SHSP + HSIP = 0

Draft Project Selection Guide

presented to

Traffic Engineer's Meeting

presented by

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Louisiana Department of Transportation and Development

June 25, 2015

DOCUMENT OUR PROCESS

DESTINATION ZERO DEATHS

ESTABLISH CRITERIA

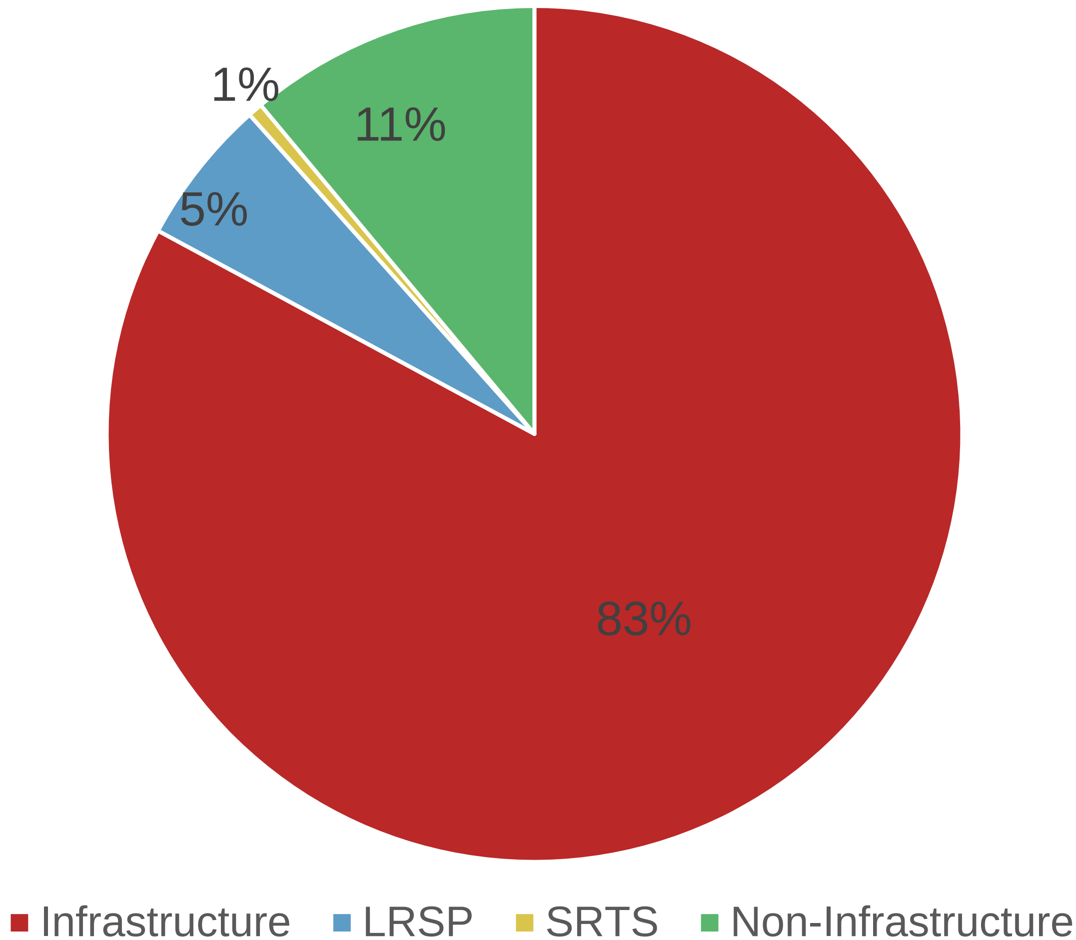
DESTINATION ZERO DEATHS

INFORM OUR PARTNERS

DESTINATION ZERO DEATHS

TRANSPARENT DECISION-MAKING

HSIP Allocations



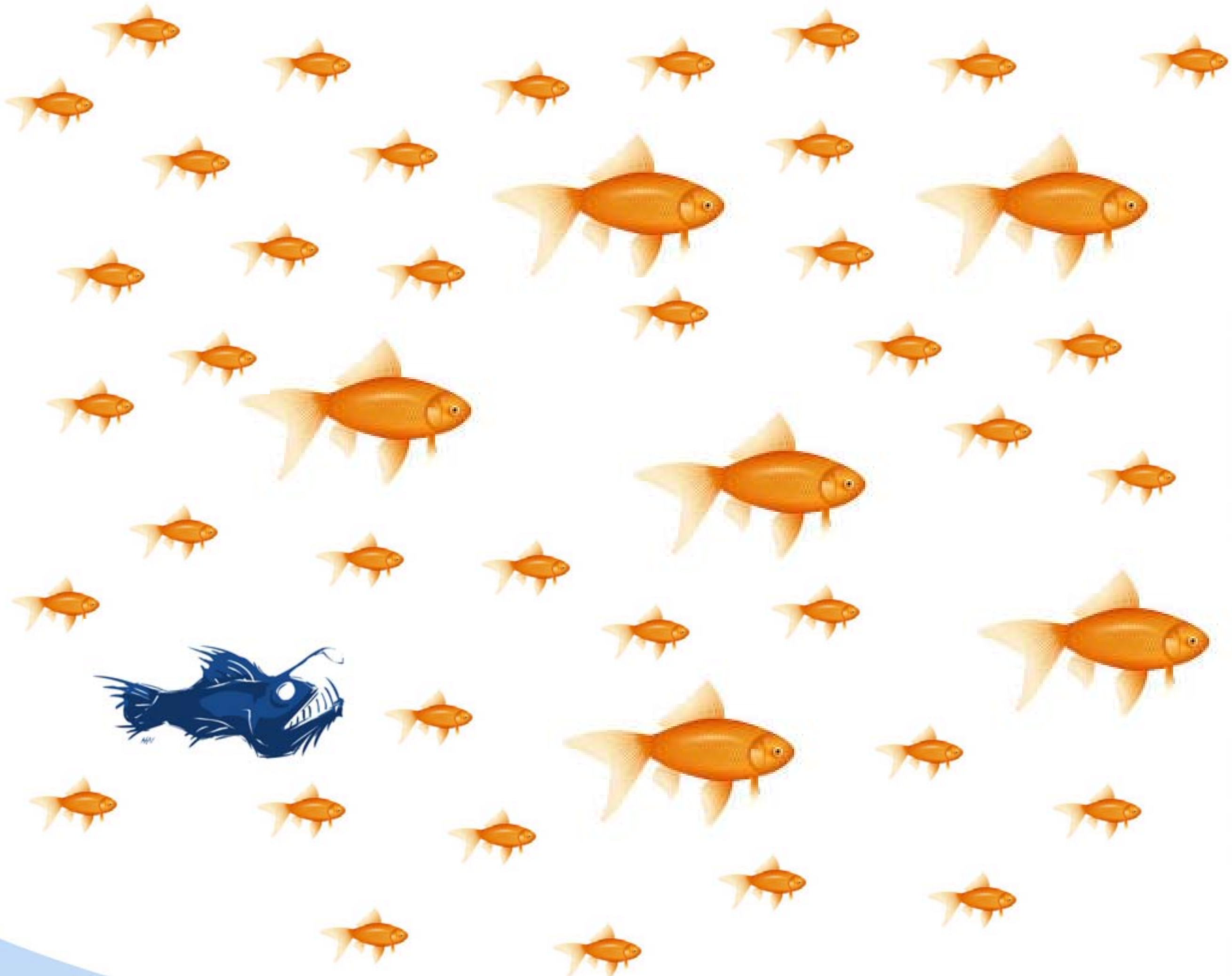
