Safety Performance Management achieved through Predictive Methods

Today's Presenter

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ADOT

HSM Predictive Methods

Arizona Applications

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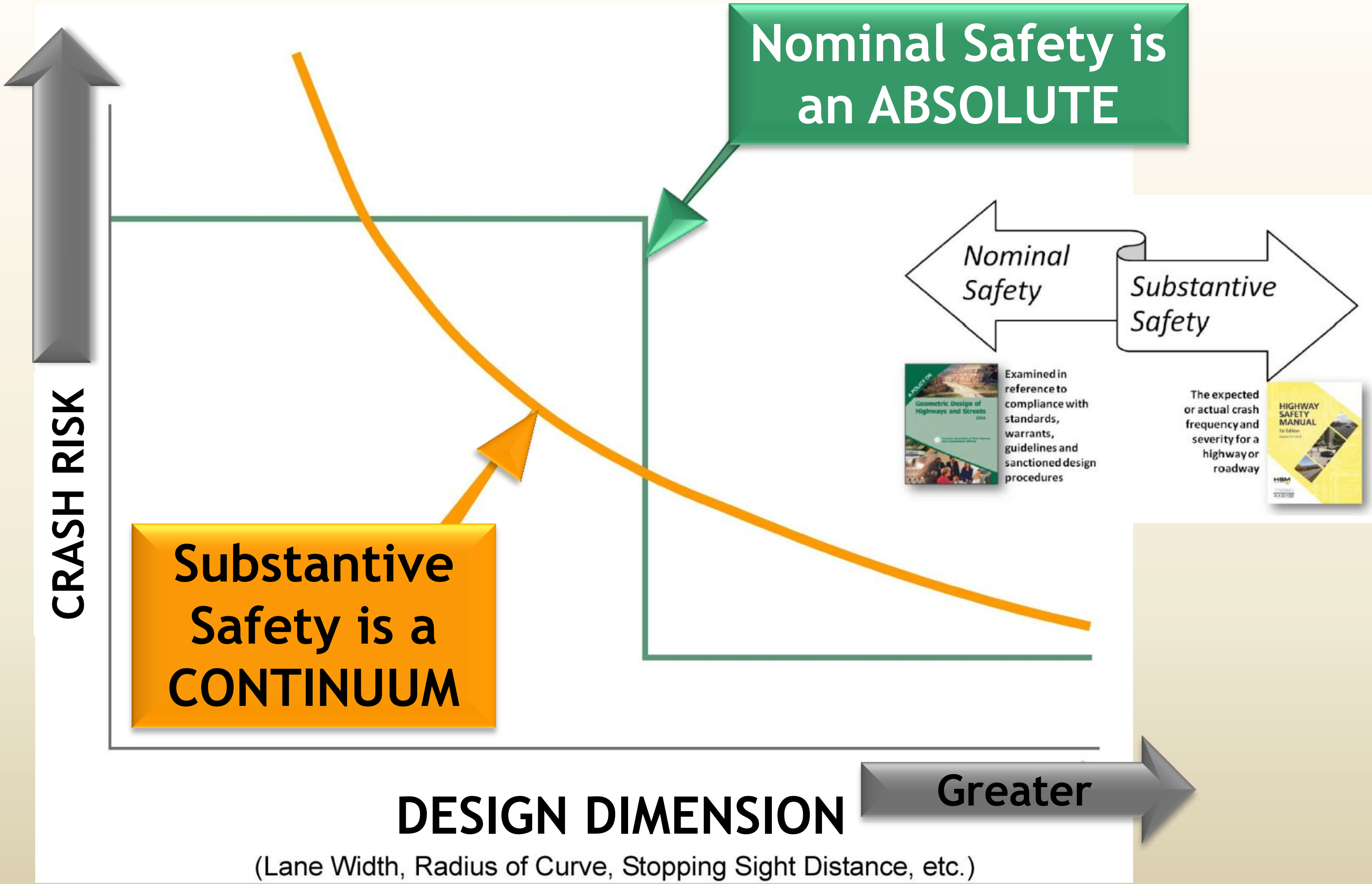
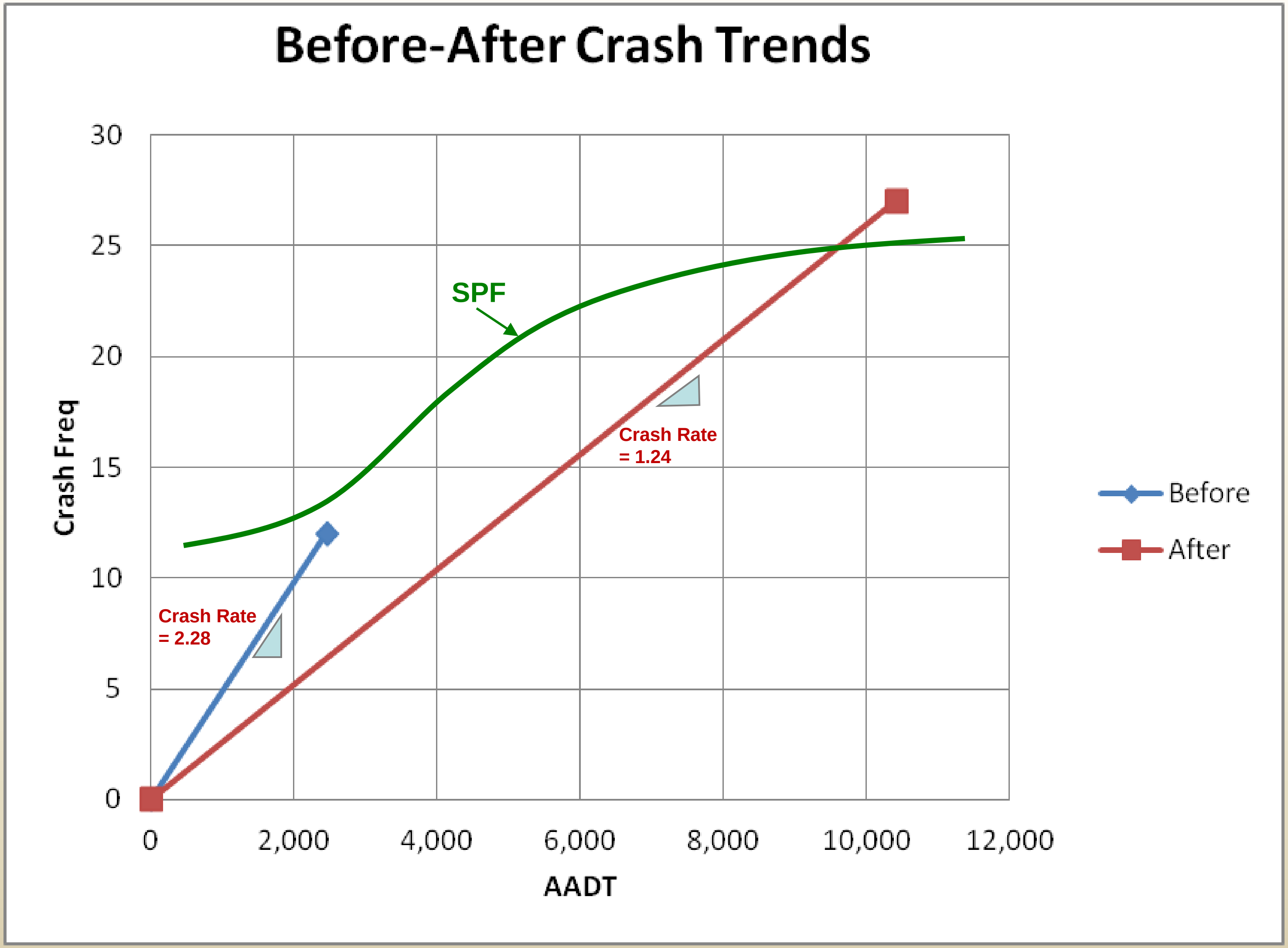
Outline

