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Introduction

In 1999 ADOT commissioned a study to: 1) establish a process to identify locations where a passing or climbing lane would provide benefit to the traveling public; 2) rank the identified passing and climbing lanes locations by the most effective and feasible projects. The end result of the study was a prioritized list of general locations for passing and climbing lanes within the State.

In the 2003 update of the study, different set of variables were considered when evaluating locations for climbing and passing lanes. In addition, ADOT District Engineers participated more actively in the study process. Thus, in 2003, two separate reports were created that prioritized the locations for climbing and passing lanes. The 2003 methodology was successful and several passing and climbing lane recommendations from the study were implemented.

A climbing lane is defined as, "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."

A passing lane is defined as, "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."

Study Purpose

The primary purpose of this study is to update the 2003 study, apply a refined methodology for prioritization, and develop a new prioritized list of both climbing and passing lane locations on the Arizona State Highway System.

Work Tasks

Work Task 1: Project Management & Coordination

**Coordination.** Rick Powers, Jacobs PM, will meet and/or coordinate with the ADOT PM once a month to review study progress, present working papers, study findings, and solicit direction. He will also monitor work progress, schedule, and budget to ensure the project is progressing in an acceptable manner.

**Stakeholder Involvement – A Collaborative Partnership.** The Climbing and Passing Lane Prioritization Study Update will be conducted according to a cooperative planning process involving stakeholders that include ADOT, FHWA, local planning agency staff, and other key stakeholders. A project charter that includes a mission statement and project goals will be created and approved by the Technical Advisory Committee. The project goals can include, but are not limited to, quality, communication, issue resolution, teamwork, schedule, budget, and project delivery. Throughout the study, information will be presented to and solicited from stakeholders through individual interviews, focus group meetings, and technical advisory meetings.

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.

Jacobs will be responsible for technical aspects of the Study. The ADOT Partnering Office will assist with facilitating the creation of the collaborative partnership agreement. In addition, the Partnering facilitator will assist with setting up the measurement tool, Partnering Evaluation Program, or PEP.

If the project team determines that this study will be submitted for a partnering award, all partnering activities should be documented, and it should be determined who be writing the submittal.
Refine Work Plan. A refined Work Plan will be developed based on input received from the ADOT Project Manager and the TAC at the kick-off meeting. The revised Work Plan will be distributed to the TAC for final approval. The Work Plan will include a detailed scope of work, schedule, and a staffing plan.

Quality Assurance/Quality Control (QA/QC). Our team will adhere to rigorous QA/QC procedures. Rick will personally oversee quality assurance, study proceedings, and document preparation throughout the study. Shanthi Krishnan will manage the overall QA/QC for the project.

Deliverables and Meetings:
- 11 Project Manager Meetings
- Kick-off/First TAC Meeting
- Technical Memorandum 1: Refined Work Plan
- Monthly Progress Reports

Work Task 2: Review Previous Study and Other Pertinent Documents

Purpose: The purpose of this task is to research and document current best practices and to assess the Pros and Cons of the previous climbing and passing lane studies' methodologies.

Activities:
- Research Current Best Practices. For this subtask, we propose to conduct phone interviews with up to four other State DOTs to identify current procedures and "best practices". In addition, we will conduct an extensive internet search of methodologies, standards, and procedures related to both passing and climbing lanes.
- Assess the Pros and Cons of the Previous Methodology. Jacobs will compare the previous methodology to current best practices; identify which projects have been completed to date; evaluate the Pros and Cons of the previous methodology. In addition, we will review the latest crash data and update existing information for this analysis.
- Prepare Working Paper 1. Best Practices research and the Pros and Cons of the previous studies' methodology will be documented in Working Paper 1 and circulated to the TAC for review and comment.

