FHWA Computation Procedure for the Pavement Condition Measures

FHWA-HIF-18-022

U.S. Department of Transportation
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Office of Infrastructure and
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The FHWA Computation Procedure for the Pavement Condition Measures presents the steps for Federal Highway Administration (FHWA) to compute pavement condition measures for the purpose of determining: (1) the minimum Interstate pavement condition level for each State (23 CFR 490.317); and (2) whether or not a State DOT has made significant progress towards the achievement of its pavement condition targets (23 CFR 490.109). While designed for internal use, FHWA is making the document public, to be transparent and give State DOTs a frame of reference when establishing their targets.</td></tr>
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Date	Page/Revision Description	Original Text	Revised Text
May 9, 2018	Table 8 in Section 2.4.4 (Pages 47 through 49) and Table C1 in Appendix C to conform to the number of decimal places for metric data specified in 23 CFR 490.311(b)(1) through (b)(4) and HPMS Field Manual (December 2016).	*[IRI_VN]*	***ROUND (****[IRI_VN]****, DIGITS = 0****)***
		[CRACKING_PERCENT_VN]	***ROUND (****[CRACKING_PERCENT_VN]****, DIGITS = 0)***
		[RUTTING_VN]	***ROUND (****[RUTTING_VN]****, DIGITS = 2)***
		[FAULTING_VN]	***ROUND (****[FAULTING_VN]****, DIGITS = 2)***
		[PSR_VN]	***ROUND (****[PSR_VN]****, DIGITS = 1)***

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May 9, 2018	Table 8 in Section 2.4.4 (Pages 47 through 49) and Table C1 in Appendix C to conform to the number of decimal places for metric data specified in 23 CFR 490.311(b)(1) through (b)(4) and HPMS Field Manual (December 2016).	---	The following footnotes were added: ***"ROUND ([IRI_VN], DIGITS = 0)" denotes rounding [IRI_VN] to the nearest inch per mile, as required in 23 CFR 490.311(b)(1)(ii) and HPMS Field Manual (December 2016) Pg. 4-91 -*** https://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/ ***An [IRI_VN] with a tenth digit value of 5 or greater will be rounded up whereas a tenth digit value of less than 5 will be rounded down to the nearest whole number (in integer inch per mile).*** ***"ROUND ([CRACKING_PERCENT_VN], DIGITS = 0)" denotes rounding [CRACKING_PERCENT_VN] to the nearest whole percent, as required in 23 CFR 490.311(b)(2)(i), (b)(3), and (b)(4)(i) and HPMS Field Manual (December 2016) Pg. 4-107. A [CRACKING_PERCENT_VN] with a tenth digit value of 5 or greater will be rounded up whereas a tenth digit value of less than 5 will be rounded down to the nearest whole number (in whole percent).*** ***"ROUND ([RUTTING_VN], DIGITS = 2)" denotes rounding [RUTTING_VN] to the nearest 0.01 inch, as required in 23 CFR 490.311(b)(2)(ii) and HPMS Field Manual (December 2016) Pg. 4-99. A [RUTTING_VN] with a thousandth digit value of 5 or greater will be rounded up whereas a thousandth digit value of less than 5 will be rounded down to the nearest hundredths (in hundredths of inches).*** ***"ROUND ([FAULTING_VN], DIGITS = 2)" denotes rounding [FAULTING_VN] nearest 0.01 inch, as required in 23 CFR 490.311(b)(4)(iii) and HPMS Field Manual (December 2016) Pg. 4-103. A [FAULTING_VN] with a thousandth digit value of 5 or greater will be rounded up whereas a thousandth digit value of less than 5 will be rounded down to the nearest hundredths (in hundredths of inches).***

<table>
<tr><th>Date</th><th>Page/Revision Description</th><th>Original Text</th><th>Revised Text</th></tr>
<tr><td>August 9, 2018</td><td>Table 8 in Section 2.4.4</td><td></td><td>The following text was added to ensure that condition rating based on distress and IRI metrics take precedence over rating based on PSR for those segments that have both distress and PSR metrics. The order of operation was also renumbered.
<table>
<tr><td>7</td><td>IF asphalt pavement surface and have valid metrics</td><td>IF {
([SURFACE_TYPE_VN] IN (2, 6, 7, 8))
AND ([IRI_VN] > 0)
AND ([CRACKING_PERCENT_VN] BETWEEN 0 AND 100)
AND ([RUTTING_VN] >= 0)
}</td><td>THEN Fair</td></tr>
<tr><td>8</td><td>IF jointed concrete pavement surface and have valid metrics</td><td>IF {
([SURFACE_TYPE_VN] IN (3, 4, 9, 10))
AND ([IRI_VN] > 0)
AND ([CRACKING_PERCENT_VN] BETWEEN 0 AND 100)
AND ([FAULTING _VN] >= 0)
}</td><td>THEN Fair</td></tr>
<tr><td>9</td><td>IF CRCP surface and have valid metrics</td><td>IF {
([SURFACE_TYPE_VN] = 5)
AND ([IRI_VN] > 0)
AND ([CRACKING_PERCENT_VN] BETWEEN 0 AND 100)
}</td><td>THEN Fair</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Date</th><th>Page/Revision Description</th><th>Original Text</th><th>Revised Text</th></tr>
<tr><td>August 9, 2018</td><td>Appendix C</td><td></td><td>Specific steps were added to provide clarity.</td></tr>
<tr><td>August 9, 2018</td><td>Table C1 in Appendix B</td><td></td><td>Table C1 was renumbered to Table C2, and added the following to ensure condition rating based on IRI metric take precedence over rating based on PSR for those segments have both IRI and PSR metrics.

<table><tr><td>3</td><td>IF a segment meets Fair Condition thresholds for IRI metric</td><td>IF {ROUND([IRI_VN], DIGITS = 0) BETWEEN 95 AND 170}</td><td>THEN Fair</td></tr></table>
The order of operation was re-numbered in the table.</td></tr>
</table>

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Table of Contents

1 Overview

This document presents the steps for Federal Highway Administration (FHWA) to compute pavement condition measures for the purpose of determining: (1) the minimum Interstate pavement condition level for each State (23 CFR 490.317); and (2) whether or not a State DOT has made significant progress towards the achievement of its pavement condition targets (23 CFR 490.109). The steps described in this document include the measure computation procedure specified in 23 CFR 490.313. The structure query language (SQL) and pseudo-codes used in this document are only for illustrating computation logic and they are not intended for any specific database or computer application.

1.1 Performance Measures

Four pavement condition measures apply to the National Highway System (NHS) and were established under Subpart C of 23 CFR 490. **The established pavement condition measures are:**

(1) "Percentage of pavements of the Interstate System in Good condition";

(2) "Percentage of pavements of the Interstate System in Poor condition";

(3) "Percentage of pavements of the non-Interstate NHS in Good condition"; and

(4) "Percentage of pavements of the non-Interstate NHS in Poor condition". (23 CFR 490.307)

The main attributes of the pavement condition measures and targets are as follows:

- **The FHWA annually[1] computes the percentage of pavements of the Interstate System in Poor condition for the purpose of the FHWA annual determination of whether or not a State DOT has maintained minimum Interstate pavement condition**.

- **All four measures are computed every two years[2] by FHWA for the purpose of FHWA determination of whether or not a State DOT has made significant progress toward target achievement**.

- **All four measures are percentages of mainline lane-miles of Interstate System or non-Interstate NHS, excluding the section of network reported as Bridges[3], Unpaved Surface[4], or "Other Surface Types[5]" and excluding the sections of network with Missing, Invalid, or Unresolved Data** (see Section 2.4). [6]

- **Performance measures and targets cover all NHS within a State's geographic boundaries.[7]**

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[1] 23 CFR 490.317(a)
[2] 23 CFR 490.109(b)
[3] Coded as "1" for Data Item STRUCTURE_TYPE (Data Item 4) – see Section 4.4 of HPMS Field Manual. The HPMS Field Manual can be found at the following link - http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/
[4] Coded as "1" for Data Item SURFACE_TYPE (Data Item 49) – see Section 4.4 of HPMS Field Manual
[5] Coded as "11" for Data Item SURFACE_TYPE (Data Item 49) – see Section 4.4 of HPMS Field Manual
[6] 23 CFR 490.313(f)
[7] 23 CFR 490.105(d) and 490.303

To ensure consistent definitions, a distinction between "performance measure" and "performance metric" was made in 23 CFR 490.101. A "metric" is defined as a quantifiable indicator of performance or condition whereas a "measure" is defined as an expression based on a metric that is used to establish targets and to assess progress toward meeting the established targets. Therefore, "metrics" refer to the reported values for International Roughness Index (IRI), rutting, faulting, cracking percent, or Present Serviceability Rating (PSR) for a section of mainline highway in the Highway Performance Monitoring System (HPMS) whereas the "measures" refer to the percentages of network lane-miles, in Good or Poor condition, computed using the reported "metrics".

1.2 Data Sources

For the purpose of computing measures, the following data will be used.

- **Highway Performance Monitoring System**: The governing data source for computing all four pavement condition measures is HPMS.

    - ***Data Items*:** The pavement condition metrics (cracking percent, faulting, IRI, PSR[8] and rutting) will come from HPMS Data Items CRACKING_PERCENT, FAULTING, IRI, PSR, and RUTTING. Also, the inventory data that contain information on bridge limits, surface types, and number of through lanes will come from HPMS Data Items STRUCTURE_TYPE, SURFACE_TYPE, THROUGH_LANES (or DIR_THROUGH_LANES[9]), respectively. In addition to pavement condition metric and inventory data, HPMS will be the governing source of determining functional class, mainline, and the extent of NHS (Data Items F_SYSTEM, FACILITY_TYPE and NHS). Finally, the data necessary for ensuring consistent data query for measure computation, as described in Section 2.1, will also come from HPMS Data Item URBAN_CODE. 23 CFR 490.309 and 490.103.

    - ***Data Year***: The "year" in HPMS dataset name refers to the year in which a snapshot of condition/performance is represented. The HPMS uses an equivalent terminology "Inventory Year[10]". For example, "2018 HPMS Data" means the dataset that includes the most recent data collected through December 31, 2018. For the pavement condition measures, Interstate System pavement condition metrics and inventory data are required to be collected on an annual basis in accordance with 23 CFR 490.309(b)(1)(i)(E) & (iv)(E) and 23 CFR 490.309(c)(1)(iii), respectively. The "2018 HPMS pavement condition metrics and inventory data" for the Interstate System must be collected between January 1, 2018 and December 31, 2018. (23 CFR 490.309(a)) On the other hand, non-Interstate NHS pavement condition metrics and inventory data are required to be collected on a biennial basis in accordance with 23 CFR 490.309(b)(2)(i)(E) & (iii)(E) and 23 CFR 490.309(c)(1)(iii), respectively. The "2021 HPMS pavement condition metrics and inventory data" for the non-Interstate NHS must be collected between January 1, 2020 and December 31, 2021.

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[8] 23 CFR 490.309(b), (b)(1)(iv) and (b)(2)(iii) - Collecting and reporting PSR is permitted where posted speed limits are less than 40 miles per hour as an alternative to the IRI, Cracking_Percent, rutting, and faulting.
[9] 23 CFR 490.309(b)(1)(iii) - Only if a State DOTs collected and reported pavement condition data separately for each direction of divided highways on the Interstate System.
[10] HPMS Field Manual: http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/

- ***Data Collection & Reporting Frequency*:** For the Interstate System, in accordance with 23 CFR 490.311(c)(4) and 23 CFR 490.311(d)(2), State DOTs are required to report their "HPMS pavement condition metrics and inventory data" by April 15 of each year for the data collected during the previous calendar year. State DOTs will report "2018 HPMS pavement condition metrics and inventory data" for the Interstate System to HPMS by April 15, 2019. For the non-Interstate NHS, State DOTs are required to report "HPMS pavement condition metrics and inventory data" by June 15 of each year for the data collected during the two previous calendar years, as required in 23 CFR 490.311(c)(5) and 23 CFR 490.311(d)(3). State DOTs will report "2021 HPMS pavement condition metrics and inventory data" for the non-Interstate NHS to HPMS by June 15, 2022.

  23 CFR 490.309(a) requires the first "full distress and IRI" [11] data collection cycle to start in calendar year 2018 for the Interstate System and to start in calendar year 2020 for the non-Interstate NHS. It is important to note that prior to the date that State DOTs are required to collect "full distress and IRI" data, they are required to meet other pavement data collection and reporting requirements specified in the HPMS Field Manual (which includes full-extent IRI data collection and reporting for NHS[12]). Hence, prior to the first "full distress and IRI" data collection cycles required under 23 CFR 490.309, full-extent IRI data must be collected every year for the Interstate System and every 2 years for the non-Interstate NHS.

  23 CFR 490.107(b)(1)(ii)(B) requires States to report baseline condition/performance derived from the latest data collected through the beginning date of the performance period, and beginning date of 1st performance period is January 1, 2018[13]. Since the first "full distress and IRI" data collection cycle does not start until 2020 for non-Interstate NHS, 23 CFR 490.313(e) provides a "transition" provision for the non-Interstate NHS pavement condition measure.

  As part of non-Interstate NHS "transition", 2017 HPMS IRI data (collected between January 1, 2016 through December 31, 2017) submitted to HPMS by June 15, 2018 will be the baseline non-Interstate NHS condition data for the 1st performance period and the overall condition of pavement sections will be rated based only on IRI values[14]. Similarly, 2019 HPMS IRI data (collected between January 1, 2018 through December 31, 2019) submitted to HPMS by June 15, 2020 will be the 2-year (or midpoint) non-Interstate NHS condition data for the 1st performance period and the overall condition of pavement sections will be

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[11] Full-extent Cracking Percent and IRI for all pavement sections with asphalt, jointed concrete, and continuously reinforced pavement Surface Types; full-extent Rutting for all pavement sections with asphalt pavement Surface Types; full-extent Faulting for all pavement sections with jointed concrete pavement Surface Types; and full-extent inventory data. All distress, IRI, and inventory data elements must be in accordance with specifications prescribed in 23 CFR 490.309 and 23 CFR 490.311.

[12] Chapters 2 and 4 of the HPMS Field Manual: http://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/

[13] 23 CFR 490.105(e)(4)(i)(A)

[14] 23 CFR 490.313(e) - During the transition period, the Overall condition for all pavement types for the non-Interstate NHS will be based on IRI rating, as described in 23 CFR 490.313(b)(1) or on PSR as described 23 CFR 490.313(c)(4) or (d)(4).

rated based only on IRI values[15]. The 2021 HPMS non-Interstate NHS "full distress and IRI" data" (collected between January 1, 2020 and December 31, 2021) will be used for computing two conditions at the same time - (1) 4-year (period-end) condition for the 1st performance period with overall condition rating based only on IRI values[16]; and (2) the baseline condition for the 2nd performance period based on the values "full distress and IRI", as provided in 23 CFR 490.313(b) through (d).

As stated above, a biennial data collection frequency is required for non-Interstate NHS, but HPMS Field Manual requires annual reporting of full-extent NHS pavement condition data[17]. To align the annual data reporting cycle with a biennial data collection cycle, the submitted data each year must consist of data covering full-extent non-Interstate NHS by replacing data from previous data collection cycle with the most recent data collected.

The "year" (i.e., performance/inventory year) in HPMS dataset name could be verified through the data values in [YEAR_RECORD] Field in the reported HPMS data.

- **National Bridge Inventory[18] (NBI)**: NBI data is not directly needed for computation of pavement condition measures, but the NBI data will be used to check reasonableness of total lane-miles of bridges reported in HPMS. Please see Section 2.4.5 for more details. The year in NBI name refers to a reporting year (the year in which performance data is reported to FHWA). For example, "2019 NBI data" means the data to be submitted on March 15, 2019. [19] Please refer to the NBI Coding Guide[20] for more information.

2 Measure Computation Methodology

This section describes details for computing pavement condition measures using all condition metrics (cracking percent, faulting, IRI, PSR and rutting). The methodology for computing non-Interstate NHS measures using IRI only during the transition period[21] is included in Appendix C.

As Section 1.1 discussed, the four pavement condition measures are:

(1) "Percentage of pavements of the Interstate System in Good condition";

(2) "Percentage of pavements of the Interstate System in Poor condition";

(3) "Percentage of pavements of the non-Interstate NHS in Good condition"; and

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[15] Ibid.
[16] Ibid.
[17] Chapter 1 and Section 2.4 in the HPMS Field Manual.
[18] National Bridge Inventory: http://www.fhwa.dot.gov/bridge/nbi.cfm
[19] 23 CFR 490.411
[20] "Recording and Coding Guide for the Structure Inventory and Appraisal of the Nations Bridges": https://www.fhwa.dot.gov/bridge/nbi.cfm
[21] 23 CFR 490.313(e)

(4) "Percentage of pavements of the non-Interstate NHS in Poor condition".

These measure computations will exclude[22] the following portions of mainline highways:

- **Identified as a "Bridge"**
- **Identified as "Unpaved" surface and "Other Surface Types"**
- **Determined having "Missing, Invalid, or Unresolved Data"**

The pavement condition measure computation is performed in the following general form in accordance with 23 CFR 490.313(f)(2). Please note that the measure computation will only be done when total mainline lane-miles of "Missing, Invalid, or Unresolved Data" segments for Interstate System and non-Interstate NHS must not be more than 5.0 percent[23]. Please see Section 2.4.3 for determining percentage of lane-miles of "Missing, Invalid, or Unresolved Data" segments.

$$\%\_Good\_IS = \frac{Good\_LM\_IS}{Network\_LM\_IS - Bridges\_LM\_IS - Unpaved\_Other\_LM\_IS - MIU\_LM\_IS} \times 100$$

$$\%\_Poor\_IS = \frac{Poor\_LM\_IS}{Network\_LM\_IS - Bridges\_LM\_IS - Unpaved\_Other\_LM\_IS - MIU\_LM\_IS} \times 100$$

$$\%\_Good\_NIN = \frac{Good\_LM\_NIN}{Network\_LM\_NIN - Bridges\_LM\_NIN - Unpaved\_Other\_LM\_NIN - MIU\_LM\_NIN} \times 100$$

$$\%\_Poor\_NIN = \frac{Poor\_LM\_NIN}{Network\_LM\_NIN - Bridges\_LM\_NIN - Unpaved\_Other\_LM\_NIN - MIU\_LM\_NIN} \times 100$$

Where,

%_Good_IS:	a pavement condition measure - percentage of Interstate System pavements in Good condition (computed to the one tenth of a percent)
%_Poor_IS:	a pavement condition measure - percentage of Interstate System pavements in Poor condition (computed to the one tenth of a percent)
%_Good_NIN:	a pavement condition measure - percentage of Non-Interstate NHS pavements in Good condition (computed to the one tenth of a percent)
%_Poor_NIN:	a pavement condition measure - percentage of Non-Interstate NHS pavements in Poor condition (computed to the one tenth of a percent)

[22] 23 CFR 490.313(f)
[23] 23 CFR 490.313(b)(4)(i)

Good _LM_IS:	total lane-miles of mainline highways on the Interstate System in Good condition (see Section 2.4.4)
Poor _LM_IS:	total lane-miles of mainline highways on the Interstate System in Poor condition (see Section 2.4.4)
Good _LM_NIN:	total lane-miles of mainline highways on the Non-Interstate NHS in Good condition (see Section 2.4.4)
Poor _LM_NIN:	total lane-miles of mainline highways on the Non-Interstate NHS in Poor condition (see Section 2.4.4)
Network_LM_IS:	total lane-miles of mainline highways on the Interstate System (see Section 2.4.4)
Network_LM_NIN:	total lane-miles of mainline highways on the Non-Interstate NHS (see Section 2.4.4)
Bridges_LM_IS:	total lane-miles of mainline highways on the Interstate System reported as bridges (see Section 2.4.1)
Bridges_LM_NIN:	total lane-miles of mainline highways on the Non-Interstate NHS reported as bridges (see Section 2.4.1)
Unpaved_Other_LM_IS:	total lane-miles of mainline highways on the Interstate System reported as “Unpaved or Other” Surface Types (see Section 2.4.2)
Unpaved_Other_LM_NIN:	total lane-miles of mainline highways on the Non-Interstate NHS reported as “Unpaved or Other” Surface Types (see Section 2.4.2)
MIU_LM_IS:	total lane-miles of mainline highways on the Interstate System determined having “Missing, Invalid or Unresolved” data (see Section 2.4.3)
MIU_LM_NIN:	total lane-miles of mainline highways on the Non-Interstate NHS determined having “Missing, Invalid or Unresolved” data (see Section 2.4.3)

2.1 HPMS Sections Data Set

The governing data source for computing pavement condition measures is HPMS. The HPMS contains the condition metric data (CRACKING_PERCENT, FAULTING, IRI, PSR[24], and RUTTING), inventory data (STRUCTURE_TYPE, SURFACE_TYPE, THROUGH_LANES, and DIR_THROUGH_LANES[25]), and other pertinent data (F_SYSTEM, FACILITY_TYPE, NHS, and URBAN_CODE) necessary to compute the pavement condition measures.

[24] 23 CFR 490.309(b), (b)(1)(iv) and (b)(2)(iii) - Collecting and reporting PSR is permitted where posted speed limits are less than 40 miles per hour as an alternative to the IRI, Cracking_Percent, rutting, and faulting.

[25] Data Item 70 “DIR_THROUGH_LANES” is needed for State DOTs that choose to submit dual-carriage data for Interstate System, as described in 23 CFR 490.309(b)(1)(i)(D) and (b)(1)(iii). Please see Chapter 4 of HPMS Field Manual for more details.

The HPMS "Sections" Data Set is "as-reported" attribute data for sections of the highway network. Each record in the Sections Data contains location information (Route_ID, Begin_Point, and End_Point values) of a segment of the highway network and values related to a single attribute (i.e., a "Data_Item"). Each record in "Sections" Data Set is in the following pipe-delimited data format:

```
Year_Record|State_Code|Route_ID|Begin_Point|End_Point|Data_Item|Sect
ion_Length|Value_Numeric|Value_Text|Value_Date|Comments
```

In the delimited data format, "Data_Item" value could be "CRACKING_PERCENT", "FAULTING", "IRI", "PSR", "RUTTING", "STRUCTURE_TYPE", "SURFACE_TYPE", "THROUGH_LANES", "DIR_THROUGH_LANES", "F_SYSTEM", "FACILITY_TYPE", "NHS", "URBAN_CODE", etc. Figure F1 in Appendix F graphically illustrates how HPMS "Sections Data" contains attribute data for a fictitious highway called "Route "AAA," and some of the data records in Sections Data for "Route "AAA" are illustrated below. Please note that "Route AAA" is an illustration of a non-Interstate NHS route.

```
2018|##| Route AAA|0.000|1.100|NHS|1.100|1| | |

2018|##| Route AAA|0.000|1.100|F_System|1.100|3| | |

2018|##| Route AAA|0.000|0.200|THROUGH_LANES|0.200|6| | |

2018|##|Route AAA|0.200|0.450|THROUGH_LANES|0.250|4| | |

2018|##|Route AAA|0.450|1.100|THROUGH_LANES|0.250|6| | |

2018|##|Route AAA|0.000|1.100|FACILITY_TYPE|1.100|2| | |

2018|##|Route AAA|0.050|0.300|SURFACE_TYPE|0.250|6| | |

2018|##|Route AAA|0.300|0.350|SURFACE_TYPE|0.050|4| | |

2018|##|Route AAA|0.350|0.400|SURFACE_TYPE|0.050|11| | |

2018|##|Route AAA|0.400|0.800|SURFACE_TYPE|0.400|4| | |

2018|##|Route AAA|0.800|1.100|SURFACE_TYPE|0.300|5| | |

2018|##|Route AAA|0.300|0.350|STRUCTURE_TYPE|0.050|1| | |

2018|##|Route AAA|0.000|0.050|IRI|0.050|60| |01/2018|

2018|##|Route AAA|0.050|0.100|IRI|0.050|65| |01/2018|

2018|##|Route AAA|0.100|0.200|IRI|0.100|115| |01/2016|

2018|##|Route AAA|0.200|0.300|IRI|0.100|180| |01/2018|

2018|##|Route AAA|0.300|0.350|IRI|0.050|126| |01/2018|

2018|##|Route AAA|0.900|0.950|PSR|0.050|3.5|A|01/2018|
```

```
2018|##|Route AAA|0.950|1.050|PSR|0.100|4.2|A|01/2018|

2018|##|Route AAA|1.050|1.100|PSR|0.100|6.0|A|01/2018|
```

"VN", in Figure F1 in Appendix F, denotes "Value_Numeric" for a particular Data Item. "SURFACE_TYPE_VN" represents "Value_Numeric" for "Data_Item" value is "SURFACE_TYPE". Similarly, "VD" denotes "Value_Date" and "VT" denotes "Value_Text" for a particular Data Item.

Please note that the reported values in `Section_Length` Field in the "Sections" Data Set will not be used for the process described in this document. Please see method for computing section lengths in each of the appropriate sections.

Because each record in the "Sections" Data Set contains related attribute values for a single Data Item for a particular segment of the highway network, the location of sections (described by the values in Route_ID, Begin_Point, and End_Point) may not be identical among different data items as illustrated in Figure F1 in Appendix F. It is necessary to transform the "Sections" Data Set into a tabular format to evaluate each section with appropriate values from different Data Items. The HPMS Software provides a segmentation capability (i.e., "full-intersections"), and segmented data set of the fictitious highway "Route "AAA", is illustrated in Figure F2 in Appendix F.

2.2 Spatial Coincidence and Section Length Requirements

23 CFR 490.309(a) and (b) requires States DOTs must report CRACKING_PERCENT and IRI metrics for all pavement sections, RUTTING metric for all asphalt pavement sections, and FAULTING metric for all jointed concrete pavement sections. This requirement is also re-iterated in 23 CFR 490.311(c)(2) stipulating that each measured section must have a single value for each of the relevant condition metrics. To implement this requirement, the HPMS Field Manual[26] specified that CRACKING_PERCENT (Data Item 52), FAULTING (Data Item 51), and RUTTING (Data Item 50) is to be reported for mile-point limits that are consistent with those reported for IRI (Data Item 47). This requirement is referred to as the "spatial coincidence requirement" (i.e., identical Route_ID, Begin_Point, and End_Point in "Sections" Data Set) for the sections for CRACKING_PERCENT, FAULTING, and RUTTING Data Items. The "spatial coincidence requirement" will be done by checking section limits of CRACKING_PERCENT (Data Item 52), FAULTING (Data Item 51), and RUTTING (Data Item 50) sections against IRI (Data Item 47) sections. Note because PSR (Data Item 48) sections may be collected in lieu of IRI, CRACKING_PERCENT, FAULTING, AND RUTTING[27], PSR (Data Item 48) sections are not subjected to "spatial coincidence requirement" for the purpose of measure computation.

As an example of checking "spatial coincidence requirement," in "Sections" Data example in Figure F1 in Appendix F, the section between Milepost 0.050 to Milepost 0.200 for RUTTING Data Item is not consistent with the section between Milepost 0.050 to Milepost 0.200 for IRI Data Item. In other words, between Milepost 0.050 to Milepost 0.200, IRI and RUTTING sections do not have identical Route_ID, Begin_Point, and End_Point, as delimited data format shown below.

---

[26] Section must be reported for milepoint limits (i.e., sections) that are consistent with those reported for Data Item 47 (IRI) - HPMS Field Manual Chapter 4 (Pages 4-109, 4-104, and 4-100/4-101) under Data Items CRACKING_PERCENT (Data Item 52), FAULTING (Data Item 51), and RUTTING (Data Item 50), respectively.

[27] 23 CFR 490.309(b)(1)(iv) and 23 CFR 490.309(b)(2)(iii)

2018|##|Route AAA|**0.050**|**0.100**|IRI|0.050|65| |01/2018|

2018|##|Route AAA|**0.100**|**0.200**|IRI|0.100|115| |01/2016|

2018|##|Route AAA|**0.050**|**0.200**|**RUTTING**|0.150|0.20| |01/2018|

The section between Milepost 0.050 to Milepost 0.200 for RUTTING Data Item violated the spatial coincidence requirement.

The section between Milepost 0.300 to Milepost 0.400 for RUTTING Data Item in the "Sections" Data Set also violates spatial coincidence requirement as shown below.

2018|##|Route AAA|**0.300**|**0.350**|IRI|0.050|126| |01/2018|

2018|##|Route AAA|**0.350**|**0.400**|IRI|0.050|195| |01/2018|

2018|##|Route AAA|**0.300**|**0.400**|**RUTTING**|0.10|0.00| |01/2018|

Also, the section between Milepost 0.500 to Milepost 0.600 and the section between Milepost 0.600 to Milepost 0.700 for CRACKING_PERCENT Data Item in the "Sections" Data Set violate spatial coincidence requirement as shown below.

2018|##|Route AAA|**0.500**|**0.650**|IRI|0.150|120| |01/2018|

2018|##|Route AAA|**0.650**|**0.700**|IRI|0.050|80| |01/2018|

2018|##|Route AAA|**0.500**|**0.600**|**CRACKING_PERCENT**|0.10|3| |01/2018|

2018|##|Route AAA|**0.600**|**0.700**|**CRACKING_PERCENT**|0.10|0| |01/2018|

The section between Milepost 0.500 to Milepost 0.600 and the section between Milepost 0.600 to Milepost 0.650 for FAULTING Data Item in the "Sections" Data Set violate spatial coincidence requirement as shown below.

