4 SAFETY ANALYSIS

This section summarizes the existing safety conditions on US 550 up to and including the US 160 intersection. It also examines the potential future safety outlook for the various alternatives of the US 550 south connection to US 160. Information provided in this review is based on existing accident data, a field review, projected traffic volumes, capacity analysis, and traffic operations analysis.

Existing Conditions Analysis

The existing conditions portion of this chapter is based on a comprehensive analysis of five years of reported accident history. A summary of the accident locations and patterns that may affect the alternatives analysis is provided; the full existing conditions report is provided in Appendix I.

Safety Performance Function Analysis

The magnitude of safety problems at the US 550 intersections was assessed using Safety Performance Functions (SPFs). The SPF models provide an estimate of the normal or expected accident frequency and severity for a range of Average Daily Traffic (ADT) among similar facilities in Colorado; statewide CDOT accident databases were used to develop these models. For this analysis, the intersection SPF models were applied where appropriate. The rural highway SPF analysis was not applicable on US 160, US 550, or SH 172 because intersection spacing was less than two miles.

Development of the SPF lends itself well to the conceptual formulation of the Level of Service of Safety (LOSS). LOSS reflects how an intersection is performing in regard to its expected accident frequency and severity given the traffic volumes on the intersecting roadway (major road and minor road).

Future Conditions Analysis

The future conditions portion of this report is based on future (2035) volume projections in the *US 160 at US 550 SEIS – Traffic Reports Technical Review*(Fehr & Peers, 2014) and the potential alignment options described previously and in Chapter 7. The different alignment options were evaluated using the predictive method from the AASHTO *Highway Safety Manual* (HSM) (TRB, 2010). The HSM predictive method provides a method for quantitatively measuring the expected average accident frequency under existing and future conditions.

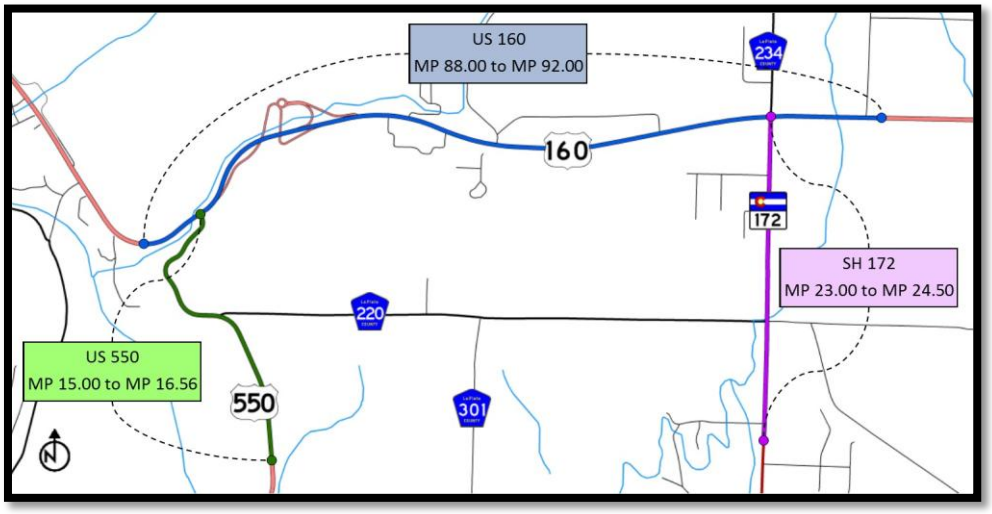
Two sets of options for the new connections were reviewed along with the existing conditions:

- On-Alignment Alternative (R5)
  - The existing US 550/US 160 intersection remains at its current location and the new US 550 alignment generally follows the existing alignment of US 550 immediately south of US 160.
- Off-Alignment Alternatives (RGM and RGM6)
  - Realign US 550 to connect with US 160 at the new Grandview interchange; there are two primary configurations in this alternative:
    - RGM utilizes a three-leg, stop-controlled intersection for traffic distribution to the eastbound US 160 ramps (could also be built with a roundabout).
    - RGM6 utilizes a roundabout for traffic distribution to the eastbound US 160 ramps.

4.1 EXISTING SAFETY SUMMARY

The accident history for the five-year period–January 2008 through December 2012–was examined to locate accident clusters and identify accident causes. US 160 is a four-lane divided highway; on the west end of the study section, it has an Average Annual Daily Traffic (AADT) (2012) of 33,000 vehicles per day (vpd). US 550 is a two-lane undivided highway with narrow outside shoulders; on the south end of the study section, it has an AADT (2012) of 6,600 vpd. AADT volumes reported in this chapter were collected by CDOT. The terrain on both US 160 and US 550 is classified by CDOT's Colorado Roadway Information System (CORIS) as mountainous. A map of the study sections is provided in **Figure 4-1**.

Figure 4-1: Vicinity Map



4.1.1 US 160: MP 88.00 to MP 92.00

During the study period, 244 accidents were reported along the section of US 160 between mileposts (MPs) 88 and 92; among these, 21 accidents resulted in 29 injuries and two accidents resulted in two fatalities. **Table 4-1** summarizes the number and severity of accidents for this section of US 160.

Table 4-1: US 160 Accidents by Year

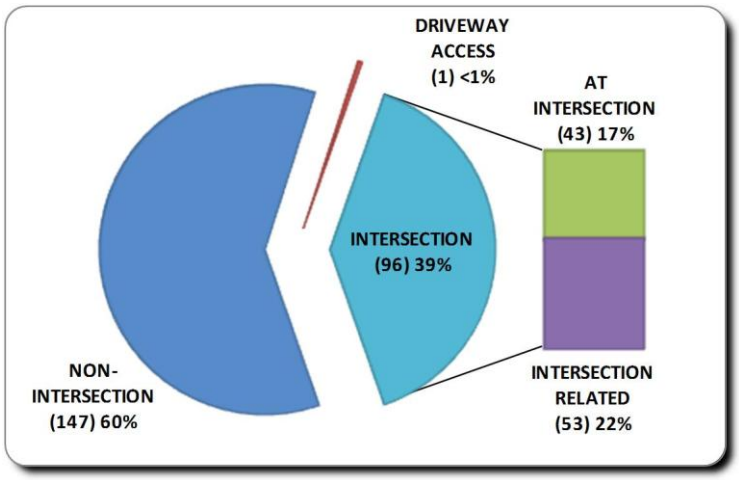
Year	AADT	Number of Accidents			
		PDO[1]	Injury	Fatality	Total
2008	20,900	49	3	1	**53**
2009	21,500	47	5	1	**53**
2010	19,400	30	6	0	**35**
2011	21,500	50	5	0	**54**
2012	24,200	45	2	0	**45**
Average/Total	**21,500**	**221**	**21**	**2**	**244**

[1] Property Damage Only

The majority of the accidents along the study corridor were non-intersection (147 of 244, or 60 percent). The remaining accidents were described either as intersection-related or at-intersection accidents (96 of

