Project Technical Memorandum Examples

Introduction

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Guanella Pass Road is located within the Pike and Arapaho National Forests, and Park and Clear Creek Counties, beginning at U.S. 285 in Grant and proceeding in a northerly direction over Guanella Pass to Georgetown. The overall project is approximately 38.2 kilometers (23.7 miles) long. The first phase of the overall project [CO PFH 80-1(1) & 2(2)] is located on the center portion of the overall corridor, and involved the rehabilitation or reconstruction of approximately 14.2 kilometers (8.8 miles) of roadway. Included were retaining walls, parking areas, guardrail, improved drainage structures and varied surfacing. This first phase is scheduled for completion in 2007. The remaining portions involve the rehabilitation or reconstruction of approximately 24.0 kilometers (14.9 miles) of roadway with additional retaining walls, parking areas, guardrail, improved drainage structures and varied surfacing. The approximate stations of the Phase 2 project are from 1+000 through 16+000 (Segment 1) and from 30+240 through 39+200 (Segment 2). Also included in the project are minor improvements within the Town of Georgetown starting from the end of the main project and progressing along the haul route to the intersection of Argentine Street and 15th Street.
The Central Federal Lands Highway Division (CFLHD) of the Federal Highway Administration (FHWA), in cooperation with the U.S.D.A Forest Service (USFS) in the Tonto National Forest (TNF), and Gila County, Arizona are proposing to reconstruct (4R) a portion of roadway within the Tonto National Forest. The reconstruction work is a continuation of the previous Forest Highway 512 project and consists of approximately 9.957 km of road reconstruction, drainage improvements, and grading.
The Central Federal Lands Highway Division (CFLHD) of the Federal Highway Administration (FHWA), in cooperation with the United States Forest Service (USFS) is proposing to reconstruct approximately 6.13 kilometers (3.81 miles) of Trinity County Route 114 from approximately milepost 10.4 to milepost 14.3. The project reconstruction entails repaving, widening, modifying alignment, grading and drainage for the CA FH /County Road 114, Hyampom Road. Hyampom Road/County Route 114 is classified as a major rural collector highway. The county route is broken into 6 segments. The proposed construction for this project encompasses the entire length of segment 5. Segment 5 is an existing single lane section proposed to be widened to two full lanes to be contiguous with the rest of the route

3R Examples

The Central Federal Lands Highway Division (CFLHD) of the Federal Highway Administration (FHWA), in cooperation with the National Park Service (NPS) is proposing to rehabilitate the pavement and drainage conditions for CO PRA MEVE 10(8) & 200(1), Chapin Mesa and Wetherill Mesa Roads. This project will consist of the rehabilitation, restoration, and resurfacing (3R) of approximately 9.50 miles of Route 10 from Park Point Overlook to the Park Headquarters Loop Intersection. This project will also include the temporary pavement preservation of approximately 12.33 miles of Route 200, beginning at Route 10, and continuing to the Wetherill Mesa parking area. Also included are the rehabilitation of guardrail, curb and various drainage structures.

The Chapin Mesa and Wetherill Mesa Roads project is located about 11 miles east of the City of Cortez, Colorado on US 160. The proposed project is in rolling and mountainous terrain. Elevation is approximately 8000 ft. The routes are wholly within Mesa Verde National Park.

These projects were originally scoped in 2002 as part of a much larger project to rehabilitate most of the paved roads at Mesa Verde National Park. The larger project was delayed and national funding constraints necessitated the larger project be broken back out into smaller projects. This project is a result of that repackaging.

Due to funding constraints, this project will be further divided into three schedules. Schedule A will consist of spot overlays and patching on Chapin Mesa Road between the park entrance and Park Point Overlook, all the improvements to Wetherill Mesa Road, and the Chapin Mesa Road improvements from just South of the intersection with Wetherill Mesa Road to the Park Headquarters Loop Intersection. Schedule B will consist of all the improvements in Schedule A plus some more spot overlays and patching on Chapin Mesa Road between the park entrance and Park Point Overlook. In addition, Schedule B will consist of spot repairs on Chapin Mesa Road between Park Point Overlook and Far View. The intent of these spot repairs is to repair exceptionally poor isolated pavement areas on Chapin Mesa Road. Schedule C will consist of the project in its entirety, without the spot repairs on Chapin Mesa Road.

The Central Federal Lands Highway Division (CFLHD) of the Federal Highway Administration (FHWA), in cooperation with Inyo National Forest (INF), and the Town of Mammoth Lakes (Town) is proposing to improve the pavement and drainage conditions for Lake Mary Road in the INF. The project, CA PFH 81-1(1), consists of the rehabilitation, restoration, and resurfacing (3R) of 2.6 miles of this route between the Horseshoe Lake Parking Area (MP 4.9) and the Twin Lakes Loop Road (04S22) (MP 2.3) in Mammoth Lakes, California. Mammoth Lakes is located in Mono County on SR 203, approximately 168 miles south of Reno, Nevada along US 395.

The Central Federal Lands Highway Division (CFLHD) of the Federal Highway Administration (FHWA), in cooperation with the National Park Service (NPS) is proposing to rehabilitate the pavement and drainage conditions for UT PRA DINO 10(2) & 100(1) Cub Creek (Route 10) and Quarry Access Roads (Route 100). This project will consist of the rehabilitation, restoration, and resurfacing (3R) of approximately 9.4 miles of Route 10 near the Dinosaurs National Monument Entrance at the end of State Highway 149, north of Jenson UT. This project will also include approximately 0.6 miles of Route 100, beginning at Route 10, heading northerly. Also included are rehabilitation of two Quarry parking lots, guardrail

and various drainage structures.

The Cub Creek Road and Quarry Access Roads project is located about 11 miles east of Vernal, UT and 25 miles west of the CO state line. The proposed project is in dissected plateau country with rolling terrain. Elevation is approximately 5100 ft. The routes are wholly within the Dinosaur National Monument.

Major Revisions from Previous Submittal

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The only major revisions to the project occurred prior to the 95% submittal. These included eliminating the corrugated metal pipe (CMP) rundown from the package and replacing it with a revet mattress rundown. A headwall was also added at the outlet of the culvert prior to the 95% submittal. Two #4 bars protruding from the bottom of the headwall will "hook" onto the revet mattress as shown in the plans. These bars will assist in holding the mattresses in place. The only considerable revision made after 95% review is the change of a 401/402 item for pavement to a 403 item. A 403 item is sufficient on this project due to the short length.
The two most significant changes made since the 50% design are four alignment shifts and the final design of the 9 retaining walls. The four alignments shifts were made to minimize the lengths and heights of proposed retaining walls. The final design of the retaining walls resulted in the selection of each wall type, dimensions, and recommended aesthetic treatments.
After the 50% PS&E review, FHWA proceeded to conduct a second review of the project design. Due to rising construction cost estimates, it was decided to have the Functional Discipline Leaders for design and geotech review the project and provide recommendations. Since the route serves only a small town and light logging operations and carries very low daily traffic, the recommendations from the design discipline leader were to take on a higher level of risk. The recommendations from geotech were to reduce risks from the current design. The recommendations from geotech were based upon the concern of the large, tall and steep proposed cuts in the 50% design. It was expressed that there is a much higher level of safety to build a fill or fill wall than to build a large cut. The main objective to accommodate the recommendations from the FDL was to move the alignment out of cut where possible. Additionally, to help minimize impacts and costs, it was recommended to use a Shored MSE wall (SMSE) instead of a traditional wall in specific locations. Typically, these walls will be utilized where shoring was already required. Doing this will greatly reduce the amount of structure excavation required to construct the walls, hopefully resulting in lowered unit prices. Roadway design changes made to take on a "higher level of risk" actually resulted in a design that is more similar to the existing roadway characteristics. The lane widths were reduced by 0.3 meters [1-ft] to be 3.0 meters [10-ft]. However, where guardrail is recommended, an additional 0.3 meters [1-ft] of setback or 'shy distance' was added, now totaling 0.9 m [3-ft]. Another measure to reduce impacts and costs was to reduce the curve widening on the project. Autoturn was used to establish the minimum widening needed for the design vehicle (S-BUS-12). The resulting values for widening are much smaller than what is required by AASHTO. The bench behind the paved ditch was also reduced to a 0.6 meter [2-ft] typical to minimize the roadway template. Additional bench is placed in specific locations where needed for

stopping sight distance. Furthermore, the roadway superelevation runoff lengths were revised to match the new recommended lane widths. The recommended values of superelevation runoff in AASHTO are based on 3.6 m [12-ft] lanes. So, with keeping the relative gradient the same, runoff lengths were shortened proportionately to minimize the lengths of tangent needed. The location of the superelevation transitions were also moved and now vary in specific segments. This also enables the new alignment to utilize shorter tangents between curves and allows a better match of the existing alignment. Overall, these design changes have created a significant change to the previous 50% design. The entire alignment and design was re-created, but the extra work has shown to be well worth it. The overall impacts and earthwork quantities are greatly reduced.

In June of 2006 a Pre-70% field review was held to verify the new alignment and the major re-design efforts after the Functional Discipline Leader reviews. Only a few minor revisions were made to the alignment. The design was then progressed to include final drainage and structural wall plans incorporating the SMSE walls.

Additionally, for funding issues, the clearing for the roadway projects has been separated and will be contracted to be completed during the fall/winter of 2007/2008.

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Major revisions since the 70% submittal include:

- The project has been broken out into bid schedules
- The Visitor Center Parking Area improvements have been separated out into a bid option.
- The road closure gate details have been received from the Park and incorporated into the plans.

The major revision from the 15% submittal is the incorporation of the Pavements recommendations. The proposed typical section now shows a 2-inch overlay instead of a double chip seal.

The major revisions from the previous submittal include incorporating data collecting during the field review in June 2006:

- Subexcavation areas included in the plans.
- Guardrail terminals that do not meet current standards have been designated to be replaced.
- The plugged 36-inch culvert at 303+20 has been designated to be replaced by a 48-inch culvert with inlet ditch grading and improved outlet protection.

Existing Conditions

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The existing paved road widths are narrow and in poor condition. The existing 18- to 20- foot paved width on Bonnie Claire Road is insufficient for the volume and type of traffic using this route. There is little or no curve widening on horizontal curves, and most horizontal curves have little superelevation and insufficient run out lengths. Raveling of pavement edges has narrowed the travel lanes, forcing drivers with large- wheel-base vehicles to drive on the unpaved shoulder. As a result shoulder drop-offs are created, causing steering problems and unsafe driving conditions for park visitors and staff. Sight distance is mostly fair, but there are sections in Grapevine Canyon where it is extremely poor. There are some long, steep downhill grades in the canyon. Sharp horizontal curves combined with minimal vertical curve lengths, steep, rock cut slopes and large cottonwood trees near the shoulder at Cottonwood Wash (station 9+400) drastically reduce sight distance.
The existing pavement along Hermit Road is generally in very poor condition with moderate and high severity transverse, block, fatigue cracking and raveling. There are several areas where the wheel path rutting is over 10 inches. The posted speed along the route is 30 mph. This roadway is classified as a Class I Principle Park Road/Rural Parkway in rolling terrain with one lane in each direction. The short access roads to the overlooks are classified as Class III Special Purpose Park Road. The existing roadway varies from 18 to 20 feet in width due to edge raveling. The approximate cross slope is 2% at normal crown.
The existing roadway is a two-lane thoroughfare with width variations between 6.1 m and 7.2 m (20 ft and 24 ft). There is little or no shoulder provided. The road location is confined by steep side-slopes generally on the west side and Glacier Creek on the east side. The route is open all year and maintained by the Park Service. The volume (currently estimated at 3,114 ADT and projected for 2020 at 4,002 ADT) and vehicle weight of the traffic traveling on the paved roads of the park have increased significantly since these roads were constructed. Pavement sections and road geometry were not initially designed to accommodate the high stresses caused by recreational vehicles, buses and vehicles pulling trailers. The current posted speed of 60 kph (35 mph) will be maintained for the first 5.6 kilometers of the project. The following 2.2 kilometers will retain the current posted speed of 40 kph (25 mph).
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The existing pavement along Route 10 is generally in poor condition with moderate and high severity transverse, longitudinal, and block cracking. The existing posted speed along the route is 35 mph. This roadway is classified as an NPS Class 1 roadway; a principal park road/rural parkway with one lane in each direction. The existing roadway varies from 23 to 26 feet in width with an approximate 2% normal crown. The existing pavement along Route 200 is in very poor condition with high severity transverse, longitudinal, block, and fatigue cracking. The existing posted speed along the route is 45 mph. This roadway is classified as an NPS Class 1 roadway; a principal park road/rural parkway with one lane in each direction. The existing roadway is approximately 20 feet in width with an approximate 2% cross slope.