2018|##|Route AAA|**0.500**|**0.650**|IRI|0.150|120| |01/2018|

2018|##|Route AAA|**0.500**|**0.600**|**FAULTING**|0.10|0.08| |01/2018|

2018|##|Route AAA|**0.600**|**0.650**|**FAULTING**|0.10|0.10| |01/2018|

Lastly, the section between Milepost 1.050 to Milepost 1.100 for FAULTING Data Item in the "Sections" Data Set violate spatial coincidence requirement because there were no data reported for IRI Data Item at this location.

2018|##|Route AAA|**1.050**|**1.100**|**FAULTING**|0.050|0.00| |01/2018|

It is important to note that the spatial coincidence violations can be determined only from the "Sections" Data Set and not from the dynamically segmented (referred to as "full-intersect") data set shown in Figure F2 in Appendix F.

23 CFR 490.309(b) and 23 CFR 490.311(c) require State DOTs to collect condition metrics (CRACKING_PERCENT, FAULTING, IRI, PSR, and RUTTING) continuously in a manner that will allow for reporting in nominally uniform pavement section lengths of 0.10[28]mile with 0.11-mile maximum length of "pavement sections." In Figure F1 in Appendix F the following sections violate section length requirement because the section lengths of the following 2 sections exceed 0.11 mile (0.15 mile > 0.11 mile). It is important to note that the section length requirement checks are done by determining section length for each section by subtracting the `Begin_Point` value from the `End_Point` value, as described in Section 2.3.2.

`2018|##|Route AAA|0.500|0.650|IRI|0.150|120| |01/2018|`

`2018|##|Route AAA|0.050|0.200|RUTTING|0.150|0.20| |01/2018|`

Again, it is important to note that the section length violations can be determined only from the "Sections" Data Set and not from the dynamically segmented (full-intersect) data set shown in Figure F2 in Appendix F.

In Figure F3 in Appendix F highlights the sections violated spatial coincidence and/or section length requirements.

As noted above, spatial coincidence violations and section length violations can be determined only from the "Sections" Data Set and not from the dynamically segmented data set shown in Figure F2 in Appendix F. Therefore the sections with spatial coincidence and/or section length violation must be identified or "flagged" in the "Sections" Data Set first and then transfer that information to the dynamically segmented data set as shown in Figure F4 in Appendix F.

2.3 Data Preparation for Computing Measures

This section describes the steps to prepare the data for measure computation. Please note that the Structure Query Language (SQL) and pseudo-codes in this section are for illustrating conceptual data preparation process for measure computation. It is anticipated that HPMS Software will automate the data preparation process by the time FHWA is required to compute pavement condition measures, and this section will be updated to reflect the data preparation method in HPMS Software.

- **Step 1**: Extract separate data sets for Data Items IRI, CRACKING_PERCENT, RUTTING, FAULTING, and PSR[29] from the "Sections" Data Set (Sections_DataSet) and extract a dynamically segmented data set (full intersection) of 13 Data Items (CRACKING_PERCENT, FAULTING, IRI, PSR, RUTTING, STRUCTURE_TYPE, SURFACE_TYPE, THROUGH_LANES, DIR_THROUGH_LANES[30], F_SYSTEM, FACILITY_TYPE, NHS, and URBAN_CODE). Please see Section 2.3.1 for more details.

[28] Shorter pavement sections are permitted only at the beginning of a route, the end of a route, at bridges, or other locations where a section length of 0.1 mile is not achievable.
[29] 23 CFR 490.309(b), (b)(1)(iv) and (b)(2)(iii) - Collecting and reporting PSR is permitted where posted speed limits are less than 40 miles per hour as an alternative to the IRI, Cracking_Percent, rutting, and faulting.
[30] 490.309(b)(1)(i)(D) & 23 CFR 490.309(b)(1)(iii) - Only if a State DOTs collected and reported pavement condition data separately for each direction of divided highways on the Interstate System.

- **Step 2**: Identify sections that violate length requirement in each of the 5 extracted data sets (Data Items IRI, CRACKING_PERCENT, RUTTING, FAULTING, and PSR) from Step 1 and identify sections that violate spatial coincidence requirement in each of the 3 extracted data sets (Data Items CRACKING_PERCENT, RUTTING, and FAULTING) from Step 1. Please see Section 2.3.2 for more details.

- **Step 3**: Incorporate identified section violation and spatial coincidence information from the 5 data sets, from Step 2, into a dynamically segmented (full-intersection) data set. Please see Section 2.3.3 for details.

- **Step 4**: Delineate Interstate System data and non-Interstate NHS data from the dynamically segmented data set with length and spatial coincidence violation information from Step 3. Please see Section 2.3.4 for more details.

- **Step 5**: Identify and flag Unresolved Data using the Interstate System data and non-Interstate NHS data from Step 4. See Section 2.3.5 for more details.

A graphical illustration of data preparation is exhibited in Figure 1 below. The descriptions of data sets are discussed in Sections 2.3.1 through 2.3.4.

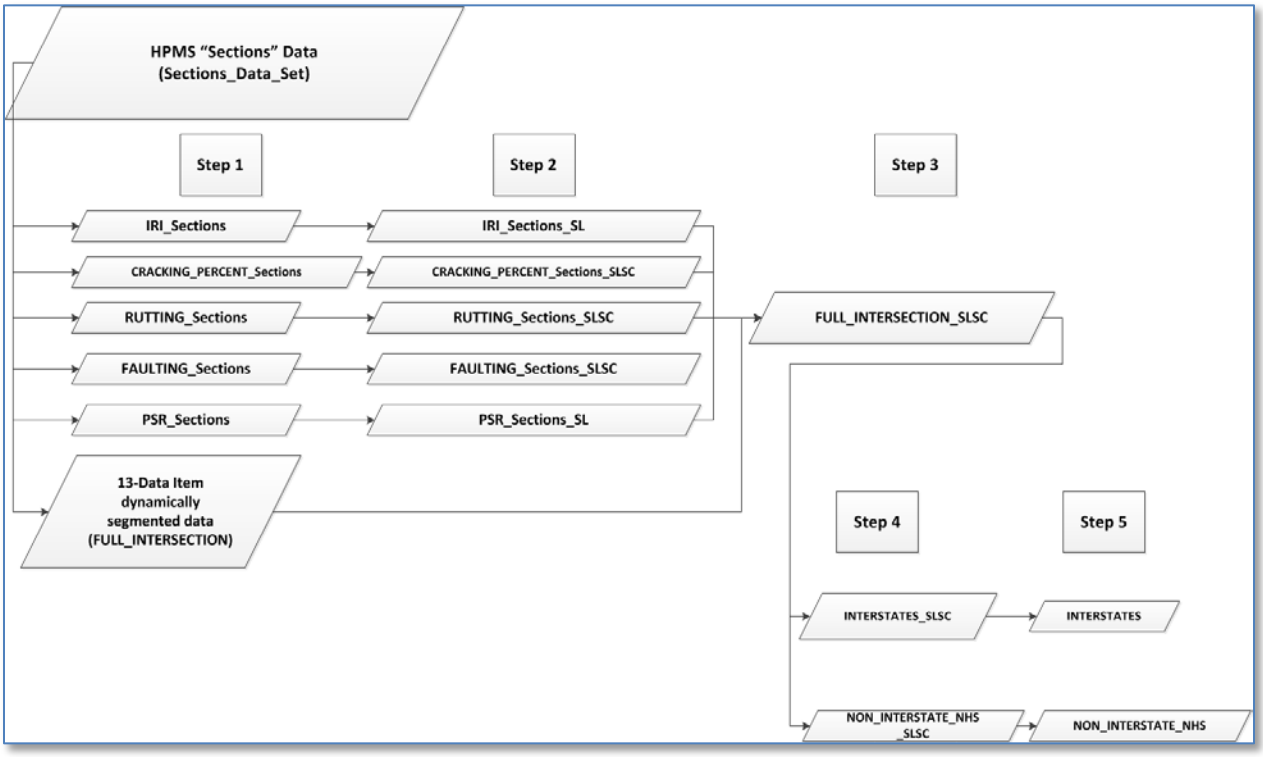


Figure 1 – Graphical Illustration of Data Preparation Steps for Computing Measures and Data Set Names

As indicated above, under Step 1 in Figure 1, the data sets (IRI_Sections, CRACKING_PERCENT_Sections, RUTTING_Sections, FAULTING_Sections, and PSR_Sections) indicate individual sections data for each

data item directly from the HPMS "Sections" Data Set (Sections_DataSet). The data set FULL_INTERSECTION under Step 1 indicate a dynamically segmented data set of the 13 Data Items.

Under Step 2 in Figure 1 above indicate the data sets directly derived from the data sets from Step 1 with flagged sections violating spatial coincidence and Length requirements. For example, IRI_Sections_SL data set (or query) under Step 2 has all fields and rows of IRI_Sections data set from Step 1 with an additional data field indicating ("flagged") whether or not individual section violated section length requirement. Similarly, CRACKING_PERCENT_SLSC data set (or query) under Step 2 has all fields and rows of CRACKING_PERCENT_Sections data set from Step 1 with an additional data fields indicating ("flagged") whether or not individual section violated section length and spatial coincidence requirements.

The data set FULL_INTERSECTION_SLSC under Step 3 contains all rows and fields from FULL_INTERSECTION data set from Step 1 with additional information pertains section length and spatial coincidence data check results ("flagged") from Step 2. The data set FULL_INTERSECTION_SLSC is then divided into two data sets (INTERSTATE_SLSC and NON_INTERSTATE_NHS_SLSC) for delineating data sets for Interstate and non-Interstate NHS, respectively. Lastly, the data sets in Step 5 (INTERSTATES and NON_INTERSTATE_NHS) are directly derived from the data sets from Step 4 with additional information pertain to data records identified as "unresolved", as described in Section 2.3.5.

2.3.1 Step 1: Extract Data from HPMS

As illustration in Sections 2.1 and 2.2, to perform pavement measure computation, 6 datasets from HPMS Software must be extracted, and they are:

(1) IRI_Sections Data Set **–** records from "Sections" Data Set (Sections_DataSet) with Data_Item = "IRI" which could be obtained through HPMS Software ("Spatial Intersector" under "Reports and Analysis" and selecting only "IRI" as selecting criteria) or use below Structural Query Language (SQL) statement on downloaded "Sections" Data Set from HPMS.

```
SELECT Sections_Dataset.*

INTO IRI_Sections

FROM Sections_Dataset

WHERE (((Sections_Dataset.Data_Item)="IRI"));
```

(2) CRACKING_PERCENT_Sections Data Set **–** records from Sections_DataSet with Data_Item = "CRACKING_PERCENT" which could be obtained through HPMS Software ("Spatial Intersector" under "Reports and Analysis" and selecting only "CRACKING_PERCENT" as selecting criteria) or use below SQL statement on downloaded "Sections" Data Set from HPMS.

```
SELECT Sections_Dataset.*

INTO CRACKING_PERCENT_Sections

FROM Sections_Dataset

WHERE (((Sections_Dataset.Data_Item)=" CRACKING_PERCENT"));
```

(3) RUTTING_Sections Data Set **–** records from Sections_DataSet with Data_Item = "RUTTING" which could be obtained through HPMS Software ("Spatial Intersector" under "Reports and Analysis" and selecting only "RUTTING" as selecting criteria) or use below SQL statement on downloaded "Sections" Data Set from HPMS.

```
SELECT Sections_Dataset.*

INTO RUTTING_Sections

FROM Sections_Dataset

WHERE (((Sections_Dataset.Data_Item)="RUTTING"));
```

(4) FAULTING_Sections Data Set **–** records from Sections_DataSet with Data_Item = "FAULTING" which could be obtained through HPMS Software ("Spatial Intersector" under "Reports and Analysis" and selecting only "FAULTING" as selecting criteria) or use below SQL statement on downloaded "Sections" Data Set from HPMS.

```
SELECT Sections_Dataset.*

INTO FAULTING_Sections

FROM Sections_Dataset

WHERE (((Sections_Dataset.Data_Item)=" FAULTING"));
```

(5) PSR_Sections Data Set[31] **–** records from Sections_DataSet with Data_Item = "PSR" which could be obtained through HPMS Software ("Spatial Intersector" under "Reports and Analysis" and selecting only "PSR" as selecting criteria) or use below SQL statement on downloaded "Sections" Data Set from HPMS.

```
SELECT Sections_Dataset.*

INTO PSR_Sections

FROM Sections_Dataset

WHERE (((Sections_Dataset.Data_Item)="PSR"));
```

(6) FULL_INTERSECTION Data Set **–** a full-intersection of 13[32] data items in "Sections" Data Set (13 Data Items are: CRACKING_PERCENT, FAULTING, IRI, PSR, RUTTING, STRUCTURE_TYPE,

---

[31] Only needed if a State DOT reported PSR data where posted speed limits are less than 40 miles per hour on mainline highway of NHS as an alternative to the IRI, Cracking_Percent, rutting, and faulting, as provided in 23 CFR 490.309(b), (b)(1)(iv) and (b)(2)(iii)

[32] "PSR" data intersection needed only if a State DOT reported PSR data where posted speed limits are less than 40 miles per hour on mainline highway of NHS as an alternative to the IRI, Cracking_Percent, rutting, and faulting, as

SURFACE_TYPE, THROUGH_LANES, DIR_THROUGH_LANES, F_SYSTEM, FACILITY_TYPE, NHS and URBAN_CODE. Please see Appendix D for details on obtaining FULL_INTERSECTION Data Set from HPMS.

2.3.2 Step 2: Flag Spatial Coincidence & Length Violation Sections

As described in Section 2.2, length and spatial coincidence validation checks must be done in the "Sections" Data Set instead in the FULL_INTERSECTION Data Set. This section describes a method of flagging sections violating spatial coincidence and Length requirements in the 5 data sets (IRI_Sections, CRACKING_PERCENT_Sections, RUTTING_Sections, FAULTING_Sections, and PSR_Sections), described in Step 1 (Section 2.3.1).

For section length check, a section length for each record in IRI_Sections, CRACKING_PERCENT_Sections, RUTTING_Sections, FAULTING_Sections, and PSR_Sections is computed by subtracting Begin_Point value from End_Point value ([End_Point])-[Begin_Point]). Then the computed section length is checked whether it is greater than 0.110 mile. If a computed section length is greater than 0.110 mile, then the record is flagged as "LENGTH VIOLATION."

For section spatial coincidence check, each record in CRACKING_PERCENT_Sections, RUTTING_Sections, and FAULTING_Sections is compared against records in IRI_Sections whether there is a record in IRI_Sections with identical Route_ID, Begin_Point, and End_Point values. If there is no record in IRI_Sections with identical Route_ID, Begin_Point, and End_Point values, then the record is flagged as "COINCIDENCE VIOLATION."

(1) IRI_Sections_SL Data Set (or Query) - For IRI, section length requirement is checked for each record in IRI_Sections (from Step 1 in Section 2.3.1) and flagged, but spatial coincidence is not checked for IRI. For the hypothetical "Route AAA" example, IRI_Sections_SL Data Set (or query) would look like as shown below table.

Table 1 – Illustration of "Flagged" IRI Sections Violating Length Requirement

Year_Record	State_Code	Route_ID	Begin_Point	End_Point	Data_Item	IRI_VN	IRI_VT	IRI_VD	IRI_SL	IRI_Sections_SL
2018	99	AAA	0	0.05	IRI	60		01/2018	0.050	
2018	99	AAA	0.05	0.1	IRI	65		01/2018	0.050	
2018	99	AAA	0.1	0.2	IRI	115		01/2018	0.100	
2018	99	AAA	0.2	0.3	IRI	180		01/2018	0.100	
2018	99	AAA	0.3	0.35	IRI	126		01/2018	0.050	
2018	99	AAA	0.35	0.4	IRI	195		01/2018	0.050	
2018	99	AAA	0.4	0.5	IRI	170		01/2018	0.100	

provided in 23 CFR 490.309(b), (b)(1)(iv) and (b)(2)(iii); and "DIR_THROUGH_LANES" data intersection is only needed when a State DOT reports dual-carriage data for Interstate System, as described in 23 CFR 490.309(b)(1)(i)(D) and (b)(1)(iii).

Year_Record	State_Code	Route_ID	Begin_Point	End_Point	Data_Item	IRI_VN	IRI_VT	IRI_VD	IRI_SL	IRI_Sections_SL
2018	99	AAA	0.5	0.65	IRI	120		01/2018	**0.150**	**LENGTH VIOLATION**
2018	99	AAA	0.65	0.7	IRI	80		01/2018	0.050	
2018	99	AAA	0.7	0.8	IRI	80		01/2018	0.100	
2018	99	AAA	0.8	0.9	IRI	86		01/2018	0.100	
2018	99	AAA	0.9	0.95	IRI	90		01/2018	0.050	
2018	99	AAA	0.95	1.05	IRI	92		01/2018	0.100	

Structural Query Language statement for making a dataset with flagged IRI section length violations is illustrated below.

```
SELECT IRI_Sections.*,

    ([End_Point])-[Begin_Point]) AS IRI_SL,

    IIf([IRI_SL]>0.11,"LENGTH VIOLATION","") AS IRI_Sections_SL INTO
    IRI_Sections_SL

FROM IRI_Sections;
```

Note, for section length requirement check above, section length for each section (`IRI_SL`) was computed by `[End_Point])-[Begin_Point]`. The reported `Section_Length` Value in the `IRI_Sections` Data Set must not be used.

(2) RUTTING_Sections_SLSC Data Set (or Query) - For RUTTING, both section length and spatial coincidence requirements are checked for each record in RUTTING_Sections (from Step 1 in Section 2.3.1) and flagged. For the hypothetical "Route AAA" example, RUTTING_Sections_SLSC Data Set (or query) would look like as shown below table.

Table 2 – Illustration of "Flagged" RUTTING Sections Violating Length and Spatial Coincidence Requirements

Year_Record	State_Code	Route_ID	Begin_Point	End_Point	Data_Item	RUTTING_VN	RUTTING_VT	RUTTING_VD	IRI_Route_ID	IRI_Begin_Point	IRI_End_Point	RUTTING_SL	RUTTING_Sections_SL	RUTTING_Sections_SC
2018	99	AAA	0	0.05	RUTTING	0			AAA	0	0.05	0.050		
2018	99	AAA	0.05	0.2	RUTTING	0.2		01/2018				**0.150**	**LENGTH VIOLATION**	**COINCIDENCE VIOLATION**
2018	99	AAA	0.2	0.3	RUTTING	0.45		01/2018	AAA	0.2	0.3	0.100		

Year_Record	State_Code	Route_ID	Begin_Point	End_Point	Data_Item	RUTTING_VN	RUTTING_VT	RUTTING_VD	IRI_Route_ID	IRI_Begin_Point	IRI_End_Point	RUTTING_SL	RUTTING_Sections_SL	RUTTING_Sections_SC
2018	99	AAA	0.3	0.4	RUTTING	0		01/2018				0.100		**COINCIDENCE VIOLATION**
2018	99	AAA	0.4	0.5	RUTTING	0.1		01/2018	AAA	0.4	0.5	0.100		

For the sections from Mile Point 0.050 to Mile Point 0.200 and Mile Point 0.300 to Mile Point 0.400 in the RUTTING sections data (RUTTING_Sections), there were no sections with identical Route_ID, Begin_Point, and End_Point in IRI Data Set (IRI_Sections). Structural Query Language statement for making a dataset with flagged RUTTING section length and spatial coincidence violations is illustrated below.

```
SELECT Rutting_Sections.*,

   IRI_Sections.Route_ID AS IRI_Route_ID,

   IRI_Sections.Begin_Point AS IRI_Begin_Point,

   IRI_Sections.End_Point AS IRI_End_Point, ([End_Point])-
   [Begin_Point]) AS RUTTING_SL,

   IIf([RUTTING_SL]>0.11,"LENGTH VIOLATION","") AS
   RUTTING_Sections_SL,

   IIf([IRI_Sections].[Route_ID] Is Null Or
   [IRI_Sections].[Begin_Point] Is Null Or
   [IRI_Sections].[End_Point] Is Null,"COINCIDENCE VIOLATION","") AS
   RUTTING_Sections

FROM Rutting_Sections LEFT JOIN IRI_Sections ON
(Rutting_Sections.Route_ID = IRI_Sections.Route_ID) AND
(Rutting_Sections.Begin_Point = IRI_Sections.Begin_Point) AND
(Rutting_Sections.End_Point = IRI_Sections.End_Point);
```

Note, for section length requirement check for RUTTING, section length for each section (RUTTING_SL) was computed by [End_Point])-[Begin_Point]. The reported Section_Length Value in the RUTTING_Sections Data Set must not be used.

(3) CRACKING_PERCENT_Sections_SLSC Data Set (or Query) - For CRACKING_PERCENT, both section length and spatial coincidence requirements are checked for each record in CRACKING_PERCENT_Sections (from Step 1 in Section 2.3.1) and flagged. The methodology is similar to RUTTING_Sections_SLSC Data Set (or Query). Note, for section length requirement check for CRACKING_PERCENT, section length for each section (CRACKING_PERCENT_SL) must be computed by [End_Point])-[Begin_Point]. The reported

Section_Length Value in the CRACKING_PERCENT_Sections Data Set must not be used.

(4) FAULTING_Sections_SLSC Data Set (or Query) - For FAULTING, both section length and spatial coincidence requirements are checked for each record in FAULTING_Sections (from Step 1 in Section 2.3.1) and flagged. The methodology is similar to RUTTING_Sections_SLSC Data Set (or Query). Note, for section length requirement check for FAULTING, section length for each section (FAULTING_SL) must be computed by [End_Point])-[Begin_Point]. The reported Section_Length Value in the FAULTING_Sections Data Set must not be used.

(5) PSR_Sections_SL Data Set (or Query) - For PSR, section length requirement is checked for each record in PSR_Sections (from Step 1 in Section 2.3.1) and flagged, but spatial coincidence is not checked for PSR. The methodology is similar to IRI_Sections_SL Data Set (or Query). Note, for section length requirement check for PSR, section length for each section (PSR_SL) must be computed by [End_Point])-[Begin_Point]. The reported Section_Length Value in the PSR_Sections Data Set must not be used.

2.3.3 Step 3: Incorporate Flagged Sections in the Sections Data Sets into Full Intersection Data Set

This section describes incorporating flagged spatial coincidence and length violation information in IRI_Sections_SL, RUTTING_Sections_SLSC, CRACKING_PERCENT_Sections_SLSC, FAULTING_Sections_SLSC, PSR_Sections_SL Data Sets (or Queries), described in Step 2 in Section 2.3.2, into the FULL_INTERSECTION Data Set, described in Step 1 in Section 2.3.1. Figure F5 in Appendix F illustrates an example of newly created FULL_INTERSECTION_SLSC Data Set resulted from incorporating flagged spatial coincidence and length violation information into the FULL_INTERSECTION Data Set.

As explained in Section 2.1, a dynamically segmented section is completely within a section in "Sections" Data Set, the following logic could be considered for whether a dynamically segment section (i.e., FULL_INTERSECTION) is within a particular section for a Data Item.

```
[FULL_INTERSECTION].[Route_ID]=[ Sections_Dataset].[Route_ID]

AND

[FULL_INTERSECTION].[Begin_Point] >=
[Sections_Dataset].[Begin_Point] AND

[FULL_INTERSECTION].[End_Point]<=[ Sections_Dataset].[End_Point]
```

Once a dynamically segmented section in FULL_INTERSECTION is determined that it is completely within a section in IRI_Sections_SL, RUTTING_Sections_SLSC, CRACKING_PERCENT_Sections_SLSC, FAULTING_Sections_SLSC, or PSR_Sections_SL Data Sets (or Queries), then any attribute (i.e., flagged information) from the corresponding section in those 5 data sets could be obtained. Figure F5 in Appendix F illustrates as an example of created data set FULL_INTERSECTION_SLSC.

Structural Query Language statement for creating is FULL_INTERSECTION_SLSC is shown below.

```
SELECT FULL_INTERSECTION.*,

   [FULL_INTERSECTION].[End_Point]-
   [FULL_INTERSECTION].[Begin_Point] AS DynSeg_SL,

   (SELECT [IRI_Sections_SL].[IRI_Sections_SL_Check] FROM
   [IRI_Sections_SL] where (
   [FULL_INTERSECTION].[Route_ID]=[IRI_Sections_SL].[Route_ID] And
   [FULL_INTERSECTION].[Begin_Point] >=
   [IRI_Sections_SL].[Begin_Point] And
   [FULL_INTERSECTION].[End_Point]<=[IRI_Sections_SL].[End_Point])

) AS IRI_Sections_SL,

(SELECT

   [CRACKING_PERCENT_Sections_SLSC].[CRACKING_PERCENT_Sections_SL_Ch
   eck] FROM [CRACKING_PERCENT_Sections_SLSC] where
   ([FULL_INTERSECTION].[Route_ID]=[CRACKING_PERCENT_Sections_SLSC].
   [Route_ID] And
   [FULL_INTERSECTION].[Begin_Point]>=[CRACKING_PERCENT_Sections_SLS
   C].[Begin_Point] And
   [FULL_INTERSECTION].[End_Point]<=[CRACKING_PERCENT_Sections_SLSC]
   .[End_Point])

) AS CRACKING_PERCENT_Sections_SL,


(SELECT

   [CRACKING_PERCENT_Sections_SLSC].[CRACKING_PERCENT_Sections_SC_Ch
   eck] FROM [CRACKING_PERCENT_Sections_SLSC] where
   ([FULL_INTERSECTION].[Route_ID]=[CRACKING_PERCENT_Sections_SLSC].
   [Route_ID] And
   [FULL_INTERSECTION].[Begin_Point]>=[CRACKING_PERCENT_Sections_SLS
   C].[Begin_Point] And
   [FULL_INTERSECTION].[End_Point]<=[CRACKING_PERCENT_Sections_SLSC]
   .[End_Point])

) AS CRACKING_PERCENT_Sections_SC,

(SELECT

   [RUTTING_Sections_SLSC].[RUTTING_Sections_SL_Check] FROM
   [RUTTING_Sections_SLSC] where
   ([FULL_INTERSECTION].[Route_ID]=[RUTTING_Sections_SLSC].[Route_ID
   ] And
   [FULL_INTERSECTION].[Begin_Point]>=[RUTTING_Sections_SLSC].[Begin
   _Point] And
```

```
   [FULL_INTERSECTION].[End_Point]<=[RUTTING_Sections_SLSC].[End_Poi
   nt])

) AS RUTTING_Sections_SL,

(SELECT

   [RUTTING_Sections_SLSC].[RUTTING_Sections_SC_Check] FROM
   [RUTTING_Sections_SLSC] where
   ([FULL_INTERSECTION].[Route_ID]=[RUTTING_Sections_SLSC].[Route_ID
   ] And
   [FULL_INTERSECTION].[Begin_Point]>=[RUTTING_Sections_SLSC].[Begin
   _Point] And
   [FULL_INTERSECTION].[End_Point]<=[RUTTING_Sections_SLSC].[End_Poi
   nt])

) AS RUTTING_Sections_SC,

(SELECT

   [FAULTING_Sections_SLSC].[FAULTING_Sections_SL_Check] FROM
   [FAULTING_Sections_SLSC] where
   ([FULL_INTERSECTION].[Route_ID]=[FAULTING_Sections_SLSC].[Route_I
   D] And
   [FULL_INTERSECTION].[Begin_Point]>=[FAULTING_Sections_SLSC].[Begi
   n_Point] And
   [FULL_INTERSECTION].[End_Point]<=[FAULTING_Sections_SLSC].[End_Po
   int])

) AS FAULTING_Sections_SL,



(SELECT

   [FAULTING_Sections_SLSC].[FAULTING_Sections_SC_Check] FROM
   [FAULTING_Sections_SLSC] where
   ([FULL_INTERSECTION].[Route_ID]=[FAULTING_Sections_SLSC].[Route_I
   D] And
   [FULL_INTERSECTION].[Begin_Point]>=[FAULTING_Sections_SLSC].[Begi
   n_Point] And
   [FULL_INTERSECTION].[End_Point]<=[FAULTING_Sections_SLSC].[End_Po
   int])

) AS FAULTING_Sections_SC,

(SELECT

   [PSR_Sections_SL].[PSR_Sections_SL_Check] FROM [PSR_Sections_SL]
   where (
   [FULL_INTERSECTION].[Route_ID]=[PSR_Sections_SL].[Route_ID] And
```

```
    [FULL_INTERSECTION].[Begin_Point] >=
    [PSR_Sections_SL].[Begin_Point] And
    [FULL_INTERSECTION].[End_Point]<=[PSR_Sections_SL].[End_Point])

) AS PSR_Sections_SL

INTO FULL_INTERSECTION_SLSC

FROM FULL_INTERSECTION;
```

2.3.4 Step 4: Delineate Interstate and Non-Interstate NHS Data for Measure Computation

Creating two data sets - INTERSTATE_SLSC and NON_INTERSTATE_NHS_SLSC from FULL_INTERSECTION_SLSC Data Set which was created through Step 3, is shown below.