Process

1. Network screening
2. Problem Identification
3. Alternatives Analysis & Countermeasure Selection
4. Economic Evaluation
5. Prioritization

DESTINATION ZERO DEATHS

NETWORK SCREENING

Network Screening

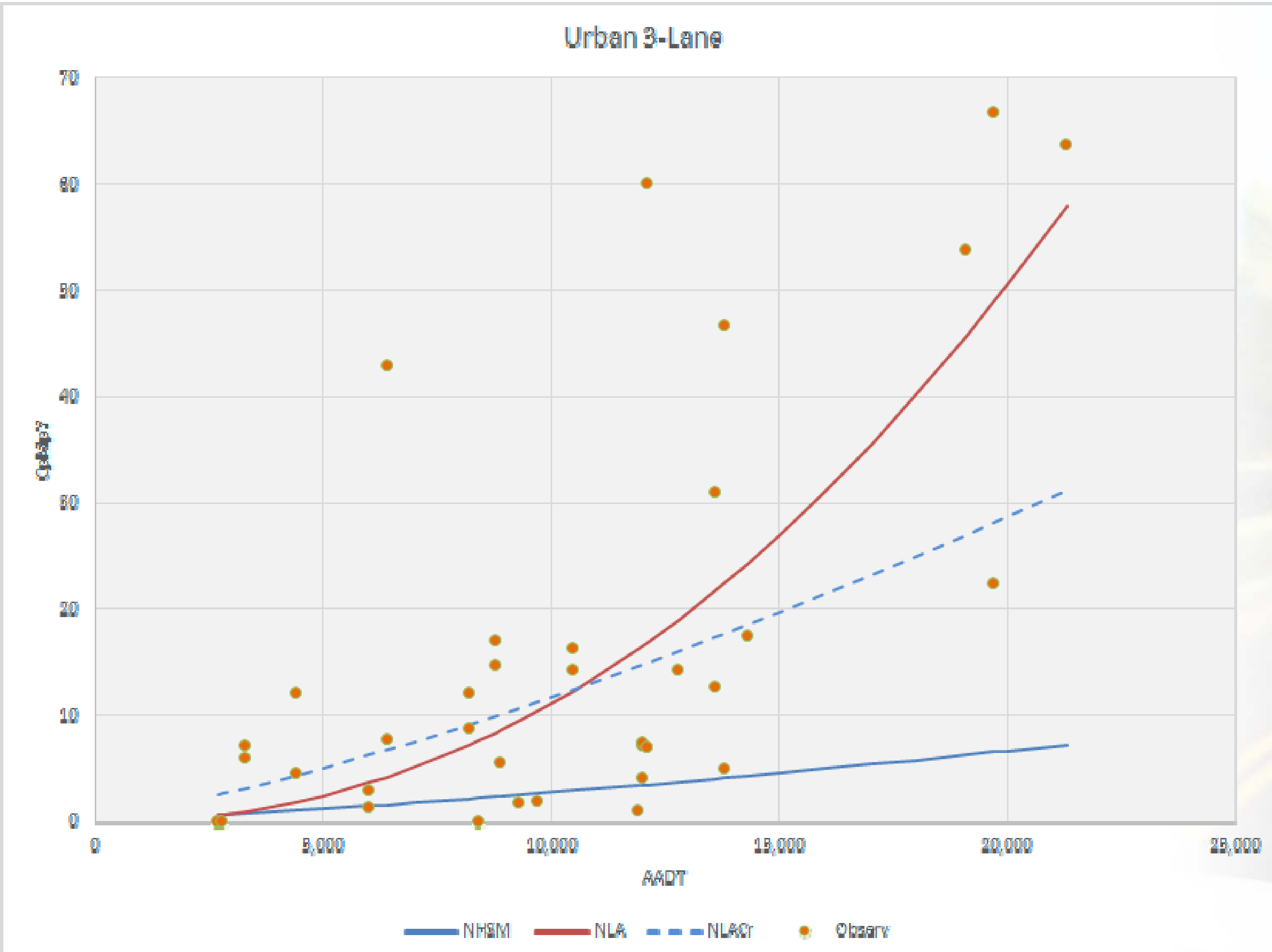


Network Screening

- **High PSI List**
  - » **Number-rate method**
  - » **State-specific SPFs (Vision Zero Suite)**
  - » **Calibrated SPFs from the HSM (i.e. SafetyAnalyst)**
- **Systemic Approach**
- **Other**