The existing roadway is paved and varies in width, with an average 20 foot travel way width and variable unpaved shoulder width. The horizontal design of the alignment does not meet the current AASHTO requirements. The vertical profile is flat and has locations of less than 0.5% grade. Sections of the alignment may need slight vertical adjustments to allow a 22 foot roadway width on the existing bench. The alignment also contains numerous pullouts and parking areas for viewing, climbing and hiking. The pullouts are a combination of formal and informal pullouts. The formal pullouts are paved or gravel surfaced. The informal pullouts are dirt surface and do not have adequate clearance from the travel way for safe access. The existing posted speed limit along the route in general is 35 mph with sporadic exceptions to it (20 and 25 mph). This roadway is classified as a Class I Principal Park Road/Rural Parkway in Rolling terrain.

Drainage culverts are not adequately spaced and some have insufficient size or have a deteriorated structure and are in need of replacement.

The Yosemite Valley Plan FEIS (November 2000) addresses the Northside and Southside Drives one way and two way circulation patterns, and recommends changes to improve the transportation patterns in the valley. This project will not change these patterns but is merely scoped to rehabilitate the existing roadways.

The existing pavement on all of the routes included in the project is in poor condition due to high severity cracking and some settlement. The roadway is estimated to be at least 30 years old, but more likely 60 years old. The posted speed limit ranges from 20 km/h (15 mph) to 40 km/h (25 mph).

The existing paved widths on Conzelman Road vary greatly. The average roadway width varies from 4.3 m (14 ft) through the one-way section up to 7.5 meters (25 ft) through the two-way section with an approximate 2% normal crown cross slope throughout the two-way segment. The average roadway width on McCullough Road is 7.2 m (24 ft), 6.6 m (22 ft) on Field Road, and 10.65 m (35 ft) on East Road.

Traffic Data

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A traffic study was prepared for the FHWA in 1993 by RUST Environment & Infrastructure. The 1993 Annual Average Daily Traffic (AADT) was 230 vpd, and the Seasonal Average Daily Traffic was 318 vpd, with 3% truck traffic and a 50% directional split. Based on historical trip generation rates and the projected population growth, the study projects an AADT of 2088 and SADT of 2873 for the year 2015. Based on the above recommendations, by year 2006, AADT volumes should be approximately 880 vpd, with 5,438 vpd being projected to year 2026. Field observation indicate traffic volumes to be much lower than projected. Traffic counters will be placed along the route, and the data will be re-anaylzed by the FHWA.
A traffic analysis technical memorandum was prepared in February 2003. Traffic counts were made for one week in October 2002 for each route segment. The traffic mix for Hyampom road mostly consists of passenger cars with one school bus each weekday in each direction and a small mixture of light to heavy trucks. When logging operations occur, primarily during the summer months, log trucks dominate the heavy vehicles. Projections for ADTs were made for the year 2028 using a 1 percent annual growth rate. The original traffic counts for segments 4 and 5 were 144. The design ADT for the year 2028 is 176. It was assumed in the mix of vehicles that 10 percent were mixed trucks and the truck mix would consist of 45 percent logging trucks, 25 percent 3-axle trucks with the remainder split between buses and two-axle trucks.
The 2003 Sequoia/Kings Canyon National Park Traffic Data Package showed existing traffic of 686 AADT. Using a 3% growth rate, the 2008 AADT would be 795 and the 2028 AADT would be 1435. Approximately 5% of the traffic is trucks.
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Traffic counters have been set out on the project and data should be back in August 2003. Traffic projection rate will be based on the park's entrance station data.
The 2005 traffic data for the project was provided by the National Park Service and is also shown in the environmental assessment document on page III-14. No long-term historical data was available, so the 2025 were calculated based on a conservative growth rate of 10% and rounded to nearest 5-vehicle increment. ADT (2005) 135 ADT (2025) 150
Traffic data was collected from the NPS Traffic Monitoring Program, Coverage Count and Data Reporting Project. The 2003 Annual Average Daily Traffic (AADT) was 109 vpd, and the Seasonal Average Daily Traffic (SADT) was 173 vpd, with 1.5% truck traffic and a 50% directional split. Based on historical trip generation rates and the projected population growth, the study projects an AADT of 315 for the year 2024.

Crash Data

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Accident data was included in the Traffic Study for the corridor from January 1989 through August 1993. The locations of the accidents are evenly spread throughout the corridor. Therefore, there does not appear to be geometric features specifically contributing to the cause of the accidents.

It is useful to analyze the cause of the accidents to determine what type of improvements can be implemented to reduce accident severity. The three leading causes of accidents are listed below:

- Speed too fast for conditions: 46%
- Shoulder failure: 15%
- Dust from other vehicles: 8%

The FHWA will contact Gila County to acquire more current data, and reanalyze the result.

There are few reported accidents along the route and little evidence of unreported crashes; The County and the State Police were unable to provide specific crash data information for this route.

Accident data was provided by the County in April 2005. The data indicates the following:

- A relatively high-accident location is at the horizontal curve near 150+00. This curve currently does not have any warning signs. Sight distance at this location is limited by the thick stand of trees on the north side.
- The only run-off-the-road accidents occurred at the curve at 150+00. The majority of the accidents were side-swipes.

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One known accident location is a sharp curve at M.P. 1.53. There is a new home built on the outside of the curve and it has little, if any, protection from errant vehicles. This may be a suitable location for guardrail. The County reported another accident location where there is an icing problem at the low point in the sag curve near the lake at M.P. 4.8. The icing is due largely to the tree canopy. The County may trim some trees to allow for more sunlight to melt the ice on the roadway. During the field review in July 2005, it was noted that there is an area (M.P. 5.0) where trees have been scarred from snowplows and other errant vehicles. This area may require guardrail.

The County is unaware of any accidents that have occurred along the project corridor. There are skid marks near 23+50; the County noted that this is a common deer crossing location.

Survey

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Topographic information used on the project varies considerably in age and accuracy. The following is a summary of the mapping history based on the best available information: Mid 1990's: Aerial mapping obtained for entire corridor. This mapping is the basis for many planimetric features shown, and is the basis for contour information further from the roadway centerline. Late 1990's: Corridor flown using LIDAR technology. Reprocessed by CFLHD in late 2004 for use on the Phase 2 project. 2004: Field survey performed by Carter & Burgess to locate utility features and provide updated survey in Georgetown and at Silverdale parking area. 2005: Additional field survey begun by Carter & Burgess at retaining wall and other miscellaneous areas. Survey will be completed as weather allows in Spring 2006. The Coordinate System used on the project is Local, Assumed The vertical datum used on the project is NAVD 88
The survey information for this project was collected with aerial photogrammetry in July 2000 in Metric units. The horizontal datum used was Lambert NAD83, the vertical datum used was NAV88 and the zone is CO North 0501
The 50% design was based on aerial mapping originally provided by CFLHD at the beginning of the environmental assessment phase. In the early fall of 2005, CH2M HILL surveyors went to the site to obtain supplemental survey information. This information included obscured areas in the aerial mapping, the proposed waste site east of Segment 3, clearance to overhead utilities, existing waterline locations, and the locations of the geotechnical bore holes. This supplemental survey was merged with the aerial mapping.

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The survey information for this project was collected via a GPS trace of the routes in May 2004 by CFLHD. Additional GPS points were taken on June 6 & 7, 2006 to confirm roadside feature locations. Otherwise, most of the information is based on field data gathered during site visits.
No formal ground or aerial survey of the project was acquired. The project has been developed on obtained USGS raster images fitted to state-plane datum. Supplemental GPS points were taken during field reviews to locate specific design elements.
Survey information at the roadway centerline, culvert locations, and key roadway locations was collected with ground survey in August 2003 in metric units. The Coordinate System used on the project is Lambert NAD83, CA Zone 1 0401 The vertical datum used on the project is NAVD88 Ground survey did not cover all project areas. Certain features were added to the topo file based on field measurements and observation (existing pavement widths, tree locations, etc.)

Environmental

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The park completed an Environmental Assessment (EA) for the Bear Lake Road Improvement Project in 2001. Due to the high cost of the project, a Value Analysis/Choosing By Advantage Workshop was conducted in April 2004 to analyze a proposed realignment near Glacier Creek. The results of this workshop indicated that there are significant advantages to relocation of the road away from the creek. Since the proposed realignment is different from the alternatives originally evaluated in the EA, a new compliance document will be required. The document will be either an EA or an EIS and will be prepared through a FHWA environmental consultant with extensive involvement from the NPS.
The FHWA hired a consultant to perform environmental studies and the Environmental Assessment (EA) for the project. The purpose and need for the project is to: • Provide a safe, year round, all weather access to Hyampom • Provide a consistent-width two-lane roadway alignment to enhance the safety for current and future traffic • Ensure mobility for emergency response, school buses, postal service, and other delivery vehicles • Reduce roadway maintenance concerns The EA will identify investigated alternatives, impacts to resources (wetlands, water resources, noise, biological resources, social and economic impacts, etc), and public and agency coordination. Mitigation for impacts to resources will also be identified. A draft EA was distributed for review in November 2004. The document was found unacceptable because it did not include the County's Segment 3 project, causing a segmentation issue. Originally the design and construction schedule for Segment 3 were well in advance of the Federal Lands project, but due to the lack of a transportation bill, the County's project will now occur at approximately the same time. The EA is in the process of being revised to include segment 3, and is anticipated to be released in early 2006. The inclusion of Segment 3 into the EA also identified some design inconsistencies between the segments.
Numerous mitigations and constraints are documented in the FEIS and Record of Decision. Key mitigation measures are being tracked on a separate form which documents status and where each measure is addressed in the contract documents, as appropriate.

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Environmental clearances will be prepared by the Park. 3R work is generally eligible for a Categorical Exclusion (CE) but an Environmental Assessment (EA) could be required. If an EA is required, 9 to 15 months is estimated for a decision document. Design should be carried forward to a 30% field review to evaluate the environmental compliance level. The culverts and whether they are retained or replaced is not an issue that should affect the environmental compliance level (CE vs. EA). Several trees below the El Portal overlook parking area may be removed to restore historic views. Trees along Wawona Road may need to be removed for wall construction and additional trees and brush removed at the proposed parking area turn lane and parking area for NPS vehicles. Selective clearing and brush removal of up to 10' from the edges of Glacier Point road will need to be evaluated by Park employees.

Even if the project is determined to only require a CE, public participation will be a part of the Park's program and certain stakeholders will be actively involved the process.

The NEPA process should be completed in 2006. The anticipated NEPA environmental document is a Categorical Exclusion. The level of effort should be minimal for this 3R project.

The California Environmental Quality Act (CEQA) would not apply to this project if no right-of-way needs to be acquired and no 404 permit is needed. If a 404 permit is required (wetland or channel impacts), then a 401 (State Water Quality Certification) permit will also be required, and the 401 permit automatically triggers an analysis under CEQA.

The following issues will need to be resolved early since they could severely limit the construction season, affecting project costs and duration of construction:

There is a critical 200 acre habitat for the Northern Gashawk around MP 6.5. If there is a nest close to the route, construction could not be done in this area between March 1st and September 15th.

