CLIMBING AND PASSING LANE
PRIORITIZATION STUDY

Executive Summary

February 2015

ADOT JACOBS

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1. PROJECT OVERVIEW

In 1999, the Arizona Department of Transportation (ADOT) commissioned a study to:

- Establish a process to identify locations where a passing or climbing lane would provide benefit to the traveling public; and
- Rank the identified passing and climbing lanes locations by the most effective and feasible projects.

The end result of that study was a prioritized list of general locations for passing and climbing lanes within Arizona. In 2003, the study was updated to refine the previous methodology and to identify and reprioritize passing and climbing lane locations. Since this study was completed there has been a significant change in traffic patterns on the Arizona State Highway System that warranted the need to develop an updated list of passing and climbing lane candidate locations. The purpose of this study is to further enhance the 2003 methodology and to develop a new priority list of locations for passing and climbing lanes utilizing ADOT's more robust and current transportation datasets.

For the purpose of this study, passing and climbing lanes are defined as:

Passing Lane - *Additional lane on highways to facilitate the passing of all types of slow moving vehicles at locations other than sustained grades where passing opportunities are unavailable or very limited over a long stretch of highway.*

Climbing Lane - *Additional lane on steep upgrades to facilitate the passing of trucks and slow moving vehicles whose speed drops because of the sustained grade rather than a lack of passing opportunity over a long stretch of highway.*

Key benefits of incorporating passing and climbing lanes on highways include:

- Reduced delays at specific bottleneck locations, such as steep upgrades where slow-moving vehicles are present;
- Improved overall traffic operations by breaking up traffic platoons and reducing delays caused by inadequate passing opportunities over substantial lengths of highway; and
- Improved safety by reducing the need for passing vehicles to travel in the opposing lane.

While passing and climbing lanes are physically identical, they serve two different purposes. Usually passing lanes are used on two-lane highways, while climbing lanes are utilized on extended upgrade locations on two-lane and multilane highways.

- For two-lane highways with moderate to high traffic volume levels, lack of passing opportunities at regular intervals often results in long queues and poor performance. In lieu of costly widening projects, adding a passing lane at these locations alleviates the problem.
- For two-lane highways with extended upgrade locations, trucks and other slow moving vehicles experience significant drop in speed causing long queues and poor performance even with low traffic volume levels. Adding a climbing lane at these locations alleviates the problem and

significantly enhances safety by reducing the need for passing vehicles to maneuver into the opposing lane.

- For multilane highways, "no passing" zones are not an issue. However, a highway with extended upgrade locations and high truck traffic causes the trucks to experience a significant drop in speed results in excessive queuing and unsafe conditions. Adding a climbing lane at these locations alleviates the problem.

For these reasons, this study identified, evaluated, and prioritized passing and climbing lanes for the following scenarios:

- Passing lanes on two-lane highways
- Climbing lanes on two-lane highways
- Climbing lanes on multilane highways

PURPOSE AND NEED

With the ultimate purpose of enhancing safety and improving mobility, the *Climbing and Passing Lane Prioritization Study* was initiated to develop a prioritized list of candidate locations for climbing and passing lanes. The need for this study stems directly from ADOT's desire to increase safety and mobility along the Arizona State Highway System. The project purpose is demonstrated with the following statement of need:

- Update the Methodology. The previous study and methodology has not been updated since 2003. ADOT now has more accurate data and several newer datasets which could be utilized to enhance the previous methodology to produce better recommendations.
- Update the List of Passing/Climbing Lane Locations. Since the last update, there has been a significant change in traffic patterns on the Arizona State Highway System that warranted the need to develop an updated list of passing and climbing lane candidate locations. In addition, several of the recommendations from the previous study have since been implemented and the list has to be updated.
- Address Safety and Improve Mobility. Adding a passing/climbing lane along an existing highway is one of the most cost effective ways to enhance safety and improve mobility. New passing/climbing lane locations would provide a tremendous benefit to the traveling public.

PROJECT CHARTER

At the first Technical Advisory Committee (TAC) meeting, a *Project Charter* was developed with assistance from members of the TAC. As part of the Project Charter, a *Mission Statement* and *Goals* were developed to provide guidance to the study team.

Mission Statement

Develop a needs based prioritization for Climbing and Passing Lane locations on the Arizona State Highway System

Study Goals

Quality - Enhance safety and improve mobility; when typical design standards can't be met, reference the 2010 Highway Safety Manual for additional guidance; work towards objective and needs based prioritization for climbing and passing lanes; consider best practices from other states

Communication - Create a website to house climbing and passing lane study documents; reach every team member and/or intended recipient when communicating

Issue Resolution - Be proactive with resolving issues; understand the process for how this team moves issues forward and resolve issues timely; discuss at TAC meetings as necessary to communicate decisions to all team members

Teamwork - Interrelationships understood; work together to meet the challenge; take ownership of the study

Schedule - Keep and attend scheduled meetings; meet the delivery dates for the prioritization

Budget - Identify projects that can realistically be programmed; sensitivity to the route and route continuity (best bang for the dollar); communicate the need for specified funding for climbing/passing lanes

Project Delivery - Reach consensus on how to prioritize; include functional class factor when setting priorities; prepare a needs based prioritization that is defendable and can be reviewed annually – the end result is the list

TECHNICAL ADVISORY COMMITTEE

The study is guided by a Technical Advisory Committee (TAC). The role of the TAC is to provide technical guidance, support, advice, suggestions, recommendations, and to perform document reviews throughout the study process. TAC members included representatives from:

ADOT Statewide Project Management

ADOT Engineering Districts

ADOT Multimodal Planning

ADOT Traffic Design/Safety

ADOT Partnering Section

ADOT Roadway Design

ADOT State Engineer's Office

ADOT Communications Division

Federal Highway Administration

AGENCY/STAKEHOLDER COORDINATION

To develop a thorough understanding of the issues, deficiencies, and needs, the study team identified a core group of stakeholders and conducted two rounds of interviews. The stakeholders included representatives from each ADOT District office. The study team also sent out email notifications to each Council of Governments (COGs) and Metropolitan Planning Organizations (MPOs) to request feedback. Stakeholders' feedback summary is presented in later chapters of this document.

