Highway Performance Monitoring System (HPMS): Concepts, Data Collection & Reporting Requirements

Module III

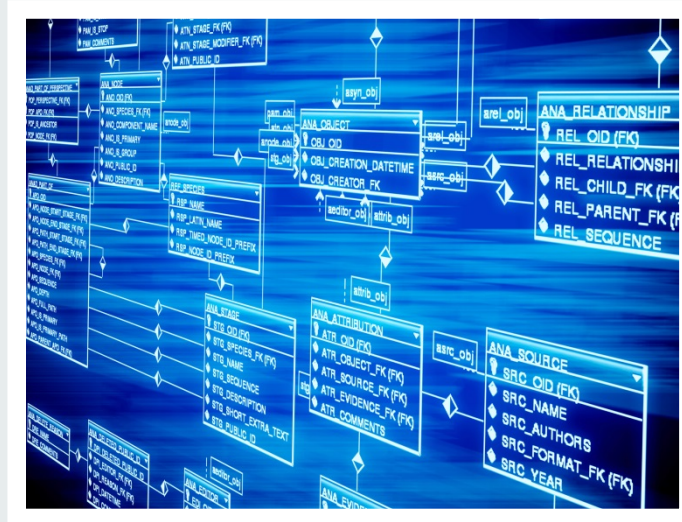# HPMS Data Reporting Requirements

Lesson 1: Sections & Sample Panel ID File Structure

Lesson 2: Pavement Data Items & TPM PM2 Rule-related Modifications

Lesson 3: Special Networks Data Items

Lesson One

Sections and Sample Panel Identification File Structures

Sections Dataset File Structure

	Field Number	Field Name
	1	Year_Record
	2	State_Code
	3	Route_ID
	4	Begin_Point
	5	End_Point
Section	6	Data_Item
	7	Section_Length
	8	*Value_Numeric*
	9	*Value_Text*
	10	*Value_Date*
	11	Comments (optional)

- Used to report the State's roadway attribute data (at most, 70 data items)
- Contains 11 data fields
  - 7 required fields
  - 3 item-dependent fields
  - 1 optional field
- Data Types
  - Numeric
  - Text
  - Date

Inventory Data Items

- **Functional System**
- *Urban Code*
- **Facility Type**
- Structure Type
- Access Control
- **Ownership**
- *Through Lanes*
- Managed Lane Operations Type
- Managed Lanes

- Peak Lanes
- Counter-peak Lanes
- Right Turn Lanes
- Left Turn Lanes
- Speed Limit
- Toll Charged
- Toll Type
- *County Code*
- Maintenance & Operations
- **Directional Through Lanes**

*Data Items shown in **blue bold** are required to be reported for all public roads.*
Data Items shown in magenta italics are required to be reported for all Federal-aid roads
*Data Items shown in **bold** are used will be used for TPM PM2 rule analysis*

Route & Traffic Data Items

- Route Number
- Route Signing
- Route Qualifier
- Alternative Route Name
- *Annual Average Daily Travel (AADT)*
- Single-unit Truck & Bus AADT
- Percent Peak Single-unit Trucks & Buses
- Combination Truck AADT

- Percent Peak Combination Trucks
- K-factor
- Directional Factor
- Future AADT
- Signal Type
- Percent Green Time
- No. of Signalized, Stop Sign, Type-Other Intersections
- Capacity

Data Items shown in magenta italics are required to be reported for all Federal-aid roads

Geometric Data Items

- Lane Width
- Median Type
- Median Width
- Shoulder Type
- Right Shoulder Width
- Left Shoulder Width
- Peak Parking

- Widening Obstacles
- Widening Potential
- Curve Classification
- Terrain Type
- Grade Classification
- Percent Passing Sight Distance

Pavement Data Items

- **International Roughness Index (IRI)**
- **Present Serviceability Rating (PSR)**
- **Surface Type**
- **Rutting**
- **Faulting**
- **Cracking Percent**

