Use of CMFs in a Road Safety Audit for Olympic National Park

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Note: Work was completed while with Jacobs Engineering

U.S. Department of Transportation
Federal Highway Administration

CRASH MODIFICATION FACTORS CLEARINGHOUSE

U.S. Department of Transportation
Federal Highway Administration

Agenda

- Road Safety Audit Overview
- Olympic National Park and Study Location Overview
- Existing Conditions
- Key Safety Observations
- Countermeasure Recommendations and CMFs

Road Safety Audit Overview

- A Road Safety Audit (RSA) is a **formal safety performance examination** of an **existing or future** road or intersection by an experienced, independent, multi-disciplinary audit team
- Goal: Identify potential road safety issues and opportunities for improvements – consider all road users

- An RSA is not:
  - A design guidelines check – standards do not guarantee the facility is safe
  - A means to evaluate alternative designs

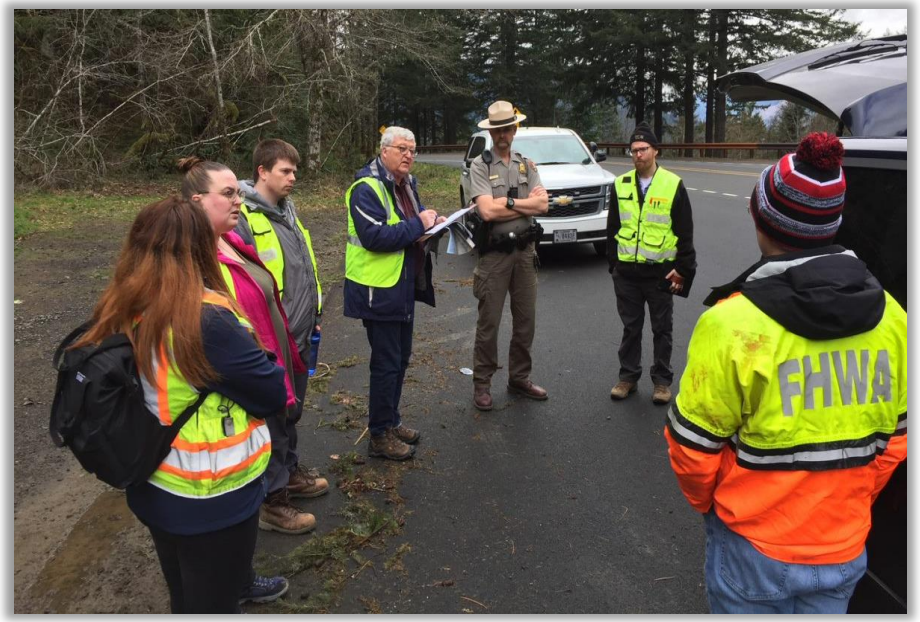
RSA Process and Considerations

- Focus on road safety sensitive to context and design objectives
  - Involvement from the Park (or whatever agency) is paramount in providing context and valued insights
- Qualitative (field work) and quantitative (IHSDM analysis)
- Proactive in nature
- Systemic considerations
- System-based deployment of strategies
  - Park-wide countermeasures possible

