HPMS and TPM – Part 4: System Performance, Freight, and CMAQ (PM3)

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Agenda

- PM3 Rulemaking
- Introduction to the National Performance Management Research Data Set (NPMRDS)
  - HPMS Attribute Conflation
- PM3 Travel Time-Based Measures – brief description metrics and measures
  - Required metric reporting to HPMS

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PM3 Rulemaking

- Effective Date: May 20, 1017

- Targets set by State DOTs by May 20, 2018

- Annual metric calculation and reporting due to FHWA June 15th (beginning with baseline metrics June 15, 2018)

- Baseline Performance Report due October 1, 2018

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Final Measures: System Performance and Freight

Measure Area	Performance Measures
Performance of the National Highway System (Subpart E)	• **Interstate Travel Time Reliability Measure**: Percent of person-miles traveled on the Interstate that are reliable • **Non-Interstate Travel Time Reliability Measure**: Percent of person-miles traveled on the non-Interstate NHS that are reliable
Freight Movement on the Interstate System (Subpart F)	• **Freight Reliability Measure**: Truck Travel Time Reliability (TTTR) Index

Note: These measures contribute to assessing the National Highway Performance Program (NHPP) and National Highway Freight Program (NHFP)

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Final Measures: CMAQ Program

Measure Area	Performance Measures
Measures to Assess the CMAQ Program – Traffic Congestion (Subpart G)	• **Peak Hour Excessive Delay(PHED) Measure**: Annual Hours of Peak Hour Excessive Delay (PHED) Per Capita • **Non-Single Occupancy Vehicle Travel (SOV) Measure:** Percent of Non-Single Occupancy Vehicle (SOV) Travel
Measure to Assess the CMAQ Program – On-Road Mobile Source Emissions (Subpart H)	• **Emissions Measure:** Total Emissions Reduction

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National Performance Management Research Data Set (NPMRDS)

- The NPMRDS is the source of travel time data for the travel time-based measures in PM3
  - All vehicle average travel times and
  - Freight vehicle travel times
- Average travel times are reported every 5 minutes when data is available on all NHS roadways
  - PM3 measures all use 15 minute average travel times
- State DOTs and MPOs can request use of equivalent data set as well
  - Must request by October 1 of the year prior
  - Has different metric reporting requirements

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NPMRDS v1

- Ended with January 2017 data submittal
- Nearly 250 licenses (around 200 agencies) for NPMRDS v1
  - Free to use for State DOTs, MPOs and their contractors for performance management activities
  - Used for myriad analyses, performance measures, reports, research efforts, etc.

FHWA's Urban

Congestion Report

CONGESTED HOURS	TRAVEL TIME INDEX	PLANNING TIME INDEX
4:50 (2015) → 4:54 (2016)	1.35 (2015) → 1.36 (2016)	2.72 (2015) → 2.65 (2016)
+4 minutes	+1 points	-7 points
Average duration of daily congestion	Peak period vs. off-peak travel times	Unreliability (variability) of travel

Performance measures have been updated using the most recently available (2013) national volumes.

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NPMRDS v2

Major Changes from v1:

1. Conflation Services –for HPMS Attributes over to the TMC network

2. Data Density indicator

3. More complete data – path processing

4. Epochs filled with nulls (makes data management a little easier for some)

5. Inner/outer TMC segments provided

6. Improved data portal

7. Faster Availability

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Data Density Indicator

- Each Average Travel Time reported will have an indicator

  - = 5 minute period, TMC, Vehicle Type

  - Values:

    - A = 1 to 4 reporting vehicles

    - B = 5 to 9 reporting vehicles

    - C = 10 or more reporting vehicles

- Key point – indicator is just that, not an actual number

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Path Processing

- Helps with completeness of data set
- Especially helpful on arterials
- Takes multiple observations from a probe and spreads them over a "trip"
  - Assigns travel times to all TMCs covered during "trip"
  - Reduces impacts of traffic signals on reported travel times

