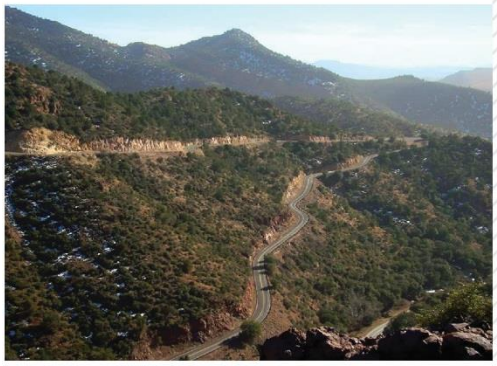

PREPARED FOR

ADOT

FEBRUARY 2017 // FINAL REPORT

Low Volume State Routes Study

PREPARED BY

WSP | PARSONS BRINCKERHOFF

ADOT WORK TASK NO. MPD 0049-16

ADOT CONTRACT NO. 11-00000507

LOW VOLUME STATE ROUTES STUDY

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Final Report

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PREPARED FOR:

Arizona Department of Transportation

PREPARED BY:

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Name
AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway Transportation Officials
ABISS	Arizona Bridge Information and Storage System
ADOT	Arizona Department of Transportation
ATV	All-Terrain Vehicle
AZTDM	Arizona Travel Demand Model
BLM	Bureau of Land Management
CAG	Central Arizona Association of Governments
CDP	Census Designated Place
CR	Cracking Rating
FHWA	Federal Highway Administration
HERS	Highway Economic Requirements System
HPMS	Highway Performance Monitoring System
IRI	International Roughness Index
MAP-21	Moving Ahead for Progress in the 21st Century Act
MP	Milepost
mph	Miles per Hour
MUTCD	Manual on Uniform Traffic Control Devices
NCA	National Conservation Area
P2P Link	Planning to Programming Link
PAG	Pima Association of Governments
PeCOS	Maintenance Performance Control System
RDG	Roadside Design Guide
RV	Recreational Vehicle
SHSP	Strategic Highway Safety Plan
SR	State Route
STBG	Surface Transportation Block Grant Program
STBG	Surface Transportation Program
TRB	Transportation Research Board
US	United States
USFS	United States Forest Service
UY	US Highway Spur
V/C	Volume-to-Capacity
VPD	Vehicles per Day

EXECUTIVE SUMMARY

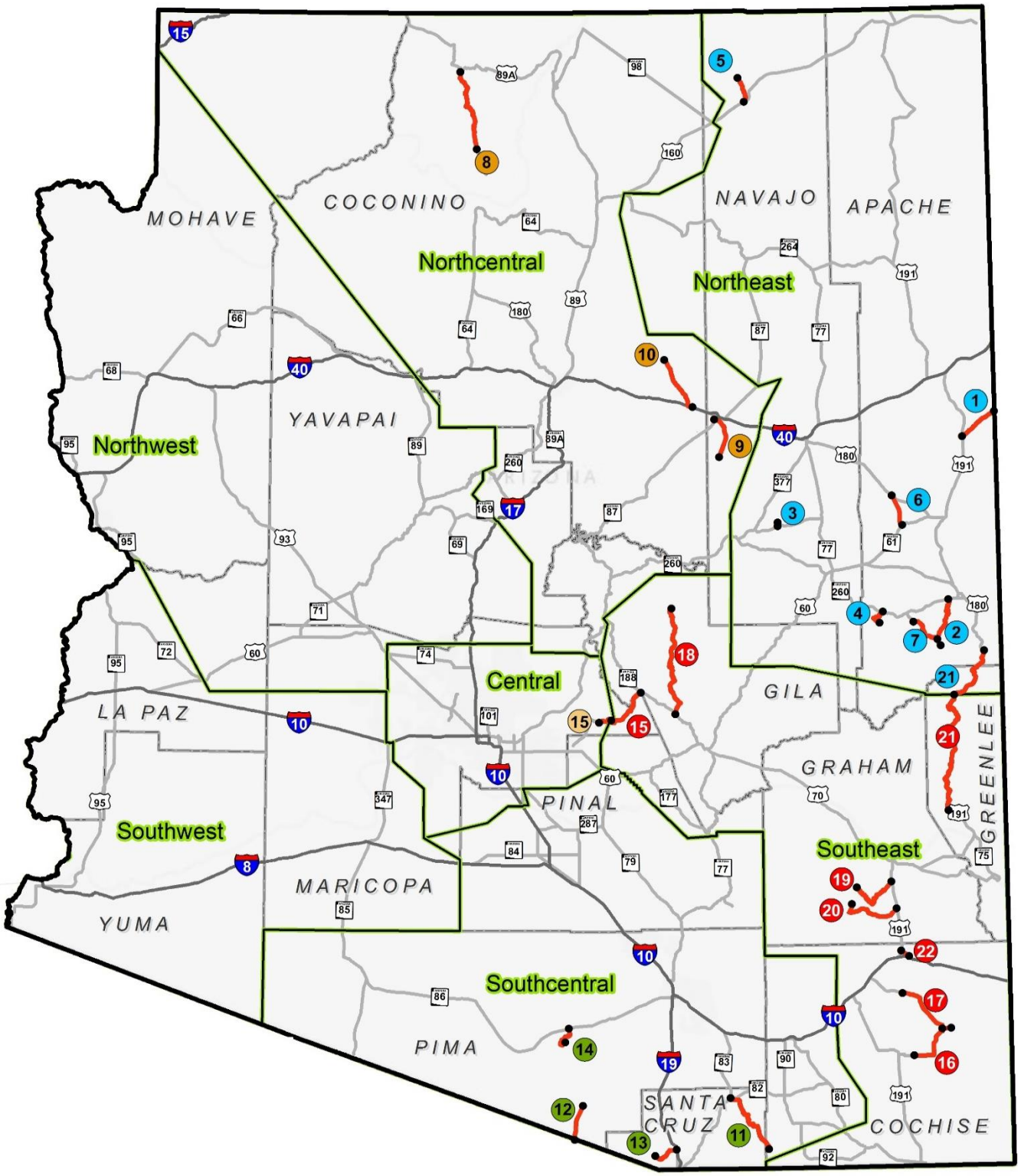
1.0 INTRODUCTION

The Low Volume State Routes Study evaluated a total of 22 low volume state routes and 457 center line miles, generally with Annual Average Daily Traffic (AADT) of 400 vehicles per day (vpd) or less. Considering financial constraints, characteristics of the highway, and impact to the local jurisdiction and regional transportation system, this study documented opportunities and limitations for each route, ultimately identifying those routes with potential for transfer to another agency as well as options for reducing ongoing costs for those routes remaining in the state system. The routes and limits included in this study are identified in Table 1 and depicted in Figure 1.

Table 1: Low Volume Routes

ID NUMBER	ROUTE	BMP		EMP	STARTS AT	ENDS AT	LENGTH (Miles)	DISTRICT
1	SR 61	416.49	to	430.26	US 191 - Witch Well	New Mexico State Line	13.77	Northeast
2	SR 261	394.37	to	412.5	SR 273	MP 412.5	16.63	Northeast
3	SR 277S	321.1	to	322.4	SR277	Old Paper Mill	1.3	Northeast
4	SR 473	0	to	9.13	SR 260	Hawley Lake Dam	9.97	Northeast
5	SR 564	374.28	to	383.46	US 160 (Near Marsh Pass)	Navajo National Monument	9.18	Northeast
6	SR 180A	343.1	to	354.27	US 180	SR 61-Concho	11.17	Northeast
7	SR 273	381.45	to	397	Sunrise Turnoff	Big Lake	15.55	Northeast
8	SR 67	579.3	to	610	Jacob Lake	North Rim	30.7	Northcentral
9	SR 99	27.5	to	42.67	15 Miles south of Winslow	SR 87 - Winslow	15.17	Northcentral
10	SR 99	53	to	72.16	I-40	Leupp	19.16	Northcentral
11	SR 83	3.19	to	31.5	Parker Canyon Lake	SR 82	28.31	Southcentral
12	SR 286	0	to	12.06	International Border	Arivaca-Sasabe Rd.	12.06	Southcentral
13	SR 289	0	to	10.83	I-19	Peña Blanca Dam	10.83	Southcentral
14	SR 386	0	to	12.22	SR 86	Kitt Peak Observatory	12.22	Southcentral
15	SR 88	213.39	to	242.23	Tortilla Flat	SR 188 (Roosevelt Dam)	28.84	Central/ Southeast
16	SR 181	44.32	to	64.02	Feather Pine Rd	Chiricahua National Monument entrance	20.7	Southeast
17	SR 186	340	to	359.42	Rocky Rd	SR 181	19.42	Southeast
18	SR 288	258.1	to	304.5	SR 188	Young	46.4	Southeast
19	SR 366	113.69	to	143.2	US 191	Columbine Ranger Station	29.51	Southeast
20	SR 266	126.17	to	104.6	Bonita	SR 191	21.57	Southeast
21	US 191	173	to	253.74	US 191X (Near Granville)	US 180 - Alpine	80.74	Southeast/ Northeast
22	UY 191	86.67	to	90.13	I-10 (Exit 355)	US 191	3.46	Southeast

Figure 1: Study Area



2.0 DEFINITION AND PURPOSE OF A STATE HIGHWAY

In the context of evaluating low volume routes and the future of low volume routes within the state system, it is also important to consider the purpose and definition of a state highway. This section summarizes the specific definition within Arizona as well as the broader national context.

The Arizona Revised Statutes (ARS) Section 28-7041 defines a state highway as follows:

- *The state highways, to be known as state routes, consist of the highways declared before August 12, 1927 to be state highways, under authority of law that the board, after receipt of a recommendation from the director, may add to, abandon, or change. If the board proceeds contrary to the recommendations of the director, it shall file a written report with the governor stating the reasons for the action.*
- *The state highways consist of the parts of the state routes designated and accepted as state highways by the board. A highway that has not been designated as a state route shall not become a state highway and any portion of a state route shall not become a state highway until it has been specifically designated and accepted by the board as a state highway and ordered to be constructed and improved.*
- *All highways, roads, or streets that have been constructed, laid out, opened, established, or maintained for 10 years or more by the state or an agency or political subdivision of the state before January 1, 1960 and that have been used continuously by the public as thoroughfares for free travel and passage for 10 years or more are declared public highways, regardless of an error, defect, or omission in the proceeding or failure to act to establish those highways, roads, or streets or in recording the proceedings.*


US 191 Chase Creek Switchbacks

State highways are generally a mixture of primary and secondary roads. More broadly, a state highway is a roadway operated and managed by the state for access and transportation to important routes or destinations. The state has all rights to permit or discourage use of the roadway to prevent crashes, reduce public safety concerns, ensure regional and statewide mobility and accessibility, and public access to regionally significant destinations or routes. No state highway should be for the exclusive benefit of private users. In general, low volume roads should not be designated as State Highways unless they serve a specific state or national purpose within the transportation system. The state has the power to control and regulate the use of public highways, provided its regulations do not constitute an unreasonable interference with the right of travel or impede interstate commerce.

3.0 EVALUATION PROCESS AND CRITERIA

This study used existing data collected by ADOT and followed an evaluation process similar to the concurrent ADOT Corridor Profile Studies, using a performance-based methodology to define baseline route performance and identify deficiencies. Using the established performance-based approach as a framework, baseline conditions for low volume routes were inventoried and evaluated through this process, relying on existing datasets and performance measures to define the conditions of the low volume routes being examined.

Additionally, this study was consistent with ADOT's Planning to Programming (P2P) Link process, which requires the preparation of annual transportation system performance reports. Using the performance areas and process of the ADOT Corridor Profile Studies ensures consistency in approach and performance measures used in various ADOT analyses.

Route Characteristics

Roadway characteristics were collected from ADOT databases to inventory conditions on each of the low volume routes. These characteristics inform the operating environment utilized in the analysis, comparison, and formulation of recommendations of these segments.

Performance Based Analysis

Existing data was collected in four performance areas, detailed below, guiding a performance-based segment analyses:

- **Pavement Performance**: International Roughness Index (IRI) and the Cracking Rating (CR) from the ADOT Pavement Database
- **Bridge Performance**: Deck Rating, Substructure Rating, Superstructure Rating, and Sufficiency Rating from ADOT's Arizona Bridge Information and Storage System (ABISS)
- **Mobility Performance**: existing ADT from Highway Performance Monitoring System (HPMS) 2010 to 2014 counts, future ADT using Arizona Travel Demand Model (AZTDM) projections
- **Safety Performance**: crash data for 2010 to 2014 provided by ADOT, Behavior Emphasis Areas from the *Strategic Highway Safety Plan* (SHSP)

Recommendations

Operations/Maintenance

Recommendations, described below, were developed based on the LVR best practices regarding operations and maintenance, identifying opportunities where cost savings could be achieved based on a review of ongoing maintenance costs for each route.

- Recommendations for **Drainage Improvements** are considered when the segment could benefit from permanent design solutions to low water crossings, which could improve safety and reduce ongoing maintenance costs.
- A **Roadside Weather Information System** (RWIS) is a recommendation for the installation of permanent solar powered RWIS, which could reduce ongoing maintenance costs associated with snow/ice patrol.
- The recommendation for **reduced maintenance with signage indicating "Minimum Maintenance Road" or "Maintenance Only"** would reduce the ongoing maintenance of the road, allowing it to be maintained at reduced service standards as long as it is passable during dry weather.
- **Reduced Speed Limit/Dynamic Speed Signs** are recommended in areas with safety concerns. Dynamic speed signs are recommended where the crash data generally suggest that the posted speed is appropriate yet commonly exceeded.
- The recommendations to **perform data analysis to identify crash patterns to determine if conducting a Road Safety Assessment (RSA) is appropriate and install Dynamic Speed Warning Systems/High Reflectivity Striping/Signage/ Centerline or Shoulder Rumble Strip/Raised Pavement Markers** are relevant for segments with potential safety needs requiring a more in-depth analysis of crash data. If an analysis of crash data identifies a pattern, the next recommendation would be to conduct an RSA.

Route Ownership and Guidelines

Overarching ownership and guidelines were evaluated to determine if there were changes that could yield an overall cost savings. These include:

- **Route transfer** may be most appropriate if the route is within the jurisdiction of another agency and does not serve a state interest.
- **Road closure** may be suitable if there is no evident need for the road, such as extremely low volume with alternative routes available.
- **Performance-based practical design using flexible design standards** is appropriate for low volume routes without safety issues, where cost savings can be achieved by implementing design exceptions.

Partnerships

There are opportunities to establish partnerships with other agencies to share in maintenance costs, while the route remains under ADOT jurisdiction. Agencies that were included in this evaluation include:

- Forest Service
- Central Federal Lands
- National Park Service
- Tribal Agencies or the Bureau of Indian Affairs, and
- US Customs and Border Protection.

SR181 EB Approach to Chiricahua National Monument

Funding Recommendations

Funding and grant opportunities exist which may help to offset maintenance, operation and construction costs of low volume routes. The following funding and grant options were evaluated for application on low volume routes:

- Surface Transportation Block Grant Program (STBG):
  The most flexible federal-aid highway funding program (formerly, Surface Transportation Program or STP). Provides flexible funding to states and local governments for projects that best address state and local transportation needs.
- Highway Safety Improvement Program (HSIP):
  Provides funding to achieve a significant reduction in traffic fatalities and serious injuries on all public roads including roads on tribal lands. This funding is formula-based and granted to each state based on a calculated measure of need and availability.

- Federal Lands Access Program (FLAP):
  Provides funding for projects on Federally owned and maintained routes to improve access along those routes. The funding is formulary and allocated based on calculated percentages of need and availability. Eligible projects include program administration, transportation planning, research, preventive maintenance, rehabilitation, restoration, construction, and reconstruction of routes on Federal lands. The following three routes are low volume routes included in this study which were shortlisted for the Arizona 2016 FLAP program:
    - SR 181 Chiricahua NM Road Reconstruction – Widening, rehabilitation and paving of 3.1 miles of SR 181 from the intersection with SR 186 east to the Chiricahua NM Boundary. Work will also include drainage and safety improvements as required.
    - Apache Trail Improvements - Reconstruction, through recycled asphalt pavement roadway base material, and minor widening of 12.4 miles of Apache Trail from the intersection with Apache Lake Marina Road (FS 79) north and east to Inspiration Point. Work will also include drainage and safety improvements as required.
    - SR 261 – Rehabilitation and paving of 11.6 miles of SR 261 from the intersection with SR 273 north to milepost 406. Work will also include shouldering, paving turnouts, safety improvements including guardrail, and the replacement of 6 cattle guards.

- Federal Lands Transportation Program (FLTP):
  Provides funding for projects on Federally owned and maintained routes to improve access within those routes. FLTP funds may be used for the non-federal share of any project that provides access to or within Federal or Tribal land.

SR88 at Fish Creek Hill

- Tribal Transportation Program Funds (TTPF):
  Provides funding for program administration, planning, research, preventive maintenance, rehabilitation, restoration, construction and reconstruction of a route on Federal land. Only Federal agencies may apply to the FLTP program. Funding from this program facilitates improvements on Federally owned and maintained routes. Eligible activities include routes that are located on or provide access to tribal land, or are administered by a tribal government.

- National Highway Freight Program (NHFP):
  Provides funds to improve the freight efficiency on the national highway freight network. This includes any projects that improve the safety, security, efficiency, and resiliency of routes identified as important to freight travel.

- National Highway Performance Program (NHPP):
  Provides support for the condition and performance of the NHS for the construction of new routes. This includes construction, reconstruction, resurfacing, restoration, rehabilitation, preservation, or operational improvements. The program funds are not guaranteed annual funding and are only available for small projects.

- Nationally Significant Federal Lands and Tribal Projects (NSFLTP):
  Provides funding for the construction, reconstruction, and rehabilitation of projects on Federal or Tribal land that are deemed nationally significant. Only projects seeking funds for reconstruction, construction, or rehabilitation funds, may be funded at a minimum of $25 million estimated project cost for eligibility.


SR366 Wet Canyon Bend

4.0 SUMMARY

This section summarizes the overall characteristics and recommendations of the low volume routes inventoried and examines trends in crashes, pavement, bridges and financial conditions.

Summary of Route Characteristics

Overall crash characteristics are summarized in Table 1. There is a high number of motorcycle crashes (67%) across the low volume routes, many occurring at high speeds while negotiating curves. Most of the crashes are in daylight in dry conditions. Most of the crashes are incapacitating (89%). Other significant contributing factors were collisions with animals (14%) and driver inattention (11%). Less than half of the passenger vehicles used a shoulder and lap belt (44%); a majority of motorcyclists used helmets (73%).

Table 1: Crash Summary

Category	Total Crash #	Total Crash %
Type	32 Incapacitating 4 Fatal	89% Incapacitating 11% Fatal
Contributing Factors	15 Speed to Fast for Conditions 5 Animal Related 4 Driver Inattention 2 Alcohol Related 2 Fatigue/Fell Asleep 2 Physical Impairment/Illness 1 Access Related 1 Avoiding Object 1 Debris in Roadway	33% Speed to Fast for Conditions 14% Animal Related 11% Driver Inattention 6% Alcohol Related 6% Fatigue/Fell Asleep 6% Physical Impairment/Illness 3% Access Related 3% Avoiding Object 3% Debris in Roadway
Lighting Conditions	18 Daylight 6 Dark - Not Lighted 1 Dark - Lighted 1 Unknown	50% Daylight 17% Dark - Not Lighted 3% Dark - Lighted 3% Unknown
Surface Conditions	33 Dry 2 Snow 1 Wet	92% Dry 6% Snow 3% Wet
Motorcycle	26 Involve Motorcycles 1 Involve ATVs	67% Involve Motorcycles 3% Involve ATVs
Comments	14 Negotiating a Curve 1 Pedestrian 4 Shoulder and Lap Belt Used 19 Helmet Used	39% Negotiating a Curve 3% Pedestrian 44% Shoulder and Lap Belt Used (Passenger Vehicles) 73% Helmet Used (Motorcycles)

An examination of the overall pavement conditions, as summarized in Table 2, indicates that there is a high number of lane miles with Very Poor and Extremely Poor pavement conditions, especially focusing on IRI. This could be related to extreme weather fluctuations, infrequent paving and poor subgrade preparation.

Table 2: Pavement Condition Summary

Condition	IRI		Cracking	
N/A	no data	43 lane miles	no data	21 lane miles
Good	<94.00	78 lane miles	<5.0	229 lane miles
Fair	94.00 – 141.99	84 lane miles	5.0 – 10.0	115 lane miles
Poor	142.00 – 170.99	79 lane miles	10.1 – 20.0	50 lane miles
Very Poor	171.00 – 222.99	119 lane miles	20.1 – 49.9	14 lane miles
Extremely Poor	223.00 - 459	40 lane miles	50.0 – 90	11 lane miles

The overall bridge summary is detailed in Table 3. The bridges along the low volume routes were either in Good or Fair condition, with no significant or concerning ratings.

Table 3: Bridge Summary

Scale	Threshold	Condition	Deck Rating	Sub Structure Rating	Super Structure Rating	Sufficiency Rating
Good	≥ 7	7 bridges	9 bridges	11 bridges	15 bridges	12 bridges
Fair	5 – 6	12 bridges	10 bridges	8 bridges	4 bridges	8 bridges
Poor	≤ 4	-	-	-	-	-

Table 4 and Table 5 summarize the overall cost/mile for each of the routes and costs by category over a five year period, from 2011 to 2016. Overall, five routes have a high level of investment. The most significant categories of investment overall are surface maintenance (22%), traffic control (15%), unpaved surface maintenance (12%), snow/ice maintenance (11%), and drainage maintenance (11%). In many cases, a significant cost is associated with surface maintenance in the absence of paving projects. Also, the unpaved roadways tend to have very high unpaved surface maintenance costs.

Table 4: Route Cost Summary

Level of Investment	Thresholds (Cost/Mile)	Number of Routes
Low	< $3,000	8
Average	$3,000 – $6,000	9
High	> $6,000	5

Table 5: Cost Summary by Category

Category	Total Cost (2011 - 2016)	Percent of Total
Traffic Signals	$19,939	<1%
Snow/Ice Maintenance	$1,351,463	11%
Roadside Maintenance	$961,681	7%
Vegetation Control/ Landscape Maintenance	$940,329	7%
Traffic Control	$1,926,875	15%
Drainage Maintenance	$1,387,370	11%
Surface Maintenance	$2,866,213	22%
Shoulder Maintenance	$272,010	2%
Contract Maintenance	$818,419	6%
Unpaved Surface Maintenance	$1,574,605	12%
Produced Materials	$46,843	<1%
Major Weather Damage	$534,237	4%
Support	$3,752	<1%
Miscellaneous Roadside	$8,312	<1%
Other Highway Maintenance	$52,586	<1%
Non-Routine Maintenance	$60,827	<1%
TOTAL	$12,825,462	100.00%

Summary of Recommendations

Each of the routes has been evaluated based on the data and information during this assessment, then ranked by need and opportunity potential, ranging from High to Medium to Low.

Table 6 provides an overview of the routes recommended to have the most potential to be removed from the state system. The routes with a "High" priority are those which are the best candidates for removal from the state system. The recommendation would be to advance these routes for transfer to another entity. Those ranked "Medium" priority are those with moderate potential, or cases where only a portion of the route is recommended for route transfer. Those ranked "Low" are considered the least likely candidates for removal from the state system.

Table 6: Segments Recommended for Consideration for Removal from State Highway System

Segment	District	Priority
Segment 3: SR 277S from SR 277 to Old Paper Mill	Northeast	High
Segment 4: SR 473 From SR 260 to Hawley Lake Dam	Northeast	High
Segment 5: SR 564 from US 160 to Navajo National Monument	Northeast	High
Segment 8: SR 67 From Jacob Lake to North Rim	Northcentral	High
Segment 9: SR 99 From 15 Miles South of Winslow to SR 87-Winslow	Northcentral	High
Segment 10: SR 99 From I-40 to Leupp	Northcentral	High
Segment 11: SR 83 From Parker Canyon Lake to SR 82	Southcentral	High
Segment 13: SR 289 From I-19 to Peña Blanca Dam	Southcentral	High
Segment 18: SR 288 From SR 188 to Young	Southeast	High
Segment 21: US 191 From US 191x near Granville to SR 180-Alpine	Southeast/North	High
Segment	District	Priority
Segment 1: SR 61 from US 191-Witch Well to New Mexico	Northeast	Medium
Segment 7: SR 273 from Sunrise Turnoff to Big Lake	Northeast	Medium
Segment 15: SR 88 From Tortilla Flat to SR 188 (Roosevelt Dam)	Central/Southeas	Medium
Segment 20: SR 266 From Bonita to SR 191	Southeast	Medium
Segment 22: UY 191 From I-10 Exit 355 to US 191	Southeast	Medium
Segment	District	Priority
Segment 2: SR 261 from SR 273 to Milepost 412.5	Northeast	Low
Segment 6: SR 180A from US 180 to SR 61-Concho	Northeast	Low
Segment 12: SR 286 From the International Border to Arivaca-Sasabe Road	Southcentral	Low
Segment 14: SR 386 From SR 86 to Kitt Peak Observatory	Southcentral	Low
Segment 16: SR 181 From Feather Pine Road to Chiricahua National Monument	Southeast	Low
Segment 17: SR 186 From Rocky Road to SR 181	Southeast	Low
Segment 19: SR 366 From SR 191 to Columbine Ranger Station	Southeast	Low

In cases where removal from the state system may not be feasible or viable in the near future, Table 7 provides a summary of the other types of recommendations for each segment if they are to remain in the state system. These recommendations are focused on reducing overall costs associated with each of the segments.