Conducting the RSA

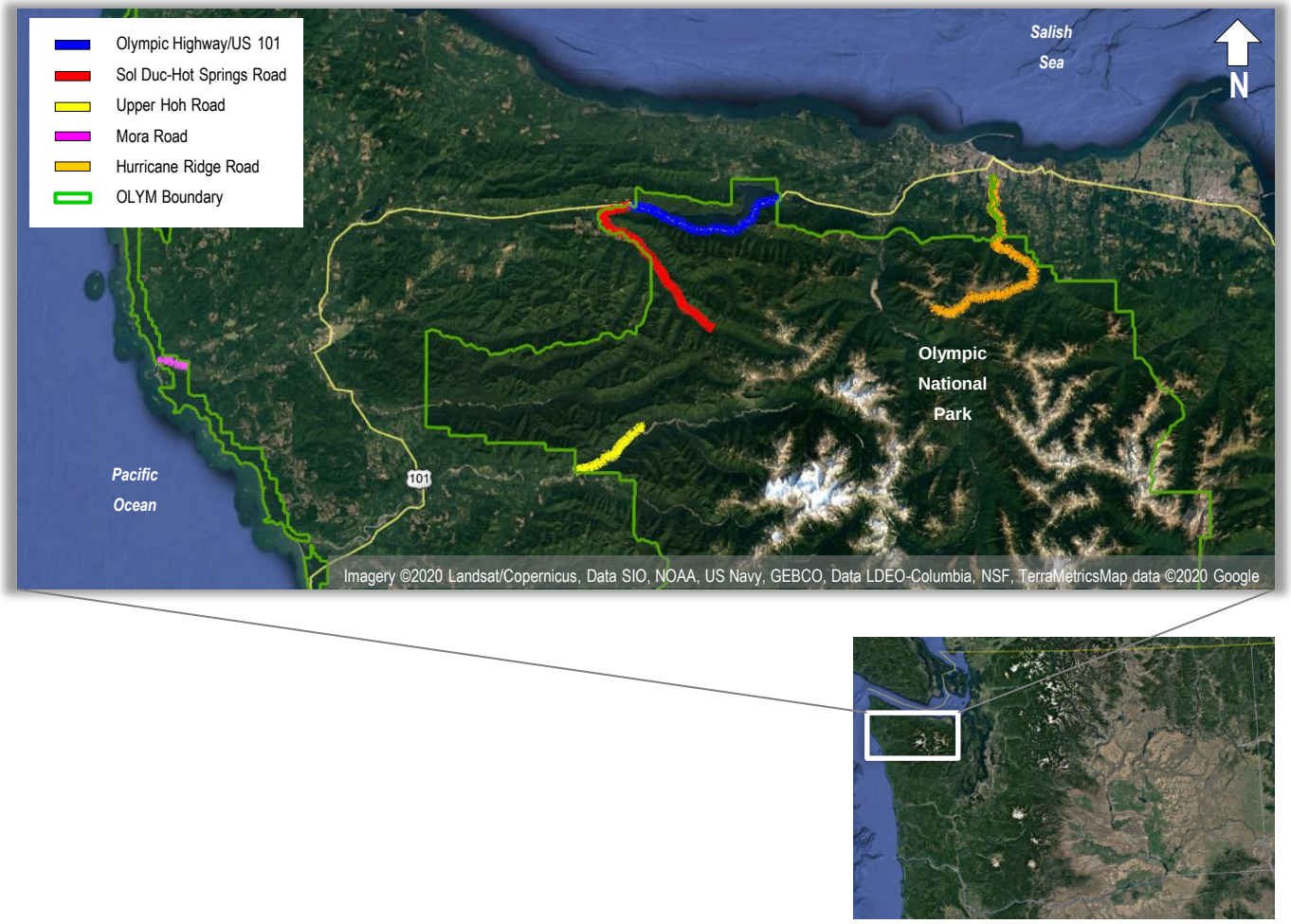
Site Discussions

- **Safety Deficiencies:** Discuss what aspects of the site may contribute to a high-risk safety environment.
- **Potential Crash Contributing Factors:** Assess the roadway or parking lot site to estimate potential contributing factors to road safety. Consider all modes and users.
- **Develop Recommended Countermeasures:** Identify candidate safety countermeasures considering the context and scope of the park
- Focus is typically on low-cost engineering context sensitive measures, but other Es are possible – creativity is encouraged!