- Year of Last Improvement
- Year of Last Construction
- Last Overlay Thickness
- Thickness Rigid
- Thickness Flexible
- Base Type
- Base Thickness
- Climate Zone
- Soil Type

*Data Items shown in **bold** are used will be used for TPM PM2 rule analysis*

Example Sections Dataset

```
Year_Record|State_Code|Route_ID|Begin_Point|End_Point|Data_Item|Section_Length|Value_Numeric|Value_Text|Value_Date|Comments
2009|41|000100200S00|0|0.75|AADT|0.75|14800|Factored '06 AADT||
2009|41|000100200S00|0.75|5.32|AADT|4.57|14700||4/2009|Est. AADT
2009|41|000100200S00|0|0.10|IRI|0.10|118||3/2009|
2009|41|000100200S00|0.10|0.20|IRI|0.10|94||5/2008|
2009|41|000100200S00|0.20|0.30|IRI|0.10|66||4/2008|
2009|41|000100200S00|0|0.75|Through_Lanes|0.75|4|||
2009|41|000100200S00|0.75|5.32|Through_Lanes|4.57|4|||Widened in '08
```

Sample Panel Identification Dataset File Structure

	Field Number	Field Name
Sample Panel Section	1	Year_Record
	2	State_Code
	3	Route_ID
	4	Begin_Point
	5	End_Point
	6	Section_Length
	7	Sample_ID

- Used to report the location of the State's sample sections
- Contains 7 data fields
- Data Types
  - Numeric
  - Text

