

Exhibit 18

**Environmental Impact Report, Appendix E
to Berlaimont Variance from Improvement
Standards, submitted to Eagle County
July 2013**

Environmental Impact Report

Proposed Berlaimont Road Variance from Improvement Standards Application

July 2013

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1.0 OVERVIEW OF DEVELOPMENT PROPOSAL

1.1 INTRODUCTION

In July 2013, Berlaimont Estates, LLC (The Applicant) submitted a request for a variance to Eagle County. The “Berlaimont Estates/Berlaimont Road Variance from Improvement Standards Application” (VIS Application) seeks Eagle County approval to construct a road to access a future residential development within its 680 acres of privately owned land. As indicated in the VIS Application, the road has been designed largely to County standards; however, due to the unique nature of public/private jurisdictional boundaries in the project area, compounded by topographical constraints, the Applicant has identified the need for several variances from the Eagle County Land Use Regulations (ECLUR). These variances fall into three categories: 1) Road Design Standards; 2) Emergency Vehicle Turnaround Areas; and 3) Dual Access.

Eagle County has requested that an Environmental Impact Report (EIR) be prepared according to Section 4-460 of the ECLUR. Therefore, this report represents the requested EIR and details the potential direct, indirect and cumulative impacts of the proposed road. While Chapter 3 includes the Environmental Inventory and Analysis, by resource, specialists’ reports that were prepared specifically for this project are attached in their entirety (see appendices).

1.2 PROJECT DESCRIPTION

In 2011, the Applicant exercised its legal right to plat this private land into 19 individual lots (each 35 acres in size or greater) for development of a low-density, year-round residential community. As such, development of the private property into a viable residential community requires year-round vehicular access across National Forest System (NFS) lands administered by the White River National Forest (WRNF). Figure 1 depicts the existing conditions of the private land in reference to surrounding WRNF lands.

As proposed, the Berlaimont Road would be a paved (asphalt) surface, with intermittent turnouts for emergency vehicles that meet the requirements of the Eagle River Fire Protection District. The road would be privately maintained for year-round residential access by a homeowners association, and because it crosses NFS lands, would be open to the public to accommodate existing recreational opportunities.

Using Table 4-620 J of the Eagle County Land Use Regulations (ECLUR), the appropriate design standard for this roadway is a Type V Rural Minor Collector within a terrain classification of “mountainous.” As defined in Section 4-620.D.2 of the ECLUR:

“Rural minor collectors serve as intra-county roads of moderate length connection residential areas to commercial and industrial areas and to major collectors within Resource zone districts that handle traffic volumes up to four hundred (400) vehicles per

day. They may also traverse great distance. Design and posted speeds range from twenty (20) to forty (40) mph, depending on terrain. Surfaces are treated gravel or pavement, depending on traffic volumes. Access to adjacent properties is limited and may require turn lanes, depending on traffic volumes. Intersection spacing ranges from six hundred (600) feet when speeds are at or above thirty-five (35) mph, to three hundred (300) feet at design speeds below thirty-five (35) mph. On-street parking on such roads is prohibited and off-street parking must be specifically provided for.”

Basic standards within the Type V Rural Minor Collector classification include:

- 10-foot travel lanes
- 3-foot shoulders
- 20 mph design speed
- 10% maximum grade
- 80-foot minimum switchback radius

Alpine Engineering, working on behalf of the Applicant, has prepared a detailed preliminary design for the Berlaimont Road, based on the above parameters. As planned, the Berlaimont Road is 5.3 miles in length and utilizes portions of two existing Forest System Roads (FSR): 774 (Berry Creek Road) and FSR 780—both of which would be improved to meet Eagle County’s Rural Minor Collector standard. In order to minimize potential resource impacts from construction and long-term use of the Berlaimont Road, preliminary mitigation measures, best management practice (BMP) and Project Design Criteria (PDC) have been considered, and are included in Table 2-1. At this point, the road terminates at a cul-de-sac at a point north of the property line, in between the east and west “legs” of the private parcel (reference Figure 2). Upon platting the inholding into 19 lots, each 35 acres in size, individual homes would be concentrated in the northern portions of the inholding and the road would be extended or driveways established, as appropriate, to provide access to individual homes.

A grading permit from Eagle County is required for construction of the proposed road (for segments that are on both NFS and private lands) and approval of a permanent road easement across public lands from the WRNF is required before a road can be constructed (see Section 1.4 – Other Reviewers). Based on the road design, the Applicant has requested several variances from the Eagle County Land Use Regulations. Specifically, the variance request relates to three issues:

- Dual Access (ECLUR 4-620J.1.h);
- Emergency Vehicle Turnaround Areas (ECLUR 4-620.D.10.d); and
- Road Design Standards (ECLUR 4-620).

As previously noted, public access to, and use of, FSRs 774 and 780 would not change with this proposal—the only difference being that portions of these existing roads would become paved/improved. Public access would be accommodated through a reciprocal agreement between Berlaimont Estates, LLC and the WRNF. The general public would retain access to the roads for seasonal motorized and year round non-motorized use on NFS lands (consistent with the current seasonal closures). Gates would be provided where necessary to limit public motorized access outside of current seasonal accommodation, and to prohibit the public from using private roads throughout the developed portions of the Inholding.

1.3 PROJECT AREA

The “project area” as used through this EIR, is located north of the I-70 Edwards interchange (see Figures 1 and 2), in sections 20 and 29 Township 4 south, Range 82 West, in Eagle County. The 680 acres of land constitutes an “inholding” that is entirely surrounded by NFS lands managed by the WRNF. As indicated in the 2002 WRNF Land and Resource Management Plan (Forest Plan), NFS lands in the vicinity of the private inholding are within two Management Areas (MAs): MA 5.41—Deer and Elk Winter Range and MA 8.32—Designated Utility Corridors. Thus, the project area includes the 680 acres of private land, and surrounding NFS lands managed by the WRNF, including FSRs 774 and 780.

Seasonal access to, and through, the inholding is currently possible via an unpaved network of Forest System Roads across public lands managed by the WRNF. FSR 774 (Berry Creek Road) starts at the County roadway behind the Moonridge Subdivision. A small segment of FSR 774 is located on an easement across private lands behind the Moonridge Subdivision. FSR 780 provides access to, and beyond, the inholding off of Berry Creek Road. Consistent with MA 5.41, FSR 774 is subject to a seasonal (winter) motorized closure.

1.4 OTHER REVIEWERS

Access to private inholdings across federal lands is addressed in the Alaska National Interest Lands Conservation Act (ANILCA) of 1980. ANILCA is not limited to the State of Alaska but has nation-wide application to NFS lands. Per ANILCA, the WRNF is obligated to “...provide such access to non-federally owned land within the boundaries of the National Forest System...to secure the owner reasonable use and enjoyment thereof...” (16 USC 3210, Title I, §1323).

Access to the private inholding is only possible by crossing public lands managed by the WRNF. Thus, beyond Eagle County review of the VIS Application, the WRNF has ultimate say over if and how public lands under its jurisdiction are used. Thus, beyond County approval for a grading permit to construct an access road to a Rural Minor Collector Road standard (including the requested variances), the WRNF will need to perform a thorough analysis of any proposal to utilize Forest System Roads or NFS lands to access the inholding under the National Environmental Policy Act (NEPA).

Per the NEPA process, a site-specific and detailed environmental analysis will be performed on the Berlaimont Road proposal. Once the WRNF initiates an analysis under NEPA, the public (including local and state entities) will be given the opportunity to provide input on the proposal, as well as to remain involved throughout, including the opportunity to comment on draft documentation. Based on identified issues (i.e., impacts to the human, physical and biological environment) alternative methods of meeting the Applicant's year-round residential access needs will be considered and potentially pursued. Because the WRNF has ultimate jurisdiction over the public lands which it administers, additional design criteria, best management practices, and mitigation measures related to road design and use may be identified and imposed via the NEPA process.

1.5 ALTERNATIVES CONSIDERED

Technically, there are multiple options for meeting the year-round residential access needs of the Applicant. However, the fact that the inholding is surrounded by NFS lands complicates, and constrains, access options. Crossing public lands to reach the inholding precludes "dual access" (as requested by Eagle County) and thus a single point of entry is the only feasible way in which it can be accessed by year-round residents of the future development.

Figure 2 of the VIS Application depicts various road segments that were considered in conjunction with this proposal. Alternatives that were eliminated from further analysis were done so because of numerous logistical and resource issues including, but not limited to: constructing the road up steep side-slopes that would have required numerous switchbacks and retaining walls and cuts/fills, visual impacts, and technical feasibility.

2.0 MITIGATION MEASURES, BEST MANAGEMENT PRACTICES & PROJECT DESIGN CRITERIA

In order to minimize potential resource impacts from construction and long-term use of the Berlaimont Road, the mitigation measures, best management practice (BMPs) and Project Design Criteria (PDCs) detailed in Table 2-1 have been incorporated into the proposal pursuant to Section 4-460 of the ECLUR. Note that these are both site-specific and routine methods of minimizing and avoiding impacts on a resource-by-resource basis. Because the majority of the Berlaimont Road will be constructed on NFS lands, the WRNF will have ultimate say over the final package of mitigation measures, BMPs and PDCs. Therefore, this list may, and likely will, be adjusted over the life of the project, particularly as the proposal undergoes site-specific NEPA analysis.

Table 2-1. Mitigation Measures, BMPs, and PDCs

HYDROLOGY AND SOILS
Cut and fill slopes should be approximately 1.5 to 1 (horizontal to vertical) in soil and stable foundation, and 1 to 1 in rock cut slopes.
Cut and fill slope erosion will be controlled by revegetation or other means, including surface netting and mulching. Draped woven wire nets may be needed to control surficial slope ravel on some of the higher rock cuts.
Soil-disturbing activities would be avoided during periods of heavy rain or wet soils.
Slope reinforcement or retaining walls will be utilized in areas where the appropriate slope (1.5 to 1 or 1 to 1) cannot be achieved.
Check dams and sediment barriers (i.e., silt fence, weed-free hay bales, wattles, etc.) will be placed in all temporary erosion channels to control runoff velocity and encourage sediment deposition.
In areas where site conditions necessitate (i.e., excessively steep slopes and/or highly erosive soil types), temporary sediment detention basins will be created to detain runoff and trap sediment. Sediment basins will be created within the overall disturbance limits of the applicable project elements. Temporary sediment basins will be reclaimed following reestablishment of permanent vegetation and will likewise be revegetated.
On slopes in excess of >30% (slope gradient), jute-netting or other appropriate geo-textiles will further stabilize disturbed soils.
Temporary water bars (12 to 18 inches deep) and cross-drains can be used to disperse road surface runoff.
The Applicant will likely need to prepare and submit, for Forest Service approval, the following documents: • Project construction and grading plans • Pre-construction erosion control/drainage management plans • Pre- and post-construction noxious weed control plans • Post-construction erosion control plans • Post-construction revegetation plans
In addition to the previously-identified documentation, a project-specific Stormwater Management Plan will be prepared and will include additional erosion protection BMPs to minimize and control soil mobilization during construction activities.
A Spill Prevention and Response Plan will be included in the Stormwater Management Plan as part of the construction documents. Petroleum products will not be discharged into drainages or bodies of water. No fuels or construction machinery will be stored adjacent to streams, ponds or wetlands.
Curbs and gutters will be installed along the improved section of FSR 774 along Berry Creek to capture and divert road runoff and any potential sediment/traction control agents.
In most cut areas soil nails are a feasible method of slope reinforcement. Where appropriate, retaining walls in cut areas could be mechanically stabilized earth systems, boulder gravity walls or cantilever concrete walls.
The road embankment fills should be placed in lifts of no more than roughly 1-foot thick and compacted to at least 95 percent of the maximum standard Proctor density at near optimum moisture content.
Prior to placing fill, the subgrade should be prepared by removing all vegetation and topsoil, scarifying the foundation soil for a depth of at least 8-inches and compacting the scarified subgrade soils to at least 95 percent of the standard Proctor density at near optimum moisture content.
On hill slopes that are steeper than roughly 20 percent, the fill foundations should be benched into the hillside.
Topsoil and frozen materials should not be used as fill material.
Cemented rock blocks larger than roughly 8-inches that cannot be broken down by the compaction equipment should not be placed in the fills.
Vegetative buffers will be maintained adjacent to any intermittent or perennial drainages and wetlands, to the extent possible.

Table 2-1. Mitigation Measures, BMPs, and PDCs

In all areas where grading or soil disturbance will occur, topsoil would be stockpiled and re-spread following slope grading and prior to re-seeding.
Areas determined to have been compacted by construction activities may require mechanical subsoiling or scarification to the compacted depth to reduce bulk density and restore porosity.
Ground cover, as a combination of revegetation and mulch applications, should meet requirements for the one and two years following completion of ground disturbing activities.
ATMOSPHERIC (AIR QUALITY)
In the absence of natural precipitation, grading areas will be watered as necessary and practical to prevent excessive amounts of particulate matter.
Erosion control filter fabric will be placed underneath a rock construction entrance to minimize fugitive dust in the vicinity of the Moonridge subdivision during construction activities.
WASTE, NOISE, AND ODORS
Prior to construction of the Berlaimont Road, a vegetated berm will be constructed between (the relocated) Berry Creek Road and the Moonridge subdivision. This will be designed to reduce short- and long-term sights and sounds of use of the road, as well as particulate matter (i.e., dust) generated during construction of the road.
BIOTIC (PLANTS AND WILDLIFE)
All disturbed areas will be revegetated after the site has been satisfactorily prepared. Seeding should be repeated until satisfactory revegetation is accomplished. Reseed with an approved (per the WRNF) native seed mixture using a variety of native seed grasses, wildflowers and forbs.
Before ground-disturbing activities begin, identify and locate all equipment staging areas on NFS lands. Treat existing noxious weeds in these areas prior to the staging of any equipment. Establish equipment wash stations for construction activities on NFS lands. All soiled equipment shall be washed before entering the project area. This includes construction personnel vehicles in addition to trucks and other heavy equipment. Equipment wash stations shall be monitored frequently and after completion of all construction activities. All weed materials shall be removed promptly.
Minimize loss of Harrington penstemon (a Forest Service Region 2 Sensitive plant species) through identification/avoidance, and by installing protective fencing in accordance with USFS recommendations. Fencing will be maintained throughout the duration of construction activities.
If the presence of any special status plant or animal species is determined in the area affected by the project, the Forest Service Biologist, or equivalent specialist, will be immediately notified. The procedure and necessity for notification would be developed by USFS botanical and wildlife specialists during the NEPA analysis. If any new populations of special status species are encountered during the construction process, work will be suspended in that area until the USFS Biologist is consulted and potential adverse impacts mitigated.
AESTHETICS
By design, the Berlaimont Road utilizes existing Forest System roads, thereby minimizing the need for new road construction and associated visual impacts.
Retaining walls have been integrated into the road design to minimize the extent of cut/fill slopes, which generally require more ground disturbance, and are therefore more visible. Retaining walls will be constructed of various materials (depending on specific conditions), but would use colors that blend into the native palette.
“Clustering” residential development in the flatter, northern portions of the inholding, as appropriate, will minimize visual impacts.
Residential construction within the inholding will promote the use of natural materials and color palettes that minimize offsite visual impacts
RECREATION
Signage will be used to inform recreationists in the project area of when/where construction is/will be occurring along FSRs 774 and 780.

3.0 SUMMARY OF IMPACTS

Section 4-460.E.4.c of the ECLUR requires a summary of the inventory and analysis. A summary of potential impacts is provided below in Table 3-1. Individual resources are analyzed in greater detail in Section 4.0 – Environmental Inventory and Analysis.

Table 3-1. Summary of Environmental Impacts

Existing Conditions	Impact Analysis
HYDROLOGY AND SOILS	
Soils: Valley slopes in the project area range from 35 to 70 percent, with benches in the range of 10 to 30 percent. Underlying parent material consists of siltstone, claystone, and sandstone. Topsoils within the project area are 1 to 5 feet thick. Hydrology: Six ephemeral streams were identified on WRNF land intersected by FSR 774 or FSR 780. Three jurisdictional WOUS were identified within the study area: Berry Creek, Beard Creek, and an unnamed intermittent tributary to Berry Creek. One isolated pond was located on private land at the north end of the parcel. No wetlands were identified within the study area.	Soils: Widening these segments of existing road to meet the Rural Minor Collector standard, including cut and fill banks, would increase the disturbed area to approximately 41 acres (which is inclusive of the 9 acres of existing disturbance, for a total of 32 acres of new disturbance). Construction of a new segment of road spurring off of FSR 780 would require roughly an additional 11 acres of disturbance. In total, the road would result in approximately 43 acres of ground disturbance, with limited tree removal. Hydrology: Proposed road construction and improvements would increase the connected disturbed areas, with potential effects to stream health due to increased sediment. Silt fence, straw bales, straw wattles and other standard erosion control best management practices (BMP) can be used to control erosion during and after construction (see Table 2-1). Netting or appropriate erosion-control matting would be used on steep fill slopes to protect soils and enhance conditions for vegetation re-establishment. Existing riparian vegetation along Berry Creek would be protected and is likely to help maintain stream health during construction. Road-side drainage ditches would be diverted to detention ponds, reducing the likelihood of road runoff flowing into the creeks.
ATMOSPHERIC (AIR QUALITY)	
Air Quality in Eagle County is considered good and is in attainment with all National Ambient Air Quality Standards (NAAQS)	Construction activities related to construction of the road across National Forest System and private lands can be expected to result in limited short-term air quality impacts. After construction, air quality is expected to improve—due to change from a native-surface road to pavement.
GEOLOGIC	
Several linear scarps and grabens were mapped and verified within the project area.	Neither hazards to life safety, nor a serious geological constraint to road construction and use, were identified through literature or field reviews.

Table 3-1. Summary of Environmental Impacts

Existing Conditions	Impact Analysis
WASTE, NOISE, AND ODORS	
I-70 is the dominant source of noise in the project area. There currently are no identified waste or odor producing sources within the project area.	Construction may increase noise levels; these increases would be minimal and temporary. Residential noise at the project site would be limited to vehicular traffic accessing future residences. This is estimated to be a maximum of 192 Average Daily Trips. A vegetated berm would be constructed adjacent to the Moonridge subdivision prior to construction activities to mitigate noise impacts on nearby homeowners. No short- or long-term increase in waste or odors are expected as a result of the project. Future homesites would be serviced by septic systems and solid waste would be collected by a residential garbage service.
BIOTIC (PLANTS AND WILDLIFE)	
Plants: Thirty-three species plants identified as “sensitive” by the WRNF are known or suspected to occur on the Forest. Based on botanical surveys conducted within the project area, habitat for thirty-one of the thirty-three WRNF sensitive plant species was determined not to occur—the exception is habitat for Harrington penstemon (<i>Penstemon harringtonii</i>) and dropleaf buckwheat (<i>Eriogonum exilifolium</i>). Threatened and Endangered Species (TES): Eight TES are potentially present on the WRNF. Only one was found to have habitat (Canada lynx) in the project area. Sensitive Wildlife Species: Thirty-three Forest Service Region 2 Sensitive Wildlife Species (R2 SWS) are present or potentially present on the WRNF. Of those, sixteen have habitat present within the project area. Other Wildlife Species: Habitat for American elk and mule deer is present within the project area.	Plants: Habitat for Harrington penstemon (<i>Penstemon harringtonii</i>) and dropleaf buckwheat (<i>Eriogonum exilifolium</i>) is present within the project area. Dropleaf buckwheat was not detected in field surveys, Although habitat is present the project would have “No Effect” to this plant species. Regarding Harrington penstemon, the proposed project “may adversely impact individuals, but is not likely to result in a loss of viability in the planning area, nor cause a trend toward federal listing.” TES: There would be “No Effect” to three of the eight federally listed TES. The project is “not likely to adversely affect” Canada lynx. Ultimate build-out of the property is “likely to adversely affect” the four big river fish because of water depletions associated with the proposed residential development. Wildlife: Of the sixteen R2 SWS, eight would not be affected through the implementation of the project. Effects to the remaining eight are considered to be limited to individuals and not likely to result in a loss of species viability in the planning area. Other Wildlife Species: Future, year-round motorized use of the access road and ultimate residential development of the private parcel (the development and use of roads, driveways, building envelopes, and septic systems) would represent most of the impacts to deer and elk associated with this overall project. Impacts would include loss of winter range, transitional range, and calving habitat, reduce habitat

Table 3-1. Summary of Environmental Impacts

Existing Conditions	Impact Analysis
	effectiveness affecting these same habitats, restricted migratory and local movements, and increased injury and road-kill probabilities on access roads and regional highways. Appendix B contains a full description of the effects of both short term construction related impacts to deer and elk habitat, as well as, long term effects related to the use of the road and development of the private parcel. Refer to <i>Appendix B</i> for a full discussion of the potential effects of the project on plants and wildlife.
AESTHETICS	
The inholding is currently undeveloped. Portions of FSRs 774 and 780 are visible from many vantage points within the area; however, at no time can the entirety of either of these roads be seen, due to landform and topography.	Visual simulations prepared in conjunction with this EIR indicate that the full extent of the project would not be visible from any one area. By utilizing portions of the existing FSRs, the amount of new disturbance would be minimized, and the incorporation of retaining walls along the route would reduce the need for cut/fill slopes that are more visible. The result would be that the aesthetic difference between existing and improved road segments would be minimal, and largely due to the installation of retaining walls along FSRs 774 and 780, and, to a lesser extent, to cut/fill slopes, when necessary. Retaining walls would use colors that blend into the native palette. Therefore, the visual character and quality, as viewed from the four viewpoints would not be substantially altered. The analysis has identified that portions of the road would be noticeable from I-70 and from certain locations within the town of Edwards, however no scenic vistas would be compromised.
CIRCULATION AND TRANSPORTATION	
Seasonal access to the private inholding is currently possible via an unpaved network of Forest System Roads (FSR) across public lands managed by the White River National Forest. FSRs 774 and 780 currently experience low levels of vehicular traffic.	Disruptions to public use of FSRs 774 and 780 can be expected during construction and reconstruction of the roads; however disruptions would be temporary and would discontinue when the project is completed. The public's use of FSRs 774 and 780 would be unchanged under the proposed project. Average Daily Traffic (ADT) would be approximately 192 vehicles, based on the potential for 19 single-family homes being developed throughout the inholding, at 10.1 vehicle trips per day/per home.