ADOT PARTNERING PROCESS

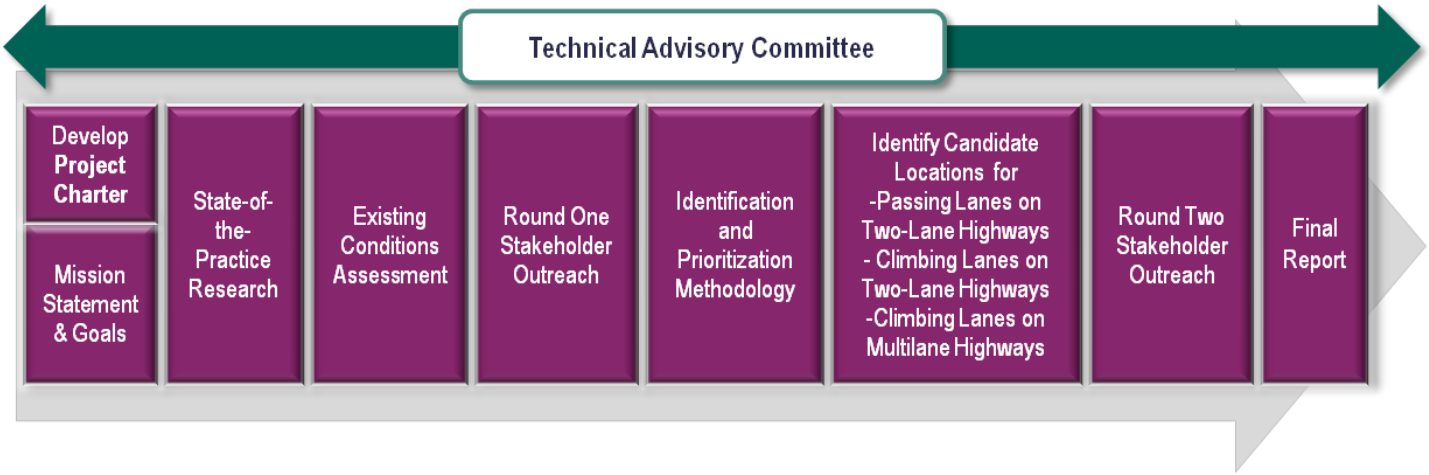
The *Climbing and Passing Lane Prioritization Study* was conducted as per the guidelines of ADOT's Partnering Process. Partnering is a process of collaborative teamwork to achieve measurable results through agreements and productive working relationships. The Partnering Principles include Communication, Commitment, Cooperation, and Continuous Improvement, and assist project teams to jointly solve problems, increase work efficiency, improve the project delivery process, and build and strengthen relationships. Project teams that agree on measurable goals, and utilize the partnering principles are more successful, and meet or exceed budget and schedule goals. In short, Partnering is a formal way for groups to work together and resolve issues.

The ADOT Partnering Office assisted with facilitating the creation of the collaborative partnership agreement. In addition, the Partnering facilitator assisted with setting up the measurement tool, Partnering Evaluation Program, or PEP. At the end of each TAC meeting, members were requested to complete and submit the PEP forms.

STUDY PROCESS

An eight step comprehensive process was used to complete this study. The study team maintained contact with TAC and stakeholders by meeting at regular intervals through the course of the study. Figure 1.1 illustrates the process utilized for this study.

Figure 1.1: Study Process



PASSING/CLIMBING LANES - STRATEGIC HIGHWAY SAFETY PLAN (SHSP)

ADOT recently adopted a Statewide SHSP; that is intended to be a "living" implementation document, coordinating the efforts of individual Emphasis Areas to the overall goals and objectives of the SHSP. The 2014 Arizona SHSP is a data-driven, strategic approach to reduce fatalities and serious injuries on state roads. The 2014 SHSP update defines 12 Emphasis Areas focused on improving specific areas of roadway safety. During the SHSP update process, the roadway infrastructure improvements were identified as an effective countermeasure.

SHSP Section 14: Roadway Infrastructure and Operations | Lane / Roadway Departure

This emphasis area addresses head-on crashes associated with highway segments. A head-on crash typically occurs when a vehicle crosses a centerline or a median and collides with an approaching vehicle, or when a driver travels the wrong way in a traffic lane. Head-on crashes are often a result of a driver's inadvertent actions, such as running off the road, or deliberate actions, such as performing unsafe passing maneuvers.

SHSP Section 14 – Goals and Objectives

The Emphasis Area goal for SHSP Section 14 is to, "reduce fatalities and the occurrence of serious injuries on all public roadways in Arizona through enhance roadway infrastructure and operations." The objectives for reducing the number of head-on fatal crashes are:

- Keep vehicles from encroaching into the opposite lane,
- Minimize the likelihood of a car crashing into an oncoming vehicle, and
- Reduce the severity of crashes that occur.

Effectiveness of Strategies and Proposed Action

The construction of passing and climbing lanes is a strategy that supports the SHSP Section 14 goals and objectives. A variety of studies conducted over the last twenty years have shown that the addition of passing and climbing lanes on highways reduces accident rates. Jacobs validated the safety benefit of adding passing and climbing lanes by conducting a crash analysis of selected location on both two-lane and multi-lane highways. The results of this analysis are documented on page 28 and 29 of this document.

2. IDENTIFICATION AND PRIORITIZATION

EXISTING CONDITIONS

Compiling a comprehensive inventory of existing passing/climbing lane locations is an essential first step before evaluating the need for new passing/climbing lanes. ADOT's existing passing and climbing lanes data set was used as the starting point. Each passing/climbing lane location and length was verified against aerial imagery. Table 2.1 provides a summary of the number of passing and climbing lanes in each ADOT District. Approximately 169 passing/climbing lanes currently exist on two-lane highways and the length of the passing lanes varies from 0.25 miles to over a mile. Shorter passing lanes are typically less effective than longer passing lanes especially on highways with higher traffic volume levels.

On multilane highways, "no passing" zones is not an issue; extended upgrade locations coupled with high truck traffic warrant the need for climbing lanes on multilane highways. Currently, only four climbing lanes exist on Arizona's multilane highways however, a few are now under construction and a few more are in the design stage.

Table 2.1: Passing and Climbing Lanes by ADOT Districts

ADOT District	Passing/Climbing Lanes on Two-Lane Highways				Climbing Lanes on Multilane Highways
	< 0.5 mile	0.5 - 1 mile	> 1 mile	Total	> 1 mile
Flagstaff	1	15	16	32	2
Globe	7	23	21	51	0
Holbrook	2	0	10	12	0
Kingman	1	8	7	16	2
Prescott	21	12	6	39	0
Safford	1	5	3	9	0
Tucson*	0	0	0	0	0
Yuma	0	5	5	10	0
Total	**33**	**68**	**68**	**169**	**4**

PASSING LANES ON TWO-LANE HIGHWAYS

Methodology for Identification and Ranking

Figure 2.1 illustrates the steps utilized to identify potential candidate locations for passing lanes on two-lane highways and Figure 2.2 illustrates the steps for prioritization of the candidate locations. Once a preliminary list of potential candidates was identified, three different prioritization methods (Table 2.2) were evaluated:

- Option 1 – Subjective Rating Method: In this method, each prioritization criteria was assigned a weight and a maximum number of points based on discussions with TAC and Districts.
- Option 2 – Z Score Method: In this method, each prioritization criteria is given the same weight. However, the points/score are determined using a z score value that is based on each record's relative distance from the mean of all records. This method is based solely on technical analysis.
- Option 3 – Combined Method: This method represents a combination of subjective and technical analysis. In this method, the z score from Option 2 is multiplied by weights used in Option 1.

