## 1.1 PURPOSE AND NEED STATEMENT

This Final Environmental Impact Statement (FEIS) is prepared in accordance with the National Environmental Policy Act (NEPA) (42 US Code (USC) 4321-4347), to address impacts of proposed highway improvements on US Highway 160 (US 160) from west of the US 160/US Highway 550 (US 550) (south) intersection in Durango to east of Bayfield (see Figure 1.1.1, Project Location). The purpose of this project is to improve the conditions for the traveling public along US 160 in the project corridor. Specifically, the purpose of the project is to:

- Increase travel efficiency/capacity to meet current and future needs
- Improve safety for the traveling public by reducing the number and severity of accidents
- Control access

The need for this project is based on the projected increase in travel demands on highway capacity and efficiency, and the existing substandard design that contributes to accidents associated with roadway deficiencies.

## 1.2 PROPOSED ACTION

The proposed project is located in La Plata County, Colorado. The project length on US 160 would be 16.2 miles, extending from milepost (MP) 88.0, located east of Durango, to MP 104.2, located east of Bayfield. The project length on US 550 would be 1.2 miles, extending from MP 16.6, located at the US 160/US 550 (south) intersection, to MP 15.4, located south of the US 550/County Road (CR) 220 intersection.

On US 160, the proposed project would extend the existing four-lane highway from Grandview east to Bayfield where it would transition to a two-lane highway. Beyond MP 104.2 the roadway provides sufficient capacity; accident data do not dictate the need for capacity and safety improvements by 2025. In Gem Village, from MP 100 to MP 101, US 160 will be realigned to the south. From the west project limit to the proposed US 160/US 550 (south) intersection, a westbound auxiliary lane and an eastbound climbing lane would be required. In addition, the project would realign approximately 1.2 miles of US 550 south of US 160. The realigned portion of US 550 would be improved to a four-lane highway.

The proposed project would include reconstruction of the US 160/US 550 (south) intersection as an interchange. A grade separation of this intersection would provide the best option to address the reconnection of US 160 and US 550 due to terrain and traffic volume. The proposed project would also include reconstruction of the US 160 intersections with CR 233 (west) and State Highway (SH) 172/CR 234 as interchanges. The US 160 intersections with CR 233 (east), CR 232 (west), and CR 232 (east) would be eliminated, with CR 233 passing beneath US 160. The realigned CR 222/CR 223 (west) intersection with US 160 would be signalized; improvements would be made to the existing US 160/CR 501 intersection; and numerous direct access points to US 160 for businesses, neighborhoods, and facilities (see Figures 1.2.1 through 1.2.5) would be consolidated or improved to provide access control.

## 1.3 PROJECT STATUS

In February 1999, the *Final US 550 and US 160 Feasibility Study* [URS Greiner (URSG 1999)] (Feasibility Study) was published after nearly three years of performing technical studies and gathering public input. Between February 1999 and January 2002, a preliminary Environmental Assessment (EA) was prepared by the Colorado Department of Transportation (CDOT) for the Federal Highway Administration (FHWA), the lead agency for this project. Based on the preliminary EA, FHWA and CDOT determined an Environmental Impact Statement (EIS) was the appropriate level of NEPA documentation for this project [40 Code of Federal Regulations (CFR) 1501.4 (c)].

Because of impacts to wetlands and waters of the United States (US), and the need for a permit under Section 404 of the Clean Water Act (CWA), the US Army Corps of Engineers (USACE) is a cooperating agency for this FEIS, and both FHWA and USACE agreed to participate in a 404/NEPA merger process. The Section 404/NEPA merger process would provide a concurrent analysis using the Section 404(b)(1) Guidelines (40 CFR Part 230) for the alternatives analysis. Permits that may be required for this project and other regulatory requirements are detailed in Chapter 4, Environmental Consequences and Mitigation, under Section 4.24, Permits.

In addition, a Section 4(f) Evaluation is included in this FEIS. Section 4(f) of the Department of Transportation (DOT) Act of 1966, codified in federal law at 49 USC. 303, was established to "…preserve the natural beauty of the countryside and public park and recreation land, wildlife and waterfowl refuges, and historic sites."

The major steps in the EIS process for this project are: (1) publication of a Notice of Intent (NOI) on December 24, 2002 in the *Federal Register* that announced FHWA's intention to prepare an EIS and hold a public scoping meeting; (2) conduct of a scoping period with a public information and scoping meeting on March 5, 2003 to identify public and agency issues and possible alternatives to be considered in the EIS; (3) publication of a Draft Environmental Impact Statement (DEIS) on September 23, 2005; (4) provision of a 45-day comment period and public hearing (October 13, 2005); (5) publication of a FEIS to assess, consider, and respond to public and agency comments received; and (6) issuance of a Record of Decision (ROD).

The project began with a Feasibility Study completed in 1999 (URSG 1999). The resultant alternatives and potential environmental impacts are being studied as part of this ongoing environmental process. The next steps would be preliminary and final design after environmental approval. Improvements would be made as funding permits, most likely in phases as capacity and safety require. This corridor is included in the CDOT Long Range Plan and has been identified as a strategic corridor and a priority for funding by the state Transportation Commission.