- Fundamental Issue
- AZ HSM Implementation
- AZ Pilot Applications
- Why Implement HSM?

Fundamental Issue



Crash Frequency and AADT



HSM Implementation…1
Completed

- Purchased 100 copies of HSM
- HSM Overview training (NCHRP 17-38)
  - 3 x 2-day sessions
- IHSDM training (NHI)
  - 1 x 2-day session
- Safety Management System Workshop (DiExSys)
  - 1 x 2-day session
- Pilot Applications of HSM Predictive Methods
  - 3 projects on the State Highway System

HSM Implementation…2

Ongoing/Planned

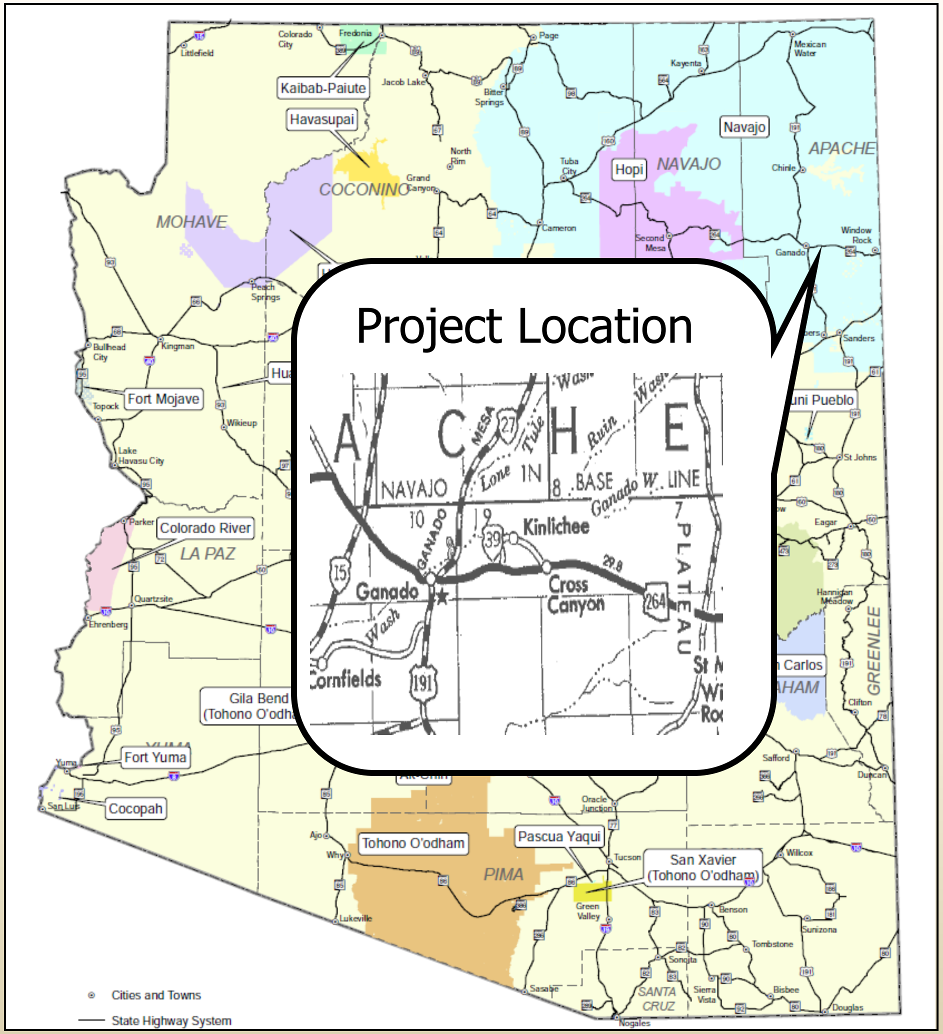
- Feasibility Study for Arizona's Roadway Management Process using HSM and SafetyAnalyst
- Framework for Integration of Substantive Safety into the ADOT Project Development Process
- Data Needs for Tree Removal CMFs on Arizona State Highways
- I-10, 35th Ave to Sky Harbor Blvd, Safety Planning Study

HSM Implementation…3

Pilot Applications

- SR 260 Segment – Convert 2-lane undivided to 4-lane divided highway
  - HSIP funding justification using HSM-based NCHRP 17-38 spreadsheet
- I-8 at Araby Road – Convert signalized intersections to roundabouts
  - HSIP funding justification using HSM-based NCHRP 17-38 spreadsheet
- SR 264 Segment – Evaluate safety benefits of widening shoulder to 5-feet vs. 8-feet
  - Quantifying the safety effects of geometric design elements using IHDSM software

SR 264 Project in Northeast Arizona



Project Information

- Rural Minor Arterial
- Navajo County, Arizona
- Undivided Two-Lane, Two-Way Road
- 12-Foot Travel Lanes
- 0-1-Foot Shoulders
- Intermittent Right and Left Turn Lanes
- Intermittent Passing Lanes