Table 7: High to Low Priority Recommendations (All Segments)

Segment	District	Priority	Recommendations
Segment 7: SR 273 from Sunrise Turnoff to Big Lake	Northeast	High	Install RWIS, install "Minimum Maintenance Road" signage, or partner with the Forest Service/Central Federal Lands/Tribe/BIA for ongoing maintenance needs.
Segment 8: SR 67 From Jacob Lake to North Rim	Northcentral	High	Install RWIS, reduce speed limit, perform data analysis to determine if conducting an RSA is appropriate and install safety features, or partner with the Forest Service/Central Federal Lands/National Park Service for ongoing maintenance needs.
Segment 13: SR 289 From I-19 to Peña Blanca Dam	Southcentral	High	Incorporate drainage improvements, install "Minimum Maintenance Road" signage, perform data analysis to determine if conducting an RSA is appropriate and install safety features, or partner with the Forest Service/Central Federal Lands for ongoing maintenance needs.
Segment 15: SR 88 From Tortilla Flat to SR 188 (Roosevelt Dam)	Central/ Southeast	High	Install "Minimum Maintenance Road" signage, reduce speed, perform data analysis to determine if conducting an RSA is appropriate and install safety features, or partner with the Forest Service for ongoing maintenance needs.
Segment 18: SR 288 From SR 188 to Young	Southeast	High	Install signage for reduced speed, install "Minimum Maintenance Road" signage, perform data analysis to determine if conducting an RSA is appropriate and install safety features, or partner with the Forest Service/Central Federal Lands for ongoing maintenance needs.
Segment 21: US 191 From US 191x near Granville to SR 180-Alpine	Southeast/ Northeast	High	Incorporate drainage improvements, install RWIS, install "Minimum Maintenance Road" signage, incorporate flexible design standards, perform data analysis to determine if conducting an RSA is appropriate and install safety features, or partner with the Forest Service/Central Federal Lands for ongoing maintenance needs.
Segment	District	Priority	Recommendations
Segment 3: SR 277S from SR 277 to Old Paper Mill	Northeast	Medium	Install "Minimum Maintenance Road" signage.
Segment 4: SR 473 From SR 260 to Hawley Lake Dam	Northeast	Medium	Install RWIS, or partner with the Tribe/BIA to facilitate maintenance costs.
Segment 5: SR 564 from US 160 to Navajo National Monument	Northeast	Medium	Install RWIS, or partner with National Park Service/Tribe/BIA to facilitate maintenance costs.
Segment 11: SR 83 From Parker Canyon Lake to SR 82	Southcentral	Medium	Install "Minimum Maintenance Road" signage, perform data analysis to determine if conducting an RSA is appropriate and install safety features, or partner with the Forest Service/Central Federal Lands for ongoing maintenance needs.
Segment 14: SR 386 From SR 86 to Kitt Peak Observatory	Southcentral	Medium	Incorporate drainage improvements, install RWIS, perform data analysis to determine if conducting an RSA is appropriate and install safety features, or partner with the Tribe/BIA to facilitate maintenance costs.
Segment 16: SR 181 From Feather Pine Road to Chiricahua National Monument	Southeast	Medium	Incorporate drainage improvements or partner with the National Park Service to facilitate maintenance costs.
Segment 17: SR 186 From Rocky Road to SR 181	Southeast	Medium	Incorporate drainage improvements or partner with the National Park Service to facilitate maintenance costs.
Segment 19: SR 366 From SR 191 to Columbine Ranger Station	Southeast	Medium	Install RWIS, perform data analysis to determine if conducting an RSA is appropriate and install safety features, incorporate flexible design standards, or partner with the Forest Service/Central Federal Lands.
Segment	District	Priority	Recommendations
Segment 1: SR 61 from US 191-Witch Well to New Mexico	Northeast	Low	Install RWIS, install "Minimum Maintenance Road" signage, or partner with the Tribe/BIA to facilitate maintenance costs.
Segment 2: SR 261 from SR 273 to Milepost 412.5	Northeast	Low	Install "Minimum Maintenance Road" signage, or partner with the Forest Service/Central Federal Lands to facilitate maintenance cost.
Segment 6: SR 180A from US 180 to SR 61-Concho	Northeast	Low	Incorporate drainage improvements, or partner with the National Park Service to facilitate maintenance costs.
Segment 9: SR 99 From 15 Miles South of Winslow to SR 87-Winslow	Northcentral	Low	Install "Minimum Maintenance Road" signage.
Segment 10: SR 99 From I-40 to Leupp	Northcentral	Low	Install "Minimum Maintenance Road" signage, or partner with the Tribe/BIA to facilitate maintenance costs.
Segment 12: SR 286 From the International Border to Arivaca-Sasabe Road	Southcentral	Low	Incorporate drainage improvements, or partner with the U.S. Customs and Border Protection to facilitate maintenance costs.
Segment 20: SR 266 From Bonita to SR 191	Southeast	Low	Incorporate flexible design standards, or partner with the Forest Service to facilitate overall maintenance costs.
Segment 22: UY 191 From I-10 Exit 355 to US 191	Southeast	Low	Install "Minimum Maintenance Road" signage, or incorporate flexible design standards.

5.0 LOW VOLUME ROUTE GUIDELINES

The proposed low volume roads guidelines were developed using the results of this analysis and a review of practices in other states and agencies. The proposed guidelines also rely on the practices specified in the ADOT Route Transfer Handbook to comply with state adopted requirements for route management and transfers regarding low volume roads.

Guidelines

For future consideration, ADOT should assess current expenditures on low volumes roads and establish a review process to ensure all low volume facilities are managed as efficiently as possible. As a recommended practice, the following should be evaluated on a periodic basis and on any roadway that meets the definition of a low volume road:

- If a low volume road does not serve a state or national purpose , do not accept it into the State Highway system. If it is already in the State system, refer to this report to divest or reduce the State's responsibility for operations and maintenance in cooperation with those who benefit directly from the roadway's existence.
- If a low volume road supports the goal of establishing and maintaining systemwide connectivity, adapt the maintenance and operations practices to be consistent with the level of use, including a reduction in maintenance frequency and investment, but ensuring an acceptable level of operating safety for motorists as recommended in this report. The level of maintenance for low volume routes should generally follow AASHTO guidelines, although for unique circumstances the best practices provides additional guidance.

ADOT's "Route Transfer Handbook" specifies the methodology to transfer a State Highway to another entity. The Handbook is intended to be a guidance document. There is significant flexibility in the route transfer process. The process outlined in the Handbook may be modified to match the needs of the route transfer proposal.

6.0 CONCLUSIONS

The State of Arizona has a number of low volume routes that are designated as State Highways. Some of these facilities do not warrant the State Highway designation because they do not serve a state or national purpose in the transportation system. The analysis in this report identifies some facilities where a transfer of the roadway to an underlying jurisdiction or agency would be appropriate.

At the same time, there are other roadways that, despite low usage levels, are important to the State's role in providing system wide transportation connectivity. These should retain their State Highway standing, but may afford ADOT an opportunity to fine-tune maintenance and operations practices to be more in keeping with the level of usage on the roadway. Recommendations for how to adjust maintenance practices are identified in the individual segment discussions and mention the potential funding sources that could aid in establishing a "right sized" low volume road maintenance strategy.

1.0 INTRODUCTION

The Low Volume State Routes Study evaluated a total of 22 low volume state routes and 457 center line miles, generally with Annual Average Daily Traffic (AADT) of 400 vehicles per day (vpd) or less. Considering financial constraints, characteristics of the highway, and impact to the local jurisdiction and regional transportation system, this study documented opportunities and limitations for each route, ultimately identifying those routes with potential for transfer to another agency as well as options for reducing ongoing costs for those routes remaining in the state system. The routes and limits included in this study are identified in Table 1 and depicted in Figure 1.

Table 1: Low Volume Routes

ID NUMBER	ROUTE	BMP		EMP	STARTS AT	ENDS AT	LENGTH (Miles)	DISTRICT
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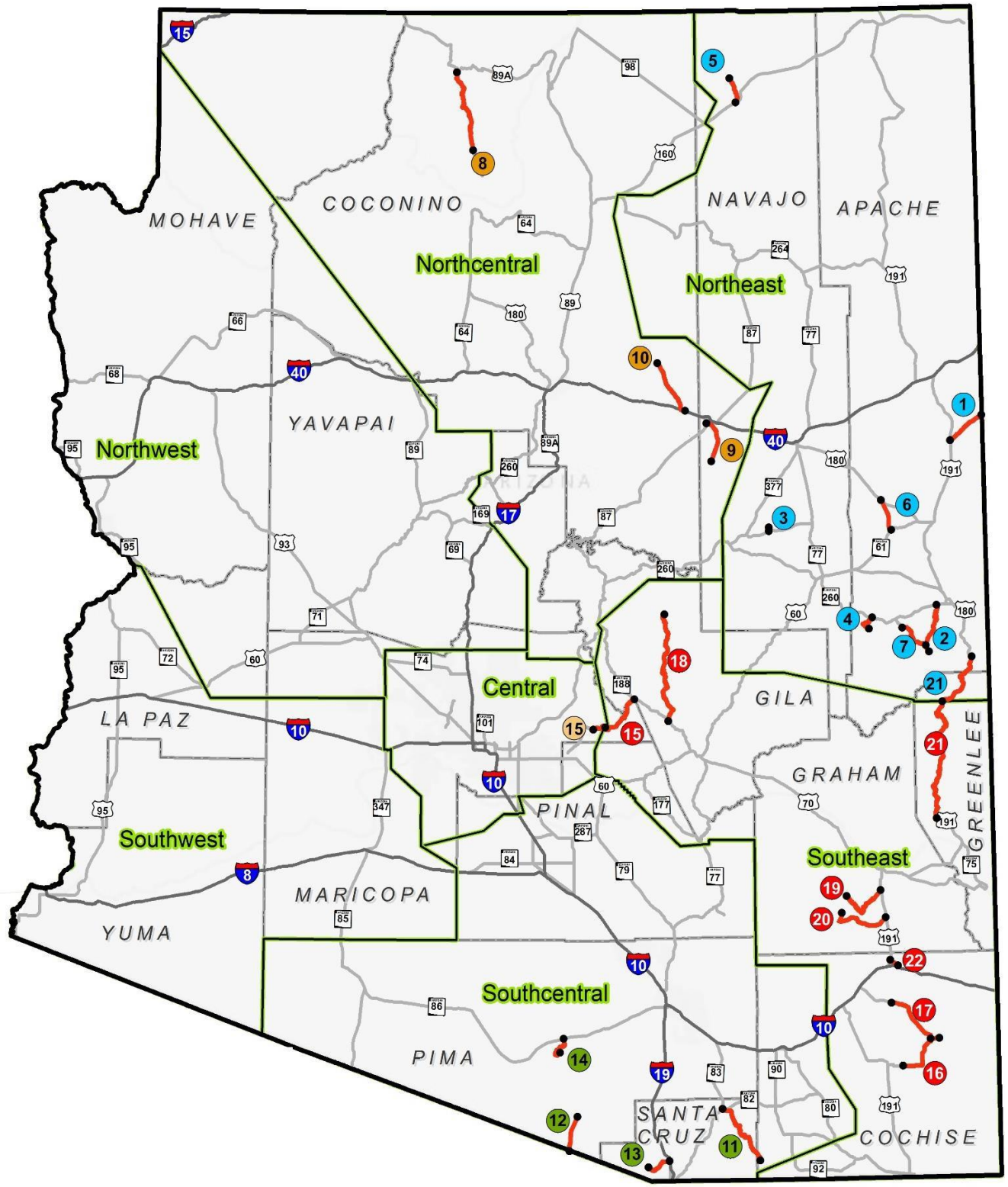
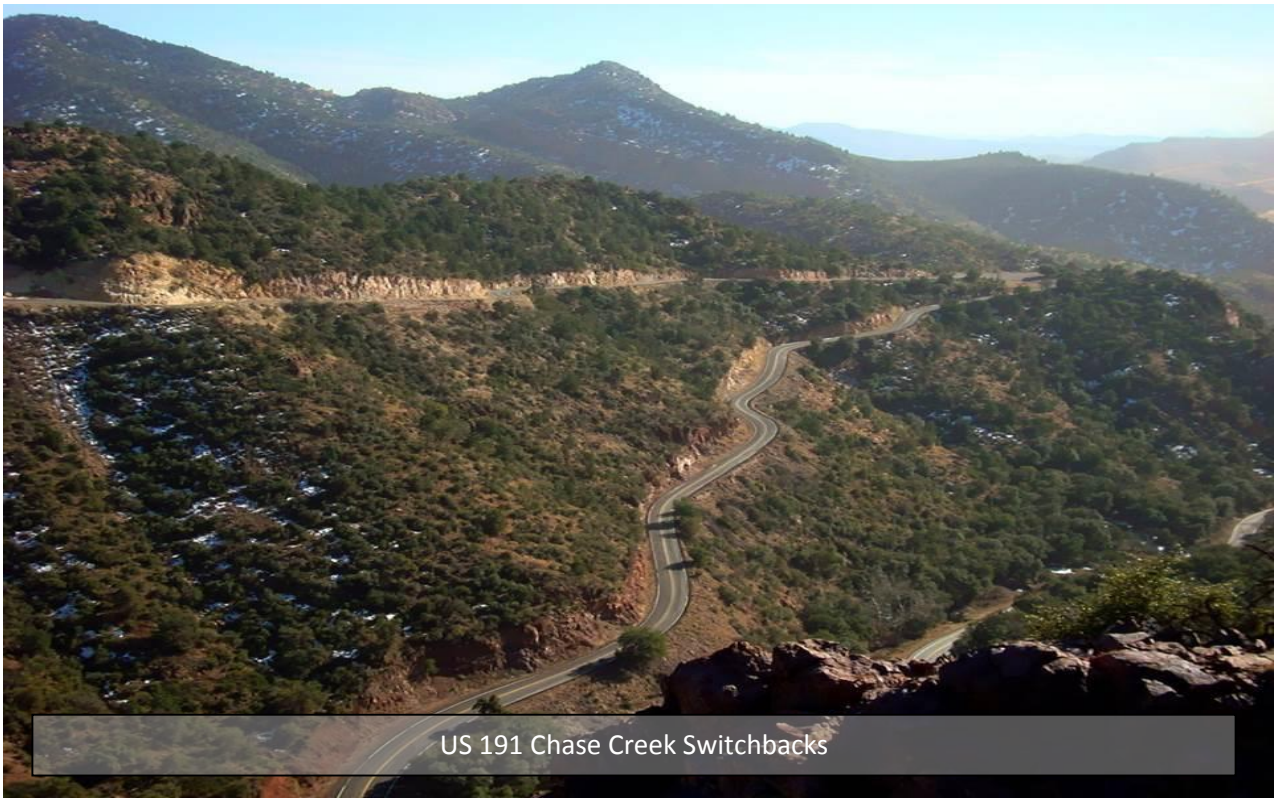
3	SR 277S	321.1	to	322.4	SR277	Old Paper Mill	1.3	Northeast
4	SR 473	0	to	9.13	SR 260	Hawley Lake Dam	9.97	Northeast
5	SR 564	374.28	to	383.46	US 160 (Near Marsh Pass)	Navajo National Monument	9.18	Northeast
6	SR 180A	343.1	to	354.27	US 180	SR 61-Concho	11.17	Northeast
7	SR 273	381.45	to	397	Sunrise Turnoff	Big Lake	15.55	Northeast
8	SR 67	579.3	to	610	Jacob Lake	North Rim	30.7	Northcentral
9	SR 99	27.5	to	42.67	15 Miles south of Winslow	SR 87 - Winslow	15.17	Northcentral
10	SR 99	53	to	72.16	I-40	Leupp	19.16	Northcentral
11	SR 83	3.19	to	31.5	Parker Canyon Lake	SR 82	28.31	Southcentral
12	SR 286	0	to	12.06	International Border	Arivaca-Sasabe Rd.	12.06	Southcentral
13	SR 289	0	to	10.83	I-19	Peña Blanca Dam	10.83	Southcentral
14	SR 386	0	to	12.22	SR 86	Kitt Peak Observatory	12.22	Southcentral
15	SR 88	213.39	to	242.23	Tortilla Flat	SR 188 (Roosevelt Dam)	28.84	Central/ Southeast
16	SR 181	44.32	to	64.02	Feather Pine Rd	Chiricahua National Monument entrance	20.7	Southeast
17	SR 186	340	to	359.42	Rocky Rd	SR 181	19.42	Southeast
18	SR 288	258.1	to	304.5	SR 188	Young	46.4	Southeast
19	SR 366	113.69	to	143.2	US 191	Columbine Ranger Station	29.51	Southeast
20	SR 266	126.17	to	104.6	Bonita	SR 191	21.57	Southeast
21	US 191	173	to	253.74	US 191X (Near Granville)	US 180 - Alpine	80.74	Southeast/ Northeast
22	UY 191	86.67	to	90.13	I-10 (Exit 355)	US 191	3.46	Southeast

Figure 1: Study Area



2.0 DEFINITION AND PURPOSE OF A STATE HIGHWAY

In the context of evaluating low volume routes and the future of low volume routes within the state system, it is also important to consider the purpose and definition of a state highway. This section summarizes the specific definition within Arizona as well as the broader national context.



US 191 Chase Creek Switchbacks

The Arizona Revised Statutes (ARS) Section 28-7041 defines a state highway as follows:

- *The state highways, to be known as state routes, consist of the highways declared before August 12, 1927 to be state highways, under authority of law that the board, after receipt of a recommendation from the director, may add to, abandon, or change. If the board proceeds contrary to the recommendations of the director, it shall file a written report with the governor stating the reasons for the action.*
- *The state highways consist of the parts of the state routes designated and accepted as state highways by the board. A highway that has not been designated as a state route shall not become a state highway and any portion of a state route shall not become a state highway until it has been specifically designated and accepted by the board as a state highway and ordered to be constructed and improved.*
- *All highways, roads, or streets that have been constructed, laid out, opened, established, or maintained for 10 years or more by the state or an agency or political subdivision of the state before January 1, 1960 and that have been used continuously by the public as thoroughfares for free travel and passage*

for 10 years or more are declared public highways, regardless of an error, defect, or omission in the proceeding or failure to act to establish those highways, roads, or streets or in recording the proceedings.

State highways are generally a mixture of primary and secondary roads. More broadly, a state highway is a roadway operated and managed by the state for access and transportation to important routes or destinations. The state has all rights to permit or discourage use of the roadway to prevent crashes, reduce public safety concerns, ensure regional and statewide mobility and accessibility, and public access to regionally significant destinations or routes. No state highway should be for the exclusive benefit of private users. In general, low volume roads should not be designated as State Highways unless they serve a specific state or national purpose within the transportation system.

The state has the power to control and regulate the use of public highways, provided its regulations do not constitute an unreasonable interference with the right of travel or impede interstate commerce.

3.0 EVALUATION PROCESS AND CRITERIA

This study used existing data collected by ADOT and followed an evaluation process similar to the concurrent ADOT Corridor Profile Studies, using a performance-based methodology to define baseline route performance and identify deficiencies. Using the established performance-based approach as a framework, baseline conditions for low volume routes were inventoried and evaluated through this process, relying on existing datasets and performance measures to define the conditions of the low volume routes being examined.

Additionally, this study was consistent with ADOT's Planning to Programming (P2P) Link process, which requires the preparation of annual transportation system performance reports. Using the performance areas and process of the ADOT Corridor Profile Studies ensures consistency in approach and performance measures used in various ADOT analyses.

A description of the route characteristics inventoried and recommendations are included in the following sections. Detail of the evaluation process is included in the Appendix.

Route Characteristics

Roadway characteristics were collected from ADOT databases to inventory conditions on each of the low volume routes. The roadway characteristics identified include the following:

- **Essential for regional system connectivity** indicates if the route is necessary for circulation and access within the state system, connects other state highways or provides access to important state or national facilities or sites.

- **Primarily serves the local traffic need, and provides access to private residences, ranches, farms, business or other abutting property** indicates if the route is integral to local access needs.
- **Primary access to National Park/Monument** indicates if the route provides key access as well as potential funding partnerships.
- **Primary access to other recreational areas** indicates if the route serves a recreational purpose.
- **Primary access to education/research facility** indicates if the route serves an education or research facility.
- **Primary access for safety/security** indicates if the route provides sole access to a community.
- **Primary access mail route/bus route** indicates a key route for a community.
- **Functional Classification of Major Collector or Higher** indicates a route which may be eligible for certain categories of funding, such as Surface Transportation Funding (STBG).
- **Existing and Future ADT** was inventoried, classified as less than 400 vehicles per day (vpd), between 400 – 1000 vpd, or greater than 1000 vpd.

These characteristics inform the operating environment utilized in the analysis, comparison, and formulation of recommendations of these segments.

Performance Based Analysis

Existing data was collected in four performance areas, detailed below, guiding a performance-based segment analyses:

- **Pavement Performance**: International Roughness Index (IRI) and the Cracking Rating (CR) from the ADOT Pavement Database
- **Bridge Performance**: Deck Rating, Substructure Rating, Superstructure Rating, and Sufficiency Rating from ADOT's Arizona Bridge Information and Storage System (ABISS)
- **Mobility Performance**: existing ADT from Highway Performance Monitoring System (HPMS) 2010 to 2014 counts, future ADT using Arizona Travel Demand Model (AZTDM) projections
- **Safety Performance**: crash data for 2010 to 2014 provided by ADOT, Behavior Emphasis Areas from the *Strategic Highway Safety Plan* (SHSP)

Additional detail regarding data utilized in this study process is provided in the Appendix.

Recommendations

Operations/Maintenance

Recommendations, described below, were developed based on the LVR best practices regarding operations and maintenance, identifying opportunities where cost savings could be achieved based on a review of ongoing maintenance costs for each route.

- Recommendations for **Drainage Improvements** are considered when the segment could benefit from permanent design solutions to low water crossings, which could improve safety and reduce ongoing maintenance costs.

- A **Roadside Weather Information System** (RWIS) is a recommendation for the installation of permanent solar powered RWIS, which could reduce ongoing maintenance costs associated with snow/ice patrol.

- The recommendation for **reduced maintenance with signage indicating "Minimum Maintenance Road" or "Maintenance Only"** would reduce the ongoing maintenance of the road, allowing it to be maintained at reduced service standards as long as it is passable during dry weather. This would only occur following a public hearing, and "Minimum Maintenance Road" signs would be installed to inform motorists of the risks associated with a reduced maintenance practice.

- **Reduced Speed Limit/Dynamic Speed Signs** are recommended in areas with safety concerns. Dynamic speed signs are recommended where the crash data generally suggest that the posted speed is appropriate yet commonly exceeded. A dynamic speed sign measures travel speed of a vehicle and displays feedback to drivers who exceed the predetermined threshold.

- The recommendations to **perform data analysis to identify crash patterns to determine if conducting a Road Safety Assessment (RSA) is appropriate and install Dynamic Speed Warning Systems/High Reflectivity Striping/Signage/ Centerline or Shoulder Rumble Strip/Raised Pavement Markers** are relevant for segments with potential safety needs requiring a more in-depth analysis of crash data. If an analysis of crash data identifies a pattern, the next recommendation would be to conduct an RSA. The ADOT RSA process would evaluate more detailed design solutions to address safety concerns. Many of these design solutions can be low cost and improve safety. RSA findings will address observed conflicts and crash patterns, roadway environmental factors, human factors and human behavior issues. RSA findings will also focus on road user interaction, consider confounding issues like feasibility, economic efficiency, practicality, affordability, legal compatibility, consistency, and improve the safety of all road users.

Route Ownership and Guidelines

Overarching ownership and guidelines were evaluated to determine if there were changes that could yield an overall cost savings. These include:

- **Route transfer** may be most appropriate if the route is within the jurisdiction of another agency and does not serve a state interest.
- **Road closure** may be suitable if there is no evident need for the road, such as extremely low volume with alternative routes available.
- **Performance-based practical design using flexible design standards** is appropriate for low volume routes without safety issues, where cost savings can be achieved by implementing design exceptions.

Partnerships

There are opportunities to establish partnerships with other agencies to share in maintenance costs, while the route remains under ADOT jurisdiction. Agencies that were included in this evaluation include:

- Forest Service
- Central Federal Lands
- National Park Service
- Tribal Agencies or the Bureau of Indian Affairs, and
- US Customs and Border Protection.

Funding Recommendations

A range of funding and grant opportunities exist which may help to offset maintenance, operation and construction costs of low volume routes. The following funding and grant options were evaluated for application on low volume routes:

- Surface Transportation Block Grant Program (STBG):
  The most flexible federal-aid highway funding program (formerly, Surface Transportation Program or STP). Provides flexible funding to states and local governments for projects that best address state and local transportation needs. This program is formulary and funds are allocated per state in lump sums then divided into appropriate programs within the state. Although STBG projects may not be used for local roads or rural minor collector roads, there are a few exceptions that could benefit low volume roads, including:
  - The ability to utilize up to 15 percent of a State's rural sub-allocation on minor collectors
  - Bridge and tunnel projects,
  - Safety projects
  - Fringe and corridor parking facilities
  - Safe routes to schools
  - Inspection/evaluation of bridges, tunnels and other highway assets.

- Highway Safety Improvement Program (HSIP):
  Provides funding to achieve a significant reduction in traffic fatalities and serious injuries on all public roads including roads on tribal lands. This funding is formula-based and granted to each state based on a calculated measure of need and availability. The funds are still prohibited for the purchase, operation, or maintenance of an automated traffic enforcement system (except in a school zone); however, funding is suggested for data collection on unpaved public roads regarding serious injury or fatalities.

- Federal Lands Access Program (FLAP):
  Provides funding for projects on Federally owned and maintained routes to improve access within those routes. The funding is formulary and allocated based on calculated percentages of need and availability. Eligible projects include program administration, transportation planning, research, preventive maintenance, rehabilitation, restoration, construction, and reconstruction of routes on Federal lands. The following three routes are low volume routes included in this study which were shortlisted for the Arizona 2016 FLAP program:

- SR 181 Chiricahua NM Road Reconstruction – Widening, rehabilitation and paving of 3.1 miles of SR 181 from the intersection with SR 186 east to the Chiricahua NM Boundary. Work will also include drainage and safety improvements as required.
- Apache Trail Improvements - Reconstruction, through recycled asphalt pavement roadway base material, and minor widening of 12.4 miles of Apache Trail from the intersection with Apache Lake Marina Road (FS 79) north and east to Inspiration Point. Work will also include drainage and safety improvements as required.
- SR 261 – Rehabilitation and paving of 11.6 miles of SR 261 from the intersection with SR 273 north to milepost 406. Work will also include shouldering, paving turnouts, safety improvements including guardrail, and the replacement of 6 cattle guards.

- Federal Lands Transportation Program (FLTP):
  Provides funding for projects on Federally owned and maintained routes to improve access within those routes. FLTP funds may be used for the non-federal share of any project that provides access to or within Federal or Tribal land.

- Tribal Transportation Program Funds (TTPF):
  Provides funding for program administration, planning, research, preventive maintenance, rehabilitation, restoration, construction and reconstruction of a route on Federal land. Only Federal agencies may apply to the FLTP program. Funding from this program facilitates improvements on Federally owned and maintained routes. Eligible activities include routes that are located on or provide access to tribal land, or are administered by a tribal government.

- National Highway Freight Program (NHFP):
  Provides funds to improve the freight efficiency on the national highway freight network. This includes any projects that improve the safety, security, efficiency, and resiliency of routes identified as important to freight travel. This funding is formulary and funds are allocated as a lump sum per state, then divided among apportioned programs based on the percentage of PHFS (Primary Highway Freight System) mileage in the state compared to the national total.