Figure 2.1: Identification Process for Passing Lanes on Two-Lane Highways

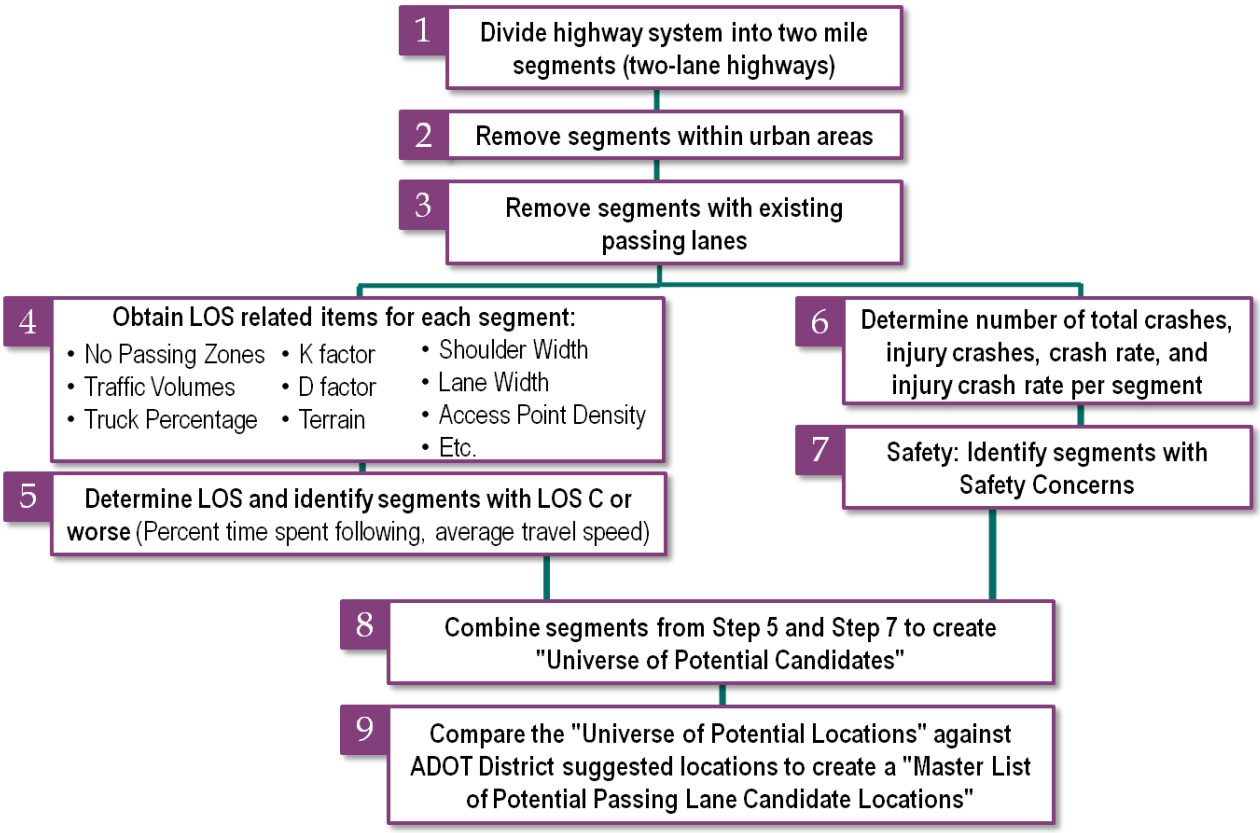


Figure 2.2: Prioritization Process for Passing Lanes on Two-Lane Highways

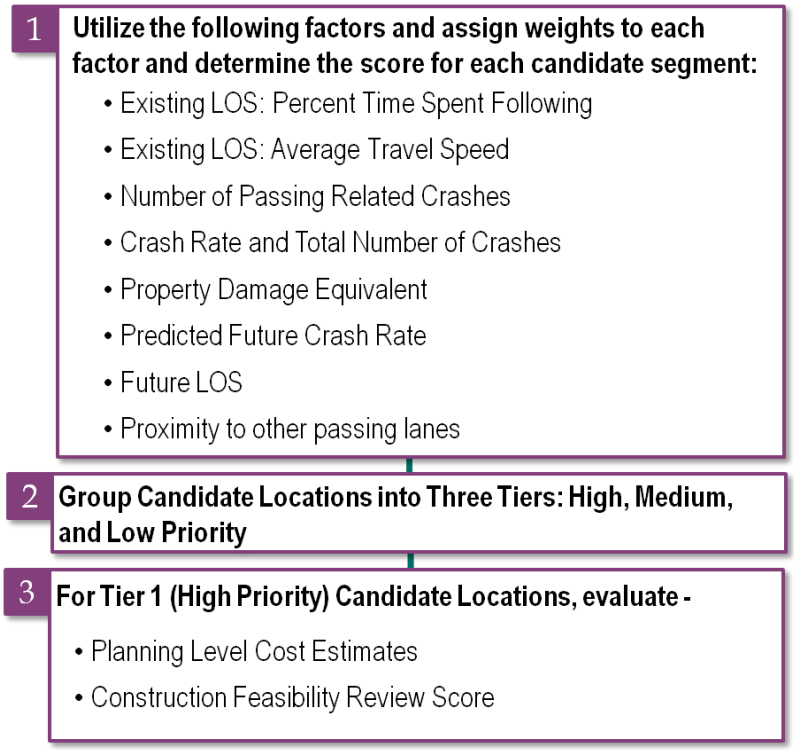


Table 2.2: Prioritization Criteria for Passing Lanes on Two-Lane Highways

Criteria	Option 1: Subjective Rating Method		Option 2: Z Score Method	Option 3: Combined Method	
	Points	Overall Percent	Z Score (From Analysis)	Z Score (From Analysis)	Overall Percent
Mobility	**14**	**35%**			**35%**
Existing LOS: PTSF – Percent Time Spent Following	4	10%			10%
Existing LOS: PFFS – Percent of Free Flow Speed	4	10%			10%
Proximity to Adjacent Passing/Climbing Lanes	2	5%			5%
Future LOS: PTSF – Percent Time Spent Following	2	5%			5%
Future LOS: PFFS – Percent of Free Flow Speed	2	5%			5%
Safety	**20**	**50%**			**50%**
Existing Crash Rate	5	13%			13%
Existing Crash Severity (EPDO)	7	18%			18%
Existing Passing Related Crash Rate	4	10%			10%
Future Crash Severity (Future EPDO)	4	10%			10%
Construction Feasibility	**6**	**15%**			**15%**
Cost per Lane Mile (Low, Med, or High - Assessed Based on Physical Constraints)	3	7.5%			7.5%
Bridge Widening Cost (Low, Medium, High - Assessed based on additional SQFT)	3	7.5%			7.5%
Total Points	**40**	**100%**			**100%**

In this method, each prioritization criteria is given the same weight. However, the points/score are determined using a z score value that is based on each record's relative distance from the mean of all records.

Recommended Prioritization

Table 2.3 presents the list of candidate locations for passing lanes on two-lane highways. The candidate locations are ranked at the statewide and district level and grouped into three tiers – high, medium, and low priority. Figure 2.3 illustrates the statewide location of the passing lanes. *Locations identified for passing lanes in Table 2.3 represent only the general problem area and not the exact location and length of the passing lanes.*