Crash and AADT Data

SR 264 Crash Data	2007	2008	2009	2010	2011*	Total
Fatal	0	4	0	2	1	**7**
Incapacitating Injury	0	3	0	0	0	**3**
Non-Incapacitating Injury	0	0	1	0	0	**1**
Possible Injury	13	7	0	4	0	**24**
Property Damage Only (PDO)	8	6	1	7	1	**23**
Total	**21**	**20**	**2**	**13**	**2**	**56**

***At the time of this study, the 2011 crash data input was still in progress and was therefore omitted from the analysis.**

SR 264	Observed 2010 AADT (vpd)	Projected 2016 AADT (vpd)	Projected 2036 AADT (vpd)
MP 441.02-MP 446.18	5,010	7,400	9,900
MP 446.18-MP 446.91	6,429	8,600	12,150
MP 446.91-MP 448.37	5,199	6,000	7,350
MP 448.37-MP 475.50	4,102	4,350	5,400

Alternative Analysis

Major Design Elements

- Widening to 5-Foot shoulders
- Widening to 8-Foot shoulders
- Improving superelevation to bring into compliance with AASHTO recommendations

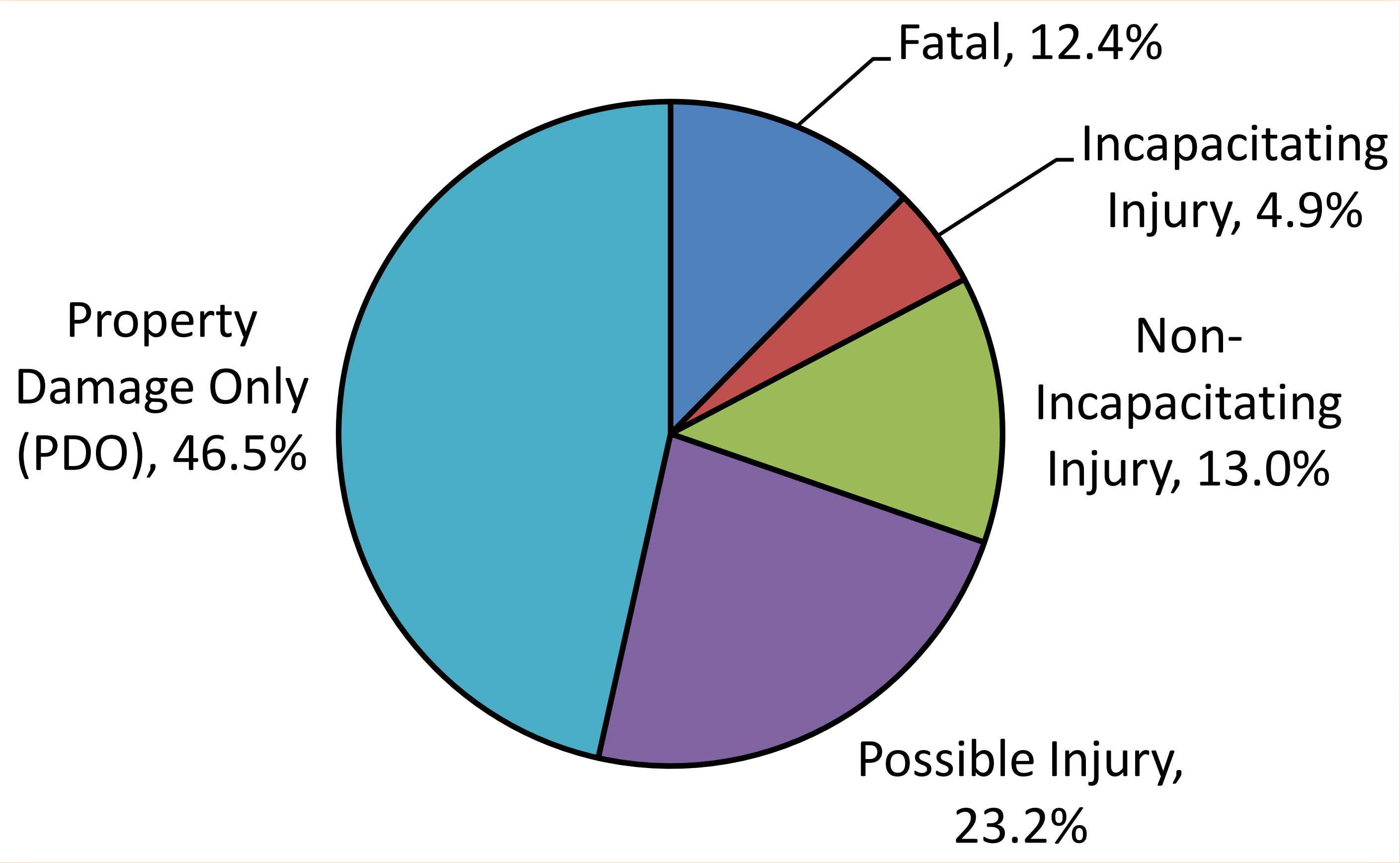
Additional Elements

- Centerline and shoulder rumble strips
- Flattening of side slopes
- Installing guardrail

Segment Prioritization
Budgetary Consideration

- Split into two separate segments to be constructed independently:
  - Segment I - MP 441.19 to MP 452.00
  - Segment II - MP 452.00 to MP 465.74
- Each segment was evaluated for prioritization
- Potential reduction in the total number of crashes over the 20-year analysis period