- National Highway Performance Program (NHPP):
  Provides support for the condition and performance of the NHS for the construction of new routes. This includes construction, reconstruction, resurfacing, restoration, rehabilitation, preservation, or operational improvements. The program funds are not guaranteed annual funding and are only available for small projects. As a result, this program is designated as a last resource for a supplementary funding option and is not meant to be the primary funding source.

- Nationally Significant Federal Lands and Tribal Projects (NSFLTP):
  Provides funding for the construction, reconstruction, and rehabilitation of projects on Federal or Tribal land that are deemed nationally significant. Only projects seeking funds for reconstruction, construction, or rehabilitation funds, may be funded at a minimum of $25 million estimated project cost for eligibility. NSFLTP funding supplements Tribal Transportation Program Funds. This type of funding is appropriate for routes that cross Tribal and Federal boundaries.

4.0 ROUTE CHARACTERISTICS AND RECOMMENDATIONS

Data were collected and analyzed to develop a set of recommendations for each route. An overview of the results is shown in this section. The Appendix provides an in-depth bridge, crash, pavement and financial data summary for each route.

Segment 1: SR 61 from US 191-Witch Well to New Mexico

This section of SR 61, depicted in Figure 2, is located in Apache County and extends from US 191 in the south to the New Mexico State Highway 56 in the north. The route has no shoulder in either direction. Most of the segment is located within the Navajo Indian Reservation. SR 61 was identified as an important route in the *2004 Apache County Comprehensive Plan*, although no specific improvements or planned projects were recommended. A small portion along the southern section of the segment is surrounded by State Trust Land. The remaining segment is located within the Navajo Indian Reservation. A summary of route characteristics is included in Table 2.

Figure 2: SR 61 from US 191-Witch Well to New Mexico Route Characteristics

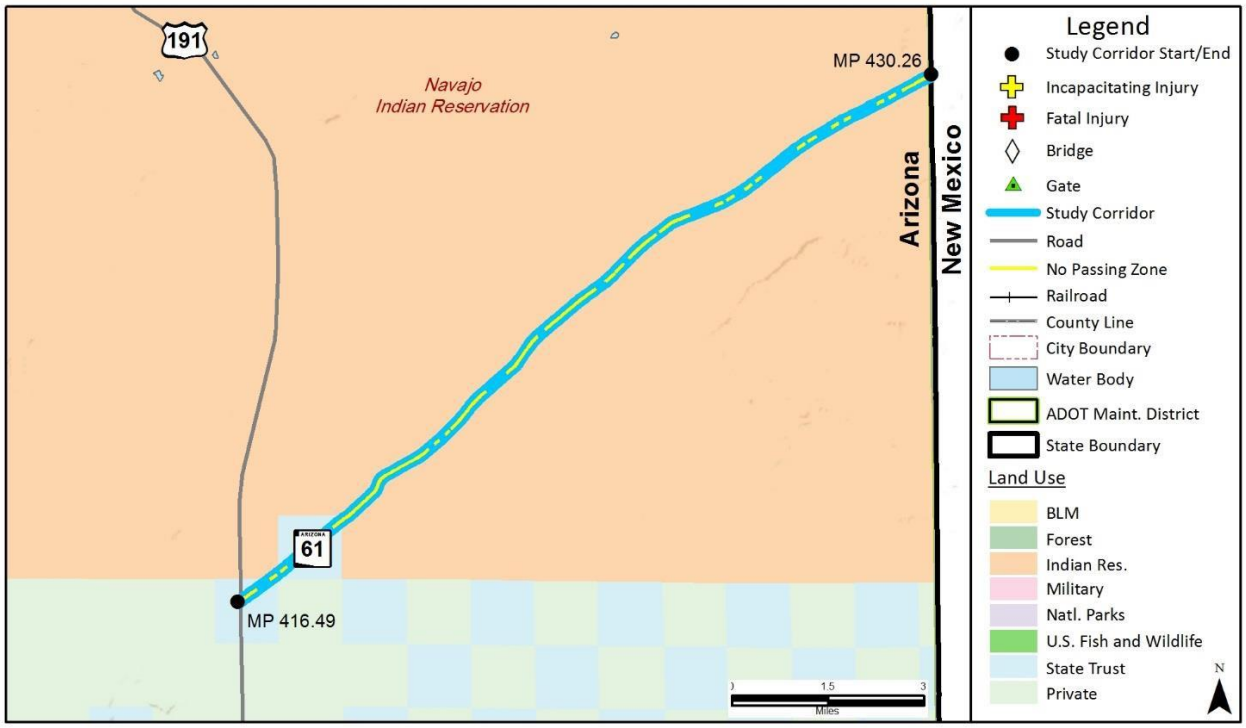


Table 2: SR 61 from US 191-Witch Well to New Mexico Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 61
	Milepost Limits	416.49 – 430.26
	District	Northeast
	Speed Limit	65 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Level
	Number of Through Lanes	2
	Function Classification	Rural Minor Collector
Mobility	Existing AADT	244 vpd
	Average Annual Growth Rate	4.8%
	Future (2035) AADT	795 vpd
Safety	Five Year Crash History	No recorded crashes
Bridge	Bridges	No bridges
Pavement	Pavement IRI (Average)	177
	Pavement Cracking (Average)	47.7
Investment History	Recently Completed Projects	No completed projects since 2010
	Programmed Projects	None
	Financial History (2011-2016)	$230,619.74 (Total) $46,123.95 (Average Annual Cost) $3,349.60 (Average Annual Cost/Mile)

The pavement in this segment has both high values of IRI and cracking. In particular, there is exceptionally high IRI and cracking from MP 424 – 431. The paving history indicates regular paving-- approximately every 20 years-- for the entire segment length. Recent maintenance includes a fog coat in 2009, applied four years after a full paving section.

The overall cost/mile for this section is average compared to other low volume routes. Most of the costs on this segment were associated with snow/ice maintenance (25%) and surface maintenance (22%), primarily application of fog coat by District Maintenance to extend the life of the pavement. Other significant costs included roadside maintenance (13%), traffic control (17%), and contract maintenance (15%). Some costs are associated with foam injection for slope stabilization due to ongoing badger problems and associated maintenance.

Recommendations for this route are summarized in Table 3. A Roadside Weather Information System (RWIS) is recommended to mitigate the high costs associated with snow/ice maintenance. Additionally, signage reading “Minimum Maintenance Road” or “Maintenance Only” to reduce overall maintenance cost is recommended. As the majority of the segment is located within the Navajo Indian Reservation, another recommendation is to transfer the route to the maintenance and ownership of the Bureau of Indian Affairs (BIA) or Navajo Nation. If route transfer to the tribe is not possible, the development of a partnership with the Navajo Nation/BIA to assist in maintenance is recommended. There is also an opportunity to partner with the tribe to pursue additional funding and grant opportunities.

Table 3: SR 61 from US 191 – Witch Well to New Mexico Recommendations

Operations/Maintenance	
Roadside Weather Information System	◑
Reduced maintenance with signage ”Minimum Maintenance Road” or "Maintenance Only"	◑
Route Ownership and Guidelines	
Route Transfer	◑
Partnerships	
Tribal/BIA	●
Funding/Grant	
Tribal Transportation Program Funds (TTPF)	◑

Segment 2: SR 261 from SR 273 to Milepost 412.5

This section of SR 261, depicted in Figure 3, connects SR 260 and Eagar in the north to SR 273 in the south. It passes through the White Mountains and is entirely located within Apache County. The route is closed during the winter, generally between December and early April. While most of the route is level, the northerly end of the route includes several switchbacks beginning around milepost 405. There are no shoulders on either side of SR 261. The posted speed limit is 45 mph from milepost 394.37 to milepost 405, where it reduces to 30 mph. Most of the route is bounded by a portion of the Apache-Sitgreaves National Forest; the last ¼ mile is located within State Trust Land. This area is considered open range with a large population of elk in the area. The route includes a number of informal pull-offs that provide recreational access. A summary of route characteristics is included in Table 4.

Figure 3: SR 261 from SR 273 to Milepost 412.5 Route Characteristics

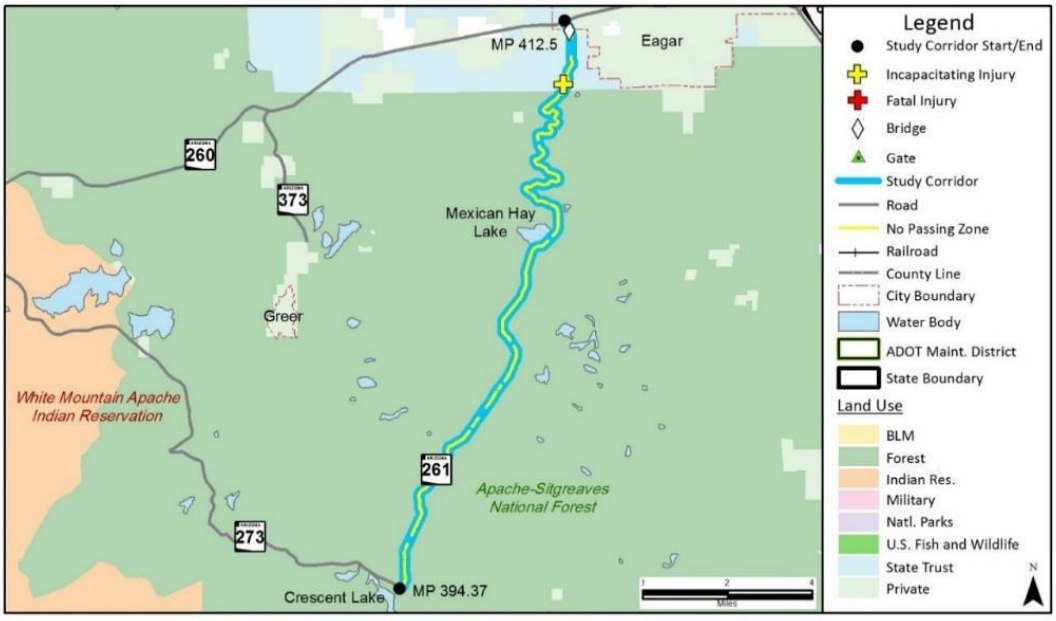


Table 4: SR 261 from SR 273 to Milepost 411 Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 261
	Milepost Limits	394.37 – 412.5
	District	Northeast
	Speed Limit	30 - 45 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Level - Rolling
	Number of Through Lanes	2
	Functional Classification	Rural Minor Collector
Mobility	Existing AADT	253 vpd
	Average Annual Growth Rate	1.2%
	Future (2035) AADT	345 vpd
Safety	Five Year Crash History	1 Total Crash
Bridge	Bridges	Bigelow Crossing Bridge (MP412.32)
Pavement	Pavement IRI (Average)	215
	Pavement Cracking (Average)	10.2
Investment History	Recently Completed Projects	No completed projects since 2010
	Programmed Projects	None
	Financial History (2011-2016)	$194,598.90 (Total) $38,919.78 (Average Annual Cost) $2,340.34 (Average Annual Cost/Mile)

**Data evaluated from MP 394.37 – 411*

Only one incapacitating crash in the last five years was recorded in this segment, which was a collision related to an animal on the roadway in dark conditions where no safety device was used.

Pavement in this segment has high values of IRI, with exceptionally high IRI from MP 395 – 403 and MP 405 - 411. The paving history indicates infrequent paving, with MP 397 – 406 and MP 406 – 411 last being paved in 1972 and 1982, respectively. This infrequent paving history and extreme weather fluctuations contribute to the poor pavement quality.

The overall cost/mile for this section is low compared to other low volume routes. The majority of costs on this segment were associated with snow/ice maintenance (22%) and traffic control (23%). Other significant costs included roadside maintenance (17%), vegetation control (14%) and surface maintenance (15%); the highest costs were associated with cattle guard maintenance, hand cut trees/brush, and crack fill.

Table 5 summarizes the recommendations for this segment. Due to the low volumes on this route, reduced maintenance is recommended, with signage reading “Minimum Maintenance” or “Maintenance Only”. This route is currently closed seasonally due to snowfall. A reduction in ongoing snow and ice patrol costs could be achieved if the route was closed earlier in the winter. There is also potential to partner with the Forest

Service and/or Central Federal Lands to facilitate maintenance costs. This route may be eligible for both FLAP and FLTP funding since it is located within the Apache-Sitgreaves National Forest.

Table 5: SR 261 from SR 273 to MP 412.5 Recommendations

Operations/Maintenance	
Reduced maintenance with signage ”Minimum Maintenance Road” or "Maintenance Only"	◑
Partnerships	
Forest Service	●
Central Federal Lands	◑
Funding/Grant	
Federal Lands Access Program (FLAP)	◑
Federal Lands Transportation Program (FLTP)	◑

Segment 3: SR 277S from SR 277 to Old Paper Mill

SR 277S, depicted in Figure 4, is located in Navajo County and was historically the access route to the Snowflake Mill, which closed in 2014. The road still provides access to the Nova power generation plant. No ranches or other property have sole access using this route. The entire length of the segment is within the Apache-Sitgreaves National Forest. While there are no distinct physical, natural or cultural amenities in the nearby area, a handful of informal pull-offs are located along the route. No recommendations or programmed projects are associated with the segment. The route characteristics are summarized in Table 6.

Figure 4: SR 277S from SR 277 to Old Paper Mill Route Characteristics

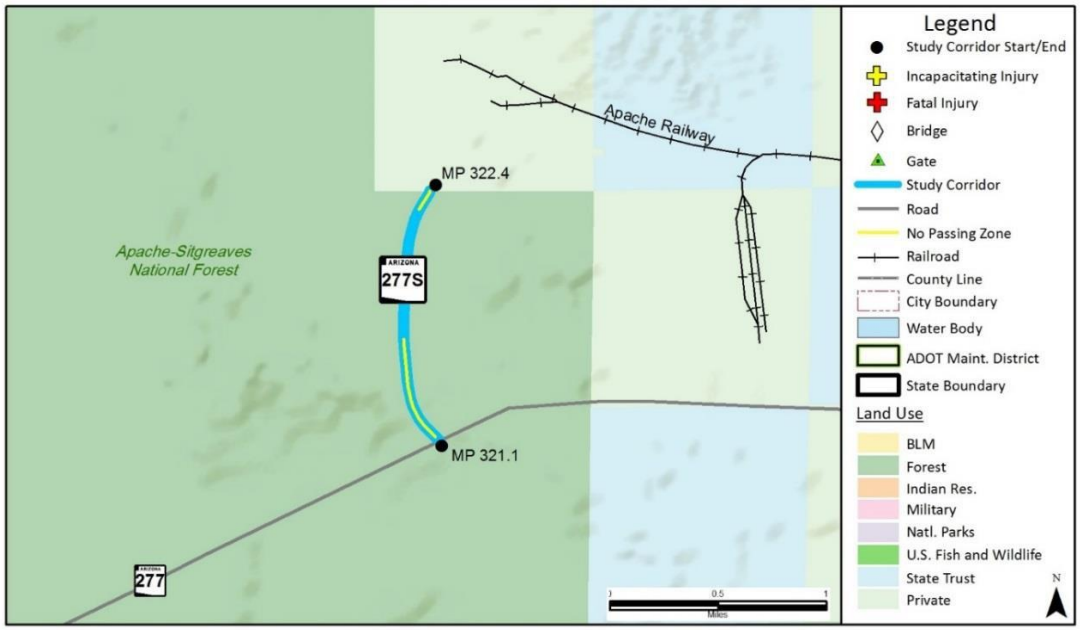


Table 6: SR 277S from SR 277 to Old Paper Mill Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 277S
	Milepost Limits	321.1 – 322.4
	District	Northeast
	Speed Limit	55 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Level
	Number of Through Lanes	2
	Functional Classification	Major Collector
Mobility	Existing AADT	N/A
	Average Annual Growth Rate	N/A
	Future (2035) AADT	N/A
Safety	Five Year Crash History	No crashes
Bridge	Bridges	No bridges
Pavement	Pavement IRI (Average)	103
	Pavement Cracking (Average)	0
Investment History	Recently Completed Projects	No completed projects since 2010
	Programmed Projects	None
	Financial History (2011-2016)	$11,616.00 (Total) $2,323.20 (Average Annual Cost) $1,787.08 (Average Annual Cost/Mile)

The pavement in this segment has a fair rating for IRI and no record of cracking. The paving history indicates a history of regular pavement maintenance, approximately every 12-18 years, from MP 321 to MP 322.5. The most recent pavement project was 3” asphaltic concrete with a double chip seal in 2008, which occurred prior to the closure of the paper mill.

The overall cost/mile for this section is low compared to other low volume routes. The majority of costs were associated with traffic control (56%) and surface maintenance (30%) and primarily related to painting guidelines and roadway patching with recycler. A summary of maintenance related expenditures from 2011 to 2016 is detailed in the Appendix.

It is recommended to pursue route transfer since this route only provides access to the power plant. If retained as a State Highway, this route could be eligible for reduced maintenance, with signage reading “Minimum Maintenance” or “Maintenance Only”. Additionally, STBG or FLTP funding would be available for this segment if it remains within the state system. A summary of recommendations for this route are included in Table 7.

Table 7: SR 277S from SR 277 to Old Paper Mill Recommendations

Operations/Maintenance	
Reduced maintenance with signage ”Minimum Maintenance Road” or "Maintenance Only"	●
Route Ownership and Guidelines	
Route Transfer	●
Funding/Grant	
STBG Eligible	●
Federal Lands Transportation Program (FLTP)	◑

Segment 4: SR 473 From SR 260 to Hawley Lake Dam

SR 473 is located entirely within the Fort Apache Indian Reservation in Apache County and is shown in Figure 5. It is used primarily to access Hawley Lake and the Hawley Lake Campground Area. Several tribal routes also access this route. The route is closed during winter months, usually beginning in November, due to snowfall. No recommendations or programmed projects are associated with the segment. Route characteristics for this segment are summarized in Table 8.

Figure 5: SR 473 From SR 260 to Hawley Lake Dam Route Characteristics

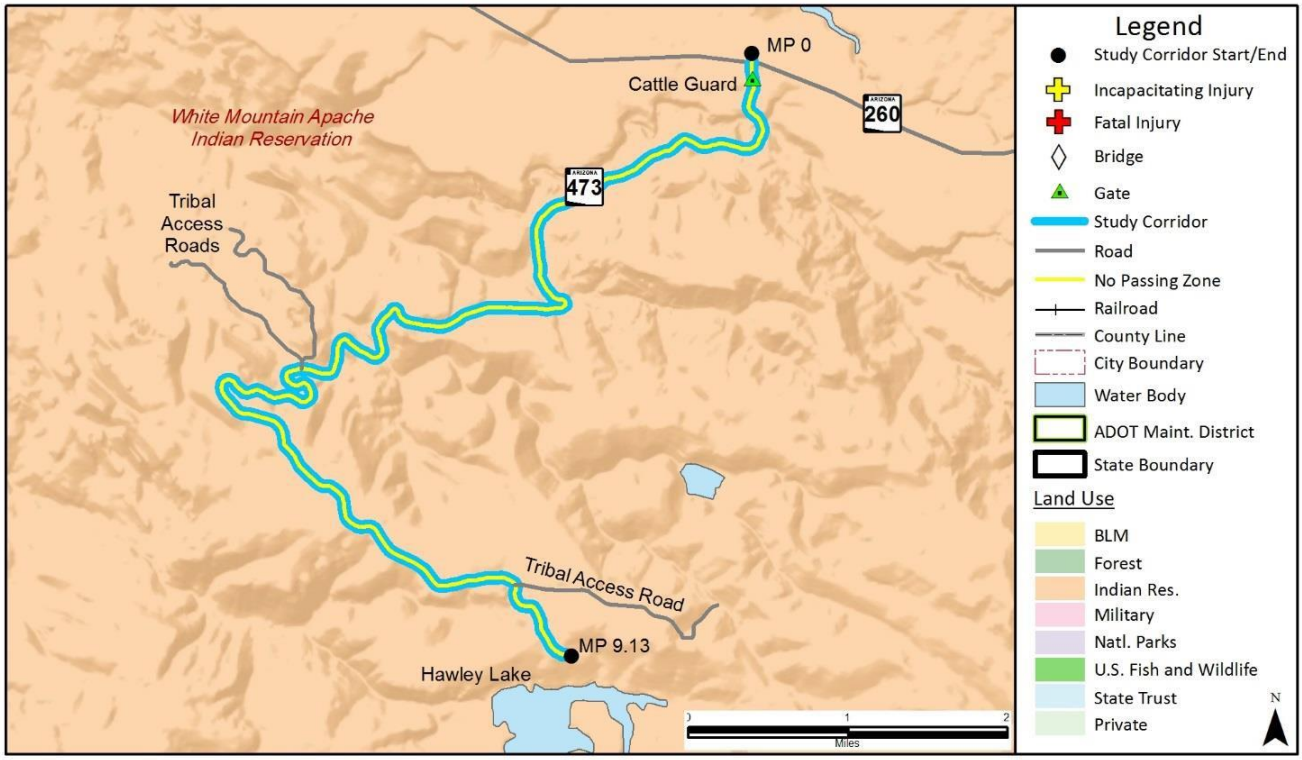


Table 8: SR 473 From SR 260 to Hawley Lake Dam Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 473
	Milepost Limits	0 – 9.13
	District	Northeast
	Speed Limit	25 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Level
	Number of Through Lanes	2
	Functional Classification	Rural Minor Collector
Mobility	Existing AADT	294 vpd
	Average Annual Growth Rate	0.5%
	Future (2035) AADT	331 vpd
Safety	Five Year Crash History	No crashes
Bridge	Bridges	No bridges
Pavement	Pavement IRI (Average)	172
	Pavement Cracking (Average)	4.7
Investment History	Recently Completed Projects	No completed projects since 2010
	Programmed Projects	None
	Financial History (2011-2016)	$106,409.20 (Total) $21,281.84 (Average Annual Cost) $2,134.59 (Average Annual Cost/Mile)

The pavement in this segment has high values of IRI, with exceptionally high IRI between MP 0 and MP 4 and between MP 9 and MP 10. The paving history indicates a history of regular paving approximately every 18 – 21 years from MP 0 to MP 9.5, although the most recent paving project only extended to MP 9. Recent maintenance includes a double chip seal in 2002. Detailed pavement data and pavement history is included in the Appendix.

The overall cost/mile for this section is low compared to other low volume routes. The majority of costs on this segment were associated with traffic control (28%) and surface maintenance (24%), with the highest costs for painting guidelines and replace surface/base. Other significant costs included snow/ice maintenance (15%) and drainage maintenance (13%), including snow/ice removal, routine drainage maintenance, and clean cuts/channels/dikes/embankments/curbs. A summary of maintenance related expenditures from 2011 to 2016 is detailed in the Appendix.

This segment is located entirely within the White Mountain Apache Indian Reservation and generally serves to access tribal routes and recreation areas, therefor it is recommended that this route be considered for route transfer. In lieu of a route transfer, there is potential for costs sharing through a partnership with the White Mountain Apache Tribe. An RWIS may be an option for this route to reduce costs associated with snow/ice patrol. Funding options to be considered for this segment include TTPF and NSFLTP. The recommendations for this route are summarized in Table 9.

Table 9: SR 473 From SR 260 to Hawley Lake Dam Recommendations

Operations/Maintenance	
Roadside Weather Information System	◑
Route Ownership and Guidelines	
Route transfer	●
Partnerships	
Tribal/BIA	●
Funding/Grant	
Tribal Transportation Program Funds (TTPF)	●
Nationally Significant Federal Lands and Tribal Projects (NSFLTP)	◑

Segment 5: SR 564 from US 160 to Navajo National Monument

SR 564, shown in Figure 6, is located entirely within the Navajo Indian Reservation. It connects US 160 in the south to the Navajo National Monument to the north. Although SR 564 is primarily a recreational route, the area is considered open range; several residences are located along the segment. There have been reoccurring requests for fencing to reduce conflicts associated with livestock on the roadway. No recommendations or programmed projects are associated with the segment. Route characteristics are summarized in Table 10.

Figure 6: SR 564 from US 160 to Navajo National Monument Route Characteristics

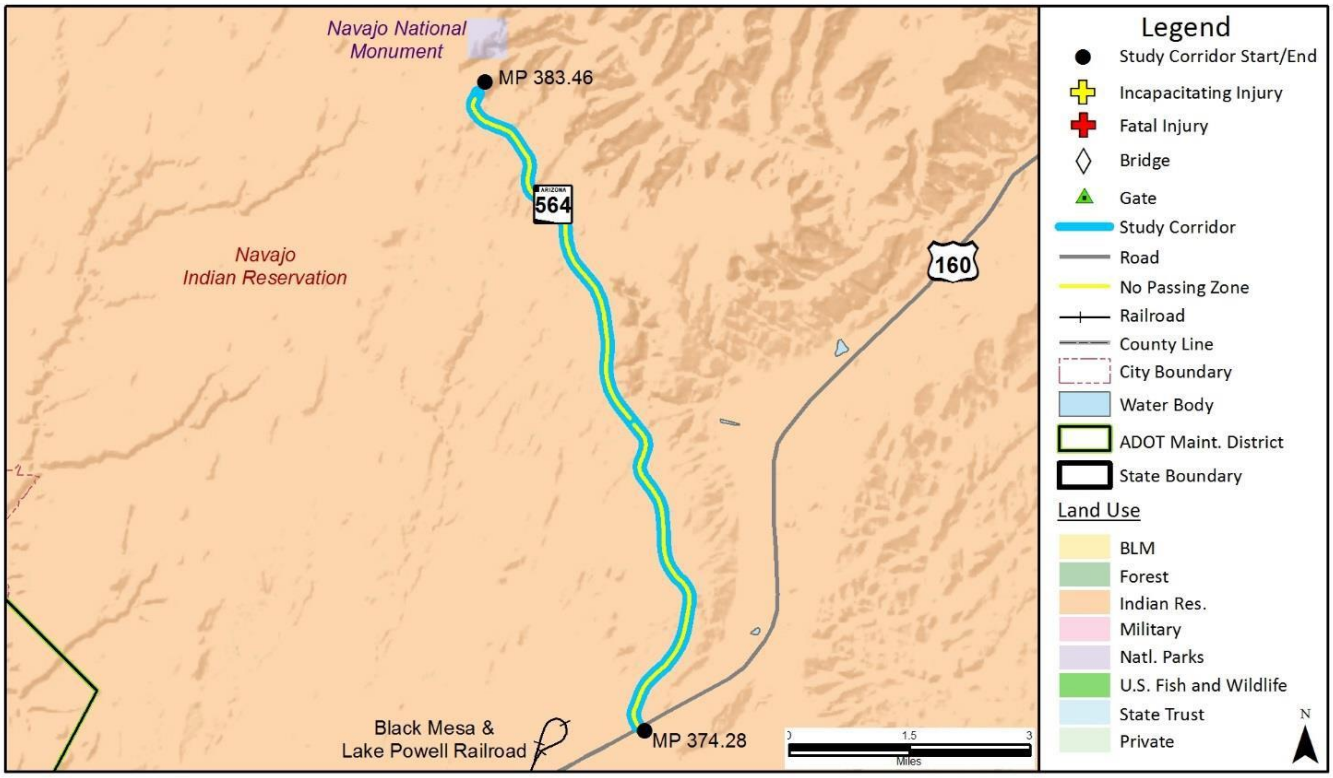


Table 10: SR 564 from US 160 to Navajo National Monument Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 564
	Milepost Limits	374.28 – 383.46
	District	Northeast
	Speed Limit	50 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Level
	Number of Through Lanes	2
	Functional Classification	Minor Collector
Mobility	Existing AADT	268 vpd
	Average Annual Growth Rate	1.7%
	Future (2035) AADT	413 vpd
Safety	Five Year Crash History	No crashes
Bridge	Bridges	No bridges
Pavement	Pavement IRI (Average)	237
	Pavement Cracking (Average)	24.1
Investment History	Recently Completed Projects	No completed projects since 2010
	Programmed Projects	None
	Financial History (2011-2016)	$110,799.08 (Total) $22,159.82 (Average Annual Cost) $2,413.92 (Average Annual Cost/Mile)

The pavement in this segment has high values of both IRI and cracking. The entire segment has exceptionally high IRI, and high cracking from MP 377 to MP 381 and from MP 383 to MP 384.4. The paving history indicates an irregular history of paving on the segment. The most recent maintenance was a slurry seal in 2009, following a double chip seal in 2001. Previously, the roadway had not had a surface treatment since receiving a seal coat in 1974.

