Model Inventory of Roadway Elements

An In-Person Peer Exchange

August 9th and 10th, 2023

Federal Highway Administration Office of Safety

U.S. Department of Transportation
Federal Highway Administration

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The 2023 Model Inventory of Roadway Elements (MIRE) Fundamental Data Elements (FDE) In-Person Peer Exchange took place on August 9 and 10, 2023, at Turner-Fairbank Highway Research Center (TFHRC) in McLean, VA. The purpose of the peer exchange was to share ideas for collecting, managing, and using the MIRE FDEs, as well as better understand emerging needs in safety analysis as a result of the Safe System Approach (SSA), vulnerable road user (VRU) assessments, and discretionary grant programs enacted through the 2021 Infrastructure Investment and Jobs Act(IIJA)/Bipartisan Infrastructure Law (BIL).</td></tr>
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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

Acronyms

Acronym	Description
A	suspected serious injury
AADT	annual average daily traffic
ADA	Americans with Disabilities Act
AEGIST	Applications of Enterprise GIS for Transportation
BIL	Bipartisan Infrastructure Law
Caltrans	California Department of Transportation
CMF	crash modification factor
DDSA	data-driven safety analysis
DMI	Distance Measuring Instrument
DOT	department of transportation
EDT	electronic data transfer
ERP	Enterprise Resource Planning
ETL	extract, transform, and load
FDE	Fundamental Data Elements
FHWA	Federal Highway Administration
FME	Feature Manipulation Engine
GDOT	Georgia Department of Transportation
GIS	geographic information system
GNSS	global navigation satellite system
GPS	global positioning system
HIN	high injury network
HPMS	Highway Performance Monitoring System
HSIP	Highway Safety Improvement Program
HSM	Highway Safety Manual
IIJA	Infrastructure Investment and Jobs Act
INDOT	Indiana Department of Transportation
ISU	Iowa State University
ITS	intelligent transportation system
K	Fatal injury
KDOT	Kansas Department of Transportation
LiDAR	light detection and ranging
LRS	linear referencing system
MassDOT	Massachusetts Department of Transportation
MoDOT	Missouri Department of Transportation
MIRE	Model Inventory of Roadway Elements

MMUCC	Model Minimum Uniform Crash Criteria
MPH	miles per hour
MPO	metropolitan planning organization
MUTCD	Manual on Uniform Traffic Control Devices
NDOT	Nevada Department of Transportation
NCDOT	North Carolina Department of Transportation
NHDOT	New Hampshire Department of Transportation
NHTSA	National Highway Traffic Safety Administration
NIEM	National Information Exchange Model
PROWAG	Public Right-of-Way Accessibility Guidelines
RCI	reduced conflict intersection
RDIP	Roadway Data Improvement Program
RFP	request for proposal
RSA	Road Safety Audit
RTPA	Regional Transportation Planning Agency
SAFER	Safety Assessment for Every Roadway
SHSP	strategic highway safety plan
SPF	safety performance function
STIP	Statewide Transportation Improvement Program
SSA	Safe System Approach
TAMS	Transportation Asset Management System
TFHRC	Turner-Fairbank Highway Research Center
TMS	Transportation Management System
TRB	Transportation Research Board
TRCC	Traffic Records Coordinating Committee
TSMO	Transportation Systems Management and Operations
TSN	Transportation System Network
TSNR	Transportation System Network Replacement
UCB	University of California-Berkeley
UDOT	Utah Department of Transportation
VDOT	Virginia Department of Transportation
VRU	vulnerable road user
WVDOT	West Virginia Department of Transportation
YOLO	You Only Look Once

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Introduction

The 2023 Model Inventory of Roadway Elements (MIRE) Fundamental Data Elements (FDE) In-Person Peer Exchange took place on August 9 and 10, 2023, at Turner-Fairbank Highway Research Center (TFHRC) in McLean, VA. The purpose of the peer exchange was to share ideas for collecting, managing, and using the MIRE FDEs, as well as better understand emerging needs in safety analysis as a result of the Safe System Approach (SSA), vulnerable road user (VRU) assessments, and discretionary grant programs enacted through the 2021 Infrastructure Investment and Jobs Act(IIJA)/Bipartisan Infrastructure Law (BIL).

The Federal Highway Administration (FHWA) hosted representatives from 12 State departments of transportation (DOTs), 1 State university, and 3 FHWA Division Offices. FHWA provided virtual attendance options for FHWA Headquarters and Division Office staff that could not attend in person. Figure 1 summarizes the distribution of participants according to geography.

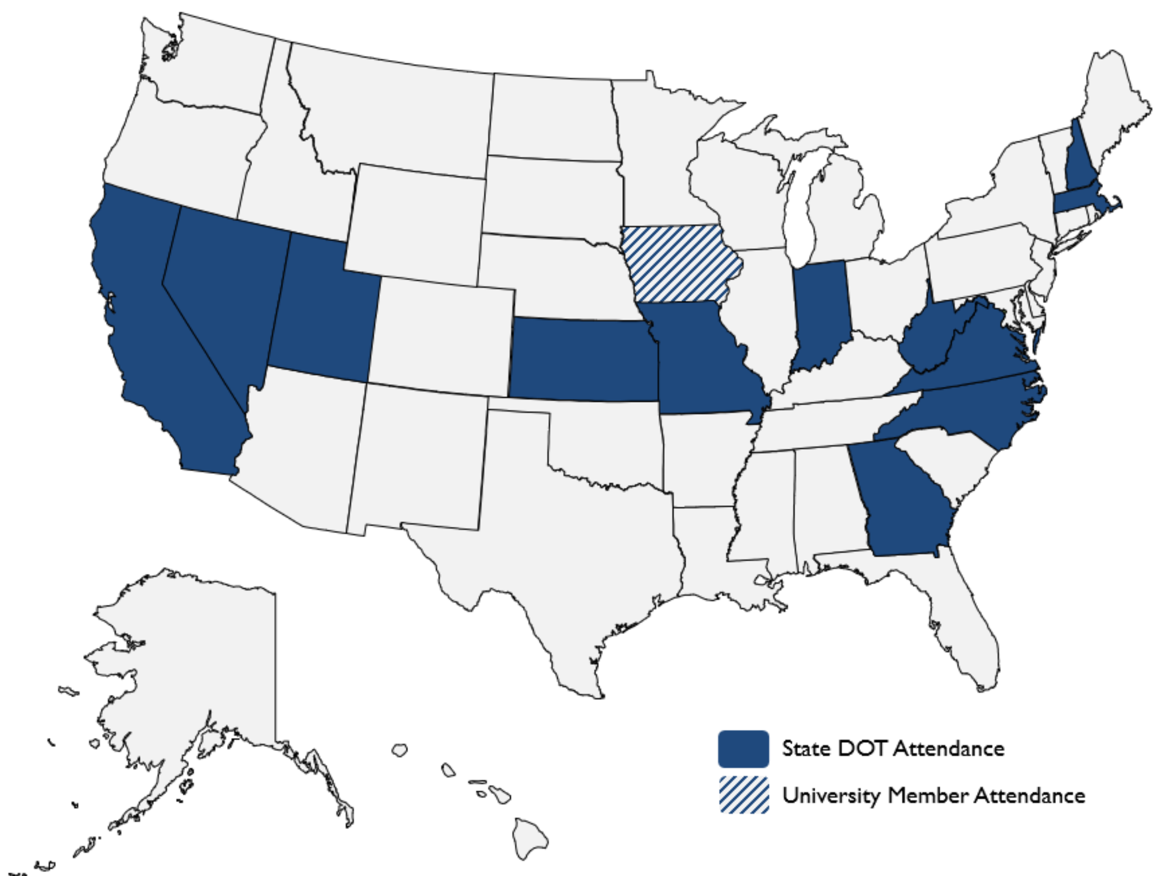

Figure 1. Graphic. In-Person Peer Exchange Representation.