Deliverables:
- Working Paper 1: Summary and Assessment of Previous Studies and Current Best Practices

Work Task 3: Coordination with TAC and ADOT Districts

Activities:
- Technical Advisory Committee (TAC) Meetings. A TAC has already been established for this Study. Our team will work closely with the ADOT PM and the TAC. The TAC will provide input, oversight, and champion the goals and objectives of the Study.
- ADOT District Engineer (DE) Meetings. In addition to the TAC, the input of ADOT District Engineers is critical to the success of this study. The District Engineers have a thorough understanding of the issues and needs on roadways in their district. We propose meeting with the District Engineers at least twice through the course of the study to obtain their viewpoints into the needs of each District.
- Stakeholder Meetings. Meetings with stakeholders such as Arizona State Land Department, Bureau of Land Management, Forest Service, and Indian Reservations may be necessary if any of the candidate passing/climbing lane locations fall in their jurisdictions. We will conduct up to six meetings with these various stakeholders to gather input.
• **Meeting Format.** We propose conducting meetings with the TAC, ADOT District Engineers, and stakeholders using phone/web conferencing whenever possible to keep the cost of the study low. Jacobs has state-of-the-art web conferencing resources in-house that can streamline this method.

**Deliverables and Meetings:**
- 11 Meetings with TAC
- 18 Meetings with DEs (some may be combined)
- 6 Meetings with Stakeholders

**Work Task 4: Data Collection**

**Purpose.** The purpose of this task is to identify and collect the datasets required to conduct the technical analysis for the study.

**Activities:**
- **Collect Data:** Work with ADOT’s Roadway Inventory Management Section (RIMS) and other departments to obtain datasets identified in the following table.

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Source</th>
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<tbody>
<tr>
<td>Accident Location Information and Surveillance System (ALISS) Crash Database</td>
<td>ADOT Traffic Records</td>
</tr>
<tr>
<td>Striping plans</td>
<td>ADOT Traffic Records</td>
</tr>
<tr>
<td>Traffic volumes (AADT) and vehicle classification</td>
<td>ADOT’s RIMS section</td>
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<tr>
<td>Future traffic volumes</td>
<td>ADOT’s RIMS section</td>
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<tr>
<td>Functional classification</td>
<td>ADOT’s RIMS section</td>
</tr>
<tr>
<td>Highway video log</td>
<td>ADOT’s RIMS section</td>
</tr>
<tr>
<td>Highway centerline GPS data</td>
<td>ADOT’s RIMS section</td>
</tr>
<tr>
<td>Highway log</td>
<td>ADOT’s RIMS section</td>
</tr>
<tr>
<td>Arizona Transportation Information System (ATIS) roads and mileposts</td>
<td>ADOT’s RIMS section</td>
</tr>
<tr>
<td>ATIS Linear Referencing System (LRS)</td>
<td>ADOT’s RIMS section</td>
</tr>
<tr>
<td>Highway Performance Monitoring System (HPMS)</td>
<td>ADOT’s RIMS section</td>
</tr>
<tr>
<td>Transportation Data Management System (TDMS)</td>
<td>ADOT’s RIMS section</td>
</tr>
<tr>
<td>Other general GIS data</td>
<td>ADOT’s RIMS section</td>
</tr>
<tr>
<td>Statewide Transportation Improvement Program (STIP)</td>
<td>ADOT MPD</td>
</tr>
<tr>
<td>Right-of-way (ROW)</td>
<td>ADOT ROW</td>
</tr>
<tr>
<td>As-built drawings</td>
<td>ADOT ROW</td>
</tr>
</tbody>
</table>

- **QA/QC Data:** Review each dataset for quality and usability.

**Work Task 5: Update Methodology and Develop Rankings for Climbing Lanes**

**Purpose:** The purpose of this task is to develop a revised methodology for identifying candidate locations for climbing lanes; identify pertinent data; evaluate each candidate location to meet AASHTO and Highway Capacity Manual (HCM) standards; and prioritize and rank the final recommendations for climbing lanes.
We propose the following preliminary methodology. This methodology will be discussed with the TAC and District Engineers and revised as necessary.

**Activities:**

- **Identify Preliminary Climbing Lane Locations:**
  - **Iteration 1:** Utilize ADOT’s roadway centerline GPS data for multilane highways and identify highway segments that have grades greater than 2.5%.
  - **Iteration 2:** Coordinate with ADOT District Engineers and identify climbing lane locations purely based on their empirical knowledge of highways in their Districts.
  - **Iteration 3:** Combine candidate locations identified in Iteration 1 and Iteration 2 to create a Comprehensive Candidate Locations List.
  - **Iteration 4:** Test each candidate location and remove the candidates that do not meet the minimum climbing lane requirements set by AASHTO and HCM.