For obtaining the Interstate System pavement data in a single Centerline data format, SQL statement is provided below.

```
SELECT FULL_INTERSECTION_SLSC.*

INTO INTERSTATE_SLSC

FROM FULL_INTERSECTION_SLSC

WHERE (((FULL_INTERSECTION_SLSC.F_SYSTEM_VN)=1) AND
((FULL_INTERSECTION_SLSC.FACILITY_TYPE_VN) In (1,2)) AND
((FULL_INTERSECTION_SLSC.NHS_VN) In (1,2,3,4,5,6,7,8,9)) AND
((FULL_INTERSECTION_SLSC.URBAN_CODE_VN)>0));
```

As described previously, 23 CFR 490.309(b)(1)(iii) provides State DOT options to report pavement condition metrics (cracking percent, faulting, IRI, PSR and rutting) and other related data items reported independently for both directions of travel associated with divided highway (i.e., dual-carriage data format) sections on Interstate System. In HPMS, the Data Items CRACKING_PERCENT, FAULTING, IRI, PSR, RUTTING, STRUCTURE_TYPE, SURFACE_TYPE, DIR_THROUGH_LANES, F_SYSTEM, FACILITY_TYPE, NHS URBAN_CODE, and ROUTE_NUMBER (Data Item 17) must be reported independently for inventory direction (i.e., FACILITY_TYPE_VN = 1 OR 2) and non-inventory direction (i.e., FACILITY_TYPE_VN = 6). Note that inventory direction and non-inventory direction must have unique Route_ID. If a State DOT elects to report their Interstate System data in a dual-carriage data format, the State DOT must indicate in the metadata that submitted with their data. Structural Query Language statement for obtaining the Interstate System pavement data in dual-carriage data format is provided below.

```
SELECT FULL_INTERSECTION_SLSC.*

INTO INTERSTATE_SLSC

FROM FULL_INTERSECTION_SLSC

WHERE (((FULL_INTERSECTION_SLSC.F_SYSTEM_VN)=1) AND
((FULL_INTERSECTION_SLSC.FACILITY_TYPE_VN) In (1,2,6)) AND
```

```
((FULL_INTERSECTION_SLSC.NHS_VN) In (1,2,3,4,5,6,7,8,9)) AND
((FULL_INTERSECTION_SLSC.URBAN_CODE_VN)>0));
```

For computing Interstate System pavement condition measures, the following values will be used for determining number lanes on mainline segments:

- **Single Centerline Data Format** – values in THROUGH_LANES_VN regardless of the values in FACILITY_TYPE_VN.

- **Dual Carriage Data Format** – values in THROUGH_LANES_VN , where FACILITY_TYPE_VN = 1; and values in DIR_THROUGH_LANES_VN, where FACILITY_TYPE_VN = 2 OR 6.

Please note that dual-carriage data format option is available only for Interstate System data. The non-Interstate NHS data must be submitted in a single Centerline data format to HPMS. For obtaining the non-Interstate NHS pavement data, the following SQL statement is provided below.

```
SELECT FULL_INTERSECTION_SLSC.*

INTO NON_INTERSTATE_NHS_SLSC

FROM FULL_INTERSECTION_SLSC

WHERE (

    ((FULL_INTERSECTION_SLSC.F_SYSTEM_VN) In (2,3,4,5,6,7)) AND
    ((FULL_INTERSECTION_SLSC.FACILITY_TYPE_VN) In (1,2)) AND
    ((FULL_INTERSECTION_SLSC.NHS_VN) In (1,2,3,4,5,6,7,8,9)) AND
    ((FULL_INTERSECTION_SLSC.URBAN_CODE_VN)>0)

    );
```

2.3.5 Step 5: Identify and Flag Unresolved Data

Data Sets INTERSTATE_SLSC and NON_INTERSTATE_NHS_SLSC from Section 2.3.4 will be used to flag Unresolved Data into two new Data Sets INTERSTATE and NON_INTERSTATE_NHS in this section.

"Unresolved" Data is FHWA-identified segment data that is to be resolved by State DOTs. The State DOTs have the opportunity to resolve data by the FHWA data extraction date[33, 34] for measure computation. For an FHWA-identified "Unresolved" data for a highway segment, if a State DOT provides an explanation acceptable to FHWA or resubmits corrected data that is acceptable to FHWA

[33] 23 CFR 490.317(b) and 23 CFR 490.109(d)(1)(i) - The FHWA extracts Interstate System pavement data (subject to data requirements in 23 CFR 490.309 and 23 CFR 490.311) on June 16, 2019 and annually thereafter from HPMS to compute measures.

[34] 23 CFR 490.109(d)(1)(ii) - The FHWA extracts non-Interstate NHS pavement data on August 16, 2020 and biennially thereafter from HPMS to compute measures.

for that segment data, FHWA will remove "Unresolved" status from that segment data. If a State DOT does not provide acceptable explanation or corrected data accepted by FHWA (see Appendix B) by the FHWA data extraction dates for measure computation, the lane-mile represent by the segment data will be counted towards "Missing, Invalid or Unresolved Data[35]" (Section 2.4.3) in accordance with 23 CFR 490.313(b)(4).

The FHWA considers data as "Unresolved" where:

- Any reported data which may suggest that they are not from the actual field measurement/observation which could result over-reported bridges, over-reported "Unpaved or Other" Surface Types, splitting data into smaller sections to avoid section length or spatial coincidence errors, extreme or unreasonably high-frequent metric values), etc; and

- Any unreported data which would prevent percentage computation such as incomplete THROUGH_LANES (or DIR_THROUGH_LANES) data coverage

2.3.5.1 Step 5a: Potential Over-Reporting of Bridges

As indicated in the beginning of Section 2, individual sections reported as "Bridge" will be excluded from the measure computation. "Over-reporting" of bridge lane-miles in HPMS (i.e., [STRUCTURE_TYPE _VN] = 1) could erroneously exclude pavement sections in measure computation. The definition of "bridges" is provided in 23 CFR 490.101 which is consistent with the definition in the National Bridge Inspection Standards.[36] The definition applies to consideration of bridges in calculating the pavement condition measures. Also, the NBI coding guide[37] requires the locations of bridges to be coded in NBI Data Item 11 ([KILOPOINT_011]) using the HPMS linear referencing system. Although NBI and HPMS share common definition of "bridges" and common location referencing system, FHWA does not expect computed bridge lane-miles (product of bridge length and number of lanes) on mainline highways from two systems to be identical because of the two main reasons below:

1. **Precision levels of reported bridge lengths are different**: NBI Data Item 49 – Structure Length ([STRUCTURE_LEN_MT_049]) is required to be reported to the nearest one-tenth of one meter (~0.3 ft precision level). In HPMS structure length of a bridge is the difference between point of origin and terminus point of a section (End_Point - Begin_Point) with

[35] Note "Unresolved" data relates to STRUCURE_TYPE data (UNRESOLVED STRUCTURE_TYPE) will be handled differently, as provided in Section 2.3.5.1. The segments with UNRESOLVED STRUCTURE_TYPE will be will be treated as non-bridges and be subjected to classification process, provided from Section 2.4.2 through Section 2.4.4.

[36] 23 CFR 650.305 - A Bridge is a structure including supports erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 feet between undercopings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes; it may also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening.

[37] "Recording and Coding Guide for the Structure Inventory and Appraisal of the Nations Bridges": https://www.fhwa.dot.gov/bridge/nbi.cfm

[STRUCTURE_TYPE] value equals to 1. The HPMS requires precision levels for Begin_Point and End_Point of a section to the nearest thousandth of a mile[38] (~5.3 ft precision level). The differences in precision levels of bridge lengths in the two systems could cause the differences in computed bridge lane-miles.

2. **Inventory Method of Bridges are different** – On a divided highway, all bridges on both travelling directions are reported in NBI with number of lanes ([TRAFFIC_LANES_ON_028A]) and bridge length ([STRUCTURE_LEN_MT_049]) for each bridge independently. However, bridges on divided highways are represented differently in HPMS. In HPMS, single travel direction on a highway is designated as "inventory direction" and the length of inventory data item (e.g., [STRUCTURE_TYPE]) is measured along the centerline in that designated inventory direction (referred to as "single Centerline"). In cases where bridges are located on a divided highway, [STRUCTURE_TYPE] in HPMS is measured only along "single Centerline" in the "inventory direction" so the bridges along the non-inventory direction are not directly measured. In terms of computing bridge lane-miles, the bridges on non-inventory bridges are not completely ignored in HPMS because [THROUGH_LANES] along "single Centerline" in the "inventory direction" in HPMS are reported for combined number of lanes on both "inventory" and "non-inventory" directions. In HPMS, therefore bridges on non-inventory direction on divided highways are assumed to have the same lengths (and locations) as the measured bridges on the inventory direction side. Consequently, the differences in how bridges are inventoried and coded in the two systems could cause the differences in computed bridge lane-miles.

Because of the provided reasons, FHWA does not expect that computed bridge lane-miles from the two data systems to be identical; however, as an effort to minimize erroneous exclusion of section in measure computation, FHWA will compare the total lane-miles of Interstate System (or Non-Interstate NHS) reported in HPMS as "Bridges" and the total lane-miles of bridges reported in NBI Interstate System (or Non-Interstate NHS). If the HPMS total is greater than NBI total, all records with [STRUCTURE_TYPE _VN] = 1 flagged as "UNRESOLVED STRUCTURE_TYPE". By comparing the lane-miles from HPMS and NBI as a reasonableness check, this process intends to foster consistency between HPMS and NBI thereby reducing a possibility of over-exclusion of sections in pavement condition measure computation. Please note that the pavement condition measure computations exclude the HPMS reported bridge data. These computations are not based on data from NBI.

As provided in Appendix B, State DOTs could resolve "flagged" sections by providing document and/or data demonstrating to FHWA that reported STRUCTURE_TYPE data is based on locating the NHS Bridges on the Linear Referencing System used for reporting its HPMS data; and/or resubmits corrected [STRUCTURE_TYPE_VN] data or removes [STRUCTURE_TYPE_VN] = 1 values to make Total Lane-miles of bridges in HPMS ≤ Total lane-miles bridges in NBI. Note "over-reporting"[39] or "under-reporting"[40] of STRUCTURE_TYPE data is at the discretion of individual State DOT. However,

---

[38] See Section 4.2 of the HPMS Field Manual: https://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/

[39] Total Lane-miles of bridges in HPMS > Total lane-miles bridges in NBI

[40] Total Lane-miles of bridges in HPMS < Total lane-miles bridges in NBI

excessively "over-reporting" of STRUCTURE_TYPE data will cause "over-exclusion" (i.e., pavement sections that are not actually on bridges to be erroneously excluded) in the computation of pavement measures thereby causing an inaccurate representation of the pavement condition of NHS.

If a State DOT does not resolve these "flagged" segments by midnight on June 15 for Interstate and by midnight on August 15 for Non-Interstate NHS,[41] then these segments with be flagged as "UNRESOLVED STRUCTURE_TYPE" will not be treated as bridges (i.e., will not be excluded in the measure computation), as described in Section 2.4.1, but they will be treated as non-bridges subjected to subsequent classification process, starting in Section 2.4.2 and the remainder of Section 2.

From the INTERSTATE_SLSC Data Set from Step 4 (Section 2.3.4), the total mainline lane-miles, on the Interstate System represented by bridges (Bridges_LM_IS_HPMS), could be obtained by the following SQL statement for the Interstate System data in a Single Centerline Data Format.

```
SELECT

    Sum(([INTERSTATE_SLSC].[ End_Point]-
    [INTERSTATE_SLSC].[Begin_Point])*[INTERSTATE_SLSC].[THROUGH_LANES
    _VN]) AS Bridges_LM_IS_HPMS

FROM INTERSTATE_SLSC

HAVING (([INTERSTATE_SLSC].[STRUCTURE_TYPE_VN]=1));
```

For Dual-carriage Data format, from the INTERSTATE_SLSC Data Set from Step 4 (Section 2.3.4), the total mainline lane-miles, on the Interstate System represented by bridges (Bridges_LM_IS_HPMS), could be obtained by the following SQL statement.

```
SELECT

    Sum(

          IIf(

                [INTERSTATE_SLSC].[FACILITY_TYPE_VN]=1,

                [INTERSTATE_SLSC].[THROUGH_LANES_VN]*([INTERSTATE_SLSC
                ].[End_Point]-[INTERSTATE_SLSC].[Begin_Point]),

                IIf([INTERSTATE_SLSC].[FACILITY_TYPE_VN]=2 Or
                [INTERSTATE_SLSC].[FACILITY_TYPE_VN]=6,

                [INTERSTATE_SLSC].[DIR_THROUGH_LANES_VN]*([INTERSTATE_
                SLSC]![End_Point]-[INTERSTATE_SLSC].[Begin_Point]),
```

[41] 23 CFR 490.109 and 490.317

```
            0)

            )

        )

AS Bridges_LM_IS_HPMS

FROM INTERSTATE_SLSC

WHERE ((INTERSTATE_SLSC.STRUCTURE_TYPE_VN)=1);
```

Similarly, from the NON_INTERSTATE_NHS_SLSC Data Set from Step 4 (Section 2.3.4), total mainline lane-miles, on the Non-Interstate NHS represented by bridges (Bridges_LM_NIN_HPMS), could be obtained by the following SQL statement.

```
SELECT

    Sum([NON_INTERSTATE_NHS_SLSC].[THROUGH_LANES_VN]
    *([NON_INTERSTATE_NHS_SLSC].[End_Point]-
    [NON_INTERSTATE_NHS_SLSC].[Begin_Point])) AS Bridges_LM_NIN_HPMS

FROM NON_INTERSTATE_NHS

HAVING (([NON_INTERSTATE_NHS_SLSC].[STRUCTURE_TYPE_VN]=1));
```

Please note that complete and accurate [THROUGH_LANES_VN] (and/or [DIR_THROUGH_LANES_VN]) data is needed for this computation.

As described in Section 1.2, the "year" in HPMS dataset name refers to a data/inventory year (the year in which a snapshot of condition/performance is represented) whereas the "year" in NBI name refers to a reporting year (the year in which performance data is reported to FHWA). The FHWA will use the latest FHWA-archived[42] NBI data at the time of State DOT submittal[43] of HPMS data. If total lane-miles of mainline highways reported in HPMS as bridge was determined using "2018 HPMS Data", then the corresponding NBI data is "2018 NBI Data." Similarly, "2019 HPMS Data" corresponds with the "2019 NBI Data."

The following SQL statement is to obtain the bridges carrying the mainline Interstate System from the NBI.

[42] The FHWA archives the NBI data twice during each calendar - archived data in June is referred to as "mid-year" archived data, and archived data in December is referred to as "end-year" archived data.

[43] State DOTs must submit HPMS data to HPMS by June 15 every year. Beginning in 2019, the Interstate pavement condition data submittal due date changes to April 15, as required in 23 CFR 490.311(c)(4) and 23 CFR 490.311(d)(2).

```
[STATE_CODE_001] = 'XXX' AND

[RECORD_TYPE_005A] = 1 AND

[RECORD_TYPE_005C] = 1 AND

[TYPE_OF_SERVICE_042A] IN (1,4,5,6,7,8) AND

[STRUCTURE_LENGTH_049] >= 000061[44] AND

[NBIS_BRIDGE_LENGTH_112] = 'Y' AND

[HIGHWAY_SYSTEM_OF_THE_INVENTORY_ROUTE_104] = 1 AND

[FUNCTIONAL_CLASS_026] IN (1, 11)
```

Then, using the queried Interstate System data, the total lane-miles of mainline highways on Interstate System reported in NBI is computed as follow:

$$\text{Bridges\_LM\_IS\_NBI} = \text{SUM}\left(\frac{[\text{STRUCTURE\_LEN\_MT\_049}]}{10} \times [\text{TRAFFIC\_LANES\_ON\_028A}] \times \frac{3.28084}{5{,}280}\right)$$

Please note that 3.2804/5,280 term is a conversion factor from meters to miles.

The following SQL statement is to obtain the bridges carrying the mainline non-Interstate NHS System from the NBI.

```
[STATE_CODE_001] = 'XXX' AND

[RECORD_TYPE_005A] = 1 AND

[RECORD_TYPE_005C] = 1 AND

[TYPE_OF_SERVICE_042A] IN (1,4,5,6,7,8) AND

[STRUCTURE_LENGTH_049] >= 000061[45] AND

[NBIS_BRIDGE_LENGTH_112] = 'Y' AND

[HIGHWAY_SYSTEM_OF_THE_INVENTORY_ROUTE_104] = 1 AND

[FUNCTIONAL_CLASS_026] IN (2,6,7,8,9,12,14,16,17,19)
```

[44] Note, this threshold indicate 6.1 meters. For example, 35.5 meters is reported in NBI as "000355". Similarly, 542.1 meters is reported in NBI as "005421". Refer to "Recording and Coding Guide for the Structure Inventory and Appraisal of the Nations Bridges" http://www.fhwa.dot.gov/bridge/mtguide.pdf.

[45] Ibid.

Then, using the queried non-Interstate NHS data, the total lane-miles of mainline highways on non-Interstate NHS reported in NBI is computed as follow:

$$\text{Bridges\_LM\_NIN\_NBI} = \text{SUM}\left(\frac{[\text{STRUCTURE\_LEN\_MT\_049}]}{10} \times [\text{TRAFFIC\_LANES\_ON\_028A}] \times \frac{3.28084}{5{,}280}\right)$$

If the total lane-miles of mainline highways on Interstate System reported in HPMS as bridge (Bridges_LM_IS_HPMS) is greater than total lane-miles of bridges carrying Interstate System reported in NBI (Bridges_LM_IS_NBI), all records with [STRUCTURE_TYPE _VN] = 1 in INTERSTATE_SLSC Data Set will be flagged as "UNRESOLVED STRUCTURE_TYPE".

Similarly, if the total lane-miles of mainline highways on Non-Interstate NHS reported in HPMS as bridge (Bridges_LM_NIN_HPMS) is greater than total lane-miles of bridges carrying Non-Interstate NHS reported in NBI (Bridges_LM_NIN_NBI), all records with [STRUCTURE_TYPE _VN] = 1 in NON_INTERSTATE_NHS_SLSC Data Set will be flagged as "UNRESOLVED STRUCTURE_TYPE".

Note, the segments with be flagged as "UNRESOLVED STRUCTURE_TYPE" will not be treated as bridges (will not be excluded in the measure computation), as described in Section 2.4.1, but they will be treated as non-bridges subjected to subsequent classification process, starting in Section 2.4.2 and the remainder of Section 2.

2.3.5.2 Step 5b: Potential Over-reporting of Unpaved/Other SURFACE_TYPE

As indicated in the beginning of Section 2, individual sections reported as "Unpaved or Other" Surface Types will be excluded from the measure computation. "Over-reporting" of "Unpaved or Other" Surface Type limits in HPMS (i.e., [SURFACE_TYPE _VN] = 1 OR [SURFACE_TYPE _VN] = 11) could erroneously exclude pavement sections in measure computation. As an effort to minimize erroneous exclusion of section in measure computation, FHWA will examine if there are any "Unpaved or Other" Surface on the Interstate System and Non-Interstate NHS. Examining the lane-miles represented by reported segments "Unpaved or Other" Surface Type is to reduce a possibility of over-exclusion of sections in pavement condition measure computation.

From the INTERSTATE_SLSC Data Set from Step 4 (Section 2.3.4), the total lane-miles, of the mainline highways on the Interstate System represented by "Unpaved or Other" Surface Type (UNP_OTHER_Len_IS), could be obtained by the following SQL statement.

```
SELECT

    Sum([INTERSTATE_SLSC].[DynSeg_SL]) AS UNP_OTHER_Len_IS

FROM INTERSTATE_SLSC

HAVING (([INTERSTATE_SLSC].[SURFACE_TYPE_VN]=1)or
([INTERSTATE_SLSC].[SURFACE_TYPE_VN]=11));
```

Similarly, from the NON_INTERSTATE_NHS_SLSC Data Set from Step 4 (Section 2.3.4), total lane-miles, of the mainline highways on Non-Interstate NHS represented by "Unpaved or Other" Surface Type (UNP_OTHER_Len_NIN), could be obtained by the following SQL statement.

```
SELECT

    Sum([NON_INTERSTATE_NHS_SLSC].[DynSeg_SL]) AS UNP_OTHER_Len_NIN

FROM NON_INTERSTATE_NHS_SLSC

HAVING (([NON_INTERSTATE_NHS_SLSC].[SURFACE_TYPE_VN]=1)or
([NON_INTERSTATE_NHS_SLSC].[SURFACE_TYPE_VN]=11));
```

Please note that `[DynSeg_SL]` is `([End_Point] - [Begin_Point])` for each mainline highway segment record in respective data set.

If there are any lane-miles of mainline highways on Interstate System reported as "Unpaved or Other" Surface Type (i.e., UNP_OTHER_Len_IS > 0) all records with [SURFACE_TYPE_VN] = 1 or [SURFACE_TYPE_VN] = 11 in INTERSTATE_SLSC Data Set will be flagged as "UNRESOLVED SURFACE_TYPE".

If there are any lane-miles of mainline highways on Non-Interstate NHS reported as "Unpaved or Other" Surface Type (i.e., UNP_OTHER_Len_NIN > 0) all records with [SURFACE_TYPE_VN] = 1 or [SURFACE_TYPE_VN] = 11 in NON_INTERSTATE_NHS_SLSC Data Set will be flagged as "UNRESOLVED SURFACE_TYPE".

Note, the segments with be flagged as "UNRESOLVED SURFACE_TYPE" will not be treated as "Unpaved or Other" Surface Type (will not be excluded in the measure computation) until State DOT provides document and/or data demonstrating that the reported sections are actually "Unpaved or Other" Surface Type. The State DOTs may submit a letter to Division Offices stating that reported sections are "Unpaved or Other" Surface Type, and Division Office concurs. If a State DOT does not resolve these segments by midnight on June 15 for Interstate and by midnight on August 15 for Non-Interstate NHS), [46] then these segments will be counted towards "Missing, Invalid, or Unresolved Data" Category, as described in Section 2.4.3.1.

2.3.5.3 Step 5c: Extreme/Unreasonably High Frequent Metric Values

It is expected that pavement metric data (IRI_VN, CRACKING_PERCENT_VN, RUTTING_VN, FAULTING_VN, and PSR_VN) from the actual field measurement will have a wide range of values and generally follow a normal distribution. The FHWA will examine the frequency distribution of the pavement metric data for the following subsets of INTERSTATE_SLSC Data Set and NON_INTERSTATE_NHS_SLSC Data Set for identifying unusually high frequent of metric values and extreme metric values.

[46] 23 CFR 490.109 and 490.307

- IRI_VN for the segments reported as asphalt, jointed concrete, or continuously reinforced concrete pavement ([SURFACE_TYPE_VN] IN (2,3,4,5,6,7,8,9,10))

- CRACKING_PERCENT_VN for the segments reported as asphalt, jointed concrete, or continuously reinforced concrete pavement ([SURFACE_TYPE_VN] IN (2,3,4,5,6,7,8,9,10))

- RUTTING_VN for segments reported as asphalt pavement ([SURFACE_TYPE_VN] IN (2, 6, 7, 8))

- FAULTING_VN for jointed concrete pavement ([SURFACE_TYPE_VN] IN (3, 4, 9, 10))

- PSR_VN for the segments reported as asphalt, jointed concrete, or continuously reinforced concrete pavement ([SURFACE_TYPE_VN] IN (2,3,4,5,6,7,8,9,10))

If a State DOT does not resolve these segments by midnight on June 15 for Interstate and by midnight on August 15 for Non-Interstate NHS),[47] then these segments with be flagged as "UNRESOLVED IRI", "UNRESOLVED CRACKING_PERCENT", "UNRESOLVED RUTTING", "UNRESOLVED FAULTING" or "UNRESOLVED PSR" will be counted towards "Missing, Invalid, or Unresolved Data", described in Sections 2.4.3.4 through 2.4.3.6.

2.3.5.4 Incorporate Flagged Unresolved Segments in New Data Sets

Pseudocode for creating Data Sets INTERSTATE and NON_INTERSTATE_NHS is described in this section.

The below table summarizes "Unresolved" identification in the INTERSTATE data that was provided in Sections 2.3.5.1 through 2.3.5.3.

Table 3 – "Unresolved" identification in the INTERSTATE Data Set

"Unresolved" Data identification Criteria	FHWA Action
If any one of segment's [THROUGH_LANES][48] is NULL or is less than 1 in the INTERSTATE_SLSC Data set	THROUGH_LANES_UN Field in INTERSTATE Data Set for all segments will be "flagged" as "UNRESOLVED THROUGH_LANES."
If Bridges_LM_IS_HPMS in Section 2.3.5.1 is greater than Birdges_LM_IS_NBI in Section 2.3.5.1	All segments with [STRUCTURE_TYPE_VN] = 1 in INTERSTATE Data Set will be "flagged" as "UNRESOLVED STRUCTURE_TYPE" in STRUCTURE_TYPE_UN Field, and those segments will be treated as non-bridges subjected to subsequent classification process, starting in Section 2.4.2 and the remainder of Section 2.

[47] Ibid.
[48] [DIR_THROUGH_LANES] for dual-carriage Interstate data.

"Unresolved" Data identification Criteria	FHWA Action
If a segment in INTERSTATE_SLSC Data set has [SURFACE_TYPE_VN] = 1 OR [SURFACE_TYPE_VN] = 11	Those segments will be "flagged" as "UNRESOLVED SURFACE_TYPE" in the SURFACE_TYPE_UN Field in INTERSTATE Data Set
If FHWA determines that [IRI_VN] values have unreasonably high frequent or extreme values for those segments with [SURFACE_TYPE_VN] value equal to 2, 3, 4, 5, 6, 7, 8, 9, or 10 in INTERSTATE_SLSC Data Set	Those segments will be "flagged" as "UNRESOLVED IRI" in IRI_UN Field in INTERSTATE Data Set
If FHWA determines that [CRACKING_PERCENT_VN] values have unreasonably high frequent or extreme values for those segments with [SURFACE_TYPE_VN] value equal to 2, 3, 4, 5, 6, 7, 8, 9, or 10 in INTERSTATE_SLSC Data Set	Those segments will be "flagged" as "UNRESOLVED CRACKING_PERCENT" in CRACKING_PERCENT_UN Field in INTERSTATE Data Set
If FHWA determines that [RUTTING_VN] values have unreasonably high frequent or extreme values for those segments with [SURFACE_TYPE_VN] value equal to 2, 6, 7, or 8 in INTERSTATE_SLSC Data Set	Those segments will be "flagged" as "UNRESOLVED RUTTING" in RUTTING_UN Field in INTERSTATE Data Set
If FHWA determines that [FAULTING_VN] values have unreasonably high frequent or extreme values for those segments with [SURFACE_TYPE_VN] value equal to 3, 4, 9, or 10 in INTERSTATE_SLSC Data Set	Those segments will be "flagged" as "UNRESOLVED FAULTING" in FAULTING_UN Field in INTERSTATE Data Set
If FHWA determines that [PSR_VN] values have unreasonably high frequent or extreme values for those segments with [SURFACE_TYPE_VN] value equal to 2, 3, 4, 5, 6, 7, 8, 9, or 10 in INTERSTATE_SLSC Data Set	Those segments will be "flagged" as "UNRESOLVED PSR" in PSR_UN Field in INTERSTATE Data Set

The below table summarizes "Unresolved" identification in the NON_INTERSTATE_NHS data that was provided in Sections 2.3.5.1 through 2.3.5.3.

Table 4 – "Unresolved" identification in the NON_INTERSTATE_NHS Data Set

"Unresolved" Data identification Criteria	FHWA Action
If any one of segment's [THROUGH_LANES] is NULL or is less than 1 in the NON_INTERSTATE_NHS_SLSC Data set	THROUGH_LANES_UN Field in NON_INTERSTATE_NHS Data Set for all segments will be "flagged" as "UNRESOLVED THROUGH_LANES."