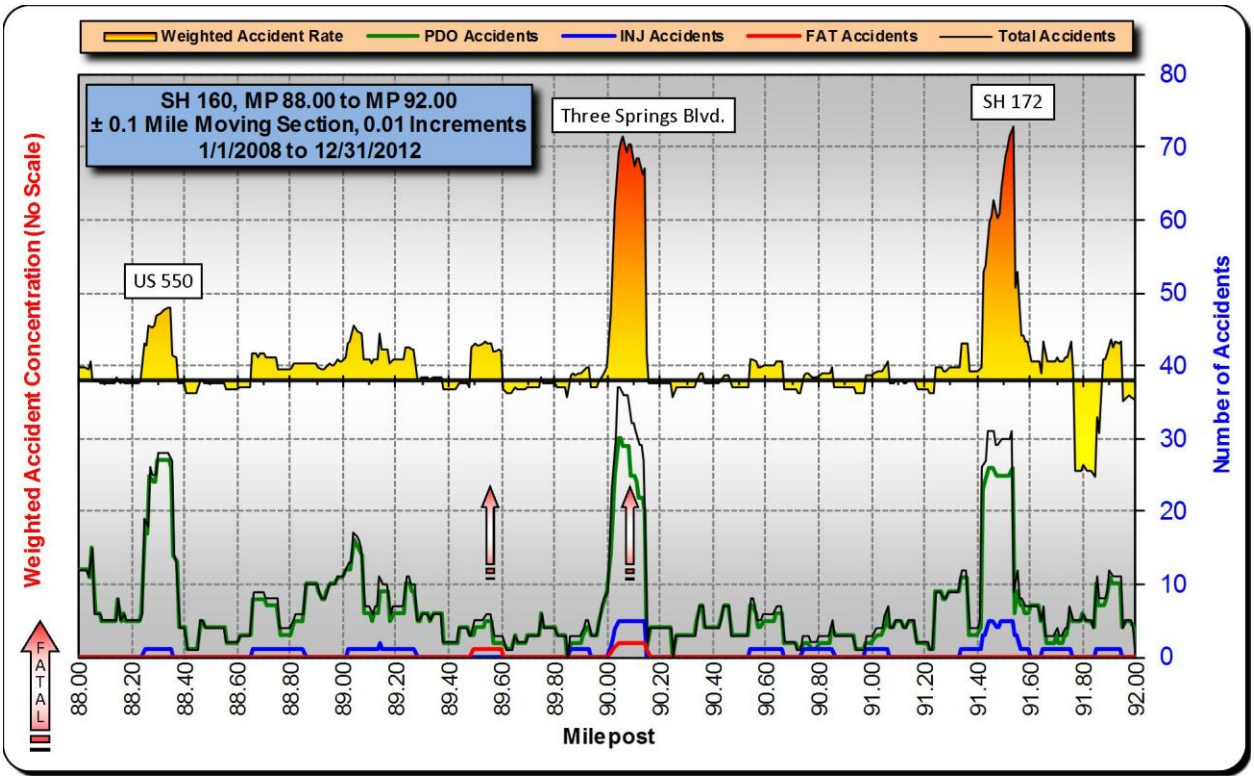
244, or 39 percent), or were attributed to driveway access locations (one of 244, less than 1 percent). This breakdown is provided in **Figure 4-2**.

Figure 4-2: US 160 Accidents by Location



A graph representing the change in the weighted accident concentration (WAC) on US 160 (**Figure 4-3**) shows the locations and severity of accidents throughout the study section.

Figure 4-3: US 160 Weighted Accident Concentration

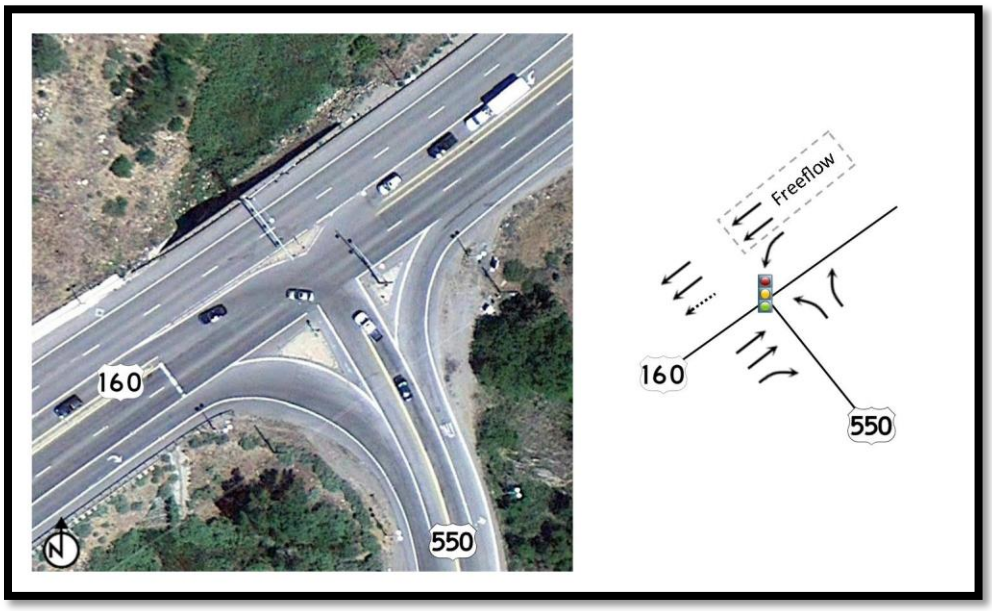


There are several locations of high accident concentration throughout the study section. These locations were found to generally coincide with intersections along US 160. The largest "spikes" in WAC were observed at Three Springs Blvd. (MP 90.10) and at SH 172 (MP 91.48).

US 160 at US 550 (MP 88.32): Three-Leg Signalized

During the five-year study period there were 16 reported accidents at this three-leg signalized intersection. This intersection functions as a continuous green T-intersection, which allows the westbound US 160 through movement to cross the signalized intersection without stopping. An aerial view of the intersection, along with the associated lane geometry, is provided in **Figure 4-4**. US 550 is a principal arterial roadway primarily serving residential properties to the south. The direction of increasing milepost (primary direction) is generally eastbound US 160 and is generally northbound on US 550.

Figure 4-4: US 160/US 550 Three-Leg Signalized Intersection

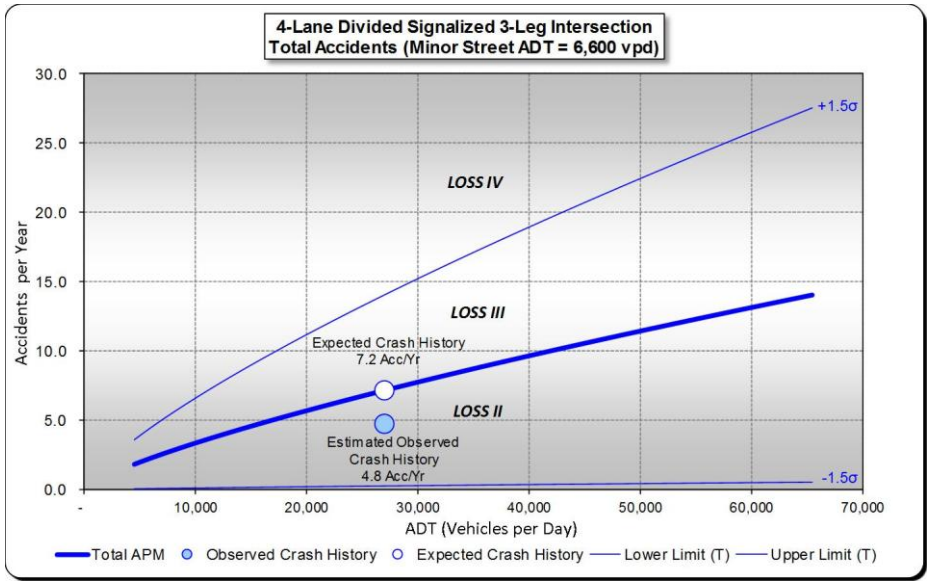


Safety Performance Function Analysis

Because the westbound through movement does not have to stop at the signal, it is likely that this condition decreases the frequency of westbound accidents. If this traffic were signal controlled, it's likely that westbound *rear-end* and *sideswipe (same direction)* accident rates would be higher because of the greater number of stops. The SPF model for an urban three-leg intersection was developed using statewide accident data for typical three-leg intersections (all legs signal controlled). To use this model for the US 160/US 550 intersection, the number of accidents was conservatively increased from 16 to 24.