The overall cost/mile for this section is low compared to other low volume routes. The majority of costs on this segment were associated with traffic control (31%), primarily guideline painting. Other significant costs included snow/ice maintenance (18%), drainage maintenance (16%) and shoulder maintenance (18%), with the majority of these costs associated with applying de-icers and drainage repairs from MP 375 to MP 382 in 2014.

Recommendations for this segment are summarized in Table 11. An RWIS is recommended to reduce ongoing costs associated with snow/ice patrol. Additionally, fencing is advisable to reduce conflicts between vehicles and livestock, although there was not a high incidence of these types of crashes. The segment is located entirely within the Navajo Nation and provides primary access to the Navajo National Monument and residences along the segment. For this reason, there may be an opportunity to transfer ownership to the Navajo Nation, or to share in maintenance costs with the tribal community, BIA or the National Park Service. This segment is entirely within Indian land and is critical to the Navajo Nation, therefore potentially benefiting from TTPF and NSFLTP funds.

Table 11: SR 564 from US 160 to Navajo National Monument Recommendations

Operations/Maintenance	
Roadside Weather Information System	◑
Route Ownership and Guidelines	
Route transfer	●
Partnerships	
National Park Service	●
Tribal/BIA	●
Funding/Grant	
Tribal Transportation Program Funds (TTPF)	●
Nationally Significant Federal Lands and Tribal Projects (NSFLTP)	◑

Segment 6: SR 180A from US 180 to SR 61-Concho

The SR 180A segment, depicted in Figure 7, connects US 180 in the north to SR 61 in the south, serving as an alternate route between the two highways. It is completely bounded by private land and provides access to the Petrified Forest National Park. A significant number of residences are served by the route. SR 180A was identified as of major importance for current circulation in the *2004 Apache County Comprehensive Plan* although no future projects were recommended. Route characteristics are summarized in Table 12.

Figure 7: SR 180A from US 180 to SR 61-Concho Route Characteristics

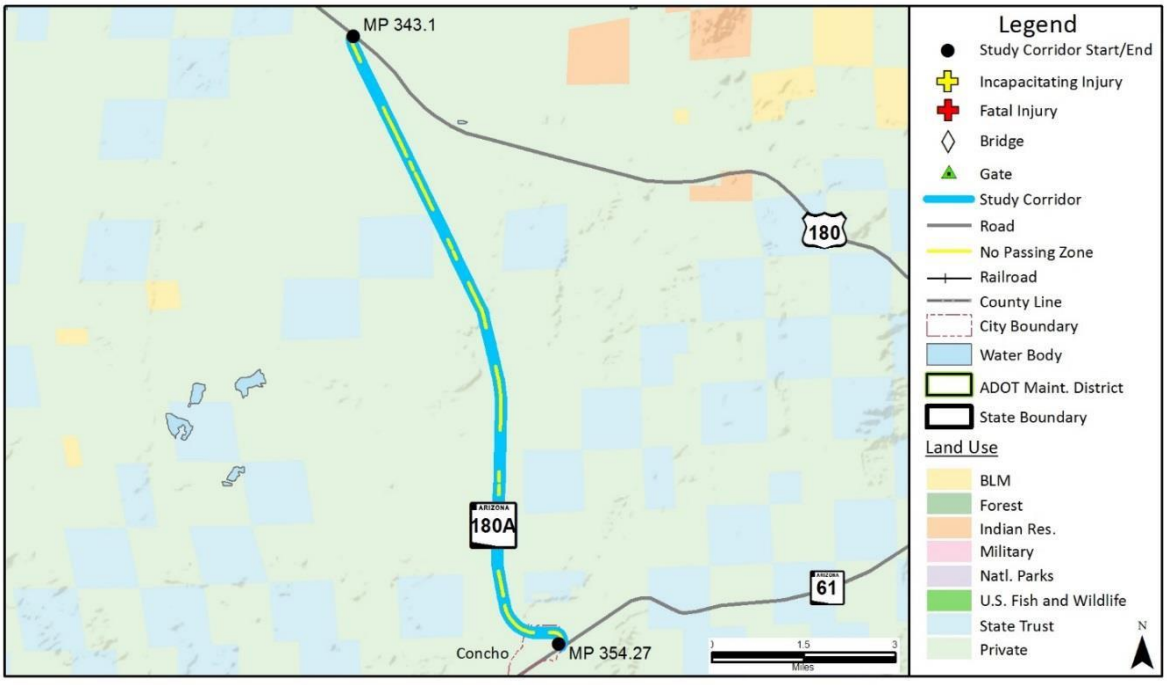


Table 12: SR 180A from US 180 to SR 61-Concho Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 180A
	Milepost Limits	343.1 – 354.27
	District	Northeast
	Speed Limit	55 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Level
	Number of Through Lanes	2
	Functional Classification	Rural Minor Collector
Mobility	Existing AADT	152 vpd
	Average Annual Growth Rate	1.7%
	Future (2035) AADT	245 vpd
Safety	Five Year Crash History	No crashes
Bridge	Bridges	No bridges
Pavement	Pavement IRI (Average)	116
	Pavement Cracking (Average)	5.8
Investment History	Recently Completed Projects	Pavement Preservation Project (Nov 2010) between milepost 347.00 and 358.20
	Programmed Projects	None
	Financial History (2011-2016)	$141,549.78 (Total) $28.309.96 (Average Annual Cost) $2,534.46 (Average Annual Cost/Mile)

The pavement in this segment has low values of both IRI and cracking, with slightly elevated IRI from MP 347 to 349. The paving history indicates a somewhat irregular paving history, with the most recent project being a fog coat in 2004.

The overall cost/mile for this section is low compared to other low volume routes. The majority of costs on this segment were associated with traffic control (32%) and surface maintenance (34%), primarily guideline painting, sign maintenance, and replace surface/base. This segment also had a high subcategory of clean cuts/channels/dikes/embankments/curbs.

A recommendation for drainage improvements may be applicable for this route and would significantly reduce overall maintenance costs. Additionally, this route may be a candidate for a cost-sharing partnership with the National Park Service. The route does not provide direct access to Petrified Forest National Park, however it connects SR 61 to US 180, which provides access to the park. Recommendations for this route are summarized in Table 13.

Table 13: SR 180A from US 180 to SR 61-Concho Recommendations

Operations/Maintenance	
Drainage Improvements	◑
Partnerships	
National Park Service	◑

Segment 7: SR 273 from Sunrise Turnoff to Big Lake

This section of SR 273, depicted in Figure 8, is located in Apache County, beginning south of SR 260 and connecting to Big Lake, Sunrise Lake, Sunrise Peak Ski Area and Sunrise Park Resort. It is an important route for many recreational activities including hiking, skiing, camping and mountain biking. Although the typical ski season is between December and March, numerous recreational activities are available throughout the year. The northern section of the segment traverses the White Mountain Apache Indian Reservation; the southern portion is located within the Apache-Sitgreaves National Forest. The route includes a shoulder on both sides of the roadway, ranging from zero to five feet. SR 273 was identified as a route of major importance for current circulation in the *2004 Apache County Comprehensive Plan* although no projects were recommended. Route characteristics are summarized in Table 14.

Figure 8: SR 273 from Sunrise Turnoff to Forest Service Boundary Route Characteristics

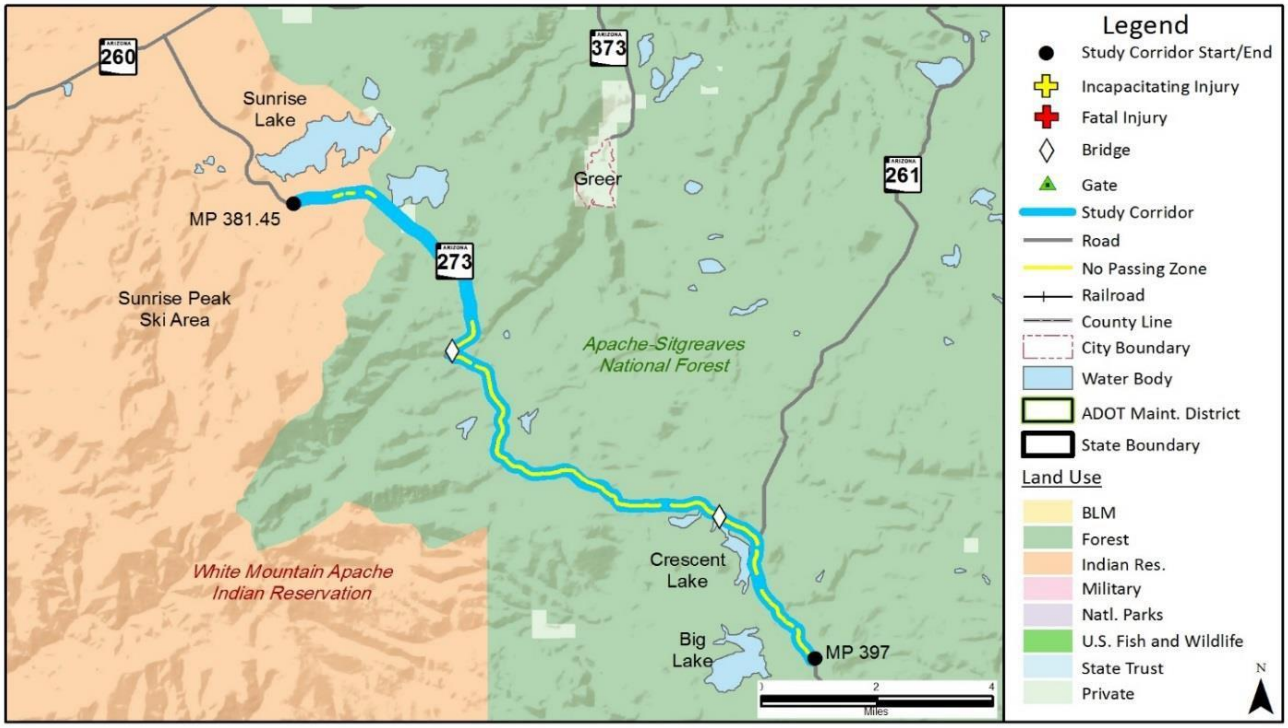


Table 14: SR 273 from Sunrise Turnoff to Big Lake Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 273
	Milepost Limits	381.45 - 397
	District	Northeast
	Speed Limit	40 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Level
	Number of Through Lanes	2
	Functional Classification	Rural Minor Collector
Mobility	Existing AADT	399 vpd
	Average Annual Growth Rate	0.8%
	Future (2035) AADT	476 vpd
Safety	Five Year Crash History	No crashes
Bridge	Bridges	West Fork Little Colorado River Bridge (MP 386.75) Crescent Lake Dam Bridge (MP 394.30)
Pavement	Pavement IRI (Average)	92
	Pavement Cracking (Average)	0
Investment History	Recently Completed Projects	2011 Central Federal Lands (MP 382 – 394)
	Programmed Projects	None
	Financial History (2011-2016)	$298,658.86 (Total) $59,731.77 (Average Annual Cost) $3,841.27 (Average Annual Cost/Mile)

The pavement in this segment has low values of both IRI and cracking, with the exception of high IRI from MP 394 to MP 397. The paving history, from MP 381 to MP 383, indicates the most recent paving being a seal coat in 1985. A portion of the roadway was constructed in 2011 through the Central Federal Lands (from MP 382 to MP 394). Paving details can be found in the Appendix.

The overall cost/mile for this section is average compared to other low volume routes. The majority of costs on this segment were associated with snow/ice maintenance (41%) and traffic control (21%), including plowing for snow, applying de-icers, other snow removal, guideline striping and sign maintenance. Other significant costs included roadside maintenance, with high costs associated with fence maintenance.

The northern portion of this route is within tribal land and the southern portion is within the Apache- Sitgreaves National Forest. There is an opportunity to partner with the Forest Service, Central Federal Lands, and the tribe to share in maintenance costs. Moreover, another opportunity is transferring the route between Sunrise Lake

and Big Lake to the Forest Service. An RWIS is recommended to reduce ongoing costs associated with snow/ice patrol. Additionally, the portion of the roadway south of the Sunrise Peak turnoff may be appropriate for reduced maintenance with associated signage for “Minimum Maintenance Road” or “Maintenance Only”. This segment may qualify for three funding options: the FLAP, FLTP, and NSFLTP. Recommendations for this route are summarized in Table 15.

Table 15: SR 273 from Sunrise Turnoff to Big Lake Recommendations

Operations/Maintenance	
Roadside Weather Information System	●
Reduced maintenance with signage ”Minimum Maintenance Road” or "Maintenance Only"	◑
Route Ownership and Guidelines	
Route Transfer	◑
Partnerships	
Forest Service	●
Central Federal Lands	◑
Tribal/BIA	◑
Funding/Grant	
Federal Lands Access Program (FLAP)	◑
Federal Lands Transportation Program (FLTP)	◑
Nationally Significant Federal Lands and Tribal Projects (NSFLTP)	◑

Segment 8: SR 67 From Jacob Lake to North Rim

This section of SR 67, depicted in Figure 9, is located in Coconino County, beginning at Jacob Lake. It provides a connection to the North Rim of the Grand Canyon. The entire length of the SR 67 segment, which is designated as a Scenic Byway, is located within the northern section of the Kaibab National Forest. Access to the North Rim of the Grand Canyon is closed in the winter months due to snow. Several formal camping and hiking trails are accessible along the route. Several formal pull-offs and rest areas, which include historic and ecological information posts, are also located along the route. There is an average of 1.2 access points per mile. There are no recommendations or programmed projects associated with the segment. Route characteristics are summarized in Table 16.

SR 67 near Crane Lake

Figure 9: SR 67 From Jacob Lake to North Rim Route Characteristics

Table 16: SR 67 From Jacob Lake to North Rim Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 67
	Milepost Limits	579.3 - 610
	District	Northcentral
	Speed Limit	45 - 55 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Level - Hilly
	Number of Through Lanes	2
	Functional Classification	Major Collector/Minor Collector
Mobility	Existing AADT	1161 vpd
	Average Annual Growth Rate	2.3%
	Future (2035) AADT	2034 vpd
Safety	Five Year Crash History	5 Total Crashes 4 Motorcycle Crashes
Bridge	Bridges	No bridges
Pavement	Pavement IRI (Average)	63
	Pavement Cracking (Average)	0.3
Investment History	Recently Completed Projects	No completed projects since 2010
	Programmed Projects	None
	Financial History (2011-2016)	$796,663.33 (Total) $159,332.67 (Average Annual Cost) $5,189.99 (Average Annual Cost/Mile)

There were five recorded crashes in this segment, four of which involved motorcycles. Three of the crashes involved negotiating a curve; two of the three involved excessive speed for conditions. One crash involved an animal on the roadway.

The pavement in this segment has low values of both IRI and cracking. The paving history indicates an irregular paving history for the entire segment, with the most recent paving being ACFC with asphaltic rubber in 2002.

The overall cost/mile for this section is average compared to other low volume routes. The majority of costs on this segment were associated with surface maintenance (40%), primarily the application of flush coat. Other significant costs included snow/ice maintenance and traffic control related to snow/ice control, plowing snow, applying de-icers, and guideline painting.

Installing an RWIS is recommended to reduce ongoing costs associated with snow/ice patrol. Dynamic Speed Signs are also proposed to reduce speeding and associated crashes. There is also an option to perform data analysis to identify crash patterns to determine if conducting an RSA would be beneficial. As this segment is entirely within the Kaibab National Forest and is used to connect to the Grand Canyon National Park, this route is recommended for route transfer to the Forest Service. If the routes remains in the state system, a partnership with the Forest Service, Central Federal Lands, or the National Park Service is recommended to share maintenance costs. Projects for this segment may be eligible for five funding sources: the STBG, HSIP, FLAP, FLTP, or NSFLTP. Recommendations are summarized in Table 17.

Table 17: SR 67 From Jacob Lake to North Rim Recommendations

Operations/Maintenance	
Roadside Weather Information System	●
Reduced Speed Limit/Dynamic Speed Signs	◑
Perform data analysis to identify crash patterns to determine if conducting a Road Safety Assessment is appropriate, and install Dynamic Speed Warning Systems/High Reflectivity Striping/Signage/ Centerline or Shoulder Rumble Strip/Raised Pavement Markers	●
Route Ownership and Guidelines	
Route Transfer	●
Partnerships	
Forest Service	●
Central Federal Lands	◑
National Park Service	●
Funding/Grant	
STBG eligible	●
Highway Safety Improvement Program (HSIP)	●
Federal Lands Access Program (FLAP)	◑
Federal Lands Transportation Program (FLTP)	◑
Nationally Significant Federal Lands and Tribal Projects (NSFLTP)	◑

Segment 9: SR 99 From 15 Miles South of Winslow to SR 87-Winslow

This section of SR 99, depicted in Figure 10, is located in Navajo County, just south of the City of Winslow. It bisects a checkerboard of private and State Trust Land. This section of SR 99 is regionally significant, connecting Winslow and the surrounding communities in the north to the Clear Creek Canyon, private lands and the Apache-Sitgreaves National Forest in the south. There are several recreational amenities only accessible from this segment. The shoulder width along both sides of the route ranges from zero to four feet. There is an average of 3.2 access points per mile due to the surrounding land ownership, a mix of private and state trust land. No recommendations or programmed projects are associated with the segment. Route characteristics are summarized in Table 18.

Figure 10: SR 99 From 15 Miles South of Winslow to SR 87/Winslow Route Characteristics

This segment has two bridge structures. The Clear Creek Arch Bridge is in Fair condition, with the deck, substructure and superstructure also rated as Fair, although the sufficiency rating was good. The Jacks Canyon bridge is in good condition overall.

Only one recorded incapacitating crash occurred in the last five years in this segment, which involved driver illness and lack of use of a safety device.

Table 18: SR 99 From 15 Miles South of Winslow to SR 87/Winslow Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 99
	Milepost Limits	27.5 – 42.67
	District	Northcentral
	Speed Limit	55 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Level
	Number of Through Lanes	2
	Functional Classification	Minor Collector
Mobility	Existing AADT	252 vpd
	Average Annual Growth Rate	-2.7%
	Future (2035) AADT	126 vpd
Safety	Five Year Crash History	1 Total Crash
Bridge	Bridges	Clear Creek Arch Bridge (MP 38.19) Jacks Canyon Bridge (MP 38.9)
Pavement	Pavement IRI (Average)	86
	Pavement Cracking (Average)	3.4
Investment History	Recently Completed Projects	No completed projects since 2010
	Programmed Projects	None
	Financial History (2011-2016)	$168,064.66 (Total) $33,612.93 (Average Annual Cost) $2,215.75 (Average Annual Cost/Mile)

The pavement in this segment has low values of both IRI and cracking. The paving history indicates regular paving for the entire segment, with paving along most of the segment every 20-30 years. The most recent project involved asphaltic concrete with double chip seal in 2003.

The overall cost/mile for this section is low compared to other low volume routes. The majority of costs on this segment were associated with traffic control (35.83%), primarily guideline painting and sign maintenance. Other significant costs included roadside maintenance, drainage maintenance, and shoulder maintenance, with high costs associated with fence and cattle guard maintenance.

All or part of this route is in a position for the potential to be transferred to the ownership and management of a local agency due to low volumes and localized nature of the facility. If the route remains in the state system, it is recommended that it have reduced maintenance practices with signage indicating “Minimum Maintenance Road” signs or “Maintenance Only” signs. Recommendations are summarized in Table 19.

Table 19: SR 99 From 15 Miles South of Winslow to SR 87-Winslow Recommendations

Operations/Maintenance	
Reduced maintenance with signage ”Minimum Maintenance Road” or "Maintenance Only”	●
Route Ownership and Guidelines	
Route transfer	●

Segment 10: SR 99 From I-40 to Leupp

This section of SR 99 is located in Coconino County north of I-40 between Winslow and Flagstaff as shown in Figure 11 and the route characteristics in Table 20. It connects Leupp in the north with I-40 in the south. The segment bisects a checkerboard of private and State Trust Land along the southern half; it is bounded by the Navajo Indian Reservation in the north. Access points are located an average of 1.9 per mile due to the surrounding land ownership, a mix of private, state trust land and the Navajo Indian Reservation. No recommendations or programmed projects are associated with the segment.

Figure 11: SR 99 From I-40 to Leupp Route Characteristics

Table 20: SR 99 From I-40 to Leupp Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 99
	Milepost Limits	53 – 72.16
	District	Northcentral
	Speed Limit	45 - 55 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Level
	Number of Through Lanes	2
	Functional Classification	Major Collector
Mobility	Existing AADT	633 vpd
	Average Annual Growth Rate	0.9%
	Future (2035) AADT	793 vpd
Safety	Five Year Crash History	None
Bridge	Bridges	Canyon Diablo Bridge (MP 71.89)
Pavement	Pavement IRI (Average)	148
	Pavement Cracking (Average)	1.7
Investment History	Recently Completed Projects	No completed projects since 2010
	Programmed Projects	None
	Financial History (2011-2016)	$560,623.81 (Total) $112,124.76 (Average Annual Cost) $5,852.02 (Average Annual Cost/Mile)

This segment has one bridge, the Canyon Diablo Bridge, which rated in Fair condition, with a fair rating for deck and superstructure, and a good rating for substructure and sufficiency.

The pavement in this segment has low values of cracking and elevated IRI. The elevated IRI varies throughout the segment, with exceptionally high IRI at the ends, generally from MP 52.6 to MP 60 and from MP 70 to MP72. The paving history indicates an irregular paving history, with projects along the segment generally segmented, occurring from MP 55 to MP 61.5 and from MP 61.5 to MP 71.5. The most recent paving project was a fog coat from MP 54 to MP 71.5 in 2008 although MP 53 to MP 54 has not been paved since 1969 and MP 71.5 to MP 72.5 has not been paved since 1989.

The overall cost/mile for this section is average compared to other low volume routes. The majority of costs on this segment were associated with surface maintenance (64%), the most significant cost being the application of chip seal coat.

As this route primarily serves local interests, it would be appropriate to transfer the northern portion of the route Navajo Nation/BIA and the southern portion of the route to a local agency. If it is not possible to transfer the route from the state system, there may be potential to establish a partnership with the Navajo Nation or BIA to share maintenance costs. Due to the low volumes and crash rate on this roadway, reduced maintenance practices are recommended on this route with signage such as “Minimum Maintenance Road” signs or “Maintenance Only” signs. This route may be eligible for TTPF funds. Recommendations are summarized in Table 21.

Table 21: SR 99 From I-40 to Leupp Recommendations

Operations/Maintenance	
Reduced maintenance with signage ”Minimum Maintenance Road” or "Maintenance Only"	●
Route Ownership and Guidelines	
Route transfer	●
Partnerships	
Tribal/BIA	◑
Funding/Grant	
Tribal Transportation Program Funds (TTPF)	◑

Segment 11: SR 83 From Parker Canyon Lake to SR 82

This section of SR 83, depicted in Figure 12, travels through Santa Cruz and Cochise counties. SR 83 connects SR 82 and Sonoita in the north to Parker Canyon Lake and various outdoor amenities in the south, bisecting the Huachuca Ecosystem Management Area of the Coronado National Forest. A portion of the segment is located along Las Cienegas National Conservation Area (NCA), managed by the Bureau of Land Management (BLM). Parker Canyon Lake is located at the southern boundary of the route; several cabins and permanent residences are located near the lake.

SR 83 at MP 7.1

The primary purpose of this route is to connect communities in the north and west to the Coronado National Forest and surrounding natural amenities. Shoulders are generally one foot wide along the segment. There are also a number of informal pull-offs located sporadically throughout the route. The *2013 Santa Cruz Comprehensive Plan* identified SR 83 as a state highway that needs to be improved or maintained in order to accommodate traffic increases. The statewide travel demand model reflects a negative growth rate due to changes in population and employment, such as closures of wineries in the region, as well as alternative routes in the future. No recommended or programmed projects were identified. The route characteristics are summarized in Table 22.

