



THE UNIVERSITY OF TEXAS AT AUSTIN
CENTER FOR TRANSPORTATION RESEARCH

Austin IAC Task 9

Implementing an Objective and Proactive Measure of Road Safety Performance for the Austin District

Hui Wu, Ph.D., P.E., Research Associate

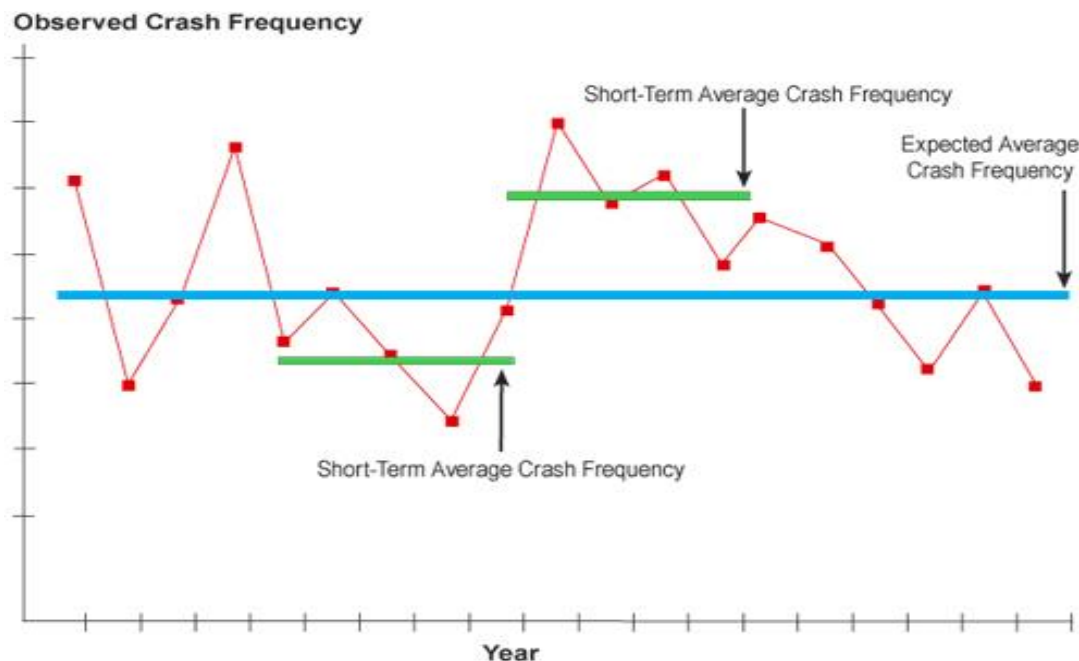
Michael R. Murphy, Ph.D., P.E., Research Engineer

Zhanmin Zhang, Ph.D., Associate Professor

Mike Arellano, P.E., District Pavement Engineer

Motivation (1/2)

