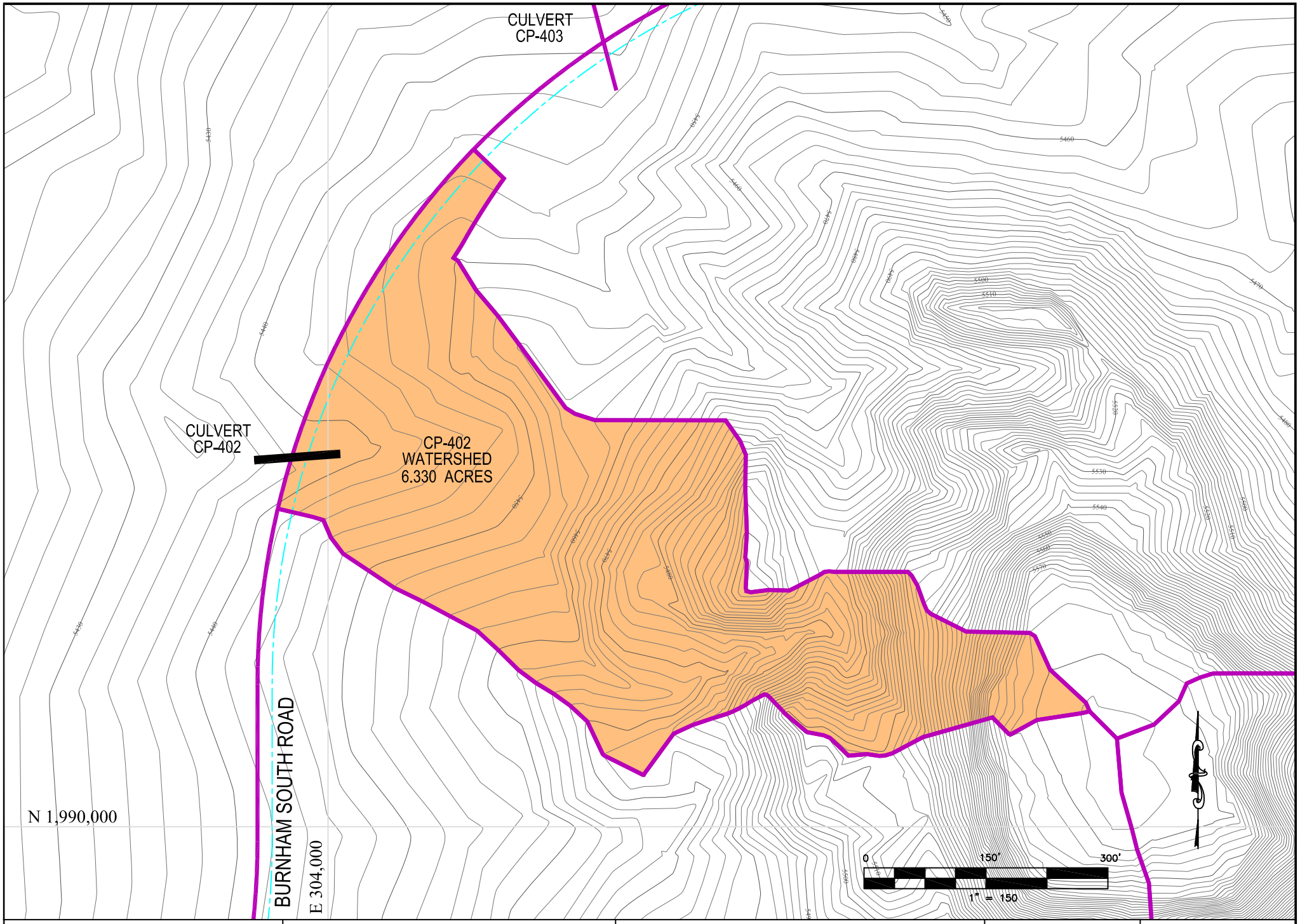
Tailwater Channel Data - Culvert CP-402

Tailwater Channel Option: Irregular Channel

Channel Slope: 0.0624

User Defined Channel Cross-Section:

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	5440.00	0.0370
2	98.78	5438.00	0.0370
3	130.34	5436.00	0.0370
4	150.00	5435.52	0.0370
5	162.24	5436.00	0.0370
6	198.91	5438.00	0.0370
7	248.77	5440.00	0.0370
8	300.00	5440.47	0.0000



GEOMAT INC.
915 Malta Avenue ◆ Farmington, NM 87401 ◆ (505) 327-7928

NAVAJO COAL COMPANY
BURNHAM SOUTH ROAD DESIGN

CULVERT CP-402 WATERSHED
BURNHAM SOUTH ROAD STA 29+71

DRAWN BY: PR & BT
PREPARED BY: PR & BT

PLATE 3
REVISED:
DATE: JAN. 27, 2012

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BURNHAM SOUTH ROAD
25-YR 24-HR STORM

