



leeengineering.com

Tesuque Roads Safety Study.

Final Report | Jan. 2023

Prepared for



leeengineering.com

Tesuque Roads Safety Study

Final Report

January 2023

Prepared for:



Prepared By:



EXECUTIVE SUMMARY

The following report summarizes a Road Safety Study conducted in the Fall of 2022 in Tesuque, NM. This study evaluates the two major corridors within Tesuque Village, Bishops Lodge Road, Tesuque Village Road, and Arroyo Griego Road, a prescriptive easement connecting the two corridors.

This Road Safety Study was conducted at the request of Santa Fe County to assess the safety of the existing roadways within the study area for all users. The corridors within the study area were identified as having a high potential for safety improvement, facing challenges common to rural roadways, including visibility, lighting, speed, and a lack of multimodal infrastructure. This study aims to evaluate operations, identify specific safety challenges, and provide recommendations for near, mid, and long-term countermeasures for the observed safety challenges within the study area. Figure 2 of this report is a vicinity map showing the study area.

SUMMARY OF OBSERVED SAFETY CHALLENGES AND RECOMMENDED COUNTERMEASURES

The following table, reproduced from the end of this report, summarizes the observed safety challenges and recommended countermeasures.

Observed Challenge	Countermeasure	Section							Crash Reduction Factor (CRF)	Opinion of Probable Cost	Timeline	Considerations and Trade-offs
		1	2	3	4	5	6	7				
Animal Crossings	Oversized Animal Crossing Signs and Warning Beacons						X	X	-	\$5000/sign	Mid-Term	The beacons need power and require maintenance. The flashing lights may be a nuisance to the community.
Bicycle Facilities	Bicycle Lanes	X							49%	\$12,000/mile	Near-Term	Depending on the location, debris removal, shoulder repairs, or pavement widening may impact the cost and time to implement.
	Sharrows				X	X	X	X	-	\$200/sharrow	Near-Term	Low cost, may need future maintenance, not a dedicated bicycle facility.
	"May Use Full Lane" Signs				X	X	X	X	-		Near-Term	Signs may need future maintenance.
	Climbing Bicycle Lanes					X	X		-	\$20,000/mile	Near-Term	Bicycle lanes only need to be striped on ascents. Additional right of way may be required to provide adequate-width bicycle lanes.
Edge and Centerline Pavement Markings	Apply and Refresh Edge line and Centerline Pavement Markings	X	X	X	X	X	X	X	-	\$6,000/mile	Near-Term	Sediment deposits must be removed before applying center and edge line markings. Though the application is not expensive, constant maintenance is needed to maintain visibility.
	Wide Edge Line Striping								-		Near-Term	Wide edge line striping must be installed according to MUTCD guidance. It will require continued maintenance to maintain visibility.
Illumination	Roadside Reflective Delineators					X	X		37%	\$2,000/mile	Near-Term	Reflective roadside delineators must be installed according to MUTCD guidance. It may require continued maintenance.
	Illumination Maintenance			X					42%	\$2,500/luminaire	Near-Term	
	Install illumination		X						-	\$10,000/each	Mid-Term	Increased overhead lighting may be a nuisance to residents. Luminaires will require power and routine maintenance.
Infrastructure	Reconfiguration and Reconstruction of Arroyo Griego Road		X						-	Study Required	Long-Term	The property is privately owned, which will involve arrangements with the owner.
Intersection Sight Distance	All-Way Stop-Controlled Intersection					X			-	\$1,200/ sign	Mid-Term	Public outreach to notify the community of the modification to avoid crashes.
Multimodal Facilities	Multiuse Trails		X						-	\$450,000/mile	Mid-Term	Earthwork may be required depending on the location and desired material.
	Continue Typical Section of Santa Fe Complete Street Project							X	-		Long-Term	
Parking	Striping			X					-		Mid-Term	Striping and signage will help make parking spaces obvious but require routine maintenance to avoid sediment buildup.
	Guidance Signs								-		Near-Term	
Sediment Deposits	Removal and Routine Maintenance	X	X	X	X	X	X	X	-		Near-Term	This countermeasure manages the symptoms of the more significant challenge and is not the long-term solution.
	Sediment/Erosion Study	X	X	X	X	X	X	X	-	Study Required	Long-Term	
Signing	Routine Maintenance and Replace Non-reflective signs	X	X	X	X	X	X	X	-	\$1200/sign	Near-Term	
Posted Speed Limit Compliance	Oversized Regulatory Speed Limit Signs	X	X	X	X	X	X	X	-	\$1200/sign	Near-Term	Oversized regulatory speed limit signs are low-cost and aim to focus the driver's attention.
	Additional Speed Feedback Signs	X	X	X	X	X	X	X	-	\$5000/sign	Mid-Term	Power and routine maintenance is needed.
	Evaluate Lowering the Posted Speed Limit	X	X	X	X	X	X	X	-	Study Required	Long-Term	A speed study is required to analyze the feasibility of lowering the speed limit. Reducing the speed limit is low-cost and can be implemented quickly. However, on its own, lowering the speed limit is not as effective as other infrastructure improvements for traffic calming.
	Median Islands and Community Gateway Features	X	X	X	X	X	X	X	28%	\$50,000/mile	Long-Term	May impact drainage, landscaping should not adversely impact visibility, and gateway signs must be crash-rated.
Transit Facilities	Enhanced and Bidirectional Transit Stops	X	X	X	X	X	X	X	-	\$15,000/shelter	Mid-Term	To meet PROWAG guidance, work needs to be done for all transit stops. Transit shelters may involve the removal of trees if space is limited, and earthwork may be required. However, meeting these metrics is crucial for allowing equitable access to transit.

TABLE OF CONTENTS

Executive Summary	ii
Summary of Observed Safety Challenges and Recommended Countermeasures	ii
Table of Figures	v
List of Tables	vi
Introduction	1
Road Safety Study Process	1
Purpose of the Tesuque Safety Study	2
Study Area.....	2
Previous and Concurrent Study Efforts.....	4
Existing Conditions	4
Roadway Characteristics	4
Apparent Right of Way – Santa Fe County.....	5
Land Use.....	6
Data Collection.....	8
Motor Vehicle Traffic Data.....	9
Turning Movement Counts	12
Pedestrian and Bicycle Activity	13
Crash Data.....	13
Crash Data Analysis.....	14
Community Engagement	19
Field Reviews	19
Field Observations and Countermeasures	20
Corridor Wide.....	21
Section 1.....	31
Section 2.....	32
Section 3.....	34
Section 4.....	38
Section 5.....	40
Section 6.....	44
Section 7.....	47
Conclusion	48

TABLE OF FIGURES

Figure 1: Safety Study Procedure and Schedule	1
Figure 2: Tesuque Safety Study Corridors.....	2
Figure 3: Santa Fe County Apparent Right-of-Way	5
Figure 4: Study Area Land Use	7
Figure 5: Data Collection Plan	8
Figure 6: Average Daily Traffic at collection sites	9
Figure 7: Vehicles per hour at data collection site 1.....	10
Figure 8: Vehicles per hour at data collection site 2.....	10
Figure 9: Vehicles per hour at data collection site 3.....	10
Figure 10: Vehicles per hour at data collection site 4.....	10
Figure 11: Tesuque speed profile.....	11
Figure 12: Motor Vehicle turning movement counts at Site 5.	12
Figure 13: Motor Vehicle turning Movement counts at Site 6.	12
Figure 14: Pedestrian and Bicycle Traffic for 13-Hour Collection Period.....	13
Figure 15: Tesuque Safety Study Crash Heat Map (N=63)	14
Figure 16: Crashes per year, 2010-2020	15
Figure 17: Crash severity by lighting condition, 2010-2020.....	16
Figure 18: Crashes by type and severity, 2010-2020	17
Figure 19: Crashes by contributing factor and severity, 2010-2020.....	18
Figure 20: Study corridor sections.	20
Figure 21: Likelihood of pedestrian fatality by vehicle speed.....	21
Figure 22: Existing and Recommended Speed Feedback Signs	22
Figure 23: Example of Oversized Regulatory Signs	23
Figure 24: Median Island on Meadowlark Lane.....	24
Figure 25: Community Gateway Concept	24
Figure 26: Potential Sites for Median Islands	25
Figure 27: Sediment deposits on Bishops Lodge Road	26
Figure 28: Sediment deposits on Arroyo Griego Road.....	26
Figure 29: Examples of Vegetation Obstructing Roadway Signs	27
Figure 30: Non-Reflective Signs	28
Figure 31: Tesuque Village Market Transit Stop	29
Figure 32: Tesuque Post Office Transit Stop	29
Figure 33: Transit Shelter on Paseo del Pueblo Norte in Taos, NM	30
Figure 34: Section 1, Tesuque Village Road between Arroyo Griego Road and Tesuque Fire Department.....	31
Figure 35: Section 2, Tesuque Village Road, between NM 592 and Bishops Lodge Road	32
Figure 36: Section 3, Tesuque Village Road, Arroyo Griego Road, and Bishops Lodge Road	34
Figure 37: Ad hoc channelized right-turn at Bishops Lodge Road	35
Figure 38: Decrepit infrastructure posing a safety challenge for pedestrians.....	35
Figure 39: Arroyo Griego Reconstruction Concept	35
Figure 40: Marked parking spaces on Bishops Lodge Road	36
Figure 41: Ad hoc parking at Tesuque Village Market	36
Figure 42: Nonoperational Luminaries on Bishops Lodge Road	37
Figure 43: Section 4, Bishops Lodge Road from Arroyo Griego Road to Polmood Farm Road.....	38
Figure 44: Shared Lane Pavement Markings.....	39
Figure 45: R4-11 Sign	39
Figure 46: Section 5, Bishops Lodge Road between Polmood Farm Road and Big Tesuque Canyon.....	40

Figure 47: Crash Heat Map for Crashes in Low Light Conditions by Section 41

Figure 48: Southbound Bishops Lodge Road at Big Tesuque Canyon..... 42

Figure 49: Conceptual drawing of All-Way Stop Control at Bishops Lodge Road and Big Tesuque Canyon 43

Figure 50: Section 6, Bishops Lodge Road between Big Tesuque Canyon and Bauer Road 44

Figure 51: Crash Heat Map for Crashes in Low Light Conditions by Section 45

Figure 52: Crash heat Map for Crashes Involving Animals 46

Figure 53: Section 7, Bishops Lodge Road from Santa Fe city limits to Bauer Road..... 47

Figure 54: Concept for a Complete Street Typical Section on Bishops Lodge in Santa Fe..... 48

LIST OF TABLES

Table 1: Tesuque Safety Study Field Review Team..... 1

Table 2: Selected Demographic and Socioeconomic Data..... 3

Table 3: Means of Transportation to Work 3

Table 4: Vehicle classifications on Tesuque Roads 12

Table 5: Crashes by severity, 2010-2020 15

Table 6: Traffic Volume Proportions 16

Table 7: Crash Proportions..... 16

Table 8: Tesuque Roads Safety Study Meeting Schedule 19

Table 9: Observed Challenges and Recommended Safety Countermeasures Summary 49

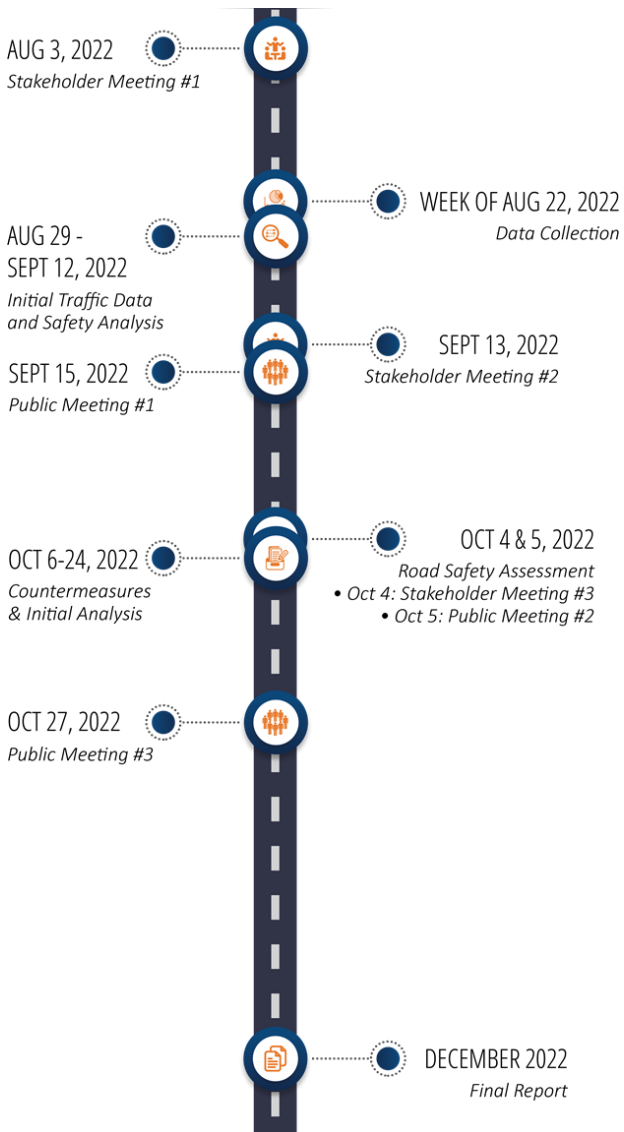


Figure 1: Safety Study Procedure and Schedule

INTRODUCTION

ROAD SAFETY STUDY PROCESS

The project team used a Road Safety Audit (RSA) process for the Tesuque Roads Safety Study. An RSA is a Federal Highway Administration-recognized formal process of evaluating and documenting potential road safety challenges and the recommended safety countermeasures benefitting all road users. The RSA process utilizes a 6-phase approach, including establishing a qualified RSA team, data collection, field briefings and reviews, and draft and final reports. The independent, multidisciplinary RSA team conducts this study based on a holistic observation of crash patterns and safety challenges during field reviews. Throughout this process, the RSA team can successfully recognize and recommend mitigations to ameliorate the safety challenges observed in the field. The Tesuque RSA team includes engineers, safety experts, transportation planners, law enforcement, and Tesuque residents.

Table 1: Tesuque Safety Study Field Review Team

RSA TEAM MEMBER	AFFILIATION
Sheriff Blaine Lattin	Santa Fe County Sheriff's Office
Johnny Baca	Santa Fe County Traffic Manager
John Nitzel	Santa Fe County Transportation Action Committee Chairman
Brett Clavio	Santa Fe County Transportation Planning Team Leader
Lynn Pickard	Tesuque Resident
Jeanne Boyles	Tesuque Resident
Dale Osmun	Tesuque Resident
Jamie Gagan	Tesuque Resident
Bruce Mcallister	Tesuque Resident
Patrick Hanson	Tesuque Resident
Paul Barricklow	Lee Engineering
Stephen Montañó	Lee Engineering

PURPOSE OF THE TESUQUE SAFETY STUDY

The Santa Fe County Growth Management Department/Planning Division has requested a Road Safety Study to evaluate the safety of major roadways within Tesuque. This safety study aims to outline opportunities for safety improvements for all users of the public right of way (ROW) in the study area and recommends near, mid, and long-term countermeasures.

STUDY AREA

The study area is Tesuque Village Road, from the Tesuque Fire Department to the village boundary; Bishops Lodge Road, from Tesuque Village Road to the village boundary; and Arroyo Griego Road, between Bishops Lodge Road and Tesuque Village Road. Tesuque Village Road and Bishops Lodge Road are Santa Fe County-maintained roadways. Arroyo Griego Road is a prescriptive easement within the study area, owned by and maintained by Santa Fe County. As a result, implementing any of the recommended safety countermeasures included in this study requires coordination between Santa Fe County and Tesuque Village Market. Figure 2 shows the study corridor and Tesuque Boundaries.

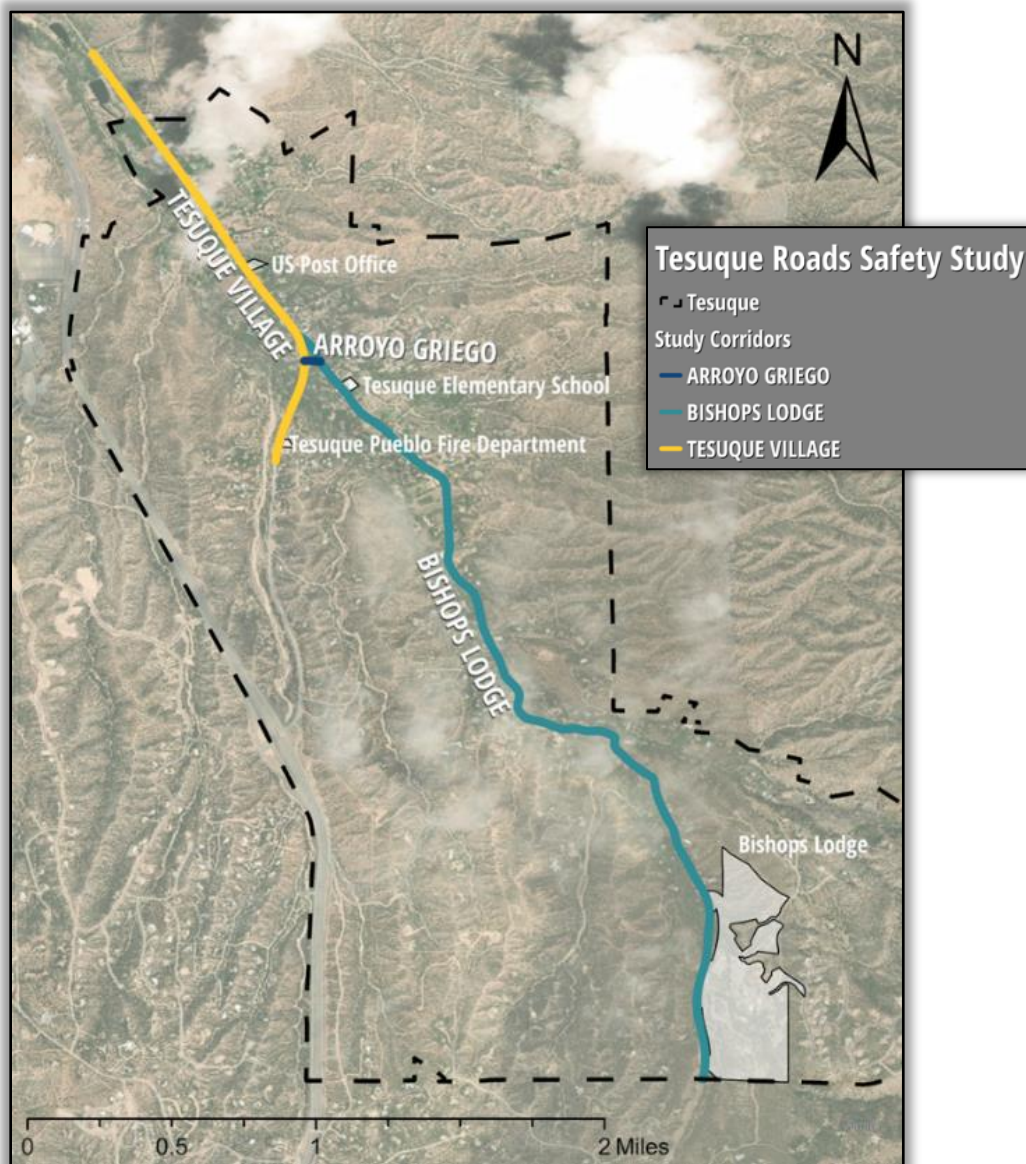


Figure 2: Tesuque Safety Study Corridors

Demographics and Socioeconomic Profile

Table 2 shows a selection of census data describing the Tesuque safety study area. The study area has a population of approximately 1,094 residents. These data suggest that the people in Tesuque are generally older, wealthier, and less ethnically diverse than the City of Santa Fe, Santa Fe County, and New Mexico. The median household income and age are higher than the City of Santa Fe, County, and State. Additionally, the lower employment rate suggests a higher population of retired individuals call Tesuque home.

Table 2: Selected Demographic and Socioeconomic Data, Source: 2020 Census and 2020 ACS 5-Year Estimates

	Study Area	City of Santa Fe	Santa Fe County	New Mexico
Population	1,094	87,497	154,823	2,117,522
Median Age	63.1	44.4	46.8	38.1
Median Household Income	\$78,750	\$57,274	\$60,668	\$51,243
Poverty Rate	4.9%	14.3%	12.5%	18.6%
Employment Rate	46.9%	57.3%	54.5%	53.2%
Rate of Households Without a Vehicle	4.2%	4.6%	3.9%	5.7%
Disability Status	13.5%	9.8%	9.6%	15.8%
Hispanic or Latino	25.4%	54.7%	50.5%	49.3%

Walking and bicycling may reflect one's travel preferences, but mode choice is shaped by an individual's financial situation, city of residence, commute time and distance, and physical ability. Table 3 shows individuals' modes when traveling to work in the study area, City, County, and State. The percentage of residents who commuted by driving alone, carpooling, walking, or bicycling was less than that of the City, County, or State, while the percentage who used public transportation or other means was zero. The proportion of residents who worked from home was significantly higher within the study area than in the City, County, and State. The mode choices in Tesuque may be attributed to the rural nature of the area and the high percentage of retirees and residents who work from home. However, the low rate of residents who walk and bicycle might also reflect the perceived safety and multimodal accessibility in the area.