Crash Severity Distribution
Navajo and Hopi Rural 2-Lane



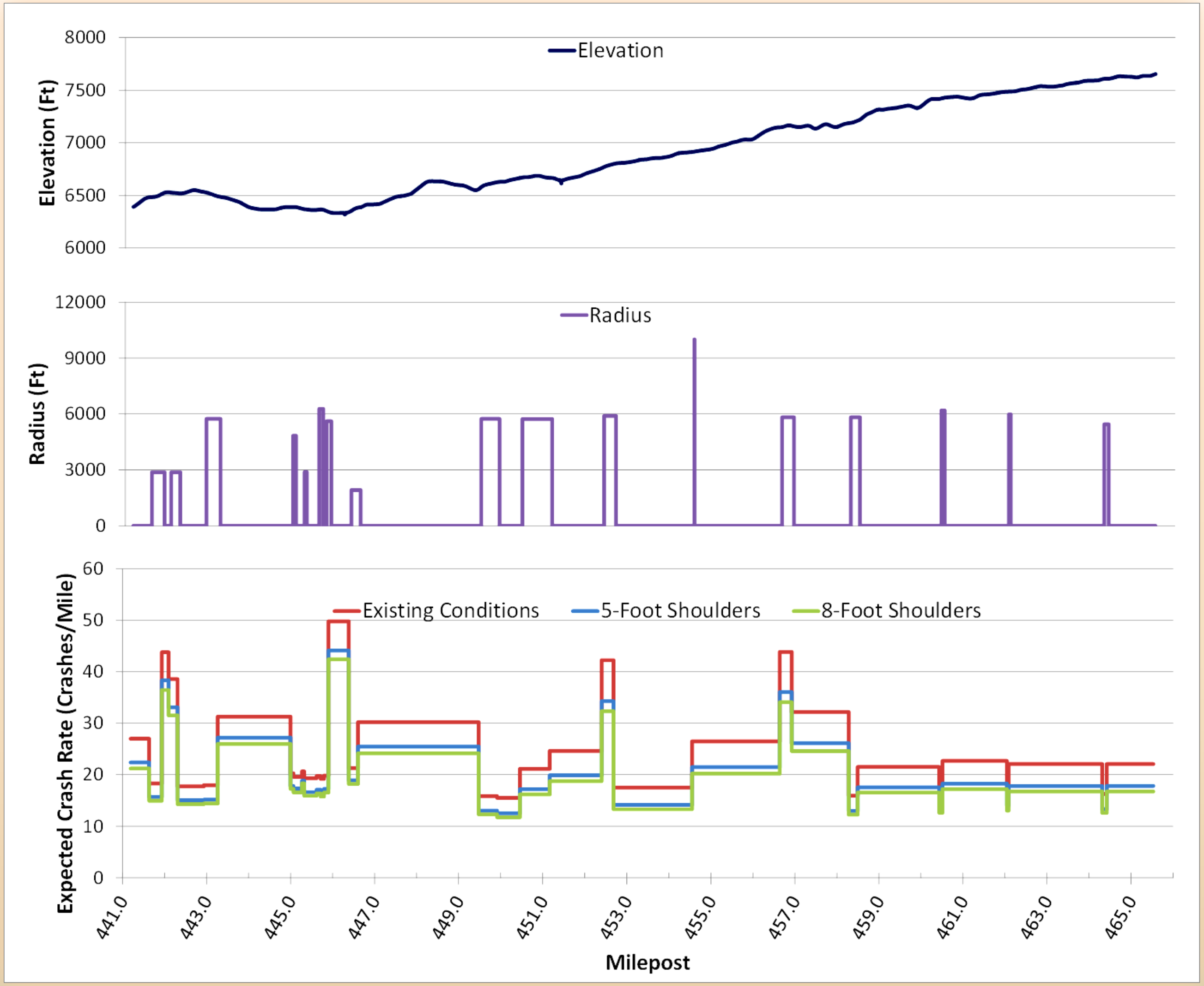
Rural 2-Lane 2-Way Parameters

Roadway Element	HSM Base Condition	Existing SR 264 (1-Foot Shoulders)	Alternative A (5-Foot Shoulders)	Alternative B (8-Foot Shoulders)
Lane width	12-Foot	12-Foot	12-Foot	12-Foot
Shoulder width	6-Foot	1-Foot	5-Foot	8-Foot
Shoulder type	Paved	Paved	Paved	Paved
Roadside hazard rating	3	Varies (6 or 7 most frequent)	Varies (1 or 2 most frequent)	Varies (1 or 2 most frequent)
Driveway Density	≤ 5 per mile	Per survey & Holbrook District turnout database	Per survey & Holbrook District turnout database	Per survey & Holbrook District turnout database
Horizontal curves: length, radius, and presence or absence of spiral transitions	None	Per best fit alignment	Per best fit alignment (match existing)	Per best fit alignment (match existing)
Horizontal curves: Super elevation	None	Per as-builts & Survey	Per as-builts & survey (match existing)	Per as-builts & survey (match existing)
Grades	≤ 3%	Per as-builts & survey	Per as-builts & survey (match existing)	Per as-builts & survey (match existing)
Centerline rumble strips	None	None	Present	Present
Passing lanes	None	Per survey	Per survey (match existing)	Per survey (match existing)
Two-way left-turn lanes	None	Per survey	Per survey (match existing)	Per survey (match existing)
Lighting	None	Present @ US 191 Intersection	Present @ US 191 Intersection (match existing)	Present @ US 191 Intersection (match existing)
Automated speed enforcement	None	None	None	None

Major Variations

- Shoulder Width
- Roadside Hazard Rating
- Centerline Rumble Strips

Expected Crash Output



Expected Number of Crashes

Segment Prioritization

	2016-2036 Expected Total Number of Crashes For Entire Project Limits		
	Existing Conditions	Segment I 5-Foot Shoulders with Segment II Existing Conditions	Segment II 5-Foot Shoulders with Segment I Existing Conditions