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Massive Data Downloader

Network & Data Completeness
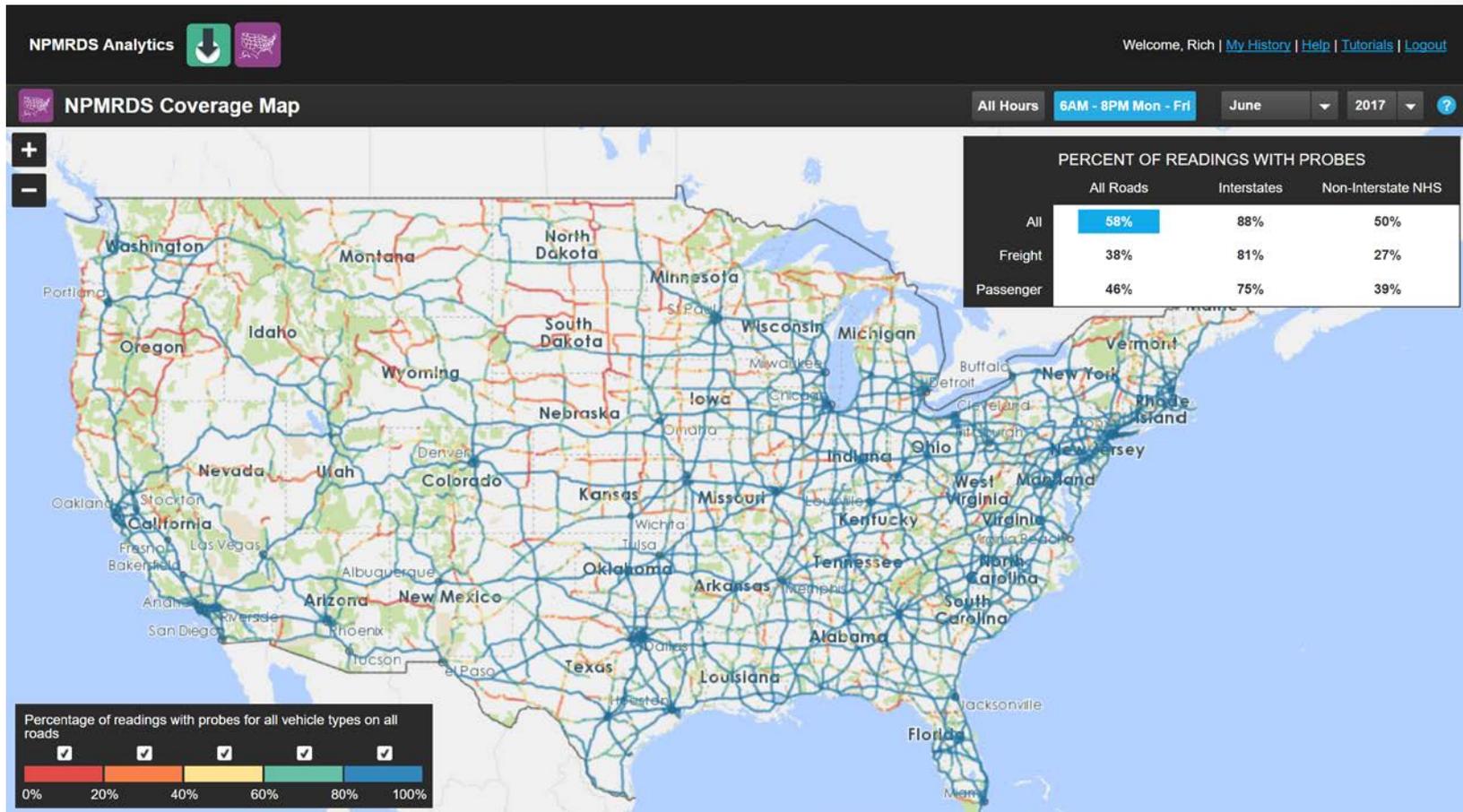
NPMRDS Information