## 1.4 BASIS OF NEED

The following sections of this chapter describe the travel efficiency and capacity issues, safety and accident analysis, and roadway and access deficiencies for this project.

The population of La Plata County has increased substantially from 1980 to 2000, resulting in residential and commercial development. According to the Colorado Demography Section (CDS) (CDS 2005), La Plata County's population is projected to increase from 45,614 in 2001 to 74,464 by 2025. Much of this growth is anticipated along the US 160 project corridor.

On US 160 between the US 550 (south) and SH 172/CR 234 intersections, the *Grandview Area Plan* (City of Durango 2004) anticipates more than 2,700 new residential units, as well as additional office and commercial uses, including the new Mercy Medical Center scheduled to open in 2006. Approximately 1,700 housing units and commercial uses are planned over the next 20 years for Ewing Mesa, a large tract of undeveloped land about 1 mile north of Farmington Hill. As delineated in the *Florida Mesa District Land Use Plan* (La Plata County 1998), a suburban density residential area extends about 1 mile east of the SH 172/CR 234 intersection with US 160. A proposal for a 584-unit residential development about 1 mile east of the Florida River on the north side of US 160 has been presented to the La Plata County Planning Department staff. In another project, La Plata County is considering developing a rural water system, piped from the Vallecito Reservoir, which would provide much of eastern La Plata County with potable water. The US 160 project corridor is part of the proposed service area. These and other proposed residential developments along US 160 are discussed in Chapter 3, Affected Environment.

The growth in population and associated commercial and office-related facilities are the major reasons for the expected traffic volume increases throughout the county and especially along the US 160 project corridor. Tourism traffic is anticipated to remain high during the summer months, and would likely increase as the number of resort and recreational facilities increases in the region.

### 1.4.1 Travel Efficiency and Capacity

US 160 is a national highway system route and is the only principal east-west highway traversing the entire state of Colorado that serves the Four Corners Region. This vital link to the transportation system provides for the transport of people, goods, and services through the state and serves as a local and regional highway for the city of Durango and town of Bayfield. US 160 and US 550 intersect in Durango at Farmington Hill. US 550 is the principal north-south highway in the western portion of Colorado, extending from the New Mexico state line to Grand Junction. As such, the junction of US 160 and US 550 is an important crossroad serving southwestern Colorado.

Highway improvements were made on the existing US 160 in La Plata County in the 1950s and 1960s. At that time, the population of La Plata County was less than 20,000 residents. Since then, the population has more than doubled, and tourist activity has increased as well. As a result, traffic volumes along the US 160 project corridor have increased and traffic volumes in the region increase by 50 percent in the summer months with the influx of tourists.

#### *1.4.1.1 Traffic Volume*

Travel efficiency, a measure of how well a roadway system functions, is based on traffic volume, capacity, and delay. Travel efficiency is an important measure of the operational conditions on US 160.

The Annual Average Daily Traffic (AADT) volumes on the corridor have increased steadily from 1981 to present at the CDOT traffic counting station No. 217, located at US 160 MP 101.30 between Gem Village and Bayfield. Figure 1.4.1, US 160 Traffic Growth Trends (1996-2001), shows the 2001 AADT volumes for specific highway segments reported in the CDOT Web site traffic database, and average yearly traffic growth trends for the 5-year period from 1996 to 2001 (http://www.dot.state.co.us).

The US 160 project corridor experiences heavy tourist/recreational traffic during the summer months between June and September. The increases in summer traffic volume are associated with a 75 percent occupancy rate of hotels and vacation homes, as reflected by Durango Area Tourism Office data (Cobb 2005). As illustrated in Figure 1.4.2, US 160 Seasonal Traffic Fluctuations (Year 2001) MP 101-Gem Village, traffic volumes in the seasonal summer months are typically 35 to 60 percent higher than the lower travel months the rest of the year. For example, the CDOT traffic counter near Gem Village recorded 6,020 vehicles per day in January 2001 and 9,470 in July 2001 – a 57 percent increase. Seasonal fluctuations in traffic volumes are considered in future 20-year traffic projections.

In areas with high seasonal fluctuations, like La Plata County, the highway should be designed to accommodate the heaviest flow in the summer months, per American Association of State Highway and Transportation Officials (AASHTO) and other highway design guidance. Thus, the seasonal land use scenario was used to determine future traffic volumes, which were subsequently used to determine the expected level of service (LOS) for this roadway. Future traffic volumes are shown in Table 1.4.1, Existing and Projected Seasonal Daily Traffic Volumes and LOS. Traffic forecasts show a two- to three-fold increase in traffic by 2025 using these population and land use projections for La Plata County and Durango.

With the projected growth in the county and city, even if the seasonal hotel occupancy rate were lower, LOS estimates and recommendations for laneage needs on US 160 or US 550 would not change. This is based on the estimated contribution of hotel traffic to the total seasonal traffic volume at morning (AM) and evening (PM) peaks (10.3 percent and 6.1 percent, respectively) (URSG 1999).