There is also a Willow Flycatcher habitat near the Crocker Campground near MP 6.5 that extends for approximately 2 miles adjacent to the alignment. If it is occupied, then construction could not be done in this area between June 1st and August 10th.

Any mitigation measures as a result of the NEPA/CEQA process will be incorporated into the project.

Design Speed

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Existing posted speed for this route is 30 mph (50 km/hr). The improved facility will have a design speed of 35 mph (60 km/h) from milepost 0.0 to milepost 17.8.

Existing posted speed for the road is 25 mph. Curve warning signs are posted in the switchback sections. The 1984 NPS Park Road Standards recommend a preferred design speed of 40 mph and a minimum of 30 mph using Principle Park Road, 1000 - 4000 ADT, and mountainous terrain criteria.

To be consistent with the previous five Generals Highway projects and to avoid major impacts, the design speed will be 25 mph.

The AASHTO 2004 recommended range of design speeds for a rural collector in rolling terrain is 30 – 50 MPH. The existing posted speed is 35 MPH.

The design speed of 35 MPH was selected to enhance design consistency along the project corridor. FHWA analyzed the horizontal curvature along the existing alignment for the paved portion of the roadway beginning at the Plumas County line on the west and extending to the intersection with Chester Juniper Lake Road on the east. The existing horizontal alignment includes curves with radii that range from about 75 feet to about 5000 feet. Assuming a maximum superelevation rate of 6%, this range of curve radii corresponds to design speeds of 15 MPH to greater than 50 MPH. See Table 1 for more information.

Table 1. Analysis of Existing Roadway Horizontal Curvature

Design Speed (MPH)	Minimum radius of curvature (ft)[(1)]	Number of Curves Meeting Design Speed
15	39	1
20	81	1
25	144	3
30	231	5
35	340	5
40	485	14
45	643	7
50 or greater	833	33

[(1)]Assumes a maximum superelevation of 6%. Values from AASHTO *A Policy on Geometric Design of Highways and Streets 2004* p. 147.

The analysis of the existing roadway horizontal curvature shows 14% of the horizontal curves have radii less than the minimum radius of curvature required for a 35 MPH design speed (340 feet), while 86% of the horizontal curves have radii flatter than 340 feet, meeting the 35 MPH design speed. Four of the sharpest-radius curves are within the proposed bridge approach realignment section, including sharp curves that are located on steep vertical downgrades. The proposed realigned roadway would include curves with radii meeting the 35 MPH design speed.

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Design speed is assumed to match the regulatory signage of 35 mph. Posted speed is 35 mph during the summer and 25 mph during the winter. The Park Road Standards recommends a design speed 5 mph to 10 mph above the posted speed. Due to the tight curves and 3R design procedure of remaining on the existing bench the posted speed will be the same as the design speed to minimize impacts to the environment.
Existing posted speed limits are 25 mph and 45 mph. The National Park Roads Standards (Park Standards) recommends a preferred design speed of 30 mph and a minimum of 15 mph using Class II Connector Road, <400 ADT, and rolling terrain criteria. Based on the existing driver use, driver expectancy, and discussion above, it is recommended that design speeds are selected to match the regulatory posted speeds. Some areas would include posting of warning signs with speed advisory plaques or reduction of the posted speed limit for individual curves or sections of curvilinear roadway where the roadway geometrics do not meet the existing posted design speed.

Typical Section

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The existing paved roadway width varies from 19 to 23 feet. The Park Road Standards recommend a 22-foot wide roadway (two 11-foot traveled ways) with 3-foot shoulders.

The typical section that will be used for this corridor is a 20-foot wide roadway (two 10-foot wide traveled ways). Additionally, a 1-foot shoulder and curb will be constructed on the cut side of the roadway. A 30-foot wide paved roadway will be provided in switchback areas. This criterion was set during the previous projects to keep the road on the existing bench, with essentially the same alignment to minimize disturbance.

A design exception for the proposed traveled way widths as well as the shoulder will be necessary, as NPS minimum standards cannot be met due to the need to minimize the impacts to the surrounding area.

A foreslope of 2.17 feet will be provided to minimize the amount of retaining walls needed. This is consistent with the previous Generals Highway projects.

The recommended ditch width is 2-foot on the cut side and will vary on fill side. This is also consistent with the previous Generals Highway projects.

The proposed typical section has 3.3 m (11 ft) wide travel lanes and 0.3 m (1 ft) wide shoulders. These widths do not meet the AASHTO 2004 guidelines for a rural minor collector with an ADT of more than 2000. (The AASHTO recommendations are 3.6 m (12 ft) wide travel lanes and 2.4 m (8 ft) wide shoulders.) Curve widening also does not meet AASHTO guidelines. (Based on the curve widening criteria used for the recently constructed project, this currently proposed project has curve widening only on curves with radii sharper than 120 meters. AASHTO guidelines include curve widening on curves with radii sharper than 150 meters.) The travel way, shoulder, and curve widening widths were selected to limit the environmental impacts and to remain generally within the existing right-of-way corridor. The intent of the roadway design is to provide improvements to the roadway alignment, grade, and drainage while limiting impacts in this environmentally sensitive area. Design exceptions will be required and will need to be agreed to by all cooperating agencies.

The shoulder on the river side of the road from milepost 0.3 to milepost 1.6 (from the start of the project in Almont to the Almont Post Office) will be widened to 1.5 m (5 feet) to allow for pedestrians.

The aggregate base course will be widened 1.2 m (4 feet) on the right side of the road to allow for pedestrian access near the bridge over Spring Creek (12+129 to 12+245).

No paved ditch will be used from Bridge #2 (milepost 7.7) to the end of the project near milepost 13.6 to accommodate the cattle drives up the canyon. Paved ditch is used at various locations in the section from Almont to Bridge #2 to minimize cut slopes.

Because of the concern to maintain the scenic quality of the corridor, guardrail will be used only at retaining wall and headwall locations. For the previous project, the design included an aggregate-topsoil course in front of the guardrail to accommodate cattle drives. However, during construction of the previous project, it was agreed to extend the asphalt pavement up to the guardrail posts.

Rockeries are used in areas with restricted widths. In some steep areas, two-tiered rockeries are used.

The typical section recommended for this corridor will be consistent with that of the previous Young-North project. The typical section consists of a 9.2 m (30-foot) wide paved roadway utilizing 3.6 m (12-foot) travel lanes and 1.0 m (3-foot) paved shoulders. A 10.2m (33-foot) width is considered the minimum to provide adequate safety and maneuverability for the current and projected volume and type of vehicle using the facility while protecting the historic integrity of the roadway and its features. Due to the sensitive nature of the route, the proposed typical section, which limits the environmental impacts to forest resources, was agreed upon by the cooperating agencies during the design phase of the previous project.

A foreslope of 1.2 m (4'-0") wide and an average slope of 1V: 4.1H is recommended. The foreslope will vary slightly depending on superelevation of the roadway and the position of the foreslope on the inside or outside of the curves. A 1V:4H foreslope was chosen to minimize environmental impacts. The foreslope is necessary to provide a recoverable zone outside of the pavement for vehicles that inadvertently leave the traveled way and provide the opportunity to regain control of their vehicles. Flat foreslopes improve safety by providing a maneuvering area in emergencies, are more stable than steep slopes, and simplify maintenance work.

The recommended ditch types are as follows: a 1.2 m (4-foot) wide graded ditch with a slope of 1V: 4H in areas where widths are favorable. Ditch widening is recommended where rock cuts may be encountered

3R Examples

The intent of this project is to provide minor widening of the existing paved roadway width. Table 10 from the National Park Service Park Road Standards (1984) states a minimum cross section requirement of 11' (3.3 m) paved lanes and 3' (0.9 m) shoulders for an ADT between 1000-4000.

Existing pavement widths average 6.1 m based on field measurements, with some areas of existing widened pavement in curves. Where an adequate bench width exists, a 7.0 m paved width is proposed to be constructed. Pavement edge will be backfilled with minor crushed aggregate to create adequate shoulder area. Most areas of the alignment have bench widths meeting or exceeding 8.4 m, providing sufficient room for the proposed pavement width and shoulders. In addition, the majority of the alignment provides sufficient room for a minimal 2.0 m wide clear zone beyond the 3.3 m travel lane.

The intent of this project is primarily to place a new typical section centered on the existing roadway bench width. The typical section will consist of two 3.3 m travel lanes and two 0.3 m paved shoulders. Table 10 from the National Park Service Park Road Standards (1984) states a Minimum Cross Section requirement of 9' (2.75 m) paved lanes and 1' (0.3m) shoulders for

an ADT between 50-200.

Existing pavement widths average 9.7 m based on field measurements. Where an adequate bench width exists, a 7.2 m paved width is proposed to be constructed. If a limited bench width exists, the shoulder width will be modified to allow the roadway template to fit. Where there are locations of a narrow bench width, and there is a proposed ditch proposed, the shoulder and/or paved ditch will be modified to allow the template to fit.

SCR Section 152 requires verification of centerline and measurement of existing grades and cross slopes. Based on this information, CO may direct contractor to take cross sections (under miscellaneous surveying) in areas requiring correction to be used to develop proposed grades which will meet the desired design values (between 1.5% and 2% normal crown, and design superelevation values shown on the plans. Areas of project which have been determined to not meet design values (based on the limited survey information) are shown on the mainline plan/profile sheets.

The intent of this project is to maximize the roadway width while remaining on the existing bench. The proposed typical section includes 12-foot wide travel lanes and 2-foot wide shoulders. A paved ditch is required in the steep sections (grades > 4%). Typical sections in fill will daylight into the slopes. These widths meet the AASHTO design for a rural collector with and ADT of 500.

Roadway Design and Safety

Examples

4R Examples

Horizontal Curvature and Superelevation

The proposed alignment has 47 horizontal curves and the existing alignment has approximately 47 horizontal curves. All proposed horizontal curves will be designed using a maximum superelevation rate of 6% according to current AASHTO policy.

Due to the tight curvature of the existing road, some superelvation overlaps occurred and the superelevations were reduced in specific curves to remove overlap and to ensure super runoff and runout lengths were met. The superelevation runoff and runout lengths that were used were for a 6% superelevation rate. This was used so more curves could have some superelevation instead of the majority of the curves having no superelvation.

Vertical Curvature

A best-fit design profile was established for the corridor to review the vertical curves and make recommendations for correcting the vertical profile. All proposed vertical curves meet the minimum AASHTO design standards. No design exceptions are anticipated.

Curve Widening

The existing roadway corridor has little to no curve widening. The recommended curve widening is shown below in Table 2. The curve widening table shows the values that were determined during the first five Generals Highway projects. They are considerably less than what is recommended by AASHTO. Based on the traffic characteristics of the roadway, it is recommended that a 22-foot Motor Home be used as the design vehicle for the design of curve widening.

Table 2: Curve Widening

Curve Radius (feet)	Curve Widening (feet)
>100	0.0
<100	1.0

Ten of the 47 curves require curve widening when using the 22-foot Motor Home design vehicle and table 2 criteria.

An additional 10 feet will be added to the roadway in the switchback areas. An additional 5 feet in both lanes will allow motor homes and trucks to make the sharp turn without encroaching into the other lane.

The route will generally follow the existing vertical and horizontal alignment with three exceptions. These exceptions, one at Bandit curve (approximately 90 m – 150 m), the section near Glacier Creek (approx. 1300 m) and the switchback at Hollowell Park will be evaluated for potential realignment to improve safety, to ease the construction of the road and to decrease the impacts to Glacier Creek. The Moraine Park intersection will be re-aligned to

create a standard 4-way intersection. The current configuration is offset. The Mill Creek Ranger Station access road intersection, the Moraine Park "mail boxes" intersection, and the intersection at Beaver Meadows will also be realigned to create a standard T-intersection.