The SPF graph in **Figure 4-5** shows the observed and expected crash frequency for the four-lane, divided, signalized, 3-leg intersection of US 160 and US 550. The minor street ADT was obtained from 2012 CDOT data. Using the higher accident count, the frequency of total accidents over the five-year study period was still lower than expected for an equivalent facility as indicated by a better-than-expected safety performance (a LOSS level of II, indicating low to moderate potential for crash reduction).

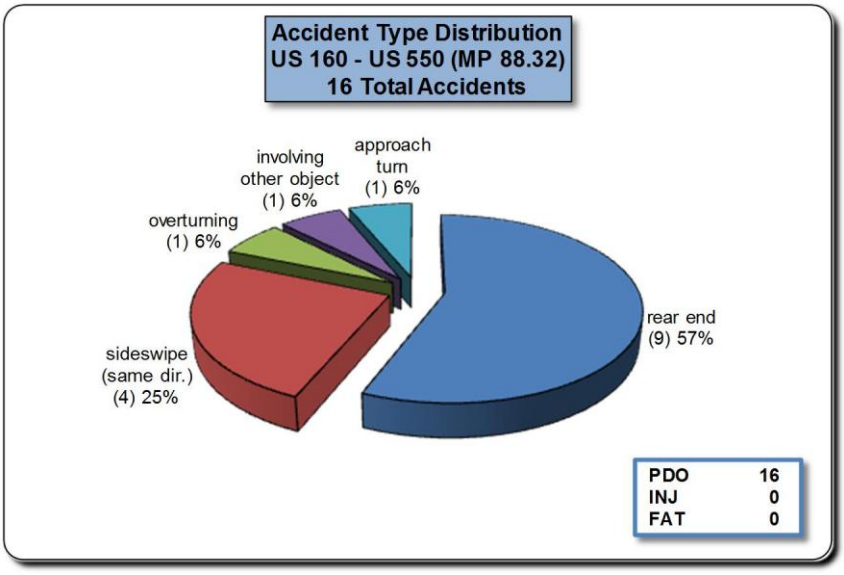
Figure 4-5: US 160 and US 550 Estimated SPF (Total Accidents)



Accident Patterns

Figure 4-6 illustrates the accident types for this intersection. *Rear end* accidents were most common (57 percent) followed by *sideswipe (same direction)* accidents (25 percent).

Figure 4-6: US 160 and US 550 Accidents by Type



Sideswipe (Same Direction) Collisions

Three of the four *sideswipe (same direction)* accidents occurred in the westbound direction when there was ice on the roadway. In all three accidents, a westbound through vehicle slid into a vehicle in the westbound left-turn lane while attempting to navigate a right-hand curve in the roadway. US 160 has a steep downhill grade of approximately four percent approaching US 550 in the westbound direction, which likely contributes to the frequency of westbound icy road accidents.

Rear End Collisions

A review of the accident records indicated that three of the five eastbound accidents occurred when traffic was stopped at a red light, one accident occurred in the right lane when the traffic was stopped by a flagger, and one occurred when a vehicle made an illegal U-turn. The three westbound *rear end* accidents all occurred under different circumstances.

NB	1
SB	0
EB	5
WB	3

US 160 at Three Springs Blvd (MP 90.10): Four-Leg Signalized

There were 23 accidents during the five-year study period at this four-leg signalized intersection. Three Springs Blvd. is a principal arterial roadway primarily serving residential properties to the north and south. The SPF analysis indicated better-than-expected safety performance when compared to similar facilities statewide.

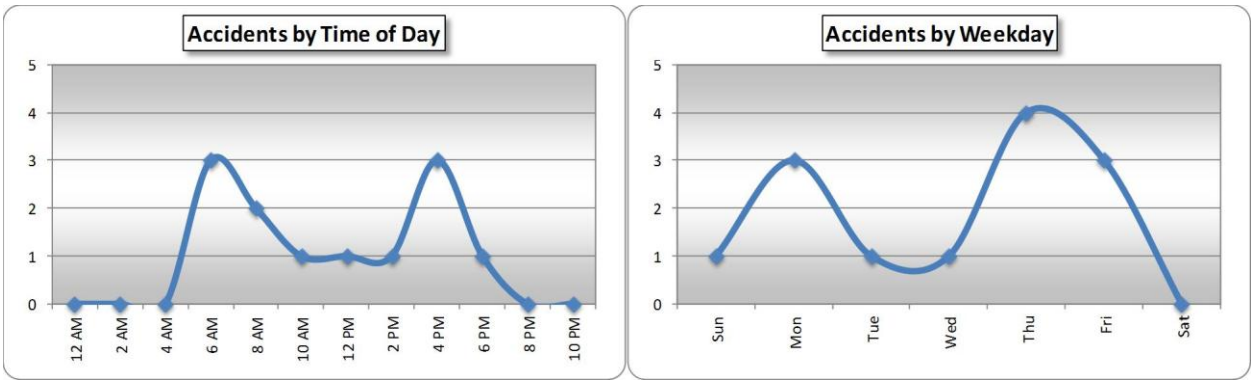
Accident Patterns

Rear end accidents were most common (12 of 23, or 52 percent), followed by *broadside* and *approach turn* accidents (four of each type, or 17 percent each). The frequency of accidents involving a *light/utility pole* was higher than expected for this type of intersection (two of 23 accidents, or 9 percent).

Rear End Collisions

A review of the accident data indicated that nine accidents occurred in the westbound direction and three occurred in the eastbound direction. **Figure 4-7** shows that these accidents occur most often during the weekday AM and PM peak periods.

Figure 4-7: *Rear End* Accidents by Time of Day and Weekday



This pattern indicates that *rear end* accidents can most likely be attributed to typical rush-hour congestion.

More detailed information about the side street crash history for this location is provided in Appendix I.

US 160 and SH 172 (MP 91.48): Four-Leg Signalized

There were 27 accidents during the five-year study period at this four-leg signalized intersection. SH 172 is a state highway primarily serving residential properties to the north and south and the Durango-La Plata County Airport. Florida Mesa Elementary School is also located on SH 172, approximately 0.20 miles south of US 160. The SPF analysis indicated better-than-expected safety performance when compared to similar facilities statewide.