Participants included the following agencies:

State DOTs:

- California DOT (Caltrans).
- Georgia DOT (GDOT).
- Indiana DOT (INDOT).
- Kansas DOT (KDOT).
- Massachusetts DOT (MassDOT).
- Missouri DOT (MoDOT).
- Nevada DOT (NDOT).
- North Carolina DOT (NCDOT).
- New Hampshire DOT (NHDOT).
- Utah DOT (UDOT).
- Virginia DOT (VDOT).
- West Virginia (WVDOT).

State University:

- Iowa State University (ISU).

FHWA Division Office:

- Massachusetts (in person).
- New Hampshire (in person).
- West Virginia (in person).
- Iowa (virtual).
- Missouri (virtual).
- California (virtual).

FHWA Office:

- Office of Safety.
- Office of Safety Research and Development.
- Office of Planning, Environment, and Realty (virtual).
- Resource Center (virtual).

Throughout this report, statements are not attributed to specific individuals. State names are used to identify sources, however, no official positions of any particular State or agency are implied. The in-person events included presentations from invited speakers, question and answer periods, and open discussions. The peer exchange facilitators managed virtual participants and introduced virtual speakers when prompted by facilitators in the room.

Break-out group discussions occurred on both days, and FHWA assigned attendees to their break out group according to similarities in State highway characteristics. These principally focused on proportion of mileage on the local system (Day 1 – Wednesday) and total public road mileage (Day 2 – Thursday).[1] FHWA and Division Office staff supported facilitation of individual break out groups. Virtual attendees formed their own break out group.

Proceedings

The Peer Exchange provided opportunities for conversation in several formats, including question and answer sessions after presentations, break out groups, and open roundtable discussion. The structure of this report follows the progression of events as they occurred during the Peer Exchange. Appendix A provides a summary of the agenda distributed to attendees prior to event; however, slight alterations were required to accommodate continuous and productive discussion.

Day One (August 9, 2023)

Welcome and Opening Remarks

FHWA opened the proceedings with a welcome to TFHRC and an overview of the facilities and agenda for the Peer Exchange. FHWA shared several goals for the Peer Exchange:

- The Peer Exchange was an opportunity to be forward-looking as the 2026 MIRE FDE deadline approaches, as well as needs beyond 2026. States are doing great work related to data-driven safety analysis (DDSA) and the data life cycle, and this is an opportunity to share that knowledge.
- States that have challenges with safety data support at their agency could look to their peers for successful examples of implementation. Related, safety data are intended to support practical analyses that improve safety on all public roads.

FHWA thanked participants for traveling to be at the peer exchange and encouraged participants to discuss topics with their peers during breaks and beyond the Peer Exchange.

Introductions and Ice Breaker

FHWA asked participants to introduce themselves in order around the room. Participants were asked to share their:

- Name.
- Agency.
- Role.
- Notable recent success in safety data collection, management, and analysis in their State.

Notable successes by State included:

[1] https://www.fhwa.dot.gov/policyinformation/statistics.cfm

- **Massachusetts** recently completed systemic risk screenings for each strategic highway safety plan (SHSP) emphasis area, as well as advancements for locating crashes at intersections and interchanges.
- **Nevada** now has a single unified linear referencing system (LRS) and has a carriageway for each road segment.
- **Kansas** is working on four corridors in the State as part of its Safety Corridor Program with a focus on pavement marking improvements and low-cost safety countermeasures. The agency is also pursuing and reviewing mobile light detection and ranging (LiDAR) for MIRE data extraction.
- **Indiana** recently migrated from Esri ArcMap to ArcGIS Pro and Portal, and the State is rolling out a new crash data system to improve crash geolocation.
- **Iowa** recently evaluated high-visibility enforcement and developed crash modification factors (CMFs) associated with this approach (5-percent reduction during enforcement and 7-percent reduction 10 days after enforcement activities have ended).
- **Georgia** is increasing the accuracy of its road names, particularly on the local system.
- **North Carolina** completed intersection and interchange inventories for all public roads and has begun to apply them in statewide safety analyses, including supporting local agency needs.
- **Missouri** plans to release an updated crash report for the first time in over a decade (scheduled January 2024), as well as a safety tool, the Safety Assessment for Every Roadway (SAFER) tool, that helps implement SSA on all Statewide Transportation Improvement Program (STIP) projects.
- **Virginia** made strides in obtaining roadway centerline and attribute data from all local agencies in the State and used imagery to locate all public road intersections.
- **New Hampshire** conducted safety-oriented training for design engineers across the DOT including Complete Streets and investigated alternative sources for traffic data for all public roads (e.g., connected vehicle and probe sources).
- **West Virginia** is working toward improving its financial system for asset management with the goal of consolidating that information in one location. The State is also implementing a new safety management system with the goal of doing more safety analysis and getting more staff within the DOT familiar with safety analysis needs.
- **Utah** is improving coverage and data for Highway Performance Monitoring System (HPMS) reporting and like West Virigina, is investing in major upgrades to its safety management system (e.g., links to crash narratives and crash diagrams).
- **California** is improving its traffic monitoring program through a variety of sources and methods, including partnering with universities and local agencies. The State is also supporting Vision Zero and the Safe System approach.

Session 1: Intersections – Presentation and Discussion

The first technical session focused on intersections. Kansas and New Hampshire presented their initiatives, and North Carolina led a guided discussion related to practical application of intersection MIRE data.

KDOT's Intersection Inventory Update (2023)

Kansas noted that the MIRE FDE present several potential benefits:

- Data can be linked with agency resources by a common LRS.
- Data support Highway Safety Manual (HSM) analysis tools, as well as the State's SHSP process.
- MIRE aids in allocating Highway Safety Improvement Program (HISP) funding more effectively.

KDOT's Bureau of Traffic Engineering began an intersection inventory in collaboration with the Planning Division. This started from an asset management perspective, and the data are primarily tabular. KDOT reached out to Ohio DOT for their 2012 data templates. This was based on Ohio's implementation of AASHTOWare Safety Analyst™ which KDOT also used at the time. KDOT used data derived from the State's Road Safey Audit (RSA) program to develop attribute data for key intersections. Now, the State is implementing a customizable Safety Performance Function (SPF) Tool that will use (spatially linked) tabular data.

The Bureau of Traffic Engineering is partnering with KDOT's Geographic Information System (GIS) Section within the Planning Division to develop unique location IDs and linkages with the State's LRS and spatial data (i.e., migrating to GIS); however, KDOT noted that this conversion process has had caveats:

- The intersection inventory followed the former AASHTOWare Safety Analyst™, which is close but does not exactly match the MIRE 2.0 codes. FHWA noted that this was ok, provided that States could convert State-specific codes with recommended MIRE attributes.
- KDOT's GIS systems and LRS may not be totally aligned with the needs of safety analysis software (e.g., Safety Analyst™), although data planning with analysis systems in mind is critical.
- Intersections on horizontal curves, grade separated crossings, and intersections that might be offset (but still one functional intersection) require manual review beyond automation.

KDOT noted that Kansas has one of the highest totals of centerline mileages in the United States, and the State has excellent MIRE FDE coverage on its State-owned system; a notable exception was related to median type and attribute discrepancies between MIRE 2.0 and HPMS, and FHWA noted that they were working to align these definitions and attributes. KDOT mentioned that they had good coverage of MIRE FDEs for State-owned intersections, although intersection geometry and traffic control were gaps. The State's recent LiDAR collection was an option to derive some of this information, including signs, signals, and retroreflective backplate presence.

KDOT noted a key gap in intersection data related to intersections was off of the State-owned system. These locations also had significant gaps in geometry and traffic control data. Furthermore, KDOT noted that unique ID linkages with GIS were a challenge, and the links could not be automated. However, the State has key initiatives to overcome these challenges:

- Statewide crash screenings can help indicate potentially signalized intersections based on crash attribute data, as well as the results of the SPF Tool.
- Kansas is actively working on an Intersection Manager Tool to maintain data long-term with its other road data systems without time consuming and complex linkage processes.