- FAQs
  - https://npmrds.ritis.org/analytics/help/#npmrds
- RITIS NPMRDS Massive Data Downloader Tutorials
  - https://npmrds.ritis.org/analytics/tutorials/?video=5
- Helpdesk Support:
  - npmrds@ritis.org

NPMRDS: v1 versus v2

	V1 (2011 – 1/31/2017)	V2 (2/1/2017 –)
Data Vendor	HERE	UMD-INRIX-TTI
Temporal	5-minute	5-, 10-, 15-, 60-minute
Epoch w/o obs.	Not included in the file	Included, but empty (null)
TMC Path	Combined TMCs	Internal/External TMCs
Path Processing	No	Yes
GIS Shapefile	HERE LinkID TMC Look Up Table	TMC path 14 HPMS Data Attributes
Data Download	Multi-States/US; large files	Flexible, Customized selection

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TMC Attributes

No.	TMC Original	No.	Conflated HPMS
1	datasource	18	border_set
2	tmc	19	f_system
3	road	20	urban_code
4	direction	21	faciltype
5	intersection	22	structype
6	state	23	thrulanes
7	county	24	route_numb
8	zip	25	route_sign
9	start_latitude	26	route_qual
10	start_longitude	27	altrtename
11	end_latitude	28	aadt
12	end_longitude	29	aadt_singl
13	miles	30	aadt_combi
14	road_order	31	nhs
15	timezone_name	32	nhs_pct
16	tmclinear	33	strhnt_typ
17	frc	34	strhnt_pct
		35	truck

TMC Original Variables: 1-12

Attribute Label	Attribute Description
datasource	The data set this record comes from. This field is only included in Massive Data Downloader exports when choosing to merge the data sets into a single CSV file.
tmc	The unique 9-digit value identifying the TMC Segment.
road	The roadway number, for TMC Segments on numbered roadways.
direction	the route number or common name of the roadway
intersection	the cross street and/or interchange associated with the TMC segment
state	the postal abbreviation of the state to which the TMC Segment is assigned
county	County name
zip	Zip code
start_latitude	the latitude of the beginning of the TMC segment
start_longitude	the longitude of the beginning of the TMC segment
end_latitude	the latitude of the end of the TMC segment
end_longitude	the longitude of the end of the TMC segment

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TMC Original Variables: 13-17

Attribute Label	Attribute Description
miles	the length of the TMC segment
road_order	a numerical value indicating in what order the TMC segment would be encountered when traveling downstream relative to the other TMC segments on the same road
Timezone_name	Local time zone name
tmclinear	a reference to the "Linear TMC" that includes the TMC Segment. Typically, several TMC Segments are part of a Linear TMC, which usually represents a road corridor through a single county. The purpose of this column is to provide assistance for filtering and locating TMC Segments and simplifying the process of linking consecutive TMC Segments.
frc	the class or group of roads to which the road belongs (assigned by TMC Consortium)

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Conflated HPMS Variables: 18-20

Attribute Label	Attribute Description
Border_set	a code to indicate whether the TMC path is within a 5-mile radius of the FHWA-designated US-Canada and US-Mexico border crossings (Y=Yes, N=No)
F_system	The FHWA-approved Functional Classification System code. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the value for the highest functional class (minimum code value) is assigned. 1. Interstate 2. Principal Arterial – Other Freeways and Expressways 3. Principal Arterial – Other 4. Minor Arterial 5. Major Collector 6. Minor Collector 7. Local
urban_code	The U.S. Census Urban Area Code. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned. < 999998 — The US Census Urban Area code 99998 — Small Urban Sections 99999 — Rural Area Sections

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Conflated HPMS Variables: 21-23

Attribute Label	Attribute Description

faciltype	The operational characteristic of the roadway. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned.
	    1. One-Way Roadway
	    2. Two-Way Roadway
	    3. Ramp
	    4. Non Mainline
	    5. Non Inventory Direction
	    6. Planned/Unbuilt

structype	Code for roadway section that is a bridge, tunnel or causeway. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned.
	    1. Bridge
	    2. Tunnel
	    3. Causeway

thrulanes	The number of lanes designated for through-traffic in BOTH TRAVEL DIRECTIONS. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned.