- Newly built highway: i.e., SH 130 section 1-6
- Regression-to-the-mean bias

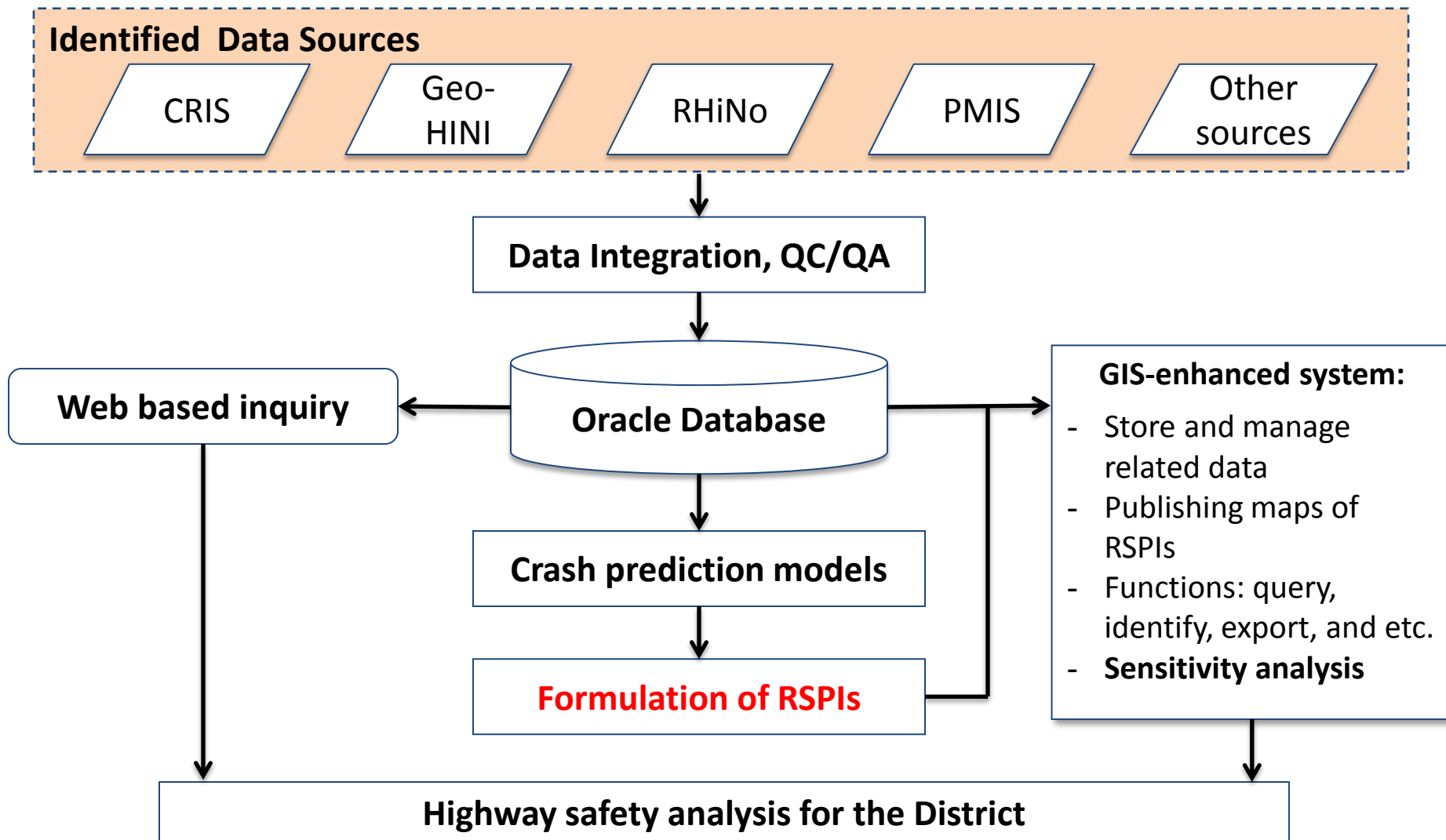


Source: FHWA, Highway Safety Improvement Program (HSIP) Manual

Motivation (2/2)

- Provide the Austin District with a method to identify locations for potential road safety improvements:
 - Performance-based
 - Proactive
 - Reliable
 - Effective
- 
- Road Safety
Performance
Indices (RSPIs)**

Framework



Formulation of RSPIs (1/2)

- **Road safety performance index for individual drivers** ($RSPI_{Ind}$): reflect the average individual risk of each exposure on a homogenous roadway segment .
 - Crash history data
 - Highway system
 - Lane width, number of lanes
 - Shoulder, curb, median
 - Horizontal/vertical curve
 - Traffic, truck volume
 - Skid/condition scores
 - Crash costs by severity levels

Formulation of RSPIs (2/2)

- **Road safety performance index of roadway sections** ($RSPI_{Acu}$) : describe the collective risk which influences the reliability of service on a roadway segment :
 - Same factors in developing $RSPI_{Ind}$
 - Exposure on roadway section (mil. vehicle-miles of travel)

Overview of the RSPIs tool

File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help

Table Of Contents

Layers

- ☐ RefMarker_Austin
- ☒ Fatal_Crash_Austin_2010-2014
- ☒ Wet_Weather_Crash_Austin_2010-2014
- ☒ Crash_Austin_2010-2014
- ☐ Crash_Austin_2003-2009
- ☐ RHiNo_Austin
- ☐ GeoHINI_Austin
- ☒ RSPIs_ACU_Lc
 - 0.0 - 2.0
 - 2.1 - 4.0
 - 4.1 - 6.0
 - 6.1 - 8.0
 - 8.1 - 10.0
- ☐ RSPIs_ACU_Pr
- ☐ RSPIs_IND_Pr
- ☐ RSPIs_IND_Lc
- ☐ PMIS_Scores_Austin_2010-2014
- ☒ Traffic
- ☐ RTE_Austin
- ☒ Water_Lake_Poly_Austin
- ☒ Water_Strm_In_Austin
- ☐ Basemap
- ☐ RTE_RDBD_Austin
- ☐ HIP_Inventory_Austin
- ☐ TXDOT_ROUTE_RTE_LN_Austin
- ☐ TXDOT_RTE_RDBD_LN_EOY_2010_Austin
- ☐ TXDOT_RTE_RDBD_LN_EOY_2010_Austin
- ☐ Austin_District_2010_GS_Map