CULVERT CP-403

STATION 35+98

BHP Billiton

GEOMAT Inc.
915 Malta Avenue
Farmingrton, NM 87401

Phone: (505) 327-7928

General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	25 yr - 24 hr
Rainfall Depth:	2.060 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	CULVERT CP-403

#1
Null

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	21.778	21.778	34.66	1.33

Structure Detail:

Structure #1 (Null)

CULVERT CP-403

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	21.778	0.060	0.000	0.000	82.900	M	34.66	1.327
	Σ	**21.778**						**34.66**	**1.327**

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	7.79	142.85	1,834.09	8.370	0.060
#1	**1**	**Time of Concentration:**					**0.060**

HY-8 Culvert Analysis Report
CULVERT CP-403 - STATION 35+98

Culvert Data Summary - Culvert CP-403

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Square Edge with Headwall

Inlet Depression: None

Site Data - Culvert CP-403

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5441.76 ft

Outlet Station: 119.00 ft

Outlet Elevation: 5437.08 ft

Number of Barrels: 1

Table 1 - Culvert Summary Table: Culvert CP-403

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	5441.76	0.000	0.0*	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
3.47	3.47	5442.53	0.765	0.0*	1-S2n	0.423	0.575	0.435	0.191	5.295	1.667
6.93	6.93	5442.86	1.098	0.0*	1-S2n	0.625	0.818	0.627	0.247	6.517	1.983
10.40	10.40	5443.12	1.364	0.0*	1-S2n	0.759	1.011	0.761	0.288	7.299	2.194
13.86	13.86	5443.36	1.602	0.0*	1-S2n	0.892	1.183	0.893	0.320	7.851	2.358
17.33	17.33	5443.59	1.832	0.0*	1-S2n	0.997	1.324	1.003	0.348	8.340	2.493
20.80	20.80	5443.81	2.049	0.0*	1-S2n	1.099	1.461	1.101	0.373	8.816	2.609
24.26	24.26	5444.02	2.258	0.0*	1-S2n	1.202	1.582	1.202	0.395	9.166	2.712
27.73	27.73	5444.22	2.464	0.0*	1-S2n	1.291	1.697	1.296	0.416	9.475	2.804
31.19	31.19	5444.43	2.669	0.0*	1-S2n	1.379	1.810	1.380	0.434	9.821	2.888
34.66	34.66	5444.64	2.878	0.0*	1-S2n	1.468	1.907	1.471	0.452	10.055	2.965

* theoretical depth is impractical. Depth reported is corrected.

****

Inlet Elevation (invert): 5441.76 ft, Outlet Elevation (invert): 5437.08 ft

Culvert Length: 119.00 ft, Culvert Slope: 0.0393

****

Roadway Data for Crossing: Culvert CP-403

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section:

Coord No.	Station (ft)	Elevation (ft)
1	0.00	5445.97
2	150.00	5446.87
3	300.00	5447.77

Roadway Surface: Gravel

Roadway Top Width: 36.00 ft

Table 2 - Downstream Channel Rating Curve (Crossing: Culvert CP-403)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	5437.08	0.00	0.00	0.00	0.00
3.47	5437.27	0.19	1.67	0.47	0.95
6.93	5437.33	0.25	1.98	0.61	0.99
10.40	5437.37	0.29	2.19	0.71	1.02
13.86	5437.40	0.32	2.36	0.79	1.04
17.33	5437.43	0.35	2.49	0.86	1.05
20.80	5437.45	0.37	2.61	0.92	1.06
24.26	5437.48	0.40	2.71	0.98	1.07
27.73	5437.50	0.42	2.80	1.03	1.08
31.19	5437.51	0.43	2.89	1.07	1.09
34.66	5437.53	0.45	2.96	1.12	1.10