Table 2.3: Prioritized List of Passing Lanes on Two-Lane Highways

ADOT DISTRICT	PASSING LANE LOCATION (VICINITY)	TOTAL POINTS	STATEWIDE RANK	DISTRICT RANK	TIER LEVEL
Flagstaff	SR 64 EB: MP223 - MP226	25.99	14	1	1
Flagstaff	SR 67 NB: MP586 - MP583	23.82	31	2	2
Flagstaff	US 180 EB: MP238 - MP236	23.59	33	3	2
Flagstaff	SR 64 WB: MP220 - MP213	23.53	34	4	2
Flagstaff	US 160 WB: MP343 - MP337	23.23	36	5	2
Flagstaff	SR 64 EB: MP195 - MP204	23.19	37	6	2
Flagstaff	SR 64 WB: MP204 - MP201	21.91	47	7	2
Flagstaff	US 89 NB: MP463 - MP 466	21.64	50	8	2
Flagstaff	US 160 EB: MP311 - MP320	21.37	53	9	2
Flagstaff	US 89 SB: MP456 - MP453	19.63	62	10	2
Flagstaff	US 89 SB: MP480 - MP477	19.41	63	11	2
Flagstaff	US 89 NB: MP451 - MP460	17.80	71	12	3
Flagstaff	US 89 NB: MP477 - MP480	17.31	77	13	3
Flagstaff	US 89 NB: MP509 - MP512	16.95	81	14	3
Flagstaff	SR 64 EB: MP211 - MP218	16.85	83	15	3
Flagstaff	US 160 EB: MP335 - MP341	16.75	85	16	3
Flagstaff	US 89 SB: MP502 - MP499	16.27	89	17	3
Flagstaff	US 89 SB: MP512 - MP509	13.55	98	18	3
Globe	US 60 WB: MP348 - MP345	26.98	6	1	1
Globe	US 60 WB: MP294 - MP296	26.26	9	2	1
Globe	US 60 EB: MP345 - MP348	25.67	15	3	1
Globe	US 60 EB: MP357 - MP360	24.76	20	4	1
Globe	US 70 WB: MP288 - MP281	21.81	48	5	2
Globe	US 70 EB: MP267 - MP270	21.38	51	6	2
Globe	US 70 WB: MP270 - MP267	21.38	51	6	2
Globe	US 60 EB: MP304 - MP307	19.27	64	8	2
Globe	US 60 WB: MP266 - MP263	15.18	95	9	3
Holbrook	US 191 SB: MP442 - MP451	25.01	17	1	1

Table 2.3: Prioritized List of Passing Lanes on Two-Lane Highways (Continued)

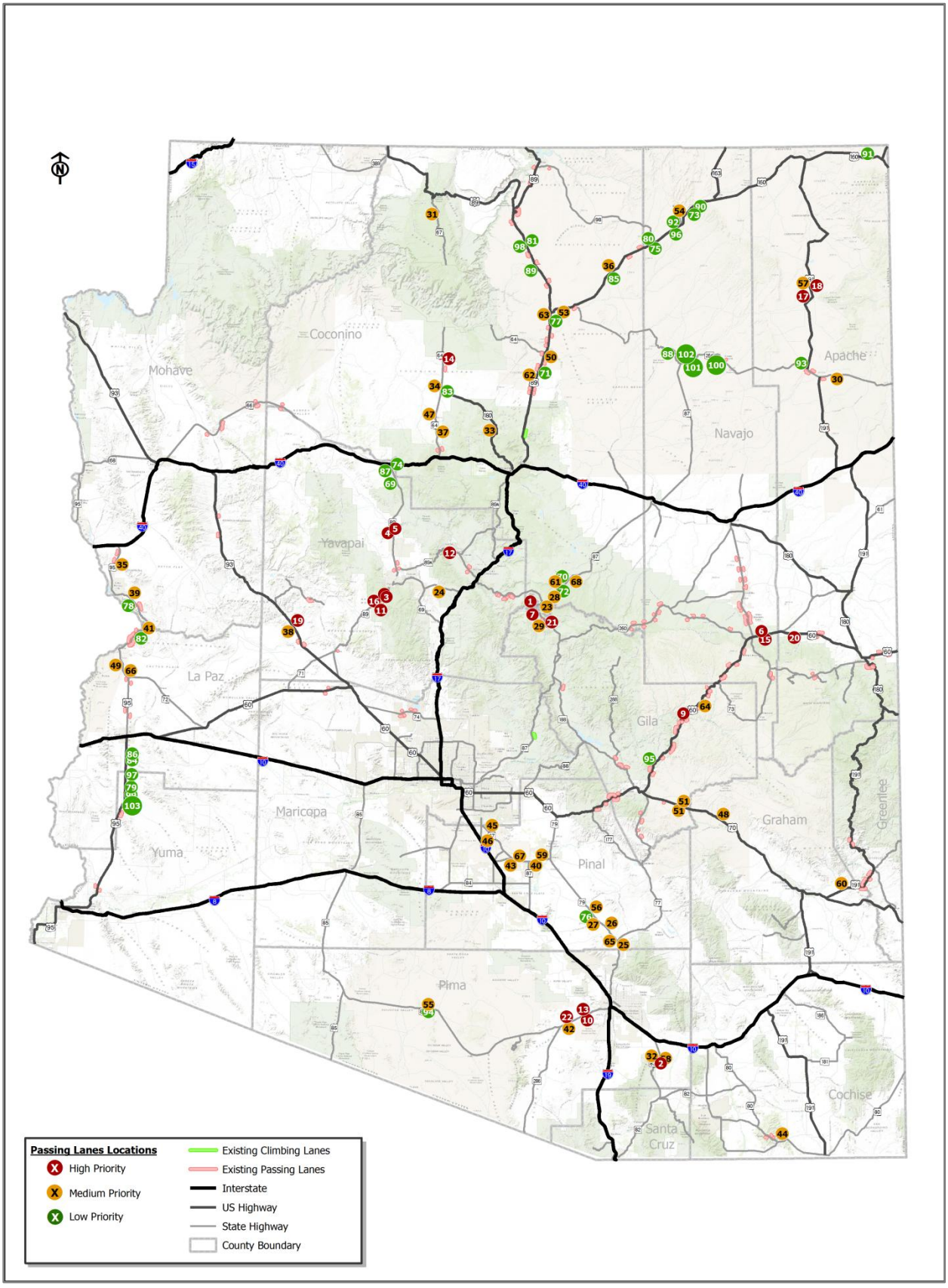
ADOT DISTRICT	PASSING LANE LOCATION (VICINITY)	TOTAL POINTS	STATEWIDE RANK	DISTRICT RANK	TIER LEVEL
Holbrook	US 191 NB: MP448 - MP455	24.96	18	2	1
Holbrook	SR 264 EB: MP453 - MP460	23.92	30	3	2
Holbrook	US 160 WB: MP377 - MP381	21.36	54	4	2
Holbrook	US 191 SB: MP455 - MP452	20.70	57	5	2
Holbrook	SR 87 NB: MP293 - MP296	18.60	68	6	2
Holbrook	SR 87 NB: MP296 - MP293	18.03	70	7	3
Holbrook	US 160 EB: MP377 - MP383	17.65	73	8	3
Holbrook	US 160 EB: MP361 - MP367	17.41	75	9	3
Holbrook	US 160 WB: MP361 - MP367	17.00	80	10	3
Holbrook	SR 264 EB: MP376 - MP378	16.29	88	11	3
Holbrook	US 160 EB: MP385 - MP391	16.25	90	12	3
Holbrook	US 160 WB: MP458 - MP463	15.89	91	13	3
Holbrook	US 160 WB: MP369 - MP375	15.80	92	14	3
Holbrook	US 191 NB: MP422 - MP425	15.43	93	15	3
Holbrook	US 160 EB: MP369 - MP375	14.58	96	16	3
Holbrook	SR 264 EB: MP401 - MP404	13.36	100	17	3
Holbrook	SR 264 EB: MP387 - MP394	12.83	101	18	3
Holbrook	SR 264 WB: MP387 - MP394	12.14	102	19	3
Kingman	US 93 NB: MP167 - MP165	24.78	19	1	1
Kingman	SR 95 NB: MP194 - 201	23.27	35	2	2
Kingman	US 93 SB: MP165 - MP172	23.06	38	3	2
Kingman	SR 95 SB: MP166 - MP175	23.00	39	4	2
Kingman	SR 89 NB: MP352 - MP358	18.18	69	5	3
Kingman	SR 89 SB: MP358 - MP364	17.52	74	6	3
Kingman	SR 95 NB: MP166 - MP173	17.17	78	7	3
Kingman	SR 89 NB: MP360 - MP362	16.40	87	8	3
Prescott	SR 87 SB: MP273 - MP279	30.73	1	1	1
Prescott	SR 89 NB: MP302 - MP304	30.00	3	2	1
Prescott	SR 89 NB: MP330 - MP334	28.66	4	3	1
Prescott	SR 89 SB: MP330 - 335	28.12	5	4	1
Prescott	SR 87 SB: MP264 - MP271	26.64	7	5	1
Prescott	SR 89 SB: MP302 - 306	26.45	8	6	1
Prescott	SR 89 NB: MP295 - MP302	26.20	11	7	1
Prescott	SA 89 SB: MP344 - MP347	26.17	12	8	1
Prescott	SR 89 SB: MP295 - MP302	25.43	16	9	1
Prescott	SR 87 NB: MP262 - MP271	24.59	21	10	1
Prescott	SR 87 NB: MP273 - MP279	24.46	23	11	2
Prescott	SR 169 NB: MP4 - MP10	24.44	24	12	2
Prescott	SR 87 NB: MP281 - MP287	24.01	28	13	2