**Table 1.4.1**
**Existing and Projected Seasonal Daily Traffic Volumes and LOS**

| Location | 2001 | | 2025 | |
|---|---|---|---|---|
| | SDTV* | LOS | SDTV* | LOS |
| US 160 west of SH 172/CR 234 | 25,500 | Eastbound = LOS D<br>Westbound = LOS E | 69,700 | LOS F |
| US 160 east of SH 172/CR 234 | 10,600 | LOS D | 31,300 | LOS F |
| US 160 east of CR 222/CR 223 (west) | 7,700 | LOS D | 25,800 | LOS E |
| US 160 west of CR 501 | 5,800 | LOS D | 16,900 | LOS E |

*Seasonal Daily Traffic Volume

### *1.4.1.2 Highway Level of Service*

LOS is designated by letter codes ranging from A for excellent conditions to F for extremely poor conditions. LOS A signifies a free-flow condition with no slowing or interference to traffic, while LOS F represents a complete breakdown in traffic flow and in the worst case, traffic jams. Figure 1.4.3, Level of Service for a Typical Two-Lane Rural Highway, depicts each category of LOS. Factors influencing LOS are the percentage of trucks and other large vehicles, directional distribution of traffic, type of terrain, number of access points, signalization, and percentage of passing lanes.

US 160 west of the SH 172/CR 234 intersection is considered to be urban because of anticipated growth and future annexation plans of Durango (*Grandview Area Plan 2004*). Figure 1.4.4, 2001 Level of Service, shows all highway sections at their 2001 LOS.

US 160 east of the SH 172/CR 234 intersection to east of Bayfield is considered a rural highway. In this section US 160 becomes a two-lane section, with climbing lanes at the Florida River and Gem Village. This section has rolling terrain, uncontrolled access, lack of turning lanes, and insufficient shoulders. The projected LOS for this section, if no improvements are made, would be LOS E during the AM peak hour and LOS F during the PM peak hour in 2025. The LOS is influenced by the high percentage of trucks and recreational vehicles, directional distribution of traffic, rolling terrain, high density of access points, and limited passing opportunities. US 160 through Bayfield is considered to be urban because US 160 bisects the town. A LOS of C is generally accepted as the lowest preferred operating level for a rural highway, and a LOS of D is generally accepted as the lowest preferred operating level for an urban highway (CDOT 1995).

Three parameters are used to determine the operating LOS of a two-lane highway: average travel speed, percent time delay, and capacity utilization. Average travel speed reflects the average speed of traffic in both directions. Percent time delay is defined as the average percent of time vehicles are delayed due to the inability to pass slower vehicles. The ratio of the traffic demand rate to the capacity of the highway is capacity utilization.

Multilane highways differ substantially from two-lane highways, mainly because the driver on a multilane highway has the ability to pass slower drivers without using lanes designated for oncoming vehicles. This highway classification has no significant presence of on-street parking or bus stops and has traffic signals spaced more than 2 miles apart. Service quality of a multilane highway is determined by density of traffic, and density is determined by dividing traffic flow by speed. Therefore, free-flow speed is a critical element of operations. This LOS analysis was performed for both 2001 and forecasted 2025 traffic volumes and has been summarized in Table 1.4.1, Existing and Projected Seasonal Daily Traffic Volumes and LOS. See Appendix A, Traffic Report, for more information.

As shown in Table 1.4.1, all highway sections were operating at or below preferred minimum operating levels, except for the eastbound section through Grandview during peak periods in 2001. Based on recorded traffic volume growth trends, the current traffic operations have deteriorated, and if left unimproved, future peak-period traffic volumes on this existing facility would fall below the minimum acceptable LOS. Peak periods are defined as the AM and PM rush hours of a typical weekday.

### *1.4.1.3 Intersection Level of Service*

After consideration of the highway segment operations, the operations of intersections should be considered to ensure good traffic operations for the entire highway. Intersection analysis consists of estimating the traffic-carrying ability of an intersection. The methodology of analyzing signalized intersections is described below.

The capacity of a highway is primarily related to roadway geometrics and traffic characteristics. For signalized intersections, time allocation is an additional element of capacity determination. The LOS is evaluated on the basis of average stopped delay per vehicle. Delays can cause driver frustration, additional fuel consumption, degradation of air quality, and increased travel time.

LOS is also dependent on quality of vehicle progression, signal cycle length, and the ratio of vehicle flow rate to intersection capacity. Generally, LOS is determined for both the AM and PM peak-hour traffic volumes. The LOS criteria are shown in Table 1.4.2, Signalized Intersection Level of Service. According to generally accepted standards, for this highway, the minimum acceptable future-year signalized intersection operation is LOS D for both the AM and PM peak hours.

**Table 1.4.2**
**Signalized Intersection Level of Service**

At **LOS A**, there is very good progression through the intersection. Most vehicles arrive during the green phase; most do not have to stop. Vehicle delay is 10 seconds per vehicle or less.

At **LOS B**, more vehicles stop than in LOS A**,** but generally there is still good progression. Delay ranges from 10 to 20 seconds per vehicle.

At **LOS C**, the number of vehicles stopping is significant, although many still pass through the intersection. Delay ranges from 20 to 35 seconds per vehicle.

