MIRECOMPLIANCE
& NETWORK SCREENING TOOL
What is MIRE?

MIRE COMPLIANCE

Model Inventory of Roadway Elements
MIRE 2.0

FHWA Safety Program
July 2017

Listing of roadway/traffic data elements and data dictionary
AT A GLANCE

MIRE HISTORY

MIRE 1.0
October 2010
- MAP-21
- Three Categories

MIRE 2.0
July 2017
- FAST Act Provisions
- Six Categories
- Identifies FDE

MIRE 1.0 Reassessed
MIRE 2.0

Released in July 2017

Provides a data framework to help transportation agencies improve roadway and traffic data inventories for safety analysis.

Divided into six data type categories:
1. Segments
2. Intersections
3. Intersection Legs
4. Interchange/Ramp
5. Horizontal Alignment
6. Vertical Alignment
States are required to have MIRE FDE for **ALL PUBLIC ROADS** by September 30, 2026.

*Because MIRE is a guideline, it is not expected that a State will collect every MIRE element, nor have all their element names and attributes match to MIRE exactly. Rather, States should take what is useful in MIRE and apply it in a way that helps improve their inventory, and ultimately lead to better data-driven decision making.*
## MIRE 2.0

### CONTENTS

Each Element Includes:
- Name
- Indicator if an FDE
- Definition
- Recommended attributes
- Illustration (if needed)
- Crosswalk table (if applicable)

## 55. Median Type

**Definition:** The type of median present on the segment.

**Recommended Attributes:**

1. Undivided
2. Flush paved median (at least 4 ft in width)
3. Raised median
4. Depressed median
5. Two-way left-turn lane
6. Railroad or rapid transit
7. Divided, separate grades without retaining wall
8. Divided, separate grades with retaining wall
9. Other divided
MIRE 2.0

Each Element Includes:

- **Name**
- **Indicator if an FDE**
- **Definition**
- **Recommended attributes**
- **Illustration (if needed)**
- **Crosswalk table (if applicable)**

### Crosswalk Table:

<table>
<thead>
<tr>
<th>Dataset</th>
<th>HPMS</th>
<th>TMG</th>
<th>SHRP 2 RID</th>
<th>FMIS</th>
<th>NBI</th>
<th>LTPP</th>
<th>NPS RIP</th>
<th>HSM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Element Name</strong></td>
<td>Median Type</td>
<td>--</td>
<td>Median Type</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>Presence/Type of Median</td>
</tr>
<tr>
<td><strong>Element Number</strong></td>
<td>35</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

Note: “--” indicates that the dataset does not include this specific MIRE element.
Fundamental Data Elements
FUNDAMENTAL DATA ELEMENTS

MIRE 2.0

REQUIREMENTS

FDE requirements vary by facility type.

Non-Local (Functional Class 1-6)
Local (Functional Class 7)

Source: Caltrans CRS Maps Web App
https://dot.ca.gov/programs/research-innovation-system-information
MIRE 2.0

FUNDAMENTAL DATA ELEMENTS

REQUIREMENTS

FDE requirements vary by facility type.

Non-Local (Functional Class 1-6)
Local (Functional Class 7)

<table>
<thead>
<tr>
<th>MIRE ID</th>
<th>MIRE ELEMENT</th>
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</thead>
<tbody>
<tr>
<td>4</td>
<td>Type of Governmental Ownership</td>
</tr>
<tr>
<td>8</td>
<td>Route Number</td>
</tr>
<tr>
<td>9</td>
<td>Route/Street Name</td>
</tr>
<tr>
<td>10</td>
<td>Begin Point Segment Descriptor</td>
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<tr>
<td>11</td>
<td>End Point Segment Descriptor</td>
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<tr>
<td>12</td>
<td>Segment Identifier</td>
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<tr>
<td>13</td>
<td>Segment Length</td>
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<td>18</td>
<td>Direction of Inventory</td>
</tr>
<tr>
<td>19</td>
<td>Functional Class</td>
</tr>
<tr>
<td>20</td>
<td>Rural/Urban Designation</td>
</tr>
<tr>
<td>21</td>
<td>Federal Aid/Route Type</td>
</tr>
<tr>
<td>22</td>
<td>Access Control</td>
</tr>
<tr>
<td>23</td>
<td>Surface Type</td>
</tr>
<tr>
<td>31</td>
<td>Number of Through Lanes</td>
</tr>
<tr>
<td>54</td>
<td>Median Type</td>
</tr>
<tr>
<td>79</td>
<td>AADT</td>
</tr>
<tr>
<td>80</td>
<td>AADT Year</td>
</tr>
<tr>
<td>91</td>
<td>One/Two-way Operations</td>
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</tbody>
</table>
FUNDAMENTAL DATA ELEMENTS