Table 2.3: Prioritized List of Passing Lanes on Two-Lane Highways (Continued)

ADOT DISTRICT	PASSING LANE LOCATION (VICINITY)	TOTAL POINTS	STATEWIDE RANK	DISTRICT RANK	TIER LEVEL
Prescott	SR 87 SB: MP258 - MP263	23.96	29	14	2
Prescott	SR 87 SB: MP289 - MP291	19.75	61	15	2
Prescott	SR 87 NB: MP289 - MP291	17.67	72	16	3
Safford	SR 80 WB: MP349 - MP346	22.13	44	1	2
Safford	US 191 NB: MP138 - MP145	20.06	60	2	2
Tucson	SR 83 NB: MP43 - MP50	30.11	2	1	1
Tucson	SR 86 EB: 161 - MP164	26.24	10	2	1
Tucson	SR 86 WB: MP161 - MP164	26.12	13	3	1
Tucson	SR 86 WB: MP153 - MP156	24.51	22	4	1
Tucson	SR 77 NB: MP91 - MP94	24.40	25	5	2
Tucson	SR 79 NB: MP93 - MP99	24.12	26	6	2
Tucson	SR 79 SB: MP103 - MP97	24.04	27	7	2
Tucson	SR 83 SB: MP45 - MP54	23.78	32	8	2
Tucson	SR 287 NB: MP137 - MP140	22.51	40	9	2
Tucson	SR 86 EB: MP153 - MP156	22.42	42	10	2
Tucson	SR 87 SB: MP138 - MP140	22.25	43	11	2
Tucson	SR 87 NB: MP152 - MP160	22.11	45	12	2
Tucson	SR 87 SB: MP152 - MP160	21.95	46	13	2
Tucson	SR 86 WB: MP85 - MP91	20.91	55	14	2
Tucson	SR 79 NB: MP101 - MP107	20.80	56	15	2
Tucson	SR 83 NB: MP49 - MP54	20.21	58	16	2
Tucson	SR 287 NB: MP142 - MP139	20.16	59	17	2
Tucson	SR 95 SB: MP95 - MP93	19.27	65	18	2
Tucson	SR 87 NB: MP138 - MP141	18.96	67	19	2
Tucson	SR 79 SB: MP107 - MP105	17.33	76	20	3
Tucson	SR 86 EB: MP85 - MP91	15.38	94	21	3
Yuma	SR 95 NB: MP158 - MP161	22.45	41	1	2
Yuma	SR 95 NB: MP132 - MP139	21.74	49	2	2
Yuma	SR 95 SB: MP132 - MP139	18.98	66	3	2
Yuma	US 95 NB: MP88 - MP90	17.10	79	4	3
Yuma	SR 95 NB: MP152 - MP155	16.89	82	5	3
Yuma	US 95 NB: MP92 - MP98	16.79	84	6	3
Yuma	US 95 SB: MP92 - MP98	16.74	86	7	3
Yuma	US 95 SB: MP84 - MP90	14.57	97	8	3
Yuma	US 95 NB: MP76 - MP82	13.40	99	9	3
Yuma	US 95 SB: MP76 - MP82	12.05	103	10	3

Note:
Statewide Rank = Projects ranking statewide
District Rank = Projects ranking within District only
Tier Level = High, medium, and low priority