At **LOS D**, the influence of congestion becomes more noticeable. Many vehicles stop and the proportion of vehicles that do not stop declines. Some vehicles do not make it through the intersection in one cycle length. The range for delay is 35 to 55 seconds per vehicle, which is considered to be the limit of acceptable delay.

At **LOS E**, there are longer delays of 55 to 80 seconds per vehicle, poor vehicle movement between signalized intersections, and individual cycle failures.

At **LOS F**, vehicle arrival rates exceed the capacity of the intersection. This condition is considered unacceptable to most drivers. Delay is greater than 80 seconds per vehicle.

Source: Transportation Research Board. 2000.

The intersections in the urban sections of the project corridor were evaluated. A signalized intersection LOS analysis was performed to evaluate operations at the intersections of US 160 with US 550 (south), CR 233 (west), SH 172/CR 234, and CR 501 based on 2001 traffic counts. The forecasted seasonal 2025 traffic volumes were analyzed to determine if LOS ratings would be above, at, or below the preferred LOS D. The results of this analysis are shown in Table 1.4.3, Signalized Intersection Level of Service Summary.

**Table 1.4.3**
**Signalized Intersection Level of Service Summary**

| Signal Location | 2001 LOS D AM/PM | 2025 LOS D No Improvements AM/PM |
|---|---|---|
| US 160 at US 550 (south) (Farmington Hill) | Above/Above | Below/Below |
| US 160 at CR 233 (west) (Grandview) | * | Below/Below |
| US 160 at SH 172/CR 234 (Grandview) | Above/Above | Below/Below |
| US 160 at CR 501 (Bayfield) | Above/At | At/Below |

*The US 160/CR 233 (west) intersection was not signalized in 2001.

In 2001, signalized intersections operated acceptably during the peak periods. If unimproved, future signalized intersection operations at the US 160/US 550 (south), CR 233 (west), and the

SH 172/CR 234 intersections would fail during the peak periods. The US 160/CR 233 (west) intersection was not signalized in 2001. The US 160/CR 501 intersection signal, installed in 2000, was temporary and construction of major intersection improvements, including a new signal, was completed in the summer of 2003. The reconstructed US 160/CR 501 signalized intersection is expected to operate at or below the desirable LOS D in 2025.

#### *1.4.1.4 Travel Efficiency and Capacity Needs Summary*

In summary, demand would exceed capacity by 2025 throughout the project corridor and at key intersections. Traffic volumes along the project corridor are expected to more than double over the next 20 years as residential and commercial development increases. These increases in traffic volume are expected to result in failing levels of service – below LOS D for urban highways and below LOS C for rural highways. Consequently, traffic operations would be unacceptable to most drivers at peak periods.

### 1.4.2 Safety Issues

US 160 has a higher than average number and severity of accidents in the state. Contributing to this rating is uncontrolled access; lack of shoulders, turning lanes, and wildlife crossings; and steep grades with insufficient lanes for passing. These problems are compounded by the increasingly high traffic demands that are being placed on this section of highway. Design improvements are needed for US 160 to reduce both the accident rates and the severity of the accidents, as well as mitigate wildlife collisions through the use of wildlife crossings.

During the 5-year period from December 31, 1996, through December 31, 2001, 532 accidents occurred on US 160 from west of the US 160/US 550 (south) intersection (MP 88.0) to east of Bayfield (MP 104.2). Of those accidents, 34 percent resulted in injuries and 1.3 percent resulted in fatalities. The most frequent accident types were rear-end (32 percent), animal (27 percent), and overturning (8 percent). Also, 42 percent of the accidents occurred at intersections, were intersection-related, or occurred at driveway accesses. Accidents typically occurred during daylight (65 percent) and under dry conditions (83 percent).

The accident data suggest that the most frequent accident types occurred at locations on US 160 with similar physical features. Rear-end, turning, and overturning accidents occurred most frequently in areas that lack turning lanes and have large numbers of access points, insufficient shoulders, steep grades, and steep embankments.

Specific segments of the corridor exhibited a higher frequency of animal-related accidents. These segments, typically 1,000 to 1,500 feet in length, are likely deer/elk migration routes that intersect the US 160 project corridor. Contributing factors to animal-related accidents are lack of wildlife crossings, insufficient shoulders, steep grades, and steep embankments. The highway characteristics described above contributed to the overall accident rate by forcing wildlife onto the highway and by limiting the ability of motorists to make evasive maneuvers.

#### *1.4.2.1 Safety Issues by Section*

The US 160 project corridor was divided into four sections for this accident analysis. US 550 from CR 220 to US 160 was also reviewed. Figures 1.4.5 through 1.4.9 are accident histograms depicting the types of accidents and accident severity for each highway section during the 5-year period of December 31, 1996, through December 31, 2001. An analysis of more recent data indicated similar traffic accident trends in the project corridor when compared to the 1996-2001 data. As development, tourism, and traffic increase, accident rates and severity are also expected to increase throughout the project corridor if no improvements are made.

