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# **SCOPM Task Force Findings on National-Level Performance Measures**

AASHTO Standing Committee on Performance Management  
Task Force on Performance Measure  
Development, Coordination and Reporting

Chair: Paul Degges, Chief Engineer, Tennessee

Vice –Chair: Bernie Arseneau, Deputy Commissioner, Minnesota

## Members

- Mal Kerley, Chief Engineer, Virginia
- Judith Corley-Lay, Pavement Analysis Engineer, North Carolina
- Mara Campbell, Customer Relations Director, Missouri
- Grant Levi, Deputy Director for Engineering, North Dakota
- John Barton, Deputy Executive Director/Chief Engineer, Texas
- Rick Land, Acting Chief Deputy Director, California
- Lynn Zanto, Administrator, Rail, Transit, and Planning, Montana
- Daniela Bremmer, Director of Strategic Assessment, Washington State
- Tim Gatz, Director, Capital Programs, Oklahoma
- Tim Henkel, Division Director, Modal Planning and Program Management, Minnesota
- Mark Van Port Fleet, Engineer of Development, Michigan
- John Selmer, Director of Statewide Operations, Iowa
- Nile Easton, Communications Director, Utah
- Lori Richter, Performance Measure Manager, Wisconsin
- Christopher Xenophontos, Assistant Director of Administration, Rhode Island

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# Introduction

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Following the passage of the federal transportation legislation – Moving Ahead for Progress in the 21st Century (MAP-21) in July, 2012, the Federal Highway Administration (FHWA) began work on developing a Notice of Proposed Rulemaking (NPRM) for the provisions of the legislation—including the establishment and implementation of national performance measures. MAP-21 requires the United States Department of Transportation (U.S. DOT) to identify national-level performance measures for various performance management areas related to safety, pavements, bridges, freight, emissions, performance, and congestion.

The American Association of State Highway Transportation Officials (AASHTO) has an opportunity to inform FHWA’s rulemaking process by providing the U.S. DOT with a clear, defensible and unifying statement on each national-level performance measure. The AASHTO Standing Committee on Performance Management (SCOPM) created a Task Force on Performance Measure Development, Coordination and Reporting charged to “assist SCOPM and AASHTO to develop a limited number of national performance measures and help prepare AASHTO members to meet new Federal performance management requirements.” The Task Force includes representatives from each performance management area and other leaders within the AASHTO organization and is chaired by Paul Degges, Chief Engineer of Tennessee Department of Transportation. The purpose of this Task Force is to serve as a single clearinghouse for recommended national-level performance measures identified by those AASHTO committees with in-depth knowledge of the technical aspects of the individual performance measure areas.

The present document sets out a recommended list of national-level performance measures, developed through the Task Force. In developing the recommended measures, the Task Force has been guided by six overarching principles on how national performance measures should be developed and implemented. These six principles are as follows:

1. **There is a Difference**—National-level performance measures are not necessarily the same performance measures State DOTs will use for planning and programming of transportation projects and funding.
2. **Specificity and Simplicity**—National-level performance measures should follow the SMART and KISS principles:
  - SMART—Specific, Measurable, Attainable, Realistic, Timely
  - KISS—Keep it Short and Simple
3. **Possession is 9/10ths of the Law**—National-level performance measures should focus on areas and assets that States DOTs have control over.
4. **Reduce and Re-use**—The initial set of national-level performance measures should build upon existing performance measures, management practices, data sets and reporting processes.
5. **Ever Forward**—National-level measures should be forward thinking to allow continued improvement over time.
6. **Communicate, Communicate, Communicate**—Messaging the impact and meaning of the national-level measures to the public and other audiences is vital to the success of this initiative.

The task force membership includes a range of technical and policy experts representing states that are urban, rural, large and small. There was broad agreement among the members that the results of the work of the task force are good. There were also some differing opinions concerning the number of performance measures being recommended. In the end, however, there was consensus among the task force members that the national performance measures recommended in this document represent an appropriate and credible set of performance measures that State DOTs can implement given the requirements in MAP-21.

The Task Force makes the following recommendations regarding the development of national-level performance measures for the following six performance management areas.

#### **SAFETY**

- **Number of Fatalities**—Five-year moving average of the count of the number of fatalities on all public roads for a calendar year.
- **Fatality Rate**—Five-year moving average of the Number of Fatalities divided by the Vehicle Miles Traveled (VMT) for a calendar year.
- **Number of Serious Injuries**—Five-year moving average of the count of the number of serious injuries on all public roads for a calendar year.
- **Serious Injury Rate**—Five-year moving average of the Number of Serious Injuries divided by the Vehicle Miles Traveled (VMT) for a calendar year.