The minimum radius curve for a 40 kph (25 mph) design speed is 43 m (141 ft). All of the proposed curves in the 40 kph section meet this criterion. The minimum radius curve for a 60 kph (35 mph) design speed is 123 m (403 ft). There are two curves within the 60 kph section which do not meet this criterion. The first substandard curve is located at the beginning of the project, and the radius is 45 m (150 ft). The second substandard curve has a radius of 85 m (282 ft). These design exceptions are required to minimize environmental and cost impacts. These design exceptions are listed on the Highway Design Standards form (See Appendix D). All vertical curves meet the stopping sight distance (crest) and headlight sight distance (sag) for 40 kph or 60 kph, as applicable.

The selected design vehicle is the Thomas SLF230, with the following dimensions: Width of 2.44 m (8 ft), Track of 2.66 m (8.7 ft), Length of 9.4 m (30.8 ft), Front Overhang of 2.35 m (7.7 ft), Rear Overhang of 2.65 m (8.7 ft) and Wheelbase of 4.4 m (14.4 ft).

Horizontal and vertical alignments generally follow the existing roadway, varying as described in typical section types above.

Horizontal Alignment

This portion of the project has nine exceptions to the minimum radius. Increasing the radius in these areas would result in high construction costs and unacceptable impacts to natural resources due to the steep terrain, or violation of the rehabilitation criteria.

Exceptions are generally at existing hairpin curves, and are documented in the HDS form.

Superelevation

Due to the low speed character of the roadway, a 6% maximum superelevation rate was selected for the design. Exceptions to the standard 6% criteria were determined to be warranted in the following scenarios:

- Short curves with less than a 10 degree deflection – matching the existing alignment as much as possible resulted in numerous short curves, often in successive reversing curve situations.
- Short curves with less than a 15 degree deflection, where the downhill (potentially higher speed) direction has the benefit of at least a 2% positive cross slope.
- Selected Rehabilitation areas where adding superelevation would result in slope impacts exceeding limits allowed by rehabilitation criteria.

The HDS form documents the curves with exceptions to the minimum superelevation criteria.

Vertical Alignment

For Rural Collector Roads, AASHTO criteria allow a maximum of 11% grade, and maximum grades of 14% to 16% for Rural Local Road classifications. For Guanella Pass Road, a desirable maximum grade of 9% was established during the EIS, due to operational, weather, safety, and maintenance considerations. The HDS form

documents individual exceptions to the desired 9% criteria, along with the justification for the exception.

Clear Zone

For the AADT anticipated (<750 VPD) and design speed (<60km/h) the AASHTO Roadside Design Guide recommends a minimum clear zone of 2.0 to 3.0 meters.

Exceptions less than the minimum recommended were allowed due to the environmental sensitivity of the project. Large hazards such as trees and boulders will be removed from the clear zone when they present a significant risk to traffic. The narrower proposed clear zone width of 2.0m is consistent with the reduced shoulder width.

Guardrail

Guardrail is used in reconstruction areas where warranted. The following types are utilized on the project.

- Steel-Backed Timber Guardrail, Type B: Used in general guardrail need areas, at MSE retaining walls, and at approaches to concrete retaining walls. Wood posts generally used, but metal posts may be considered on MSE walls due to proximity of post to face of wall.

- Steel Tube-Backed Timber Guardrail: Used with metal posts bolted on top of cast-in-place concrete retaining walls.

- End Terminals: FAT-9 (approach end) and FAT-6 (departure end).

Wildlife crossing areas were identified by the Division of Wildlife (CDOW) and USFS during a review held on June 27, 2005. At selected crossing locations, the guardrail gap detail (localized lowering of guardrail with berm behind) was implemented. Other locations only received a berm behind guardrail where roadway curvature prohibited lowering of the guardrail for safety reasons.

Clear Zone

For a speed equal to or less than 60 kph, and an ADT between 1500 and 6000, the clear zone widths are as follows (based on AASHTO Roadside Design Guide 2002):

SLOPE (V:H)	**FILL SLOPES (meter)**	**CUT SLOPES (meter)**
1:6 or flatter	3.5 – 4.5	3.5 – 4.5
1:5 to 1:4	4.5 – 5.0	3.5 – 4.5
1:3	Not measured as Clear Zone	3.5 – 4.5
> 1:3	Not measured as Clear Zone	Not measured as Clear Zone

This roadway will need to be analyzed for clear zone compliance based on a clear zone width, as noted above, from the edge of travel way. See Appendix E for the summarization of the findings. It is expected that the clear zone criteria will not be met in a significant amount of locations. The expense and impact of providing the clear zone width, in many cases, is unacceptable.

Guardrail

Guardrail is warranted on any fill slope steeper than 1V:3H, if the height of embankment is 3 m or greater. For a fill slope of 1V:2H, barrier is warranted for an embankment height of 2 m (AASHTO Roadside Design Guide 2002). The expense and impact created from upgrading the entire route to these standards is prohibitive. Guardrail has been placed on any embankment sections that meet the above criteria, that is a newly introduced embankment situation. However, where existing conditions are being maintained and guardrail is not currently installed, guardrail was not introduced.

The proposed retaining walls will be topped with steel-backed timber guardrail for aesthetic reasons. Small amounts of guardrail will be considered in other locations to protect against possible roadside hazards. Railing on the Big Thompson River bridge will be upgraded to meet current safety standards. Guardrail will also be used at the Mill Creek crossing. See Appendix E for Guardrail Summary.

Sight Distances

The stopping sight distance (SSD) and intersection sight distances (ISD) for the roadway and intersections were reviewed and evaluated for compliance with current standards. The minimum stopping sight distance and intersection sight distances for a 40 kph and 60 kph roadway are as follows:

Description	40 kph Distance	60 kph Distance
SSD	50 m	85 m
ISD (vehicle turning left from stop)	85 m	130 m
ISD (vehicle turning right from stop)	75 m	110 m

The roadway horizontal and vertical alignments meet the requirements for sight except at the proposed location of the re-aligned intersection at Moraine Park (station 12+000 Rt). It is recommended that the trees within the sight triangle be removed (approx. 12 m2) as part of this project to improve the sight distance at this intersection.

Clear Zone

This roadway was analyzed for clear zone compliance based on a clear zone width of 10 to12 feet from the edge of travel way (based on 30 mph, AASHTO Roadside Design Guide). A summarization of the finding is shown in Appendix D.

Guardwall

There is not existing guardrail or guardwalls. Initial review of the cross-sections indicated three locations where guardwalls may be necessary. See the typical sections located in the plan set for locations.

Sight Distances

The stopping sight distance (SSD) and intersection sight distances (ISD) for the roadway and intersections were reviewed and evaluated for compliance with current standards. The minimum stopping sight distance and intersection sight distances for a 30 mph roadway (assuming flat terrain) are as follows:

Description	Distance

S.S.D.	155 feet
Stop Control	
I.S.D. (vehicle looking right, turning left)	290
I.S.D. (vehicle looking left, turning left)	335
I.S.D. (vehicle looking left, turning right)	290
I.S.D. (vehicle crossing 2-lane roadway)	290
Yield Control	
I.S.D. (vehicle looking right, turning left)	355
I.S.D. (vehicle looking left, turning left)	355
I.S.D. (vehicle looking left, turning right)	355
I.S.D. (vehicle crossing 2-lane roadway)	300

The roadway horizontal and vertical alignments meet the requirements for sight for all alternatives except as stated previously for Alternative A at station 174+60. The only road intersection is with Rowe-Well Road. The general public restricted from this road. Based on field observations the existing roadway and intersections meet sight distance criteria for 25 mph. The only exception this the horseshoe curve around Hopi Point. From field observations the horizontal sight distance appears limited. Checking the mapping preliminarily shows the sight distance to be slightly above the minimum for 25 mph design. It may be necessary to clear vegetation from the interior of the curve to improve sight distance. The accesses to the overlooks in this area are also at or below minimum intersection sight distance. Once an alternative is chosen as a preferred, a detailed analysis will be done at all the intersections.

3R Examples

The horizontal and vertical alignments for the roadway generally will not change. The horizontal alignment has been set to match as close as possible to the centerline of the existing road. There are four areas along the project where the horizontal alignment has been shifted.

The station ranges and reasons regarding horizontal alignment shifts are listed below:

Station Ranges	Reason
1+310 to 1+470	Pull roadway away from cut slope.
1+740 to 2+050	Center roadway on existing bench.
2+250 to 2+370	Center roadway on existing bench.
2+800 to 3+300	Pull roadway left away from cut slope.

The vertical profile along the project is intended to generally match the existing, with the final grade being 0-50 mm above the existing grade. The profile may be varied to better balance the available quantity of millings.

No modifications to the existing bench width are anticipated. The proposed roadway template will match the existing 24’ paved traveled way and the existing 1’ – 2’ shoulders. No changes to the existing curvilinear alignment and bench width are anticipated.

There are three County Roads intersecting Wentworth Springs Road. They are Brauer Road, Breedlove Road, and Balderston Road. All remaining roads are private. There are

approximately 40 private roads and driveways. Construction easements may be required for work near the private roads and driveways. The speed is posted as 45 mph with several curves posted at 25, 30 and 35 mph.

At Balderston Road, there is a sight distance issue along the vertical curve just west of the intersection. One possible solution would be to lower the vertical curve, and regrade and clean the ditch. Determination if this improvement is within 3R scope will be necessary.

The horizontal and vertical alignments for this roadway will not change. The extent of repair does not allow for revising the vertical or horizontal alignment.

The AASHTO Roadside Design Guide and The Federal Lands Highway Project Development Design Manual were reviewed to develop clear zone requirements for the roadway. The Clear Zone is a term used to define the limits to which a motorist can safely traverse an unobstructed roadside recovery area that is as wide as practical on a specific roadway section. Based on design speed and traffic projections, a 14-foot clear zone is recommended, however, due to the sensitive nature of the roadside features within this park setting, engineering judgment is used to determine the extents to which improvements can reasonably be made to provide safe operating conditions for park personnel and visitors.

The scope of the project is to rehabilitate the existing roadway with allowance for safety improvements where deemed necessary based on engineering judgment. The following table summarizes the "deemed necessary" clear zone encroachments requiring corrective action:

Table 3 - Clear Zone Deficiency Areas Requiring Corrective Action

Station to Station	Side	Length (ft)	Obstruction Type	Encroachment within Clear Zone	Corrective Action Proposed
51+505 to 51+800	Lt./Rt	295	Fill Slope >1V:4H	8'	Lower Grade to Achieve Required Width and Allow for a 1H:4V Foreslope
584+65 & 587+95	Rt.	150	Steep Drop-offs Along Ditch & Culvert Inlet	6'	Install Grated Inlet / Reshape Rock Ditch. Widen Pavement
72+592 to 72+883	Rt.	290'	Guardwall Settlement to Unacceptable Heights	2'	Reset Guardwall

The accident history does not indicate a need, or a specific site identified showing a definite crash potential that can be significantly lessened by increasing the clear zone width.

<u>Clear Zone</u>

The clear zone requirement for this roadway (based on the AASHTO Roadside Design Guide) is 2.0 m (50 km/h or less and Design ADT of < 750). Due to the low roadway design speed and the sensitivity of the surrounding terrain a project clear zone distance was not universally implemented. The new roadway alignment, which has been adjusted along the

route to center of the existing roadway bench, gives the maximum amount available to the motorists.

Guardrail

Due to anticipated speeds, rehabilitation criteria, and sensitive environmental nature of the project, no new guardrail additions are anticipated along the project except at one location. The intersection of Alder Camp Road and Klamath Beach Road will have new guardrail at the northwest corner of the intersection. This will replace the existing guardrail that is being removed.

Sight Distances

The stopping sight distance (SSD) of 65 m required for this roadway was based on the AASHTO Geometric Design of Highways and Streets. Due to the location of the roadway within the Redwood National Park, and the sensitivity of the surrounding terrain, providing the required SSD will not be possible along certain areas within the project. The new roadway alignment, which has been adjusted along the route to the center of the existing roadway bench and/or pulled away from cut slopes, gives the maximum amount available to the motorists. Exceptions are documented in the HDS form. Curve warning signs with speed reduction placards were added to mitigate exceptions.

