APPENDIX F

TRANSPORTATION PLAN
WEST TAVAPUTS FULL FIELD DEVELOPMENT
ENVIRONMENTAL IMPACT STATEMENT

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1.0 INTRODUCTION

1.1 PURPOSE

This Transportation Plan (plan) was prepared to supplement a proposal by BBC and other oil and gas companies to drill new wells in the West Tavaputs Plateau (WTP) Project Area as described in the West Tavaputs Plateau Full Field Development Environmental Impact Statement (EIS). This plan provides an assessment of the existing transportation system and proposed road development within the WTP Project Area and provides a basis for the analysis of potential environmental impacts.

The purpose of this plan is to assist the Bureau of Land Management (BLM), Price Field Office in transportation planning as it relates to proposed oil and gas development in the WTP Project Area. This plan could be a useful tool for County governments (e.g. Carbon, Duchesne, and Uintah) that are responsible for management of various roads within the transportation planning area (TPA).

1.2 SCOPE

The TPA includes roads within the WTP Project Area and roads that would be used to access the proposed development. The TPA is comprised of Federal and State Highways, county roads (e.g. Carbon, Duchesne, and Uintah Counties), and roads that are part of the BLM transportation system. The primary objective of this plan is determine the current standard of each BLM system road and the extent that BLM system roads would have to be modified to accommodate or support BBC and other operator's proposal. In addition, the primary county roads that provide access to the WTP Project Area are also briefly discussed.

This plan contains information regarding:

- The existing transportation system within the WTP Project Area;
- BLM transportation objectives, road standards, and design elements;
- Environmental and engineering constraints;
- Expected traffic increases associated with the Proposed Action;
- BBC and other operators road improvement and maintenance plans for the Proposed Action;
- Road improvement plans for BLM alternatives (alternatives C, D and E);
- Road maintenance responsibilities;
- County road specifications and proposed improvements; and
- The effectiveness and environmental impacts of selected dust suppression methods.

1.3 LIMITATIONS

General maintenance provisions are included in this document; however, specific road upgrading and maintenance responsibilities would be identified and approved by the BLM. Prior to beginning new construction, BBC and other operators would be required file and APD or submit

a ROW grant for access. Specific construction requirements would be determined during an on-site inspection and attached as conditions of approval (COA).

In accordance with the BLM 9113 roads manual, BLM has completed an inventory of all roads within the WTP Project Area regardless of current use or condition. Each road is identified on **Figure F-1**. In this plan, priority considerations are based upon existing and potential high-traffic volume routes which are part of the BLM road system. In addition to these roads, the complete roads inventory showed that there is an extensive network of low-traffic volume roads which could also be used for project-related activities. Not every road is considered equally in this analysis.

This plan does not discuss the environmental impacts associated with road improvements. Rather, the plan provides a baseline for environmental analysis in the WTP Full Field Development EIS.

2.0 PROPOSED ACTION

Under the Proposed Action, BBC and other oil and gas operators propose to develop up to 807 natural gas wells from up to 538 well pads in the WTP Project Area. For the purposes of analysis, it is assumed that during the first or peak-year of development, BBC would operate six drill rigs year-round and other WTP operators would operate the remaining three rigs year-round. Following the first or peak-year of development, drilling activity would likely begin to decline as other operators begin to exhaust their well locations. In total, drilling and construction activities would occur for approximately 8 years. The anticipated life of an individual well is 20 years. The anticipated time it will take for field abandonment and final reclamation is 5 years. Therefore, the anticipated life of project (LOP) under the Proposed Action would be approximately 33 years. Of all the alternatives fully analyzed in the WTP Full Field Development EIS, the Proposed Action would involve the most intense development. A detailed description of the Proposed Action and Alternatives is contained in Chapter 2 of the West Tavaputs Plateau Full Field Development EIS.

3.0 SCOPING AND PUBLIC INVOLVEMENT

Transportation was identified as a key issue during the scoping process of the West Tavaputs Full Field Development EIS. The BLM PFO requested public and agency input on the project though scoping letters, press releases, and direct correspondence with affected area uses and management agencies. Comments which directly or indirectly were associated with transportation were considered in the development of this plan. The following is a summary of the transportation-related comments which were received:

- Increased traffic will damage rock art
- Increased industrial traffic will create conflicts with other users
- Industrial traffic will change the visual landscape and diminish the visitor experience
- Nine Mile Canyon and other roads were not designed for the proposed traffic levels
- Increased traffic will increase the risk of accidents
- Traffic studies need to be done to determine the current traffic levels
- Some roads should be closed to the public

- Roads should be maintained by the lease holders (i.e. BBC and other operators)
- Appropriate road standards should be identified
- Increased law enforcement will be needed
- Improvements of existing roads should be addressed
- Roads should only be built on the plateaus, set back from canyon edges
- Roads should be surfaced to decrease dust
- Proximity of roads to other resources should be discussed
- Dust suppression will be needed on roads and may impact air and water quality and rock art
- Excessive speeds should be controlled
- Roads have inadequate drainage and poor surfaces
- All road improvements should be done by proper design
- Imposed speed limits do alleviate dust problems
- Full disclosure of the expected ADT should be required
- The backcountry byway designation should prevent the road from being used for extensive industrial purposes
- Dust suppression efforts thus far have been ineffective
- Dust poses a health risk to people and animals

The majority of these issues are addressed within this plan; however, some issues (e.g., impacts to cultural resources and recreation) are more appropriately addressed in specific resource sections of the EIS.

4.0 TRAFFIC CONDITIONS

4.1 EXISTING CONDITIONS

Baseline traffic studies for the West Tavaputs Full Field Development EIS were conducted between September 2005 and October 2006. Traffic monitors were placed in Gate Canyon to count traffic originating in the Vernal/Roosevelt area, and in Nine Mile Canyon to capture traffic originating in the Price/Wellington area. The counters recorded traffic 24 hours per day.

The Gate Canyon monitor was located approximately 2 miles north of the Gate Canyon/Nine Mile Canyon intersection. The Nine Mile Canyon counter was located where the pavement turns from paved to dirt road, near the Soldier Creek Mine. **Table 4.1-1** shows the monthly and total average daily traffic (ADT).

4.1-1. Baseline Traffic within the WTP Project Area				
Monitor Location	**Month/Year**	**Monitored Number of Days**	**Number of Vehicles**	**Average Daily Traffic**
Soldier Creek Mine	September 2005	30	698	23
	October 2005	31	1,561	50
	April 2006	16	541	34
	May 2006	31	841	27
	June 2006	30	266	9
	July 2006	23	370	16
	September 2006	30	660	22
	October 2006	6	136	23
	Total/ Average	**197**	**5,073**	**26**
Wells Draw (Gate Canyon)	September 2005	30	2,664	89
	October 2005	31	2,034	66
	November	30	1,668	56
	December	13	746	57
	April 2006	30	2,583	86
	May 2006	15	1,348	92
	July 2006	21	2,650	126
	August 2006	31	1,597	52
	September 2006	20	1,708	85
	October 2006	5	628	125
	Total/ Average	**226**	**17,626**	**78**

Source: EIS 2006f

The 2005/2006 study showed that approximately 75 percent of all traffic (78 vehicles) came from Vernal/Roosevelt. The remaining 25 percent of traffic (26 vehicles) came from Price/Wellington. When combined, it can be assumed that current traffic levels in Nine Mile Canyon average approximately 106 vehicles per day.

4.2 ESTIMATED TRAFFIC VOLUMES

The total traffic estimates during the development phase are based upon the number of trips associated with construction, drilling, and completion activities for an individual well or well pad as appropriate. Oil and gas vehicles range in size and weight from light to heavy trucks. The number of trips for each vehicle weight class is shown in **Table 4.2-1**.

The pace and level of drilling activity in the WTP Project Area would determine the level of daily traffic during the development phase. BBC and other operator's proposed drilling schedule was used to calculate the ADT associated with construction, drilling, and completion during each year of development phase if the Proposed Action were implemented. As shown in **Table 4.2-2**, traffic volumes would be highest during the first or peak year of development and would likely decline relative to development decline.

During the production phase, the number of producing wells would determine the level of daily traffic. Pumper traffic, and traffic associated with the collection of produced water and condensate would occur throughout the LOP. As shown in **Table 4.2-3**, traffic would be highest during peak field production, which would occur between years 8 and 20.

Table 4.2-1. Traffic Estimates under the Proposed Action

Phase of Construction	Vehicle Type	Average Weight (lbs)	Daily Round Trips per Well / Pad	Total Round Trips per Well / Pad [1]	Total Round Trips Development[2]	Total Vehicle Traffic[4]
Construction	Haul Trucks	80,000	1	7	3,766	7,532
	Light Trucks	20,000	4	28	15,064	30,128
	Total		**5**	**35**	**18,830**	**37,660**
Drilling (Vertical wells)	Haul Trucks[5]	80,000	2	26	13,988	27,976
	Logging/Mud Trucks	70,000	0.5	6.5	3,497	6,994
	Water Trucks	60,000	1.5	19.5	10,491	20,982
	Light Trucks	8,000	4	52	27,976	55,952
	Total		**8**	**104**	**55,952**	**111,904**
Drilling (Directional wells)	Haul Trucks	80,000	2	52	13,988	27,976
	Logging/Mud Trucks	70,000	0.5	13	3,497	6,994
	Water Trucks	60,000	1.5	39	10,491	20,982
	Light Trucks	8,000	4	104	27,976	55,952
	Total		**8**	**208**	**55,952**	**111,904**
Completion	Semi/Transport/ Water/Sand	80,000	7	203	163,821	327,642
	Haul Trucks[5]	80,000	1	29	23,403	46,806
	Light Trucks	8,000	4	116	93,612	187,224
	Total		**12**	**348**	**280,836**	**561,672**
Reclamation	Haul Trucks	80,000	1	6	4,842	9,684
	Light Trucks	8,000	3	18	14,526	29,052
	Total		**4**	**24**	**19,368**	**38,736**
Infrastructure Development[3]		NA	NA	NA	**73,000**	**146,000**
Total Development Traffic					**503,938**	**1,007,876**
Total Production Traffic					**922,747**	**1,845,494**
Total Traffic LOP					**1,426,685**	**2,853,370**

[1]Traffic Estimates are based upon an approximately 7-day construction period, 13-day drilling period at vertical locations (shallow wells), 26-day drilling period at direction wells (shallow wells), 29-day completion period, and 6-day reclamation period per well or well pad as appropriate.
[2]Traffic estimates are based upon approximately 807 gas wells drilled from up to 538 well pads.
[3] Infrastructure development includes approximately 25 vehicles per day for pipeline installation, road construction, compressor station, worker housing construction, etc over an approximately 8 year period.
[4]Total vehicle traffic equals number of roundtrips multiplied by two (inbound and outbound traffic).
[5]Haul trucks include drill and completion rigs.

Table 4.2-2. AADT during Development under the Proposed Action			
Year	**Number of Wells**	**Total Annual Vehicle Traffic**	**AADT**
1	168	209,818	575
2	127	158,612	435
3	120	149,870	411
4	80	99,913	274
5	80	99,913	274
6	80	99,913	274
7	80	99,913	274
8	72	89,922	246

Table 4.2.3. Daily Roundtrips during Production under the Proposed Action					
Project Year	**Approximate Number of Producing Wells**	**Approximate Daily Roundtrips by Pumpers[1]**	**Approximate Daily Roundtrips for Produced Water Disposal[1]**	**Approximate Daily Roundtrips for Condensate Disposal[1]**	**Approximate Total Daily Roundtrips During Production by Project Year**
1	168	6	17	3	**26**
2	295	11	30	6	**47**
3	415	16	42	8	**66**
4	495	19	50	9	**78**
5	575	22	58	11	**91**
6	655	25	66	12	**103**
7	745	28	75	14	**117**
8	807	30	81	15	**126**
9	807	30	81	15	**126**
10	807	30	81	15	**126**
11	807	30	81	15	**126**
12	807	30	81	15	**126**
13	807	30	81	15	**126**
14	807	30	81	15	**126**
15	807	30	81	15	**126**
16	807	30	81	15	**126**
17	807	30	81	15	**126**
18	807	30	81	15	**126**
19	807	30	81	15	**126**
20	807	30	81	15	**126**
21	641	24	64	12	**100**
22	514	19	51	10	**80**
23	394	15	39	7	**61**
24	314	12	31	6	**49**
25	234	9	23	4	**36**

Table 4.2.3. Daily Roundtrips during Production under the Proposed Action					
Project Year	**Approximate Number of Producing Wells**	**Approximate Daily Roundtrips by Pumpers[1]**	**Approximate Daily Roundtrips for Produced Water Disposal[1]**	**Approximate Daily Roundtrips for Condensate Disposal[1]**	**Approximate Total Daily Roundtrips During Production by Project Year**
26	154	6	15	3	**24**
27	72	3	7	1	**11**

For comparison purposes, the average daily trips associated with peak-year development and production were contrasted with baseline traffic data collected for the EIS. Combining estimated peak-year average daily trips with baseline data allows for an assessment of the potential project related traffic impacts in a base-year context; however, it is anticipated that other variables (e.g., increased recreational use of the WTP Project Area) would also contribute to a gradual increase in traffic on the affected roads.

For the transportation assessment annual round trips were converted to AADT by multiplying by two and dividing by 365. This conversion allows comparison baseline traffic data collected for this EIS. Traffic impacts may be overstated because not all vehicles would leave the WTP Project Area everyday.

5.0 BLM SYSTEM ROADS

5.1 EXISTING CONDITIONS

Within the WTP Project Area there are approximately 199 miles of existing road, the majority of which is managed by the BLM. During the scoping process, members of the BLM interdisciplinary team (IDT) identified roads that would be use as the primary access routes if the Proposed Action were implemented. With the exception of Jack Canyon, each of these existing roads would be high-traffic corridors under the Proposed Action. The following is a brief discussion of each of these access roads.

5.1.1 Harmon Canyon Road

Harmon Canyon Road (BLM system road #6513) is located 4.2 miles west of the Gate Canyon and Nine Mile Canyon junction. This road serves as the primary access route to the western portion of the WTP Project Area including the Stone Cabin Gas Field. Considerable upgrades have been made to the road in the past to accommodate oil and gas development that has been ongoing since the 1950s. The majority of the upgrades have provided temporary solutions to drainage problems caused by a natural spring that crosses the road and the stream channel that parallels the road. In addition to drainage problems, unstable geology is found in portions of the canyon. Because of the roads width, seasonal bottleneck problems occur on this route when drill rigs are moved in or out of the WTP Project Area. Bottleneck problems also frequently occur during periods of inclement weather.

5.1.2 Prickly Pear Canyon Road

Prickly Pear Road (BLM system road #6514) is located 3.1 miles east of the Gate Canyon and Nine Mile Canyon junction. Like Harmon Canyon Road, Prickly Pear Road provides access to

the Stone Cabin Gas Field. Prickly Pear Road, which is visible from Nine Mile Canyon, is steeper and narrower than Harmon Canyon Road; however, the road is used by pickup-trucks to access the plateau. The road currently has excessive gradients, a narrow travel surface, and corners with limited turn radius.

5.1.3 Dry Canyon Road

Dry Canyon Road (BLM system road #6519) is located to the east of Prickly Pear Canyon Road and is approximately 4.8 miles from the Gate Canyon and Nine Mile Canyon junction. Dry Canyon is the largest drainage in the WTP Project Area. In the lower portion of Dry Canyon, the road is in close proximity to, and at times encroaches upon Dry Creek. In the upper reaches of the canyon the road narrows and crosses Dry Creek numerous times. In the past, the road has occasionally been washed out by flash floods.

5.1.4 Cottonwood Canyon Road, Dugway to Flat Iron Mesa, Dugway to Peter's Point, and Cottonwood Spur

Cottonwood Canyon Road, located downstream of Dry Canyon Road, provides access to Flat Iron Mesa and Peter's Point and is currently used by drilling vehicles. The road is located 6.6 miles from the Gate Canyon and Nine Mile Canyon junction and is used by recreational vehicles to access to the Hunt Panel, which is one of the most recognized rock art walls in the Nine Mile Canyon. Below the Hunt Panel the road is narrow with blind corners. Above the Hunt Panel, the road becomes narrow and is frequently flooded by Cottonwood Creek. From the canyon bottom, Flat Iron Mesa is reached via a dugway (a road cut into a steep hillside), which has gradients of approximately 20 percent. Peter's Point is reached via another dugway with similar gradients, or the Cottonwood Spur Road. Cottonwood Spur Road is longer and less steep than the dugway to Peter's Point; but receives less use by oil by oil and gas traffic. All roads that provide access from the canyon to the plateau have steep initial grades, narrow surfaces, and drainage issues. Seasonal bottleneck problems occur in Cottonwood Canyon, and in particular on the dugways to Flat Iron Mesa and Peter's Point, when drill rigs are moved in or out of the WTP Project Area. Because of the excessive gradients, heavy equipment is required to assist haul trucks during rig mobilization. Bottleneck problems also frequently occur during periods of inclement weather.

5.1.5 Horse Bench Road

Horse Bench Road (BLM system road #6552) begins 9.1 miles from the Gate Canyon and Nine Mile Canyon junction at the Peter's Point airstrip. The road was constructed by the BLM to provide access to the Naval Oil Shale Reserve #2, which was transferred from the Department of Energy back to the BLM in 2001 through the Department of Defense Authorization Act. This less-traveled road is narrow (10-12 feet) along most sections and is precariously pitched and exposed. Horse Bench Road also has steep grades (approximately 18 percent in certain areas) and drainage problems. Portions of Horse Bench Road are also characterized by shallow and rocky soils. In its current condition a high clearance vehicle is need to travel the Horse Bench Road. The road could properly be characterized as primitive.

5.1.6 Jack Canyon Road

Jack Canyon Road is accessed from the Sage Brush Flat area located on Peter's Point. Portions of the road were constructed during 1976. The road was extended in 1981 to provide access to the Peter's Point 5-14 well, which is located in the Desolation Canyon Wilderness Study Area (WSA). The extended portion of the road is a BLM-issued ROW inside the WSA. However, the

ROW was issued prior to establishment of the WSA. In the upper portions of the canyon, the road is located in a stream channel. Jack Canyon is steep, rocky, narrow, and prone to flooding. Once the stream channel converges with Jack Creek the road encroaches upon the stream in numerous places causing additional drainage problems. In its current condition the road is not passable by motorized vehicle.

5.1.7 Cedar Ridge Road

Cedar Ridge Road (BLM system #6547) runs from Cottonwood Ridge Road to the end of Cedar Ridge. Cedar Ridge Road is approximately 12.7 miles long. For its entire length, the road forms the boundary of the Jack Canyon WSA. For approximately half of its length the road also forms the boundary of the Desolation Canyon WSA. As with other roads in the WTP Project Area, segments of Cedar Ridge Road have steep gradients, shallow soils, a narrow traveling surface, and drainage issues. In its current condition a high clearance vehicle is need to travel the Horse Bench Road. The road could properly be characterized as primitive.

5.2 BLM DESIGN SPECIFICATIONS

Road design standards are based upon the expected traffic volume and other factors such as seasonal or year around use, soil type, precipitation, topography, construction costs, compatibility with other resource values, and safety.

To ensure public safety and the protection of resources, roads on Federal land should be constructed to an appropriate standard no higher than necessary to accommodate their intended use. Oil and gas roads that are not closed to public use have potential to serve secondary uses such as providing access for hunters, range management, ATVs, wildlife viewing, and cultural and heritage tourism. Therefore, safety is the primary design consideration.

Roads also have the potential to cause environmental harm through increased erosion, air pollution, stream degradation, habitat alteration, and increased public use of an area. In areas of environmental sensitivity, the road location, and proper design, construction, and maintenance may minimize environmental harm (DOI-USDA 2007).

BLM road standards can effectively mitigate environmental impacts while ensuring user and public safety. BLM road standards are established in the *BLM/U.S. Forest Service (USFS) publication Surface Operating Standards for Oil and Gas Exploration and Development – The Gold Book (Fifth Edition)* (DOI-USDA 2007); *BLM Manual 9113- Roads*; and in Appendix 19 of the *Price Field Office's Hydrological Modification Standards for Roads* (BLM 2004a).

Road design specifications vary according to the classification of the road. An abbreviated definition of the various road classifications is contained below:

5.2.1 Resource Road

Resource roads are low volume, single-lane roads. They normally have a 12 to 14 foot wide travel surface with "intervisible turnouts," as appropriate, where approaching drivers have a clear view of the section or road between the two turnouts and can pull off to the side to let the approaching driver pass. They are usually used for dry weather, but may be surfaced, drained, and maintained for all-weather use. These roads connect terminal facilities, such as well site, to higher class roads. They serve low ADT and are located on the basis of the specific resources activity need rather than travel efficiency (DOI-USDA 2007).

5.2.2 Local Road

Local roads may be single-lane or double-lane with travel surfaces 12 to 24 feet in width and intervisible turnouts. They are normally graded, drained, and surfaced and are capable of carrying highway loads. These roads provide access to large areas and for various uses. They collect traffic from resource roads and are connected to collector roads or public highways. The location and standards for these roads are based on both long-term resource needs and travel efficiency. They may be operated for either constant or intermittent service, depending on land use and resource management objectives for the area being served (DOI-USDA 2007).

5.2.3 Collector Roads

Collector roads are usually double-lane, graded, drained and surfaced, with a 20 to 24 foot travel surface. They serve large land areas and are major access routes in to development areas with high ADT rates. The locations and standards are often determined by a demand for maximum mobility and travel efficiency rather than a specific resource management service. They usually connect with public highways or other collector roads to form an integrated network of primary travel routes and are operated for long-term land and resource management purposes and constant service (DOI-USDA 2007).

Table 5.2-1 provides a summary of the basic design requirements for each classification of road.

Table 5.2-1. Geometric Standards for BLM Roads

Road Classification	ADT	Terrain	Design Speed		Travel Way Width		Maximum Grade	
			Preference	Min.	Preference	Min.	Preference	Max.
Resource	<20	Level & Rolling	30	NA	14	NA	8	10
		Mountainous	15	NA	14	NA	8	16
Local	<100	Level & Rolling	40	30	20	20	6	10
		Mountainous	20	15	14	12	8	15
	>75	Level & Rolling	50	40	24	20	6	10
		Mountainous	30	15	24	20	8	14
Collector	50-100	Level & Rolling	50	30	24	20	6	8
		Mountainous	30	20	20	20	8	12
	>100	Level & Rolling	50	40	24	20	6	8
		Mountainous	30	20	24	20	8	12

Source: BLM 1985

As previously stated, appropriate road classifications are based largely upon traffic volumes. As required by the BLM 9113 manual, BLM must identify the anticipated type and volume of traffic and assign each road a functional classification. Based upon BBC and other operator's proposed development plan, a tentative road classification has been assigned to all existing and proposed access roads within the WTP Project Area based upon the anticipated use. For the purposes of this analysis, it is assumed that all roads that provide access to less than 10 well pads would be designated as resource roads, roads that would provide access to between 10 and 50 well pads would be designated as local roads, and roads that provide access to more than 50 well pads would be designated as collector roads. In some instances road standards may vary along the same route depending on the operator's access needs.

Table 5.2-2 shows the road classifications that have been assigned to the primary BLM system roads within the WTP Project Area. Each of these roads is illustrated on **Figure F-1**.

Table 5.2-2. Tentative Functional Road Classifications for Primary BLM System Roads	
Road Name	**Road Standards**
Harmon Canyon	Class 1- Collector
Prickly Pear	Class 3- Resource
Cottonwood Canyon	Class 1- Collector
Flat Iron Mesa	Class 2- Local
Cedar Ridge Road	Class 2- Local/ Class 3- Resource
Dry Canyon	Class-2 Local
Horse Bench	Class 1 Collector/ Class 2 Local/ Class 3- Resource
Jack Canyon	Class 3- Resource
Cottonwood Dugway (to Horse Bench)	Class 1- Collector
Cottonwood Spur	Class 1- Collector

Once roads have been assigned a functional classification the BLM must consider road design elements. Road design elements are closely related to design speed and elements including curve radii, vertical curve lengths, sight distance, and drainage structures. For example, on single lane roads, turnouts are required to provide safe travel for opposing traffic. For low-traffic volume roads, turnouts should be spaced at a maximum distance of 1,000 feet. For high-traffic volume roads, a maximum of 700 feet is recommended. Turnouts should be located so they are at intervisible points. Appropriate drainage structures including road crown, side ditches, ditch relief culverts, drainage culverts, inlet and outlet protection, and other appropriate structural devices that provide protection of the road and adjacent water resources.

6.0 ENGINEERING AND ENVIRONMENTAL CONSTRAINTS

During the scoping process, numerous visits were made to the field by members of the BLM IDT to examine the primary access roads within the WTP Project Area on a site-specific basis. Following field visits by IDT members, the BLM IDT decided that an engineer would have to examine WTP Project Area roads prior to conducting an impact analysis. At BLM request, BBC contracted with EIS Consulting to conduct preliminary engineering studies for each primary road within the WTP Project Area (see **Appendix F-1** *Road Evaluation Report- West Tavaputs EIS*). The purpose of the preliminary study was to determine the practicality of upgrading each road to meet the BLM road standards contained in the BLM 9113 Manual and the Gold Book. At the termination of the preliminary study, EIS concluded that the majority of the existing roads did not meet BLM requirements; however, with minor modifications most roads could be developed into safe and usable roads. EIS also concluded that bringing roads into compliance with BLM standards could cause unnecessary environmental damage and take excessive financial resources (EIS 2006f).

The preliminary study indicated that all existing roads in the WTP Project Area could be greatly improved if proper drainage structures were installed at regular intervals and additional aggregate was placed along existing roads. The report specifically stated that the majority of the existing

problems could be attributed to runoff flowing down roadways causing erosion and poor surface conditions. In addition, the report indicated that the removal of vegetation along existing road corridors could substantially improve sight distance.

Table **6.0-1** provides a summary of the preliminary Road Evaluation Report. The table shows each primary road and any inconsistencies with BLM road standards.

Table 6.0-1. Preliminary Evaluation of Critical Roads in the WTP Project Area

Road Name	Design Requirements	Existing Issues	Issues that can be resolved	Issues difficult to resolve
Harmon Canyon	Gradient			
	Width	X		X
	Turnouts	X		X
	Curve Radius			
Prickly Pear	Gradient	X		X
	Width	X		X
	Turnouts	X		X
	Curve Radius	X		X
Horse Bench	Gradient	X	X	
	Width	X	X	
	Turnouts	X	X	
	Curve Radius			
Cottonwood Canyon	Gradient			
	Width	X	X	
	Turnouts	X	X	
	Curve Radius			
Dugway to Flat Iron Mesa	Gradient	X		X
	Width	X		X
	Turnouts	X	X	
	Curve Radius	X	X	
Cottonwood Dugway	Gradient	X		X
	Width	X	X	
	Turnouts	X	X	
	Curve Radius	X	X	
Cottonwood Spur	Gradient	X	X	
	Width	X	X	
	Turnouts	X	X	
	Curve Radius	X	X	
Dry Canyon	Gradient			
	Width	X	X	
	Turnouts	X	X	
	Curve Radius			
Cedar Ridge	Gradient	X		X
	Width	X	X	
	Turnouts	X	X	
	Curve Radius	X		X
Jack Canyon	Gradient	X	X	
	Width	X	X	
	Turnouts	X	X	
	Curve Radius	X	X	

Source: EIS 2006f

7.0 BBC'S AND OTHER OPERATORS' PROPOSED ROAD PLAN

7.1 PROPOSED ROAD CLASSIFICATIONS

Following completion of the preliminary engineering report, BBC contracted with EIS Consulting to assist them in building a road development plan to supplement their proposal for drilling and production operations in the WTP Project Area (see **Appendix F-2** *West Tavaputs Plateau EIS-Road Disturbance Evaluation Report*). In an effort to simplify the BLM road construction requirements, BBC determined that two road classifications would be sufficient for proposed drilling and production operations in the WTP Project Area. The two classifications are primary roads and secondary roads. A definition of these two classifications is provided below.

7.1.1 Primary Roads

Primary roads are a hybrid of BLM Collector and Local roads. These roads would have an average travel width of 22 feet and provide access to major operations. This type of road would be used in locations where greater that 10 well pads are designated for a given area. The primary roads would be constructed to minimize environmental impact. Where practical and available, road surfaces would be graveled (EIS 2007f).

7.1.2 Secondary Roads

Secondary roads would take the place of BLM Resource roads. These roads would have an average travel width of 16 feet and provide access to less active sites. This type of road would be used in locations where less than 10 well pads are designated for an area. This type of road is presently being used for drilling operations in the Nine Mile Canyon area (EIS 2007e).

7.2 PLANNED ROAD IMPROVEMENTS

Consistent with the preliminary engineering report, under the Proposed Action BBC is proposing to maintain and/or slightly improve the condition of the majority of the existing roads in the WTP Project Area proposed for project use. Typical maintenance activities would include monitoring, surface replacement, dust abatement, spot repairs, slide removal, and improvement of drainage structures as necessary. In general, maintenance activities would not require additional surface disturbance and/or construction outside of the existing ROWs; however, on some occasions additional disturbance could be required.

After review of the *Road Evaluation Report* and the *Road Disturbance Evaluation Report*, it was determined that select segments of four of the primary roads would require extensive improvement. BBC reviewed each of these segments and concluded that additional engineering work would be required to present the necessary improvements, realignments, and/or reroutes being considered. In order to provide a sufficient level of detail, Golden Engineering Group LLC (GEG) was retained by BBC to complete a supplemental engineering analysis. GEG's findings were included in a report titled *Access Road Assessment West Tavaputs Plateau Carbon County, Utah* (GEG 2007) (see **Appendix F-3**).

In general, the report provides detail on extensive improvements, realignments, and/or reroutes of the following roads:

- Horse Bench Road;

- Harmon Canyon Road;
- The dugway from Cottonwood Canyon to Flat Iron Mesa; and
- Jack Canyon Road.

As noted in the *Access Road Assessment West Tavaputs Plateau Carbon County, Utah* report, Horse Bench Road, Harmon Canyon Road, and the dugway from Cottonwood Canyon to Flat Iron Mesa would be designated as primary roads based on the proposed use. However, following improvement, in certain areas compliance with BLM road standards would still be limited due to narrow canyons, proximity to drainages, steep side slopes, and steep gradients.

7.3 NEW ROAD CONSTRUCTION

In terms of new construction, implementation of the Proposed Action would require the construction and improvement of 178 miles of access roads on BLM, State, and private surface. The majority of the proposed access roads (165 miles) would be installed with a new co-located pipeline ROW. Initial surface disturbance resulting from the construction or improvement of access roads would be approximately 1,700 acres.

Road improvements and new road construction would only occur on an as-needed basis to facilitate access to well pads and other facilities. All roads would be constructed or improved to facilitate drainage and control erosion.

Aggregate for road surfacing would be obtained from existing quarries on State of Utah lands or new aggregate borrow areas on Federal land. Aggregate would be of sufficient size, type, and amount to allow all weather access and alleviate dust.

Following interim reclamation, access roads co-located with proposed pipeline and roads alone would be reduced to a 30-foot wide disturbance corridor. Long-term surface disturbance from the approximately 173 miles of access road would be approximately 648 acres.

8.0 BLM'S PROPOSED ROAD PLAN

After reviewing BBC's proposal, a BLM engineer evaluated each of the primary roads that would be used for Full Field development in the WTP Project Area to determine whether additional road improvements would be necessary (see **Appendix F-4** *West Tavaputs Plateau Analysis of Select Roads*). The BLM concluded that where technically feasible, BBC and other operators should be required to meet BLM road standards on all of the primary access roads, which means BBC and other operators will be required to improve roads beyond those detailed in GEG's report *Access Road Assessment West Tavaputs Plateau Carbon County, Utah* (**Appendix F-3**). However, consistent with the preliminary engineering report, the BLM's engineer determined that in certain situations the resource damage incurred by complying with specific road standards outweighs the advantages of compliance. Based upon this finding, the BLM's report recommends that BBC and other operators should be allowed to apply for variances to certain of 9113 standards on a site-specific basis. Conditions under which variances would be allowed are discussed in the enclosed report.

In terms of new road construction, all roads proposed by BBC and other operators would be authorized and constructed in compliance with BLM directives, standards, and stipulations. Construction would be authorized under a ROW grant, APD, or Sundry Notice. BBC and other

operators would be responsible for the work, which would be subject to the terms of the ROW authorization. Prior to construction and subsequent utilization of roads on lands administered by the BLM, BBC and other operators would coordinate with the BLM Price Field Office. Roads and bridges constructed or improved would be constructed or improved in accordance with the applicable BLM handbook (BLM 1985).

9.0 BLM MAINTENANCE REQUIREMENTS

BBC and other operators would be required to maintain transportation corridors which they construct or use to the standards specified in the use authorization. BBC and other operators may either undertake maintenance responsibilities in their entirety, or coordinate with other users of the road. BLM ROWs that are not maintained in accordance with the terms of authorization would be considered noncompliant. BLM retains the authority to terminate any ROW that is determined to be noncompliant (BLM 1985).

BLM is responsible for the enforcement of all ROW authorizations. As such, it is BLM responsibility to inspect and ensure compliance with all ROW authorizations. It is the PFO current policy that ROWs would be inspected for compliance once within 2 years of a pipeline being built and within 5 years of a road being built. After that, inspections will be done on a 10 year basis at minimum or as needed. In good faith, BBC and operators are expected to initiate their own inspections programs, identify noncompliance, and take appropriate actions rather then relying on the Federal inspection process.

Under BLM alternatives, BBC, other operators, and BLM would select a third party contractor to inspect roads and monitor compliance with maintenance obligations. A description of the third party monitoring plan is contained in **Appendix D**.

New roads that are no longer required for development or production activities would be closed and the site restored. The rehabilitation would be the responsibility of BBC and other operators.