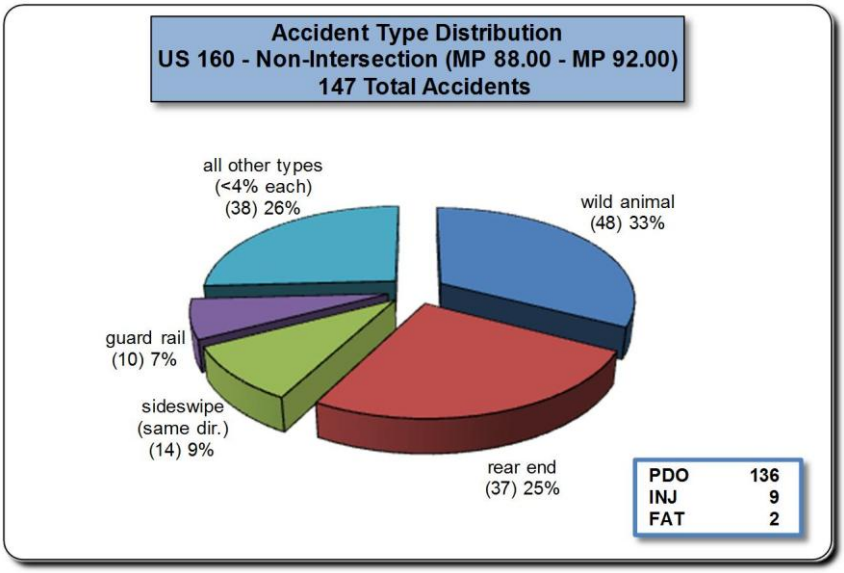
Accident Patterns

Rear end accidents were most common (35 percent), followed by *approach turn* accidents (22 percent); these proportions were within the expected range when compared to similar facilities statewide.

Non-Intersection Accident Analysis

Over the five-year study period, there were 147 accidents within the project limits on US 160 that can be categorized as non-intersection accidents. **Figure 4-8** shows the accident type distribution for these accidents.

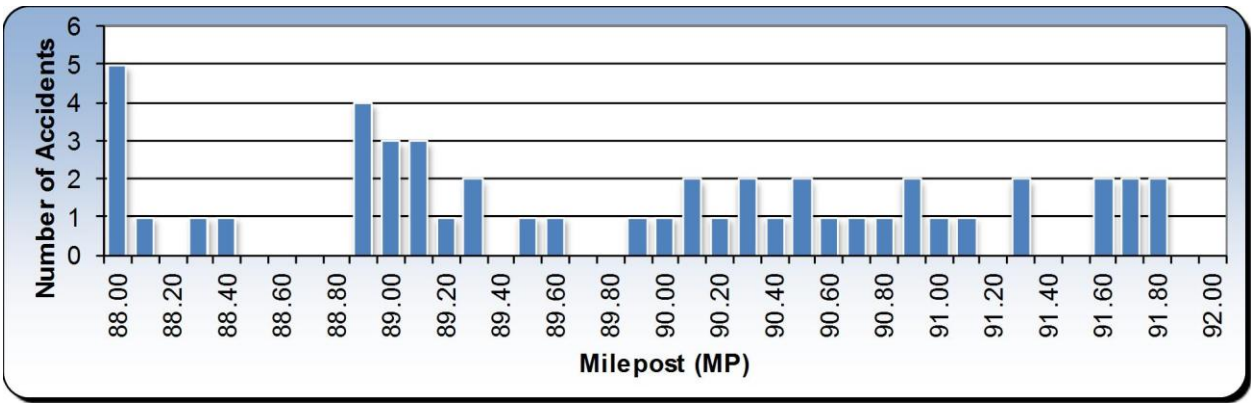
Figure 4-8: US 160 Non-Intersection Accidents



Wild Animal Collisions

During the five-year study period there were 48 *wild animal* accidents. These accidents occurred at different locations along the segment, as shown in **Figure 4-9**.

Figure 4-9: Wild Animal Collisions by Milepost

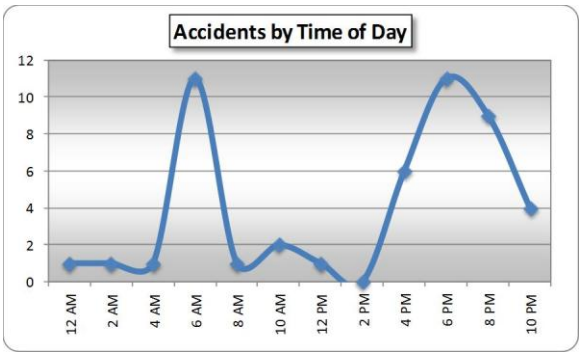


The highest concentrations of these accidents occurred between MP 88.00 and MP 89.60, where Wilson Gulch runs alongside US 160. Sections near MP 88.00 and MP 88.90 also saw a higher incidence of wild animal collisions. There is easier access to Wilson Gulch from the roadway at MP 88.00 and MP 88.90, as

there are fewer physical barriers (such as walls and steep slope drop-offs) that would discourage animals from entering the roadway.

Figure 4-10 shows wild animal crashes by time of day. Most occur in the early morning and in the evening, the times of day when deer and many other wild animals are most active.

Figure 4-10: Wild Animal Collisions by Time of Day



4.1.2 SH 172: MP 23.00 to MP 24.50

During the study period, 25 accidents were reported along this section of SH 172; six accidents resulted in eight injuries. **Table 4-2** summarizes the number and severity of accidents for SH 172 over the five-year study period.

Table 4-2: SH 172 Accidents

Year	AADT	Number of Accidents			
		PDO[1]	Injury	Fatality	Total
2008	7,800	6	1	0	**7**
2009	7,800	4	2	0	**6**
2010	7,700	3	3	0	**6**
2011	7,900	4	0	0	**4**
2012	7,800	2	0	0	**2**
Average/Total	**7,800**	**19**	**6**	**0**	**25**

[1] Property Damage Only

Accident Patterns

Of the 25 accidents that occurred on this highway, seven occurred at the intersection with CR 220. A review of the accident history did not indicate any other accident patterns on SH 172.

SH 172 at CR 220 (MP 23.59): Four-Leg Unsignalized

Of the seven reported accidents at this intersection, five were *broadside* accidents (72 percent), one was a *rear end* accident (14 percent), and one was an *approach turn* accident (14 percent). The proportion of *broadside* accidents was higher than expected when compared to similar intersections statewide. A review of the accident records indicated that three of the five *broadside* accidents involved a collision between an eastbound CR 220 vehicle and a northbound or southbound vehicle on SH 172.

4.1.3 US 550: MP 15.00 to MP 16.56

There were 42 accidents reported along this section of US 550 during the study period; four accidents resulted in five injuries and no accidents resulted in fatality. **Table 4-3** summarizes the number and severity of accidents in this section of US 550 over the five-year study period.