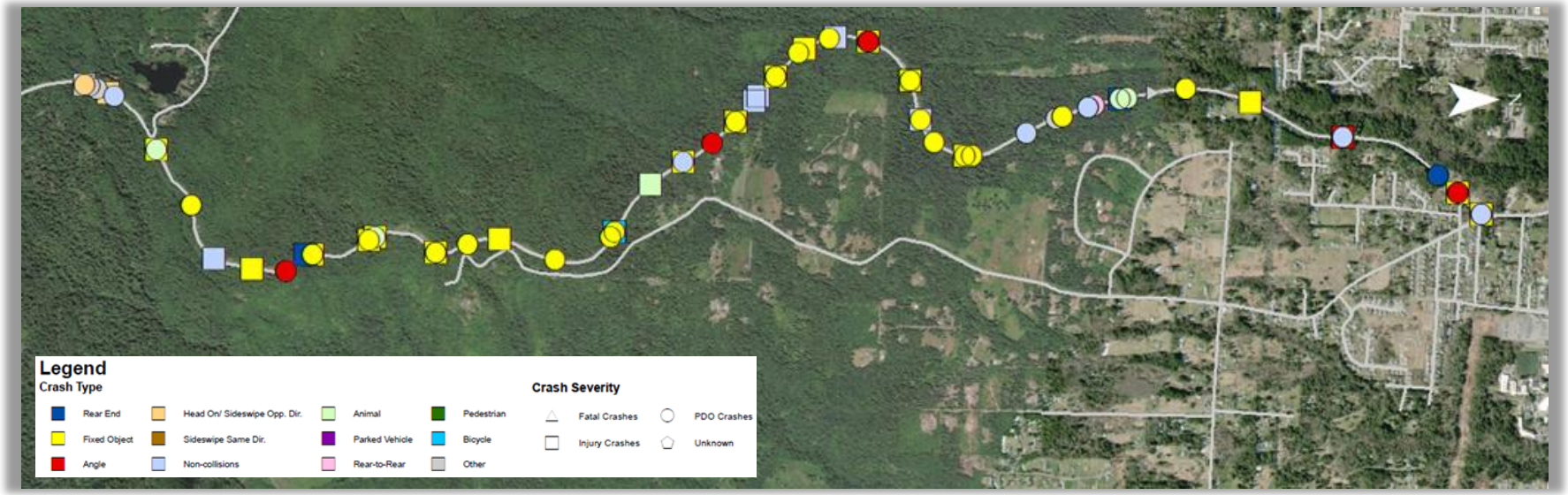
ONP RSA Locations Overview

- Olympic National Park (ONP) located on the Olympic Peninsula of Washington State
- Unique Park layout and diverse environments
  - Weather, types of users, driver populations, volumes, other environmental/contextual factors
- Five priority roads identified with ONP
  - *Olympic Highway/US 101 (Lake Crescent)*
  - Sol Duc-Hot Springs Road (Sol Duc Valley)
  - Upper Hoh Road (Hoh Rain Forest)
  - Mora Road (Rialto Beach)
  - *Hurricane Ridge Road (Hurricane Ridge)*
- RSA field work conducted in March and August 2020