Clear Zone

A clear zone of 8 to 10 feet is desirable on rural roads. The existing clear zones range from 2' to 10'. Many of the roadway's fill slopes and ditch slopes, some created by the widespread erosion within the park, exceed a recoverable or traversable grade. A few areas were noted where the roadside ditches had eroded sufficiently to damage the roadway foreslopes and in some cases slightly undermine the roadway pavement.

Since this is a 3R project, the design will not reduce the effective roadway clear zones due to normal cut and fill slopes with one exception: From station 592+75 to 623+25 a 3:1 fore-slope is proposed to maximize the roadway bench and pavement width.

This roadway section travels through the kiosk and is posted at 25 mph with very low risk. Additionally, it is proposed to extend any drainage culvert inlet/outlet beyond the clear zone limits.

Guardrail

No existing or proposed guardrail is located on the project. If guardrails are used, an addendum to the document must be made

Sight Distances

The stopping sight distance (SSD) and intersection sight distances (ISD) for the roadway and intersections were reviewed and evaluated for compliance with current standards. The minimum stopping sight distances for the project (assuming flat terrain) are as follows:

Description	**Distance**
Stopping Sight Distance (45 mph)	360 feet
Stopping Sight Distance (35 mph)	250 feet
Stopping Sight Distance (25 mph)	155 feet

The roadway horizontal and vertical alignments meet the requirements for sight except as stated previously at stations 677+10 – 682+00.

Geotechnical

Examples

4R Examples

Geotechnical investigations were performed in 1995, 1997, 2003, 2004, and 2005. Recommendations from each of these investigations are described below:

- **January 1995**
  This was a preliminary investigation. Recommendations included preliminary slope ratios, shrink/swell factors, and structural section.

- **August 1997**
  This was a retaining wall foundation investigation. Originally the design included a mechanically stabilized earth wall from 6+802 to 7+110 LT, but the design has since been changed to include a concrete wall on the left from 6+800 to 6+940 and a rockery wall on the right from 6+970 to 7+070.

- **October 22, 2003**
  The intent of this review was to determine the feasibility of eliminating concrete fill-side retaining walls by moving into cut slopes and to visually investigate the rockery wall locations. Recommendations were based on preliminary observations.

Station	Original 30% design	Recommendation
15+140 to 15+220	Rockery	Eliminate rockery from 15+200 to 15+220
15+640 to 15+740	Rockery with tiers	Eliminate the upper tier
17+080 to 17+410	Concrete fill wall	Rockery 17+070 to 17+230. Soil nail wall with rockery facing 17+230 to 17+360
17+740 to 17+950	Concrete fill wall	Rockery
21+120 to 21+160	Rockery	Rockery
22+320 to 22+565	Concrete fill wall	Concrete fill wall *Note*: During subsequent field reviews in 2004, it was decided to shift the alignment into the rock cut to eliminate this concrete fill wall. This alignment shift will avoid the irrigation headworks and will eliminate the need to build a fill wall in the river. Geotech has concurred with this decision.

- **June 9, 2004**
  The intent of this site visit was to review the proposed cut slopes and options for

eliminating fill walls. Recommendations were based on preliminary observations.

Station	Original 30% design	Recommendation
4+560 to 4+825	MSE wall	Cut slope, in rock and soil
5+050 to 5+310	MSE wall	Cut slope, in rock and soil
5+560 to 5+720	MSE wall	Cut slope
6+805 to 7+150	Concrete fill wall	Cut slope, in rock and soil
8+750 to 8+770	Cut slope varies from 1:1.75 to 4:1	Cut slope 1:1.75
9+140 to 9+380	Cut slope	Clean up brow
14+660 to 14+760	Cut slope varies from 4:1 to 1:2	Cut slope 1:2
21+160 to 21+170	Cut slope	Extend rockery
21+170 to 21+220	Cut slope 1:1	Cut slope 1:1.5
21+380 to 21+420	Cut slope	Cut slope 1:1.5

Also recommended was to repair the surface water runoff problem at the MSE wall built under the CO PFH 59-1(3) project.

- **August 2005**

The intent of this investigation was to review and develop recommendations for the proposed cut slopes, rockeries, and large culverts and to develop estimated shrink/swell values. Kleinfelder, Inc. conducted the investigation and wrote the Geotechnical Investigation Report dated April 2006. Refer to this report for specific recommendations.

The following geotechnical investigations have been performed or are in progress covering this portion of the project:

<u>Final Geotechnical Investigation and Design Report – Station 30+240 to 39+080 October, 2005, includes:</u>

1. Investigation and Analysis of slopes, fill walls, and cut walls.
2. Pavement distress survey
3. Geotechnical recommendations for slopes, fill walls, and cut walls.
4. Investigation and recommendations for Cabin Creek rockfall area

<u>Geotechnical Investigation and Design Report – Material Sources and Argentine Street in Georgetown – (In progress), includes:</u>

1. Investigation and Analysis of Green Lake Material Source
2. Investigation for Argentine Street in Georgetown
3. (Argentine pavement analysis and design being performed by CFLHD Materials)

Refer to Reports for further details. Copies of the Reports can be furnished upon request.

Two geotechnical reports have been written for this project. The initial report was written in May 2006 and the follow up report was finalized in November 2006. The final report

includes wall analysis, boring results and rock-cut studies.

It was noted during the field review that slope scaling will be needed throughout the project and directed by the CO. There are also many areas that have the potential to be rock fall hazards during construction. Rockfall fencing will be needed during blasting.

As an addition to the second geotech report, shrink swell factors were provided. These range from -2.1 to 27%.

Pavements and Materials

Examples

4R Examples

The pavement design was done for the first 16.5 miles of Generals Highway in 1988. The report recommends 5-inches of cold in-place recycled pavement and base and 2.5" of hot asphalt concrete pavement. The design R-value is 48 and the required structural number is 2.26. It was also recommended that the pavement be placed in 2 lifts.

To remain consistent with the previous projects on Generals Highway, it was decided that 4-inches of aggregate base and 4.5-inches of hot asphalt concrete pavement would be used.

3R Examples

A pavement report was performed for this project in August, 2003. The existing pavement was found generally to be in poor condition with moderate and high severity transverse, block, and fatigue cracking. It is recommended that the pavement be rehabilitated by recycling (pulverizing) the existing pavement, re-compacting, and overlaying with a 4 inch surface course.

The pavement at mile marker 5.2 shows signs of subgrade failure. It is recommended that the subgrade be excavated and replaced with select backfill. After compaction of the backfill, a base course of 12 inches and a surface course of 4 inches shall be constructed.

Refer to appendix B, Pavement Report for further analysis.

A pavement investigation was performed for this project in September, 2003. Recommended pavement sections from the investigation and subsequent communications are summarized as follows:

A. Main Park Entrance Road/Pullouts:
   1. Normal Section: 75mm HACP with 125mm to 175mm Road Reconditioning / Pulverizing.
   2. Widening: Place roadway aggregate to depth of pulverization, pulverize with roadway pavement and pave with 75mm HACP
   3. Reconstruction Areas: Place HACP leveling course for minor grade corrections prior to pulverizing. For large grade differences, pulverize existing pavement, place roadway aggregate to established grade, and pave with 75mm HACP.

B. Lassen Peak Parking Area: Slurry seal

C. Parking Areas with Curb & Gutter, Access Roads with existing 90 mm of HACP or more (Summit Lake South & North, Hat Lake, Devastated Area):
   1. 50 mm HACP
   2. 125 mm Road Reconditioning/Pulverizing (bid item 303).

D. Pullouts, Parking Areas & Access Roads with existing 65 mm of HACP or less (Lake Helen, King's Creek Picnic Area, Summit Lake Ranger Station/Trailhead):
   1. Areas with existing HACP: 100 mm Road Reconditioning/Pulverize with 50mm HACP.
   2. Areas without existing HACP: Place 150mm roadway aggregate with 50 mm HACP.

Refer to Pavement Report for further analysis. Copies of the Pavement Report can be furnished upon request by FHWA
Pavement testing was completed in September 2005 to supplement the pavement testing completed by FHWA in the 1990's. New results and reports are pending (October 2005). No pavement testing was completed by FHWA or included in the scope for the Wawona Road (SR 41) but the Park may have information or it could be included in a future task to complete pavement cores and design recommendations at Chinquapin intersection.

Hydraulics

Examples

4R Examples
There has been no reported overtopping of the existing bridge and no visible evidence of high water on the bridge abutments. It is anticipated that the profile of the new structure will be raised, thereby increasing the freeboard under the bridge. A hydraulic analysis will be performed for Warner Creek at the bridge location and the recommendations will be used in determining the bridge profile and mitigating the potential scour of the bridge foundations. The minimum design flood for roadway cross culverts is the 25-year event.
All drainage features will be redesigned and reconstructed. Culverts will be designed for Q50 and ditches for Q10. A large box culvert at Mill Creek will be evaluated and replaced with either a small bridge or box culvert. Fish passage will be maintained. FHWA is currently working on a Draft Hydraulics report.
The project does not cross any major streams tributaries. The project will use the rational method to determine the size and location of all cross culverts. The hydraulic report will be finalized for incorporation into the 50% plans, a draft report is incorporated into the 30% plans.
3R Examples
Culverts are generally in good condition with outlets in very steep fill slopes and inlets fit into small roadside ditches. Clogging with silt and debris is prevalent and cleaning is very difficult with the steep slopes, dense vegetation, and limited room for machinery. Routine maintenance is done by hand and these conditions must be improved with the project design. In areas with narrow roadside ditches or paved ditches, more frequent ditch relief culverts are needed. Due to the large amount of snowmelt that occurs along Glacier Point Road in the spring, the Park has requested that larger pipes (> 24”) be considered where there is room (especially just below the ski area). Some of the existing culverts also have stone faced headwalls that will require special consideration during the design. Stone headwalls should be reconstructed using the same stones once the new culverts are installed. In locations where existing headwalls are to be replaced with drop inlets, alternatives are being developed to preserve or salvage the existing structures. A number of culverts are in very deep fill slopes and will not be replaced but may require extensions and/or end treatments consisting of flared end sections, headwalls, or drop inlets. Additional culverts will need to be installed periodically. Approximately 30 to 35 new culverts are proposed for the project, which will approximately double the culvert frequency along the roadway. Outlet ditch grading and outlet protection will be needed in a few locations. Drainage at the Badger Pass Ski Area parking lot is in very poor condition. Groundwater percolates up through the asphalt parking lot every spring, which has deteriorated the parking lots and roads. The embankment on the west side of the upper parking lot is eroding into the

parking area. Underdrains and additional drainage features will be needed to control the runoff and groundwater. Existing concrete curbs around the edge of the parking area have deteriorated and need to be replaced. New curbing will be added around the entire perimeter of the parking lot, including the interior island areas. Existing inlets will be replaced with more efficient curb inlets, and new ones will be added. Existing culverts will be replaced, and in some cases upsized.

Other drainage tasks within the project scope of work, such as research of existing data and reports, development of required hydrologic and hydraulic criteria, basin delineation, and peak discharge calculations, are discussed in further detail in the Draft Hydraulics Report, which is included with the 30% plan submittal.

There are 24 existing culverts within the project area. Most of them appear to be hydraulically adequate. However, many of them are in fair to poor condition, and appear to have reached their useful life, so they will be replaced with the project. Culvert replacements are proposed at 14 locations, most of them 600 mm in diameter. Of the existing culverts to remain in place, many of them will receive other improvements, as further discussed below. New ditch relief culverts are proposed at 5 locations. Culvert cross-sections for all of these locations are included in the plans, based on the limited survey information available. Culvert locations should be surveyed and limits adjusted during construction as appropriate.