"Unresolved" Data identification Criteria	FHWA Action
If Bridges_LM_IS_HPMS in Section 2.3.5.1 is greater than Birdges_LM_IS_NBI in Section 2.3.5.1	All segments with [STRUCTURE_TYPE_VN] = 1 in NON_INTERSTATE_NHS Data Set will be "flagged" as "UNRESOLVED STRUCTURE_TYPE" in STRUCTURE_TYPE_UN Field and those segments will be treated as non-bridges subjected to subsequent classification process, starting in Section 2.4.2 and the remainder of Section 2.
If a segment in NON_INTERSTATE_NHS_SLSC Data set has [SURFACE_TYPE_VN] = 1 OR [SURFACE_TYPE_VN] = 11	Those segments will be "flagged" as "UNRESOLVED SURFACE_TYPE" in the SURFACE_TYPE_UN Field in NON_INTERSTATE_NHS Data Set
If FHWA determines that [IRI_VN] values have unreasonably high frequent or extreme values for those segments with [SURFACE_TYPE_VN] value equal to 2, 3, 4, 5, 6, 7, 8, 9, or 10, in NON_INTERSTATE_NHS_SLCS	Those segments will be "flagged" as "UNRESOLVED IRI" in IRI_UN Field in NON_INTERSTATE_NHS Data Set
If FHWA determines that [CRACKING_PERCENT_VN] values have unreasonably high frequent or extreme values for those segments with [SURFACE_TYPE_VN] value equal to 2, 3, 4, 5, 6, 7, 8, 9, or 10 in NON_INTERSTATE_NHS_SLSC	Those segments will be "flagged" as "UNRESOLVED CRACKING_PERCENT" in CRACKING_PERCENT_UN Field in NON_INTERSTATE_NHS Data Set
If FHWA determines that [RUTTING_VN] values have unreasonably high frequent or extreme values for those segments with [SURFACE_TYPE_VN] value equal to 2, 6, 7, or 8 in NON_INTERSTATE_NHS_SLSC	Those segments will be "flagged" as "UNRESOLVED RUTTING" in RUTTING_UN Field in NON_INTERSTATE_NHS Data Set
If FHWA determines that [FAULTING_VN] values have unreasonably high frequent or extreme values for those segments with [SURFACE_TYPE_VN] value equal to 3, 4, 9, or 10 in NON_INTERSTATE_NHS_SLSC	Those segments will be "flagged" as "UNRESOLVED FAULTING" in FAULTING_UN Field in NON_INTERSTATE_NHS Data Set
If FHWA determines that [PSR_VN] values have unreasonably high frequent or extreme values for those segments with [SURFACE_TYPE_VN] value equal to 2, 3, 4, 5, 6, 7, 8, 9, or 10 in NON_INTERSTATE_NHS_SLSC	Those segments will be "flagged" as "UNRESOLVED PSR" in PSR_UN Field in NON_INTERSTATE_NHS Data Set

The remainder of Section 2 uses the prepared Data Sets INTERSTATE and NON_INTERSTATE_NHS for segment classification and measure computation. The INTERSTATE and NON_INTERSTATE Data Sets will look like Figure F6 in Appendix F and the source of the fields are described below.

- FULL_INTERSECTION Data Set in Section 2.3.1: Year_Record, State_Code, Route_ID, Begin_Point, End_Point, NHS_VN, F_SYSTEM_VN, THROUGH_LANES_VN[49], FACILITY_TYPE_VN, SURFACE_TYPE_VN, STRUCTURE_TYPE_VN, IRI_VN, IRI_VD, CRACKING_PERCENT_VN, CRACKING_PERCENT_VD, RUTTING_VN, RUTTING_VD, FAULTING_VN, FAULTING_VD, PSR_VN, PSR_VD, PSR_VT, and URBAN_CODE_VN

- Computed Segment Length: DynSeg_SL = End_Point - Begin_Point

- Incorporate Flagged Sections in the Sections Data Sets into Full Intersection Data Set from Section 2.3.3: IRI_Sections_SL, CRACKING_PERCENT_Sections_SL, CRACKING_PERCENT_Sections_SC, RUTTING_Sections_SL, RUTTING_Sections_SC, FAULTING_Sections_SL, FAULTING_Sections_SC, and PSR_Sections_SL

- Flagged Unresolved Segments in Section 2.3.5: THROUGH_LANES_UN, STRUCTURE_TYPE_UN, SURFACE_TYPE_UN, IRI_UN, CRACKING_PERCENT_UN, RUTTING_UN, FAULTING_UN, and PSR_UN

2.4 Segment Classification

The FHWA will perform the steps provided in this section after June 15 for Interstate and after August 15 for Non-Interstate NHS [50].

For computing measures, all mainline highway segments on the Interstate System and Non-Interstate NHS must be classified into the following categories:

(1) "Bridges"

(2) "Unpaved or Other" Surface Types

(3) "Missing, Invalid or Unresolved Data"

(4) "in Good condition"

(5) "in Fair condition"

(6) "in Poor condition

The classification is all inclusive for the mainline highway segments on the Interstate System and Non-Interstate NHS, and the categories are mutually exclusive as shown in Figure 2 below.

[49] DIR_THROUGH_LANES for dual-carriage Interstate data.
[50] 23 CFR 490.109 and 490.307

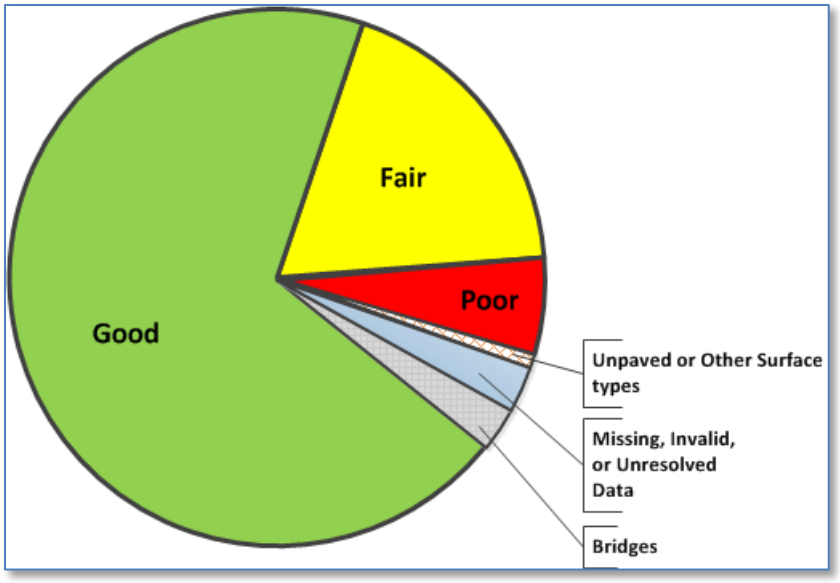


Figure 2 – Six Categories of Mainline Highway Segments in Measure Computation

Please note that FHWA will complete the classification process in sequence (ordered steps) as provided in this section.

2.4.1 Step 1: Identify Bridges

A record in Dataset INTERSTATE or NON_INTERSTATE_NHS is classified as a "Bridge" if the following criteria are met. Please note that Null in [STRUCTURE_TYPE_UN] Field means the data record was not flagged for "Unresolved" Data, described in Section 2.3.5.1.

- For Interstate System,

```
[INTERSTATE].[STRUCTURE_TYPE_VN] = 1 AND
[INTERSTATE].[STRUCTURE_TYPE_UN] IS NULL
```

- For non-Interstate NHS,

```
[NON_INTERSTATE_NHS].[STRUCTURE_TYPE_VN] = 1 AND
[NON_INTERSTATE_NHS].[STRUCTURE_TYPE_UN] IS NULL
```

Note once a segment in INTERSTATE or NON_INTERSTATE_NHS is classified as a "Bridge", then no further classification process (i.e., Steps 2 through 4 in Sections 2.4.2 through 2.4.4) are necessary.

Total mainline lane-miles, on the Interstate System represented by bridges in a Single Centerline Data Format, could be obtained by the following SQL statement.

```
SELECT

    Sum([INTERSTATE].[DynSeg_SL]*[INTERSTATE].[THROUGH_LANES_VN]) AS
    Bridges_LM_IS
```

```
FROM INTERSTATE

HAVING (([INTERSTATE].[STRUCTURE_TYPE_VN]=1) AND
[INTERSTATE].[STRUCTURE_TYPE_UN] IS NULL);
```

The total mainline lane-miles, on the Interstate System represented by bridges in a Dual-carriage Data Format, could be obtained by the following SQL statement.

```
SELECT

   Sum(IIf([INTERSTATE].[FACILITY_TYPE_VN]=1,

   [INTERSTATE].[THROUGH_LANES_VN]*[INTERSTATE].[DynSeg_SL],

   IIf([INTERSTATE].[FACILITY_TYPE_VN]=2 Or
   [INTERSTATE].[FACILITY_TYPE_VN]=6,

   [INTERSTATE].[DIR_THROUGH_LANES_VN]*[INTERSTATE].[DynSeg_SL],0))

   )

AS Bridges_LM_IS

FROM INTERSTATE

WHERE ([INTERSTATE].[STRUCTURE_TYPE_VN]=1 AND
[INTERSTATE].[STRUCTURE_TYPE_UN] IS NULL);
```

The total mainline lane-miles, on the Non-Interstate NHS represented by bridges, could be obtained by the following SQL statement.

```
SELECT

   Sum([NON_INTERSTATE_NHS].[DynSeg_SL]*[NON_INTERSTATE_NHS].[THROUG
   H_LANES_VN]) AS Bridges_LM_NIN

FROM NON_INTERSTATE_NHS

HAVING (([NON_INTERSTATE_NHS].[STRUCTURE_TYPE_VN]=1) AND
[NON_INTERSTATE_NHS].[STRUCTURE_TYPE_UN] IS NULL);
```

Please note that `[DynSeg_SL]` is `([End_Point] – [Begin_Point])` for each mainline highway segment.

2.4.2 Step 2: Identify "Unpaved or Other" Surface Types

Classification Step 2 in this section only applies to segments, in Dataset INTERSTATE or NON_INTERSTATE_NHS, not classified as "Bridge" in Step 1 in Section 2.4.1. A record in Dataset INTERSTATE or NON_INTERSTATE_NHS is classified as having "Unpaved and Other" Surface Types" if the following criteria is met. Please note that Null for [SURFACE_TYPE_UN] Field means the data record was not flagged for "Unresolved" Data, as described in Section 2.3.5.2.

- For Interstate System,

```
([INTERSTATE].[SURFACE_TYPE_VN] = 1 OR

[INTERSTATE].[SURFACE_TYPE_VN] = 11) AND
([INTERSTATE].[SURFACE_TYPE_UN] IS NULL)
```

- For non-Interstate NHS,

```
([NON_INTERSTATE_NHS].[SURFACE_TYPE_VN] = 1 OR

[NON_INTERSTATE_NHS].[SURFACE_TYPE_VN] = 11) AND
([NON_INTERSTATE_NHS].[SURFACE_TYPE_UN] IS NULL)
```

Note once a segment in INTERSTATE or NON_INTERSTATE_NHS is classified as having "Unpaved or Other" Surface Types, then no further classification process (i.e., Steps 3 and 4 in Sections 2.4.3 and 2.4.4) are necessary.

Total mainline lane-miles, on the Interstate System identified as "Unpaved or Other" Surface Types in a Single Centerline Data Format, could be obtained by the following SQL statement.

```
SELECT

   Sum([INTERSTATE].[DynSeg_SL]*[INTERSTATE].[THROUGH_LANES_VN]) AS
   Unpaved_Other_LM_IS

FROM INTERSTATE

HAVING ((([INTERSTATE].[SURFACE_TYPE_VN] = 1) OR
([INTERSTATE].[SURFACE_TYPE_VN] = 11)) AND

([INTERSTATE].[SURFACE_TYPE_UN]) IS NULL);
```

Total mainline lane-miles, on the Interstate System identified as "Unpaved or Other" Surface Types in a dual-Carriage Data Format, could be obtained by the following SQL statement.

```
SELECT

   Sum(IIf([INTERSTATE].[FACILITY_TYPE_VN]=1,

   [INTERSTATE].[THROUGH_LANES_VN]*[INTERSTATE].[DynSeg_SL],

   IIf([INTERSTATE].[FACILITY_TYPE_VN]=2 Or
   [INTERSTATE].[FACILITY_TYPE_VN]=6,

   [INTERSTATE].[DIR_THROUGH_LANES_VN]*[INTERSTATE].[DynSeg_SL],

   0))
```

```
    )

AS Unpaved_Other_LM_IS

FROM INTERSTATE

WHERE ((([INTERSTATE].[SURFACE_TYPE_VN] = 1) OR
([INTERSTATE].[SURFACE_TYPE_VN] = 11)) AND

([INTERSTATE].[SURFACE_TYPE_UN]) IS NULL);
```

Total mainline lane-miles, on the Non-Interstate NHS identified as "Unpaved or Other" Surface Types, could be obtained by the following SQL statement.

```
SELECT

    Sum([NON_INTERSTATE_NHS].[DynSeg_SL]*[NON_INTERSTATE_NHS].[THROUG
    H_LANES_VN]) AS Unpaved_Other_LM_NIN

FROM NON_INTERSTATE_NHS

HAVING ((([NON_INTERSTATE_NHS].[SURFACE_TYPE_VN] = 1) OR
[NON_INTERSTATE_NHS].[SURFACE_TYPE_VN] = 11)) AND
([NON_INTERSTATE_NHS].[SURFACE_TYPE_UN]) IS NULL);
```

Please note that `[DynSeg_SL]` is `([End_Point] – [Begin_Point])` for each mainline highway segment.

2.4.3 Step 3: Identify "Missing, Invalid and Unresolved Data"

Classification Step 3 in this section only applies to segments, in Dataset INTERSTATE or NON_INTERSTATE_NHS, not classified as "Bridge" in Step 1 in Section 2.4.1 and not classified as having "Unpaved or Other" Surface Types in Step 2 in Section 2.4.2.

23 CFR 490.313(b)(4) stipulates FHWA determination of "Missing, Invalid or Unresolved Data" in State DOT reported data in HPMS for Interstate System and for non-Interstate NHS. The FHWA will make a final determination that a reported section in HPMS has "Missing, Invalid or Unresolved Data" with the data in HPMS as of June 15, 2019[51] and annually thereafter for the Interstate System and with the data in HPMS as of August 15, 2018[52] and biennially thereafter for the non-Interstate NHS after coordinating with the respective State DOT. "Missing, Invalid or Unresolved Data" is identified by FHWA through assessing whether or not State DOT reported data meets the data requirements specified in 23 CFR 490.309 and 490.311(c) and provides sufficient information for FHWA to rate an Overall Condition Rating (Good, Fair, or Poor), described in 23 CFR 490.313(c) and(d) for each of the sections on Interstate System and non-Interstate NHS. This section describes

[51] 23 CFR 490.317(b)
[52] 23 CFR 490.109(d) and 490.313(e)

the criteria that FHWA uses to identify "Missing, Invalid or Unresolved Data" in State DOT reported data in HPMS. Please note that FHWA will identify "Missing, Invalid or Unresolved Data" initially when State DOT submits their data to HPMS by April 15[53] for the Interstate System and by June 15[54] for the Non-Interstate NHS. Upon receiving the data from State DOTs, FHWA then will go through the 4-step classification process in Section 2.4 to initially classify segments as "Missing, Invalid, and Unresolved Data", if erroneous data are identified per the criteria specified in this section. "Missing, Invalid, and Unresolved Data" status can only be removed for a segment, if State DOT resubmits corrected data (or explanation accepted by FHWA) before FHWA data extraction dates for measure computation (June 15, 2019 and annually thereafter for the Interstate System and August 15, 2018 and biennially thereafter for the non-Interstate NHS). Please see Appendix B describing resolution process for "Missing, Invalid, and Unresolved Data."

2.4.3.1 Step 3a: Null or Erroneous SURFACE TYPE

A record in Datasets INTERSTATE or NON_INTERSTATE_NHS is classified as "Missing, Invalid and Unresolved Data" if that record has a Null or invalid SURFACE_TYPE data, as shown below.

For INTERSTATE:

```
([INTERSTATE].[SURFACE_TYPE_VN] IS NULL) OR
([INTERSTATE].[SURFACE_TYPE_VN] NOT IN (2,3,4,5,6,7,8,9,10))OR
([INTERSTATE].[SURFACE_TYPE_UN] = "UNRESOLVED SURFACE_TYPE")
```

For NON_INTERSTATE_NHS:

```
([NON_INTERSTATE_NHS].[SURFACE_TYPE_VN] IS NULL) OR
([NON_INTERSTATE_NHS].[SURFACE_TYPE_VN] NOT IN
(2,3,4,5,6,7,8,9,10))) OR ([NON_INTERSTATE_NHS].[SURFACE_TYPE_UN] =
"UNRESOLVED SURFACE_TYPE")
```

Note once a segment in INTERSTATE or NON_INTERSTATE_NHS is classified as having "Missing, Invalid and Unresolved Data" because that segment has Null or invalid SURFACE_TYPE or Unresolved SURFACE_TYPE (described in Section 2.3.5.2), then no further classification processes (i.e., Steps 3b, 3c, 3d and 4 in the remainder of Section 2.4.3 and Section 2.4.4) are necessary. This is illustrated in the segment from Milepost 0 to Milepost 0.05 in the hypothetical "Route AAA" example in Figure F7 in Appendix F.

2.4.3.2 Step 3b: Asphalt Pavement

A record in Datasets INTERSTATE or NON_INTERSTATE_NHS is classified as "Missing, Invalid or Unresolved Data" if that record has been reported as an asphalt surface segment and determined having errors in both IRI/CRACKING_PERCENT/RUTTING related data and PSR related data, as shown in Table 5 below. Note a segment in INTERSTATE or NON_INTERSTATE_NHS could have an error in IRI/CRACKING_PERCENT/RUTTING related data items (e.g., flagged as "COINCIDENCE VIOLATION" for CRACKING_PERCENT and/or RUTTING), but that segment is not necessarily classified as "Missing,

[53] 23 CFR 490.311(c)(4) and (d)(2)
[54] 23 CFR 490.311(c)(5) and (d)(3)

Invalid, or Unresolved Data". The logic in Table 5 also checks whether the segment has valid PSR related data.

Table 5 – Missing, Invalid or Unresolved Data Criteria for an INTERSTATE and NON_INTERSTATE NHS Segments with Asphalt Surface as SURFACE_TYPE

Criteria Description	Criteria Expression	INTERSTATE / NON_INTERSTATE_NHS
IF {Asphalt Pavement Surface**}**;	**IF {**[SURFACE_TYPE_VN] IN (2, 6, 7, 8)**}**	Both
AND {Any one of the IRI/CRACKING_PERCENT/RUTTING related data has an error**}**;	**AND {**[IRI_VN] IS NULL OR	Both
	[IRI_VN] <= 0 OR	Both
	[IRI_VD] IS NULL OR	Both
	YEAR([IRI_VD]) <> [YEAR_RECORD] OR	INTERSTATE only
	YEAR([IRI_VD]) NOT BETWEEN ([YEAR_RECORD-1] AND[YEAR_RECORD]) OR	NON_INTERSTATE_NHS only
	[IRI_Sections_SL] = "LENGTH VIOLATION" OR	Both (See Sections 2.3.2 and 2.3.3)
	[IRI_UN] = "UNRESOLVED IRI" OR	Both (See Sections 2.3.5.3 and 2.3.5.4)
	[CRACKING_PERCENT_VN] IS NULL OR	Both
	([CRACKING_PERCENT_VN] NOT BETWEEN 0 AND 100) OR	Both
	[CRACKING_PERCENT _VD] IS NULL OR	Both
	YEAR([CRACKING_PERCENT_VD]) <> [YEAR_RECORD] OR	INTERSTATE only
	YEAR([CRACKING_PERCENT_VD]) NOT BETWEEN ([YEAR_RECORD-1] AND[YEAR_RECORD])OR	NON_INTERSTATE_NHS only
	[CRACKING_PERCENT_Sections_SL] = "LENGTH VIOLATION" OR	Both (See Sections 2.3.2 and 2.3.3)
	[CRACKING_PERCENT_Sections_SC] = "COINCIDENCE VIOLATION" OR	Both (See Sections 2.3.2 and 2.3.3)
	[CRACKING_PERCENT_UN] = "UNRESOLVED CRACKING_PERCENT" OR	Both (See Sections 2.3.5.3 and 2.3.5.4)
	[RUTTING_VN] IS NULL OR	Both
	[RUTTING_VN] < 0 OR	Both
	[RUTTING_VD] IS NULL OR	Both
	YEAR([RUTTING_VD]) <> [YEAR_RECORD] OR	INTERSTATE only
	YEAR([RUTTING_VD]) NOT BETWEEN ([YEAR_RECORD-1] OR	NON_INTERSTATE_NHS only

Criteria Description	Criteria Expression	INTERSTATE / NON_INTERSTATE_NHS
	[RUTTING_Sections_SL] = "LENGTH VIOLATION" OR	Both (See Sections 2.3.2 and 2.3.3)
	[RUTTING_Sections_SC] = "COINCIDENCE VIOLATION" OR	Both (See Sections 2.3.2 and 2.3.3)
	[RUTTING_UN] = "UNRESOLVED RUTTING"	Both (See Sections 2.3.5.3 and 2.3.5.4)
	[THROUGH_LANES_UN] = "UNRESOLVED THROUGH_LANES"**}**	Both (See Section 2.3.5.4)
AND {Any one of the PSR related data has an error, where Post Speed Limit is less than 40 mph.**}**	**AND {**[PSR_VN] IS NULL OR	Both
	([PSR_VN] NOT BETWEEN 0.1 AND 5.0) OR	Both
	[PSR_VT] IS NULL OR	Both
	([PSR_VT] <> "A") OR	Both
	[PSR_VD] IS NULL OR	Both
	YEAR([PSR_VD]) <> [YEAR_RECORD] OR	INTERSTATE only
	YEAR([PSR_VD]) NOT BETWEEN ([YEAR_RECORD-1] AND[YEAR_RECORD])OR	NON_INTERSTATE_NHS only
	[PSR_Sections_SL] = "LENGTH VIOLATION" OR	Both (See Sections 2.3.2 and 2.3.3)
	[PSR_UN] = "UNRESOLVED PSR" OR	Both (See Sections 2.3.5.3 and 2.3.5.4)
	[THROUGH_LANES_UN] = "UNRESOLVED THROUGH_LANES"**}**	Both (See Section 2.3.5.4)

Please note that although [PSR_VD] reporting is not required in the HPMS Field Manual. However, to ensure PSR data is collected annually[55] for Interstate System and every 2 years[56] for Non-Interstate NHS, the FHWA expects State DOT to provide [PSR_VD] for applicable pavement sections.

2.4.3.3 Step 3c: Jointed Concrete Pavement

A record in Datasets INTERSTATE or NON_INTERSTATE_NHS is classified as "Missing, Invalid or Unresolved Data" if that record has been reported as a jointed concrete surface segment and determined having errors in both IRI/CRACKING_PERCENT/FAULTING related data and PSR related data, as shown in Table 6 below.

[55] 23 CFR 490.309(b)(1)(iv)(E)
[56] 23 CFR 490.309(b)(2)(iii)(E)

Table 6 – Missing, Invalid or Unresolved Data Criteria for an INTERSTATE and NON_INTERSTATE NHS Segments with Jointed Concrete Surface as SURFACE_TYPE

Criteria Description	Criteria Expression	INTERSTATE / NON_INTERSTATE_NHS
IF {Jointed Concrete Pavement Surface};	**IF** {[SURFACE_TYPE_VN] IN (3, 4, 9, 10)}	Both
AND {Any one of the IRI/CRACKING_PERCENT/FAULTING related data has an error};	**AND** {[IRI_VN] IS NULL OR	Both
	[IRI_VN] <= 0 OR	Both
	[IRI_VD] IS NULL OR	Both
	YEAR([IRI_VD]) <> [YEAR_RECORD] OR	INTERSTATE only
	YEAR([IRI_VD]) NOT BETWEEN ([YEAR_RECORD-1] AND[YEAR_RECORD]) OR	NON_INTERSTATE_NHS only
	[IRI_Sections_SL] = "LENGTH VIOLATION" OR	Both (See Sections 2.3.2 and 2.3.3)
	[IRI_UN] = "UNRESOLVED IRI" OR	Both (See Sections 2.3.5.3 and 2.3.5.4)
	[CRACKING_PERCENT_VN] IS NULL OR	Both
	([CRACKING_PERCENT_VN] NOT BETWEEN 0 AND 100) OR	Both
	[CRACKING_PERCENT _VD] IS NULL OR	Both
	YEAR([CRACKING_PERCENT_VD]) <> [YEAR_RECORD] OR	INTERSTATE only
	YEAR([CRACKING_PERCENT_VD]) NOT BETWEEN ([YEAR_RECORD-1] AND[YEAR_RECORD])OR	NON_INTERSTATE_NHS only
	[CRACKING_PERCENT_Sections_SL] = "LENGTH VIOLATION" OR	Both (See Sections 2.3.2 and 2.3.3)
	[CRACKING_PERCENT_Sections_SC] = "COINCIDENCE VIOLATION" OR	Both (See Sections 2.3.2 and 2.3.3)
	[CRACKING_PERCENT_UN] = "UNRESOLVED CRACKING_PERCENT" OR	Both (See Sections 2.3.5.3 and 2.3.5.4)
	[FAULTING_VN] IS NULL OR	Both
	[FAULTING_VN] < 0 OR	Both
	[FAULTING_VD] IS NULL OR	Both
	YEAR([FAULTING_VD]) <> [YEAR_RECORD] OR	INTERSTATE only
	YEAR([FAULTING_VD]) NOT BETWEEN ([YEAR_RECORD-1] OR	NON_INTERSTATE_NHS only
	[FAULTING_Sections_SL] = "LENGTH VIOLATION" OR	Both (See Sections 2.3.2 and 2.3.3)
	[FAULTING_Sections_SC] = "COINCIDENCE VIOLATION" OR	Both (See Sections 2.3.2 and 2.3.3)
	[FAULTING_UN] = "UNRESOLVED FAULTING" OR	Both (See Sections 2.3.5.3 and 2.3.5.4)
	[THROUGH_LANES_UN] = "UNRESOLVED THROUGH_LANES"}	Both (See Section 2.3.5.4)

Criteria Description	Criteria Expression	INTERSTATE / NON_INTERSTATE_NHS
AND {Any one of the PSR related data has an error, where Post Speed Limit is less than 40 mph.}	**AND** {[PSR_VN] IS NULL OR	Both
	([PSR_VN] NOT BETWEEN 0.1 AND 5.0) OR	Both
	[PSR_VT] IS NULL OR	Both
	([PSR_VT] <> "A") OR	Both
	[PSR_VD] IS NULL OR	Both
	YEAR([PSR_VD]) <> [YEAR_RECORD] OR	INTERSTATE only
	YEAR([PSR_VD]) NOT BETWEEN ([YEAR_RECORD-1] AND[YEAR_RECORD])OR	NON_INTERSTATE_NHS only
	[PSR_Sections_SL] = "LENGTH VIOLATION" OR	Both (See Sections 2.3.2 and 2.3.3)
	[PSR_UN] = "UNRESOLVED PSR" OR	Both (See Sections 2.3.5.3 and 2.3.5.4)
	[THROUGH_LANES_UN] = "UNRESOLVED THROUGH_LANES"}	Both (See Section 2.3.5.4)

Note a segment in INTERSTATE or NON_INTERSTATE_NHS could have an error in IRI/CRACKING_PERCENT/FAULTING related data items (e.g., flagged as "COINCIDENCE VIOLATION" for CRACKING_PERCENT and/or FAULTING), but that segment is not necessarily classified as "Missing, Invalid, or Unresolved Data". The logic in Table 5 also checks whether the segment has valid PSR related data. For example, the segment from Milepost 1.050 to Milepost 1.100 in Figures 6 and 7 (and Figure F5 in Appendix F) violated spatial coincidence requirement (flagged as "COINCIDENCE VIOLATION" for FAULTING Data Item) because there were no data reported for IRI Data Item at this location.

2018|##|Route AAA|**1.050**|**1.100**|**FAULTING**|0.050|0.00| |01/2018|

But that segment was not classified as "Missing, Invalid, or Unresolved Data" because this segment contained valid data for all PSR related data items. Please see Figure F7 in Appendix F for its classification.

As stated in previous section, [PSR_VD] reporting is not required in the HPMS Field Manual. However, to ensure PSR data is collected annually[57] for Interstate System and every 2 years[58] for Non-Interstate NHS, the FHWA expects State DOT to provide [PSR_VD] for applicable pavement sections.

2.4.3.4 Step 3d: Continuously Reinforced Concrete Pavement (CRCP)

A record in Datasets INTERSTATE or NON_INTERSTATE_NHS is classified as "Missing, Invalid or Unresolved Data" if that record was reported as a CRCP surface segment and determined having errors in both IRI/CRACKING_PERCENT related data and PSR related data, as shown in Table 7 below.

[57] 23 CFR 490.309(b)(1)(iv)(E)
[58] 23 CFR 490.309(b)(2)(iii)(E)

Note a segment in INTERSTATE or NON_INTERSTATE_NHS could have an error in IRI/CRACKING_PERCENT related data items (e.g., flagged as "COINCIDENCE VIOLATION" for CRACKING_PERCENT), but that segment is not necessarily classified as "Missing, Invalid, and Unresolved Data". The logic in Tables 7 also checks whether the segment has valid PSR related data.