Conflated HPMS Variables: 24-30

Attribute Label	Attribute Description
route_numb	The signed route number. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned.
route_sign	Code for the type of route signing. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned.
route_qual	Code for the route signing descriptive qualifier. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned.
altrtename	A familiar, non-numeric designation for a route. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned.
aadt	Annual Average Daily Traffic. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the length-weighted average is assigned.
aadt_single	Annual Average Daily Traffic for single-unit trucks and buses. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the length-weighted average is assigned.
addt_combi	Annual Average Daily Traffic for Combination Trucks. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the length-weighted average is assigned.

Conflated HPMS Variables: 31-35

Attribute Label	Attribute Description
nhs	Code for a roadway that is a component of the National Highway System (NHS). If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant "on-NHS" value (i.e., 1 through 9) by length is assigned.
nhs_pct	The percentage of the TMC path length that is designated as NHS by HPMS (applicable when multiple HPMS segments assigned to a single TMC path).
strhnt_typ	Code for a roadway section that is a component of the Strategic Highway Network (STRAHNET). If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned.
strhnt_pct	The percentage of the TMC path length that is designated as STRAHNET by HPMS (applicable when multiple HPMS segments assigned to a single TMC path). This attribute value is calculated by the NPMRDS Development Team and is not an HPMS attribute.
truck	Code for a roadway section that is a component of the National Truck Network (NTN) as defined by 23 CFR 658. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned

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Using Linear Reference System (LRS) to Link NPMRDS TMC and HPMS

Table 4.1: HPMS Sections 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)

Italicized fields are used to report values and additional information pertaining to the data item (in Field 6).

year_record	state_code	route_id	begin_point	end_point	data_item	section_length	value_numeric	value_text	value_date	comments
2015	37	1000002610	28.574	29.167	TMC	0.593	0	125-05197		
2015	37	1000002610	25.3522	28.0122	TMC	2.66	0	125-05198		
2015	37	1000002610	20.7391	24.8473	TMC	4.1082	0	125-05199		
2015	37	1000002610	19.2246	20.5218	TMC	1.2972	0	125-05200		
2015	37	1000002610	0	0.3336	TMC	0.3336	0	125-10243		
2015	37	1000002610	28.0122	28.244	TMC	0.2318	0	125N05198		
2015	37	1000002610	24.8472	25.3522	TMC	0.505	0	125N05199		
2015	37	1000002610	20.5218	20.7391	TMC	0.2173	0	125N05200		

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Metric Reporting

- Metric calculations, including related data, to be reported to HPMS by June 15th of each year
- Metric reporting done by NPMRDS TMC code/reporting segment
  - No requirement to tie to HPMS LRS unless using equivalent data set
  - FHWA does measure calculation and provides that to State DOTs and MPOs for their October 1st reports (Baseline, Biennial Performance reports)
- Details will be provided in an HPMS Supplemental Guidance document
  - Currently under review, not yet public

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§ 490.511 Level of Travel Time Reliability (LOTTR) <u>Metric</u> (Example)

$$\frac{\text{Longer Travel Time (80th)}}{\text{Normal Travel Time (50th)}} = \frac{\text{\# seconds}}{\text{\# seconds}} = \text{Level of Travel Time Reliability Ratio}$$