10.0 COUNTY ROADS

Duchesne County roads would be used to access the WTP Project Area from U.S. Highway 40, whereas Carbon County roads would be used to access the WTP project Area from the U.S. Highway 6. During the scoping process, the public voiced concern about the impacts the Proposed Action would have on county roads, and in particular the impacts that increased traffic would have on Nine Mile Canyon Road and the road in Gate Canyon. The BLM recognizes the importance of these access roads; however, jurisdiction of these roads, and thus maintenance responsibilities, belong to the respective counties. As such, BLM does not have authority to require BBC and other operators to improve or maintain these roads in accordance with Federal road construction standards (BLM-Carbon County 1981).

10.1 EXISTING CONDITIONS

10.1.1 Nine Mile Canyon Road

The existing road through Nine Mile Canyon is maintained by Carbon and Duchesne Counties. Surfacing, road width, and general condition along the road all vary tremendously.

Portions of the road that do not have adequate surface materials have been eroded into native material, which results in dust or mud when very dry or very wet. Vehicles traversing the area frequently have trouble maintaining control, traction, and vision because of problems associated with the road surface.

The travel corridor within Nine Mile Canyon is very narrow (approximately 14 to 18 feet wide) in sections, and there are numerous blind curves. The width of the road is generally constrained by the incised channel of Nine Mile Creek, cliffs, boundary fences on private land, irrigation ditches, and cultural sites.

Finally, Nine Mile Canyon is the primary drainage in the WTP Project Area, meaning that numerous side canyon drainages intersect the road. Flash floods and debris flows across the road from side canyons may occur during inclement weather. Since the road runs along the base of steep slopes and/or cliffs, occasional rock falls have also been known to occur in the area.

10.1.2 Gate Canyon Road

The Wells Draw Road travels through Gate Canyon (and is often referred to as Gate Canyon Road). In general, the issues in Gate Canyon are similar to those just discussed for Nine Mile Canyon. Gate Canyon is one of the major tributaries intersecting Nine Mile Canyon. The road through the canyon parallels and frequently crosses the stream channel. Runoff from flash floods frequently damages the road at channel crossings. In addition, segments of the road in Gate Canyon have steep gradients.

From US 40/191 to US 6/191, Nine Mile Canyon/ Gate Canyon is designated as a BLM Backcountry Byway and as a Utah State Scenic Backway. Backcountry Byways are components of the National Scenic Byway system established by the Department of Transportation in 1991. BLM Backcountry Byways are a system of low-standard roads that pass through areas with high archaeological, cultural, historic, natural, recreational, and scenic values. The Nine Mile Canyon Backcountry Byway is approximately 78 miles long. Approximately 25 miles are included in the WTP Project Area. For a detailed description of Backcountry Byways see **Section 3.18** in the WTP Full Field Development EIS.

10.2 COUNTY ROAD SPECIFICATIONS

10.2.1 Carbon County

It is Carbon County's policy that unpaved roads should be constructed and maintained in accordance with the standard specifications promulgated by the American Association of State Highway and Transportation Officials (AASHTO) and the Utah Department of Transportation (UDOT). Compliance with these widely accepted road specifications helps ensure proper drainage and road surfacing keeping roads safe and useable for public use. According to the Carbon County Encroachment Ordinance, unpaved roads used for heavy haulage should have a minimum of 4 inches of aggregate during the dry seasons and approximately 8 inches of aggregate during other seasons (Carbon County 2005a).

10.2.2 Duchesne County

Duchesne County has general specifications for road construction and maintenance; however, actual design requirements are determined on a site-specific basis by the County Roads Supervisor. General requirements include a properly shaped and compacted subgrade, a six-inch

road base, a 24-foot wide travel surface, 3-foot shoulders on both sides of the road, and appropriate drainage structures (Duchesne County 2007).

10.3 COUNTY ROAD MAINTENANCE

Nine Mile Canyon Road and the road in Gate Canyon are both classified as Class B County roads. Class B roads are maintained by the individual counties. UDOT is responsible for distributing money to counties for the maintenance of roads. The money comes from the motor fuels tax.

By accepting Class B roads funds, the counties agree to comply with the laws, regulations, and procedures regarding Class B roads. UDOT reserves the right to disqualify funding if maintenance is below the minimum standards. Minimum standards for roads with unimproved surfaces include keeping the roadway free from obstructions, grading on a regular basis, and traversable by a conventional two-wheel drive passenger vehicle during dry weather conditions. State allocations are insufficient to cover the full cost of road maintenance (State of Utah 2006). Maintenance costs that are not covered by the state are generally covered by county property tax revenues.

Impacts directly associated with oil and gas development are partially mitigated by mineral royalties collected on state and Federal land. These royalties collected by or distributed to the State are then distributed to various state agencies and or programs including UDOT. UDOT redistributes money back to individual counties that are impacted through special service districts. Revenues received by county transportation special service districts can then be used to assist with the costs of maintaining roads that are utilized for resource extraction activities.

As discussed in greater detail in the socioeconomic section of the WTP Full Field Development EIS, Carbon County would be a recipient of mineral royalties which would be collected on oil and gas resources extracted in the WTP Project Area. However, the majority of project-related vehicles would be traveling to and from the WTP Project Area on roads which are maintained by Duchesne County, which would not receive royalties from production. Thus, if the Proposed Action were implemented, there would be disproportional maintenance costs placed upon Duchesne County and inadequate funding for maintenance activities.

To eliminate some maintenance costs, Carbon County has issued an Encroachment Ordinance (Carbon County 2005a) which requires operators to maintain roads that they use for heavy haulage or roads that they disproportionately use for extraordinary activities. Under the Carbon County Encroachment Ordinance BBC and other operators would be responsible for maintaining roads according to County specifications in proportion with their road use.

Because of the cost of maintaining roads, and because these routes provide access to BBC and other operator's leaseholds, it is in the best interest of the respective Counties as well as BBC and other operators to enter into formal or informal maintenance agreements that would grant BBC and other operators the authority to conduct routine maintenance activities on county roads as necessary. Routine maintenance activities are generally limited to operations such as grading, snow removal, dust suppression, and clearing debris from flash floods and rock falls. Carbon County and BBC have signed a formal maintenance agreement; whereas Duchesne County and BBC continue to work under an informal agreement.

BBC and the other operators are providing support for long-term improvements planned by the respective counties for Nine Mile Canyon Road and the road in Gate Canyon. Long-term

improvements for Nine Mile Canyon Road and the road in Gate Canyon could include such things as widening where appropriate, hard surfacing where appropriate, straightening sections that have poor line of sight, and improving drainage structures.

10.4 COUNTY ROAD IMPROVEMENTS

10.4.1 Nine Mile Canyon Road

Approximately 50 new signs were installed by Carbon County in Nine Mile Canyon in September 2006 as part of Federal aid project STP-9999(808), also known as the "Rural Run Off Road Mitigation Program." In conjunction with signage improvements, the County has also been monitoring crashes in Nine Mile Canyon. The Carbon County Safety Coordinator, with the assistance of Carbon County GIS Department, are mapping all traffic accident sites to create a file showing hot spots that need special attention to reduce the number of crashes (Sacco 2006a, 2007).

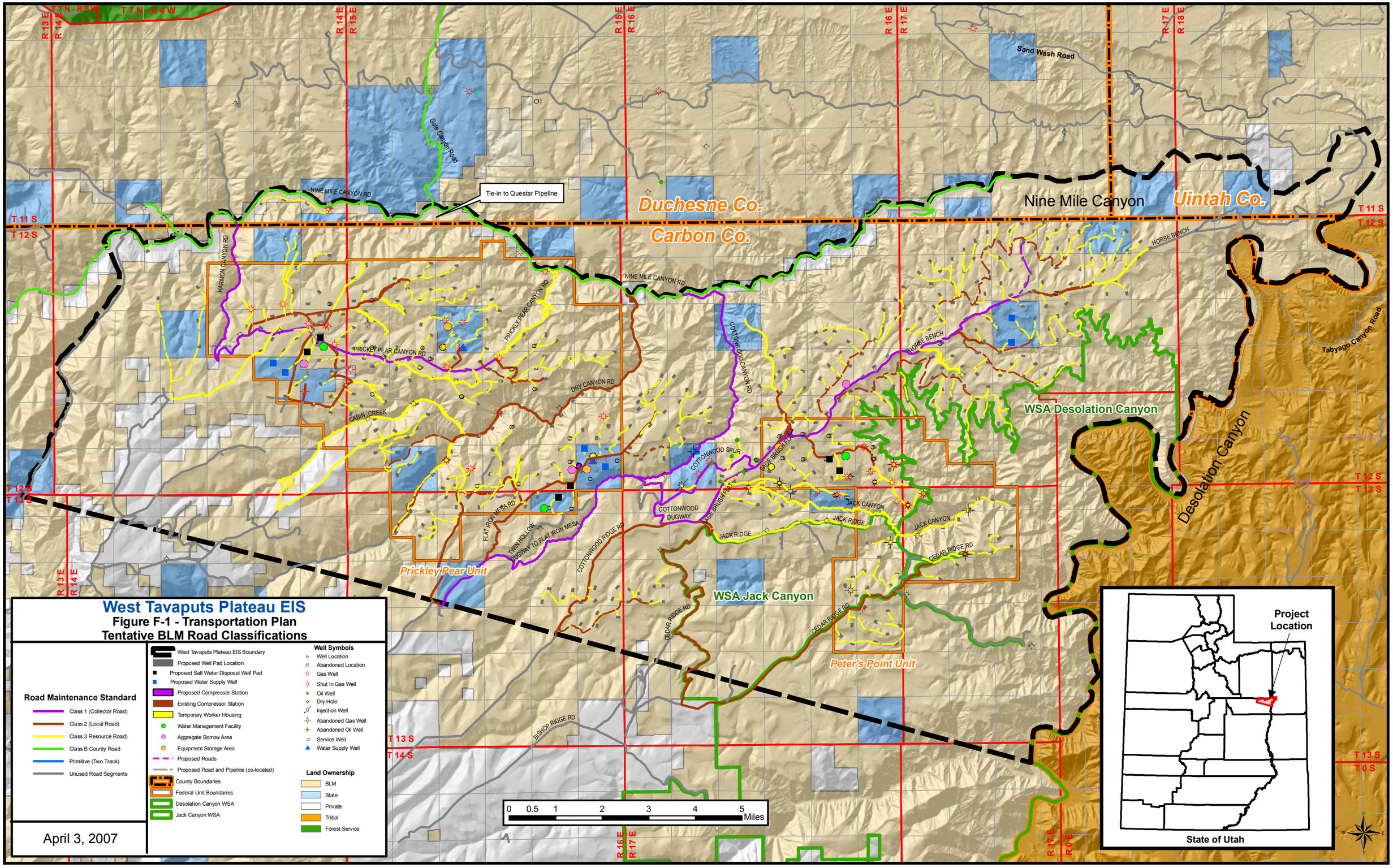
The Carbon County Commission is committed to improving the road surface in portions of Nine Mile Canyon. During 2007, roto-mill, which consists or recycled asphalt pavement, was hauled to the canyon and laid near Nine Mile Canyon Ranch, the Hammerschmidt place, Cottonwood Glen rest area, the Argyle Canyon Road intersection, and Big Sulfur Canyon. Roto-mill is laid by a grader, which places the material on the road to a predetermined width. The road is then chipped and sealed to prevent deterioration. Additional roto-mill will likely be acquired in the future (Sacco 2006b).

In addition, BBC has committed to spend approximately $1,000,000 on reconstruction and maintenance of Nine Mile Canyon. BBC has rendered a construction estimate for road work in 2007 which would be approximately $540,000. Proposed improvements include widening and straightening portions of the Nine Mile canyon Road east of the Duchesne County line, as well as improving the road surface on segments by homes and recreation and cultural sites. BBC has reserved approximately $200,000 for dust abatement on the Nine Mile Canyon road (Sacco 2007).

10.4.2 Gate Canyon Road

County standards for roads include a 24-foot wide travel surface, 3-foot side ditches, a 6-inch road base, and appropriate drainage structures. As feasible, Duchesne County plans to bring the entire Wells Draw Road up to County standards. Planned improvements would be made in three phases that are expected to take approximately three years (Curtis 2007).

According to the County, the first phase of road improvements would target areas that are impacted by flooding and contain unsafe turns. In an effort to mitigate the problems associated with flash flooding, the County will install concrete drainage dips at a number of channel crossings. BBC has informally agreed to assist with construction activities to realign sections of the Wells Draw Road where unsafe turns are located. The County and BBC are currently working on an informal agreement that would include a scope of work and a project schedule (Curtis 2007).


West Tavaputs Plateau EIS
Figure F-1 - Transportation Plan
Tentative BLM Road Classifications
Road Maintenance Standard
Class 1 (Collector Road)
Class 2 (Local Road)
Class 3 Resource Road)
Class B County Road
Primitive (Two Track)
Unused Road Segments
West Tavaputs Plateau EIS Boundary
Proposed Well Pad Location
Proposed Salt Water Disposal Well Pad
Proposed Water Supply Well
Proposed Compressor Station
Existing Compressor Station
Temporary Worker Housing
Water Management Facility
Aggregate Borrow Area
Equipment Storage Area
Proposed Roads
Proposed Road and Pipeline (co-located)
County Boundaries
Federal Unit Boundaries
Desolation Canyon WSA
Jack Canyon WSA
Well Symbols
Well Location
Abandoned Location
Gas Well
Shut In Gas Well
Oil Well
Dry Hole
Injection Well
Abandoned Gas Well
Abandoned Oil Well
Service Well
Water Supply Well
Land Ownership
BLM
State
Private
Tribal
Forest Service
April 3, 2007
Duchesne Co.
Carbon Co.
Uintah Co.
Nine Mile Canyon
Tie-in to Questar Pipeline
Prickley Pear Unit
Peter's Point Unit
WSA Jack Canyon
WSA Desolation Canyon
Desolation Canyon
Sand Wash Road
Gate Canyon Road
NINE MILE CANYON RD
HARMON CANYON RD
PRICKLY PEAR CANYON RD
DRY CANYON RD
CABIN CREEK
COTTONWOOD CANYON RD
HORSE BENCH
COTTONWOOD SPUR
SAGE BRUSH FLAT
COTTONWOOD DUGWAY
JACK CANYON
JACK RIDGE
CEDAR RIDGE RD
FLAT IRON MESA RD
TWIN HOLLOW
HIGHWAY TO FLAT IRON MESA
COTTONWOOD RIDGE RD
BISHOP RIDGE RD
Tabyago Canyon Road
T 7 N - R 4 W
T 7 N - R 5 W
R 13 E
R 14 E
R 15 E
R 16 E
R 17 E
R 18 E
T 11 S
T 12 S
T 13 S
T 14 S
T 0 S
0 0.5 1 2 3 4 5 Miles
Project Location
State of Utah

Appendix F-1

Road Evaluation Report- West Tavaputs Plateau EIS

ROAD EVALUATION REPORT

WEST TAVAPUTS PLATEAU EIS

Prepared for:

BILL BARRETT CORPORATION

September 2006

Prepared by:

J. T. Paluso, P. E.

EIS ENVIRONMENTAL & ENGINEERING CONSULTING
31 North Main, Helper, Utah 84526

INTRODUCTION

The following information as per your request and after talking to Dawn Martin and Tyler Ashcroft of Buys and Associates, Roger Mitchell and I spent two days evaluating the following roads: Harmon Canyon, Horse Bench, Cottonwood, Prickly Pear, Flat Iron Mesa, Dry Canyon, Cedar Ridge, and Jack Canyon. The purpose of this evaluation was to determine the practicality of upgrading these roads to meet the Gold Book Standards. The Gold Book is a summary of Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development used by the Bureau of Land Management and Forest Service. For this project I used the 2006 Fourth Edition.

According to Tyler Ashcroft the Tavaputs Plateau EIS (EIS) has these roads classified as to the number of wells serviced by each road. The various roads are classified as follows:

Class 1 (Collector Road)	**Greater than 50 wells**
Class 2 (Local Road)	**10-50 wells**
Class 3 (Resource Road)	**Less than 10 wells**

The description of each section of road will conform to the West Tavaputs Plateau EIS Transportation-Road Maintenance Standard map produced by Buys and Associates. The order of discussion on the road analyses is per Dawn Martin's of Buys and Associates suggested priority list.

GOLD BOOK REQUIREMENTS

	RESOURCE CLASS 3	**LOCAL CLASS 2**	**COLLECTOR CLASS 1**
	Normally graded Drained & Surfaced	Same	Usually double lane graded, drained & surfaced
Width	12-14’	14-24’ 14’ Single Lane 24’ Double Lane	20-24’
Design Speed	10-30 mph	15-50 mph	30 mph min
Horizontal Curve	Vehicle Requirements	220’	460’
Gradient	8 % Max >8 % for < 300’	8 % Max >8 % for < 300’	8 % Max 8-10 % for < 300’
Mountains	8-16 % with Permission	>8 % with Permission	
Turnouts	1000’ or less Or intervisible	1000’ on single lane	Not Required
Culverts	25 year storm	18” min 25-year storm	18” min 25-year storm

Under the above classification system the study roads would be classified as follows:

EIS ROAD CLASSIFICATION

HARMON CANYON ROAD	COLLECTOR CLASS 1
HORSE BENCH ROAD	COLLECTOR CLASS 1 & LOCAL CLASS 2
COTTONWOOD ROAD	COLLECTOR CLASS 1
PRICKLY PEAR ROAD	LOCAL CLASS 2
FLAT IRON MESA ROAD	LOCAL CLASS 2
DRY CANYON ROAD	COLLECTOR CLASS 1 & LOCAL CLASS 2
CEDAR RIDGE ROAD	LOCAL CLASS 2 & RESOURCE CLASS 3
JACK CANYON ROAD	RESOURCE CLASS 3

HARMON CANYON ROAD (CLASS 1)

Main Harmon Canyon Road (Except for the Two Areas Listed Below)

	Can Meet BLM Requirements	Difficult to Meet BLM Requirements	Cannot Meet BLM Requirements
Slope	X		
Width	X		
Pullouts	X		
Turn Radius	X		

Approximately 1.5 miles of the road adjacent to the Interplanetary Airstrip was graveled in the fall of 2005. This portion of the road was rebuilt and culverts were installed as needed. This work was necessary to eliminate low areas where water was accumulating and to improve the overall road condition. The majority of this road is well graded and wide. Pullouts in areas where the road is adjacent to the drainage may be difficult due to the limited space between the road and drainage channel.

Harmon Canyon Spring Area (Class 1)

	Can Meet BLM Requirements	Difficult to Meet BLM Requirements	Cannot Meet BLM Requirements
Slope	X		
Width		X	
Pullouts		X	
Turn Radius	X		

Bill Barrett Corporation (BBC) has been given permission by the BLM to improve this problem area. BLM staff members visited this site on May 11, 2006. Attending this meeting from the BLM were Mike Robinson, Don Stephens, Mary Maddux, and Jeff Brower. Under routine maintenance issues and staying within the disturbed area, BBC, this fall, will install drainage ditches and culverts, raise the road elevation, and widen curves in this area. The distance between the upper and lower work boundary on this road maintenance project is approximately 2000 feet. This section of road also needs to be widened and have some of the sharp turns removed. Refer to Exhibit A.

The road height will have to be increased at least 30” in areas where 18” culverts will be installed. This will be necessary to provide sufficient cover over the culverts. Additional width beyond the road disturbance would be helpful to provide the necessary area for raising the road grade and allowing the road and drainage to exist side by side.

An impact hammer will be used to construct drainage ditches in rocky areas. The new ditches will channel the spring generated flows toward the newly installed culverts. This will keep water in the summer and ice in the winter from accumulating on the road.

The excess rocky material will be used to raise the elevation of the road in areas where the drainage channel and existing road are at the same elevation. This will help keep the road and the Harmon Canyon drainage separated. This routine maintenance will make this section of the Harmon Canyon Road safer and more reliable.

The above mentioned maintenance work will improve the road through the spring area. To provide for a long term solution of this problem additional width for the road and stream channel would have to be obtained. This would require getting 10-15' additional width over approximately 900 feet. In this zone some near vertical ledge rock would have to be removed to provide this width. This rock material would then be used to raise the elevation of the road in critical areas, where the road and drainage channel are not separated, by approximately 4 feet. This rocky material would act as a French drain and allow the water from the springs to pass under the roadway into the natural drainage channel. A geotech filter fabric could be placed above the rock to prevent infiltration of road base material and keep the drain operational.

The road should be sloped towards the inside drainage ditch and culverts would be installed to allow water to pass under the road in this section. The outside of the road should be riprapped to prevent erosion due to high water flows from the adjacent channel.

Harmon Canyon Slide Area (Class 1)

	Can Meet BLM Requirements	**Difficult to Meet BLM Requirements**	**Cannot Meet BLM Requirements**
Slope	X		
Width		X	
Pullouts	X		
Turn Radius	X		

A potential slide area is located approximately 200 yards upstream from the above mentioned spring improvement area. This problem was reviewed by the BLM in 2002. Initially the BLM was looking at available options and the feasibility of correcting this problem in-house. Preliminary engineering on stabilizing this site was completed by the BLM. Due to the size of the disturbance to correct this problem and the total cost of this project, this issue was dropped.

The potential slide area is approximately 250' long. Presently this area is stable with no recent signs of movement even with the higher precipitation of the last two years. The road width in this area is 22' wide. This area has not given BBC any road maintenance issues. Refer to Exhibit A for the location of the slide area. If the slide area were to be removed or stabilized, the final disturbance could extend up the slope several hundred feet.

HORSE BENCH ROAD (CLASS 1)

	Can Meet BLM Requirements	Difficult to Meet BLM Requirements	Cannot Meet BLM Requirements
Slope	X		
Width	X		
Pullouts	X		
Turn Radius	X		

The Horse Bench Road has not had any maintenance for years. There are four main areas where the road crosses dugways or hogback ridgelines and there are several other areas where material has sloughed onto the road. Refer to Exhibit B for the location of these four areas (Site 1-4). In all of these areas the road could be upgraded or slightly relocated to meet BLM requirements.

All four sites on the Horse Bench road are very similar in upgrading requirements. Sites 1 and 3 both have a dugway and hogback ridgeline road. Sites 2 and 4 have the narrow hogback ridgeline road only. The dugways will have to be widened, sloped inward, and drainage ditches and dips installed. The spacing of drainage dips will depend upon the final road grade, soil type, and precipitation amounts. The road going over the hogback will have to be widened to meet the 20-24' Class 1 width requirement. The roads in these areas are presently 10-15' wide.

Widening of these roads could be done with a hydraulic backhoe. The backhoe would allow the operator to remove and place material more precisely and eliminate large amounts of material that would be pushed with the dozer. This would help conserve material and possibly eliminate the need to bring in added construction material.

Roads on Horse Bench (Class 2)

	Can Meet BLM Requirements	Difficult to Meet BLM Requirements	Cannot Meet BLM Requirements
Slope	X		
Width	X		
Pullouts	X		
Turn Radius	X		

The EIS shows a Class 2 road coming off of the Horse Bench Road and proceeding north toward Nine Mile Canyon. A new 12" surface pipeline follows this road as it proceeds toward Nine Mile. This area is relatively flat and upgrading to Class 2 should not be a problem.

The main soil type in this area according to Natural Resources Conservation Service (NRCS) is Podo-Cabba family complex. This soil type can be mechanically treated and seeded for reclamation purposes.

COTTONWOOD CANYON ROAD (CLASS 1)

	Can Meet BLM Requirements	Difficult to Meet BLM Requirements	Cannot Meet BLM Requirements
Slope	X		
Width	X		
Pullouts	X		
Turn Radius	X		

The Cottonwood Canyon Road does not include the following three sections, which are discussed separately:

Dugway to Flat Iron Mesa Road
Cottonwood Spur Road
Dugway to Horse Bench Road

The main Cottonwood Canyon Road from Nine Mile to the dugway going up to Horse Bench Road is relatively flat and wide and should not have many problems meeting Class 1 standards. Removal or trimming of vegetation near the Cottonwood Bridge would help improve visibility after crossing the bridge. In this area the visibility is very poor when going around curves by the bridge.

Another section of this road is further up Cottonwood Canyon, above the dugway going to the Horse Bench Road, and terminates at the Flat Iron Mesa Dugway. This portion of the Cottonwood Canyon Road is narrower and closer to Cottonwood Creek. This road presently crosses the creek in one or two places. Obtaining a Class 1 road in this section would require more engineering effort. The road would have to be widened in most places to comply with BLM standards.

The remainder of the Cottonwood Canyon Road, which is above the Dugway to Flat Iron Mesa Road, is relatively flat and should be able to be brought up to Class 1 standards.

Dugway to Flat Iron Mesa Road (Class 1)

	Can Meet BLM Requirements	Difficult to Meet BLM Requirements	Cannot Meet BLM Requirements
Slope		X	
Width		X	
Pullouts	X		
Turn Radius	Most Sections		

This section of road is approximately .5 miles in length and runs from the bottom of Cottonwood Canyon toward the Flat Iron Mesa Road. Presently this section of road is very steep and averages approximately 18 percent. The grade on this section of road could be dropped to 8 % to meet BLM grade requirements by rerouting in the same canyon. The 8 % grade would keep the road close to the bottom of the canyon. By increasing the grade to a maximum of 10 % over 300

foot sections would allow the road to separate from canyon bottom more quickly. This will also meet BLM grade requirements. A 10 % grade would keep the new route away from the canyon bottom. Refer to Exhibit C for two possible new 10 % routes.

Route 1 would remain on the north side of the canyon and is approximately 1-mile long. This route would remain in the shade longer and have icier winter conditions but, is shorter. Route 2 is on the south slope and is approximately 1.7-miles long. Some rockwork would be required because of large ledges on this side of the canyon. Normally there is more soil on north facing slopes. Whichever route is taken, drainage ditches and dips along with in sloping should be installed to control runoff and prevent erosion. The installation of gravel on the road surface would also improve traction and reduce erosion.

Cottonwood Spur (Class 1)

	Can Meet BLM Requirements	Difficult to Meet BLM Requirements	Cannot Meet BLM Requirements
Slope	X		
Width	X		
Pullouts	X		
Turn Radius	X		

This section of road is listed as Cottonwood Spur Road on the EIS Transportation-Road Maintenance Standard map. On the north shoulder of this road there is a 10” pipeline running from Drill Hole 14-32 to the airstrip located on Sage Brush Flat. This road needs to remain open for maintenance of the pipeline. This road is in fairly good condition. Drainage ditches and drainage dips, the entire length of this road, would keep this section of road in good condition.

Dugway to Horse Bench Road (Class 1)

	Can Meet BLM Requirements	Difficult to Meet BLM Requirements	Cannot Meet BLM Requirements
Slope		X	
Width	X		
Pullouts	X		
Turn Radius	Most Sections		

This section of road starts in the bottom of Cottonwood Canyon and connects with the Cottonwood Spur Road. The first .5-mile of road averages 17 percent grade. This section of road approaches 30’ wide in places. The narrowest point is 21’ wide. The surface of this section is fairly rocky and does not get very muddy during wet periods.

In order to meet BLM grade requirements in this section of the road the route would have to be changed. Rerouting of this portion of the road, due to steep side slopes, rock ledges, and lack of vegetation, would cause considerable disturbance to the Cottonwood Canyon drainage and would not provide a more useable road. This section of road has held up quite well over the last few years.

The BLM, during the May 11, 2006 field trip, gave BBC permission to improve the turn radius of a 90-degree turn located near the southeast corner of Section 32. Refer to Exhibit C for the location of this turn. This maintenance work will remove some of the material, approximately 6 feet, on the inside curve allowing loaded trucks to make the turn without their cargo dragging on nearby ledge rock. The road in this area is approximately 30 feet wide but the sharp radius makes it necessary to remove some of the ledge material. All work in this area will be kept within the existing road ROW width.

To make sure that this turning radius problem is solved permanently, an additional 10' of material could be removed on the inside of turn. This would insure that trucks could make the turn without running into the rock ledge.

Another section of this road starts on the west end of the Cottonwood Spur Road and provides a shorter route to the Cedar ridge Road. This road starts in Section 6 and is approximately .7-miles long. Drainage ditches and dips need to be installed on this section of road to improve surface conditions. This section of road averages approximately 11 percent which is slightly above BLM standards for a Class 1 road.

PRICKLY PEAR ROAD (CLASS 2)

	Can Meet BLM Requirements	**Difficult to Meet BLM Requirements**	**Cannot Meet BLM Requirements**
Slope		X	
Width		X	
Pullouts		X	
Turn Radius	X		

Prickly Pear Road runs from the Nine Mile Road and goes approximately 2.5 miles up Prickly Pear Canyon and connects with the Harmon Canyon Road at the top. Refer to Exhibit D. This road is very narrow and steep. Presently, BBC pumpers use this road occasionally as a shortcut for getting off of the mountain after checking their wells near the Interplanetary Airstrip. All big trucks and service equipment use the Harmon Canyon Road.

Due to the steep side slope grades and the limited turning radius space in this area, it would be difficult to construct a Class 2 road without causing large disturbances. It may be possible to reduce speeds and to limit the size of vehicles traveling this road. BBC presently has no intentions of using this road above its current level of use.

The Nine Mile Creek crossing gets very difficult, if not impossible, to cross in the cold winter months due to the ice buildup. Crossings during winter months and high runoff periods have resulted in numerous vehicle damage incidents. The crossing area was surveyed during the summer of 2006 and a detailed topography map was completed. The purpose of this topography map was to investigate the possibility and best possible location for a bridge. A bridge at this location would allow small vehicles to cross Nine Mile Creek in the winter months and during high runoff periods. Refer to Appendix D for the location of the proposed bridge.

FLAT IRON MESA ROAD (CLASS 2)

	Can Meet BLM Requirements	Difficult to Meet BLM Requirements	Cannot Meet BLM Requirements
Slope	X		
Width	X		
Pullouts	X		
Turn Radius	X		

Due do the current ongoing drilling activities in this area and the relatively flat terrain on Flat Iron Mesa, this road is presently in fairly good condition. The addition of more drainage ditches and dips would provide for a more reliable road.

DRY CANYON ROAD (CLASS 1)

	Can Meet BLM Requirements	Difficult to Meet BLM Requirements	Cannot Meet BLM Requirements
Slope	X		
Width	X		
Pullouts	X		
Turn Radius	X		

The Dry Canyon Road from Nine Mile Creek up to Drill Hole 2-B-27 is relatively flat and wide. There is one narrow section of road approximately 500' above the Dry Canyon Compressor Site that would require widening. Refer to Exhibit D. The road narrows above Drill Hole 2-B-27 to 10-15'. A buried pipeline also follows up the road to within approximately one mile of the drill hole. From this point up to the drill hole, there is a 3" pipeline laid on the surface. Due to the location of the pipeline and the depth that it is buried, widening of this road should not be a real problem.

In several places the road is located near the stream channel. This could provide problems during high flow events. Sight distance is relatively good in most places do to the flat terrain. Removal or trimming of vegetation in certain areas would increase site distance.

Above the Stone Cabin turnoff there are at least four stream crossings on the Dry Canyon Road up to the EIS boundary. Refer to Exhibit E. Due to the large flow events in this canyon, it will be necessary to construct low water crossings, large culverts to accommodate these flows, or reroute the road in some places, if possible. The minimum size culvert for these crossings, including Stone Cabin Draw, would be 48 inch. Low water crossings, if used, need to be designed so that any water that overflows the crossings will stay in the drainage channel and not cause additional erosion.

CEDAR RIDGE ROAD (CLASS 2)

	Can Meet BLM Requirements	Difficult to Meet BLM Requirements	Cannot Meet BLM Requirements
Slope		In Some Sections	
Width	X		
Pullouts	X		
Turn Radius	Most Sections		

The Cedar Ridge Road is approximately 22' wide at the beginning but quickly starts down a steep narrow dugway that averages 10 % grade for approximately 2000 feet. Refer to Exhibit F. This section could be modified or rerouted to meet BLM grade requirements. The 10% grade on the southwest face would not impose too many problems for BBC's drilling operations. With a graveled surface, this section of road could provide good traction even during wet and winter periods.

Within the first 1.5 miles the road crosses two drainages that flow into Jack Canyon. These two crossing have had substantial flows in the past and would require culverts or low water crossings. At the Jack Canyon crossing there is one 48" culvert, which is periodically being overtopped. At a minimum another 48" culvert should be installed to help minimize this overtopping. Also the approach road to the Jack Canyon crossing would have to be widened to accommodate the turning radius of large trucks. The turning radius is too small for these large trucks. Refer to Exhibit F. Large sections of this road are wide and relatively flat. To improve drainage along these sections, drainage ditches and drainage dips should be installed.

The Class 1 road coming off of the Cedar Ridge Road and heading southeast toward Desolation Canyon, averages approximately 3 percent. Due to lack of maintenance, this section of road would require work. Getting this road up to Class 1 standards should not be a real problem.

JACK CANYON ROAD (CLASS 3)

	Can Meet BLM Requirements	Difficult to Meet BLM Requirements	Cannot Meet BLM Requirements
Slope	X		
Width	X		
Pullouts	X		
Turn Radius	X		

The first section of this road coming off of the Horse Bench Road averages 8 percent. The road then drops into the drainage channel of one of the major drainages going into Jack Canyon. The road approximates the channel for nearly 3.5 miles until connecting with the main Jack Canyon Drainage. Refer to Exhibit G. In the past, portions of this road existed outside of the drainage channel but have since been abandoned. Erosion problems, due to the road being in the bottom of the drainage, are a very significant problem.

Relocation of this section of road is possible but the area is very rocky and steep. Two possible 10 % routes (Alternate 1 and 2) are shown in Exhibit G. Both of these routes will eliminate approximately 3 miles of the road that is presently located in the drainage channel. The exact location of the road would have to be surveyed to minimize environmental problems. The survey may also extend the proposed routes and eliminate more of the existing road that is in the drainage channel.