Table 3-1. Summary of Environmental Impacts

Existing Conditions	Impact Analysis
RECREATION	
There are no developed recreation facilities within or abutting the project area. Due to proximity to the town of Edwards, public and private lands in the vicinity of the project area are popular sources of dispersed, year-round recreation activities—primarily by locals. This includes: mountain biking, hunting, horseback riding, hiking, running, Nordic skiing, camping, and off-road vehicle driving. A network of social trails has also evolved on public and private lands throughout the project area.	Short-term disturbances to dispersed recreationists from truck/equipment traffic, equipment noise, and dust associated with construction activities can be expected. Recreational access to public lands would not change. FSR 774 and 780 would remain open and available for public recreational use, subject to the same seasonal motorized closure that is currently in place. The dispersed recreation experience would be altered as recreationists would experience more traffic in the project area as home owners enter and exit private lands. To a certain degree, a loss of solitude can be expected for some people who value the project area in its current, undeveloped state. Hikers, mountain bikers and equestrians who currently use this area might move elsewhere, or migrate to the system of social trails that are already in place on adjacent NFS lands. For some recreationists (e.g., road bikers and runners) increased accessibility would result with the addition of the paved road surface.
ECONOMICS	
The project area is currently undeveloped and is therefore not a contributor to the local economy.	Short term construction related spending would contribute significantly to the local economy. The cumulative impact would be to create 1,367 FTE jobs and over \$203.6 million in total dollar flows to the local economy. Long term occupancy and maintenance of the community will result in approximately \$9.5million in direct spending in the area of the project.

4.0 ENVIRONMENTAL INVENTORY & ANALYSIS

Per Section 4-460 of the ECLUR, Chapter 4 includes inventory information and analysis of impacts on the following topics and natural systems:

- Hydrologic
- Atmospheric
- Geologic
- Biological Environment
- Wastes, Noise and Odors
- Visual
- Circulation and Transportation
- Recreation
- Economic

4.1 HYDROLOGY & SOILS

Section 4-460.E.4.d of the ECLUR requires that an inventory and analysis be included in the EIR to address and incorporate the applicable Environmental Conditions. The following is a summary of the hydrology and soils in the project area, and potential impacts to this resource as a result of construction and use of the Berlaimont Road.

Existing Conditions

Because the proposed Berlaimont Road occurs on NFS lands, and because the primary variable of management concern associated with the proposed road would be an increase in Connected Disturbed Area (CDA, defined below), the hydrology and soils assessment uses the Forest Service Region 2 *Watershed Conservation Practices Handbook* (WCPH) to assess stream health and design criteria for the proposed project.¹ The WCPH identifies stream health as the condition of the stream versus the reference, or natural, condition for the stream type and geology.

The WCPH defines CDA:

High-runoff areas like roads and other disturbed sites that have a continuous surface flow path into a stream or lake. Hydrologic connection exists where overland flow, sediment, or pollutants have a direct route to the channel network. CDAs include roads, ditches, compacted soils, bare soils, and areas of high burn severity that are connected to the channel system. Ground disturbing activities located within the water influence zone (WIZ) should be considered connected unless site-specific actions are taken to disconnect them from streams.²

The WCPH defines the Water Influence Zone as:

The land next to water bodies where vegetation plays a major role in sustaining long-term integrity of aquatic systems. It includes the geomorphic floodplain (valley bottom), riparian ecosystem, and inner gorge. Its minimum horizontal width (from top of each bank) is 100 feet or the mean height of mature dominant late-seral vegetation, whichever is most.

Soils

The topography of the Southern Rockies within the study area extends from 7,500 feet on a high level river terrace, to 9,250 feet on the northern side of the Eagle River valley. Valley slopes range from 35 to 70 percent, with benches in the range of 10 to 30 percent.

Field samples within the project area were collected by HP Geotech along the existing and proposed road alignment in August 2009 to determine geologic and subsurface information for soil classification

¹ USDA Forest Service, 2005

² USDA Forest Service, 2006

and engineering characteristics (the HP Geotech report is contained in Appendix A). The following soils and geologic information for the project area is a summary of their findings. Topsoil was found to be 1 to 5 feet thick with underlying colluvium and small alluvial fan deposits and overlies formation rock. Subsoils are typically nonstratified deposit of angular rocks from gravel to boulder-size in a matrix of sandy, low plasticity silt and clay. Groundwater was not encountered in any of the exploratory pits and subsoils were relatively dry. Formation rock was encountered at depths up to 12 feet. Rock formations within the project area are Pennsylvanian-age evaporites (Eagle Valley Formation) in the north and younger Paleozoic-age sedimentary rock (Maroon Formation) in the south. These formations consist of cemented or firm siltstone, claystone and sandstone.

Hydrology

An analysis of the Waters of the U.S. (WOUS), including wetlands delineation, was conducted within the project area on private and WRNF lands in September 2008. The project area is located in hydrologic unit 14, the Upper Colorado River Basin. Generally, waterways within the project area consist of non-navigable, isolated, non-permanent (flowing less than 3 months per year) stream beds determined by topography (gullies and swales). Six ephemeral streams were identified on WRNF land intersected by FSR 774 or FSR 780. The ephemeral streams did not have distinct channels indicating lack of permanence (permanence can apply to streams flowing more than three months per year) and did not have a physical or biological connectivity to downstream navigable waters. Therefore these six streams were not considered jurisdictional WOUS under the Clean Water Act.³

One isolated pond was located on private land at the north end of the parcel. The pond appeared to fill intermittently; however, this pond lacks a surface water and perceptible groundwater connection to other WOUS, including wetlands and, as a result, is not considered a WOUS in this analysis.

Three WOUS were identified within the project area: Berry Creek, Beard Creek, and an unnamed intermittent tributary to Berry Creek (s-3). Berry Creek and Beard Creek are perennial tributaries to Eagle River and are connected by surface water flow to the Colorado River. These tributaries have eroded steep narrow valleys primarily covered by sparse grass, sage and other brush.

Berry Creek is a perennial Class B stream located on NFS lands within the project area and is a tributary to Eagle River, connected by surface flow. Class B indicates a riffle dominated stream, with infrequent scour-pool features.⁴ The Creek flows south, approximately 65 to 150 feet from the eastern edge of Berry Creek Road on NFS lands. Several segments of the existing FSR 774 are within the Berry Creek WIZ, and are therefore considered CDAs.

In June 2009, a stream health survey was conducted on Berry Creek to establish the baseline environmental condition of the creek. Three levels of stream health are recognized in the Rocky

³ Ibid.

⁴ Rosgen, D.L. 1994. A classification of natural rivers. *Catena* 22; 169-199.

Mountain Region. These classes are recommended to be used for assessing long-term stream health and impacts from management activities:

1. *Robust Stream Health*: Stream exhibits high geomorphic, hydrologic and/or biotic integrity relative to its natural potential condition
2. *At Risk*: Stream exhibits some change from the natural potential condition.
3. *Diminished*: Stream exhibits changes in geomorphic, hydrologic and/or biotic integrity from its natural condition.

Table 4-1 provides the parameters for each of the stream health categories.

Table 4-1. WRNF Class B Channels – Stream Health Categories

Class	Fine Sediment	Unstable Banks
	(%)	(%)
Robust	< 19%	< 6.2%
At Risk	19–22%	6.2 - 7.0%
Diminished	> 22%	> 7.0%

Source: USDA Forest Service, 2006a

Berry Creek is a confined stream with an average width of 6 feet, with well vegetated banks. Bank vegetation includes primarily *Salix sp.*, *Populus balsamifera*, and *Cercocarpus montanus*. Banks showed minimal undercutting (0.5 percent), despite the gradient within the project area varying from 3 percent to 6.5 percent, indicating robust stream stability.

Fine sediment within Berry Creek was measured at 23 percent, indicating that stream health is potentially diminished from its potential condition. Fine sediments can affect habitat and stream health by filling the interstitial spaces of otherwise well-aerated gravels and cobbles. However, because no reference reaches (segments of stream unaffected by anthropogenic development) have been surveyed at this time, it is uncertain how this compares with the natural condition. It is possible that the existing, unpaved segment of FSR 774—adjacent the sampling reach—may be contributing sediment to Berry Creek.

Beard Creek crosses the southeast corner of the inholding and passes under FSR 780 by culvert and, per site visits to the project area, appears to be used by livestock or wildlife. Beard Creek has an average width of 4 feet and may be fed by non-permanent drainages originating within the project area during snowmelt and directly following precipitation events. Dominant riparian vegetation along Beard Creek within the project area includes *Populus tremuloides*, *Salix sp.*, *Chrysothamnus nauseosus*, and *Rosa acicularis*.

The intermittent tributary (s-3) to Berry Creek is located on Forest Service land near I-70 and is crossed by FSR 774. The intermittent channel is fed by a groundwater spring and is classified as connected due to the amount of hydrology present; it is presumed to have a connection to Berry Creek. This channel

includes adjacent upland vegetation *Juniperus scopulorum*, *Chrysothamnus nauseosus*, and *Artemesia tridentata*.

Wetlands

No wetlands were identified within the project area. Hydrology within the project area was confined to the intermittent and perennial stream beds which lacked hydrophylic vegetation and hydric soil indicators.

Environmental Impacts

Soils

For reference, the segments of FSR 774 and 780 have an average width of 18 feet within the project area, resulting in an existing disturbance of approximately 9 acres. Widening these segments of existing road to meet the Rural Minor Collector standard, including cut and fill banks, would increase the disturbed area to approximately 41 acres (which is inclusive of the 9 acres of existing disturbance, for a total of 32 acres of new disturbance). Construction of a new segment of road spurring off of FSR 780 would require roughly an additional 11 acres of disturbance. In total, the road would result in approximately 43 acres of ground disturbance, with limited tree removal.

The disturbed area would be inherently more prone to erosion; however Table 2-1 identifies preliminary best management practices (BMPs) and Project Design Criteria (PDC) which have been incorporated into the design of the Berlaimont Road. These BMPs and PDCs have been proven to minimize erosion and sediment transport in similar situations.

Hydrology

The primary stream health metric of concern within the context of this project is channel sedimentation. The effect of land disturbances such as roads, roadside drainages, and utilities corridors within forested watersheds tend to cause an increase in exposed surface soils and therefore increased erosion and sediment transport. Sediment transport within the stream network of the watershed is often indicated by higher percentages of fine-grained particles within the channel substrate, as was identified in Berry Creek. Although the channel appears to be stable due to extensive bank vegetation, currently the Class B stream exhibits potential diminished stream health due to the percent of fine sediment recorded in the stream. Constructing a paved road would stabilize some of the existing exposed soils; however it would also increase the CDA and result in higher velocity runoff, potentially increasing erosion of cut and fill slopes.

Silt fence, straw bales, straw wattles and other standard erosion control best management practices (BMP) can be used to control erosion during and after construction (see Table 2-1). Netting or appropriate erosion-control matting would be used on steep fill slopes to protect soils and enhance conditions for vegetation re-establishment. Existing riparian vegetation along Berry Creek would be

4.0 Environmental Inventory & Analysis

4.1 Hydrology & Soils

protected and is likely to help maintain stream health during construction. Road-side drainage ditches would be diverted to detention ponds, reducing the likelihood of road runoff flowing into the creeks.

4.2 ATMOSPHERIC

This section addresses the potential short-term (construction-related) and long-term air quality impacts resulting from the proposed project pursuant to Section 4-460.E.4.e of the ECLUR.

Existing Conditions

Air quality monitoring within Colorado occurs primarily along the Front Range and in Grand Junction. The closest air quality monitoring sites to the project area are established in Breckenridge, Aspen, and Rifle. Other monitoring stations can be found infrequently throughout the state. All Colorado communities are currently in attainment with all National Ambient Air Quality Standards (NAAQS), with the exception of the Front Range ozone control area, which is in non-attainment for the 8-hour ozone standard.

By being proactive, Eagle County remains in attainment of NAAQS as established by the Environmental Protection Agency.⁵ Eagle County adopted a new policy on December 18, 1990, followed by regulations which became effective February 1, 1992, restricting wood burning devices in new construction to one per unit, and requiring new devices to meet or exceed emission standards from the EPA for new technology. Open burning and ground disturbing development requires permitting as well as controls and abatement plans.

Environmental Impacts

Overall, potential impacts to air quality from project implementation are not anticipated to be significant. Short- and long-term air quality impacts can be expected as a result of this project. Each is discussed below.

Short-Term Construction-Related Impacts

Construction activities related to construction of the road across NFS and private lands can be expected to result in limited, short-term air quality impacts, resulting from the movement of heavy equipment. Construction activities would be temporary and would occur in a localized area. Contaminants generated from construction would include particulate matter, vehicle emissions, and increased windborne dust (i.e., fugitive dust).

This localized condition would be temporary and intermittent over a multiple-season construction period for the road, and would be discontinued when the road is completed. The amount of fugitive dust generated would depend largely on weather conditions during construction, with windy and dry weather generating the most fugitive dust. Due to the project site's somewhat remote location, mobilized fugitive dust generated during road construction would not be expected to have much of an effect on people or residents in the Edwards area, with the possible exception of the some recreationists using FSRs 774 and 780 residents of the Moonridge subdivision. After construction, air quality is

⁵ Air Quality in Eagle County. www.eaglecountyairport.us/envHealth/air.cfm last accessed June 29, 2010.

expected to improve—due to the native road surface changing to pavement. This would be particularly true for Moonridge residents.

Short-term, construction-related fugitive dust and emissions will be minimized through the employment of best management practices (BMPs), which are identified in Table 2-1. Vehicular emissions from construction equipment and construction worker vehicles are anticipated to have very minimal short-term impacts. None of the short-term construction related impacts are expected to cause any violations of the State or Federal ambient air quality standards.

Beyond BMPs, an important element in reducing short and long-term air quality impacts for Moonridge residents is relocating Berry Creek Road slightly to the west, and installing a vegetated, earthen berm prior to commencement of construction activities. This berm will be vegetated with native trees and shrubs to minimize the sights, sounds, and dust (i.e., fugitive dust) generated from construction of the road and related traffic.

Long-Term Impacts

The only long term air quality impact that is anticipated to result from this project is related to the increase in vehicular exhaust emissions from future homeowners and supporting traffic. The primary pollutants associated with vehicular exhaust emissions are nitrous oxides and carbon monoxide (NO_x and CO). It is reasonable to assume that vehicle emissions would be higher in comparison to the existing condition due to vehicle traffic accessing future home sites on the property. Based on construction of 19 single family homes across the private property, and applying 10.1 vehicle trips per day/per unit, the maximum average daily traffic would be 191.9 vehicles. Despite this increase in vehicle traffic over time, vehicular exhaust emissions are consistently being reduced through technological innovations and individual vehicle contributions to air quality can be expected over the course of time to decrease. Therefore, this relatively low level of vehicular traffic would not result in any measureable direct or indirect impact to local and regional air quality.

4.3 GEOLOGY

Pursuant to Section 4-460.E.4.e of the ECLUR Geologic resources were reviewed and inventoried within the project area. This section briefly summarizes the “Geologic Reconnaissance of the Berlaimont Access Road” prepared by James McCalpin, PhD of GEO-HAZ Consulting and included as Appendix A in this EIR.

Existing Conditions

GEO-HAZ performed a two-phased study of the geologic setting within the project area. Phase 1 consisted of a review of available geologic literature and maps in an effort to identify any contradictions with existing geotechnical mapping. The Phase 1 effort discovered that the U.S. Geological Survey had mapped two landslides across southern portions of the project area.⁶ However, two later geologic maps did not map these same two areas as landslides.⁷ To resolve the geological uncertainty and possible geohazard constraints related to road construction within the project area, GEO-HAZ field checked the mapping in September, 2009 as part of their Phase 2 review. The Phase 2 field review had two purposes: to review several potential road alignments for geologic stability and/or suitability, and to eliminate the uncertainty about the origin of the landforms.

The proposed road alignment enters the northern “landslide” section mapped by the USGS at its south-central boundary, turns west at a hairpin curve and travels west for approximately 2,480 feet, then turns north at a triple jeep road junction and travels north for approximately 2,000 feet before exiting the polygon’s northern boundary (see Appendix A, Fig. 2). The entire road alignment in the northern slide section is within road segment “D” and follows an existing jeep road. The road alignment would cross two types of anomalous landforms just north and south of the triple junction. Just south of the triple junction the road crosses a graben-like landform bounded by a sharp scarp on its northern side. The road then turns north at the triple junction and travels north through an approximately 630 feet long zone of anomalous, east-west trending troughs that are not bounded by sharp scarp margins.

Environmental Impacts

The linear scarps and grabens mapped in the Colton survey evidently formed by an evaporite dissolution/subsidence process. The process does not appear to be currently active, although movement on the grabens (see Appendix A, Fig. 3) appears to be younger than that on the east-west troughs. Even when the subsidence process was active it was likely a slow, discontinuous process, active only during periods of extreme precipitation. Therefore, it would not constitute a hazard to life safety nor a serious geological constraint to road construction and use.

The only geologic concern within the proposed road alignment is whether the inslope cuts on new section of road that would be constructed on NFS lands would undermine (daylight) the local bedding in

⁶ Colton et al., 1975

⁷ Tweto et al., 1978; Lidke, unpublished

the Minturn Formation. However, the closest bedding dip measured and regional dip are to the north rather than to the west.

Based on the existing conditions of the project area, the identified geologic strata and conditions were considered in the engineering of the Berlaimont Road. Potential geologic concerns were avoided and effectively mitigated through design.

4.4 WASTES, NOISE & ODORS

This section addresses the potential short-term (construction-related) and long-term air quality impacts resulting from the proposed project pursuant to Section 4-460.E.4.e of the ECLUR.

Existing Condition

Vehicular traffic on I-70 is the dominant source of ambient noise in the project vicinity. Traffic noise levels along existing Forest Service or County roads do not significantly influence the ambient noise levels at the project site.