#### **PAVEMENT CONDITION**

- **Interstate Pavement in Good, Fair and Poor Condition based on the International Roughness Index (IRI)**—Percentage of 0.1 mile segments of Interstate pavement mileage in good, fair and poor condition based on the following criteria: good if IRI<95, fair if IRI is between 95 and 170, and poor if IRI is greater than 170.
- **Non-Interstate NHS Pavement in Good, Fair and Poor Condition based on the International Roughness Index (IRI)**—Percentage of .1 mile segments of non- Interstate NHS pavement mileage in good, fair and poor condition based on the following criteria: good if IRI<95, fair if IRI is between 95 and 170, and poor if IRI is greater than 170.
- **Pavement Structural Health Index**—Percentage of pavement which meet minimum criteria for pavement faulting, rutting and cracking.

#### **BRIDGES**

- **Percent of Deck Area on Structurally Deficient Bridges**—NHS bridge deck area on structurally deficient bridges as a percentage of total NHS bridge deck area.
- **NHS Bridges in Good, Fair and Poor Condition based on Deck Area**—Percentage of National Highway System bridges in good, fair and poor condition, weighted by deck area.

#### **FREIGHT**

- **Annual Hours of Truck Delay (AHTD)**—Travel time above the congestion threshold in units of vehicle-hours for Trucks on the Interstate Highway System.
- **Truck Reliability Index (RI<sub>80</sub>)**—The RI is defined as the ratio of the total truck travel time needed to ensure on-time arrival to the agency-determined threshold travel time (e.g., observed travel time or preferred travel time).

## SYSTEM PERFORMANCE

- **Annual Hours of Delay (AHD)**—Travel time above a congestion threshold (defined by State DOTs and MPOs) in units of vehicle -hours of delay on Interstate and NHS corridors.
- **Reliability Index (RI<sub>80</sub>)**—The Reliability Index is defined as the ratio of the 80th percentile travel time to the agency-determined threshold travel time.

## CONGESTION MITIGATION AND AIR QUALITY (CMAQ)

- **Criteria Pollutant Emissions**—Daily kilograms of on-road, mobile source criteria air pollutants (VOC, NO<sub>x</sub>, PM, CO) reduced by the latest annual program of CMAQ projects.
- **Annual Hours of Delay (AHD)**-Travel time above a congestion threshold (defined by State DOTs and MPOs) in units of vehicle -hours of delay reduced by the latest annual program of CMAQ projects.

The remainder of this report is organized into two sections:

1. A Summary Table of the recommended measures that meet MAP-21 performance measurement requirements. This table presents a concise overview of the recommended measures' key characteristics.
2. Briefing chapters for each performance measurement area covered in MAP-21. These chapters include a more in-depth discussion of what is recommended within each performance measurement area, providing additional detail on measure definition, methodology, target setting, reporting, progress assessment, and additional considerations.

# Summary Table

Measure Considerations	Safety				Pavements		Bridges		Freight		System Performance		CMAQ	
	Number of Fatalities	Fatality Rate	Number of Serious Injuries	Serious Injury Rate	IRI	Structural Health Index	Percent of Deck Area on Structurally Deficient Bridges	NHS Bridges in Good, Fair and Poor Condition	Annual Hours of Truck Delay	Truck Reliability Index	Annual Hours of Delay	Reliability Index	Criteria Pollutant Emissions	Annual Hours of Delay
Is the measure focused?	Yes		Need a consistent definition of serious injury.		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Has the measure been developed in partnership with stakeholders?	Standing Committee on Highway Traffic Safety Subcommittee on Safety Management GHSA CVSA NACE				AASHTO Joint Technical Committee on Pavements		AASHTO Subcommittee on Bridges and Structures		AASHTO Freight Team		AASHTO Subcommittee on System Operations and Maintenance AASHTO Subcommittee on Traffic Engineering AASHTO Special Committee on Transportation Security and Emergency Management		AASHTO Subcommittee on Air Quality AMPO	<<See System Performance>> AMPO
Is the measure maintainable to accommodate changes?	Yes	Yes	Yes	Yes	Need to develop structural health measure.	Yes	Yes	Yes	Adaptable and can be adjusted to varying needs	Adaptable and can be adjusted to varying needs	Adaptable and can be adjusted to varying needs	Yes	Yes	Yes
Can the measure be used to support investment decisions, policy making and target setting?	Yes	Yes	Yes	Yes	Need to avoid using the measure to institute a worst-first asset management approach.	This is an improved measure that reinforces an asset management approach.	Need to avoid using the measure to institute a worst-first asset management approach.	This is an improved measure that reinforces an asset management approach.	Sensitive enough to account for the effects of many types of transportation investments, travel patterns and land use changes.	Sensitive enough to account for the effects of many types of transportation investments, travel patterns and land use changes.	Sensitive enough to account for the effects of many types of transportation investments, travel patterns and land use changes.	Yes	Yes	Yes
Can the measure be used to analyze performance trends?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Well tested, widely used, robust and scalable measure in terms of time frames and different spatial and geographic areas.	Well tested, widely used, robust and scalable measure in terms of time frames and different spatial and geographic areas.	Well tested, widely used, robust and scalable measure in terms of time frames and different spatial and geographic areas.	Yes	Yes	Yes
Has the feasibility and practicality to collect, store and report data in support of the measure been considered?	Yes	Yes	Yes	Yes	Yes	Need to further develop this measure in terms of measurement and reporting	Yes	Need to address thresholds of good/fair/poor.	Several federal databases and private sector data can be used to compute both measures.	Several federal databases and private sector data can be used to compute both measures.	Several federal databases and private sector data can be used to compute both measures.	Utilize existing federal CMAQ reporting methodologies and requirements		