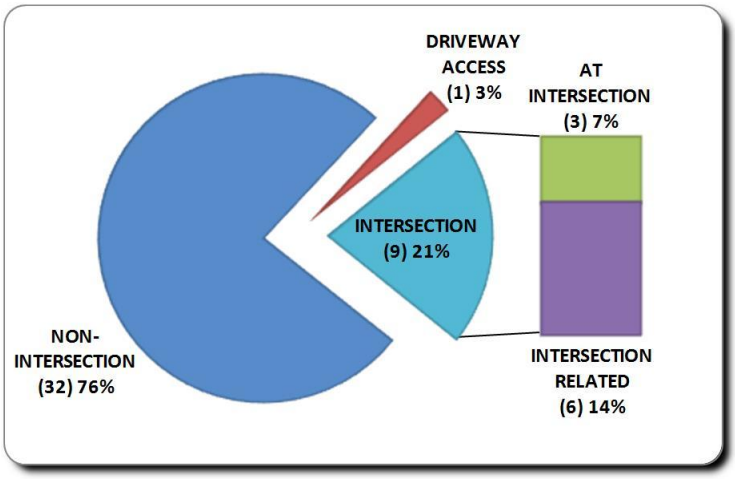
Table 4-3: US 550 Accidents by Year

Year	AADT	Number of Accidents			
		PDO[1]	Injury	Fatality	Total
2008	8,000	7	0	0	**7**
2009	8,400	12	3	0	**15**
2010	6,800	4	0	0	**4**
2011	7,500	10	0	0	**10**
2012	6,600	5	1	0	**6**
Average/Total	**7,500**	**38**	**4**	**0**	**42**

[1] Property Damage Only

The majority of the accidents along the study corridor were non-intersection (32 of 42, or 76 percent). Of the remaining accidents, nine (21 percent) were described as either intersection-related or at-intersection accidents; one occurred at a driveway access location (3 percent). This breakdown is shown in **Figure 4-11**.

Figure 4-11: US 550 Accidents by Location



Intersection Analysis

Intersection accidents accounted for 21 percent of the total accidents on this section of highway (nine of 42, or 21 percent). **Table 4-4** lists the location, number of legs, signalization, and number of accidents for each intersection along the study segment.

Table 4-4: US 550 Intersection Accidents by Location

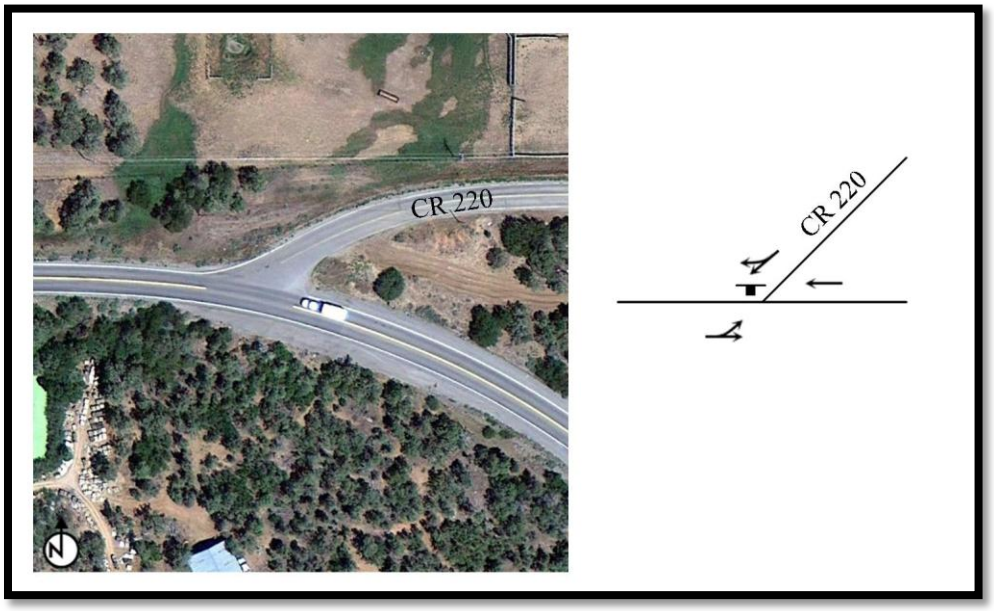
MP	Intersection	Legs	Signalized	Number of Accidents			
				PDO[1]	Injury	Fatality	Total
15.68	CR 220 (North Leg)	3	No	2	0	0	2
15.81	CR 220 (East Leg)	3	No	5	1	0	6
Non-Specific Intersection Accidents (located over 100-ft from intersection)				1	0	0	1
Overall Total				**8**	**1**	**0**	**9**

[1] Property Damage Only

US 550 at CR 220 (MP 15.81): Three-Leg Unsignalized

Six of the nine accidents that occurred at US 550 intersections occurred at the east leg of the CR 220 three-leg, stop-controlled intersection. An aerial view of the intersection, along with the associated lane geometry, is provided in **Figure 4-12**. CR 220 (East Leg) is a minor collector roadway primarily serving the residential properties to the east.

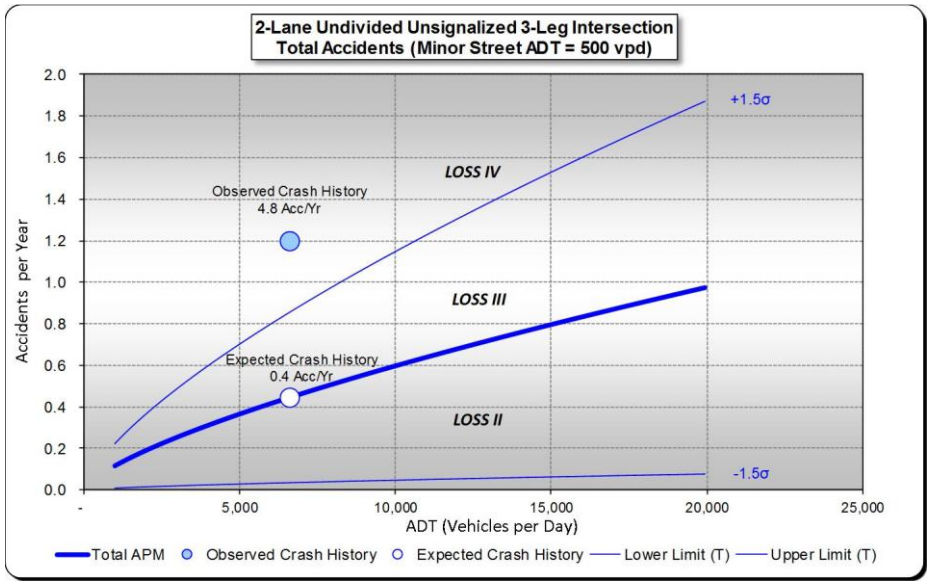
Figure 4-12: US 550 and CR 220 (East Leg)



Safety Performance Function Analysis

The SPF graph in **Figure 4-13** shows the observed and expected crash frequency for the two-lane, undivided, unsignalized three-leg intersection of US 550 and CR 220 (East Leg). The frequency of total accidents over the five-year study period was higher than expected for this type of facility as indicated by a worse-than-expected safety performance (LOSS IV, indicating high potential for crash reduction).