Table 3: Means of Transportation to Work, Source: 2020 ACS 5-Year Estimates

Commute Mode	Study Area	City of Santa Fe	Santa Fe County	New Mexico
Drove Alone	62.0%	86.4%	77.0%	79.1%
Carpool	1.1%	9.2%	9.0%	10.0%
Public Transportation	0.0%	1.1%	0.9%	1.0%
Walked	1.3%	2.2%	1.8%	1.9%
Bicycle	0.3%	0.7%	0.5%	0.6%
Other means	0.0%	0.7%	0.8%	1.1%
Worked from home	35.4%	8.8%	10.1%	6.4%

PREVIOUS AND CONCURRENT STUDY EFFORTS

Tesuque Community Plan (2022) – Identifies challenges and opportunities for improvement within the community, such as drainage and erosion problems, insufficient sight distance at driveways, and other dangerous roadway and utility features. The addition of transit services, safer cycling conditions, and a fire safety and prevention plan are among the detailed improvements. The plan emphasizes the protection of natural and historical resources through sustainable growth. This community plan influences the Sustainable Growth Management Plan and the Sustainable Land Development Code, which outline goals and regulations for development in Santa Fe County.

Bishops Lodge Road Reconstruction Study (2022) – Location study, preliminary and final design of Bishops Lodge Road reconstruction from Artist Road to the City Limits. This study identifies speeding, lack of pedestrian and bicycle facilities, and ADA compliance issues as safety concerns on Bishops Lodge Road, south of Tesuque.

Santa Fe County Complete Streets Resolution (2022) – Resolution to advance Complete Streets within Santa Fe County, to make transportation safer and more equitable while reducing the impacts of climate change. Attached to this resolution is the Federal Highway Administration’s “Small Town and Rural Multimodal Networks” manual, which provides national design guidelines for implementing complete streets in rural settings.

EXISTING CONDITIONS

ROADWAY CHARACTERISTICS

Bishops Lodge Road is a Santa Fe County-maintained roadway that runs north and south. Its functional class is minor arterial. From Tesuque Village Road to Arroyo Griego Road, the roadway segment comprises a 12-foot-wide cross-section with one-way, northbound-only travel permitted. From Arroyo Griego Road to the village boundary, the roadway segment comprises a 2-lane cross-section with one travel lane in each direction, ranging from 8 to 11 feet wide. An 11-foot-wide exclusive right-turn lane is available on northbound Bishops Lodge Road for accessing Bauer Road. The northbound posted speed limit is 35 miles per hour (MPH) from the southern boundary of the study area to the south of Rancho Escondito, where it decreases to 25 MPH. The posted speed limit is 25 MPH on southbound Bishops Lodge Road, from Arroyo Griego Road to the south of Senda Vieja, where it increases to 35 MPH. The southbound posted speed limit increases again south of Bishop’s Lodge Resort to 50 MPH. Advisory speed postings of 15 and 20 MPH are between White Boulder Road and Rancho Escondito. Near Tesuque Elementary, 15 MPH school speed limit postings are present. Striping is present on some sections of the roadway. Asphalt and dirt shoulders abut the roadway for most of the corridor. Bicycle facilities are not on either side of the roadway, and a painted crosswalk is at Arroyo Griego Road. No other pedestrian facilities are available throughout the study corridor.

Tesuque Village Road (County Road 73) is a Santa Fe County-maintained roadway that runs north and south. Its functional class is minor arterial. The roadway segment comprises a 2-lane cross-section with one 11-foot-wide travel lane in each direction. The northbound posted speed limit is 35 MPH at the south boundary of the study area, decreasing to 30 MPH south of Arroyo Griego Road and increasing to 45 MPH at Cerro Azul. The southbound posted speed limit is 45 MPH from NM 492 to Cerro Azul, then decreases to 30 MPH. The southbound posted speed limit increases to 45 MPH at Senda De Fuego. Asphalt and dirt shoulders abut the roadway for most of the corridor. Between the southern boundary of the study area to a quarter of a mile south of Arroyo Griego Road, 4-foot-wide bicycle lanes are present on each side of the roadway. No pedestrian facilities are available.

Arroyo Griego Road is privately owned and runs east and west. Santa Fe County maintains the stretch of Arroyo Griego Road under a prescriptive easement. It includes 220 feet of paved roadway between Tesuque Village Road and Bishops Lodge Road. The road comprises a 2-lane cross-section in this segment, with one 10-foot-wide travel lane in each direction delineated by centerline striping. On both sides of the road is parking for Tesuque Village Market, located to the south. No bicycle or pedestrian facilities are available.

APPARENT RIGHT OF WAY – SANTA FE COUNTY

Acquiring right-of-way or investigating and renewing the prescriptive easements may be necessary to implement recommended countermeasures along the corridor. The apparent right of way (ROW) along each roadway is assumed to be the available space between parcels using the Santa Fe County Parcel map. The ROW varies between approximately 46 and 130 feet on Tesuque Village Road; the paved surface also varies between 24 and 27 feet. On Bishops Lodge Road, the ROW varies between zero and 300 feet, with paved surface widths ranging between 17 and 24 feet. On Bishops Lodge Road, where the ROW does not exist, privately owned parcels span the road. Additionally, according to Santa Fe County’s parcel map, Arroyo Griego Road is privately owned. These parcels are highlighted in red in Figure 2.

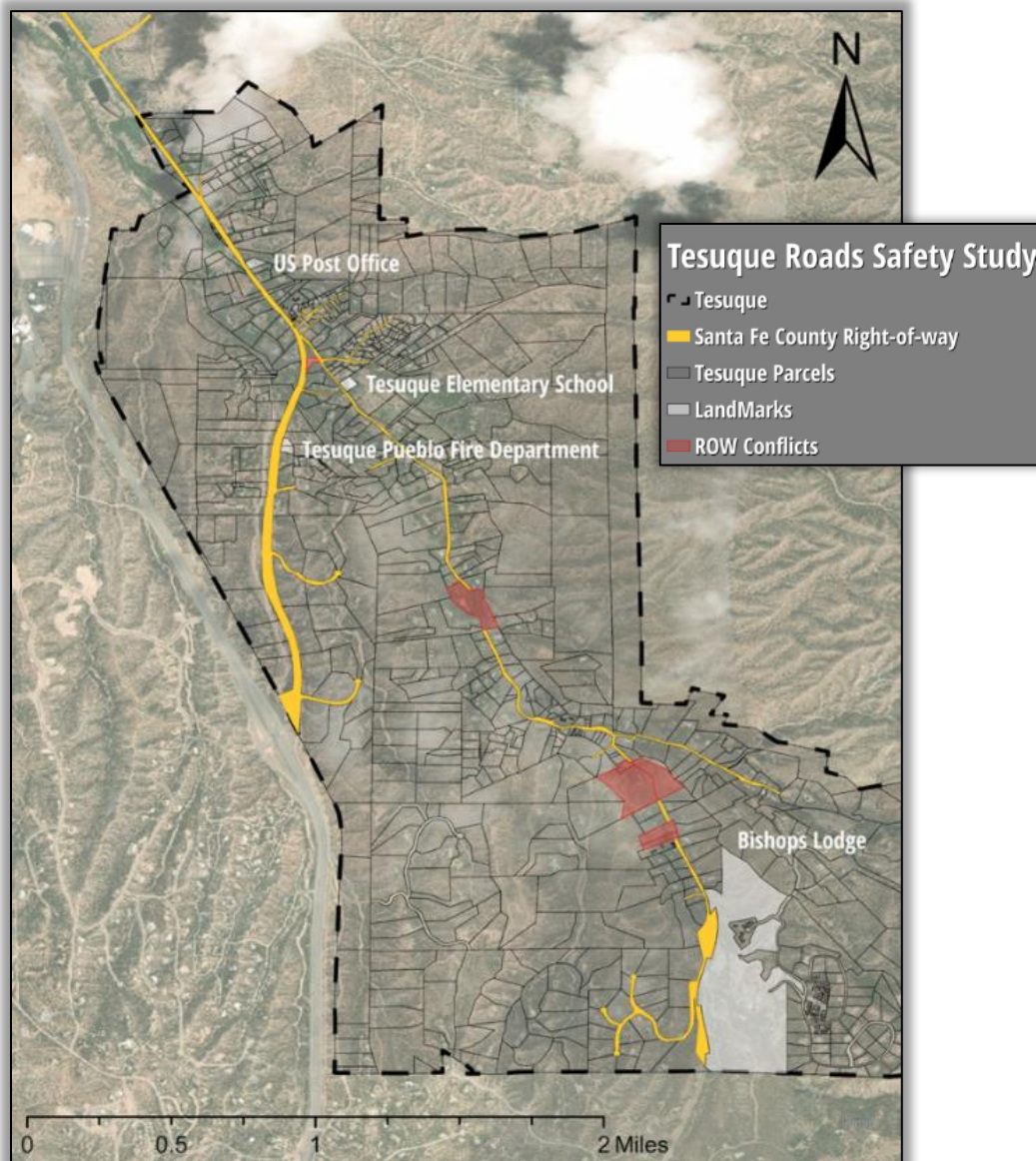


Figure 3: Santa Fe County Apparent Right-of-Way

LAND USE

The study corridors provide access to several adjacent land uses, including:

Residential – Residential community zones are adjacent to the study corridors throughout most of the study area. Rural and fringe residential zones lie beyond the residential community zones, to the east and west. A residential estate zone is east of Bishops Lodge Road, southeast of the residential community zone. Single-family residences are prominent throughout the study area.

Residential Fringe - Residential fringe zones are located north and west of the study area. These zones designate areas for estate-type residential developments or small agricultural uses.

Public/Institutional – Three public/Institutional land use areas are located within the study area. Tesuque Elementary School is located east of Bishops Lodge Road, south of Arroyo Griego Road. A United States Postal Service office and the Tesuque Fire Department are located on Tesuque Village Road, towards the north of the study corridor and near the south boundary of the study limits, respectively.

Traditional Community – A traditional community zone is located east of the intersection between Bishops Lodge Road and Tesuque Village Road. This zone designates the area suitable for residential, small-scale commercial, and traditional agriculture uses.

Planned Development District – Planned development districts are flexible zoning tools that combine uses with an approved plan that protects adjacent properties. A planned development district is located south of the study area, east of Bishops Lodge Rd.

Figure 4 shows the land uses in Tesuque.

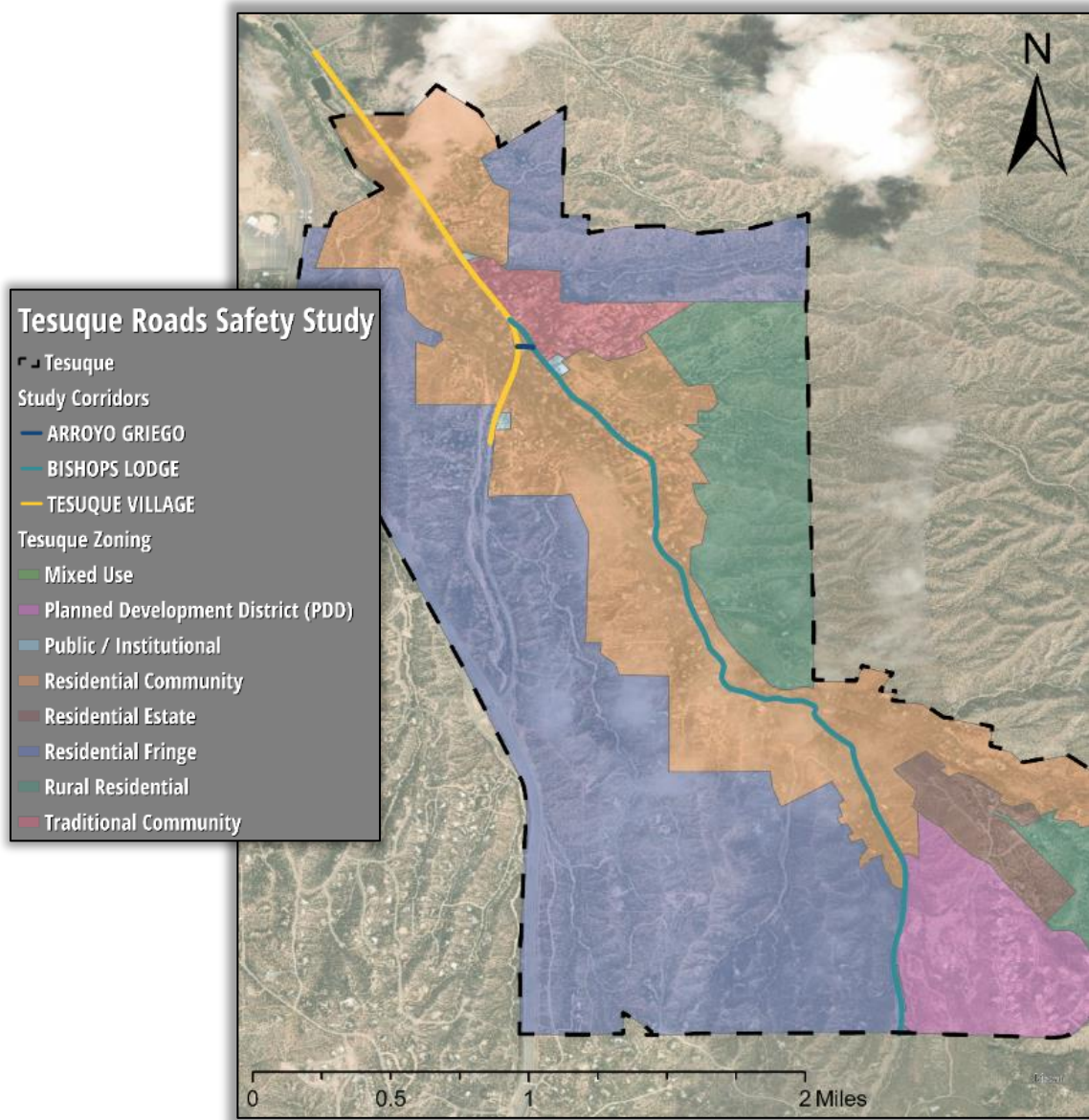


Figure 4: Study Area Land Use

DATA COLLECTION

To understand the existing traffic conditions in the study corridors, the project team conducted pneumatic tube counts and collected video data to quantify the multimodal activity. The four pneumatic tube deployments provided motor vehicle volumes, speeds, and classification. Additionally, video data were collected at two locations, providing insight into vehicle turning movements and pedestrian and bicycle activity on Arroyo Griego Road. The video cameras and pneumatic tube deployments occurred in August 2022 at the locations shown in Figure 5.

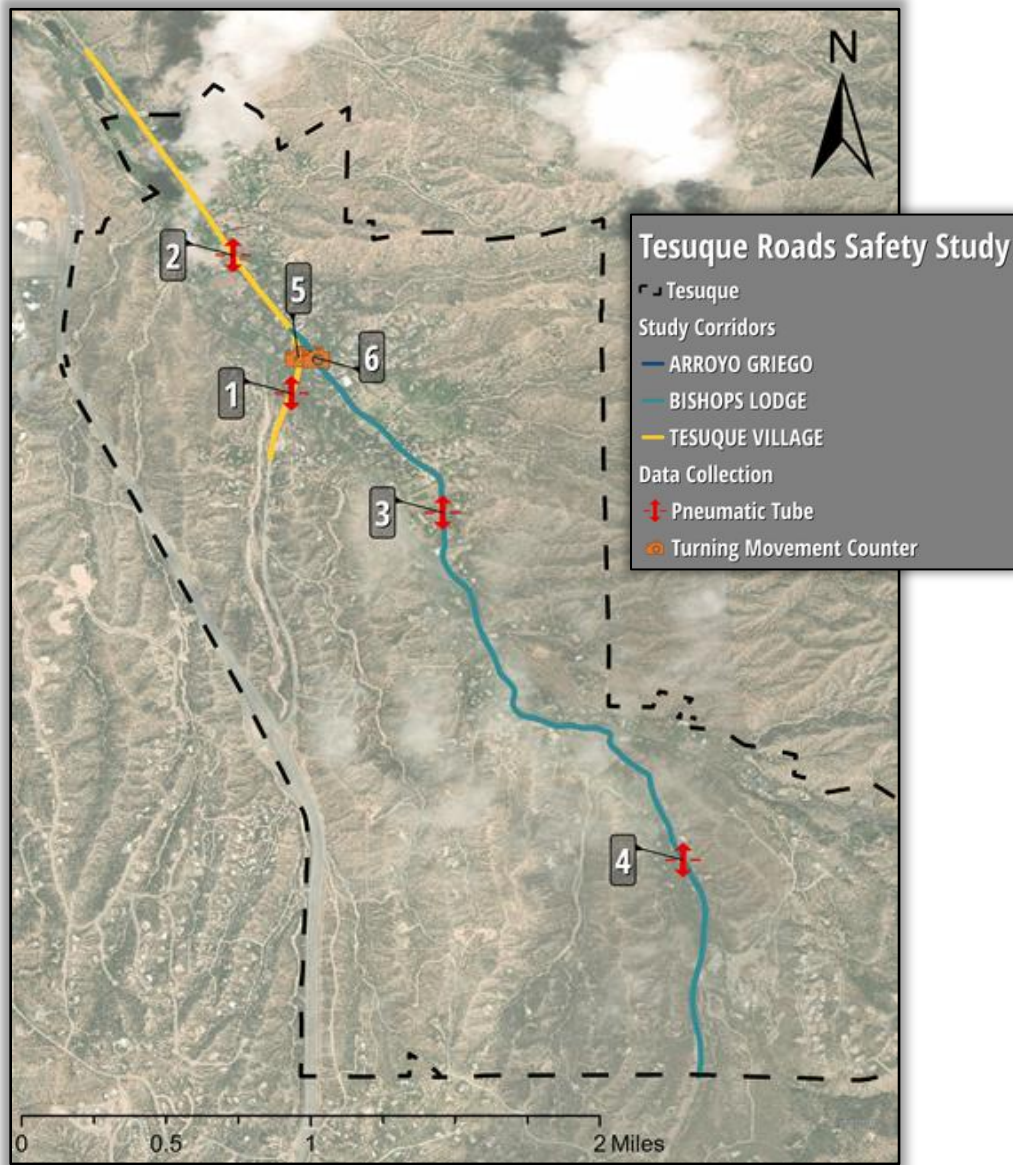


Figure 5: Data Collection Plan

MOTOR VEHICLE TRAFFIC DATA

Traffic Volumes

The project team collected vehicle volumes and speed profiles of vehicles traveling within the study corridor. Pneumatic tube counters were deployed for 48 hours on August 24 and August 25, 2022. The average daily traffic at each data collection site is shown in Figure 6 in vehicles per day (vpd). Higher traffic volumes exist on Tesuque Village Road. This observation may result from Tesuque Village Road providing access to US Route 84/US Route 285, a major north/south route in New Mexico. Bishops Lodge Road traffic volumes are less than half of Tesuque Village Road's traffic.