# Safety

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## Definition

1. **Number of Fatalities**—Five-year moving average of the count of the number of fatalities on all public roads for a calendar year.
2. **Fatality Rate**—Five-year moving average of the Number of Fatalities divided by the Vehicle Miles Traveled (VMT) for a calendar year.
3. **Number of Serious Injuries**—Five-year moving average of the count of the number of serious injuries on all public roads for a calendar year.
4. **Serious Injury Rate**—Five-year moving average of the Number of Serious Injuries divided by the Vehicle Miles Traveled (VMT) for a calendar year.

These four measures are consistent with Highway Safety Plan requirements. The Serious Injury Rate was not included in the NHTSA/GHSA measures, but is responsive to the HSP requirements. As at least an interim step, until there is further development of definitions (such as for Serious Injuries), data, or reporting requirements and schedules in conjunction with HSP needs, HSIP performance metrics and reporting should be consistent with those used for HSPs. The NCHRP 17-57 project (Development of an Approach for Serious Traffic Crash Injury Measurement and Reporting Systems) is expected to develop guidance on serious injury data, including a recommendation on an injury scoring system that, if implemented nationwide, would lead to consistency in serious injury data. Because implementation of this guidance would be expected to require some effort by states, it is recommended that at this point in time, no further effort is required of states to reach consistency in the way states are to report serious injuries.

## Methodology

To be consistent with the information reported in HSPs, data on fatalities, serious injuries, and traffic volumes for mileage-based rates reported for the HSIP should be defined in the same way and should be from the same data sources as for the HSPs:

1. **Fatalities**—Fatal Accident Reporting System (FARS) from NHTSA
  - The significant lag in the availability of FARS data should be addressed. Though fatality data from state crash files are not consistent among the states, these data do have the advantage of being available sooner. It is recommended that:
    - Federal agencies explore and implement methods for improving the timeliness of fatality and VMT data to improve the use of FARS data for national-level performance measures.
    - Incentives to encourage states to submit crash and VMT data sooner are explored.
2. **Serious Injuries**—Individual State crash data files.
  - Since there is no uniform definition for serious injuries, states should report the same way that they currently do for their Highway Safety Plans. This should be an interim approach until a more uniform manner for reporting serious injuries is possible (i.e., when NCHRP 17-57 is complete and the results are implemented). With this interim approach, there will likely be issues developing a national-level measure, since the definitions across states are not consistent.
3. **VMT**—FHWA Highway Performance Monitoring System (HPMS)

## Target Setting

AASHTO supports state flexibility in the setting of targets; as provided in MAP-21.

## Reporting

Individual states should determine whether to report general measures by urban vs. rural geographies; if they do, these measures should be reported in a manner consistent with numbers and rates currently reported in the HSP.

## Progress Assessment

In terms of assessing making progress towards targets established by the states, it is recommended that state-set targets be based on a 3- to 5-year projection of the five-year moving average data. Annual reports would demonstrate progress using these projections. Targets should be evaluated every two years. For example, in 2015 a 3-year (or 5-year) target is set for 2018 (or 2020). In 2017, FHWA assesses whether progress has been made toward the 2018 (or 2020) target based on what the five-year moving average is in 2017.

Further, it is recommended that any USDOT progress assessments take into account unique characteristics of a state's situation that would affect their ability to meet some targets and not others. For example, dramatic changes in VMT may affect a state's ability to meet both of the rate-based measures, but not the count-based measures (and vice-versa). Therefore, USDOT needs to consider these situations when assessing progress towards targets. After considering these unique situations, for a state to be penalized it should fail to meet at least two of its targets. For example, if a state misses one target, such as serious injuries per VMT, it should not have the same effect as if all four targets had not been met. Similarly, if a state has been a historically high performer, it should not be penalized for failing to meet an aggressive target this first time.

## NHTSA e-Reporting Initiative

As part of a NHTSA initiative, many local and statewide law enforcement agencies are adopting the use of e-citation and e-crash reporting. This change is increasing the data reporting which is helpful when making law enforcement decisions to be data driven. However an unintended consequence will impact states/territories when it comes to the Special Rules under the MAP-21's language for the Strategic Highway Safety Plan (page 55). With added data, the current number of serious injury crashes has increased (and will increase for other jurisdictions converting to e-crash reporting). The MAP-21 expectation is to reduce serious injury crashes yet the baseline data in many states/territories will be rising. The program guidance should be built to allow states/territories the ability to explain how or if a movement to e-reporting has influenced their crash data file. This does not impact the FARS system, as that data base already contains all of the data on fatal crashes.