Figure 4-13: CR 220 (East Leg) SPF (Total Accidents)



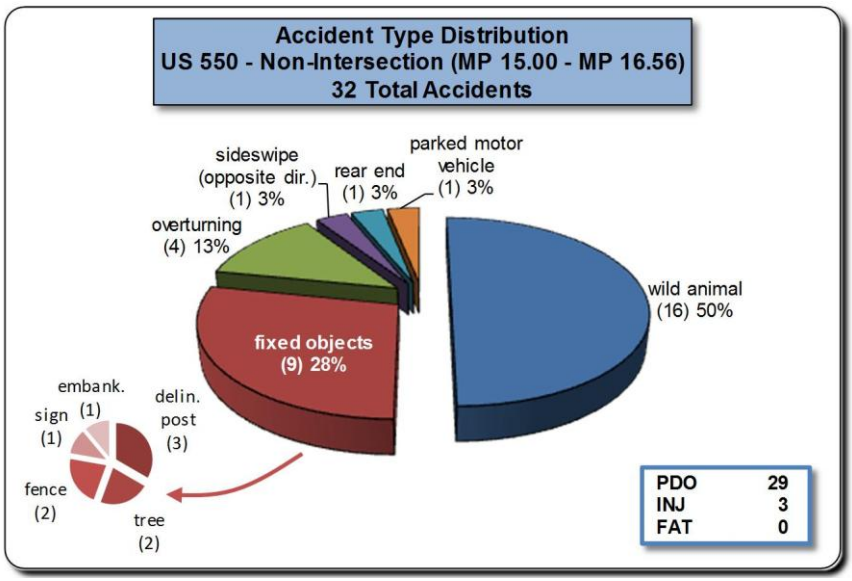
Accident Patterns

There were four *rear end* accidents (66 percent), one involving a *fence* and one an *approach turn* (17 percent each). The frequency of *rear end* accidents was higher than expected for this type of intersection. A review of the accident records indicated that three of the four accidents occurred on CR 220 when a vehicle that was stopped at the stop sign was rear-ended by another vehicle. As CR 220 intersects US 550 on a skew, drivers often are unsure exactly where to stop.

Non-Intersection Accident Analysis

There were 32 accidents within the project limits over the five-year study period that can be categorized as non-intersection accidents. **Figure 4-14** shows the accident type distribution for these accidents.

Figure 4-14: US 550 Non-Intersection Accidents



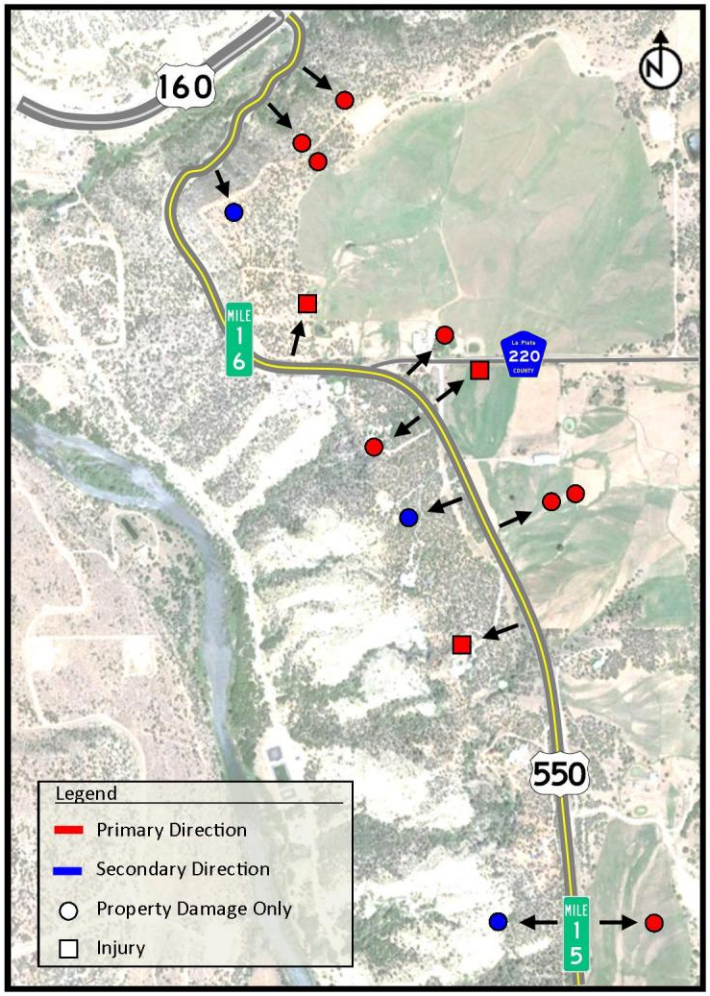
Wild Animal Collisions

There were 16 accidents involving wild animals during the study period, approximately 2.05 accidents per mile per year (APMPY). A review of the accident data indicated that 13 of the accidents occurred south of the CR 220 intersection. Ten of the 16 accidents occurred during dark/unlighted conditions (similar to the US 160 *wild animal* type accidents) and there was no apparent seasonal trend.

Run-off-Road Accidents

Out of the 32 accidents that occurred on this segment of US 550, 14 involved vehicles that ran off the road: nine of those involved fixed objects, four were *overturning* accidents, and one involved a *wild animal*. Eleven of the run-off-road accidents were off-right and occurred in the primary direction (true north). **Figure 4-15** shows the approximate locations of the run-off-road accidents.

Figure 4-15: Run-Off-Road Accidents



A review of the run-off-road accident locations indicated that these accidents were not focused around any specific geometric feature. US 550 contains sharp curves, steep grades, and narrow outside shoulders, which likely contributes to the frequency of run-off-road accidents.

4.2 FUTURE SITE CONDITIONS

Future (2035) turning movement counts and ADT volumes were estimated by Fehr & Peers (2014). These traffic volumes were applied to the *Highway Safety Manual* (HSM) (AASHTO, 2010) predictive method in order to compare the expected future accident frequencies on each of the alignment options.

4.2.1 The Highway Safety Manual Predictive Method

In the HSM predictive models, the total number of expected crashes is derived by combining national SPFs with crash modification factors (CMFs) and a calibration factor. This procedure is used on roadway segments, delineated by geometric features and the location of intersections.

SPF Selection

In the future, it is expected that US 550 will be converted to a four-lane divided highway and that the AADT will increase to approximately 21,600 vpd. Because of these changes, the alignment options for US 550 were analyzed using the HSM predictive method for urban and suburban arterials.

Significant differences among the three alignment options include:

- Interchange configuration with US 160
- Roadway curvature
- Roadway grade

Crash Modification Factors

Unlike the methodology used for rural two-lane roads, the urban arterial SPF procedure does not account for changes in roadway curvature or grade. CMFs are, by default, limited to the following design features:

- The presence of on-street parking
- Roadside fixed objects
- Median width
- Roadway lighting
- Automated speed enforcement

To aid in this analysis, additional CMFs based on studies not included in the HSM were retrieved from the CMF Clearinghouse website (FHWA, 2009), which offers a web-based library of CMFs and supporting documentation on how to properly apply them. This site is funded by the Federal Highway Administration (FHWA) and is maintained by the University of North Carolina Highway Safety Research Center. The following CMFs were added to the urban arterial analysis:

- Convert unsignalized intersection to roundabout (applied to RGM6 Alignment only) (DeBrabander & Vereeck, 2007)
- Increase in horizontal curvature (Park, Fitzpatrick, & Lord, 2010)

Because no other CMF was found to account for grade, the CMF used in the HSM's rural two-lane road procedure was applied.

Instead of applying the urban/suburban SPF to the entire length of the study segment, US 550 was split at locations where the roadway curvature changed, in a manner consistent with the two-lane rural HSM

procedure. The segmentation applied to the various US 550 alignment options, along with the CMFs used for each segment, are included in Appendix J.