The lower section of road below the Jack Canyon drainage confluence again is relatively flat and could be made to meet BLM requirements. This section of road approximately 1.7-miles, presently crosses Jack Canyon drainage several times as it makes its way to Drill Hole 5-14. This road is also located in the Desolation WSA and has an existing ROW. Maintenance on this road would be permitted due to the existing ROW but relocation of various sections would be difficult due to the WSA designation.

CONCLUSION

With the original scope of work and the amount of time allowed for this project, it is difficult to come up with a more definitive description of road improvements necessary to meet BLM Gold Book Standards. Additional time in the field would be needed to develop a more comprehensive description of road upgrade requirements.

All of the roads evaluated would be greatly improved if proper drainage ditches and drainage dips were installed at regular intervals. Culverts could also be used in areas where silting is not a problem. The majority of erosion problems on the roads in the Nine Mile area are caused by the combination of runoff from property adjacent to the roads combining with flows generated on the road surface. This combined flow normally proceeds down the roadway causing erosion problems and muddy road surface conditions. The removal of this excess runoff, along with the installation of gravel, would greatly improve the road conditions and help reduce vehicle maintenance.

Developing several gravel sources in the area would be beneficial to the development and maintenance of the road system. To my knowledge there are no natural gravel sources in the EIS area. Sources would have to be developed on private, state, or federal ground close to the final usage point. In the 2005 drilling year excess material was taken from state well pads and crushed for use on roads. This material was used on a 1.5-mile portion of the Horse Bench Road (approximately one mile southeast of the airport) and a 1.5-mile portion of Harmon Canyon Road (adjacent to the Interplanetary Airstrip). In both cases the two roads have held up nicely under heavy traffic.

With the amount of gravel needed to maintain the roads and to comply with BLM requirements, it may be necessary to develop gravel sources. This would require ripping and possible blasting of rock to obtain material that can be crushed into gravel that would be suitable for road surfacing. The addition of gravel to any of the roads would greatly improve the durability and reduce the maintenance required on the road.

Construction or widening of roads in steep areas could be done with a hydraulic backhoe. The backhoe would allow the operator to remove and place material more precisely and eliminate large amounts of material to be pushed with the dozer. Under normal construction procedures the material pushed by the dozer will cascade down the steep side slopes resulting in greater disturbances and loss of material. The use of a hydraulic backhoe will reduce disturbances and minimize the amount of material needed to construct a section of road.

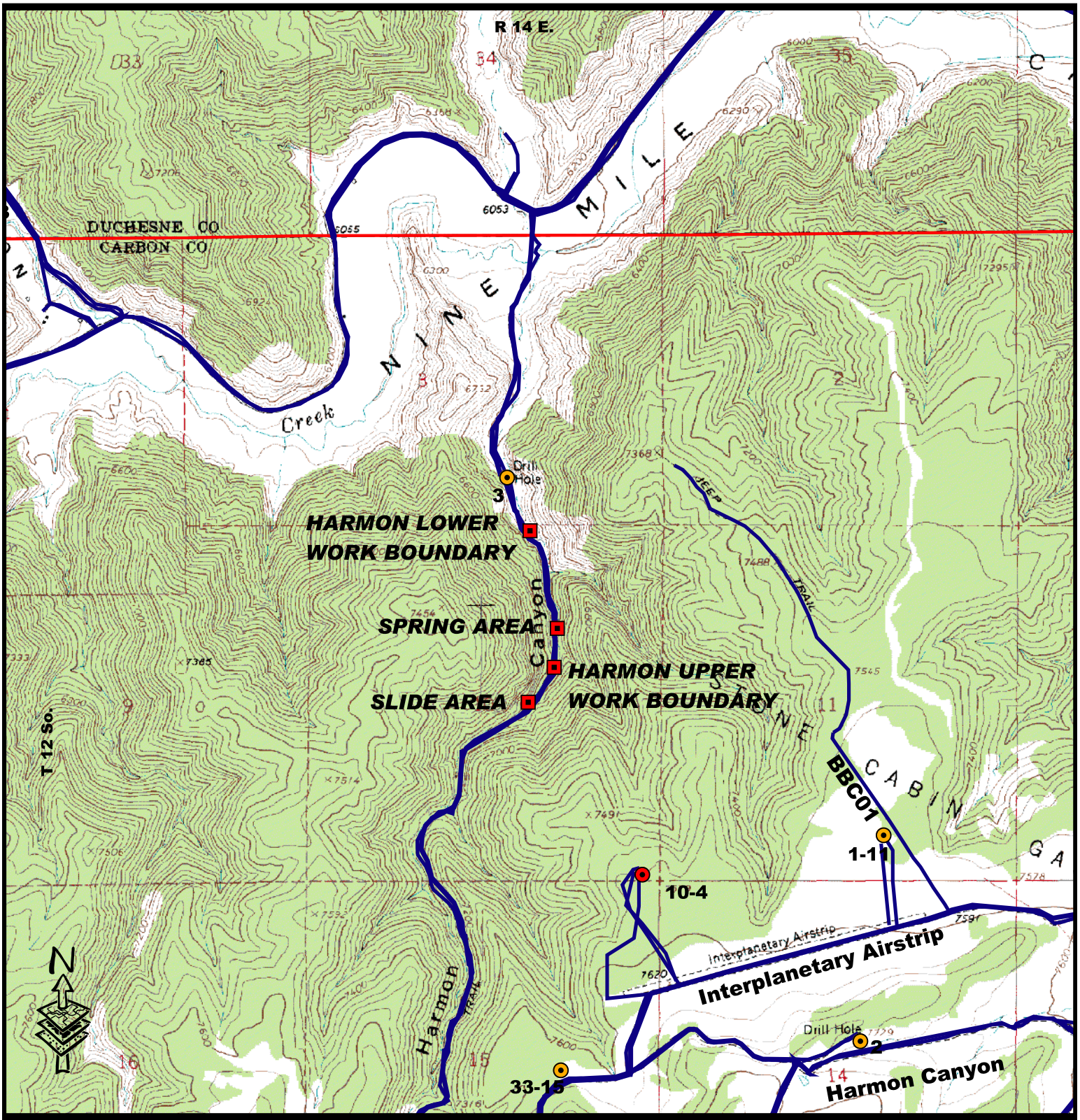
Trimming or removing the vegetation that is adjacent to the road could improve sight distance around curves. This problem occurs mainly on roads that are adjacent to stream and canyon bottoms. An example of this problem is just down stream of the bridge in Cottonwood Canyon. Once you cross the bridge and come to the first curve going up Cottonwood Canyon it is very difficult to see oncoming traffic due to the tall sagebrush that is located around the curve. This same problem exists in several locations in Dry Canyon.

In certain areas road grades are slightly in excess of BLM requirements. To prevent additional environmental damage bringing these roads into compliance, BBC needs to work with the BLM in getting permission to use these perfectly functional and useable roads. It is obvious that with an unlimited amount of money and the disregard for additional disturbances, all roads in the Nine Mile EIS area could be brought up to BLM standards. In my opinion, these extreme measures are not required. Most roads, with minor modifications in alignment and the addition of additional drainage structures, could be developed into safe and usable BLM roads.

APPENDIX 1

ROAD MAPS

EXHIBITS A-G



Created For:

Bill Barrett Corporation
1099 18TH STREET
SUITE 2300
DENVER, CO 80202

LEGEND

- Problem Areas
- Existing Road (GPS Locations)

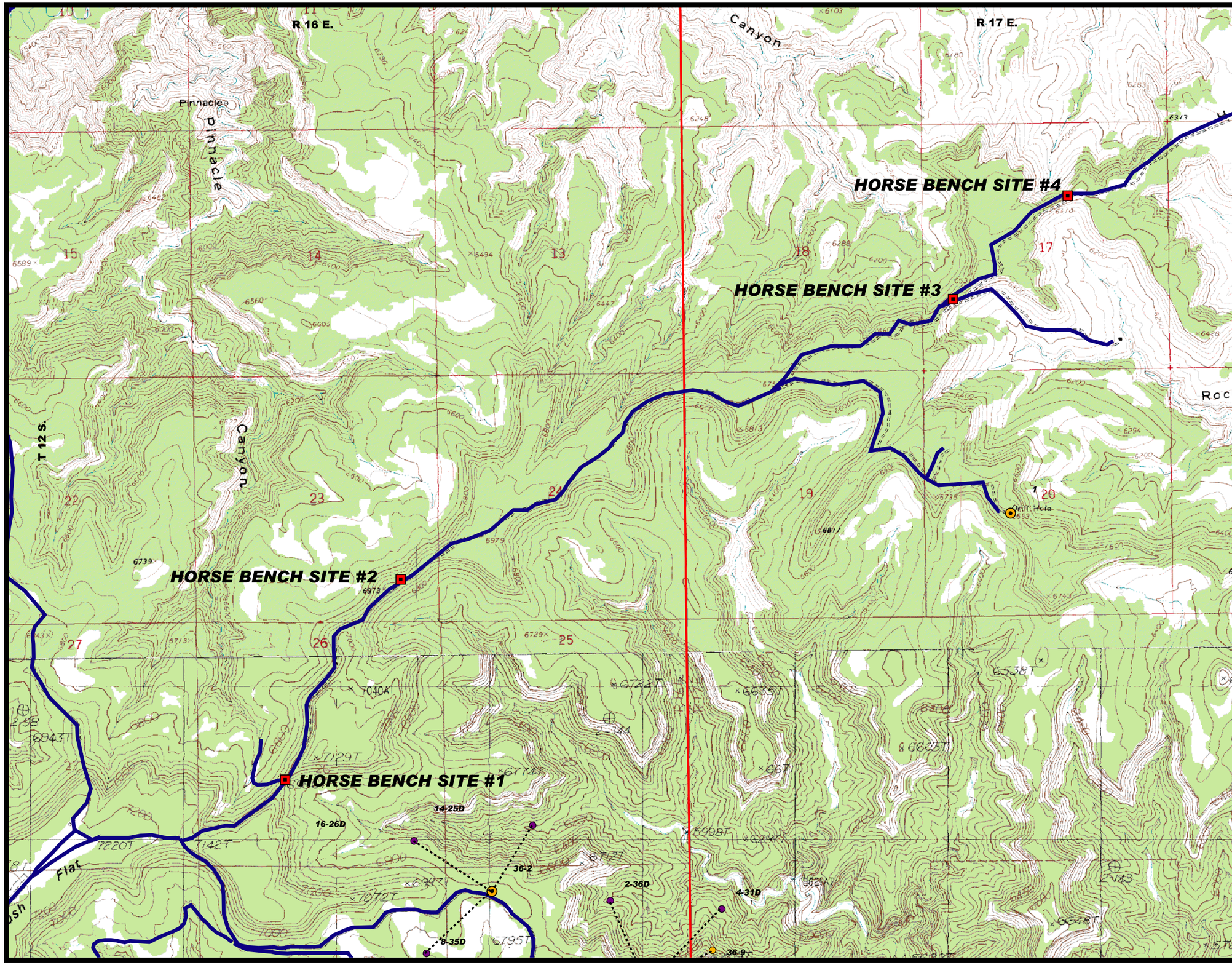
Existing Wells
- 1950-2003
- 1950-2003 D
- 2004
- 2004 D
- 2005
- 2005 D
- 2006
- 2006 D

HARMON CANYON ROAD

SEC. 10, T-12-S R-14-E S.L.B.&M.
CARBON COUNTY, UTAH

DRAWN BY:	SCALE:	EXHIBIT
PJJ	1" = 2000'	A
APPROVED BY:	DATE:	
JTP	27 SEPT. 2006	

Environmental Industrial Services
Environmental & Engineering Consulting
31 North Main Street
Helper, Utah 84526
(435) 472-3814
Fax (435) 472-8780
eisec@preciscom.net



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DENVER, CO 80202

HORSE BENCH ROAD

T-12-S R-16 TO 17-E S.L.B.&M.
CARBON COUNTY, UTAH

LEGEND

- *Existing Roads (GPS Locations)*
- *Problem Areas*

Existing Wells

- *1950-2003*
- *1950-2003 D*
- *2004*
- *2004 D*
- *2005*
- *2005 D*
- *2006*
- *2006 D*

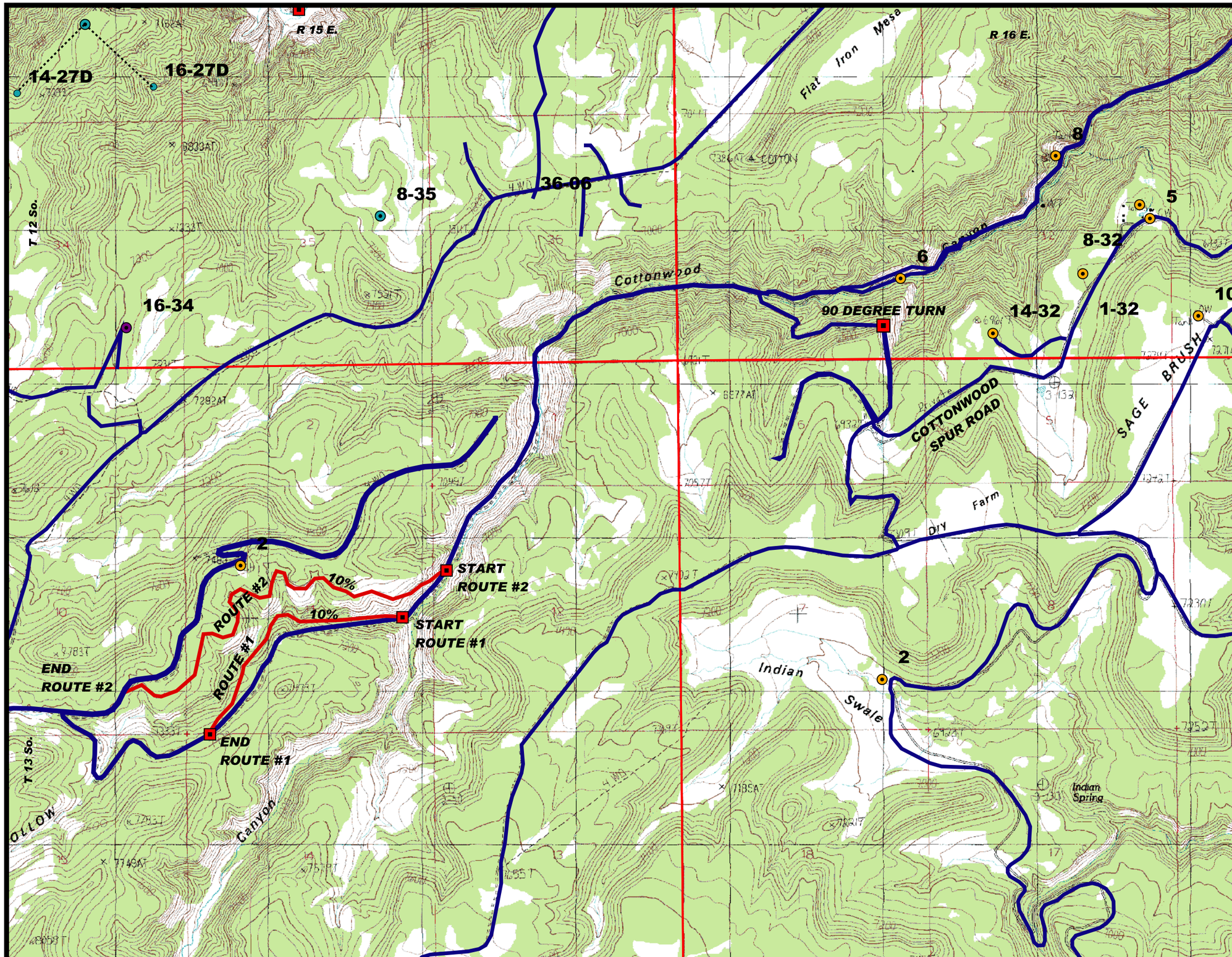
N

Environmental Industrial Services
Environmental & Engineering Consulting

31 North Main Street
Helper, Utah 84526
(435) 472-3814
Fax (435) 472-8780
eisec@preciscom.net

SCALE:	1" = 2000'
DATE:	27 SEPT. 2006
DRAWN BY:	PJJ
APPROVED BY:	JTP

EXHIBIT B



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COTTONWOOD CANYON ROAD

T-12 TO 13-S R-15 TO 16-E S.L.B.&M.
CARBON COUNTY, UTAH

LEGEND

- *Existing Roads (GPS Locations)*
- *Problem Areas*
- *Proposed Reroute Steep Road Portion*

Existing Wells

- *1950-2003*
- *1950-2003 D*
- *2004*
- *2004 D*
- *2005*
- *2005 D*
- *2006*
- *2006 D*

N

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Environmental & Engineering Consulting

31 North Main Street
Helper, Utah 84526
(435) 472-3814
Fax (435) 472-8780
eisec@preciscom.net

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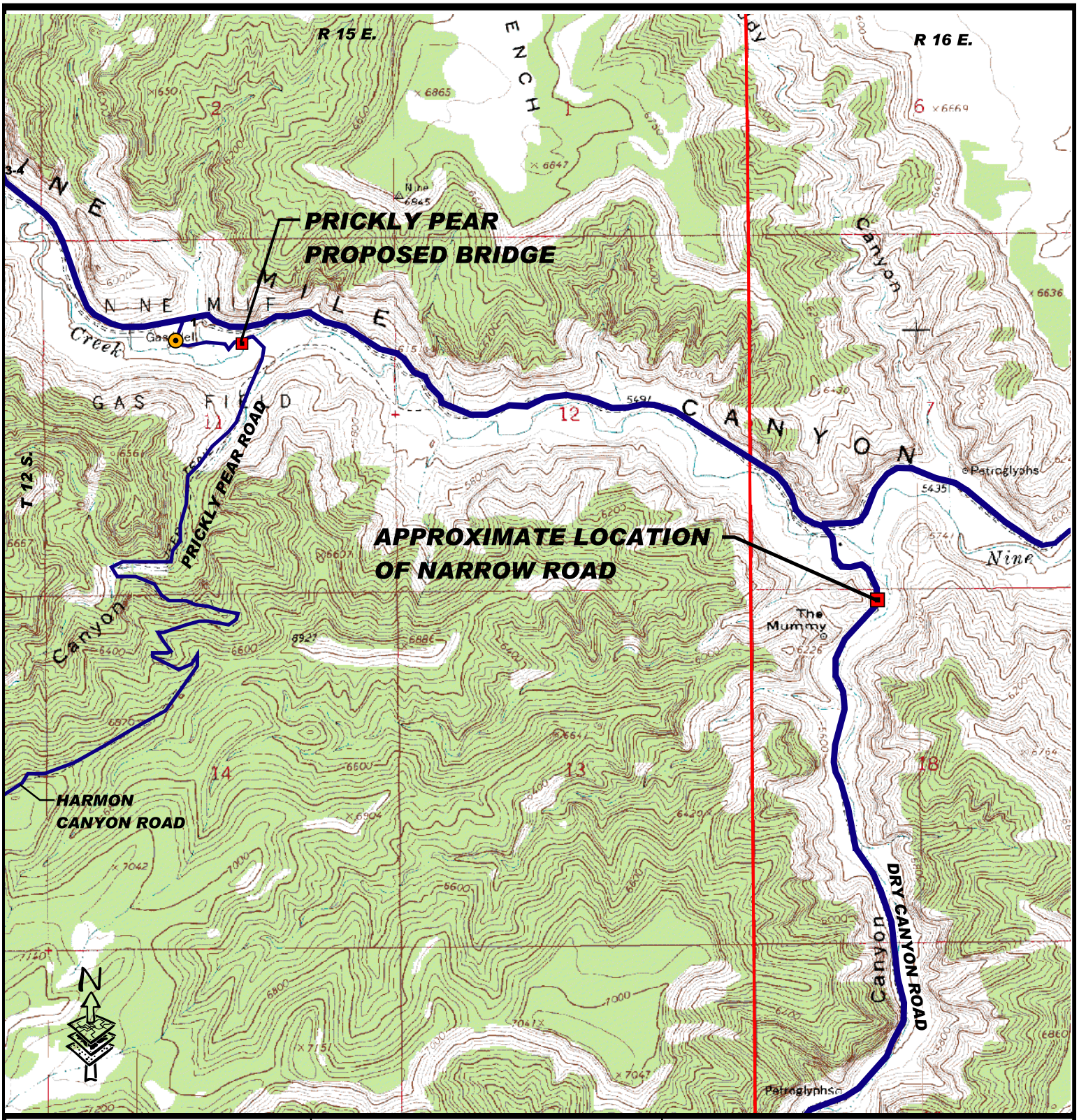
DATE:	*27 SEPT. 2006*
DRAWN BY:	*PJJ*
APPROVED BY:	*JTP*

EXHIBIT C



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Bill Barrett Corporation
1099 18TH STREET
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DENVER, CO 80202

LEGEND

Problem Areas

Existing Road (GPS Locations)

Existing Wells

- 1950-2003
- 1950-2003 D
- 2004
- 2004 D
- 2005
- 2005 D
- 2006
- 2006 D

PRICKLY PEAR CROSSING I

SEC. 11, T-12-S R-15-E S.L.B.&M.

MOUTH OF DRY CANYON

SEC. 18, T-12-S R-16-E S.L.B.&M.
CARBON COUNTY, UTAH

DRAWN BY:	SCALE:	EXHIBIT
PJJ	1" = 2000'	D
APPROVED BY:	DATE:	
JTP	27 SEPT. 2006	

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Environmental & Engineering Consulting
31 North Main Street
Helper, Utah 84526
(435) 472-3814
Fax (435) 472-8780
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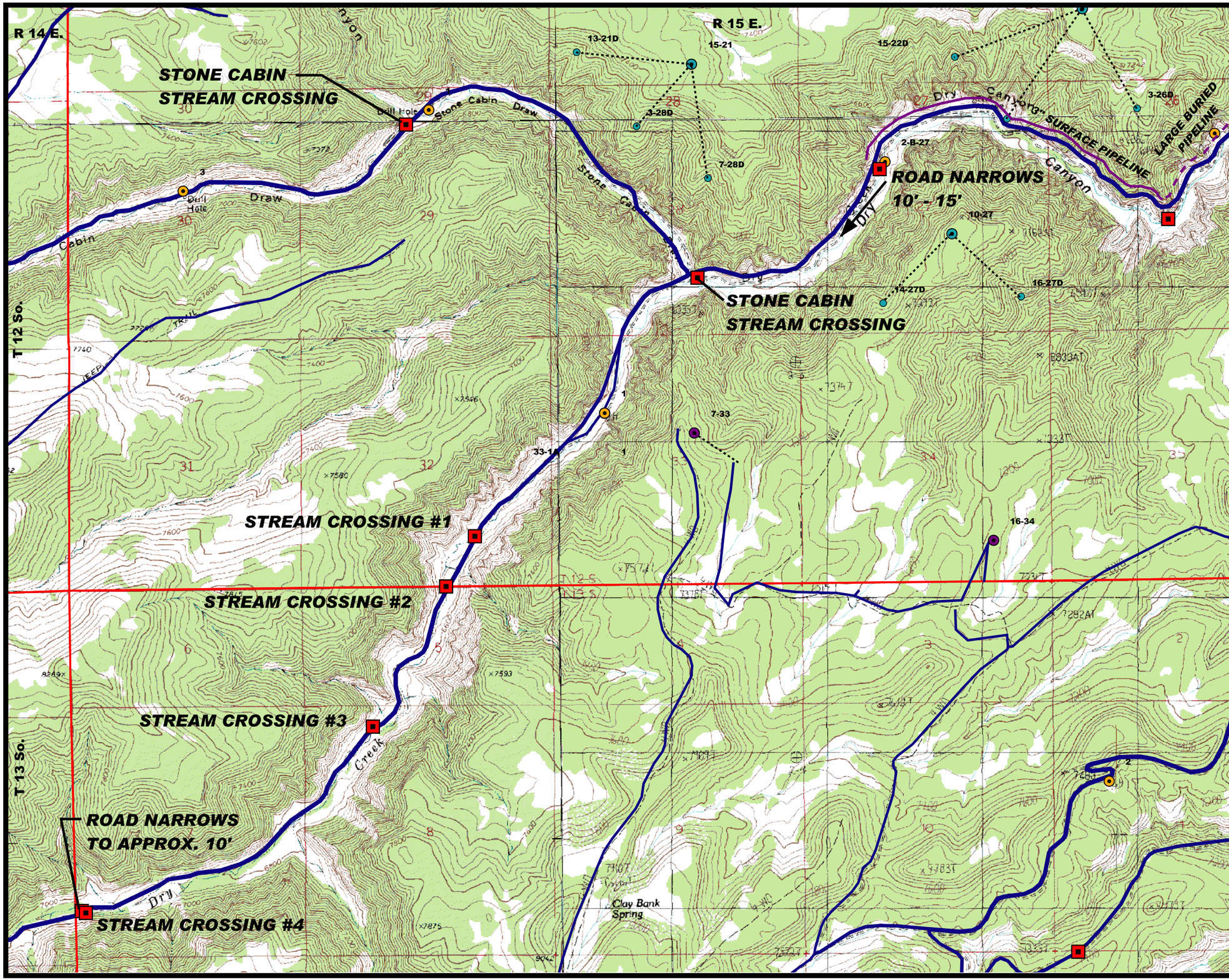

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DENVER, CO 80202

STONE CABIN / DRY CANYON

T-12 TO 13-S R-15-E S.L.B.&M.
CARBON COUNTY, UTAH

LEGEND

- *Existing Roads (GPS Locations)*
- *Problem Areas*

Existing Wells

- *1950-2003*
- *1950-2003 D*
- *2004*
- *2004 D*
- *2005*
- *2005 D*
- *2006*
- *2006 D*

N

Environmental Industrial Services
Environmental & Engineering Consulting

31 North Main Street
Helper, Utah 84526
(435) 472-3814
Fax (435) 472-8780
eisec@preciscom.net

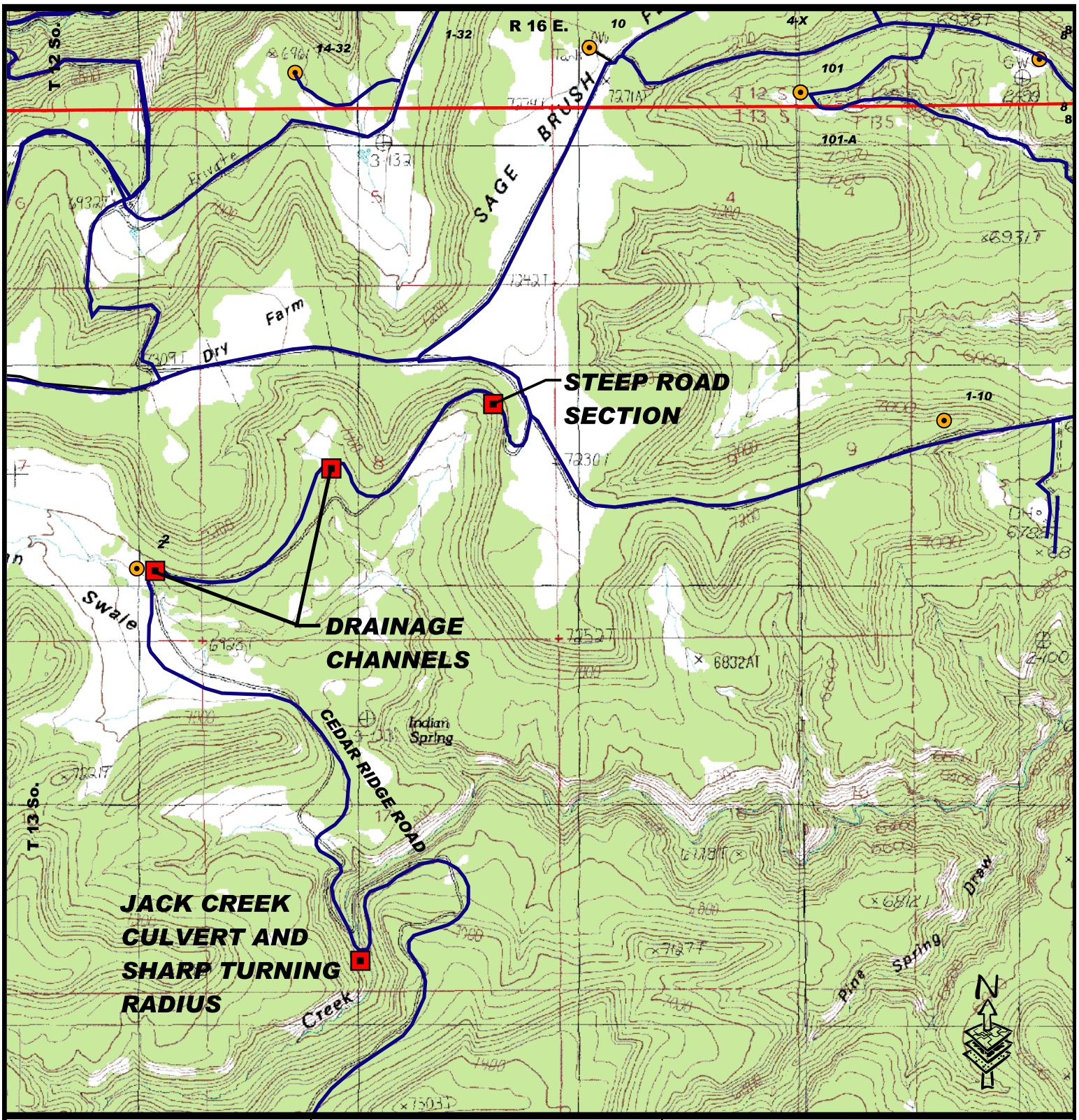
SCALE: *1" = 2000'*

DATE: *27 SEPT. 2006*

DRAWN BY: *PJJ*

APPROVED BY: *JTP*

EXHIBIT E



Created For:

Bill Barrett Corporation
1099 18TH STREET
SUITE 2300
DENVER, CO 80202

LEGEND

- Problem Areas
- Existing Road (GPS Locations)

Existing Wells
- 1950-2003
- 1950-2003 D
- 2004
- 2004 D
- 2005
- 2005 D
- 2006
- 2006 D

CEDAR RIDGE ROAD
T-13-S R-16-E S.L.B.&M.
CARBON COUNTY, UTAH

DRAWN BY:	SCALE:	EXHIBIT
PJJ	1" = 2000'	F
APPROVED BY:	DATE:	
JTP	27 SEPT. 2006	

Environmental Industrial Services
Environmental & Engineering Consulting
31 North Main Street
Helper, Utah 84526
(435) 472-3814
Fax (435) 472-8780
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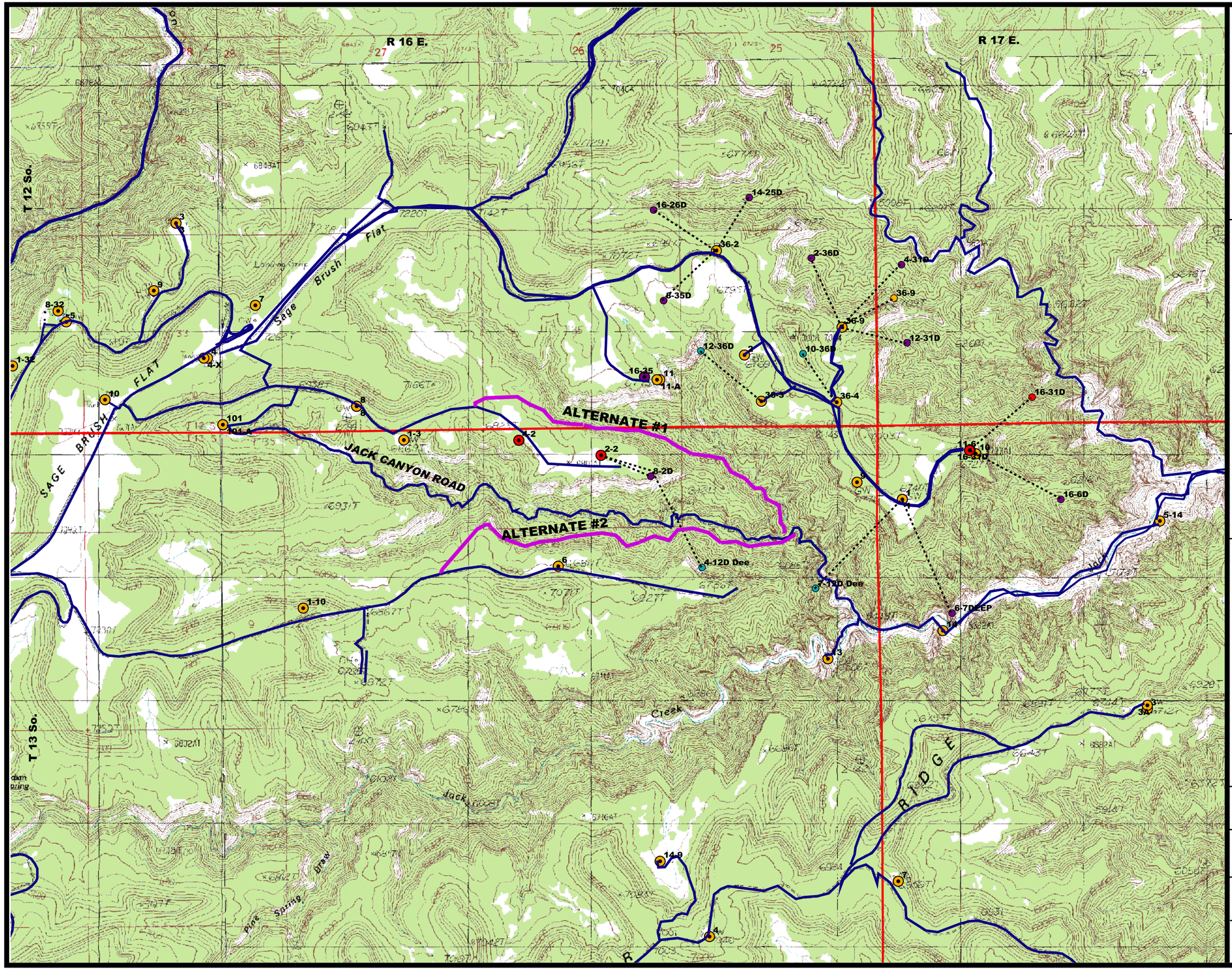

Created For:

Bill Barrett Corporation
1099 18TH STREET
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DENVER, CO 80202

JACK'S CANYON ROAD

T-12 TO 13-S R-16 TO 17-E S.L.B.&M.
CARBON COUNTY, UTAH

LEGEND

Existing Roads (GPS Location)

Proposed Alternate Jack's Canyon Road Locations

Existing Wells

- *1950-2003*
- *1950-2003 D*
- *2004*
- *2004 D*
- *2005*
- *2005 D*
- *2006*
- *2006 D*

N

Environmental Industrial Services
Environmental & Engineering Consulting

31 North Main Street
Helper, Utah 84526
(435) 472-3814
Fax (435) 472-8780
eisec@preciscom.net

SCALE:	*1" = 2500'*
DATE:	*27 SEPT. 2006*
DRAWN BY: *PJJ*	**EXHIBIT**
APPROVED BY: *JTP*	**G**

Appendix F-2

West Tavaputs Plateau EIS-Road Disturbance Evaluation Report

WEST TAVAPUTS PLATEAU EIS

ROAD DISTURBANCE EVALUATION REPORT

Prepared for:

BILL BARRETT CORPORATION

October 2006

Revised March 19, 2007

Prepared by:

J. T. Paluso, P. E.

EIS ENVIRONMENTAL & ENGINEERING CONSULTING
31 North Main, Helper, Utah 84526

INTRODUCTION

The purpose of this report is to determine total disturbance from Bill Barrett Corporation (BBC) proposed road development plan. BBC is proposing two separate road classifications for their drilling and production operations in West Tavaputs Plateau EIS. The two classifications would be designated as primary roads and secondary roads.