Following the presentation, attendees asked Kansas several questions:

- FHWA asked how the State is doing on non-State-owned public roads. Kansas has local data by functional class and interchange. The State needs more data on traffic control and geometry. Off-system data are Kansas' current focus, including determining the type of intersection. Kansas noted that it has good annual average daily traffic (AADT) coverage statewide, and it can automate approaching AADTs for intersections. Kansas clarified that the "local" definition in the presentation referred to the non-State-owned system.
- Virginia noted that geometry and traffic control type is also a challenge for them. Virginia uses imagery data and manually reviews crash reports. Kansas noted that their Intersection Manager is a point-based system, and they review crash reports for stop control/not stop controlled as an indicator. Kansas has just started this process primarily for local (non-State) roads. All crash types and severities have been helpful to find stop-controlled intersections. Kansas has used LiDAR to flag State signals and 4-way stops. Retroreflective backplates for signals are an important part of Kansas' safety efforts and they have worked with local agencies, like the Mid-America Regional Council (Kansas City), to determine what exists on the network. This is part of the State's SHSP.
- Caltrans asked how Kansas collected AADT on local roads. Kansas noted that some locals have it and they contact those agencies directly. Some agencies have methods to estimate traffic volumes and some averages are developed by county. These are trip-based estimates. Kansas has also purchased vendor camera systems with counts using National Highway Traffic Safety Administration (NHTSA) grant funds, sharing it with their partners.
- North Carolina asked if the intersection data were tabular or spatial. Kansas clarified that the data are tabular with latitude and longitude embedded. This process is converting spreadsheets from 2012, and Kansas does not have total confidence in the old spreadsheets.

MIRE: Developing Intersection Inventories – the NHDOT Experience

New Hampshire discussed the history of intersection data over the last decade. Since 2014, the State has roughly 90 percent of intersections complete with data. New Hampshire has compiled this data from several sources, including:

- HPMS database that includes pavement type, functional class, and ownership information.
- Nodal (i.e., point) database that indicates a change along the roadway; these may or may not change at a true intersection.
- Intersection traffic control inventories.
- Field data collected through mobile units (i.e., vans).

Linkages to HPMS data allow New Hampshire to derive approach-level information at each node. New Hampshire uses Esri ModelBuilder in ArcGIS Pro to edit and standardize the integration process. This allows the State to adapt to changes in the HPMS route network and accommodate updates to traffic control inventories from asset managers. This includes sign and roundabout layers collected through vehicles in the field. New Hampshire is currently integrating sign locations acquired through new mobile collection efforts to modify its database.

Following the presentation, attendees asked New Hampshire and FHWA several questions:

- Indiana asked if a ModelBuilder approach required substantial effort. New Hampshire agreed that a Python coding-based approach might be more efficient, but engineers and other staff may not code. The ModelBuilder approach is highly visual, and it may be easier to train new staff or communicate needs as a hedge against staff turnover. Indiana recommended Feature Manipulation Engine (FME) as a highly effective way to program data extract, transform, and load (ETL) processes in GIS. New Hampshire also noted that the State's HPMS GIS network does break at overpasses and grade separation was not a major concern. FHWA also clarified that FHWA does not intend for States to use HPMS for their own programs, and internal analysis applications can differ from HPMS.
- North Carolina asked about data maintenance going forward. New Hampshire noted that the Bureau of Maintenance is a major partner to obtain the latest attribute data, and sometimes HPMS might not be accurate. New Hampshire integrates some data, such as signs, manually.
- Kansas noted that it is sometimes beneficial to mix automated and manual processes. Manual processes may help notice and report issues to other bureaus within a DOT. Kansas and New Hampshire also discussed legacy systems for crash location that might influence data system needs, including link, node, and offset methods compared to latitude and longitude.
- Caltrans asked about unique situations, such as dual carriageways and roundabouts. New Hampshire noted that roundabouts are their own collection effort, and they are

developing the business rules as they go. Kansas noted that they use "conflict points" as a means for mapping intersections. New Hampshire also reported that MIRE has been helpful in communicating these types of priorities to their leadership.

- FHWA mentioned that OpenStreetMap can be a useful tool for data validation. Although these data are crowdsourced and should not be assumed to be accurate, they can point to gaps in the existing State database. North Carolina noted that the State used a combination of OpenStreetMap and crash data attributes to derive and validate potential traffic signals on the local system.
- Virginia asked if an intersection between a public road and a private driveway could be considered an intersection from the perspective of MIRE. FHWA clarified that an intersection had to include two or more public roads as defined by 23 CFR 460.2.
- There was a discussion about the specific definition and reporting framework for intersections. FHWA noted that there were definitions of intersections that suited several disciplines, but for safety-related data, the Model Minimum Uniform Crash Criteria (MMUCC) and MIRE followed the National Information Exchange Model (NIEM), and FHWA was working to align MIRE and HPMS.
- There was also discussion about the appropriate definition of "local." FHWA clarified and reinforced that local in terms of MIRE reporting requirements refers to the functional class of the road, not the ownership of the road.
- Finally, many participants were interested in how unpaved roads may affect the intersection reporting requirements. FHWA clarified that if the unpaved road connects with a non-local paved road and meets the definition of a public road, then it should be counted.

NCDOT Use Cases for the Traffic Safety Intersection Inventory and Guided Discussion

North Carolina shared some recent analysis applications of the State's intersection inventory. The State completed the first version of its GIS-based statewide intersection inventory in Spring 2023. The State has completed several noteworthy applications of these data, including:

- Nighttime-related crash screening for a mixed urban, suburban, rural county.
- Approach skew in a countermeasure evaluation study.
- Pedestrian and bicycle screening warrants.
- Developing and expanding a high injury network (HIN) for the Greensboro metropolitan planning organization (MPO).
- Dashboard to communicate the prevalence of innovative and unique intersections such as roundabouts and reduced conflict intersections (RCIs).

North Carolina also offered several other potential use cases for the data, including:

- Identify intersections with high proportion of angle crashes.
- Determine typical crash performance at roundabouts.
- Calculate crash rates at intersections by categories of traffic control and AADT.
- Identify Divisions or counties with the highest and lowest usage of new intersection designs.

North Carolina noted that it was implementing the inventory as part of the State's upcoming crash and safety management system upgrade and plans for using image extraction for MIRE data collection and verification. North Carolina then led a guided discussion about the safety applications of intersection data with the attendees:

- Kansas noted that its intersection inventory started tabularly, not spatially. The State is working to implement the data in the SPF Tool and other HSM analysis tools, which can screen intersections of different types. Kansas plans to build a safety pipeline of projects. Projects in the pipeline will be a mix of risk factors, exposure, HSM analysis results, public involvement, VRU assessments, and equity considerations. This will rank sites by points and will produce a source of high-risk projects to fund. This is a way to connect the dots starting with the intersection inventory and populating the pipeline of projects. Kansas wants to get projects out on a dashboard, but they are not ready to unfold the curtain yet.
- Nevada has had a robust intersection database going back 15 years. It has improved over time. Major MPOs have also contributed and benefitted. Nevada reviewed each MPO using streetview imagery to try and verify detailed information. Originally, Nevada used predictive methods and all crashes to identify top intersection sites. This approach did not work for Nevada originally. Nevada had to focus on reducing fatal (K) and suspected serious injury (A) crashes using a weighting system. This required fewer attributes but greater coverage across all sites for comparison. The focus was on low-cost improvements. In the Nevada experience, detailed attributes are beneficial for knowing what treatments to apply and less where to focus on network screening.
- Missouri has a spatial inventory of all intersections on non-local and local roads. The State used to chase all crashes but has since focused on K and A crashes like Nevada. Missouri also noted substantial crashes at crossover locations where the public was allowed. The State has implemented several unique intersection designs (e.g., RCIs) and has also focused on roundabouts.