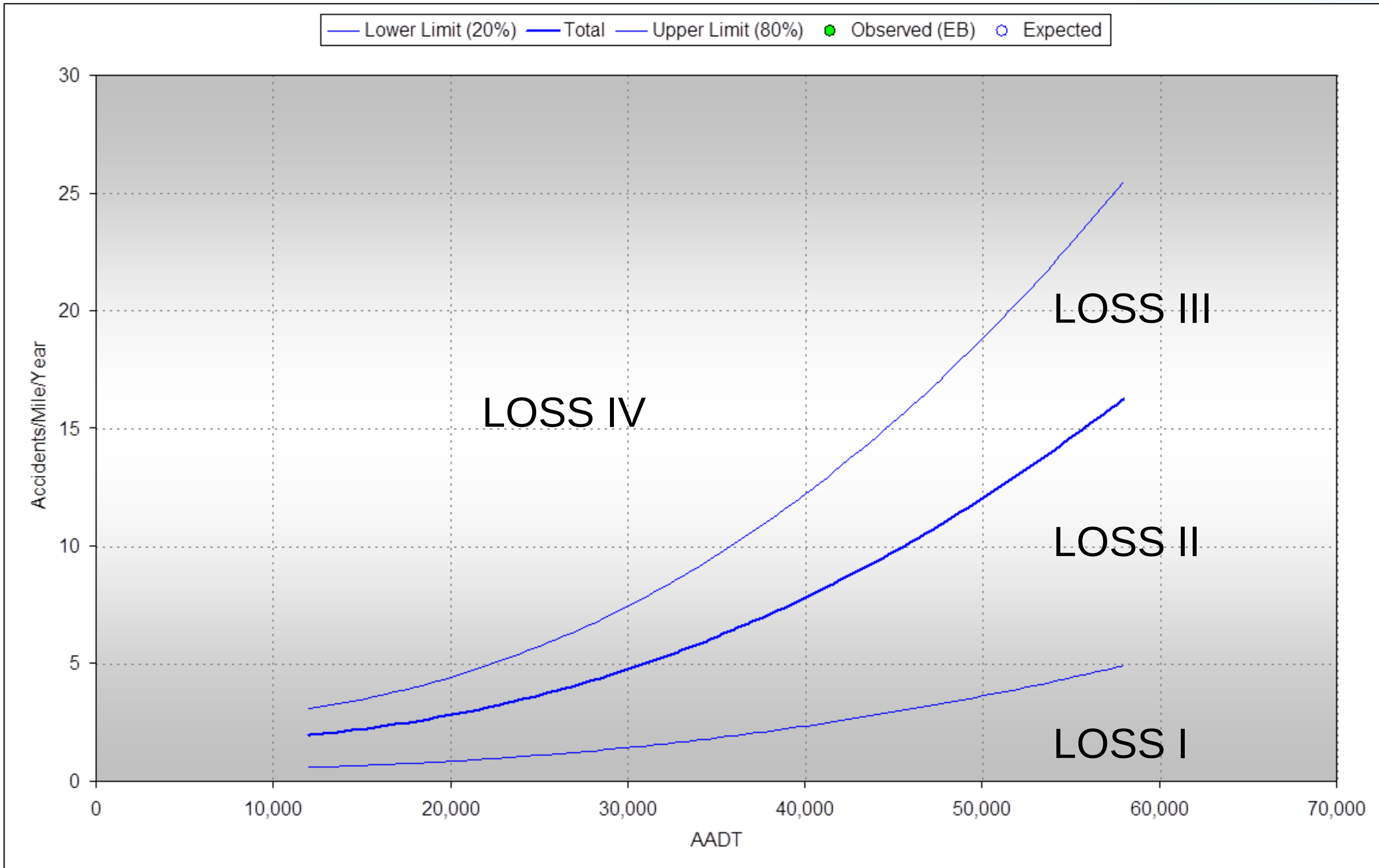
DESTINATION ZERO DEATHS

All models are wrong, but some are useful



DESTINATION ZERO DEATHS

Vision Zero



Lower Limit (20%)
Total
Upper Limit (80%)
Observed (EB)
Expected
30
25
20
15
10
5
0
Accidents/Mile/Year
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
AADT
LOSS IV
LOSS III
LOSS II
LOSS I

Systemic Approach

1. Crashes correlated with roadway features
2. Roadway features associated with risk
3. Locations selected based on roadway features

Other

- Other fed-aid programs
- District offices
- MPOs
- Local officials
- Regional Safety Coalitions
- Media
- General public

PROBLEM IDENTIFICATION

Problem Identification

- Relative severity
- Crash types
- Narrow down location

Problem Identification

- Roadway Safety Triage Tool
- Crash DART
- Vision Zero Suite
- CrashMagic
- GIS

DESTINATION ZERO DEATHS

Roadway Safety Triage Tool

Analysis Performed by:

Date:

CRASH ANALYSIS

Project Name/Number =
Route =
Control Section = (i.e XXX-XX)
Logmile From = (i.e XX.XX)
Logmile To = (i.e XX.XX)
AADT =
Highway Class =
Number of Years =

For roadway segments: When calculating crash rates for segments, nor crashes only are to be considered in the crash data analysis.

$VMT = L \times AADT \times 365$

$R_{seg} = (C \times 10^6) / (T \times VMT)$

Whereas:
- VMT = vehicle miles traveled
- L = length of segment
- AADT = annual average daily traffic
- R_{seg} = crash rate
- C = total number of crashes
- T = number of analysis years

1. CRASH RATE - ABNORMAL LIST

A. SEGMENT

Project	Route	Control Section	Logmile From	Logmile To	Segment Length	AADT	Number of years

Total Crashes	Total per year	E (PDO)	B+C+D (Injury)	A (Fatal)	Number Fatalities	Number Injuries

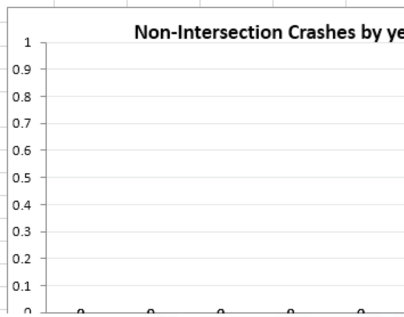
Crash Rate	State Avg.	Abnormal List	Segment in Abn	Exactly	Logmile From	LMF on LMT	Logmile To	LMT on LMF	Abn in Segment

B. INTERSECTION

Is there any Abnormal Intersections within the segment?