Primary Roads

Primary roads would include Bureau of Land Management (BLM) Collector and Local roads. These roads would have an average travel width of 22' and provide access to major operations. This type of road would be used in locations where greater than 10 wells are designated for a given area. Refer to Appendix 1 for proposed typical details on a primary road. The primary roads would be constructed to minimize environmental impact. Where practical and if available, road surfaces would be graveled and dust suppression would be implemented if needed.

Secondary Roads

Secondary roads would take the place of BLM Resource roads. These roads would have an average travel width of 16' and provide access to less active site. This type of road would be used in locations where less than 10 wells are designated for an area. This type of road is presently being used for drilling operations in the Nine Mile area. Refer to Appendix 1 for proposed typical details on a secondary road. Construction of these secondary roads would be in such a manor as to minimize impact on the surrounding environment.

ADDITIONAL ROAD PROPOSALS

Existing Roads

BBC is proposing to maintain the condition of certain existing roads in the EIS area. These roads are colored pink on the attached map. These roads will have routine maintenance to maintain or improve their present condition. Maintenance activities, where needed, would include some or all of the following: monitoring, blading, surface replacement, dust abatement, spot repairs, slide removal, drainage ditch and dip installation, ditch cleaning, and culvert cleaning. The majority of activities would be limited to the present road disturbance width. Occasionally, additional minor disturbances may be created when making upgrades or improvements to existing roads.

Special Road Improvement Sections

Harmon Canyon

Due to springs and limited width, this area is very difficult to maintain open in the winter months. Bill Barrett Corporation (BBC) has been given permission by the BLM to improve this problem area. BLM staff members visited this site on May 11, 2006. Attending this meeting from the BLM were Mike Robinson, Don Stephens, Mary Maddux, and Jeff Brower. Under routine maintenance issues and staying within the disturbed area, BBC, this fall, will install drainage ditches and culverts, raise the road elevation, and widen curves in this area. The distance between the upper and lower work boundary on this road maintenance project is approximately 2000 feet. This section of road also needs to be widened and have some of the sharp turns removed. Refer to Exhibit A in Appendix 2

The above mentioned maintenance work will improve the road through the spring area. To provide for a long term solution of this problem additional width for the road and stream channel would have to be obtained. This would require getting 10-15' additional width over approximately 900 feet. In this zone some near vertical ledge rock would have to be removed to provide this width. This rock material would then be used to raise the elevation of the road in critical areas, where the road and drainage channel are not separated, by approximately 4 feet. This rocky material would act as a French drain and allow the water from the springs to pass under the roadway into the natural drainage channel. A geotech filter fabric could be placed above the rock to prevent infiltration of road base material and keep the drain operational.

The road should be sloped towards the inside drainage ditch and culverts would be installed to allow water to pass under the road in this section. The outside of the road should be riprapped to prevent erosion due to high water flows from the adjacent channel.

Horse Bench Road

The Horse Bench Road has not had any maintenance for years. There are four main areas where the road crosses dugways or hogback ridgelines and there are several other areas where material has sloughed onto the road. Refer to Exhibit B in Appendix 2 for the location of these four areas (Site 1-4). In all of these areas the road could be upgraded or slightly relocated to meet BLM requirements.

All four sites on the Horse Bench road are very similar in upgrading requirements. Sites 1 and 3 both have a dugway and hogback ridgeline road. Sites 2 and 4 have the narrow hogback ridgeline road only. The dugways will have to be widened, sloped inward, and drainage ditches and dips installed. The spacing of drainage dips will depend upon the final road grade, soil type, and precipitation amounts. The road going over the hogback will have to be widened to meet the 22' Primary Road width requirement. The roads in these areas are presently 10-15' wide.

Widening of this road could be done with a hydraulic backhoe. The backhoe would allow the operator to remove and place material more precisely and eliminate large amounts of material that would be pushed with the dozer. This would help conserve material and possibly eliminate the need to bring in added construction material.

Dugway to Flat Iron Mesa (Cottonwood Canyon Road)

This section of road is approximately .5 miles in length and runs from the bottom of Cottonwood Canyon toward the Flat Iron Mesa Road. Presently this section of road is very steep and averages approximately 18 percent. The grade on this section of road could be dropped to 8 % by rerouting in the same canyon. The 8 % grade would keep the road close to the bottom of the canyon. A 10 % grade would keep the new route away from the canyon bottom. Refer to Exhibit C in Appendix 2 for two possible new 10 % routes.

Route 1 would remain on the north side of the canyon and is approximately 1-mile long. This route would remain in the shade longer and have icier winter conditions but, is shorter. Route 2 is on the south slope and is approximately 1.7-miles long. Some rockwork would be required because of large ledges on this side of the canyon. Normally there is more soil on north facing slopes. Whichever route is taken, drainage ditches and dips along with in sloping should be installed to control runoff and prevent erosion. The installation of gravel on the road surface would also improve traction and reduce erosion.

Dugway to Horse Bench 90-Degree Turn (Cottonwood Canyon Road)

The BLM, during the May 11, 2006 field trip, gave BBC permission to improve the turn radius of a 90-degree turn located near the southeast corner of Section 32. Refer to Exhibit C in Appendix 2 for the location of this turn. This maintenance work will remove some of the material, approximately 6 feet, on the inside curve allowing loaded trucks to make the turn without their cargo dragging on nearby ledge rock. The road in this area is approximately 30 feet wide but the sharp radius makes it necessary to remove some of the ledge material. All work in this area will be kept within the existing road ROW width.

To make sure that this turning radius problem is solved permanently, an additional 10’ of material could be removed on the inside of turn. This would insure that trucks could make the turn without running into the rock ledge.

Jack Canyon Road

The first section of this road coming off of the Horse Bench Road averages 8 percent. The road then drops into the drainage channel of one of the major drainages going into Jack Canyon. The road approximates the channel for nearly 3.5 miles until connecting with the main Jack Canyon Drainage. Refer to Exhibit D in Appendix 2. In the past, portions of this road existed outside of the drainage channel but have since been abandoned. Erosion problems, due to the road being in the bottom of the drainage, are a very significant problem.

Relocation of this section of road is possible but the area is very rocky and steep. Two possible 10 % routes (Alternate 1 and 2) are shown in Exhibit D in Appendix 2. Both of these routes will eliminate approximately 3 miles of the road that is presently located in the drainage channel. The exact location of the road would have to be surveyed to minimize environmental problems. The survey may also extend the proposed routes and eliminate more of the existing road that is in the drainage channel.

The lower section of road below the Jack Canyon drainage confluence again is relatively flat. This section of road approximately 1.7-miles, presently crosses Jack Canyon drainage several times as it makes its way to Drill Hole 5-14. This road is also located in the Desolation WSA and has an existing ROW. Maintenance on this road would be permitted due to the existing ROW but relocation of various sections would be difficult due to the WSA designation.

Prickly Pear Bridge

The Nine Mile Creek crossing gets very difficult, if not impossible, to cross in the cold winter months due to the ice buildup. Crossings during winter months and high runoff periods have resulted in numerous vehicle damage incidents. The crossing area was surveyed during the summer of 2006 and a detailed topography map was completed. The purpose of this topography map was to investigate the possibility and best possible location for a bridge. A bridge at this location would allow small vehicles to cross Nine Mile Creek in the winter months and during high runoff periods. Refer to Exhibit E in Appendix 2 for the location of the proposed bridge.

DISTURBANCE

A summary of the disturbed acreage for the Proposed Action is listed in the following table.

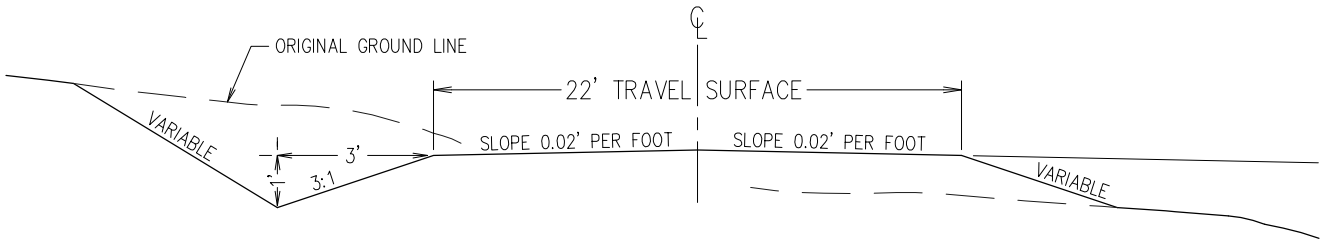
CATEGORY	LENGTH (FT)	DISTURBANCE (ACRES)
Existing Primary < 20%	350,050	321.44
Existing Primary > 20%	124,002	142.33
Existing Secondary < 20%	84,225	48.34
Existing Secondary > 20%	25,799	18.95
New Primary < 20%	57,338	52.65
New Primary > 20%	38,416	44.10
New Secondary < 20%	468,001	268.60
New Secondary > 20%	185,662	136.39
Existing (Maintenance Only)	246,568	0
Special Construct Required	Not Calculated	Not Calculated

Refer to Appendix 3 for the disturbance. The disturbances for the Special Construction Sites have not been calculated in this draft copy. These can be added after BBC makes the decision as to how they would like to proceed on each area.

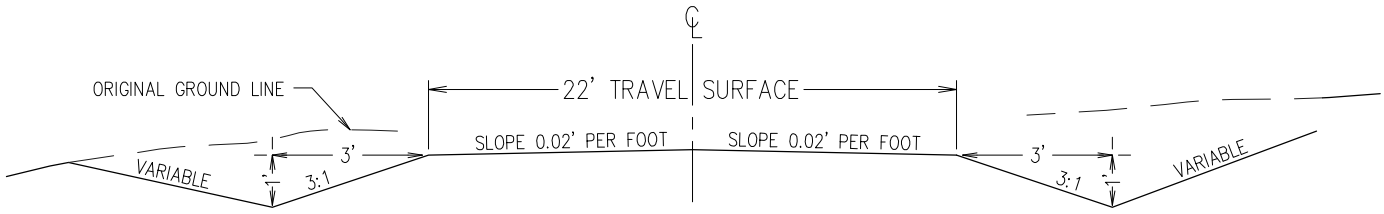
APPENDIX 1

TYPICAL ROAD DETAILS

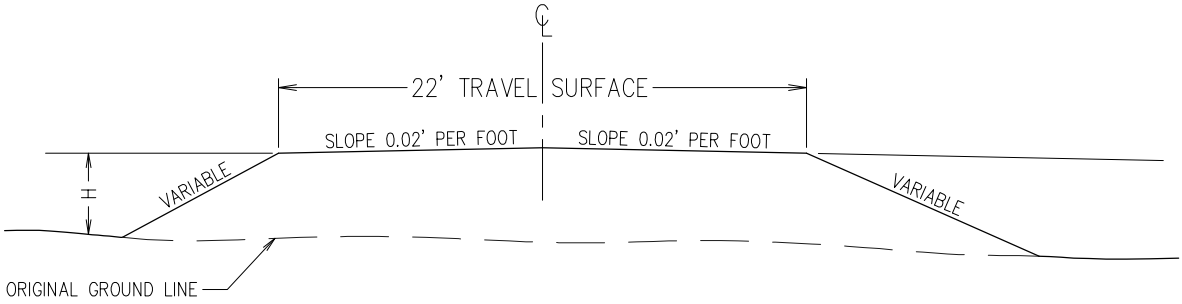
PRIMARY & SECONDARY ROADS



TYPICAL SIDE HILL SECTION



TYPICAL FULL CUT SECTION



TYPICAL EMBANKMENT SECTION

SOIL CONDITIONS	NATURAL GROUND SLOPE	SUGGESTED BACK SLOPE (1)
NORMAL SOIL	0 – 30%	2 : 1
NORMAL SOIL	30 – 55%	1–1/2 : 1
NORMAL SOIL	55% and OVER	1 : 1
SOLID ROCK	ALL SLOPES	1/4 : 1

WHEN THE CUTS ARE RELATIVELY SHALLOW (UNDER 4 FEET), FLATTER SLOPES OF 2:1 OR 3:1 MAY BE USED.

(1) SLOPES MAY VARY TO PREVENT ENVIRONMENTAL DAMAGE FROM EXCESSIVE FILLS & CUTS.

WIDTH COMPARISONS	
TRAVEL WIDTH	22'
APPROXIMATE DISTURBANCE WIDTH <20%	40'
APPROXIMATE DISTURBANCE WIDTH >20%	50'

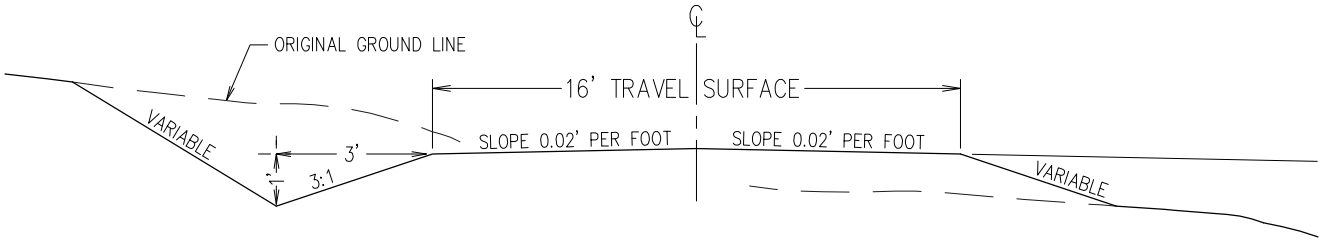
REVISIONS		
#	DATE	BY

Environmental Industrial Services
Environmental & Engineering Consulting
31 NORTH MAIN STREET
(435) 472–3814 HELPER, UTAH 84526

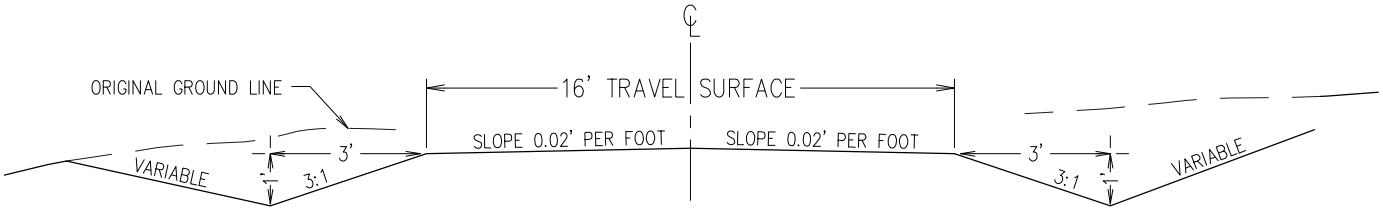
WEST TAVAPUTS PLATEAU E.I.S.

PRIMARY ROAD DISTURBANCE DETAILS

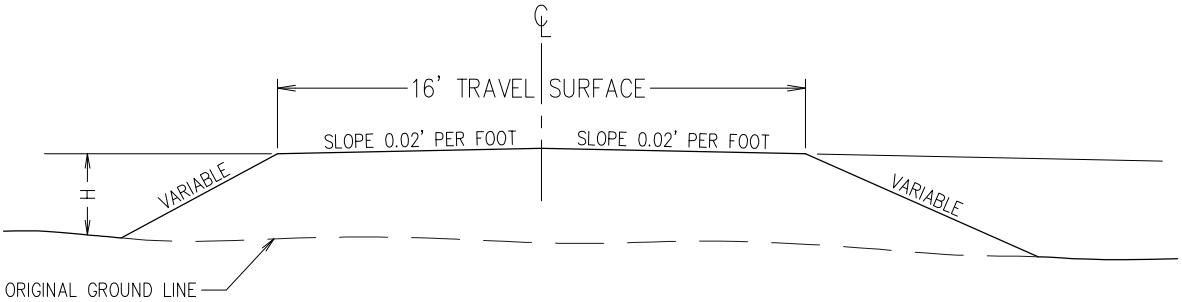
DRAWN BY:	PJJ	SCALE:	NONE
APPROVED BY:	JTP	DATE:	5 OCT. 2006
		SHEET:	1 OF 1



TYPICAL SIDE HILL SECTION



TYPICAL FULL CUT SECTION



TYPICAL EMBANKMENT SECTION

SOIL CONDITIONS	NATURAL GROUND SLOPE	SUGGESTED BACK SLOPE (1)
NORMAL SOIL	0 – 30%	1-1/2 : 1
NORMAL SOIL	30 – 55%	1 : 1
NORMAL SOIL	55% and OVER	3/4 : 1
SOLID ROCK	ALL SLOPES	1/4 : 1

WHEN THE CUTS ARE RELATIVELY SHALLOW (UNDER 4 FEET), FLATTER SLOPES OF 2:1 OR 3:1 MAY BE USED.

(1) SLOPES MAY VARY TO PREVENT ENVIRONMENTAL DAMAGE FROM EXCESSIVE FILLS & CUTS.

WIDTH COMPARISONS	
TRAVEL WIDTH	16'
APPROXIMATE DISTURBANCE WIDTH <20%	25'
APPROXIMATE DISTURBANCE WIDTH >20%	32'

REVISIONS		
#	DATE	BY

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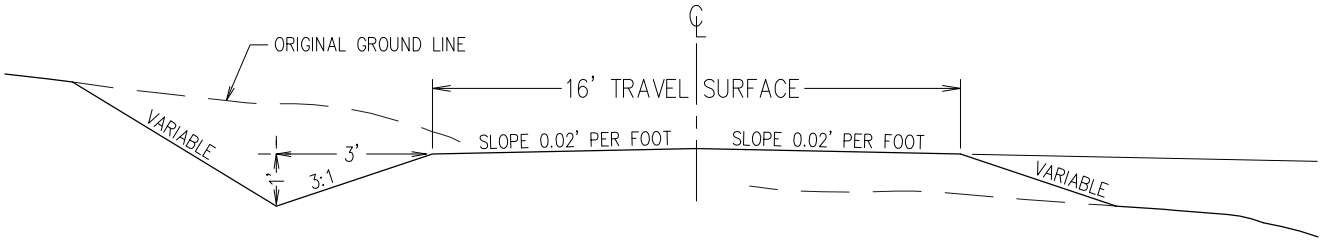
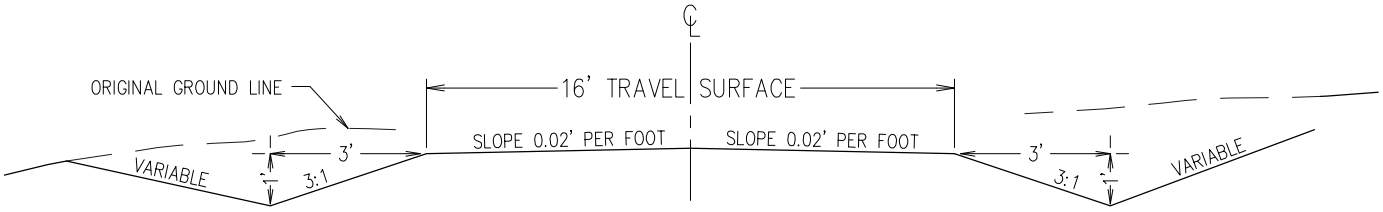
WEST TAVAPUTS PLATEAU E.I.S.

SECONDARY ROAD DISTURBANCE DETAILS

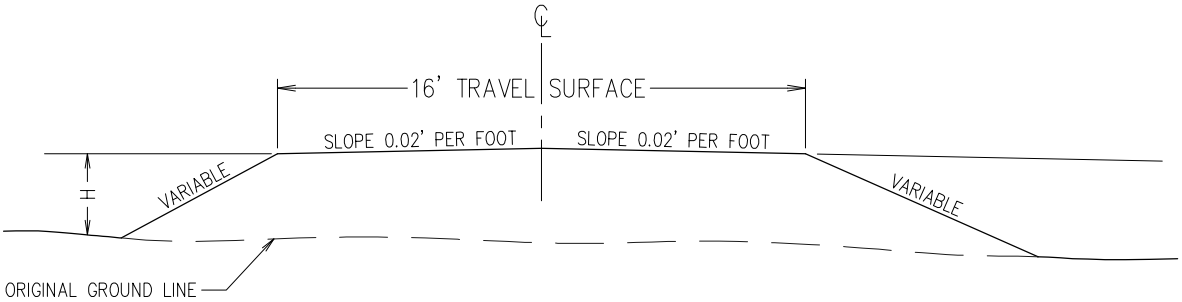
DRAWN BY:	PJJ	SCALE:	NONE
APPROVED BY:	JTP	DATE:	5 OCT. 2006
		SHEET:	1 OF 1



TYPICAL SIDE HILL SECTION



TYPICAL FULL CUT SECTION



TYPICAL EMBANKMENT SECTION

SOIL CONDITIONS	NATURAL GROUND SLOPE	SUGGESTED BACK SLOPE (1)
NORMAL SOIL	0 – 30%	1-1/2 : 1
NORMAL SOIL	30 – 55%	1 : 1
NORMAL SOIL	55% and OVER	3/4 : 1
SOLID ROCK	ALL SLOPES	1/4 : 1

WHEN THE CUTS ARE RELATIVELY SHALLOW (UNDER 4 FEET), FLATTER SLOPES OF 2:1 OR 3:1 MAY BE USED.

(1) SLOPES MAY VARY TO PREVENT ENVIRONMENTAL DAMAGE FROM EXCESSIVE FILLS & CUTS.

WIDTH COMPARISONS	
TRAVEL WIDTH	16'
APPROXIMATE DISTURBANCE WIDTH <20%	25'
APPROXIMATE DISTURBANCE WIDTH >20%	32'

REVISIONS		
#	DATE	BY

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(435) 472-3814 HELPER, UTAH 84526

WEST TAVAPUTS PLATEAU E.I.S.

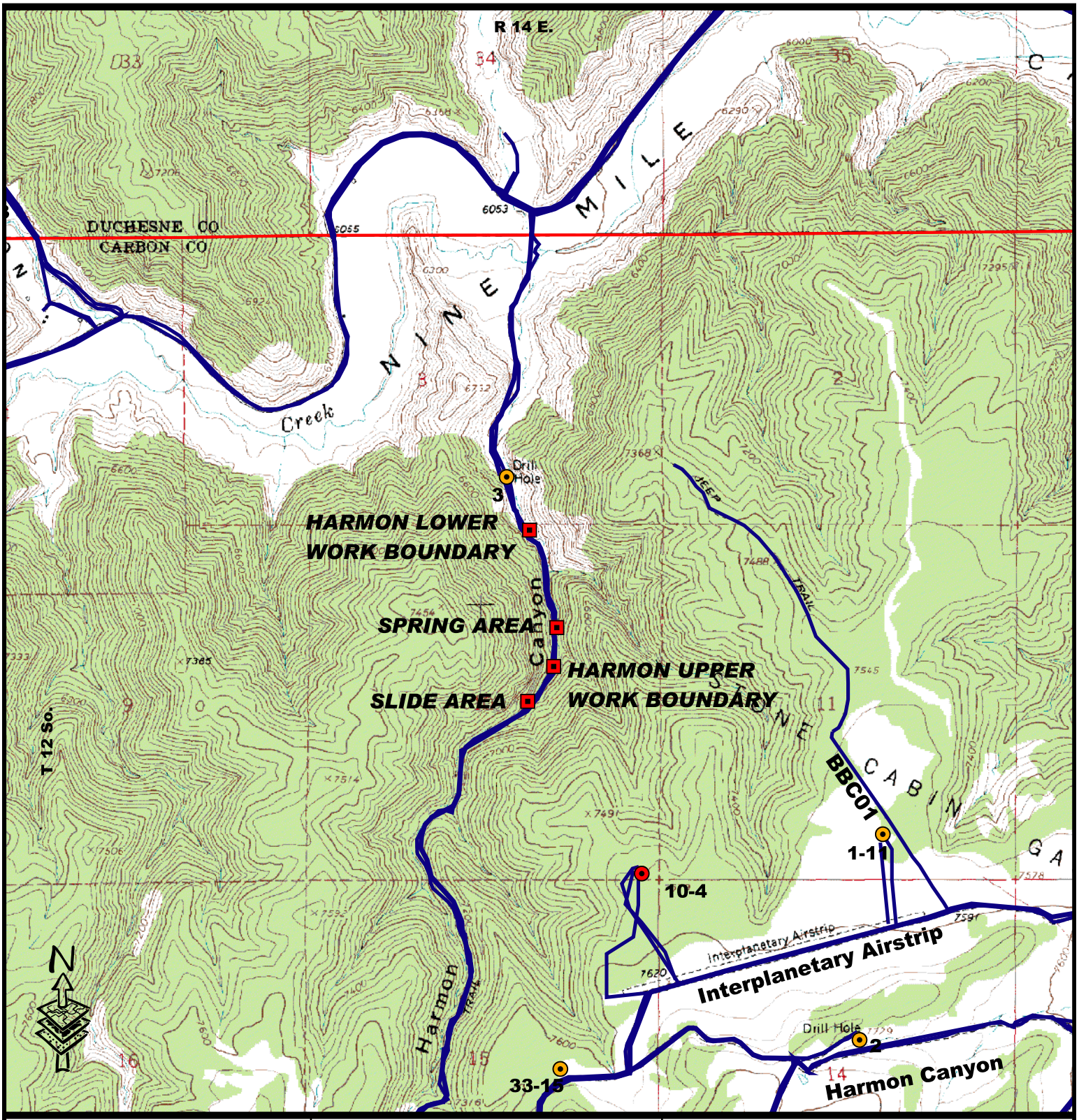
SECONDARY ROAD DISTURBANCE DETAILS

DRAWN BY:	PJJ	SCALE:	NONE
APPROVED BY:	JTP	DATE:	5 OCT. 2006
		SHEET:	1 OF 1

APPENDIX 2

SPECIAL ROAD SECTIONS

EXHIBITS A-E



Created For:

Bill Barrett Corporation
1099 18TH STREET
SUITE 2300
DENVER, CO 80202

LEGEND

- Problem Areas
- Existing Road (GPS Locations)

Existing Wells
- 1950-2003
- 1950-2003 D
- 2004
- 2004 D
- 2005
- 2005 D
- 2006
- 2006 D

HARMON CANYON ROAD

SEC. 10, T-12-S R-14-E S.L.B.&M.
CARBON COUNTY, UTAH

DRAWN BY:	SCALE:	EXHIBIT
PJJ	1" = 2000'	A
APPROVED BY:	DATE:	
JTP	5 OCT. 2006	

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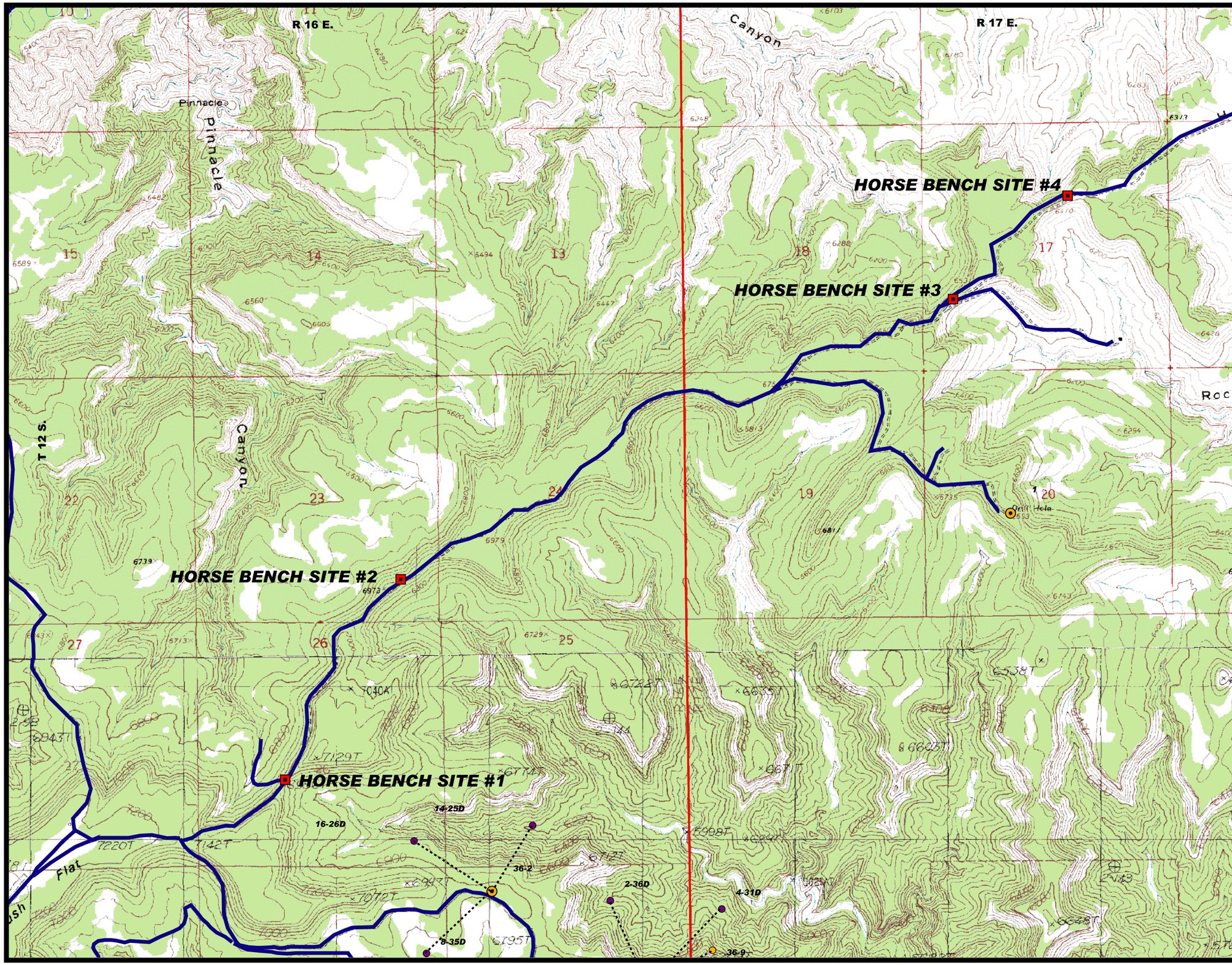
Environmental & Engineering Consulting
31 North Main Street
Helper, Utah 84526
(435) 472-3814
Fax (435) 472-8780
eisec@preciscom.net



Created For:

Bill Barrett Corporation
1099 18TH STREET
SUITE 2300
DENVER, CO 80202

HORSE BENCH ROAD

T-12-S R-16 TO 17-E S.L.B.&M.
CARBON COUNTY, UTAH

LEGEND

- *Existing Roads (GPS Locations)*
- *Problem Areas*

Existing Wells

- *1950-2003*
- *1950-2003 D*
- *2004*
- *2004 D*
- *2005*
- *2005 D*
- *2006*
- *2006 D*

N

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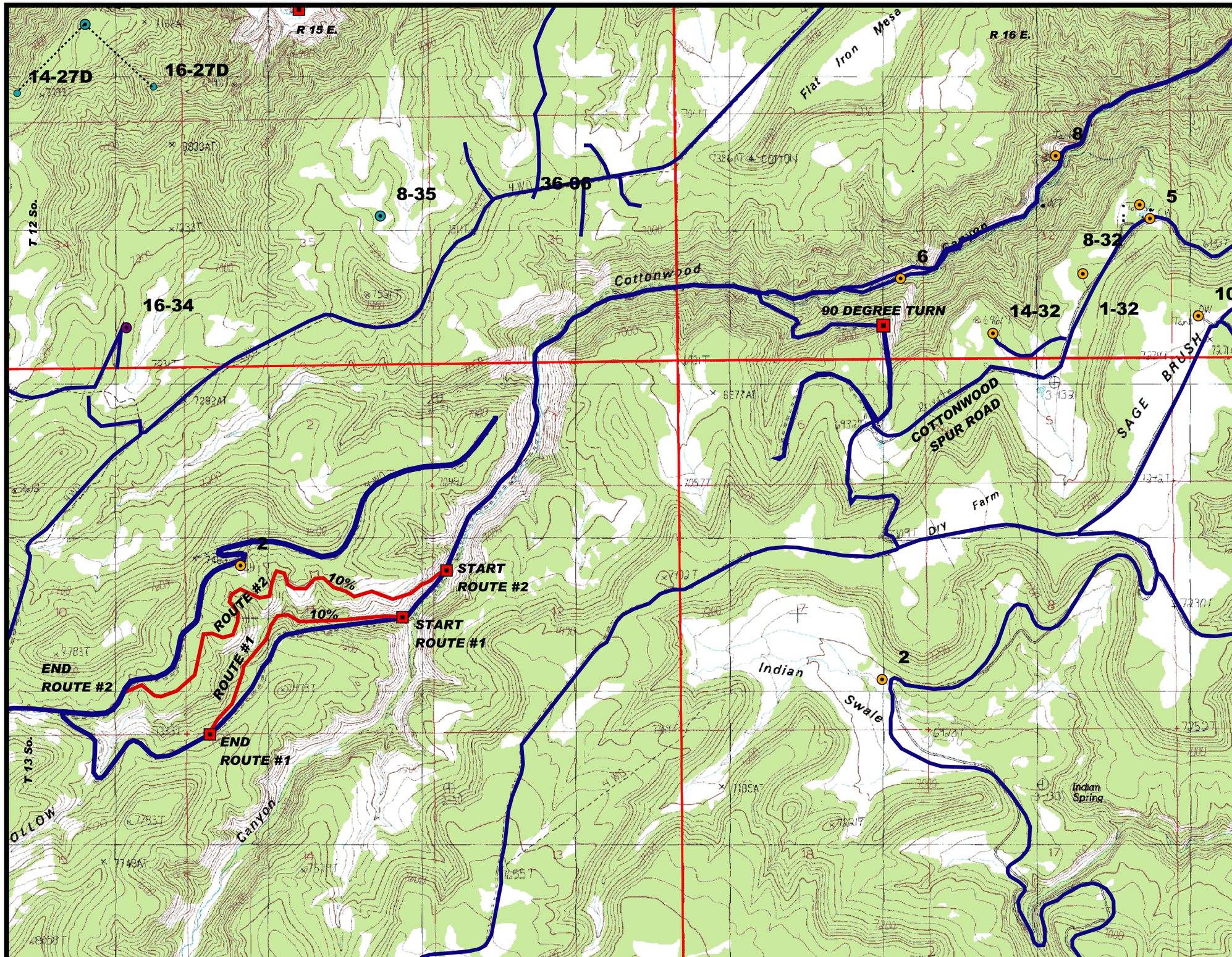
Environmental & Engineering Consulting

31 North Main Street
Helper, Utah 84526
(435) 472-3814
Fax (435) 472-8780
eisec@preciscom.net

SCALE:	1" = 2000'
DATE:	5 OCT. 2006
DRAWN BY:	PJJ
APPROVED BY:	JTP

EXHIBIT B



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Bill Barrett Corporation
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SUITE 2300
DENVER, CO 80202

COTTONWOOD CANYON ROAD

T-12 TO 13-S R-15 TO 16-E S.L.B.&M.
CARBON COUNTY, UTAH

LEGEND

- *Existing Roads (GPS Locations)*
- *Problem Areas*
- *Proposed Reroute Steep Road Portion*

Existing Wells

- *1950-2003*
- *1950-2003 D*
- *2004*
- *2004 D*
- *2005*
- *2005 D*
- *2006*
- *2006 D*

N

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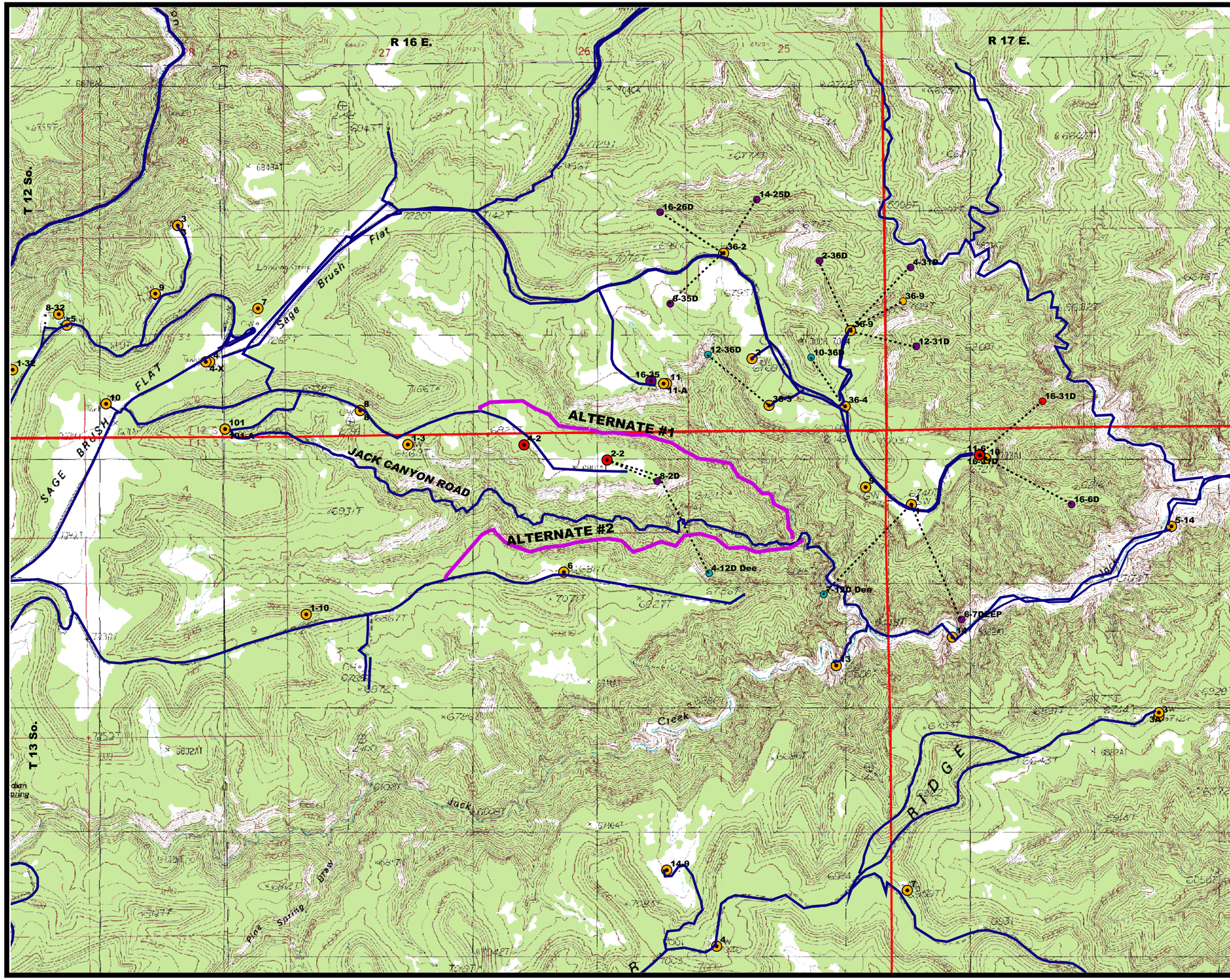
Environmental & Engineering Consulting

31 North Main Street
Helper, Utah 84526
(435) 472-3814
Fax (435) 472-8780
eisec@preciscom.net

SCALE:	*1" = 2000'*
DATE:	*5 OCT. 2006*
DRAWN BY:	*PJJ*
APPROVED BY:	*JTP*

EXHIBIT C



Created For:

Bill Barrett Corporation
1099 18TH STREET
SUITE 2300
DENVER, CO 80202

JACK'S CANYON ROAD

T-12 TO 13-S R-16 TO 17-E S.L.B.&M.
CARBON COUNTY, UTAH

LEGEND

Existing Roads (GPS Location)

Proposed Alternate Jack's Canyon Road Locations

Existing Wells

- *1950-2003*
- *1950-2003 D*
- *2004*
- *2004 D*
- *2005*
- *2005 D*
- *2006*
- *2006 D*

N

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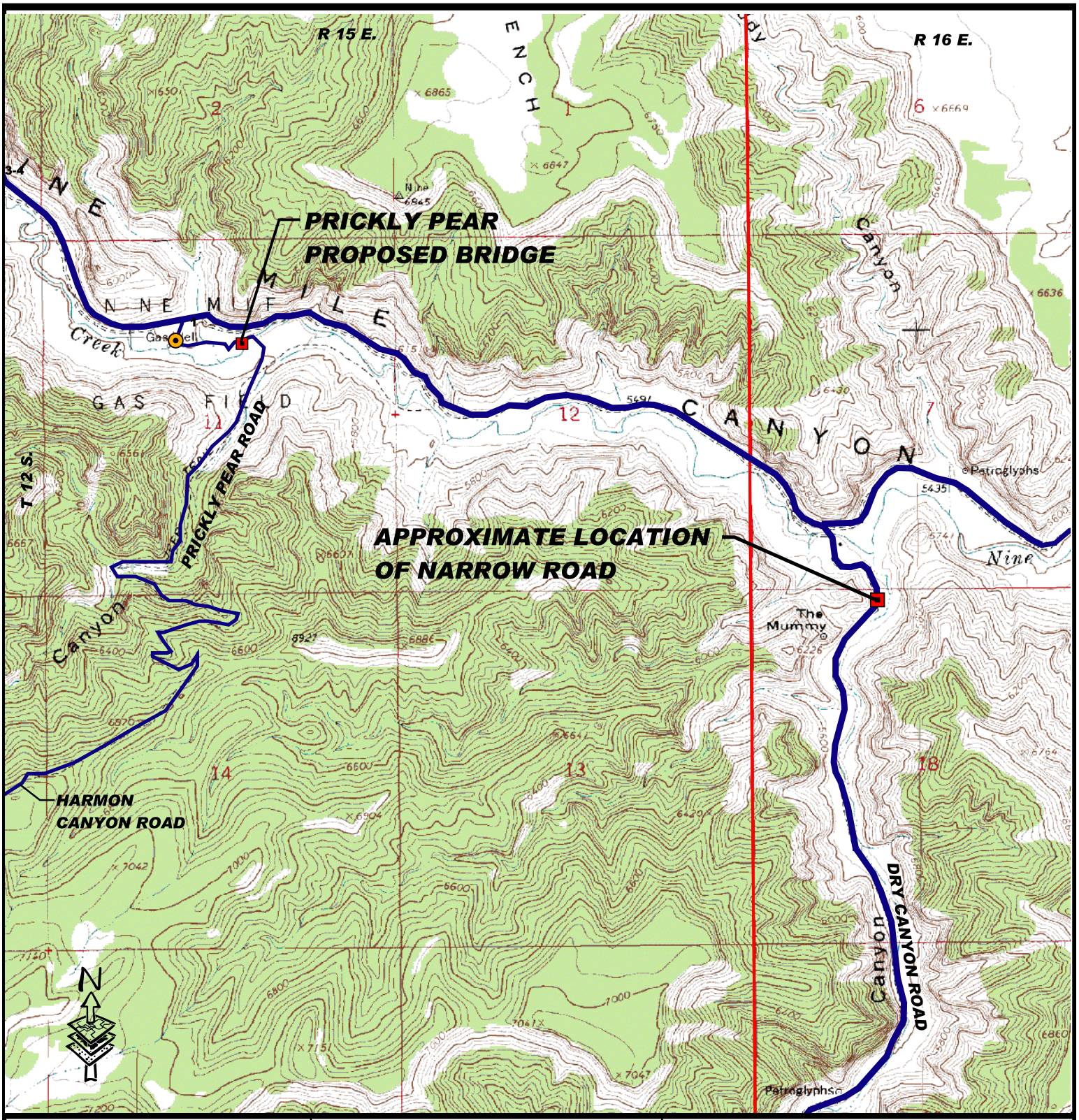
SCALE:	***1" = 2500'***
DATE:	***5 OCT. 2006***
DRAWN BY:	***PJJ***
APPROVED BY:	***JTP***

EXHIBIT
D



Created For:

Bill Barrett Corporation
1099 18TH STREET
SUITE 2300
DENVER, CO 80202

LEGEND

- Problem Areas
- Existing Road (GPS Locations)

Existing Wells
- 1950-2003
- 1950-2003 D
- 2004
- 2004 D
- 2005
- 2005 D
- 2006
- 2006 D

PRICKLY PEAR CROSSING I

SEC. 11, T-12-S R-15-E S.L.B.&M.

MOUTH OF DRY CANYON

SEC. 18, T-12-S R-16-E S.L.B.&M.
CARBON COUNTY, UTAH

DRAWN BY:	SCALE:	EXHIBIT
PJJ	1" = 2000'	
APPROVED BY:	DATE:	
JTP	5 OCT. 2006	E

Environmental Industrial Services
Environmental & Engineering Consulting
31 North Main Street
Helper, Utah 84526
(435) 472-3814
Fax (435) 472-8780
eisec@preciscom.net

APPENDIX 3

DISTURBANCE CALCULATIONS

Appendix 3

Primary or Secondary	Slope %	Existing or New	Length (ft.)	Width	Acres
Secondary	>20%	Existing	826.01	32.00	0.61
Secondary	>20%	Existing	909.71	32.00	0.67
Secondary	>20%	Existing	1,790.93	32.00	1.32
Secondary	>20%	Existing	1,942.15	32.00	1.43
Secondary	>20%	Existing	2,485.51	32.00	1.83
Secondary	>20%	Existing	2,721.24	32.00	2.00
Secondary	>20%	Existing	3,838.51	32.00	2.82
Secondary	>20%	Existing	3,864.49	32.00	2.84
Secondary	>20%	Existing	7,420.26	32.00	5.45
			25,798.81		**18.95**
Secondary	<20%	Existing	616.48	25.00	0.35
Secondary	<20%	Existing	628.23	25.00	0.36
Secondary	<20%	Existing	760.09	25.00	0.44
Secondary	<20%	Existing	794.64	25.00	0.46
Secondary	<20%	Existing	859.36	25.00	0.49
Secondary	<20%	Existing	959.06	25.00	0.55
Secondary	<20%	Existing	977.90	25.00	0.56
Secondary	<20%	Existing	1,119.55	25.00	0.64
Secondary	<20%	Existing	1,162.40	25.00	0.67
Secondary	<20%	Existing	1,179.27	25.00	0.68
Secondary	<20%	Existing	1,297.61	25.00	0.74
Secondary	<20%	Existing	1,302.75	25.00	0.75
Secondary	<20%	Existing	1,338.99	25.00	0.77
Secondary	<20%	Existing	1,410.52	25.00	0.81
Secondary	<20%	Existing	1,716.29	25.00	0.99
Secondary	<20%	Existing	1,746.76	25.00	1.00
Secondary	<20%	Existing	2,227.62	25.00	1.28
Secondary	<20%	Existing	2,357.16	25.00	1.35
Secondary	<20%	Existing	2,514.84	25.00	1.44
Secondary	<20%	Existing	3,449.30	25.00	1.98
Secondary	<20%	Existing	3,618.65	25.00	2.08
Secondary	<20%	Existing	3,654.02	25.00	2.10
Secondary	<20%	Existing	3,739.37	25.00	2.15
Secondary	<20%	Existing	4,329.01	25.00	2.48
Secondary	<20%	Existing	4,445.09	25.00	2.55
Secondary	<20%	Existing	4,571.45	25.00	2.62
Secondary	<20%	Existing	4,720.91	25.00	2.71
Secondary	<20%	Existing	6,212.28	25.00	3.57
Secondary	<20%	Existing	6,372.85	25.00	3.66
Secondary	<20%	Existing	6,848.77	25.00	3.93
Secondary	<20%	Existing	7,293.46	25.00	4.19
			84,224.68		**48.34**
Primary	>20%	New	1,564.14	50.00	1.80
Primary	>20%	New	2,123.30	50.00	2.44
Primary	>20%	New	2,155.40	50.00	2.47
Primary	>20%	New	2,475.56	50.00	2.84

Primary	>20%	New	3,037.80	50.00	3.49
Primary	>20%	New	5,165.67	50.00	5.93
Primary	>20%	New	5,438.87	50.00	6.24
Primary	>20%	New	7,122.91	50.00	8.18
Primary	>20%	New	9,332.00	50.00	10.71
			38,415.65		**44.10**
Secondary	<20%	New	43.02	25.00	0.02
Secondary	<20%	New	77.30	25.00	0.04
Secondary	<20%	New	169.43	25.00	0.10
Secondary	<20%	New	172.22	25.00	0.10
Secondary	<20%	New	216.65	25.00	0.12
Secondary	<20%	New	219.71	25.00	0.13
Secondary	<20%	New	221.32	25.00	0.13
Secondary	<20%	New	244.27	25.00	0.14
Secondary	<20%	New	249.30	25.00	0.14
Secondary	<20%	New	256.89	25.00	0.15
Secondary	<20%	New	257.86	25.00	0.15
Secondary	<20%	New	259.13	25.00	0.15
Secondary	<20%	New	259.89	25.00	0.15
Secondary	<20%	New	272.78	25.00	0.16
Secondary	<20%	New	287.24	25.00	0.16
Secondary	<20%	New	296.93	25.00	0.17
Secondary	<20%	New	297.85	25.00	0.17
Secondary	<20%	New	310.05	25.00	0.18
Secondary	<20%	New	316.48	25.00	0.18
Secondary	<20%	New	347.52	25.00	0.20
Secondary	<20%	New	360.94	25.00	0.21
Secondary	<20%	New	364.37	25.00	0.21
Secondary	<20%	New	370.73	25.00	0.21
Secondary	<20%	New	380.51	25.00	0.22
Secondary	<20%	New	386.80	25.00	0.22
Secondary	<20%	New	402.91	25.00	0.23
Secondary	<20%	New	403.77	25.00	0.23
Secondary	<20%	New	409.63	25.00	0.24
Secondary	<20%	New	431.07	25.00	0.25
Secondary	<20%	New	431.48	25.00	0.25
Secondary	<20%	New	447.31	25.00	0.26
Secondary	<20%	New	459.37	25.00	0.26
Secondary	<20%	New	473.56	25.00	0.27
Secondary	<20%	New	483.18	25.00	0.28
Secondary	<20%	New	489.75	25.00	0.28
Secondary	<20%	New	497.36	25.00	0.29
Secondary	<20%	New	517.49	25.00	0.30
Secondary	<20%	New	538.80	25.00	0.31
Secondary	<20%	New	542.84	25.00	0.31
Secondary	<20%	New	543.26	25.00	0.31
Secondary	<20%	New	551.20	25.00	0.32
Secondary	<20%	New	573.21	25.00	0.33
Secondary	<20%	New	579.98	25.00	0.33
Secondary	<20%	New	581.01	25.00	0.33

Secondary	<20%	New	594.50	25.00	0.34
Secondary	<20%	New	605.67	25.00	0.35
Secondary	<20%	New	615.31	25.00	0.35
Secondary	<20%	New	615.45	25.00	0.35
Secondary	<20%	New	617.64	25.00	0.35
Secondary	<20%	New	622.57	25.00	0.36
Secondary	<20%	New	624.66	25.00	0.36
Secondary	<20%	New	632.79	25.00	0.36
Secondary	<20%	New	634.63	25.00	0.36
Secondary	<20%	New	641.32	25.00	0.37
Secondary	<20%	New	642.44	25.00	0.37
Secondary	<20%	New	655.22	25.00	0.38
Secondary	<20%	New	681.40	25.00	0.39
Secondary	<20%	New	689.71	25.00	0.40
Secondary	<20%	New	707.27	25.00	0.41
Secondary	<20%	New	709.11	25.00	0.41
Secondary	<20%	New	709.14	25.00	0.41
Secondary	<20%	New	724.19	25.00	0.42
Secondary	<20%	New	731.58	25.00	0.42
Secondary	<20%	New	732.38	25.00	0.42
Secondary	<20%	New	733.42	25.00	0.42
Secondary	<20%	New	750.44	25.00	0.43
Secondary	<20%	New	753.29	25.00	0.43
Secondary	<20%	New	761.63	25.00	0.44
Secondary	<20%	New	769.22	25.00	0.44
Secondary	<20%	New	771.99	25.00	0.44
Secondary	<20%	New	772.35	25.00	0.44
Secondary	<20%	New	774.99	25.00	0.44
Secondary	<20%	New	794.60	25.00	0.46
Secondary	<20%	New	795.63	25.00	0.46
Secondary	<20%	New	801.62	25.00	0.46
Secondary	<20%	New	802.95	25.00	0.46
Secondary	<20%	New	806.47	25.00	0.46
Secondary	<20%	New	811.77	25.00	0.47
Secondary	<20%	New	847.82	25.00	0.49
Secondary	<20%	New	858.17	25.00	0.49
Secondary	<20%	New	917.88	25.00	0.53
Secondary	<20%	New	928.37	25.00	0.53
Secondary	<20%	New	936.24	25.00	0.54
Secondary	<20%	New	951.04	25.00	0.55
Secondary	<20%	New	954.34	25.00	0.55
Secondary	<20%	New	957.79	25.00	0.55
Secondary	<20%	New	962.29	25.00	0.55
Secondary	<20%	New	964.36	25.00	0.55
Secondary	<20%	New	967.71	25.00	0.56
Secondary	<20%	New	983.99	25.00	0.56
Secondary	<20%	New	998.32	25.00	0.57
Secondary	<20%	New	1,017.95	25.00	0.58
Secondary	<20%	New	1,043.11	25.00	0.60
Secondary	<20%	New	1,065.91	25.00	0.61
Secondary	<20%	New	1,066.75	25.00	0.61
Secondary	<20%	New	1,078.27	25.00	0.62

Secondary	<20%	New	1,080.68	25.00	0.62
Secondary	<20%	New	1,094.10	25.00	0.63
Secondary	<20%	New	1,097.76	25.00	0.63
Secondary	<20%	New	1,124.66	25.00	0.65
Secondary	<20%	New	1,124.86	25.00	0.65
Secondary	<20%	New	1,128.22	25.00	0.65
Secondary	<20%	New	1,145.87	25.00	0.66
Secondary	<20%	New	1,146.85	25.00	0.66
Secondary	<20%	New	1,174.05	25.00	0.67
Secondary	<20%	New	1,180.71	25.00	0.68
Secondary	<20%	New	1184.42	25.00	0.68
Secondary	<20%	New	1,186.30	25.00	0.68
Secondary	<20%	New	1,195.39	25.00	0.69
Secondary	<20%	New	1,202.95	25.00	0.69
Secondary	<20%	New	1,203.87	25.00	0.69
Secondary	<20%	New	1,206.88	25.00	0.69
Secondary	<20%	New	1,275.63	25.00	0.73
Secondary	<20%	New	1,306.62	25.00	0.75
Secondary	<20%	New	1,325.96	25.00	0.76
Secondary	<20%	New	1,327.77	25.00	0.76
Secondary	<20%	New	1,341.05	25.00	0.77
Secondary	<20%	New	1,344.25	25.00	0.77
Secondary	<20%	New	1,347.06	25.00	0.77
Secondary	<20%	New	1,348.11	25.00	0.77
Secondary	<20%	New	1,367.27	25.00	0.78
Secondary	<20%	New	1,378.61	25.00	0.79
Secondary	<20%	New	1,413.03	25.00	0.81
Secondary	<20%	New	1,424.13	25.00	0.82
Secondary	<20%	New	1,428.40	25.00	0.82
Secondary	<20%	New	1,453.57	25.00	0.83
Secondary	<20%	New	1,456.13	25.00	0.84
Secondary	<20%	New	1,456.81	25.00	0.84
Secondary	<20%	New	1,459.14	25.00	0.84
Secondary	<20%	New	1,464.64	25.00	0.84
Secondary	<20%	New	1,468.02	25.00	0.84
Secondary	<20%	New	1,480.11	25.00	0.85
Secondary	<20%	New	1,486.03	25.00	0.85
Secondary	<20%	New	1,511.19	25.00	0.87
Secondary	<20%	New	1,558.30	25.00	0.89
Secondary	<20%	New	1,565.06	25.00	0.90
Secondary	<20%	New	1,595.81	25.00	0.92
Secondary	<20%	New	1,599.23	25.00	0.92
Secondary	<20%	New	1,604.72	25.00	0.92
Secondary	<20%	New	1,609.96	25.00	0.92
Secondary	<20%	New	1,622.31	25.00	0.93
Secondary	<20%	New	1,625.61	25.00	0.93
Secondary	<20%	New	1,630.98	25.00	0.94
Secondary	<20%	New	1,647.19	25.00	0.95
Secondary	<20%	New	1,656.95	25.00	0.95
Secondary	<20%	New	1,661.35	25.00	0.95
Secondary	<20%	New	1,690.66	25.00	0.97
Secondary	<20%	New	1,700.54	25.00	0.98

Secondary	<20%	New	1,709.69	25.00	0.98
Secondary	<20%	New	1,711.51	25.00	0.98
Secondary	<20%	New	1,713.91	25.00	0.98
Secondary	<20%	New	1,721.54	25.00	0.99
Secondary	<20%	New	1,721.88	25.00	0.99
Secondary	<20%	New	1729.12	25.00	0.99
Secondary	<20%	New	1,733.02	25.00	0.99
Secondary	<20%	New	1,738.94	25.00	1.00
Secondary	<20%	New	1,745.57	25.00	1.00
Secondary	<20%	New	1,767.81	25.00	1.01
Secondary	<20%	New	1,778.19	25.00	1.02
Secondary	<20%	New	1,798.81	25.00	1.03
Secondary	<20%	New	1,809.34	25.00	1.04
Secondary	<20%	New	1,820.92	25.00	1.05
Secondary	<20%	New	1,821.40	25.00	1.05
Secondary	<20%	New	1,825.72	25.00	1.05
Secondary	<20%	New	1,830.56	25.00	1.05
Secondary	<20%	New	1,840.36	25.00	1.06
Secondary	<20%	New	1,844.38	25.00	1.06
Secondary	<20%	New	1,874.41	25.00	1.08
Secondary	<20%	New	1,891.27	25.00	1.09
Secondary	<20%	New	1,911.32	25.00	1.10
Secondary	<20%	New	1,932.98	25.00	1.11
Secondary	<20%	New	1,998.33	25.00	1.15
Secondary	<20%	New	2,026.94	25.00	1.16
Secondary	<20%	New	2,028.93	25.00	1.16
Secondary	<20%	New	2,052.89	25.00	1.18
Secondary	<20%	New	2,084.33	25.00	1.20
Secondary	<20%	New	2,095.60	25.00	1.20
Secondary	<20%	New	2,112.86	25.00	1.21
Secondary	<20%	New	2,169.59	25.00	1.25
Secondary	<20%	New	2,178.94	25.00	1.25
Secondary	<20%	New	2,190.83	25.00	1.26
Secondary	<20%	New	2,251.16	25.00	1.29
Secondary	<20%	New	2,312.31	25.00	1.33
Secondary	<20%	New	2,331.80	25.00	1.34
Secondary	<20%	New	2,339.13	25.00	1.34
Secondary	<20%	New	2,363.18	25.00	1.36
Secondary	<20%	New	2,430.89	25.00	1.40
Secondary	<20%	New	2454.87	25.00	1.41
Secondary	<20%	New	2,489.55	25.00	1.43
Secondary	<20%	New	2,501.20	25.00	1.44
Secondary	<20%	New	2,510.72	25.00	1.44
Secondary	<20%	New	2,521.59	25.00	1.45
Secondary	<20%	New	2,665.64	25.00	1.53
Secondary	<20%	New	2,716.79	25.00	1.56
Secondary	<20%	New	2,761.94	25.00	1.59
Secondary	<20%	New	2,777.82	25.00	1.59
Secondary	<20%	New	2,797.93	25.00	1.61
Secondary	<20%	New	2,863.08	25.00	1.64
Secondary	<20%	New	2,937.40	25.00	1.69
Secondary	<20%	New	2,944.78	25.00	1.69

Secondary	<20%	New	2,954.05	25.00	1.70
Secondary	<20%	New	2977.16	25.00	1.71
Secondary	<20%	New	3,061.34	25.00	1.76
Secondary	<20%	New	3,120.01	25.00	1.79
Secondary	<20%	New	3,176.75	25.00	1.82
Secondary	<20%	New	3,193.78	25.00	1.83
Secondary	<20%	New	3,202.70	25.00	1.84
Secondary	<20%	New	3,224.28	25.00	1.85
Secondary	<20%	New	3,263.48	25.00	1.87
Secondary	<20%	New	3,313.57	25.00	1.90
Secondary	<20%	New	3,416.47	25.00	1.96
Secondary	<20%	New	3,428.48	25.00	1.97
Secondary	<20%	New	3,456.19	25.00	1.98
Secondary	<20%	New	3,493.88	25.00	2.01
Secondary	<20%	New	3,557.93	25.00	2.04
Secondary	<20%	New	3,612.51	25.00	2.07
Secondary	<20%	New	3,693.86	25.00	2.12
Secondary	<20%	New	3,746.04	25.00	2.15
Secondary	<20%	New	3,861.44	25.00	2.22
Secondary	<20%	New	3,867.59	25.00	2.22
Secondary	<20%	New	3,873.36	25.00	2.22
Secondary	<20%	New	3,879.87	25.00	2.23
Secondary	<20%	New	3,932.75	25.00	2.26
Secondary	<20%	New	3,983.45	25.00	2.29
Secondary	<20%	New	4,171.08	25.00	2.39
Secondary	<20%	New	4,277.78	25.00	2.46
Secondary	<20%	New	4,429.27	25.00	2.54
Secondary	<20%	New	4,460.93	25.00	2.56
Secondary	<20%	New	4,485.71	25.00	2.57
Secondary	<20%	New	4,607.69	25.00	2.64
Secondary	<20%	New	4,678.52	25.00	2.69
Secondary	<20%	New	5,172.92	25.00	2.97
Secondary	<20%	New	5,180.87	25.00	2.97
Secondary	<20%	New	5,385.43	25.00	3.09
Secondary	<20%	New	5,419.75	25.00	3.11
Secondary	<20%	New	5,726.12	25.00	3.29
Secondary	<20%	New	5,922.60	25.00	3.40
Secondary	<20%	New	5,980.73	25.00	3.43
Secondary	<20%	New	6,015.42	25.00	3.45
Secondary	<20%	New	6,232.93	25.00	3.58
Secondary	<20%	New	6,247.29	25.00	3.59
Secondary	<20%	New	6,263.65	25.00	3.59
Secondary	<20%	New	6,735.00	25.00	3.87
Secondary	<20%	New	7,629.27	25.00	4.38
Secondary	<20%	New	8,034.17	25.00	4.61
Secondary	<20%	New	8,120.59	25.00	4.66
Secondary	<20%	New	8,761.38	25.00	5.03
Secondary	<20%	New	9,893.33	25.00	5.68
			468,000.84		**268.60**
Secondary	>20%	New	235.34	32.00	0.17

Secondary	>20%	New	334.24	32.00	0.25
Secondary	>20%	New	344.11	32.00	0.25
Secondary	>20%	New	346.48	32.00	0.25
Secondary	>20%	New	368.21	32.00	0.27
Secondary	>20%	New	502.68	32.00	0.37
Secondary	>20%	New	510.34	32.00	0.37
Secondary	>20%	New	516.45	32.00	0.38
Secondary	>20%	New	558.62	32.00	0.41
Secondary	>20%	New	561.63	32.00	0.41
Secondary	>20%	New	571.76	32.00	0.42
Secondary	>20%	New	577.79	32.00	0.42
Secondary	>20%	New	621.38	32.00	0.46
Secondary	>20%	New	682.97	32.00	0.50
Secondary	>20%	New	695.25	32.00	0.51
Secondary	>20%	New	731.89	32.00	0.54
Secondary	>20%	New	796.18	32.00	0.58
Secondary	>20%	New	807.55	32.00	0.59
Secondary	>20%	New	808.72	32.00	0.59
Secondary	>20%	New	870.75	32.00	0.64
Secondary	>20%	New	879.81	32.00	0.65
Secondary	>20%	New	888.84	32.00	0.65
Secondary	>20%	New	907.00	32.00	0.67
Secondary	>20%	New	974.87	32.00	0.72
Secondary	>20%	New	999.87	32.00	0.73
Secondary	>20%	New	1,004.28	32.00	0.74
Secondary	>20%	New	1,055.86	32.00	0.78
Secondary	>20%	New	1,066.87	32.00	0.78
Secondary	>20%	New	1,143.86	32.00	0.84
Secondary	>20%	New	1,164.61	32.00	0.86
Secondary	>20%	New	1,196.90	32.00	0.88
Secondary	>20%	New	1,237.03	32.00	0.91
Secondary	>20%	New	1,320.22	32.00	0.97
Secondary	>20%	New	1,321.18	32.00	0.97
Secondary	>20%	New	1,345.78	32.00	0.99
Secondary	>20%	New	1,359.35	32.00	1.00
Secondary	>20%	New	1,396.29	32.00	1.03
Secondary	>20%	New	1,436.59	32.00	1.06
Secondary	>20%	New	1,450.14	32.00	1.07
Secondary	>20%	New	1,460.09	32.00	1.07
Secondary	>20%	New	1,480.61	32.00	1.09
Secondary	>20%	New	1,485.22	32.00	1.09
Secondary	>20%	New	1,497.20	32.00	1.10
Secondary	>20%	New	1,539.63	32.00	1.13
Secondary	>20%	New	1,557.54	32.00	1.14
Secondary	>20%	New	1,609.68	32.00	1.18
Secondary	>20%	New	1,618.20	32.00	1.19
Secondary	>20%	New	1,644.89	32.00	1.21
Secondary	>20%	New	1,691.27	32.00	1.24
Secondary	>20%	New	1,694.97	32.00	1.25
Secondary	>20%	New	1,723.02	32.00	1.27
Secondary	>20%	New	1,750.40	32.00	1.29
Secondary	>20%	New	1,762.38	32.00	1.29