North Carolina asked the group if safety applications affected how the States collected and managed their intersection data:

- Kansas noted that innovative designs can sometimes be difficult to communicate and sell to locals. These data help show they have been implemented elsewhere in the State, and conflict points help communicate the why associated with these designs.

- California has focused on integrating these data with AADT for crash rates. This is especially important if your State must meet warrants for certain safety improvements.
- Virginia currently runs SPFs and scores each road segment and intersection in the State for which inventory and traffic data are available. The State expects to expand the network screening to intersections on public roadways with complete MIRE FDEs to better address the priority of highway safety improvement needs.
- Kansas added that data elements can help inform issues being observed in crash diagrams (e.g., left-turn lanes and signal characteristics). The zone of influence can also inform which crashes get linked to the intersection. Utah also emphasized the importance of turn lanes in their network safety analysis, and Nevada echoed that the influence area can substantially influence whether intersections or segments get flagged for study and improvement.
- Massachusetts also mentioned that these data can be linked to VRU-related data elements, land use, and environmental justice layers to improve network screening.

FHWA clarified that intersection approach lengths and "influence areas" would ideally be dynamic based on turn lane queue lengths and other information, but States can start more simply (e.g., based on the functional class of the approach). North Carolina noted that data does not need to be perfect to start. The purpose is for the data to be reliable and actionable. California asked what local agencies ask for in other States:

- Kansas advised that States should try to find issues (i.e., opportunities for safety improvements) for the locals. HSIP solicitation is not enough, and the State could take an active screening role to capture the most effective projects.
- FHWA added that Minnesota and other States share HSIP dollars in exchange for data. This can create a virtuous quality assurance cycle.

FHWA asked if States needed more VRU-related data, particularly with respect to midblock crossings. There was general agreement that this was important for safety analysis going forward. Indiana collects pavement markings and signs through a combination of manual collection over several years, as well as mobile vehicle collection and extraction.

Data elements associated with the Americans with Disabilities Act (ADA) are not currently required by MIRE, but these can be informative for safety. Kansas mentioned that the State was interested in lighting and ADA ramp inventories. North Carolina concluded the conversation by communicating that the Access Board published the Public Right-of-Way Accessibility Guidelines (PROWAG) Final Rule to the Federal Register on August 8, 2023.[2]

[2] https://www.federalregister.gov/documents/2023/08/08/2023-16149/accessibility-guidelines-for-pedestrian-facilities-in-the-public-right-of-way

Session 2: Addressing the Whole System

The second technical session focused on data collection for all public roads, particularly on the local system. Nevada presented on its use of mobile LiDAR and machine learning, and the attendees were split into breakout groups to discuss how to engage local partners on data collection. Presentations by Missouri and California concluded the first day.

Nevada's MIRE

Nevada discussed its enterprise data system and the increasing scale and complexity of enterprise data. Nevada owns and operates its own data collection vehicles, and these are outfitted with the following equipment:

- Dual Cameras – One front facing, and one 45 degrees angled to roadside. Images are taken every 26.4 ft or 200 frames per mi.
- Dual LiDAR heads on the back of the vehicle. LiDAR heads collect over 1.4 million points per second and accurately (+/- 2 cm) range out to 100+ m.
- Both Global Positioning System (GPS) and Global Navigation Satellite System (GNSS) are used for location accuracy.
- Distance Measuring Instrument (DMI) is used for distance measuring.

All data are post-processed using base station data to increase accuracy, and data can be collected up to 70 miles per hour (mph). Nevada collects data for State-maintained roadways and functionally classified local roadways on a 3-year cycle. Field collection requires two staff per vehicle, and the data are highly precise. The State has been able to extract a fully populated sign inventory with Manual on Uniform Traffic Control Devices (MUTCD)-compliant designations, as well as other safety-related information (e.g., sight distance).

Nevada also recognized that this approach is time consuming and costly. The State approached the University of Nevada-Reno to explore methods of data extraction that could be scaled. The university recommended an open-source object detection package, You Only Look Once (YOLO), that could be trained using imagery and produce general feature classifications. Nevada also used an open-source dataset produced by Mapillary with 4,000 classified images of traffic signs as a base for training the YOLO model and used data from the Kaggle Traffic Recognition Challenge. The State's model training was expanded using the Roboflow tool to tag and classify images that included traffic signals and pedestrian midblock beacons.

Nevada noted that these classification models based on static imagery may have some limitations, including:

- The images may not recognize or capture the flashing action of crossing beacons.
- Railroad crossing gates in the up position can be problematic.

Finally, Nevada used classification models to detect intersection geometry (tee, y, four-leg, roundabouts, etc.) and midblock pedestrian crossings. The State concluded by noting that they will continue with a mix of LiDAR collection and open-source object detection modeling. LiDAR and mobile data collection costs are decreasing, but it is still costly. Safety provides an opportunity to use Federal funds to accomplish the agency's goals. Open-source technologies should not be seen as a black box, and they are the future of data collection. However, States should be wary of legal implications, especially with respect to using proprietary imagery or other data sources.

Following the presentation, attendees asked Nevada several questions:

- Kansas asked if Nevada owned and operated its fleet of vehicles. Nevada confirmed that the State did, although a contractor supported the technology on the vehicles. Nevada also noted that they segment their data manually based on feature breaks.
- New Hampshire inquired how much Python experience is required to train and test the open-source models. Nevada noted that they did not require expertise, but some familiarity is helpful to begin exploring the tools.
- West Virginia asked how many miles Nevada collected and the cost. Nevada estimated 20,000 mi per year and Federal funds help with system costs. States can also lease vehicles and equipment. West Virginia mentioned that the State had explored a similar approach and that they determined it would not be cost effective.
- In response to States mentioning that they used to have a van and have moved to contractor services, Nevada noted that data collection requirements are important. Other States such as Louisiana have had data collection on all public roads, and it is important to know where they are.
- West Virginia asked how many GIS staff Nevada had. Nevada responded that there were 11 staff over 6 programs. Mobile collection has two staff in the field with one supervising helping to extract information.
- Indiana asked if images used to train models overlapped. Nevada obtained images from every 100 ft using OpenStreetMap, and the images did not overlap.

Breakout Discussion and Report Out: How do you engage local partners? What does an ideal program look like?

FHWA asked participants to discuss the following questions:

- What data elements do you really need? Which are less necessary?
- How often do you engage your locals? Which forums work well?
- What do they collect? What do they simply validate/correct based on your collection efforts?
- Who are your effective (non-local government) partners?
- What resources do you (States) need?

After the discussion, each group reported out their conclusions:

Group 1

Data that support network screening are essential, such as AADT and VRU related data (sidewalks and crosswalks). The data requirements may depend on the project. New Hampshire engages locals through nine regional planning commissions for AADT. New Hampshire has thousands of counting stations, and the State performs quality control on the data. Several States get AADT from locals. Many States were also interested in using probe and connected vehicle data, although there were questions about its accuracy and practical application. Some States noted that lower AADT roads, less than 5,000, may not be very reliable. Many States asked for FHWA assistance in assessing and applying these data sources.

Group 2

California reaches out to locals quarterly, both through email and virtual/in-person meetings. California noted that in-person meetings work best, and email is not very effective. There are also issues with locals providing data in a format that works for California, and funding requirements might be a solution. Continuous education of the "why" behind the State's data activities is essential. Local agencies also need funding and staffing. The States also asked about assumptions that could be made about MIRE data globally across the system, similar to HPMS. With respect to unpaved roads, the need will vary by State and whether the State DOT maintains many of these facilities.

Group 3

Many States have issues engaging with locals. This is especially true in States with unique political systems, like Virginia. Some States, like Georgia, reported successful engagement with counties, and Missouri is working with counties to complete its statewide database. This is especially applicable to surface type information. Locals do not always send information in a useful format, but Missouri accepts what they receive. Interactive mapping tools are (or can be) effective methods for receiving information in a format that is compatible with the State's information.