Within the project site there currently are no waste or odor producing sources.

Environmental Impacts

Short-Term Construction-Related Noise Impacts

Although construction of the Berlaimont Road is anticipated to increase noise levels, these increases would be minimal and temporary. Eagle County does not currently have a noise ordinance; however construction-generated noise is expected to be limited to the hours of 7 a.m. to 7 p.m. Elevated noise occurrences are typically sporadic during any construction period. Noise levels actually experienced on nearby properties would vary, depending upon the distance of the property from the noise source and the type of activity. It is anticipated that nearby properties would experience elevated noise levels at occasional periods during construction of the proposed project. This is a temporary, unavoidable impact resulting from project construction.

Vehicles used by construction crews to access the site during construction and trucks being used to transport materials and heavy equipment to the site would create noise. Noise levels from these activities would depend on the distance from any receptor. For sensitive receptors such as residences (e.g., the Moonridge subdivision), the level of impact from construction noise sources depends upon the type and number of pieces of construction equipment being operated, the duration of the construction activities, as well as the distance of the receptor from the construction site. The closest residences are located in the Moonridge subdivision and are generally within 100 feet from the portions of the lower section of FSR 774 to be reconstructed, therefore moderate, temporary construction-related noise impacts are anticipated. A densely landscaped berm at least 4 feet in height and extending the length of the roadway adjacent to the Moonridge property has been incorporated into the design of the Berlaimont Road to mitigate the sights and sounds related to construction equipment. Overall, the relatively remote location of the developable portions of the property would minimize any noise impacts.

Long-Term Impacts

Residential noise at the project site would be limited to vehicular traffic accessing future residences. Based on the 19 single family lots allowed by right and using the Average Daily Traffic (ADT) of 10.1 for weekends (land use 210, ITE 7th Edition) the maximum ADT would be 191.9 vehicles. Despite this

estimated increase in local traffic, the project is unlikely to cause any noticeable impact to adjacent homesites within the Moonridge subdivision. Although vehicular traffic on Berry Creek Road would be expected to increase as a result of residential development within the inholding, residential vehicles utilizing the roadway would be expected to create less ambient noise than the existing condition through the conversion of the native dirt surface to a paved surface. Additionally, the landscaped berm constructed prior to project initiation would reduce noise and dust that currently affects Moonridge homeowners.

Waste and Odors

No short term increase in waste or odors are expected as a result of the project. A construction stormwater management plan (SWMP) would be developed as part of the construction documents. Petroleum products would not be discharged into drainages or bodies of water. No fuels or construction machinery would be stored adjacent to streams and/or surface waters. Refer to Table 2-1 for more information on BMPs and PDCs.

Any future homesites constructed as a result of the approval of the roadway improvements would be required to apply for an individual sewage disposal system permit reviewed by the Eagle County Department of Environmental Health. Solid waste would be collected and hauled off site via a residential garbage service.

4.5 BIOLOGICAL ENVIRONMENT

This section summarizes the “Biotic Assessment of the Berlaimont Estates Access Road, Eagle County, Colorado” prepared by Rick Thompson of Western Ecosystems, Inc. included as Appendix B to this Environmental Impact Report. Because the proposed road occurs on National Forest System (NFS) lands, the Biotic Assessment addresses Forest Service conventions and species lists, which also include all species of concern to Eagle County on private lands. This section addresses the potential impacts to vegetation and wildlife resulting from the proposed project pursuant to Section 4-460.E.4.e of the ECLUR.

Existing Conditions

Background information on the species addressed in this EIR is contained in 2002 WRNF Land and Resource Management Plan (Forest Plan). Those Forest Service documents were supplemented with information on species status, distribution, and ecology derived from Colorado Natural Heritage Program (CNHP) data base maps and reports, Colorado Division of Wildlife (CDOW) Wildlife Resource Information System and Natural Diversity Information System (NDIS) mapping, Forest Service data, personal knowledge of the local CDOW District Wildlife Manager, Forest Service wildlife biologists, applicable scientific studies and reports, and field surveys. Field surveys for vegetation and wildlife were conducted along potential access road corridors and on the private parcel in 2001, 2002, 2006, and in June 2008, specifically for this project.

Plants

The project area contains the middle portions of several ridges extending southwest off Red and White Mountain that terminate in the Eagle River Valley. Elevations range between approximately 7,440 and 9,270 feet on affected NFS lands and 8,040 and 9,640 feet on the private parcel. The generally south-facing project area supports undeveloped mountain shrub, big sagebrush (*Seriphidium tridentata*), and juniper (*Sabina scopulorum*) woodlands along the lower portion of the project area. The upper section of the project area traverses through aspen forest, before entering a sagebrush-tufted hairgrass (*Deschampsia caespitosa*) community on the private parcel. Berry and Beard Creeks are the only perennial creeks in the vicinity of the project area and both support riparian corridors in the vicinity of existing and proposed road alignments. Tames Creek and other tributaries are intermittent in the vicinity of the access road and private parcel.

Forest Service Region Two Sensitive Plant Species

Thirty-three species of sensitive plants are known or suspected to occur on the WRNF. Based on botanical surveys conducted within the project area, habitat for thirty-one of the thirty-three WRNF sensitive plant species was determined not to occur—the exception is habitat for Harrington penstemon (*Penstemon harringtonii*) and dropleaf buckwheat (*Eriogonum exilifolium*). Accordingly, the thirty-one species not present were excluded from further consideration in the Biotic Assessment (see Appendix B). The remaining two plant species (i.e., *Harrington penstemon* and *dropleaf buckwheat*) are briefly

described below. For a full description of these two plant species and their potential for occurrence within the project area, please refer to Appendix B.

Harrington penstemon is a Colorado endemic that grows on pinyon pine, juniper, and sagebrush covered slopes between 6,800 and 9,200 feet in Eagle, Garfield, Grand, Pitkin, Routt, and Summit Counties. Harrington penstemon surveys were conducted in the project area on June 7 and 19, 2001, June 7, 2002, June 5, 2006, and June 5, 11, 17, and 19, 2008, when plants were in bloom. During 2008 surveys, 204 aggregations containing 14,610 plants within 22.16 acres were recorded on public and private lands within the project area. Aggregations ranged in size from a single plant to 2.58 acres. Mean aggregation size and area were 72 plants and 0.107 acre, respectively.

Dropleaf buckwheat was added to the WRNF species list in July 2009. This species is a regional endemic known only from twenty-six occurrences in Wyoming and Colorado. In Colorado the plant has been found in North Park and Middle Park of Jackson and Grand counties at elevations ranging from 7,500 to 9,000 feet. Habitat along portions of the existing Forest System Roads and at a mid-elevations of the private parcel's western leg fall outside of this species' known distribution, but within its elevational range and general habitat continuum. There are currently no documented occurrences of dropleaf buckwheat on the WRNF or in Eagle County.⁸ While this species was considered as a species of local concern and as an R2 species at the time of the Berlaimont botanical surveys and potential habitat for it was located, this species was not detected during surveys.

Threatened and Endangered Plant and Wildlife Species

Listed, proposed, and candidate threatened and endangered plant and animal species that were initially considered included those identified by the United States Fish and Wildlife Service (USFWS) and Forest Service as potentially present on the WRNF, potentially present in the project area, or potentially affected by the project. The Forest Service (2010) identified Penland alpine fen mustard (*Eutrema penlandii*), Uncompahgre fritillary butterfly (*Boloria acrocynema*), humpback chub (*G. cypha*), bonytail (*Gila elegans*), Colorado pikeminnow (*Ptychocheilus lucius*), razorback sucker (*Xyrauchen texanus*), greenback cutthroat trout (*Oncorhynchus clarkii stomias*), and Canada lynx (*Lynx canadensis*).

After due consideration three of the eight listed, proposed, and candidate species initially considered herein, were dropped from detailed and further consideration because their range distributions are outside the project area and/or habitats necessary for their life requirements would not be affected by the project. These include: Penland alpine fen mustard, Uncompahgre fritillary butterfly, and greenback cutthroat trout. None of the four listed, endangered fish (Colorado pikeminnow, bonytail, humpback chub, and razorback sucker, collectively hereinafter, the "big river fish") occur any closer to the project area than the main stem of the Colorado River, near Rifle. Habitat for the one remaining species—Canada lynx—was considered present in the area. Based on field validation the access road corridor crosses through lynx "non-habitat" on NFS lands. While the Forest Service lynx habitat mapping

⁸ CNHP, 2008

database shows “other” habitat in the vicinity of the private parcel’s eastern “leg” associated with a mountain shrub stand, that stand is greater than 500 meters from denning or non-denning winter foraging habitat and, therefore, warrants “non-habitat” status, based on WRNF lynx habitat classification criteria. For a more detailed discussion of lynx habitat in the vicinity of the project site, refer to Appendix B.

Forest Service Region 2 Sensitive Wildlife Species

From the updated Region Two (R2) species list (Forest Service 2010), one insect, five fish, two amphibians, 17 birds, and eight mammals are considered to be present or potentially present on the WRNF. Other listed, proposed, and candidate animal “sensitive species” known to occur elsewhere in Colorado were considered, but dropped from detailed analysis because they were not identified by the USFWS or Forest Service as potentially present on the WRNF, their habitats do not occur in the project area, they have no affinities to project area habitats, the project area is outside of the species' range, and the project would have “no effect” on the species or on designated critical habitat.

Table 4-2 briefly describes the sensitive animal species potentially affected by the project, occurrence and habitat. For a more detailed description of the range, habitat and presence of these sensitive animal species, refer to Appendix B.

Table 4-2. Animal Species Potentially Affected by the Project

Species	Habitat	Habitat Present
Roundtail Chub and Mountain Sucker	The roundtail chub and mountain sucker occur far downstream in the Colorado River.	Potential habitat
Bluehead Sucker and Flannelmouth Sucker	Bluehead sucker and flannelmouth suckers are likely present in the Eagle River (B. Healy, Forest Service, pers. comm., Jan 29, 2009) at least downstream of Alkali Creek.	Potential habitat
Colorado River Cutthroat Trout	A conservation population of Colorado River cutthroat trout (CRCT) occurs in Berry Creek, a reach of which closely parallels approximately 3,200 feet of Berry Creek Road. Multiple electro-fishing passes were not performed and, therefore, population estimates could not be calculated. The CDOW sampled this population in 2007 and considered it healthy.	Present
Boreal Toad	Reaches of Berry and Beard Creeks represent potential boreal toad habitat in the vicinity of the proposed access road. No boreal toads (or other amphibians) were detected along either stream. Habitat exists within the project area (e.g., riparian areas) but no boreal toads were detected in the project area.	Potential habitat
Northern Leopard Frog	No leopard frogs (or other amphibians) were detected in the project area. See the boreal toad discussion, above, for aquatic habitats surveyed for this project.	Potential habitat
Bald Eagle	Bald eagle winter range and foraging habitat extend up the Eagle River through the project area. Those activity areas include upland habitats north of I-70, approximately up to the 8,200-8,400 foot contour.	Potential habitat

Table 4-2. Animal Species Potentially Affected by the Project

Species	Habitat	Habitat Present
Northern Goshawk	Goshawks are a forest-interior species generally associated with mature aspen and conifer forests between 7,500 and 11,300 feet on the WRNF. There are no suitable goshawk nesting or foraging habitats within the project area.	Potential habitat
American Peregrine Falcon	Two active peregrine falcon eyries are present in the Minturn and Vail areas. Both are further than 10 miles from the closest disturbance areas associated with the access road.	Potential habitat
Greater Sage Grouse	No sage grouse have been reported in the Berlaimont project area for the last 20 years (approx.). There are no documented leks within the project area.	Potential habitat, not present
Loggerhead Shrike	One or two sightings have recently been reported each year in the Eagle Valley, but none have been above Wolcott, several miles down valley from the project area and in more suitable shrike habitat. Shrikes were not detected in the Berlaimont project area during four years of field surveys that overlapped the breeding season.	Potential habitat
Brewer's Sparrow	Brewer's sparrows are breeding summer residents in portions of the project area. They were most common in the tall, dense sagebrush stand located at the southern end of the private parcel's western "leg," where a relatively high density of birds overlapped NFS and private lands.	Present
Townsend's Big-eared Bat	Townsend's big-eared bat occurs throughout the western two-thirds of Colorado, roosting in caves, mine shafts, crevices, and, occasionally, buildings to elevations of 9,500 feet. This species has been detected in Eagle County, but not in the vicinity of the project area (Scott et al. 1984).	Potential habitat
North American Wolverine	Although the Berlaimont project area is located within the wolverine's historic range (Bissell 1978), only two, positive identifications of a wild wolverine have been documented in Colorado in the last 30 years.	Potential travel habitat
River Otter	Individual otters are occasionally present in mid-reaches of the Eagle River. It is unlikely that otters would move out of the river and into project areas creeks, including Berry Creek, because of the limited forage base.	Potential habitat

Other Wildlife Species

American Elk

Elk are a common, widespread species that inhabit a wide variety of montane through alpine habitats in Eagle County. They are seasonally present along the road access corridors and on the private parcel from late fall into summer (i.e., fall transitional range, winter range, spring transitional range, calving, and calf-rearing).

Elk habitat on the WRNF includes all of the dominant vegetation types, and most of the other types found in the Southern Rocky Mountains. The WRNF provides most of the summer range for the herds resident in the general area. Certain areas in the extreme lower elevations of the Forest are used as

winter or transitional range, but the vast majority of the winter range occurs off the Forest. Winter range is considered the most limiting seasonal range for most elk populations on the Forest. Approximately 10 percent of the winter range is found on NFS lands for the populations of elk that spend the summer on the WRNF. The remaining 90 percent is located on either Bureau of Land Management lands or private lands surrounding the Forest.

The State of Colorado has responsibility for the management of wildlife populations; the Colorado Division of Wildlife (CDOW) manages elk to provide healthy populations capable of supporting both significant harvests and opportunities for non-consumptive uses. The CDOW has specific elk management goals and objectives that have been developed in cooperation with landowners, the public, and federal land management agencies. These plans help guide the State's direction in the management of elk.

Elk are seasonally present in the project area—along the road access corridors and on the private parcel from late fall into summer. Elk winter range covers the entire project area, including all access road segments on NFS land and the entire private parcel. South-facing slopes are particularly valuable because of enhanced snow-shedding characteristics. The relatively mesic conditions on side slopes of most project area ridges support more vigorous mountain shrub communities with a greater abundance of serviceberry and mountain mahogany, two important winter browse species.

Three important elk seasonal ranges/ activity areas are identified by NDIS mapping in the vicinity of the project area:

1. Elk winter range covers the entire project area, including all access road segments on NFS land and the entire private parcel.
2. Elk winter concentration area (EWCA) is defined as “that part of the winter range of a species where densities are at least 200 percent greater than the surrounding winter range density during the same period used to define winter range in the average five winters out of ten.” Three EWCA polygons occur in the vicinity of the project area. Two polygons overlap portions of the private parcel and a portion of the upper FSR 780 road segment in upper Tames, Beard, and Berry Creeks. The third polygon is located just northeast of the private parcel's northeast tip in upper Berry Creek.
3. Elk severe winter range (ESWR) is defined as “that part of the winter range of a species where 90 percent of the individuals are located when the annual snowpack is at its maximum and/or temperatures are at a minimum in the two worst winters out of 10. The winter of 1983/84 is a good example of a severe winter.” Polygons of ESWR in the vicinity of the project area occur in lower to mid-elevations of Beard and Berry Creeks, overlapping almost the entire lower FSR 780 corridor and a portion of the private parcel's eastern “leg,” and a second polygon overlapping the private parcel's northwestern tip in upper Spring Creek and the East Fork of Red Canyon Creek.

Per the 2002 WRNF Forest Plan, NFS lands in the project area are located in Management Area (MA) 5.41, Deer and Elk Winter Range, and MA 8.32, Utility Corridors. The objective of MA 5.41 is to provide habitat and winter forage for deer and elk along with cover and solitude. Human activities are managed so that deer and elk can effectively use the area.

Project area roads are currently unplowed in winter and receive some use by over the snow vehicles for recreational use and occasional power line maintenance. Other motorized vehicle access to this area is currently restricted by a gate at the beginning of Berry Creek Road that is closed to protect big game winter range and damage to roads from two days after the end of the last big game rifle season to May 1.

Mule Deer

Mule deer are a common, widespread species that inhabit a wide variety of montane through alpine habitats in Eagle County. Deer are present year-round in the project area, although different animals are present during summer and winter. For a more detailed discussion of the habitat types available for Mule Deer in the project area, refer to Appendix B.

Environmental Impacts

The Biotic Assessment (see Appendix B) was prepared to evaluate the potential effects of the proposed project on plant and wildlife species that may occur in the project vicinity. This section of the EIR summarizes the Biotic Assessment and the potential effects of the project on vegetation and wildlife resources within the project area.

Construction of the Berlaimont Road would result in direct impacts, both long-term and short-term to vegetation, wildlife and wildlife habitat through vegetation clearing and more frequent use of the road surface. Examples of potential long-term impacts include 1) the loss or conversion of habitat, 2) fragmentation of wildlife habitat resulting in decreased connectivity and a decrease in travel habitat effectiveness; and 3) increased human use on a year-round basis making the habitat in the area less suitable for species that are sensitive to human presence. These impacts were considered during the development of the Biotic Assessment and used to make effects determinations for Threatened/Endangered and Special Status plant and animal species that occur, or that may occur within the project area. The tables below provide a summary of the effect determinations for plant and animal species in the project area.

Effects to Forest Service Region Two Sensitive Plant Species

Dropleaf buckwheat was considered as a species of local concern at the time of botanical surveys and potential dropleaf buckwheat habitat was located along some portions of the access road; however, this species was not detected in surveys. Based on surveys conducted to date, the proposed project would have “**no impact**” on this species.

Based upon the current road design, actual disturbance areas, and proposed cut and fill slopes and emergency turn-arounds associated with the requested variances, approximately 3.32 acres of occupied Harrington penstemon habitat would be crossed (impacted) by the proposed road right-of-way—3.08 acres on NFS lands and 0.24 acre on Private land. All impacts to Harrington penstemon would result from road construction (vs. private residential development). Most impacts would occur on NFS (vs. private) land. Regarding Harrington penstemon, the proposed project **“may adversely impact individuals, but is not likely to result in a loss of viability in the planning area, nor cause a trend toward federal listing.”** Proper identification and avoidance of plants would minimize potential adverse effects to Harrington penstemon.

Effects to Threatened and Endangered Wildlife and Plant Species

The three possible effects determinations for Threatened and Endangered species are: 1) No Effect, 2) May Affect, but Not Likely to Adversely Affect; and 3) May Affect, and Likely to Adversely Affect. There would be **“No Effect”** to three of the eight federally listed TES (see Table 4-3). The project is **“not likely to adversely affect”** Canada lynx. The project is **“likely to adversely affect”** the four big river fish because of water depletions associated with the future residential development of the parcel (refer to footnote in Table 4-3). Effects of the project to the remaining wildlife species—Canada lynx—are considered to be insignificant and discountable. These determinations are summarized in the following table.

Table 4-3. Federally listed and proposed plant and animal species that may be affected by the Proposed Action associated with the Berlaimont Estates project

Common and Scientific Name	Status	Effect Determination
Penland alpine fen mustard, <i>Eutrema penlandii</i>	T	No effect
Uncompahgre fritillary butterfly, <i>Boloria acrocnema</i>	E	No effect
Humpback chub, <i>Gila cypha</i> *	E	Likely to adversely affect
Bonytail chub, <i>G. elegans</i> *	E	Likely to adversely affect
Colorado pikeminnow, <i>Ptychocheilus lucius</i> *	E	Likely to adversely affect
Razorback sucker, <i>Xyrauchen texanus</i> *	E	Likely to adversely affect
Greenback cutthroat trout, <i>Oncorhynchus clarkii stomias</i>	T	No effect
Canada lynx, <i>Lynx canadensis</i>	T	Not likely to adversely affect

Note:

Other listed and proposed species are not listed in this table because they have no affinities to action area habitats, the project area is outside of the species' range, and the proposed project would have no effect on the species. Species are listed phylogenetically. Federal status, listed after species, is as follows: E = Endangered, T = Threatened, C-Candidate. Potential pre-field survey occurrence on the project area and habitat affinity is summarized for each species.