Secondary	>20%	New	1,791.40	32.00	1.32
Secondary	>20%	New	1,803.31	32.00	1.32
Secondary	>20%	New	1,803.92	32.00	1.33
Secondary	>20%	New	1,887.67	32.00	1.39
Secondary	>20%	New	1,975.04	32.00	1.45
Secondary	>20%	New	2,026.26	32.00	1.49
Secondary	>20%	New	2,043.40	32.00	1.50
Secondary	>20%	New	2,079.78	32.00	1.53
Secondary	>20%	New	2,276.87	32.00	1.67
Secondary	>20%	New	2,282.67	32.00	1.68
Secondary	>20%	New	2,347.45	32.00	1.72
Secondary	>20%	New	2,754.47	32.00	2.02
Secondary	>20%	New	2,832.85	32.00	2.08
Secondary	>20%	New	2,886.19	32.00	2.12
Secondary	>20%	New	2,907.61	32.00	2.14
Secondary	>20%	New	2,944.34	32.00	2.16
Secondary	>20%	New	3,155.73	32.00	2.32
Secondary	>20%	New	3,536.03	32.00	2.60
Secondary	>20%	New	3,687.32	32.00	2.71
Secondary	>20%	New	3,813.66	32.00	2.80
Secondary	>20%	New	3,832.84	32.00	2.82
Secondary	>20%	New	3,846.44	32.00	2.83
Secondary	>20%	New	3,964.21	32.00	2.91
Secondary	>20%	New	4,395.23	32.00	3.23
Secondary	>20%	New	4,606.79	32.00	3.38
Secondary	>20%	New	4,725.04	32.00	3.47
Secondary	>20%	New	4,998.58	32.00	3.67
Secondary	>20%	New	5,299.58	32.00	3.89
Secondary	>20%	New	5,534.79	32.00	4.07
Secondary	>20%	New	6,527.11	32.00	4.79
Secondary	>20%	New	9,353.07	32.00	6.87
Secondary	>20%	New	9,659.07	32.00	7.10
Secondary	>20%	New	11,976.09	32.00	8.80
			185,661.60		**136.39**
Primary	<20%	Existing	443.44	40.00	0.41
Primary	<20%	Existing	660.84	40.00	0.61
Primary	<20%	Existing	697.81	40.00	0.64
Primary	<20%	Existing	804.87	40.00	0.74
Primary	<20%	Existing	850.37	40.00	0.78
Primary	<20%	Existing	952.33	40.00	0.87
Primary	<20%	Existing	971.73	40.00	0.89
Primary	<20%	Existing	975.39	40.00	0.90
Primary	<20%	Existing	1,001.03	40.00	0.92
Primary	<20%	Existing	1,035.48	40.00	0.95
Primary	<20%	Existing	1,037.23	40.00	0.95
Primary	<20%	Existing	1,053.89	40.00	0.97
Primary	<20%	Existing	1,067.74	40.00	0.98
Primary	<20%	Existing	1,086.51	40.00	1.00
Primary	<20%	Existing	1,087.06	40.00	1.00
Primary	<20%	Existing	1,099.97	40.00	1.01

Primary	<20%	Existing	1,103.12	40.00	1.01
Primary	<20%	Existing	1,209.29	40.00	1.11
Primary	<20%	Existing	1,260.15	40.00	1.16
Primary	<20%	Existing	1,260.99	40.00	1.16
Primary	<20%	Existing	1,265.61	40.00	1.16
Primary	<20%	Existing	1,324.92	40.00	1.22
Primary	<20%	Existing	1,518.37	40.00	1.39
Primary	<20%	Existing	1,519.27	40.00	1.40
Primary	<20%	Existing	1,538.73	40.00	1.41
Primary	<20%	Existing	1,559.02	40.00	1.43
Primary	<20%	Existing	1,671.20	40.00	1.53
Primary	<20%	Existing	1,740.78	40.00	1.60
Primary	<20%	Existing	1,742.10	40.00	1.60
Primary	<20%	Existing	1,799.59	40.00	1.65
Primary	<20%	Existing	1,801.80	40.00	1.65
Primary	<20%	Existing	1,821.35	40.00	1.67
Primary	<20%	Existing	1,844.26	40.00	1.69
Primary	<20%	Existing	1,935.64	40.00	1.78
Primary	<20%	Existing	1,940.53	40.00	1.78
Primary	<20%	Existing	2,000.54	40.00	1.84
Primary	<20%	Existing	2,011.32	40.00	1.85
Primary	<20%	Existing	2,266.77	40.00	2.08
Primary	<20%	Existing	2,268.13	40.00	2.08
Primary	<20%	Existing	2,286.54	40.00	2.10
Primary	<20%	Existing	2,346.65	40.00	2.15
Primary	<20%	Existing	2,419.12	40.00	2.22
Primary	<20%	Existing	2,448.56	40.00	2.25
Primary	<20%	Existing	2,511.09	40.00	2.31
Primary	<20%	Existing	2,559.81	40.00	2.35
Primary	<20%	Existing	2,672.63	40.00	2.45
Primary	<20%	Existing	2,792.05	40.00	2.56
Primary	<20%	Existing	2,903.42	40.00	2.67
Primary	<20%	Existing	2,955.50	40.00	2.71
Primary	<20%	Existing	3,231.01	40.00	2.97
Primary	<20%	Existing	3,245.94	40.00	2.98
Primary	<20%	Existing	3,602.54	40.00	3.31
Primary	<20%	Existing	3,905.52	40.00	3.59
Primary	<20%	Existing	3,936.42	40.00	3.61
Primary	<20%	Existing	4,246.34	40.00	3.90
Primary	<20%	Existing	4,578.51	40.00	4.20
Primary	<20%	Existing	4,741.37	40.00	4.35
Primary	<20%	Existing	4,770.01	40.00	4.38
Primary	<20%	Existing	5,214.20	40.00	4.79
Primary	<20%	Existing	5,219.85	40.00	4.79
Primary	<20%	Existing	5,295.84	40.00	4.86
Primary	<20%	Existing	5,422.15	40.00	4.98
Primary	<20%	Existing	5,782.27	40.00	5.31
Primary	<20%	Existing	6,297.20	40.00	5.78
Primary	<20%	Existing	6,880.07	40.00	6.32
Primary	<20%	Existing	7,532.68	40.00	6.92
Primary	<20%	Existing	8,286.50	40.00	7.61
Primary	<20%	Existing	9,712.32	40.00	8.92

Primary	<20%	Existing	9,987.97	40.00	9.17
Primary	<20%	Existing	10,639.50	40.00	9.77
Primary	<20%	Existing	12,686.52	40.00	11.65
Primary	<20%	Existing	12,847.67	40.00	11.80
Primary	<20%	Existing	13,501.61	40.00	12.40
Primary	<20%	Existing	17,057.04	40.00	15.66
Primary	<20%	Existing	19,208.68	40.00	17.64
Primary	<20%	Existing	21,627.58	40.00	19.86
Primary	<20%	Existing	23,728.89	40.00	21.79
Primary	<20%	Existing	27,739.15	40.00	25.47
			350,049.89		**321.44**
Primary	>20%	Existing	659.50	50.00	0.76
Primary	>20%	Existing	763.49	50.00	0.88
Primary	>20%	Existing	878.12	50.00	1.01
Primary	>20%	Existing	900.83	50.00	1.03
Primary	>20%	Existing	926.91	50.00	1.06
Primary	>20%	Existing	1,072.76	50.00	1.23
Primary	>20%	Existing	1,082.29	50.00	1.24
Primary	>20%	Existing	1,123.44	50.00	1.29
Primary	>20%	Existing	1,204.73	50.00	1.38
Primary	>20%	Existing	1,400.73	50.00	1.61
Primary	>20%	Existing	1,418.44	50.00	1.63
Primary	>20%	Existing	1,485.49	50.00	1.71
Primary	>20%	Existing	1,511.65	50.00	1.74
Primary	>20%	Existing	1,548.18	50.00	1.78
Primary	>20%	Existing	1,578.11	50.00	1.81
Primary	>20%	Existing	2,007.13	50.00	2.30
Primary	>20%	Existing	2,011.85	50.00	2.31
Primary	>20%	Existing	2,304.49	50.00	2.65
Primary	>20%	Existing	2,472.04	50.00	2.84
Primary	>20%	Existing	2,564.54	50.00	2.94
Primary	>20%	Existing	2,663.59	50.00	3.06
Primary	>20%	Existing	2,671.21	50.00	3.07
Primary	>20%	Existing	2,840.59	50.00	3.26
Primary	>20%	Existing	2,950.15	50.00	3.39
Primary	>20%	Existing	3,032.90	50.00	3.48
Primary	>20%	Existing	3,102.41	50.00	3.56
Primary	>20%	Existing	3,209.91	50.00	3.68
Primary	>20%	Existing	3,258.22	50.00	3.74
Primary	>20%	Existing	3,778.79	50.00	4.34
Primary	>20%	Existing	5,193.85	50.00	5.96
Primary	>20%	Existing	5,397.14	50.00	6.20
Primary	>20%	Existing	5,865.04	50.00	6.73
Primary	>20%	Existing	6,487.76	50.00	7.45
Primary	>20%	Existing	6,524.02	50.00	7.49
Primary	>20%	Existing	7,551.87	50.00	8.67
Primary	>20%	Existing	8,918.35	50.00	10.24
Primary	>20%	Existing	9,224.40	50.00	10.59
Primary	>20%	Existing	12,417.21	50.00	14.25
			124,002.13		**142.33**

Primary	<20%	New	1,440.23	40.00	1.32
Primary	<20%	New	1,508.94	40.00	1.39
Primary	<20%	New	2,396.69	40.00	2.20
Primary	<20%	New	3,387.25	40.00	3.11
Primary	<20%	New	4,055.79	40.00	3.72
Primary	<20%	New	4,350.22	40.00	3.99
Primary	<20%	New	5,710.95	40.00	5.24
Primary	<20%	New	10,439.51	40.00	9.59
Primary	<20%	New	11,764.31	40.00	10.80
Primary	<20%	New	12,284.00	40.00	11.28
			57,337.89		**52.65**
No Additional Disturbance		Existing	108.77		
No Additional Disturbance		Existing	184.41		
No Additional Disturbance		Existing	194.82		
No Additional Disturbance		Existing	195.06		
No Additional Disturbance		Existing	211.43		
No Additional Disturbance		Existing	211.43		
No Additional Disturbance		Existing	270.00		
No Additional Disturbance		Existing	286.84		
No Additional Disturbance		Existing	310.40		
No Additional Disturbance		Existing	331.82		
No Additional Disturbance		Existing	368.76		
No Additional Disturbance		Existing	393.49		
No Additional Disturbance		Existing	414.87		
No Additional Disturbance		Existing	548.67		
No Additional Disturbance		Existing	558.74		
No Additional Disturbance		Existing	699.34		
No Additional Disturbance		Existing	790.63		
No Additional Disturbance		Existing	820.17		
No Additional Disturbance		Existing	863.29		
No Additional Disturbance		Existing	880.12		
No Additional Disturbance		Existing	923.28		
No Additional Disturbance		Existing	957.00		
No Additional Disturbance		Existing	965.49		
No Additional Disturbance		Existing	975.92		
No Additional Disturbance		Existing	982.59		
No Additional Disturbance		Existing	1,048.67		
No Additional Disturbance		Existing	1,060.96		
No Additional Disturbance		Existing	1,113.54		
No Additional Disturbance		Existing	1,210.78		
No Additional Disturbance		Existing	1,242.72		
No Additional Disturbance		Existing	1,492.56		
No Additional Disturbance		Existing	1,513.93		
No Additional Disturbance		Existing	1,592.47		
No Additional Disturbance		Existing	1,600.31		
No Additional Disturbance		Existing	1,949.98		
No Additional Disturbance		Existing	1,953.15		

No Additional Disturbance		Existing	2,019.54		
No Additional Disturbance		Existing	2,052.96		
No Additional Disturbance		Existing	2,087.34		
No Additional Disturbance		Existing	2,775.12		
No Additional Disturbance		Existing	2,853.61		
No Additional Disturbance		Existing	2,905.92		
No Additional Disturbance		Existing	2,919.91		
No Additional Disturbance		Existing	2,984.07		
No Additional Disturbance		Existing	3,107.81		
No Additional Disturbance		Existing	3,132.30		
No Additional Disturbance		Existing	3,380.90		
No Additional Disturbance		Existing	3,403.24		
No Additional Disturbance		Existing	3,480.03		
No Additional Disturbance		Existing	3,647.27		
No Additional Disturbance		Existing	3,702.80		
No Additional Disturbance		Existing	3,752.94		
No Additional Disturbance		Existing	3,777.77		
No Additional Disturbance		Existing	3,825.03		
No Additional Disturbance		Existing	3,854.80		
No Additional Disturbance		Existing	3,888.93		
No Additional Disturbance		Existing	3,999.10		
No Additional Disturbance		Existing	4,084.90		
No Additional Disturbance		Existing	4,253.37		
No Additional Disturbance		Existing	4,286.78		
No Additional Disturbance		Existing	4,309.41		
No Additional Disturbance		Existing	4,561.03		
No Additional Disturbance		Existing	4,812.21		
No Additional Disturbance		Existing	4,891.94		
No Additional Disturbance		Existing	4,950.55		
No Additional Disturbance		Existing	5,006.64		
No Additional Disturbance		Existing	5,023.49		
No Additional Disturbance		Existing	5,183.69		
No Additional Disturbance		Existing	5,408.28		
No Additional Disturbance		Existing	5,689.48		
No Additional Disturbance		Existing	6,383.22		
No Additional Disturbance		Existing	6,417.12		
No Additional Disturbance		Existing	6,698.12		
No Additional Disturbance		Existing	6,832.83		
No Additional Disturbance		Existing	7,519.26		
No Additional Disturbance		Existing	7,590.76		
No Additional Disturbance		Existing	9,652.00		
No Additional Disturbance		Existing	10,342.87		
No Additional Disturbance		Existing	11,942.27		
No Additional Disturbance		Existing	13,950.36		
			246,568.38		

Appendix F-3

Access Road Assessment West Tavaputs Plateau, Carbon County Utah

Access Road Assessment
West Tavaputs Plateau
Carbon County, Utah

Prepared for:

Bill Barrett Corporation
1099 18th Street Suite 2300
Denver, Colorado 80202

Prepared by:

Golden Engineering Group. LLC
16542 West 55th Place
Golden, Colorado 80401

February 2007

Access Road Assessment
West Tavaputs Plateau
Carbon County, Utah

Prepared for:

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Denver, Colorado 80202

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Golden, Colorado 80401

February 2007

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1.0 Introduction

Bill Barrett Corporation (BBC) is currently considering a full field development plan for the West Tavaputs Plateau area of Utah. Part of the development plan is the improvement of existing access roads and the construction of new access roads to natural gas wellsites and associated facilities. The purpose of this report is to present necessary improvements that are needed for existing access roads, present road alignments and alternatives for proposed new access roads being considered, and provide estimates of the areas of disturbance that each of these will impose.

In order to assess each of the access roads in question, Golden Engineering Group, LLC, (GEG) was retained by BBC to establish preferred access road alignments for the consideration of new access and to assess existing conditions along certain sections of several existing roads and to provide recommendations as needed. To assist with the field assessments, a representative of BBC and Nielson Construction (NC) accompanied GEG during each site visit. Site visits were made November 7-10, 19-22, and December 3-6, 2006. A representative of BBC was not present during the December site visit.

Field reconnaissance included walking each segment of the proposed road improvement and new road alignment alternatives during which field notes were recorded, and locations were identified on topographic base maps for reference. An aerial reconnaissance flight was also conducted to assist with sighting alternative routes. The field notes and maps generated during the field inspections along with consultation with BBC and NC personnel provide the basis of this report.

2.0 General Discussion of Typical Access Roadway

The access roads discussed in this report are considered to be or similar to Bureau of Land Management (BLM) resource roads, local roads and collector roads (BLM, 2006; BLM, 1982). Abbreviated definitions of these three types of roads as described by the BLM are provided below:

Resource Roads

BLM resource roads are low volume, single-lane roads. They normally have a 12 to 14 foot travelway with "intervisable turnouts", ...They are usually used for dry weather but may be surfaced, drained, and maintained for all-weather use. These roads connect terminal facilities, such as a well site, to collector, local arterial, or other higher class road. These roads generally provide for less than 10 wells in the area. They serve low average daily traffic (ADT) and are located on the basis of the specific resources activity need rather than travel efficiency.

Local Roads

BLM local roads may be single-lane or double-lane with travelways 12 to 24 feet in width and intervisible turnouts. They are normally graded, drained and surface and are capable of carrying highway loads. These roads provide access to large areas and for various uses. They collect traffic from resource or local roads or terminal facilities and are connected to arterial roads or public highways. The location and standards for these roads are based on both long-term resource needs and travel efficiency. These roads generally provide for between 10 and 50 wells in the area. They may not be operated for either constant or intermittent service, depending on land use and resource management objectives for the area being served.

Collector Roads

BLM collector roads are usually double-lane, graded, drained and surfaced, with a 20 to 24 foot travelway. They serve large land areas and are the major access route into development areas with high average daily traffic rates. The locations and standards are often determined by a demand for maximum mobility and travel efficiency rather than a specific resource management service. These roads generally provide for more than 50 wells in the area. They usually connect with public highways or other arterials to form an integrated network of primary travel routes and are operated for long-term land and resource management purposes and constant service.

As previously reported and documented (EIS 2006), Barrett is proposing two road classifications for the proposed drilling and production operations in the West Tavaputs Plateau area. The two classifications would be designated a primary roads and secondary roads. A definition of these two classifications is provided below.

Primary Roads

Primary roads would include BLM Collector and Local roads. These roads would have an average travel width of 22 feet and provide access to major operations. This type of road would be used in locations where greater that 10 wells are designated for a given area. The primary roads would be constructed to minimize environmental impact. Where practical and available, road surfaces would be graveled.

Secondary Roads

Secondary roads would take the place of BLM Resource roads. These roads would have an average travel width of 16 feet and provide access to less active sites. This type of road would be used in locations where less than 10 wells are designated for an area. This type of road is presently being used for drilling operations in the Nine Mile Canyon area.

For the purpose of this report, collector / local roads (Primary roads) are considered to have an average travel width of 22 feet and provide or will provide access to major operations. Resource roads (Secondary roads) are considered to have an average travel width of 16 feet and provide or will provide access to remote locations.

The overall width of disturbance associated with new construction depends on the surrounding terrain and varies from location to location. For example and assuming a 16 ft travel width, the overall width of disturbance from edge of cut to toe of fill would be approximately 30 feet for a 3 horizontal (h):1 vertical (v) existing ground cross slope with a 1(h):1(v) cut slope and a 1.5(h):1(v) fill slope. The overall width from edge of cut to toe of fill will vary between approximately 35 feet for a 1.5(h):1(v) cross slope with 0.5(h):1 (v) cut slope with no fill to greater than 60 feet for a 1.5(h):1(v) cross slope with 0.75(h):1(v) cut slope with no fill. Typical road sections will have a small drainage ditch adjacent to the up-gradient area, which is included in the permanent disturbance area. In certain instances, the temporary disturbance widths during construction can be somewhat greater than the estimates above. In general, typical disturbance widths are no greater than 60 feet and for estimating anticipated disturbance a width of 60 feet was used.

In areas of limited width due to narrow canyons created by natural rock walls, special considerations unique to this application were considered. In these special cases, the water course in the drainage path will be restricted to one side of the channel by re-establishing the road embankment fill on the other side of the channel with rip-rap armor at the base of the fill section. In this case, the water course is not altered but rather constrained to within the limits of the engineered boundaries while at the same time being allowed to infiltrate the engineered rock-fill road buttress during periods of high water flow.

Typical sections illustrating road construction geometry associated with a 16 foot travel width are presented in Figures 5 and 6. Sections that would represent typical road construction include:

- roads constructed on embankment fill;

- gentle side slope excavation and fill;
- side slope excavation on steep hillsides (dugway); and
- roads constructed entirely by excavation into the existing terrain.

Sections that would represent special road construction are presented on Figure 7 and include:

- roads constructed entirely by deep excavation into the existing terrain, and
- roads constructed on embankment fill adjacent to a channel bottom.

Generalized areas of disturbance associated with various terrain scenarios are tabulated on each section.

It is assumed that the road maintenance and alignments recommended and presented in this report could be constructed with conventional earth moving equipment including dozers, excavators, compactors, graders and haul trucks. An un-quantified amount of drilling and blasting would be required in limited areas that could not be excavated with conventional road construction equipment due to rock or other consolidated material.

Mitigation of impacts will need to be enforced by limiting work boundary zones during construction together with storm-water management plans. It is recommended that extensive use of Best Management Practices be compulsory during all construction activity.

3.0 Proposed Improvements to Existing Access Roads

Assessment of improvements that are needed to existing roads included the Harmon Canyon and Horse Bench Roads. Improvements to these two roads are primarily based upon safety and strong considerations for operation and maintenance.

3.1 Harmon Canyon Access Road

BBC made limited improvements to the Harmon Canyon road in the fall of 2006. Improvements that were made by BBC included the installation of drainage ditches and culverts, raising the road surface and widening of the curves along an approximate 2000 foot section of the road. A naturally occurring spring is located in this area and contributes to the ongoing drainage issues. A landslide is also present along this segment of the canyon which will require particular attention during the design and construction phase of the remedial work. The maintenance work that was performed in the fall of 2006 will provide a short term remedy to the drainage and safety issues that exist with this road, however additional remedial work is necessary for the proposed full field development.

The Harmon Canyon road classification is Primary based on current and proposed use however due to the nature of this canyon, i.e. narrow channel, high canyon walls, tight curves and steep grade, adherence to BLM design criteria recommended for Primary (Collector) roads will only be possible where practicable.

The alignment of the Harmon Canyon Road is illustrated in Figure 1. Recommendations regarding adequate drainage management, elimination of blind curves, and removal of dangerous sidewalls are summarized in Table 3.1a. Table 3.1a refers to stationing that is presented on Figure 1.

An estimate of the area of disturbance associated with the proposed improvements outlined in Table 3.1a are provided and summarized in Table 3.1b. Due to the characteristics of Harmon Canyon no realignment or construction of a new road route other than the improvements recommended is discussed. It is recommended that a minimum of 3 corrugated metal pipe (CMP) culverts be installed to help manage drainage runoff. The diameter of these culverts will be dependent on a site specific hydrologic analysis.

Approximately 1.3 miles of the Harmon Canyon road was assessed as part of the field reconnaissance. The total length of existing road that needs some type of maintenance is approximately 1,950 ft. The total area of disturbance that would occur as a result of the recommendations for Harmon Canyon is approximately 0.3 acres.

3.2 Horse Bench Access Road

The Horse Bench access road classification is Primary based on the proposed use, however due to the rough terrain that this road alignment traverses , i.e. steep side slopes, and steep grade, adherence to BLM design criteria recommended for Primary (Collector) roads will only be possible where practicable.

The alignment of the Horse Bench Access Road is illustrated in Figure 2. Recommendations regarding adequate drainage management, removal of exposed dugways on steep slopes and maintaining minimal grades is summarized in Table 3.2a. Table 3.2a refers to stationing that is presented on Figure 2. An estimate of the area of disturbance associated with the proposed improvements outlined in Table 3.2a are provided and summarized in Table 3.2b.

Approximately 6.1 miles of the Horse Bench road was assessed as part of the field reconnaissance. The total length of existing road that needs some type of maintenance or mitigation is approximately 2.5 miles (13,000 ft).

A specific concern is a section from approximate Sta. 210+00 to Sta. 220+00 along which the existing road follows an alignment around a knoll or ridge while descending to a saddle to the north. The existing road is narrow (10-12 feet) along most of this section and is precariously pitched and exposed on the hill slope. Two options are presented for safely traversing this area. Option A involves widening the existing dugway by at least 5 feet at the same time reducing the grade towards the saddle which is presently 17 -18%. Option B entails excavating a trough like passage through the top of the ridge that would require an estimated 10 to 15 foot deep excavation. The excavated materials from both options would be needed to widen and raise the road bed across the saddle to the north to reduce and maintain the grade to less than 10%.

If Option B is selected as the preferred improvement from approximate Sta. 210+00 to Sta. 220+00, 1000 feet of existing road needs to be realigned. If the road is realigned between Sta. 210+00 and 220+00 an equivalent amount of existing road could be reclaimed (approximately 0.37 acres). The total area of new disturbance that would result from the realignment is approximately 0.64 acres. If Option B is selected as the preferred improvement along Sta. 210+00 to Sta. 220+00 the total area of disturbance including other recommended improvements is approximately 1.5 acres.

It is recommended that at minimum of 3 or 4 CMP culverts be installed to help manage drainage runoff. The diameter of these culverts will be dependent on a site specific hydrologic analysis.

4.0 Proposed Alternatives for New Access and or Improvements to Existing Access Roads

Two areas requiring improved access that currently have access or partial access were investigated. The existing access to both Flat Iron Mesa and Jack Canyon were assessed along with consideration and location of alternative routes. The following sections discuss the alternatives for each of these areas.

4.1 Flat Iron Mesa Access Road Alternatives

Two alternatives are presented for improved access to the Flat Iron Mesa area. Each of the Flat Iron Mesa access road alternatives presented classify as Primary based on the proposed use in the area, however due to the rough terrain that these road alignments traverse, i.e. relatively steep grades, high rock outcrops and moderately steep side slopes, adherence to BLM design criteria recommended for Primary (Collector) roads is and will only be possible where practicable.

Alternative 1 involves the realignment of the existing dugway to reduce the present grade from approximately 20% to approximately 10%. Alternative 2 is an entirely new alignment located in the adjacent drainage to the north. The alignments of these alternatives are illustrated on Figure 3. The existing road that is located in between Alternative 1 and Alternative 2 was determined not to be feasible since approximately 7500 feet of new road would need to be constructed at a10% grade to tie into the road at the upper end. In addition, the new section of road would require extensive drill and blast of ledge rock to construct a dugway in this south facing slope.

4.1.1 Improvements to the Existing Flat Iron Mesa Dugway – Alternative 1

The primary reason to identify an alternative to the existing Flat Iron dugway is due to the steep (18 – 20%) grade of the lower segment of this road. Alternative 1 reduces the maximum grade to approximately 10 - 11%. Alternative 1 has less of an impact than Alternative 2 although Alternative 2 is located on the north slope and therefore has no sun exposure during winter months. Slick conditions created by ice build-up will always be a concern with the Alternative 1 alignment.

Recommendations regarding the Flat Iron Alternative 1 alignment are summarized in Table 4.1a. Table 4.1a refers to stationing that is presented on Figure 3. An estimate of the area of disturbance associated with the proposed Flat Iron Alternative 1 outlined in Table 4.1a are provided and summarized in Table 4.1b.

Over 9000 feet of the existing Flat Iron dugway road was assessed as part of the field reconnaissance. The total length of existing road that needs re-alignment is approximately 6100 ft. It is estimated that this new alignment will require approximately 8 or 9 CMP culverts. The diameter of these culverts will be dependent on hydrologic analysis associated with final design. The approximate locations of these culverts are

indicated on Figure 3. The total area of new disturbance that would result from the Alternative 1 realignment is approximately 7.4 acres.

4.1.2 Proposed Flat Iron Mesa Access Alternative 2

The proposed Flat Iron Mesa access Alternative 2 is located in a neighboring drainage to the north of the existing Flat Iron dugway. This alignment would provide a favorable approach (straighter and less grade) to the increased grade associated with the ascent out of Cottonwood Canyon in route to Flat Iron Mesa. Once out of the steeper canyon walls of Cottonwood Canyon, the alignment follows a gentle grade to the tie-in with existing access on top of the mesa. As previously mentioned, Alternative 2 is located on the south facing slope minimizing the potential for ice accumulation during winter weather.

Recommendations regarding the Flat Iron Alternative 2 alignment are summarized in Table 4.2a. Table 4.2a refers to stationing that is presented on Figure 3. An estimate of the area of disturbance associated with the proposed improvements outlined in Table 4.2a are provided and summarized in Table 4.2b.

Approximately 10,200 feet of new access for Flat Iron Mesa (Alternative 2) was assessed as part of the field reconnaissance. It is estimated that this new alignment will require approximately 10 CMP culverts. The diameter of these culverts will be dependent on hydrologic analysis associated with final design. The locations of these culverts are indicated on Figure 3. The total area of new disturbance that would result from the Alternative 2 realignment is approximately 11.3 acres.

If Alternative 2 is constructed for the Flat Iron Mesa access, the existing dugway would remain as is until the full well field is developed at which time this access (existing dugway) would be reclaimed.

4.2 Jack Canyon Access Road Alternatives

Two alternatives are presented for improved access to the Jack Canyon area. Each of the Jack Canyon access road alternatives presented classify as Secondary based on the proposed use in the area, however due to the rough terrain that these road alignments traverse, i.e. relatively steep side slopes, high rock outcrops, narrow valley walls, and moderately steep grade (Alternative 2), adherence to BLM design criteria recommended for Secondary (Resource) roads will only be possible where practicable.

Alternative 1 involves the relocation of the upper portion of the existing road in the valley bottom to eliminate ongoing flood damage mitigation. Alternative 2 is an entirely new alignment located in a downstream tributary drainage on the north side of Jack Canyon. The alignments of these alternatives are illustrated on Figure 4.

For clarification, the two alternatives for the Jack Canyon area are divided into an upper and a lower segment. Both upper end segments for each alternative converge and meet at the same location (Alternative 1 Sta. 172+00 and Alternative 2 Sta. 93+25). Each alternative continues along the single access in the lower portion of the canyon. In other words the upper section for each alternative is different although there is only one alignment for each alternative in the lower portion of the canyon.

4.2.1 Jack Canyon Alternative 1

The start of the alignment for the Jack Canyon access road Alternative 1 begins at Site Location 101 in Section 33. The upper section of this road alignment is exclusively located on the north slope (south aspect) of the canyon. The north side of the canyon was primarily selected for the purpose of sun exposure during the winter months. The upper section of this alignment will predominately require cross slope road construction with side slopes varying from approximately 5(h):1(v) to 1(h):1(v) along some segments. Several near vertical and vertical rock ledges at the termination point of ridges will need to be removed in the lower portions of this upper section. The upper portion of this alignment from Sta. 0 to Sta. 172+00 has an average gradient of 6.5%. The height of the road will be maintained at a minimum of 15 to 20 feet above the existing drainage bottom to prevent damage due to high water during flood events.

The lower section of the road alignment from approximate Sta. 172+00 to Sta. 315+85 which extends below the Jack Canyon drainage confluence has an average gradient of 4.4%. This section of the road is approximately 2.7 miles in length and crosses the channel bottom several times in route to the BBC 5-14 well location. This lower section of the alignment (Sta. 172+00 to Sta. 315+85) will be included with Alternative 1 although would apply to the lower portion of Alternative 2 should Alternative 2 be selected as the preferred route.

Recommendations regarding the Jack Canyon Alternative 1 alignment are summarized in Table 4.3a. Table 4.3a refers to stationing that is presented on Figure 4. An estimate of the area of disturbance associated with the proposed Jack Canyon Alternative 1 outlined in Table 4.3a are provided and summarized in Table 4.3b.

The total area of disturbance associated with Jack Canyon Alternative 1 from Sta. 0 to Sta. 315+85 is approximately 36.3 acres. Of the estimated 36.3 acres of disturbance, approximately 19 acres from Sta. 0 to Sta. 172+00 are associated with new disturbance and the remaining 17.3 acres are proximate to the stream channel and existing road access from Sta. 172+00 to Sta. 315+85. If Alternative 1 were selected for the new access it is estimated that approximately 17000 to 18000 feet (3.2 to 3.4 miles corresponding to the abandonment of the existing road) or 6 - 7 acres of the existing access in the valley bottom could be reclaimed.

4.2.2 Jack Canyon Alternative 2

The start of the alignment for Jack Canyon access road Alternative 2 begins near the BBC 36-2 well location in Section 35. The upper section of this road alignment is exclusively located on the northeast slope (southwest aspect) of the canyon. The northeast side of the canyon was selected for the purpose of sun exposure during the winter months. The upper section of this alignment (from approximate Sta. 0 to Sta. 21+00) will require cross slope road construction with side slopes varying from approximately 5(h):1(v) to 4:1. A rock ledge at Sta. 21+00 to Sta. 25+00 will need to be blasted to get through to the lower portion of this tributary canyon. Cross slope construction will be necessary from approximate Sta. 25+00 to Sta. 65+00 at which point the alignment is restricted to the valley bottom. Several near vertical and vertical rock ledges at the termination point of ridges will need to be removed in the lower portions of the lower section.

Recommendations regarding the Jack Canyon Alternative 2 alignment are summarized in Table 4.4a. Table 4.4a refers to stationing that is provided on Figure 4. An estimate of the area of disturbance associated with the proposed Jack Canyon Alternative 2 outlined in Table 4.4a is provided and summarized in Table 4.4b.

The average grade of Jack Canyon Alternative 2 from Sta. 0 to Sta. 21+00 would be approximately 6% and approximately 12.5% in the lower section of the road alignment from Sta. 21+00 to Sta. 93+25 at which point this alignment intersects the Alternative 1 alignment in the main Jack Canyon. The total area of disturbance associated with the Jack Canyon Alternative 2 is estimated to be approximately 10 acres.

As with Alternative 1, if Alternative 2 is selected as the preferred access to Jack Canyon approximately 17000 to 18000 feet (3.2 to 3.4 miles) or 6 -7 acres of the existing access road in the main valley bottom could be reclaimed.

5.0 Conclusions

Based on reconnaissance of Harmon Canyon and Horse Bench, assessments of the existing access road conditions were made and recommendations regarding alterations and mitigation for these routes have been provided. Additionally and also based on reconnaissance level investigation, assessments of the existing access road conditions, alterations, and recommended alternative routes have been provided for Flat Iron Mesa (Cottonwood Canyon) and Jack Canyon.

The area of impact that the proposed improvements and new construction would impose as well as reclamation of resulting abandoned access have been assessed and are summarized in Table 5.1.