Group 4

AADT is an essential data element. The group noted that FHWA's Roadway Data Improvement Program (RDIP) had been a successful way to assemble a forum of State and local analysts to share information. Nevada noted that they received pedestrian pathways that an MPO had collected through LiDAR and video extraction. This approach had been helpful in identifying complementary data and shortcomings. Engaging locals is also effective when funding is tied to data; this includes project funding being tied to roadway data being available in the State's basemap, as well as certified public mileage. The public can also be a source of data validation as they will comment if data are incorrect. Finally, the group noted that FHWA could provide more resources, including technical assistance funding, hubs for sharing coding or open-source data support tools, and data requirements that apply to emerging technologies such as connected and autonomous vehicles.

Missouri's MIRE

Missouri began with a discussion of the State's planning framework. It is a bottom-up structure with local agencies coordinating with division offices and division offices communicating with the central office. As a result, local coordination is essential. The statewide enterprise database, the Transportation Management System (TMS), has been in place since 1998. Missouri developed it completely in-house using an Oracle database and associated LRS. The TMS Datazone is the external component that allows public access to AADT, traffic signals, and other data.

Missouri collects traffic information from a mix of continuous/permanent count stations and portable short-duration counts. The State collects roughly 4,300 short counts per year, along with special counts for work zones and new development. The State also supplements count data with Streetlight data; this uses a variety of sources to derive volumes on public roads. Missouri noted several benefits with this approach:

- It is a safer method for collecting data on roads as MoDOT staff do not need to lay tubes across active roads.
- It can be used to validate observations or modify segmentation of Missouri's network.
- It provides access to local road volumes that Missouri would otherwise not have access to, including low-volume and newly developed roads.

Missouri concluded with two new developments as part of the State's safety program:

1. TITAN is a big data platform intended to manage the growth in data streams from several sources. This partnership with the University of Missouri at Columbia will allow Missouri to integrate data from TMS and other proprietary big data sources and conduct performance monitoring and predictive analytics.
2. The SAFER Tool is a checklist for every project funded as part of the State's STIP. This includes maintenance projects. This allows SSA concepts and VRU accommodations to be considered in every project.

After concluding, the attendees asked Missouri several questions:

- Massachusetts asked about Missouri's experience with Streetlight. Missouri noted that early feedback indicated the data were accurate for planning purposes, although the DOT was still reviewing the data.
- Kansas noted that KDOT and MoDOT collaborate on the SAFER Tool and exchange ideas between agencies.
- New Hampshire asked about the brand of permanent counting devices used by MoDOT and the use of video data for traffic counts. Missouri uses Oriux-Peek, Wavetronix, and International Road Dynamics for permanent counting devices. Missouri did not use video for traffic counts.

Caltrans MIRE FDE - AADT Data Collection on Locally Owned Roads

California has approximately 177,000 public road miles, with over 112,000 miles classified as local roads. MIRE requires AADT for local paved roads, non-local paved, intersection, and ramps. California has several sources for traffic data:

1. **Caltrans internal data sources:** This includes data collected from HPMS, as well as the State's Transportation System Network (TSN).
2. **External data sources:** These include MPOs, Regional Transportation Planning Agencies (RTPAs), counties, cities, and Tribes. Roughly 30 percent of these agencies report data to Caltrans. These data can be in various formats and can be time consuming to ingest.
3. **Traffic Data Collection Contracts:** Field data collection based on functional classification; a 3-year cycle for Federal aid routes (not including interstates), and a 6-year cycle for rural minor collectors and local roads.

There is a big gap to fill to complete data collection. In the past, HPMS made efforts to contact local agencies, and around 30 percent of these agencies shared data with Caltrans. To improve the participating agencies and increase the percentage of data received, Caltrans is now considering a formal data-sharing agreement for seamless and periodic data sharing. The purpose of this agreement is to establish a common understanding regarding Caltrans sharing electronic files of traffic safety-related data to support MIRE. This agreement intends to formally extend data sharing for the future. California also plans to take a top-down approach through district offices where districts contact the MPO and the MPOs reach out to county and city agencies.

California is also exploring Streetlight data to supplement data from locals, particularly on the local functional class system, as well as proposing a new AADT Sampling Selection Method. Local roads comprise 60 percent of the mileage in California, and the method would divide the State by region and several other HPMS metrics, including functional class, urban area, facility type (one-way/two-way), through lanes, and surface type.

California concluded with several updates as part of its MIRE program:

- **Contracted with the University of California-Berkeley (UCB)** in March 2020 to participate in and provide input to planning for MIRE FDE data governance, data integration, data collection methods, and data gaps.
- **Completed a draft data-sharing agreement** which will be essential for sharing/transfer of data between California and different local agencies and jurisdictions.
- **Provided two MIRE FDE training modules** were developed by UCB and are now available on Caltrans' Local Assistance Division Website.
- **Developing MIRE FDE storage needs and capabilities**: The Caltrans Transportation System Network Replacement (TSNR) project is being developed for a

new statewide safety database that will not only include MIRE FDE but also accommodate other safety-related data such as bicycle and pedestrian information.

- **Developing MIRE FDE Data Collection work plan:** The primary objective of this work plan is to effectively close existing gaps within the current model inventory system and ensure full compliance with the MIRE FDE requirements by the year 2026.
- **Developing the statewide intersection dataset:** The development of the intersection layer, in partnership with Chico State University, is essential because it includes the AADT data for intersections, which is one of the elements in the MIRE FDE.

After concluding, the attendees discussed California's presentation:

- North Carolina noted they found Streetlight useful from a planning perspective, but not for all engineering purposes. It has been especially helpful for assigning AADTs to intersection approaches.
- Kansas wanted to know California's experience with Streetlight on the local system. California added that the State was still exploring the data.
- Nevada asked if Big Data could be used to satisfy MIRE requirements. FHWA clarified that HPMS requirements have a specific threshold of accuracy, but MIRE can only specify the "what" and not the "how." Data for MIRE should be reasonably reliable and accurate.
- California asked if other States had experience with developing and applying SPFs. Kansas, Missouri, and North Carolina indicated they did.

Day Two (August 10, 2023)

Welcome and Day 1 Recap

FHWA initiated the proceedings with follow-up questions on specific discussion points including a summary of the first day of the Peer Exchange. FHWA noted the following takeaways from Day 1:

- Do not let the dream of perfect stand in the way of good.
- A key guiding principle – the purpose of MIRE is to move the needle. The data need to be actionable to make informed safety decisions.
- LiDAR and street-level imagery are highly effective, but costly.
- Automation from Python/other coding packages from open sources are the future, but they are a black box to transportation professionals.
- AADT for all public roads (from a variety of sources) is high on the list for technical guidance.

- There is an emerging need for VRU data elements (e.g., midblock crossings).
- 2026 is just the beginning.