Figure 12: SR 83 From Parker Canyon Lake to SR 82 Route Characteristics

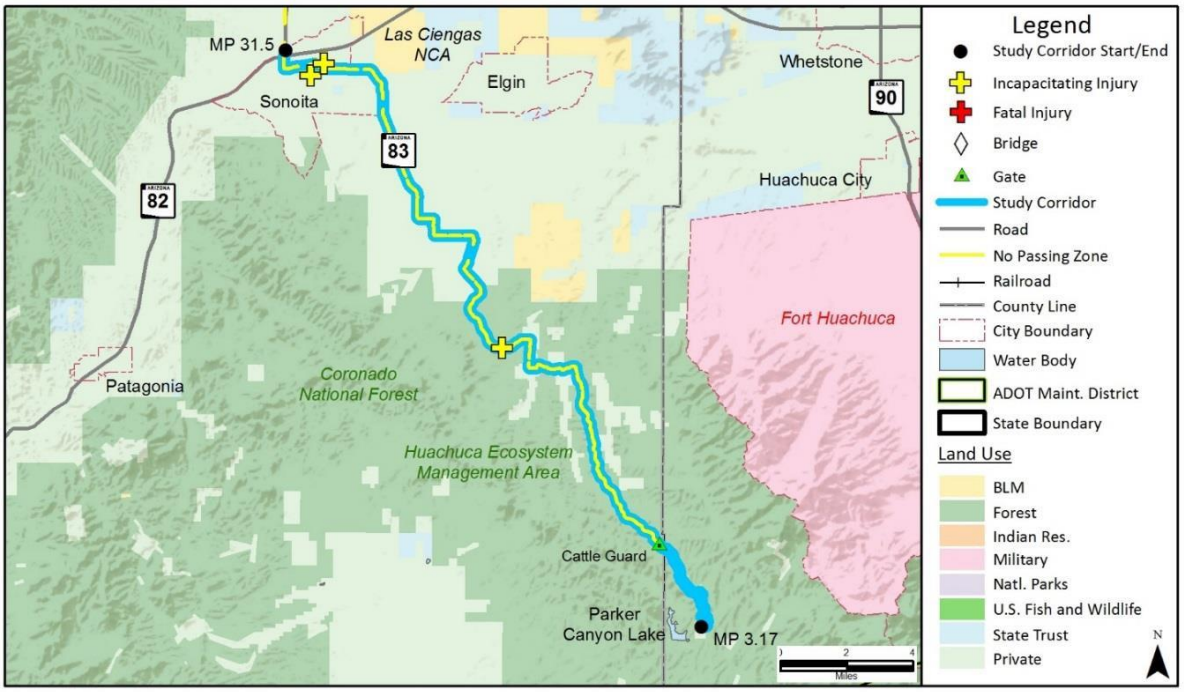


Table 22: SR 83 From Parker Canyon Lake to SR 82 Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 83
	Milepost Limits	3.19 – 31.5
	District	Southcentral
	Speed Limit	35 - 55 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Level - Hilly
	Number of Through Lanes	2
	Functional Classification	Major Collector/Minor Collector
Mobility	Existing AADT	146 vpd
	Average Annual Growth Rate	-4.5%
	Future (2035) AADT	47 vpd
Safety	Five Year Crash History	3 Total Crashes
Bridge	Bridges	No bridges
Pavement	Pavement IRI (Average)	226
	Pavement Cracking (Average)	5.8
Investment History	Recently Completed Projects	Pavement preservation project (2014) MP 11.90 - 14.00
	Programmed Projects	None
	Financial History (2011-2016)	$924,621.84 (Total) $184,924.37 (Average Annual Cost) $6,532.12 (Average Annual Cost/Mile)

There were three recorded crashes in this segment. Two were involving motorcycles, one of which was at a speed too fast for conditions. Two crashes occurred while negotiating a curve. Two of the collisions were at MP 30.

The pavement in this segment has extremely high IRI values from MP 14 to MP 24 and a range of slightly elevated cracking values from MP 15 to MP 25. No data is available from MP 3.19 to MP 7; however this section is paved but not striped. From MP 3.19 to MP 7.1, the section was originally millings, however District Maintenance has since put chipseals. Additionally, the MP 3.14 to MP 4.5 and MP 5 to MP 6 segments were milled and paved in 2013 and 2015, respectively. On the northern end of the route, MP 14 to MP15, MP 16.6 to MP17.05 and MP 17.9 to MP18.4 were paved through Contract Maintenance in 2015. Additionally, District Maintenance used cold mix to patch MP 21.7 to MP 22.0, MP 22.06 to MP 22.17, and MP 22.76 to MP 22.91. The paving history indicates an irregular paving history, with no record of paving projects in the section of high IRI. The recent projects through District Maintenance may have addressed some of the high IRI areas.

The overall cost/mile for this section is high compared to other low volume routes. The majority of costs on this segment were associated with paving activities as described previously, most of which is included in surface maintenance (30%). Other significant costs included traffic control and contract maintenance, including costs associated with signage for “Rough Road Ahead” to notify drivers of the road conditions. In cases where contract maintenance performs paving improvements, the district still provides traffic control. Other costs in traffic control maintenance are associated with potholes and overlays.

SR 83 Chipseal

This segment is a candidate for route transfer. If it remains in the state system, reduced maintenance costs with minimum maintenance signage is recommended for this segment. Additionally, there is opportunity to perform data analysis to identify crash patterns to determine if conducting a Road Safety Assessment would be beneficial. Since this segment is within the Coronado National Forest and Huachuca Ecosystem Management Area, there is potential to partner with the Forest Service or Central Federal Lands for shared maintenance costs. This segment may be eligible for up to five funding sources: the STBG, HSIP, FLAP, and FLTP. Recommendations are summarized in Table 23.

Table 23: SR 83 From Parker Canyon Lake to SR 82 Recommendations

Operations/Maintenance	
Reduced maintenance with signage ”Minimum Maintenance Road” or "Maintenance Only"	◑
Perform data analysis to identify crash patterns to determine if conducting a Road Safety Assessment is appropriate and install Dynamic Speed Warning Systems/High Reflectivity Striping/Signage/ Centerline or Shoulder Rumble Strip/Raised Pavement Markers	◑
Route Ownership and Guidelines	
Route transfer	●
Partnerships	
Forest Service	◑
Central Federal Lands	◑
Funding/Grant	
STBG Eligible	●
Highway Safety Improvement Program (HSIP)	◑
Federal Lands Access Program (FLAP)	◑
Federal Lands Transportation Program (FLTP)	◑

Segment 12: SR 286 From the International Border to Arivaca-Sasabe Road

This section of SR 286, depicted in Figure 13, travels from the Sasabe Port of Entry north through Sasabe, private and State Trust Land, and the Buenos Aires National Wildlife Refuge. The primary purpose for this route is to access the Sasabe Port of Entry, which has limited hours of operation, from 8am to 8pm. Much of the traffic along this segment is related to border patrol activities. A small portion of the route, located in the Sasabe area, includes a five foot shoulder on each side. The Pima Association of Governments (PAG) has identified SR 286 as a regionally significant segment however, no recommended or programmed projects were identified. Route characteristics are summarized in Table 24.

Figure 13: SR 286 From the International Border to Arivaca-Sasabe Road Route Characteristics

Table 24: SR 286 From the International Border to Arivaca-Sasabe Road Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 286
	Milepost Limits	0 – 12.06
	District	Southcentral
	Speed Limit	55 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Level
	Number of Through Lanes	2
	Functional Classification	Major Collector
Mobility	Existing AADT	212 vpd
	Average Annual Growth Rate	1.0%
	Future (2035) AADT	271 vpd
Safety	Five Year Crash History	No crashes
Bridge	Bridges	Bailey Wash Bridge (MP 8.65)
Pavement	Pavement IRI (Average)	171
	Pavement Cracking (Average)	1.6
Investment History	Recently Completed Projects	Culvert replacement project (2013) MP 12.50 - 12.95
	Programmed Projects	None
	Financial History (2011-2016)	$547,730.82 (Total) $109,546.16 (Average Annual Cost) $9,083.43 (Average Annual Cost/Mile)

This segment has one bridge which is in overall Fair condition. It has a fair rating in deck, substructure and sufficiency, and a good rating for superstructure.

The pavement in this segment has high IRI values from MP 0 to MP 8 and no significant cracking. This corresponds to an area where a private company conducted overweight hauling for a short time in 2014-2015 during construction of a pipeline, which damaged the roadway. The private company provided a patchwork of paving improvements but the area has experienced continuing deterioration. The paving history indicates an irregular paving history, with the most recent project along most of the segment being asphaltic concrete with seal coat from MP 1 to MP 12 in 1982. Since that time, a series of projects from MP 11 to MP 12 have been conducted, with the most recent being a seal coat in 2013.

SR 286 Pavement and Shoulder

The overall cost/mile for this section is high compared to other low volume routes. The majority of costs on this segment were associated with surface maintenance (44.36%), which generally consisted of chip seals with fog coats and crack sealing performed by District Maintenance. This section also experiences a range of ongoing maintenance costs associated with low water crossings, which are located at MP 0.38, 1.00, 1.41, 2.91, 7.01, 9.57, 9.66, 0.52, 11.67, and 11.84. Other significant costs include crack sealing, fence installation, and mill and replace as part of the contract maintenance category, generally at side roads and low water crossings.

Significant costs for this route are associated with low water crossings. Potential reductions in maintenance costs could be achieved with more permanent drainage improvements, such as culverts. The majority of traffic along this segment is related to border patrol activities, therefore it is a recommendation to partner with the US Customs and Border Protection Agency and FWHA to fund maintenance costs. This segment may be eligible for STBG funds for projects regarding safety improvements, an inspection of roadway assets, or the improvement of bridges. Recommendations are summarized in Table 25.

Table 25: SR 286 From the International Border to Arivaca-Sasabe Road Recommendations

Operations/Maintenance	
Drainage Improvements	●
Partnerships	
US Customs and Border Protection	●
Funding/Grant	
STBG Eligible	●

Segment 13: SR 289 From I-19 to Peña Blanca Dam

This section of SR 289 begins west of I-19 just north of Nogales and extends into the Tumacacori Ecosystem Management Area of the Coronado National Forest to Peña Blanca Dam. It is shown in Figure 14 and described in Table 26. The primary purpose of the route is access to the National Forest and various outdoor amenities, mostly associated with Peña Blanca Lake. The segment extends along generally level topography; however, the western portion of the route beginning near MP 7.5 includes many sharp turns. The road is divided to conform to the terrain between roughly MP 7.1 and MP 7.5. Shoulders are generally not present, although a few portions of the route include two-foot shoulders. The posted speed limit also varies along the route. The posted speed limit is 50 mph between MP 2.9 and MP 6. This is reduced to 40 mph to MP 7 and drops again to 25 mph for the remainder of the route. No recommendations or programmed projects are associated with the segment.

Figure 14: SR 289 From I-19 to Peña Blanca Dam Route Characteristics

Table 26: SR 289 From I-19 to Peña Blanca Dam Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 289
	Milepost Limits	0 – 10.83
	District	Southcentral
	Speed Limit	25 - 50 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Level
	Number of Through Lanes	2
	Functional Classification	Minor Collector
Mobility	Existing AADT	198 vpd
	Average Annual Growth Rate	1.9%
	Future (2035) AADT	317 vpd
Safety	Five Year Crash History	1 Total Crash 1 Motorcycle Crash
Bridge	Bridges	No bridges
Pavement	Pavement IRI (Average)	19
	Pavement Cracking (Average)	13.4
Investment History	Recently Completed Projects	No completed projects since 2010
	Programmed Projects	None
	Financial History (2011-2016)	$309,661.33 (Total) $61,932.27 (Average Annual Cost) $5,718.58 (Average Annual Cost/Mile)

There was only one recorded incapacitating crash in the last five years in this segment, which was a motorcycle crash involving excessive speed and alcohol. The entire length of this segment has exceptionally high IRI values and much of the segment also has elevated cracking. MP 10 to MP 11 has an extremely high IRI value. The paving history indicates an irregular paving history, although the most recent project completed was a seal coat along the entire length in 2005.

The overall cost/mile for this section is average compared to other low volume routes. The majority of costs on this segment were associated with traffic control (32%) and drainage maintenance (28%). Due to the number of curves along the segment, traffic control costs are high as three flaggers and sometimes a pilot car are necessary for almost all operations. The costs included paint guidelines and maintaining delineators. Cleaning out the drainages along the segment are a significant reoccurring cost. This segment has several low water crossings, located at MP 3.32, 4.03, 10.27 and 10.58. These low water crossings have reoccurring maintenance costs across several categories, including a significant cost associated with removal of large debris. Other significant costs included surface maintenance and roadside maintenance. For the surface maintenance costs, there were two counts of flush coating in April 2012. Additionally, this segment experiences frequent and reoccurring potholing, which are generally repaired through District Maintenance. There is frequent sign damage in the vicinity of Peña Blanca Dam during hunting season which requires regular sign replacements.

As this route is mostly within the Coronado National Forest, there is potential to partner with the Forest Service or Central Federal Lands to share in maintenance costs. There is also potential to transfer the route to the Forest Service for ownership. Drainage improvements are highly recommended for this route due to the high costs of drainage maintenance and reoccurring maintenance costs associated with low water crossings. Due to the low volumes and recreational nature of the roadway, reduced maintenance with associated signage is recommended. Another option may be to perform data analysis to identify crash patterns near Peña Blanca Lake to determine if conducting an RSA would be beneficial. This route may be eligible for three funding sources: the HSIP, FLAP, or the FLTP. Since the route is mostly on Federal land, there may be eligible projects for some of the grants listed. Recommendations are summarized in Table 27.

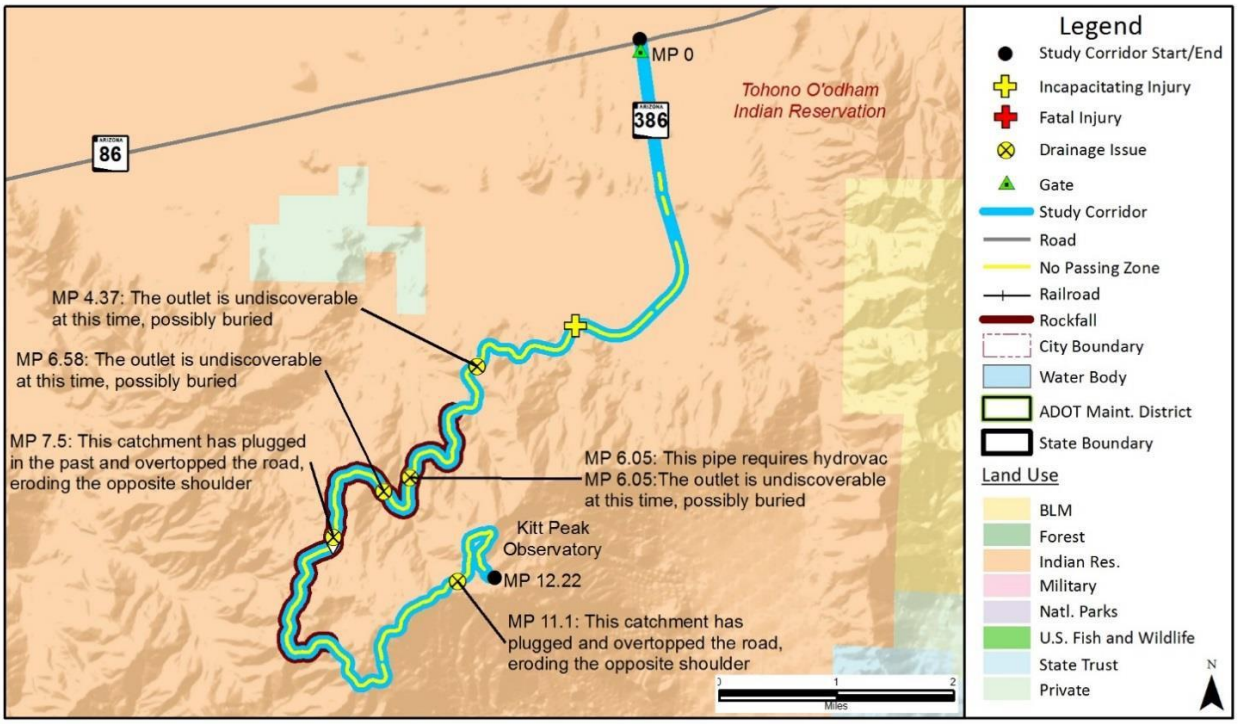
Table 27: SR 289 From I-19 to Peña Blanca Dam Recommendations

Operations/Maintenance	
Drainage Improvements	●
Reduced maintenance with signage ”Minimum Maintenance Road” or "Maintenance Only"	◑
Perform data analysis to identify crash patterns to determine if conducting a Road Safety Assessment is appropriate and install Dynamic Speed Warning Systems/High Reflectivity Striping/Signage/ Centerline or Shoulder Rumble Strip/Raised Pavement Markers	◑
Route Ownership and Guidelines	
Route Transfer	●
Partnerships	
Forest Service	●
Central Federal Lands	◑
Funding/Grant	
Highway Safety Improvement Program (HSIP)	◑
Federal Lands Access Program (FLAP	◑
Federal Lands Transportation Program (FLTP)	◑

Segment 14: SR 386 From SR 86 to Kitt Peak Observatory

This section of SR 386, shown in Figure 15, is located entirely within the Tohono O'odham National Reservation; it is used to access the Kitt Peak Observatory. The route characteristics are summarized in Table 28. The first two miles of the route are level and straight. However, beginning at MP 3, the road climbs up Kitt Peak including many hairpin turns. A gate is located at MP 2. It is closed at 6 pm due to dark sky needs of the Kitt Peak Observatory. Shoulders are generally two feet wide along the segment; several informal pull- offs are located sporadically throughout the route. The posted speed limit also varies. The posted speed limit is 55 mph between MP 0 and MP 2.8. Speeds are reduced to 45 mph through MP 3 and drops again to 25 mph for the remainder of the route. No recommendations or programmed projects are associated with the segment.

Figure 15: SR 386 From SR 86 to Kitt Peak Observatory Route Characteristics



This segment has one bridge, Kitt Peak Bridge, which is in Good condition overall. Only one incapacitating crash was recorded in the last five years in this segment. It involved a motorcycle traveling at a speed too fast for conditions, debris in the roadway, and negotiating a curve.

The entire length of this segment has high IRI values, with a concentration from MP 2 to MP 4 and from MP 10 to MP 11, and some cracking from MP 0 to MP 7 and from MP 10 to MP 11. The paving history indicates paving projects every 9 – 16 years. The most recent projects were in 2006: a seal coat from MP 0 to MP 7 and double chip seal from MP 7 to MP 12.

Table 28: SR 386 From SR 86 to Kitt Peak Observatory Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 289
	Milepost Limits	0 – 12.22
	District	Southcentral
	Speed Limit	25 - 55 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Mountainous
	Number of Through Lanes	2
	Functional Classification	Major Collector
Mobility	Existing AADT	171 vpd
	Average Annual Growth Rate	1.1%
	Future (2035) AADT	224 vpd
Safety	Five Year Crash History	1 Total Crash 1 Motorcycle Crash
Bridge	Bridges	Kitt Peak Bridge (MP 7.5)
Pavement	Pavement IRI (Average)	164
	Pavement Cracking (Average)	5.8
Investment History	Recently Completed Projects	No completed projects since 2010
	Programmed Projects	None
	Financial History (2011-2016)	$449,668.79 (Total) $89,933.76 (Average Annual Cost) $7,369.55 (Average Annual Cost/Mile)

The overall cost/mile for this section is high compared to other low volume routes. The majority of costs on this segment were associated with drainage maintenance (23.44%) and contract maintenance (23.04%), which consisted of crack seal and asphaltic rubber seal from MP 1-12 in 2013. Other significant costs included snow/ice and roadside maintenance. A summary of maintenance related expenditures from 2011 – 2016 is detailed in the Appendix. This route is affected by natural elements such as rock-fall, wildfires and snow/ice in the winter. Additionally, significant damage from snow plows occurs, which requires ongoing surface maintenance. Rockfall damage in the vicinity of MP5 – 9 contributes to maintenance costs across several categories. Specific active rockfall locations include:

- MP 3.9
- MP 4.5
- MP 6.2
- MP 6.5
- MP 7.5
- MP 8.2
- MP 8.4 – 8.5
- MP 8.6 – 8.9
- MP 9.3 – 9.5
- MP 9.7 – 9.8
- MP 10.5
- MP 10.7
- MP 11.7

Specific locations with drainage issues include:

- MP 7.5- this catchment has plugged in the past and overtopped the road eroding the opposite shoulder.
- MP 11.1- this catchment has plugged and overtopped the road eroding the opposite shoulder.
- MP 4.37- the outlet is undiscoverable at this time, possibly buried.
- MP 6.05- this pipe requires hydrovac.
- MP 6.05- the outlet is undiscoverable at this time, possibly buried.
- MP 6.58- the outlet is undiscoverable at this time, possibly buried.

Drainage improvements are recommended to this segment to reduce the significant ongoing maintenance costs associated with flooding and rockfall. Permanent drainage solutions could reduce some of the reoccurring maintenance costs. Additionally, the installation of an RWIS along this segment could reduce costs associated with ongoing snow/ice patrol. Another recommendation is to perform data analysis to identify crash patterns to determine if conducting an RSA would be beneficial. This segment is located entirely within the Tohono O'odham National Reservation, therefore there may be opportunity to partner with the tribe or BIA to share in maintenance costs. The University of Arizona is also a potential partnership option for the roadway.

SR386 During a Snowstorm

This route may be eligible for HSIP and TTPF funding. Both programs may fund a qualifying project since the route is on tribal land. Moreover, through a partnership with the University of Arizona, which funds the Kitt Peak National Observatory. Route recommendations are detailed in Table 29.

Table 29: SR 386 From SR 86 to Kitt Peak Observatory Recommendations

Operations/Maintenance	
Drainage Improvements	●
Roadside Weather Information System	●
Perform data analysis to identify crash patterns to determine if conducting a Road Safety Assessment is appropriate and install Dynamic Speed Warning Systems/High Reflectivity Striping/Signage/ Centerline or Shoulder Rumble Strip/Raised Pavement Markers	◑
Partnerships	
Tribal/BIA	◑
Funding/Grant	
Highway Safety Improvement Program (HSIP)	●
Tribal Transportation Program Funds (TTPF)	◑

Segment 15: SR 88 From Tortilla Flat to SR 188 (Roosevelt Dam)

This section of the SR 88 segment, shown in Figure 16, connects Tortilla Flats to SR 188. It is a historical route associated with the construction of the dams, and historic transportation features such as guardrail, masonry walls and bridges. ADOT does not have documented right-of-way for roadside maintenance; it has contracted for survey of the alignment to define specific areas needed for routine maintenance activity which will serve as a basis for right-of-way delineation.

The entire segment is located within the Tonto National Forest and traverses mountainous terrain with limited sight distance and infrequent passing opportunities. The Central District is responsible for MP 213.39 – MP 220.2 (mostly paved) and Southeast District is responsible for MP 220.2 – MP 242.23 (mostly unpaved). The bridges, steep grades and deep drop-offs are not traffic friendly. In the Tortilla Flat area, the Tortilla Flat Crossing, between MP 213.39 – 220, is planned for construction in FY 2017. The Southeast District was selected for a Federal Lands Access Project to improve the surface to all-weather access from the Apache Lake Marina to Roosevelt Lake. Table 30 summarizes the route characteristics.

Figure 16: SR 88 From Tortilla Flat to SR 188 Route Characteristics

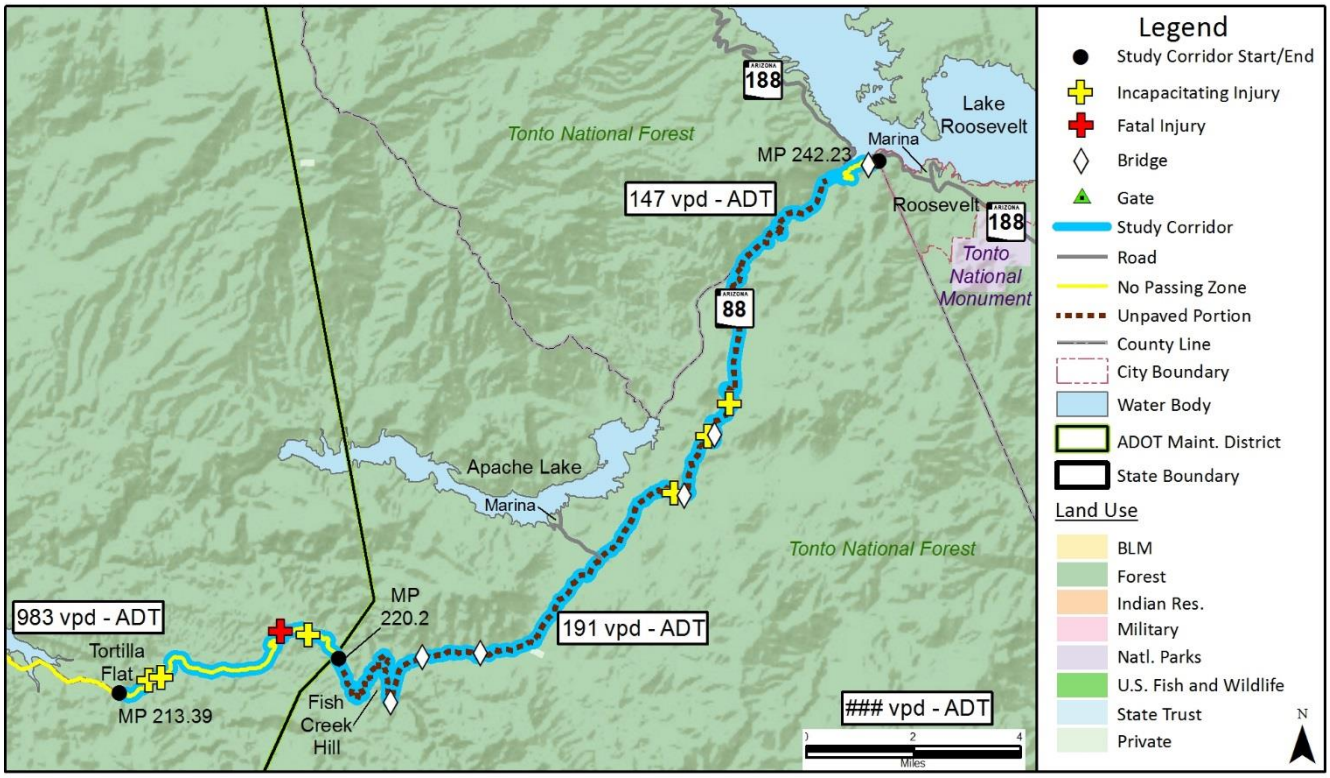


Table 30: SR 88 From Tortilla Flat to SR 188 Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 88
	Milepost Limits	213.39 – 242.23
	District	Central/Southeast
	Speed Limit	25 - 45 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Mountainous
	Number of Through Lanes	2
	Functional Classification	Major Collector
Mobility	Existing AADT	154 vpd
	Average Annual Growth Rate	3.2%
	Future (2035) AADT	340 vpd
Safety	Five Year Crash History	7 Total Crashes 1 Fatality, 5 Motorcycles Crashes
Bridge	Bridges	Fish Creek Bridge (MP 223.5) Lewis Pranty Creek Bridge (MP 224.6) Dry Wash Bridge (MP 225.55) Davis Wash Bridge (MP 231.7) Pine Creek Bridge (MP 233.5) Apache Trail Bridge (MP242.30)
Pavement	Pavement IRI (Average)	146
	Pavement Cracking (Average)	8.2
Investment History	Recently Completed Projects	No completed projects since 2010
	Programmed Projects	Tortilla Flats At-Grade Crossing DCR (current)
	Financial History (2011-2016)	$500,530.91 (Unpaved Total) $671,275.82 (Paved Total) $231,398.06 (Average Annual Cost $8,023.51 (Average Annual Cost/Mile)

This segment has five bridges. All are rated in Fair condition overall; several are one lane bridges. The individual ratings that contribute to the Fair condition ranges from good to fair.