## Special Rules for Older Drivers, Pedestrians and Rural Roads

There are several concerns about special rules for older drivers, pedestrians and rural roads. These include the following:

- Because the rules are based on the most recent two-year period and two years of data will not account for normal variation in crashes, states should be measured using the change in 5-year moving averages during that two-year period, for both the older road user and rural road rules.
- A special rule for rural roads is based on fatality rates, but rates are not defined. The rate should be based on VMT to be consistent with HSPs and with the required general fatality rate measure.



- It is recommended that the population that is used for the rate of older driver and pedestrian fatalities is older population of the state rather than the total population.
- It is further recommended that the following options for implementing the special rules should be considered :
  - Since the determination of whether states are meeting requirements of the special rules could occur before evaluation of whether states are making significant progress toward their general safety targets, the special rules test should be deferred until the overall targets are evaluated.
- The requirements and penalties for these special rules should be based on progress a state is making toward its required targets for the four performance measures.
  - For example, if a state is making significant progress toward its performance targets, then the state should not be subject to the considerations mandated in law if the older road user fatality and serious injury rate per capita increases in a two-year period.
  - Also states meeting their overall targets, but not experiencing a decrease in the rural fatality rates, should not be required to obligate the FY2009 amount of high risk rural road program funds for rural high risk roads.

# Pavement Condition

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## Definition

- 1. Interstate Pavement in Good, Fair and Poor Condition based on the International Roughness Index (IRI)**—Percentage of 0.1 mile segments of Interstate pavement mileage in good, fair and poor condition based on the following criteria: good if IRI<95, fair if IRI is between 95 and 170, and poor if IRI is greater than 170.
- 2. Non-Interstate NHS Pavement in Good, Fair and Poor Condition based on the International Roughness Index (IRI)**—Percentage of .1 mile segments of non- Interstate NHS pavement mileage in good, fair and poor condition based on the following criteria: good if IRI<95, fair if IRI is between 95 and 170, and poor if IRI is greater than 170.
- 3. Pavement Structural Health Index**—Percentage of pavement which meet minimum criteria for pavement faulting, rutting and cracking.

The first two measures concerning IRI, are ready for implementation today. The IRI measure was selected because it is suitable for both flexible and rigid pavements, transportation agencies are already required to collect them for HPMS, and the measure can be collected with a single piece of equipment. The breakpoints associated with these two measures for good, fair and poor will need to be evaluated based on functional class. These breakpoints are expected to apply to rural roadways. Following the first year of data submission, a study of the current breakpoints versus IRI on the ground should be conducted with the goal of reducing IRI on rural roadways and setting IRI breakpoints if possible for urban roadways. This will also give a state by state measure of percentage of miles that are overlooked if a rural only approach is used.

The third measure, which addresses pavement structure, is a measure that will require additional development. AASHTO estimates that a Pavement Structural Health Index measure will be ready for implementation in the next 3 to 5 years. The inclusion of the third measure is to illustrate the shortfall of the IRI measurement as a good representation of pavement structural health.

Ideally, the national performance measure for pavements would reflect both the ride quality and the structural health of the pavement system. The third measure deals with structural health (e.g. rutting, cracking, faulting). While a recent FHWA/AMEC study on performance measures over a three state roadway showed reasonable consistency for IRI and Rutting, faulting was far from consistent and the report recommended against use of faulting at this time. Use of IRI and rutting for flexible pavement and IRI alone for rigid pavement may present an unfair test as far as industry is concerned. In addition, there is no national consensus for various types and severities of cracking.

Therefore, AASHTO recommends proceeding in the short term with a pavement measure based on IRI, with a goal to include a Pavement Structural Health Index measures in the next 3 to 5 years. . This interim approach will allow uniformity on the method of data collection and allow for the development of the technologies and standardization of a pavement structural health index.

## Methodology

**Data Source:** A state can choose to submit their HPMS data or data from their state database. If the state database is used, the data should also include the functional class (also available in HPMS) to identify and perhaps modify the good/fair/poor breakpoints for urban versus rural roadway segments

**Spatial Segregation:** IRI testing is not appropriate at low traffic speeds and in urban environments. IRI may be adversely impacted by utilities. Data from urban sections should be submitted, but will be used to set reasonable urban ride quality goals in the future.

**Standards and Procedures:** Generally require HPMS protocols, deleting any segment that is less than 0.1 mile long. Portions of roadways that are under construction should be “skipped” in the current year of data collection and reporting.

- We recommend that states adhere to the most current version of AASHTO M328, R 56, R57, and R43.
- To improve consistency of IRI data between states, it is recommended that IRI data be processed using PROVAL, which is available at no cost. In addition, agencies should select a local site where a weekly data check is performed, and develop a control chart. No IRI determination should vary more than 5% from the control.