6.0 References

Bureau of Land Management, 2006, Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development, Gold Book, Fourth Ed., 51 pg.

Bureau of Land Management, 1982, Excerpts From BLM Manual Section 9113 on Road Standards, 27 pg.

EIS Environmental & Engineering Consulting, October 2006, West Tavaputs Plateau EIS, Road Disturbance Evaluation Report, prepared for Bill Barrett Corporation.

United States Geological Survey 7.5 minute, 1:24,000 Topographic Map of the Cedar Ridge Canyon Quadrangle.

United States Geological Survey 7.5 minute, 1:24,000 Topographic Map of the Currant Canyon Quadrangle.

United States Geological Survey 7.5 minute, 1:24,000 Topographic Map of the Pinnacle Canyon Quadrangle.

United States Geological Survey 7.5 minute, 1:24,000 Topographic Map of the Twin Hollow Quadrangle.

Table 3.1a. Proposed Action Corridor Improvement and Rationale for Harmon Canyon

Approximate Station		Land Ownership	Relationship to Existing Road	Recommended Improvement/Mitigation	Reason for Improvement / Route Deviation
Start	End				
0	0	Federal BLM	East – West	Installation of 24in culvert	Improve drainage and reduce road erosion potential
29+00	30+00	Federal BLM	East	Increase road width by 5ft for a distance of 100 ft	Improve sight distance and two way traffic
34+00	37+00	Federal BLM	East	Increase road width by 5ft for a distance of 300ft	Improve sight distance and two way traffic
50+00	-	Federal BLM	East – West	Installation of 36in culvert	Improve drainage and reduce road erosion potential
51+00	52+00	Federal BLM	East	Removal of partially detached mass of colluvium extending 12 – 18 ft above road	Severe safety issue
55+50	56+00	Federal BLM	East	Increase road width by 5ft for a distance of 50ft	Improve sight distance and two way traffic, elevate road to increase erosion resistance
58+00	70+00	Federal BLM	East	Elevate road bed for a distance of approx. 1200ft. Ridge points need to be removed to straighten road. Cut material could be used to elevate road	Improve sight distance and two way traffic, elevate road to increase erosion resistance
65+00	67+00	Federal BLM	West	Removal of 2 rock ledges	Straighten alignment and eliminate blind curves

Table 3.1b Proposed Action Area of Impact for Harmon Canyon

Approximate Station		Type of Road Mitigation		Disturbance	
Start	**End**	**(Reference Sections on Figures 5, 6 and 7)**	**Culvert Number and Size***	**Approx. Change in Travel Width (feet)**	**Approx. Area (acres)**
0	0	Installation of culvert	1 - 24 inch	-	-
29+00	30+00	Increase road width by 5ft for a distance of 100 ft	-	5	0.028
34+00	37+00	Increase road width by 5ft for a distance of 300 ft	-	5	0.083
50+00	-	Installation of 36in culvert	1 - 36 inch	-	-
51+00	52+00	Removal of partially detached mass of colluvium extending 12 – 18ft above road	-	5 - 8	0.023
55+50	56+00	Increase road width by 5ft for a distance of 50ft	-	5	0.006
58+00	70+00	Elevate road bed for a distance of approx. 1200ft. Ridge points need to be removed to straighten road. Cut material used to elevate road	-	2 - 4	0.138
65+00	67+00	Removal of 2 rock ledges	-	2 - 5	0.012

* Note: Culvert number and size will need to be determined during final design complete with hydrologic analysis.

Table 3.2a. Proposed Action Corridor Improvement and Rationale for Existing Horse Bench Road

Station		Land Ownership	Relationship to Existing Road	Recommended Improvement / Mitigation	Reason for Route Deviation / Improvement
Start	End				
11+00	11+00	Federal BLM	Same	Install 18-24 inch culvert	Improve road erosion resistance
20+00	35+00	Federal BLM	Same	Cut west and east approach to saddle area. Fill low point in saddle. West approach needs to be widened by 5 – 8 feet for 200 ft.	Reduce existing 15% grade to 10%. Increase road width to 16 ft min.
40+00	45+00	Federal BLM	southeast	Possible turn-out	Allow for safe passing of oversize vehicles
57+00	57+00	Federal BLM	Same	Install 18-24 inch culvert	Improve road erosion resistance
55+00	60+00	Federal BLM	southeast	Possible turn-out	Allow for safe passing of oversize vehicles
80+00	92+00	Federal BLM	Same	Move vertical PI 100ft to east by cutting several feet from of road grade and filling to west along flatter section	Reduce existing 15% road grade to less than 10%
95+00	105+00	Federal BLM	southeast	Possible turn-out	Allow for safe passing of oversize vehicles
110+00	140+00	Federal BLM	Same	Install water bars	Increase road performance and erosion potential
182+00	200+00	Federal BLM	Same	Smooth over rough jagged rock with road base/blade	Increase road quality and decrease tire puncture potential
199+00	199+00	Federal BLM	Same	Install 18-24 inch culvert	Improve road erosion resistance
210+00	220+00	Federal BLM	Same	Option A: increase existing road width around dugway from 12 feet to 18 ft and install safety berm.	Road width currently too narrow and with no berm is safety issue particularly in winter
210+00	220+00	Federal BLM	South southeast	Option B: cut through knoll eliminating precarious route on north facing south slope (Option A)	This option would eliminate exposed route on hill cross slope (Option A) and generate fill that could be used to reduce grade to east
225+00	240+00	Federal BLM	Same	Reduce existing grade by cutting from east end at top of hill to fill at bottom of hill.	Reduce grade and improve site distance.
260+00	270+00	Federal BLM	Same	Increase travel width across hogback ridge by 2 – 5 ft	Improve safety and tafficability
285+00	304+00	State of Utah	Same	-	-
304+00	320+00	Federal BLM	Same	-	-

Table 3.2b. Proposed Action Area of Impact for Existing Horse Bench Road

Approximate Station		Type of Road Mitigation		Disturbance	
Start	End	(Reference Sections on Figures 5, 6 and 7)	Culvert Number and Size*	Approx. Change in Travel Width (feet)	Approx. Area (acres)
11+00	11+00	Install culvert	1 - 24 inch	-	-
20+00	35+00	Cut west and east approach to saddle area. Fill low point in saddle. West approach needs to be widened by 5 – 6 feet for 200 ft.	-	6	0.028
40+00	45+00	Possible turn-out	-	12	0.138
57+00	57+00	Install culvert	1 - 36 inch	-	
55+00	60+00	Possible turn-out	-	12	0.138
80+00	92+00	Move vertical PI 100ft to east by cutting several feet from of road grade and filling to west along flatter section	-	2	0.055
95+00	105+00	Possible turn-out	-	10	0.230
110+00	140+00	Install water bars	-	-	-
182+00	200+00	Smooth over rough jagged rock with road base/blade	-	-	-
199+00	199+00	Install culvert	1 - 24 inch	-	-
210+00	220+00	Option A: increase existing road width around dugway from 12 feet to 18 ft and install safety berm.	-	6	0.138
210+00	220+00	Option B: cut through knoll eliminating precarious route on north facing south slope (Option A)	-	28	0.643
225+00	240+00	Reduce existing grade by cutting from east end at top of hill to fill at bottom of hill.	-	4	0.138
260+00	270+00	Increase travel width across hogback ridge by 2 – 5 ft	-	5	0.115
285+00	304+00	No Comments	-	-	-
304+00	320+00	No Comments	-	-	-

* Note: Culvert number and size will need to be determined during final design complete with hydrologic analysis.

Table 4.1a. Proposed Action Corridor Improvement and Rationale for Existing Flat Iron Dugway, Alternate 1

Station		Land Ownership	Relationship to Existing Road	Recommended Improvement / Mitigation	Reason for Route Deviation / Improvement
Start	End				
0	0	Federal BLM	same	Tie-in with existing road	Reduce grade
6+00	6+00	Federal BLM	northwest	Install culvert	Improve road erosion resistance
0	20+00	Federal BLM	northwest	Cut new alignment at less than 10% grade	Decrease existing grade
17+00	17+00	Federal BLM	northwest	Install culvert	Improve road erosion resistance
20+00	25+00	Federal BLM	northwest	Cut new alignment at less than 10% grade	Decrease existing grade
21+00	21+00	Federal BLM	northwest	Install culvert	Improve road erosion resistance
25+00	34+00	Federal BLM	northwest	Cut new alignment at less than 10% grade	Decrease existing grade
33+00	33+00	Federal BLM	north	Install culvert	Improve road erosion resistance
34+00	38+00	Federal BLM	north	Cut new alignment at less than 10% grade	Decrease existing grade
38+00	38+00	Federal BLM	north	Install culvert	Improve road erosion resistance
38+00	41+00	Federal BLM	north	Cut new alignment at less than 10% grade	Decrease existing grade
41+00	41+00	Federal BLM	north	Install culvert	Improve road erosion resistance
41+00	43+00	Federal BLM	north	Cut new alignment at less than 10% grade	Decrease existing grade
43+00	43+00	Federal BLM	north	Install culvert	Improve road erosion resistance
43+00	54+00	Federal BLM	north	Cut new alignment at less than 10% grade	Decrease existing grade
54+00	54+00	Federal BLM	north	Install culvert	Improve road erosion resistance
54+00	60+00	Federal BLM	north	Cut new alignment at less than 10% grade	Decrease existing grade
60+00	61+00	Federal BLM	same	Tie – in with existing road	Improve grade transition

Table 4.1b. Proposed Action Area of Impact for Existing Flat Iron Dugway, Alternate 1

Station		Type of Road Construction		Disturbance	
Start	End	(Reference Sections on Figures 5, 6)	Culvert Number and Size*	Width (feet)	Area (acres)
0	0	Tie-in with existing road.	-	-	-
6+00	6+00	Install culvert	1 - 24 inch	-	-
0	20+00	Hill slope between Sta. 0 and Sta. 2000 is approx. 4:1. Road grade will be less than 10%, material consists of thinly bedded sandstone and shallow (<2ft) colluvium.	-	45	2.07
17+00	17+00	Install culvert	1 - 24 inch	-	-
2100	21+00	Install culvert	1 - 24 inch	-	-
20+00	28+00	New road alignment will break through resistive sandstone ledge that is more weathered and fractured in this area. Competent rock excavated will be used to buttress fill. Hill slope is approximately 2:1 that will incur 15 ft high cut slope. Material consists of sandstone and shallow (<2 ft) colluvium.	-	50	0.92
28+00	31+00	Hill slope is approximately 1.5:1 and will incur 25-30 ft high cut slopes. Material consists of bedded sandstone and shallow (<2 ft) colluvium.	-	60	0.41
31+00	33+00	Hill slope is approximately 1.75 – 2:1. Hill slope will incur 12 – 16 ft high cut slopes. Material consists of bedded sandstone and shallow (<2 ft) colluvium.	-	55	0.25
33+00	33+00	Install culvert	1 - 36 inch	-	-
33+00	35+00	Hill slope changes from 1.5:1 to 2:1 Hill slope will incur 20 – 30' high cut slopes. Material consists of bedded sandstone and very (<1 ft) shallow colluvium.	-	50	0.23
38+00	38+00	Install CMP culvert.	1 - 36 inch	-	-
41+00	41+00	Install CMP culvert.	1 - 36 inch	-	-
43+00	43+00	Install CMP culvert.	1 - 36 inch	-	-
35+00	49+00	Hill slope is predominately 2:1 which will incur 10-15 high cut slopes.	-	45	1.45
49+00	54+00	Tie-in with existing road where existing road narrows to approximate 14 ft road width. Material from existing road above tie-in will be pushed down to fill on top of existing road below tie-in to construct and maintain 10% or less grade.	-	20	0.23
54+00	55+10	Crossing Twin Hollow. New road crossing of Twin Hollow drainage will require one or two 60-inch dia. CMP culverts. Hollow crossing will require embankment fill with the following dimensions: 18 – 20 ft wide crest; 20 – 25 ft high; 110 ft in length at the base and 115 ft in length along the crest. Fill from excess cut of the existing road at Sta 5300 along with hill slope material above existing road between Sta. 4900 and Sta. 5300 will be used to generate fill for embankment crossing. Cut from hill slope above existing road will also straighten existing road alignment between Sta. 4900 and Sta. 5300.	2 – 60-in.	120x40	1.10

Table 4.1b continued					
54+00	61+00	Tie-in with existing road along Cottonwood Creek at 6100. Between 5400 and 6100 hill slope is roughly 3:1. Road construction will incur 4 ft high cut slopes for a distance of approximately 200 ft. A sandstone ledge may need to be drilled and blasted just below north (left abutment of embankment) crossing.	-	45	0.72

* Note: Culvert number and size will need to be determined during final design complete with hydrologic analysis.

Table 4.2a. Proposed Action Corridor Improvement and Rationale for New Flat Iron Access, Alternate 2

Station		Land Ownership	Relationship to Existing Road	Recommended Improvement / Mitigation	Reason for Route Deviation / Improvement
Start	**End**				
0	7+50	Federal BLM	new	New alignment	Shorter route, flatter grade to Flat Iron Mesa; predominately southern exposure
7+50	65+00	State of Utah	new	New alignment	Shorter route, flatter grade to Flat Iron Mesa; predominately southern exposure
65+00	86+00	Federal BLM	new	New alignment	Shorter route, flatter grade to Flat Iron Mesa; predominately southern exposure
86+00	102+00	State of Utah	new	New alignment	Shorter route, flatter grade to Flat Iron Mesa; predominately southern exposure; smooth, gentle approach to incline

Table 4.2b. Proposed Action Area of Impact for New Flat Iron Access, Alternate 2

Station		Type of Road Construction		Disturbance	
Start	**End**	**(Reference Sections on Figures 5, 6)**	**Culvert Number and Size***	**Width (feet)**	**Area (acres)**
0	0	Tie-in with existing road	-	-	-
9+00	9+00	Install CMP culvert.	1 - 12 inch	-	-
12+00	12+00	Install CMP culvert.	1 - 12 inch	-	-
0	30+00	Hill slope between Sta. 0 and Sta. 3000 is approx. 5-4:1. Road grade will be approx. 5%, material consists of thinly bedded shale and sandstone and shallow (<2ft) colluvium	-	45	3.10
34+50	34+50	Install CMP culvert. Minor ground water spring noted in drainage	1 - 36 inch	-	-
30+00	63+00	Hill slope between Sta. 3000 and Sta. 6100 is approx. 3:1. Road grade will be < 10%, material consists of thinly bedded shale and sandstone and shallow (<2ft) colluvium along upper portion and thicker more massively bedded sandstone along lower portion	-	50	3.79
45+00	45+00	Install CMP culvert.	1 - 36 inch	-	-
51+50	51+50	Install CMP culvert.	1 - 48 inch	-	-
56+00	56+00	Install CMP culvert.	1 - 48 inch	-	-
63+00	65+00	Transition from minor road cut to minor embankment fill to low water stream crossing at head of nick point in stream channel. Nick point has developed a 20 ft water drop in the channel at this location	-	40	0.18
65+00	80+00	Hill slope between Sta. 6500 and Sta. 8000 is approx. 3-2.5:1. Road grade will be < 5%, material consists of massively bedded sandstone overlain by shallow (<3ft) colluvium and large boulders in stream channel.	-	45	1.55
80+00	82+50	Transition from road cut to embankment fill with culvert(s) and stream crossing back to north side of valley, large boulders present in stream channel can be used to buttress/armor embankment fill.	2 - 60 inch	50	0.29
82+50	99+00	Hill slope between Sta. 8200 and Sta. 9900 is approx. 2:1. Road grade will be < 10%, material consists of thinly bedded shale and sandstone and shallow (<2ft) colluvium	-	55	2.08
99+00	100+00	Transition from road cut to embankment fill and stream crossing	-	45	0.10
100+00	102+00	Embankment fill with culverts for Cottonwood Canyon stream crossing	2 - 60 inch	45	0.21
102+00	102+00	Tie-in with existing Cottonwood Canyon road	-	-	-

* Note: Culvert number and size will need to be determined during final design complete with hydrologic analysis.

Table 4.3a. Proposed Action Corridor Improvement and Rationale for Jack Canyon Alternate 1

Station		Land Ownership	Relationship to Existing Road	Recommended Improvement / Mitigation	Reason for Route Deviation / Improvement
Start	End				
0	50+00	Federal BLM	north	Mirror existing road and creek bed with new alignment 20 to 60 ft above creek bed. Prominent rock nose at Sta. 5000	Relocate road out of flood levels for safety and operations and maintenance
50+00	66+00	Federal BLM	north	Road alignment continues to mimic canyon 40 to 50 ft above creek bed. Prominent rock nose at Sta. 6600.	Relocate road out of flood levels for safety and operations and maintenance
66+00	77+00	Federal BLM	north	Road alignment continues to mimic canyon 40 to 50 ft above creek bed.	Relocate road out of flood levels for safety and operations and maintenance
77+00	135+00	State of Utah	north	Road alignment continues to mimic canyon 40 to 50 ft above creek bed, however at Sta. 13000 alignment would be 20 to 25 ft above creek.	Relocate road out of flood levels for safety and operations and maintenance
135+00	152+00	Federal BLM	north	Road alignment continues to mimic canyon 15 to 20 ft above creek bed,	Relocate road out of flood levels for safety and operations and maintenance
152+00	152+50	Federal BLM	intersect	Low water crossing to south side of channel	Due to confines of canyon low water crossing only viable alternative.
152+50	158+00	Federal BLM	south	Road alignment continues to mimic canyon 10-15 ft above creek bed on south side of channel	Relocate road out of flood levels for safety and operations and maintenance
158+00	158+50	Federal BLM	intersect	Low water crossing to north side of channel	Due to confines of canyon low water crossing only viable alternative.
158+50	160+00	Federal BLM	north	Road alignment continues to mimic canyon 10 to 15 ft above creek bed,	Relocate road out of flood levels for safety and operations and maintenance
160+00	160+50	Federal BLM	intersect	Low water crossing to south side of channel	Due to confines of canyon low water crossing only viable alternative.
160+50	170+00	Federal BLM	south	Road alignment continues to mimic canyon 10ft above creek bed on south side of channel	Relocate road out of flood levels for safety and operations and maintenance

Table 4.3a continued					
170+00	170+50	Federal BLM	intersect	Low water crossing to north side of channel	Due to confines of canyon low water crossing only viable alternative.
170+50	180+00	Federal BLM	north	Road alignment continues to mimic canyon 10ft above creek bed on north side of channel	Relocate road out of flood levels for safety and operations and maintenance
180+00	220+00	Federal BLM	north	Road alignment continues to mimic creek course 10ft above creek bed on north side of channel.	Relocate road out of flood levels for safety and operations and maintenance
220+00	232+00	Federal BLM	north	Road alignment continues to mimic creek course 10ft above creek bed on north side of channel. Channel would need to be re-aligned through this section to maintain road on north side of channel	Relocate road out of flood levels for safety and operations and maintenance
232+00	253+00	Federal BLM	north	Road alignment continues to mimic creek course 10ft above creek bed on north side of channel.	Relocate road out of flood levels for safety and operations and maintenance
253+00	254+00	Federal BLM	intersect	Low water crossing to south side of channel	Due to channel course low water crossing best alternative, ie lowest impact
254+00	293+00	Federal BLM	south	Road alignment continues to mimic creek course 10ft above creek bed on south side of channel.	Relocate road out of flood levels for safety and operations and maintenance
293+00	294+00	Federal BLM	intersect	Low water crossing to north side of channel	Due to channel course low water crossing best alternative, ie lowest impact
294+00	301+00	Federal BLM	north	Road alignment continues to mimic creek course 10ft above creek bed on north side of channel.	Relocate road out of flood levels for safety and operations and maintenance
301+00	301+50	Federal BLM	intersect	Low water crossing to south side of channel	Due to channel course low water crossing best alternative, ie lowest impact
301+50	315+85	Federal BLM	south	Road alignment continues to mimic creek course 10ft above creek bed on south side of channel to 5-14 site.	Relocate road out of flood levels for safety and operations and maintenance

Table 4.3b Proposed Action Area of Impact for Jack Canyon Access, Alternate 1

Station		Type of Road Construction		Disturbance	
Start	End	(Reference Sections on Figures 5, 6 and 7)	Est. Culvert Number and Size*	Width (feet)	Area (acres)
0	50+00	Hill slope between Sta. 0 and Sta. 5000 is approx. 3-2.5:1. Road grade will be approx. 5%, material consists of thinly bedded shale and sandstone and shallow (<2ft) colluvium	5 - 24 to 36 inch dia.	50	5.74
50+00	66+00	Hill slope between Sta. 5000 and Sta. 6600 is approx. 1.5:1. Road grade will be approx. 5%, material consists of thinly to moderately bedded sandstone w/thinly bedded claystone and shallow (<2ft) colluvium	-	55	2.02
66+00	80+00	Stay above rock ledge (atop nose) hill slope between Sta. 6600 and Sta. 8000 is approx. 2:1. Install 2 - 3 culverts with approx. 15 ft embankment fill	3 - 36 to 48 inch dia.	50	1.61
80+00	135+00	Stay above creek bed on north side of creek approx 40-50, hill slope between Sta. 8000 and Sta. 13500 is varies from approx. 2-1.5:1. Install 4 – 5 culverts with 10 - 25 ft embankment fill each location	5 - 36 to 48 inch dia.	50	6.31
135+00	152+00	Descend to valley bottom at Sta 15200. Hill slope between 13500 and 15200 varies 3-2:1	2 – 24 to 36 inch dia.	55	2.15
152+00	152+50	Concrete apron type low water crossing	-	25	0.03
152+50	158+00	Stay 10 ft above creek bed on south side of creek	-	55	0.69
158+00	158+50	Concrete apron type low water crossing	-	25	0.03
158+50	160+00	Road alignment continues to shadow creek approx 10 ft above creek bed on north side of channel	-	55	0.19
160+00	160+50	Concrete apron type low water crossing	-	25	0.03
160+50	170+00	Road alignment continues to shadow creek 10ft above creek bed on south side of channel	-	55	1.15
170+00	170+50	Concrete apron type low water crossing	-	25	0.03
170+50	180+00	Road alignment continues to shadow creek 10ft above creek bed on north side of channel. Prominent rock ridge need to be shot to straighten alignment and increase width. Large quantity of large boulders for rip-rap and embankment armor	-	55	1.15
180+00	220+00	Road alignment continues to shadow creek 10ft above creek bed on north side of channel. Prominent rock ridge need to be shot to straighten alignment and increase width. Large quantity of large boulders for rip-rap and embankment armor	3 – 24 to 36 inch dia.	55	5.05
220+00	232+00	Road alignment continues to parallel creek course 10ft above creek bed on north side of channel. Channel would need to be re-aligned and confined through this section to maintain road on north side of channel	1 – 36 inch	55	0.15
232+00	253+00	Road alignment continues to parallel creek course 10ft above creek bed on north side of channel.	2 – 36 inch	45	2.17
253+00	254+00	Concrete apron type low water crossing	-	25	0.06

Table 4.3b continued					
254+00	293+00	Road alignment parallels creek course 10ft above creek bed on south side of channel	2 – 36 inch	55	4.92
293+00	294+00	Concrete apron type low water crossing	-	25	0.06
294+00	301+00	Road alignment parallels creek course 10ft above creek bed on north side of channel.	1 – 36 inch	55	0.88
301+00	301+50	Concrete apron type low water crossing	-	25	0.03
301+50	315+85	Road alignment parallels creek course 10ft above creek bed on south side of channel to Site location 5-14.	1 – 24 inch	55	1.81

* Note: Culvert number and size will need to be determined during final design complete with hydrologic analysis.

Table 4.4a. Proposed Action Corridor Improvement and Rationale for Jack Canyon Alternate 2

Station		Land Ownership	Relationship to Existing Road	Recommended Improvement / Mitigation	Reason for Route Deviation / Improvement
Start	**End**				
0	93+25	Federal BLM	new	New alignment	Shorter route, outside WSA predominately southern exposure

WSA – denotes Wilderness Study Area

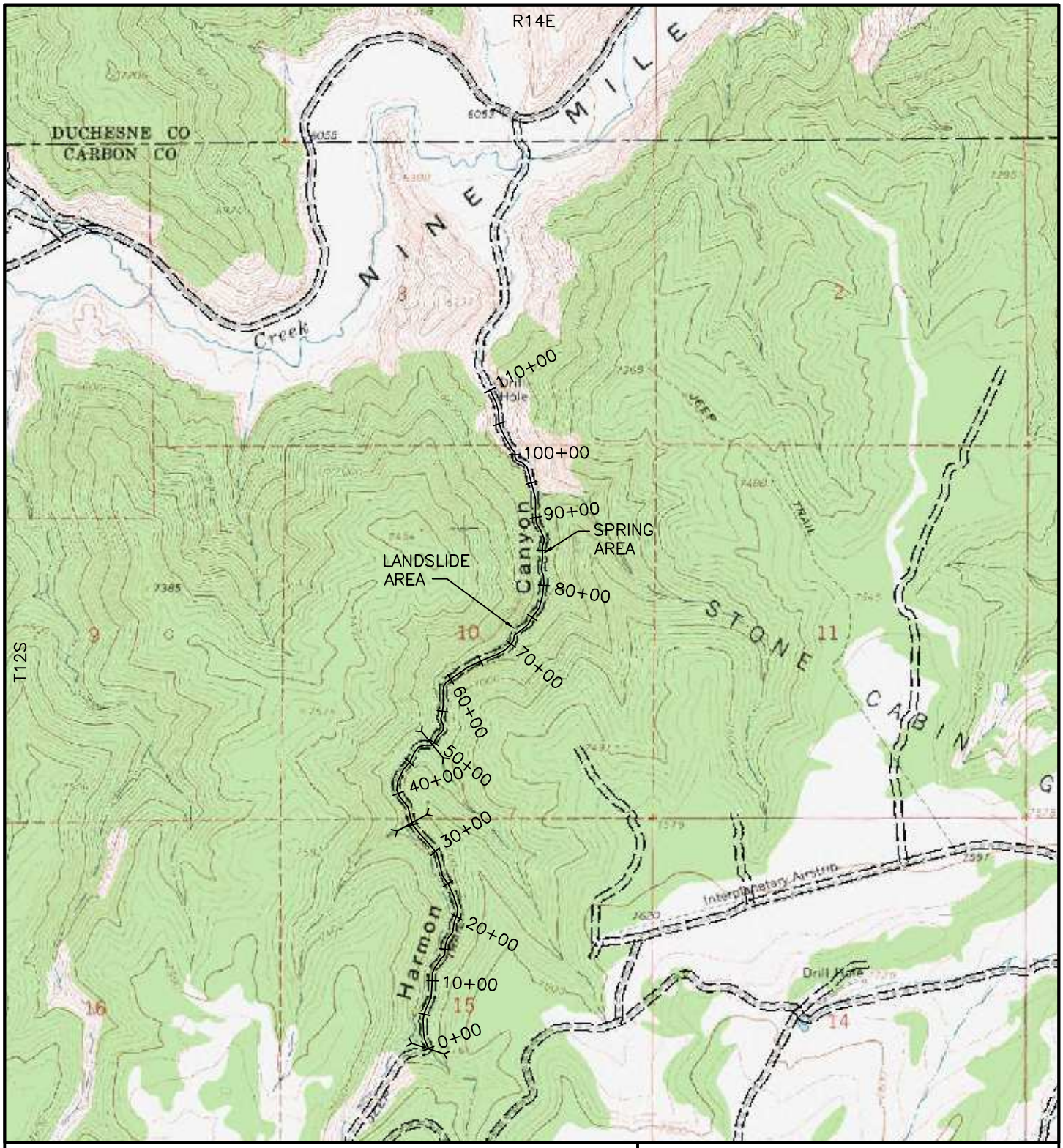
Table 4.4b Proposed Action Area of Impact for Jack Canyon Access, Alternate 2

Station		Type of Road Construction		Disturbance	
Start	**End**	**(Reference Figures 5, 6, and 7)**	**Culvert Number and Size***	**Width (feet)**	**Area (acres)**
0	0	Tie-in with existing road	-	-	-
0	21+00	Hill slope between Sta. 0 and Sta. 2100 is approx. 5:1. Road grade will be approx. 6%, material consists of thinly bedded shale and sandstone and shallow (<2-3ft) colluvium	2 - 24 inch dia.	45	2.17
21+00	25+00	Alignment breaks through prominent ledge rock consisting of very resistive sandstone approx. 25 ft thick.	-	50	0.46
25+00	36+00	Hill slope between Sta. 2500 and Sta. 3600 varies from 1.5:1 to 1:1 to 1.75:1. Road grade will be approx. 8-10%, material consists of thinly bedded shale/claystone and sandstone and shallow (<2-3ft) colluvium	3 - 24 inch dia.	45-55	1.26
36+00	45+00	Hill slope between Sta. 3600 and Sta. 4500 varies from 2:1 to 1.75:1. Road grade will be approx. 10-14%, material consists of thinly bedded shale/claystone and sandstone and shallow (<2ft) colluvium	4 - 24 inch dia.	50	1.03
45+00	52+00	Hill slope between Sta. 4500 and Sta. 5200 varies from 2:1 to 2.5:1. Road grade will be approx. 10-12%, material consists of thinly bedded shale/claystone and mod. bedded sandstone and shallow (<2ft) colluvium	3 – 24 inch dia.	55	0.88
52+00	66+00	Hill slope between Sta. 5200 and Sta. 6600 varies from 2:1 to 3:1. Road grade will be approx. 10-12%, material consists of thinly bedded shale/claystone and mod. bedded sandstone and shallow (<2ft) colluvium	2 – 24 to 36 inch dia.	50	1.61
66+00	66+50	Concrete apron low water crossing	-	30	0.03
66+50	72+00	Alignment on south side of channel on approx. 10 ft road embankment above stream bed for flood protection. Road grade approx 6-7%.	-	45	0.57
72+00	72+50	Concrete apron low water crossing	-	30	0.03
72+50	80+00	Alignment on north side of channel on approx. 10 ft road embankment above stream bed for flood protection. Road grade 6-8%.	2 – 36 inch dia.	35	0.60
80+00	92+00	Alignment on north side of channel approx. 15 to 20 ft above stream bed for flood protection.	2 – 24 to 36 inch dia.	45	1.24
92+00	93+25	Alignment ramps down and ties in with lower segment of Alternate 1		40	0.11

* Note: Culvert number and size will need to be determined during final design complete with hydrologic analysis.

Table 5.1 West Tavaputs Plateau Proposed Access Road Land Requirements

Access Road	Land Ownership	Estimated Area of Access Construction Impact (acres)	Abandoned Access Reclamation Area (acres)
Harmon Canyon	100% BLM	0.3	0
Horse Bench	95% BLM 5% State	0.6 – 1.5	0.4
Flat Iron Alternate 1	100% BLM	7.5	7 - 7.5
Flat Iron Alternate 2	72% State 28% BLM	11 – 11.5	7 - 7.5
Jack Canyon Alternate 1	82% BLM 18% State	36 – 36.5	6 - 7
Jack Canyon Alternate 2	100% BLM	10 – 10.5	6 - 7



SCALE

2000 0 2000 FEET

N

UTAH

PROJECT LOCATION

LEGEND:

PROPOSED CULVERT LOCATION

SOURCE:
–USGS TOPOGRAPHIC MAP, IN SCANNED JPEG FORMAT.

BILL BARRETT CORPORATION

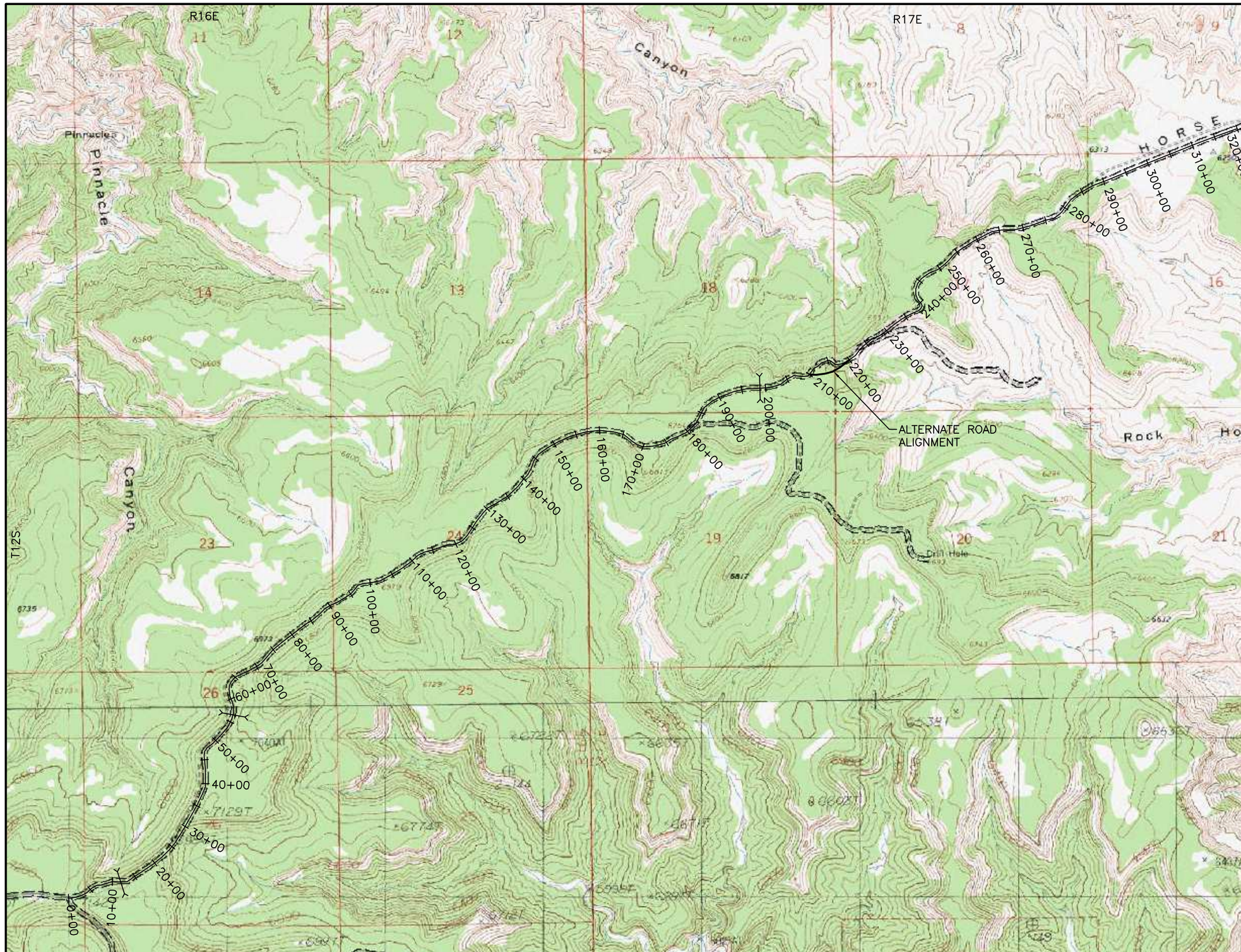
ACCESS ROAD ASSESSMENT

FIGURE 1

HARMON CANYON ROAD

PROJECT: 30–20–06	DATE: JANUARY 2007	
REV: 2	BY: SCG	CHECKED: JPF

GOLDEN ENGINEERING GROUP, LLC



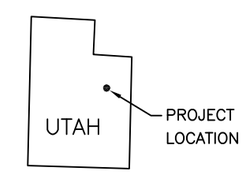
LEGEND:

PROPOSED CULVERT LOCATION

N

SCALE

2000 0 2000 FEET



SOURCE:
–USGS TOPOGRAPHIC MAP, IN SCANNED JPEG FORMAT.