Attribute Table

Severity	Collsn_Desc	Intrsect_Rel	Surf_Cond	Wthr_Cond	Rd_Al
APACITATING	SD ONE STRAIGHT-ONE LEFT TURN	INTERSECTION	WET	RAIN	STRAIGHT, LEVEL
RED	ANGLE - ONE STRAIGHT-ONE RIGHT TURN	INTERSECTION	WET	CLOUDY	STRAIGHT, LEVEL
	SD ONE STRAIGHT-ONE STOPPED	INTERSECTION RELATED	WET	CLEAR	STRAIGHT, GRADE
	ANGLE - ONE STRAIGHT-ONE LEFT TURN	INTERSECTION	WET	RAIN	STRAIGHT, LEVEL
	SD ONE STRAIGHT-ONE STOPPED	NON INTERSECTION	WET	CLEAR	STRAIGHT, LEVEL
	OMV VEHICLE GOING STRAIGHT	NON INTERSECTION	WET	RAIN	STRAIGHT, LEVEL
	OMV VEHICLE GOING STRAIGHT	NON INTERSECTION	WET	RAIN	CURVE, GRADE
	SD ONE STRAIGHT-ONE STOPPED	INTERSECTION RELATED	WET	CLEAR	STRAIGHT, LEVEL
	ONE STRAIGHT-ONE STOPPED	INTERSECTION RELATED	WET	RAIN	STRAIGHT, HILLCREST
	V VEHICLE GOING STRAIGHT	NON INTERSECTION	WET	RAIN	CURVE, HILLCREST
	BOTH GOING STRAIGHT-REAR END	INTERSECTION RELATED	WET	RAIN	STRAIGHT, LEVEL
	V VEHICLE GOING STRAIGHT	NON INTERSECTION	WET	RAIN	CURVE, LEVEL
	ONE STRAIGHT-ONE STOPPED	INTERSECTION RELATED	WET	RAIN	STRAIGHT, GRADE
	ONE STRAIGHT-ONE RIGHT TURN	INTERSECTION RELATED	WET	RAIN	STRAIGHT, LEVEL
	BOTH GOING STRAIGHT-SIDESWIPE	NON INTERSECTION	WET	RAIN	STRAIGHT, LEVEL
	ONE STRAIGHT-ONE STOPPED	INTERSECTION RELATED	WET	CLOUDY	STRAIGHT, LEVEL
	BOTH GOING STRAIGHT-REAR END	NON INTERSECTION	WET	RAIN	STRAIGHT, LEVEL
	ONE STRAIGHT-ONE STOPPED	INTERSECTION	WET	CLOUDY	STRAIGHT, LEVEL
	V VEHICLE GOING STRAIGHT	NON INTERSECTION	WET	RAIN	CURVE, LEVEL
	ONE STRAIGHT-ONE STOPPED	INTERSECTION RELATED	WET	CLOUDY	STRAIGHT, LEVEL
	GLE - ONE STRAIGHT-ONE LEFT TURN	INTERSECTION	WET	RAIN	STRAIGHT, LEVEL
	V VEHICLE GOING STRAIGHT	NON INTERSECTION	WET	RAIN	STRAIGHT, LEVEL

Select by Attributes

Enter a WHERE clause to select records in the table window.