Calibration

The HSM predictive method was developed using crash statistics for multiple states. Because there are regional factors that affect accident frequency (such as driver behavior, accident reporting procedures, and weather), the SPF results were adjusted for use on US 550. The rural two-lane road HSM methodology was used to predict the number of crashes for each year during the study period on US 550 using the existing roadway geometry and AADT. This predicted value was then compared to the actual accident experience. A calibration factor of 0.90 was calculated by dividing the observed accident history during the five-year analysis period by the unadjusted predicted accident frequency. After calibrating the model, the future accident frequency was estimated for the No-Action Alternative using the future ADT on the existing road geometry. This calibration factor was also applied to the US 550 future alignment alternatives, as the same regional factors are expected to apply in the future conditions.

Results

Using the SPF models along with the calibration factor and CMFs described above, the HSM predictive model was used to estimate the total number of crashes (all collision types and all severities) on each of the three potential alignment options for US 550 along with the No-Action Alternative. **Table 4-5** shows the number of predicted future accidents, calculated in accidents per mile per year (APMPY), for each alternative.

Table 4-5: HSM Predictive Method

Results	No-Action Alternative	On-Alignment Alternatives	Off-Alignment Alternatives	
		R5	***RGM***	***RGM6***
Length (miles)	1.49	1.30	1.66	1.64
Predicted accident frequency (APMPY)	34	9	7	7

Using the predictive method, it is expected that both the On-Alignment and Off-Alignment Alternatives have a high potential for accident reduction when compared to the No-Action Alternative. In addition, it is expected that the Off-Alignment Alternatives (RGM and RGM6) will experience slightly fewer accidents than the On-Alignment Alternative. This is partially due to the fact that the On-Alignment Alternative has steeper grades and more severe changes in roadway curvature.

Safety Implications

While the HSM predictive models provide a quantitative method of predicting future crash frequency, there are also location and alternative-specific differences that can only be addressed qualitatively. In particular, this applies to the design options for the new ramp terminal intersections and how well the alternatives address the observed run-off-road and wild animal accident patterns.

US 550/US 160 Intersection

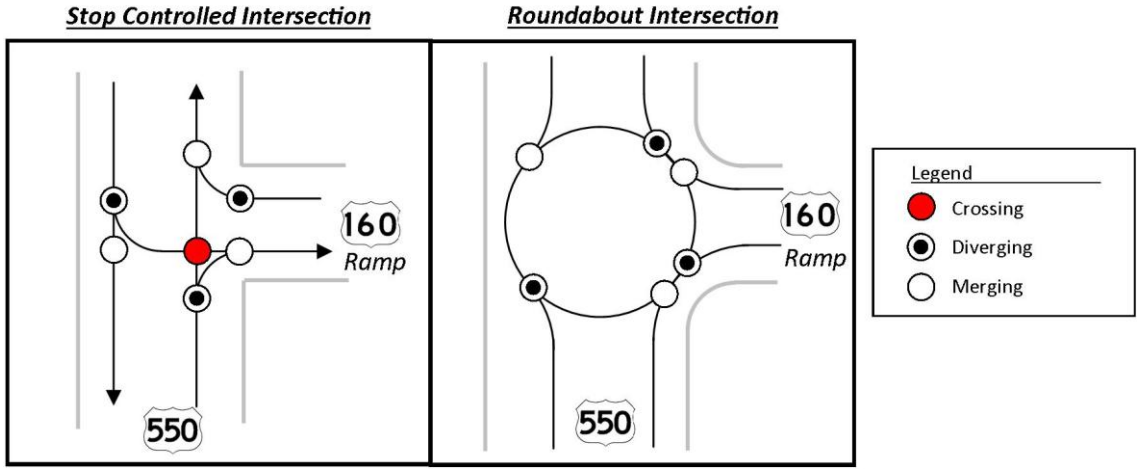
The two sets of alignment options (On- and Off-Alignment) would provide different US 550 connections to US 160. The safety-related configuration details of the US 550 south connection to US 160 are as follows:

- On-Alignment (R5):
  - US 550 and US 160 would become a grade-separated hybrid diamond interchange at the location of the existing US 160/US 550 intersection. The US 160 westbound ramp terminal intersection on US 550 would be signalized with three legs. The eastbound US 160 ramps would be free-flow, with a direct connection to US 550 and no ramp terminal intersection.
- Off-Alignment (RGM and RGM6)
  - For the RGM Alignment, a three-leg, stop-controlled intersection would provide access to the eastbound US 160 ramps at the Grandview interchange.
  - For the RGM6 Alignment, a roundabout would provide access to the eastbound US 160 ramps at the Grandview interchange.

Ramp Terminal Intersection Treatments

For the Off-Alignment Alternatives, two different primary configurations were analyzed for the US 160 eastbound ramp terminal intersection: a roundabout and a stop-controlled intersection. Roundabouts are typically associated with a lower accident frequency when compared to signal-controlled and stop-controlled intersections, as they encourage slower speeds and reduce the number of conflict points among vehicles. Conflict diagrams of the two different US 550/US 160 interchange configurations are shown in **Figure 4-16**.

Figure 4-16: Off-Alignment Alternatives Conflict Diagrams



The three-leg, stop-controlled intersection has seven conflict points, while the roundabout intersection has only six. It should also be noted that the roundabout option eliminates all crossing conflict points, which should reduce the severity of accidents at this location.