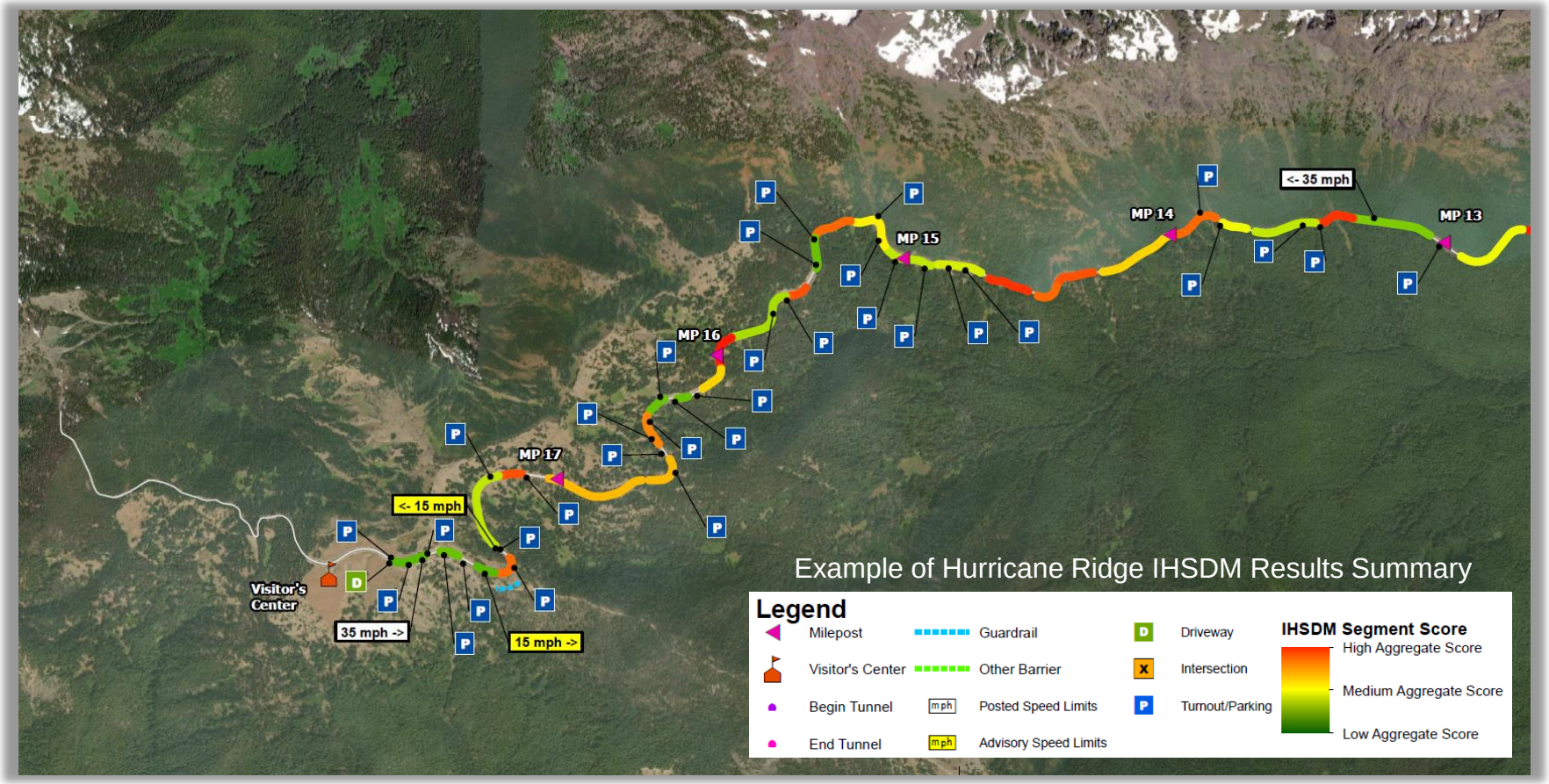


Existing Conditions

- Prior to going into the field
  - Reviewed available crash data
  - Identified trends
  - Identified key locations
- Completed for all 5 locations



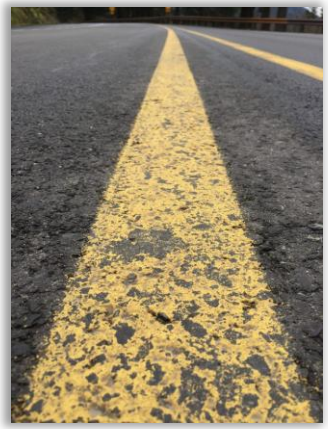
Existing Conditions: IHSDM

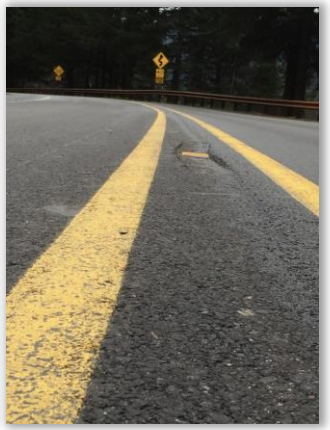


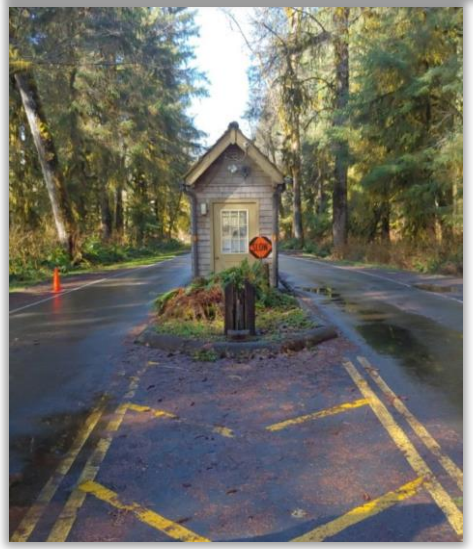
- Additional existing conditions analysis
- Interactive Highway Safety Design Model (IHSDM)
  - Lake Crescent and Hurricane Ridge
- Aggregate score
- Highlight locations that may have geometric deficiencies or improvement opportunities