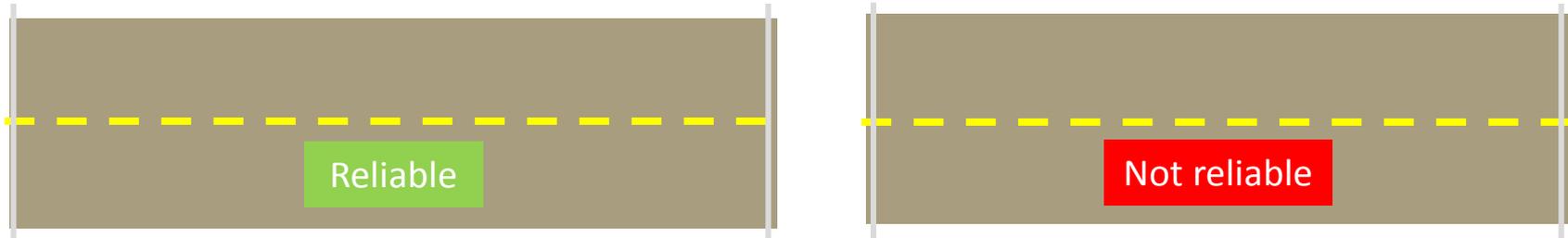| **Level of Travel Time Reliability (LOTTR)** *(Single Segment, Interstate Highway System)*		
Monday – Friday	6am – 10am	LOTTR = $\frac{44 \text{ sec}}{35 \text{ sec}}$ = 1.26
	10am – 4pm	LOTTR = 1.39
	4pm – 8pm	LOTTR = 1.54
Weekends	6am – 8pm	LOTTR = 1.31
Must exhibit LOTTR below 1.50 during **all** of the time periods		**Segment is not reliable**

HPMS Submittal: *Starting in 2018, State DOTs report LOTTR metrics and the corresponding 80th and 50th percentile times for each time period and directional AADT for each reporting segment by June 15 of each year, for the previous year's measures*

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§ 490.513 Calculating Travel Time Reliability <u>Measures</u> (Example)

	Reliable	Not reliable
Length	1.000 mi.	0.750 mi.
	x	x
Annual Traffic Volume	2,000,000	3,500,000
	x	x
Occupancy Factor	1.3 persons/vehicle	1.7 persons/vehicle
Segment Total	Reliable: 2,600,000 person-miles	Unreliable: 4,462,500 person-miles

$$\frac{\Sigma \text{ (Reliable person–miles)}}{\Sigma \text{ (Total person–miles)}}$$

Measure: % of person-miles reliable, for full extent of the system

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§ 490.611 Freight Reliability <u>Metric</u> (Example)

$$\frac{\text{Longer Truck Travel Time (95th)}}{\text{Normal Truck Travel Time (50th)}} = \frac{\text{\# seconds}}{\text{\# seconds}} = \text{Truck Travel Time Reliability (TTTR) Ratio}$$

Truck Travel Time Reliability (TTTR) (Single Segment, Interstate Highway System)		
Monday – Friday	6am – 10am	$\text{TTTR} = \dfrac{72 \text{ sec}}{50 \text{ sec}} = 1.44$
	10am – 4pm	TTTR = 1.39
	4pm – 8pm	TTTR = **1.49**
Weekends	6am – 8pm	TTTR = 1.31
Overnight	8pm – 6am	TTTR = 1.20
Maximum TTTR		**1.49**

HPMS Submittal: *Starting in 2018, State DOTs report TTTR metrics and the corresponding 95[h] and 50th percentile times for each time period and each reporting segment by June 15 of each year, for the previous year's measures*

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§ 490.613 Calculating Freight Reliability <u>Measure</u> (Example)

$$\text{TTTR Index} = \frac{\sum \text{All segment length weighted TTTR}}{\sum \text{All serment lengths}}$$

Segment length (mi.)	0.500	0.500	1.000	1.000	5.000

	x	x	x	x	x
MaxTTTR	1.49	1.59	1.50	1.41	1.36
	=	=	=	=	=
Length-weighted TTTR	0.75	0.80	1.50	1.41	6.80

$$\text{TTTR Index} = \frac{11.25}{8.000 \text{ mi}} = \mathbf{1.41}$$

Measure: TTTR Index, full extent of the Interstate system

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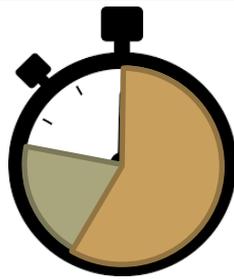# § 490.711 PHED <u>Metric</u> (Example)