Total	636.38	593.09	574.87
Reduction in Total Crashes over Existing Conditions	N/A	43.29	61.51
Percentage Reduction in Total Crashes over Existing Conditions	N/A	6.8%	9.7%

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Benefit-to-Cost Ratio
Design Alternatives

Benefit / Cost (5-Foot Shoulders)		
Annual Benefit	Annual cost	Benefit / Cost Ratio
$3,873,681	$1,680,561	**2.30**

Benefit / Cost (8-Foot Shoulders)		
Annual Benefit	Annual cost	Benefit / Cost Ratio
$5,084,207	$2,678,713	**1.90**

Benefit / Cost (Superelevation Improvements)		
Annual Benefit	Annual cost	Benefit / Cost Ratio
$41,807	$135,464	**0.31**

Conclusions
Lessons Learned

- IHSDM provides a user-friendly interface for implementing the HSM Predictive Method to real world project applications
- IHSDM can be used to quantify the safety benefits for a wide variety of proposed improvements
- Improvements that can be evaluated using IHSDM is restricted to those identified in Part C of the HSM
- Based on the analysis outcome, 5-feet shoulder provides greatest safety benefit per dollar spent

Why Implement HSM?
Better Safety Performance

- Better safety analysis using quantitative approach to support decision-making
- Cost effective investments to reach our safety goals
- More directly integrate safety in the overall program and project development process
- Better assess tradeoffs with other values such as, cost, environmental concerns, right-of-way, and operations
- Communicate direct and meaningful return on investments in safety

Bottom line: More lives and injuries saved per dollar invested

Thank You!

Questions?

Comments?

Disclaimer: Information contained in this presentation are for informational purpose only and may not necessarily reflect current ADOT policies or guidelines.

For additional information, please contact

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