Key Safety Observations

- Speeding
- Lack of sufficient enforcement personnel
- Pavement markings
- Guardrail
- Inconsistent warning signs, advisory speed signs, and chevrons/directional arrows
- Entrance stations

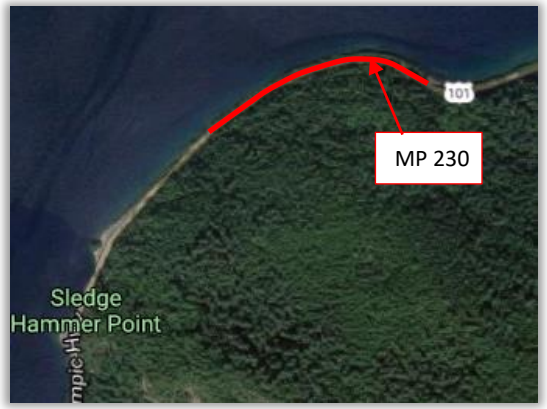






Key Safety Observations

- Driver demographics
- Road departure crashes, clear zone, and recoverability
- Adverse weather/roadway conditions
- Parking capacity/overflow
- Emergency vehicle access
- Horizontal alignment



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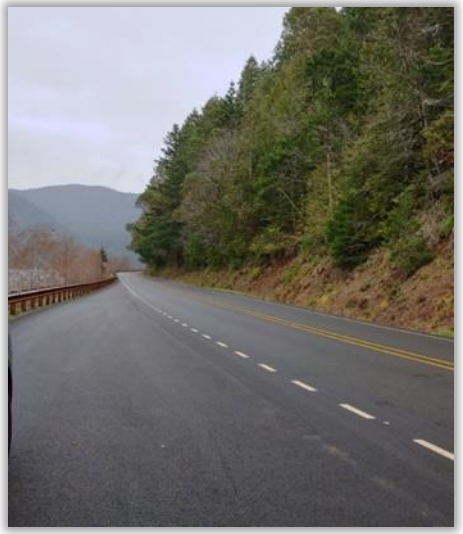


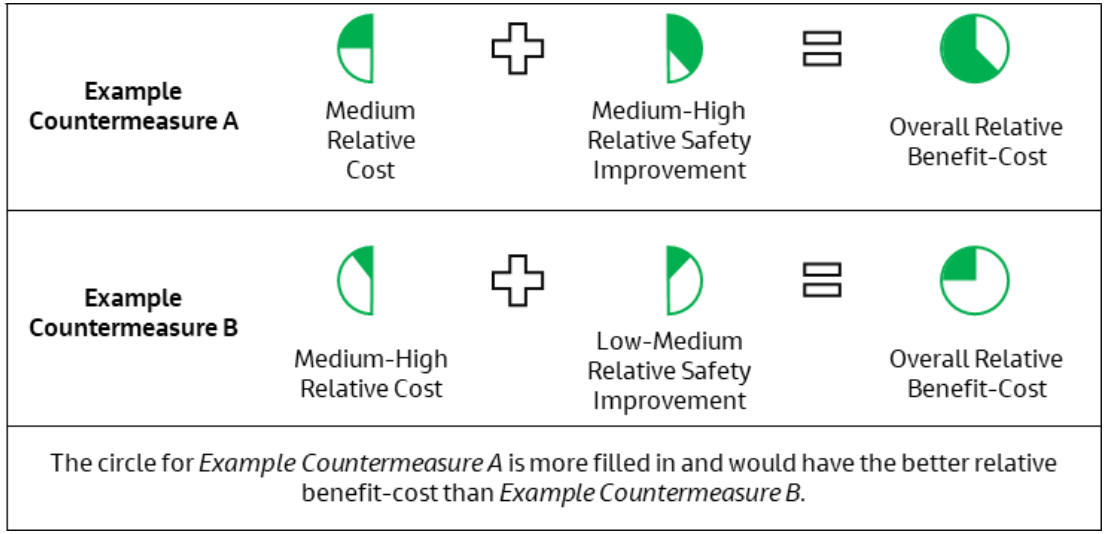
- Pedestrian facilities and vehicle conflicts
- Limited sight distance and visibility
- Delineation
- Sign and post conditions
- Passing locations and/or pull-outs
- Additional signing needs