We recommend that FHWA consider the following additional actions to improve future data consistency and incorporate a future measures on pavement structural health:

- Develop regional calibration sites, similar to those for FWD calibration.
- Consider use of regional or national data collection contractors to reduce variability and achieve consistency in test equipment, training, quality assurance.
- Undertake a national study to determine the sensor type and the spacing of data collection intervals necessary to allow repeatable consistent measurement of faulting so that rutting for flexible pavements and faulting for rigid pavements could be considered for use in performance measurement, at a future date.

## Target Setting

AASHTO supports state flexibility in the setting of targets; as provided in MAP-21. Because IRI testing is not appropriate at low traffic speeds and may be adversely impacted by utilities, we do not recommend establishing targets for urban environments without further study.

We recommend that a state set targets to increase the % of rural road segments rated good and limit % of rural road segments rated poor. For example, a state may set a goal to increase the % good by 1%, while not allowing the % poor for rural roadways to exceed 20%. If a state has a very low percentage of road sections rated as poor, then a target maintaining current IRI should be acceptable.

## Reporting

Utilize either the IRI data reported as part of states’ annual HPMS submittal, or data separately submitted by states from their pavement data files.

## Progress Assessment

Progress towards meeting state-established targets should be assessed based on analysis of HPMS or state-reported data for the target year.

## **National Minimum Condition Level for Interstates**

Given that MAP-21 requires establishment of a national minimum condition level for Interstates, we recommend that this level be established only for rural interstate segments given the above referenced issues with urban IRI measurement. We recommend that a minimum condition level for rural interstate segments be set at less than or equal to 20% of segments rated poor based on IRI. Based on current HPMS reports, only three reporting agencies will struggle with the percentage poor requirement: Washington, DC, Puerto Rico, and New Jersey. When urban roadways are removed, New Jersey should fall under the 20% poor threshold. Many state agencies have less than 10% of segments rated poor.

# Bridge Condition

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## Definition

1. **Percent of Deck Area on Structurally Deficient Bridges**—NHS bridge deck area on structurally deficient bridges as a percentage of total NHS bridge deck area.
2. **NHS Bridges in Good, Fair and Poor Condition based on Deck Area**—Percentage of National Highway System bridges in good, fair and poor condition, weighted by deck area.

The first measure is required in MAP-21 and AASHTO supports this as an initial measure. However, this measure could steer a State DOT to implement a worst-first approach for maintaining bridge condition. Therefore, AASHTO is exploring the second measure.

The second measure currently appears to be a simple, easy to track using currently available data, reinforces an asset management approach, and is readily interpreted by the general public. Initially, this measure, if ultimately recommended by AASHTO, would be derived based on National Bridge Inventory (NBI) data. However, AASHTO recognizes that MAP-21 requires states to begin reporting element-level inspection data for NHS bridges by October 1, 2014. Use of element level data will create opportunities for development of improved performance measures. Therefore, flexibility should be provided to move to a national bridge performance measure based on element level data in the future. Several measures are currently under investigation<sup>1</sup>.

## Methodology

Both measures are to be calculated with data from the NBI<sup>2</sup>.

For the second measure, AASHTO has obtained input from its members on establishment of a Good-Fair-Poor categorization. However, at this time there is not sufficient consensus on how such a measure would be derived to present a detailed recommendation here. Therefore, AASHTO plans to convene a task force to agree on the details of how this measure would be calculated over the next few months. This Task Force will address topics such as:

- Specific NBI data elements and ranges to be used for categorizing structures as good, fair or poor
- Methods for combining individual NBI items ratings
- Derivation of the measure for states currently collecting only element-level data and using the NBI Translator to derive deck, superstructure and substructure ratings
- Methodology for deck area calculations for culverts

## Target Setting

AASHTO supports state flexibility in the setting of targets as long as the Percent of Deck Area on Structurally Deficient Bridges does not exceed 10%; as provided in MAP-21. National performance measurement targets should not be adopted. USDOT and professional organizations should provide

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<sup>1</sup> Refer to the AASHTO Standing Committee on Maintenance – Bridge Subcommittee resolution 12-02, July 19, 2012.

<sup>2</sup> See FHWA *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges*

guidance to states that need assistance to adopt various recommended national performance measures, and leading states should be able to continue their performance management path. Every state should be allowed to set their individual targets. Individual states should determine whether to set separate targets for bridges on urban vs. rural roads.

For the second measure, given that the recommended performance measure includes three values to be reported (percent good, fair and poor), the Task Force to be convened will consider selection of single measure for target setting (e.g. percent good or percent poor) or use of multiple measures (e.g. targets for both percent good and percent poor) – balancing the desire to support an asset management approach yet minimize complexity.

## **Reporting**

Rely on existing reporting processes already in place for the National Bridge Inventory.

## **Progress Assessment**

Progress towards meeting state-established targets should be assessed based on analysis of state NBI data for the target year.

# Freight System Performance: Delay

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## Definition

- **Annual Hours of Truck Delay (AHTD)**—Travel time above the congestion threshold in units of vehicle-hours for Trucks on the Interstate Highway System.