Method: Create a new selection

RRl_Ind_Pr
RRl_Ind_NB
RRl_Acu_Lc
RRl_Acu_Pr
RRl_Acu_NB

= <> Like 0

> >= And

< <= Or

% () Not

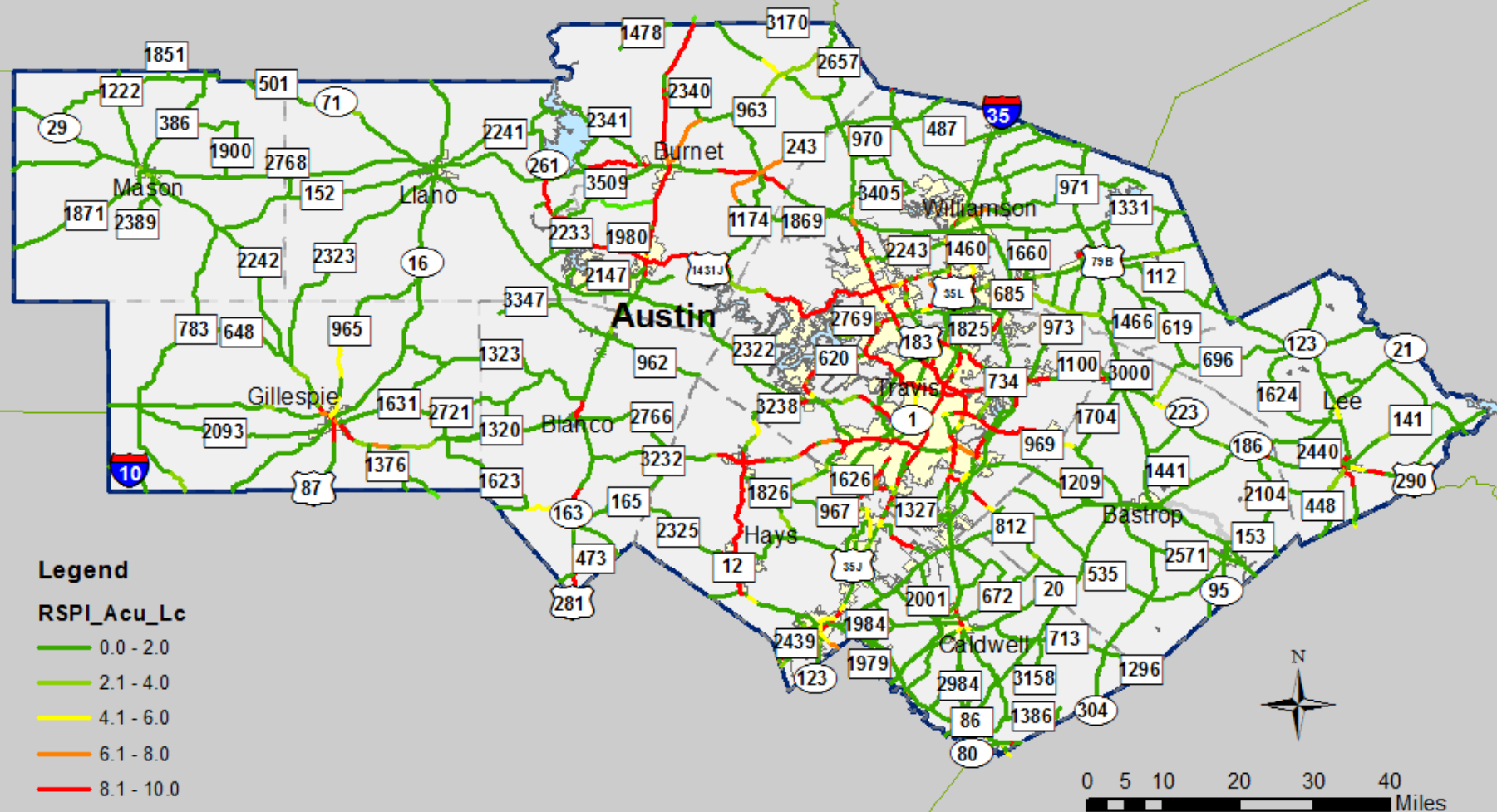
Is Get Unique Values Go To:

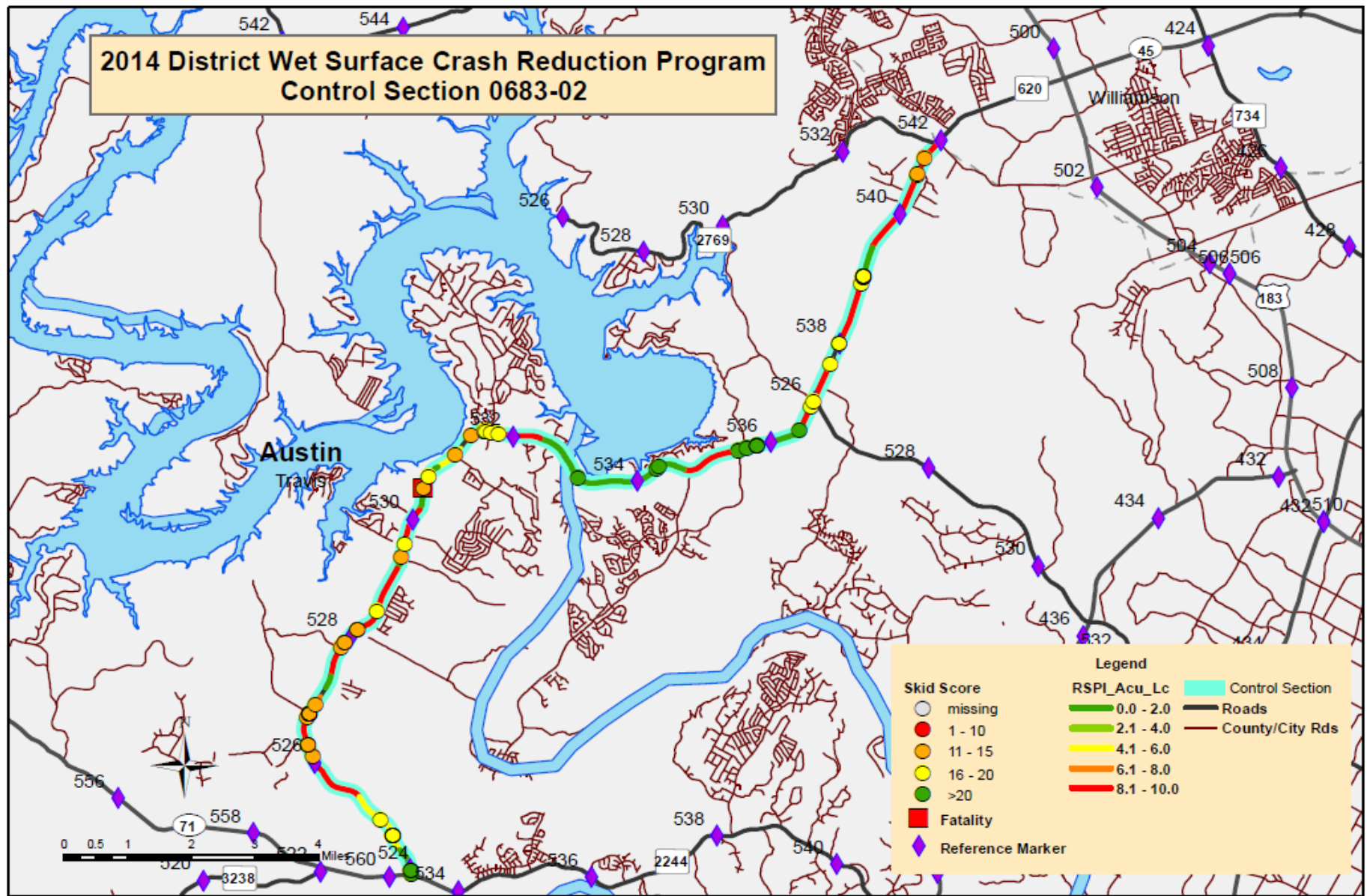
0.263543

Query

SELECT * FROM RSPIs_CG_Austin_V5 WHERE:
"RRl_Acu_Lc" > 8

Clear Verify Help Load... Save... Apply Close





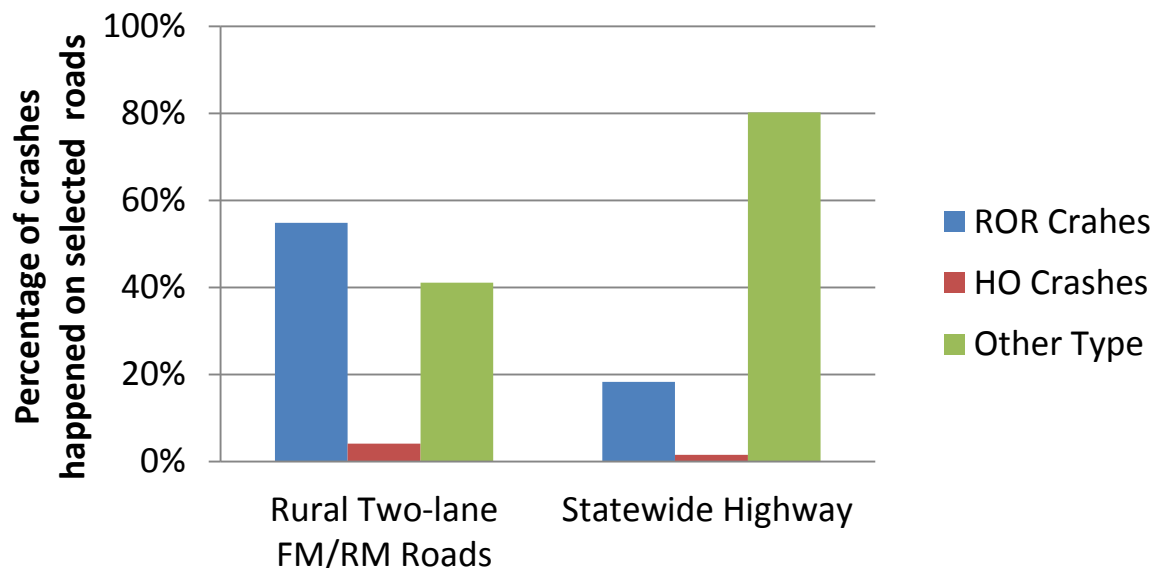
Evaluating a Specific Measure

Empirical Bayes Before-After Study on Safety Effect of Narrow Pavement Widening Projects