Following is an analysis of the types and severity of accidents for each section of US 160. Hazardous sections of roadway are identified through calculation of the weighted hazard index (WHI). WHI is a statistic computed by considering accident frequency, accident severity, and traffic volumes, and comparing these data with the accident history of similar highways. Positive values of the WHI indicate highway sections that have an accident frequency and severity higher than the statewide average. All of the US 160 and US 550 sections analyzed yielded hazard indexes higher than the statewide average, demonstrating that the majority of the US 160 project corridor and the connecting US 550 segment are in need of improvement.

**Photo 1.4.1**
**Farmington Hill**

### *US 550 – From CR 220 to US 160*

This section of US 550 extends south from the US 160/US 550 (south) intersection as a two-lane highway, ascending from the Animas River Valley to the Florida Mesa in an area known as Farmington Hill (Photo 1.4.1). The roadway is cut into the side of the Farmington Hill embankment and follows the sharp horizontal curves of the hillside at a steep grade, rising over 200 feet in approximately 0.66 mile. There are minimal paved shoulders of 2 feet or less. The traversable ground surface outside the roadway is as narrow as 5 feet in many places, and only one-third of the section has guardrail along the downward slope embankment, leaving little room for driver error or emergency stops. Outside the traversable area, the embankment both above and below the roadway is steep: approximately 34 degrees. The embankment below the roadway ranges from 46 to 290 feet in height. The north-facing slope of the road surface makes this area prone to winter icing. The steep embankment above the roadway comprises decomposed shale overlain by sandy cobbles and boulders, which are prone to sloughing onto the roadway surface, creating hazards for drivers. Because of the sharp horizontal curves, driver visibility along the road is short—as little as 100 feet at some locations; hence, assuming a 30-miles per hour (mph) travel speed, drivers have only 2 seconds to react to roadway hazards.

The roadway conditions are factors in the type and severity of accidents occurring on Farmington Hill (Figure 1.4.5, US 550 Accident Histogram CR 220 to US 160). The steep winding roadway, icing conditions, and roadway obstructions contribute to drivers losing control of their vehicles. If drivers lose control, the narrow shoulders, lack of guardrails, and steep embankments make it difficult for them to regain control once their vehicles leave the roadway. Accidents on Farmington Hill generally fall into two categories: drivers lose the ability to slow or stop their vehicles due to the steep grade and either strike vehicles located in front of them or run out into the US 160/US 550 (south) intersection, or drivers lose control and run off the roadway surface and down the steep embankment below the roadway.

***US 160 – From West of the US 160/US 550 (south) Intersection to and Including the SH 172/CR 234 Intersection***

This section (Figure 1.4.6, US 160 Accident Histogram West of Farmington Hill to SH 172/CR 234) is one of the most developed along the project corridor, and development in this area is increasing. Development is residential, commercial, and industrial. The existing traffic volumes in this section are the highest in the project corridor and are projected to more than double within the next 20 years (see Section 1.4.1, Travel Efficiency and Capacity). This segment also includes the heavily traveled Farmington Hill and the SH 172/CR 234 intersection with US 160. The data indicate that uncontrolled access and lack of turning lanes are contributing factors to accidents in this section.

***US 160 – From the SH 172/CR 234 Intersection to and Including the CR 222/CR 223(west) Intersection***

This section [Figure 1.4.7, US 160 Accident Histogram SH 172/CR 234 to CR 222/CR 223 (west)] is semi-rural with sparse residential and commercial development. Development is expected to accelerate as residential density increases in the Grandview area and pushes growth to the east. The data indicate that uncontrolled access, lack of turning lanes, and insufficient shoulders are contributing factors to accidents in this section.

***US 160 – From the CR 222/CR 223 (west) Intersection to and Including CR 502***

This section [Figure 1.4.8, US 160 Accident Histogram CR 222/CR 223 (west) to CR 502] is rural with sparse residential and commercial development, with the exception of Gem Village. Development along US 160 in this region is generally occurring at a slower rate than other sections. However, development along the county road system is increasing, resulting in additional traffic demands at the existing county road connections.

The high percentage of animal-related accidents is due to this area being a prime migration corridor for wintering elk and mule deer. The data indicate that lack of wildlife crossings, insufficient shoulders, steep grades, and steep embankments are contributing factors to accidents in this section.

***US 160 – From CR 502 to East of Bayfield***

This is one of the more developed sections (Figure 1.4.9, US 550 Accident Histogram CR 502 to East of Bayfield) along the project corridor. Additionally, there are commercial developments currently in the planning and construction phases. Development consists of residential and commercial. The accident data along this section indicate that intersections, driveways, and lack of wildlife crossings are contributing factors to accidents, as well as insufficient shoulders and steep embankments.

#### *1.4.2.2 Roadway Deficiencies*

Roadway deficiencies are a major contributor to the safety problems in the project corridor. Steep grades, a lack of passing lanes, narrow shoulders, insufficient sight distance, inadequate clear zones, substandard vertical and horizontal alignments, and poor intersection geometry are the major roadway deficiencies. The following guidance would be used in the project design to correct these problems:

- *Policy on Geometric Design of Highways and Streets* (AASHTO 2001)
- *CDOT Design Guide* (CDOT 1995)
- *Roadside Design Guide* (AASHTO 2002)

These design guidelines have been developed over the years as traffic speeds have increased, and vehicles and habits of the traveling public have changed. They are designed to provide a safer and more uniform traveling experience that the public has come to expect.