Crash data indicate crashes concentrated at locations with sharp turns, narrow bridge crossings and in the area of Tortilla Flats. Three of the seven crashes occurred on unpaved roadway. Five of the total crashes involved motorcycles. There was only one crash in which a safety device was not used. Additionally, speed too fast for conditions is also consistently a factor, although there is no posted speed on the unpaved portion.

The paved portion of this route extends from MP 213 to MP 223 and continues unpaved to MP 242. Some of the paved portions have elevated IRI values and much of the segment also has elevated cracking. MP 220 to MP 223 has an extremely high IRI value. The paving history indicates irregular paving; the most recent project completed was ACFC with asphaltic rubber along the entire paved length in 1998 and a fog coat from MP 213 – 216.5 in 2009.


SR88 at Fish Creek Hill

The overall cost/mile for the unpaved portion of this segment is high, with the majority of costs on this segment were associated with unpaved surface maintenance (86%). For example, there are multiple episodes of blading unpaved roads on a monthly basis since 2011. Additionally, ADEQ air quality requirements in Maricopa County require that unpaved grading include applications by a water truck which incurs additional operations and associated costs. Spot reconditioning was also a significant part of the surface maintenance costs. Within the Central District portion of the segment, the majority of costs were associated with vegetation control/landscape maintenance (47%) and traffic control (27%). Traffic control costs are high along this segment as a pilot car is typically needed for any maintenance due to narrow, winding conditions with limited sight distance.

This segment is located entirely within the Tonto National Forest. The Salt River Project (SRP) utilizes the route with oversized vehicles to repair power outages for the valley. Potential for route transfer to the Forest Service between Apache Lake and Roosevelt Lake is the most feasible. For the remainder of the segment, from Tortilla Flats to Apache Lake, there are a range of recommendations in Table 31. It is recommended to incorporate reduced speed limits or Dynamic Speed Signs due to the high number of crashes that have occurred along the segment, as noted in the Five Year Crash History in the *Current Conditions* working paper. Another recommendation is to perform data analysis to identify crash patterns to determine if conducting an RSA would be beneficial. Moreover, it is recommended to incorporate “Minimum Maintenance Road” signage to reduce maintenance costs by lowering maintenance standards. This segment may be eligible for STBG, HSIP, FLAP, or FLTP funding. Recommendations are summarized in Table 31.

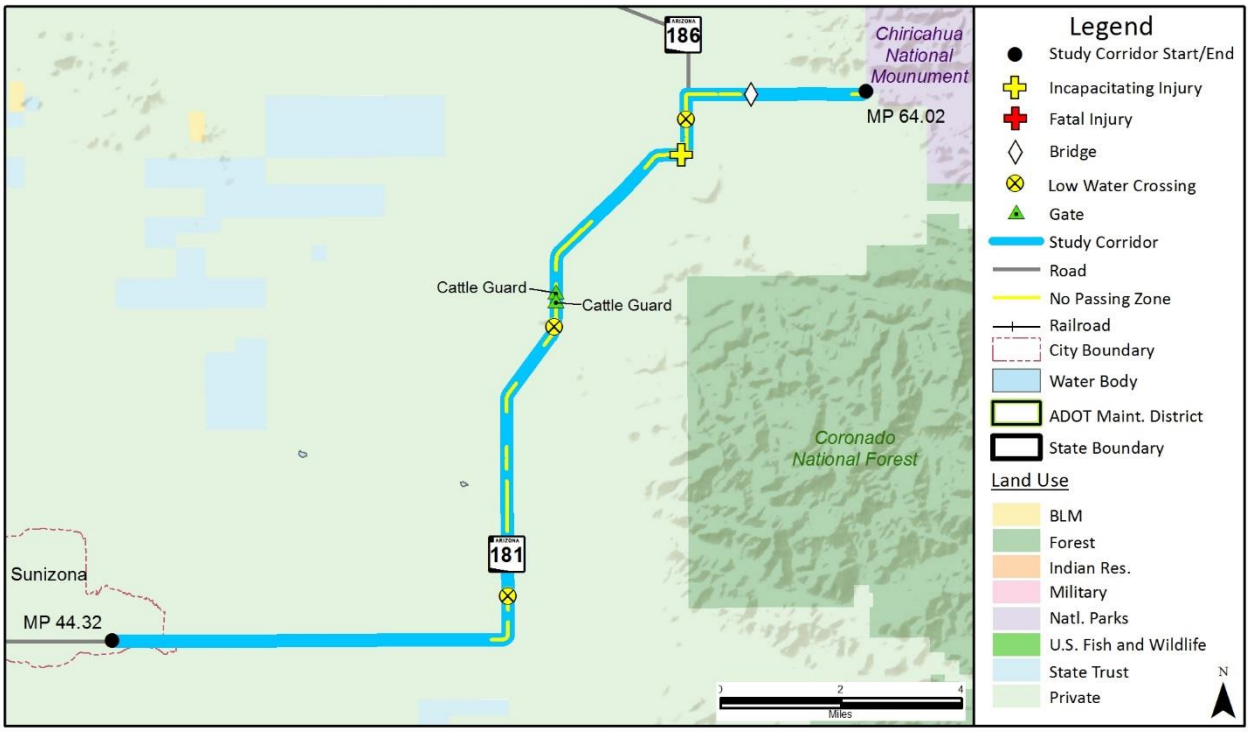
Table 31: SR 88 From Tortilla Flat to SR 188 Recommendations

Operations/Maintenance	
Reduced maintenance with signage ”Minimum Maintenance Road” or "Maintenance Only"	◑
Reduced Speed Limit/Dynamic Speed Signs	◑
Perform data analysis to identify crash patterns to determine if conducting a Road Safety Assessment is appropriate and install Dynamic Speed Warning Systems/High Reflectivity Striping/Signage/ Centerline or Shoulder Rumble Strip/Raised Pavement Markers	◑
Route Ownership and Guidelines	
Route Transfer	◑
Partnerships	
Forest Service	●
Funding/Grant	
STBG Eligible	●
Highway Safety Improvement Program (HSIP)	●
Federal Lands Access Program (FLAP)	◑
Federal Lands Transportation Program (FLTP)	◑

Segment 16: SR 181 From Feather Pine Road to Chiricahua National Monument

This section of SR 181, shown in Figure 17, stretches from the western boundary of Sunizona to the Chiricahua National Monument. Most of the route is surrounded by private land except a small portion of the eastern boundary within the National Monument. The route generally follows the terrain with many low flow crossings. During heavy rainfall, portions of this route adjacent to washes are subject to overtopping, shoulder failures, potholes and ponding. Traffic flow along the route is interrupted. This segment did receive FLAP project funds and is programmed in the FLAP system. Route characteristics are summarized in Table 32.

Figure 17: SR 181 From Feather Pine Road to Chiricahua National Monument Route Characteristics



This segment has one bridge which is in Fair condition overall. The deck, substructure and sufficiency all have a Fair rating, while the superstructure is rated as Good. One incapacitating crash was recorded in the last five years in this segment. This crash involved a motorcycle negotiating a curve where the driver fell asleep at a 90 degree turn.

The paved portions of this segment have elevated IRI values, concentrated from MP 50 to MP 64, and much of the segment also has slightly elevated cracking. MP 63 to MP 64 has extremely high cracking. This segment has an irregular maintenance history and generally in this area the pavement is oxidized as evidenced by a significant number of crack seals. Only two short segments were paved in the last 20 years.

Table 32: SR 181 From Feather Pine Road to Chiricahua National Monument Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 181
	Milepost Limits	44.32 – 64.02
	District	Southeast
	Speed Limit	35 - 55 mph
	Facility Type	Rural
	Flow Type	Uninterrupted
	Topography	Level
	Number of Through Lanes	2
	Functional Classification	Major Collector
Mobility	Existing AADT	148 vpd
	Average Annual Growth Rate	1.5%
	Future (2035) AADT	214 vpd
Safety	Five Year Crash History	1 Total Crash 1 Motorcycle Crash
Bridge	Bridges	Pinery Creek Bridge (MP 62.2)
Pavement	Pavement IRI (Average)	173
	Pavement Cracking (Average)	7.6
Investment History	Recently Completed Projects	None
	Programmed Projects	MP 61 – 64 Reconstruction (FLAP)
	Financial History (2011-2016)	$536,497.07 (Total) $107,299.41 (Average Annual Cost) $5,183.55 (Average Annual Cost/Mile)

The overall cost/mile for this section is average compared to other low volume routes. The majority of costs on this segment were associated with traffic control (27%) and surface maintenance (43%). Within the traffic control category, there were high costs associated with sign maintenance, maintain delineators, and guideline painting for large and small stripes. Surface maintenance includes crack sealing and patching with premix.

For this route, as noted in Table 33, permanent drainage improvements are recommended for the low flow crossings to reduce high reoccurring drainage costs, which will reduce overall maintenance costs. As this route provides access to the Chiricahua National Monument, it is recommended to partner with the National Park Service to share in maintenance costs. SR 181 from the intersection with SR 186 East to the Chiricahua National Monument Boundary was selected for FLAP funds for rehabilitation and paving, and includes drainage and safety improvements. This project is anticipated in the next five years but is not programmed.

SR181 EB Approach to Chiricahua National Monument

Table 33: SR 181 From Feather Pine Road to Chiricahua National Monument Recommendations

Operations/Maintenance	
Drainage Improvements	●
Partnerships	
National Park Service	◑
Funding/Grant	
STBG Eligible	●
Federal Lands Access Program (FLAP)	●

Segment 17: SR 186 From Rocky Road to SR 181

SR 186, shown in Figure 18, is a spur route located in Cochise County off of the old SR 86 prior to the construction of I-10. It provides access to Willcox, Dos Cabezas and the Chiricahua National Monument. The Apache Pass Road which supports the American Museum of Natural History and the Southwest Research Station, is an intersecting county route providing access to the Fort Bowie National Historic Site and I-10 and also used to connect to SR 181. Most of the route is surrounded by private land except for a small portion of the western boundary which is bordered by State Land. There is an average of 2.9 access points per mile with one-foot shoulder or less in both directions. Sight distance is limited at vertical curve locations, with few passing opportunities along the segment. Several segments of guardrail do not meet current standards. No recommendations or programmed projects are associated with the segment. Route characteristics are summarized in Table 34.

Figure 18: SR 186 From Rocky Road to SR 181 Route Characteristics

Table 34: SR 186 From Rocky Road to SR 181 Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 186
	Milepost Limits	340 – 359.42
	District	Southeast
	Speed Limit	50 - 65 mph
	Facility Type	Rural
	Flow Type	Uninterrupted
	Topography	Level - Hilly
	Number of Through Lanes	2
	Functional Classification	Major Collector
Mobility	Existing AADT	234 vpd
	Average Annual Growth Rate	1.7%
	Future (2035) AADT	354 vpd
Safety	Five Year Crash History	1 Total Crash (motorcycle) 1 Motorcycle Crash
Bridge	Bridges	No bridges
Pavement	Pavement IRI (Average)	157
	Pavement Cracking (Average)	3.8
Investment History	Recently Completed Projects	Pavement preservation project (2011) MP 345 - 359.40 Center Line Strip MP 345-351
	Programmed Projects	None
	Financial History (2011-2016)	$518,415.52 (Total) $103,683.10 (Average Annual Cost) $5,338.99 (Average Annual Cost/Mile)

One incapacitating crash in the last five years in this segment was recorded. It involved a motorcycle negotiating a curve and driver inattention.

Most of the segment has elevated IRI values, concentrated from MP 340 to 343, and much of the segment has only slightly elevated cracking. The paving history indicates a paving treatment every ten years or less. The most recent projects were fog coat from MP 340 to MP 345 in 2013 and double chip seal in 2011 from MP 345 to MP 359.5.

SR186 Approaching Dos Cabezas

The overall cost/mile for this section is average compared to other low volume routes. The majority of costs on this segment were associated with drainage (27%) and landscape maintenance (28%), in particular related to maintenance at the many low water crossings. In the case of significant rain events, air evacuation has been needed between low water crossings. Other significant costs included snow/ice maintenance, roadside maintenance, and traffic control.

Drainage improvement are strongly recommended for this route due to high costs associated with drainage maintenance. Based on the location of the route, a partnership with the National Park Service is also recommended to manage and mitigate maintenance of the route. Table 35 shows the recommendations for this segment.

Table 35: SR 186 From Rocky Road to SR 181 Recommendations

Operations/Maintenance	
Drainage Improvements	●
Partnerships	
National Park Service	◑
Funding/Grant	
STBG Eligible	●
Federal Lands Access Program (FLAP)	●

Segment 18: SR 288 From SR 188 to Young

This section of the SR 288 segment, depicted in Figure 19, is located in Gila County, south of Young, and bisects the Tonto National Forest. It has mountainous terrain with numerous hairpin turns and is heavily wooded along the northern section. Additionally, this route is located on the western edge of the Sierra Ancha Wilderness Area, which is designated as a primitive area. Due to the nature of the terrain, some areas have limited sight distance with potentially hidden access points and informal pull-offs. This route is affected by natural elements such as rock-fall, wildfires and snow/ice in the winter. The *Central Arizona Association of Governments (CAG) Regional Transportation Plan* identifies the route as a major truck traffic highway segment in the region and a regionally significant route. Route characteristics are summarized in Table 36.

Figure 19: SR 288 From SR 188 to Young Route Characteristics

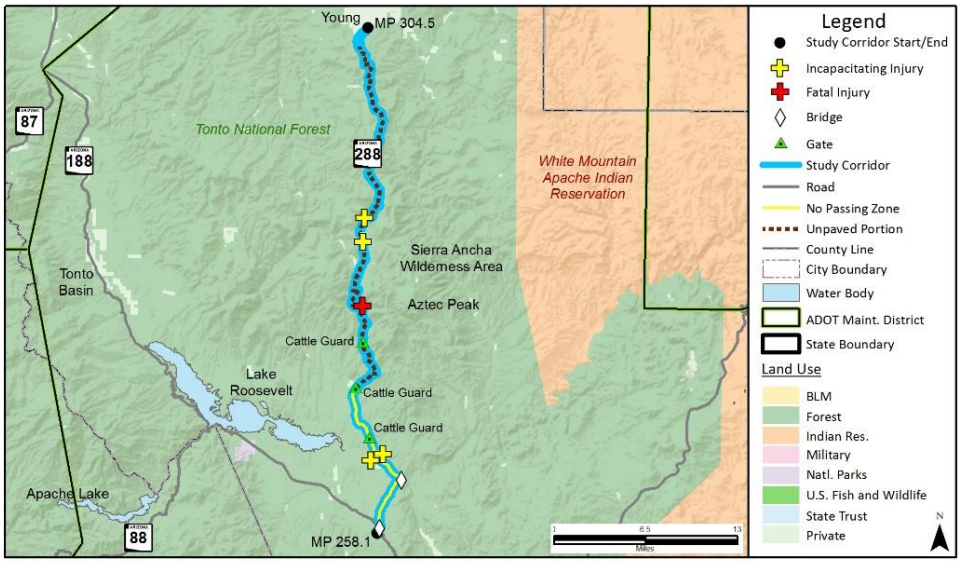


Table 36: SR 288 From SR 188 to Young Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 288
	Milepost Limits	258.1 – 304.5
	District	Southeast
	Speed Limit	25 - 50 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Mountainous
	Number of Through Lanes	2
	Functional Classification	Major Collector
Mobility	Existing AADT	101 vpd
	Average Annual Growth Rate	0.1%
	Future (2035) AADT	105 vpd
Safety	Five Year Crash History	5 Total Crashes 1 Fatality 3 Motorcycle Crashes
Bridge	Bridges	Poison Springs Wash Bridge (MP 258.5) Salt River Bridge (MP 262.44)
Pavement	Pavement IRI (Average)	170
	Pavement Cracking (Average)	11.4
Investment History	Recently Completed Projects	Drainage improvement project (2014) MP 285 – 286
	Programmed Projects	None
	Financial History (2011-2016)	$1,304,119.04 (Total) $260,823.81 (Average Annual Cost) $5,621.20 (Average Annual Cost/Mile)

This segment has two bridges. The Poison Springs Wash Bridge is in Good condition overall and the Salt River Bridge is in Fair condition. All of the ratings contributing to the overall rating are also Fair.

This segment had five recorded crashes, one of which was a fatality. Three crashes involved motorcycles, two of which at MP 265. Three crashes occurred on unpaved roadway. The fatal crash involved a pedestrian during daylight. Speed too fast for conditions was a factor in two of the crashes although there is no posted speed on the unpaved portion.

Most of the paved portions of this segment have elevated IRI values, with high IRI concentrated from MP 264 to MP 266 and from MP 269 to MP 271. Much of the paved portion of the segment also has moderate cracking with elevated values from MP 264 to MP 266. The segment MP 271 to MP 304 is unpaved. The segment from MP 270.4 to MP 304 is designated as improved hard surface and improved aggregate. The sections on SR 288 from MP 270.4 to MP 281.0, from MP 283.0 to MP 287.7, and from MP 303.0 to MP 305.0 were improved with millings and chip seal. However, these sections are not designated as a paved roadway

for operations. SR 288 is an improved aggregate road from MP 281.0 to MP 283.0 and from MP 287.7 to MP 303.0. The paving history indicates a seal coat was applied from MP 258 to MP 262.5 in 1990 and seal coat was applied from MP 262.5 to MP– 268.5 in 2000.

The overall cost/mile for this section is average compared to other low volume routes. The majority of costs on this segment were associated with unpaved surface maintenance (40%), including blading, which is reoccurring multiple times per month, as well as spot reconditioning.

This segment has a high number of crashes, therefore it is recommended to reduce speed limits and/or install dynamic speed signs on the paved portion of the segment. Recommended for the paved and unpaved portion is increased curve signing and installation of advisory speed plates. Another recommendation is to incorporate "Minimum Maintenance Road" signage to lower maintenance expectations and costs. Furthermore, data analysis to identify crash patterns to determine if conducting a Road Safety Assessment would be beneficial. This route primarily provides access to the community of Young and is a candidate for turnover to a local agency. Additionally, as the route bisects the Tonto National Forest, funding partnerships for shared maintenance costs are recommended with the Forest Service or Central Federal Lands. This segment may qualify for five funding sources: the HSIP, FLAP, FLTP, NHFP or the NSFLTP. The HSIP may be the most appropriate source for funding projects regarding safety improvements. The summary of recommendations is shown in Table 37.

Table 37: SR 288 From SR 188 to Young Recommendations

Operations/Maintenance	
Reduced maintenance with signage "Minimum Maintenance Road" or "Maintenance Only"	●
Reduced Speed Limit/Dynamic Speed Signs	●
Perform data analysis to identify install Dynamic Speed Warning crash patterns to determine if conducting a Road Safety Assessment is appropriate and Systems/High Reflectivity Striping/Signage/ Centerline or Shoulder Rumble Strip/Raised Pavement Markers	●
Route Ownership and Guidelines	
Route Transfer	●
Partnerships	
Forest Service	◑
Central Federal Lands	◑
Funding/Grant	
STBG Eligible	●
Highway Safety Improvement Program (HSIP)	●
Federal Lands Access Program (FLAP)	◑
Federal Lands Transportation Program (FLTP)	◑
National Highway Freight Program (NHFP)	◑
Nationally Significant Federal Lands and Tribal Projects (NSFLTP)	◑

Segment 19: SR 366 From SR 191 to Columbine Ranger Station


SR366 Wet Canyon Bend

This section of SR 366, shown in Figure 20, is located in Graham County, south of Safford, and traverses State Trust Land and the Coronado National Forest, providing access to Mount Graham, including the Mount Graham International Observatory. Mount Graham is also home to many unique animal species. From MP 117, the route is considered mountainous and includes numerous hairpin turns and steep cliffs. Most of the route has no effective shoulder although there are numerous informal pull-offs. The speed limit ranges from 55 mph along the eastern section between MP 115.8 and MP 117.75, is reduced to 40 mph through MP 119, and further reduced to 25 mph for the remainder of the route. The route is only paved between MP 113.69 to MP 136.2. At MP 136.2, a "Road Closed" sign and gate marks the beginning of the unpaved route. The route is closed each year on November 15 for ecosystem management. Additionally, the Coronado National Forest has started working with the University of Arizona and Eastern Arizona College to construct a learning center near their visitor center near Columbine for their National Resources program. There are also discussions with the San Carlos Apache Tribe to allow the construction of a building and facility on Mount Graham for ceremonial use. This route is affected by natural elements such as rock-fall, wildfires and snow/ice in the winter. No recommendations or programmed projects are associated with the segment. Route characteristics are detailed in Table 38.

Figure 20: SR 366 From SR 191 to Columbine Ranger Station Route Characteristics

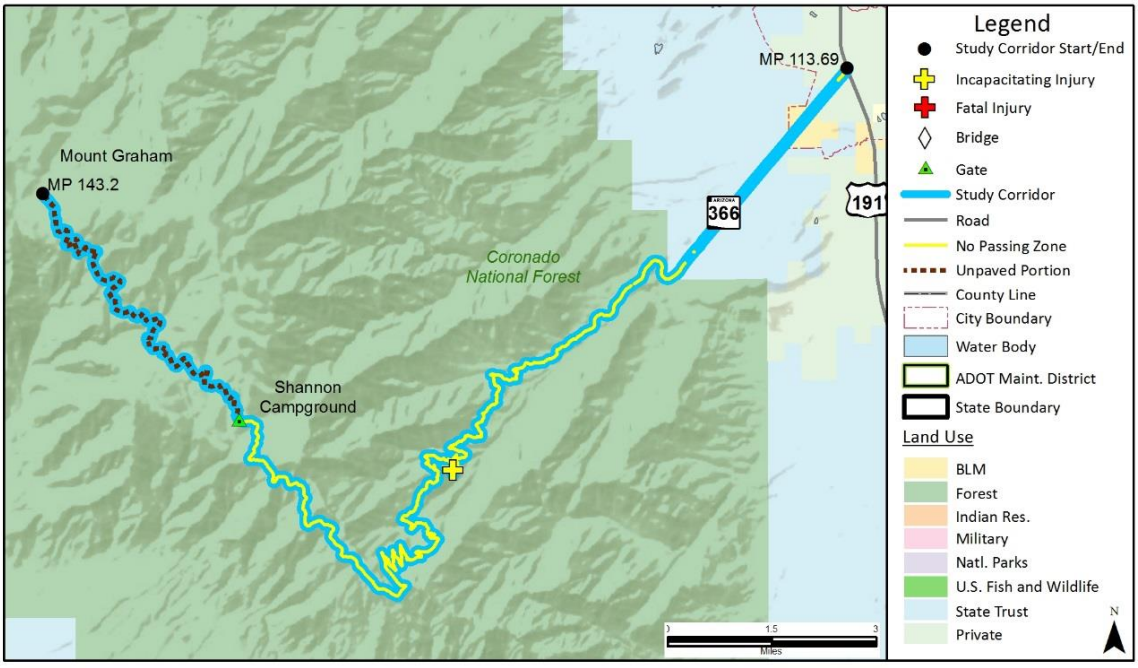


Table 38: SR 366 From SR 191 to Columbine Ranger Station Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 366
	Milepost Limits	113.69 – 143.2
	District	Southeast
	Speed Limit	40 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Mountainous
	Number of Through Lanes	2
	Functional Classification	Major Collector/Minor Collector
Mobility	Existing AADT	147 vpd
	Average Annual Growth Rate	2.5%
	Future (2035) AADT	431 vpd
Safety	Five Year Crash History	1 Total Crash MP 124
Bridge	Bridges	Wet Canyon Bridge (MP 123.54)
Pavement	Pavement IRI (Average)	148
	Pavement Cracking (Average)	12.0
Investment History	Recently Completed Projects	Geometry improvements project (MP 121.05 - 123.58) including road reconstruction, drainage and bridge construction
	Programmed Projects	None
	Financial History (2011-2016)	$168,517.12 (Unpaved Total) $650,516.93 (Paved Total) $163,806.81 (Average Annual Cost) $5,550.89 (Average Annual Cost/Mile)

This segment contains one bridge and has an overall rating of Good. Only one incapacitating crash was recorded in the last five years in this segment, and it was on the paved portion. The crash involved a motorcycle traveling at speeds too fast for conditions.

Most of the paved portions of this segment have elevated IRI values, concentrated from MP 120 to MP 122, and much of the segment also has slightly elevated cracking. MP 128 to MP 130 has extremely high cracking. IRI data was unavailable for MP 122 to MP 137; the section from MP 137 to MP 143 is unpaved. The paving history indicates a prolonged period without paving projects. The most recent project was a fog coat in 2009 from MP 113.5 to MP 139.5.

SR 366 Oversized Load Delivery to Observatory

The overall cost/mile for this segment is average compared to other low volume routes. The majority of costs on this segment were associated with drainage maintenance (23%). Other significant costs included snow/ice maintenance, traffic control, surface maintenance and unpaved surface maintenance.

Table 39 indicates a recommendation to perform data analysis to identify crash patterns to determine if conducting an RSA would be helpful. Due to the low traffic volumes along this route, it is recommended that design standards be reduced at curves where there is not a history of crashes. As the route is within the Coronado National Forest, there may be potential to partner with the Forest Service or Central Federal Lands to share in maintenance costs. The University of Arizona might also be considered as a potential partner in the maintenance of access to the observatory. The university is currently responsible for snow plowing above Shannon Campground. The funding sources for this segment include the HSIP, FLAP, and FLTP. The HSIP may be the most appropriate source for safety improvement projects.

Table 39: SR 366 From SR 191 to Columbine Ranger Station Recommendations

Operations/Maintenance	
Perform data analysis to identify crash patterns to determine if conducting a Road Safety Assessment is appropriate and install Dynamic Speed Warning Systems/High Reflectivity Striping/Signage/ Centerline or Shoulder Rumble Strip/Raised Pavement Markers	◑
Route Ownership and Guidelines	
Flexible Design Standards	◑
Partnerships	
Forest Service	●
Central Federal Lands	◑
Funding/Grant	
STBG Eligible	●
Highway Safety Improvement Program (HSIP)	◑
Federal Lands Access Program (FLAP)	◑
Federal Lands Transportation Program (FLTP)	◑

Segment 20: SR 266 From Bonita to SR 191

SR 266, shown in Figure 21, is located in Graham County, south of Swift Trail Junction. It is bounded by a mixture of BLM land, State Trust Land, Private Land and the Coronado National Forest. There are approximately 2.3 access points per mile. The primary purpose of the route is to access National Forest recreation facilities, the small community of Bonita and Fort Grant. South of Bonita is a regional Graham/Cochise County route commonly called Fort Grant Road. This road serves local agricultural interests and dispersed residential areas. West of Bonita it connects to a local Graham County route commonly known as Aravaipa Road. This road serves ranching operations and the Coronado National Forest and BLM recreation sites. This route is affected by natural elements such as rock-fall, wildfires and snow/ice in the winter. No recommendations or programmed projects are associated with the segment. No pavement data was available along this route. Route characteristics are summarized in Table 40.