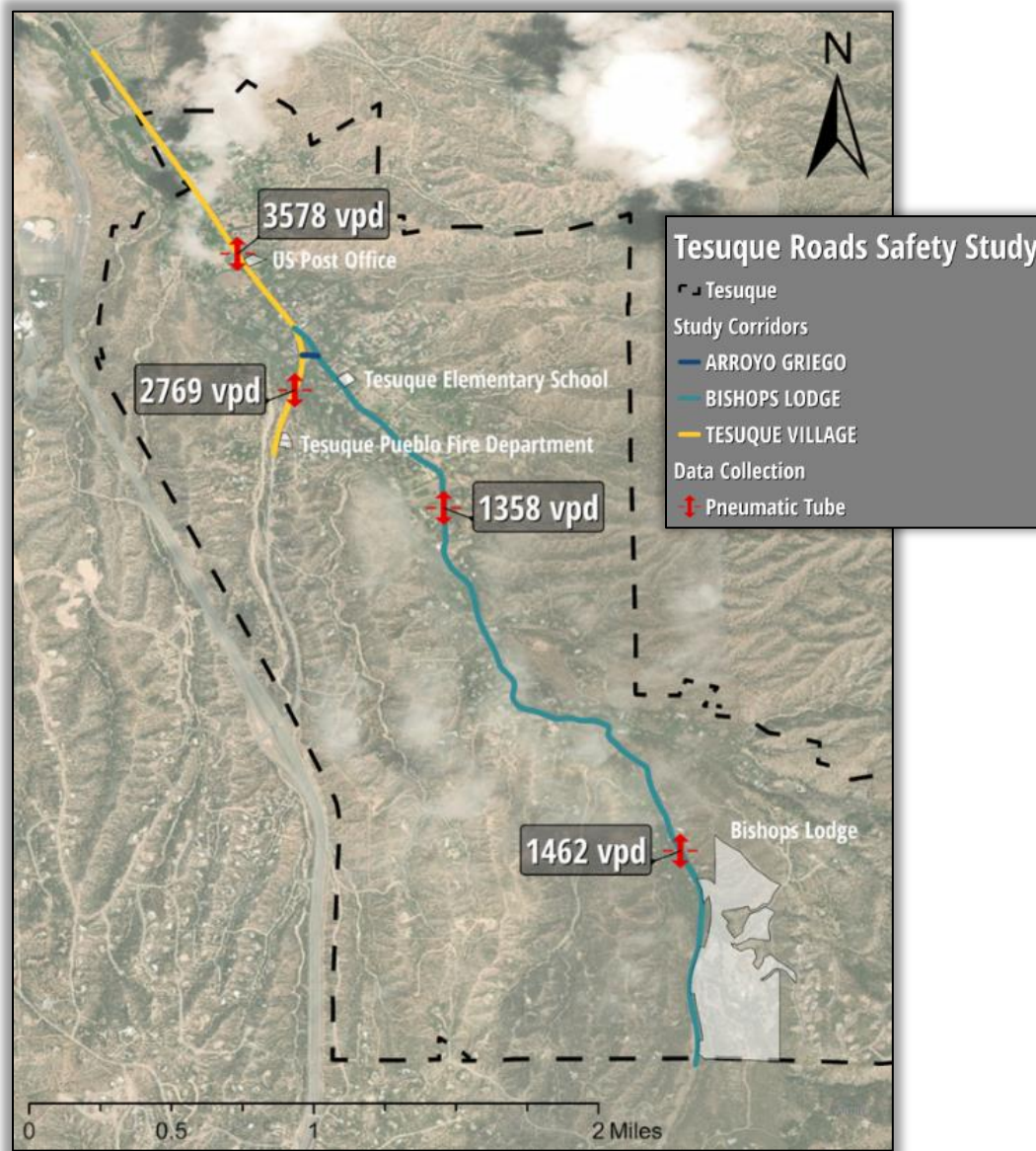


Figure 6: Average Daily Traffic at collection sites

The daily traffic patterns resemble typical rural behavior, with traffic volumes increasing throughout the day to an evening peak before decreasing again in the evening. The morning peak occurs at 11:00 AM, and the evening peak at 3:00 PM. The morning peak hour at site 2 diverges from the other locations, with the AM peak occurring during the 8:00 AM hour. This deviation from the other collection sites may be driven by Tesuque Elementary's bell schedule, with school starting at 8:15 AM. Figure 7 through Figure 10 show vehicle volumes per hour (vph).

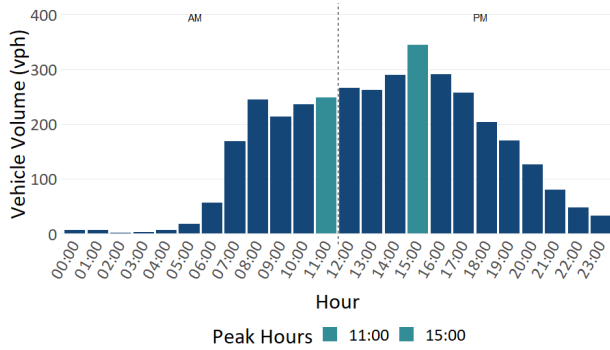


Figure 7: Vehicles per hour at data collection site 1

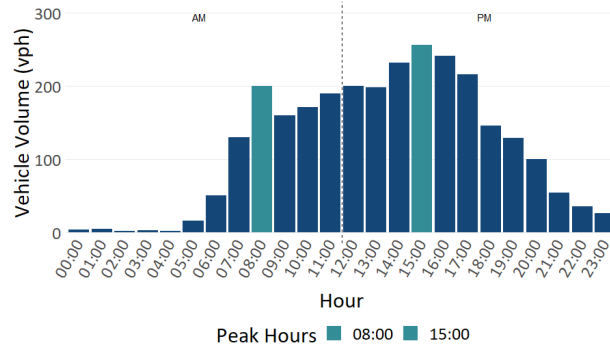


Figure 8: Vehicles per hour at data collection site 2

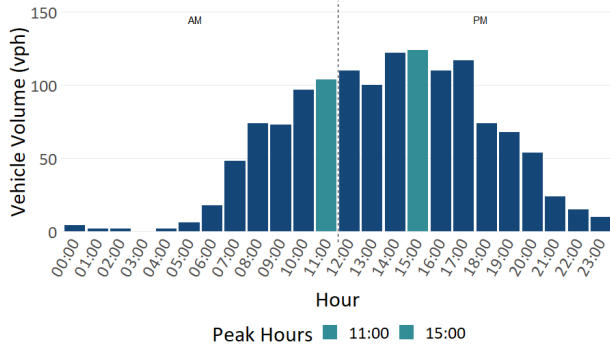


Figure 9: Vehicles per hour at data collection site 3

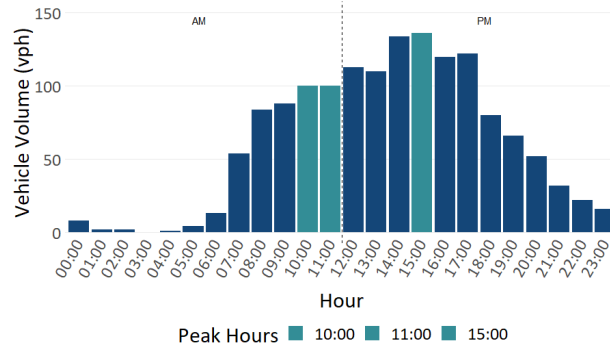


Figure 10: Vehicles per hour at data collection site 4

Speed Profile

The project team developed a speed profile of the traffic in the study corridor using data collected from the pneumatic tubes. Figure 11 shows the speed profile at each data collection site. The 50th percentile speed at site 1 is 36 MPH, and the 85th percentile speed is 43 MPH. These observations indicate that over half of the motor vehicle traffic exceeds the posted speed limit of 30 MPH by 6 MPH, with 15 percent exceeding the speed limit by 13 MPH. Traffic speeds are similar, with a higher proportion of motor vehicles speeding at collection site 2. The posted speed limit is also 30 MPH at collection site 2. However, the 50th and 85th percentile speeds are 42 MPH and 48 MPH, respectively. Over half of the motor vehicles traveling this segment of Tesuque Village Road exceed the speed limit by at least 12 MPH, and 15 percent exceed the posted speed limit by 18 MPH.

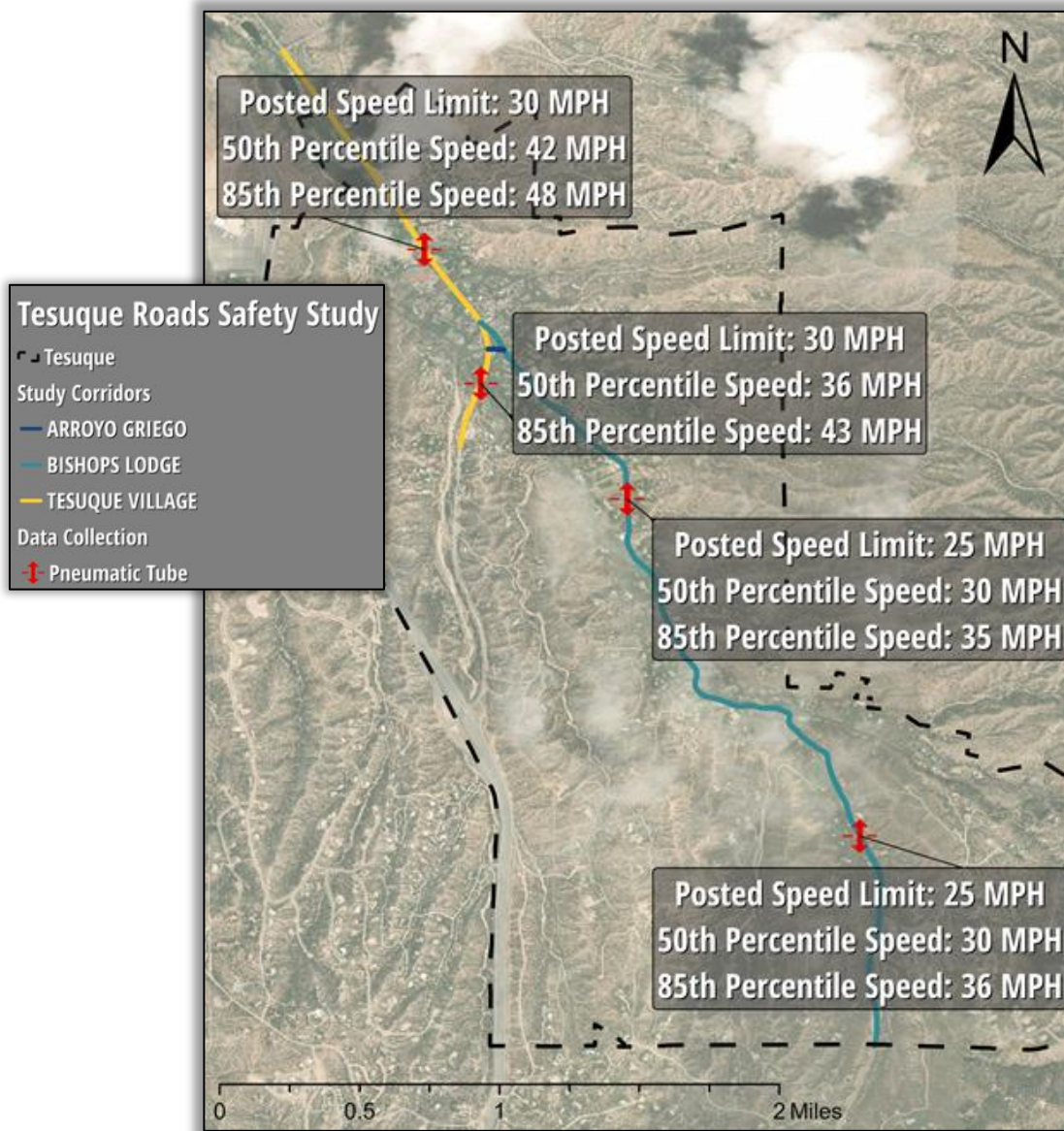


Figure 11: Tesuque speed profile

On Bishops Lodge Road, the posted speed limit at collection sites 3 and 4 is 25 MPH. At both collection sites, the 50th percentile speed is 30 MPH, and the 85th percentile speed is 35 MPH at site 3 and 36 MPH at site 4. These speeds indicate marginally better compliance with Bishops Lodge Road's posted speed limit than Tesuque Village Road.

Tesuque Village Road serves as ingress and egress from US Route 84/US Route 285, where the posted speed limit is 65 MPH. The speed profile also indicates that vehicle speeds are generally higher on the north end of Tesuque on Tesuque Village Road. These speeds may be due to motorists not shifting their behavior to observe the lower speed limit after traveling at the higher speeds on the highway.

The speed profile on Bishops Lodge Road may result from the context and environment of the road; narrow, winding, and primarily abutting residential properties. The narrow winding road likely commands the driver's attention and acts as a passive traffic calming feature.

Vehicle Classifications

The pneumatic tube counters provided insight into the types of vehicles traveling through the study corridors. Vehicle classifications are identified by vehicle axle spacing. In general, most of the vehicles were passenger vehicles; this class includes passenger cars and trucks. The next sizeable class was single-unit two-axle trucks. Vehicles in this class include delivery trucks, flatbeds, small public transit vans, recreational vehicles, and dual-rear-wheel passenger trucks (dually trucks). Larger trucks with three axles or more, such as semi-trucks and cement trucks, accounted for less than two percent of vehicular traffic on average. Table 1 summarizes the vehicle classifications revealed by the pneumatic tube counters.

Table 4: Vehicle classifications on Tesuque Roads

Vehicle Classification	Site 1	Site 2	Site 3	Site 4
Cars & Trailers	86.90%	89.40%	89.10%	90.50%
2 Axle, 6 Tire - Single unit	10.30%	7.80%	7.60%	7.40%
Heavy Trucks	1.40%	1.50%	1.70%	0.80%
Motorcycles	1.00%	0.90%	1.00%	0.90%
Buses	0.40%	0.40%	0.60%	0.30%

TURNING MOVEMENT COUNTS

At two intersections, 13-hour turning movement counts were collected in the study area on August 24, 2022, between 6:00 AM and 7:00 PM using video cameras. Figure 12 and Figure 13 show the AM and PM peak hour turning movement volumes.

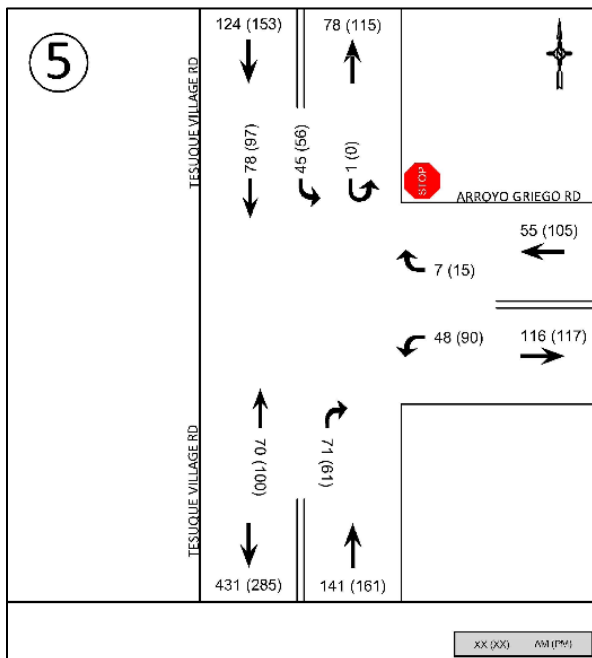


Figure 12: Motor Vehicle Turning Movement counts at Site 5.

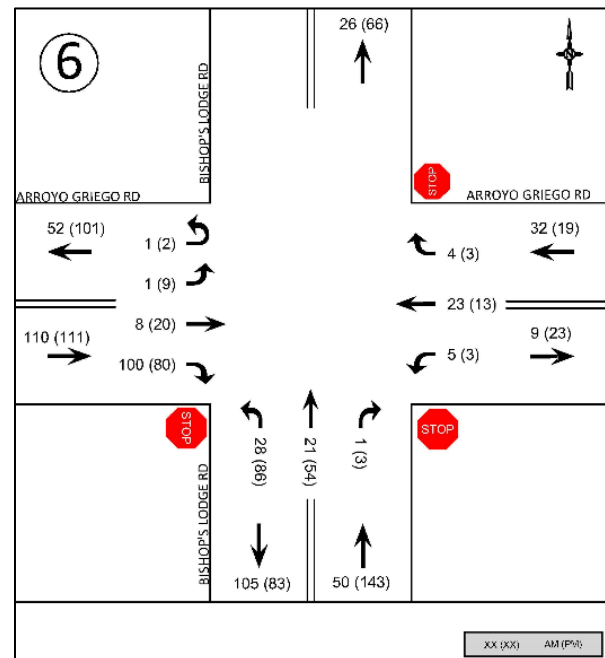


Figure 13: Motor Vehicle Turning Movement counts at Site 6.

From the 13 hours counted, the number of vehicles traveling along Arroyo Griego Road is 1,985. While this number only considers 13 hours of the day, it provides some insight into the Average Daily Traffic on Arroyo Griego Road.

PEDESTRIAN AND BICYCLE ACTIVITY

Pedestrian and bicycle activity was collected over 13 hours at data collection sites 5 and 6.

Figure 14: Pedestrian and Bicycle Traffic for 13-Hour Collection Period

	Site 5	Site 6	Total
Pedestrians	153	30	183
Bicycles	28	12	40

The total pedestrian and bicycle counts for the 13 hours were 183 and 40, respectively. Site 5, at Tesuque Village Road and Arroyo Griego Road, saw the most significant multimodal traffic, possibly resulting from residents and visitors accessing the Tesuque Village Market. Additionally, the camera at this location observed foot traffic resulting from ingress and egress from vehicles parked on the north side of Arroyo Griego Road.

CRASH DATA

This study analyzed ten years of crashes occurring in the study corridor between 2010 and 2020 provided by The University of New Mexico, Geospatial and Population Studies, Traffic Research Unit. This crash dataset, the most recent available at the time of this study, contained 63 crashes. The crash data is from reported crashes to law enforcement, and this data often fails to capture other minor crashes, unreported crashes, or near-misses. Crash data is extracted from crash reports filed by law enforcement officers. The following injury codes identify crash severity in New Mexico:

- K – Killed (Fatal)
- A – Incapacitated (Serious Injury)
- B – Visible Injury
- C – Complaint of Injury (Suspected Injury)
- O – Property Damage Only

Figure 15 shows a heat map of the reported crashes in the study corridor.

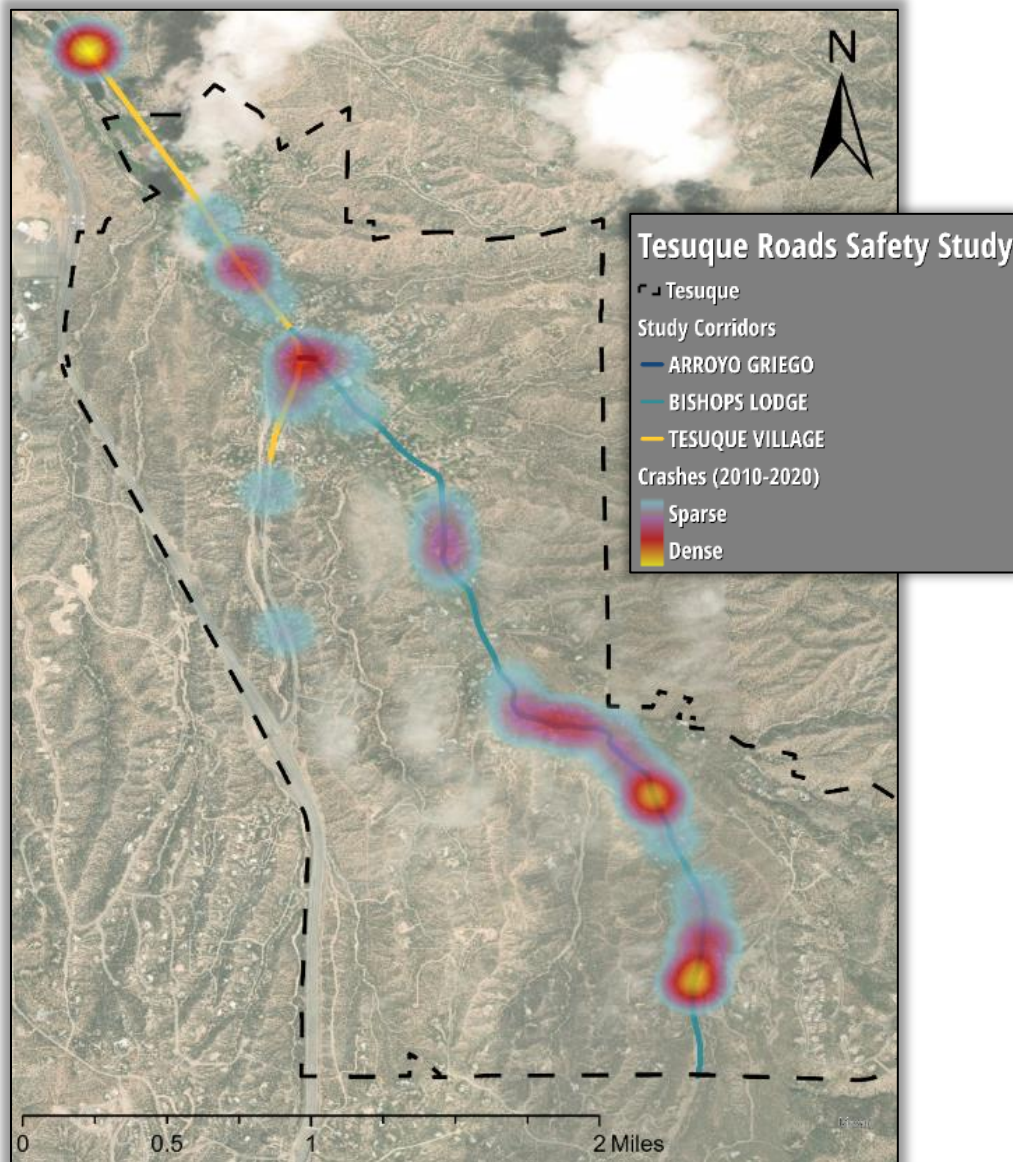


Figure 15: Tesuque Safety Study Crash Heat Map (N=63), 2010-2020 Source: UNM, Geospatial, and Population Studies, Traffic Research Unit

CRASH DATA ANALYSIS

Severity

One reported crash was fatal (K), and three resulted in serious injuries (A). Furthermore, the fatal crash involved a pedestrian. One serious injury crash involved a bicyclist. Crashes resulting in Visible (B), Suspected Injuries (C), or Property Damage Only (O) comprise the remaining crashes.