Most of the existing culvert end treatments are concrete headwalls. In some of the cut areas, the culvert entrance is a drop inlet within the roadside or paved ditch. As previously noted, other improvements are proposed for some of the existing culverts that are to remain, such as adding riprap protection at the inlet and/or outlet, adding headwalls, and cleaning the culverts in place, as well as cleaning and/or regrading the culvert entrance and outlet areas. Two of the existing concrete box culverts (600 mm x 600 mm) will be extended by adding an "inspection box" to the existing headwall, and then adding a short section of 900 mm pipe with a headwall. Box is a Caltrans Type G2 drop inlet. This solution was preferred by the Park to preserve the existing historic concrete headwalls.

There is also an existing 600 mm CMP culvert that is badly rusted along its invert. Due to the large depth of fill over the pipe (8-9 m) and close proximity to Redwood trees, it would be very difficult to replace, so it is proposed to slip-line this culvert with a 500 mm PVC. The proposed improvements at each existing culvert location are noted on the plans. The slip lining operation will need to be planned carefully since the terrain constrains the inlet end, which will require the use of short sections of pipe to be used in the lining operation.

Other drainage tasks within the project scope of work, such as research of existing data and reports, development of required hydrologic and hydraulic criteria, basin delineation, and peak discharge calculations, are discussed in further detail in the Draft Final Hydraulics Report, included with the final 95% plan submittal.

<u>Access Routes</u>
Access to the existing culvert ends is typically difficult due to steep slopes and dense vegetation. Access routes have been generally defined based on design field reviews, and are shown on the erosion control plans. These routes will be flagged by the CO with support from the NPS prior to the contractor clearing the access routes.

Existing culverts will be located on the plans, and an inventory of the conditions with

proposed improvements will be provided. The culvert locations and conditions will be verified at the 30% field review meeting.

Most culvert ends (concrete headwalls and non-flared end section) lie within the clear zone. The ends are constrained by the existing ditch offsets in cut sections. Some culverts can be extended in fill slope conditions outside the clear zone. Many culverts outlet on the mid-height of fill slopes steeper than 1:3 and extending these culverts would require downspout connections to extend to the bottom of the fill slopes.

Approximately 50% of the existing culverts were plugged or filled with debris and will need cleaning. The culverts that were observed were generally in good condition. Most culverts without concrete headwalls do not have flared end sections.

Structural Design

Examples

4R Examples
The design of the project calls for multiple types of structures and structural embankments. Mechanically stabilized earth (MSE) walls, Shored Mechanically Stabilized Earth (SMSE) walls, soil nail walls, and reinforced stabilizes slopes (RSS) will be utilized throughout the project. Generally on the fill side of the road, MSE and SMSE walls will be used. A cost comparison study was performed, and in most cases they were the cheapest solution as well as minimizing impacts. Where appropriate, in areas where there is an existing landing bench below the road, RSS at 2V:1H or 1V:1H slopes make better sense and are less of an impact visually. In areas where tall cuts are not stable and there is no practical option of shifting the alignment away from the cut side of the road, soil nail walls will be used. Currently, a colored and/or sculpted shot-crete finish is proposed for soil nail walls. An example needs to be identified for the final product simulation.
Due to the steep terrain and presence of wetlands, the current design utilizes a significant amount of concrete cantilever retaining walls and cut walls. The roadway crosses Mill Creek, and an option of replacing the existing box culvert with a small bridge is being considered. A Draft Geotechnical Investigation report was completed in January 2005 by Yeh and Associates, Inc. for PBS&J, Inc. (See appendix F). The report presents the results for the construction of a bridge over Mill Creek (sta 15+825), four fill wall locations (14+260-14+395 Lt, 14+710-14+905 Lt, 15+050-15+260 Lt and 16+075-16+260 Lt) and two cut wall locations (15+230-15+400 Rt and 16+240-16+330 Rt). Additional investigations of the wall locations are scheduled for 2005.
There are no bridges or large culverts on the project. The use of any kind of retaining wall is not anticipated.
3R Examples
There are no bridges or large culverts on the project. The use of any kind of wall is not anticipated.

Bicycle Design

Examples

4R Examples

The design of the shared use path will be based on the design guidelines from 2012 AASHTO's Guide for the Development of Bicycle Facilities and the DRAFT Accessibility Guidance for Bicycle and Pedestrian Facilities, Recreational Trails, and Transportation Enhancement Activities by FHWA. For ADA compliance, the US Access Board's Supplemental Notice of Proposed Rulemaking titled *Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way; Shared Use Paths* will be followed. Below is a list of the standards and the values designed to.

GEOMETRIC CRITERIA			
GEOMETRIC AND BRIDGE CRITERIA	**STANDARD**	**AS DESIGNED**	**EXCEPTION**
1. Design Speed *(AASHTO Bicycle Facilities, Section 5.2.4)*	18–30 MPH: Dependent on user type and terrain.	18 MPH on grades	No
	Discussion: Maximum speed was chosen based on anticipated path use. Pedestrians are expected to make up a large percentage of the path users. Due to this bicyclists are not expected to be able to reach speeds greater than 18 MPH. Excessive speeds above 18 MPH are also not wanted within the park due to negative impacts on pedestrians. The project area consists of rolling hills and forested terrain. A lower design speed was also chosen to allow the trail to meander and avoid trees.		
2. Width *(AASHTO 5.2.1)*	10 ft	10 -12 ft	No
3. Shoulder Width *(AASHTO 5.2.1)*	3 - 5 ft	1 ft	Yes
	Discussion: The shoulder width was reduced to limit the amount of environmental disturbance caused by a wider trail. The trail is in a heavily forested area and there are mature trees that would have to be removed in order to accommodate a wider trail. Risk associated with the reduced shoulder width is considered to be low. A safety edge will be constructed along the pavement edge to decrease the possibility of a bicyclist losing control if they veer off the trail.		
4. Shoulder Slope *(AASHTO Figure 5-1 and 5.2.1)*	1V:6H	1V:6H	No
5. Cross Slope *(AASHTO 5.2.6)*	2% max	1.8%	No
6. Horizontal Curvature	60 ft @ 18 MPH	60 ft @ 18 MPH Reduced at lower	Yes

(AASHTO Table 5-2)		speeds	
	Discussion: For the majority of the path the standard horizontal curve is met. However, in areas of steep terrain smaller curves were used in order to reduce grades and meet accessibility requirements and reduce impacts to existing features and to reduce the path's footprint. These areas are primarily in high pedestrian use areas where bicyclists are not expected to be able to reach the higher speeds. The risk associated this this exception is considered low.		
7. Superelevation	e(max) = N/A Δ = N/A	(max) = N/A Δ = N/A	N/A
8. Grades *(AASHTO 5.2.7)*	5% max	5%	No
9. Vertical Curvature *(AASHTO Figure 5-8)*	Determine vertical curve length from *Figure 5-8, AASHTO Bicycle Facilities*	Designed using *Figure 5-8, AASHTO Bicycle Facilities*	Yes
	Discussion: For the majority of the path the standard vertical curve is met. However, in areas of steep terrain smaller curves were used in order to reduce grades and meet accessibility requirements and reduce impacts to existing features and to reduce the path's footprint. These areas are primarily in high pedestrian use areas where bicyclists are not expected to be able to reach the higher speeds. The risk associated this this exception is considered low.		
10. Stopping Sight Distance *See Table 5-4, AASHTO Bicycle Facilities*	164 ft @ 18 MPH 195 ft @ 20 MPH	180 ft @ 18 MPH 200 ft @ 20 MPH	No
11. Horizontal Clearance to Structure (not clear zone) *(AASHTO 5.2.1)*	1 ft	1 ft	No
12. Vertical Clearance to Obstruction *(AASHTO 5.2.1)*	8 ft min, 10 ft preferred	10 ft	No
13. Clear Zone *(AASHTO 5.2.1)*	2 ft	1 ft	Yes
	Discussion: The clear zone was reduced to limit the amount of environmental disturbance caused by a wider trail. The trail is in a heavily forested area and there are mature trees that would have to be removed in order to accommodate a wider trail. Risk associated with the reduced clear zone is considered to be low. A safety edge will be constructed along the pavement edge to decrease the possibility of a bicyclist losing control if they veer off the trail.		

Erosion and Sediment Control

Examples

4R Examples

During construction, erosion control measures (i.e., silt fence, sediment logs) will be implemented in non-riparian upland areas and on approach embankments.

Erosion control to be performed will consist of application of erosion control materials within non-riparian upland areas and approach fills, embankment slopes, excavation slopes, and other areas designated by the Project Engineer. These materials will consist of fiber, native grass and seed, commercial fertilizer, and water. Additional erosion control measures that will be implemented include:

1. An *Erosion and Sediment Control Plan* will be prepared and included in the final construction plans. This plan will be provided to the National Marine Fisheries Service (NMFS) for review.
2. Any construction activities proposed within the ordinary high water line of a water of the United States, excluding passive vegetation removal activities above ground level (no major soil disturbance), will be restricted exclusively to the dry season (May 1-October 31).
3. Major ground disturbing activities will be restricted to the dry season, which is defined as May 1-October 31. Ground disturbing may occur outside the defined dry season based on a forecast of dry weather and permission from the National Marine Fisheries Service (NMFS). Permission may be granted by email. Temporary erosion and sediment control structures must be in place and operational at the end of each construction day and maintained until disturbed ground surfaces have been successfully re-vegetated.
4. Areas where wetland and upland vegetation need to be removed will be identified in advance of ground disturbance and limited to only those areas that have been approved by the FHWA.
5. Erosion control (i.e., hydroseeding) will be applied to areas where vegetation has been removed to reduce short-term erosion prior to the start of the rainy season. Soils will not be left exposed during the rainy season.
6. Filter fences and catch basins will be placed below all construction activities and all perennial and intermittent streams to intercept sediment before it reaches the waterway. These structures will be installed prior to any clearing or grading activities.
7. After construction is complete waste sites will be reclaimed (graded and vegetated) to reduce the potential for erosion.
8. Sediment control measures will be in place prior to the onset of the rainy season and will be monitored and maintained in good working condition until the disturbed areas have been re-vegetated.

In addition, Best Management Practices will be followed. A detailed description of the BMP's for the project can be found in the Environmental Assessment.

At this time, it is anticipated that only standard erosion and sediment control measures will be

required for this project including silt fence, inlet protection, sediment control logs, check dams and other best management practices in accordance with the NPDES criteria.
Silt fences are proposed at the toe of fill slopes parallel to the toe. Erosion control log check dams are proposed for erosion control in ditches. Erosion logs are also proposed for inlet protection. Bonded fiber matrix is proposed for use on slopes steeper than 1:2 (V:H).
3R Examples
At this time, it is anticipated that only standard erosion and sediment control measures will be required for this project including silt fence, inlet protection, sediment control logs, and other best management practices in accordance with the NPDES criteria. Some temporary erosion control devices were removed from the design to install permanent check dams and better utilize project costs. Due to soils/sands in the project area, the usefulness and effectiveness of logs and wattles are limited
During construction, temporary erosion control measures will be implemented to avoid and reduce impacts to adjacent areas in the park due to runoff. As appropriate, dust abatement will also be required during excavation activities. Permanent erosion control measures will be implemented at the outlet of the pipe; such as placing revet mattresses to dissipate the energy and reduce the velocity of the water as it exits the pipe and, therefore, reduce the sliding of the soils and prevent further washing away of the slope. Following completion of construction, the Contractor will install a rolled erosion control blanket and seed the disturbed slopes with a specific seed mix developed by the NPS. In addition, the FHWA *Best Management Practices for Erosion and Sediment Control* will be followed. A detailed description of the BMP's can be found in Chapter 7 of the *Project Development and Design Manual* located on FHWA's website.
Standard erosion and sediment control measures will be required for the project, including silt fence, inlet protection, sediment control logs, and other Best Management Practices (BMP's) in accordance with the NPDES criteria. Erosion control plans have been developed and are included in the plans. The erosion and sediment control plans also show locations of temporary plastic fence. This fencing is shown around environmentally sensitive areas, including wetlands, riparian areas, and archaeological sites. It is noted in the plans to install the fence prior to any soil disturbance activities, and not to disturb any areas beyond the fence.