2. NON - INTERSECTION CRASHES

Year	Crash Severity PDO	Injury	Fatal	Total
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0



Crash DART

Assumptions & Explanations

Read this column first

DART => Data Analysis Research Tool

Assumptions

- Those using this tool are Engineers, capable of making Engineering judgments.
- The road segment under examination shall be geometrically & operationally homogeneous. The analysis is geared toward motorized vehicles following the lead of the Louisiana Motor Vehicle Traffic Crash Report.
- Only tab's "sum", "B&A", "location", "ORL", "CToD", "QC&T", or "Ref" shall be printed
- Without vetting, the results are only as good as the crash data. Vet the higher priority crashes to attain better results. Vetting is accomplished by correcting errors.
- You already have access to Crash1, the Abnormal <http://engrapps/crash1r/abnormal.asp>, ThinkStream, Surface type log file , and Highway Geographic features. The last two are the sixth and fifth links respectively under "Highway Inventories" at
- Crash data is available each year pulled. If not extra spaces will need to be added with the year.
- All other sections of the Crash1 search box are left to their default values
- You have an average knowledge of MS Excel
- No more than 390±3 (depending on some search parameters) crashes are pulled. If more than 390±3 crashes are needed, then additional rows will need to be inserted in "all crash", "location", "ORL", and "Other" tab between rows

Tab Explanations

more explanations below Row-99

Troubleshooting

Having a problem that you can not resolve, contact Bryan Costello <Bryan.Costello@LA.gov> for assistance.

Other

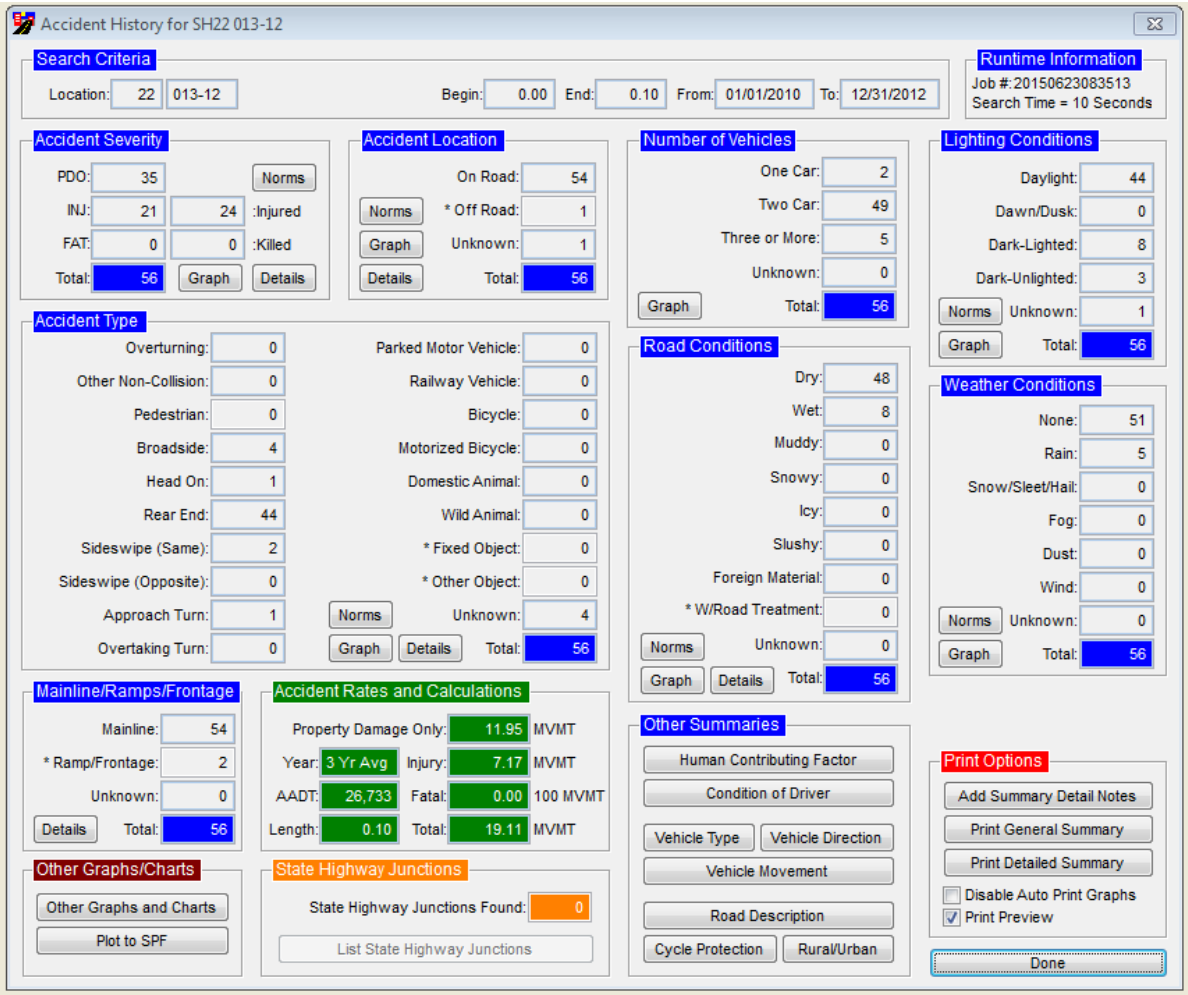
Send me, Bryan Costello <Bryan.Costello@LA.gov> , any comments, thoughts, or suggestions to improve this program.