Table 5 summarizes the severity and quantity of crashes within each study corridor. All crashes resulting in a fatality or serious injury occurred on Tesuque Village Road or Bishops Lodge Road. One reported crash was fatal (K), and three resulted in serious injuries (A). Furthermore, the fatal crash involved a pedestrian. One serious injury crash involved a bicyclist. Crashes resulting in Visible (B), Suspected Injuries (C), or Property Damage Only (O) comprise the remaining crashes.

Table 5: Crashes by severity, 2010-2020 - Source: UNM, Geospatial and Population Studies, Traffic Research Unit

Crash Severity	Tesuque Village Road	Arroyo Griego Road	Bishops Lodge Road	Total Crashes
Fatal (K)	1	0	0	1
Serious Injury (A)	1	0	2	3
Visible Injury (B)	2	1	4	7
Complaint of Injury (C)	2	1	6	9
Property Damage Only (O)	15	1	27	43
Total	21	3	39	63

Year

Figure 16 summarizes the number of crashes per year from 2010 through 2020 within the study corridor. The number of crashes peaked in 2015 and has remained higher than in previous years. Additionally, Figure 16 shows an increased frequency of fatal and injury crashes in the corridor after 2015 compared to prior years.

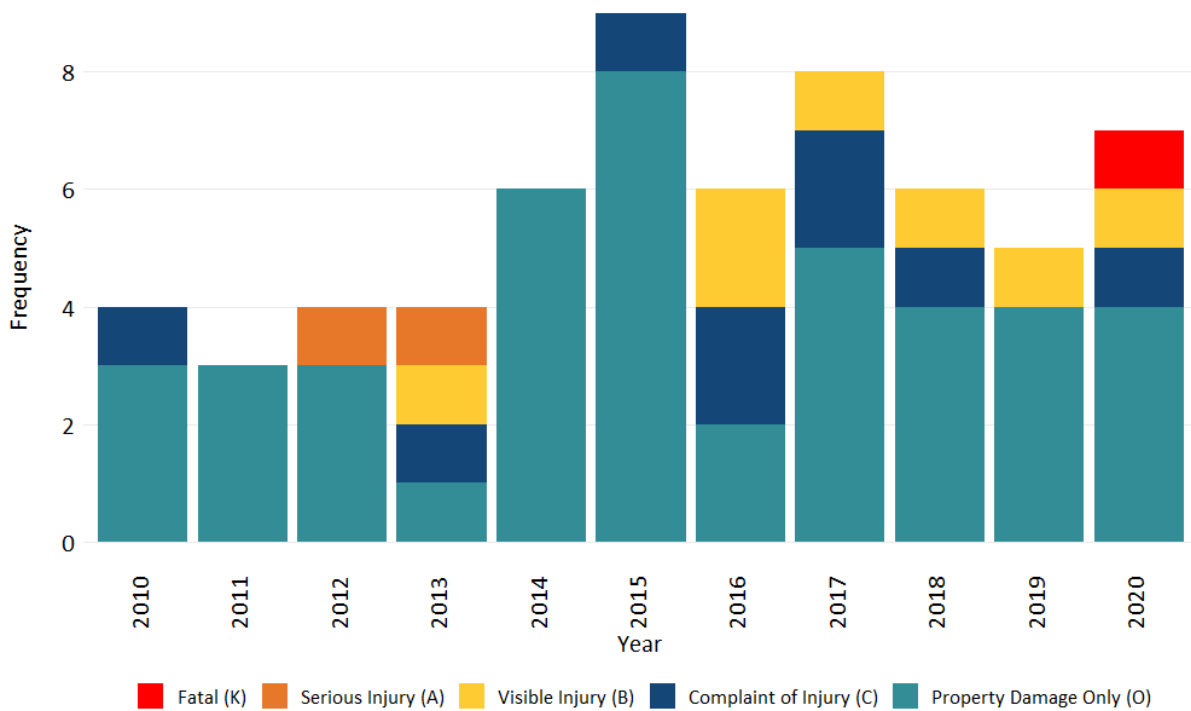


Figure 16: Crashes per year, 2010-2020 - Source: UNM, Geospatial and Population Studies, Traffic Research Unit

Lighting Condition

Figure 17 shows crashes by lighting condition and severity. As expected, the highest proportion of crashes occurred during daylight hours.

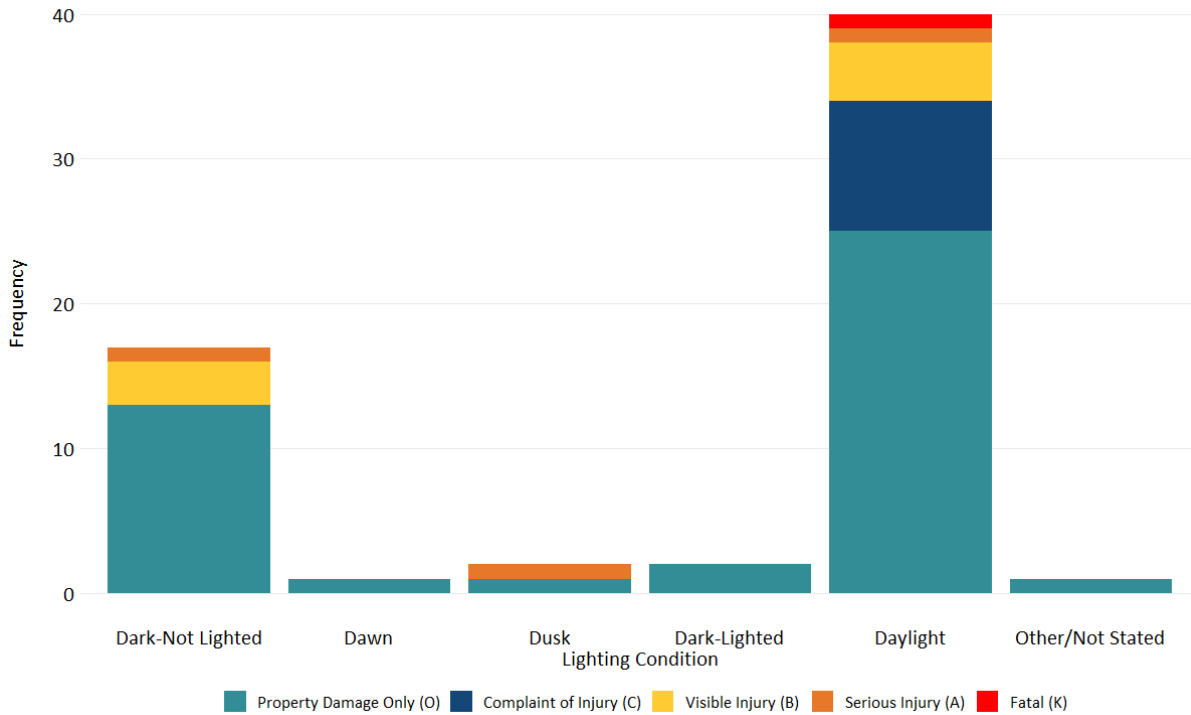


Figure 17: Crash severity by lighting condition, 2010-2020 - Source: UNM, Geospatial and Population Studies, Traffic Research Unit

Crashes occurring under dark conditions are overrepresented compared to the proportion of traffic volumes. Table 6 shows the proportion of traffic volumes during Dark and Light hours. On average, traffic volumes during Dark Hours contribute 10.6% of daily traffic. However, crashes occurring under Dark conditions represent 31.75% of crashes. Table 7 shows the proportion of crashes under various lighting conditions.

Table 6: Traffic Volume Proportions

Light Condition	Site 1	Site 2	Site 3	Site 4	Average
Dark Hours (8:00 PM – 6:00 AM)	10.7%	10.8%	10.1%	10.6%	10.6%
Light Hours (7:00 AM – 7:00 PM)	89.3%	89.1%	89.9%	89.4%	89.4%

Table 7: Crash Proportions

Light Condition	Crash Proportions	Total
Dark-Not Lighted	26.98%	31.75%
Dark Dawn	1.59%	
Dusk	3.17%	
Light Dark-Lighted	3.17%	66.67%
Daylight	63.49%	
Not Stated	1.59%	1.59%

Crash Type

Figure 18 shows the crashes by type and severity. The highest proportion of crashes involved a fixed object, likely influenced by road curvature, lane width, unclear roadway delineation, or lack of lighting. The second highest number of crashes involved another vehicle, while the third involved an animal.

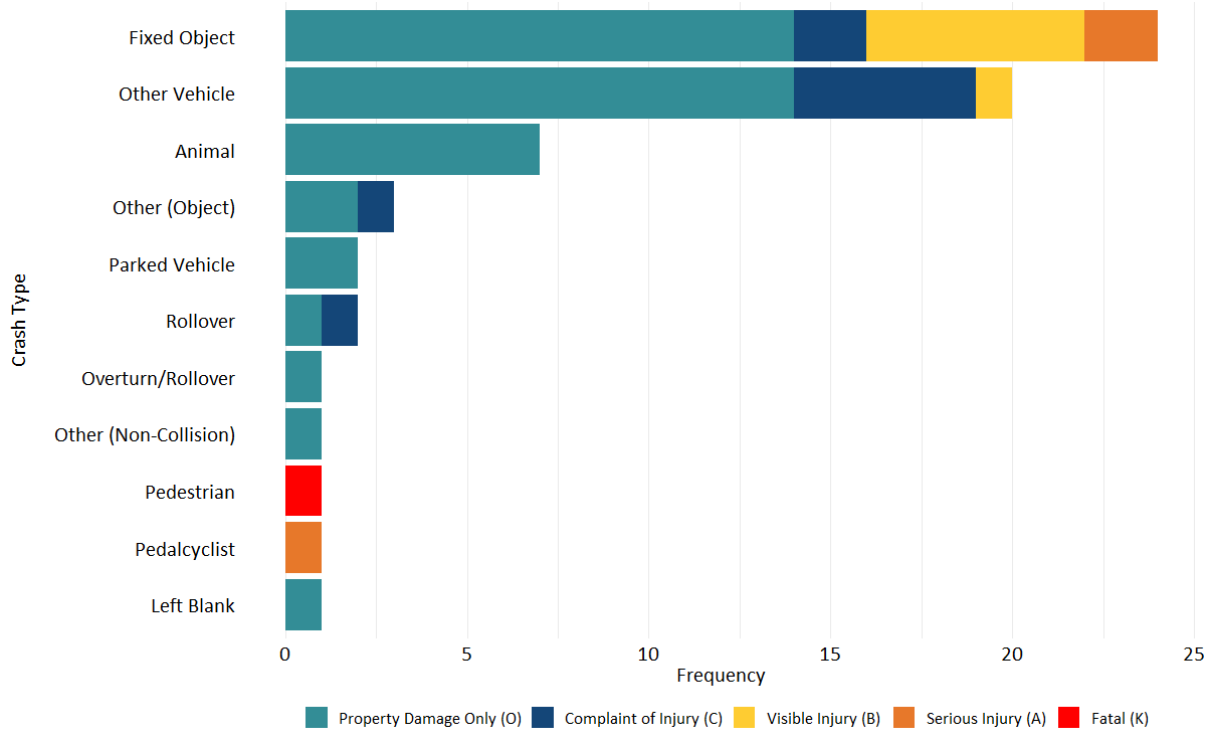


Figure 18: Crashes by type and severity, 2010-2020 - Source: UNM, Geospatial and Population Studies, Traffic Research Unit

Highest Contributing Factor

Figure 19 shows crashes by highest contributing factor and severity. Crashes with the highest contributing factor listed as “Other – No Driver Error” or missing data pose a challenge to analyze since minimal information is provided. The highest contributing factor for crashes where data is available is vehicle speed. Also, speed-related crashes comprise a large proportion of crashes resulting in injury.

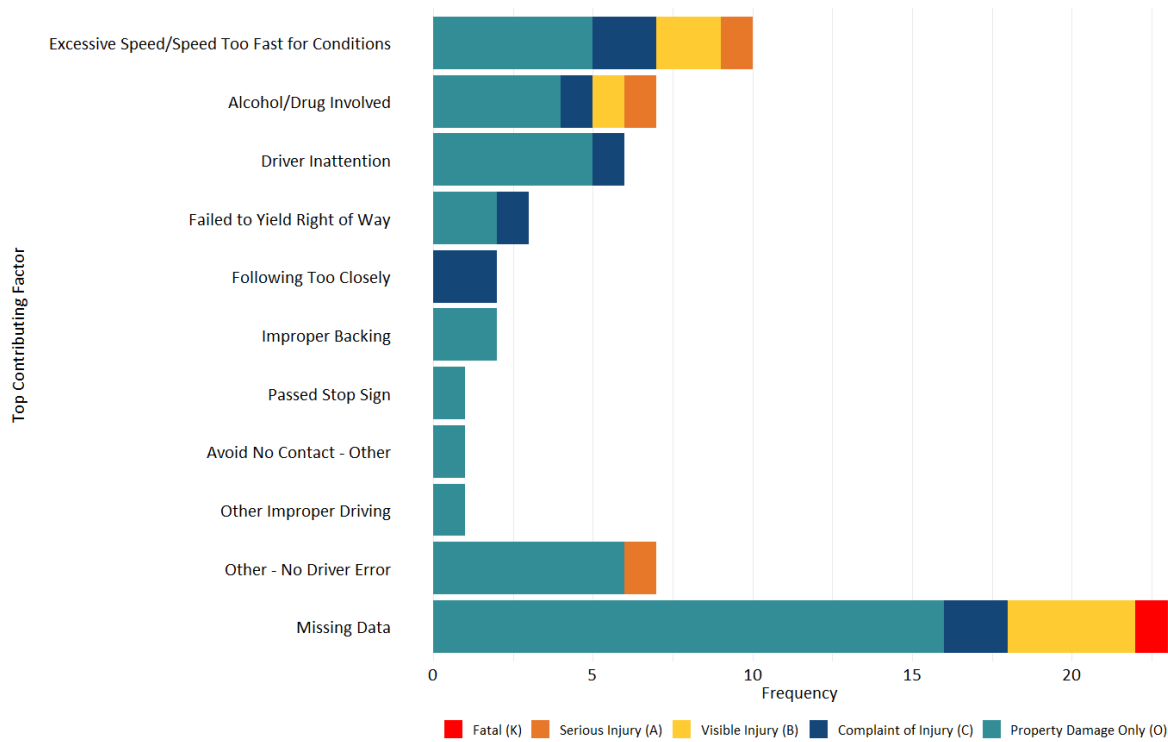


Figure 19: Crashes by contributing factor and severity, 2010-2020 - Source: UNM, Geospatial and Population Studies, Traffic Research Unit

Crash Reports

Redacted crash reports were requested from the New Mexico Statewide Traffic Records System for fatal, serious injuries and crashes involving pedestrians or bicycles. However, at the time of publication, the project team received only one crash report for a bicycle crash resulting in a serious injury; its summary follows:

23369361 – A bicyclist injury occurred at 8:40 AM on January 4, 2016, located on Bishops Lodge Road near milepost 4. At the time of the crash, the weather was clear, and the sun was out. The contributing factor was “Other – No Driver Error.” The bicyclist was traveling southbound on Bishops Lodge Road when struck from behind by a motor vehicle also traveling south. The officer noted that there was glare from the rising sun, obstructing the driver’s vision. The motorist stopped and called for help. The bicyclist was transported to the hospital with back pain, pelvic pain, difficulty breathing, and possible rib injuries.

COMMUNITY ENGAGEMENT

A series of stakeholder and public meetings were held to involve the community in Tesuque. The intention of involving the community throughout the process was to gather qualitative input and obtain buy-in to the process. Additionally, soliciting feedback from the public on the recommended countermeasures allows residents to participate in decisions that affect them directly.

Table 8: Tesuque Roads Safety Study Meeting Schedule

Stakeholder Engagement Meeting	August 3 rd , 2022
Stakeholder Outreach Meeting	September 13 th , 2022
Public Outreach Meeting	September 15 th , 2022
Safety Insights Meeting 1	October 4 th , 2022
Safety Insights Meeting 2	October 5 th , 2022
Final Stakeholder Meeting	October 25 th , 2022
Final Public Meeting	October 27 th , 2022

Stakeholder and Public Outreach Meetings were held after the data collection process to share the project team's initial observations and preliminary analyses and gather resident feedback and comments. These meetings began with introductions, followed by a presentation of the background of this study, a review of the existing conditions, crash data analysis, and preliminary observed challenges. The first stakeholder meeting allowed the project team to introduce themselves and the project to the community and let the project team hear about resident concerns and focus areas in Tesuque. The next series of stakeholder and public meetings occurred concurrently with the Field Reviews to discuss the observed challenges with stakeholders and residents.

FIELD REVIEWS

The RSA Team conducted field reviews on Tuesday, October 4th, and Wednesday, October 5th, 2022, according to the following schedule:

- Tuesday, October 4:
 - 2:30 PM – 3:30 PM: Afternoon Field Observations
 - 3:30 PM – 4:00 PM: Insight Discussion Meeting Day 1
 - 7:30 PM – 8:30 PM: Dark/PM Field Observations (Lee Engineering Only)
- Wednesday, October 5
 - 8:00 AM – 9:30 AM: AM Field Observations
 - 10:30 AM – 11:30 AM: Mid-day Peak hour Observations
 - 11:30 AM – 12:00 AM: Insight Discussion Meeting Day 2

Subsequent sections of this report document the observed challenges from the field reviews and recommended safety countermeasures.

FIELD OBSERVATIONS AND COUNTERMEASURES

The recommended countermeasures are organized by sections of the study corridor. The seven sections are shown in Figure 19. Each section contains specific challenges and countermeasures within that segment of the study corridors.

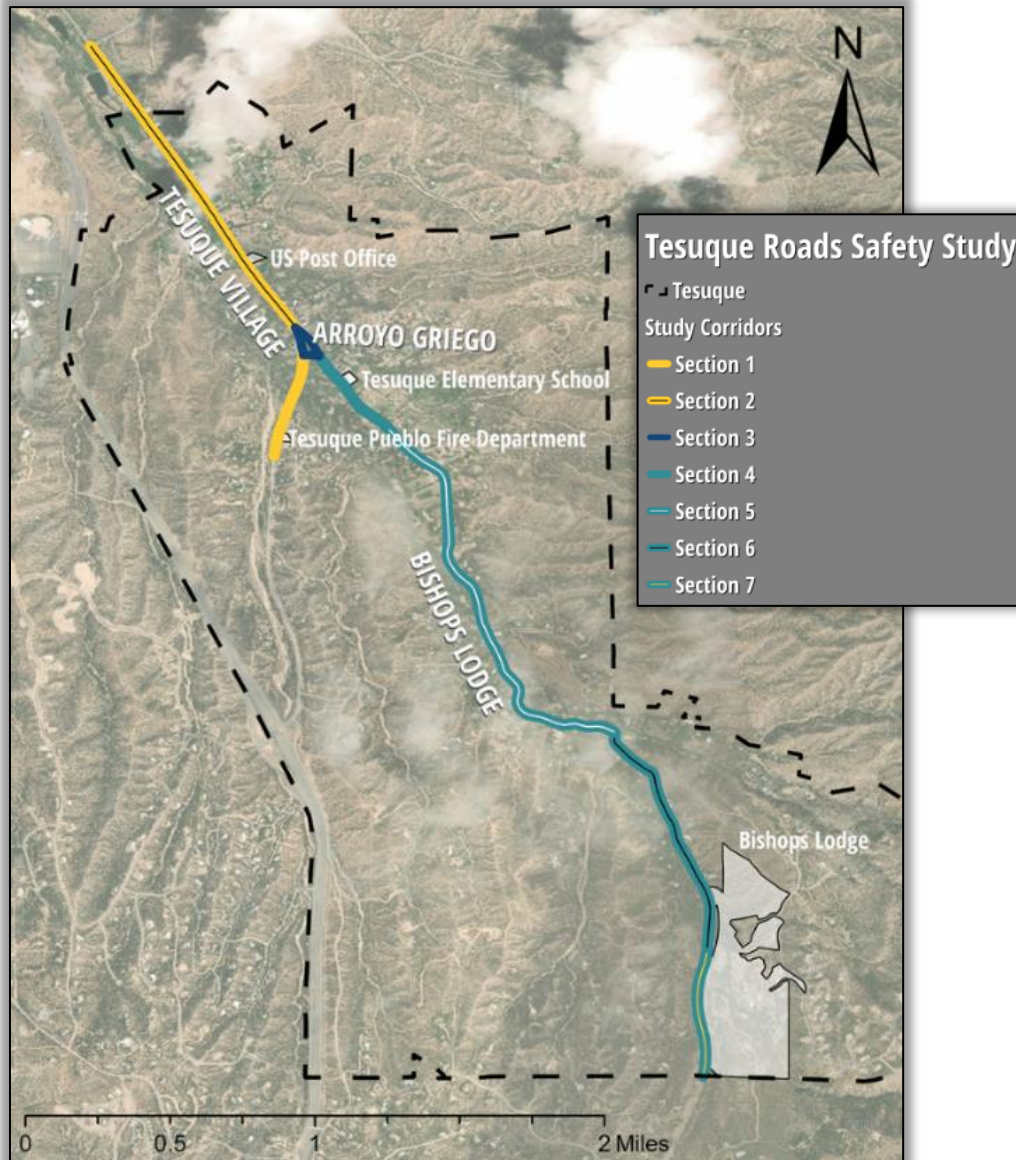


Figure 20: Study corridor sections

Each identified safety challenge is described along with its recommended safety countermeasure. Where available, crash reduction factors (CRF) show the potential for crash reductions for the recommended safety countermeasures. The CRFs are from the Crash Modification Factor Clearinghouse or the FHWA's Proven Safety Countermeasures. CRFs do not exist for some of the recommended countermeasures. Therefore, not all the recommended countermeasures have an associated CRF. This report concludes with a summary of all the observed safety challenges and the recommended safety countermeasures.