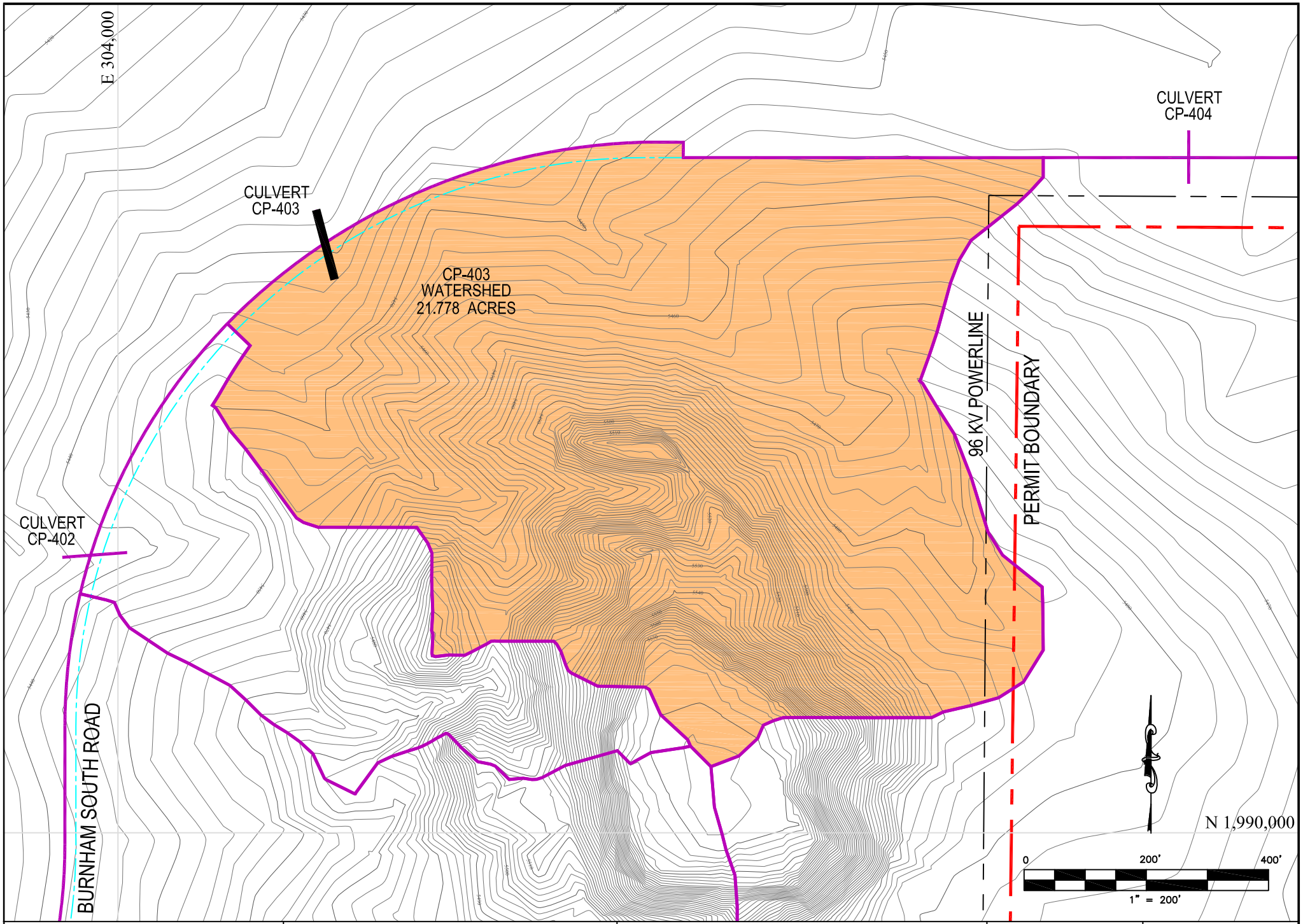
Tailwater Channel Data - Culvert CP-403

Tailwater Channel Option: Irregular Channel

Channel Slope: 0.0396

User Defined Channel Cross-Section:

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	5440.00	0.0370
2	97.80	5438.00	0.0370
3	150.00	5437.08	0.0370
4	203.14	5438.00	0.0370
5	275.05	5440.00	0.0370
6	300.00	5440.63	0.0370



GEOMAT INC. 915 Malta Avenue ◆ Farmington, NM 87401 ◆ (505) 327-7928	NAVAJO COAL COMPANY BURNHAM SOUTH ROAD DESIGN	CULVERT CP-403 WATERSHED BURNHAM SOUTH ROAD STA 35+98	DRAWN BY: PR & BT PREPARED BY: PR & BT PLATE 4 REVISED: DATE: JAN. 27, 2012

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BURNHAM SOUTH ROAD
25-YR 24-HR STORM

CULVERT CP-404

STATION 50+38

BHP Billiton

GEOMAT Inc.
915 Malta Avenue
Farmingrton, NM 87401

Phone: (505) 327-7928

General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	25 yr - 24 hr
Rainfall Depth:	2.060 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	CULVERT CP-404

#1
Null

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	38.909	38.909	61.92	2.37

Structure Detail:

Structure #1 (Null)

CULVERT CP-404

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	38.909	0.118	0.000	0.000	82.900	M	61.92	2.370
	Σ	**38.909**						**61.92**	**2.370**

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	4.75	132.28	2,783.03	6.540	0.118
#1	**1**	**Time of Concentration:**					**0.118**