Extension Calculator

# of crashes

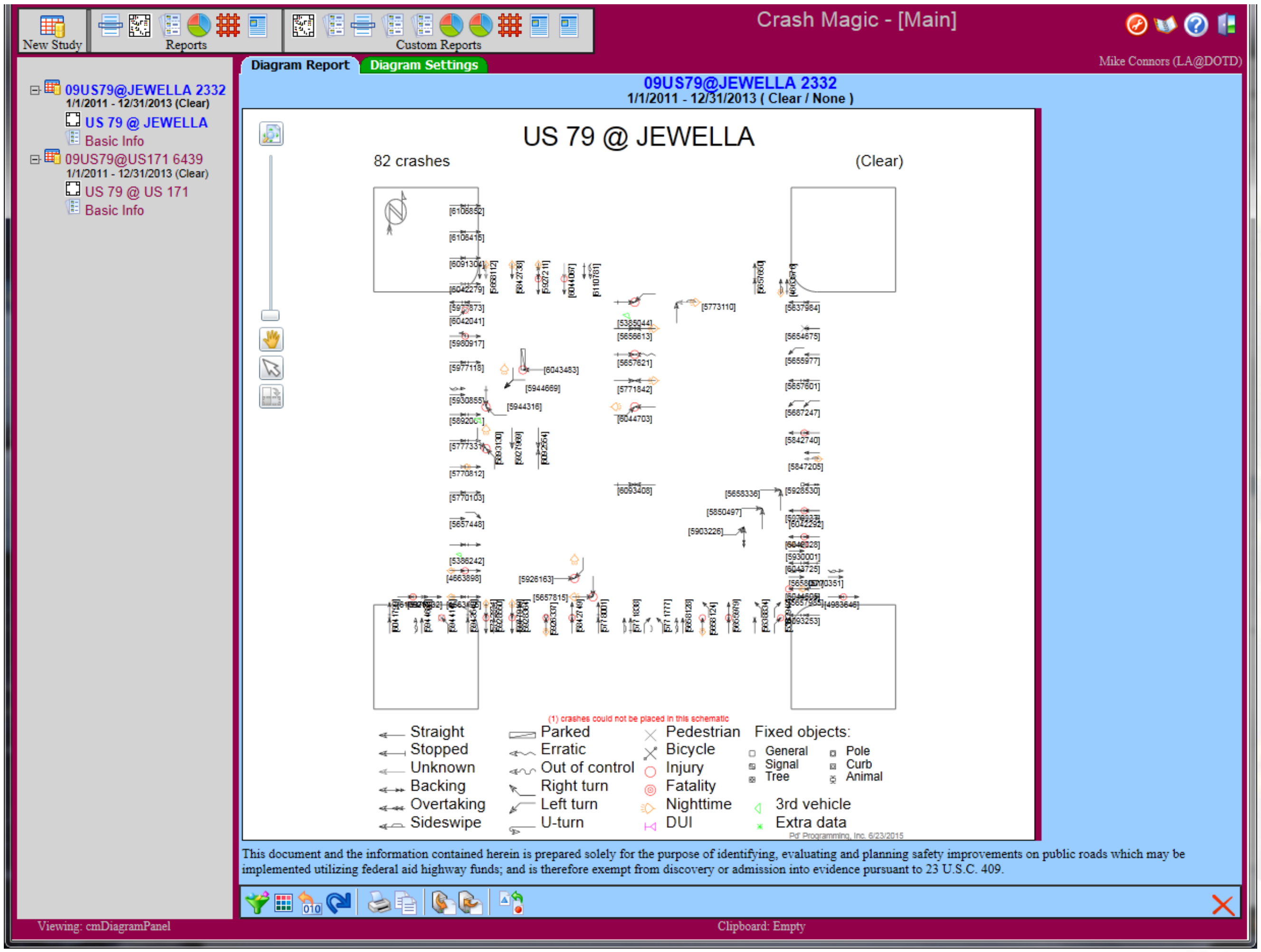
extension not

Vision Zero Suite



DESTINATION ZERO DEATHS

Crash Magic



New Study
Reports
Custom Reports
Crash Magic - [Main]
Mike Connors (LA@DOTD)
Diagram Report
Diagram Settings
09US79@JEWELLA 2332
1/1/2011 - 12/31/2013 (Clear)
US 79 @ JEWELLA
Basic Info
09US79@US171 6439
1/1/2011 - 12/31/2013 (Clear)
US 79 @ US 171
Basic Info
09US79@JEWELLA 2332
1/1/2011 - 12/31/2013 (Clear / None)
US 79 @ JEWELLA
82 crashes
(Clear)
(1) crashes could not be placed in this schematic
Straight
Stopped
Unknown
Backing
Overtaking
Sideswipe
Parked
Erratic
Out of control
Right turn
Left turn
U-turn
Pedestrian
Bicycle
Injury
Fatality
Nighttime
DUI
Fixed objects:
General
Signal
Tree
Pole
Curb
Animal
3rd vehicle
Extra data
This document and the information contained herein is prepared solely for the purpose of identifying, evaluating and planning safety improvements on public roads which may be implemented utilizing federal aid highway funds; and is therefore exempt from discovery or admission into evidence pursuant to 23 U.S.C. 409.
Viewing: cmDiagramPanel
Clipboard: Empty

GIS

ALTERNATIVES ANALYSIS & COUNTERMEASURE SELECTION

DESTINATION ZERO DEATHS

Alternatives Analysis & Countermeasure Selection

- Address problem ID
- Effectiveness
- Cost
- Feasibility
- Maintenance

Alternatives Analysis & Countermeasure Selection

- **HSM Predictive Method**
- **CMF Clearinghouse**
- **Other research and/or pilot project**