Sample Panel ID Dataset

```
Year_Record|State_Code|Route_ID|Begin_Point|End_Point|Section_Length|Sample_ID
2009|41|000100200S00|0|0.75|0.75|111
2009|41|000100200S00|.75|5.32|4.57|112
2009|41|000100200S00|0|0.75|0.75|113
2009|41|000100200S00|0.75|5.32|4.57|114
2009|41|000100200S00|5.32|5.69|0.37|115
2009|41|000100200S00|0|0.75|0.75|116
2009|41|000100200S00|.75|5.32|4.57|117
```
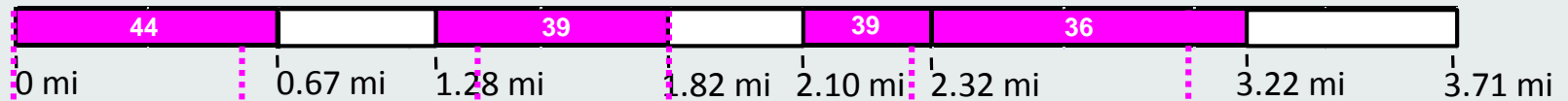
TOPS Development Process
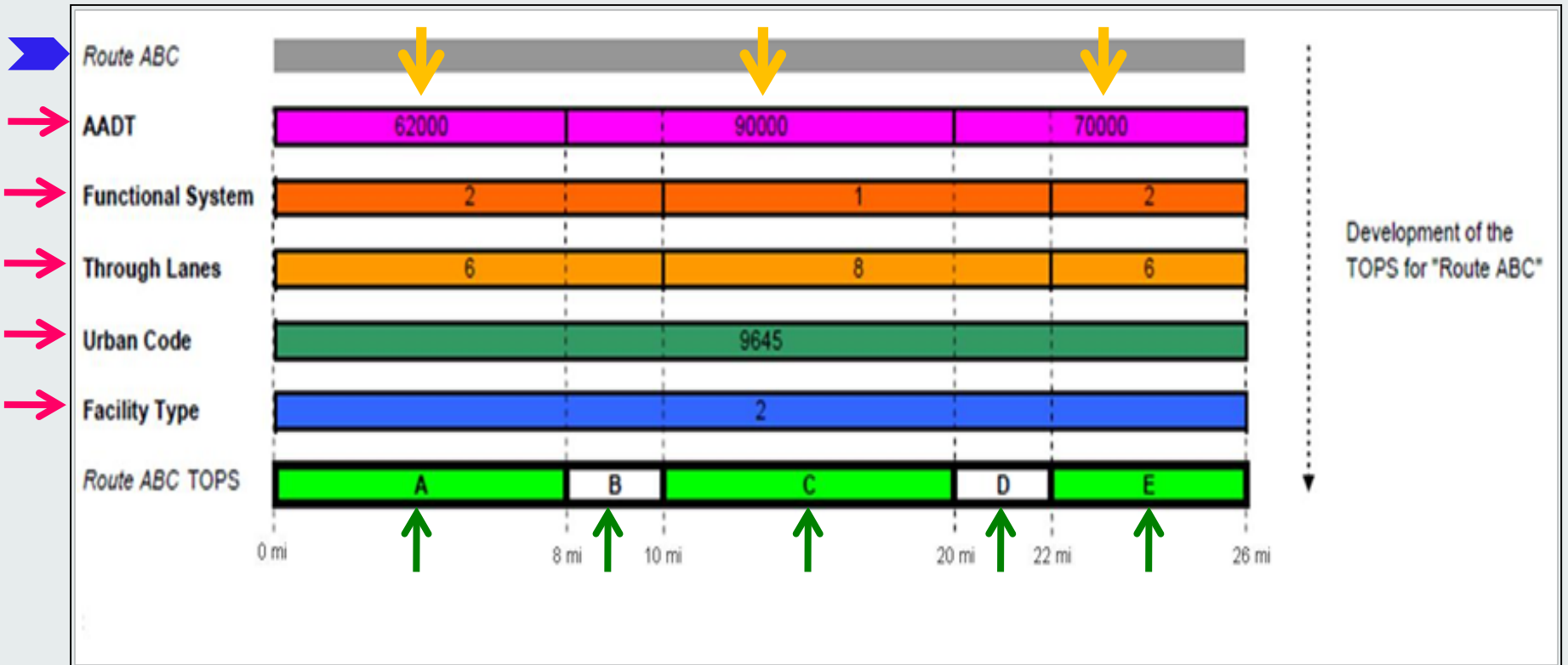
Sections and Sample Panel ID Datasets - Relationship
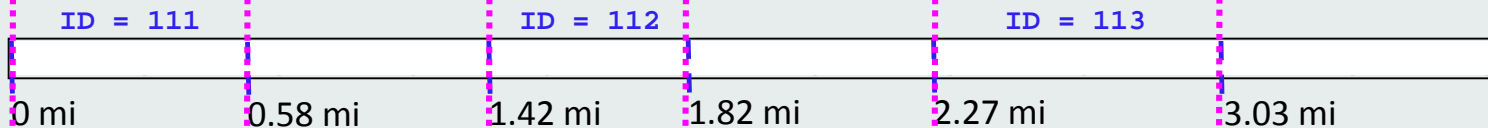
- **Sections Data**

```
2009|41|000100200S00|0|0.67|Pct_Green_Time|0.67|44|||
2009|41|000100200S00|1.28|1.82|Pct_Green_Time|0.54|39|||
2009|41|000100200S00|2.10|2.32|Pct_Green_Time|0.22|39|||
2009|41|000100200S00|2.32|3.22|Pct_Green_Time|0.90|36|||
```

| 44 | 39 | 39 | 36 |

0 mi   0.67 mi   1.28 mi   1.82 mi   2.10 mi   2.32 mi   3.22 mi   3.71 mi

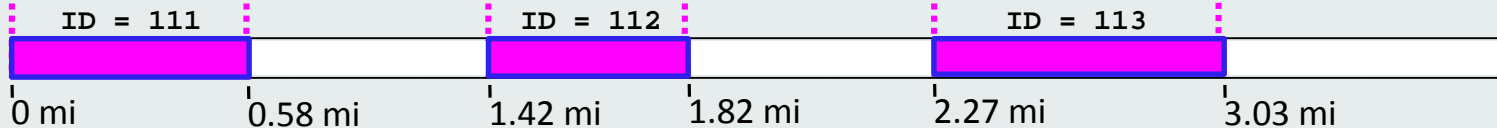- **Sample Panel ID Data**

```
2009|41|000100200S00|0|0.58|0.58|111
2009|41|000100200S00|1.42|1.82|0.40|112
2009|41|000100200S00|2.27|3.03|0.76|113
```