The sections that follow describe conditions within the project corridor relative to the standards and criteria described in these design guides.

#### *Capacity and Passing Deficiencies*

Within the majority of the project corridor, US 160 is a two-lane highway with 12-foot-wide traveling lanes. The year 2025 projected traffic volumes, as shown in Table 1.4.1, Existing and Projected Seasonal Daily Traffic Volumes and LOS, would exceed the capacity of a two-lane highway, resulting in less than an LOS C. Slower-moving vehicles and steep grades slow traffic in the project corridor. Trucks comprise more than 5 percent of the traffic volume. During the summer months, the highway experiences heavy tourist traffic, including slow-moving recreational vehicles. More than 38 percent of the alignment has highway grades in excess of 3 percent. Limited passing lanes are present at three locations; two eastbound and one westbound. Outside of these areas, passing opportunities are very limited due to horizontal and vertical roadway alignment deficiencies and poor sight distance conditions.

#### *Shoulder and Clear Zone Deficiencies*

The majority of the US 160 project corridor does not meet current CDOT and AASHTO standards for shoulder widths. Additionally, several sections of the highway have insufficient clear zones.

Substandard shoulder widths pose a hazard to both disabled vehicles and through traffic. Currently, the shoulder width along US 160 varies between 1 and 10 feet, with the majority being less than 5 feet. According to CDOT and AASHTO standards, heavily traveled or high-speed arterial highways should have usable shoulders of at least 8 feet and preferably 10 feet to adequately accommodate vehicles making an emergency stop.

Clear zone is defined by AASHTO as “the total roadside border area, starting at the edge of the traveled way, available for safe use by errant vehicles” (AASHTO 1996). For a design speed of 70 mph, the *AASHTO Roadside Design Guide* (1996) recommends a clear zone width between 21 and 46 feet, depending on whether in cut or fill slopes. The design speed along this portion of US 160 would be 45 to 70 mph, depending on the location. Currently, there are several areas along US 160 that do not meet AASHTO clear zone criteria. Many drainage and irrigation structures with concrete headwalls and wing walls (the pieces placed on the ends of culverts to help channel flows) are located within 15 feet of the edge of travel lanes. There are also many trees located inside the recommended clear zone width.

A vehicle impacting any of these objects could sustain considerable damage. In addition, roadway fill slopes throughout much of the corridor are steeper than 3:1 (horizontal to vertical), which exceeds the maximum embankment slope recommended by AASHTO. Fill slopes steeper than 3:1 are defined as critical slopes and could cause out-of-control vehicles to overturn. Along the portion of US 160 from the SH 172/CR 234 intersection to Bayfield, between 7 and 12.6 percent of the accidents that occurred have been overturned vehicles. These overturning accidents are most likely attributed to the steep side slopes.

***Alignment Deficiencies***

Portions of US 160, including the alignment of US 550 (Farmington Hill), do not meet current AASHTO and CDOT design standards for both vertical and horizontal alignment. The current design standards for a 60-mph highway in rolling terrain (e.g., Farmington Hill and Grandview) call for a maximum grade of 4 percent. Grades between 4 and 6.5 percent comprise approximately 17 percent of the existing alignment in the project corridor. These steep grades slow trucks and larger vehicles, resulting in increased traffic congestion on the highway.

These grades also present a safety hazard in winter months when roads are snow-packed or icy. This is of particular concern at Farmington Hill, where vehicles traveling north on US 550 descend on a 6 percent grade for approximately 1 mile to the intersection with US 160. The last 2,000 feet of this 6 percent grade just before entering the intersection is on a north-facing slope prone to icing, making it difficult to stop (Photo 1.4.2). Steep grades are also a concern through Grandview where portions of US 160 westbound are on a 6 percent downgrade.


**Photo 1.4.2**
**Farmington Hill's north-facing slope**

Another area of deficiency is the hill west of the Florida River. Climbing out of the Florida River valley, US 160 is at a 6 percent grade west of the river. This steep grade, coupled with substandard shoulder widths, can create a hazard for motorists, particularly during snowy weather when vehicles occasionally get stuck attempting to climb the hill. US 160 also climbs at a steep grade (greater than 6 percent) east of the Florida River, but this area does not experience as many problems due to the additional eastbound (uphill) climbing lane and good sun exposure. Currently, when the highway is snow-packed or icy, westbound vehicles slow excessively, causing traffic to back up throughout this stretch during the AM peak hour. Reducing the grades through the corridor to within CDOT standards would improve the safety and efficiency of the highway.

The horizontal alignment is deficient in several locations. Curve radii in some sections need to be increased to meet current CDOT and AASHTO standards for a highway of this type. The horizontal alignment of US 550 at Farmington Hill has significant deficiencies. The last 4,600 feet of US 550 as it approaches the intersection with US 160 include a series of seven curves with an average degree of curvature of approximately 12 degrees, equating to a design speed of

30 mph. In accordance with current standards, there is not enough straight roadway between these curves to safely construct super-elevated (banked) curves. This problem is compounded by the 6 percent vertical grade through this section of highway. Major realignment of this section of US 550 would be required to meet current design standards.