DESTINATION ZERO DEATHS

HSM Spreadsheets

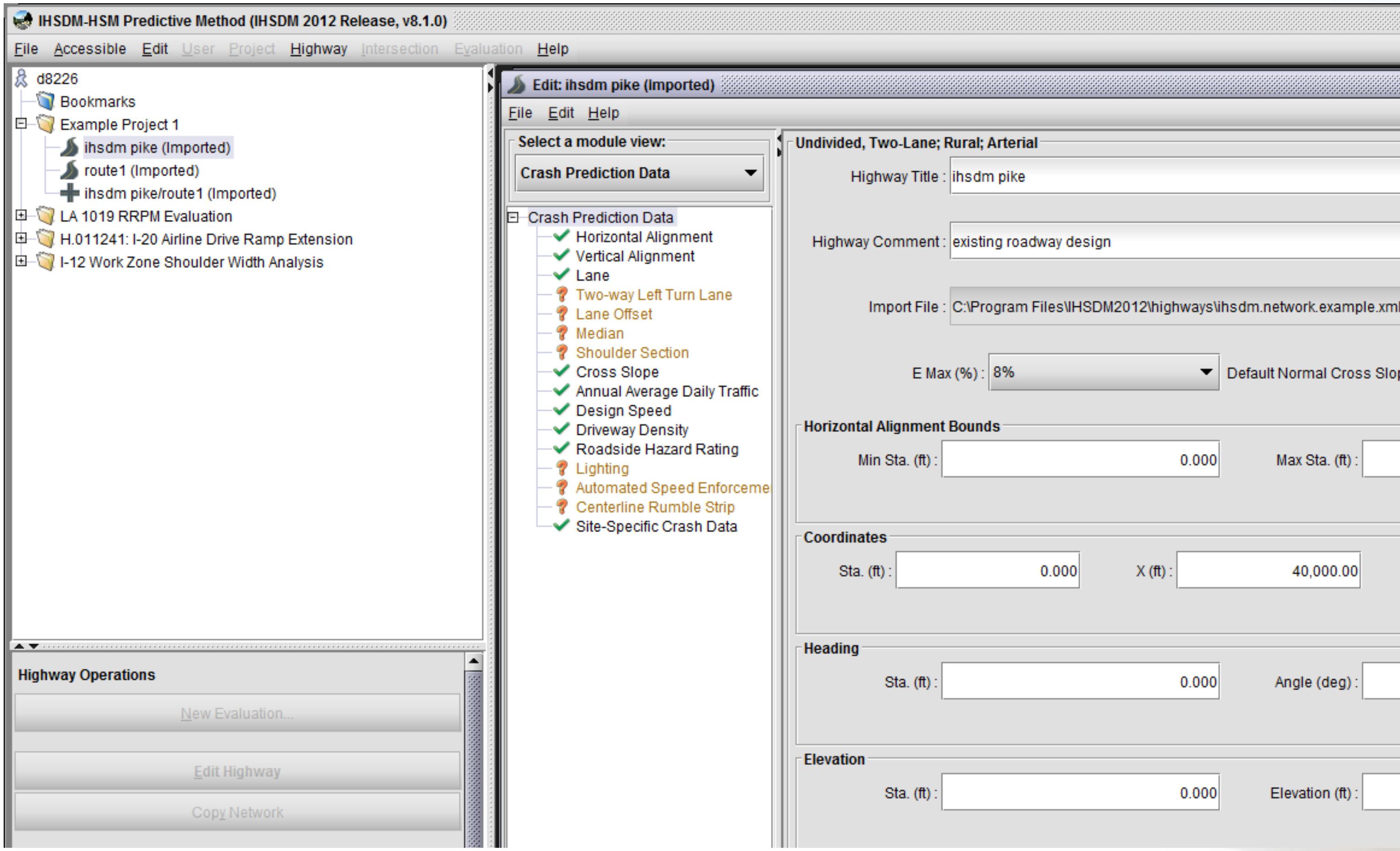
Worksheet 1A -- General Information and Input Data for Rural Two-Lane Two-Way Roadway Segments			
General Information		**Location Information**	
Analyst	JMR	Roadway	LA XX
Agency or Company	DOTD	Roadway Section	CS XXX-XX LM 0.0 to LM 1.5
Date Performed	06/05/15	Jurisdiction	Anywhere, LA
		Analysis Year	2015

Input Data		Base Conditions	Site Conditions				
Length of segment, L (mi)		--	1.5				
AADT (veh/day)	$AADT_{MAX}$ = 17,800 (veh/day)	--	10,000				AADT OK
Lane width (ft)		12	10				
Shoulder width (ft)		6	Right Shld:	4	Left Shld:	4	
Shoulder type		Paved	Right Shld:	Gravel	Left Shld:	Gravel	
Length of horizontal curve (mi)		0	0.0				
Radius of curvature (ft)		0	0				**Radius Value OK**
Spiral transition curve (present/not present)		Not Present	Not Present				
Superelevation variance (ft/ft)		< 0.01	0				
Grade (%)		0	2				
Driveway density (driveways/mile)		5	6				
Centerline rumble strips (present/not present)		Not Present	Not Present				
Passing lanes [present (1 lane) /present (2 lane) / not present)]		Not Present	Not Present				
Two-way left-turn lane (present/not present)		Not Present	Not Present				
Roadside hazard rating (1-7 scale)		3	4				
Segment lighting (present/not present)		Not Present	Not Present				
Auto speed enforcement (present/not present)		Not Present	Not Present				
Calibration Factor, Cr		1	--				

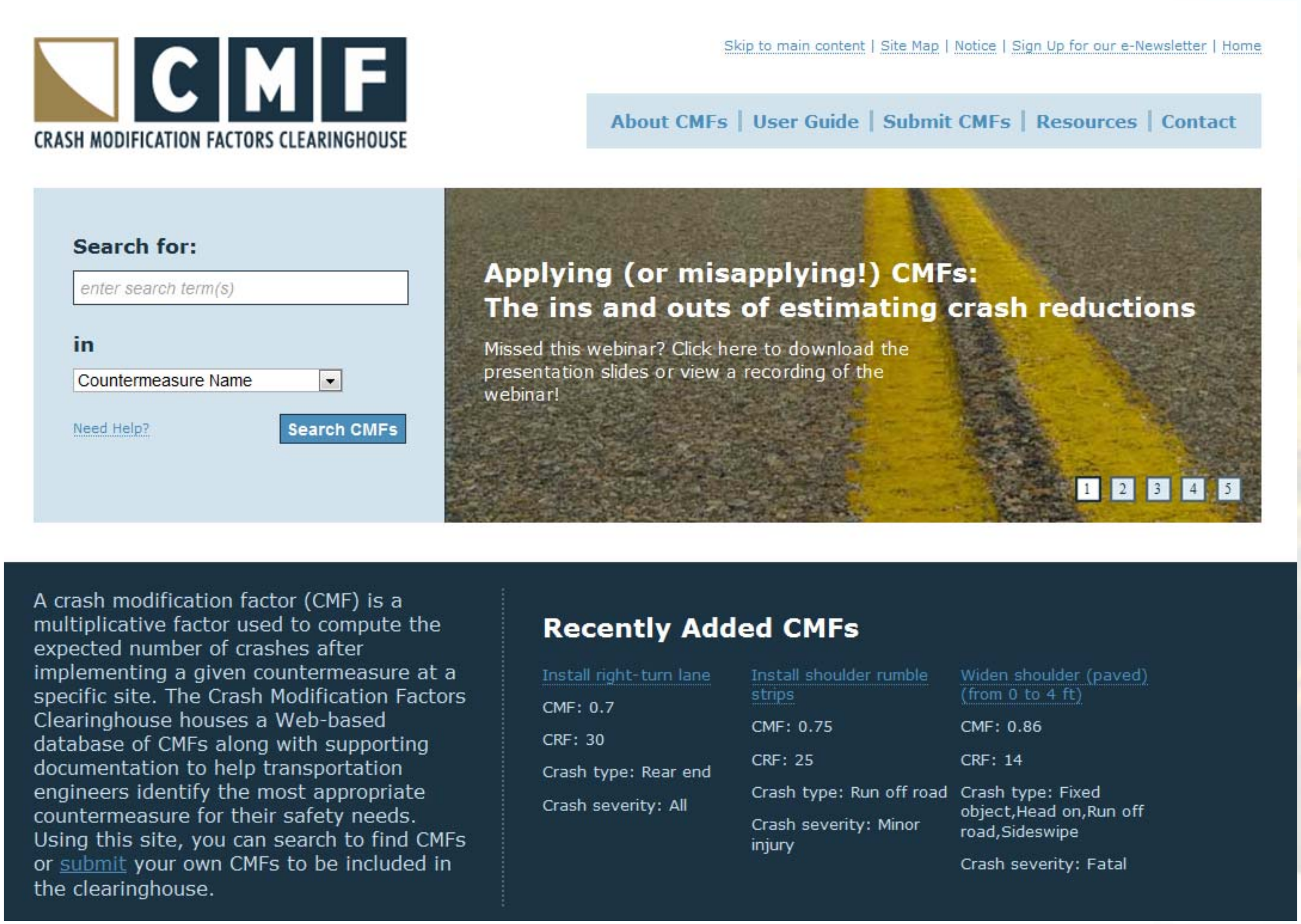
Worksheet 1B -- Crash Modification Factors for Rural Two-Lane Two-Way Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
CMF for Lane Width	CMF for Shoulder Width and Type	CMF for Horizontal Curves	CMF for Super-elevation	CMF for Grades	CMF for Driveway Density	CMF for Centerline Rumble Strips	CMF for Passing Lanes	CMF for Two-Way Left-Turn Lane	CMF for Roadside Design	CMF for Lighting	CMF for Automated Speed Enforcement	Combined CMF
CMF 1r	*CMF 2r*	*CMF 3r*	*CMF 4r*	*CMR 5r*	*CMF 6r*	*CMF 7r*	*CMF 8r*	*CMF 9r*	*CMF 10r*	*CMF 11r*	*CMF 12r*	*CMF comb*
from Equation 10-11	from Equation 10-12	from Equation 10-13	from Equations 10-14, 10-15, or 10-16	from Table 10-11	from Equation 10-17	from Section 10.7.1	from Section 10.7.1	from Equation 10-18 & 10-19	from Equation 10-20	from Equation 10-21	from Section 10.7.1	(1)x(2)x ... x(11)x(12)
1.15	1.08	1.00	1.00	1.00	1.01	1.00	1.00	1.00	1.07	1.00	1.00	1.335