ID = 111   ID = 112   ID = 113

0 mi   0.58 mi   1.42 mi   1.82 mi   2.27 mi   3.03 mi

- **Sample Sections**

ID = 111   ID = 112   ID = 113

0 mi   0.58 mi   1.42 mi   1.82 mi   2.27 mi   3.03 mi

13

Data Aggregation/Calculation

- In most cases, Sections data can be reported for any given extent

- FHWA applies business rules to Sections data for sample data purposes

- Business rules are used to calculate roadway section-specific values for each applicable data item

Data Aggregation Rules and Calculation Methods

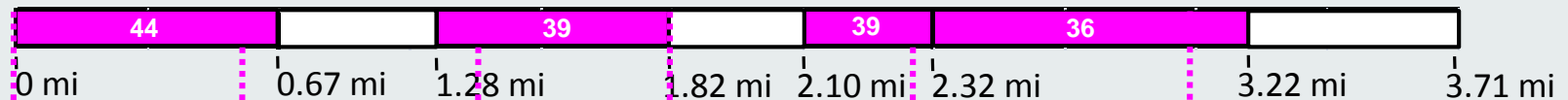| Item Number	Data Item	Method
1	**F_System ***	No Calculation Required
2	**Urban_Code ***	No Calculation Required
3	**Facility_Type ***	No Calculation Required
4	Structure_Type	No Calculation Required
5	Access_Control	Predominance
6	Ownershp	Predominance
7	**Through_Lanes ***	No Calculation Required
8	HOV_Type	Predominance
9	HOV_Lanes ***	Predominance
10	Peak_Lanes	Predominance
11	Counter_Peak_Lanes	Predominance
12	Turn_Lanes_R	Predominance
13	Turn_Lanes_L	Predominance
14	Speed_Limit	Predominance
15	Toll_Charged	Predominance
16	Toll_Type	Predominance
17	Route_Number	Predominance
18	Route_Signing	Predominance
19	Route_Qualifier	Predominance
20	Alternative_Route_Name	Predominance
21	**AADT ***	No Calculation Required#
22	AADT_Single_Unit	Weighted Averaging
23	Pct_ Peak_ Single	Weighted Averaging

- Combination

- Minimum Value

- Predominance

- Weighted Averaging

15

Aggregating/Calculating Sample Section Values

- ## Sections Data

```
2009|41|000100200S00|0|0.67|Pct_Green_Time|0.67|44|||
2009|41|000100200S00|1.28|1.82|Pct_Green_Time|0.54|39|||
2009|41|000100200S00|2.10|2.32|Pct_Green_Time|0.22|39|||
2009|41|000100200S00|2.32|3.22|Pct_Green_Time|0.90|36|||
```
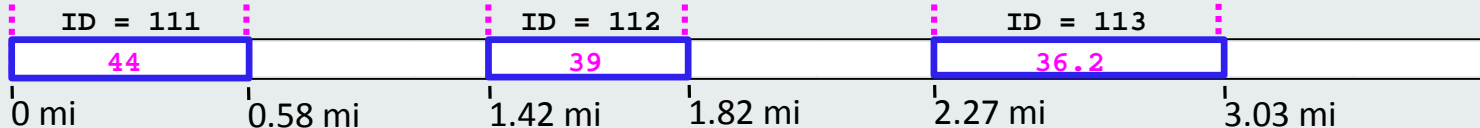
44		39		39	36	

0 mi   0.67 mi   1.28 mi   1.82 mi   2.10 mi   2.32 mi   3.22 mi   3.71 mi

- ## Sample Panel ID Data

```
2009|41|000100200S00|0|0.58|0.58|111
2009|41|000100200S00|1.42|1.82|0.40|112
2009|41|000100200S00|2.27|3.03|0.76|113
```