Figure 21: SR 266 From Bonita to SR 191 Route Characteristics

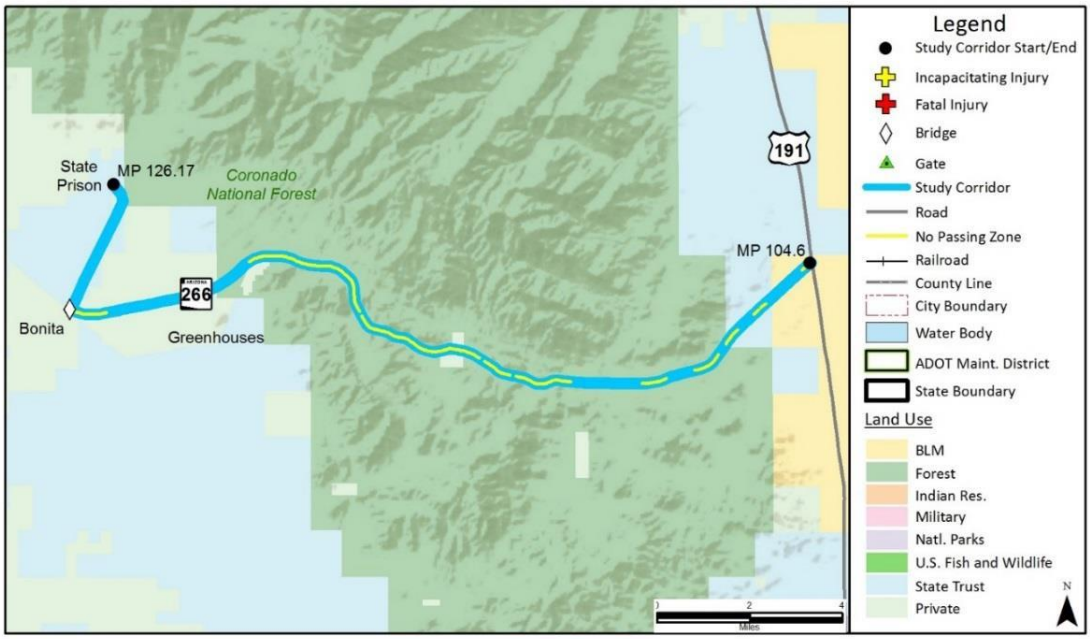


Table 40: SR 266 From Bonita to SR 191 Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	SR 266
	Milepost Limits	126.17 – 104.6
	District	Southeast
	Speed Limit	65 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Mountainous
	Number of Through Lanes	2
	Functional Classification	Major Collector
Mobility	Existing AADT	233 vpd
	Average Annual Growth Rate	2.5%
	Future (2035) AADT	473 vpd
Safety	Five Year Crash History	No crashes
Bridge	Bridges	Pitchfork Creek Bridge (MP 123.12)
Pavement	Pavement IRI (Average)	No data
	Pavement Cracking (Average)	No data
Investment History	Recently Completed Projects	Chip seal (2014) MP 104.60 - 123.78 Pavement preservation (2014) MP 113.76 and 123.78
	Programmed Projects	None
	Financial History (2011-2016)	$317,238.68 (Total) $63,447.74 (Average Annual Cost) $2,941.48 (Average Annual Cost/Mile)

This segment has one bridge with an overall condition of Fair. The deck and substructure are rated Fair but the superstructure and sufficiency rating are Good.

On an annual basis, one maintenance crew provides dedicated maintenance and repairs for approximately three weeks per year. The overall cost/mile for this section is low compared to other low volume routes. The majority of costs on this segment were associated with vegetation control (23%) and traffic control (21%). Other significant costs included roadside, drainage and surface maintenance. In the winter, maintenance crews provide ongoing patrol for snow removal.

Due to the low volume and crash rate, there is an opportunity to incorporate flexible design standards which can reduce overall maintenance costs. The route travels through the Coronado National Forest, and as a result, a partnership with the Forest Service is recommended to share ongoing maintenance costs. This route may be eligible for STBG funds. Recommendations are summarized in Table 41.

Table 41: SR 266 From Bonita to SR 191 Recommendations

Route Ownership and Guidelines	
Flexible Design Standards	◑
Route Transfer	◑
Partnerships	
Forest Service	◑
Funding/Grant	
STBG Eligible	●

Segment 21: US 191 From US 191x near Granville to SR 180-Alpine


US 191 following the Wallow Fire

This section of the US 191 segment, depicted in Figure 22, begins just north of the Morenci mine and is primarily located within the Apache-Sitgreaves National Forest. The route connects the towns of Clifton and Morenci in the south to SR 180 in the north. Legacy ranches, numerous campgrounds and trailheads are located directly off of US 191. The two most popular areas accessed from this segment are the Hannagan Meadow Recreation Area and the Blue Range Primitive Area. The area experiences a spike in traffic during hunting season. This route is affected by natural elements such as rock-fall, wildfires and snow/ice in the winter. US 191 was identified as of major importance for current circulation in the 2004 Apache County Comprehensive Plan. Most of the route includes winding narrow lanes and limited shoulder width. Route Characteristics are presented in Table 42.

Figure 22: US 191 From US 191x near Granville to SR 180-Alpine Route Characteristics

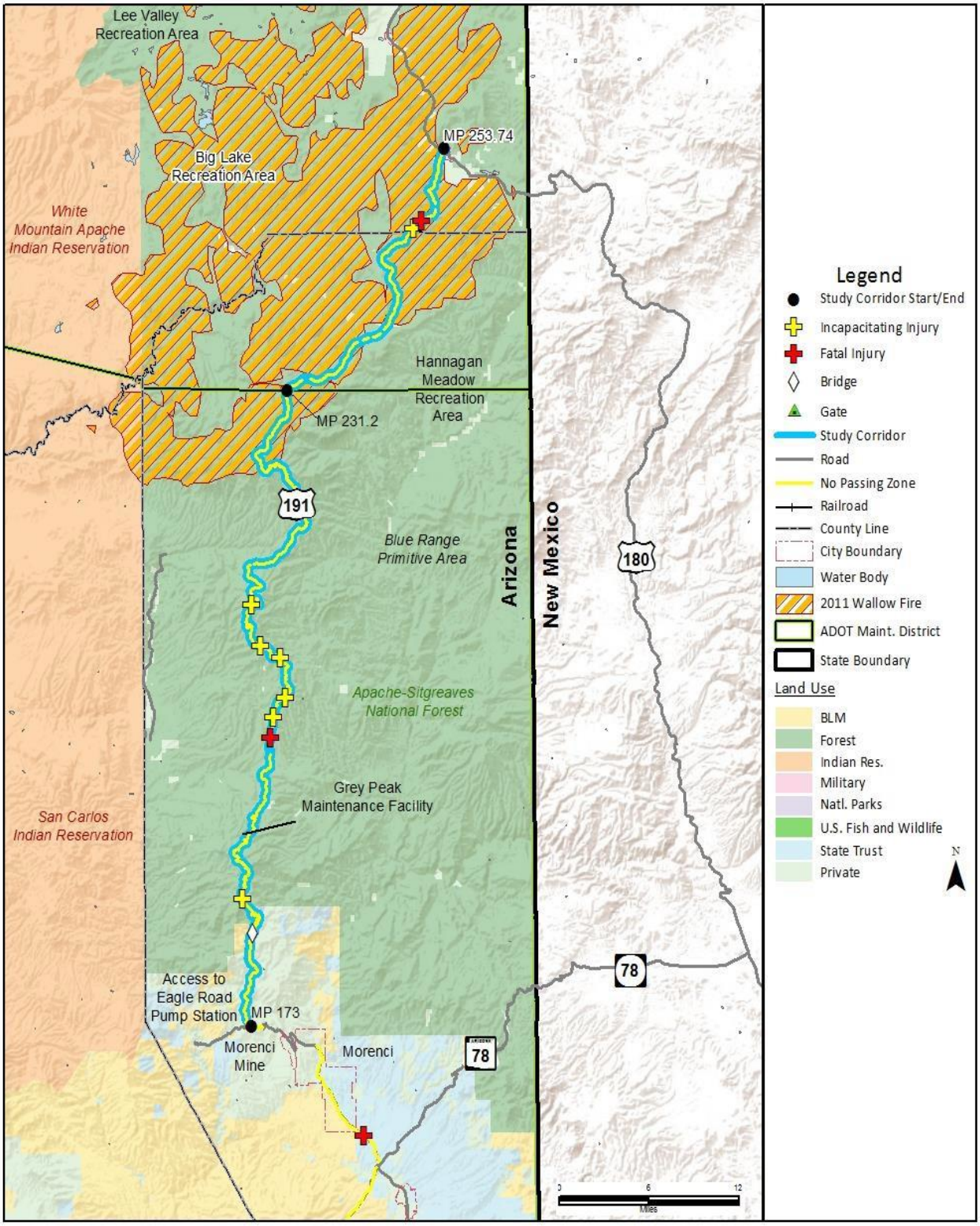


Table 42: US 191 From US 191x near Granville to SR 180-Alpine Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	US 191
	Milepost Limits	173 – 253.74
	District	Southeast/Northeast
	Speed Limit	35 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Mountainous
	Number of Through Lanes	2
	Functional Classification	Major Collector to Rural Major Collector
Mobility	Existing AADT	81 vpd
	Average Annual Growth Rate	1.8%
	Future (2035) AADT	127 vpd
Safety	Five Year Crash History	9 Total Crashes 2 Fatal Crashes 8 Motorcycle Crashes
Bridge	Bridges	Chase Creek Bridge No. 2 (MP 173.4)
Pavement	Pavement IRI (Average)	149
	Pavement Cracking (Average)	4.7
Investment History	Recently Completed Projects	Double chip seal (2013) MP 184.5 - 198 Double slurry seal (2013) MP 225 – 239 Fence replacement (2014) – MP247.8 – 252.5)
	Programmed Projects	None
	Financial History (2011-2016)	$3,291,246.86 (Total $658,249.37 (Average Annual Cost) $8,152.70 (Average Annual Cost/Mile)

This segment contains one bridge which has an overall condition of Good. There were nine crashes in this segment. Seven involved motorcycles; one involved an all-terrain vehicle (ATV). There were six crashes where no safety device was used. Crash hot spots included from MP 194 to MP 207, in winding and mountainous conditions, and two crashes at MP 247.

This segment has a range of elevated IRI values and only slightly elevated cracking. There is a concentration of elevated IRI from MP 173 to MP 192, from MP 195 to MP 203 and from MP 208 to MP 225. The one area of exceptionally high IRI is located between MP 185 and MP 186. This section has a very irregular paving history with the most recent paving project being a fog coat from MP 184.5 to MP 198 in 2013, which overlaps somewhat with the section of elevated IRI.

The overall cost/mile for this segment is high compared to other low volume routes. The majority of costs on this segment were associated with surface maintenance (25% for Northeast District) and snow/ice maintenance (27% for Southeast District). The Northeast district regards this route as priority four and the Southeast District regards it as priority three. The difference is the dedication of resources during winter storms. The Northeast District does not plow the route on nights, weekends, or when other routes require all the resources. The Southeast District is only restricted to plowing during daylight hours.

In the Southeast District, one lane is maintained for local access to Alpine during snow closures. The cost data indicates snowplow activity was engaged throughout the segment, however areas with the highest snowplow expenditures were MP 225 to MP 253. Other significant costs included drainage maintenance and major weather damage, in particular cut cleaning due to rock-fall on shoulder, which occurs every few years. Additionally, the 2011 Wallow fire significantly impacted this roadway. Costs in 2012 were associated with mitigation of fire damage, including tree removal and repairs to the roadway, shoulder and guardrail. A significant cost of $266,887.50 from MP 225 to MP 247 was associated with Contract Tree Removal following the fire. Additionally, ADOT has a small maintenance camp at MP 186 at Grey Peak with two operations technicians throughout the year.

Table 43 shows the recommendations for this route, including consideration of an RWIS installation to reduce ongoing snow/ice patrol costs provided the RWIS is feasible under low cell coverage and the need for solar power. Performing data analysis to identify crash patterns to determine if conducting an RSA would be helpful is also recommended. This route provides regional connectivity in the eastern portion of Arizona, connecting to wilderness, recreation areas and private ranches. It is a demanding section of highway to care for due to the remote, rugged terrain and weather. Fires, deteriorating historic rock retaining walls and snow plowing are all challenges. The portion of US191 that passes through the Morenci open-pit copper mine lies on an easement granted by the Freeport McMoRan Copper and Gold Corporation. The highway must be periodically relocated within the pit to accommodate the operations of the mine which is done at Freeport's expense.

Table 43: US 191 From US 191x near Granville to SR 180-Alpine Recommendations

Operations/Maintenance	
Drainage Improvements	◑
Roadside Weather Information System	●
Reduced maintenance with signage "Minimum Maintenance Road" or "Maintenance Only"	◑
Reduced Speed Limit/Dynamic Speed Signs	◑
Perform data analysis to identify crash patterns to determine if conducting a Road Safety Assessment is appropriate and install Dynamic Speed Warning Systems/High Reflectivity Striping/Signage/ Centerline or Shoulder Rumble Strip/Raised Pavement Markers	●
Route Ownership and Guidelines	
Route Transfer	●
Flexible Design Standards	◑
Partnerships	
Forest Service	◑
Central Federal Lands	◑
Funding/Grant	
STBG Eligible	●
Highway Safety Improvement Program (HSIP)	●
Federal Lands Access Program (FLAP)	◑
National Highway Freight Program (NHFP)	◑
National Highway Performance Program (NHPP)	◑

Based on the boundaries of the mine property and the ore body being processed, Freeport McMoRan has invested funds into a feasibility study regarding permanent relocation of US 191 out of the mine. The implications of relocating the highway is that traffic will be disrupted to one degree or another on US191 between Morenci and Alpine. Three basic alternatives have been envisioned:

- Continue the current practice to realign the highway within the pit but through an inactive portion of the mine.
- Realign the highway on or adjacent to mine property on private, state, BLM or Forest Service lands.
- Close the US191 segment through the mine either temporarily or permanently and dual designate SR78 and US180 to include US191. If a temporary dual-designation is pursued, this could still represent several years or even decades of mine segment closure while the ore body is exposed and processed to its economic limits.

Ongoing projects in the area of the Morenci mine include:

- Grade separation project at the Bee Hill site, between mileposts 171 and 172, where Freeport McMoRan will construct a grade separation structure between highway traffic and mine traffic where currently mine traffic drives across the highway under control of flaggers. Freeport McMoRan desires to have this new feature open to traffic by spring of 2018.
- A realignment project that will nominally be between mileposts 172 and 177 but the actual limits will be refined in the near future. The south terminus of the realignment will essentially match the north terminus of the grade separation project. Projected completion is slated to be mid-2020.

Additionally, several areas would continue to require access, either from both directions or solely from the north, including Hannigan Meadow, Blue Range Primitive Area, other informal recreation sites, and private ranches. Access to the Grey Peak Maintenance Area and the Eagle Road Pump Station just north of Morenci would also be required. If the route were to remain in the state system, there is opportunity to incorporate flexible design standards, as well as open an opportunity for turnover or shared maintenance with the Forest Service or Central Federal Lands.

This segment may be eligible for five funding sources: STBG, HSIP, FLAP, NHFP, or NHPP. STBG or HSIP funds may be most viable due to their flexible nature and focus on safety.

Segment 22: UY 191 From I-10 Exit 355 to US 191

UY 191, shown in Figure 23, is an alternate route connecting I-10 to US 191. It originally provided a shorter connection to and from Safford and New Mexico. The segment has five foot shoulders in both directions. Most of the route is bounded by State Trust Land. Based on findings from the previous US 191 widening study, ADOT may consider transferring responsibility of this route in the future. No recommendations or programmed projects are associated with the segment. Route characteristics are summarized in Table 44.

Figure 23: UY 191 From I-10 Exit 355 to US 191 Route Characteristics

Table 44: UY 191 From I-10 Exit 355 to US 191 Route Characteristics

Category	Characteristic	Value
Roadway Characteristics	Route	UY 191
	Milepost Limits	86.67 – 90.13
	District	Southeast
	Speed Limit	65 mph
	Facility Type	Rural
	Flow Type	Non-signalized
	Topography	Level
	Number of Through Lanes	2
	Functional Classification	Minor Arterial
Mobility	Existing AADT	240 vpd
	Average Annual Growth Rate	1.3%
	Future (2035) AADT	328 vpd
Safety	Five Year Crash History	No crashes
Bridge	Bridges	No bridges
Pavement	Pavement IRI (Average)	150
	Pavement Cracking (Average)	44.6
Investment History	Recently Completed Projects	No completed projects since 2010
	Programmed Projects	Pavement Preservation (current)
	Financial History (2011-2016)	$30,635.31 (Total) $6,127.06 (Average Annual Cost) $1,770.83 (Average Annual Cost/Mile)

This segment has elevated IRI and extremely high cracking. The high IRI is concentrated from MP 87 to MP 89 and the extremely high cracking is from MP 87 to MP 90. The paving history indicates extremely infrequent paving, with asphaltic concrete and fog coat from MP 87 to MP 90.5 in 2005; it was preceded only by a full paving section in 1961.

The overall cost/mile for this section is low compared to other low volume routes. The majority of costs on this segment were associated with vegetation control (39%) and traffic control (46%). Standard swath mowing is a majority of the vegetation control costs. Moreover, the majority of traffic control costs are the maintenance of delineators followed by striping and sign maintenance.

It is recommended to reduce maintenance on this route with “Minimum Maintenance Road” signage. Transferring this route to a local agency is recommended as this route does not serve a state purpose. Additionally, due to the low volumes, it would be appropriate to incorporate flexible design standards as applicable to reduce overall design and maintenance costs. At present, only funding from the State would be available. Further investigation of available grants and funding opportunities would be completed at the time of project development. Table 45 summarizes the recommendations for this route.

Table 45: US 191 From I-10 Exit 355 to US 191 Recommendations

Operations/Maintenance	
Reduced maintenance with signage ”Minimum Maintenance Road” or "Maintenance Only"	●
Route Ownership and Guidelines	
Route Transfer	◑
Flexible Design Standards	●

5.0 SUMMARY

This section summarizes the overall characteristics and recommendations of the low volume routes inventoried and examines trends in crashes, pavement, bridges and financial conditions.

Summary of Route Characteristics

Overall crash characteristics are summarized in Table 46. There is a high number of motorcycle crashes (67%) across the low volume routes, many occurring at high speeds while negotiating curves. Most of the crashes are in daylight in dry conditions. Most of the crashes are incapacitating (89%). Other significant contributing factors were collisions with animals (14%) and driver inattention (11%). Less than half of the passenger vehicles used a shoulder and lap belt (44%); a majority of motorcyclists used helmets (73%).

Table 46: Crash Summary

Category	Total Crash #	Total Crash %
Type	32 Incapacitating 4 Fatal	89% Incapacitating 11% Fatal
Contributing Factors	15 Speed to Fast for Conditions 5 Animal Related 4 Driver Inattention 2 Alcohol Related 2 Fatigue/Fell Asleep 2 Physical Impairment/Illness 1 Access Related 1 Avoiding Object 1 Debris in Roadway	33% Speed to Fast for Conditions 14% Animal Related 11% Driver Inattention 6% Alcohol Related 6% Fatigue/Fell Asleep 6% Physical Impairment/Illness 3% Access Related 3% Avoiding Object 3% Debris in Roadway
Lighting Conditions	18 Daylight 6 Dark - Not Lighted 1 Dark - Lighted 1 Unknown	50% Daylight 17% Dark - Not Lighted 3% Dark - Lighted 3% Unknown
Surface Conditions	33 Dry 2 Snow 1 Wet	92% Dry 6% Snow 3% Wet
Motorcycle	26 Involve Motorcycles 1 Involve ATVs	67% Involve Motorcycles 3% Involve ATVs
Comments	14 Negotiating a Curve 1 Pedestrian 4 Shoulder and Lap Belt Used 19 Helmet Used	39% Negotiating a Curve 3% Pedestrian 44% Shoulder and Lap Belt Used (Passenger Vehicles) 73% Helmet Used (Motorcycles)

An examination of the overall pavement conditions, as summarized in Table 47, indicates that there is a high number of lane miles with Very Poor and Extremely Poor pavement conditions, especially focusing on IRI. This could be related to extreme weather fluctuations, infrequent paving and poor subgrade preparation.

Table 47: Pavement Condition Summary

Condition	IRI		Cracking	
N/A	no data	43 lane miles	no data	21 lane miles
Good	<94.00	78 lane miles	<5.0	229 lane miles
Fair	94.00 – 141.99	84 lane miles	5.0 – 10.0	115 lane miles
Poor	142.00 – 170.99	79 lane miles	10.1 – 20.0	50 lane miles
Very Poor	171.00 – 222.99	119 lane miles	20.1 – 49.9	14 lane miles
Extremely Poor	223.00 - 459	40 lane miles	50.0 – 90	11 lane miles

The overall bridge summary is detailed in Table 48. The bridges along the low volume routes were either in Good or Fair condition, with no significant or concerning ratings.

Table 48: Bridge Summary

Scale	Threshold	Condition	Deck Rating	Sub Structure Rating	Super Structure Rating	Sufficiency Rating
Good	≥ 7	7 bridges	9 bridges	11 bridges	15 bridges	12 bridges
Fair	5 – 6	12 bridges	10 bridges	8 bridges	4 bridges	8 bridges
Poor	≤ 4	-	-	-	-	-

Table 49 and Table 50 summarize the overall cost/mile for each of the routes and costs by category over a five year period, from 2011 to 2016. Overall, five routes have a high level of investment. The most significant categories of investment overall are surface maintenance (22%), traffic control (15%), unpaved surface maintenance (12%), snow/ice maintenance (11%), and drainage maintenance (11%). In many cases, a significant cost is associated with surface maintenance in the absence of paving projects. Also, the unpaved roadways tend to have very high unpaved surface maintenance costs.

Table 49: Route Cost Summary

Level of Investment	Thresholds (Cost/Mile)	Number of Routes
Low	< $3,000	8
Average	$3,000 – $6,000	9
High	> $6,000	5

Table 50: Cost Summary by Category

Category	Total Cost (2011 - 2016)	Percent of Total
Traffic Signals	$19,939	<1%
Snow/Ice Maintenance	$1,351,463	11%
Roadside Maintenance	$961,681	7%
Vegetation Control/ Landscape Maintenance	$940,329	7%
Traffic Control	$1,926,875	15%
Drainage Maintenance	$1,387,370	11%
Surface Maintenance	$2,866,213	22%
Shoulder Maintenance	$272,010	2%
Contract Maintenance	$818,419	6%
Unpaved Surface Maintenance	$1,574,605	12%
Produced Materials	$46,843	<1%
Major Weather Damage	$534,237	4%
Support	$3,752	<1%
Miscellaneous Roadside	$8,312	<1%
Other Highway Maintenance	$52,586	<1%
Non-Routine Maintenance	$60,827	<1%
TOTAL	$12,825,462	100.00%

Summary of Recommendations

Each of the routes has been evaluated based on the data and information previously presented. The overall summary of the routes is provided in Table 51 (Segments 1 – 11) and Table 52 (Segments 12 – 22), grouping recommendations by subcategories: Operations and Maintenance, Route Ownership and Guidelines, Partnerships, and Funding potential. Each of the routes has been evaluated based on potential in each subcategory and ranked by need and opportunity potential, ranging from High, Medium and Low.