Background and Motivation

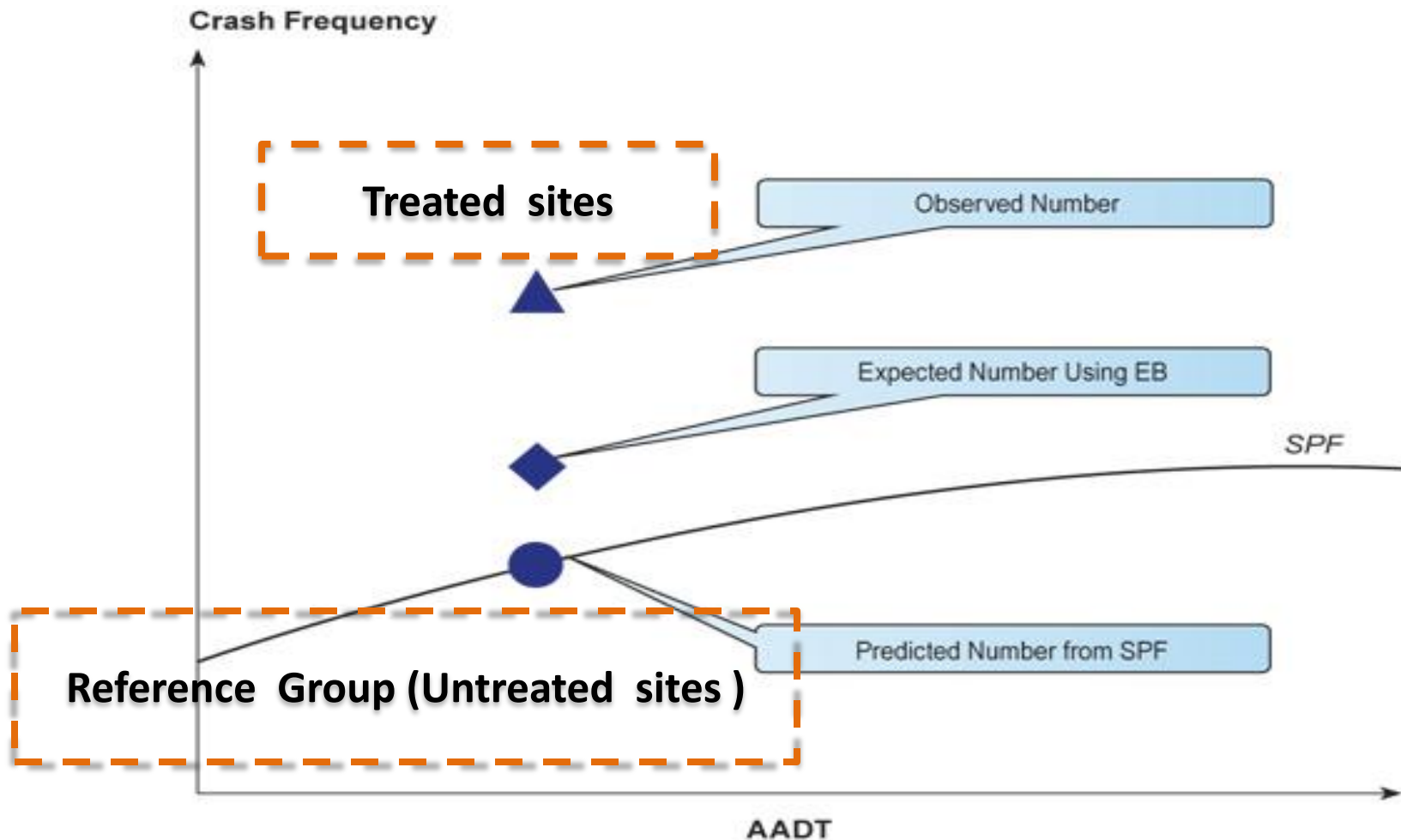
- Texas -- 40,000 lane-miles narrow two-lane FM/RM roads
- Crash rate -- 108.4 per 100 million VMT in 2012
- Crashes happened on these roads -- relative high risk of fatal, run-off-the-road (ROR), head-on (HO) crashes