Figure 2.3: Statewide Ranking of Passing Lanes



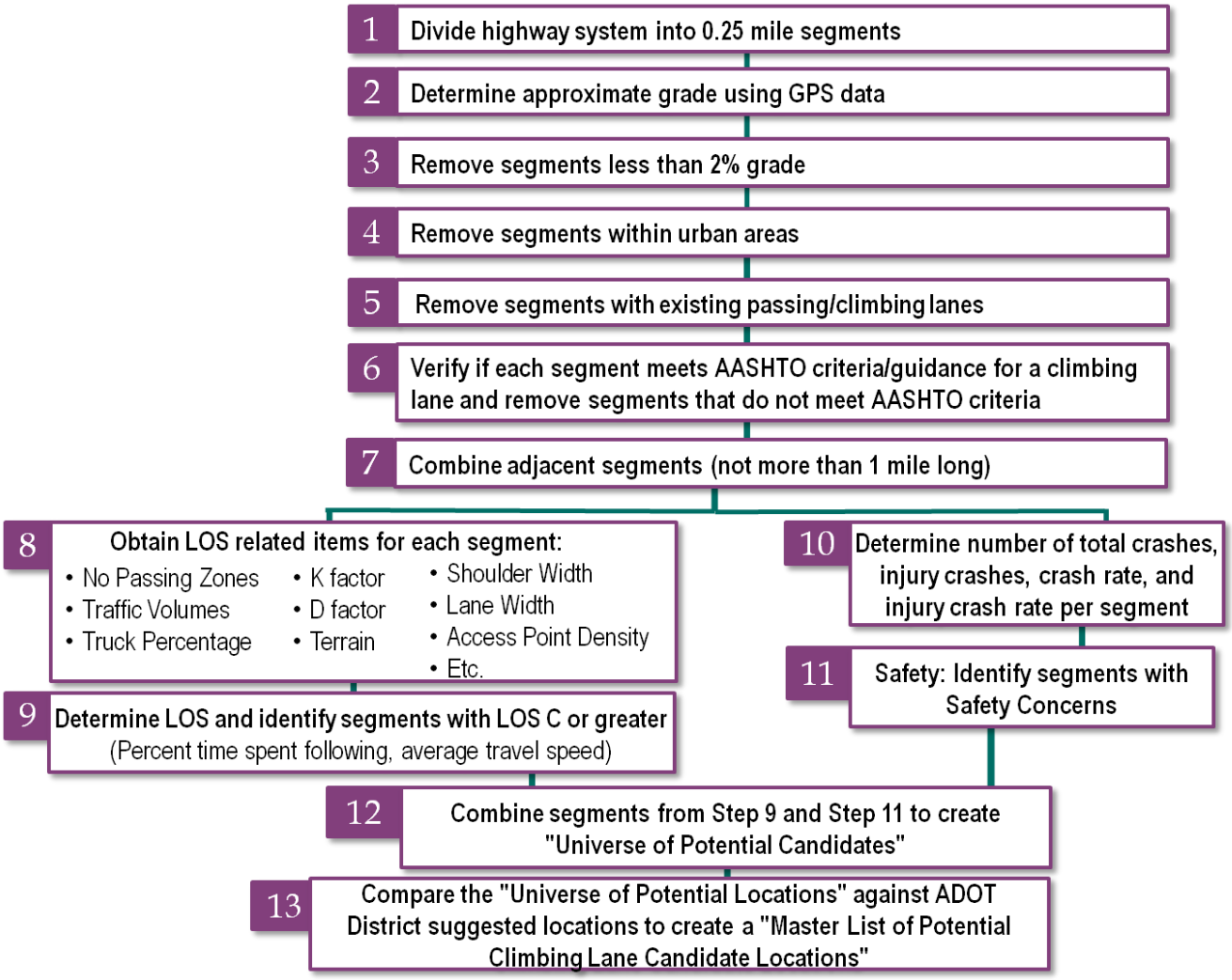
CLIMBING LANES ON TWO-LANE HIGHWAYS

Methodology for Identification and Ranking

Figure 2.4 illustrates the steps utilized to identify potential candidate locations for climbing lanes on two-lane highways. The prioritization process for climbing lanes is the same as that for passing lanes on two-lane highways and illustrated in Figure 2.4. Once a preliminary list of potential candidates was identified, similar to passing lanes, three different prioritization methods (Table 2.2) were evaluated:

- Option 1 – Subjective Rating Method: In this method, each prioritization criteria was assigned a weight and a maximum number of points based on discussions with TAC and Districts.
- Option 2 – Z Score Method: In this method, each prioritization criteria is given the same weight. However, the points/score are determined using a z score value that is based on each record's relative distance from the mean of all records. This method is based solely on technical analysis.
- Option 3 – Combined Method: This method represents a combination of subjective and technical analysis. In this method, the z score from Option 2 is multiplied by weights used in Option 1.

Figure 2.4: Identification Process for Climbing Lanes on Two-Lane Highways



Recommended Prioritization

Table 2.4 presents the list of candidate locations for climbing lanes on two-lane highways. The candidate locations are ranked at the statewide and district level and grouped into three tiers – high, medium, and low priority. Figure 2.5 illustrates the statewide location of the climbing lanes. *Locations identified for climbing lanes in Table 2.4 represent only the general problem area and not the exact location and length of the climbing lanes.*

Table 2.4: Prioritized List of Climbing Lanes on Two-Lane Highways

ADOT DISTRICT	CLIMBING LANE LOCATION (VICINITY)	TOTAL POINTS	STATEWIDE RANK	DISTRICT RANK	TIER LEVEL
Flagstaff	SR 67 NB: MP591 - MP589	24.25	9	1	2
Flagstaff	SR 64 SB: MP199 - MP197	23.44	11	2	2
Flagstaff	US 180 WB: MP219 - MP221	22.96	15	3	2
Flagstaff	SA 89 NB: MP392- MP398	22.93	16	4	2
Flagstaff	SR 64 EB: MP196 - MP198	22.66	18	5	2
Flagstaff	US 160 WB: MP345 - MP343	22.65	19	6	2
Flagstaff	UA 89 NB: MP566 - MP571	19.97	24	7	2
Flagstaff	US 89 NB: MP550 - MP552	18.44	30	8	3
Flagstaff	US 160 EB: MP312 - MP314	18.13	32	9	3
Flagstaff	US 89 SB: MP557 - MP555	17.29	33	10	3
Flagstaff	UA 89 NB: MP550 - MP551	13.67	44	11	3
Globe	US 60 EB: MP306 - MP307	23.02	14	1	2
Globe	US 70 WB: MP282 - MP288	22.00	21	2	2
Globe	US 70 EB: MP262 - MP264	19.06	28	3	2
Globe	US 60 WB: MP267 - MP266	14.20	41	4	3
Holbrook	SR 87 NB: MP295 - MP297	23.38	12	1	2
Holbrook	SR 264 EB: MP457 - MP461	23.19	13	2	2
Holbrook	SR 87 NB: MP290 - MP296	21.38	22	3	2
Holbrook	SR 87 SB: MP290 - MP296	19.81	26	4	2
Holbrook	US 160 WB: MP462 - MP460	17.25	34	5	3
Holbrook	US 160 EB: MP381 - MP384	16.65	35	6	3
Holbrook	US 191 SB: MP356 - MP354	16.52	36	7	3
Holbrook	US 191 SB: MP444 - MP442	15.58	38	8	3
Holbrook	SR 264 EB: MP377 - MP379	15.46	39	9	3
Holbrook	SR 264 EB: MP402 - MP404	12.66	45	10	3
Kingman	US 93 SB: MP161 - MP163	25.03	8	1	1
Kingman	SR 95 SB: MP177 - MP175	23.53	10	2	2
Prescott	SA 89 SB: MP339 - MP343	30.73	1	1	1

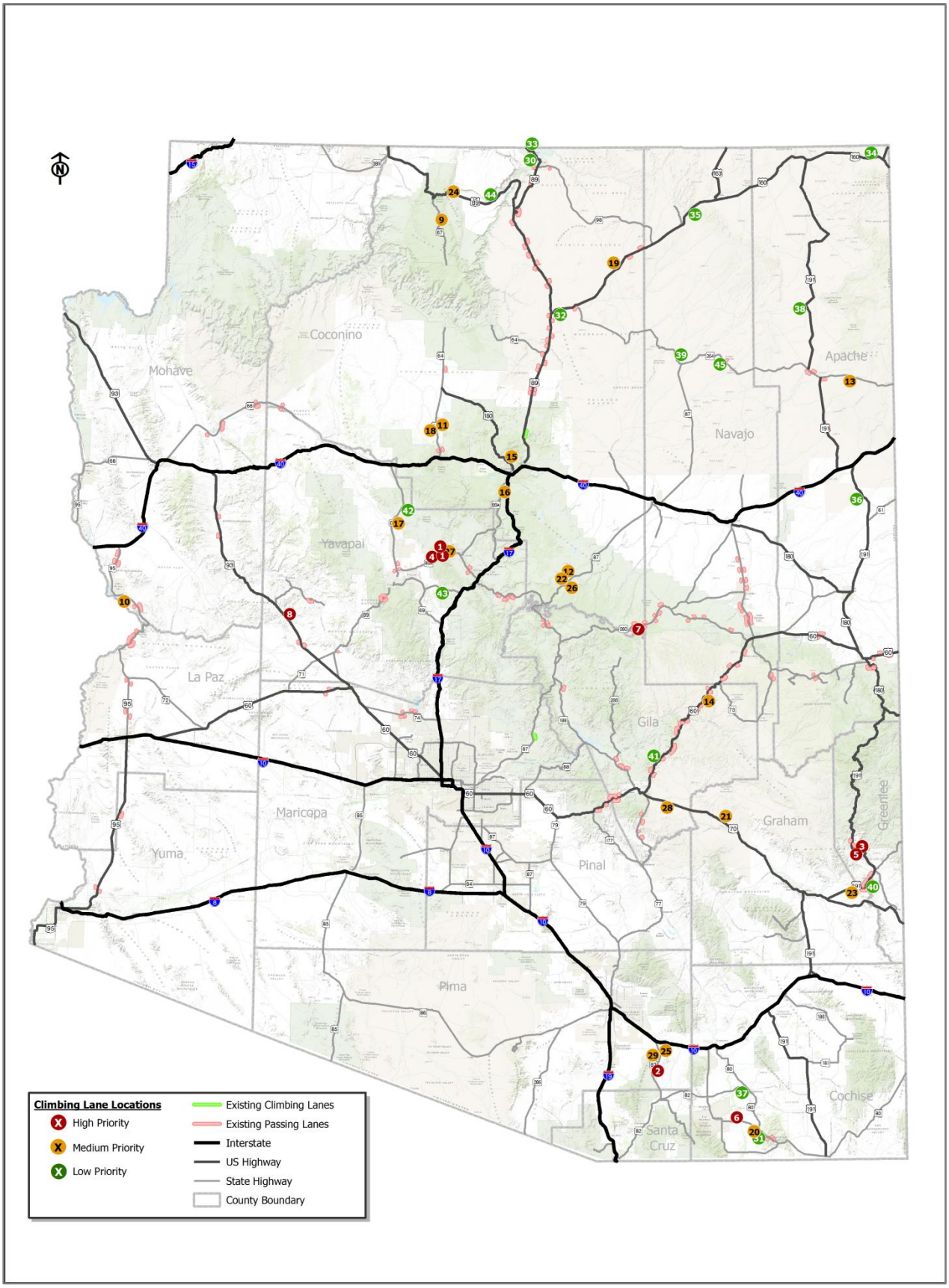
Table 2.4: Prioritized List of Climbing Lanes on Two-Lane Highways (Continued)