* There would be relatively small (<0.5 AF/yr.) consumptive water losses associated with the proposed project. Federal actions that would result in new depletions of water or degradation of water quality to tributaries of the Colorado River require consultation with the USFWS. No compensatory mitigation would be required because consumptive losses would be <100 acre-feet/ year at full buildout.

Source: Forest Service (20010) and Western Ecosystems, Inc.

Effects to Forest Service Region Two Sensitive Wildlife Species

Sixteen Forest Service R2 sensitive animal species have the potential to occur within the project area. Of these sixteen, eight would not be affected through the implementation of the project. Effects to the remaining eight are considered to be limited to individuals and not likely to result in a loss of species viability in the planning area.

Table 4-4. Forest Service R2 Sensitive Animal Species that occur on the WRNF and Potential Occurrence in Impact Zones (NFS and private lands) Associated with Berlaimont Estates

Common name, Scientific name	Effect Determination
FISH	
Roundtail chub, <i>Gila robusta</i>	No Impact
Mountain sucker, <i>Catostomus platyrhynchus</i>	No Impact
Bluehead sucker, <i>Catostomus discobolus</i>	No Impact
Flannelmouth sucker, <i>Catostomus latipinnis</i>	No Impact
Colorado River cutthroat trout, <i>Oncorhynchus clarki pleuriticus</i>	May adversely impact individuals, but is not likely to result in a loss of viability in the planning area, nor cause a trend toward federal listing
AMPHIBIANS	
Boreal western toad, <i>Anaxyrus boreas boreas</i>	May adversely impact individuals, but is not likely to result in a loss of viability in the planning area, nor cause a trend toward federal listing
Northern leopard frog, <i>Lithobates pipiens</i>	May adversely impact individuals, but is not likely to result in a loss of viability in the planning area, nor cause a trend toward federal listing
BIRDS	
Bald eagle, <i>Haliaeetus leucocephalus</i>	May adversely impact individuals, but is not likely to result in a loss of viability on the planning area, nor cause a trend to federal listing or a loss of species viability rangewide
Northern goshawk, <i>Accipiter gentilis</i>	May adversely impact individuals, but is not likely to result in a loss of viability in the planning area, nor cause a trend toward federal listing
American peregrine falcon, <i>Falco peregrinus anatum</i>	No impact
Greater sage grouse, <i>Centrocercus urophasianus</i>	No impact
Loggerhead shrike, <i>Lanius ludovicianus</i>	No impact
Brewer's sparrow, <i>Spizella breweri</i>	May adversely impact individuals, but is not likely to result in a loss of viability in the planning area, nor cause a trend toward federal listing
Townsend's big-eared bat, <i>Corynorhinus townsendii townsendii</i>	May adversely impact individuals, but is not likely to result in a loss of viability in the planning area, nor cause a trend toward federal listing
North American wolverine, <i>Gulo gulo luscus</i>	May adversely impact individuals, but is not likely to result in a loss of viability in the planning area, nor cause a trend toward federal listing
River otter, <i>Lontra canadensis</i>	No impact

Note:

Other R2 species are not listed because they have not been found on the WRNF, they have no affinities to project area habitats, the project area is outside of the species' range or elevational distribution. Potential pre-field survey occurrence on the project area, potential for project effects, and habitat affinity is summarized for each species. Wildlife are listed phylogenetically.

Source: Forest Service (2010), J. Proctor, Forest Service, Jan. 28, 2010 pers. comm., and Western Ecosystems, Inc.

American Elk

Constructing an engineered access road (i.e., the Berlaimont Road) would result in the net loss of approximately 30.9 acres of elk habitat, primarily on NFS lands, between the current entrance to Berry Creek Road and the cul-de-sac in the “crotch” of the private parcel (refer to Figure 2). This would result in the loss of elk winter range, elk winter concentration area, and elk severe winter range. This acreage includes (1) habitat permanently lost to the road surface, shoulders, and cut and fill slopes (whether or not they may be revegetated), (2) locally reduced habitat effectiveness associated with retaining walls, guard rails, and snow deposition areas, and (3) the acreage of the existing Forest System roads that are within the proposed road alignment.⁹

Much of the proposed Berlaimont Road would be on slopes ≥ 30 percent, resulting in additional and steeper cut and fill slopes (i.e., over those now present). Upgrading road sections crossing steeper slopes would further affect the ability of animals to (1) move across and up and down local hillsides and (2) access winter forage. Replacing or reducing cut and fill slopes with retaining walls along either the cut slope or fill slope would reduce the area of habitat loss, but would create a complete barrier to local animal movements. Furthermore, adding guard rails to road sections on steep slopes would create additional barriers to wildlife movements, even in very light snow cover. Elk that are on the slope below the guard rail may not be able to jump the guard rail depending on the relative height of the rail relative to the terrain below.

Reduced habitat effectiveness would be the largest impact associated with the overall project. Sources of reduced habitat effectiveness include winter use of the road by future residents, road plowing, and snow handling. That being said, year-round motorized use of the access road and residential development of the private parcel (the development and use of roads, driveways, building envelopes, and septic systems) would result in the vast majority of impacts to elk associated with this overall project. Impacts would include loss of winter range, transitional range, and calving habitat, reduced habitat effectiveness affecting these same habitats, restricted migratory and local movements, and increased injury and road-kill probabilities. For a more detailed discussion of impacts to elk, refer to Appendix B.

Mule Deer

Deer are present year-round in the project area, although different animals are present during summer and winter. Deer issues (e.g., habitat impacts, restricted movements, reduced habitat effectiveness, road and highway mortality, and further secondary development), road construction effects, road design variance effects, and road use and private residential development effects associated with the project are virtually identical to those described above for elk. For a more detailed discussion of impacts specific to mule deer, refer to Appendix B.

⁹ The proposed access disturbance limits would cover approximately 42.5 acres. The proposed access road surface would cover approximately 14.6 acres. The acreage of existing Forest System roads that are within the proposed road alignment totals approximately 11.6 acres.

4.6 AESTHETICS

This section addresses the potential visual impacts resulting from the proposed project pursuant to Section 4-460.E.4.e of the ECLUR.

Inventory and Analysis

The Eagle Valley is an east-west trending valley surrounded by the Gore and Sawatch Ranges with mountain peaks averaging over 11,000 feet. Public and private lands north of Interstate 70 in the vicinity of Edwards are composed primarily of mountain scrubland. Public lands administered by the White River National Forest surround the 680-acre private inholding.

The pattern of existing development in the Eagle Valley has been shaped by the natural constraints of the land including Brush Creek, the Eagle River and the surrounding mountains. Development within the Eagle Valley includes residential, industrial, retail, golf courses, ski resorts, and schools. Along the Eagle River, developed parcels are a mix of residential, agricultural and recreational uses. Several hillside developments have been constructed within the Eagle Valley to date. For travelers on Interstate 70, Beaver Creek ski area and the Town of Edwards are in the viewing corridor to the south. Numerous and significant residential developments exist north and south of the I-70 corridor between Edwards and Avon, and are readily visible to drivers. These include Cordillera, Bachelor Gulch, Arrowhead, the Homestead, and Wildridge. In addition to the I-70 corridor, development in the Edwards area consists of housing developments near the Highway 6 and Highway 163 interchange and near Beaver Creek ski area.

Specifically related to the project area north of the Edwards interchange, there are two existing, unpaved Forest System Roads above the Moonridge Subdivision. FSR 774 (Berry Creek Road) intersects with the County roadway near Moonridge Subdivision and traverses the hillside towards the eastern leg of the property. It is currently gated as it enters the National Forest and provides only seasonal (summer) motorized access. A second road (FSR 780) intersects with FSR 774 at a point higher along the hillside. Portions of both of the existing Forest Service roads are visible from many vantage points within the area, including several locations along the I-70 corridor and from the south side of I-70. Note that at no time can the entirety of either of these roads within the project area be seen, due to landform and topography.

Forest Service Scenery Management System

Because so much of the project area is on NFS lands, the Forest Service's Scenery Management System (SMS) is referenced here. The Forest Service adopted the SMS in 1995 as its primary scenery management direction. In brief, the SMS is a systematic approach for assessing scenic resources in a project area and then using the findings to help make management decisions on the project. The system is founded on an ecological aesthetic, which recognizes that management which preserves the integrity, stability, and beauty of the biotic community, preserves the scenery as well.

By assessing the existing scenic character of an area in terms of pattern elements (form, line, color and texture) and pattern character (dominance, scale diversity and continuity), it is possible to identify the extent to which the scenic character would exhibit scenic contrast with the landscape, or its converse, scenery compatibility.

The 2002 WRNF Forest Plan establishes acceptable limits of change for Scenic Resources.¹⁰ The acceptable limits of change of a particular area are the documented Scenic Integrity Levels (SIL), which serve as a management goal for scenic resources. SILs provide a measure of visible disruption of landscape character, and range from *Very High* (unaltered environment) to *Unacceptably Low* (extremely altered environment). Per the 2003 WRNF Forest Plan, NFS lands in the project area have a SIL of *moderate*. The *moderate* SIL is defined as:

“...refers to landscapes where the valued landscape character “appears slightly altered.” Noticeable deviations must remain visually subordinate to the landscape character being viewed.

Environmental Impacts

Representative viewpoints and photo simulations have been prepared to analyze potential visual impacts associated with the proposed construction of the Berlaimont Road within the project area. Viewpoints 1 through 4 (each with a corresponding “A” and “B” referring to the existing conditions and visually simulated photos, respectively) are included following this narrative, and are intended to represent locations of high public visibility in the vicinity of the project area.

Note that from any one area (e.g., along the I-70 corridor) neither the full extent of the existing or improved road system is, or would be, visible from an single location due to a combination of existing topography, landforms, and/or development. As indicated in Viewpoints 1B, 2B, 3B and 4B, portions of the proposed Berlaimont Road would be noticeable from I-70 and from certain locations; however several mitigating design and topographic factors effectively reduce the visual effects of the Berlaimont Road. They include:

- The Berlaimont Road would largely conform to existing road surfaces (FSRs 774 and 780) which minimizes new disturbance,
- The need for, and extent of, cuts/fills has reduced by the incorporation of retaining walls which utilize naturally-colored materials, and
- The project area is effectively screened from areas of high public visibility (e.g., I-70) by virtue of topography.

The proposed Berlaimont Road can be constructed and maintained consistent with the *moderate* SIL.

¹⁰ USDA Forest Service, 2002a

Furthermore, construction of individual homes and driveways/access roads throughout the northern portions of the inholding is expected to be minimally visible with low potential to impact visual quality. The northern portion of the inholding is relatively flat, and this “plateauing” has the effect of masking new development, especially from lower-elevation viewpoints.”

Therefore, although construction of the proposed Berlaimont Road would result in a net change over the existing condition, the new road would not compromise any scenic vistas. Therefore, the visual character and quality, as viewed from the four viewpoints, is not anticipated to be substantially altered.

Viewpoint #1 - Homestead

Viewpoint #1 is located within the Homestead neighborhood nearly due south of the property (see Viewpoints 1A and 1B). The elevation at this location is 7,475 feet and it affords a direct view of the project area. The viewpoint is approximately two miles away from the Berlaimont property, which has been identified on the photo for reference. Note that from this vantage point, only the lower portions of the eastern and western “legs” of the property are visible, and the higher elevation, developable portions of the property cannot be seen. As the existing condition photo shows (Viewpoint 1A), FSRs 774 and 780 are readily visible within the project area. In particular, Berry Creek Road (FSR 774) is visible in the lower elevations.

Viewpoint 1B has been simulated to include the Berlaimont Road (i.e., the improvement of FSRs 774 and 780 to a Rural Minor Collector standard). From this vantage point a significant percentage of the improved Forest System Road network is obscured by intervening ridgelines. While Berry Creek Road is visible, it disappears behind a prominent rise then reemerges as it approaches the eastern “leg” of the Berlaimont property.

Portions of the improved road surface are likely to be seen as it traverses across NFS lands from the eastern to western leg. Within this area the road design largely follows FSR 780, minimizing the distinction between existing and proposed conditions. As it moves upward along the drainage (Tames Creek), it would be largely obscured by an intervening ridgeline.

Viewpoint #2 - 1-70 Rest Area

Viewpoint #2 is near the Interchange 163 rest area. From this perspective the Berlaimont Road would only be minimally visible due to the grade difference to the vantage point. The development associated with the Moonridge Subdivision essentially limits views of the proposed road as it accesses the property. This vantage point is 7,225 feet in elevation and 1.50 miles away from the property.

Viewpoint #3 - Cordillera

Viewpoint #3 was selected as it represents a view of the project area looking from the west and at an altitude substantially above the I-70 corridor. From this vantage point, numerous and significant existing visual elements dominate the foreground and middleground, including the Cordillera development and I-70.

At roughly 2.7 miles from the property and at an elevation of 8,135 feet, the existing FSR network is clearly visible in the existing conditions image (see Viewpoint 3A). In Viewpoint 3B, a simulation of the view based on the proposed road design illustrates how it would maintain essentially the same line as the existing road network as it traverses from the eastern leg towards the western leg of the property, with retaining walls and cut/fill slopes evident.

Viewpoint #4 - Arrowhead

Viewpoint #4 is located near the existing Arrowhead Golf Course roughly 2.5 miles away from the project and at approximately 7,340 feet in elevation. From this eastern vantage point the switch backing up towards the eastern leg of the property (identified in red) can be seen. The incorporation of a natural color palette into retaining walls would soften the aesthetic impact of the improved roadway. Once the roadway begins its traverse across NFS land towards the western leg of the property, it would be hidden by intervening ridgelines, as is apparent in both Viewpoints 4A and 4B. The views from this vantage point are more dominated by foreground commercial and middle-ground residential development.

4.7 CIRCULATION & TRANSPORTATION

This section addresses the potential short- and long-term circulation and transportation impacts resulting from the proposed project pursuant to Section 460.E.4.e of the ECLUR.

Existing Conditions

Seasonal access to the private inholding is currently possible via an unpaved network of Forest System Roads across public lands managed by the WRNF. FSR 774 (Berry Creek Road) starts at the County roadway behind the Moonridge Subdivision. A small segment of FSR 774 is located on an easement across private lands behind the Moonridge Subdivision. A short distance up FSR 774, a gate regulates motorized access on NFS lands to the north from late spring through early fall. From this point, FSR 774 ascends the hill generally to the north and west. A second unpaved road (FSR 780) intersects with FSR 774 at a point higher along the hillside. FSR 780 exits NFS lands—crossing the southeastern “leg” of the private inholding—and then re-enters NFS lands, continuing to the west (refer to Figure 1).

FSRs 774 and 780 currently experience low levels of vehicular traffic (primarily associated with off-road and high-clearance vehicles) and higher levels of dispersed recreation activities like hiking, trail running and mountain biking. Neither of these FSRs provides public access to any developed recreation facilities, camping or constructed trails. These roads are primarily lower maintenance level native surface roads, requiring high clearance vehicles to travel, particularly in poor weather conditions in comparison with main arterial roads that receive higher maintenance which are suitable for passenger cars.

Environmental Impacts

Short Term Impacts

Disruptions to public use of FSRs 774 and 780 are expected during construction and reconstruction of the road; however disruptions would be temporary and would discontinue when the project is completed. Construction-related traffic would include vehicles used by construction crews to access the site during construction and trucks/machinery used to transport materials and heavy equipment to the site. At certain times (e.g., blasting or heavy construction) portions of FSRs 774 and 780 may be temporarily closed to public use for safety reasons.

Long Term Impacts

From a long-term, public use perspective, three primary changes would occur to FSR 774 and 780 from the existing conditions:

- FSRs 774 and 780 would be widened and paved;
- the paved road across public and private lands would be maintained throughout the year; and
- residential traffic would be on the road.

According to the design standards from the ECLUR, the Type V Rural Minor Collector road is designed to accommodate approximately 191.9 vehicle trips per day, which would be approximately 58 daily vehicle trips below the maximum designed capacity of the road (see ECLUR Table 4-620 J). The public's access to FSRs 774 and 780 would be unchanged under the project. Construction of the proposed project would not alter the existing pattern of access and circulation over the existing condition. Although the existing gate on FSR 774 may be moved further north, a seasonal motorized closure would still be in effect for the general public, limiting their use of FSRs 774 and 780 to late spring through early fall (as is the current situation). Likewise, beyond the intersection of (the paved portion of) FSR 780 and the new segment of road, FSR 780 would remain a native surface road, and use would not change.

As indicated in ECLUR 4-620J.1.h, "... two (2) points of ingress/egress to the public roadway system shall be provided, such that in the event a road within the subdivision becomes impassable, all properties will continue to have access to a public roadway system." While the design of the Berlaimont Road generally conforms to the Rural Minor Collector standard, the VIS Application (page 7) notes that the Applicant is not able to provide a second access point into the property due to several important special circumstances or conditions. These include:

1. The limitation on access across National Forest System (NFS) lands to one access roadway.
2. Limitation of access through adjoining private properties.
3. The exceptional topographic conditions approaching and within the property.
4. The consideration of visual and environmental factors.

As depicted in detail in the VIS Application (both in the design set and in Figure 3), the proposed Berlaimont Road design incorporates 14 emergency vehicle turnarounds in accordance with 4-620.D.11 of the ECLUR. The topographic gradients along the roadway do not allow the regular 1,000-foot spacing prescribed by Section 4-620.D.10.d. However, as provided by that Section, the Local Fire Authority Having Jurisdiction, the Eagle County Fire Protection District, recommends this alternative spacing plan. The ECFPD memorandum contained in Appendix 5 of the VIS Application notes that the road design includes areas of widening to accommodate ECFPD emergency vehicles.

As designed, the Berlaimont Road is safe for residential use. While it is not possible to provide for dual access, it accommodates emergency vehicles along all segments and switchbacks, and incorporates emergency vehicle turnarounds.

4.8 RECREATION

This section addresses the potential short and long term recreation impacts resulting from the proposed project pursuant to Section 460.E.4.e of the ECLUR.

Existing Conditions

There are no developed recreation facilities within or abutting the project area (e.g., campgrounds, day use areas, toilets, and available potable water or trash services). Seasonal access to public lands in the vicinity of the project area is currently possible via a network of Forest System Roads across public lands managed by the WRNF. Per the 2003 WRNF Forest Plan, the recreation opportunity spectrum (ROS) for NFS lands in the project area is identified as “semi-primitive motorized” with a scenic integrity level (SIL) of *moderate*. FSRs 774 (Berry Creek Road) and 780 are primarily used in this area. At FSR 774, a gate regulates motorized access to late spring through early fall. Beyond the gate, winter recreational use of FSRs 774 and 780 is non-motorized. Neither of these FSRs provides public access to developed recreation. These roads are primarily lower maintenance level native surface roads, requiring high clearance off highway vehicles (OHV) to travel. Note that the condition of FSR 780 was improved in 2009, when the road was graded and smoothed.

Due to proximity to the town of Edwards, public and private lands in the vicinity of the project area are popular sources of dispersed, year-round recreation activities by locals. This includes: mountain biking, hunting, horseback riding, hiking, running, Nordic skiing, camping, and off-road vehicle driving. (e.g., motorcycles, jeeps, snowmobiles, etc.). A network of social trails has also evolved on public and private lands throughout the project area. For example “Endo Ally” is a popular two-track trail that mountain bikers use to loop back to Berry Creek Road from the lower portions of FSR 780. The project area’s south-facing aspects dictate that that snow melt and green-up occurs earlier in the spring, and snow accumulation does not occur until late fall, allowing an extended non-winter recreational season.

Although data on public use of the project area is scarce, the White River National Forest set up infrared counters on FSRs 774 and 780 to monitor use for an approximate 45-day period in 2009 (spanning March 17 through June 1). During this period of time, recreational use on lower Berry Creek Road (FSR 774) averaged 39 people per day, with a maximum of 102. Higher up, after FSR 780 branches off of Berry Creek Road, use was slightly lower—averaging 14 people per day with a maximum of 44.