ID = 111   ID = 112   ID = 113

0 mi   0.58 mi   1.42 mi   1.82 mi   2.27 mi   3.03 mi

- ## Sample Sections

ID = 111   ID = 112   ID = 113

44		39		36.2	

0 mi   0.58 mi   1.42 mi   1.82 mi   2.27 mi   3.03 mi
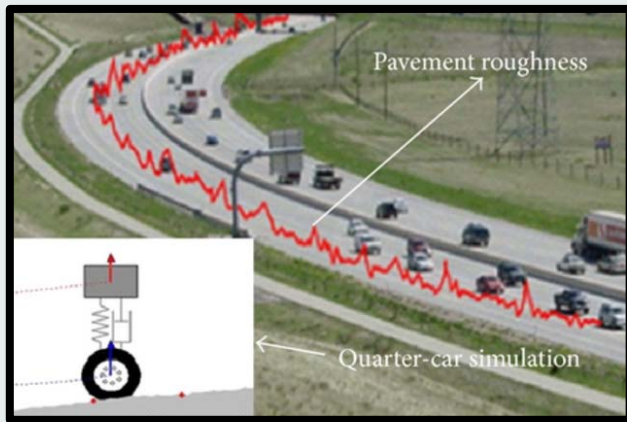
Questions???

Lesson Two

Pavement Data Items & TPM PM2 Rule-related Modifications

Lesson Topics

- Pavement Distress Items
- Data Collection and Reporting Cycles
- Special Data Reporting Guidance
- Coding Scenarios
- Directional Reporting Options

Pavement Data & Distress Items

Pavement roughness

Quarter-car simulation

IRI (International Roughness Index):

- Road roughness measurement
- Required for **all surface types**
- Reported in inches/mile

PSR (Pavement Serviceability Rating):

- Visual inspection-based pavement condition rating
- Can be reported in lieu of IRI
- Reported/coded on scale of 0 (poor) to 5 (very good, in units of tenths (e.g., 4.2)

Pavement Data & Distress Items (cont'd)

Rutting :

- Longitudinal surface depressions in asphalt pavement

- Required for **asphalt** pavements

- Reported as the average depth of ruts on a section to the nearest 0.01 inch

Faulting :

- Vertical misalignment of joints in Jointed Concrete Pavement

- Req. for **jointed-concrete** pavements

- Reported as average/mean absolute faulting to the nearest 0.01 inch

Pavement Data & Distress Items (cont'd)

Cracking Percent :

- Percentage of pavement surface exhibiting cracking
- Required for **all surface types**
- Reported as percent of section area or slabs to the nearest 1%

Surface Type:

- One of 11 FHWA surface type codes determined from visual inspection or construction records
- Preservation treatments of < 0.5 in. compacted material shall be excluded surface type determination