BILL BARRETT CORPORATION

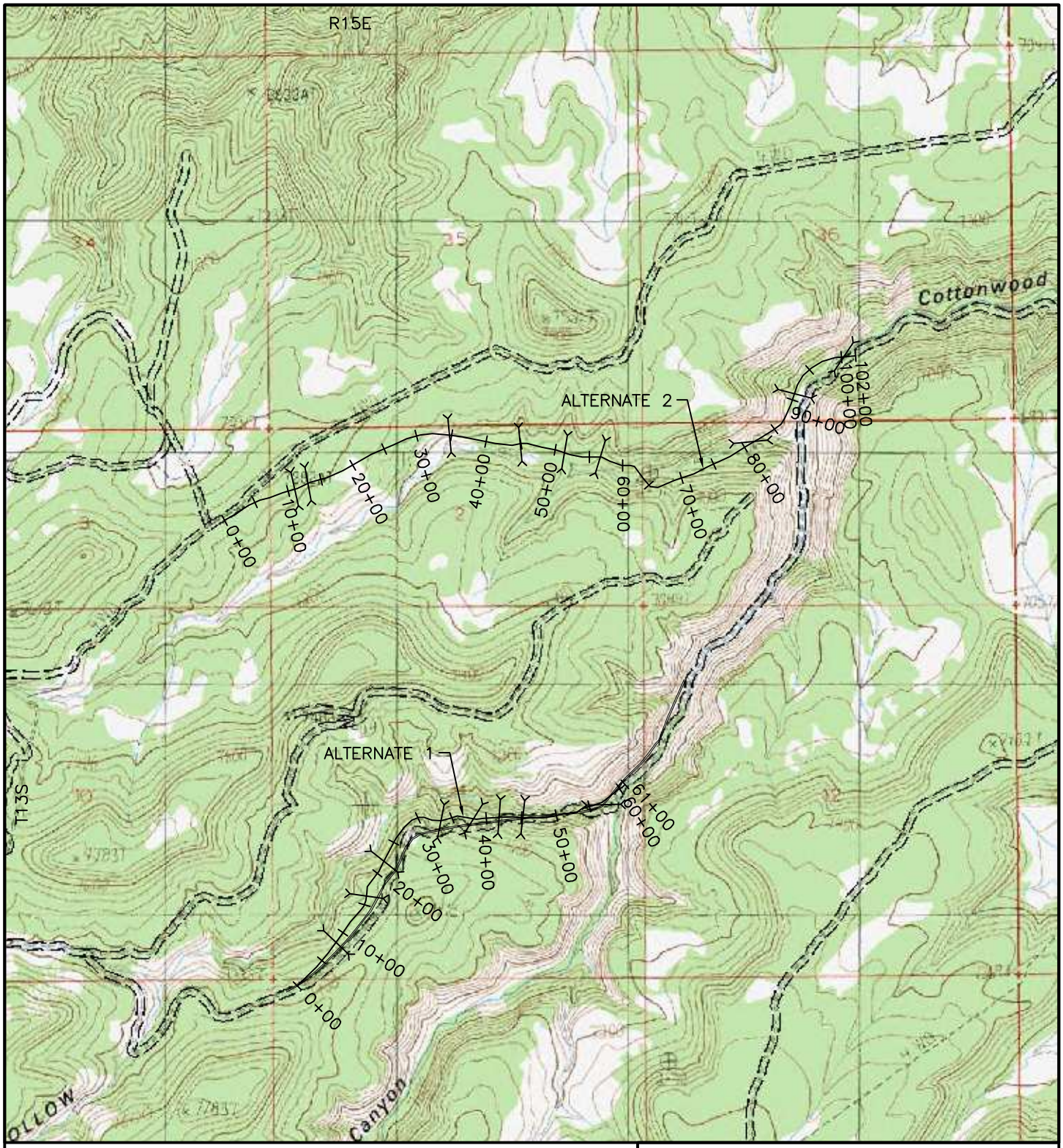
ACCESS ROAD ASSESSMENT

FIGURE 2

HORSE BENCH ROAD

PROJECT: 30–20–06	DATE: JANUARY 2007	
REV: 2	BY: SCG	CHECKED: JPF

GOLDEN ENGINEERING GROUP, LLC



SCALE

2000 0 2000 FEET

N

UTAH

PROJECT LOCATION

LEGEND:

PROPOSED CULVERT LOCATION

SOURCE:
–USGS TOPOGRAPHIC MAP, IN SCANNED JPEG FORMAT.

BILL BARRETT CORPORATION

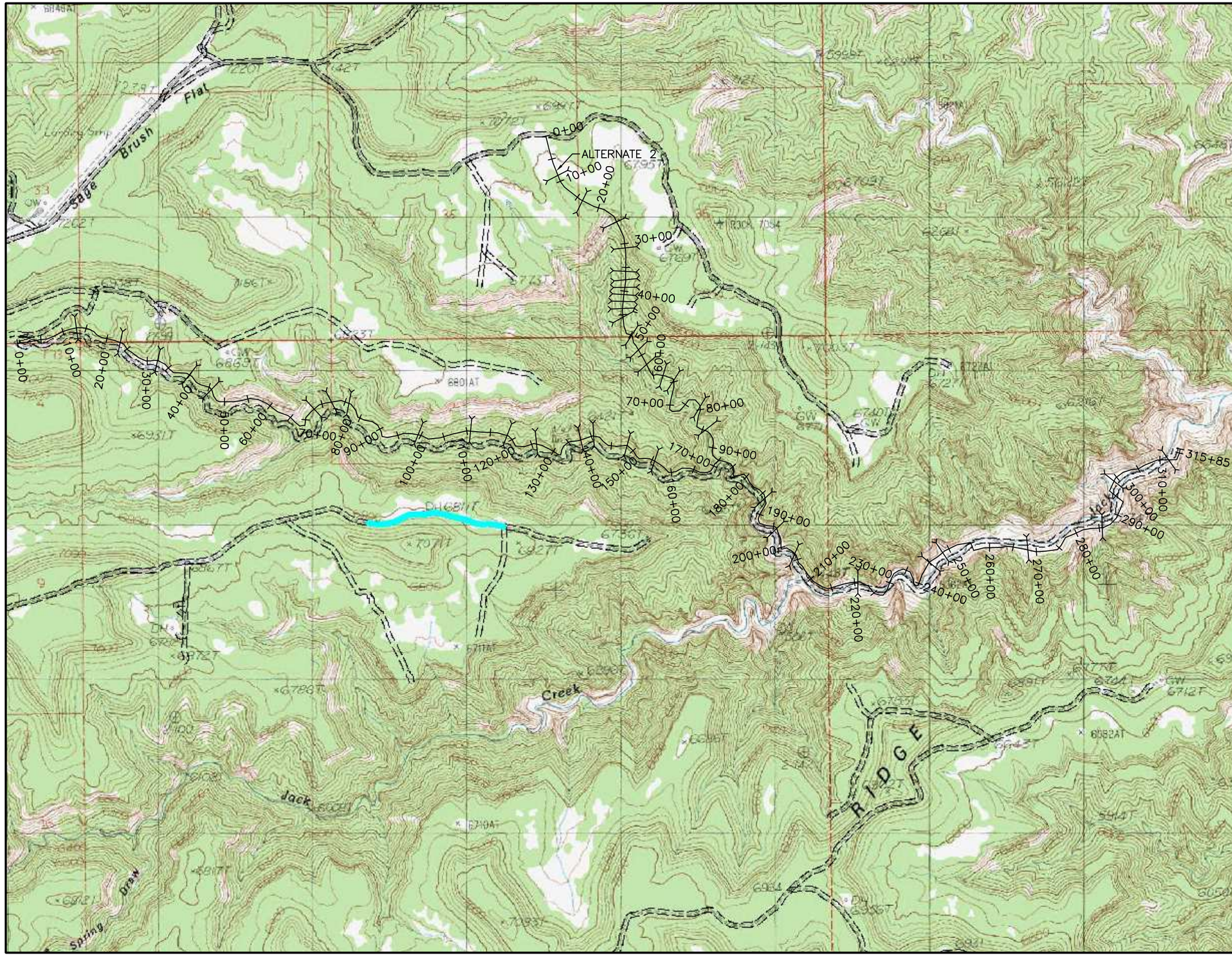
ACCESS ROAD ASSESSMENT

FIGURE 3

FLAT IRON MESA ROAD

PROJECT: 30–20–06	DATE: JANUARY 2007	
REV: 2	BY: SCG	CHECKED: JPF

GOLDEN ENGINEERING GROUP, LLC



LEGEND:

PROPOSED CULVERT LOCATION

N

SCALE

2000 0 2000 FEET

UTAH

PROJECT LOCATION

SOURCE:

–USGS TOPOGRAPHIC MAP, IN SCANNED JPEG FORMAT.

BILL BARRETT CORPORATION

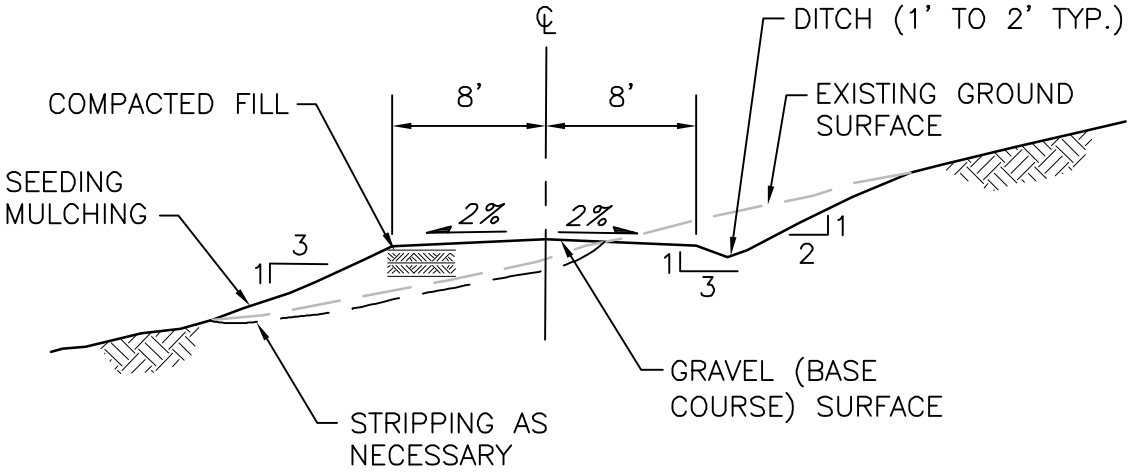
ACCESS ROAD ASSESSMENT

FIGURE 4

JACK CANYON ROAD

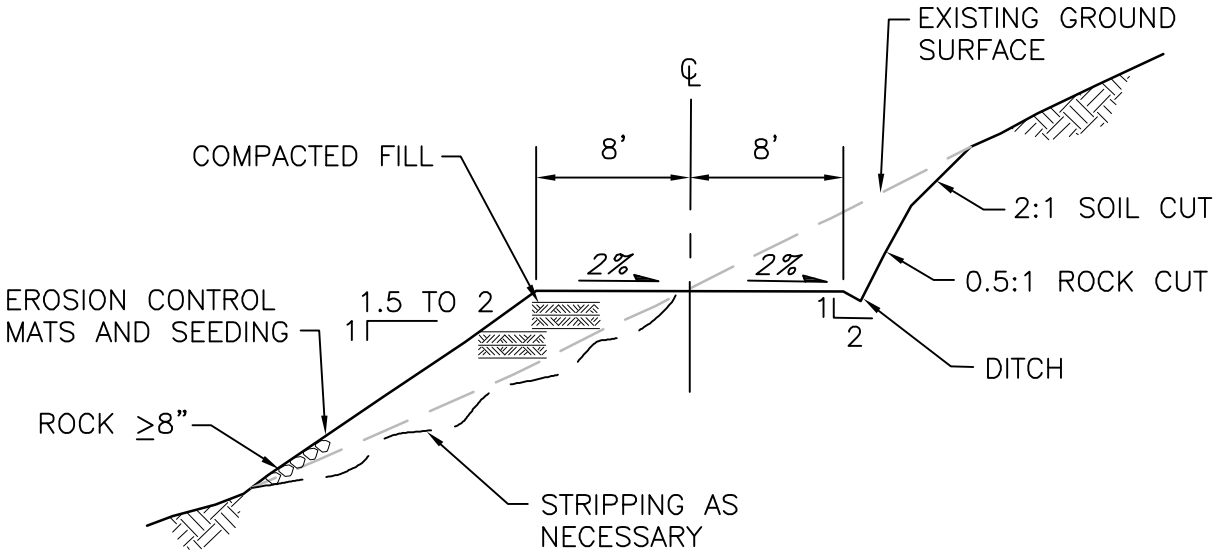
PROJECT: 30–20–06	DATE: JANUARY 2007	
REV: 2	BY: SCG	CHECKED: JPF

GOLDEN ENGINEERING GROUP, LLC



TYPICAL ROAD SECTION RELATIVELY LEVEL TERRAIN

APPROXIMATE SCALE
1" = 10'



TYPICAL ROAD SECTION ON STEEP HILLSIDE

APPROXIMATE SCALE
1" = 10'

SLOPE AND DISTURBANCE TABLE	
EXISTING GROUND SLOPE	DISTURBANCE WIDTH
LEVEL TO ≤20% (5:1)	25 FT. TO 40 FT.
>20% ≤ 50% (5:1 TO 2:1)	40 FT. TO 60 FT.
>50% ≤ 100% (2:1 TO 1:1)	40 FT. TO 70 FT.
CULVERT CROSSING (CHANNEL SLOPE = 10% TO 30%)	50 FT. TO 80 FT.

BILL BARRETT CORPORATION

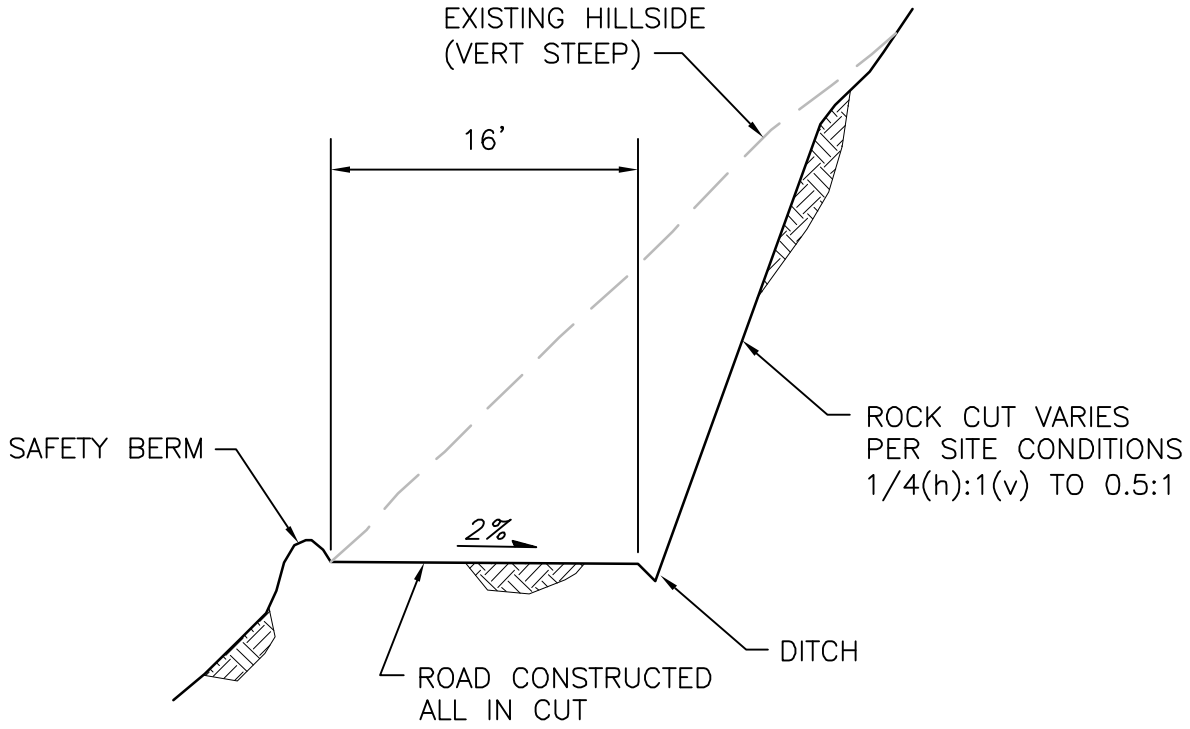
ACCESS ROAD ASSESSMENT

FIGURE 5

TYPICAL ROAD SECTIONS

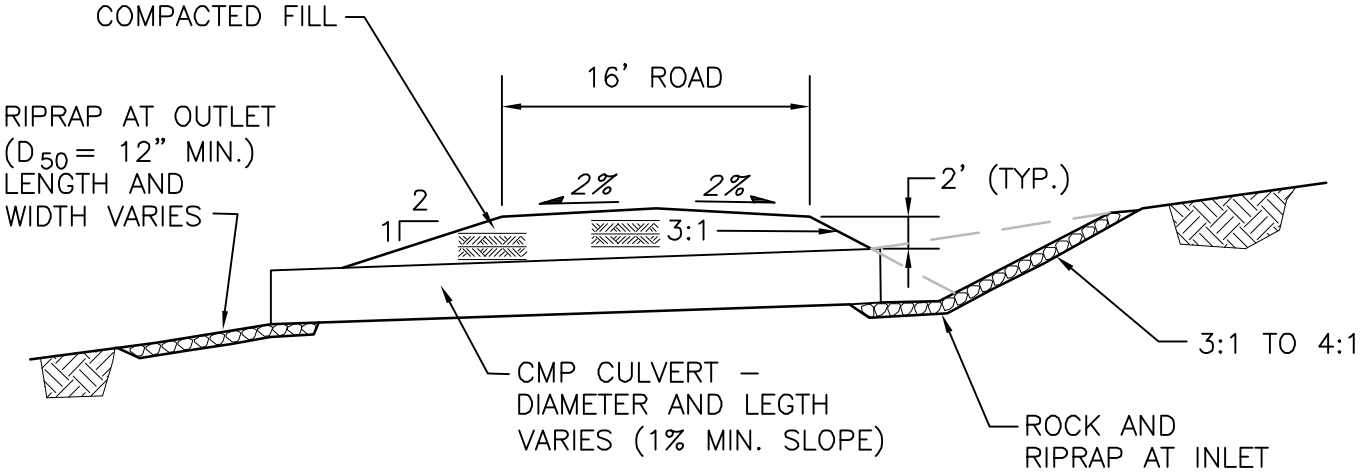
PROJECT: 30-20-06	DATE: JANUARY 2007	
REV: 2	BY: SCG	CHECKED:JP/JR

GOLDEN ENGINEERING GROUP, LLC



TYPICAL ROAD SECTION ON VERY STEEP HILLSIDE

APPROXIMATE SCALE
1" = 10'



TYPICAL ROAD SECTION AT DRAINAGE CULVERT

APPROXIMATE SCALE
1" = 10'

SLOPE AND DISTURBANCE TABLE	
EXISTING GROUND SLOPE	DISTURBANCE WIDTH
LEVEL TO ≤20% (5:1)	25 FT. TO 40 FT.
>20% ≤ 50% (5:1 TO 2:1)	40 FT. TO 60 FT.
>50% ≤ 100% (2:1 TO 1:1)	40 FT. TO 70 FT.
CULVERT CROSSING (CHANNEL SLOPE = 10% TO 30%)	50 FT. TO 80 FT.

BILL BARRETT CORPORATION

ACCESS ROAD ASSESSMENT

FIGURE 6

TYPICAL ROAD SECTIONS

PROJECT: 30-20-06	DATE: JANUARY 2007	
REV: 2	BY: SCG	CHECKED:JP/JR

GOLDEN ENGINEERING GROUP, LLC

Appendix F-4

West Tavaputs Plateau Evaluation of Select Roads

West Tavaputs Plateau
Analysis of Select Roads
August 2007

INTRODUCTION

On August 13 and 14, 2007 the Bureau of Land Management (BLM) and Buys & Associates (B&A) spent two days analyzing select roads within the West Tavaputs Plateau in preparation for publication of the DEIS. BLM representatives included Don Stephens, Casey Matthews, and Brad Higdon while B&A were represented by Tyler Ashcroft.

The selected roads included Cottonwood Canyon Road, Harmon Canyon Road, Cottonwood Dugway to Peter's Point, Cedar Ridge Road, Dugway to Flat Iron Mesa, Dry Canyon Road, Jack Canyon Road, Horse Bench Road, Cottonwood Spur Road, and Bruin Point.

Design standards of BLM roads are provided in BLM Manual 9113 which specifically establish geometric standards for design speed, travel way width, and maximum grade. The Manual also sets maximum cut and fill slopes in mountainous terrain at 1.5:1. One of the main objectives of the analysis was to compare allowing variances from the design standards to the impacts of bringing all proposed local and collector roads into compliance for width, grade, and side slope requirements.

DISCUSSION

The majority of the roads on the West Tavaputs Plateau are existing BLM resource roads. Prior to full-field development, these roads are anticipated being upgraded to local or collector roads, which will increase the minimum travel width, reduce the design grade, and provide for drainage control due to the increased geometric standards associated with the newly assigned road classifications.

Specific details of each road analyzed are discussed in attachment 1 of this report. In general, some roads do not meet existing design standards by exceeding design grades for local and collector roads, and due to the reclassification caused by an increase of the estimated average daily traffic (ADT) under full-field development, the roads will now require an increased travel width design standard of 20 feet minimum. Placing more stringent design requirements on the typical road does not come without consequences. For example, since the roads are generally providing access from the canyon bottom to the plateau through areas with very steep slopes, staying within the 12 percent to 15 percent grade can not be accomplished in all areas without the installation of switch backs. Because some roads traverse side slopes which are naturally at a 1:1 slope, the installation of switch backs would essentially make a cut scar or escarpment out of the entire hillside since a 1.5:1 cut slope will not daylight on the 1:1 natural repose of the hillside. This situation forces the choice between large visual and resource disturbances

or allowing variances of specific geometric standards outside the limits set forth in BLM Manual 9113.

Every effort should be made to comply with the road design standards and a variance to the standards should only be granted when it is determined, through the analysis of the environmental impacts that the resource damage incurred by complying with the grade and side slope requirements outweighs the advantages of compliance. Each specific request for a variance should be proposed by the operators with an analysis of the associated impacts. Safety concerns should be addressed in each proposal and any possible liability should be assumed by the operators. This protocol should be established in a formal document and signed by all parties involved.

ANALYSIS

The three main design requirements in the BLM Manual 9113 that would result in significant excavation (large volumes of cut) are grade, travel way width, and side slopes in cut and fill areas. Each of these elements has an affect on the other. Therefore, variance to these standards should be considered. In order to relieve grades over 14 percent for local roads and 12 percent for collector roads, some areas would require the construction of switch backs. Once switch backs are cut, the maximum allowable side slope from the bottom of the cut up or the top of the fill down is 1.5:1. When this is attempted in areas where the natural slope of the hill side is 1:1, meeting standards could require removal of material to the top of the hill. This would result in large amounts of material being excavated from the hill side to remove approximately 2 to 4 percent grade in a section of road that may only exceed BLM standards for a short distance. Meeting travel width standards in areas where the natural slow is approximately 1:1 could also require extensive excavation. For example, if a section of road is approximately 16 feet wide, an additional 4 feet of width would be needed to meet the minimum 20 foot width requirement for local and collector roads. If a variance were granted to the side slope requirements, the amount of excavation will be significantly less; however the side slopes would be nearly vertical.

Many of the roads on the West Tavaputs Plateau are roads that were developed out of use and therefore, have no formal design standards. User defined routes that are parts of Utah BLM's transportation system are intended to be used primarily for BLM administrative purposes. Public safety on user defined routes is addressed on a case by case basis. However, once a road is designed and constructed to a defined standard, BLM has effectively incorporated the safety of the user into the design. Therefore, BLM should consider safety of the user in the analysis of any proposed variance to the 9113 standards.

In general, BLM roads are for use, development, protection, and administration of public lands and resources, and though administered by the BLM and generally open to use by the public, are not public roads. Once these roads have been designed and upgraded to BLM Manual 9113 standard, consideration for the safety of the user should be analyzed. The proposed improvement of these roads is for natural gas extraction. The BLM should

ensure that an interdisciplinary route selection team reviews each route proposal and any associated requests for variance from BLM Manual 9113 standards prior to approval.

If BLM allows a variance from the Manual 9113 standards, they should be selective on which requirements they are removing. For example, if the operator is allowed to exceed the maximum side slope criteria (approximately 1.5:1), than there is no justification for allowing the roadway width to be less than the minimum standard. Making all the roads at least 20 feet wide will improve safety. Roads should be wide enough for two haul trucks to pass at any point on the road. Meeting the 20 foot minimum travel way width requirement is the design requirement from BLM Manual 9113 that would cause the least amount of excavation if BLM were to allow a variance to cut and fill slope requirements in some areas.

RECOMMENDATIONS

The proposal for full-field development of the West Tavaputs Plateau will require the operator(s) to improve or upgrade the existing access roads in the area to local and collector road standards in accordance with BLM Manual 9113. In doing so, it is anticipated that the operator(s) may apply for a variance to the standards on some sections of road to avoid additional excavation. The BLM should analyze these proposals on a case by case basis to ensure they are in compliance with the approved environmental documents. In addition, the analysis should consider the safety of the user, maintenance of the roads throughout the life of the project (LOP), and the reclamation or acceptance of each route at project completion.

Attachment 1

Harmon Canyon Road

The Harmon Canon Road presents some of the biggest construction challenges in the WTP Project Area. As with many of the roads, the Harmon Canyon Road provides access to the plateau through a very narrow canyon with steep slopes on both sides of the creek that runs out the canyon bottom. Based upon anticipated traffic volumes, Harmon Canyon Road has been classified as a collector road. The problems associated with this road include excessive grades, narrow travel width, and steep side slopes. The narrowest width of the current travel surface is approximately 14 feet. The road width could be increased to the desired 20 feet minimum in most cases; however, increasing the road width and keeping the cut and fill slopes to less than 1.5:1 could result in excessive earth work. The maximum grade allowed by BLM Manual 9113 may be exceeded in a few areas by approximately 2 to 4 percent. To remedy the narrow travel way and steep grades under current conditions, spotters have been placed at both top and bottom of the steep narrow section to allow only one vehicle on the road at a time thus eliminating the safety concern of passing vehicles in this section.

With significant construction, or re-construction, the Harmon Canyon Road can be greatly improved by widening the narrow sections and attempting to provide constant grade on the roadbed above and below sections where the grade is excessive. In addition, drainage controls needs to be installed to remove runoff from the in-sloped road at intervals frequent enough to prevent clogging of the ditches.

Cottonwood Canyon Road

The Cottonwood Canyon Road, from Nine Mile Canyon Road to approximately 3.8 miles up the canyon is in good condition with the exception of the drainage structures. From approximately 3.8 miles to the Cottonwood Dugway to Peter's Point, the road has a few narrow sections that are constrained between the steep side slopes of the canyon and Cottonwood Creek. In addition to drainage improvements, this section of road will need widening in select locations, but could be improved to acceptable standards.

Dugway to Flat Iron Mesa

From the base of the dugway to Peter's Point (approximately 6.6 miles from Nine Mile Canyon Road) to Flat Iron Mesa the road is very steep with grades near 20 percent. In addition, there are some site distance issues. Alternative routes have been proposed to lessen the grade and improve the general road condition. Alternative 1 includes a slight realignment of approximately 6,000 feet of the existing route. This would bring the grades into acceptable limits but would include new surface disturbance. Alternative 2 would include a new section of road up the canyon to the north of the existing route and would be approximately 10,000 feet in length. Either alternative could improve the upper portion of the Cottonwood Canyon Road to acceptable standards; however, Alternative 1 would result in less surface disturbance and less visual impacts.

Dugway to Peter's Point

The dugway to Peter's Point has a relatively constant grade, which is near 20 percent. In addition to the steep grade, there are a few horizontal curves that are relatively tight for long vehicles and the existing hillside is steep which will make upgrades challenging.

An alternate to accessing the Peter's Point is via the Cottonwood Spur Road, which leads to the same general location without forcing traffic through the Sage Brush Flat area. The Cottonwood Spur has similar issues to the dugway; however, the travel way is wider and the horizontal curve issues are eliminated. This would be a great alternative to the dugway to Peter's Point and though it would be a challenge, the issues could be overcome with less excavation.

Horse Bench

The Horse Bench Road, with a few exceptions, is level. Therefore, grade issues are not significant. Within the first mile of the road there are a few sections where width is an issue; however, the issue could be resolved without excessive excavation or significant visual impacts. At approximately 4 miles, the Horse Bench Road climbs a dugway to reach the top of the bench. This section would have to be relocated to lessen the grade to acceptable limits. Width would also need to be increased in this particular section. Since the majority of the Horse Bench Road is located on the plateau operators should be able to comply with all requirements of BLM 9113 Manual. The Horse Bench Road needs to be in-sloped and constructed with appropriate drainage structures. Though significant construction efforts would be involved, the Horse Bench Road could be upgraded to a collector road standard without causing excessive disturbance.

Cedar Ridge Road

Current issues on the Cedar Ridge Road include steep grades, narrow road widths, and inadequate drainage structures. The road has not been maintained in the recent past, and in its current condition, would be classified as a primitive road since a high clearance vehicle is required for driving it. The beginning and ending sections of Segment 1 of the Cedar Ridge Road, which runs from the beginning of the road to ridge, need to be slightly realigned with a constant slope in order to bring the approximately 17 percent grade into acceptable limits. The remainder of road presents no significant problems or design issues. This road could be upgraded to a local road standard without excessive excavation through grading, correcting horizontal curves, and providing drainage control.

Jack Canyon Road

The first portion of the Jack Canyon Road (approximately 0.5 miles) which leads to the existing drill pad could be improved to meet the BLM standards for road construction as a local road. These improvements would require grading and the installation of drainage ditches and culverts to convey storm water off the travel surface.

The remainder of the Jack Canyon Road, approximately 6 miles, follows the canyon bottom down to proposed well locations near the bottom of Jack Canyon. There exists very little evidence of an existing route since Jack Canyon conveys significant storm water runoff, which has repeatedly scoured the canyon bottom leaving washouts and very large boulders exposed. The operator is proposing two alternatives for the construction of the Jack Canyon Road. The first alternative is to construct the road down the alignment of the existing drainage and the second alternative is to construct the road down the drainage immediately to the north of Jack Canyon. After approximately 3 miles the roads would converge. The remainder of the proposed road would follow Jack Creek to the last well location. The most significant challenge associated with the construction of the Jack Canyon Road will be the removal of large boulders and, in some areas, the removal of portions of rock ledge which will be required to keep the proposed alignment out of the canyon bottom. Preliminary road design will be required to further analyze the alternatives for the Jack Canyon Road.

Dry Canyon Road

Dry Canyon Road has been classified as a local road based on the number of proposed wells. The Dry Canyon Road intersects with Nine Mile Canyon Road and is constrained between a buried 12 inch diameter natural gas pipeline, which parallels Dry Creek, and cliffs on the other side. Efforts to upgrade this road to a local road standard would be significant and in some areas may involve either relocating the natural gas pipeline or blasting rock to increase the travel width.

Bruin Point Access (Alternative)

The Bruin Point route is one of the least developed roads in the area and has the same design challenges as the majority of the roads on the West Tavaputs Plateau. These challenges include steep grades, narrow travel widths, short sight distances, steep side slopes, and tight horizontal curves. Consideration for this route as an alternative access to the WTP Project Area would require extensive design and construction operations to accommodate the size and number of vehicles accessing the project. For the Bruin Point route to be an access to the WTP Project Area, the majority of the existing route would have to be realigned to facilitate the larger turning radius and increased sight distances needed for the haul trucks and other equipment. This would result in significant visual damage from cut and fill slopes, especially in the areas of the existing switch backs and excessive grades. As for the other critical design elements of travel width and side slopes, these criteria could not be satisfied in accordance with BLM Manual 9113 without significant visual resource damage and extensive construction operations. In addition to the above mentioned design and construction challenges, maintaining this route during the winter months at elevations that exceed 10,000 feet would be a daunting task.