Because FSR 780 crosses the lower portion of the private property in the project area, and due to its relatively remote location, evidence of trespass (e.g., camping, hunting, shooting, dumping, and random acts of vandalism) is common. Attempts at keeping the public mindful and respectful of private property as FSR 780 passes through private property (e.g., signage) have been unsuccessful.

Environmental Impacts

Short Term Impacts

By bringing FSRs 774 and 780 up to the Rural Minor Collector standard, recreational users in the project area could expect to encounter the sights and sounds of a construction project for two construction seasons (the entire 5+-mile road could not be constructed and paved in one season). However disruptions would be temporary and would discontinue once the road is constructed. Short-term disturbances to dispersed recreationists from truck/equipment traffic, equipment noise, and dust associated with construction activities could be expected. Additionally, some recreational users may be displaced for short durations during construction activities (e.g., blasting) in some areas.

During road construction/reconstruction, recreational users seeking a sense of solitude and quiet would likely find this area unsuitable, and would likely need to look elsewhere on other NFS lands. However, a variety of recreational opportunities and settings would remain available during construction activities, and the network of social trails that exists in the project area would be unaffected, although access to them may be affected in the short-term.

Long Term Impacts

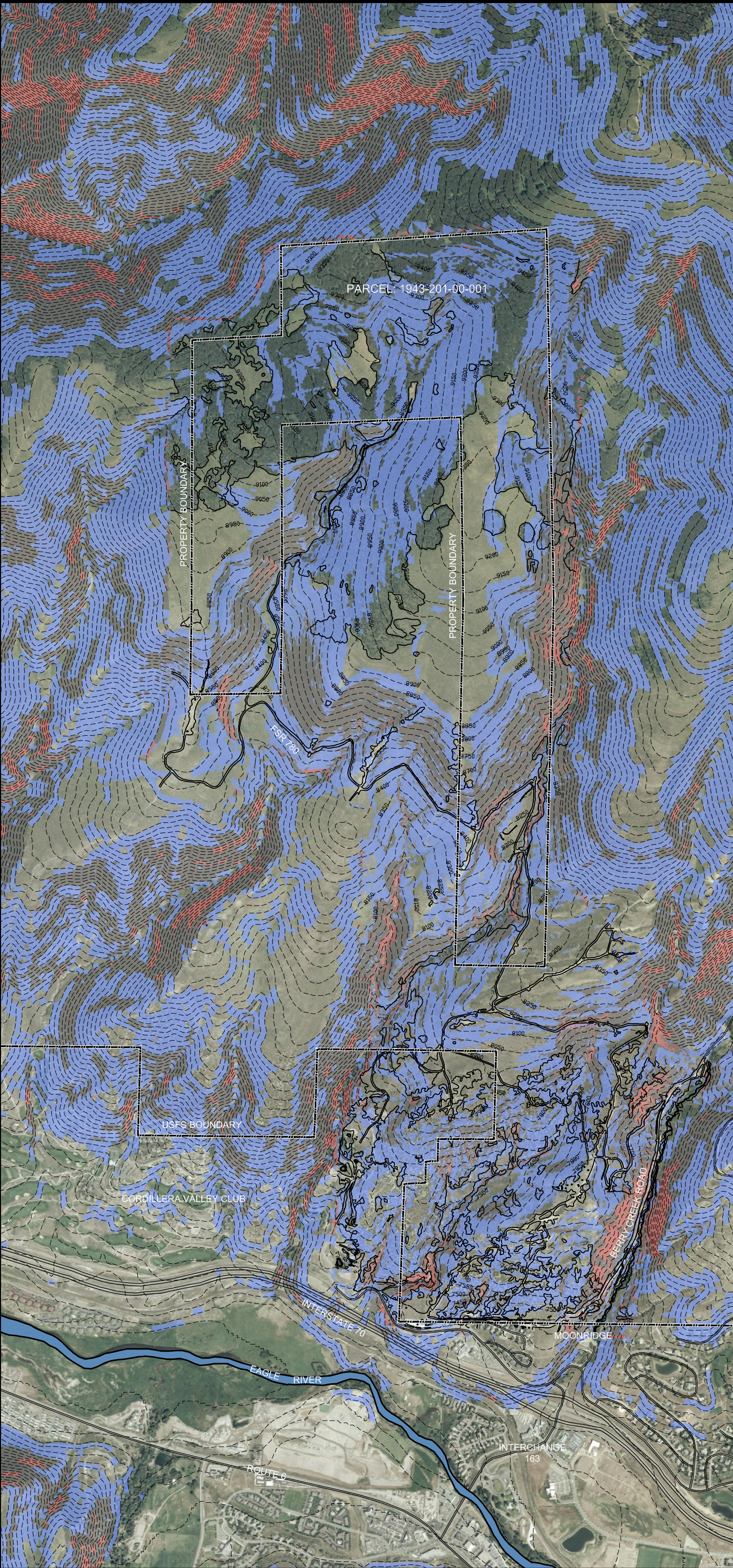
The proposal to reconstruct FSRs 774 and 780 to the Rural Minor Collector Road standard would result in a paved surface for approximately four miles between the start of Berry Creek Road and where the new road segment branches off of FSR 780. This would not alter current recreational access to public lands, as both FSR 774 and 780 would remain open and available for public recreational use, subject to the same seasonal motorized closure for the general public. Contingent upon approval from the WRNF, future residents would have year-round motorized access to the private land, while motorized access to the general public would be restricted during the late fall, winter, and early spring.

To the extent that FSRs 774 and 780 would be widened and paved, direct recreational use of them would be altered from an unmaintained experience to a paved one. Four miles of paved road in the project area may be viewed as favorable to some recreationists, and unfavorable to others.

Regardless, long-term residential traffic on the paved sections of FSR 780 and 774 would be a result of developing the private land. Therefore, long-term recreational displacement for some users is a potential. Recreationists could be expected to experience a loss of solitude as hiking a trail or old road prism is a more desirable experience than sharing a paved road with vehicles. Hikers, mountain bikers and equestrians who currently use this area might move elsewhere, or migrate to the system of social trails that are already in place on adjacent National Forest System lands. Recreational road biking and running would become available with the addition of the paved road surface, thereby allowing increased accessibility.

4.9 ECONOMIC

The potential economic impact of the proposed Berlaimont Estates residential community is summarized in Appendix C – Economic Impact Assessment: for the proposed: “Berlaimont Estates.” Appendix C includes a summary of short term construction inputs to the local/regional economy (e.g., engineering fees, employment during construction) and long term occupancy and maintenance projections (e.g., property management services, home user expenditures).



Berlaimont Estates

Variance From Improvement Standards
July 2013
Figure 1 - Existing Conditions

LEGEND

- USFS Land Boundary
- Inholding Boundary
- Gravel Road
- Existing Paved Road
- 25 - 45% SLOPE
- 45 - 70% SLOPE
- 70 + % SLOPE

PROJECT DETAILS

PARCEL #: 1943-201-00-001
ACRES: 680


NORTH

0 750' 1500' 3000'

Scale: 1"=1500'


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Figure 1 - Existing Conditions

TURNAROUNDS

NO.	TYPE	MILEAGE	LINEAL FEET
1	Bubble	0.16	830
2	Bubble	0.40	2,100
3	Hammerhead	1.04	5,475
4	Bubble	1.51	7,982
5	Bubble	1.73	9,147
6	Hammerhead	1.91	10,092
7	Hammerhead	2.45	12,922
8	Bubble	2.69	14,229
9	Bubble	2.99	15,809
10	Hammerhead	3.49	18,419
11	Hammerhead	3.92	20,704
12	Bubble	4.16	21,995
13	Hammerhead	4.93	26,045
14	Cul-de-sac	5.32	28,095

Berlaimont Estates

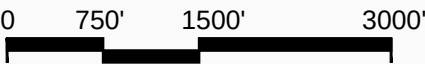
Variance From Improvement Standards
July 2013
Figure 2 - Berlaimont Road Design

LEGEND

- USFS Land Boundary
- Inholding Boundary
- Gravel Road
- Existing Paved Road
- Proposed Road
- Emergency Turn-Around

PROJECT DETAILS

ROAD LENGTH: 5.3 MILES



Scale: 1"=1500'

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Figure 2 - Berlaimont Road Design

Berlaimont Estates

Variance From Improvement Standards
July 2013
Viewpoint 1A - Homestead
Existing Conditions

LEGEND

 Property Boundary

PROJECT DETAILS

Distance From Property Boundary:
2.03 Miles

Elevation: 7,475 FT

Scale: N.T.S.

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Berlaimont Estates

Variance From Improvement Standards
July 2013
Viewpoint 1B - Homestead
Visual Simulation

LEGEND

 Property Boundary

PROJECT DETAILS

Distance From Property Boundary:
2.03 Miles

Elevation: 7,475 FT

Scale: N.T.S.

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Berlaimont Estates

Variance From Improvement Standards
July 2013
Viewpoint 2A - Rest Area
Existing Conditions

LEGEND

 Property Boundary

PROJECT DETAILS

Distance From Property Boundary:
1.50 Miles

Elevation: 7,225 FT

Scale: N.T.S.

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Berlaimont Estates

Variance From Improvement Standards
July 2013
Viewpoint 2B - Rest Area
Visual Simulation

LEGEND

 Property Boundary

PROJECT DETAILS

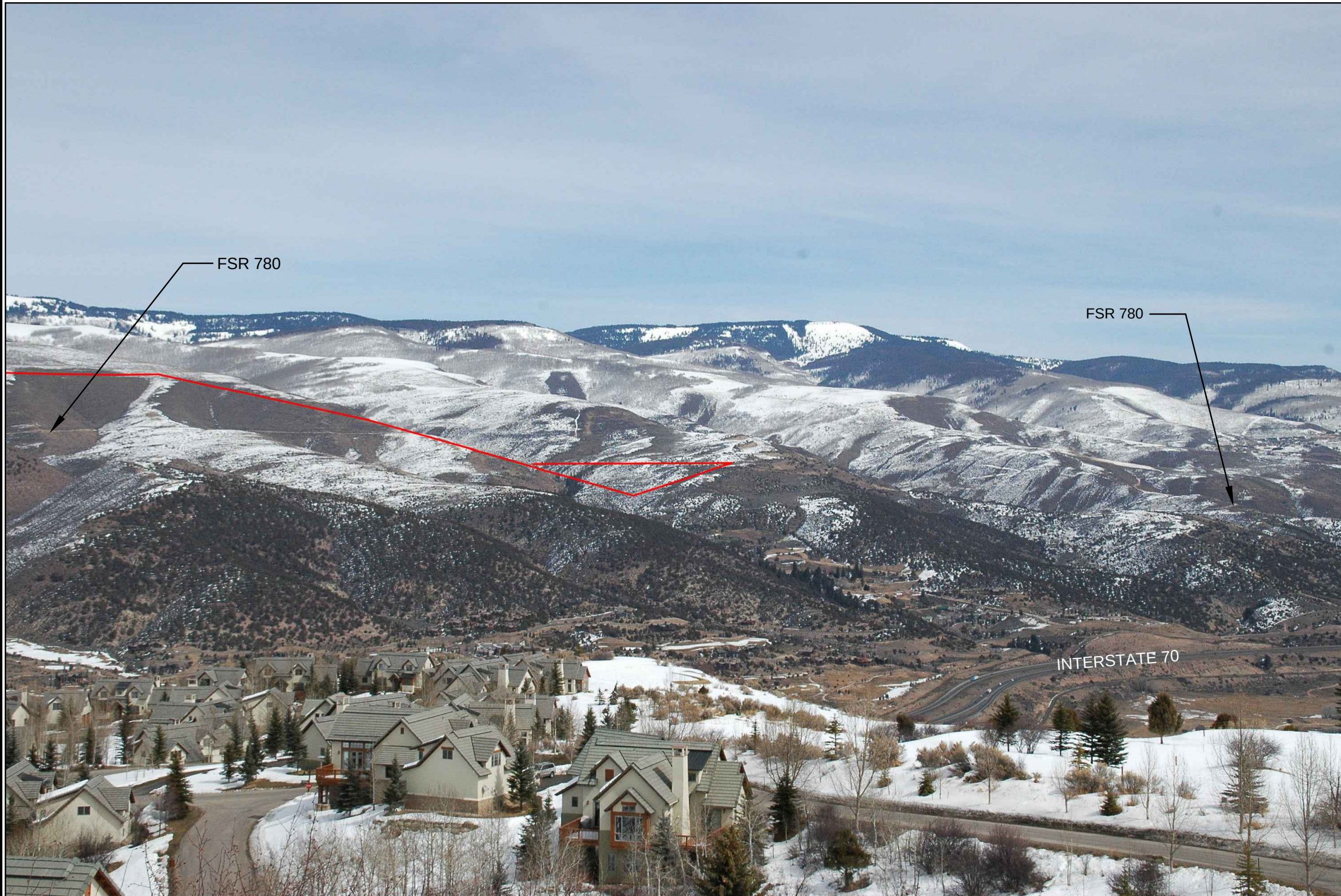
Distance From Property Boundary:
1.50 Miles

Elevation: 7,225 FT

Scale: N.T.S.

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Berlaimont Estates

Variance From Improvement Standards
July 2013
Viewpoint 3A - Cordillera
Existing Conditions

LEGEND

 Property Boundary

PROJECT DETAILS

Distance From Property Boundary:
2.69 Miles

Elevation: 8,135 FT

Scale: N.T.S.

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Berlaimont Estates

Variance From Improvement Standards
July 2013
Viewpoint 3B - Cordillera
Visual Simulation

LEGEND

 Property Boundary

PROJECT DETAILS

Distance From Property Boundary:
2.69 Miles

Elevation: 8,135 FT

Scale: N.T.S.

ALPINE
AEI
ENGINEERING INC

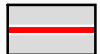
EDWARDS BUSINESS CENTER • P.O. BOX 97
EDWARDS, COLORADO 81632
• 970 926-3373 • FAX 926-3390 •



Berlaimont Estates

Variance From Improvement Standards
July 2013
Viewpoint 4A - Arrowhead
Existing Conditions

LEGEND

 Property Boundary

PROJECT DETAILS

Distance From Property Boundary:
2.53 Miles

Elevation: 7,341 FT

Scale: N.T.S.

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• 970 926-3373 • FAX 926-3390 •



Berlaimont Estates

Variance From Improvement Standards
July 2013
Viewpoint 4B - Arrowhead
Visual Simulation

LEGEND

 Property Boundary

PROJECT DETAILS

Distance From Property Boundary:
2.53 Miles

Elevation: 7,341 FT

Scale: N.T.S.

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APPENDIX A

GEOLOGY AND SOILS REPORTS

GEO-HAZ CONSULTING PHASE 1 REPORT

LITERATURE SURVEY AND PHOTOGEOLOGIC MAP, ACCESS ROAD TO BERLAIMONT PROPERTY, EDWARDS, COLORADO

J.P. McCalpin, GEO-HAZ Consulting, Box 837, Crestone, CO. 81131

EXECUTIVE SUMMARY

Based on a review of geologic literature and maps, there is some disagreement among geologists about the origin of anomalous ridge-and-trough swarms crossed by alternatives of the Berlaimont access road. Colton et al. (1975) mapped the swarms as landslide deposits, but bedrock mappers (Tweto et al., 1978; Lidke, unpublished) mapped the areas as undisturbed bedrock.

To decrease this ambiguity I made a detailed photogeologic map of the two swarms of anomalous landforms, and a reconnaissance landslide map of the larger area around Berlaimont. The southern landslide polygon of Colton et al. (1975) does contain a landslide which covers about the southern half of the polygon. That slide would be traversed by the proposed access road in Alternative 5, but not in any other Alternative.

In the northern landslide polygon all Alternatives follow the same alignment, which crosses two types of linear troughs. These troughs may reflect southward toppling of a steep south-facing slope and extension at its crest, but this cannot be confirmed without on-site studies.

It is my recommendation that a geologist familiar with evaporate karst, landslides, and deep-seated gravitational spreading examine the areas IN THE FIELD where the proposed road crosses the anomalous troughs and ridges. Such an examination might eliminate the uncertainty about the origin of the landforms, and thus also, about the degree of constraint the landforms indicate for stability of the road alignment in these spots.

LITERATURE REVIEW

I searched the published and unpublished literature for geologic maps and papers covering the project area, with an emphasis on the USFS lands between the Berlaimont property and I-70. Key maps are: (1) Colton et al. (1975) landslide map of the Leadville 1° by 2° quadrangle; (2) Tweto et al. (1978) geologic map of the Leadville 1° by 2° quadrangle; (3) Lidke geologic mapping of the Edwards 7.5' quadrangle (unpublished); and (4) regional mapping of evaporate karst by White (2003).

Landslide Mapping of Colton et al., 1975

Colton et al. mapped landslides (and other related mass-movement deposits) in the Leadville 1° by 2° quadrangle, as part of a Statewide assessment. They mapped two landslide polygons in USFS land south of the Berlaimont property (Fig. 1). The larger, northern polygon lies across the proposed road in all Alternatives. The smaller, southern polygon lies across the proposed road only in Alternative 5.

The Colton et al map, being a preliminary map product, suffers from two shortcomings. First, it was based mainly on photogeologic mapping from 1:60,000-scale aerial photographs with little to no field checking. Second, they drew polygons around not only landslides deposits, but talus fields, rocks glaciers, and many other forms of mass movement, but these are not differentiated on the map. Thus, not all of their mapped polygons are actually landslides; some are just consist of "anomalous" topography and landforms.

Fig. 2 shows the anomalous landforms that resulted in Colton et al mapping them as landslides. Each polygon contains a swarm of anomalous NE-SW ridges and troughs, some of which cross-cut other landforms such as gullies and swales. The swales are often bounded by sharp, upslope-facing scarps. These landforms do not exist anywhere else in the vicinity on ridges underlain by the Eagle Valley Formation, non-evaporite facies (see next section).

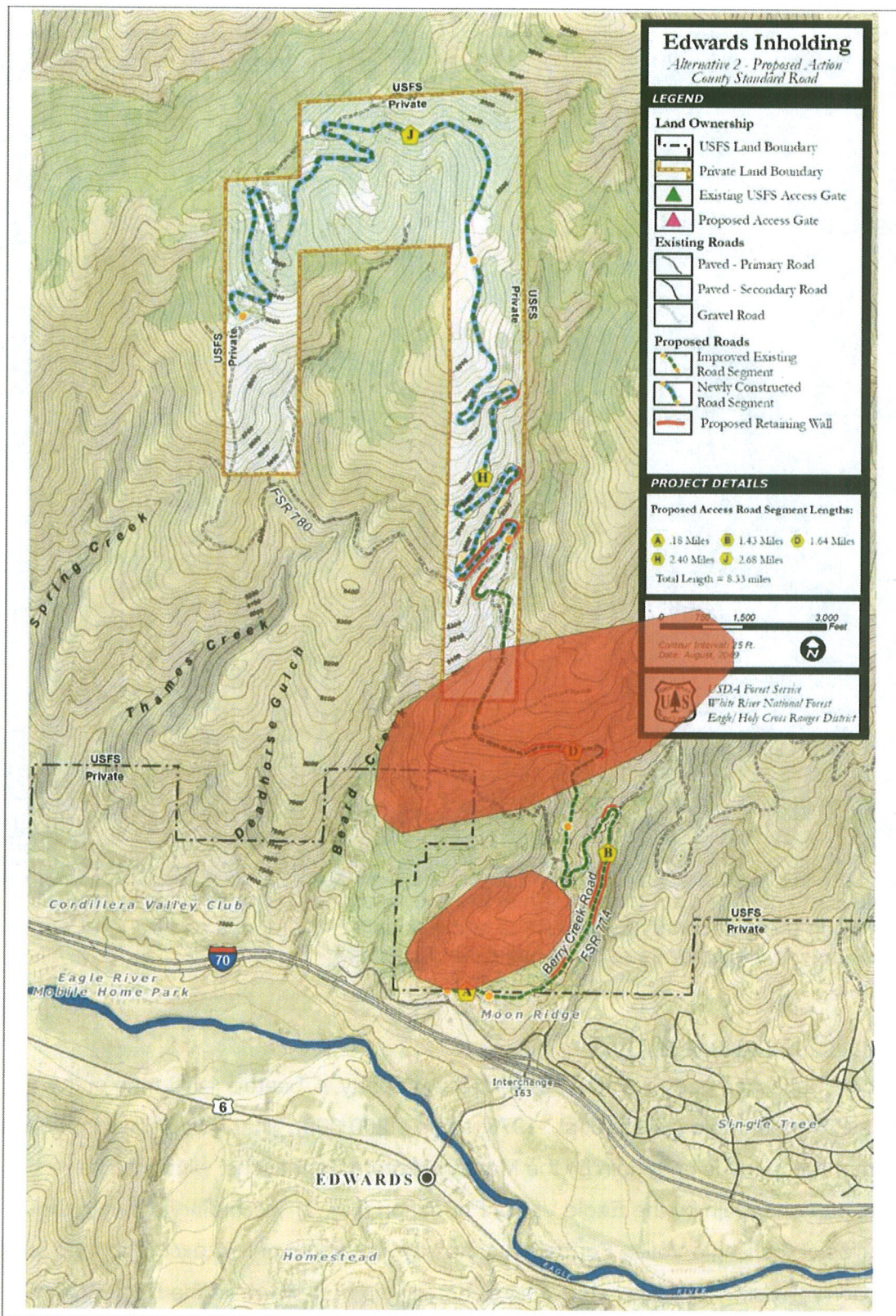


Fig. 1. Map of Alternative 2 with the landslide polygons of Colton et al. (1975) in pink.