- **Establish Evaluation Criteria:** Coordinate with the TAC and ADOT Districts to identify evaluation criteria for prioritizing and ranking climbing lane locations. Evaluation criteria could include:
  - Existing and Future ADT - including seasonal adjustment
  - AASHTO guidelines and constructability
  - Magnitude of cost parameters
  - Physical features
  - Access locations
  - Topography
  - Environmental considerations
  - Affected structures
  - Right-of-way impacts
  - Is it planned/scoped by Statewide Project Management
  - Predicted or expected crash frequency following the highway safety manual
  - Input from ADOT districts
  - Driver complaint areas
  - Vehicle classification (percent trucks)
  - Vertical grades
  - Level of service
  - Vehicle delay, speed reduction
  - Consider accommodation of bicyclists

- **Evaluate for Viability and Constructability:** Coordinate with TAC and District Engineers to evaluate each candidate location for viability and constructability using the following criteria:
  - Are there constraints in proximity to a candidate location that make the location not viable such as intersections, turn bays, or physical constraints?
  - Are there opportunities to locate a climbing lane on one side of the road?
  - Are bridges and culverts if they result in shoulder width restriction avoided?
  - Does the climbing lane location appear logical to the driver?
  - Are sections with low-speed curves avoided?
  - Are climbing lanes on tangent sections where the length of the tangent exceeds the passing sight distance avoided, so as not to delay opposing vehicles by eliminating passing opportunities?
  - Are climbing lane sections that are not feasible or cost effective avoided?
  - Are sections in urban areas avoided?

- **Rank Candidate Locations:** Collect evaluation criteria data for each candidate location. Develop a scoring methodology to rank the candidate locations. Each evaluation criteria can be assigned a score range based on value and importance of the criteria.

- **Prioritize Recommended Climbing Lane Locations:** Based on the ranking and the highest/lowest total scores, the recommendations will be grouped in three Tiers: High Priority (Tier 1); Medium Priority (Tier 2); Low Priority (Tier 3).
Refine Climbing Lane Start/End Limits: For the Tier 1 recommendations only, Jacobs will review as-built drawings to derive actual slopes and re-adjust the start/end milepost limits of each segment. This will aid in moving recommendations into implementation.

Planning and Environmental Linkages (PEL) Documentation: We will develop the PEL documentation for the Tier 1 recommendations only, to make them ready for the design phase.

Prepare Working Paper 2: Climbing Lanes - Updated Methodology & Prioritized Recommendations, and distribute to the TAC for review.

Schedule TAC Meeting to discuss the Working Paper 2 comments.

Incorporate comments from the TAC and finalize Working Paper 2.

Deliverables:
- Working Paper 2: Climbing Lanes - Updated Methodology and Prioritized Recommendations

**Work Task 6: Update Methodology and Rankings for Passing Lanes**

**Purpose:** The purpose of this task is to develop a revised methodology for identifying candidate locations for passing lanes; identify pertinent appropriate data; evaluate each candidate location to meet AASHTO and Highway Capacity Manual (HCM) standards; prioritize and rank the final recommendations for passing lanes.

We propose the following preliminary methodology. This methodology will be discussed with the TAC and District Engineers and revised as necessary.

**Identify Preliminary Passing Lane Locations:**
- **Iteration 1:** Utilize roadway striping plans from ADOT’s Traffic Records division and the video log from the ADOT RIMS division to identify highway segments where lack of sufficient passing opportunities is an issue. Collect traffic volumes, crash information, and other pertinent data and test each location and remove the candidates that do not meet the minimum passing lane requirements set by AASHTO and HCM.
- **Iteration 2:** Coordinate with ADOT District Engineers and identify passing lane candidate locations purely based on their empirical knowledge of highways in their Districts. Test each candidate location and remove the candidates that do not meet the minimum passing lane requirements set by AASHTO and HCM.
- **Iteration 3:** Combine candidate locations identified in Iteration 1 and Iteration 2 to create a Comprehensive Candidate Locations List.