MIRE 2.0

REQUIREMENTS

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<tr>
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<td>Functional Class</td>
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<td>Rural/Urban Designation</td>
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<tr>
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<td>Surface Type</td>
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<td>31</td>
<td>Number of Through Lanes</td>
</tr>
<tr>
<td>79</td>
<td>AADT</td>
</tr>
</tbody>
</table>

Non-Local (Functional Class 1-6)

Local (Functional Class 7)
FDE REQUIREMENTS

Fundamental Data Elements (FDE) are required by Functional Class and pavement (yes/no)

Non-Local Roads
• 26 Segment
• 8 Intersection
• 11 Interchange/Ramp

Local Paved Roads
• 9 Segment

Local Unpaved Roads
• 5 Segment

Stanislaus County Road Network: 1507.23 Miles
While all based on similar datasets, various programs and methodologies require specific subsets of data for analysis.
Prioritization of Highway Safety Manual (HSM) Data Variables
Using Random Forest Algorithm

by

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November, 2014
FUNDAMENTAL DATA ELEMENTS

FDE for Safety Analysis

WHAT DO WE REALLY NEED?

FDE is the minimum set of attributes.

Through analysis, we can identify the most influential elements.

Maintaining the data will be difficult, so reducing that data maintenance need is important for success.

<table>
<thead>
<tr>
<th>Variables</th>
<th>IncNodePurity</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>AADT</td>
<td>735.7</td>
<td>1</td>
</tr>
<tr>
<td>Driveway density</td>
<td>318.9</td>
<td>2</td>
</tr>
<tr>
<td>Shoulder width</td>
<td>151.6</td>
<td>3</td>
</tr>
<tr>
<td>Roadside hazard rating</td>
<td>110.9</td>
<td>4</td>
</tr>
<tr>
<td>Lane width</td>
<td>65.0</td>
<td>5</td>
</tr>
<tr>
<td>Shoulder type</td>
<td>50.6</td>
<td>6</td>
</tr>
<tr>
<td>Presence of lighting</td>
<td>11.2</td>
<td>7</td>
</tr>
<tr>
<td>Presence of passing lane</td>
<td>5.9</td>
<td>8</td>
</tr>
<tr>
<td>Presence of TWLTL</td>
<td>4.9</td>
<td>9</td>
</tr>
<tr>
<td>Presence of short four-lane section</td>
<td>2.3</td>
<td>10</td>
</tr>
<tr>
<td>Presence of centerline rumble strip</td>
<td>1.7</td>
<td>11</td>
</tr>
<tr>
<td>Presence of automated speed enforcement</td>
<td>0.2</td>
<td>12</td>
</tr>
</tbody>
</table>

Note: Mean of squared residuals: 0.430; Percent of variance explained: 44.60%.
## Prioritization of Highway Safety Manual (HSM) Data Variables Using Random Forest Algorithm

**FUNDAMENTAL DATA ELEMENTS**

**FDE for Safety Analysis**

### Rural Roadway Segments

<table>
<thead>
<tr>
<th>Variables</th>
<th>FDE for Safety Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>AADT</td>
<td></td>
</tr>
<tr>
<td>Driveway Density</td>
<td></td>
</tr>
<tr>
<td>Shoulder Width</td>
<td></td>
</tr>
<tr>
<td>Roadside hazard rating</td>
<td></td>
</tr>
<tr>
<td>Lane width</td>
<td></td>
</tr>
<tr>
<td>Shoulder type</td>
<td></td>
</tr>
<tr>
<td>Presence of Lighting</td>
<td></td>
</tr>
<tr>
<td>Presence of passing lane</td>
<td></td>
</tr>
<tr>
<td>Presence of TWLTL</td>
<td></td>
</tr>
<tr>
<td>Presence of short-four lane section</td>
<td></td>
</tr>
<tr>
<td>Presence of centerline rumble strip</td>
<td></td>
</tr>
<tr>
<td>Presence of automated speed enforcement</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>County Initial Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>AADT</td>
<td></td>
</tr>
<tr>
<td>Rural 2-Lane Undivided (yes/no)</td>
<td></td>
</tr>
<tr>
<td>Number of Lanes</td>
<td></td>
</tr>
<tr>
<td>Median Width</td>
<td></td>
</tr>
<tr>
<td>Uncontrolled Int. Density</td>
<td></td>
</tr>
<tr>
<td>Lighting Presence</td>
<td></td>
</tr>
</tbody>
</table>