Countermeasure Recommendations

- Over 90 total countermeasures recommended across the five locations including a few suggested for the Park overall (systemic applications)
- Prioritize recommendations – Benefit-Cost Analysis
- However, many countermeasures did not have applicable CMFs available – i.e. a way to quantify the safety benefit

Relative Benefit-Cost

- Developed methodology to create a “relative benefit-cost”
- All countermeasures could be compared regardless of available CMFs or data
- For benefits, included CMFs, when available, and used engineering judgment to fill in holes
- 5 levels of benefit or cost
  - Low
  - Low-Medium
  - Medium
  - Medium-High
  - High



Example Relative Benefit-Cost Summary

ID	Countermeasure	Location(s)	Short/Long Term	Relative Safety Improvement	Relative Cost	Overall Relative Benefit-Cost
Olympic National Park Overall (A-H)						
A1	Implement public information program that advises visitors of general roadway information in OLYM	Throughout OLYM	Short	Low	Low	
A2	Install permanent speed feedback signs	Speed limit change locations (or other appropriate locations – see Table 6-2)	Short	Low-Medium	Low	
A3	Increase enforcement (speeding and distracted driving)	Key locations: Lake Crescent (entire corridor), Hurricane Ridge (Parkway, entrance station, Visitor's Center)	Short	Medium-High	Low-Medium	
A4	Utilize speed trailers	Various locations, specific suggestions included in Table 6-2	Short	Low	Low	
B1	Install 6-inch edgelines (or edgelines and centerlines)	Throughout OLYM	Short	Medium	Low-Medium	
C1	Install MASH-compliant guardrail (replacements and additions)	Throughout OLYM	Long	Low-Medium	Medium	
C2	IHSDM results and cost effectiveness analysis to align guardrail applications with locations with the highest potential for severe crashes	Any current or future locations with IHSDM analysis. Lake Crescent and Hurricane Ridge included as part of this study.	Long	Medium-High	Medium-High	

Example Relative Benefit-Cost Summary

ID	Countermeasure	Location(s)	Short/Long Term	Relative Safety Improvement	Relative Cost	Overall Relative Benefit-Cost
D1/D2	Sign inventory review, evaluation, new signing plan development and install identified signs (retroreflectivity, mounting height, appropriate use of advisory speeds, curve/turn warning, chevrons, etc.)	Throughout OLYM	Short	Medium	Low-Medium	
D3	Add installation date stickers to back of signs	Throughout OLYM	Short	Low	Low	
D4	Install fluorescent yellow advisory signs	Throughout OLYM	Short	Medium	Low	
D5	Review and update all swing-arm gates to ensure they meet the NPS guidelines (security and MUTCD consistency; see Section 5.1.4)	Throughout OLYM	Short	Low	Medium	
E1	Develop LRSP	Throughout OLYM	Short	Medium	Medium	
F1	Add speed tables	Entrance stations (both directions) throughout OLYM	Short	High	Low	
G1	Increase the number of LEOs	Throughout OLYM	Long	Medium	Medium-High	
G2	Explore potential partnerships with other law enforcement agencies	Throughout OLYM	Long	Medium	High	
G3	Explore additional enforcement funding opportunities	Throughout OLYM	Short	Medium	Low	

Summary and Benefits of Approach

- Lots of CMFs available, but not always for everything you may need
- RSAs may include atypical or creative solutions that are likely to impact safety, but are not explicitly quantifiable
- Often, we have a sense of relative or general benefit of many treatments
- Easy to understand graphical representation of “scores”
- Able to differentiate between short- and long-term recommendations
- Simple reference and resource to provide to an agency

Questions?

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