IHSDM


IHSDM-HSM Predictive Method (IHSDM 2012 Release, v8.1.0)
File Accessible Edit User Project Highway Intersection Evaluation Help
d8226
Bookmarks
Example Project 1
ihsdm pike (Imported)
route1 (Imported)
ihsdm pike/route1 (Imported)
LA 1019 RRPM Evaluation
H.011241: I-20 Airline Drive Ramp Extension
I-12 Work Zone Shoulder Width Analysis
Highway Operations
New Evaluation...
Edit Highway
Copy Network
Edit: ihsdm pike (Imported)
File Edit Help
Select a module view:
Crash Prediction Data
Crash Prediction Data
Horizontal Alignment
Vertical Alignment
Lane
Two-way Left Turn Lane
Lane Offset
Median
Shoulder Section
Cross Slope
Annual Average Daily Traffic
Design Speed
Driveway Density
Roadside Hazard Rating
Lighting
Automated Speed Enforceme
Centerline Rumble Strip
Site-Specific Crash Data
Undivided, Two-Lane; Rural; Arterial
Highway Title : ihsdm pike
Highway Comment : existing roadway design
Import File : C:\Program Files\IHSDM2012\highways\ihsdm.network.example.xml
E Max (%) : 8%
Default Normal Cross Slop
Horizontal Alignment Bounds
Min Sta. (ft) : 0.000
Max Sta. (ft) :
Coordinates
Sta. (ft) : 0.000
X (ft) : 40,000.00
Heading
Sta. (ft) : 0.000
Angle (deg) :
Elevation
Sta. (ft) : 0.000
Elevation (ft) :

CMF Clearinghouse



DESTINATION ZERO DEATHS

CMF Resource Guide

Guidance for Using Crash Modification Factors (CMF)

What is a CMF?

A Crash Modification Factor (CMF) is a value that quantifies the expected change in crash frequency at a site as a result of implementing a specific countermeasure or treatment.

$$\text{CMF} = \frac{\text{Expected crashes with treatment}}{\text{Expected crashes without treatment}}$$

Where,

CMF > 1 - expected to increase crashes

CMF < 1 - expected to decrease crashes

CMF = 1 - no effect on crash frequency

CMFs can be used in the transportation project development process to:

- Estimate the expected change in crash frequency associated with various countermeasures.
- Select among alternative countermeasures.
- Estimate safety benefits (crash savings) associated with a particular countermeasure.
- Identify cost-effective safety strategies.

The following table illustrates a CMF (HSM Table 13-21) for increasing the distance to roadside features for rural two-lane roads and freeways.

CMF Resources

Treatment	Setting (Road Type)	Traffic Volume	Crash Type (Severity)	CMF	Standard Error
Increase distance to roadside features from 3.3 feet to 16.7 feet	Rural two-lane roads and freeways	Unspecified	All Types (All Severities)	0.78	0.02
Increase distance to roadside features from 16.7 feet to 30.0 feet				0.56	0.01
Base condition: Distance to roadside features of 3.3 feet or 16.7 feet depending on geometry.					

CMFs can be found in several different resources, but two of the main resources include the FHWA CMF Clearinghouse (www.cmfclearinghouse.com) and the AASHTO Highway Safety Manual (HSM). While the HSM provides only the best available research-based CMFs, the CMF Clearinghouse is a comprehensive database of available CMFs, including all of the CMFs listed in the HSM. The CMF Clearinghouse is updated regularly, with new CMFs from researchers and state agencies.

Key Considerations in Selecting CMFs

When selecting CMFs it is imperative to consider the evaluation study method used to develop the CMF, the quality of the CMF, and the applicability to the site of interest.