AHTD is the amount of extra time spent by each truck on an Interstate corridor based upon a state-determined threshold of what constitutes congestion and/or other factors for trucks. Truck delay on the Interstate system may be caused by congestion and/or other factors such as severe weather, safety inspections or roadway geometrics. AHTD is a summation of the number of truck-hours of delay due to congestion along Interstate corridors within a State. It is composed of miles, trucks traveling, and the speed of travel.

AHTD, in general, is a scalable measure that can be measured across different time frames (peak/off-peak, daily, weekly, monthly, annually) and geographic areas (statewide, metropolitan area, individual corridors and project specific). Also, AHTD is the most agreed upon metric employed by various state agencies, MPOs, and research organizations to measure congestion. This measure is easy to communicate and understand and it shows the effects of many transportation investments and land use changes. AHTD is a flexible measure used at the facility level (e.g., individual corridors) or at the system-level. AHTD, and its derivatives, can also be calculated for non-truck truck delay and public transportation systems, making it a good basis for a multi-modal performance measure. It is widely used and understood by many audiences.

## Data

Implementation of an AHTD performance measure is dependent on U.S. DOT providing to State DOTs and MPOs private sector speed data and vehicle miles traveled data from HPMS volume data and the respective analysis tools. Several federal databases and private sector data can be used to compute the AHTD and various AHTD ratios. A combination of the FHWA Highway Performance Monitoring System (HPMS) data set and nationwide private sector speed data provided to states in a ready-to-use format by FHWA will be the basis for states to produce these measures.

Variable	Type	Source	Availability
Corridor Segments	Inventory	State DOT	Informed by the USDOT/FHWA national framework and identified by each State DOT.
Agency-specified Threshold Speed	Determined and used in calculations	State DOT	Determined by each State DOT for each Corridor Segment. The Agency-specified Threshold Speed may change over time for individual corridors.
Freight VMT for each Corridor Segment	Measured	FHWA HPMS	Freight VMT would have to be calculated using the FHWA HPMS Average Annual Daily Truck Traffic (AADTT) and modified by both a daily and hourly truck factor determined by the State DOT.
Travel Speed	Measured	FHWA National Travel Data Set (Could be separate data sets for passenger vehicle and truck speeds).	Annually

## Methodology

### *Input Data:*

- Corridor Segments— Definition of Interstate Corridors being analyzed for trucks consisting of an origin and destination. At a minimum, the Corridor Segments defined by the states would need to reflect congestion at freight bottlenecks and those corridors identified in the National Freight Strategic Plan located within the state.
- Time Period—Daily.
- Freight Vehicle Miles Traveled (VMT)—VMT needs to be available in appropriate units depending on the measurement being analyzed. For AHTD, the truck volume times the corridor length is the appropriate measure. Hourly values would be estimated for trucks for each of the 24 hours during each of the seven days of the average week.
- Travel Speed—Average speed of the trucks during the time period on the corridor segments. An hourly value would be calculated for each hour of the day and each Corridor Segment.
- Agency-specified Threshold Speed—This is the agency-specified threshold speed for the analysis time period from which AHTD would be calculated. The threshold speed should account for the different aspects of slowing trucks on the Interstate including weather conditions, enforcement, work zones, and congestion. For example, the Threshold Speed could be free-flow (65mph),



posted speed (55mph), maximum throughput speed (50mph), severe congested speed (35mph) or some other speed. Regardless, this is specified by the transportation agency.<sup>3</sup>

*Procedure:*

1. Establish Corridor Segments.
2. For each Corridor Segment, determine the Agency-specified Threshold Speed.
3. For each day and Corridor Segment, calculate the Daily Truck-Hours of Delay:

$$\text{Daily Truck Hours of Delay} = \frac{\text{Freight VMT}}{\text{Travel Speed}} - \frac{\text{Freight VMT}}{\text{Agency-specified Threshold Speed}}$$

4. Sum the Daily Truck-Hours of Delay for each Day → Weekly Truck-Hours of Delay per Corridor Segment.
5. Multiply Weekly Hours of Delay per Corridor Segment by 52 → Annual Truck-Hours of Delay per Corridor Segment.
6. Sum the Annual Hours of Delay per Corridor Segment → Annual Truck-Hours of Delay.

*Output Data:*

- AHTD per Corridor Segment
- AHTD Statewide for all Corridor Segments

## Threshold Setting

Agencies have used a variety of congestion thresholds to meet the analysis and communication needs. For example, California uses 35 mph on freeways as a threshold to identify serious congestion problems. Washington State uses a maximum productivity-based threshold where a value of 85% of the free-flow speed (51 mph) is used to define the point where the maximum vehicle volume per hour per lane occurs; the freeway is not as productive at moving people at speeds above this level. Rural areas, or areas with less congestion, may use the speed limit or free-flow speeds as the basis to identify the size of the congestion problem.