FHWA MIRE Website

Interactive Illustrations

https://safety.fhwa.dot.gov/fde/

1 and the FAST Act required the Secretary to establish a subset of the MIRE that are useful for the inventory of safety and ensure that States adopt and use the subset to improve data collection. [23 U.S.C. 148(f)(2)]. FHWA shed a subset of the MIRE as part of the HSIP Final Rule changes to 23 CFR Part 924, effective April 14, 2016. The subset is referred to as the fundamental data elements (FDEs). The FDEs are categorized by roadway functional class and surface type and include three categories for roadway segments, one each for non-local paved roads, roads, and unpaved roads. They are further refined, for non-local paved roads, into subcategories of data elements and interchanges.

Developed a set of interactive graphic images to depict the MIRE FDEs for each of the roadway categories. By clicking on the roadway categories boxes at the top of the screen, a sample graphic image appears for that category (e.g., intersection and interchange). There are three categories of road segments (e.g., non-local paved road, local unpaved road), clicking in the box associated with that category changes the screen to a graphic depiction of that category. Within each graphic image, the bottom middle of the image provides a set of tabs with data element names by placing the cursor over a data element name tab and clicking produces the data element name, element definitions, suggested to describe the data element. Also, the roadway graphic visually depicts the element and provides information that could be collected to describe the data element within a roadway inventory database.

If you encounter any difficulties or would like additional information regarding the MIRE FDE graphics, please contact Brian Pollack at: Robert.pollack@dot.gov, 202-366-5019.
Developing a custom network tool
Available Tools

Highway Safety Manual

- Tool lists available on the FHWA Roadway Safety Data Programs (RSDP) Toolbox Webpage and EDC-4 DDSA resource page
- Handful of Network Screening Tools
- Predominately Location Analysis Tools (Site specific input)

I felt available options were not well suited for a local agency’s resources.

What usable data do we have?

Use available resources that are already part of our workflow

- i-SWITRS collision data
- GIS road data (Public Works/OES)
- ArcGIS Server with Enterprise Portal
- Some attributes don’t vary enough to maintain data

Use new resources that are available, but require integration

Caltrans Linear Reference System
**RESOURCES**
Developing a Solution for Local Agencies

**How much expertise (and time) do we have?**
Using tools such as IHSDM or the HSM spreadsheets requires staff to be very familiar with the methodologies. This can be time consuming, collecting location data and analyzing, then comparing.

**What opportunities exist?**
- Help Caltrans with MIRE Compliance
- Customizable to our needs
- Can utilize simplified defaults where data doesn't exist yet based on roadway attributes
Where and what are our problems?
• We typically concentrate on collision history, but not on exposure to risk.
• Network Screening tools can help:
  • Identify hard to see risks
  • Prioritize Locations, crash types, and treatments

Where are our successes?
• Identify roadway attributes that correlate with low collision rates


**OPPORTUNITY**

**SYSTEMIC SAFETY ANALYSIS REPORT PROGRAM**

**Roadway Safety Audits**

- We didn’t even know WHERE to look
- Rural collisions are sporadic
- Correlation is difficult to find study corridors for audits
- Ends up mostly being based on total collisions
- Results in a static report

**Developing an Application**

- We wanted a true “program” moving forward
- Ability to update easily
- Develop priority lists, even as our priorities may change
- Expandable
CURRENT PLATFORM

OUR APPROACH

- Data stored in MS SQL (ArcGIS Server)
- ArcGIS Web Application through Enterprise Portal
  - Requires additional python libraries for analysis.
- Data being tied to Caltrans All Roads Linear Referencing System (LRS)
- Collision Data from i-SWITRS
- ADT data from county database and estimate system using “kriging”, a geo-spatial interpolation technique.
WELCOME SCREEN