Table 51: Summary of Route Recommendations (Segments 1 – 11)

Low ○ ◔ ◑ ◕ ● High

			Segment 1: SR 61 from US 191-Witch Well to New Mexico Northeast District	Segment 2: SR 261 from SR 273 to Milepost 412.5 Northeast District	Segment 3: SR 277S from SR 277 to Old Paper Mill Northeast District	Segment 4: SR 473 From SR 260 to Hawley Lake Dam Northeast District	Segment 5: SR 564 from US 160 to Navajo National Monument Northeast District	Segment 6: SR 180A from US 180 to SR 61-Concho Northeast District	Segment 7: SR 273 from Sunrise Turnoff to Big Lake Northeast District	Segment 8: SR 67 From Jacob Lake to North Rim Northcentral District	Segment 9: SR 99 From 15 Miles South of Winslow to SR 87-Winslow Northcentral District	Segment 10: SR 99 From I-40 to Leupp Northcentral District	Segment 11: SR 83 From Parker Canyon Lake to SR 82 Southcentral District
Roadway Characteristics		Essential for regional system connectivity						✓					
		Primarily serves local travel need, providing access to private residences, ranches, farms, business or other abutting property	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
		Primary access to National Park/Monument					✓			✓			
		Primary access to other recreation areas		✓		✓	✓		✓	✓	✓		✓
		Primary access to education/research facility											✓
		Primary route for safety/security											
		Primary mail route/bus route						✓			✓	✓	
		Functional Classification Major Collector or Higher			✓					✓			✓
		Subcategory Total	◔	◑	◔	◑	◑	◕	◑	◑	◑	◑	◕
	Existing ADT	<400 vpd	✓	✓	*	✓	✓	✓	✓		✓		✓
		400-1000 vpd										✓	
		>1000 vpd								✓			
	Future ADT	<400 vpd		✓	*	✓		✓			✓		✓
		400-1000 vpd	✓				✓		✓			✓	
		>1000 vpd								✓			
Recommendations		**Operations/Maintenance**											
		Drainage Improvements	○	○	○	○	○	◑	○	○	○	○	○
		Roadside Weather Information System	◑	○	○	◑	◑	○	●	●	○	○	○
		Reduced Maintenance with Signage ”Minimum Maintenance Road” or "Maintenance Only"	◑	◑	●	○	○	○	◑	○	●	●	◑
		Reduced Speed Limit/Dynamic Speed Signs	○	○	○	○	○	○	○	◑	○	○	○
		Perform data analysis to identify crash patterns to determine if conducting a Road Safety Assessment is appropriate and install Dynamic Speed Warning Systems/High Reflectivity Striping/Signage/ Centerline or Shoulder Rumble Strip/Raised Pavement Markers	○	○	○	○	○	○	○	●	○	○	◑
		Subcategory Total	◔	○	◔	○	○	○	◔	◑	◔	◔	◔
		Route Ownership and Guidelines											
		Route transfer	◑	○	●	●	●	○	◑	●	●	●	●
		Road closure	○	○	○	○	○	○	○	○	○	○	○
		Flexible Design Standards	○	○	○	○	○	○	○	○	○	○	○
		Subcategory Total	◔	○	◔	◔	◔	○	◔	◔	◔	◔	◔
		Partnerships											
		Forest Service	○	●	○	○	○	○	●	●	○	○	◑
		Central Federal Lands	○	◑	○	○	○	○	◑	◑	○	○	◑
		National Park Service	○	○	○	○	●	◑	○	●	○	○	○
		Tribal/BIA	●	○	○	●	●	○	◑	○	○	◑	○
		US Customs and Border Protection	○	○	○	○	○	○	○	○	○	○	○
		Subcategory Total	◔	◔	○	◔	◑	○	◑	◑	○	○	◔
		Funding/Grant											
		STP Eligible	○	○	●	○	○	○	○	●	○	○	●
		Highway Safety Improvement Program (HSIP)	○	○	○	○	○	○	○	●	○	○	◑
		Federal Lands Access Program (FLAP)	○	◑	○	○	○	○	◑	◑	○	○	◑
		Federal Lands Transportation Program (FLTP)	○	◑	◑	○	○	○	◑	◑	○	○	◑
		Tribal Transportation Program Funds (TTPF)	◑	○	○	●	●	○	○	○	○	◑	○
		National Highway Freight Program (NHFP)	○	○	○	○	○	○	○	○	○	○	○
		National Highway Performance Program (NHPP)	○	○	○	○	○	○	○	○	○	○	○
		Nationally Significant Federal Lands and Tribal Projects (NSFLTP)	○	○	○	◑	◑	○	◑	◑	○	○	○
		Subcategory Total	○	◔	◔	◔	◔	○	◔	◑	○	○	◔
TOTAL			◔	◔	◔	◔	◔	○	◔	◑	○	◔	◔
RANK (Highest Need/Most Opportunity)			**Low**	**Low**	**Medium**	**Medium**	**Medium**	**Low**	**High**	**High**	**Low**	**Low**	**Medium**

** indicates data not available*

Table 52: Summary of Route Recommendations (Segments 12 – 22)

Low ○ ◔ ◑ ◕ ● High

			Segment 12: SR 286 From the International Border to Arivaca-Sasabe Road	Segment 13: SR 289 From I-19 to Peña Blanca Dam	Segment 14: SR 386 From SR 86 to Kitt Peak Observatory	Segment 15: SR 88 From Tortilla Flat to SR 188 (Roosevelt Dam)	Segment 16: SR 181 From Feather Pine Road to Chiricahua National Monument	Segment 17: SR 186 From Rocky Road to SR 181	Segment 18: SR 288 From SR 188 to Young	Segment 19: SR 366 From SR 191 to Columbine Ranger Station	Segment 20: SR 266 From Bonita to SR 191	Segment 21: US 191 From US 191x near Granville to SR 180-Alpine	Segment 22: UY 191 From I-10 Exit 355 to US 191
			Southcentral District	Southcentral District	Southcentral District	Central/ Southeast District	Southeast District	Southeast District	Southeast District	Southeast District	Southeast District	Southeast/ Northeast District	Southeast District
Roadway Characteristics	Essential for regional system connectivity							✓				✓	
	Primarily serves local travel need, providing access to private residences, ranches, farms, business or other abutting property		✓				✓	✓	✓		✓	✓	
	Primary access to National Park/Monument						✓	✓					
	Primary access to other recreation areas		✓	✓	✓	✓		✓	✓	✓	✓	✓	
	Primary access to education/research facility				✓			✓		✓			
	Primary route for safety/security		✓						✓				
	Primary mail route/bus route												
	Functional Classification Major Collector or Higher		✓		✓	✓	✓	✓	✓	✓	✓	✓	
	Subcategory Total		◕	○	◔	◔	◔	●	◑	◔	◑	◕	○
	Existing ADT	<400 vpd	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		400-1000 vpd											
		>1000 vpd											
	Future ADT	<400 vpd	✓	✓	✓	✓	✓	✓	✓			✓	✓
		400-1000 vpd								✓	✓		
		>1000 vpd											
Recommendations	**Operations/Maintenance**												
	Drainage Improvements		●	●	●	○	●	●	○	○	○	◑	○
	Roadside Weather Information System		○	○	●	○	○	○	○	○	○	●	○
	Reduced Maintenance with Signage ”Minimum Maintenance Road” or "Maintenance Only"		○	◑	○	◑	○	○	●	○	○	◑	●
	Reduced Speed Limit/Dynamic Speed Signs		○	○	○	◑	○	○	●	○	○	◑	○
	Perform data analysis to identify crash patterns to determine if conducting a Road Safety Assessment is appropriate and install Dynamic Speed Warning Systems/High Reflectivity Striping/Signage/ Centerline or Shoulder Rumble Strip/Raised Pavement Markers		○	◑	◑	◑	○	○	●	◑	○	●	○
	Subcategory Total		◔	◑	◑	◔	◔	◔	◑	○	○	◕	◔
	Route Ownership and Guidelines												
	Route transfer		○	●	○	◑	○	○	●	○	◑	●	◑
	Road closure		○	○	○	○	○	○	○	○	○	○	○
	Flexible Design Standards		○	○	○	○	○	○	○	◑	◑	◑	●
	Subcategory Total		○	◔	○	◔	○	○	◔	◔	◔	◑	◑
	Partnerships												
	Forest Service		○	●	○	●	○	○	◑	●	◑	◑	○
	Central Federal Lands		○	◑	○	○	○	○	◑	◑	○	◑	○
	National Park Service		○	○	○	○	◑	◑	○	○	○	○	○
	Tribal/BIA		○	○	◑	○	○	○	○	○	○	○	○
	US Customs and Border Protection		●	○	○	○	○	○	○	○	○	○	○
	Subcategory Total		◔	◔	○	◔	○	○	◔	◔	○	◔	○
	Funding/Grant												
	STP Eligible		●	○	●	●	●	●	●	●	●	●	○
	Highway Safety Improvement Program (HSIP)		○	◑	◑	●	○	○	●	◑	○	●	○
	Federal Lands Access Program (FLAP)		○	◑	○	◑	●	●	◑	◑	○	◑	○
	Federal Lands Transportation Program (FLTP)		○	◑	○	◑	○	○	◑	◑	○	○	○
	Tribal Transportation Program Funds (TTPF)		○	○	◑	○	○	○	○	○	○	○	○
	National Highway Freight Program (NHFP)		○	○	○	○	○	○	◑	○	○	◑	○
	National Highway Performance Program (NHPP)		○	○	○	○	○	○	○	○	○	◑	○
	Nationally Significant Federal Lands and Tribal Projects (NSFLTP)		○	○	○	○	○	○	◑	○	○	○	○
	Subcategory Total		◔	◔	◔	◑	◔	◔	◑	◔	◔	◑	○
TOTAL			◔	◔	◔	◔	◔	◔	◑	◔	○	◑	○
RANK (Highest Need/Most Opportunity)			**Low**	**High**	**Medium**	**High**	**Medium**	**Medium**	**High**	**Medium**	**Low**	**High**	**Low**

** indicates data not available*

Table 53 provides an overview of the routes recommended to have the most potential to be removed from the state system. The routes with the highest priority are those which are the best candidates for removal from the state system. The recommendation would be to advance these routes for transfer to another entity. Those ranked medium priority are those with moderate potential, or cases where only a portion of the route is recommended for route transfer. Those ranked low are considered the least likely candidates for removal from the state system.

Table 53: Segments Recommended for Consideration for Removal from State Highway System

Segment	District	Priority
Segment 3: SR 277S from SR 277 to Old Paper Mill	Northeast	High
Segment 4: SR 473 From SR 260 to Hawley Lake Dam	Northeast	High
Segment 5: SR 564 from US 160 to Navajo National Monument	Northeast	High
Segment 8: SR 67 From Jacob Lake to North Rim	Northcentral	High
Segment 9: SR 99 From 15 Miles South of Winslow to SR 87-Winslow	Northcentral	High
Segment 10: SR 99 From I-40 to Leupp	Northcentral	High
Segment 11: SR 83 From Parker Canyon Lake to SR 82	Southcentral	High
Segment 13: SR 289 From I-19 to Peña Blanca Dam	Southcentral	High
Segment 18: SR 288 From SR 188 to Young	Southeast	High
Segment 21: US 191 From US 191x near Granville to SR 180-Alpine	Southeast/Northeast	High
Segment	District	Priority
Segment 1: SR 61 from US 191-Witch Well to New Mexico	Northeast	Medium
Segment 7: SR 273 from Sunrise Turnoff to Big Lake	Northeast	Medium
Segment 15: SR 88 From Tortilla Flat to SR 188 (Roosevelt Dam)	Central/Southeast	Medium
Segment 20: SR 266 From Bonita to SR 191	Southeast	Medium
Segment 22: UY 191 From I-10 Exit 355 to US 191	Southeast	Medium
Segment	District	Priority
Segment 2: SR 261 from SR 273 to Milepost 412.5	Northeast	Low
Segment 6: SR 180A from US 180 to SR 61-Concho	Northeast	Low
Segment 12: SR 286 From the International Border to Arivaca-Sasabe Road	Southcentral	Low
Segment 14: SR 386 From SR 86 to Kitt Peak Observatory	Southcentral	Low
Segment 16: SR 181 From Feather Pine Road to Chiricahua National Monument	Southeast	Low
Segment 17: SR 186 From Rocky Road to SR 181	Southeast	Low
Segment 19: SR 366 From SR 191 to Columbine Ranger Station	Southeast	Low

In cases where removal from the state system may not be feasible or viable in the near future, Table 54 provides a summary of the other types of recommendations for each segment if they are to remain in the state system. These recommendations are focused on reducing overall costs associated with each of the segments.

Table 54: High to Low Priority Recommendations (All Segments)

Segment	District	Priority	Recommendations
Segment 7: SR 273 from Sunrise Turnoff to Big Lake	Northeast	High	Install RWIS, install "Minimum Maintenance Road" signage, or partner with the Forest Service/Central Federal Lands/Tribe/BIA for ongoing maintenance needs.
Segment 8: SR 67 From Jacob Lake to North Rim	Northcentral	High	Install RWIS, reduce speed limit, perform data analysis to determine if conducting an RSA is appropriate and install safety features, or partner with the Forest Service/Central Federal Lands/National Park Service for ongoing maintenance needs.
Segment 13: SR 289 From I-19 to Peña Blanca Dam	Southcentral	High	Incorporate drainage improvements, install "Minimum Maintenance Road" signage, perform data analysis to determine if conducting an RSA is appropriate and install safety features, or partner with the Forest Service/Central Federal Lands for ongoing maintenance needs.
Segment 15: SR 88 From Tortilla Flat to SR 188 (Roosevelt Dam)	Central/ Southeast	High	Install "Minimum Maintenance Road" signage, reduce speed, perform data analysis to determine if conducting an RSA is appropriate and install safety features, or partner with the Forest Service for ongoing maintenance needs.
Segment 18: SR 288 From SR 188 to Young	Southeast	High	Install signage for reduced speed, install "Minimum Maintenance Road" signage, perform data analysis to determine if conducting an RSA is appropriate and install safety features, or partner with the Forest Service/Central Federal Lands for ongoing maintenance needs.
Segment 21: US 191 From US 191x near Granville to SR 180-Alpine	Southeast/ Northeast	High	Incorporate drainage improvements, install RWIS, install "Minimum Maintenance Road" signage, incorporate flexible design standards, perform data analysis to determine if conducting an RSA is appropriate and install safety features, or partner with the Forest Service/Central Federal Lands for ongoing maintenance needs.
Segment	District	Priority	Recommendations
Segment 3: SR 277S from SR 277 to Old Paper Mill	Northeast	Medium	Install "Minimum Maintenance Road" signage.
Segment 4: SR 473 From SR 260 to Hawley Lake Dam	Northeast	Medium	Install RWIS, or partner with the Tribe/BIA to facilitate maintenance costs.
Segment 5: SR 564 from US 160 to Navajo National Monument	Northeast	Medium	Install RWIS, or partner with National Park Service/Tribe/BIA to facilitate maintenance costs.
Segment 11: SR 83 From Parker Canyon Lake to SR 82	Southcentral	Medium	Install "Minimum Maintenance Road" signage, perform data analysis to determine if conducting an RSA is appropriate and install safety features, or partner with the Forest Service/Central Federal Lands for ongoing maintenance needs.
Segment 14: SR 386 From SR 86 to Kitt Peak Observatory	Southcentral	Medium	Incorporate drainage improvements, install RWIS, perform data analysis to determine if conducting an RSA is appropriate and install safety features, or partner with the Tribe/BIA to facilitate maintenance costs.
Segment 16: SR 181 From Feather Pine Road to Chiricahua National Monument	Southeast	Medium	Incorporate drainage improvements or partner with the National Park Service to facilitate maintenance costs.
Segment 17: SR 186 From Rocky Road to SR 181	Southeast	Medium	Incorporate drainage improvements or partner with the National Park Service to facilitate maintenance costs.
Segment 19: SR 366 From SR 191 to Columbine Ranger Station	Southeast	Medium	Install RWIS, perform data analysis to determine if conducting an RSA is appropriate and install safety features, incorporate flexible design standards, or partner with the Forest Service/Central Federal Lands.
Segment	District	Priority	Recommendations
Segment 1: SR 61 from US 191-Witch Well to New Mexico	Northeast	Low	Install RWIS, install "Minimum Maintenance Road" signage, or partner with the Tribe/BIA to facilitate maintenance costs.
Segment 2: SR 261 from SR 273 to Milepost 412.5	Northeast	Low	Install "Minimum Maintenance Road" signage, or partner with the Forest Service/Central Federal Lands to facilitate maintenance cost.
Segment 6: SR 180A from US 180 to SR 61-Concho	Northeast	Low	Incorporate drainage improvements, or partner with the National Park Service to facilitate maintenance costs.
Segment 9: SR 99 From 15 Miles South of Winslow to SR 87-Winslow	Northcentral	Low	Install "Minimum Maintenance Road" signage.
Segment 10: SR 99 From I-40 to Leupp	Northcentral	Low	Install "Minimum Maintenance Road" signage, or partner with the Tribe/BIA to facilitate maintenance costs.
Segment 12: SR 286 From the International Border to Arivaca-Sasabe Road	Southcentral	Low	Incorporate drainage improvements, or partner with the U.S. Customs and Border Protection to facilitate maintenance costs.
Segment 20: SR 266 From Bonita to SR 191	Southeast	Low	Incorporate flexible design standards, or partner with the Forest Service to facilitate overall maintenance costs.
Segment 22: UY 191 From I-10 Exit 355 to US 191	Southeast	Low	Install "Minimum Maintenance Road" signage, or incorporate flexible design standards.

6.0 BEST PRACTICES AND GUIDELINES

Low Volume Route Best Practices

Low volume activity on a roadway demands an assessment of the road's intent and performance. In the case of a designated state highway, it requires a thorough consideration of the reasons for low use and demands on state resources if usage levels are expected to continue to be low volume. Understanding these elements of the roadway can help the state make an informed decision about the proper levels of maintenance and capital investment to ensure a safe operating environment for users. Alternatively, it can help determine if the state highway designation should be modified to address an updated roadway purpose.

The process for making any decision regarding a low volume state highway requires close coordination with property owners served by the road and roadway users, an evaluation of the conditions of the road, and an analysis of how the road has been managed over time. For purposes of this analysis, a survey of practices in literature and in other areas was conducted and summarized as representative of typical practices associated with the LVR questions facing ADOT.

Best Practices Review

The Transportation Research Board (TRB) sponsors a quadrennial Conference on Low-Volume Roads that focuses largely on road surface materials and maintenance. Although few papers address traffic operations or safety and how an LVR should be managed for optimum performance, one pertinent conference paper by Calvert and Wilson *(Incremental Safety Improvements for Unpaved Rural Roads, 1999)* noted that full conformance to standard minimum criteria is not reasonable, viable, or necessary in cases with unpaved rural roads. The question may be how that conclusion applies to a state highway LVR. Understanding what that could mean is critical to establishing a viable and sustainable LVR approach for ADOT.

AASHTO's Roadside Design Guide (RDG) (2002) addresses issues such as clear zones, sideslopes, roadside objects, and barriers. According to the guide, clear zone widths for the lowest volume road category (under 750 ADT) with a design speed of 55 mph range from 8 to 18 feet. The RDG notes that its barrier warrants may not be cost-effective on low-volume roads and recommends that highway agencies "develop similar warranting based upon their own cost-effectiveness evaluations."

AASHTO recently published *Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT # 400) (2001).* Defining Very Low Volume Routes as those whose "primary function is to provide access to residences, farms, businesses or other abutting property," the report suggests guidelines for several functional subclasses of local roads based primarily on user type. The report generally assumes that most motorists are familiar with the roadway and its geometry. Separate guidelines are provided for the following roadway distinctions:

- Low speed (0 to 45 mph) vs. high speed (> 45 mph)
- Newly constructed vs. reconstructed
- Paved vs. unpaved
- Three ADT levels: 100 vehicles per day (vpd) or less, 100 to 250 vpd, 250 to 400 vpd

AASHTO permits the use of different design parameters on low-volume roads, particularly at low-risk locations, defined as those not near intersections, narrow bridges, railroad-highway grade crossings, sharp curves, or steep downgrades. For example, allowable stopping sight distances are shortened in low-risk locations by using a perception-reaction time of 2.0 sec, rather than the Green Book value of 2.5 sec, and a deceleration rate of 3.4 ft/sec^2, rather than 11.2 ft/sec^2.

Several states have developed their own manuals for LVR operations. The most complete example is the *Handbook of Traffic Control Practices for Low Volume Rural Roads (1991)* developed by the Kansas Department of Transportation. This handbook defines low-volume rural roads as "county and township roads carrying less than 400 vehicles per day." The intent of the manual is to balance safety and cost and the suggested practices are highly dependent on the principles of driver expectancy, positive guidance, and consistency in the nature of the road from one section to another.

According to an article from the University of Kansas Transportation Center, *Closing a Rural Road: Does it Make Economic Sense? (2014)*, Kansas is looking at ownership and maintenance of low volume rural roadways as a way to reduce construction and maintenance costs. Closing a road, or designating a road as "a minimum maintenance road," may be a consideration in some circumstances. State statute also designates procedures for classifying a road as a "minimum maintenance road". Following a public hearing process, a road may be re-signed as a "minimum maintenance road." This is intended to notify drivers of potential risks and manage the liability associated with maintaining a roadway to normal standards. A minimum maintenance road is not the same as closing a road, but allows standards to be adapted to the low demand on the roadway. A minimum maintenance road "...needs some maintenance and should be passable during dry weather. The road should not have hidden defects that could cause an accident, such as a washed-out culvert" (*Kansas Local Road Management Handbook, 2011*). Additionally, this article notes that Nebraska also utilizes the term "minimum maintenance road" and will not designate a road as minimum maintenance if it is (1) a mail route, (2) a school bus route, or (3) the only access to an occupied building.

Other states with LVR guidance include New York and Washington State. New York permits the use of a "MINIMUM MAINTENANCE ROAD" sign on an unpaved, low volume road. The *Washington State Modifications to the MUTCD (1996)* includes a provision to use the "PRIMITIVE ROAD" sign on a portion of a county road that:

- Is not classified as part of the county primary road system,
- Has a gravel or earth driving surface, and
- Has an average annual daily traffic of one hundred or fewer vehicles

An accompanying "CAUTION – NO WARNING SIGNS" sign may also be posted with or without a "NEXT XX MILES" plaque.

According to *Low Volume Road Program in Oregon (2013)*, Oregon began a Low Volume Road (LVR) Preservation Program in 1999 which defined LVR as having an ADT less than 1,000 vehicles per day. By 2009, the threshold was increased to 5,000 daily vehicles. The intent of the program was to maintain LVRs at 1999 conditions with thin "maintenance only" treatments such as chip seals and thin overlays.

Design Standards

The Manual on Uniform Traffic Control Devices (MUTCD) (2009) is the official national standard specified by the Code of Federal Regulations for traffic control on public streets, highways and bicycle trails. It limits application of LVR regulations to roadways under 400 vehicles per day that are not on a designated state highway system. That makes a consistent approach to managing LVRs on designated state highways difficult to establish. Additionally, the *Handbook of Traffic Control Practices for Low Volume Rural Roads (2005)* serves as a supplemental document to the 2003 MUTCD specifically for LVR.

More recently, in 2015 the Maricopa County Department of Transportation (MCDOT) developed design standards for Very Low Volume Roads. These guidelines are intended to be used on local residential roads providing direct access only to residential properties, roadways less than 400 ADT, and where the road does not carry through traffic. These design standards include:

- Design speed
- Lane width
- Clear zone
- Cross sections
- Pavement structure
- Surface stabilization
- Right-of-way
- Horizontal alignment
- Profile grades
- Sight line distance
- Stopping site distance
- Vertical curves
- Drainage design
- Encroachments
- Fencing
- Driveways

The *US Forest Service (USFS) Handbook (1992)* and *Sign and Poster Guidelines for the Forest Service (1998)* provide extensive detail on the designation of various roadway maintenance levels based on volume, type, class and composition of traffic, surface type, travel speed, user comfort and convenience, and environmental protection needs as well as signing information relevant to the special needs of Forest Service roads. For example, speed warrants for use of Turn and Curve warning signs are reduced (from the MUTCD) by 10 mph due to the lower speeds on these roads. In addition, the USFS places traffic signs on dead-end roads only for the inbound motorist.

Safety Treatments for LVR

The study *Highway Safety Challenges on Low-Volume Rural Roads (2005)* examined the crash occurrence and potential safety treatments on low-volume rural roads with less than 400 vehicles per day based on rural state

highways in New Mexico. Based on the findings from this study, the following safety treatments may be cost-effective and deserve consideration for application on LVR within Arizona:

- Replace signs that have been damaged or lost their retro-reflectivity.
- Require that Stop Ahead signs be placed in advance of all STOP signs on these routes with approach segment lengths greater than 10 miles.
- Use larger warning signs at sites where getting the drivers' attention is essential.
- Limit sign installations to those necessary.
- Use animal crossing signs judiciously.
- Install advisory speed plaques, large arrows, and/or properly-spaced chevrons at curves where the safe speed is below the posted speed limit.
- Consider using the new NO TRAFFIC SIGNS sign on appropriate, unpaved roadways.
- Use edge line markings on all paved low volume roads with a posted speed limit of 45 mph or greater, as well as center line markings where the traveled width exceeds 18 ft.
- Use properly-spaced delineators to outline confusing alignments, and indicate the edge of the roadway when the side slope is precarious but not warranting of a greater treatment.
- Use object markers for obstructions near the roadway and for positive guidance.
- Consider using transverse rumble strips on approaches to STOP signs on segments where the distance from the previous stop is more than 10 miles. Also consider placing them in advance of horizontal curves when the site's accident history suggests more aggressive warnings are necessary.
- Install guardrail if an embankment is extremely deep or steep, or if the site's accident history suggests this more expensive treatment would be beneficial.
- Use Jersey barriers for containment of falling rocks that would otherwise enter the roadway.
- Design reconstructed roads with at least 10-ft lanes and 2-ft shoulders; 11-12 ft lanes are preferred on those roads with a design speed of 60 mph or more.
- Avoid use of excessive superelevation in areas where snow and ice are prevalent.

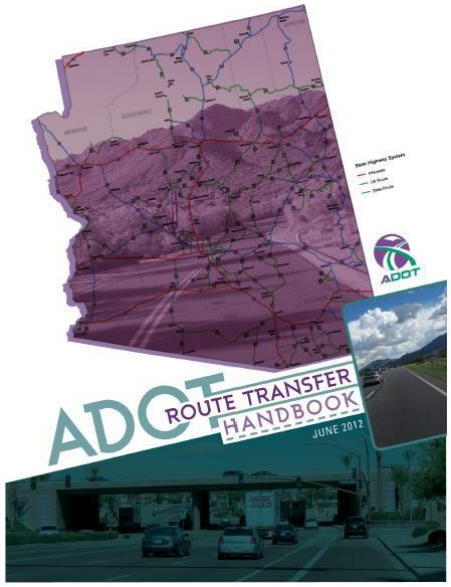
Low Volume Route Guidelines

For future consideration, ADOT should assess current expenditures on low volumes roads and establish a review process to ensure all low volume facilities are managed as efficiently as possible. As a recommended practice, the following should be evaluated on a periodic basis and on any roadway that meets the definition of a low volume road:

- If a low volume road does not serve a state or national purpose, do not accept it into the State Highway system. If it is already in the State system, refer to this report to divest or reduce the State's responsibility for operations and maintenance in cooperation with those who benefit directly from the roadway's existence.

- If a low volume road supports the goal of establishing and maintaining systemwide connectivity, adapt the maintenance and operations practices to be consistent with the level of use, including a reduction

in maintenance frequency and investment, but ensuring an acceptable level of operating safety for motorists as recommended in this report. The level of maintenance for low volume routes should generally follow AASHTO guidelines, although for unique circumstances the best practices provides additional guidance.



ADOT's "Route Transfer Handbook" specifies the methodology to transfer a State Highway to another entity. To ensure that ADOT can sustain its primary mission of facilitating safe and efficient regional and statewide transportation connectivity, a cooperative process was developed to work with local and tribal government agencies to evaluate the historic, current, and future functions of certain State highways to determine which agency is best suited to provide long-term facility ownership and management.

The Route Transfer Handbook describes the processes and procedures associated with transfers of road jurisdiction, both to and from the State Highway System. The intended users of the Handbook are ADOT, local government agencies, tribal governments, Councils of Governments (COGs), Metropolitan Planning Organizations (MPOs), and other agencies that may be involved in the decision-making process regarding jurisdictional responsibility for the State Highway System. The Handbook is intended to be a guidance document. There is significant flexibility in the route transfer process. The process outlined in this Handbook may be modified to match the needs of the route transfer proposal.

7.0 CONCLUSIONS

The State of Arizona has a number of low volume routes that are designated as State Highways. Some of these facilities do not warrant the State Highway designation because they do not serve a state or national purpose in the transportation system. The analysis in this report identifies some facilities where a transfer of the roadway to an underlying jurisdiction or agency would be appropriate.

At the same time, there are other roadways that, despite low usage levels, are important to the State's role in providing systemwide transportation connectivity. These should retain their State Highway standing, but may afford ADOT an opportunity to fine-tune maintenance and operations practices to be more in keeping with the level of usage on the roadway. Recommendations for how to adjust maintenance practices are identified in the individual segment discussions and mention the potential funding sources that could aid in establishing a "right sized" low volume road maintenance strategy.