An Agency-specified Threshold Setting for truck speed thresholds could be similar to passenger vehicle values, or could be different for purposes of calculating the AHTD measure.

## Example

A state would use their Agency-specified Threshold Speed in comparison with a dataset of hourly speeds for each day of the average week on each Corridor Segment. Any of the 168 speeds (7 days x 24 hours) that are below the Agency-specified Threshold Speed would be determined “experiencing delay”; the truck-miles of travel for that hour on that Corridor Section would be multiplied by the minutes of extra travel time (determined by the difference in the time to travel the Corridor Segment at the average speed and the Agency-specified Threshold Speed) to estimate delay.

## Target Setting

AASHTO supports state flexibility in the setting of targets; as provided in MAP-21. To that end, the AHTD target would be set by individual state DOTs and MPOs expressed in terms of the continuous variable of Annual Hours of Truck Delay. This continuous variable will not be represented through categorical

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<sup>3</sup> Freight and passenger cars could have different Agency-specified Threshold Speed.

variables of good-fair-poor or similar. Targets could have a negative or positive direction. For example “AHTD should not increase more than 5 percent per year”.

## Reporting

AHTD would be reported on individual Interstate corridors, as determined by the State DOT.

- Individual Corridors—AHTD for Interstate corridors would be reported separately.
- Statewide— Accumulation of AHD across Interstate corridors.

AHTD is a cumulative number. While we are not proposing a ratio as a national measure, AHTD can be easily incorporated into many different ratio calculations including Delay per Truck; Delay per Truck trip; Delay per Truck-mile; Truck delay per weekday, etc. For example Delay per Truck is the AHTD during a given time period divided by the number of trucks. Calculating Truck Delay per Mile provides a method to compare truck corridors with varying length.

# Freight System Performance: Reliability

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## Definition

- **Truck Reliability Index (RI<sub>80</sub>)**—The RI is defined as the ratio of the total truck travel time<sup>4</sup> needed to ensure on-time arrival to the agency-determined threshold travel time (e.g., observed travel time or preferred travel time).

The Reliability Index is defined as the ratio of the total travel time needed to ensure on-time arrival at the desired destination to the agency-determined threshold travel time. For System Performance, the measure will use the 80th percentile worst travel time recorded during the weekday peak periods each year.

The Reliability Index performance measure, which is a ratio, removes the distance variable and therefore can be used to measure and compare corridors of any length. Travel time is defined as the time taken to traverse a fixed distance between the origin and destination of the route and is not independent of the distance traveled. For example, truckers and shippers can apply the Reliability Index to a trip of any length to identify the amount of time that should be allowed so that they arrive on-time for 4 out of 5 trips. A Reliability Index of 1.50, for example, indicates that truckers and shippers should allow 30 minutes for a trip that would take only 20 minutes at the agency-determined congestion threshold conditions (20 minutes times 1.50 = 30 minutes).

By comparing this number for each corridor and/or system, on segments selected by the State, year by year, the agency can determine if the corridor or the system has become less or more reliable. A lower index for a succeeding year means reliability has improved relative to the previous year.

## Data

Implementation of RI<sub>80</sub> performance measure is dependent on U.S. DOT providing to State DOTs and MPOs private sector speed data and vehicle miles traveled data from HPMS volume data and the respective analysis tools. Various existing federal databases and private sector data can be used to compute the Truck RI<sub>80</sub>. A nationwide private sector speed data provided to states in a ready to use format by FHWA will be the basis for states to produce these measures.

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<sup>4</sup> 80th percentile was chosen instead of the 95th percentile because in congested urban areas, SHRP2 research project data indicates that the 95th percentile travel times usually involves non routine events that are difficult to predict and are well outside of an agency's ability to control (for example, extreme weather, law enforcement criminal investigations, and similar events). SHRP2 data shows that, in general, events that contribute to travel times around the 80th percentile are more common events such as multi-lane injury crashes and secondary crashes. These 80th percentile travel times are more likely to be affected by agency actions such as changes in infrastructure, policy actions and operational strategies.

Variable	Type	Source	Availability
Corridor Segments	Inventory	State DOT	Informed by the USDOT/FHWA national framework and identified by State DOTs.
Agency-specified Threshold Speed	Determined and used in calculations	State DOT	Determined by each State DOT for each Corridor Segment. The Agency-specified Threshold Speed may change over time for individual corridors.
5-Minute Corridor Speeds	Measured	FHWA National Travel Data Set (Could be separate data sets for passenger vehicle and truck speeds).	Annually

The collection and use of private sector is important. To ensure the private sector historic speed data is of high quality, FHWA can institute a requirement for evaluation of the datasets in similar fashion to what is currently being accomplished with the I-95 Corridor Coalition evaluations. The cost of historic data is relatively inexpensive (compared to the cost of real-time data). FHWA would require a third-party evaluation of the private sector vendor data that validates the speed data for performance analyses.