Traffic Control

Examples

4R Examples
Due to extreme narrowness of the roadway, particularly in Segment 5, extended road closures up to 4 hours at a time will be required. There is no viable detour in the area. The closures have been presented to the public during public meetings, and the impacts of the closures will be discussed in the EA.
All construction activity must be coordinated with operation of the shuttle bus system. The requirements of the shuttle contract must be accommodated during road construction. Constraints that will be committed to in the EA/EIS must be honored during construction. For example, this will include restricting construction activities during peak wildlife viewing times. Construction must include accommodation of two-way traffic. Full public road closure will not be allowed under this phase. The specifics of allowable delays will be determined during project development.
The road will be closed due to snow from approximately November 1 to May 1. During the summer months, the road will remain open during construction to allow access for private residences, logging, Forest Service and recreational use. Access to the High Bridge Campground will also be maintained during construction of the bridge. It is anticipated that the existing bridge will be used for public traffic during construction of the new bridge.
3R Examples
If construction requires any temporary or permanent closures under live traffic, the minimum roadway width will have to be wide enough to permit the safe passage of logging trucks. However, the contractor will have to coordinate with both the County and Forest Service for any roadway closures or vehicle restrictions. There is a box culvert that needs to be replaced at MP 6.6. During the replacement of the culvert, the road will likely be closed, and traffic will need to be detoured. Either a temporary detour will need to be constructed around the culvert or a temporary detour route will need to be implemented. During construction, access will have to be provided for the Ceresola Ranch and other residents along the route. If the roadway is used as a mail route or school bus route, access will have to be provided accordingly.
It is anticipated that only standard traffic control set-ups will be required for the construction of this project. Limitations to the construction operations are listed in the Special Contract Requirements. Special considerations with operations will need to be taken to address the Ferry Boat schedule between Bullfrog and Halls Crossing marinas. The last departure ferry schedule for Halls Crossing Marina is as follows (local time): **April 15 – May 14** Depart 4:00 pm

May 15 – September 14
Depart 6:00 pm

September 15 – October 31
Depart 4:00 pm

November 1 – April 14
Depart 2:00 pm

Generally, standard traffic control set-ups will be required for the construction of this project. One lane shutdowns (with flaggers and pilot cars) will be allowed Monday through Friday with a maximum delay of 30 minutes. Two pilot car-managed work zones will be allowed on Chapin Mesa Road – one work zone south of Far View Visitor's Center and one north of Far View Visitor's Center. The Park agreed to close Chapin Mesa Road from Far View Visitor's Center to Park Headquarters Loop intersection during the nighttime.

Signing and Striping

Examples

4R Examples

Standard signing and striping will be required on this portion of the project.

Signing
Existing signing within the construction limits will generally be removed with the exception of a few special private property related signs. New signs will be added at selected locations to alert users to winding or sharp curves, with speed reduction panels added as necessary. Due to low speed and recreational nature of the road, signing has been minimized to the extent possible.

Special signs and kiosks will be added at parking areas and interpretive sites as requested by the USFS. Sign panels will be provided by the USFS, the contractor will erect sign supports and kiosks and install panels.

Striping
One-hundred millimeter Type B pavement marking as well as miscellaneous markings will be used on the project for roadway centerline, edge lines, and parking areas. The roadway has been reviewed and limited passing zones identified. While passing may generally not be needed on this low speed facility, having designated zones allow the typical user to pass extremely slow moving vehicles on the steep grades.

It is anticipated that standard signing and striping will be required on this project. 4-inch type B pavement marking will be used. Existing signing within the construction limits will be removed and replaced with new posts. Signs within the clearzone will have breakaway posts.

The USFS provided recommendations for permanent sign installations on November 3, 2004. Signs within the clear zone will have breakaway posts.

Passing zones will be included where possible. Waterborne traffic paint (type B) will be used

3R Examples

No lane striping exists along Halls Crossing Road. This will be added per project requirements. It is anticipated that standard signing and striping will be required on this project. 4-inch type b pavement marking will be used. Existing signing (unless noted otherwise in plans) within the construction limits will be removed and replaced with new signs and non-wooden painted posts. Signs within the clearzone will have breakaway post. The park will maintain or replace any of the brown park signs and would like a shoulder stripe placed on the new roadway. If any of the park “brown” signs needs to be reset due to construction, the park would like to contractor to handle this.

Existing signing within the construction limits will be removed and reset as needed per YNP standards. Due to low speed and recreational nature of the road, signing has been kept to a minimum. All roads will be restriped (centerline and edge stripes) and parking lots restriped

to match existing layouts. 4” width, Type B pavement marking will be used on the project.
It is anticipated that standard signing and striping will be required on this project. 4 inch type b pavement marking will be used. Existing signing will remain in place, and supplemented were necessary. The damaged speed limit sign at Sta. 119+25 will be replaced

Revegetation

Examples

4R Examples

The USFS provided recommendations for revegetation on November 3, 2004 and discussed these recommendations during the 70% field review in August 2005. These recommendations have been included in the project Special Contract Requirements. Recommendations include:

- Minimize ground disturbance as much as possible.
- Conserve topsoil within the construction limits. Topsoil stockpiles will not be permitted on top of state-listed noxious weed locations.
- The weed-free seed mix required is:
  Slender wheatgrass (*Elymus trachycaulus*) – 11.5 #s/AC (55% of mix)
  Western wheatgrass (*Pascopyrum smithii*) – 11 #s/AC (45% of mix)
  Total = 22.5 PLS #s/AC (50 seeds per square foot)

- Test seed brought from out of state for Colorado Noxious Weeds.
- Place matting on slopes steeper than 1:2.5 (40%). Place weed-free straw or hay mulch on slopes 1:2.5 and flatter. Ensure the matting is biodegradable.
- Locations of noxious weed infestation include:
  - 7+010 to 7+200 left
  - 7+140 to 7+200 right
  - 11+750 to 11+850 left

In these areas, the construction equipment will be cleaned before and after disturbing any soil. Any topsoil removed from these areas will be buried to avoid spread of the noxious weeds.

Landscaping on the project will include roadway obliteration, creation of a replacement wetland, spreading of logs and woody debris in selected areas to create habitat for sensitive species, seeding with native vegetation.

Subalpine and montane seed mixes are currently included in the project. Additional input from the USFS is expected prior to the 95% submittal
Plantings are shown in the parking areas and other selected sites based on input from the USFS.

3R Examples

Landscaping on the project will be limited to minor roadway obliteration and spreading of conserved topsoil. Seeding will be completed by the NPS.

The seed mix is anticipated to be provided by the USFS prior to the 70% submittal in June.

This project includes only minor disturbance of the area adjacent to the roadway. The existing shoulder material will be windrowed during recycling operations. After the pavement is placed, the existing shoulder material will be replaced to approximate original position. The NPS is currently collecting seed and will provide the seed for the Contractor to use.

Right of Way

Examples

4R Examples

This portion of the Beaver to Junction Road is completely within the Fishlake National Forest. There is no private property adjacent to this portion of the road. The Utah Department of Transportation owns and maintains the route in Segment 3. The 70% plans depict a proposed 200 foot right of way corridor (100 foot offset left and right of the proposed centerline). In three locations, the proposed right of way is offset greater than 100 feet from the centerline to accommodate proposed improvements that go beyond 100 feet.
All proposed improvements shown in the 70% plans are contained within the proposed right of way limits depicted on the plan sheets. One temporary easement is proposed in order to tie-in the construction of an existing approach road to the new alignment at Station 762+36.

Efforts have been made to minimize impacts to private property along the route, including raising the grade, shifting the horizontal alignment, minimizing ditch width, and steepening slopes. Various existing fences and gates that will be affected by construction will be replaced. Specific areas are detailed below:

3+320 to 4+280
Cut and fill slopes are steepened to 1:3 or greater.
5+395 to 5+770
Cut slope rounding is eliminated and construction limits are reduced to 0.5 m outside of the slope stake to preserve the fence on the right.
6+270 to 6+345
Cut slope rounding is eliminated and construction limits are reduced to 0.5 m outside of the slope stake to preserve the fence on the right.
12+100 to 12+550
Adjusted centerline to more closely match existing alignment. Used reduced width ditch on the left from 12+155 to 12+280.
18+300 to 19+150
Cut and fill slopes are steepened to 1:3 or greater. Horizontal alignment revised to better match existing alignment.
20+300 to 20+450
Horizontal alignment shifted to the left to avoid fence.
20+450 to 22+200
On November 6, 2003, representatives from FHWA and Gunnison County met with some of the Crystal Creek subdivision property owners. Decisions made during this meeting include:

- Avoid impacts to Vader property at 20+450 LT
- Maintain screen of trees at 20+620 LT
- Avoid irrigation ditch 21+300 to 21+350 LT
- Eliminate access to gravel roadway at 21+450 LT

Shift roadway to the right to maintain a screen of trees between the Shaw's cabin and the roadway near 22+200 LT

Segments 4 and 5 are mostly within Forest Service boundaries with a few small private

parcels. It is proposed to re-write the existing highway deed. The new deed would take effect when construction is complete. The current deed describes the ROW as 20 meters [66-ft] each side of centerline of the existing roadway. It is proposed to increase the corridor limits to 30 meters [100-ft] on both sides of the proposed centerline. This will enable the county to have access for maintenance of the larger cuts and fills on the new project. Additional easements may also be included at specific locations.
3R Examples
The project is wholly within the boundary of the park; therefore no right of way will be required.
The 3R work will not significantly affect the ROW. However, the possible realignment of the bridge at Grizzly Creek may require ROW negotiation. The County indicated at the Scoping Review meeting that there is ROW information at this location. There may be ROW issues on the project if the historic landslide area is added to the scope of work. The County will be responsible for document preparation and acquisition.
Colorado Forest Highway 16 currently is maintained by Rio Blanco County. Maintenance access is granted to Rio Blanco County via a Highway Easement Dedication (HED). The limits of this current dedication are 50’ from the centerline of the existing roadway. The current improvements for project PFH CO 16-1(2) extend beyond this 50’ width. The Forest Service requested that modifications to the HED be executed through a Special Use Permit.

Utilities

Examples

4R Examples

Anza Electric

Anza Electric currently has overhead power lines throughout the project area. Multiple poles are anticipated as being relocated due to construction. The County of Riverside will provide the funding for these relocations. It is anticipated that all pole relocations will be completed prior to construction.

Verizon

Verizon currently has a fiber optic line running along the existing Bautista Canyon Road for the length of the project. The existing line will have major impacts that will cause a complete relocation. The existing line south of Tripp Flats Road may possibly be retained with adjustments to the manholes.

It is assumed that a temporary overhead line will need to be installed prior to construction. As part of this contract, FHWA will install conduit and manholes within the roadway template. Verizon will then be responsible to pull there lines through the conduit.

The following utilities and contacts have been identified on this segment of the project. Also described is current status of utility coordination for each facility.

Xcel Energy - Overhead and Underground Power and Video Surveillance

Contact: Jonnye Knoll
Xcel Energy
(303) 445-4504

Cabin Creek area: Construction will impact a number of poles along the reservoir. These poles carry electrical, phone, and some video surveillance. Coordination and discussions are still ongoing for the potential undergrounding of this line as a part of this project.

Xcel Energy - Underground Penstocks

Contact: Dan Brown
Xcel Energy
(303)569-1120

Penstock from Upper Cabin Creek Reservoir: Penstock was tunneled through rock beneath road area at 30+560. This project requires removal of portions of the rock outcrop on the east side of the road over the penstock, adjacent to the security fence. Xcel prefers that this rock be removed during the maintenance shut down of the penstock scheduled for September, 2006. Per meeting with Xcel they believe penstock is 20’ deep at this location. CFLHD will have Phase 1 contractor remove as much rock as possible in Summer 2006. Any remaining rock that needs to be sawed or removed by other means will be done during shut down period.