FHWA asked participants 1) if they had any additions or corrections to these takeaways or 2) if there were any topics that were not discussed on Day 1 that they would like to discuss with their peers. The subsequent inquiries and specific discussion points raised during the discussion are as follows:

- California has interest in obtaining more specific SPFs for different roadway classifications in the State, and the State asked for others that could help. Kansas and North Carolina offered support. Kansas mentioned that they hired external assistance to develop the SPFs and shared with Caltrans.
- Nevada asked about the deadline for MIRE 2.1, the formalized document, and the potential involvement of States in the development process. FHWA responded that the goal is to publish the document by the next Transportation Research Board (TRB) annual meeting if possible, and partners within USDOT are aiding the effort. Additionally, the discussion of the Peer Exchange (i.e., noteworthy practices) will be included along with providing noteworthy practices and examples from other States. Suggested practices with respect to specific data elements are being collected to include in the report and to provide additional technical assistance considerations. Some of these practices may align with HPMS if data elements are shared in common, while others may be unique to MIRE and considerations for safety. MIRE 2.1 will also incorporate edit checks to help guide States in their data programs.
- Additionally, Nevada asked about any potential changes to the schema or attributes in MIRE 2.0, specifically the crosswalk tables and whether there were any discussions about changing the HPMS format and crosswalk. FHWA responded that MIRE 2.1 will update these tables due to the phasing out of IHSDM. FHWA noted that MMUCC 6 has removed all roadway data elements, and it may also be removed. Also, the FDEs will be placed at the beginning of the document.
    - Kansas added that MIRE 1.0 did not have attribute codes, but the State derived codes from the former AASHTOWare Safety Analyst™. For example, roundabouts were coded as "4" in the software, but MIRE 2.0 coded them as "6." FHWA clarified that the required FDEs will not change, only the attributes and values may change (particularly for non-FDEs). MIRE will match the attribute code to HPMS as much as possible.
    - Nevada added that MIRE could be submitted jointly through HPMS, and the schema could be built in a way that allows for easy uploading. In response, FHWA answered that MIRE FDEs have no reporting requirement, but States are required to have MIRE FDEs by 2026. FHWA is trying to align MIRE with HPMS because half of the FDEs are already in HPMS. Additionally, the issue of integrating crash data from NHTSA electronic data transfer (EDT) and MIRE

FDEs is a long-term goal. There is currently no reporting requirement for MIRE, and while FHWA is working to add MIRE FDEs to HPMS, that is a separate issue.

- Kansas asked about the progress of MIRE in annual reports and how FHWA coordinates this information. Many States include evaluations in their reports, as FHWA requests more verbiage to assess evaluations. Kansas wanted to understand the future goals of FHWA and how the data from HPMS, MIRE, MMUCC, and HSIP are connected. FHWA responded by stating that all these programs have a purpose. The initial requirement for MIRE was initiated back in 2017, and States worked with Traffic Records Coordinating Committees (TRCCs) to develop their plan. There is a reporting requirement every year in the HSIP annual report, and FHWA collects the reports collectively to track progress and understand the challenges. Each agency has a piece of the puzzle to support their programs.
- Kansas asked if FHWA could provide more context in the future and have a stronger connection between the FHWA Division with the Office of Safety. This could be accomplished through fact sheets or other brief communications materials. These fact sheets could detail the goals and coordination between different offices for different initiatives. An example could include how VRU assessments are tied to other programs.

- Massachusetts raised the topic of working on interchanges and transitioning from a point system to a line system. Different methods were shared by various participants, including Missouri, Nevada, Kansas, North Carolina, Virginia, and California. New Hampshire also had a similar question regarding dual carriageways causing issues for their intersection model and Massachusetts offered support for guidance.
  - North Carolina shared their approach of using GIS road centerlines to create one big shape for traffic safety analysis. This area can be used broadly as the area where crashes occurred.
  - Kansas mentioned the distinction between segments and intersections, particularly in the context of ramps approaching an interchange. They were unsure about how this is handled in GIS and acknowledged that there is still work to be done in this area.
  - California is using both point and line systems for crashes at off-ramps and in the ramp. They are looking to incorporate both systems into one and learn more about the use of polygons. Everyone in the room expressed interest in this topic.
- The New Hampshire FHWA Division Office suggested moving away from email chains and instead having recurring meetings and a community of practice (i.e., "office hours" or "MIRE FDE Champions") to continue the conversation and facilitate learning for the

safety data community nationwide. California emphasized the need for a support system due to the amount of information to learn.

- FHWA currently has regular calls with Division Office staff and proposed recurring webinars with State MIRE stakeholders; the frequency of these calls was discussed. Kansas suggested twice a year, while Nevada suggested intermittent and ad-hoc conference call meetings for informal discussions. Missouri suggested having office hours every other month in a virtual format, allowing anyone to participate and addressing both detailed and high-level questions. FHWA would facilitate the questions and keep the list broad. Quarterly office hours were also suggested and generally approved.
- North Carolina suggested brainstorming topics for office hours to create a seed list of ideas.
- FHWA has its own working group with State HPMS staff, though this communication can we ad-hoc.
- KDOT shared that Kansas has small informal meetings to discuss the activities of councils across groups. These meetings allow for easier communication with fewer participants and provide an opportunity to exchange ideas with peers in the same State.
- California shared their experience of organizing a monthly roundabout forum where designers, planners, and safety experts from all 12 districts come together to share ideas, ask questions, and discuss case studies. They are seeking feedback from other districts on how to deal with challenges related to a specific roundabout project.

- During the discussion, FHWA asked how many attendees were aware of the MIRE-related staff in surrounding States. Most participants acknowledged that they were generally unsure of MIRE and safety data representatives in other States. FHWA noted that there are likely one to three MIRE people in every State because MIRE is a complex and multi-faceted concept. West Virginia added that MIRE is a group effort rather than an individual one. FHWA further explained that the MIRE group consists of individuals with different areas of expertise, and it is important to bring in different people to help identify those responsible for MIRE in each State.
  - Missouri mentioned that highway safety and traffic are the owners of MIRE, and the collection process takes place in Transportation Planning.
  - In Kansas there are at least three different people involved in MIRE work, and it is not solely the responsibility of safety. Additionally, the decision making and collaboration between different departments have improved in the past year, and it is necessary to utilize each other's expertise to make informed decisions.

    - FHWA requested that attendees provide names and contacts for the development of a "Champion List."

Session 3: The Future – Managing Change and Maintaining Data

The third technical session focused on data management, particularly change management over time. ISU began with the university perspective from Iowa, and West Virgina discussed the State's enterprise data infrastructure. The session concluded with a breakout group discussion on noteworthy practices and needs for maintaining MIRE data into the future.

Iowa and the University Perspective

Iowa discussed its safety data history, and how the State began creating a database for in 2012, specifically focusing on intersections. The database included various elements such as approach surface type, right-turn offset distance, longitudinal distance from rumble strips to intersection, number of exclusive bike lanes, number of approaching driveways, and number of departing driveways. Additional data elements such as beacon presence and type, date of roadway image, date of aerial image, and complex intersections were also collected. Initially, the process was mostly manual but transitioned to automated methods, such as LiDAR, in 2017. ISU supported the work for Iowa DOT with undergraduate students from the University. These staff checked the accuracy of every 15th intersection.

- The average collection time for each road type and intersection was shared during the presentation, averaging between 2 and 4 minutes per intersection.
- The manual process was found to be efficient and easy to justify. However, the transition to Esri Roads and Highways, specifically the LRS version with dual carriageways, proved to be more challenging for ISU.
- Currently, Iowa is transitioning to MIRE 2.0, which requires elements from the LRS and utilizes Esri ArcGIS Pro for the process.
- The top priority for new intersections is to collect MIRE data, with higher volume roadways receiving greater volume.
- Iowa has also developed SPFs for all paved intersections in the State and has comprehensive knowledge of the location of all stop-sign beacons. This allowed the State to develop a CMF for beacons.
- Additionally, Iowa has a list of expected crashes for all intersections in the State, which enables them to analyze characteristics and make informed decisions regarding funding requests from cities.

Following the presentation, attendees asked Iowa several questions:

- North Carolina inquired about the use of more than just AADT for SPFs. Iowa mentioned that characteristics such as roadways (turn lanes) were also considered, if available.

- New Hampshire asked about the appearance of intersections in the LRS and whether they were represented as a grouping of four lines for dual carriageways. Initially, intersections were represented as points, but the transition to the LRS caused confusion regarding the identification of intersections. The use of GIS shapefiles and a line database for all characteristics was found to be challenging to overlay on the intersections.
- Virginia mentioned that Wejo data had recently been purchased for a six-month period and partnerships with universities were being formed to evaluate its effectiveness in different crash scenarios. Documentation regarding the use of Wejo data and its applicability to different types of crashes can be obtained by emailing Shauna. However, Wejo is no longer an operating firm.
- North Carolina inquired about the transition from manual efforts in 2017 to a more automated approach. The process of change detection and updating the inventory was discussed, although Iowa suggested contacting Zach Hans (ISU) for more information.