CORRIDOR WIDE

Observed Safety Challenge – Speed Limit Compliance

Based on the observed safety challenges, a recurring theme of the following countermeasures is to discourage excessive motor vehicle speed. Additionally, the study corridors do not afford pedestrians safe facilities. Studies have found an association between vehicle speed and the likelihood of pedestrian fatality in the event of a crash¹. Figure 21 shows that this association is not linear but exponential, indicating pedestrian safety is a function of motor vehicle speed. The study corridors have posted speed limits ranging between 25 and 50 MPH.

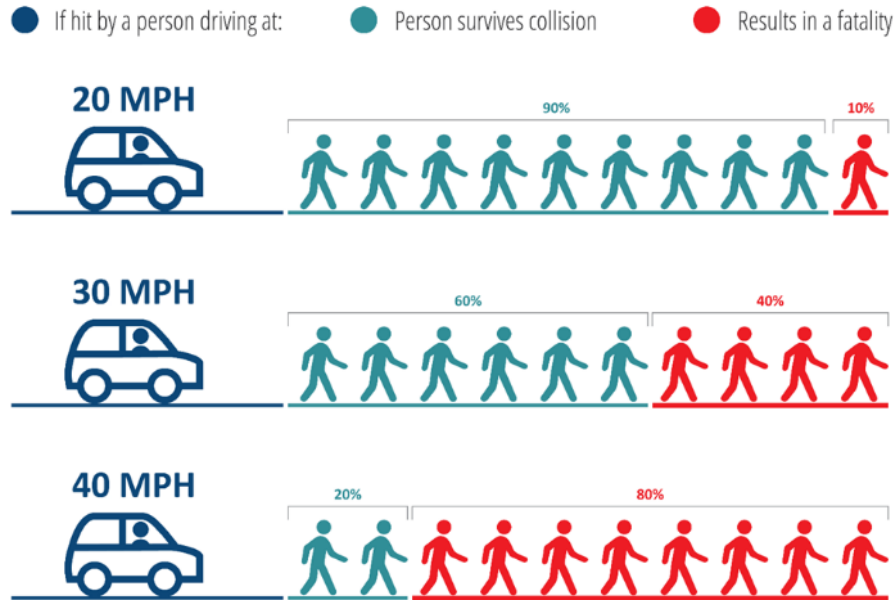


Figure 21: Likelihood of pedestrian fatality by vehicle speed - adapted from San Francisco MTA Vision Zero Action Plan, February 2015

Recommended Countermeasure: Additional Speed Feedback Signs

The first recommended countermeasure is to increase awareness of the posted speed limit and compliance by installing additional speed feedback signs. Two existing speed feedback signs accompany 25 MPH speed limit postings on Bishops Lodge Road. One is installed on northbound Bishops Lodge Road, approximately half a mile north of Senda Vieja. The second is installed on southbound Bishops Lodge Road, just south of Tesuque Elementary School. The recommendation is to establish a second speed feedback sign on northbound Bishops Lodge Road before northbound motorists reach Tesuque Elementary. Tesuque Village Road has the highest traffic volumes and the least compliance with the posted speed limit in the 30 MPH zone. As a result, the project team recommends that two speed feedback signs be installed on Tesuque Village Road. These signs should be installed in the 30 MPH speed zone, one for southbound motorists near the Post Office and another for northbound travelers before they approach Arroyo Griego Road. Figure 22 shows the locations of the existing speed feedback signs and suggestions for the recommended installations.

¹Pasanen, "Driving Speeds and Pedestrian Safety: A Mathematical Model."

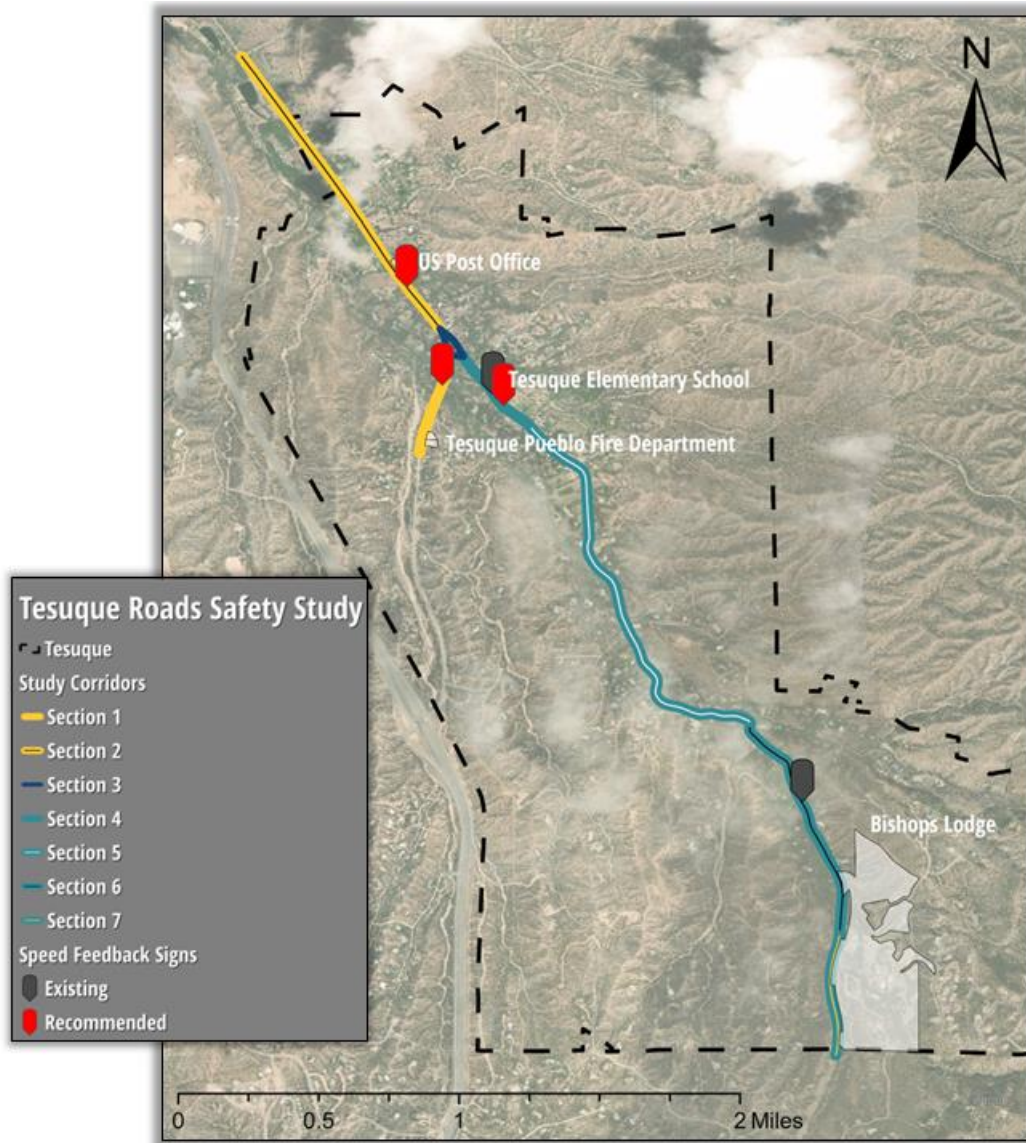


Figure 22: Existing and Recommended Speed Feedback Signs

Recommended Countermeasure: Evaluate Lowering the Posted Speed Limit

The World Health Organization (WHO) recommends a speed limit of 20 MPH for roads where motor vehicles, pedestrians, and bicycles mix unless facilities are provided for vulnerable road users. This study recommends a speed study to evaluate the feasibility of lowering the speed limit in the study area. Reducing the speed limit is low cost and can be implemented quickly but should be considered after other infrastructure improvements are made since lowering the speed limit alone is not as effective. Arbitrarily lowering the posted speed limit will not yield the desired impact on driver behavior unless doing so is part of a greater effort, including geometric modifications to the road, enforcement, and education. Safe roadway designs provide drivers with visual cues that command their attention, shape their driving behavior, and achieve a safer environment through slower driving speeds.

Recommended Countermeasure: Oversized Regulatory Speed Limit Signs

This low-cost countermeasure aims to highlight the 25 MPH speed zone on Bishops Lodge Road and the 30 MPH speed zone on Tesuque Village Road by replacing the existing 24" by 30" 20 MPH signs with 30" by 36" signs. The oversized signs aim to focus the driver's attention and reinforce the posted speed limits in Tesuque. Additionally, these oversized signs act as a passive gateway since these treatments are more conspicuous than the standard size and are placed where the speed zone begins as motorists approach Tesuque on both corridors.



Figure 23: Example of Oversized Regulatory Signs

Recommended Countermeasure: Median Islands and Community Gateway Features

This countermeasure aims to calm traffic as motorists enter Tesuque by creating a horizontal deflection. This horizontal deflection or shift in the roadway reduces drivers' speed to navigate around the median island safely and comfortably. These median islands are also potential sites for installing a community gateway feature to enhance the aesthetics of the roadway and communicate the community's values and identity. The gateway feature adds a vertical presence to the road, aiming to calm traffic. More importantly, this gateway feature reinforces that the roadway environment changes with corresponding slower posted speed limits. Landscaping the medians would also enhance the rural nature of this area. Figure 24 shows an example of a median island located in Corrales, New Mexico, and Figure 25 shows a concept of a median island with a gateway feature.



Figure 24: Median Island on Meadowlark Lane



Figure 25: Community Gateway Concept

Figure 26 shows three potential sites for median Islands with community gateway features. These sites are chosen for their available apparent right-of-way and because they precede the 25 and 30 MPH speed zones on Bishops Lodge and Tesuque Village Roads; they are intended to act as another reinforcement of the reduced posted speed limits.

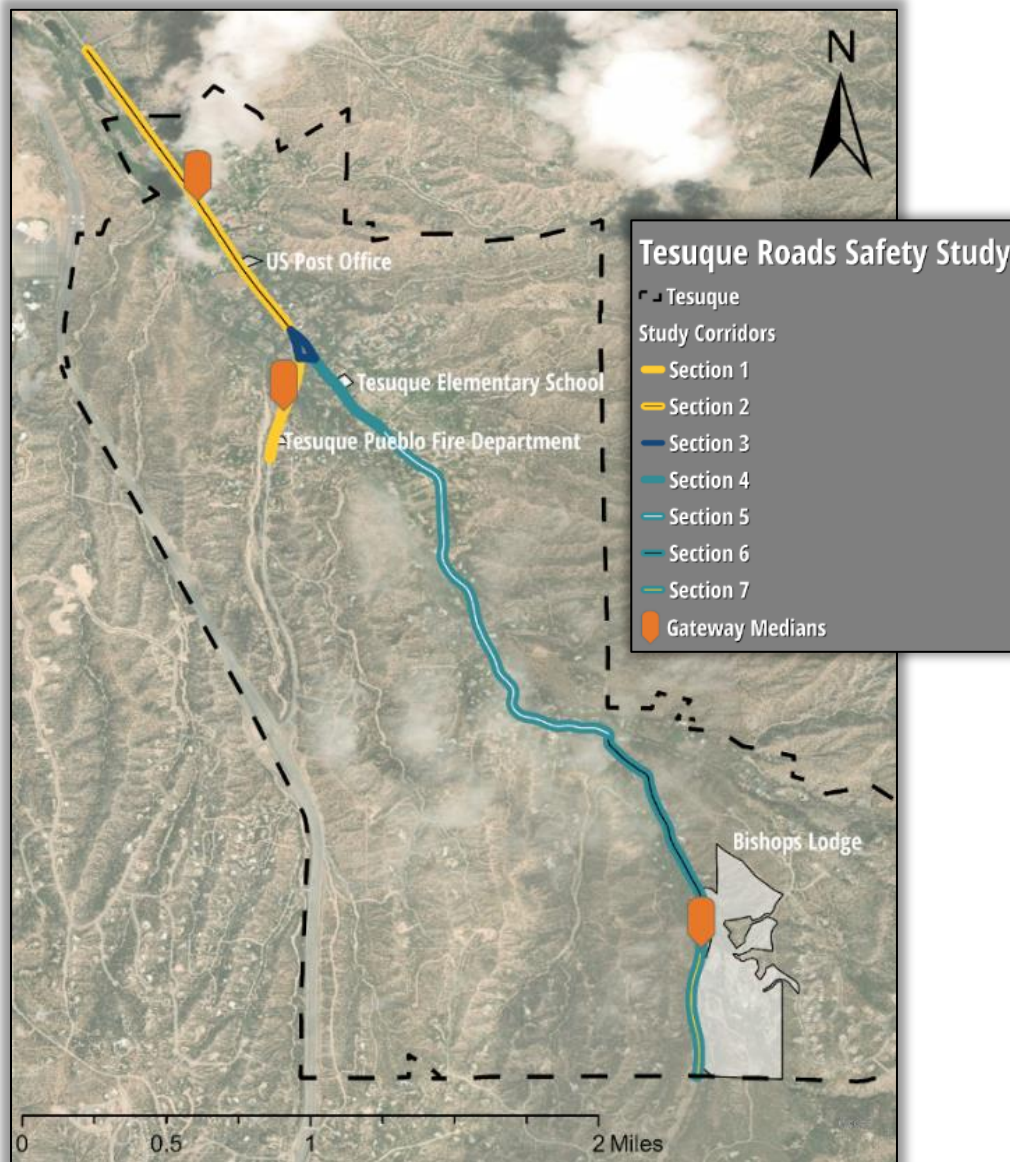


Figure 26: Potential Sites for Median Islands

Observed Safety Challenge – Walkways

Safe pedestrian facilities can enable residents and visitors to access the post office and the village market. Additionally, these same facilities can provide students living in Tesuque safe access to Tesuque Elementary School by foot. The only available walking spaces are narrow shoulders, further limited by guard rails, trees, and objects. Dedicated walkways can improve pedestrian safety and encourage more pedestrian trips.

Recommended Countermeasure: Paved Shoulders

Tesuque's limited right-of-way and drainage concerns present challenges to providing sidewalks or separated, paved, and stable surfaces separated from the roadway. However, paving road shoulders may be an option to provide some walkways in Tesuque. Along the Tesuque Village Road segment of the study area, approximately 91% of the road has roadside space for at least four-foot-wide shoulders. The Bishops Lodge Road segment has roadside space for at least four-foot-wide shoulders for about 62% of its length. Providing paved shoulders in the study area would require additional land acquisition and roadside alterations to Tesuque Village and Bishops Lodge Roads.

Observed Safety Challenge – Sediment Deposits

The rustic nature of Tesuque contributes to its charm. However, multiple arroyos with dry creek beds deposit significant sediment where the arroyos intersect with Bishops Lodge and Arroyo Griego Roads. Arroyo Griego Road is a paved portion of the arroyo with an engineered culvert filled with sedimentation, rendering it ineffective. These sediment deposits and buildup on the road's edges obstruct and cover the edge line pavement markings; the significant sediment buildup on the road shoulder is shown in Figure 27. Figure 28 shows the sediment buildup on the paved portion of Arroyo Griego Road. Curvy, hilly roads with loose debris may cause vehicles to lose traction and prevent motorists from understanding the road's delineation. The loose debris poses a safety challenge for bicyclists, and sediment buildup on the shoulders eliminates road space for pedestrians and bicycles.



Figure 27: Sediment deposits on Bishops Lodge Road



Figure 28: Sediment deposits on Arroyo Griego Road

Recommended Countermeasure: Removal and Routine Maintenance

The recommended countermeasures include removing the existing sediment buildup on the roadside and the culvert on Arroyo Griego Road. Once these deposits have been removed, a plan for routine sediment removal is recommended to be developed and prioritized after storm events. Currently, no practical solutions are readily available to address future sediment deposition. Before developing any mitigations to address this challenge, understanding the water flows is necessary; this may be accomplished by performing a sedimentation and erosion study.

Observed Safety Challenge – Edge and Center Line Pavement Markings

The pavement markings throughout the corridor are worn by traffic and weather conditions, reducing their visibility and ability to delineate the road.

Recommended Countermeasure: Apply and Refresh Edge Line and Center Line Pavement Markings

Visible pavement markings can help reduce the number of roadway departures and head-on collisions and act as a traffic calming feature since the striping will convey the narrow travel lanes to motorists. This countermeasure requires removing sediment deposits and applying edge and center line pavement markings. The Manual on Uniform Traffic Control Devices (MUTCD) guides center line and edge use. The MUTCD states, "Center line markings should also be placed on all rural arterials and collectors that have a traveled way of 18 feet or more in width and an average daily traffic (ADT) of 3,000 vehicles per day or greater." Tesuque Village and Bishops Lodge Roads have a functional class of minor arterial, but only Tesuque Village Road experiences ADTs near 3,000. In this case, the MUTCD guides that "...center lines can be applied to travel ways less than 18 feet wide where an engineering study indicates such a need."

Additionally, edge line guidance in the MUTCD states, "Rural arterials and collectors with a traveled way of 20 feet or more in width and an ADT of 3,000 vehicles per day or greater." The roads in Tesuque do not meet these requirements, but like the center lines, the MUTCD states, "At other paved streets and highways where an engineering study indicates a need for edge line markings." Based on this guidance, the project team recommends center and edge line striping throughout the corridor.

Observed Safety Challenge – Signing

The MUTCD defines standards and guidance for Traffic Control Devices (TCDs). TCDs, i.e., roadway signs, are vital to road safety because they convey regulations and roadway conditions and guide road users. The messages, shapes, colors, and locations are well-researched and effective. However, the efficacy of roadway signs is diminished when they are not visible. Visibility can be reduced by vegetation or other objects; Figure 29 shows examples of roadway signs obstructed by vegetation in Tesuque.

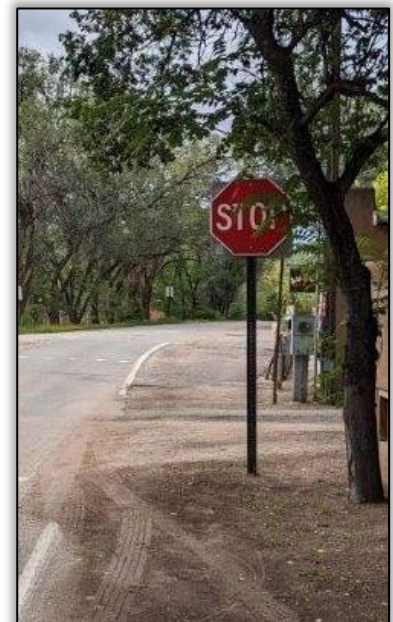


Figure 29: Examples of Vegetation Obstructing Roadway Signs

Additionally, nighttime visibility is diminished when a roadway sign loses its retroreflectivity. During the “Dark” field reviews, the project team identified four MUTCD signs that were no longer reflective. These signs and their locations are shown in Figure 30.