ADOT DISTRICT	CLIMBING LANE LOCATION (VICINITY)	TOTAL POINTS	STATEWIDE RANK	DISTRICT RANK	TIER LEVEL
Prescott	SA 89 NB: MP334 - MP336	27.80	4	2	1
Prescott	SR 260 EB: MP288 - MP289	25.40	7	3	1
Prescott	SR 89 NB: MP339 - MP341	22.84	17	4	2
Prescott	SA 89 SB: MP348 - MP349	19.75	27	5	2
Prescott	SR 89 NB: MP344 - MP345	14.07	42	6	3
Prescott	SR 169 SB: MP9 - MP7	13.68	43	7	3
Safford	UX 191 NB: MP168 - MP171	28.23	3	1	1
Safford	UX 191 SB: MP169 - MP167	26.54	5	2	1
Safford	SR 90 WB: MP329 - MP327	25.93	6	3	1
Safford	SR 90 EB: MP335 - MP337	22.46	20	4	2
Safford	US 191 NB: MP139 - MP144	20.08	23	5	2
Safford	SR 80 EB: MP334 - MP338	18.14	31	6	3
Safford	SR 80 EB: MP314 - MP317	15.75	37	7	3
Safford	US 191 NB: MP147 - MP149	15.40	40	8	3
Tucson	SR 83 NB: MP43 - MP49	30.56	2	1	1
Tucson	SR 83 SB: MP54 - MP52	19.90	25	2	2
Tucson	SR 83 NB: MP52 - MP54	19.04	29	3	2

Note:
Statewide Rank = Projects ranking statewide
District Rank = Projects ranking within District only
Tier Level = High, medium, and low priority

In some instances, need for a climbing and passing lane may have been identified in the same vicinity. The TAC recommended leaving the overlaps/duplicates in place to illustrate that those locations were deemed warranted in both analysis.

Figure 2.5: Statewide Climbing Lane (Two-Lane Highways) Rankings



CLIMBING LANES ON MULTILANE HIGHWAYS

Methodology for Identification and Ranking

Figure 2.6 illustrates the steps utilized to identify potential candidate locations for climbing lanes on multilane highways and Figure 2.7 illustrates the steps for prioritization of the candidate locations. Once a preliminary list of potential candidates was identified, three different prioritization methods (Table 2.5) were evaluated:

- Option 1 – Subjective Rating Method: In this method, each prioritization criteria was assigned a weight and a maximum number of points based on discussions with TAC and Districts.
- Option 2 – Z Score Method: In this method, each prioritization criteria is given the same weight. However, the points/score are determined using a z score value that is based on each record's relative distance from the mean of all records. This method is based solely on technical analysis.
- Option 3 – Combined Method: This method represents a combination of subjective and technical analysis. In this method, the z score from Option 2 is multiplied by weights used in Option 1.