HY-8 Culvert Analysis Report
CULVERT CP-404 - STATION 50+38

Culvert Data Summary - Culvert CP-404

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Square Edge with Headwall

Inlet Depression: None

Site Data - Culvert CP-404

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5450.91 ft

Outlet Station: 88.00 ft

Outlet Elevation: 5450.45 ft

Number of Barrels: 2

Table 1 - Culvert Summary Table: Culvert CP-404

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	5450.91	0.000	0.0*	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
6.19	6.19	5451.75	0.741	0.837	2-M2c	0.685	0.534	0.548	0.311	3.504	0.753
12.38	12.38	5452.11	1.067	1.205	2-M2c	0.987	0.768	0.781	0.403	4.231	0.895
18.58	18.58	5452.41	1.326	1.498	2-M2c	1.233	0.956	0.963	0.469	4.745	0.990
24.77	24.77	5452.66	1.550	1.754	2-M2c	1.451	1.110	1.118	0.523	5.161	1.064
30.96	30.96	5452.90	1.762	1.989	2-M2c	1.660	1.251	1.255	0.569	5.525	1.125
37.15	37.15	5453.12	1.962	2.207	2-M2c	1.869	1.373	1.381	0.609	5.848	1.178
43.34	43.34	5453.33	2.154	2.421	2-M2c	2.083	1.496	1.497	0.645	6.149	1.224
49.54	49.54	5453.54	2.339	2.633	2-M2c	2.333	1.599	1.605	0.678	6.437	1.266
55.73	55.73	5453.76	2.523	2.845	2-M2c	2.696	1.702	1.707	0.709	6.709	1.303
61.92	61.92	5453.97	2.706	3.057	2-M2c	3.000	1.803	1.803	0.737	6.975	1.338

* theoretical depth is impractical. Depth reported is corrected.

****

Inlet Elevation (invert): 5450.91 ft, Outlet Elevation (invert): 5450.45 ft

Culvert Length: 88.00 ft, Culvert Slope: 0.0052

****

Roadway Data for Crossing: Culvert CP-404

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section:

Coord No.	Station (ft)	Elevation (ft)
1	0.00	5455.75
2	50.00	5456.03
3	100.00	5456.19
4	150.00	5456.23
5	200.00	5456.13
6	250.00	5455.91
7	300.00	5455.63

Roadway Surface: Gravel

Roadway Top Width: 36.00 ft

Table 2 - Downstream Channel Rating Curve (Crossing: Culvert CP-404)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	5450.45	0.00	0.00	0.00	0.00
6.19	5450.76	0.31	0.75	0.08	0.34
12.38	5450.85	0.40	0.89	0.11	0.35
18.58	5450.92	0.47	0.99	0.12	0.36
24.77	5450.97	0.52	1.06	0.14	0.37
30.96	5451.02	0.57	1.13	0.15	0.37
37.15	5451.06	0.61	1.18	0.16	0.38
43.34	5451.10	0.65	1.22	0.17	0.38
49.54	5451.13	0.68	1.27	0.18	0.38
55.73	5451.16	0.71	1.30	0.19	0.39
61.92	5451.19	0.74	1.34	0.19	0.39