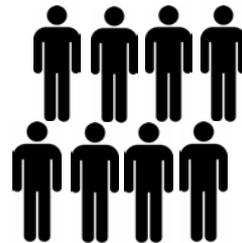**0.500 Mile Reporting Segment**

Average of 105 seconds for a 15-min. segment per vehicle

Excessive Delay Threshold: **90 seconds**

105 - 90 = **15 seconds**

500,000 people traveling during **peak hours** (per mode)

For all **peak periods** in a full calendar year

= 863.025 person-hours

Travel Time → *Threshold Travel Time* → *Travel Time Segment Delay* → *Total Excessive Delay**

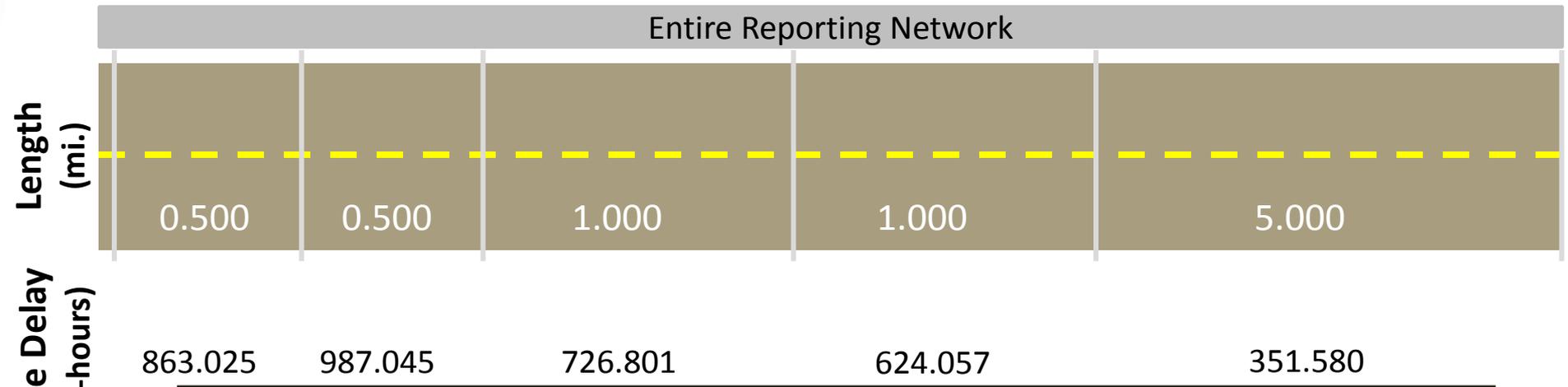***HPMS Submittal:*** *Starting in 2018, State DOTs report PHED metric for each reporting segment by June 15 of each year, for the previous year's measures*

§ 490.713 Calculating PHED <u>Measure</u> (Example)

Entire Reporting Network				

Length (mi.)

0.500	0.500	1.000	1.000	5.000

Excessive Delay (person-hours)

863.025	987.045	726.801	624.057	351.580

$$\frac{\text{4.46M person-hours excessive delay}}{\text{1.05M urbanized area population}}$$

= 4.3 hours per capita

Measure: Peak hour excessive delay per capita

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For More Information

- Contact:
  - Rich Taylor, FHWA Office of Operations
    - E-mail: rich.taylor@dot.gov
- Operations Performance Measures and Management Website:
  - https://ops.fhwa.dot.gov/perf_measurement/index.htm
- FHWA Transportation Performance Management (TPM) Website:
  - https://www.fhwa.dot.gov/tpm/

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