Table 7 – Missing, Invalid or Unresolved Data Criteria for an INTERSTATE and NON_INTERSTATE NHS Segments with Jointed Concrete Surface as SURFACE_TYPE

Criteria Description	Criteria Expression	INTERSTATE / NON_INTERSTATE_NHS
IF {CRCP Surface;	**IF** {[SURFACE_TYPE_VN] = 5}	Both
AND {Any one of the IRI/CRACKING_PERCENT related data has an error};	**AND** {[IRI_VN] IS NULL OR	Both
	[IRI_VN] <= 0 OR	Both
	[IRI_VD] IS NULL OR	Both
	YEAR([IRI_VD]) <> [YEAR_RECORD] OR	INTERSTATE only
	YEAR([IRI_VD]) NOT BETWEEN ([YEAR_RECORD-1] AND[YEAR_RECORD]) OR	NON_INTERSTATE_NHS only
	[IRI_Sections_SL] = "LENGTH VIOLATION" OR	Both (See Sections 2.3.2 and 2.3.3)
	[IRI_UN] = "UNRESOLVED IRI" OR	Both (See Sections 2.3.5.3 and 2.3.5.4)
	[CRACKING_PERCENT_VN] IS NULL OR	Both
	([CRACKING_PERCENT_VN] NOT BETWEEN 0 AND 100) OR	Both
	[CRACKING_PERCENT _VD] IS NULL OR	Both
	YEAR([CRACKING_PERCENT_VD]) <> [YEAR_RECORD] OR	INTERSTATE only
	YEAR([CRACKING_PERCENT_VD]) NOT BETWEEN ([YEAR_RECORD-1] AND[YEAR_RECORD])OR	NON_INTERSTATE_NHS only
	[CRACKING_PERCENT_Sections_SL] = "LENGTH VIOLATION" OR	Both (See Sections 2.3.2 and 2.3.3)
	[CRACKING_PERCENT_Sections_SC] = "COINCIDENCE VIOLATION" OR	Both (See Sections 2.3.2 and 2.3.3)
	[CRACKING_PERCENT_UN] = "UNRESOLVED CRACKING_PERCENT" OR	Both (See Sections 2.3.5.3 and 2.3.5.4)
	[THROUGH_LANES_UN] = "UNRESOLVED THROUGH_LANES"}	Both (See Section 2.3.5.4)
AND {Any one of the PSR related data has an error, where Post Speed Limit is less than 40 mph.	**AND** {[PSR_VN] IS NULL OR	Both
	([PSR_VN] NOT BETWEEN 0.1 AND 5.0) OR	Both
	[PSR_VT] IS NULL OR	Both
	([PSR_VT] <> "A") OR	Both
	[PSR_VD] IS NULL OR	Both
	YEAR([PSR_VD]) <> [YEAR_RECORD] OR	INTERSTATE only
	YEAR([PSR_VD]) NOT BETWEEN ([YEAR_RECORD-1] AND[YEAR_RECORD])OR	NON_INTERSTATE_NHS only

Criteria Description	Criteria Expression	INTERSTATE / NON_INTERSTATE_NHS
	[PSR_Sections_SL] = "LENGTH VIOLATION" OR	Both (See Sections 2.3.2 and 2.3.3)
	[PSR_UN] = "UNRESOLVED PSR" OR	Both (See Sections 2.3.5.3 and 2.3.5.4)
	[THROUGH_LANES_UN] = "UNRESOLVED THROUGH_LANES" **}**	Both (See Section 2.3.5.4)

As stated in previous section, [PSR_VD] reporting is not required in the HPMS Field Manual. However, to ensure PSR data is collected annually[59] for Interstate System and every 2 years[60] for Non-Interstate NHS, the FHWA expects State DOT to provide [PSR_VD] for applicable pavement sections where the State DOT is using PSR to comply with 23 CFR 490.309 -490.317.

2.4.3.5 Percent Lane-miles of "Missing, Invalid, or Unresolved Data"

Note that any segment in INTERSTATE and NON_INTERSTATE_NHS falls into the any one of the conditions described in Section 2.4.3 will be counted towards the total lane-miles of "Missing, Invalid, or Unresolved Data". Please note that the lane-miles of each segment in the Datasets INTERSTATE and NON_INTERSTATE_NHS is computed by multiplying [THROUGH_LANES_VN] and/or [DIR_THROUGH_LANES_VN] by [DynSeg_SL] for each mainline highway segment where [DynSeg_SL] is ([End_Point] – [Begin_Point]) for the corresponding segment.

Also note that once a segment in INTERSTATE or NON_INTERSTATE_NHS is classified as having "Missing, Invalid or Unresolved Data", then no further classification process (i.e., Step 4 in Section 2.4.4) is necessary.

23 CFR 490.313(b)(4)(i) specified that a total mainline lane-miles of "Missing, Invalid, or Unresolved Data" segments for Interstate System and non-Interstate NHS must not be more than 5.0 percent of the total lane-miles of the respective network, excluding the lane-miles represented by "Bridges" and "Unpaved or Other" Surface Types. The percent lane-miles of mainline highways on the Interstate System and Non-Interstate NHS determined having "Missing, Invalid and Unresolved Data" is performed in the following general form in accordance with 23 CFR 490.313(b)(4)(i).

$$\%\_MIU\_IS = \frac{MIU\_LM\_IS}{Network\_LM\_IS - Bridges\_LM\_IS - Unpaved\_Other\_LM\_IS} \times 100$$

$$\%\_MIU\_NIN = \frac{MIU\_LM\_NIN}{Network\_LM\_NIN - Bridges\_LM\_NIN - Unpaved\_Other\_LM\_NIN} \times 100$$

[59] 23 CFR 490.309(b)(1)(iv)(E)
[60] 23 CFR 490.309(b)(2)(iii)(E)

Where,

%_MIU_IS:	percentage of Interstate System determined having "Missing, Invalid or Unresolved" data (computed to the one tenth of a percent)
%_MIU_NIN:	percentage of Non-Interstate NHS determined having "Missing, Invalid or Unresolved" data (computed to the one tenth of a percent)
MIU_LM_IS:	total lane-miles of mainline highways on the Interstate System determined having "Missing, Invalid or Unresolved" data (see Sections 2.4.3.1 through 2.4.3.4)
MIU_LM_NIN:	total lane-miles of mainline highways on the Non-Interstate NHS determined having "Missing, Invalid or Unresolved" data (see Sections 2.4.3.1 through 2.4.3.4)
Network_LM_IS:	total lane-miles of mainline highways on the Interstate System
Network_LM_NIN:	total lane-miles of mainline highways on the Non-Interstate NHS
Bridges_LM_IS:	total lane-miles of mainline highways on the Interstate System reported as bridges (See Section 2.4.1)
Bridges_LM_NIN:	total lane-miles of mainline highways on the Non-Interstate NHS reported as bridges (see section 2.4.1)
Unpaved_Other_LM_IS:	total lane-miles of mainline highways on the Interstate System reported as "Unpaved or Other" Surface Types (see Section 2.4.2)
Unpaved_Other_LM_NIN:	total lane-miles of mainline highways on the Non-Interstate NHS reported as "Unpaved or Other" Surface Types (See Section 2.4.2)

The total lane-miles of mainline highways on the Interstate System determined having "Missing, Invalid or Unresolved" data (MIU_LM_IS) could be obtained by following pseudo-code for a Single Centerline data format.

```
SELECT

    Sum([INTERSTATE].[THROUGH_LANES_VN]*[INTERSTATE].[DynSeg_SL])

    AS MIU_LM_IS

FROM INTERSTATE

WHERE (Segments meet any one of the Missing, Invalid or Unresolved
Data criteria in Steps 3a through 3d in Sections 2.4.3.1 through
2.4.3.4);
```

The total lane-miles of mainline highways on the Interstate System determined having "Missing, Invalid or Unresolved" data (MIU_LM_IS) could be obtained by following pseudo-code for a Dual-Carriage data format.

```
SELECT

    Sum(IIf([INTERSTATE].[FACILITY_TYPE_VN]=1,

    [INTERSTATE].[THROUGH_LANES_VN]*[INTERSTATE].[DynSeg_SL],

    IIf([INTERSTATE].[FACILITY_TYPE_VN]=2 Or
    [INTERSTATE].[FACILITY_TYPE_VN]=6,

    [INTERSTATE].[DIR_THROUGH_LANES_VN]*[INTERSTATE].[DynSeg_SL],

    0)))

AS MIU_LM_IS

FROM INTERSTATE

WHERE (Segments meet any one of the Missing, Invalid or Unresolved
Data criteria in Steps 3a through 3d in Sections 2.4.3.1 through
2.4.3.4);
```

The total lane-miles of mainline highways on the Non-Interstate NHS determined having "Missing, Invalid or Unresolved" data (MIU_LM_NIN) could be obtained by following pseudo-code.

```
SELECT

    Sum([NON_INTERSTATE_NHS].[THROUGH_LANES_VN]*[NON_INTERSTATE_NHS].
    [DynSeg_SL])

    AS MIU_LM_NIN

FROM NON_INTERSTATE_NHS

WHERE (Segments meet any one of the Missing, Invalid or Unresolved
Data criteria in Steps 3a through 3d in Sections 2.4.3.1 through
2.4.3.4);
```

Total lane-miles of mainline highways on the Interstate System (Network_LM_IS) could be obtained by following SQL for a Single Centerline data format.

```
SELECT

    Sum([INTERSTATE].[THROUGH_LANES_VN]*[INTERSTATE].[DynSeg_SL])

    AS Network_LM_IS
```

```
FROM INTERSTATE;
```

Total lane-miles of mainline highways on the Interstate System (Network_LM_IS) could be obtained by following SQL for a Dual-Carriage data format.

```
SELECT

    Sum(IIf([INTERSTATE].[FACILITY_TYPE_VN]=1,

    [INTERSTATE].[THROUGH_LANES_VN]*[INTERSTATE].[DynSeg_SL],

    IIf([INTERSTATE].[FACILITY_TYPE_VN]=2 Or
    [INTERSTATE].[FACILITY_TYPE_VN]=6,

    [INTERSTATE].[DIR_THROUGH_LANES_VN]*[INTERSTATE].[DynSeg_SL],

    0)))

AS Network_LM_IS

FROM INTERSTATE;
```

Total lane-miles of mainline highways on the Non-Interstate NHS (Network_LM_NIN) could be obtained by following SQL.

```
SELECT

    Sum([NON_INTERSTATE_NHS].[THROUGH_LANES_VN]*[NON_INTERSTATE_NHS].
    [DynSeg_SL])

    AS Network_LM_NIN

FROM NON_INTERSTATE_NHS;
```

2.4.4 Step 4: Good/Fair/Poor Condition Rating

Classification Step 4 in this section only applies to segments, in Dataset INTERSTATE or NON_INTERSTATE_NHS, not classified as “Bridge”, “Unpaved or Other” Surface Types and “Missing, Invalid, Unresolved Data in Steps 1 through 3 in Sections 2.4.1 through 2.4.3. A record in Datasets INTERSTATE or NON_INTERSTATE_NHS is classified as in Good, Fair or Poor condition if that record meets any one of the following condition shown in Table 8 below. Please note that FHWA will complete the classification process in sequence (ordered steps) as provided in Table 8. For example, if a segment meets the first set of criteria (Order of Operation 1), then that segment will be classified as in Good condition and will not be evaluated for subsequent sets of criteria (Order of Operations 2 through 12). Similarly, if a segment does not meet the first set of criteria (Order of Operation 1) but meets the second set of criteria (Order of Operation 2) then that segment will be classified as in Good condition and will not be evaluated for subsequent sets of criteria (Order of Operations 3 through 12).

Table 8 – Condition Rating for an INTERSTATE and NON_INTERSTATE NHS Segment

Order of Operation	Criteria Description	Criteria Expression	Classification (Overall Rating)

1	IF asphalt pavement surface and meets Good Condition thresholds for all 3 metrics	IF {
		([SURFACE_TYPE_VN] IN (2, 6, 7, 8)
		AND ROUND[61]([IRI_VN], DIGITS = 0) < 95
		AND ROUND[62]([CRACKING_PERCENT_VN], DIGITS = 0) < 5
		AND ROUND[63]([RUTTING_VN], DIGITS = 2) < 0.20
		)
		}
			THEN Good

2	IF jointed concrete pavement surface and meets Good Condition thresholds for all 3 metrics	IF {
		([SURFACE_TYPE_VN] IN (3, 4, 9, 10)
		AND ROUND([IRI_VN], DIGITS = 0) < 95
		AND ROUND([CRACKING_PERCENT_VN], DIGITS = 0) < 5
		AND ROUND[64]([FAULTING_VN], DIGITS = 2) < 0.10
		)
		}
			THEN Good

3	IF CRCP surface and meets Good Condition thresholds for both metrics	IF {
		([SURFACE_TYPE_VN] = 5
		AND ROUND([IRI_VN], DIGITS = 0) < 95
		AND ROUND([CRACKING_PERCENT_VN], DIGITS = 0) < 5
		)
		}
			THEN Good

[61] "ROUND ([IRI_VN], DIGITS = 0)" denotes rounding [IRI_VN] to the nearest inch per mile, as required in 23 CFR 490.311(b)(1)(ii) and HPMS Field Manual (December 2016) Pg. 4-91 - https://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/ An [IRI_VN] with a tenth digit value of 5 or greater will be rounded up whereas a tenth digit value of less than 5 will be rounded down to the nearest whole number (in integer inch per mile).

[62] "ROUND ([CRACKING_PERCENT_VN], DIGITS = 0)" denotes rounding [CRACKING_PERCENT_VN] to the nearest whole percent, as required in 23 CFR 490.311(b)(2)(i), (b)(3), and (b)(4)(i) and HPMS Field Manual (December 2016) Pg. 4-107. A [CRACKING_PERCENT_VN] with a tenth digit value of 5 or greater will be rounded up whereas a tenth digit value of less than 5 will be rounded down to the nearest whole number (in whole percent).

[63] "ROUND ([RUTTING_VN], DIGITS = 2)" denotes rounding [RUTTING_VN] to the nearest 0.01 inch, as required in 23 CFR 490.311(b)(2)(ii) and HPMS Field Manual (December 2016) Pg. 4-99. A [RUTTING_VN] with a thousandth digit value of 5 or greater will be rounded up whereas a thousandth digit value of less than 5 will be rounded down to the nearest hundredths (in hundredths of inches).

[64] "ROUND ([FAULTING_VN], DIGITS = 2)" denotes rounding [FAULTING_VN] nearest 0.01 inch, as required in 23 CFR 490.311(b)(4)(iii) and HPMS Field Manual (December 2016) Pg. 4-103. A [FAULTING_VN] with a thousandth digit value of 5 or greater will be rounded up whereas a thousandth digit value of less than 5 will be rounded down to the nearest hundredths (in hundredths of inches).

Order of Operation	Criteria Description	Criteria Expression	Classification (Overall Rating)

4	IF asphalt pavement surface and meets Poor Condition thresholds at least 2 metrics	IF {
		([SURFACE_TYPE_VN] IN (2, 6, 7, 8))
		AND (
		(ROUND([IRI_VN], DIGITS = 0) > 170
		AND ROUND([CRACKING_PERCENT_VN], DIGITS = 0) > 20)
		OR
		(ROUND([IRI_VN], DIGITS = 0) > 170
		AND ROUND([RUTTING_VN], DIGITS = 2) > 0.40)
		OR
		(ROUND([CRACKING_PERCENT_VN], DIGITS = 0) > 20
		AND ROUND([RUTTING_VN], DIGITS = 2) > 0.40)
		)
		}
			THEN Poor

5	IF jointed concrete pavement surface and meets Poor Condition thresholds for at least 2 metrics	IF {
		([SURFACE_TYPE_VN] IN (3, 4, 9, 10))
		AND (
		(ROUND([IRI_VN], DIGITS = 0) > 170
		AND ROUND([CRACKING_PERCENT_VN], DIGITS = 0) > 15)
		OR
		(ROUND([IRI_VN], DIGITS = 0) > 170
		AND ROUND([FAULTING_VN], DIGITS = 2) > 0.15)
		OR
		(ROUND([CRACKING_PERCENT_VN], DIGITS = 0) > 15
		AND ROUND([FAULTING_VN], DIGITS = 2) > 0.15)
		)
		}
			THEN Poor

6	IF CRCP surface and meets Poor Condition thresholds for both metrics	IF {
		([SURFACE_TYPE_VN] = 5)
		AND (ROUND([IRI_VN], DIGITS = 0) > 170)
		AND [ROUND(CRACKING_PERCENT_VN], DIGITS = 0) > 10
		)
		}
			THEN Poor

7	IF asphalt pavement surface and have valid metrics	IF {
		([SURFACE_TYPE_VN] IN (2, 6, 7, 8))
		AND ([IRI_VN] > 0)
		AND ([CRACKING_PERCENT_VN] BETWEEN 0 AND 100)
		AND ([RUTTING_VN] >= 0)
		}
			THEN Fair

Order of Operation	Criteria Description	Criteria Expression	Classification (Overall Rating)

8	IF jointed concrete pavement surface and have valid metrics	IF {
		([SURFACE_TYPE_VN] IN (3, 4, 9, 10))
		AND ([IRI_VN] > 0)
		AND ([CRACKING_PERCENT_VN] BETWEEN 0 AND 100)
		AND ([FAULTING _VN] >= 0)
		}
			THEN Fair

9	IF CRCP surface and have valid metrics	IF {
		([SURFACE_TYPE_VN] = 5)
		AND ([IRI_VN] > 0)
		AND ([CRACKING_PERCENT_VN] BETWEEN 0 AND 100)
		}
			THEN Fair

10	IF meets Good Condition thresholds for PSR metric	IF {
		ROUND[65]([PSR_VN], DIGITS = 1) BETWEEN 4.0 AND 5.0
		}
			THEN Good

11	IF meets Poor Condition thresholds for PSR metric	IF {
		ROUND([PSR_VN], DIGITS = 1) BETWEEN 0.1 AND 2.0
		}
			THEN Poor

12	ELSE	ELSE	Fair

Figure F7 in Appendix F presents the classification of the dynamically segmented sections of the hypothetical "Route AAA." This example assumes there were no "Unresolved" Data or State DOT provided acceptable explanation or corrected all identified "Unresolved" data, as described in Section 2.3.5.

It is important to note that the condition rating process described in Table 8 must be done in the specified order of operation. An example illustrating the importance of the operation order could be observed in the segment from Milepost 0.900 to Milepost 0.950. This CRCP segment contains valid data for all IRI/CRACKING_PERCENT related data and all PSR related data. The process described in Table 7 has condition rating based on IRI and distresses (CRACKING_PERCENT. RUTTING, AND FAULTING) takes precedence over the condition rating based on PSR. This segment contains IRI_VN =

[65] "ROUND ([PSR_VN], DIGITS = 1)" denotes rounding [PSR_VN] nearest tenth, as required in 23 CFR 490.311(b)(5)(ii) and HPMS Field Manual (December 2016) Pg. 4-93. A [PSR_VN] with a hundredth digit value of 5 or greater will be rounded up whereas a hundredth digit value of less than 5 will be rounded down to the nearest tenths.

60 and CRACKING_PERCENT_VN = 2, which would result the overall condition rating as Good. This IRI and distress based condition rating will take precedence over Fair condition rating based on PSR (PSR_VN = 3.5).

The total lane-miles of mainline highways on the Interstate System in Good condition is computed by adding all computed lane-miles of segments classified as in Good condition. Similarly, the total lane-miles of mainline highways on the Interstate System in Poor condition is computed by adding all computed lane-miles of segments classified as in Poor condition.

Please note that the lane-miles of each segment in the Datasets INTERSTATE and NON_INTERSTATE_NHS is computed by multiplying [THROUGH_LANES_VN] and/or [THROUGH_LANES_VN] by [DynSeg_SL] for each mainline highway segment where [DynSeg_SL] is ([End_Point] – [Begin_Point]) for the corresponding segment.

Total lane-miles of mainline highways on the Interstate System in Good condition (Good _LM_IS) could be obtained by following pseudo-code for a Single Centerline data format.

```
SELECT

   Sum([INTERSTATE].[THROUGH_LANES_VN]*[INTERSTATE].[DynSeg_SL])

   AS Good_LM_IS

FROM INTERSTATE

WHERE (Segments classified as in Good condition per Table 8);
```

Whereas total lane-miles of mainline highways on the Interstate System in Poor condition (Poor _LM_IS) could be obtained by following pseudo-code for a Single Centerline data format.

```
SELECT

   Sum([INTERSTATE].[THROUGH_LANES_VN]*[INTERSTATE].[DynSeg_SL])

   AS Poor_LM_IS

FROM INTERSTATE

WHERE (Segments classified as in Poor condition per Table 8);
```

Total lane-miles of mainline highways on the Interstate System in Good condition (Good _LM_IS) could be obtained by following pseudo-code for a Dual-Carriage data format.

```
SELECT

   Sum(IIf([INTERSTATE].[FACILITY_TYPE_VN]=1,
```

```
    [INTERSTATE].[THROUGH_LANES_VN]*[INTERSTATE].[DynSeg_SL],

    IIf([INTERSTATE].[FACILITY_TYPE_VN]=2 Or
    [INTERSTATE].[FACILITY_TYPE_VN]=6,

    [INTERSTATE].[DIR_THROUGH_LANES_VN]*[INTERSTATE].[DynSeg_SL],

    0)))

AS Good_LM_IS

FROM INTERSTATE

WHERE (Segments classified as in Good condition per Table 8);
```

Total lane-miles of mainline highways on the Interstate System in Poor condition (Poor _LM_IS) could be obtained by following pseudo-code for a Dual-Carriage data format.

```
SELECT

    Sum(IIf([INTERSTATE].[FACILITY_TYPE_VN]=1,

    [INTERSTATE].[THROUGH_LANES_VN]*[INTERSTATE].[DynSeg_SL],

    IIf([INTERSTATE].[FACILITY_TYPE_VN]=2 Or
    [INTERSTATE].[FACILITY_TYPE_VN]=6,

    [INTERSTATE].[DIR_THROUGH_LANES_VN]*[INTERSTATE].[DynSeg_SL],

    0)))

AS Poor_LM_IS

FROM INTERSTATE

WHERE (Segments classified as in Poor condition per Table 8);
```

Total lane-miles of mainline highways on the Non-Interstate NHS in Good condition (Good _LM_NIN) could be obtained by following pseudo-code.

```
SELECT

    Sum([NON_INTERSTATE_NHS].[THROUGH_LANES_VN]*[NON_INTERSTATE_NHS].
    [DynSeg_SL])

    AS Good_LM_NIN

    FROM NON_INTERSTATE_NHS

WHERE (Segments classified as in Good condition per Table 8);
```

Whereas total lane-miles of mainline highways on the Non-Interstate NHS in Poor condition (Poor _LM_NIN) could be obtained by following pseudo-code.

```
SELECT

    Sum([NON_INTERSTATE_NHS].[THROUGH_LANES_VN]*[NON_INTERSTATE_NHS].
    [DynSeg_SL])

    AS Poor_LM_NIN

FROM NON_INTERSTATE_NHS

WHERE (Segment classified as in Poor condition per Table 8);
```

Appendix A – References & Acronyms Table

References

- Final Rule on "National Performance Management Measures; Assessing Pavement Condition for the National Highway Performance Program and Bridge Condition for the National Highway Performance Program": Docket No. FHWA–2013–0053, RIN 2125–AF53, Federal Register - Vol. 82, No. 11 - January 18, 2017: https://www.gpo.gov/fdsys/pkg/FR-2017-01-18/pdf/2017-00550.pdf

- HPMS Field Manual: https://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/

- National Bridge Inventory: https://www.fhwa.dot.gov/bridge/nbi.cfm

Acronyms Table

Acronym	Full Form
CFR	Code of Federal Regulation
CY	Calendar Year
FHWA	Federal Highway Administration
FR	Federal Register
FY	Federal Fiscal Year
HPMS	Highway Performance Monitoring System
IRI	International Roughness Index
NBI	National Bridge Inventory
PSR	Present Serviceability Rating
SQL	Structural Query Language
State DOT	State Department of Transportation
U.S.C.	United States Code

Appendix B – Missing, Invalid, or Unresolved Data Resolution

Data Item	Criteria for Identifying Missing, Invalid, or Unresolved Data	HPMS Software Response Upon Receipt of Data	FHWA Acceptable Resolution/Correction	HPMS Software Action Upon Accepting State DOT's Resolution/Correction	Consequence of Resolution/Correction not Acceptable by FHWA or No State DOT Response
STRUCTURE_TYPE	Total Lane-miles of bridges in HPMS > Total lane-miles bridges in NBI?	Flag all segments in a network (Interstate System or Non-Interstate NHS) with [STRUCTURE_TYPE_VN] = 1 as [STRUCTURE_TYPE_UN] = "UNRESOLVED STRUCTURE_TYPE". See Section 2.3.5.1.	State DOT provides document and/or data demonstrating that reported STRUCTURE_TYPE data is based on locating the NHS Bridges on the Linear Referencing System used for reporting its HPMS data; and/or resubmits corrected [STRUCTURE_TYPE_VN] data or removes [STRUCTURE_TYPE_VN] = 1 values to make Total Lane-miles of bridges in HPMS ≤ Total lane-miles bridges in NBI.	FHWA removes Unresolved status by [STRUCTURE_TYPE_UN] = "" and Reclassify. Also corrected or justified segments with [STRUCTURE_TYPE_VN] = 1 would be excluded in measure computation per Section 2.4.1.	Unresolved flagged segments will be subjected to sequential classification process from Step 2 in Section 2.4.2.
SURFACE_TYPE	Any segment a network (Interstate System or Non-Interstate NHS) has [SURFACE_TYPE_VN] = 1 OR 11?	Flag all segments in a network (Interstate System or Non-Interstate NHS) with [SURFACE_TYPE_VN] = 1 OR 11 as [SURFACE_TYPE_UN] = "UNRESOLVED SURFACE_TYPE". See Section 2.3.5.2.	State DOT provides document and/or data demonstrating that reported [SURFACE_TYPE_VN] = 1 OR 11 is "Unpaved or Other" Surface Type based on the actual field measurement/observation; or resubmits corrected [SURFACE_TYPE_VN] = 1 OR 11 per the actual field measurement/observation. State DOTs may submit a letter to Division Offices stating that reported sections are "Unpaved or Other" Surface Type, and Division Office must concur.	FHWA removes Unresolved status by [SURFACE_TYPE_UN] = "" and Reclassify. Also corrected or justified segments with [SURFACE_TYPE_VN] = 1 OR 11 would be excluded in measure computation per Section 2.4.2.	Unresolved flagged segments will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.1.
SURFACE_TYPE	[SURFACE_TYPE_VN] IS NULL) OR [SURFACE_TYPE_VN] NOT IN (2,3,4,5,6,7,8,9,10))?	Segments will be classified as "Missing, Invalid, or Unresolved Data" per Section 2.4.3.1.	State DOT resubmits corrected [SURFACE_TYPE_VN].	Reclassify	Segments will be classified as "Missing, Invalid, or Unresolved Data" per Section 2.4.3.1.
IRI	Section length (in Sections_DataSet) greater than 0.110 mile?	Flag segments as [IRI_Sections_SL] = "LENGTH VIOLATION" per Sections 2.3.2 and 2.3.3. If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.	Re-compute field measurement data to provide IRI Sections with length ≤ 0.110 mile and resubmit. Splitting the flagged segments is not acceptable.	FHWA removes Invalid status by [IRI_Sections_SL] ="" and Reclassify	If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.
IRI	[IRI_VN] IS NULL OR 0?	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.	State DOT provides valid [IRI_VN].	Reclassify	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.

Data Item	Criteria for Identifying Missing, Invalid, or Unresolved Data	HPMS Software Response Upon Receipt of Data	FHWA Acceptable Resolution/Correction	HPMS Software Action Upon Accepting State DOT's Resolution/Correction	Consequence of Resolution/Correction not Acceptable by FHWA or No State DOT Response
IRI	[IRI_VD] IS NULL?	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.	State DOT provides valid [IRI_VD].	Reclassify	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.
IRI	IRI data collected in specified data collection cycle? YEAR([IRI_VD]) <> [YEAR_RECORD] for Interstate; or YEAR([IRI_VD]) NOT BETWEEN ([YEAR_RECORD-1] AND[YEAR_RECORD]) for Non-Interstate NHS?	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.	If State DOT collected IRI data in specified data collection year(s), then resubmit [IRI_VN] and [IRI_VD]. Correction of [IRI_VD] alone will not be accepted. State DOT has to provide document and/or data demonstrating that IRI data actually collected in specified data collection year(s).	Reclassify	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.
IRI	Segment has unreasonably high frequent or extreme [IRI_VN] values?	Flag segments as [IRI_UN] = "UNRESOLVED IRI" per Section 2.3.5.3. If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.	State DOT has to provide document and/or data demonstrating that the flagged [IRI_VN] are from actual field measurement.	FHWA removes Unresolved status by [IRI_UN] = "" and Reclassify	If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.
CRACKING_PERCENT	Section length (in Sections_DataSet) greater than 0.110 mile?	Flag segments as [CRACKING_PERCENT_Sections_SL] = "LENGTH VIOLATION" per Sections 2.3.2 and 2.3.3. If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.	Re-compute field measurement data to provide CRACKING_PERCENT Sections with length $\leq$ 0.110 mile and resubmit. Splitting the flagged segments is not acceptable.	FHWA removes Invalid status by [CRACKING_PERCENT_Sections_SL] ="" and Reclassify	If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.
CRACKING_PERCENT	Sections spatially coincident with IRI Sections (in Sections_DataSet)?	Flag segments as [CRACKING_PERCENT_Sections_SC] = "COINCIDENCE VIOLATION" per Sections 2.3.2 and 2.3.3. If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.	Re-compute field measurement data to provide CRACKING_PERCENT and IRI Sections spatially coincident and resubmit. Splitting the flagged segments is not acceptable. Shifting or rubber-banding method must be approved by FHWA.	FHWA removes Invalid status by [CRACKING_PERCENT_Sections_SC] ="" and Reclassify	If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.
CRACKING_PERCENT	[CRACKING_PERCENT_VN] IS NULL OR NOT BETWEEN 0 AND 100?	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.	State DOT provides valid [CRACKING_PERCENT_VN].	Reclassify	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.