Figure 2.6: Identification Process for Climbing Lanes on Multilane Highways

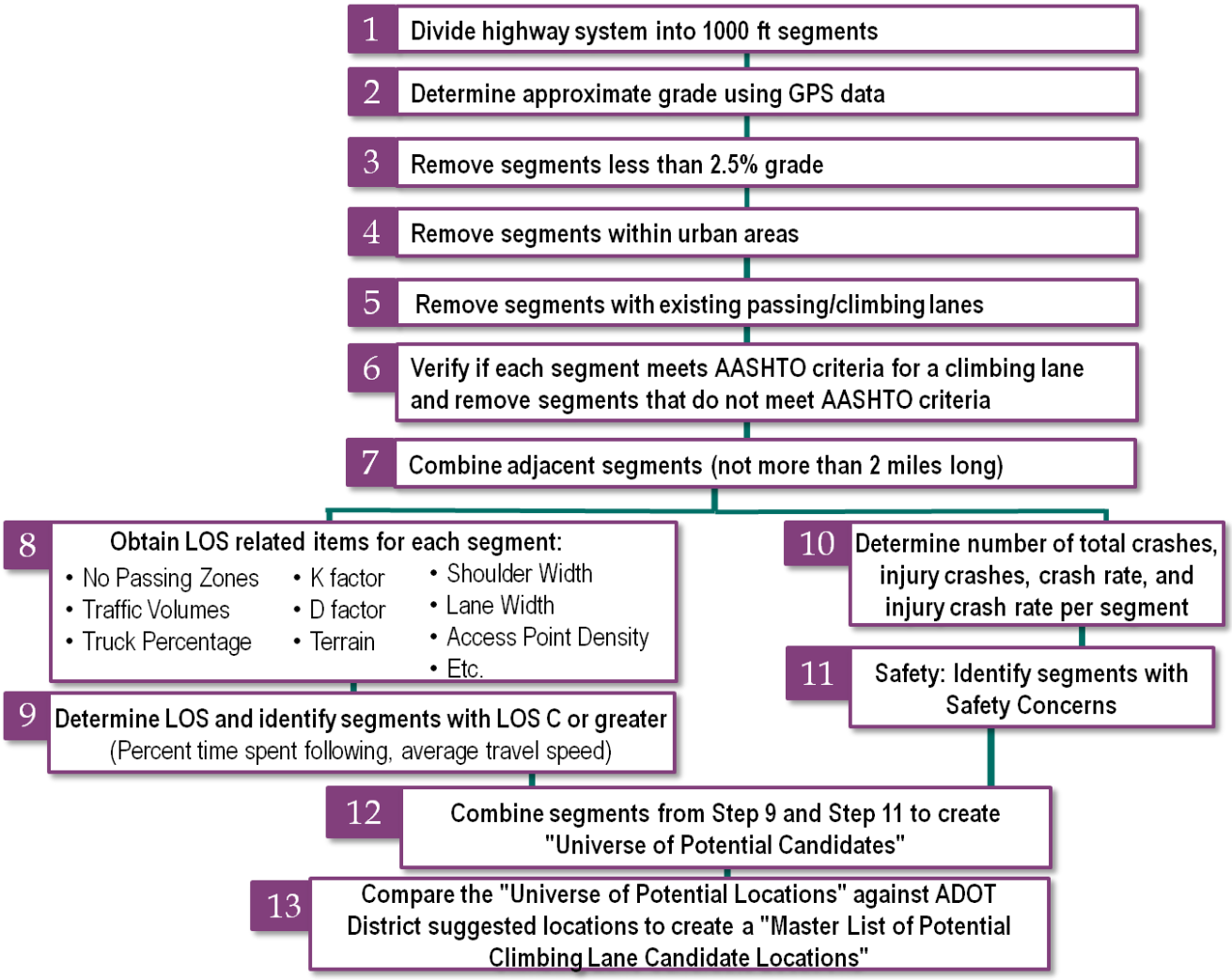


Figure 2.7: Prioritization Process for Climbing Lanes on Multilane Highways

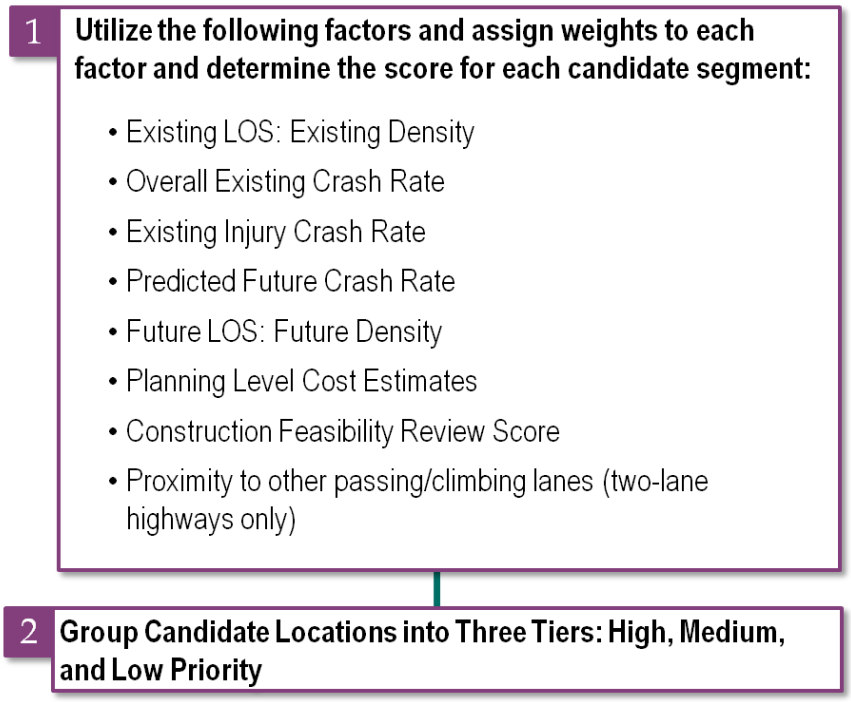


Table 2.5: Prioritization Criteria for Climbing Lanes on Multilane Highways

Criteria	Option 1: Subjective Rating Method		Option 2: Z Score Method	Option 3: Combined Method	
	Points	Overall Percent	Z Score (From Analysis)	Z Score (From Analysis)	Overall Percent
Mobility	**14**	**35%**			**35%**
Existing LOS: Existing Density	8	20%			10%
Proximity to Adjacent Passing/Climbing Lanes	2	5%			5%
Future LOS: Future Density	4	10%			5%
Safety	**20**	**50%**			**50%**
Existing Crash Rate	5	13%			13%
Existing Crash Severity (EPDO)	7	18%			18%
Existing Passing Related Crash Rate	4	10%			10%
Future Crash Severity (Future EPDO)	4	10%			10%
Construction Feasibility	**6**	**15%**			**15%**
Cost per Lane Mile (Low, Medium, or High - Assessed Based on Physical Constraints)	3	7.5%			7.5%
Bridge Widening Cost (Low, Medium, High - Assessed based on additional SQFT)	3	7.5%			7.5%
Total Points	**40**	**100%**			**100%**

Recommended Prioritization

Table 2.6 presents the list of candidate locations for climbing lanes on multilane highways. The candidate locations are ranked at the statewide and district level and grouped into three tiers – high, medium, and low priority. Figure 2.8 illustrates the statewide location of the climbing lanes. *Locations identified for climbing lanes in Table 2.6 represent only the general problem area and not the exact location and length of the climbing lanes.*

Table 2.6: Prioritized List of Climbing Lanes on Multilane Highways

DISTRICT	CLIMBING LANE LOCATION (VICINITY)	TOTAL POINTS	STATEWIDE RANK	DISTRICT RANK	TIER LEVEL
Flagstaff	I 40 EB: MP188 - MP190	32.45	2	1	1
Flagstaff	I 17 NB: MP307 - MP311	27.84	5	2	1
Flagstaff	I 17 SB: MP318 - MP316	24.15	8	3	2
Flagstaff	I 17 NB: MP299 - MP305	24.01	9	4	2
Flagstaff	I 40 WB: MP193 - MP191	20.43	12	5	2
Flagstaff	I 40 EB: MP151 - MP152	19.08	14	6	2
Flagstaff	I 15 NB: MP19 - MP25	18.59	16	7	3
Flagstaff	I 15 SB: MP21 - MP19	16.65	22	8	3
Flagstaff	I 40 EB: MP156 - MP159	14.19	25	9	3
Flagstaff	I 40 WB: MP163 - MP162	13.81	28	10	3
Kingman	I 40 EB: MP47 - MP49	25.35	7	1	2
Kingman	I 40 WB: MP132 - MP136	18.56	17	2	3
Kingman	I 40 EB: MP58 - MP60	17.30	20	3	3
Kingman	I 40 EB: MP81 - MP83	17.24	21	4	3
Kingman	I 40 EB: MP125 - MP128	16.32	23	5	3
Kingman	I 40 EB: MP76 - MP77	14.07	27	6	3
Kingman	I 40 WB: MP115 - MP114	12.09	30	7	3
Kingman	I 40 EB: MP93 - MP97	11.48	31	8	3
Prescott	I 17 NB: MP246 - MP250	33.07	1	1	1
Prescott	I 17 SB: MP281 - MP285	30.12	3	2	1
Prescott	I 17 NB: MP255 - MP256	27.27	6	3	1
Prescott	I 17 SB: MP293 - MP295	21.08	10	4	2
Prescott	I 17 SB: MP284 - MP286	20.19	13	5	2
Prescott	I 17 NB: MP294 - MP298	19.06	15	6	2
Prescott	I 17 SB: MP240 - MP238	17.86	18	7	3
Prescott	I 17 NB: MP270 - MP275	14.09	26	8	3
Safford	I 10 WB: MP306 - MP302	29.51	4	1	1
Safford	I 10 EB: MP315 - MP317	17.55	19	2	3
Safford	I 10 EB: MP309 - MP311	12.10	29	3	3
Tucson	I 10 EB: MP286 - MP291	21.01	11	1	2
Yuma	I 8 EB: MP18 - MP20	15.70	24	1	3

Note: Statewide Rank = Projects ranking statewide; District Rank = Projects ranking within District only; Tier Level = High, medium, and low priority

Figure 2.8: Statewide Ranking of Climbing Lanes on Multilane Highways