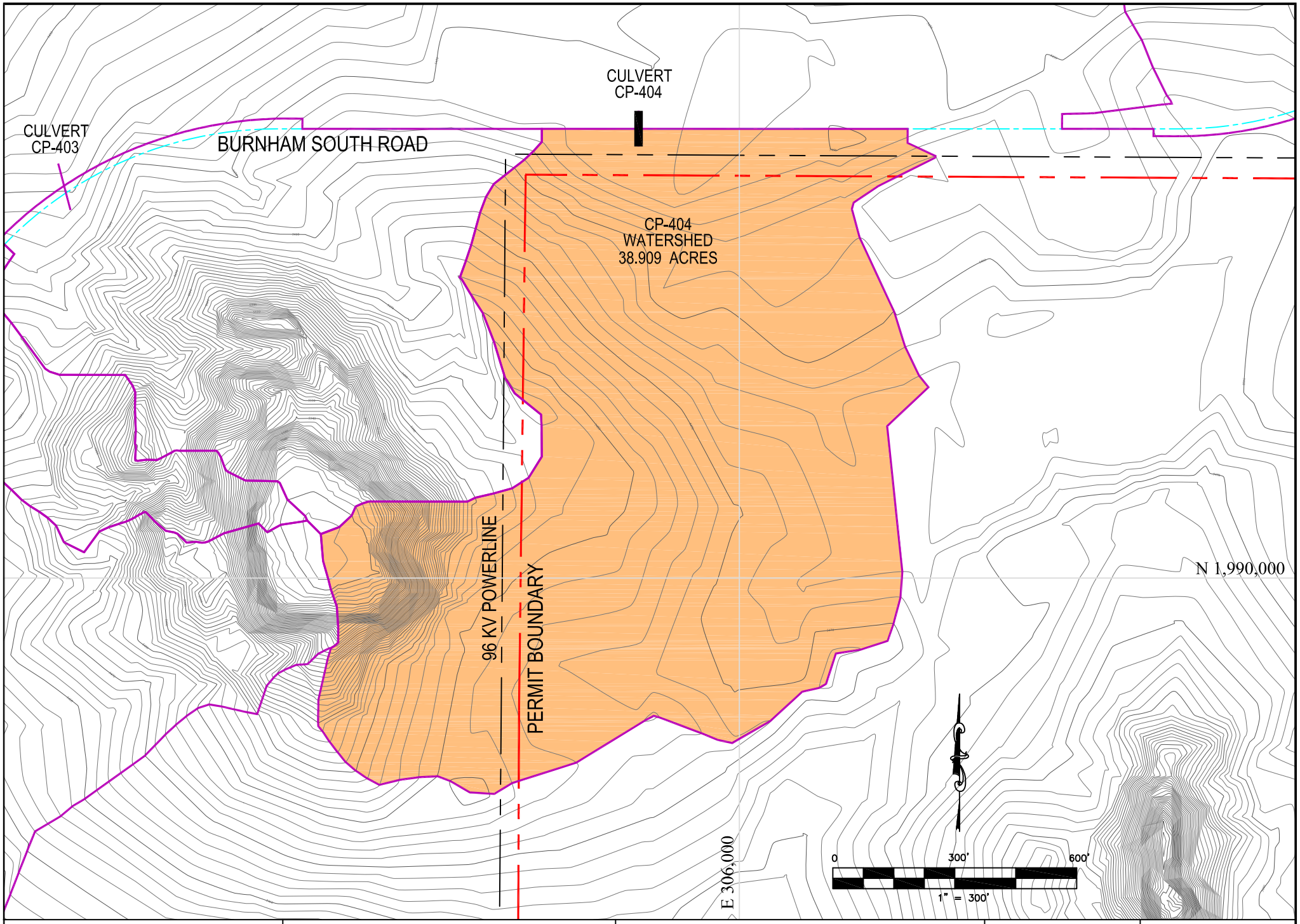
Tailwater Channel Data - Culvert CP-404

Tailwater Channel Option: Irregular Channel

Channel Slope: 0.0042

User Defined Channel Cross-Section:

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	5454.00	0.0370
2	20.37	5452.00	0.0370
3	100.00	5451.21	0.0370
4	150.00	5450.45	0.0370
5	250.00	5451.41	0.0370
6	279.89	5452.00	0.0370
7	300.00	5454.00	0.0370



GEOMAT INC.
915 Malta Avenue ◆ Farmington, NM 87401 ◆ (505) 327-7928

NAVAJO COAL COMPANY
BURNHAM SOUTH ROAD DESIGN

CULVERT CP-404 WATERSHED
BURNHAM SOUTH ROAD STA 50+38

DRAWN BY: PR & BT
PREPARED BY: PR & BT

PLATE 5
REVISED:
DATE: JAN. 27, 2012

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BURNHAM SOUTH ROAD
25-YR 24-HR STORM

CULVERT CP-405

STATION 76+10

BHP Billiton

GEOMAT Inc.
915 Malta Avenue
Farmingrton, NM 87401

Phone: (505) 327-7928

General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	25 yr - 24 hr
Rainfall Depth:	2.060 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	CULVERT CP-405

#1
Null

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	9.491	9.491	15.10	0.58

Structure Detail:

Structure #1 (Null)

CULVERT CP-405

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	9.491	0.115	0.000	0.000	82.900	M	15.10	0.578
	Σ	**9.491**						**15.10**	**0.578**

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	1.56	24.27	1,558.15	3.740	0.115
#1	**1**	**Time of Concentration:**					**0.115**

HY-8 Culvert Analysis Report
CULVERT CP-405 - STATION 76+10

Culvert Data Summary - Culvert CP-405

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Square Edge with Headwall

Inlet Depression: None

Site Data - Culvert CP-405

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5430.87 ft

Outlet Station: 117.00 ft

Outlet Elevation: 5426.75 ft

Number of Barrels: 1

Table 1 - Culvert Summary Table: Culvert CP-405

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	5430.87	0.000	0.0*	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
1.51	1.51	5431.44	0.567	0.0*	1-S2n	0.334	0.421	0.340	0.192	4.173	1.065
3.02	3.02	5431.68	0.813	0.0*	1-S2n	0.480	0.606	0.485	0.249	5.089	1.266
4.53	4.53	5431.88	1.008	0.0*	1-S2n	0.601	0.743	0.602	0.290	5.687	1.402
6.04	6.04	5432.07	1.196	0.0*	1-S2n	0.694	0.865	0.699	0.323	6.161	1.506
7.55	7.55	5432.24	1.370	0.0*	1-S2n	0.787	0.975	0.788	0.351	6.566	1.593
9.06	9.06	5432.41	1.537	0.0*	1-S2n	0.869	1.070	0.869	0.376	6.908	1.667
10.57	10.57	5432.57	1.702	0.0*	1-S2n	0.949	1.162	0.952	0.398	7.162	1.732
12.08	12.08	5432.74	1.867	0.0*	1-S2n	1.028	1.246	1.028	0.419	7.423	1.791
13.59	13.59	5432.91	2.038	0.0*	5-S2n	1.105	1.323	1.107	0.438	7.620	1.845
15.10	15.10	5433.09	2.218	0.0*	5-S2n	1.181	1.400	1.181	0.455	7.818	1.894

* theoretical depth is impractical. Depth reported is corrected.