Data Item	Criteria for Identifying Missing, Invalid, or Unresolved Data	HPMS Software Response Upon Receipt of Data	FHWA Acceptable Resolution/Correction	HPMS Software Action Upon Accepting State DOT's Resolution/Correction	Consequence of Resolution/Correction not Acceptable by FHWA or No State DOT Response
CRACKING_PERCENT	[CRACKING_PERCENT _VD] IS NULL?	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.	State DOT provides valid [CRACKING_PERCENT _VD].	Reclassify	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.
CRACKING_PERCENT	CRACKING_PERCENT data collected in specified data collection cycle? YEAR([CRACKING_PERCENT _VD]) <> [YEAR_RECORD] for Interstate; or YEAR([CRACKING_PERCENT _VD]) NOT BETWEEN ([YEAR_RECORD-1] AND[YEAR_RECORD]) for Non-Interstate NHS?	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.	If State DOT collected CRACKING_PERCENT data in specified data collection year(s), then resubmit [CRACKING_PERCENT _VN] and [CRACKING_PERCENT _VD]. Correction of [CRACKING_PERCENT _VD] alone will not be accepted. State DOT has to provide document and/or data demonstrating that CRACKING_PERCENT data actually collected in specified data collection year(s).	Reclassify	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.
CRACKING_PERCENT	Segment has unreasonably high frequent or extreme [CRACKING_PERCENT _VN] values?	Flag segments as [CRACKING_PERCENT _UN] = "UNRESOLVED CRACKING_PERCENT" per Section 2.3.5.3. If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.	State DOT has to provide document and/or data demonstrating that the flagged [CRACKING_PERCENT _VN] are from actual field measurement.	FHWA removes Unresolved status by [CRACKING_PERCENT _UN] = "" and Reclassify	If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.
RUTTING	Section length (in Sections_DataSet) greater than 0.110 mile?	Flag segments as [RUTTING_Sections_SL] = "LENGTH VIOLATION" per Sections 2.3.2 and 2.3.3. If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2.	Re-compute field measurement data to provide RUTTING Sections with length ≤ 0.110 mile and resubmit. Splitting the flagged segments is not acceptable.	FHWA removes Invalid status by [RUTTING_Sections_SL] ="" and Reclassify	If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2.
RUTTING	Sections spatially coincident with IRI Sections (in Sections_DataSet)?	Flag segments as [RUTTING_Sections_SC] = "COINCIDENCE VIOLATION" per Sections 2.3.2 and 2.3.3. If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2.	Re-compute field measurement data to provide CRACKING_PERCENT and IRI Sections spatially coincident and resubmit. Splitting the flagged segments is not acceptable. Shifting or rubber-banding method must be approved by FHWA.	FHWA removes Invalid status by [RUTTING_Sections_SC] = "" and Reclassify	If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2.
RUTTING	[RUTTING_VN] IS NULL OR <0?	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2.	State DOT provides valid [RUTTING_VN].	Reclassify	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2.

Data Item	Criteria for Identifying Missing, Invalid, or Unresolved Data	HPMS Software Response Upon Receipt of Data	FHWA Acceptable Resolution/Correction	HPMS Software Action Upon Accepting State DOT's Resolution/Correction	Consequence of Resolution/Correction not Acceptable by FHWA or No State DOT Response
RUTTING	[RUTTING _VD] IS NULL?	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2.	State DOT provides valid [RUTTING _VD].	Reclassify	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2.
RUTTING	RUTTING data collected in specified data collection cycle? YEAR([RUTTING _VD]) <> [YEAR_RECORD] for Interstate; or YEAR([RUTTING _VD]) NOT BETWEEN ([YEAR_RECORD-1] AND[YEAR_RECORD]) for Non-Interstate NHS?	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2.	If State DOT collected RUTTING data in specified data collection year(s), then resubmit [RUTTING _VN] and [RUTTING _VD]. Correction of [RUTTING _VD] alone will not be accepted. State DOT has to provide document and/or data demonstrating that RUTTING data actually collected in specified data collection year(s).	Reclassify	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2.
RUTTING	Segment has unreasonably high frequent or extreme [RUTTING _VN] values?	Flag segments as [RUTTING_UN] = "UNRESOLVED CRACKING_PERCENT" per Section 2.3.5.3. If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2.	State DOT has to provide document and/or data demonstrating that the flagged [RUTTING _VN] are from actual field measurement.	FHWA removes Unresolved status by [RUTTING _UN] = "" and Reclassify	If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2.
FAULTING	Section length (in Sections_DataSet) greater than 0.110 mile?	Flag segments as [FAULTING_Sections_SL] = "LENGTH VIOLATION" per Sections 2.3.2 and 2.3.3. If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.3.	Re-compute field measurement data to provide FAULTING Sections with length ≤ 0.110 mile and resubmit. Splitting the flagged segments is not acceptable.	FHWA removes Invalid status by [FAULTING_Sections_SL] = "" and Reclassify	If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.3.
FAULTING	Sections spatially coincident with IRI Sections (in Sections_DataSet)?	Flag segments as [FAULTING_Sections_SC] = "COINCIDENCE VIOLATION" per Sections 2.3.2 and 2.3.3. If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.3.	Re-compute field measurement data to provide FAULTING and IRI Sections spatially coincident and resubmit. Splitting the flagged segments is not acceptable. Shifting or rubber-banding method must be approved by FHWA.	FHWA removes Invalid status by [FAULTING_Sections_SC] = "" and Reclassify	If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.3.
FAULTING	[FAULTING_VN] IS NULL OR <0?	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.3.	State DOT provides valid [FAULTING_VN].	Reclassify	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.3.

Data Item	Criteria for Identifying Missing, Invalid, or Unresolved Data	HPMS Software Response Upon Receipt of Data	FHWA Acceptable Resolution/Correction	HPMS Software Action Upon Accepting State DOT's Resolution/Correction	Consequence of Resolution/Correction not Acceptable by FHWA or No State DOT Response
FAULTING	[FAULTING_VD] IS NULL?	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.3.	State DOT provides valid [FAULTING_VD].	Reclassify	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.3.
FAULTING	FAULTING data collected in specified data collection cycle? YEAR([FAULTING_VD]) <> [YEAR_RECORD] for Interstate; or YEAR([FAULTING_VD]) NOT BETWEEN ([YEAR_RECORD-1] AND[YEAR_RECORD]) for Non-Interstate NHS?	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.3.	If State DOT collected FAULTING data in specified data collection year(s), then resubmit [FAULTING_VN] and [FAULTING_VD]. Correction of [FAULTING_VD] alone will not be accepted. State DOT has to provide document and/or data demonstrating that FAULTING data actually collected in specified data collection year(s).	Reclassify	If there are any erroneous PSR related data for an identified segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.3.
FAULTING	Segment has unreasonably high frequent or extreme [FAULTING_VN] values?	Flag segments as [FAULTING_UN] = "UNRESOLVED CRACKING_PERCENT" per Section 2.3.5.3. If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.3.	State DOT has to provide document and/or data demonstrating that the flagged [FAULTING_VN] are from actual field measurement.	FHWA removes Unresolved status by [FAULTING_UN] = "" and Reclassify	If there are any erroneous PSR related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.3.
PSR	Section length (in Sections_DataSet) greater than 0.110 mile?	Flag segments as [PSR_Sections_SL] = "LENGTH VIOLATION" per Sections 2.3.2 and 2.3.3. If there are any erroneous IRI or distress related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.	Re-compute field measurement data to provide PSR Sections with length $\leq$ 0.110 mile and resubmit. Splitting the flagged segments is not acceptable.	FHWA removes Invalid status by [PSR_Sections_SL] = "" and Reclassify	If there are any erroneous IRI or distress related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.
PSR	[PSR _VN] IS NULL OR NOT BETWEEN 0.1 AND 5?	If there are any erroneous IRI or distress related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.	State DOT provides valid [PSR_VN].	Reclassify	If there are any erroneous IRI or distress related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.
PSR	[PSR _VT] IS NULL	If there are any erroneous IRI or distress related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.	State DOT provides valid [PSR_VT] for the sections are located on highways with posted speed limit less than 40 miles per hour.	Reclassify	If there are any erroneous IRI or distress related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.

Data Item	Criteria for Identifying Missing, Invalid, or Unresolved Data	HPMS Software Response Upon Receipt of Data	FHWA Acceptable Resolution/Correction	HPMS Software Action Upon Accepting State DOT's Resolution/Correction	Consequence of Resolution/Correction not Acceptable by FHWA or No State DOT Response
PSR	[PSR_VD] IS NULL	If there are any erroneous IRI or distress related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.	State DOT provides valid [PSR_VD].	Reclassify	If there are any erroneous IRI or distress related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.
PSR	PSR data collected in specified data collection cycle? YEAR([PSR_VD]) <> [YEAR_RECORD] for Interstate; or YEAR([PSR_VD]) NOT BETWEEN ([YEAR_RECORD-1] AND[YEAR_RECORD]) for Non-Interstate NHS?	If there are any erroneous IRI or distress related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.	If State DOT collected PSR data in specified data collection year(s), then resubmit [PSR_VN] and [PSR_VD]. Correction of [PSR_VD] alone will not be accepted. State DOT has to provide document and/or data demonstrating that IRI data actually collected in specified data collection year(s).	Reclassify	If there are any erroneous IRI or distress related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.
PSR	Segment has unreasonably high frequent or extreme [PSR_VN] values?	Flag segments as [PSR_UN] = "UNRESOLVED PSR" per Section 2.3.5.3. If there are any erroneous IRI or distress related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.	State DOT has to provide document and/or data demonstrating that the flagged [PSR_VN] are from actual field measurement.	FHWA removes Unresolved status by [PSR_UN] = "" and Reclassify	If there are any erroneous IRI or distress related data for a flagged segment, then that segment will be classified as "Missing, Invalid, or Unresolved Data" per Sections 2.4.3.2, 2.4.3.3, or 2.4.3.4.

Appendix C – Computing Measures based on IRI Metric for Non-Interstate NHS Pavement Condition Measures

As indicated in Section 1.2, for the two Non-Interstate NHS pavement condition measures and the first performance period only, measures (baseline condition, 2-year condition and 4-year condition) and the targets are based on IRI only as part of "transition" requirements specified in 23 CFR 490.313(e). The following are the only times when non-Interstate NHS pavement condition measures are computed based only in IRI metric.

- 2017 HPMS Data (reported to HPMS in 2018) contained in HPMS on August 15, 2018 for computing Non-Interstate NHS Baseline Condition for the first Performance Period. 2017 HPMS Data for Non-Interstate NHS contains data collected in 2016 and 2017.

- 2019 HPMS Data (reported to HPMS in 2020) contained in HPMS on August 15, 2020 for computing Non-Interstate NHS 2-year Condition for the first Performance Period. 2019 HPMS Data for Non-Interstate NHS contains data collected in 2018 and 2019.

- 2021 HPMS Data (reported to HPMS in 2022) contained in HPMS on August 15, 2022 for computing Non-Interstate NHS 4-year Condition for the first Performance Period. 2021 HPMS Data for Non-Interstate NHS contains data collected in 2020 and 2021.

Please note that the computed measures in the specified years above will be used for State DOT significant progress determination, described in 23 CFR 490.109.

For computing pavement measures based only on IRI follows the same processes described in Section 2 except for 2 areas.

First area is Data Extraction in Section 2.3.1. Instead of 6 datasets from HPMS Software, up to 3 datasets are needed and they are:

> **(1) IRI_Sections** Data Set **–** records from "Sections" Data Set (Sections_DataSet) with Data_Item = "IRI" which could be obtained through HPMS Software ("Spatial Intersector" under "Reports and Analysis" and selecting only "IRI" as selecting criteria) or use below Structural Query Language (SQL) statement on downloaded "Sections" Data Set from HPMS.

```
SELECT Sections_Dataset.*

INTO IRI_Sections

FROM Sections_Dataset

WHERE (((Sections_Dataset.Data_Item)="IRI"));
```

(2) PSR_Sections Data Set (if applicable) **–** records from Sections_DataSet with Data_Item = "PSR[66]" which could be obtained through HPMS Software ("Spatial Intersector" under "Reports and Analysis" and selecting only "PSR" as selecting criteria) or use below SQL statement on downloaded "Sections" Data Set from HPMS.

```
SELECT Sections_Dataset.*

INTO PSR_Sections

FROM Sections_Dataset

WHERE (((Sections_Dataset.Data_Item)="PSR"));
```

(3) FULL_INTERSECTION Data Set **–** a full-intersection of 9 data items in "Sections" Data Set (9 Data Items are: IRI, PSR, STRUCTURE_TYPE, SURFACE_TYPE, THROUGH_LANES, F_SYSTEM, FACILITY_TYPE, NHS and URBAN_CODE.

Note the FULL_INTERSECTION Data Set for IRI based measure require a full-intersection of 9 data items in "Sections" Data Set instead of 12 data items.

In Section 2.3.4, only NON_INTERSTATE_NHS Data is needed so INTERSTATE data is not needed.

Similar to Section 2.4, FHWA will complete the segment classification process in sequence (ordered steps) as provided in this section.

Step 1: Identify Bridges

A record in Dataset NON_INTERSTATE_NHS is classified as a "Bridge" if the following criteria are met. Please note that Null in [STRUCTURE_TYPE_UN] Field means the data record was not flagged for "Unresolved" Data, described in Section 2.3.5.1.

- For non-Interstate NHS,

```
[NON_INTERSTATE_NHS].[STRUCTURE_TYPE_VN] = 1 AND
[NON_INTERSTATE_NHS].[STRUCTURE_TYPE_UN] IS NULL
```

Note once a segment in NON_INTERSTATE_NHS is classified as a "Bridge", then no further classification process (i.e., Steps 2 through 4 in this section) are necessary.

The total mainline lane-miles, on the Non-Interstate NHS represented by bridges, could be obtained by the following SQL statement.

```
SELECT
```

[66] 23 CFR 490.313(e) – Collecting and reporting PSR permitted where posted speed limits are less than 40 miles per hour as an alternative to the IRI for non-Interstate NHS transition.

```
    Sum([NON_INTERSTATE_NHS].[DynSeg_SL]*[NON_INTERSTATE_NHS].[THROUG
    H_LANES_VN]) AS Bridges_LM_NIN

FROM NON_INTERSTATE_NHS

HAVING (([NON_INTERSTATE_NHS].[STRUCTURE_TYPE_VN]=1) AND
[NON_INTERSTATE_NHS].[STRUCTURE_TYPE_UN] IS NULL);
```

Please note that `[DynSeg_SL]` is `([End_Point] – [Begin_Point])` for each mainline highway segment.

Step 2: Identify "Unpaved or Other" Surface Types

Classification Step 2 in this section only applies to segments, in Dataset NON_INTERSTATE_NHS, not classified as "Bridge" in Step 1 in this section. A record in Dataset NON_INTERSTATE_NHS is classified as having "Unpaved and Other" Surface Types" if the following criteria is met. Please note that Null for [SURFACE_TYPE_UN] Field means the data record was not flagged for "Unresolved" Data, as described in Section 2.3.5.2.

- For non-Interstate NHS,

```
([NON_INTERSTATE_NHS].[SURFACE_TYPE_VN] = 1 OR

[NON_INTERSTATE_NHS].[SURFACE_TYPE_VN] = 11) AND
([NON_INTERSTATE_NHS].[SURFACE_TYPE_UN] IS NULL)
```

Note once a segment in NON_INTERSTATE_NHS is classified as having "Unpaved or Other" Surface Types, then no further classification process (i.e., Steps 3 and 4 in this section) are necessary.

Total mainline lane-miles, on the Interstate System identified as "Unpaved or Other" Surface Types in a Single Centerline Data Format, could be obtained by the following SQL statement.

Total mainline lane-miles, on the Non-Interstate NHS identified as "Unpaved or Other" Surface Types, could be obtained by the following SQL statement.

```
SELECT

    Sum([NON_INTERSTATE_NHS].[DynSeg_SL]*[NON_INTERSTATE_NHS].[THROUG
    H_LANES_VN]) AS Unpaved_Other_LM_NIN

FROM NON_INTERSTATE_NHS

HAVING ((([NON_INTERSTATE_NHS].[SURFACE_TYPE_VN] = 1) OR
[NON_INTERSTATE_NHS].[SURFACE_TYPE_VN] = 11)) AND
([NON_INTERSTATE_NHS].[SURFACE_TYPE_UN]) IS NULL);
```

Please note that `[DynSeg_SL]` is `([End_Point] – [Begin_Point])` for each mainline highway segment.

Step 3: Identify "Missing, Invalid and Unresolved Data"

Classification Step 3 in this section only applies to segments, in Dataset NON_INTERSTATE_NHS, not classified as "Bridge" in Step 1 in this section and not classified as having "Unpaved or Other" Surface Types in Step 2 in this section.

23 CFR 490.313(b)(4) stipulates FHWA determination of "Missing, Invalid or Unresolved Data" in State DOT reported data in HPMS for non-Interstate NHS. The FHWA will make a final determination that a reported section in HPMS has "Missing, Invalid or Unresolved Data" with the data in HPMS as of August 15, 2018[67] and biennially thereafter for the non-Interstate NHS after coordinating with the respective State DOT. "Missing, Invalid or Unresolved Data" is identified by FHWA through assessing whether or not State DOT reported data meets the data requirements specified in 23 CFR 490.309 and 490.311(c) and provides sufficient information for FHWA to rate an Overall Condition Rating (Good, Fair, or Poor), described in 23 CFR 490.313(c) and(d) for each of the sections on non-Interstate NHS. This section describes the criteria that FHWA uses to identify "Missing, Invalid or Unresolved Data" in State DOT reported data in HPMS. Please note that FHWA will identify "Missing, Invalid or Unresolved Data" initially when State DOT submits their data to HPMS by June 15[68] for the Non-Interstate NHS. Upon receiving the data from State DOTs, FHWA then will go through the 4-step classification process in this section to initially classify segments as "Missing, Invalid, and Unresolved Data", if erroneous data are identified per the criteria specified in this section. "Missing, Invalid, and Unresolved Data" status can only be removed for a segment, if State DOT resubmits corrected data (or explanation accepted by FHWA) before FHWA data extraction dates for measure computation (on or after August 16, 2018 and biennially thereafter for the non-Interstate NHS). Please see Appendix B describing resolution process for "Missing, Invalid, and Unresolved Data."

Note once a segment in NON_INTERSTATE_NHS is classified as having "Missing, Invalid and Unresolved Data" per Table C1 below, then no further classification processes (i.e., Step 4 in the remainder of this section) are necessary.

A record in Dataset NON_INTERSTATE_NHS is classified as "Missing, Invalid or Unresolved Data" if that record has been reported as an asphalt surface segment and determined having errors in both IRI related data and PSR related data, as shown in Table C1 below.

Table C1 – Missing, Invalid or Unresolved Data Criteria for NON_INTERSTATE NHS Segments

Criterion Description	Criterion Expression	INTERSTATE / NON_INTERSTATE_NHS
IF {Any one of the IRI related data has an error**}**;	**IF {**[IRI_VN] IS NULL OR	NON_INTERSTATE_NHS
	[IRI_VN] <= 0 OR	NON_INTERSTATE_NHS
	[IRI_VD] IS NULL OR	NON_INTERSTATE_NHS
	YEAR([IRI_VD]) NOT BETWEEN ([YEAR_RECORD-1] AND[YEAR_RECORD]) OR	NON_INTERSTATE_NHS

[67] 23 CFR 490.109(d) and 490.313(e)
[68] 23 CFR 490.311(c)(5) and (d)(3)

Criterion Description	Criterion Expression	INTERSTATE / NON_INTERSTATE_NHS
	[IRI_UN] = "UNRESOLVED IRI" OR	NON_INTERSTATE_NHS
	[THROUGH_LANES_UN] = "UNRESOLVED THROUGH_LANES"}	NON_INTERSTATE_NHS
AND {Any one of the PSR related data has an error, where Post Speed Limit is less than 40 mph.**}**	**AND {**[PSR_VN] IS NULL OR	NON_INTERSTATE_NHS
	([PSR_VN] NOT BETWEEN 0.1 AND 5.0) OR	NON_INTERSTATE_NHS
	[PSR_VD] IS NULL OR	NON_INTERSTATE_NHS
	YEAR([PSR_VD]) NOT BETWEEN ([YEAR_RECORD-1] AND[YEAR_RECORD])OR	NON_INTERSTATE_NHS
	[PSR_UN] = "UNRESOLVED PSR" OR	NON_INTERSTATE_NHS
	[THROUGH_LANES_UN] = "UNRESOLVED THROUGH_LANES"}	NON_INTERSTATE_NHS

Please note that although [PSR_VD] reporting is not required in the HPMS Field Manual. However, to ensure PSR data is collected every 2 years[69] for Non-Interstate NHS, the FHWA expects State DOT to provide [PSR_VD] for applicable pavement sections.

Step 4: Good/Fair/Poor Condition Rating

Lastly, Table 8 in Section 2.4.4 for "full-distress and IRI", Table C2 below will be used for Overall condition rating based only on IRI, as required in 23 CFR 490.313(e).

Classification Step 4 in this section only applies to segments, in Dataset NON_INTERSTATE_NHS, not classified as "Bridge", "Unpaved or Other" Surface Types and "Missing, Invalid, Unresolved Data in Steps 1 through 3 above. A record in Dataset INTERSTATE_NHS is classified as in Good, Fair or Poor condition if that record meets any one of the following condition shown in Table C2 below.

Please note that FHWA will complete the classification process in sequence (ordered steps) as provided in Table C2. For example, if a segment meets the first set of criteria (Order of Operation 1), then that segment will be classified as in Good condition and will not be evaluated for subsequent sets of criteria (Order of Operations 2 through 6). Similarly, if a segment does not meet the first set of criteria (Order of Operation 1) but meets the second set of criteria (Order of Operation 2) then that segment will be classified as in Poor condition and will not be evaluated for subsequent sets of criteria (Order of Operations 3 through 6).

[69] 23 CFR 490.309(b)(2)(iii)(E)

Table C2 – Condition Rating for NON_INTERSTATE NHS Segment using only IRI Metric

Order of Operation	Criteria Description	Criteria Expression	Classification (Overall Rating)
1	IF a segment meets Good Condition thresholds for IRI metric	IF {ROUND[70]([IRI_VN], DIGITS = 0) < 95}	THEN Good
2	IF a segment meets Poor Condition thresholds for IRI metric	IF {ROUND([IRI_VN], DIGITS = 0) > 170}	THEN Poor
3	IF a segment meets Fair Condition thresholds for IRI metric	IF {ROUND([IRI_VN], DIGITS = 0) BETWEEN 95 AND 170}	THEN Fair
4	IF a segment meets Good Condition thresholds for PSR metric	IF {ROUND[71]([PSR_VN], DIGITS = 1) BETWEEN 4.0 AND 5.0}	THEN Good

[70] "ROUND ([IRI_VN], DIGITS = 0)" denotes rounding [IRI_VN] to the nearest inch per mile, as required in 23 CFR 490.311(b)(1)(ii) and HPMS Field Manual (December 2016) Pg. 4-91 - https://www.fhwa.dot.gov/policyinformation/hpms/fieldmanual/ An [IRI_VN] with a tenth digit value of 5 or greater will be rounded up whereas a tenth digit value of less than 5 will be rounded down to the nearest whole number (in integer inch per mile).

[71] "ROUND ([PSR_VN], DIGITS = 1)" denotes rounding [PSR_VN] nearest tenth, as required in 23 CFR 490.311(b)(5)(ii) and HPMS Field Manual (December 2016) Pg. 4-93. A [PSR_VN] with a hundredth digit value of 5 or greater will be rounded up whereas a hundredth digit value of less than 5 will be rounded down to the nearest tenths.

Order of Operation	Criteria Description	Criteria Expression	Classification (Overall Rating)
5	IF a segment meets Poor Condition thresholds for PSR metric	IF {ROUND([PSR_VN], DIGITS = 1) BETWEEN 0.1 AND 2.0}	THEN Poor
6	ELSE	ELSE	Fair

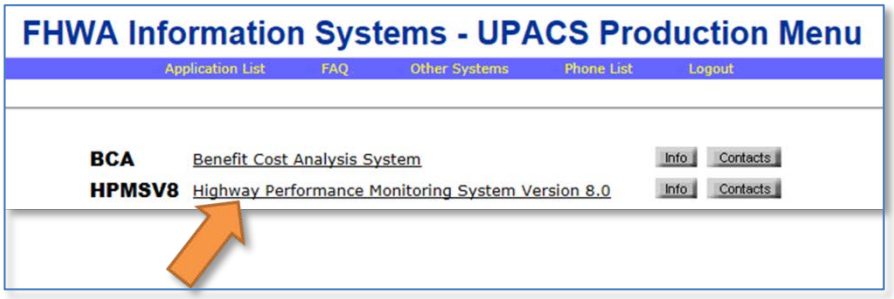
Appendix D – Method for Obtaining "Sections" Data Set and Full Intersection Data Set from HPMS Software

The data from HPMS can be obtained from HPMS Software via User Profile & Access Control System (UPACS)[72]. The images in this Appendix are from FHWA's Highway Performance Monitoring System Software.

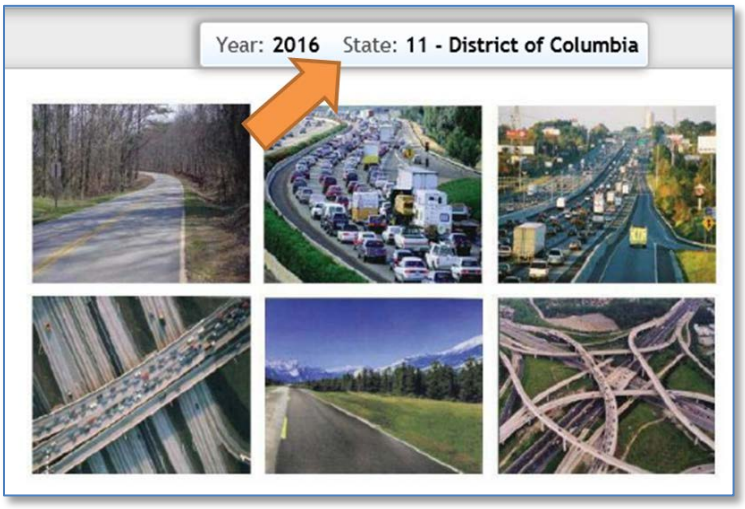
Obtaining "Sections" Data Set

Step 1. Log into FHWA UPACS website[73].

Step 2. Under "UPACS Production Menu", select "Highway Monitoring System Version 8.0".



Step 3. Click on "Year: #### State: ## - State Name" Bar. Note that the "Year" in screen capture below represents "Data year". Please see Section 1.2 for the description of "Data Year".

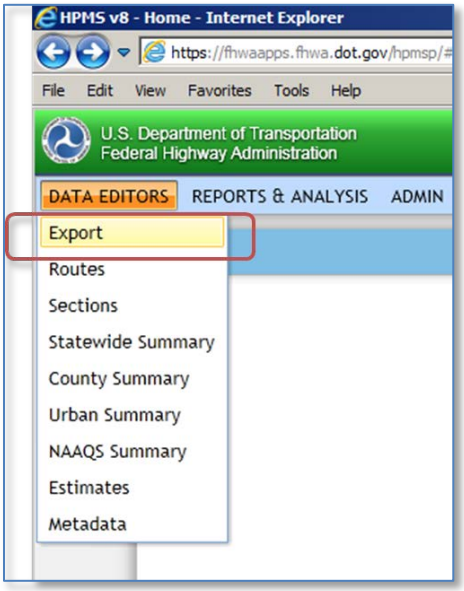


[72] UPACS Log in site: https://fhwaapps.fhwa.dot.gov/upacsp/tm?transName=MenuSystem&action=buildHTML
[73] Ibid.

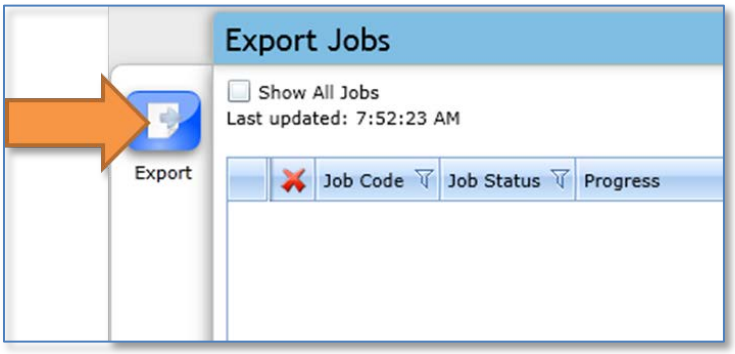
Step 4. Enter a Data Year in “Year” Textbox; select a State under “State” Dropdown List; and click “OK” Button.