Objectives

- To investigate if narrow pavement widening projects can improve overall traffic safety or reduce for the risks of certain *types* and/or *severity* levels of crashes;
- To quantify the impact, if they are significant.
 - **Treatment Effect**
 - Exposure Effect
 - Trend Effect
 - Random Effect

Before-After Study



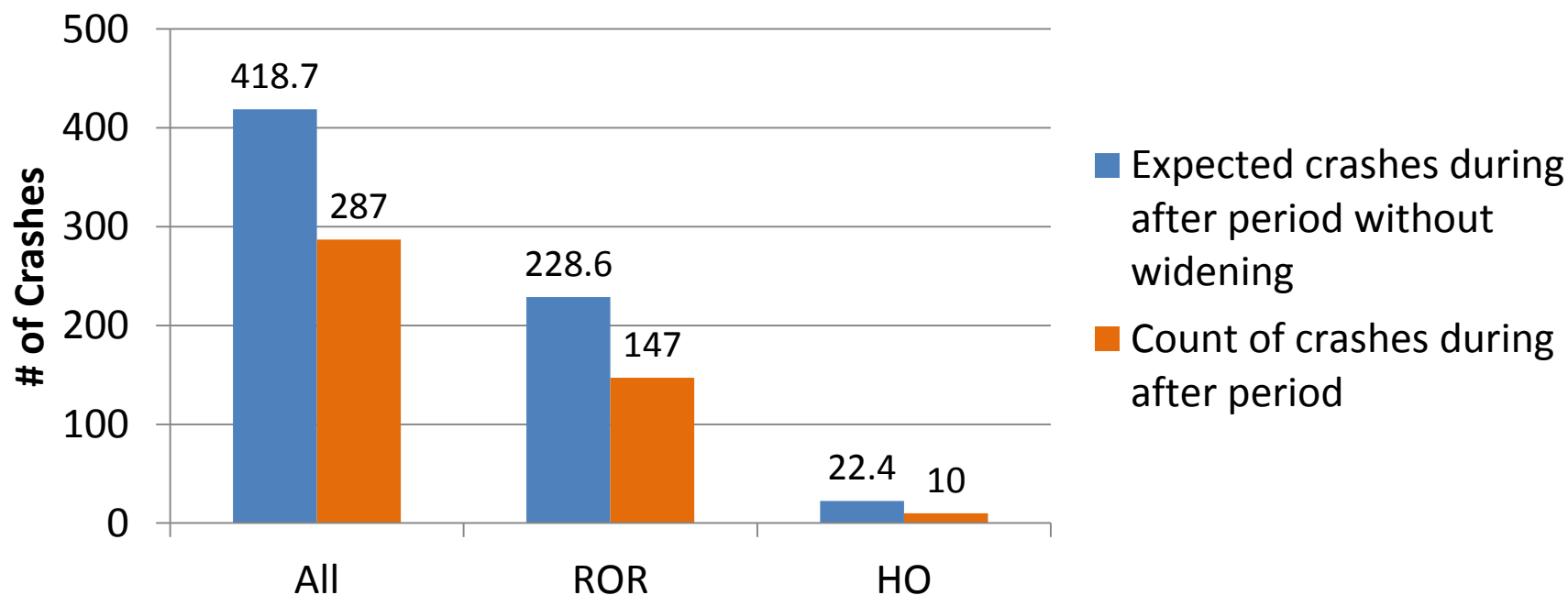
Source: FHWA, Highway Safety Improvement Program (HSIP) Manual

Data Description

- **22 Narrow Widening (NW)** projects in Austin rural areas from 2004 to 2011
 - Average length of 3.54 miles
 - Crash data from 2003 to 2012
 - For each project, a minimum of 12 months of crash data was available for the before/after periods
- **Reference group:** 1,585 roadway segments with similar characteristics as the 22 NW projects