West Virginia's Managing Change & Maintaining Data

West Virginia discussed the implementation of Enterprise Resource Planning (ERP) in the State, which involved updating all computer programs and addressing issues with the aging mainframe.

The implementation followed a phased approach and included the creation of a Transportation Asset Inventory (98 inventories) to track assets on the highway network, facilitate necessary changes, and know where to install assets. For instance, it solved the need for an ability to track signs from the time materials were brought in, to their deployment in the field, in order to recoup costs and replace signs before they become problematic. The inventory consisted of 98 inventories divided into 3 modules.

The ERP system was revisited to improve integration with internal systems and was reintegrated into one system called the Transportation Asset Management System (TAMS). The implementation of TAMS occurred in three phases, with the first phase focusing on maintenance management. Phases 2 and 3 involved adding assets and reporting work to various assets to track expenses and address issues. Phase 2 included assets such as sign signals, lighting, and intelligent transportation systems (ITS). Initially, all components of the system went live on the same day, but later adjustments were made to turn on parts of the system as they were ready, such as the speed limit database. Phase 3 included additional assets, including remaining MIRE elements.

West Virginia concluded by emphasizing data governance with the establishment of data standards and the creation of a network of users from each system. This would help ensure consistent storage and linking of datasets and by addressing staffing challenges with a focus on documenting standards, systems, and practices. States could also begin their inventory process with basic assets and supporting business units can help assess change detection.

Additionally, the importance of communication and collaboration, with the need for an open mind and the involvement of other States in the implementation process. Documentation is a buffer against liability, and the importance of documentation needs to be reinforced with field staff. Technology can help make documentation more efficient, and newer staff are increasingly more tech savvy and can more readily adopt new technologies and workflows.

Following the presentation, attendees asked West Virginia several questions:

- Kansas asked about the importance of signing and how to keep track of assets and their condition. Kansas added that the State currently does not have a sign inventory, but assets are tracked based on MUTCD recommendations. However, the lack of inventory means that the agency is no longer able to use Federal money. Kansas suggested that high mast lighting should also be included in asset management, as it is important for maintaining structural integrity. Kansas added that HSIP dollars could embrace operational needs and maintenance concerns. An example could be retroreflectivity of signs improving both components of the system.
    - West Virginia explained that they do not currently have retroreflectivity, but they are exploring options. They have video logs for the highway system going back 15 years, which allows them to collect asset data based on MUTCD codes. However, the data collected are imperfect and need to be cleaned and improved. West Virginia mentioned that they have started with basic signs and have recorded the replacement of guardrails.
- New Hampshire asked about the arguments for updating assets. West Virginia explained that the biggest argument is the need for work orders to focus on areas that require attention. It can be challenging and has its difficult moments, but management has supported the initiative.
- New Hampshire manages their assets through work order inventory. They consider signals and beacons as assets and use maintenance work orders when necessary. They also manage traffic data as an asset and have developed an inspection list for every installation to track the aging of the system. New Hampshire also suggested finding good examples of asset management practices to learn from and support each other.
    - West Virginia suggested focusing on the assets itself rather than the work being done, as everyone has their own agenda. By tracking the work based on the asset, it becomes easier to determine costs and address specific issues. For instance, a sign that is struck often may actually need to be moved. WVDOT emphasizes the importance of knowing the history of assets and what is happening behind them to solve problems effectively.
- California raised the question of how to deal with assets that include interim countermeasures. Temporary all way stops, for instance.

- West Virginia explained that they have discussed temporary speed limits for work zones and the ability to flag them as temporary. They can analyze the data based on these temporary measures.
- New Hampshire mentioned that they have a system for virtual work, with short counts and asset counts for 1-2 days.
- California expressed concern about the amount of documentation required for assets such as signs and guardrails and asked about the consequences of not documenting.
- West Virginia explained that not documenting can lead to challenges and difficulties in analyzing the data.
- California suggested developing a relationship with maintenance staff and hiring someone to write conceptual reports to initiate projects. West Virginia agreed and suggested automating the process. Younger, tech-savvy staff can adapt more readily. In addition, California emphasizes the importance of changing the process rather than the people.
- Kansas mentioned the use of a form and PowerBI to make recommendations.
- Indiana suggested making the process as easy as possible within reason and highlighting the benefits for the agency to move aware from more time-consuming practices (e.g., updating paper maps).
- West Virginia mentioned that they have streamlined some processes and realized time savings once they had an inventory.

Breakout Discussion and Report Out: Practices (and Challenges) in Maintaining MIRE Data

FHWA asked participants to discuss the following questions, particularly with respect to developing case studies that States would be interested in:

- What challenges have been overcome?
- Which technologies have you explored (or want to explore)?
- Who is involved in planning data collection?
- Any other considerations where you're not sure how it applies to your State (e.g., data governance)?

After the discussion, each group reported out their conclusions:

Group 1

AADT is a major challenge. New Hampshire uses estimation, but States need to know what can be more relied on or what needs to be verified. Traffic control is also more difficult. Signals are easier but stop-control can be challenging. Technologies include probe and other Big Data, as well as other open data sources. Big Data are generally good for planning level, and machine learning is needed to extract different features. Pavement and HPMS units are often involved in data collection.

Some States were unsure how asset management might apply to MIRE. Future schema could help standardize data collection across safety and performance monitoring. The States would also benefit from further clarification of what non-local/local means for MIRE, as well as a distinction from State and non-State system ownership. Intersection approaches would also benefit from clear definitions.

Group 2

The group identified topics for case studies:

- Interchanges, intersections, and how States can organize these data in different ways.
- Capturing surface type, paved and unpaved, at a high level for all roads. Other critical elements included traffic control, AADT, and road ownership.
- How to handle non-State sourced data. Machine learning based off of images as an example, as well as integrating data from other sources into State datasets and maintain fidelity of data source. In other words, how can State's know for certain where a data element came from?

The group concluded by echoing the need for a repository of examples and community of practice for States to share their experiences regularly on these emerging topics.

Group 3

AADT is a critical data element for all public roads, and States need more experience with external data sources; it can be difficult to feed data from external sources into enterprise systems. Camera systems and Big Data sources can help keep collectors out of the road. Additional elements included auxiliary and turn lanes. In particular, determining the stop/start of tapers. These are not FDEs currently, but they are important and part of the future, so they need to be considered. Interchange data design was important, particularly with the consistency of design associated with these elements.

States may also have differences in paving practices that affect how data are managed. Kansas will pave to the right-of-way line with an intersecting unpaved road, and pavement markings can be a helpful indicator of MIRE data elements. These practices also affect how States screen their network and ultimately implement countermeasures (e.g., turn lane markings, angle crashes, and presence of stop bars).

Several departments are partners in data collection, including hydraulics, pavement surface programs, structures, signals, traffic operations, and district offices. There are pockets of data throughout the agency, and coordination with GIS units and Data Governance can improve access for all. With respect to locals, targeted and personal outreach can be highly effective.

SSA is not new, and many MIRE data elements are related to SSA even if they are not framed as such. For instance, pavement markings are important for safer vehicles and safer roads, and signage and Transportation Systems Management and Operations (TSMO) elements help with post-crash care.

The definition of urban and rural is also important for several safety applications, including crash classification and funding allocation. Splits between urban and rural are all a function of these definitions.

Group 4

Case studies documenting the organizational structure of the DOT would be beneficial because of the variability between DOTs. This organization will help States understand how the practices might apply to the DOT. Case studies could highlight how agencies obtained buy-in and the motivating factors that led States to build a successful practice. Related, case studies could demonstrate that the effort was worth it and the benefits were observed. FHWA could help collect and document MIRE coordinators for agency buy-in, highlighting and identifying champions.

As States navigate multiple data collection options, particularly when they involve a vendor or consultant, it would be helpful if States or FHWA could share noteworthy practices for vetting approaches. This could include sample request for proposal (RFP) language or examples of how States have tested approaches using sample data from their State. Finally, case studies should highlight applicability to DDSA, particularly the benefits observed to reinforce the need for these data.