Step 5. For reviewing submitted data, “Review” Tab should be activated on the upper right hand corner of the screen.

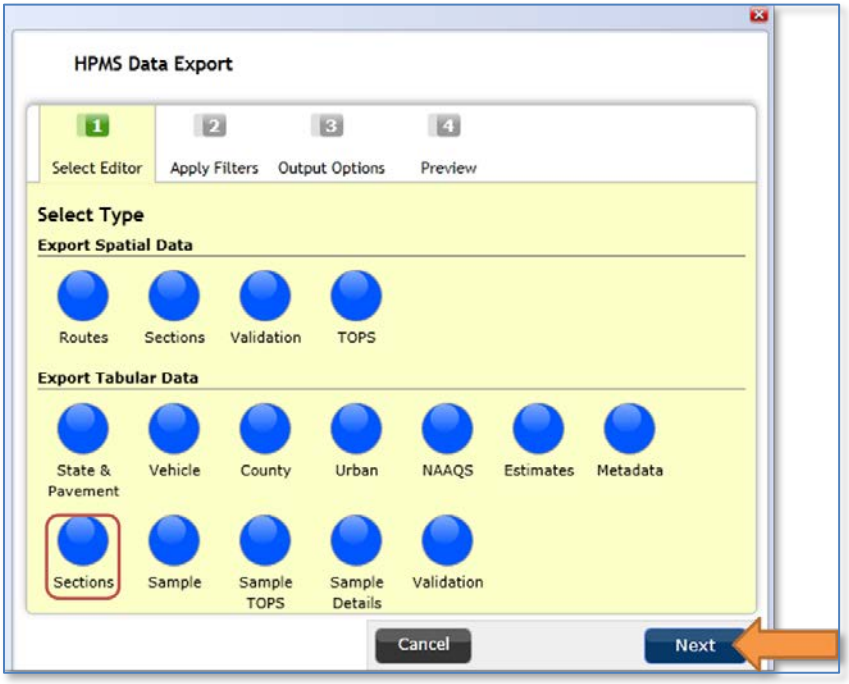
Step 6. Under “DATA EDITORS” Dropdown Menu, Select “Export”.



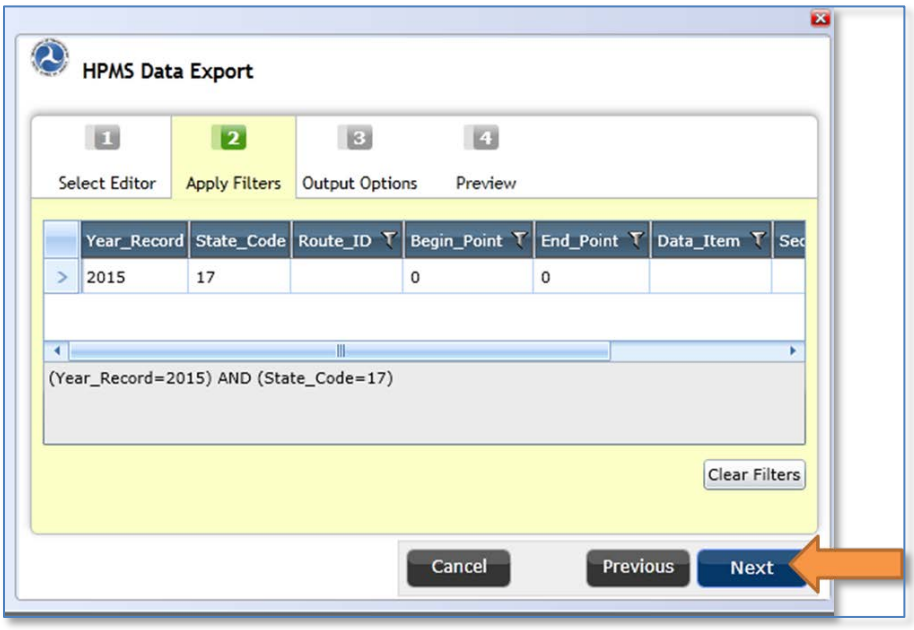
Step 7. Click on the “Export” Button.



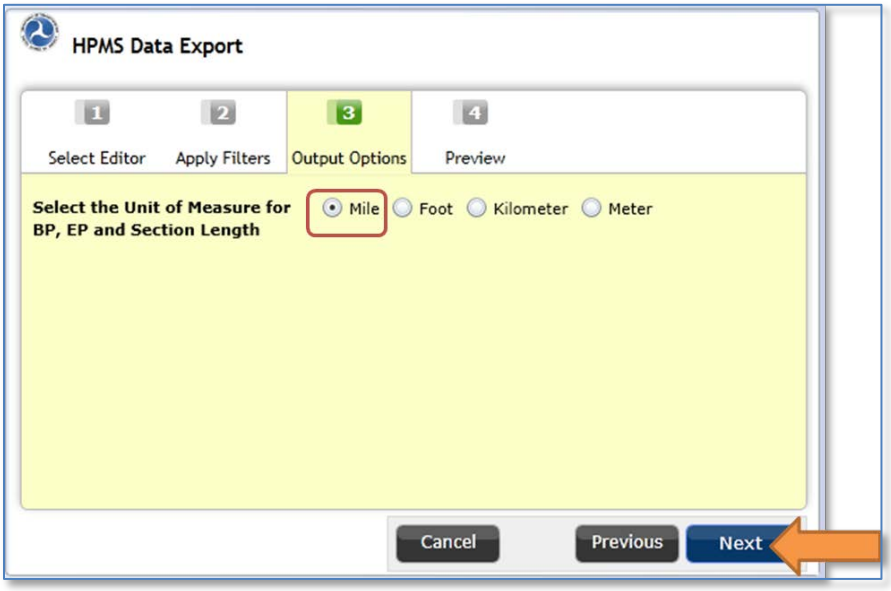
Step 8. On “Select Editor” Tab, Click on “Sections” Button under “Export Tabular Data”. Then, click “Next” Button.



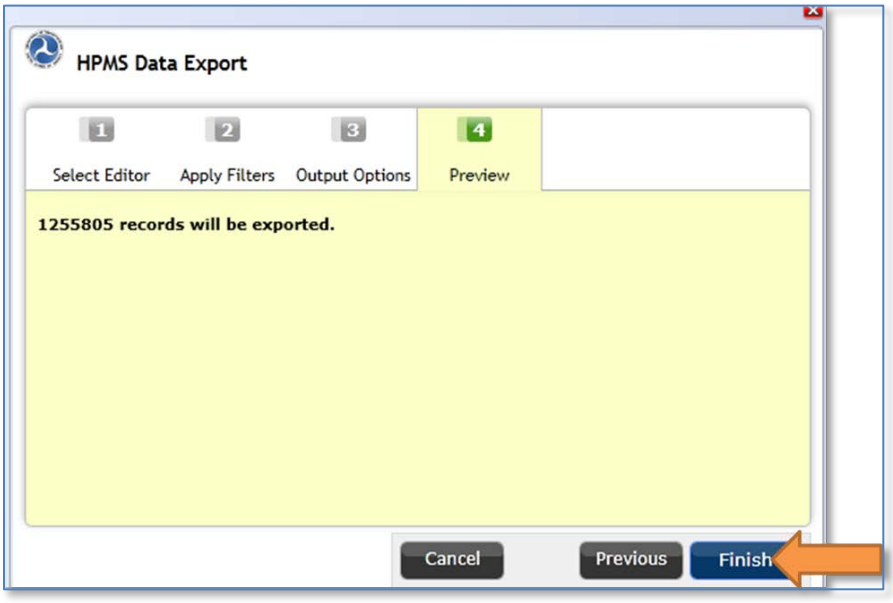
Step 9. On “Apply Filters” Tab, click “Next” Button.



Step 10. On “Output Options” Tab, click “Mile” Radio Button and click “Next” Button.

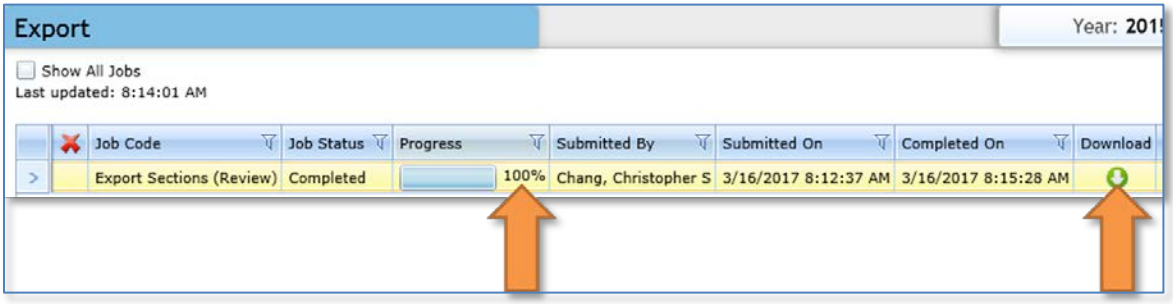


Step 11. Under “Preview” Tab, click “Finish” Button.

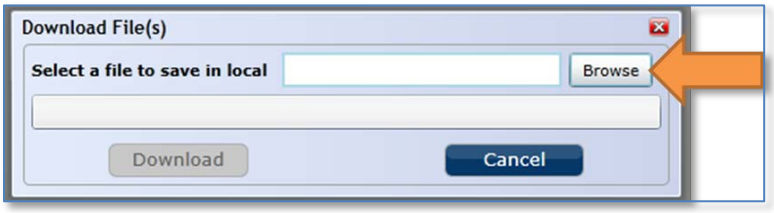


,

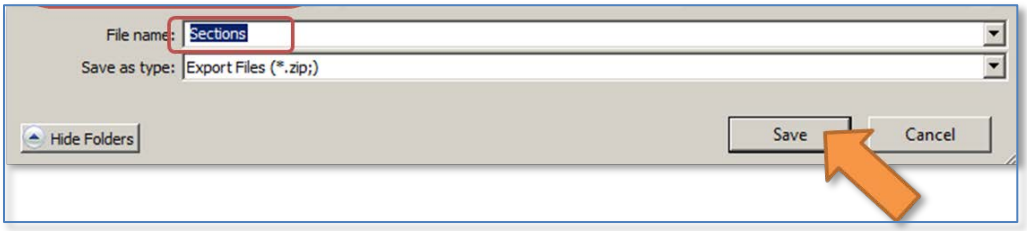
Step 12. Once, the “Progress” Status indicate “100%”, click on the green arrow below text “Download”.



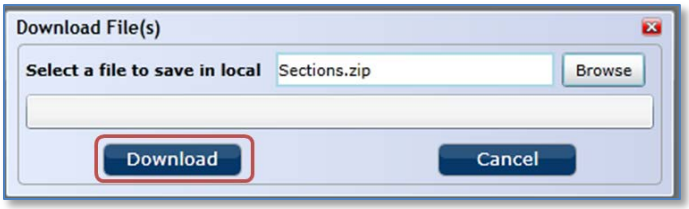
Step 13. Click on “Browse” Button.



Step 14. In “Save As” Window, select a directory, provide a file name, and click “Save” Button.



Step 15. In the “Download file(s)” Window, click on “Download” Button.



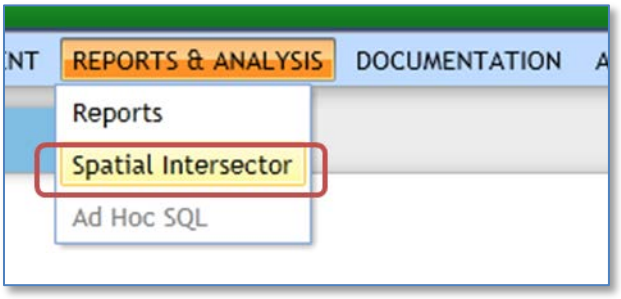
Obtaining Full Intersection Data Set

Step 1. If not logged on to UPACS, follow Steps 1 and 2 for “Sections” Data Set above.

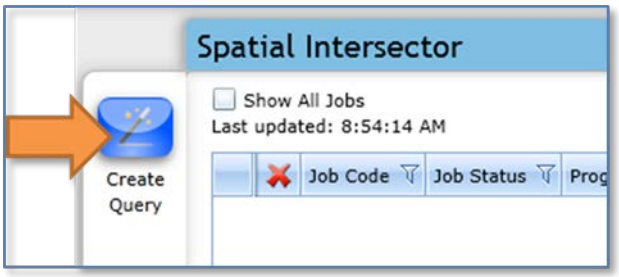
Step 2. If Select Data Year and State are not selected, then follow Steps 3 and 4 for “Sections” Data Set above.

Step 3. For reviewing submitted data, “Review” Tab should be activated on the upper right hand corner of the screen.

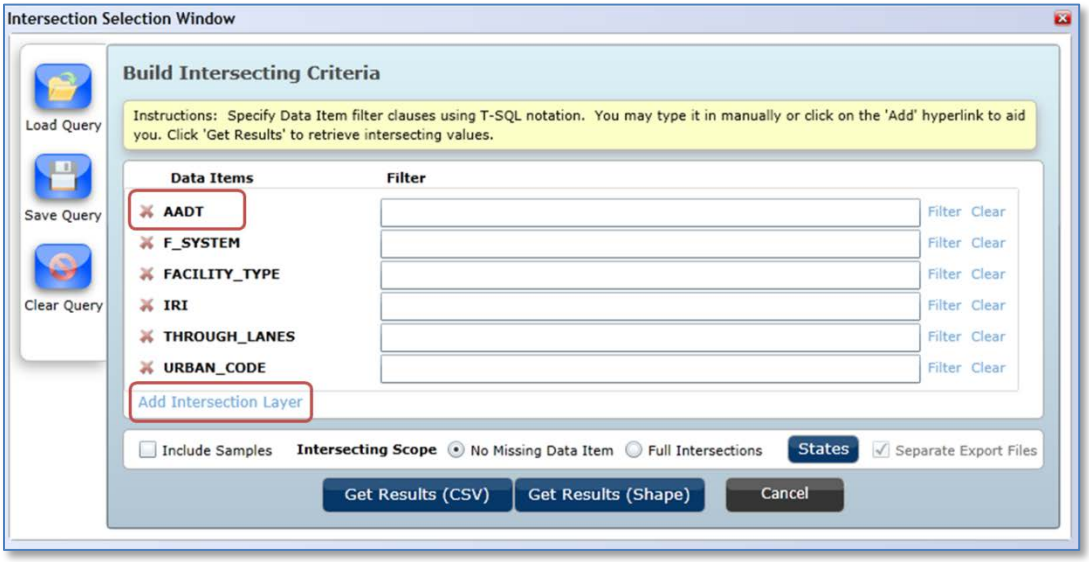
Step 4. Under “REPORTS & ANALYSIS” Menu, Select “Spatial Intersector”.



Step 5. Click on “Create Query” Button.

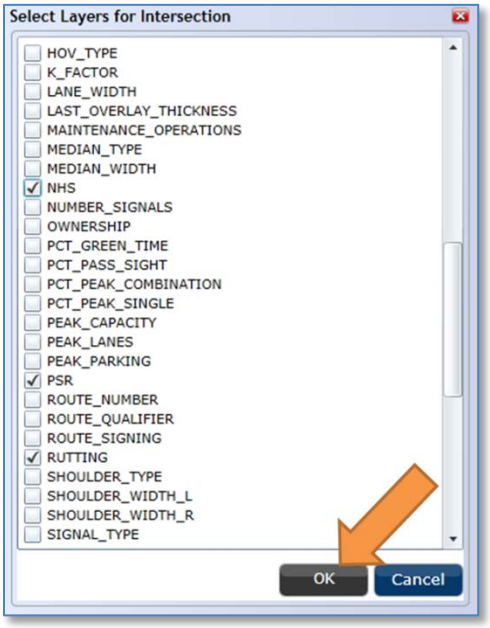


Step 6. Unselect “AADT” (by click on the “**X**” left of the “AADT” text) and click on “Add Intersection Layer”.



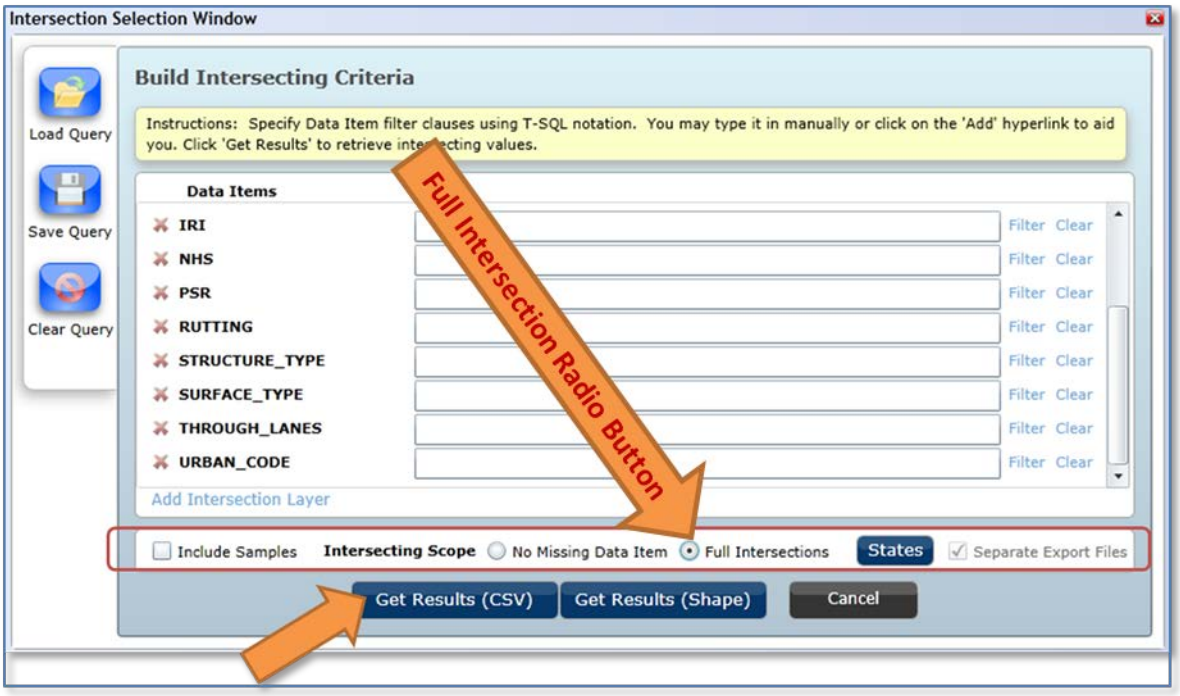
Step 7. Check the Checkboxes for the following Data Items: CRACKING_PERCENT, DIR_THROUGH_LANES, FAULTING, PSR, RUTTING, STRUCTURE_TYPE, SURFACE_TYPE, and NHS, and click “OK” Button.

Selected 13 Data Items are: CRACKING_PERCENT, DIR_THROUGH_LANES[74], FAULTING, IRI, PSR, RUTTING, STRUCTURE_TYPE, SURFACE_TYPE, THROUGH_LANES, F_SYSTEM, FACILITY_TYPE, NHS and URBAN_CODE.

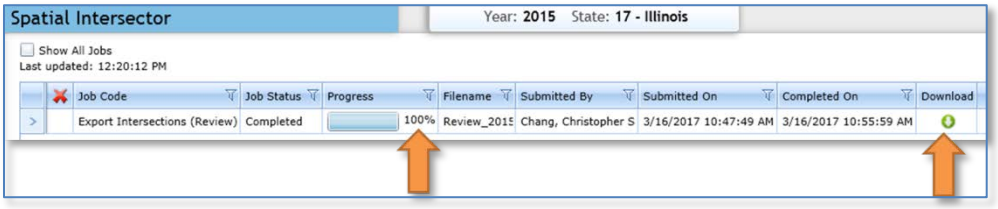


[74] 490.309(b)(1)(i)(D) & 23 CFR 490.309(b)(1)(iii) - Only if a State DOTs collected and reported pavement condition data separately for each direction of divided highways on the Interstate System.

Step 8. Make sure “Full Intersections” Radio Button is the only thing selected. Then, Click on “Get Results (CSV)” Button.

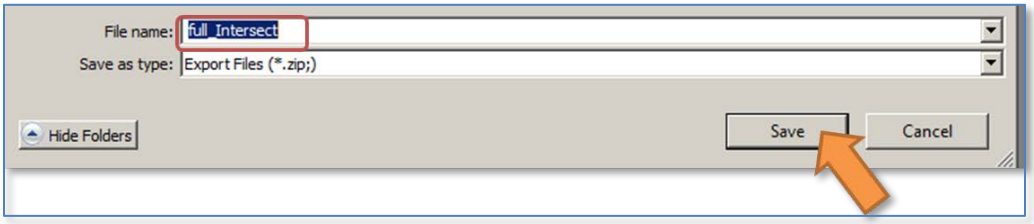


Step 9. Once, the “Progress” Status indicate “100%”, click on the green arrow below text “Download”.

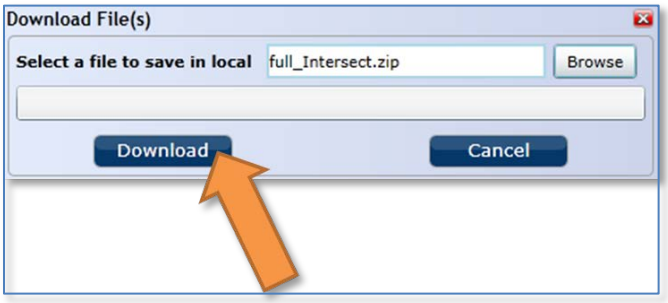


Step 10. Click on “Browse” Button.

Step 11. In “Save As” Window, select a directory, provide a file name, and click “Save” Button.



Step 12. In the “Download file(s)” Window, click on “Download” Button.



Appendix E – Percent Lane-Miles of Missing Data

This section describes data check method for Percent Lane-Miles of Missing Data for the Interstate System data submitted before April 16 00:00:00AM local time and non-Interstate NHS data submitted before June 16 00:00:00AM local time. [75]

Data Preparation

To compute the Percent lane-miles of Missing Data, a full-intersection of 13 data items in "Sections" Data Set (13 Data Items are: CRACKING_PERCENT, FAULTING, IRI, PSR, RUTTING, STRUCTURE_TYPE, SURFACE_TYPE, THROUGH_LANES, DIR_THROUGH_LANES[76], F_SYSTEM, FACILITY_TYPE, NHS and URBAN_CODE. Please see Appendix D for details on obtaining FULL_INTERSECTION Data Set from HPMS.

From the FULL_INTERSECTION Data Set, two data sets INTERSTATE_INI and NON_INTERSTATE_NHS_INI from FULL_INTERSECTION Data Set.

For obtaining the Interstate System pavement data (INTERSTATE_INI) in a single Centerline data format, SQL statement is provided below.

```
SELECT FULL_INTERSECTION.*

INTO INTERSTATE_INI

FROM FULL_INTERSECTION

WHERE (((FULL_INTERSECTION.F_SYSTEM_VN)=1) AND
((FULL_INTERSECTION.FACILITY_TYPE_VN) In (1,2)) AND
((FULL_INTERSECTION.NHS_VN) In (1,2,3,4,5,6,7,8,9)) AND
((FULL_INTERSECTION.URBAN_CODE_VN)>0));
```

For obtaining the Interstate System pavement data (INTERSTATE_INI) in a Dual-Carriage data format[77], SQL statement is provided below.

```
SELECT FULL_INTERSECTION.*

INTO INTERSTATE_INI

FROM FULL_INTERSECTION

WHERE (((FULL_INTERSECTION.F_SYSTEM_VN)=1) AND
((FULL_INTERSECTION.FACILITY_TYPE_VN) In (1,2,6)) AND
((FULL_INTERSECTION.NHS_VN) In (1,2,3,4,5,6,7,8,9)) AND
((FULL_INTERSECTION.URBAN_CODE_VN)>0));
```

---

[75] 23 CFR 490.311

[76] 490.309(b)(1)(i)(D) & 23 CFR 490.309(b)(1)(iii) - Only if a State DOTs collected and reported pavement condition data separately for each direction of divided highways on the Interstate System.

[77] Ibid.

For obtaining the non-Interstate NHS pavement data (NON_INTERSTATE_NHS_INI), the following SQL statement is provided below.

```
SELECT FULL_INTERSECTION.*

INTO NON_INTERSTATE_NHS_INI

FROM FULL_INTERSECTION

WHERE (((FULL_INTERSECTION.F_SYSTEM_VN) In (2,3,4,5,6)) AND
((FULL_INTERSECTION.FACILITY_TYPE_VN) In (1,2)) AND
((FULL_INTERSECTION.NHS_VN) In (1,2,3,4,5,6,7,8,9)) AND
((FULL_INTERSECTION.URBAN_CODE_VN)>0));
```

Missing Data

Note that any segment in INTERSTATE_INI and NON_INTERSTATE_NHS_INI falls into the criteria described in Tables E1 and E2, respective, will be considered as Missing Data.