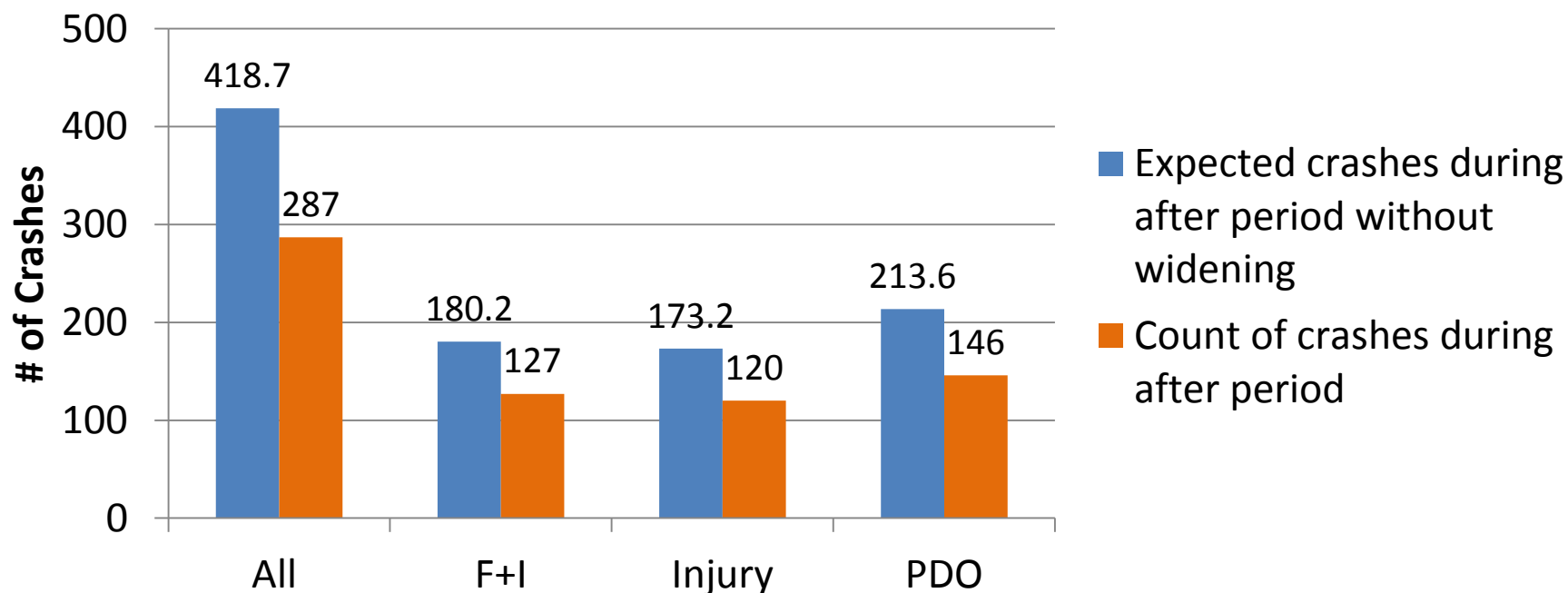
Before-after Analysis Results (1/2)

	All	ROR	HO
# of crashes in after period	287	147	10
Expected crashes in after period without widening (STDV)	418.7 (22.1)	228.6 (15.6)	22.4 (4.4)
% reduction in crashes (STDV)	31.5 (5.4)	35.7 (6.8)	55.4 (15.4)
Index of effectiveness (STDV)	0.68 (0.05)	0.64 (0.07)	0.43 (0.15)



Before-after Analysis Results (2/2)

	All	F+I	Injury	PDO
# of crashes in after period	287	127	120	146
Expected crashes in after period without widening (STDV)	418.7 (22.1)	180.2 (15.8)	173.2 (12.7)	213.6 (15.1)
% reduction in crashes (STDV)	31.5 (5.4)	29.5 (8.7)	30.7 (8.0)	31.7 (7.4)
Index of effectiveness (STDV)	0.68 (0.05)	0.70 (0.09)	0.69 (0.08)	0.68 (0.07)



Conclusions

- Project and forecast road safety management efforts under Department policy goals
- Screen the network to identify sites for treatment
- Monitor the effectiveness of safety actions applied
- Easily integrate safety analysis in the current pavement management system