***Intersection Deficiencies***

Several county road intersections along the US 160 project corridor lack sufficient sight distance. In addition, other geometric elements such as turning lanes, approach grades, and intersection geometry do not meet current design guidelines (CDOT 1995).

Sight distance is defined as the length of roadway ahead visible to the driver. The current standard for sight distance for this type of highway intersecting a stop-controlled rural road is 900 feet. US 160 intersects several roads along this section, and with the exception of the US 550 (south), CR 233 (west), SH 172/CR 234, and CR 501 intersections, all are stop-controlled. Three county road intersections do not meet the recommended sight distance guidelines:

- **CR 222/CR 223 (west)–** This intersection is located near the crest of a 6 percent grade. Sight distance to the east at the intersection is less than 200 feet (Photo 1.4.3).
- **CR 223 (east) –** This intersection is located along a horizontal curve at the base of a steep hill. Sight distance to the east around the curve is less than 500 feet.
- **CR 502 –** This intersection is located just west of the Los Pinos River on a 4 percent grade near the crest of a vertical curve. Sight distance to the west is less than 600 feet.


**Photo 1.4.3**
**CR 222/CR 223 (west) intersection, looking east**

Other geometric elements contribute to the inadequacy of several of the county road intersections. Intersections should not be located at a skew angle of less than 60 degrees. The most severe example of poor intersection skew is the CR 222/CR 223 (west) intersection. CR 223 intersects US 160 at an angle of 25 degrees, and CR 222 intersects US 160 at an angle of 55 degrees. These low skew angles do not accommodate certain turning movements and greatly decrease the already poor sight distance at the intersection.

Intersection approach grades should be as flat as possible, particularly within a distance equivalent to 3 seconds of driving time on each approach. The *CDOT Design Guide* (CDOT 1995) recommends that intersection approach grades greater than 3 percent be avoided on high-speed highways. Almost half of the intersections along this section of highway are located on grades steeper than 3 percent: US 550 (south), CR 233 (east), SH 172/CR 234, CR 222/CR 223 (west), CR 502, and CR 501.

In addition to the steep approach grade, the existing US 160/US 550 (south) intersection has several other deficiencies. Currently, the intersection operates near maximum traffic capacity during peak hours and is expected to fail by the design year of 2025. The acceleration lane lengths on both southbound US 550 and eastbound US 160 are shorter than recommended by CDOT design guidelines. In addition, the horizontal and vertical alignments on US 550 approaching the intersection do not meet current CDOT and AASHTO design standards. The 6 percent grade coupled with the substandard horizontal curvature compounds the intersection deficiencies.

In the project corridor, US 160 contains intersections with US 550 (south), SH 172/CR 234, Commerce Drive in Bayfield, US 160 Business Route (US 160B) (east) and (west), and 13 county road intersections. Only four intersections [US 550 (south), CR 233 (west), SH 172/CR 234, and CR 501] are currently signalized. Of the unsignalized intersections, only one (Commerce Drive) has left-turn storage lanes. At the remaining unsignalized intersections, vehicles waiting to turn left must do so from the through lane.

The lack of left-turn storage and acceleration/deceleration lanes is a safety issue at all of these intersections. Additionally, many of these intersections do not have adequate geometry to accommodate the turning radii of larger vehicles, and trucks and larger vehicles are forced to wait in the through lanes until the intersection clears before turning off or onto the highway. As traffic volumes increase along the corridor, the number of rear-end and other turn-related accidents at these intersections would likely increase.

### *Maintenance Issues*

Existing maintenance issues include chronic winter roadway icing on some segments, sloughing of roadside cut slopes onto the highway, undersized or damaged culverts, poor roadway surface drainage, difficult snow removal conditions, removal of wildlife hit on the highway, and generally poor pavement conditions.

### *Other Issues*

Other roadway deficiencies include drainage and bridge deficiencies. Many of the existing culverts along the corridor are undersized or in deteriorating condition. The northeast corner of the SH 172/CR 234 intersection with US 160 floods during large storms, partly due to insufficient highway drainage.

There are two river crossings along this corridor: the Florida River and the Los Pinos River. These bridges were constructed in 1953 and 1962, respectively, and are near their intended design life of 50 years. In addition, these bridges do not meet current standards. They are deficient in shoulder widths and bridge approach protection. These deficiencies present fixed object hazards for the traveling public.

The most recent major improvements to US 160 were made in the 1960s, and the typical design life for a highway facility is 20 years. This highway has been in use without major reconstruction for 20 years longer than was intended. Without major upgrading, this highway will continue to deteriorate, causing increased safety hazards and maintenance costs.