****

Inlet Elevation (invert): 5430.87 ft, Outlet Elevation (invert): 5426.75 ft

Culvert Length: 117.00 ft, Culvert Slope: 0.0352

****

Roadway Data for Crossing: Culvert CP-405

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section:

Coord No.	Station (ft)	Elevation (ft)
1	0.00	5435.57
2	150.00	5436.47
3	300.00	5437.37

Roadway Surface: Gravel

Roadway Top Width: 36.00 ft

Table 2 - Downstream Channel Rating Curve (Crossing: Culvert CP-405)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	5426.75	0.00	0.00	0.00	0.00
1.51	5426.94	0.19	1.06	0.19	0.61
3.02	5427.00	0.25	1.27	0.25	0.63
4.53	5427.04	0.29	1.40	0.29	0.65
6.04	5427.07	0.32	1.51	0.32	0.66
7.55	5427.10	0.35	1.59	0.35	0.67
9.06	5427.13	0.38	1.67	0.38	0.68
10.57	5427.15	0.40	1.73	0.40	0.68
12.08	5427.17	0.42	1.79	0.42	0.69
13.59	5427.19	0.44	1.84	0.44	0.69
15.10	5427.21	0.46	1.89	0.45	0.70

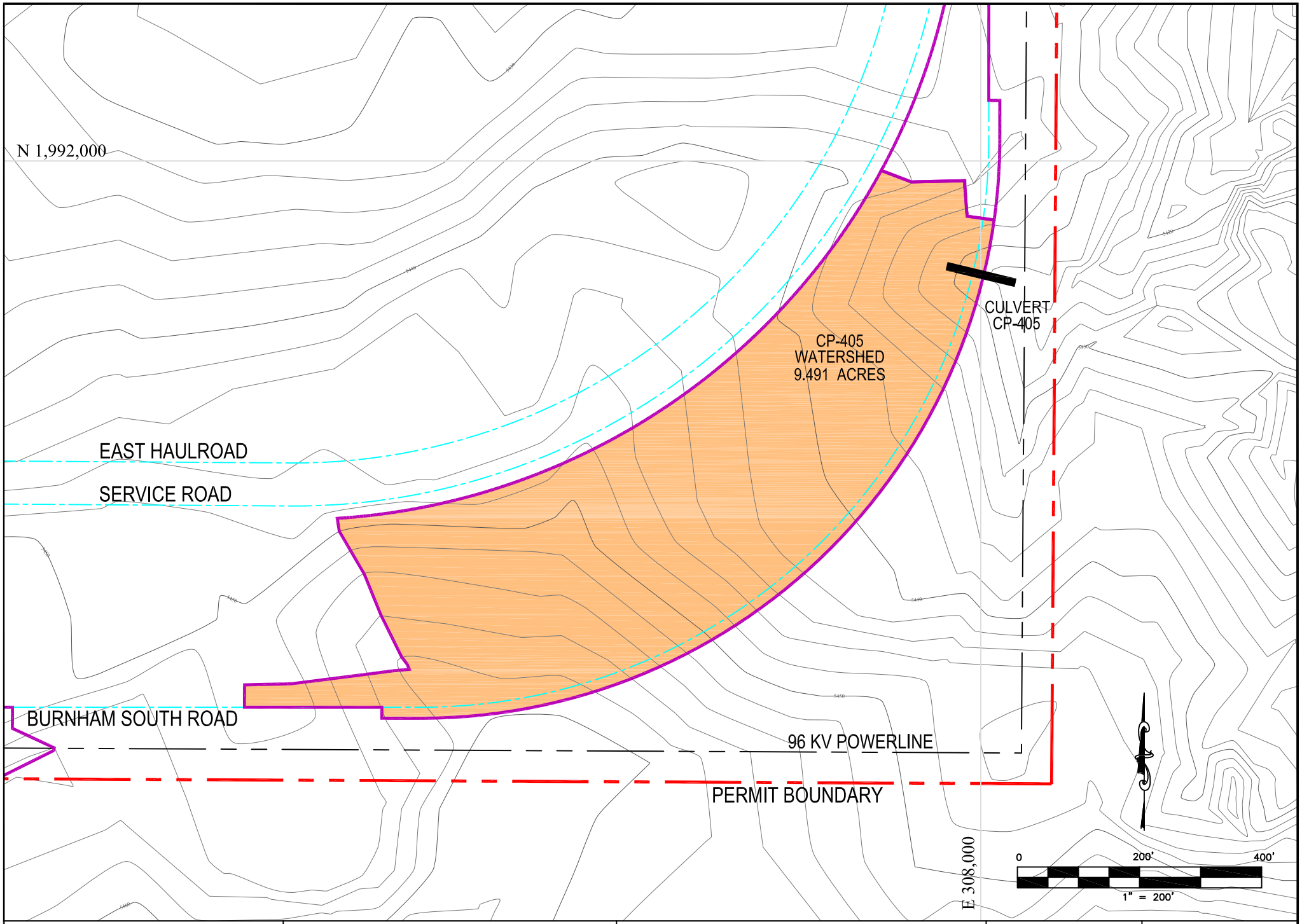
Tailwater Channel Data - Culvert CP-405

Tailwater Channel Option: Irregular Channel

Channel Slope: 0.0160

User Defined Channel Cross-Section:

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	5432.91	0.0370
2	42.40	5432.00	0.0370
3	91.30	5430.00	0.0370
4	124.48	5428.00	0.0370
5	150.00	5426.75	0.0370
6	220.43	5428.00	0.0370
7	300.00	5430.00	0.0000



GEOMAT INC.
915 Malta Avenue ◆ Farmington, NM 87401 ◆ (505) 327-7928

NAVAJO COAL COMPANY
BURNHAM SOUTH ROAD DESIGN

CULVERT CP-405 WATERSHED
BURNHAM SOUTH ROAD STA 76+10

DRAWN BY: PR & BT	PLATE 6
PREPARED BY: PR & BT	REVISED:
	DATE: JAN. 27, 2012

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BURNHAM SOUTH ROAD
25-YR 24-HR STORM

CULVERT CP-406

STATION 115+90

BHP Billiton

GEOMAT Inc.
915 Malta Avenue
Farmingrton, NM 87401

Phone: (505) 327-7928

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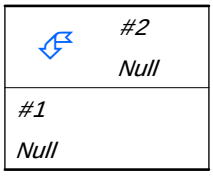
General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	25 yr - 24 hr
Rainfall Depth:	2.060 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	CULVERT CP-406
Null	#2	==>	#1	0.000	0.000	CP-406 DROP INLET



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#2	4.152	4.152	4.70	0.30
#1	5.477	9.629	12.36	0.63

Structure Detail:

Structure #2 (Null)

CP-406 DROP INLET

Structure #1 (Null)

CULVERT CP-406

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)
#2	1	4.152	0.303	0.000	0.000	89.000	M	4.70	0.298
	Σ	**4.152**						**4.70**	**0.298**
#1	1	5.477	0.066	0.000	0.000	82.900	M	8.72	0.334
	Σ	**9.629**						**12.36**	**0.632**

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	1.90	18.90	993.33	4.130	0.066
#1	**1**	**Time of Concentration:**					**0.066**
#2	1	8. Large gullies, diversions, and low flowing streams	1.48	58.80	3,978.57	3.640	0.303
#2	**1**	**Time of Concentration:**					**0.303**

HY-8 Culvert Analysis Report
CULVERT CP-406 – STATION 155+90

Culvert Data Summary - Culvert CP-406

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Square Edge with Headwall

Inlet Depression: None

Site Data - Culvert CP-406

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5380.95 ft

Outlet Station: 180.00 ft

Outlet Elevation: 5380.00 ft

Number of Barrels: 1

Table 1 - Culvert Summary Table: Culvert CP-406

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	5380.95	0.000	0.0*	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
1.24	1.24	5381.50	0.483	0.553	2-M2c	0.458	0.341	0.361	0.280	2.830	2.715
2.47	2.47	5381.74	0.703	0.791	2-M2c	0.651	0.511	0.514	0.364	3.403	3.228
3.71	3.71	5381.93	0.863	0.983	2-M2c	0.809	0.621	0.632	0.423	3.802	3.573
4.94	4.94	5382.09	1.007	1.144	2-M2c	0.945	0.730	0.733	0.472	4.122	3.839
6.18	6.18	5382.24	1.134	1.292	2-M2c	1.069	0.816	0.823	0.513	4.392	4.059
7.42	7.42	5382.38	1.251	1.434	2-M2c	1.186	0.897	0.904	0.549	4.633	4.249
8.65	8.65	5382.51	1.365	1.562	2-M2c	1.301	0.977	0.980	0.582	4.851	4.416
9.89	9.89	5382.64	1.475	1.690	2-M2c	1.412	1.046	1.050	0.611	5.055	4.565
11.12	11.12	5382.76	1.581	1.814	2-M2c	1.524	1.111	1.117	0.639	5.243	4.702
12.36	12.36	5382.89	1.683	1.938	2-M2c	1.640	1.175	1.180	0.665	5.422	4.827

* theoretical depth is impractical. Depth reported is corrected.

****

Inlet Elevation (invert): 5380.95 ft, Outlet Elevation (invert): 5380.00 ft

Culvert Length: 180.00 ft, Culvert Slope: 0.0053

****

Roadway Data for Crossing: Culvert CP-406

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section:

Coord No.	Station (ft)	Elevation (ft)
1	0.00	5384.48
2	50.00	5385.59
3	100.00	5386.65
4	150.00	5387.64
5	200.00	5388.56

Roadway Surface: Gravel

Roadway Top Width: 97.00 ft

Table 2 - Downstream Channel Rating Curve (Crossing: Culvert CP-406)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	5280.00	0.00	0.00	0.00	0.00
1.24	5280.28	0.28	2.71	1.19	1.28
2.47	5280.36	0.36	3.23	1.55	1.33
3.71	5280.42	0.42	3.57	1.80	1.37
4.94	5280.47	0.47	3.84	2.01	1.39
6.18	5280.51	0.51	4.06	2.18	1.41
7.42	5280.55	0.55	4.25	2.34	1.43
8.65	5280.58	0.58	4.42	2.48	1.44
9.89	5280.61	0.61	4.57	2.61	1.46
11.12	5280.64	0.64	4.70	2.72	1.47
12.36	5280.66	0.66	4.83	2.83	1.48