Evaluation Study Design

The evaluation study design (i.e., how the study was conducted to calculate the CMF) plays a critical role in the quality of the CMF and should be considered when evaluating CMFs. Depending on the evaluation study design used to develop a CMF, the CMF could over or underestimate the effectiveness of a safety treatment. When a period with a comparatively high crash frequency is observed, it is statistically probable that the following period will have a comparatively low crash frequency. This statistical phenomenon is known as regression to the mean and also applies to the converse situation; a low crash frequency period will probably be followed by a high crash frequency period. The most reliable CMFs are those developed using statistical methods that account for regression to the mean.

Most agencies currently use the simple (or naïve) before-after study to estimate changes in crash frequency due to a specific change (safety treatment) at a site. However, this method doesn`t account for regression to the mean or other changes (e.g., traffic volumes, weather, or driver behavior) that may have impacted the site. The HSM presents methods for estimating changes in crash frequency using statistical methods that address these issues. The methods are observational

ECONOMIC EVALUATION

Cost Estimates

- **Safety benefit**

*The **safety benefit cost** is calculated based on the expected reduction in fatal, injury, and PDO crashes over the life of the project with an adjustment for inflation.*

- **Implementation cost**

*The **implementation cost** should include costs associated with preconstruction (engineering/design, topographic survey, ROW, utilities, and maintenance costs).*

Cost of Crashes

Severity	Average Cost per Person*
Fatal	$1,270,370
Severe	$938,791
Moderate	$164,396
Complaint	$8,141
PDO	$3,292

*Based on NHTSA's "The Economic Impact of Motor Vehicle Crashes, 2000" and updated by the CPI

Benefit-Cost Ratio (BCR)

US 190 / LA 25 Intersection Improvements

Benefit/Cost Ratio Analysis

Clearing House CMFs

CMF	Standard Error	Crash Severity	Crash Type	Area Type	Star Rating	
1.06	0.153	All	All	All	4	
0.37	0.128	Fatal, injury	All	All	4	
0.81	0.06	All	All	Urban / suburban	4	2 lane roundabout
0.29	0.07	injury	All	Urban / suburban	4	2 lane roundabout

▾ Countermeasure: Conversion of intersection into multi-lane roundabout

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Area Type	Reference	Comments
1.062	-6.23	★★★★☆	All	All	All	Qin et al., 2013	- Study included three-year before ... [read more]
0.367	63.28	★★★★☆	All	Fatal,Serious injury,Minor injury	All	Qin et al., 2013	- Study included three-year before ... [read more]

▾ Countermeasure: Conversion of signalized intersection into single- or multi-lane roundabout

CMF	CRF (%)	Quality	Crash Type	Crash Severity	Area Type	Reference	Comments
0.81	19	★★★★☆	All	All	Urban and suburban	Gross et al., 2012	Conversion to 2-lane roundabout ... [read more]
0.29	71	★★★★☆	All	Serious injury,Minor injury	Urban and suburban	Gross et al., 2012	Conversion to 2 lane roundabout ... [read more]

US190 / LA 25, intersection Crashes (2011-2013)

Crash Severity	Total	Average per yr		
Fatal	0	0		
Injury	20	6.666667		
PDO	38	12.66667		
Fatalities	0			
n. Injured	50			
Total =	58	** Fatal, Injury, and PDO		19.3333333

Inflation = 4%
f Service = 20

figuration

Existing*

Crash Severity	Existing Nexp
al + injury	4.6
PDO	9.2
Total =	13.8

Intersection Improvements*

Crash Severity	Alt 1 Nexp
Fatal + injury	3.5
PDO	6.8
Total =	10.3

Multi Lane Roundabout**

Crash Severity	Existing Nexp	CMF	Alt 2 Nexp
Fatal + injury	4.6	0.37	1.70
All	13.8	0.81	11.18

*HSM predictive method applied

**HSM predictive method not available for this alternative

Statewide Avg - Urban 4-Lane Divided Interesections

SEVERITY_CD	Crashes/yr	Percent	Existing	Alt 1	Alt 2
Fatal - A	18.67	0.28%	0.039	0.030	0.014
Severe Injury - B	54.67	0.83%	0.116	0.088	0.043
Moderate Injury - C	474	7.17%	1.002	0.762	0.371
Complaint - D	1629	24.65%	3.443	2.620	1.274
PDO - E	4432.67	67.07%	9.200	6.800	9.476
TOTAL			13.800	10.300	11.178

Crash Severity	Existing	Benefits/Yr (Crashes) Alt 1	Benefits/Yr (Crashes) Alt 2	Annual Cost/crash	Existing Costs/yr	Benefits/Yr Alt 1 ($)	Benefits/Yr Alt 2 ($)	$PV_{benefit}$ Alt 1	$PV_{benefit}$ Alt 2
Fatal	0.039	0.009	0.025	$ 1,270,370	$ 49,688	$ 11,882	$ 31,304	$ 161,480	$ 425,427
Severe	0.116	0.028	0.073	$ 938,791	$ 108,846	$ 26,028	$ 68,573	$ 353,735	$ 931,931
Moderate	1.002	0.240	0.631	$ 164,396	$ 164,656	$ 39,374	$ 103,733	$ 535,108	$ 1,409,766
Complaint	3.443	0.823	2.169	$ 8,141	$ 28,032	$ 6,703	$ 17,660	$ 91,101	$ 240,011
PDO	9.200	2.400	-0.276	$ 3,292	$ 30,286	$ 7,901	$ (909)	$ 107,374	$ (12,348)
TOTAL	13.800				$ 381,509			$ 1,248,799	$ 2,994,786

	PVcost *** Alt 1	PVcost *** Alt 2	B/C Alt 1	B/C Alt 2
Construction	$2,800,000	$2,700,000		
Engineering		$500,000		
ROW		$540,000		
Utilities		$135,000		
Misc. (signal maintenance)*	$32,617			
TOTAL	$ 2,832,617	$ 3,875,000	0.44	0.77
	$ 1,248,799	$ 2,994,786	1.00	1.00
	$ 624,399	$ 1,497,393	2.00	2.00

*Signal Maintenance (avg $2400/yr) $ 32,617

DESTINATION ZERO DEATHS

PRIORITIZATION

Factors

- High PSI
- Part of a systemic study
- Aligned with Louisiana SHSP emphasis areas
- Relative severity
- Effective countermeasure / FHWA proven countermeasure
- Local support
- BCR
- Costs
- Constructability
- Consistent with other nearby projects under development by state, regional, or local entities

DESTINATION ZERO DEATHS