Takeaways, Discussion, and Wrap Up

FHWA asked States about their ideas for potential "office hours" topics. These could inform future community of practice meetings or peer exchanges.

- Intersections and integration with the LRS and enterprise data.
- Assumptions associated with data collection or application of data; a framework for why decisions are made.
- AADT and the various methods it could be obtained; when are certain sources appropriate, when are they less appropriate, and best practices for validation.
- A collaboration corner, similar to HSIP and State safety engineer forums, that points to existing resources and practices; this would be similar to a Github but not directly hosted by FHWA. This would ideally avoid duplication of efforts. Nevada and New Hampshire offered to share their technical approaches.
- Sample RFPs for vetting vendors, including standards and practices for streamlining testing; States should already have an open RFP process.

FHWA closed the proceedings by thanking the States and reminded the States to 1) offer names and contacts for future MIRE discussions and 2) fill out the Peer Exchange evaluation form (Appendix B).

Themes Arising from the Peer Exchange

MIRE and safety data need a connected national community of practice. MIRE data collection, management, and analysis is multi-disciplinary and involves staff from several units (e.g., HPMS, safety, GIS, information technology, asset management, etc.). Many people may be directly or indirectly responsible for MIRE within a State DOT. Furthermore, States are faced with several options and vendors offering potential to collect data on public roads, as well as staff turnover that might subvert institutional knowledge. FHWA can help foster a community of practice for safety data, both spatial (i.e., GIS) and non-spatial, so that peer learning can happen continuously.

Do not let the dream of perfect stand in the way of good. Although data quality standards for Federal programs still apply (e.g., HPMS), the purpose of MIRE is to serve as a guide for States to improve their safety data programs. Data need to be actionable and reliable enough to make informed safety planning and engineering decisions, and the exact level of accuracy and precision may vary by use case.

Data can be collected using a variety of methods, and the most appropriate option will vary by purpose and use case. LiDAR and street-level imagery data collection are highly effective data collection methods, but they are also costly and difficult to scale and maintain over time. Automation from Python, R, or other programming languages and tools, particularly open-source tools like YOLO object detection, are a more practical solution long-term. These tools still require more traditional data inputs (e.g., aerial imagery) and accuracy will vary according to the quality of those inputs.

Engaging locals is most successful with direct interaction. Data sharing with locals is generally most successful with face-to-face or direct interactions. Passive methods, such as emails, are typically ineffective. Furthermore, tying data to funding, either through State policy or through successfully completing competitive grants, can be an effective “carrot” to spur data sharing. States have found Federal technical assistance to be helpful in bringing State and local agencies together, as well as providing additional funding for these activities.

AADT and traffic volumes are a major data need. The variety of methods and technologies that can potentially address this need is representative of many safety data elements. Many States are interested in crowd-sourced and alternative collection methods (e.g., probe and connected vehicle data), but many States are still in the process of evaluating its accuracy and applicability to their business needs, as well as the most appropriate uses of these data (e.g., planning-level decisions).

There is a need for VRU-related data. Federally-mandated VRU assessments and national trends in VRU safety are generating a need for data that can support these analyses. This includes mid-block crossings, crosswalks, pavement markings, and count/estimate data.

2026 is just the beginning. States will have to collect and update MIRE data over time, collect additional data elements that reflect the state of practice (e.g., VRU assessments), and evaluate emerging technologies for suitability. A national, multidisciplinary community of practice can help support the States going forward and maintain a body of knowledge for all safety data stewards and users.

Appendix A: Peer Exchange Agenda

Day 1: August 9, 2023	
8:00 AM	**Pick up and transportation from Staybridge Suites**
9:00 AM	**Welcome and Opening Remarks** • Welcome to Turner-Fairbank Highway Research Center (TFHRC) – Carol Tan, FHWA • Welcome to the 2023 MIRE FDE Peer Exchange – Sarah Weissman Pascual, FHWA and other FHWA representatives
9:15 AM	**Introductions and Icebreaker** • Peer Exchange Format, Ground Rules, and Goals – VHB and FHWA • Introductions – All Participants • Icebreaker
10:00 AM	**Session 1: Intersections – Presentation and Discussion** • Kansas – Carla Anderson, KDOT • New Hampshire – Amanda-Joe Zatecka, NHDOT • *Break* • **Guided Discussion:** How can intersection inventories best support your safety program? What are your successes? – Daniel Carter, NCDOT
11:45 AM	**Lunch**
1:00 PM	**Human Factors and Mini Sims Lab Tours**
2:00 PM	**Session 2: Addressing the Local System** • Nevada (MIRE data on the local system) – Casey Smith, NDOT • **Breakout Group Discussion and Report Out:** How do you engage local partners? What does an ideal program look like? • *Break* • Missouri (AADT) – Myrna Tucker and Karen Miller, MoDOT • California (AADT) – Quyen Ngo, Caltrans • **Roundtable Discussion:** What experiences do you have supporting safety planning with MIRE data? How do we strengthen that connection?
4:45 PM	**Day 1 Wrap Up**

Day 2: August 10, 2023	
7:30 AM	**Pick up and transportation from Staybridge Suites**
8:00 AM	**Coffee and networking**
8:30 AM	**Welcome and Day 1 Recap** • Follow up questions or specific discussion points
9:00 AM	**Session 3: The Future – Managing Change and Maintaining Data** • Iowa and the university perspective – Shauna Hallmark, Iowa State • West Virginia – Marsha Mays and Hussein Elkhansa, WVDOT • *Break* • **Breakout Group Discussion and Report Out:** Noteworthy practices (and challenges) in maintaining MIRE data – what do you look for in a case study?
11:00 AM	**Takeaways, Discussion, and Wrap Up** • Individual takeaways from participants • How can FHWA support the States? • Is your State (or a local partner) willing to participate in a case study?
12:00 PM	**Closing Proceedings**

Appendix B: Peer Exchange Evaluation Form

Participants completed paper forms or submitted electronic forms after the Peer Exchange. The electronic form was created and hosted on Microsoft Forms and is available at:

https://forms.office.com/Pages/ResponsePage.aspx?id=mV5cNo_260uJ2avstBsaG_MRTQqA0adCsnv1xYR6Bs1UNEdKUFJBU1hHMlY3WlJLSzZDVFY3NEsySy4u.

The form included the following questions:

1. Affiliation
   (Options: DOT, FHWA, Other)
2. Presentations
   (Options: Strongly Agree, Agree, Neutral, Disagree, Strongly disagree)
   a. Presentations were pertinent to the subject matter.
   b. Subject matter was applicable to my job.
   c. Provided enough time for questions and discussions.
3. Comments on Presentations.
4. Roundtable Discussions
   (Options: Strongly Agree, Agree, Neutral, Disagree, Strongly disagree)
   a. Discussions were well facilitated and kept to the subject matter.
   b. Discussions were applicable to my job.
   c. Enough time was provided for questions and discussions.
   d. Facilitated discussions aided in generating new ideas.
5. Comments on Roundtable Discussions:
6. In general, the Peer Exchange:
   (Options: Strongly Agree, Agree, Neutral, Disagree, Strongly disagree)
   a. Provided opportunities for me to participate.
   b. Met my expectations.
   c. Deepened my knowledge of MIRE FDEs.
   d. Resulted in implementable steps for my agency.
   e. Facilitated discussion aided in generating new ideas.
7. Comments on the Peer Exchange:
8. What did you like best about the structure/format of the Peer Exchange?
9. What aspects were the most relevant to your job?
10. How can we improve the structure/format (e.g., travel arrangements, time for breaks and networking) of the Peer Exchange?
11. How can we improve the topics/content of the Peer Exchange? What topics should be added or eliminated in the future?
12. Please explain what the highlight(s) of the Peer Exchange was/were for you.
13. Would you like additional information on any specific topics discussed?