Penstock from Georgetown Forebay: New 30" Penstock was installed in 2003, and is directly beneath the road from 36+350 to 36+850. Penstock was potholed in 2005 to verify depths at culvert crossing locations. Penstock will not need to be disturbed, but access manholes to two vaults on the line will need to be adjusted.

Qwest Communications - Overhead and Underground Communications

Contact: Dan Lewis
Field Engineer
Qwest Communications
(303) 441-7142

Overhead phone line shares poles with Xcel overhead power, and will be impacted in same locations. If power undergrounded, it is assumed separate conduit will be installed for phone service.

Sanitary (Owens Property)

Contact: Brian Carlson
Town of Georgetown
(303) 269-2897

Existing PVC sanitary sewer from Owens property at 38+670 will be impacted by project when installing culvert at 38+692. This sanitary line reportedly has problems freezing in the winter, so other adjustments may be necessary by owner or Georgetown.

Existing utilities located within the project limits include telephone, electric and water. No impacts to telephone and water are expected.

3R Examples

Existing utilities located within the project limits include telephone and water. No impacts to these utilities are expected.

There are multiple utilities in the project area, especially along East Road, including telephone, gas, sewer, power and water. Since this is a 3R project, only minor adjustments to facilities within the road are expected.

There is an underground phone line running along the southerly edge of roadway and there is an overhead power line at the west end of the project and the east end near the parking lot.

Verizon owns the underground telephone line. The line needs to remain in service and be protected during construction. As of the 95% submittal, discussions are still ongoing with Verizon regarding responsibility for locating, potholing, exposing, and adjusting the phone line around culverts and drainage structures. Verizon has initially indicated that they will locate and expose the line, and be on site during construction to advise on protecting and adjusting line. If the contractor needs to do more of the exposure and adjustment work, this can be paid under equipment hours.

The overhead power facilities are owned by Pacific Power and Light and should not be affected by the project construction, but care should be taken to not disturb the existing facilities

Specifications

Examples

4R Examples
This project will be designed according to the FP-14. Specifications will be included in the 50% design submittal.
This project will be designed according to the FP-14. Specifications are included in the 70% design submittal.
This project will be designed according to the FP-14.
3R Examples
This project was designed and will be constructed in accordance with FP-14.

Construction Schedule

Examples

4R Examples
The significant restrictions imposed on this project are: No major ground disturbing activities from November 1 thru April 31 and all clearing must be performed during the non-nesting season which is August 1 to January 31. These restrictions will have the most impact on the construction contract time. The key activity driving the duration of construction is wall construction. It was assumed that there would be 2 wall crews working. This assumption was chosen to be conservative.
The biggest restriction imposed on this project is weather conditions. It is possible that this project may have to shut down due to snow from the beginning of November to the end of March. The key activity during construction will be wall construction. It is anticipated that this project will need three construction seasons to complete the 1.5 mile section. The time to complete the project will be reduced with the length of the project actually being construction. The current estimate for the construction schedule has the project starting on April 21, 2008 and ending on November 3, 2010. Please see the attached CPM for more detailed information.
The anticipated start of construction is May 13, 2005 and the completion date is September 30, 2005. No interim dates are necessary. The critical path method (CPM) was used to generate the schedule. The completion date can be extended by 15 days, if necessary. Completion of temperature critical work becomes an issue if construction occurs beyond October 30.
3R Examples
The anticipated start of construction is May 13, 2005 and the completion date is September 30, 2005. No interim dates are necessary. The critical path method (CPM) was used to generate the schedule. The completion date can be extended by 15 days, if necessary. Completion of temperature critical work becomes an issue if construction occurs beyond October 30.
Due to the higher elevations and mountainous location of the project, the construction season would be limited to May through October.
This construction package is planned for advertisement on January 15, 2006. Subsequently, the bid opening and notice to proceed will be February 15th and March 15th respectively. Final completion of the project is expected by September 1, 2006. Originally, the National Park Service goal was to have the construction completed by the Fourth of July weekend. This is generally one of the two biggest weekends for visitation at the park. At 70% design a preliminary construction schedule using the critical path method

(CPM) was put together to estimate if this goal could be accomplished. The opening of the local batch plants was and still is the critical path for paving and ultimately the completion of the project. The 70% schedule had NTP on January 1st and paving operations beginning in mid-March. The parks' goal was reachable with the project completion shown on May 19th.

Due to the shelving of the Halls Crossing project, the construction schedule had to be reviewed once again. The Glen Canyon NRA inquired if the project, or at least the paving operations, could be completed before the Memorial Day Holiday weekend. In taking another look at the paving operations and long haul required for this remote site, it was determined that paving operations would take significantly longer than first estimated. Additionally, the first schedule done at 70% was overly optimistic when paving could begin. Even if the local batch plant opens early, daytime temperatures would not become warm enough until later in the year, especially with a possible 3-hour haul to the project site. Pulverization and paving is estimated to take 5 and 7 weeks respectively. Both the parks' goals of being completed by Memorial Day and Fourth of July weekend are not unattainable.

Construction Cost Estimate

Examples

4R Examples

The preliminary 30% cost estimate (class "C") for this project was $17,235,000. This estimate includes major pay items (excavation, surfacing quantities, etc…) and includes a 20% contingency for small work items, a 10% contingency for traffic control and a 5% contingency for erosion control (See appendix G).

The cost estimates for the five alternatives that will be presented in the Environmental Document are as follows (contingency amounts are the same as those listed above):

Alternative 1: No Action
Cost Estimate: N/A

Alternative 2: Reconstruction of the roadway along the existing alignment. Two minor realignment sections are proposed, including Bandit Curve and Hollowell Park. This alternative would utilize retaining walls along the edge of Glacier Creek to minimize resource impacts. This alternative would not address a multi-use path.
Cost Estimate: $18,848,000

Alternative 3: Reconstruction of the roadway including three realignment sections. Realignments include Bandit Curve, Hollowell Park and relocation away from Glacier Creek. Under this alternative, half of the abandoned roadway near Glacier Creek would be rehabilitated and reclaimed using FLHP funds. The other half of the roadway would be converted into a multi-use trail. The remaining segments of the multi-use trail, from the YMCA to Bandit Curve, and from the Park and Ride facility to Sprague Lake, would be constructed by the NPS using a separate funding source. A small parking area would be constructed just north of the Park and Ride to allow for visitor parking to access the multi-use trail.
Cost Estimate: $17,065,000

Alternative 4: Reconstruction of the roadway including three realignment sections. Under this alternative, all of the abandoned roadway near Glacier Creek would be reclaimed using FLHP funds. Bicycle lanes would be constructed along the shoulders of the roadway from Hollowell Park to just north of the Park and Ride using FLHP funds. The remaining segments of the multi-use trail, from the YMCA to Hollowell Park, and from the Park and Ride to Sprague Lake, would be constructed by the NPS using a separate funding source.
Cost Estimate: $17,695,000

Alternative 5: Reconstruction of the roadway along the existing alignment. Two minor realignment sections are proposed, including Bandit Curve and Hollowell Park. Instead of utilizing retaining walls along the edge of Glacier Creek, this alternative would shift the roadway into a cut section with increased resource impacts. This alternative would not address a multi-use path.
Cost Estimate: $18,810,000

The preliminary 30% cost estimate (class "C") for this project is $970,000. This estimate

includes major pay items (excavation, aggregate surfacing quantities, drainage, etc…) and includes a 30% contingency for small work items. The cost does not include a cost for widening and/or a wall at the Burr Canyon Side drainage due to the limited survey information. Also, the cost does not include any cost for revegetation and/or mitigation. Revegetation/mitigation measures will be discussed at the 30% Design Review if required. The current funding available for this project is $989,000.

The construction cost estimate for the Segment 3 50% design was $11,710,000 (April 2006). The current construction cost estimate for the Segment 3 70% design is $12,141,000.

Significant Changes

Major changes to the cost estimate resulted from a larger volumes of Roadway Excavation, Waste and higher Wall cost. Roadway Excavation changed from 148,000 CY to 155,000 CY and Waste changed from 29,500 CY to 46,400 CY based on the new alignment. The retaining wall's increase in cost of $236k is due to the increase in Soil Nail Wall area and the addition of two new items, Rockery Wall and Shotcrete. The soil nail wall area increased by 1,350 SY based on the SMSE wall design and tiering one soil nail wall. The MSE wall area was reduced by 1,763 SY, however, the unit price for MSE walls is $150 /SY less then soil nail walls. Using the CFL – Engineer Estimate Inflation Spreadsheet, which applied inflation rates of 18% through 1/1/2008 and 12% beyond 1/1/2008, results in a construction cost estimate of $16,475,000 in March of 2009 and $18,195,000 in March of 2010.

3R Examples

The engineer's estimate for the 95% PS&E submittal is $2,295,000.00 including a $25,000 incentive for meeting an interim completion date.

The engineer's estimate at the 70 % submittal was $2,020,000. Main increases in cost were due to revised quantities or estimated unit costs based on the anticipated complexity of the work for the following items: Surveying, clearing and grubbing, subexcavation, pavement milling and placement, additional roadway aggregate to supplement millings if needed, and additional equipment hours to cover unknown work items.

The current engineer's estimate for this project is $664,659.30. The engineer's estimate at 70% was $1,038,298.75. The cost difference in these estimates is due to the following items/issues:

Cost sharing by Garfield County

As part of this project Garfield County will assist with the construction cost. The 95% engineer's estimate is based on Garfield County providing the following:

- Roadway aggregate: Contractor will have access to material stockpiled by the County approximately 12 miles from the project site at the Eggnog Pit.
- Riprap: Contractor will have access to material stockpiled by the County approximately 12 miles from the project site at the Eggnog Pit.
- Select Borrow: Contractor will have access to material stockpiled by the County approximately 12 miles from the project site at the Eggnog Pit.
- Cattleguard: County will supply one cattleguard to the contractor for replacement of the existing cattleguard. The Park will provide the other cattleguard.
- Concrete barrier: County will provide concrete barrier to be used as a cutoff wall at unvented low water ford locations.
- Signing: Signs will be installed by the contractor.
- Culverts and End sections: Culverts and end sections will be installed by the

contractor.

- Waste: Contractor will stockpile waste on site which the County will haul off site and dispose of.

With the supply of materials by the County, the cost estimate for this project has decreased significantly.

Other

Pay Item #	Description	70% Quantity/Cost	95% Quantity/Cost
15216-2000	Survey and Staking, Grade Finishing Stake	0/$0	42.13 Sta./$8,847.30
Item added for construction of Roadway Aggregate.			
15701-0000	Soil Erosion Control	LS/$8,000	$30,100 (Cost for silt fence and sediment log)
Item was broken out at 95% with a more accurate quantity takeoff.			
20401-0000	Roadway Excavation	3,000 cy/$51,000	1,440 cy/$24,480
Profile was adjusted due to a change in the thickness of the roadway aggregate.			
25101	Placed Riprap (All classes)	1,570 cy/$138,700	1,330/$47,880
Material will be supplied by the County.			
30801	Roadway Aggregate	7,425 tons/$207,900	1,970 cy / $23,640
Thickness reduced from 12 inches to 8 inches.			
50101-0900	Reinforced Rigid Pavement	1,350 sy/$101,250	1,610 sy/$201,250
Unit cost increased to reflect current costs.			
60201	Pipe Culverts (All sizes)	780 lf/$91,850	710 lf/$44,000
Culverts to be supplied by the County. Unit cost decreased.			
61801-0000	Concrete Barrier	800 lf/$48,000	750 lf/$9,000
Barrier to be supplied by County. Unit cost decreased.			

The remaining difference in cost is due to modifications to the design from 70% to 95% and a more complete quantity takeoff.

The preliminary 70% cost estimate for this project is $2,575,000 in 2007 dollars. Adjusting for inflation (+12%), the estimate in the year 2008 is $2,770,000. This estimate includes major pay items (excavation, surfacing quantities, etc…). The current funding available for this project is $2,800,000.00.