Pavement Data Item Requirements by Surface Type

Reference: HPMS Field Manual - Table 4.5

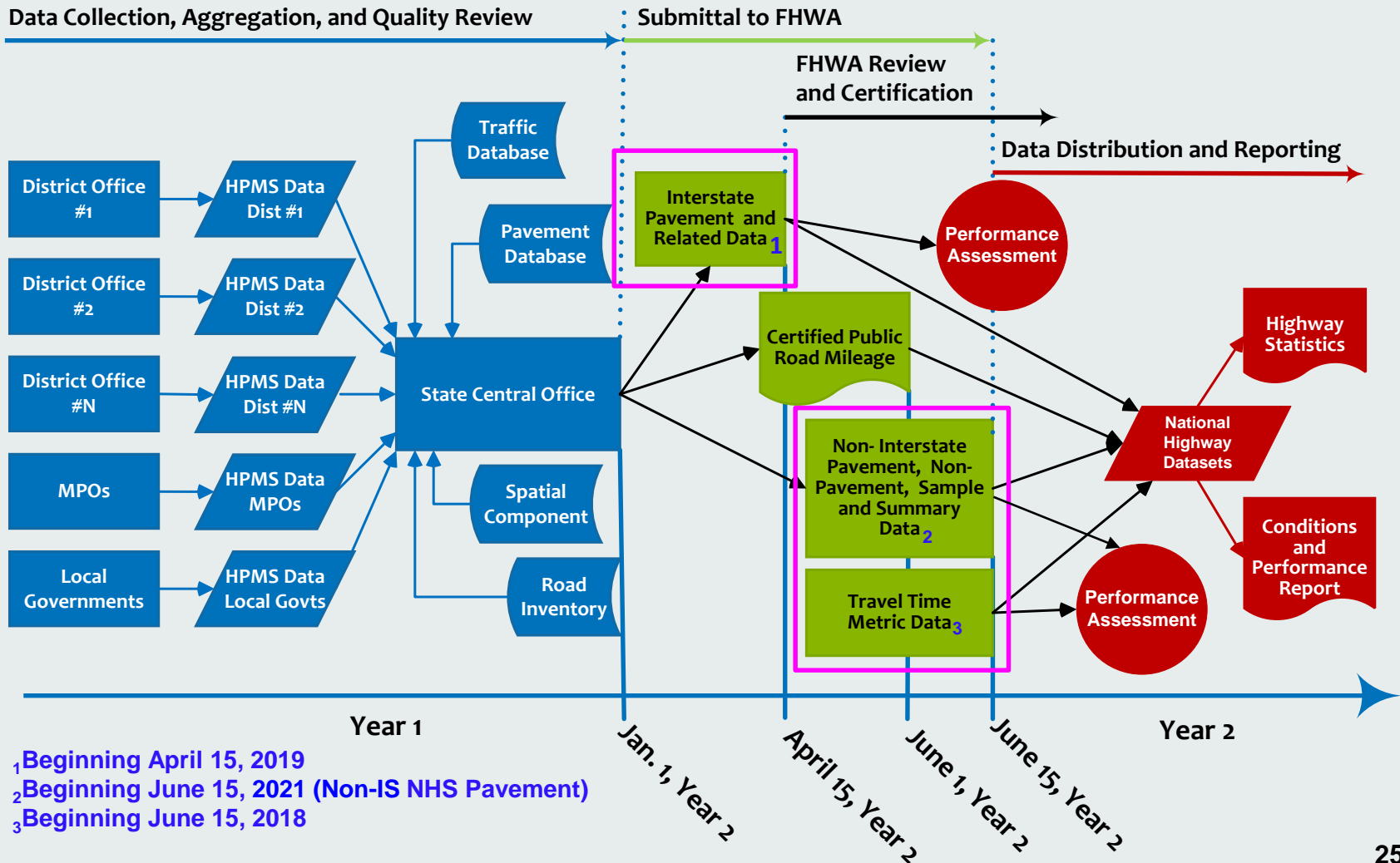| Code	IRI	PSR	Rutting	Faulting	Cracking Percent	Thickness Rigid	Thickness Flexible
1 - Unpaved							
2 - Bituminous	in/mi	0.1-5.0	0.01"		Fatigue % area		0.5"
3 - JPCP (includes whitetopping)	in/mi	0.1-5.0		0.01"	% cracked slabs	0.5"	0.5" include for white-topping only
4 - JRCP (includes whitetopping)	in/mi	0.1-5.0		0.01"	% cracked slabs	0.5"	0.5" include for white-topping only
5 - CRCP	in/mi	0.1-5.0			Punchout/long. /patch % area	0.5"	
6 - Composite (AC / AC)	in/mi	0.1-5.0	0.01"		Fatigue % area		0.5"
7 - Composite (AC / JCP)	in/mi	0.1-5.0	0.01"		Fatigue % area	0.5"	0.5"
8 - Composite (Bituminous / CRCP)	in/mi	0.1-5.0	0.01"		Fatigue % area	0.5"	0.5"
9 - Composite (Unbonded JC / PCC)	in/mi	0.1-5.0		0.01"	% cracked slabs	0.5"	
10 - Composite (Bonded JC / PCC)	in/mi	0.1-5.0		0.01"	% cracked slabs	0.5"	
11 - Other (e.g., brick, cobblestone, etc.)	in/mi	0.1-5.0					