Table E1 – Criteria for Identifying Missing Data for INTERSTATE_INI Data Set

Criteria Description	Criteria Expression
IF { a segment is not a bridge and not an "Other" Surface Type and not "Unpaved" Surface Type **}**	**IF {** [INTERSTATE_INI].[STRUCTURE_TYPE_VN] <> 1 AND [INTERSTATE_INI].[SURFACE_TYPE_VN] <> 1 AND [INTERSTATE_INI].[SURFACE_TYPE_VN] <> 11 **}**
AND {	**AND {**
(IF SURFACE TYPE IS Missing.**)**	**(**[INTERSTATE_INI].[SURFACE_TYPE_VN] IS NULL.**)**
OR (IF (Asphalt Pavement Surface); AND (Any one of the IRI/CRACKING_PERCENT /RUTTING related data is Missing); AND (Any one of the PSR related data is Missing.) **)**	**OR (** ([INTERSTATE_INI].[SURFACE_TYPE_VN] IN (2, 6, 7, 8)) AND ([INTERSTATE_INI].[IRI_VN] IS NULL OR [INTERSTATE_INI].[IRI_VD] IS NULL OR [INTERSTATE_INI].[CRACKING_PERCENT_VN] IS NULL OR [INTERSTATE_INI].[CRACKING_PERCENT _VD] IS NULL OR [INTERSTATE_INI].[RUTTING_VN] IS NULL OR [INTERSTATE_INI].[RUTTING_VD] IS NULL) AND ([INTERSTATE_INI].[PSR_VN] IS NULL OR ([INTERSTATE_INI].[PSR_VT] IS NULL) OR [INTERSTATE_INI].[PSR_VD] IS NULL) **)**

Criteria Description	Criteria Expression
OR (IF (Jointed Concrete Pavement Surface); AND (Any one of the IRI/CRACKING_PERCENT /FAULTING related data is Missing); AND (Any one of the PSR related data is Missing.) **)**	**OR (** ([INTERSTATE_INI].[SURFACE_TYPE_VN] IN (3, 4, 9, 10)) AND ([INTERSTATE_INI].[IRI_VN] IS NULL OR [INTERSTATE_INI].[IRI_VD] IS NULL OR [INTERSTATE_INI].[CRACKING_PERCENT_VN] IS NULL OR [INTERSTATE_INI].[CRACKING_PERCENT _VD] IS NULL OR [INTERSTATE_INI].[FAULTING_VN] IS NULL OR [INTERSTATE_INI].[FAULTING_VD] IS NULL) AND ([INTERSTATE_INI].[PSR_VN] IS NULL OR ([INTERSTATE_INI].[PSR_VT] IS NULL) OR [INTERSTATE_INI].[PSR_VD] IS NULL) **)**
OR (IF CRCP Surface; AND (Any one of the IRI/CRACKING_PERCENT related is Missing); AND (Any one of the PSR related data is Missing.) **)**	**OR (** ([INTERSTATE_INI].[SURFACE_TYPE_VN] = 5) AND ([INTERSTATE_INI].[IRI_VN] IS NULL OR [INTERSTATE_INI].[IRI_VD] IS NULL OR [INTERSTATE_INI].[CRACKING_PERCENT_VN] IS NULL OR [INTERSTATE_INI].[CRACKING_PERCENT _VD] IS NULL) AND ([INTERSTATE_INI].[PSR_VN] IS NULL OR ([INTERSTATE_INI].[PSR_VT] IS NULL) OR [INTERSTATE_INI].[PSR_VD] IS NULL) **)**
}	**}**

Table E2 – Criteria for Identifying Missing Data for NON_INTERSTATE_NHS_INI Data Set

Criteria Description	Criteria Expression
IF { a segment is not a bridge and not an "Other" Surface Type and not "Unpaved" Surface Type **}**	**IF {**[NON_INTERSTATE_NHS_INI].[STRUCTURE_TYPE_VN] <> 1 AND [NON_INTERSTATE_NHS_INI].[SURFACE_TYPE_VN] <> 1 AND [NON_INTERSTATE_NHS_INI].[SURFACE_TYPE_VN] <> 11 **}**
AND {	**AND {**
(IF SURFACE TYPE IS Missing.**)**	**(**[NON_INTERSTATE_NHS_INI].[SURFACE_TYPE_VN] IS NULL.**)**
OR (IF (Asphalt Pavement Surface); AND	**OR (** ([NON_INTERSTATE_NHS_INI].[SURFACE_TYPE_VN] IN (2, 6, 7, 8)) AND ([NON_INTERSTATE_NHS_INI].[IRI_VN] IS NULL OR

Criteria Description	Criteria Expression
(Any one of the IRI/CRACKING_PERCENT /RUTTING related data is Missing); AND (Any one of the PSR related data is Missing.) **)**	[NON_INTERSTATE_NHS_INI].[IRI_VD] IS NULL OR
	[NON_INTERSTATE_NHS_INI].[CRACKING_PERCENT_VN] IS NULL OR
	[NON_INTERSTATE_NHS_INI].[CRACKING_PERCENT _VD] IS NULL OR
	[NON_INTERSTATE_NHS_INI].[RUTTING_VN] IS NULL OR
	[NON_INTERSTATE_NHS_INI].[RUTTING_VD] IS NULL)
	AND ([NON_INTERSTATE_NHS_INI].[PSR_VN] IS NULL OR
	([NON_INTERSTATE_NHS_INI].[PSR_VT] IS NULL) OR
	[NON_INTERSTATE_NHS_INI].[PSR_VD] IS NULL) **)**
OR (IF (Jointed Concrete Pavement Surface); AND (Any one of the IRI/CRACKING_PERCENT /FAULTING related data is Missing); AND (Any one of the PSR related data is Missing.) **)**	**OR (** ([NON_INTERSTATE_NHS_INI].[SURFACE_TYPE_VN] IN (3, 4, 9, 10))
	AND ([NON_INTERSTATE_NHS_INI].[IRI_VN] IS NULL OR
	[NON_INTERSTATE_NHS_INI].[IRI_VD] IS NULL OR
	[NON_INTERSTATE_NHS_INI].[CRACKING_PERCENT_VN] IS NULL OR
	[NON_INTERSTATE_NHS_INI].[CRACKING_PERCENT _VD] IS NULL OR
	[NON_INTERSTATE_NHS_INI].[FAULTING_VN] IS NULL OR
	[NON_INTERSTATE_NHS_INI].[FAULTING_VD] IS NULL)
	AND ([NON_INTERSTATE_NHS_INI].[PSR_VN] IS NULL OR
	([NON_INTERSTATE_NHS_INI].[PSR_VT] IS NULL) OR
	[NON_INTERSTATE_NHS_INI].[PSR_VD] IS NULL) **)**
OR (IF CRCP Surface; AND (Any one of the IRI/CRACKING_PERCENT related is Missing); AND (Any one of the PSR related data is Missing.) **)**	**OR (** ([NON_INTERSTATE_NHS_INI].[SURFACE_TYPE_VN] = 5)
	AND ([NON_INTERSTATE_NHS_INI].[IRI_VN] IS NULL OR
	[NON_INTERSTATE_NHS_INI].[IRI_VD] IS NULL OR
	[NON_INTERSTATE_NHS_INI].[CRACKING_PERCENT_VN] IS NULL OR
	[NON_INTERSTATE_NHS_INI].[CRACKING_PERCENT _VD] IS NULL)
	AND ([NON_INTERSTATE_NHS_INI].[PSR_VN] IS NULL OR
	([NON_INTERSTATE_NHS_INI].[PSR_VT] IS NULL) OR
	[NON_INTERSTATE_NHS_INI].[PSR_VD] IS NULL) **)**
}	**}**

Percent Missing Data Computation

Based on the identified Missing Data through criteria in Tables E1 and E2, Percent Missing Data could be computed as the equation shown below.

$$\%\_M\_IS = \frac{M\_LM\_IS}{Network\_LM\_IS - Bridges\_LM\_IS - Unpaved\_Other\_LM\_IS} \times 100$$

$$\%\_M\_NIN = \frac{M\_LM\_NIN}{Network\_LM\_NIN - Bridges\_LM\_NIN - Unpaved\_Other\_LM\_NIN} \times 100$$

Where,

%_M_IS:	percentage of Interstate System determined having "Missing" data (computed to the one tenth of a percent)
%_M_NIN:	percentage of Non-Interstate NHS determined having "Missing" data (computed to the one tenth of a percent)
M_LM_IS:	total lane-miles of mainline highways on the Interstate System determined having "Missing" data
M_LM_NIN:	total lane-miles of mainline highways on the Non-Interstate NHS determined having "Missing" data
Network_LM_IS:	total lane-miles of mainline highways on the Interstate System
Network_LM_NIN:	total lane-miles of mainline highways on the Non-Interstate NHS
Bridges_LM_IS:	total lane-miles of mainline highways on the Interstate System reported as bridges
Bridges_LM_NIN:	total lane-miles of mainline highways on the Non-Interstate NHS reported as bridges
Unpaved_Other_LM_IS:	total lane-miles of mainline highways on the Interstate System reported as "Unpaved or Other" Surface Types
Unpaved_Other_LM_NIN:	total lane-miles of mainline highways on the Non-Interstate NHS reported as "Unpaved or Other" Surface Types

The total lane-miles of mainline highways on the Interstate System determined having "Missing" Data (M_LM_IS) could be obtained by following pseudo-code for a Single Centerline data format. Please note that `[DynSeg_SL]` is `([End_Point] – [Begin_Point])` for each mainline highway segment in this Section.

```
SELECT

    Sum([INTERSTATE_INI].[THROUGH_LANES_VN]*[INTERSTATE_INI].[DynSeg_
    SL])

    AS M_LM_IS

FROM INTERSTATE_INI
```

```
WHERE (Segments meet any one of the Missing Data criteria in Table
E1);
```

The total lane-miles of mainline highways on the Interstate System determined having "Missing" Data (M_LM_IS) could be obtained by following pseudo-code for a Dual-Carriage data format.

```
SELECT

   Sum(IIf([INTERSTATE_INI].[FACILITY_TYPE_VN]=1,

   [INTERSTATE_INI].[THROUGH_LANES_VN]*[INTERSTATE_INI].[DynSeg_SL],

   IIf([INTERSTATE_INI].[FACILITY_TYPE_VN]=2 Or
   [INTERSTATE_INI].[FACILITY_TYPE_VN]=6,

   [INTERSTATE_INI].[DIR_THROUGH_LANES_VN]*[INTERSTATE_INI].[DynSeg_
   SL],0)))

   AS M_LM_IS

FROM INTERSTATE_INI

WHERE (Segments meet any one of the Missing Data criteria in Table
E1);
```

The total lane-miles of mainline highways on the Non-Interstate NHS determined having "Missing" Data (M_LM_NIN) could be obtained by following pseudo-code.

```
SELECT

   Sum([NON_INTERSTATE_NHS_INI].[THROUGH_LANES_VN]*[NON_INTERSTATE_N
   HS_INI].[DynSeg_SL])

   AS M_LM_NIN

FROM NON_INTERSTATE_NHS_INI

WHERE (Segments meet any one of the Missing Data criteria in Table
E2);
```

Total lane-miles of mainline highways on the Interstate System (Network_LM_IS) could be obtained by following SQL for a Single Centerline data format.

```
SELECT

   Sum([INTERSTATE_INI].[THROUGH_LANES_VN]*[INTERSTATE_INI].[DynSeg_
   SL])

   AS Network_LM_IS
```

```
FROM INTERSTATE_INI;
```

Total lane-miles of mainline highways on the Interstate System (Network_LM_IS) could be obtained by following SQL for a Dual-Carriage data format.

```
SELECT

   Sum(IIf([INTERSTATE_INI].[FACILITY_TYPE_VN]=1,

   [INTERSTATE_INI].[THROUGH_LANES_VN]*[INTERSTATE_INI].[DynSeg_SL],

   IIf([INTERSTATE_INI].[FACILITY_TYPE_VN]=2 Or
   [INTERSTATE_INI].[FACILITY_TYPE_VN]=6,

   [INTERSTATE_INI].[DIR_THROUGH_LANES_VN]*[INTERSTATE_INI].[DynSeg_
   SL],0)))

   AS Network_LM_IS

FROM INTERSTATE_INI;
```

Total lane-miles of mainline highways on the Non-Interstate NHS (Network_LM_NIN) could be obtained by following SQL.

```
SELECT

   Sum([NON_INTERSTATE_NHS_INI].[THROUGH_LANES_VN]*[NON_INTERSTATE_N
   HS_INI].[DynSeg_SL])

   AS Network_LM_NIN

FROM NON_INTERSTATE_NHS_INI;
```

Appendix F – Graphical Illustrations of Example Data

Figure F1 – Graphical Illustration of HPMS "Sections" Data Set Contain Attributes of Selected Data Items

Mile Point	0.000	0.050	0.100	0.150	0.200	0.250	0.300	0.350	0.400	0.450	0.500	0.550	0.600	0.650	0.700	0.750	0.800	0.850	0.900	0.950	1.000	1.050	1.100
NHS_VN	1 (Non Connector NHS)																						
F_SYSTEM_VN	3 (Principal Arterial)																						
THROUGH_LANES_VN	6				4						6												
FACILITY_TYPE_VN	2 (2-way Roadway)																						
SURFACE_TYPE_VN	N/R		6(AC)				4(JRC)	11(O)	4(JRC)								5(CRC)						
STRUCTURE_TYPE_VN	N/R						1	N/R															
IRI_VN	60	65	115	180	126	195	170	120					80	80	86	90	92	N/R					
IRI_VD	01/2018	01/2018	01/2016	01/2018	01/2018	01/2018	01/2018	01/2018					01/2018	01/2018	01/2018	01/2018	01/2018	N/R					
CRACKING_PERCENT_VN	0	1	1	7	8	5	3	3	0					1	1	2	N/R						
CRACKING_PERCENT_VD	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018					01/2018	01/2018	01/2018	N/R						
RUTTING_VN	0.00	0.20		0.45	0.00		0.10	N/R															
RUTTING_VD	01/2018	01/2018		01/2018	01/2018		01/2018	N/R															
FAULTING_VN	N/R							0.08	0.08	0.10	0.10	0.00	0.00	0.00	0.10	0.00							
FAULTING_VD	N/R							01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018							
PSR_VN	N/R																3.5	6.0	4.2				
PSR_VT	N/R																"A"	"A"	"A"				
URBAN_CODE_VN	99999																						

N/R Denotes "data not-reported" for a Data Item for a particular segment of the highway network.

Figure F2 – Tabular Illustration of Dynamically Segmented "Sections" Data Set (Full-Intersections)

Mile Point	0.000	0.050	0.100	0.150	0.200	0.250	0.300	0.350	0.400	0.450	0.500	0.550	0.600	0.650	0.700	0.750	0.800	0.850	0.900	0.950	1.000	1.050
Begin_Point	0.000	0.050	0.100		0.200		0.300	0.350	0.400	0.450	0.500		0.600	0.650	0.700		0.800		0.900	0.950		1.050
End_Point	0.050	0.100	0.200		0.300		0.350	0.400	0.450	0.500	0.600		0.650	0.700	0.800		0.900		0.950	1.050		1.100
Section_Length of FULL_INTERSECT	0.05mi	0.05mi	0.1mi		0.1mi		.05mi	.05mi	.05mi	.05mi	0.1mi		.05mi	.05mi	0.1mi		0.1mi		.05mi	0.1mi		.05mi
NHS_VN	1	1	1		1		1	1	1	1	1		1	1	1		1		1	1		1
F_SYSTEM_VN	3	3	3		3		3	3	3	3	3		3	3	3		3		3	3		3
THROUGH_LANES_VN	6	6	6		4		4	4	4	6	6		6	6	6		6		6	6		6
FACILITY_TYPE_VN	2	2	2		2		2	2	2	2	2		2	2	2		2		2	2		2
SURFACE_TYPE_VN		6(AC)	6(AC)		6(AC)		4(JRC)	4(JRC)	4(JRC)	4(JRC)	4(JRC)		4(JRC)	4(JRC)	4(JRC)		5(CRC)		5(CRC)	5(CRC)		5(CRC)
STRUCTURE_TYPE_VN							1															
IRI_VN	60	65	115		180		126	195	170	170	120		120	80	80		86		90	92		
IRI_VD	01/2018	01/2018	01/2016		01/2018		01/2018	01/2018	01/2018	01/2019	01/2018		01/2017	01/2018	01/2018		01/2018		01/2018	01/2018		
CRACKING_PERCENT_VN	0	1	1		7		8	5	3	3	3		0	0	1		1		2			
CRACKING_PERCENT_VD	01/2018	01/2018	01/2018		01/2018		01/2018	01/2018	01/2018	01/2019	01/2018		01/2018		01/2018		01/2018		01/2018			
RUTTING_VN	0.00	0.20	0.20		0.45		0.00	0.00	0.10	0.10												
RUTTING_VD		01/2018	01/2018		01/2018		01/2018	01/2018	01/2018	01/2018												
FAULTING_VN									0.08	0.08	0.08		0.1	0.1	0		0		0	0.1		0
FAULTING_VD									01/2018	01/2018	01/2018		01/2018	01/2018	01/2018		01/2018		01/2018	01/2018		01/2018
PSR_VN																			3.5	6.0		4.2
PSR_VT																			"A"	"A"		"A"
URBAN_CODE_VN	99999	99999	99999		99999		99999	99999	99999	99999	99999		99999	99999	99999		99999		99999	99999		99999

Figure F3 – Graphical Illustration of Sections Violated Length and Spatial Coincidence Requirements in HPMS "Sections" Data Set

Mile Point	0.000	0.050	0.100	0.150	0.200	0.250	0.300	0.350	0.400	0.450	0.500	0.550	0.600	0.650	0.700	0.750	0.800	0.850	0.900	0.950	1.000	1.050	1.100
NHS_VN	1 (Non Connector NHS)																						
F_SYSTEM_VN	3 (Principal Arterial)																						
THROUGH_LANES_VN	6						4						6										
FACILITY_TYPE_VN	2 (2-way Roadway)																						
SURFACE_TYPE_VN	N/R		6(AC)				4(JRC)	11(O)	4(JRC)								5(CRC)						
STRUCTURE_TYPE_VN	N/R						1	N/R															
IRI_VN	60	65	115	180	126	195	170	120			80	80	86	90	92	N/R							
IRI_VD	01/2018	01/2018	01/2016	01/2018	01/2018	01/2018	01/2018	01/2018			01/2018	01/2018	01/2018	01/2018	01/2018	N/R							
CRACKING_PERCENT_VN	0	1	1	7	8	5	3	3	0		1	1	2	N/R									
CRACKING_PERCENT_VD	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018		01/2018	01/2018	01/2018	01/2018	N/R								
RUTTING_VN	0.00	0.20		0.45	0.00		0.10	N/R															
RUTTING_VD	01/2018	01/2018		01/2018	01/2018		01/2018	N/R															
FAULTING_VN	N/R						0.08	0.08	0.10	0.10	0.00	0.00	0.00	0.10	0.00								
FAULTING_VD	N/R						01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018								
PSR_VN	N/R																		3.5	6.0	4.2		
PSR_VT	N/R																		"A"	"A"	"A"		
URBAN_CODE_VN	99999																						

##	Denotes Sections with length violation
##	Denotes Sections with spatial coincidence violation
##	Denotes Sections with both length and spatial coincidence violations
N/R	Denotes "data not-reported" for a Data Item for a particular segment of the highway network.

Figure F4 – Graphical Illustration of Dynamically Segmented Data Set "Flagged" where Sections are in Length and Spatial Coincidence Violation

Mile Point	0.000	0.050	0.100	0.150	0.200	0.250	0.300	0.350	0.400	0.450	0.500	0.550	0.600	0.650	0.700	0.750	0.800	0.850	0.900	0.950	1.000	1.050	1.100
BEGIN_POINT	0.000	0.050	0.100		0.200		0.300	0.350	0.400	0.450	0.500		0.600	0.650	0.700		0.800		0.900	0.950		1.050	
END_POINT	0.050	0.100	0.200		0.300		0.350	0.400	0.450	0.500	0.600		0.650	0.700	0.800		0.900		0.950	1.050		1.100	
FULL_INTERSECT (Section Length)	0.05mi	0.05mi	0.1mi		0.1mi		.05mi	.05mi	.05mi	.05mi	0.1mi		.05mi	.05mi	0.1mi		0.1mi		.05mi	0.1mi		.05mi	
NHS_VN	1	1	1		1		1	1	1	1	1		1	1	1		1		1	1		1	
F_SYSTEM_VN	3	3	3		3		3	3	3	3	3		3	3	3		3		3	3		3	
THROUGH_LANES_VN	6	6	6		4		4	4	4	6	6		6	6	6		6		6	6		6	
FACILITY_TYPE_VN	2	2	2		2		2	2	2	2	2		2	2	2		2		2	2		2	
SURFACE_TYPE_VN		6(AC)	6(AC)		6(AC)		4(JRC)	11(O)	4(JRC)	4(JRC)	4(JRC)		4(JRC)	4(JRC)	4(JRC)		5(CRC)		5(CRC)	5(CRC)		5(CRC)	
STRUCTURE_TYPE_VN							1																
IRI_VN	60	65	115		180		126	195	170	170	120		120	80	80		86		90	92			
IRI_VD	01/2018	01/2018	01/2016		01/2018		01/2018	01/2018	01/2018	01/2018	01/2018		01/2018	01/2018	01/2018		01/2018		01/2018	01/2018			
CRACKING_PERCENT_VN	0	1	1		7		8	5	3	3	3		0	0	1		1		2				
CRACKING_PERCENT_VD	01/2018	01/2018	01/2018		01/2018		01/2018	01/2018	01/2018	01/2019	01/2018		01/2018	01/2018	01/2018		01/2018		01/2018				
RUTTING_VN	0.00	0.20	0.20		0.45		0.00	0.00	0.10	0.10													
RUTTING_VD	01/2018	01/2018	01/2018		01/2018		01/2018	01/2018	01/2018	01/2018													
FAULTING_VN									0.08	0.08	0.08		0.10	0.10	0.00		0.00		0.00	0.10		0.00	
FAULTING_VD									01/2018	01/2018	01/2018		01/2018	01/2018	01/2018		01/2018		01/2018	01/2018		01/2018	
PSR_VN																			3.5	6.0		4.2	
PSR_VT																			"A"	"A"		"A"	
URBAN_CODE_VN	99999	99999	99999		99999		99999	99999	99999	99999	99999		99999	99999	99999		99999		99999	99999		99999	
Length Violation (Flagged)		**X**	**X**								**X**		**X**										
Spatial Coincidence Violation (Flagged)		**X**	**X**				**X**	**X**			**X**		**X**	**X**								**X**	

Figure F5 – Data Set FULL_INTERSECTION_SLSC - Illustration of Incorporating "Flagged" Sections Violating Length and Spatial Coincidence Requirements into a Dynamically Segmented Data Set

Year_Record	State_Code	Route_ID	Begin_Point	End_Point	NHS_VN	F_SYSTEM_VN	THROUGH_LANES_VN	FACILITY_TYPE_VN	SURFACE_TYPE_VN	STRUCTURE_TYPE_VN	IRI_VN	IRI_VD	CRACKING_PERCENT_VN	CRACKING_PERCENT_VD	RUTTING_VN	RUTTING_VD	FAULTING_VN	FAULTING_VD	PSR_VN	PSR_VD	PSR_VT	URBAN_CODE_VN	DynSeg_SL	IRI_Sections_SL	CRACKING_PERCENT_Sections_SL	CRACKING_PERCENT_Sections_SC	RUTTING_Sections_SL	RUTTING_Sections_SC	FAULTING_Sections_SL	FAULTING_Sections_SC	PSR_Sections_SL
2018	99	AAA	0	0.05	1	3	6	2			60	01/2018	0	01/2018	0							99999	0.050								
2018	99	AAA	0.05	0.1	1	3	6	2	6		60	01/2018	1	01/2018	0.2	01/2018						99999	0.050				**LENGTH VIOLATION**	**COINCIDENCE VIOLATION**			
2018	99	AAA	0.1	0.2	1	3	6	2	6		115	01/2016	1	01/2018	0.2	01/2018						99999	0.100				**LENGTH VIOLATION**	**COINCIDENCE VIOLATION**			
2018	99	AAA	0.2	0.3	1	3	4	2	6		180	01/2018	7	01/2018	0.45	01/2018						99999	0.100								
2018	99	AAA	0.3	0.35	1	3	4	2	4	1	126	01/2018	8	01/2018	0	01/2018						99999	0.050					**COINCIDENCE VIOLATION**			
2018	99	AAA	0.35	0.4	1	3	4	2	4		195	01/2018	5	01/2018	0	01/2018						99999	0.050					**COINCIDENCE VIOLATION**			
2018	99	AAA	0.4	0.45	1	3	4	2	4		170	01/2018	3	01/2018	0.1	01/2018	0.08	01/2018				99999	0.050								
2018	99	AAA	0.45	0.5	1	3	6	2	4		170	01/2018	3	01/2018	0.1	01/2018	0.08	01/2018				99999	0.050								
2018	99	AAA	0.5	0.6	1	3	6	2	4		120	01/2018	3	01/2018			0.08	01/2018				99999	0.100	**LENGTH VIOLATION**		**COINCIDENCE VIOLATION**				**COINCIDENCE VIOLATION**	
2018	99	AAA	0.6	0.65	1	3	6	2	4		120	01/2018	0	01/2018			0.1	01/2018				99999	0.050	**LENGTH VIOLATION**		**COINCIDENCE VIOLATION**				**COINCIDENCE VIOLATION**	
2018	99	AAA	0.65	0.7	1	3	6	2	4		80	01/2018	0	01/2018			0.1	01/2018				99999	0.050			**COINCIDENCE VIOLATION**					
2018	99	AAA	0.7	0.8	1	3	6	2	4		80	01/2018	1	01/2018			0	01/2018				99999	0.100								
2018	99	AAA	0.8	0.9	1	3	6	2	5		86	01/2018	1	01/2018			0	01/2018				99999	0.100								
2018	99	AAA	0.9	0.95	1	3	6	2	5		90	01/2018	2	01/2018			0	01/2018	3.5	01/2018	A	99999	0.050								
2018	99	AAA	0.95	1.05	1	3	6	2	5		92	01/2018	2	01/2018			0.1	01/2018	4.2	01/2018	A	99999	0.100								
2018	99	AAA	1.05	1.1	1	3	6	2	5										6	01/2018	A	99999	0.050							**COINCIDENCE VIOLATION**	

Figure F6 – Illustration of INTERSTATE and NON_INTERSTATE_NHS Data Sets for Measure Computation

Year_Record	State_Code	Route_ID	Begin_Point	End_Point	NHS_VN	F_SYSTEM_VN	THROUGH_LANES_VN	FACILITY_TYPE_VN	SURFACE_TYPE_VN	STRUCTURE_TYPE_VN	IRI_VN	IRI_VD	CRACKING_PERCENT_VN	CRACKING_PERCENT_VD	RUTTING_VN	RUTTING_VD	FAULTING_VN	FAULTING_VD	PSR_VN	PSR_VD	PSR_VT	URBAN_CODE_VN	DynSeg_SL	IRI_Sections_SL	CRACKING_PERCENT_Sections_SL	CRACKING_PERCENT_Sections_SC	RUTTING_Sections_SL	RUTTING_Sections_SC	FAULTING_Sections_SL	FAULTING_Sections_SC	PSR_Sections_SL	THROUGH_LANES_UN	STRUCTURE_TYPE_UN	SURFACE_TYPE_UN	IRI_UN	CRACKING_PERCENT_UN	RUTTING_UN	FAULTING_UN	PSR_UN
2018	99	AAA	0	0.05	1	3	6	2			60	01/2018	0	01/2018	0							99999	0.050																
2018	99	AAA	0.05	0.1	1	3	6	2	6		60	01/2018	1	01/2018	0.2	01/2018						99999	0.050				LENGTH VIOLATION	COINCIDENCE VIOLATION											
2018	99	AAA	0.1	0.2	1	3	6	2	6		115	01/2016	1	01/2018	0.2	01/2018						99999	0.100				LENGTH VIOLATION	COINCIDENCE VIOLATION											
2018	99	AAA	0.2	0.3	1	3	4	2	6		180	01/2018	7	01/2018	0.45	01/2018						99999	0.100																
2018	99	AAA	0.3	0.35	1	3	4	2	4	1	126	01/2018	8	01/2018	0	01/2018						99999	0.050					COINCIDENCE VIOLATION											
2018	99	AAA	0.35	0.4	1	3	4	2	4		195	01/2018	5	01/2018	0	01/2018						99999	0.050					COINCIDENCE VIOLATION											
2018	99	AAA	0.4	0.45	1	3	4	2	4		170	01/2018	3	01/2018	0.1	01/2018	0.08	01/2018				99999	0.050																
2018	99	AAA	0.45	0.5	1	3	6	2	4		170	01/2018	3	01/2018	0.1	01/2018	0.08	01/2018				99999	0.050																
2018	99	AAA	0.5	0.6	1	3	6	2	4		120	01/2018	3	01/2018			0.08	01/2018				99999	0.100	LENGTH VIOLATION		COINCIDENCE VIOLATION				COINCIDENCE VIOLATION								
2018	99	AAA	0.6	0.65	1	3	6	2	4		120	01/2018	0	01/2018			0.1	01/2018				99999	0.050	LENGTH VIOLATION		COINCIDENCE VIOLATION				COINCIDENCE VIOLATION								
2018	99	AAA	0.65	0.7	1	3	6	2	4		80	01/2018	0	01/2018			0.1	01/2018				99999	0.050			COINCIDENCE VIOLATION												
2018	99	AAA	0.7	0.8	1	3	6	2	4		80	01/2018	1	01/2018			0	01/2018				99999	0.100																
2018	99	AAA	0.8	0.9	1	3	6	2	5		86	01/2018	1	01/2018			0	01/2018				99999	0.100																
2018	99	AAA	0.9	0.95	1	3	6	2	5		90	01/2018	2	01/2018			0	01/2018	3.5	01/2018	A	99999	0.050																
2018	99	AAA	0.95	1.05	1	3	6	2	5		92	01/2018	2	01/2018			0.1	01/2018	4.2	01/2018	A	99999	0.100																
2018	99	AAA	1.05	1.1	1	3	6	2	5										6	01/2018	A	99999	0.050						COINCIDENCE VIOLATION								

Figure F7 – Graphical Illustration of Dynamically Segmented Data Set with Classification

Mile Point	0.000	0.050	0.100 – 0.150	0.200 – 0.250	0.300	0.350	0.400	0.450	0.500 – 0.550	0.600	0.650	0.700 – 0.750	0.800 – 0.850	0.900	0.950 – 1.000	1.050 – 1.100
BEGIN_POINT	0.000	0.050	0.100	0.200	0.300	0.350	0.400	0.450	0.500	0.600	0.650	0.700	0.800	0.900	0.950	1.050
END_POINT	0.050	0.100	0.200	0.300	0.350	0.400	0.450	0.500	0.600	0.650	0.700	0.800	0.900	0.950	1.050	1.100
FULL_INTERSECT (Section Length)	0.05mi	0.05mi	0.1mi	0.1mi	.05mi	.05mi	.05mi	.05mi	0.1mi	.05mi	.05mi	0.1mi	0.1mi	.05mi	0.1mi	.05mi
NHS_VN	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
F_SYSTEM_VN	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
THROUGH_LANES_VN	6	6	6	4	4	4	4	6	6	6	6	6	6	6	6	6
FACILITY_TYPE_VN	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SURFACE_TYPE_VN		6(AC)	6(AC)	6(AC)	4(JRC)	**11(O)**	4(JRC)	4(JRC)	4(JRC)	4(JRC)	4(JRC)	4(JRC)	5(CRC)	5(CRC)	5(CRC)	5(CRC)
STRUCTURE_TYPE_VN					**1**											
IRI_VN	60	65	115	**180**	126	195	**170**	**170**	120	120	80	**80**	**86**	**90**	92	
IRI_VD	01/2018	01/2018	01/2016	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	
CRACKING_PERCENT_VN	0	1	1	**7**	8	5	**3**	**3**	3	0	0	**1**	**1**	**2**		
CRACKING_PERCENT_VD	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2019	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018		
RUTTING_VN	0.00	0.20	0.20	**0.45**	0.00	0.00	0.10	0.10								
RUTTING_VD	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018								
FAULTING_VN							**0.08**	**0.08**	0.08	0.10	0.10	**0.00**	0.00	0.00	0.10	0.00
FAULTING_VD							01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018	01/2018
PSR_VN														3.5	**6.0**	**4.2**
PSR_VT														"A"	"A"	"A"
URBAN_CODE_VN	99999	99999	99999	99999	99999	99999	99999	99999	99999	99999	99999	99999	99999	99999	99999	99999
Length Violation (Flagged)		X	X						X	X						
Spatial Coincidence Violation (Flagged)		X	X		X	X			X	X	X					X
Invalid or Missing (Non-Length, Non-Coincidence)	X															
Unresolved Data																
Classification	**MIU**	**MIU**	**MIU**	**Poor**	**Bridge**	**Other**	**Fair**	**Fair**	**MIU**	**MIU**	**MIU**	**Good**	**Good**	**Good**	**MIU**	**Good**