Fig. 2. Google Earth oblique view to the north of the two landslide polygons mapped by Colton et al. (1975). Each polygon contains a swarm of anomalous NE-SW ridges and troughs, some of which cross-cut other landforms such as gullies and swales.

Geologic Mapping of Tweto et al., 1978

The most recent published geologic map covering the property is Tweto's 1978 map of the Leadville 1° by 2° quadrangle (Tweto et al., 1978; scale 1:250,000). That map shows that most of the Berlaimont property is underlain by the Maroon-Minturn Formations, with only the southernmost part underlain by the Eagle Valley Formation (Fig. 3). According to Tweto the evaporate facies of the Eagle Valley Formation generally lies south of I-70 except for one small area east of Berry Creek. The beds in this area generally dip northward, so the Eagle Valley evaporate underlies the two other formations that outcrop on USFS land and the Berlaimont property. Although Colton et al. (1975) mapped only two landslides in the eagle Valley

Formation north of I-70, they mapped numerous landslides in the formation (including the evaporate member) south of I-70.

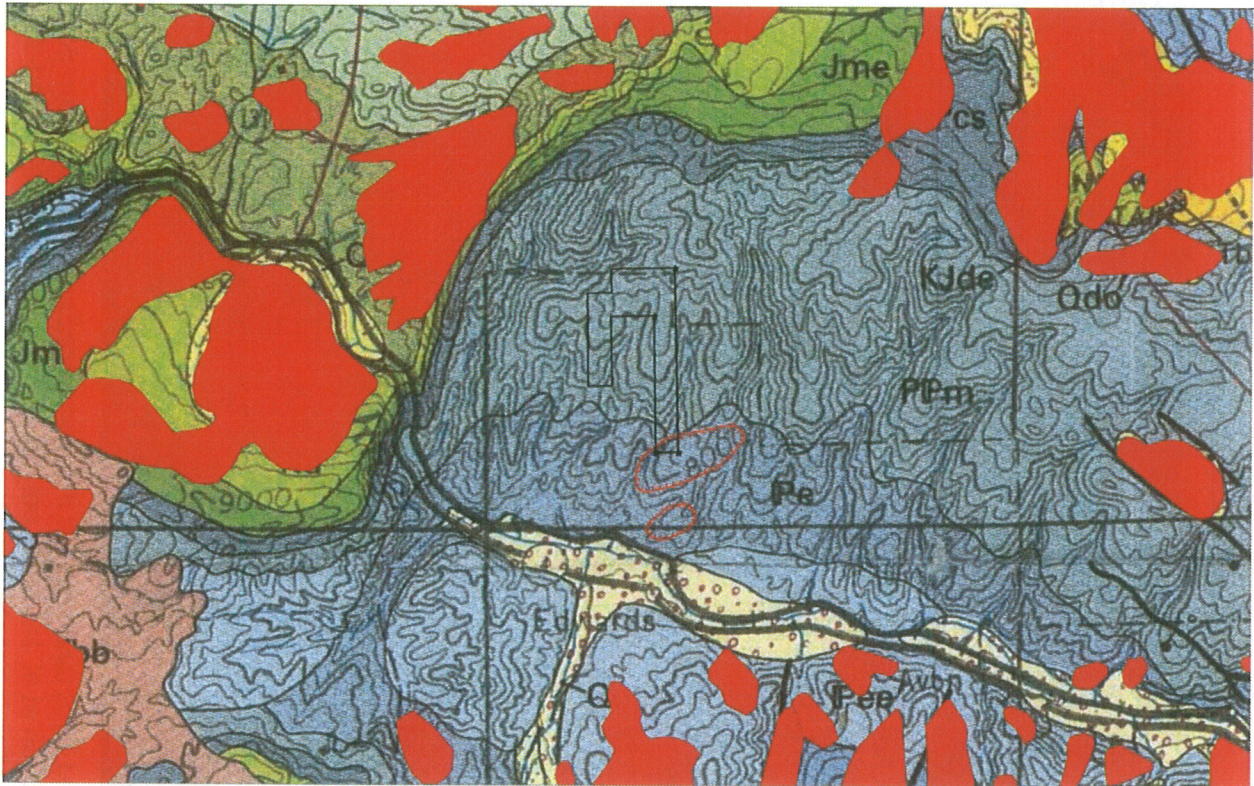


Fig. 3. Portion of geologic map of Tweto (1978) centered on the Berlaimont property (rectangle) and the town of Edwards. The two landslide polygons mapped by Colton et al. (1975) in USFS land south of the property are indicated by red ovals south of the property. Relevant bedrock formations in the project area: Pee, Eagle Valley Formation, evaporite facies; Pe, Eagle Valley Formation, non-evaporite facies; Ppm, Maroon and Minturn Formations, Undivided. Solid red polygons show other landslides mapped by Colton et al. (1975).

Detailed Geologic Mapping of Lidke, unpublished

David Lidke of U.S. Geological Survey (Denver) mapped the geology of the Edwards 7.5' quadrangle at 1:24,000-scale in 1999, but it has not yet been published. Fig. 4 shows a portion of his field compilation map covering the USFS lands south of the Berlaimont property. Lidke did not map either of Colton's two polygons as landslide deposits, although he did notice the anomalous ridges and swales. He inferred that these landforms are "bedrock" or perhaps old block slides, possibly modified by dissolution and subsidence of evaporites in the Eagle Valley Formation (Appendix 1).



Fig. 4. Unpublished 1:24,000-scale mapping of Lidke in the USFS land south of the Berlaimont property (southern portion is the rectangle at upper center). Red ovals with hachures are Colton et al. landslide polygons. Symbols show strike-and-dip of bedding in the Eagle Valley Formation. Contact with the Maroon Formation is not shown.

Regional Mapping of Evaporate Karst by White (2003)

White (2003) mapped sinkholes and other karst landforms caused by dissolution of the Eagle Valley Evaporite. He classifies the USFS land south of Berlaimont as “evaporite terrain” even though the formation at the surface is mainly the non-evaporite facies of the Eagle Valley Formation (see Fig. 3). He writes “*The evaporite terrains of the Roaring Fork and Eagle River areas are centered in areas of Neogene deformation and regional collapse, related to flowage, diapiric upwelling, and dissolution of evaporite minerals. Highly contorted strata, collapse debris, structural sag features, deformation of river terrace gravel, piercement structures, and river-centered anticlines are all geomorphic evidence of the subsidence and deformation (Kirkham and Scott, 2002).*”



Fig. 5. Locations of west-central Colorado evaporite terrain (in tan shading), regional collapse centers, and occurrences of karst features (shown as red crosses). From White, 2003.

White (2003) mapped sinkholes in the terrace alluvium north of I-70 in the USFS lands, but not up on the ridge itself. However, his "evaporate terrain" extends up on to the ridges, presumably because the evaporate facies underlies the non-evaporite facies at shallow depth.

Summary of the Literature and Maps Surveyed

Neither of the geologic maps covering USFS lands south of Berlaimont interpret landslides on the ridges, where the proposed road alignments lie in Alternatives 2-5. Two areas of anomalous ridges and troughs were included in the broad category of "landslides" by Colton et al. (1975). Given this difference of opinion, the true origin of the anomalous topography is unknown. Jon White (pers. Commun., 2009) speculated that the troughs resulted from dissolution and collapse of narrow evaporate beds in the Eagle Valley Formation.

In order to reduce the uncertainty about the origin of this topography, I made a photogeologic map that depicts individual landforms within Colton's two polygons (next section).

MY PHOTOGEOLOGIC MAPPING

Using 1:16,000-scale color aerial photos from the White River National Forest, I made a preliminary photogeologic map of the areas covered by the two landslide polygons mapped by Colton et al. (1975).

The Southern Polygon of Colton et al., 1975

Fig. 6 shows my photogeologic map of the southern polygon. The most prominent landforms are the ridges and troughs that trend roughly E-W. These ridges are parallel to three of the seven bedding-plane strikes measured in the area, which dip 15-20°N, suggesting they are controlled by bedding. However, the troughs are asymmetrical, with the downhill edge of the trough formed by a steep, linear, uphill-facing scarp. In some cases these scarps cut small gullies that trend N-S. In other words, the scarps cross-cut erosional swales of the hillslope, indicating they are both younger than the swales, and were not formed by erosion. These types of antislope scarps are the common expression of deep-seated gravitational spreading, but are also found in some types of landslides. A third explanation, less likely, is that the troughs were formed by dissolution of evaporites and collapse.

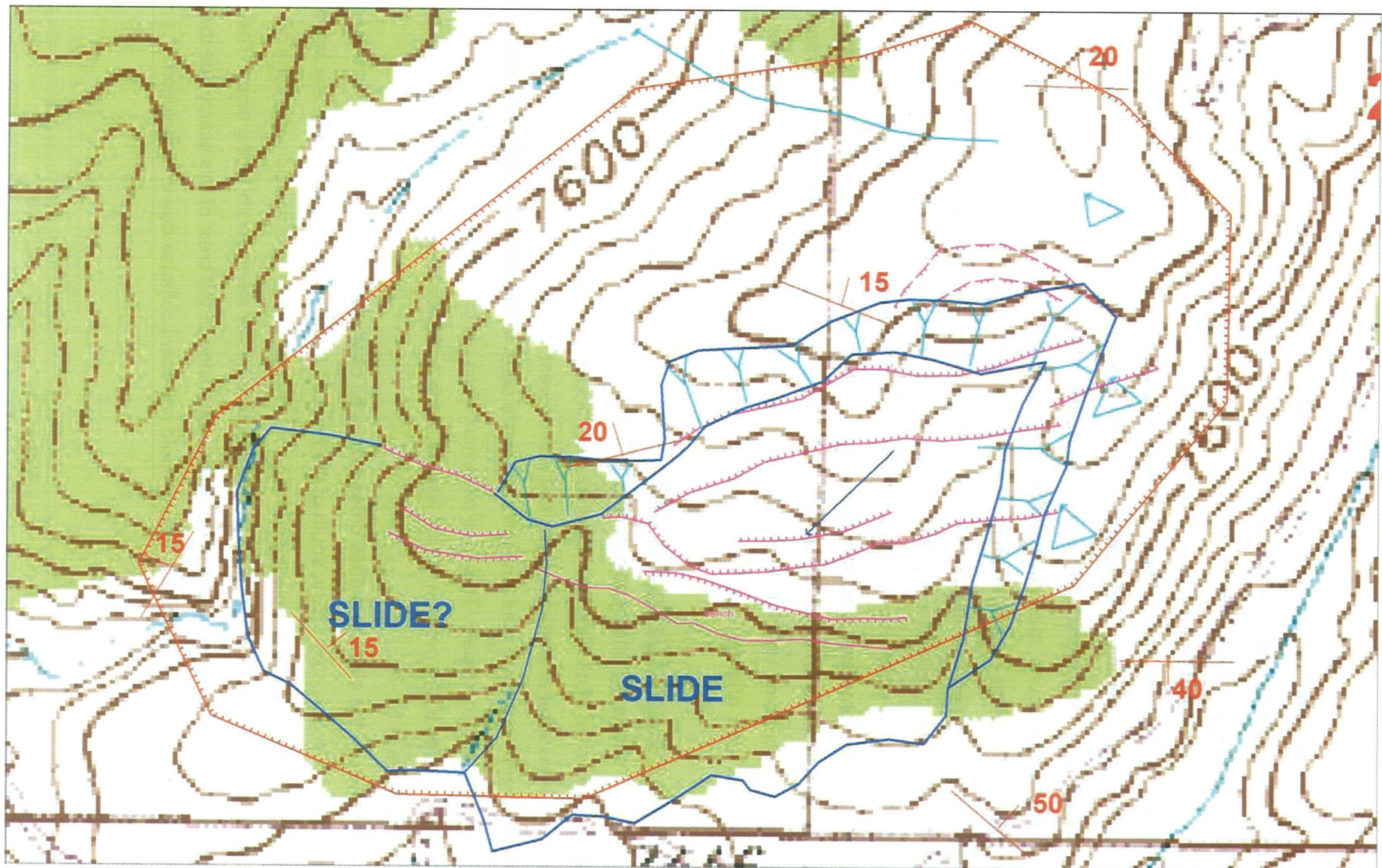


Fig. 6. Photogeologic mapping of landforms with Colton's south polygon (red line). Purple, scarps (hachures on down side); dark blue, margins of landslides; light blue, slope of landslide headscarp. Strike-and-dips from Lidke (unpub.).

The large swarm of antisllope scarps is bounded to the N and E by an L-shaped, downhill-facing, gentler scarp. I interpret this scarp as the headscarp of a landslide, probably a wedge failure along two joint planes, since bedding dips generally N into the slope here. The landslide body is shown by thick dark blue lines in Fig. 6. Note that Lidke was not able to measure any strike-and-dips on bedding in the landslide body, but was able to do so in all the areas around the slide body. This suggests that the outcrops in the slide body are poor, which would be compatible with fracturing within a landslide mass.

There is a second, queried landslide to the west of the main landslide. This block is bounded by anomalous drainages on the east and north, and contains sharp scarps at its head. The scarps at the head may indicate extension in the pull-away zone of a slide block.

In summary, I believe there IS a landslide within the southern polygon mapped by Colton et al. (1975), but the slide only occupies roughly the southern half of Colton's polygon. Unfortunately, the proposed road alignment in Alternative 5 zig-zags up across this landslide, and even has to make an extra switchback to climb over its headscarp. Therefore, Alternative 5 should not be approved until a field investigation examines the landslide, and assesses its impact on the road, and the road's impact on the landslide.

The Northern Polygon of Colton et al., 1975

Fig. 7 shows my photogeologic map of the landforms within Colton's northern polygon. The proposed road of all Alternatives enters the polygon from downslope at its south-central boundary, turns west at a hairpin curve and travels west for 2480 ft (straight-line dimension), then turns north at a triple road junction and travels north for about 2000 ft before exiting the polygon's northern boundary. This road alignment does not cross the only unambiguous landslide mapped in the polygon, which lies just north of the north-central polygon boundary (dark blue lines in fig. 7).

However, the alignment does cross two types of anomalous landforms just north and south of the triple junction. To the south of the junction the road crosses a graben-line landforms bounded by sharp scarps (purple lines on Fig. 7). This graben is an extension of a zone of similar scarps that lies farther east at the crest of a relatively steep south-facing slope. The scarps of this zone may represent deep-seated extension of the crest of this scarp, due to the slope bulging or sliding southward, or they could represent collapse due to dissolution of underlying evaporate rocks.

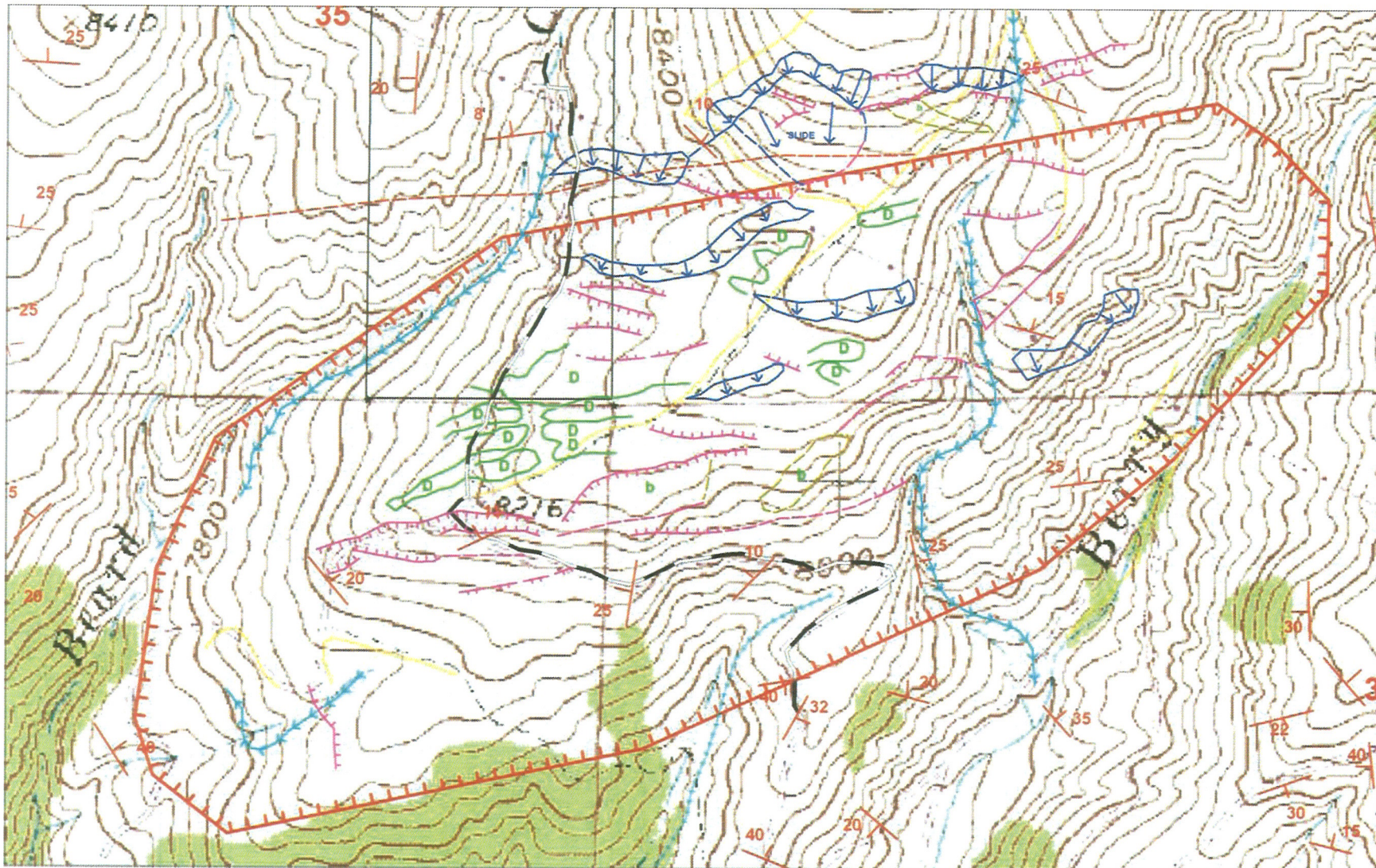


Fig. 7. Photogeologic mapping of landforms with Colton's south polygon (thick red line with hachures). Southernmost part of Berlaimont property is a black rectangle at upper left center. Road alignment of all Alternatives is shown as a thick black-white segmented line. Purple, scarp slopes (hachures on down side); dark blue, suspected landslide scarp slopes; green, linear troughs/depressions, probably created by dissolution/collapse. Strike-and-dips from Lidke (unpub.).