#### 1.4.2.3 Safety Needs Summary

The WHI indicates that accident rates in the project corridor are higher than the statewide average for comparable roadways. Accident types vary by roadway section. Accident types and their causes generally include:

- Uncontrolled access, which is discussed in detail in Section 1.4.3, Access Control
- Overturning vehicles due to steep side slopes and lack of recovery areas
- Collisions with fixed objects due to lack of clear zones
- Rear-end and side-swipes due to lack of shoulders and turning lanes
- Wildlife accidents due to lack of recovery and avoidance areas and wildlife crossings
- Poor intersection geometry such as steep grades, limited sight distance, sharp angles, and lack of left-turn storage lanes and acceleration/deceleration lanes

### 1.4.3 Access Control

Uncontrolled access is one of the contributors to accidents in the project corridor. There are almost 200 access points on this segment of US 160, creating a situation where unsafe movements are a common occurrence. For example, drivers have been observed traveling on the shoulder and on the wrong side of the highway, and passing left-turning vehicles on the right shoulder.

**Photo 1.4.4**
**Two of the hundreds of uncontrolled accesses along US 160**

This situation is due in part to the extensive development in the urban areas along US 160 over the past 20 years. Numerous roads and driveways intersect US 160. Most of these driveways and roads are unsignalized intersections. The most developed area along the US 160 project corridor is the area between the US 550 (south) and SH 172/CR 234 intersections, known as Grandview. In this 3-mile stretch of the highway, there are 57 access points. One is a US highway, one is a state highway, five are county road connections, five are private road connections, and 45 are private driveways (Photo 1.4.4). Development in this area is residential, commercial, and industrial.

This 3-mile road segment is a Non-Rural Principal Highway (NR-A) access category in the State Highway Access Code. The Code states that for this category, direct access service to abutting land is subordinate to providing service to through-traffic movements, and the minimum spacing for intersecting streets or other accesses that are full movement is 0.5 mile.

The existing traffic volumes are the highest in the project corridor and expected to more than double within the next 20 years.

Although the US 160 project corridor east of Grandview from the SH 172/CR 234 intersection to the Los Pinos River is less developed than the Grandview area, there are many access problems nonetheless. There are 122 access points on this 10.7-mile segment, including one state highway connection, eight county roads, four frontage road connections, three federal land accesses, 19 private roads, and 87 driveways or field accesses. Many of these access points are uncontrolled. The majority of the land in this segment is classified agricultural/rural residential. There are pockets of land classified as suburban density residential and Gem Village is classified as mixed use. However, developers have sought amendments in the land use plans to allow a higher density in this segment, which would exacerbate the existing access problems.

This 10.7-mile road segment is divided into two state highway access category classifications in the State Highway Access Code. Between the SH 172/CR 234 and CR 223 (east) intersections, US 160 is designated as a Regional Highway (R-A). The Code states that for this category, direct access service to abutting land is subordinate to providing service to through-traffic movements, and the minimum spacing for intersecting streets or other accesses that are full movement is 0.5 mile. Between the CR 223 (east) intersection and the Los Pinos River, US 160 is classified as an expressway. The Code states that typical spacing of intersecting streets, roads, and highways for this category shall be planned on 1-mile intervals, and no private property access may be permitted unless reasonable access cannot be obtained.

From the Los Pinos River to east of Bayfield, access has been controlled, and highway improvements in this area would incorporate limited turning movements (i.e., right-in/right-out) except at key areas with allowable turning lanes.

The US 160 project corridor would be considered for access improvements, which may include frontage roads, access consolidation, access relocation, restricted access, or access elimination. These improvements would be applied as needed throughout the project corridor based on the various access conditions and development expectations.

The data gathered and presented in Section 1.4.2, Safety Issues, indicate that uncontrolled access and the number of full-movement unsignalized accesses are contributing factors to accidents. In the Grandview area, 62 percent of the accidents were either rear-end, broadside, or turn-related (Figure 1.4.6, US 160 Accident Histogram West of Farmington Hill to SH 172/CR 234). The majority of these types of accidents can be attributed to vehicles entering and exiting the highway at the many access points. As development pressure continues to the east of the SH 172/CR 234 intersection, similar problems would escalate throughout the corridor. In the roadway segment from the SH 172/CR 234 intersection to the CR 222/CR 223 (west) intersection, 57 percent of the accidents were either rear-end, broadside, or turn-related [Figure 1.4.7, US 160 Accident Histogram SH 172/CR 234 to CR 222/CR 223 (west)]. Highway improvements to consolidate accesses and restrict left turns would reduce the occurrence of these types of accidents and greatly improve safety along this corridor.

#### *1.4.3.1 Access Control Needs Summary*

The following access issues contribute to the traffic capacity and safety problems:

- High density of undefined business and private accesses

- Terrain features that affect sight distance and intersection geometry
- Areas with poorly defined accesses that create problems for drivers to predict when cars are going to turn
- The density of development along US 160 that is anticipated to increase in the future

### 1.4.4 Basis of Need Summary

As discussed in the preceding sections, improvements are necessary within the US 160 project corridor to address a number of issues. Accident rates throughout the corridor demonstrate the need for this project to remedy design deficiencies that include poor sight distance, steep roadway grades, lack of shoulders, insufficient recovery zones, uncontrolled access, steep embankments, lack of wildlife crossings, and lack of turning lanes. The results of traffic analyses for US 160 intersections and roadway segments indicate that present conditions in some areas do not have acceptable levels of service. Future traffic projections indicate that US 160, as presently constructed, would exceed capacity by 2025. The purpose of alternatives presented in Chapter 2, Alternatives, is to address these needs.