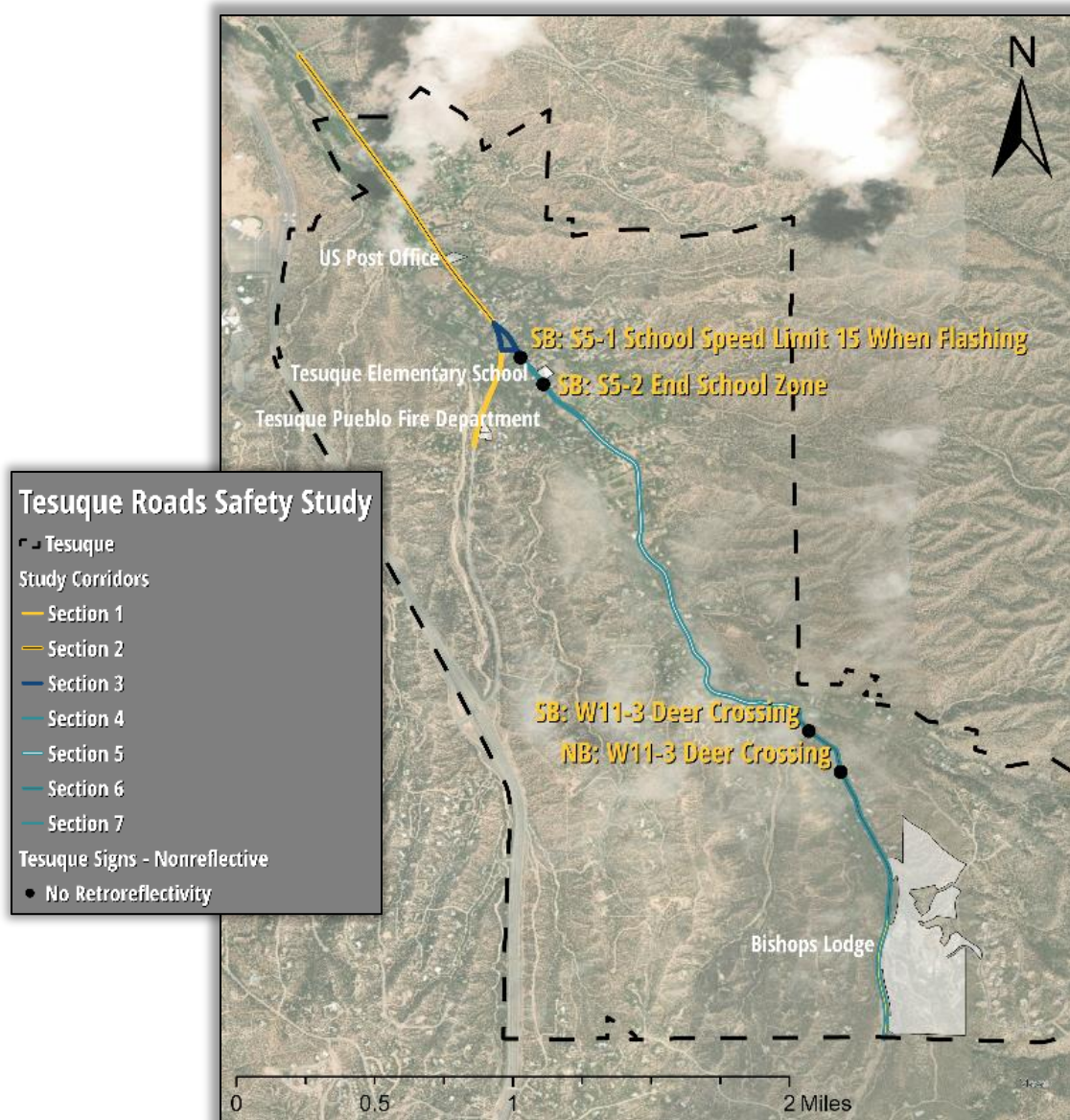


Figure 30: Non-Reflective Signs

Recommended Countermeasure: Routine Maintenance and Replace Non-reflective Signs

The safety countermeasure for this challenge is performing routine maintenance to maintain the visibility of roadside signs and replace the signs that are no longer reflective at night.

Observed Challenge – Transit Facilities

Tesuque Village Road lies along Transit Route 220 of the North Central Regional Transit Districts network. The current schedule shows five northbound and five southbound stops at Tesuque Village Market and Tesuque Post Office. However, only northbound stops are identified by signs, as shown in Figure 31 and Figure 32. As discussed, the Tesuque Village Road corridor exhibits the highest ADT and lowest compliance with the posted speed limits. These stops are not ADA Accessible and are separated by ambiguous edge line markings from motor vehicles traveling at high speeds.



Figure 31: Tesuque Village Market Transit Stop



Figure 32: Tesuque Post Office Transit Stop

Recommended Countermeasure: Enhanced and Bidirectional Transit Stops

This recommendation establishes bidirectional transit stops that meet and exceed PROWAG guidance of 4-foot-wide access routes and 5-foot-wide passing spaces. Additionally, transit stops should comply with section R308.1 of PROWAG

by providing a "...level and stable surface for boarding vehicles."² Another recommendation is to enhance the transit stops from a posted sign to a transit shelter, as seen in Figure 33. CRFs were researched; however, a CRF is not available for these countermeasures.



Figure 33: Transit Shelter on Paseo del Pueblo Norte in Taos, NM

² U.S. Access Board, Public Rights-of-Way Accessibility Guidelines

SECTION 1

Section 1 comprises the segment of Tesuque Village Road between Arroyo Griego Road and the southern boundary of the study corridor. Figure 34 is an aerial photo showing Section 1 of the study corridor.

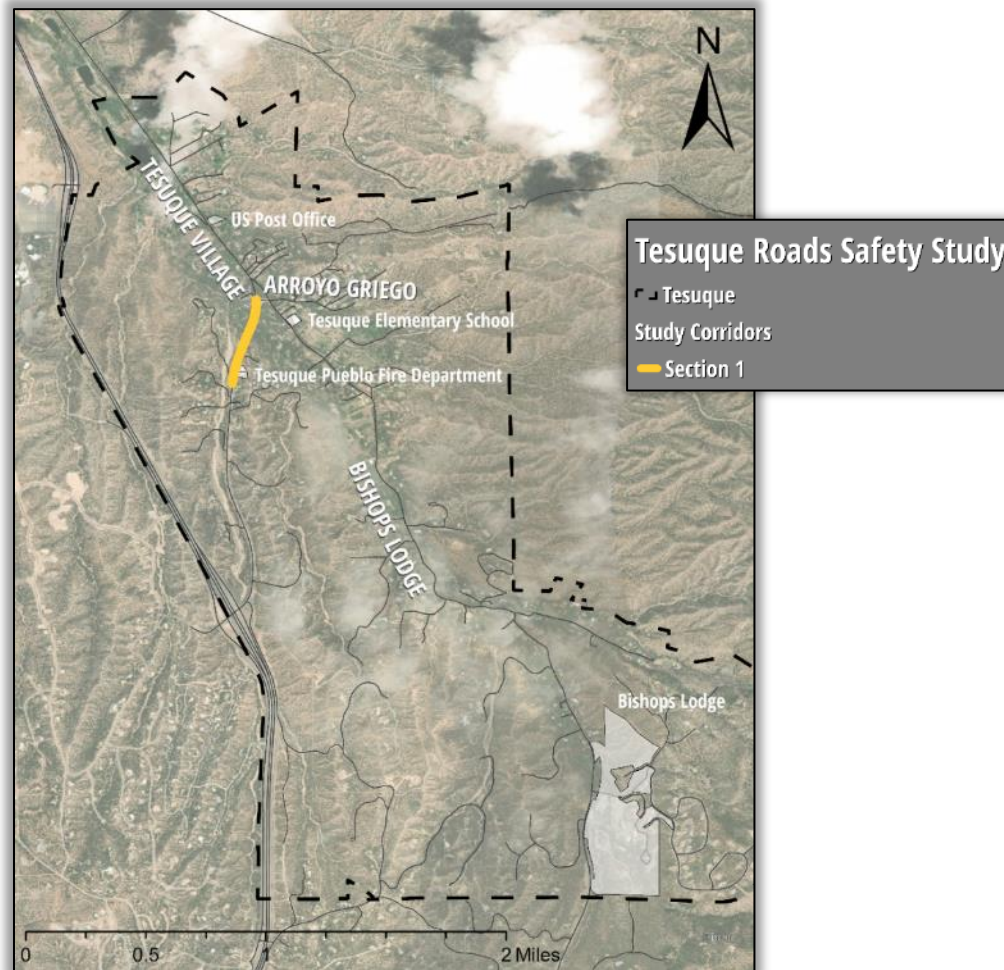


Figure 34: Section 1, Tesuque Village Road between Arroyo Griego Road and Tesuque Fire Department

Observed Safety Challenge – Bicycle Facilities

Due to the speed and mass differences between motor vehicles and bicycles, crashes involving bicyclists often result in severe injuries and fatalities. Crashes involving bicyclists often occur at non-intersection locations. The only bicycle lanes in Section 1 extend from south of the study's extent to 500 feet north of the Tesuque Fire Department.

Recommended Countermeasure: Bicycle Lanes

Implementing bicycle lanes recognizes human vulnerability by enhancing safety for all road users and can aid in preventing motor vehicle and bicycle crashes. A recent study of bicycle and road safety finds that implementing safe bicycle infrastructure, such as separated and protected bicycle lanes, can lead to fewer fatal crashes and enhanced safety for all roadway users³. Continuing the existing bicycle lanes on Tesuque Village Road can increase the perceived safety of bicycling.

³ W. Marshall and N. Ferenchak, "Why cities with high bicycling rates are safer for all road users"

SECTION 2

Section 2 comprises the segment of Tesuque Village Road from NM-592 to the beginning of Bishops Lodge Road. Figure 35 is an aerial photo showing Section 2 of the study corridor.

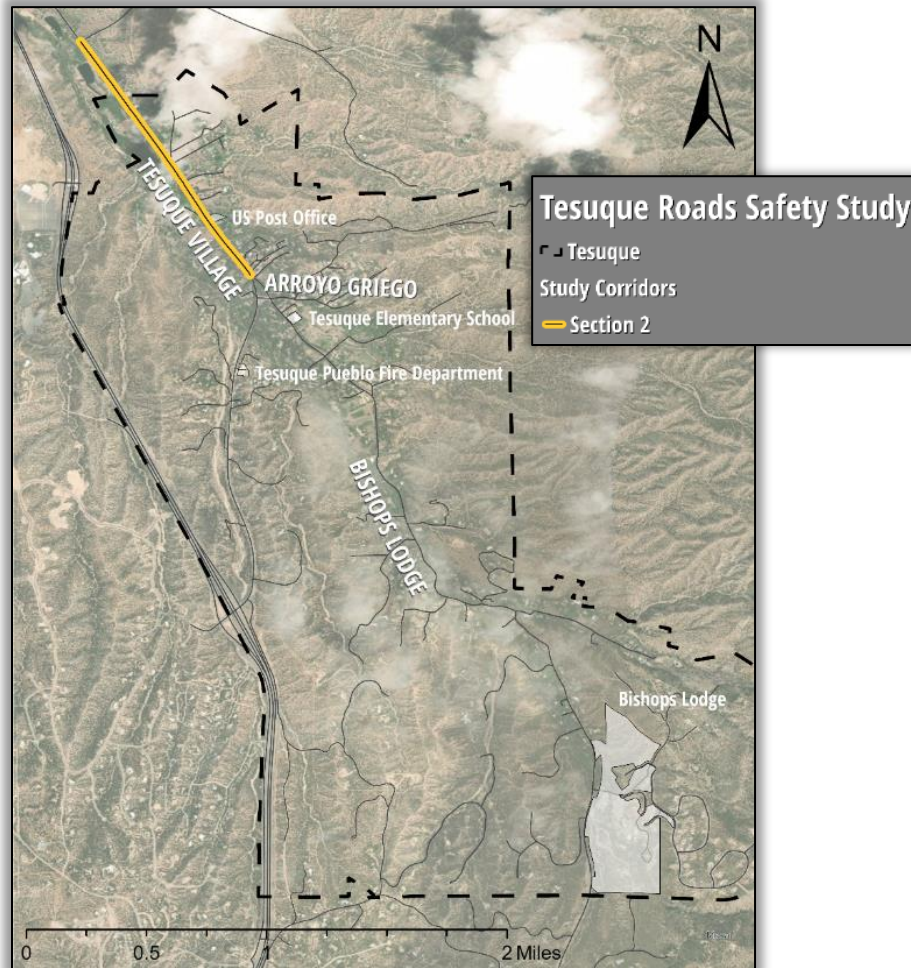


Figure 35: Section 2, Tesuque Village Road, between NM 592 and Bishops Lodge Road

Observed Safety Challenge – Multimodal Facilities

Like Section 1, Section 2 lacks pedestrian and bicycle facilities along Tesuque Village Road, forcing pedestrians and bicyclists to walk or cycle on undeveloped shoulders or share the lane with motor vehicles on a stretch of roadway where the speed limit ranges between 30 and 45 MPH. The Post Office is a generator for local pedestrian and bicycle traffic in this section.

Recommended Countermeasure: Multiuse Trails

Implementing a multiuse trail will provide a safer space to use by pedestrians and bicyclists than sharing the road with motor vehicles. This recommendation provides a facility for pedestrians and bicyclists in Section 2 to safely access the Post Office outside a motor vehicle. The project team recommends installing lighted bollards to further separate the multimodal trail from the road and enhance pedestrian and bicyclist safety. The bollards should be spaced wide enough to be ADA accessible but not so wide as to allow vehicles to fit between the bollards. Lighted bollards are recommended for increased safety and visibility after the sun sets. Additionally, using a different surface treatment and color than the roadway may further define this facility for pedestrians and bicyclists.

Observed Challenge – Illumination

Inadequate roadway illumination reduces the ability of motor vehicles to avoid collisions at night when solely relying on the vehicle's headlights to identify objects in the roadway. Section 2 has minimal roadway illumination.

Recommended Countermeasure: Install Illumination

FHWA's Proven Safety Countermeasures include illumination because it enhances roadway safety for all users. Roadway illumination has a CRF of 28% for nighttime crashes resulting in injuries⁴. However, residents have expressed a desire to use roadway illumination conservatively. The recommended safety countermeasure to address the lack of roadway illumination in Section 2 is to Install luminaires on Tesuque Village Road at NM 592 and near the Tesuque Post Office.

⁴ M. Albee and P. Bobitz, "Making Our Roads Safer: One Countermeasure at a Time"

SECTION 3

Section 3 comprises three road segments: Tesuque Village Road between the intersection of Bishops Lodge Road and Tesuque Village Road and Arroyo Griego Road, Bishops Lodge Road north of Arroyo Griego Road, and Arroyo Griego Road, between Tesuque Village Road and Bishops Lodge Road. Figure 36 is an aerial photo showing Section 3.

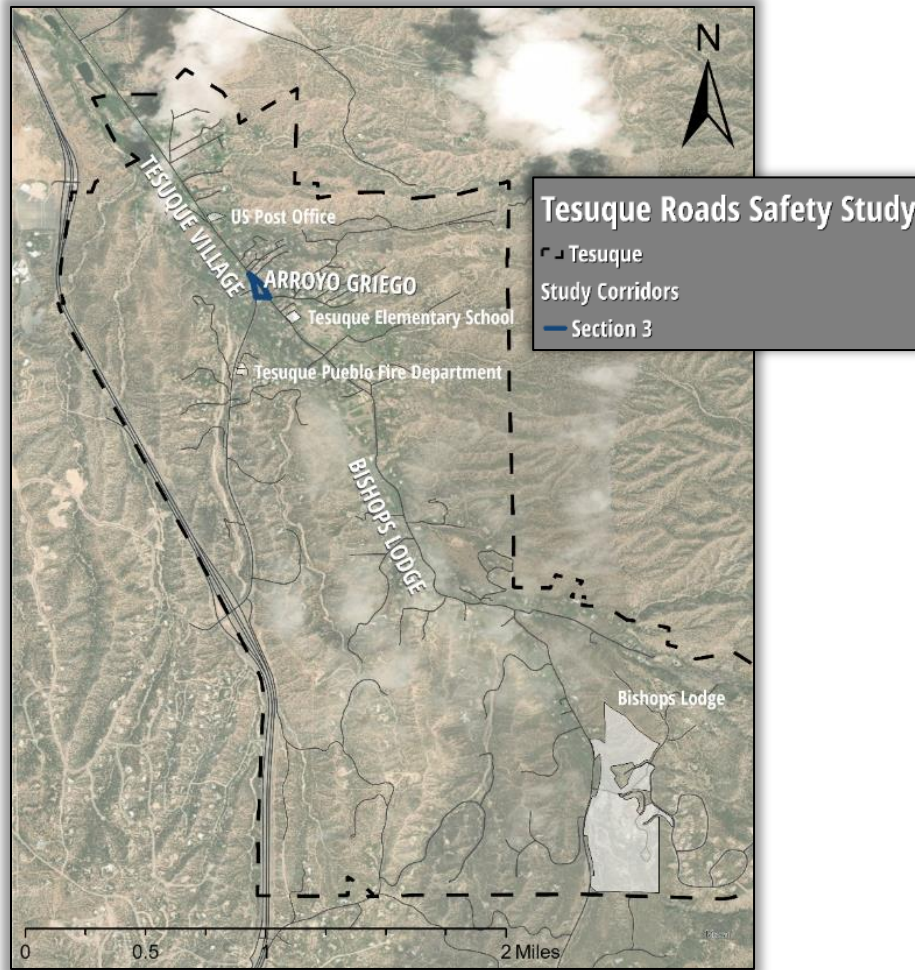


Figure 36: Section 3, Tesuque Village Road, Arroyo Griego Road, and Bishops Lodge Road

Observed Safety Challenge – Infrastructure

The lack of clear delineations and worn concrete infrastructure leads to ad hoc movements like the channelized right turn at Bishops Lodge Road, shown in Figure 37. Additionally, there is no striping for the parking spaces on either side of Arroyo Griego Road. This creates a lack of clarity for road users and increases the risk of conflicts between motorists, pedestrians, and bicyclists near Tesuque Village Market. Additionally, the area’s decrepit infrastructure, shown in Figure 38, poses a safety challenge for pedestrians who park and patronize the local businesses.



Figure 37: Ad hoc channelized right-turn at Bishops Lodge Road



Figure 38: Decrepit infrastructure posing a safety challenge for pedestrians

Recommended Countermeasure: Reconfiguration and Reconstruction of Arroyo Griego Road

Figure 35 is a conceptual drawing of the recommended countermeasures. Striping the center and edge lines of Arroyo Griego Road will aid in conveying that it is a road, not a parking lot. Additional recommended pavement markings are crosswalks at Tesuque Village Road and Bishops Lodge Road and parking spaces; some marked indicating they are for compact cars only to prevent large vehicles from protruding into the road. A significant modification to this area is to remove the channelized right turns and daylighting corners by constructing concrete pads to define the road. Daylighting is a technique that aims to increase visibility at intersections by eliminating objects around an intersection. The concrete pads also supply a location for bicycle parking facilities.



Figure 39: Arroyo Griego Reconstruction Concept

Observed Challenge – Parking

Section 3 is perceived as the hub of Tesuque, with regular visits from locals and visitors; the demand for parking in this area is high. While there is parking on Arroyo Griego Road, additional parallel parking is available on Tesuque Village Road and Bishops Lodge Road. However, the pavement markings are covered by sediment, as shown in Figure 36. Additionally, visitors that create ad hoc parking that poses a safety challenge by adversely impacting the intersection sight distance like the red vehicle in Figure 37. This challenge is related to the infrastructure on Arroyo Griego Road but deserves its own attention.



Figure 40: Marked parking spaces on Bishops Lodge Road



Figure 41: Ad hoc parking at Tesuque Village Market

Recommended Countermeasures: Maintenance, Striping, and Guidance Signs

Several of the recommended countermeasures regarding parking piggyback off previously discussed countermeasures in Tesuque. These countermeasures include removing sediment and maintaining pavement marking visibility. Additionally, this recommendation involves striping all available parking spaces in Section 3 and posting signs indicating “Compact Parking Only” where applicable. These countermeasures can significantly improve the parking dynamics on Arroyo Griego Road. These countermeasures can be enhanced by raising the parking areas with rolled curbs and adding additional signs to direct motorists to the parallel parking on Tesuque Village and Bishops Lodge Roads.

Observed Challenge – Illumination

During Dark field reviews, several luminaires on the one-way segment of Bishops Lodge Road were nonoperational at night. Two of these luminaires are shown in Figure 42.