The road turns north at the triple junction and travels north through a 630 ft-long zone of anomalous, E-W-trending troughs that are not bounded by sharp scarp margins (green in Fig. 7). These troughs are part of an E-W-trending belt of similar landforms, each of which exhibits a semicircular head reminiscent of those formed by spring sapping. These troughs are roughly parallel to the strike of bedding measured just south of the triple junction, where beds dip 15° north. Thus, they probably represent selective dissolution of evaporate beds, although they could conceivably also represent collapse troughs such as bounded by sharper antislope scarps (the purple lines).

General Constraints on Road Construction from Evaporite Karst Dissolution and Collapse

There are two types of constraints to the proposed road alignment, assuming that my photogeologic interpretation of the landforms is correct; (1) constraints from future dissolution and collapse processes, and (2) constraints from downslope mass movement (deep or shallow landslide movement). The first constraint is well described by White (2003, p. 16-18), extracted below:

ENGINEERING CONCERNS WITH EVAPORITE KARST SUBSIDENCE

Where evaporite is exposed at the surface or underlies unconsolidated surficial deposits, karst features occur and there is potential risk that other features, currently hidden, could manifest themselves in the future. Dissolution of evaporite rock creates subsurface voids, chimney rubble and dissolution breccia zones, and fissures. Caverns, open fissures, ground depressions, and sinkholes occur at the surface, all of which can be of concern for development in the area. The hazard is probably greater in areas with higher sinkhole densities; however, future sinkholes may not be restricted to these areas. While spontaneous collapse and openings of subsurface voids can be dangerous and life threatening, such occurrences are relatively rare. More commonly, differential settlement subsidence and removal of fine-grained soils by piping into subsurface voids or fissures, with the resulting differential stress and strain to rigid structures, cause damage to facilities that are unknowingly constructed over or near sinkholes, subsidence troughs, or near-surface underground voids.

Avoidance of known subsidence features is the preferred mitigation alternative, but this is not always possible. Many areas having karst and potential sinkhole and subsidence risks lie in areas of Colorado that are experiencing heavy development pressure.....

Many older sinkholes have been covered with recent soil in-filling, or historically filled and forgotten, and are now completely concealed at the surface. Near-surface voids that have not broken through to the surface would also be similarly concealed. Subsurface investigations, either by trenching, a series of borings, or observations made during overlot grading or utility installation, can ascertain whether filled sinkholes and near-surface voids exist within a development area. Low-altitude stereo and oblique aerial photography, eyewitness reports, and historical records may also be helpful to identify filled sinkhole locations. At times, vegetation changes in aerial photography can delineate the boundaries of an ancient sinkhole that is now completely in-filled and not noticeable in the field. There are also geophysical investigation methods that can detect shallow-subsurface voids and soil/rock property changes, such as ground penetration radar, electric resistivity imaging surveys, downhole tomography, magnetic surveys, and seismic surveys.

If sinkholes, near-surface voids, or filled sinkholes are detected and located, an experienced geotechnical firm should be retained to evaluate the hazard and risk potential for future subsidence on the property. On a number of occasions, evaporite bedrock voids have been encountered during

excavation of grading and foundation footprints..... There are ground modification and structural solutions to mitigate the threat of subsidence if avoidance is not an option. Owners and developers should consult with knowledgeable geotechnical and structural engineering firms and ground modification specialty contractors.

Drainage issues and proper water management are important in evaporite karst terrain. Because the bedrock and gypsiferous soils derived from them are soluble, changed hydrologic conditions and increases in fresh water may destabilize certain subsidence areas, rejuvenate older sinkhole locations, or cause new dissolution to occur.....

The second constraint, that of landslides caused by evaporite beds on slopes, is less well-documented in the scientific literature. Alberto et al. (2008) describe such landslides in Europe:

"Moreover, in such high-relief areas, often the [evaporate] dissolution is followed by slope gravitational processes (landslides and Deep-seated Gravitational Slope Deformations — DSGSD, [Dramis and Sorriso-Valvo, 1994](#)). In some cases dissolution can be interpreted as the primary cause of slope instabilities, in others it amplifies their effects ([White, 1988](#)). There are different factors conditioning the activity of DSGSD.....including geological factors ([Varnes et al., 1989](#)), tectonic factors, such as the characteristic and the orientation of the discontinuities....., glacial erosion and retreat....., but only few studies concerning the importance of deep dissolution have been carried out ([Wu, 2003](#))....."

Several slopes of the studied area show stepped profiles, both transversally and longitudinally compared to the main valley. Transversally, the following can generally be observed: a series of scarps and counterslope scarps of gravitational-origin, which at times correspond to structural discontinuities linked to the main valley systems....."

The "scarps and counterslope scarps" described by Alberto et al. are similar to the scarps observed in the southern polygon (where I infer they are related to landsliding), and in the northern polygon (where their origin is unclear). Fig. 8 shows a schematic cross-section showing how such scarps are related to deeper landsliding in evaporate terrains of Italy.

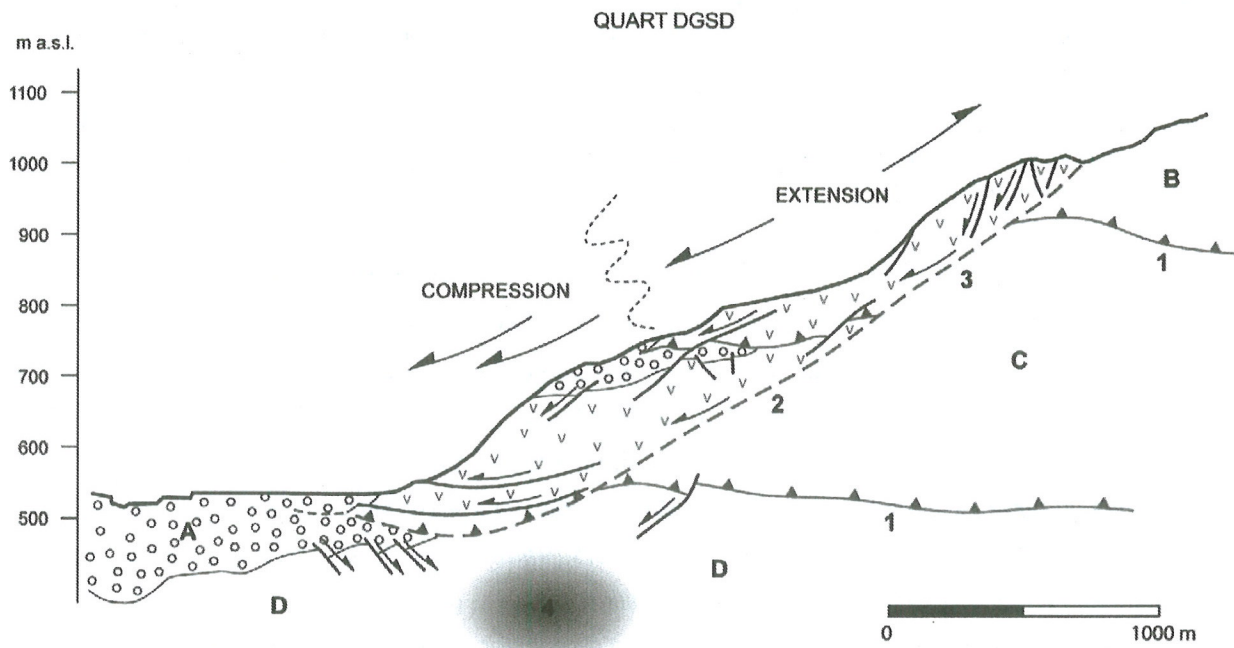


Fig. 8. Transversal profile of the Quart DSGSD (Aosta Valley, Italy; from Alberto et al., 2008). 1) Pre-existing planar shear zone; 2) multi-event gravitational sliding plane; 3) single-event gravitational sliding plane; 4) volume reduction zone. A: Quaternary deposits (glacial, fluvio-glacial, fluvial); B, C, D: different tectonic units of pre-Quaternary bedrock (modified from: Giardino, 1995).

In addition to the landforms mapped within Colton's two polygons, I also mapped three large landslides on the eastern wall of Berry Creek (Fig. 9). None of these slides impact the proposed access road to Berlaimont, but they do show that landslides can and do occur in the Eagle Valley and Maroon/Minturn Formations, in numbers and sizes that are currently under-represented by published geologic maps. Therefore, the possibility that the anomalous scarps mapped herein across proposed road alignments were in fact caused by downslope landslide movement cannot be discounted at present.

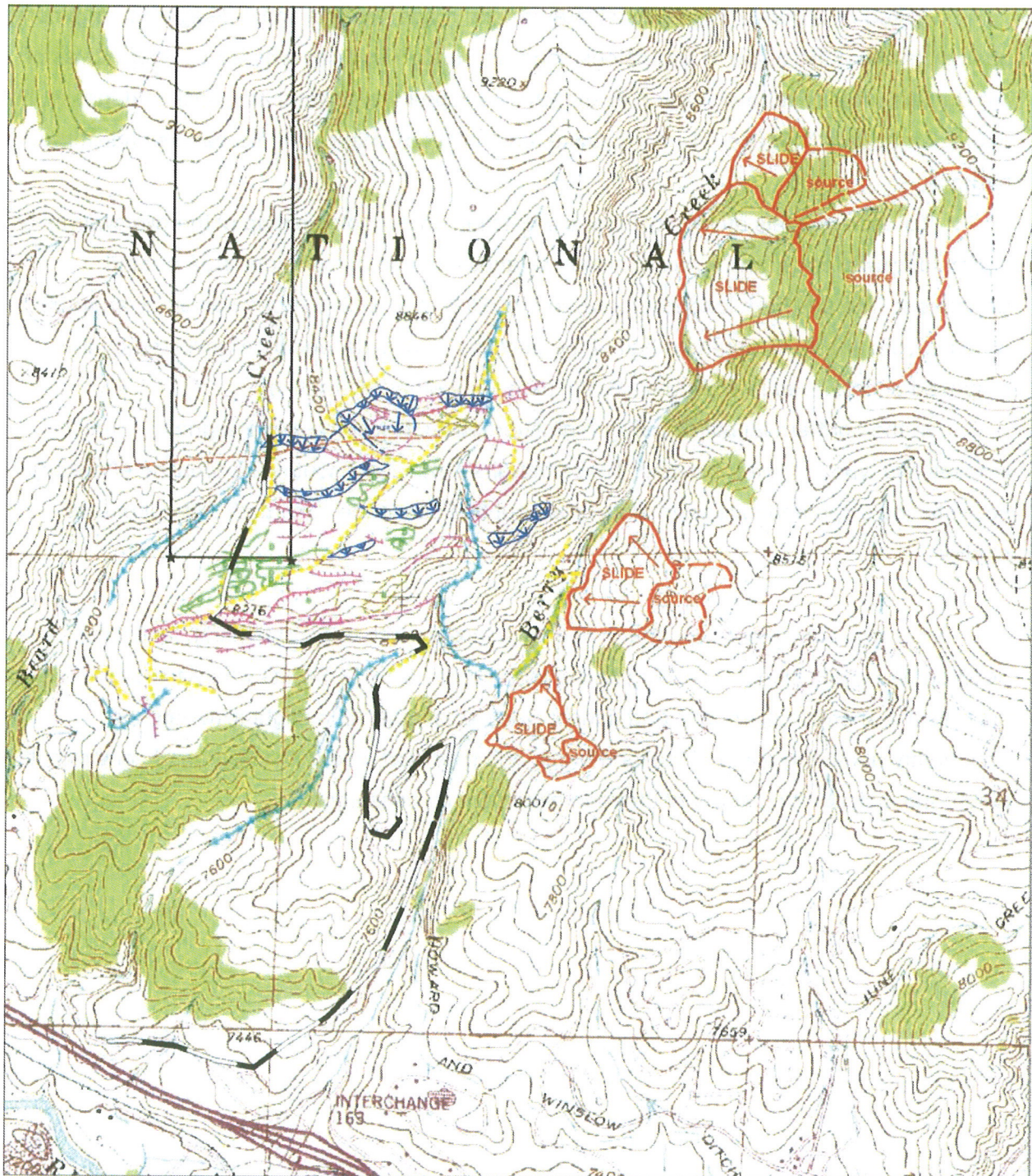


Fig. 9. Photogeologic map showing three large, previously unmapped landslides (in red) on the east wall of Berry Creek. The lower part of the access road to Berlaimont is shown as a thick, black-and-white segmented line. The south end of the Berlaimont property is shown as a black-rimmed rectangle at upper left. Scarps of the northern polygon of Colton et al. (1975) are shown in various colors.

CONCLUSIONS AND RECOMMENDATIONS

Based on a review of geologic literature and maps, there is some disagreement among geologists about the origin of anomalous ridge-and-trough swarms crossed by alternatives of the Berlaimont access road. Colton et al. (1975) mapped the swarms as landslide deposits, but bedrock mappers (Tweto et al., 1978; Lidke, unpublished) mapped the areas as undisturbed bedrock.

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It is my recommendation that a geologist familiar with evaporate karst, landslides, and deep-seated gravitational spreading examine the areas IN THE FIELD where the proposed road crosses the anomalous troughs and ridges. Such an examination might eliminate the uncertainty about the origin of the landforms, and thus also, about the degree of constraint the landforms indicate for stability of the road alignment in these spots.

REFERENCES

- Alberto, W., Giardino, M., Martinotti, G., and Tiranti, D., 2008, Geomorphological hazards related to deep dissolution phenomena in the western Italian Alps; Distribution, assessment, and interaction with human activities: *Engineering Geology*, vol. 99, p. 147-159.
- Colton, R.B., Holligan, J.A., Anderson, L.W. and Patterson, P.E., 1975, Preliminary map of landslide deposits, Leadville 1 degree by 2 degree quadrangle, Colorado: U.S. Geol. Survey Map MF-701, scale 1:250,000.
- Dramis, F., Sorriso-Valvo, M., 1994. Deep-seated gravitational slope deformations, related landslides and tectonics. *Eng. Geol.* 38, 231B243.
- Tweto, O., Moench, R.H. and Reed, J.C. Jr., 1978, Geologic map of the Leadville 1 degree by 2 degree quadrangle, Colorado: U.S. Geol. Survey Map I-999, scale 1:250,000.
- Varnes, D.J., Radbruch-Hall, D.H., Savage, S.Z., 1989. Topographic and structural conditions in areas of gravitational spreading of ridges in the Western United States. *U. S. Geol. Surv. Prof. Pap.* 1496, 28.
- White, J. L., 2003, Evaporite karst subsidence hazards in Colorado, *in* Boyer, D.D., Santi, P.M. and Rogers, W.P. (eds.), *Engineering Geology in Colorado: Contributions, Trends, and Case Histories*: Colo. Geol. Survey Special Publication 55 (CD-ROM), 21 p.
- White, W.B., 1988. *Geomorphology and Hydrology of Karst Terrains*. Oxford University Press, p. 464.
- Wu, Y., 2003. Mechanism analysis of hazards caused by the interaction between groundwater and geo-environment. *Environ. Geol.* 44, 811B819.

APPENDIX 1

FROM: David J Lidke [dlidke@usgs.gov]
DATE: Monday, August 31, 2009 4:45 PM
TO: James McCalpin
SUBJECT: Re: Edwards quad, weird landslides
Attachments: Imagery.jpg; Compilation.jpg

Hi Jim,

I've looked some at my air photos, notes, etc., for the region of the weird landslides you're wondering about. I've attached two .jpg files that show NAIP color imagery for that area (maybe you already have this, if not I can tell you where to get it) and show my compilation of that area as it currently exists (mostly attitudes, see below). I do see some odd surface morphology in the two areas that Colton mapped as landslides and that morphology is no doubt what caused them to map these areas as landslides. The northern area is the most suspicious looking, but when I look at it in stereo it looks far less odd and I am fairly certain that it's essentially bedrock--it could represent old block-slides, but I don't think so. The southern area I think is obviously bedrock and I think the ENE-trending linear features in the SE part of the southern area are related to faulting, but I don't know that for sure. I know I crossed the northern area, but I don't have any points or notes from that area and at this point I don't recall any specific thoughts about that area from the mapping I did 10 years ago. I'm pretty certain that the northern area is bounded to the north by an WNW-trending fault, which I found some lithified breccia along--you can see it's trace fairly well in the imagery.

As you probably know, the underlying bedrock in this area is Eagle Valley Formation/Minturn Formation--these two in part laterally equivalent Pennsylvanian Formations interfinger in this area and it was (and still is) difficult for me to decide which is really dominant in this area (also see Tweto's Leadville quad).

Another problem I was having in this area, was getting a good handle on the folding and faulting in this area, which is at least partly expressed in the crazy attitudes--some are apparent in the attached .jpg file.

Regionally, the Penn-Perm and younger units dip gently to moderately northward in the area north of I-70, but particularly in the lower part of the section (e.g., the Eagle Valley/Minturn Formations) there is obvious folding and faulting. I think much or all of that deformation is tectonic (Laramide?), but it's also possible that some of it is evaporite-related deformation from large-scale dissolution and/or movement of evaporite in the underlying Eagle Valley Evaporite that is mapped as a Formation in this region (again, see Tweto's Leadville quad).

I hope this is of some help to you. If I think of anything else I'll let you know, and please feel free to call or email me again if you'd like to talk more about this area. I'd definitely like to take another look at some parts of the Edwards quadrangle (such as this area) as well as publish the quadrangle. Hopefully, I'll at least be able to do the latter even if the product would no doubt have flaws.

Cheers,
Dave

David J. Lidke
U.S. Geological Survey
Box 25046, Federal Center, MS-980
Denver CO 80225
Phone 303-236-1286; Fax 303-236-5349
dlidke@usgs.gov

GEO-HAZ Consulting, Inc.

From: "James McCalpin" <mccalpin@geohaz.com>
To: <dldike@usgs.gov>
Date: 08/31/2009 11:19 AM
Subject: Edwards quad, weird landslides

David,

I've attached a JPEG showing the southern part of the Edwards quad, with Colton's 1976 landslides overlaid.

I made the 2 weird landslides in question, the ones north of I-70, a semi-transparent red fill so you can see the contours beneath the polygons.

Anything you can tell me about the geology of these two polygons would be appreciated.

Thanks-----jpm

James P. McCalpin
GEO-HAZ Consulting, Inc.
P.O. Box 837
600 E. Galena Ave.
Crestone, CO 81131 USA
office 719-256-5227
mobile 719-588-4279
www.geohaz.com

[attachment "Colton slides LoRes.jpg" deleted by David J Lidke/GD/USGS/DOI]

GEO-HAZ CONSULTING PHASE 2 REPORT

GEOLOGIC RECONNAISSANCE OF THE BERLAIMONT ACCESS ROAD, EDWARDS, COLORADO

J.P. McCalpin, GEO-HAZ Consulting, Box 837, Crestone, CO 81131
05-OCT-2009; Job. No 2127

EXECUTIVE SUMMARY

The owners of the 680-acre Berlaimont inholding wish to create a full-width, paved 2-lane road through National Forest Lands to access their parcel. GEO-HAZ (2009) performed a Phase 1 study of the geologic setting of the access road as part of the NEPA process, and discovered that U.S. Geological Survey (Colton et al., 1975) had mapped two landslides across parts of the proposed alignment (Fig. 1). However, two later geologic maps (Tweto et al., 1978; Lidke, unpublished) did not map these same two areas as landslides. To resolve the geological uncertainty and geohazard constraints on road alternatives, we performed a this Phase 2 study of field checking on Sept. 28, 2009.

Based on our field observations, we conclude the following:

ALL ALTERNATIVES (2, 3, 4, 5): The linear scarps and grabens crossing the road alignment of all Alternatives in the USGS northern "landslide" polygon evidently formed by an evaporite dissolution/subsidence process sometime in the Quaternary. The process does not appear to be currently active, although movement on the grabens appears to be younger than that on the east-west troughs. Even when the subsidence process was active it was probably a slow, discontinuous process, active only during periods of extreme precipitation. Therefore, in our opinion it does not constitute a hazard to life safety nor a serious geological constraint to road building.