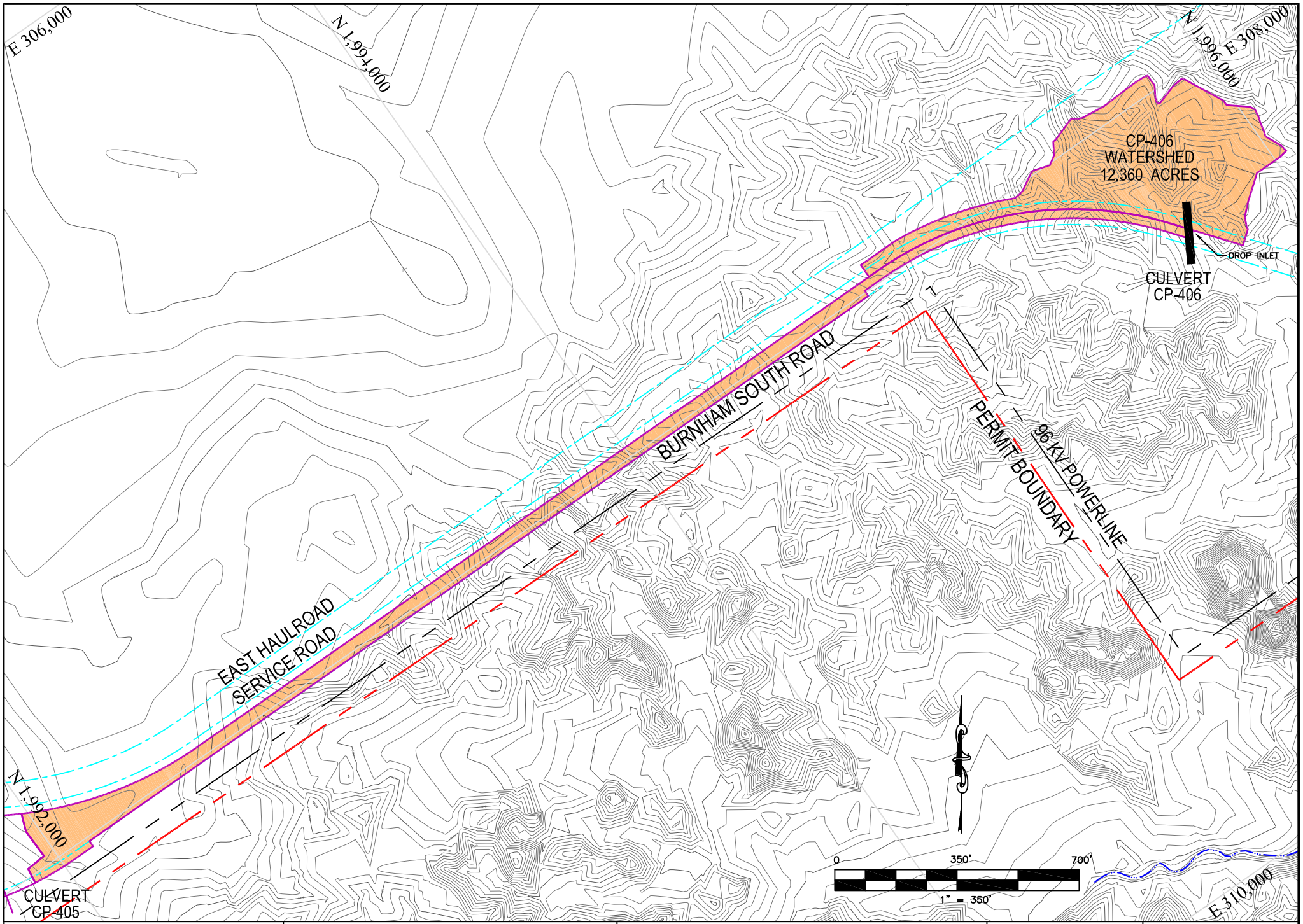
Tailwater Channel Data - Culvert CP-406

Tailwater Channel Option: Irregular Channel

Channel Slope: 0.0683

User Defined Channel Cross-Section:

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	5384.00	0.0370
2	32.64	5382.00	0.0370
3	66.21	5380.00	0.0370
4	100.00	5280.00	0.0370
5	122.49	5282.00	0.0370
6	140.43	5284.00	0.0370
7	160.86	5286.00	0.0370
8	200.00	5387.64	0.0000



GEOMAT INC. 915 Malta Avenue ◆ Farmington, NM 87401 ◆ (505) 327-7928	NAVAJO COAL COMPANY BURNHAM SOUTH ROAD DESIGN	CULVERT CP-406 WATERSHED BURNHAM SOUTH ROAD STA 115+90	DRAWN BY: PR & BT PREPARED BY: PR & BT PLATE 7 REVISED: DATE: JAN. 27, 2012