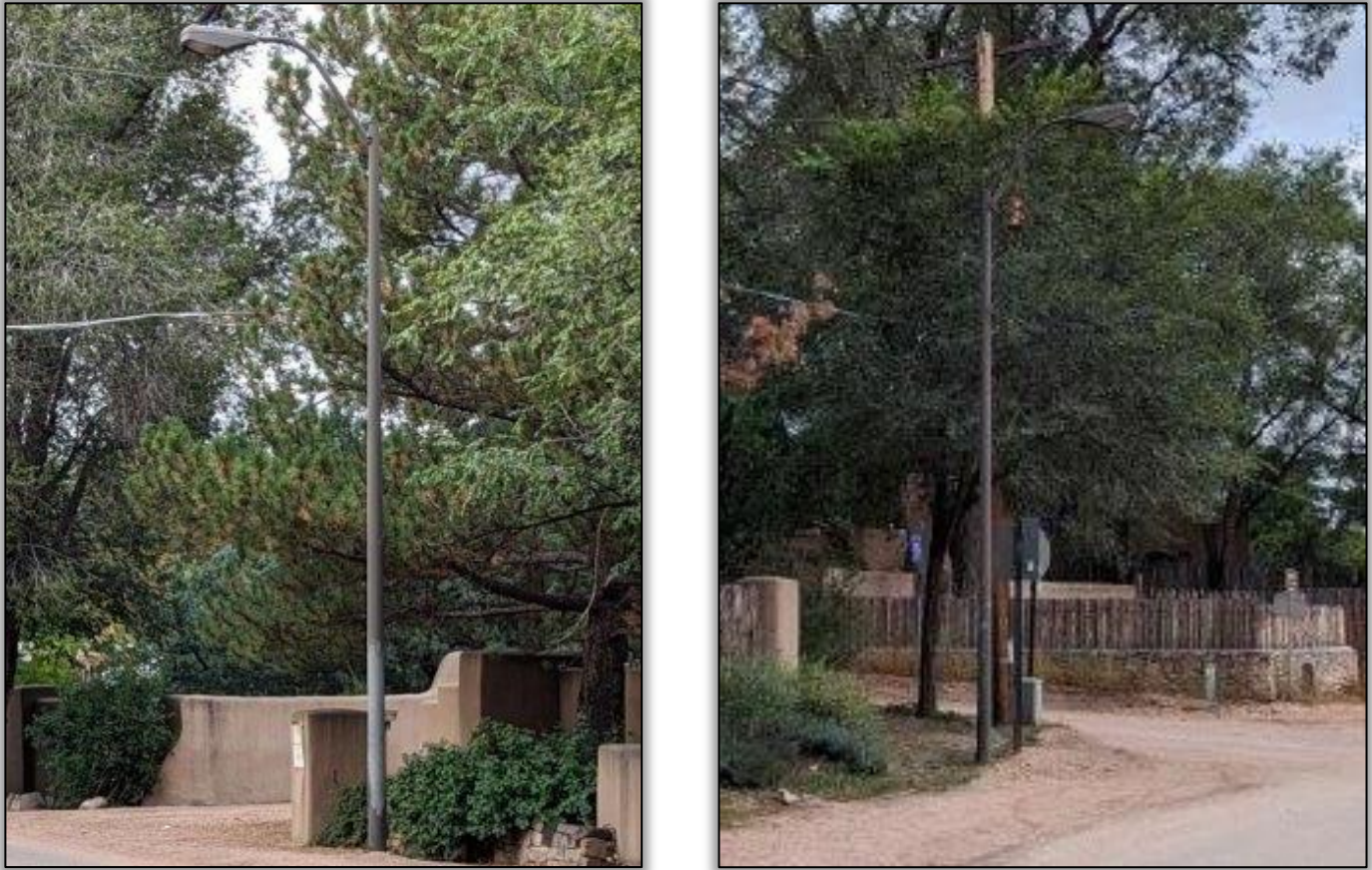


Figure 42: Nonoperational Luminaries on Bishops Lodge Road

Recommended Countermeasure: Illumination Maintenance

The recommended countermeasure is to repair the nonoperational luminaires. However, since these luminaires are privately owned, coordination between the County and the property owners is necessary. Right-of-way in this segment is limited to the traveled way and parking. Additional lighting may be installed where Bishops Lodge Road intersects with Arroyo Griego Road and Tesuque Village Road. This public lighting should comply with Santa Fe County guidelines and be oriented to minimize light encroachment on nearby residences.

SECTION 4

Section 4 comprises the segment of Bishops Lodge Road between Arroyo Griego Road and Polmood Farm Road. Figure 43 is an aerial photo showing Section 4 of the study corridor.

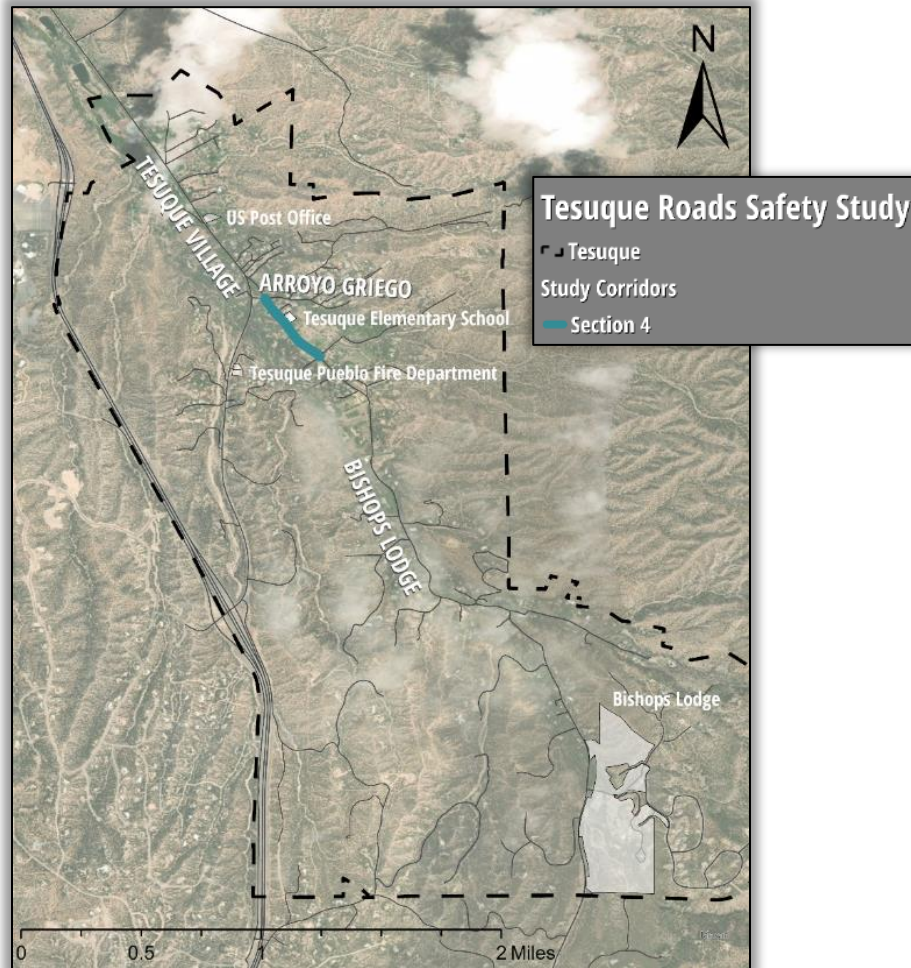


Figure 43: Section 4, Bishops Lodge Road from Arroyo Griego Road to Polmood Farm Road

Observed Safety Challenge – Bicycle Facilities

Bicycle facilities do not exist in Section 4.

Recommended Countermeasure: Sharrows

Due to the limited right-of-way and low posted speed limit, the recommendation is to apply and maintain shared lane pavement markings, and R4-11 “May Use Full Lane” signs should be installed per MUTCD standards. These countermeasures communicate to motorists that bicyclists are permitted to and may be occupying the traveled way.

Figure 9C-9. Shared Lane Marking

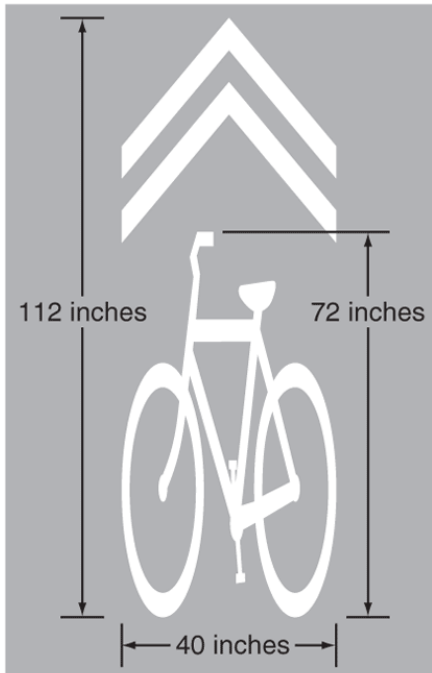


Figure 44: Shared Lane Pavement Markings



Figure 45: R4-11 Sign

SECTION 5

Section 5 comprises the segment of Bishops Lodge Road between Polmood Farm Road and Big Tesuque Canyon. Figure 46 is an aerial photo showing Section 5 of the study corridor.

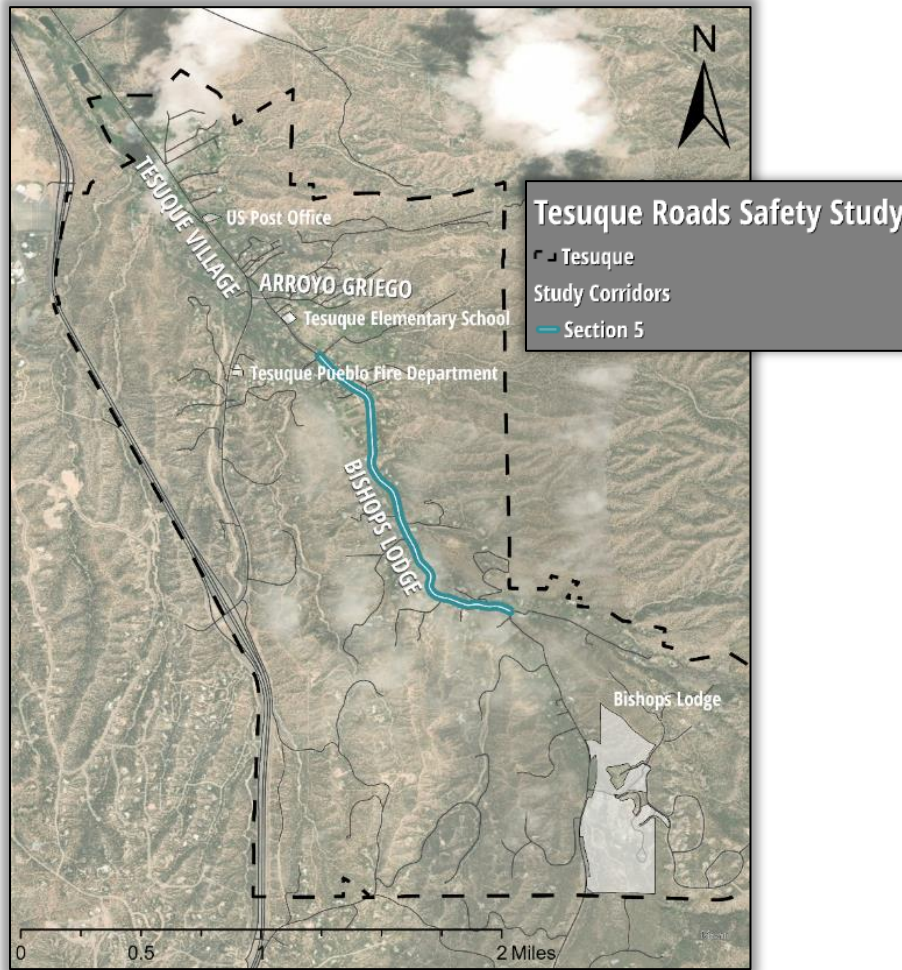


Figure 46: Section 5, Bishops Lodge Road between Polmood Farm Road and Big Tesuque Canyon

Observed Safety Challenge – Bicycle Facilities

Section 5 does not offer bicycle facilities, and the limited right-of-way does not offer adequate shoulders.

Recommended Countermeasure: Sharrows and Climbing Bicycle Lanes

Like Section 4, the recommendation is to apply and maintain shared lane pavement markings, and R4-11 “May Use Full Lane” signs should be installed per MUTCD standards. However, in this section, the project team recommends striping bicycle lanes on hilly ascents where the speed differential between bicycles and motor vehicles widens. This countermeasure creates an exclusive space for bicyclists to climb hills safely and comfortably.

Observed Challenge – Illumination

This road segment is inadequately illuminated, as evidenced by the heavy concentration of crashes in low-light conditions. Figure 47 shows a heat map of crashes occurring in Dark-Not Lighted, Dusk, or Dawn conditions.

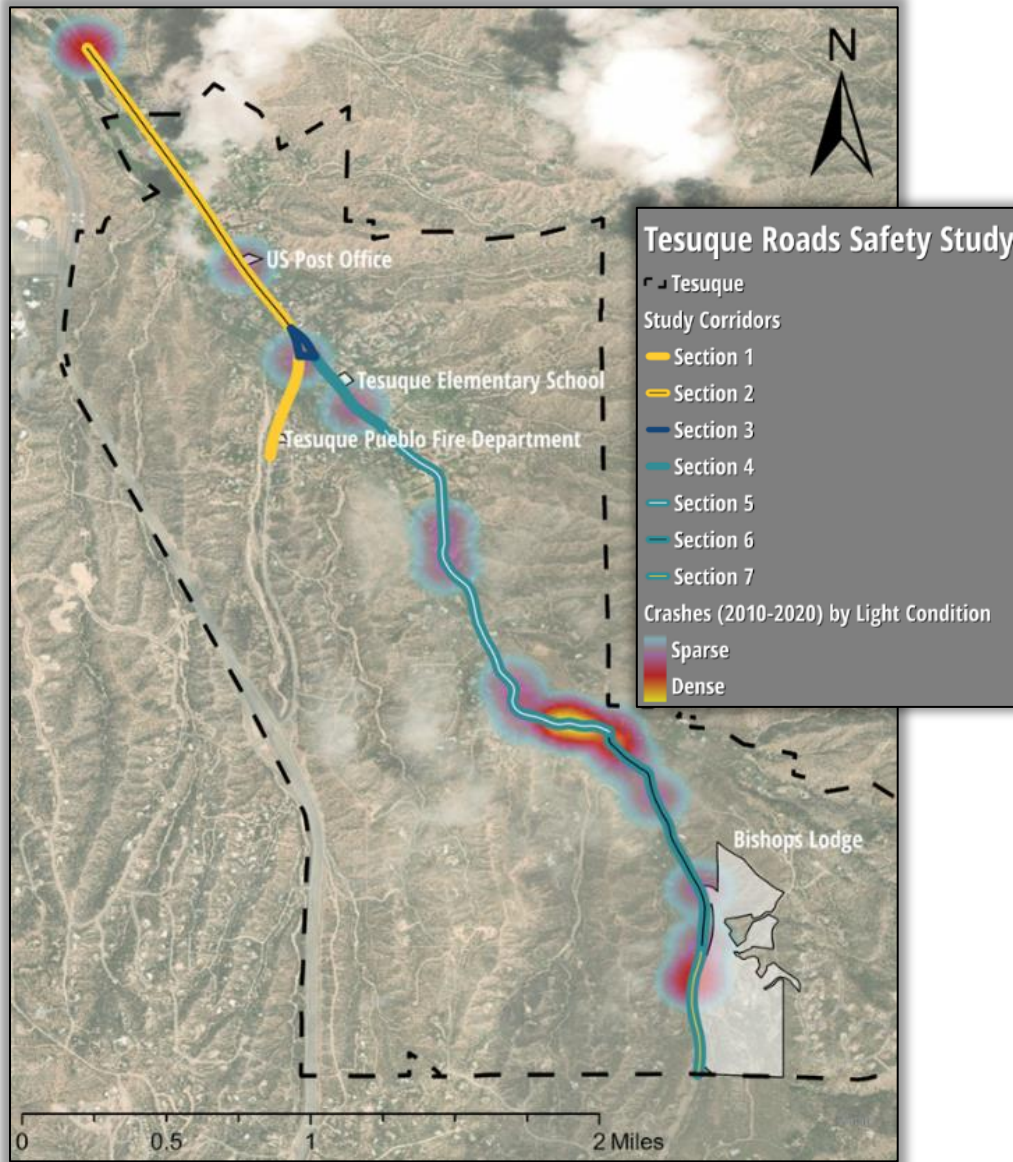


Figure 47: Crash Heat Map for Crashes in Low Light Conditions by Section

Recommended Countermeasure: Install Roadside Reflective Delineators and Wide Edge Line Striping

Given that this segment bisects residential properties, overhead luminaries are not desired. However, residents are concerned about increasing low-light visibility. As such, the first recommendation is to install roadside reflective delineators to highlight the curvy roadway alignment. The reflective delineators must be installed according to MUTCD standards outlined in section 3F.04. Moreover, reflectors should call attention to objects in the clear zone of the roadway, the area adjacent to the traveled way. AASHTO’s Roadside Design Guide guides clear zone widths based on volume, speed, and roadside slope. Lastly, edge line striping should be six inches wide as opposed to the standard of four inches when approaching and traversing curves with limited sight distances. This countermeasure highlights horizontal curves and calls the motorists' attention to areas that demand compliance with the posted speed limit.

Observed Safety Challenge – Intersection Sight Distance

At the intersection of Bishops Lodge Road and Big Tesuque Canyon, there is a sharp horizontal curve on Bishops Lodge Road. While there is a stop sign on Big Tesuque Canyon, Bishops Lodge Road traffic is free-flowing through the curve. The limited visibility and additional conflict points created by the curve at this intersection pose a safety challenge to road users.



Figure 48: Southbound Bishops Lodge Road at Big Tesuque Canyon

Recommended Countermeasure: Intersection Awareness

Option 1 – Enhance Pavement Markings and Sight Distance

Adding centerline *striping* on Bishops Lodge Road to delineate the travel lanes *throughout the curve* and guide motorists. Additionally, this intersection should utilize 6-inch edge lines. Skipped edge lines should be used across the Big Tesuque Canyon Road approach.

Roadside vegetation should be maintained to improve sight distance. The east side of the northbound approach has a propensity for vegetation, limiting the sight distance from Big Tesuque Canyon Road.

Option 2 – Stop Control

Adding all-way stop control on Bishops Lodge Road at the intersection of Bishops Lodge Road and Big Tesuque Canyon would increase safety at the intersection. MUTCD-compliant Stop Ahead (W3-1 signs should be installed on the Bishops Lodge approaches to Big Tesuque Canyon to alert motorists of the upcoming traffic control. Eliminating the free flow of traffic on Bishops Lodge Road at this intersection can mitigate the risk of crashes due to speeds and limited intersection sight distance. Figure 49 shows a conceptual drawing of an all-way stop at this intersection. The drawing shows centerline skipped striping on Bishops Lodge Road to delineate the travel lanes throughout the curve and guide motorists. Additionally, this intersection should utilize 6-inch edge lines.



Figure 49: Conceptual drawing of All-Way Stop Control at Bishops Lodge Road and Big Tesuque Canyon

SECTION 6

Section 6 comprises the segment of Bishops Lodge Road between Big Tesuque Canyon and Bauer Road. Figure 50 is an aerial photo showing Section 6 of the study corridor.

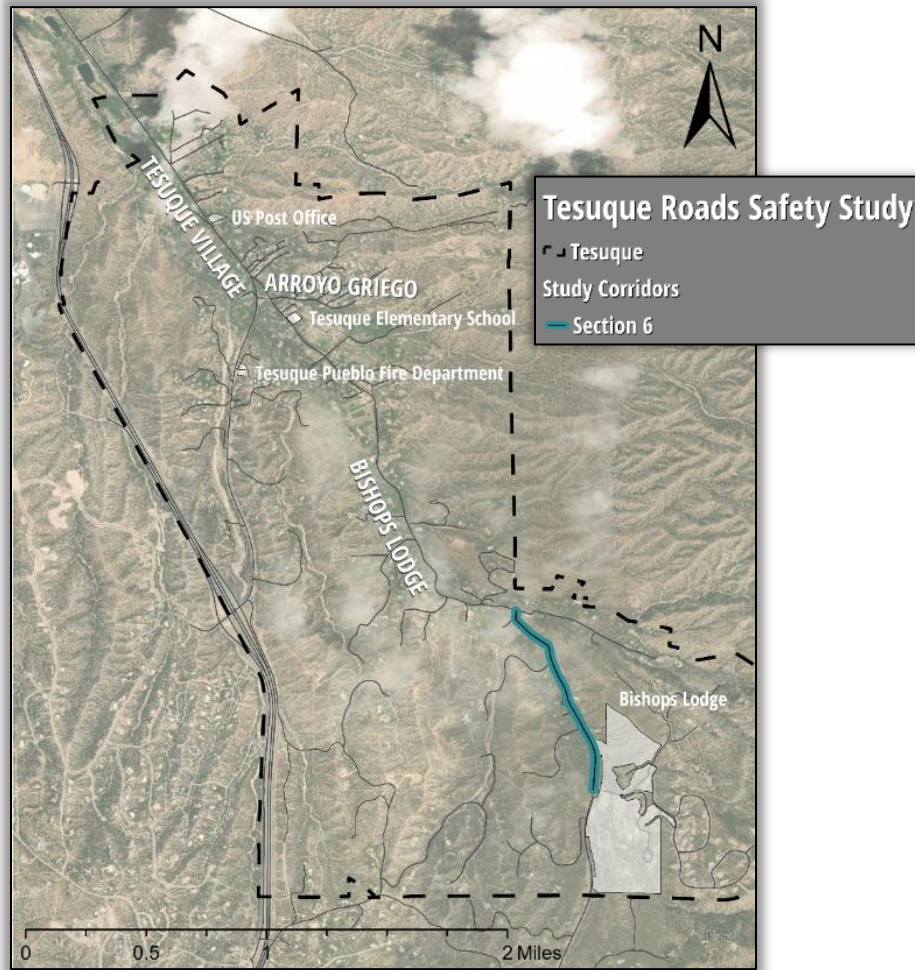


Figure 50: Section 6, Bishops Lodge Road between Big Tesuque Canyon and Bauer Road

Observed Safety Challenge – Bicycle Facilities

Section 6 does not offer bicycle facilities, and the limited right-of-way does not offer adequate shoulders.