ALTERNATIVE 3: There are two anomalous landforms on Thames Creek that could be the result of old evaporate subsidence. However, the landforms look old (before the late Quaternary) and no sign of contemporary subsidence could be found in the stream alluvium.

Therefore, we do not think that Alternative 3 is limited by any geological constraints in the Thames Creek area.

ALTERNATIVE 4: Segment G of the Alternative 4 alignment will traverse a west-facing slope on the eastern side of Thames Creek. Inslope cuts, even if they do encounter bedrock, should not underline the bedding layers because dip appears to be to the north here, not to the west. Therefore, we do not think that Alternative 4 is limited by any geological constraints in the Thames Creek area.

ALTERNATIVE 5 (Southern slide polygon): The linear scarps crossing the southern Alternative 5 road alignment, in the USGS southern "landslide" polygon, evidently formed by an evaporite dissolution/subsidence process sometime in the late Quaternary. The process may be ongoing currently on the northernmost mapped scarp (S1), based on the steep unvegetated appearance of the eastern half of that scarp. Field reconnaissance could not distinguish whether past displacement episodes were rapid or a slow, progressive subsidence process. The apparently large and recent displacement on the eastern half of scarp S1 may not constitute a life safety hazard, but would constitute a significant maintenance issue if movement occurred during the lifespan of the road. *To avoid such problems, we suggest that the original Alternative 5 alignment be shifted in part to the west, so that it ascends the western half rather than the eastern half of scarp S1.*

PROPOSED ACTION AND PREVIOUS WORK

The owners of the 680-acre Berlaimont inholding wish to create a full-width, paved 2-lane road through National Forest Lands to access their parcel. All four road alternatives identified by the U.S. Forest Service traverse Forest land between I-70 and the southern boundary of the inholding. Upgrading the road would be a significant Federal action under NEPA.

GEO-HAZ (2009) performed a Phase 1 study of the geologic setting of the access road as part of the NEPA process, to look for any geologic constraints that might favor one alignment alternative over another. We discovered that U.S. Geological Survey (Colton et al., 1975) had mapped two landslides across parts of the proposed alignment (Fig. 1). However, two later geologic maps (Tweto et al., 1978; Lidke, unpublished) did not map these same two areas as landslides. The area is underlain by the Eagle Valley Formation, a gypsum-rich formation that is widely affected by dissolution, and subsidence (White, 2003). Thus, a competing interpretation was that the "landslides" mapped by USGS were actually evaporate subsidence features. The two alternative origins pose different types of geo-constraints on road construction and maintenance.

To try to resolve the conflicting interpretations, GEO-HAZ performed additional photogeologic mapping within the Phase 1 study on stereoscopic aerial photos. The end result of the the remote sensing study was inconclusive, however. The morphology of the features visible by on airphotos could be interpreted as the result of landsliding or of evaporate dissolution and subsidence.

After we completed the Phase 1 study, HP Geotechnical issued a draft geotechnical report (HP, 2009a) and a final report (HP, 2009b) on the geology and geotechnical engineering of the roadway. However, they used only Tweto (1978) as their geology source, and did not acknowledge the Colton et al. (1975) landslide mapping.

To resolve the uncertainty about the landform's origin, and thus the geohazard constraints on road alternatives, we performed a Phase 2 study of field checking on Sept. 28, 2009. The results of that study are contained in this report.

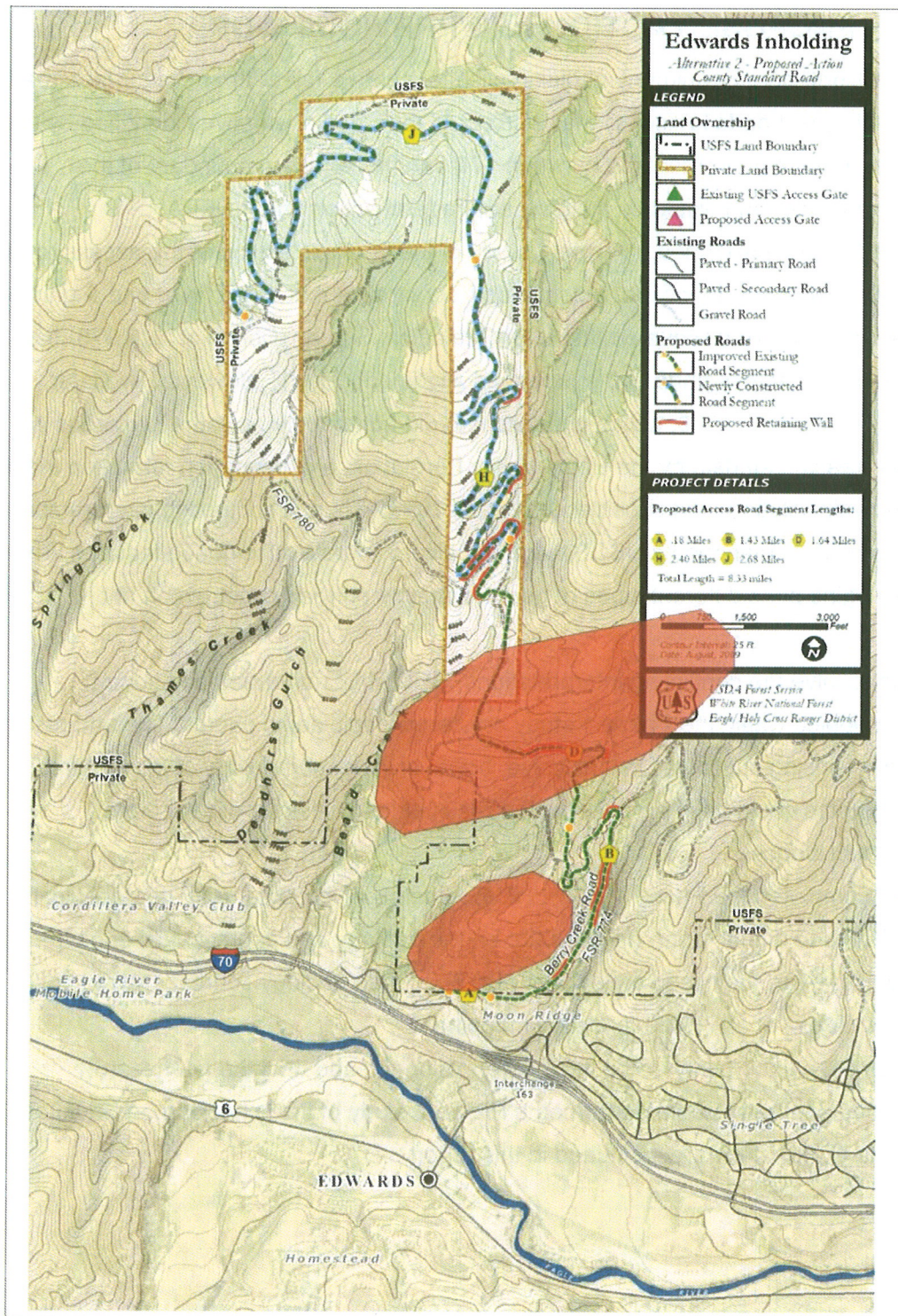


Fig. 1. Map of Alternative 2 with the landslide polygons of Colton et al. (1975) in pink.

THE NORTHERN SLIDE POLYGON OF COLTON ET AL. (1975)

The proposed road alignment in all four Alternatives enters the northern "landslide" polygon at its south-central boundary, turns west at a hairpin curve and travels west for 2480 ft (straight-line dimension), then turns north at a triple jeep road junction and travels north for about 2000 ft before exiting the polygon's northern boundary (Fig. 2). The entire road alignment in the northern slide polygon is within road segment "D" and follows an existing jeep road.

The road alignment crosses two types of anomalous landforms just north and south of the triple junction, as identified in our Phase 1 geologic report (GEO-HAZ, 2009). Depending on the origin and age of these features, they may pose a geologic constraint to road building and maintenance. Just south of the triple junction the road crosses a graben-like landform (purple lines, Fig. 2) bounded by a sharp scarp on its northern side. The road then turns north at the triple junction and travels north through a 630 ft-long zone of anomalous, E-W-trending troughs (green lines, Fig. 2) that are not bounded by sharp scarp margins.

The Graben at the Triple Junction

The graben at the triple junction trends E-W and is 450 ft long and 100 ft wide (Fig. 2). It is a small component of a zone of sharp, young-looking scarps and grabens that trends NNE, is 3300 ft long and 400-450 ft wide (all purple lines on Fig. 2). The purpose of our field reconnaissance was twofold: (1) to determine if this graben was related to landsliding or evaporate subsidence, and (2) to determine if the graben was a young, active feature or an old, exhumed bedrock feature.

The graben is asymmetrical, with a northern boundary scarp 3-10 ft high and a southern boundary scarp 1.5-3 ft high (Fig. 3). The higher northern boundary scarp crosses the present jeep road (and future alignment of road segment D) at the triple junction, where it forces the road to ascend about 6 ft. Along the crest of the scarp east of the road, Minturn sandstone beds are subhorizontal. However, the scarp face itself is primarily a dip slope formed by beds of sandstone dipping 42° south (Fig. 3). The transition from subhorizontal beds to steeply south-dipping beds is abrupt and occurs at the crest of the scarp. In places a tension fissure exists between the two dip domains, such as formed at the crest of a monocline. Thus, the overall structure of the northern boundary scarp is that of a segmented (or articulated) monocline, similar to that observed over active normal faults such as the Pajarito fault (McCalpin, 2005).

Along the crest of the southern boundary scarp east of the road, Minturn sandstone beds are likewise subhorizontal. However, within the graben itself there is an outcrop band of Minturn sandstone identical to that exposed on the northern scarp face, in which sandstone beds dip 15° N (Fig. 3). The remainder of the graben floor is covered by fine Quaternary sediment.

Based on the sharpness of the northern monocline and its crestal tension fissure, we do not believe that the graben is the expression of an old fold that has been exhumed by erosion. Instead, its morphology and sharpness is similar to that along active Quaternary faults such as the Paajrito fault cited previously. At the Pajarito fault tilted slabs form the margins of a graben, and were formed by near-vertical displacement on underlying steeply-dipping normal faults. This interpretation of the segment D graben is shown at left center in Fig. 3.

The young fault movement here is restricted to the 1 mile-wide ridge between Berry and Beard Creeks, so does it not have the appearance of a tectonic normal fault, which would have a much longer extent than 1 mile. In addition, no Quaternary faults have been mapped anywhere near this location (USGS, 2009). Therefore, the most likely origin for the graben is evaporite subsidence (e.g. White, 2003). Its sharpness suggests the subsidence occurred after the major erosional shaping of the ridge, which probably dates from the latest Tertiary to earliest Quaternary. However, there are no cracks in the present jeep road where it crosses either the northern or southern boundary scarps, so the subsidence process does not appear to have been active since the latest road grading.

The Zone of East-West-Trending Troughs

The northern half of the proposed road alignment within the northern "landslide" polygon is crossed by three east-west-trending troughs (green lines in Fig. 2). These troughs appear to be older, more subdued versions of the grabens described previously. Each trough heads in a curved, amphitheater-shaped bowl, and landform often created by sapping-type collapse. We infer that these troughs were also created by an evaporate subsidence process, although bedrock exposures were too poor along their margins to confirm that their structure is identical to the younger grabens. From their more subdued appearance, we infer that these troughs are older than the younger troughs and quit subsiding longer ago. In addition, their total amount of subsidence may be less than the younger troughs. For both of these reasons the troughs are considered to be even less of a geologic constraint to roads than the younger grabens.

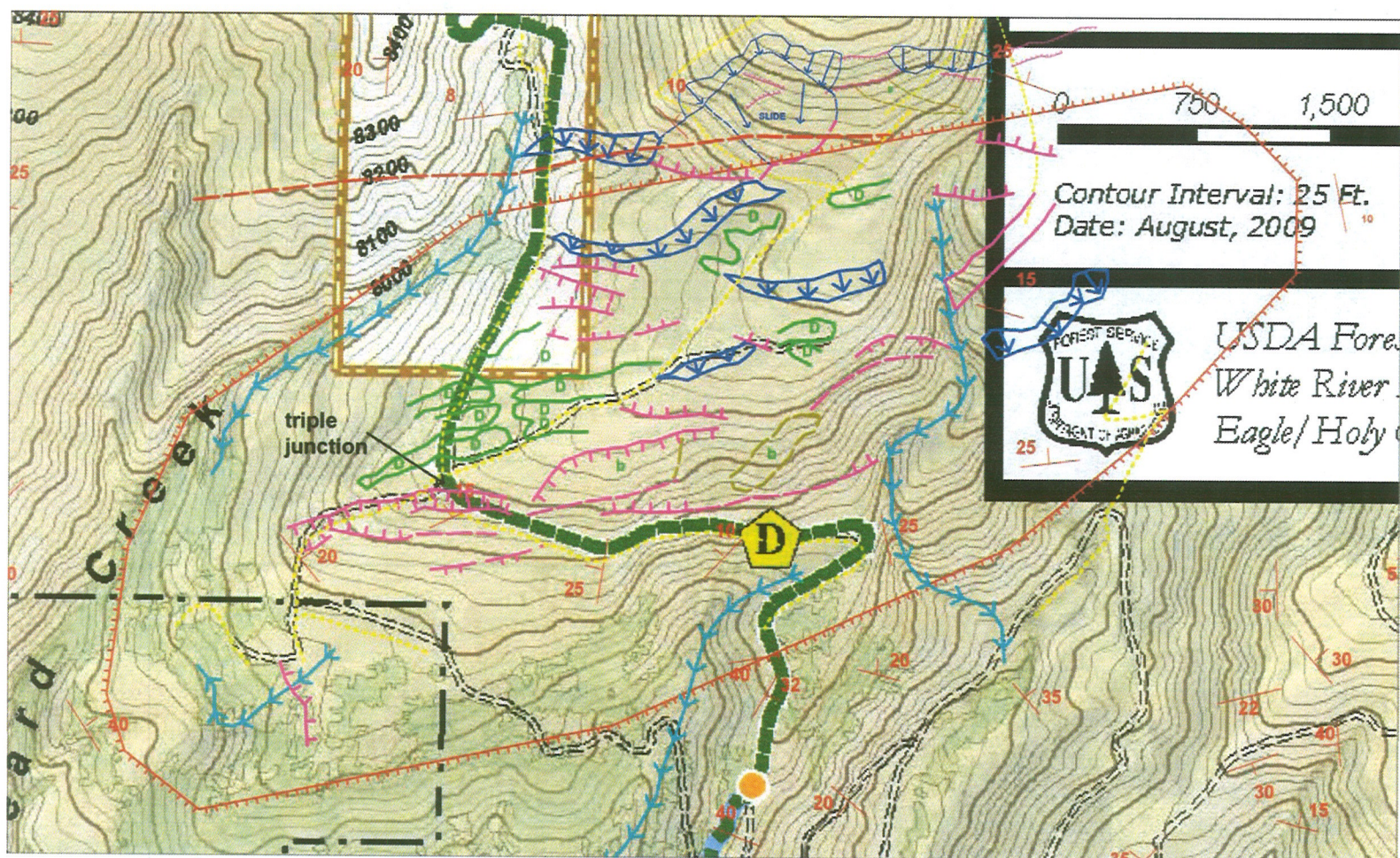


Fig. 2. Geologic map of the northern "landslide" polygon. Road alignment in all 4 alternatives is the thick green line. Boundary of the Colton et al. (1975) northern "landslide" is shown by red line with hachures. Purple lines show young-looking scarps and grabens; green lines show older linear depressions; dark blue lines are older south-facing scarps. Light blue lines show selected drainages. Red strike-and-dip symbols shown bedding orientation from Lidke (unpublished).

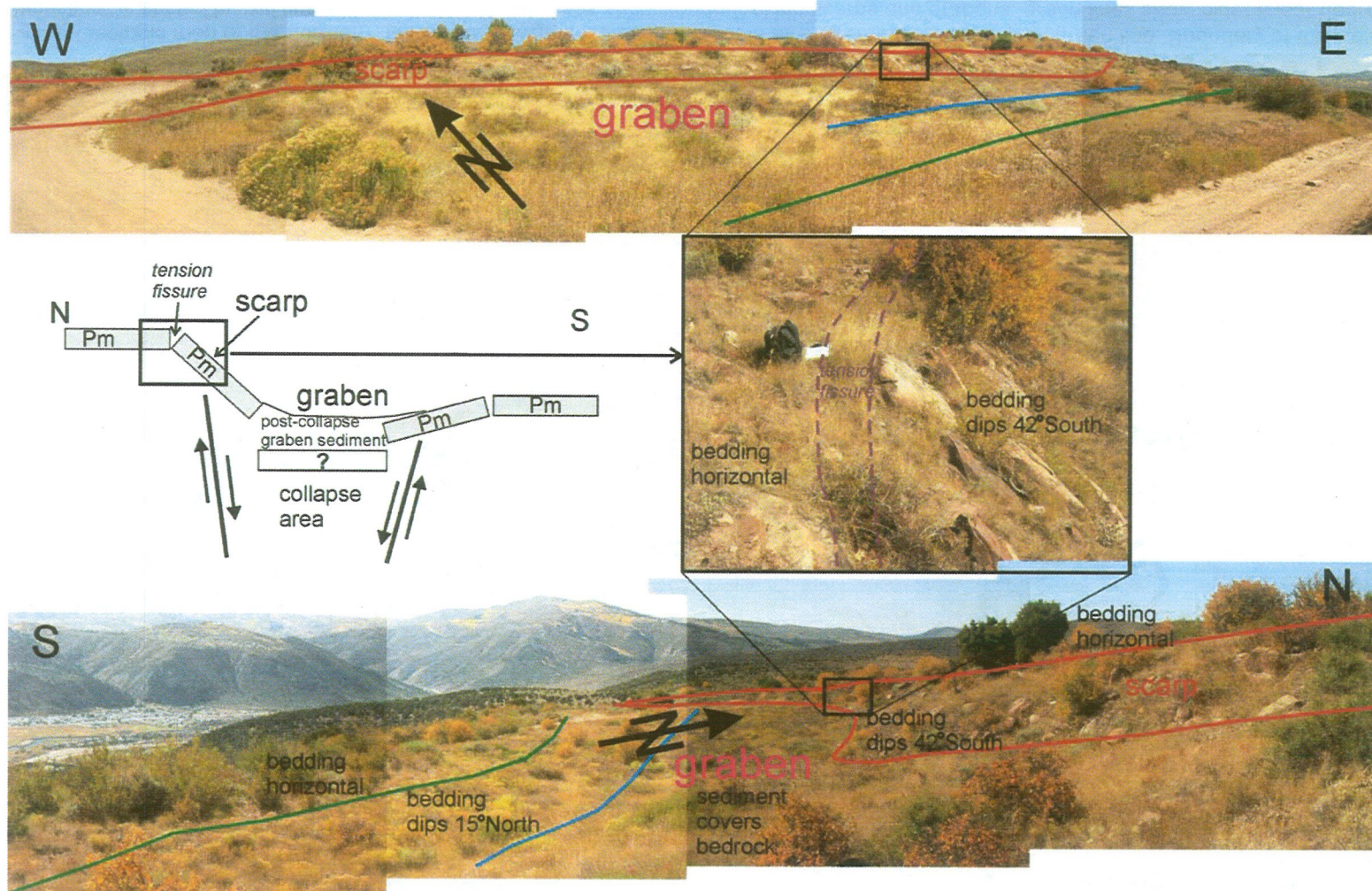


Fig. 3. Views of the graben that crosses road segment D. Top panorama looks north; existing road is visible, triple junction is at far left. Bottom panorama looks west; triple junction is at center (above north arrow). Photo at right center shows the scarp is formed by south-tilted slabs of Minturn sandstone. Drawing at left center shows our interpretation of how the graben was formed by subsidence, probably due to evaporate dissolution.