**Establish Evaluation Criteria:** Coordinate with the TAC and ADOT Districts to identify evaluation criteria for prioritizing and ranking passing lane locations. Evaluation criteria could include:

- Existing and Future ADT - including seasonal adjustment
- AASHTO guidelines and constructability
- Magnitude of cost parameters
- Physical features
- Access locations
- Is it planned/scoped by Statewide Project Management
- Predicted or expected crash frequency following the highway safety manual
- Benefit-to-Cost (B/C) Ratio
- Possible Environmental Impacts
- Input from ADOT districts
- Driver complaint areas
- Vehicle classification (percent trucks)
**Topography**
- Vertical grades
**Environmental considerations**
- Level of service
**Affected structures**
- Vehicle delay, speed reduction, percent time spent following
**Right-of-way impacts**
- Consider accommodation of bicyclists

**Evaluate for Viability and Constructability:** Coordinate with TAC and District Engineers to evaluate each candidate location for viability and constructability using the following criteria:
- Are there constraints in proximity to a candidate location that make the location not viable such as intersections, turn bays, physical constraints?
- Are there opportunities to locate a passing lane on one side of the road?
- Are bridges and culverts if they result in shoulder width restriction avoided?
- Does the passing lane location appear logical to the driver?
- Are sections with low-speed curves avoided?
- Are sections that are not feasible or cost effective avoided?
- Are sections in urban areas avoided?

**Rank Candidate Locations:** Collect evaluation criteria data for each candidate location. Develop a scoring methodology to rank the candidate locations. Each evaluation criteria can be assigned a score range based on value and importance of the criteria.

**Prioritize Recommended Passing Lane Locations:** Based on the ranking and the highest/lowest total scores, the recommendations will be grouped in three Tiers: High Priority (Tier 1); Medium Priority (Tier 2); Low Priority (Tier 3).

**Refine Passing Lane Start/End Limits:** For the Tier 1 recommendations only, Jacobs will review as-built drawings to evaluate any design elements (sight distance, horizontal and vertical curves) and right-of-way constraints and re-adjust the start/end milepost limits of each segment. This will aid in moving recommendations into implementation.

**Planning and Environmental Linkages (PEL) Documentation:** We will develop the PEL documentation for the Tier 1 recommendations only, to make them ready for the design phase.

**Prepare Working Paper 3: Passing Lanes - Updated Methodology & Prioritized Recommendations, and distribute to the TAC for review.**

**Schedule TAC Meeting to discuss the Working Paper 3 comments.**

**Incorporate comments from the TAC and finalize Working Paper 3.**

**Deliverables:**

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**Work Task 7: Combined Prioritization of Climbing and Passing Lane Locations**

**Purpose:** The purpose of this task is to develop a prioritization of climbing and passing lane projects collectively using feedback from the TAC and District Engineers and the evaluation criteria identified in Tasks 5 and 6.

**Activities:**
- Conduct work sessions with the District Engineers and the TAC to
  - Identify common evaluation criteria to conduct an unbiased evaluation of the collective list of climbing and passing lane recommendations.
  - Prioritize and rank the combined recommendations.
Perform a common sense review of the ranking results and make any necessary adjustments.

- If necessary, meet with stakeholders to review results and obtain feedback.
- Prepare Working Paper 4 and distribute to the TAC for review.
- Schedule TAC Meeting to discuss the Working Paper 4 comments.

**Deliverables:**

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**Work Task 8: Final Report**

**Activities:**

- Distribute final draft reports to the TAC and District Engineers for review and comment.
- Incorporate comments on the draft reports received from the TAC and the District Engineers into the Final Report and Executive Summary.
- Upon approval and final acceptance of the study, the Final Report and Executive Summary will be provided to ADOT (two CDs and two hard copies), TAC Members (one CD and one hard copy), and District Engineers (one CD and one hard copy). The data developed for the study will also be provided to ADOT. Electronic copies will be provided in Microsoft Word and Adobe Acrobat PDF formats.

**Deliverables and Meetings:**

- Final Report and Executive Summary
Project Team

The Project Team’s structure, staff, and roles are outlined in the organization chart below.