2017 Pavement & Bridge Condition Rule (PM2)-related Modifications

Data Item	Roadway System	Pre-PM2			Post-PM2		
		Extent	Collection Cycle	Direction	Extent	Collection Cycle	Direction
IRI	Interstate (IS)	Full Extent	Annual	Inventory	Full Extent	Annual	Inventory*
	Non-IS NHS	Full Extent	Annual	Inventory	Full Extent	Biennial	Inventory
Surface Type	Interstate (IS)	Sample	Biennial	Inventory	Full Extent	Annual	Inventory*
	Non-IS NHS	Sample	Biennial	Inventory	Full Extent	Biennial	Inventory
Rutting	Interstate (IS)	Sample	Biennial	Inventory	Full Extent	Annual	Inventory*
	Non-IS NHS	Sample	Biennial	Inventory	Full Extent	Biennial	Inventory
Faulting	Interstate (IS)	Sample	Biennial	Inventory	Full Extent	Annual	Inventory*
	Non-IS NHS	Sample	Biennial	Inventory	Full Extent	Biennial	Inventory
Cracking Percent	Interstate (IS)	Sample	Biennial	Inventory	Full Extent	Annual	Inventory*
	Non-IS NHS	Sample	Biennial	Inventory	Full Extent	Biennial	Inventory

*States can opt to report distress data independently for divided Interstate highway sections

24

HPMS Workflow / Timeline

Pavement Data Collection/Reporting Guidance

- Collect in the rightmost through lane or one consistent lane

- Collect and report in **uniform** section lengths of 0.1 mi. (528 ft.); sections <u>shall not exceed 0.11 mi.</u>

- PSR, Rutting, Faulting, Cracking shall be collected for milepoint limits (i.e., sections) that are consistent with those reported for IRI

Pavement Data Collection/Reporting Guidance (cont'd)

- The following codes must be used to specify why data could not be collected on an <u>NHS section</u>

  - **A**: Construction - Roadway under construction

  - **B**: Closure - Roadway closed to traffic

  - **C**: Disaster - Roadway is in area declared as a disaster zone

  - **D**: Deterioration - Roadway too deteriorated to measure and already rated "poor"

  - **E**: Other – E.g. section added to NHS post data collection

Pavement Data Collection/Reporting Guidance (cont'd)

- Report existing values until they can be replaced by newly measured values

- Use Value Text field (Field 9) to indicate why measured value has not been reported for NHS sections

- An estimated date can be provided when exact collection date is unavailable

Data Item 47 (IRI): Coding

Pertinent Fields to be Coded:

- Field 6 = Data Item ("**IRI**")

- Field 8 = Value Numeric (e.g. '**94**')

- Field 9 = Not required

- Field 10 = Value Date (e.g. "**10/2016**")

Example Record:

2017|41|123A|0|0.10|**IRI**|0.10|**94**|-----|**10/2016**|-----

Data Item 47 (IRI): Coding (cont'd)

Pertinent Fields to be Coded:

- Field 6 = Data Item ("**IRI**")

- Field 8 = Value Numeric

- Field 9 = Value Text ("**A**", for Construction)

- Field 10 = Value Date

Example Record:

*2018|41|123A|0|0.10|IRI|0.10|94|A|5/2017|-----

*Indicates an NHS section where IRI was not collected in 2018

Data Item 48 (PSR): Coding

- **For NHS sections where posted speed limit is less than 40 mph,** measured PSR can be reported

- Use Value Text Field code of "**A**" to indicate that Speed Limit is below 40 if PSR is reported for NHS sections

Data Item 48 (PSR): Coding (for NHS)

Pertinent Fields to be Coded:

- Field 6 = Data Item ("**PSR**")

- Field 8 = Value Numeric (e.g. '**3.5**')

- Field 9 = Value Text ("**A**", for speed <40 mph)

- Field 10 = Value Date (e.g. "**10/2016**")

Example Record:

2017|41|123A|0|0.10|**PSR**|0.10|**3.5**|**A**|**10/2016**|-----

Directional Pavement Metrics Reporting Options

- If pavement data/distresses (i.e. IRI, PSR, Surface Type, Rutting, Faulting, Cracking Percent) is being reported independently for both directions of travel on **divided Interstate roadways**, then the following data items <u>shall be reported</u> in the same manner:
    - o Urban Code
    - o Structure Type
    - o Route Number
    - o Directional Through Lanes

Directional Reporting Option
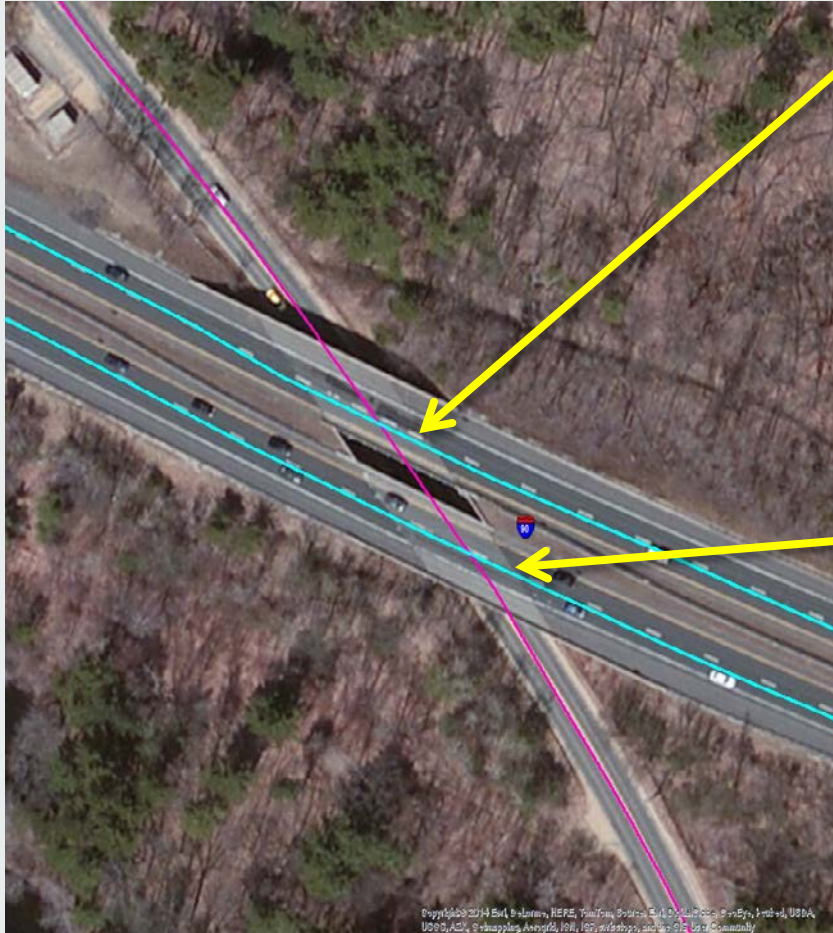
Interstate 90 (I-90) West
- Functional System, Facility Type, Ownership, NHS
- **IRI/PSR, Rutting, Faulting, Cracking Pct.**
- **Urban Code, Structure Type, Route Number, Directional Through Lanes**

Interstate 90 (I-90) East
- Functional System, Facility Type, Ownership, NHS
- **IRI/PSR, Rutting, Faulting, Cracking Pct.**
- **Urban Code, Structure Type, Route Number, Directional Through Lanes**

Inventory Direction Reporting

Interstate 90 (I-90) West
- Functional System, Facility Type, Ownership, NHS

Interstate 90 (I-90) East
- Functional System, Facility Type, Ownership, NHS
- **IRI/PSR, Rutting, Faulting, Cracking Pct.**
- **Urban Code, Structure Type, Route Number, Directional Through Lanes**

Questions???

Data Collection/Reporting Guidance (cont'd)

For IRI purposes:

- Report the average of right and left quarter-car IRI Mean Roughness Index (MRI)

- **Include structures and railroad crossings in measurement**