SAFETY ANALYSIS

SETTINGS + CALIBRATION
ESTABLISH FOCUS

ESTABLISH CRASH FOCUS

START DATE:
END DATE:

CRASH TYPE:
- HIT OBJECT
- BROADSIDE
- HEAD-ON

MODES INVOLVED:
- VEHICLE
- PEDESTRIAN
- BICYCLE

CRASH ATTRIBUTE LIMITATIONS:
- SEVERITY (FATAL, FATAL + SEVERE, FATAL + INJURY, ALL)
- CONTRIBUTING FACTORS (DUI, IMPROPER TURNING, WRONG SIDE OF ROAD
- LIGHTING/TIME OF DAY

ESTABLISH REFERENCE POPULATION

SELECT BY CHARACTERISTICS

GEOGRAPHY:
ALL SITES

SEGMENTS
- URBAN/RURAL
- # OF LANES
- FUNCTIONAL CLASSIFICATION

INTERSECTIONS
- SIGNALIZED
- UNSIGNALIZED

SELECT BY MAP

SUBAREA (POLYGON)
CORRIDOR
INTERSECTION(S)
EABLISH REFERENCE POPULATION

SELECT BY CHARACTERISTICS
- RATES
- N/RURAL
- PLAN
- TIONAL CLASSIFICATION

SELECTED
- ALIZED
- NALED

SELECT BY MAP
- EA (POLYGON)
- DOR
- SECTION(S)

SELECT PERFORMANCE MEASURES

PREDICTIVE SAFETY ANALYSIS
- CALCULATE EXPECTED/PREDICTED CRASHES FOR REFERENCE POPULATION

HSM NETWORK SCREENING PERFORMANCE MEASURES
- CRASH FREQUENCY
  - BY SEVERITY
  - BY TYPE
- CRASH RATE
- CRITICAL CRASH RATE
- EQUIVALENT PROPERTY DAMAGE ONLY
- RELATIVE SEVERITY INDEX
- EXCESS PROPORION OF SPECIFIC CRASH TYPES
- EXCESS PREDICTED AVERAGE CRASH FREQUENCY
- LEVEL OF SERVICE OF SAFETY

SELECT SCREENING METHOD

INTERSECTION
- ADJUST CRASH SEARCH DISTANCE
- SCREEN AND RANK BY SUBCATEGORY
  - TRAFFIC CONTROL
  - FUNCTIONAL CLASSIFICATION
  - # OF APPROACHES
  ....

SEGMENTS
- EXISTING SEGMENTATION
- DEFINED LENGTH
  - ANALYSIS LENGTH
- SLIDING WINDOW
  - WINDOW LENGTH
  - INTERVAL LENGTH
- PEAK SEARCHING

CALCULATION
SELECT PERFORMANCE MEASURES

PREDICTIVE SAFETY ANALYSIS
- Calculate expected/predicted crashes for reference population

HSM NETWORK SCREENING PERFORMANCE MEASURES
- H Freq
- H Severity
- Type
- H Rate
- CAL Crash Rate
- Val lent Property Damage Only

SELECT SCREENING METHOD

INTERSECTION
- Adjust crash search distance
- Screen and rank by subcategory
  - Traffic control
  - Functional classification
  - # of approaches

SEGMENTS
- Existing segmentation
- Defined length
  - Analysis length
- Sliding window
  - Window length
  - Interval length
- Peak searching
SELECT SCREENING METHOD

SCREEN AND EVALUATE RESULTS

VIEWS:
- RESULTS TABLE VIEW
- MAP VIEW BY PERFORMANCE RESULT

EXPORT:
- TABLE
- SHAPEFILES
- SUMMARY REPORTS
CURRENT PLATFORM

WHAT’S NEXT?

• Data has been collected and processed
• SPF’s have been calculated
• Priority treatments and location lists are being developed.
• The tool is still under development, specifically front-end development and integration with our enterprise server.
• All the backend work is completed
• Open source licensing options are being pursued to share with others and keep development of the tool on-going.
• Every Day Counts 4 – DDSA resource page https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/ddsa_resourc es/
MIRE
COMPLIANCE

& NETWORK SCREENING TOOL
for Local Agencies

Thank You

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