Recommended Countermeasure: Sharrows and Climbing Bicycle Lanes

Like Section 5, the recommendation is to apply and maintain shared lane pavement markings, and R4-11 “May Use Full Lane” signs should be installed per MUTCD standards. However, in this section, the project team recommends striping bicycle lanes on hilly ascents where the speed differential between bicycles and motor vehicles widens.

Observed Challenge – Illumination

This inadequate illumination from Section 5 continues in Section 6. Figure 51 shows a heat map of crashes occurring in Dark-Not Lighted, Dusk, or Dawn conditions.

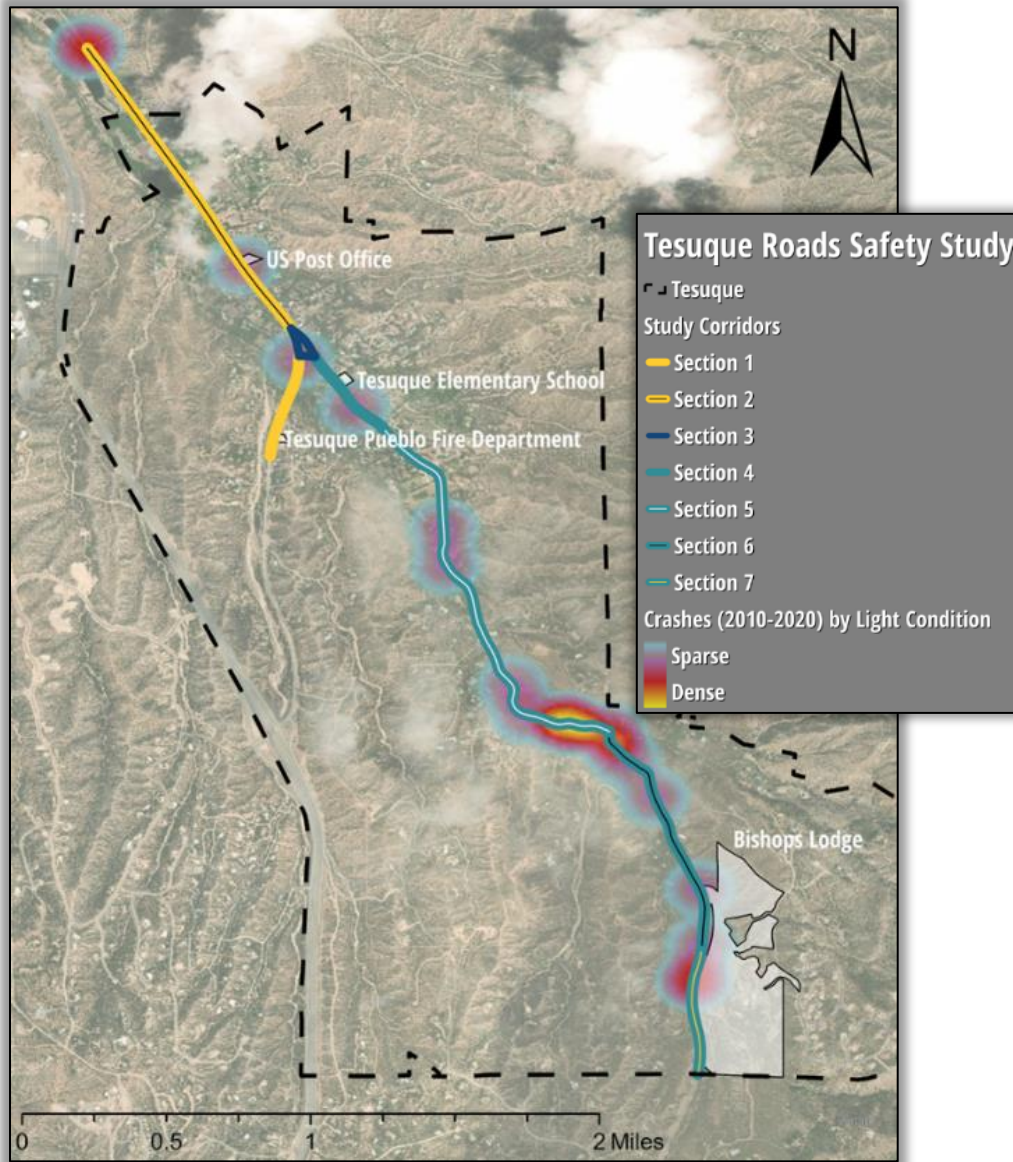


Figure 51: Crash Heat Map for Crashes in Low Light Conditions by Section

Recommended Countermeasure: Install Roadside Reflective Delineators and Wide Edge Line Striping

This segment also bisects residential properties, deeming overhead luminaires undesirable. In Section 6, the project team recommends the installation of roadside reflective delineators to highlight the curvy roadway alignment. The reflective delineators must be installed according to MUTCD standards outlined in section 3F.04. Additionally, reflectors should call attention to objects in the clear zone of the roadway, the area adjacent to the traveled way. The reflectors should be installed according to AASHTO’s Roadside Design Guide. As in Section 5, edge line striping should be six inches wide as opposed to the standard of four inches when approaching and traversing curves with limited sight distances to highlight horizontal curves and call the motorists' attention to areas that demand compliance with the posted speed limit.

Observed Safety Challenge – Animal Crossings

Figure 52 is a heat map of crashes involving animals. High concentrations of these types of crashes occur in Section 6.

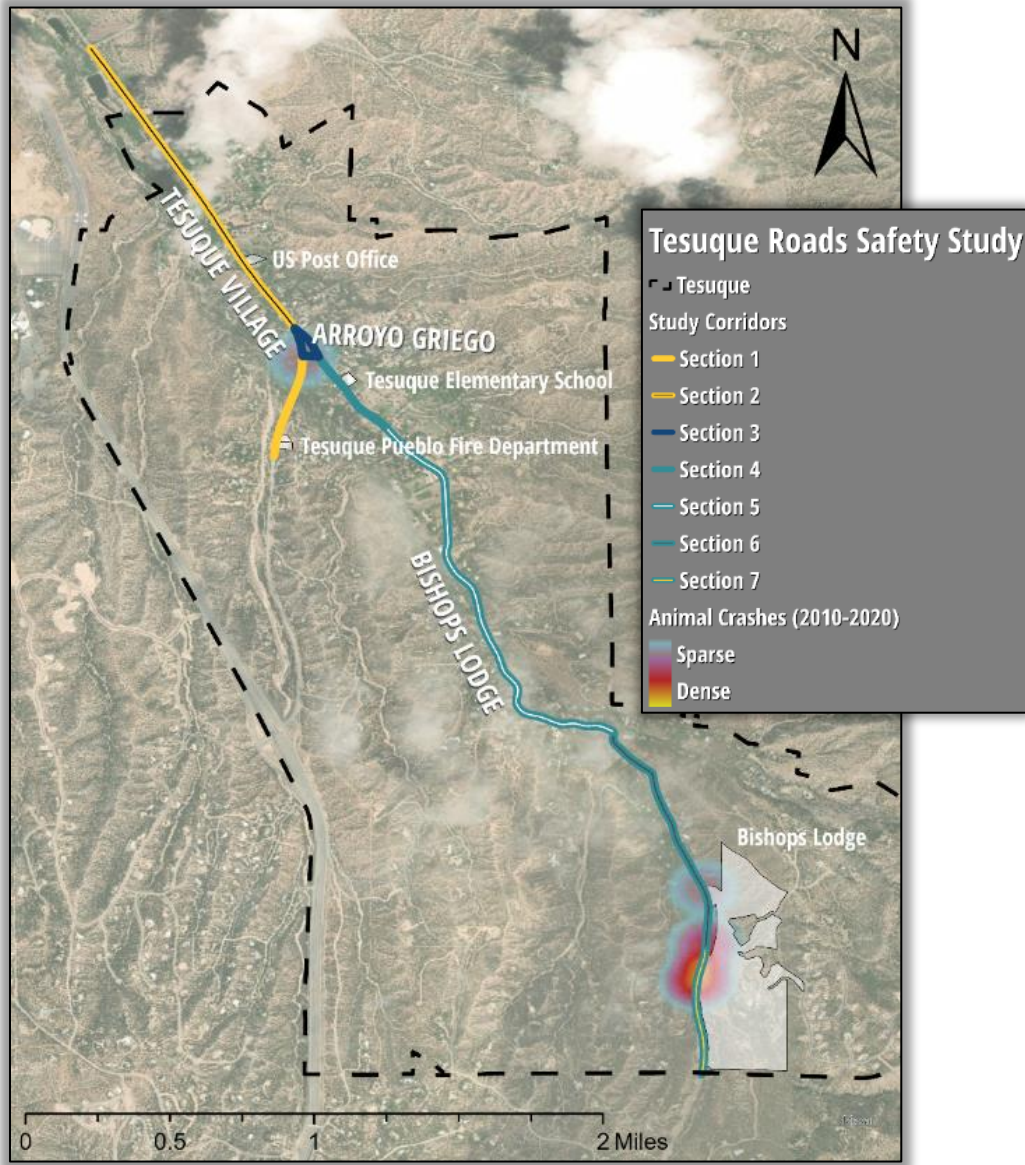


Figure 52: Crash heat Map for Crashes Involving Animals

Recommended Countermeasure: Oversized Animal Crossing Signs and Warning Beacons

The recommended countermeasure is replacing the existing 30" by 30" signs with oversized 36" by 36" ones. These oversized signs should be enhanced with flashing warning beacons to alert motorists of frequent animal crossings in this area.

SECTION 7

Section 7 is the segment of Bishops Lodge Road extending from Bauer Road to the southern boundary of the study corridor. Figure 53 is an aerial photo showing Section 7 of the study corridor.

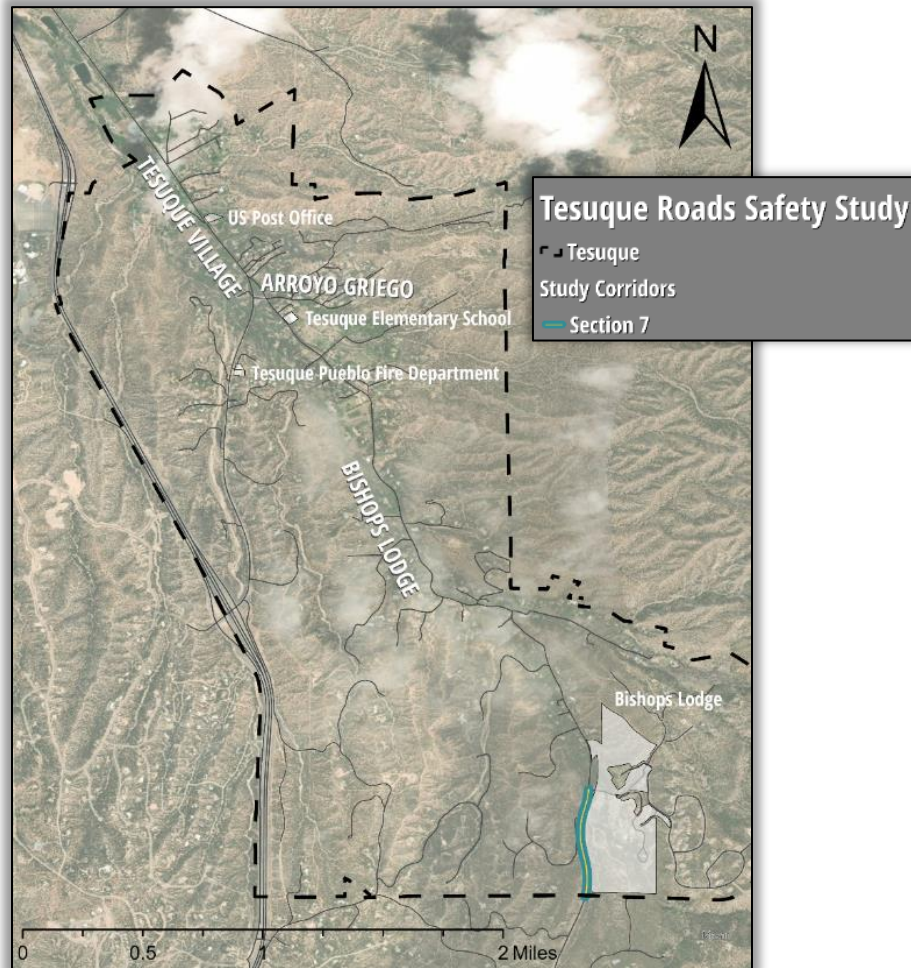


Figure 53: Section 7, Bishops Lodge Road from Santa Fe city limits to Bauer Road

Observed Safety Challenge – Multimodal Facilities

Like previous sections, Section 7 lacks pedestrian and bicycle facilities. Pedestrians and bicyclists must walk or cycle on undeveloped shoulders or share the lane with motor vehicles on a stretch of roadway where the speed limit ranges between 35 and 50 MPH.

Recommended Countermeasure: Continue Typical Section of Santa Fe Complete Street Project

The City of Santa Fe is reconstructing Bishops Lodge Road between Paseo de Peralta and the Santa Fe border with Tesuque. This project has several complete street alternatives for the City’s segment. One of these alternatives, with a walking path and buffered bicycle lane, is shown in Figure 50. The project team recommends continuing the complete street typical section through Bauer Road in Tesuque.

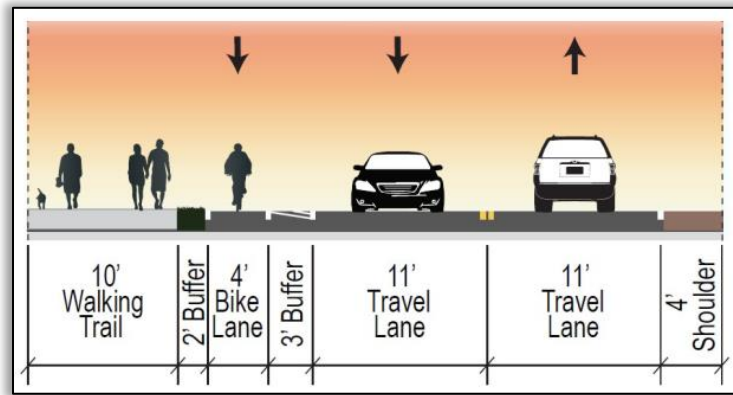


Figure 54: Concept for a Complete Street Typical Section on Bishops Lodge in Santa Fe

Observed Safety Challenge – Animal Crossings

High concentrations of these types of crashes occur in Section 7.

Recommended Countermeasure: Oversized Animal Crossing Signs and Warning Beacons

The recommended countermeasure is replacing the existing 30” by 30” signs with oversized 36” by 36” ones. These oversized signs should be enhanced with flashing warning beacons to alert motorists of frequent animal crossings in this area.

CONCLUSION

As detailed in this report, the RSA team identified safety challenges and countermeasures throughout the study corridor. A comprehensive list is provided in Table 9. Opinions of probable cost are supplied on a unit-cost basis. Costs are for informational purposes only, as actual costs may vary.

Table 9: Observed Challenges and Recommended Safety Countermeasures Summary

Observed Challenge	Countermeasure	Section							Crash Reduction Factor (CRF)	Opinion of Probable Cost	Timeline	Considerations and Trade-offs
		1	2	3	4	5	6	7				
Animal Crossings	Oversized Animal Crossing Signs and Warning Beacons						X	X	-	\$5000/sign	Mid-Term	The beacons need power and require maintenance. The flashing lights may be a nuisance to the community.
Bicycle Facilities	Bicycle Lanes	X							49%	\$12,000/mile	Near-Term	Depending on the location, debris removal, shoulder repairs, or pavement widening may impact the cost and time to implement.
	Sharrows				X	X	X	X	-	\$200/sharrow	Near-Term	Low cost, may need future maintenance, not a dedicated bicycle facility.
	"May Use Full Lane" Signs				X	X	X	X	-		Near-Term	Signs may need future maintenance.
	Climbing Bicycle Lanes					X	X		-	\$20,000/mile	Near-Term	Bicycle lanes only need to be striped on ascents. Additional right of way may be needed to provide adequate-width bicycle lanes.
Edge and Centerline Pavement Markings	Apply and Refresh Edge line and Centerline Pavement Markings	X	X	X	X	X	X	X	-	\$6,000/mile	Near-Term	Sediment deposits must be removed before applying center and edge line markings. Though the application is not expensive, constant maintenance is needed to maintain visibility.
	Wide Edge Line Striping								-		Near-Term	Wide edge line striping must be installed according to MUTCD guidance. Will require continued maintenance to maintain visibility.
Illumination	Roadside Reflective Delineators					X	X		37%	\$2,000/mile	Near-Term	Reflective roadside delineators must be installed according to MUTCD guidance. May require continued maintenance.
	Illumination Maintenance			X					42%	\$2,500/luminaire	Near-Term	
	Install illumination		X						-	\$10,000/each	Mid-Term	Increased overhead lighting may be a nuisance to residents. Luminaires will require power and routine maintenance.
Infrastructure	Reconfiguration and Reconstruction of Arroyo Griego Road			X					-	Study Required	Long-Term	The property is privately owned which will involve arrangements with the property owner.
Intersection Sight Distance	All-Way Stop-Controlled Intersection					X			-	\$1,200/ sign	Mid-Term	Public outreach to notify the community of the modification to avoid crashes.
Multimodal Facilities	Multiuse Trails		X						-	\$450,000/mile	Mid-Term	Earthwork may be required depending on the location and desired material.
	Continue Typical Section of Santa Fe Complete Street Project							X	-		Long-Term	
Parking	Striping			X					-		Mid-Term	Striping and signage will help make parking spaces clearer but will need routine maintenance to avoid sediment build up.
	Guidance Signs								-		Near-Term	
Sediment Deposits	Removal and Routine Maintenance	X	X	X	X	X	X	X	-		Near-Term	This countermeasure manages the symptoms of the larger problem and is not the long term solution.
	Sediment/Erosion Study	X	X	X	X	X	X	X	-	Study Required	Long-Term	
Signing	Routine Maintenance and Replace Non-reflective signs	X	X	X	X	X	X	X	-	\$1200/sign	Near-Term	
Posted Speed Limit Compliance	Oversized Regulatory Speed Limit Signs	X	X	X	X	X	X	X	-	\$1200/sign	Near-Term	Oversized regulatory speed limit signs are low-cost and aim to focus the driver's attention.
	Additional Speed Feedback Signs	X	X	X	X	X	X	X	-	\$5000/sign	Mid-Term	Power and routine maintenance is needed.
	Evaluate Lowering the Posted Speed Limit	X	X	X	X	X	X	X	-	Study Required	Long-Term	A speed study is required to analyze the feasibility of lowering the speed limit. Reducing the speed limit is low cost and can be implemented quickly. However, on its own, lowering the speed limit is not as effective as other infrastructure improvements for traffic calming.
	Median Islands and Community Gateway Features	X	X	X	X	X	X	X	28%	\$50,000/mile	Long-Term	May impact drainage, landscaping should not adversely impact visibility; gateway signs must be crash-rated.
Transit Facilities	Enhanced and Bidirectional Transit Stops	X	X	X	X	X	X	X	-	\$15,000/shelter	Mid-Term	To meet PROWAG guidance, work needs to be done for all transit stops. Transit shelters may involve the removal of trees if space is limited, and earthwork may be required. However, meeting these metrics is crucial for allowing equitable access to transit.