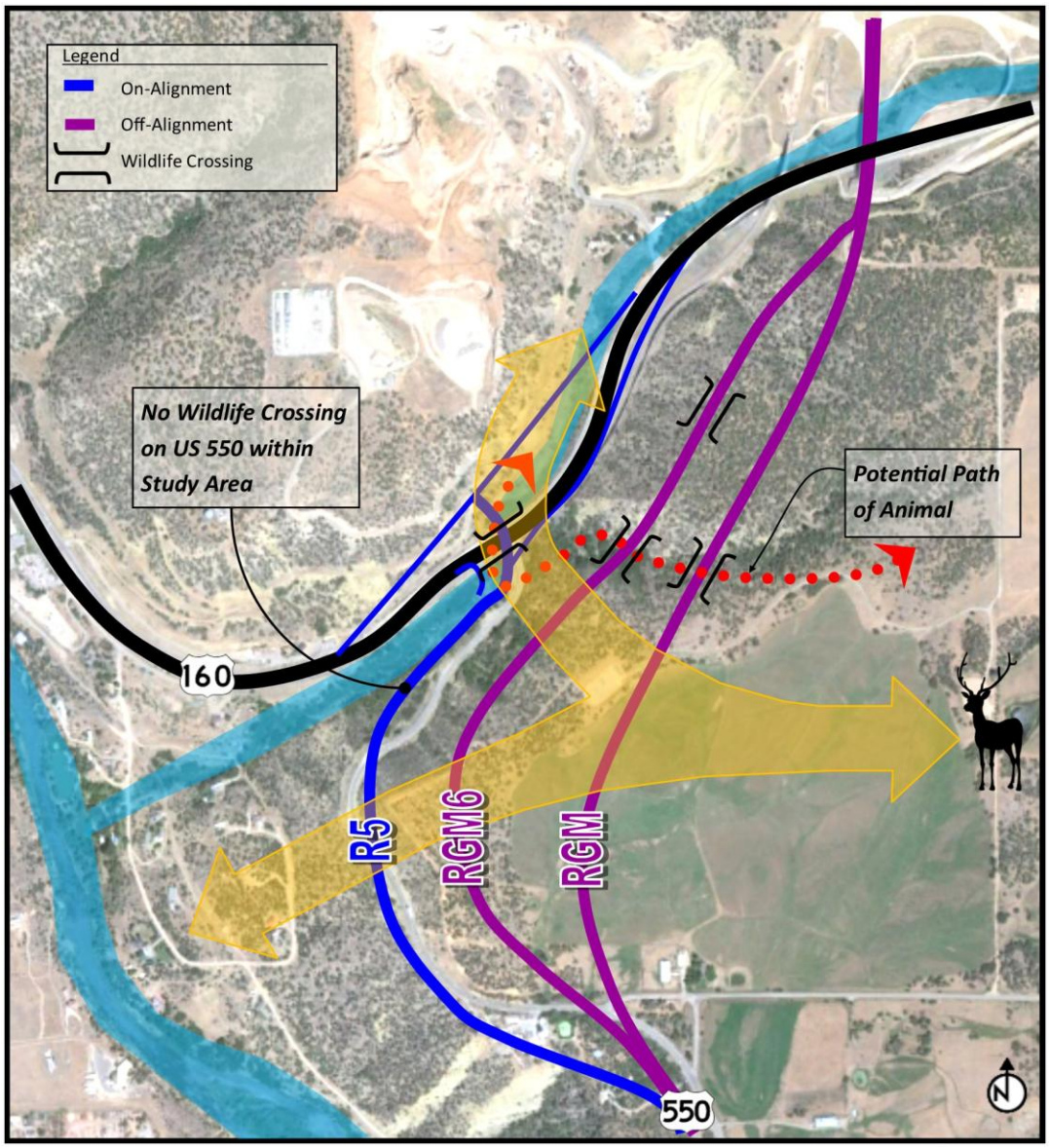
Both of the Off-Alignment Alternatives, RGM and RGM6, realign US 550 to the Grandview interchange, 0.6 miles east of the existing US 160/US 550 signalized intersection. The RGM Alignment has longer curves and tangents, while the RGM6 Alignment has tighter curves approaching the Grandview

interchange. The RGM6 alignment has the advantage of utilizing geometric changes to slow traffic approaching the interchange, while the RGM alignment will likely result in higher approach speeds due to the flatter horizontal curvature, meaning the RGM6 alignment will likely experience fewer accidents at the Grandview interchange.

Wild Animal Collisions

Crashes involving wild animals accounted for 50 percent of the non-intersection accidents on US 550 between 2008 and 2012. Due to the close proximity of Wilson Gulch to US 550 and US 160, deer will continue to enter the highway in the future. And because US 550 will be widened to four lanes and the ADT will likely increase, it will be even more difficult for deer to cross the road without conflicting with a vehicle. Each of the three alignment options discussed here provides wildlife crossings on US 160, but only the Off-Alignment Alternatives provide wildlife crossings on US 550. **Figure 4-17** shows Wilson Gulch and each potential alignment option, along with its large-animal crossing locations.

Figure 4-17: Wildlife Crossing Locations



The Off-Alignment Alternatives provide wildlife crossings (one in RGM, two in RGM6), which will allow animals to cross under the roadway. Furthermore, wildlife can be channeled from the US 550 crossings to the planned wildlife underpass bridge on US 160, which was included in the 2006 US 160 EIS. Deer and elk will therefore be able to travel between Florida Mesa and Wilson Gulch on either side of US 160 without being forced to cross either US 160 or US 550. This is not the case in the On-Alignment Alternative (R5), as animals will have to cross one roadway or the other in order to reach Wilson Gulch under that plan.

Run-off-Road Collisions

In the existing conditions analysis, run-off-road crashes comprise 44 percent of the non-intersection accidents on US 550. The current US 550 alignment contains many sharp curves and steep grades along with narrow shoulders, which likely contribute to the frequency of run-off-road accidents.

In all three alignment alternatives, US 550 will be widened to four lanes and 10-foot outside shoulders will be provided. With a wider roadway cross-section, drivers will have more room to correct before they drift off the road on a curve, which should decrease the occurrence of run-off-road accidents. Because the R5 Alternative must connect to US 160 at the base of Farmington Hill, this option includes only marginal improvements to the existing curves and grades. Both of the Off-Alignment Alternatives provide larger-radius curves and more gradual grades, as they tie into US 160 further east at the Grandview interchange. As a result, it is likely that the Off-Alignment Alternatives (RGM and RGM6) will experience fewer run-off-road accidents than the On-Alignment Alternative (R5).

4.3 SUMMARY

The existing safety conditions were analyzed on three state highways that are associated with the *US 550 South Connection Independent Alternatives Analysis*: US 160, US 550, and SH 172. Where SPF analysis was applicable, the accident frequencies experienced on these roadways were typically lower than expected when compared to similar facilities statewide.

Despite better-than-expected safety performance for these roadways, some segments had higher-than-expected rates of certain crash types. On US 160 and US 550, *wild animal* accidents represented a high proportion of the non-intersection accidents. These roadways are in close proximity to Wilson Gulch, which has a lot of deer and other wildlife. US 550 also experienced a high frequency of run-off-road accidents. The tight curves, steep grades, and narrow outside shoulders likely contribute to these crashes.

A quantitative analysis was performed using the HSM predictive method to calculate the expected number of accidents for each alignment in 2035. The alignments were also reviewed qualitatively in order to determine how each alignment and ramp terminal intersection option might affect future safety performance on US 550.

Each of the three alignment options was reviewed, along with the No-Action Alternative, in order to assess the degree to which they meet the Purpose and Need requirement for improving safety by reducing accident frequency and severity. **Table 4-6** provides a list of the alignment alternatives and criteria along with a summary of the safety-related issues for each.

Table 4-6: Purpose and Need Comparison by Accident Analysis

Safety Issue[1]	No-Action Alternative	On-Alignment Alternative	Off-Alignment Alternatives	
		R5	RGM	RGM6
HSM predicted accident frequency at year-2035 traffic volume	34 crashes per year	9 crashes per year	7 crashes per year	7 crashes per year
Potential for reducing wild animal accidents	No change from existing conditions	No change from existing conditions	Adds 1 large-animal crossing	Adds 2 large-animal crossings
Potential for reducing run-off-road accidents	No change from existing conditions	Widens road/shoulders	Widens road/shoulders and decreases curvature/grades	Widens road/shoulders and decreases curvature/grades

[1] See Chapter 6 for additional discussion of safety elements of Purpose and Need.

Based on the 2035 volume forecasts and certain geometric characteristics of each of the alignment options, it was determined that the No-Action Alternative does not meet the Purpose and Need with respect to safety. The On-Alignment and Off-Alignment Alternatives generally meet the Purpose and Need requirements with respect to safety for the categories listed in **Table 4-6**. It should be noted that the Off-Alignment Alternatives (RGM and RGM6) have greater potential for safety improvements than the On-Alignment Alternative (R5) due to the addition of wildlife crossings. Further discussion of the safety elements of Purpose and Need will be provided in Chapter 6.

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