## Methodology

### Input Data

- Corridor Segments—Definition of Interstate Corridors being analyzed for trucks consisting of an origin and destination. At a minimum, the Corridor Segments defined by the state would need to reflect congestion at freight bottlenecks and those corridors identified in the National Freight Strategic Plan located within the state.
- Time Intervals—The day is divided into 288 five-minute intervals (24 hours x (60/5) = 288).
- Travel Time—Corridor Segment length (miles) divided by Average Speed (mph).
- Agency-specified Threshold Speed— This is the agency-specified threshold speed for the analysis time period. The threshold speed should account for the different aspects of slowing trucks on the Interstate including weather conditions, enforcement, work zones, and congestion. For example, the Threshold Speed could be free-flow (65mph), posted speed (55mph), maximum throughput speed (50mph), severe congested speed (35mph) or some other speed. Regardless, this is specified by the transportation agency.<sup>5</sup>

<sup>5</sup> Freight and passenger cars could have different Agency-specified Threshold Speed.

### Procedure<sup>6</sup>

1. Establish Corridor Segments and repeat Steps 2 through 6 for each.
2. Determine the Agency-specified Threshold Speed for Corridor Segment and calculate the Agency Travel Time.
3. Calculate the Travel Time for each Time Interval for each day of the calendar year (365).
4. For each Time Interval, array the Travel Time.
  - a. From these 365 calendar days, travel times are arranged in ascending order.
  - b. From this list, the 80<sup>th</sup> percent worst travel time is selected.
  - c. This will be the Annual Average 80<sup>th</sup> Percentile Travel Time for that 5-minute interval across all days.
  - d. Repeat the same process for the other 287 five-minute intervals.
5. From Step 4, array the 288 Annual Average 80<sup>th</sup> Percentile Travel Time values.
  - a. Arrange them in ascending order.
  - b. From the list, the 80<sup>th</sup> percent worst travel time is selected.
  - c. This will be the 80<sup>th</sup> Percentile Travel Time.
6. Calculate the Freight Reliability Index:

$$\text{Freight } RI_{80} = \frac{80\text{th Percentile Travel Time}}{\text{Agency Travel Time}}$$

7. The individual corridor RI values will be weighted by the number of truck-miles traveled in each corridor and a statewide average RI value is calculated. This step requires volume data (truck vehicle miles traveled data) in addition to speed data and should be provided in the same manner as volume data is provided in the delay measure proposal.

### Output Data

- Truck  $RI_{80}$  per Corridor Segment

## Threshold Setting

This measure uses the Agency-specified Speed Threshold determined by the State DOTs and MPOs to define the comparison standard. The Agency-specified Speed Threshold speed could be based on several factors that the state considers appropriate such as (among others): corridors' characteristics; local conditions; community opinion about the desirability of additional capacity in a corridor; freight movement goals; rural/urban routes; capacity assumptions and/or level of potential investment required to achieve performance levels. Using one condition, the Agency-specified Speed Threshold, for both the reliability and delay measure simplifies the communication of the freight performance measure results (particularly with non-technical audiences) and supports the expectations of the local community as expressed in the threshold.

## Example

The distance for a Corridor Segment is 10 miles, and the posted speed is 60 mph. During congested conditions, however, the system is not stable; incidents, weather conditions or special events could impact performance and reliability of the corridor. The state DOT has decided that based on local

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<sup>6</sup> Given a fixed travel distance between the origin and destination of a trip, speed and travel time are inversely related. Meaning, higher travel speeds result in lower travel times for a given commute distance and vice versa. Hence the RI can be calculated using the speed input as well.

conditions, community concern for neighborhoods and environment and investment levels required to achieve a solution, the Agency-specified Speed Threshold is 70% of posted speed for freight (42 mph). The 80<sup>th</sup> Percentile Travel Time recorded was 26 minutes for trucks. Using these data, the Agency Travel Time for freight to traverse these 10 miles is 14.3 minutes ((60 minutes per hour x 10 miles) / 42 miles per hour). Thus:

$$\text{Freight } RI_{80} = \frac{\text{80th Percentile Travel Time}}{\text{Agency Travel Time}} = \frac{26 \text{ minutes}}{14.3 \text{ minutes}} = 1.82$$

The Freight  $RI_{80}$  of 1.82 means that the truckers and shippers have to plan for travel times almost twice as long as the speeds the agency has determined represent the beginning of congestion (26 minutes).

## Target Setting

AASHTO supports state flexibility in the setting of targets; as provided in MAP-21. To that end, the targets would be set by individual State DOTs and MPOs expressed in terms of the Reliability Index. Targets may vary by facility, by corridor, by region, by rural or urban, by freight versus commute route or other factors such as investment levels, available transit options, remaining capacity and levels of recurrent versus non recurrent congestion levels.

## Reporting

The Truck  $RI_{80}$  would be reported on individual Interstate corridors, as determined by the State DOT.

- Individual Corridors—Truck  $RI_{80}$  for Interstate corridors would be reported separately.
- Statewide—Averages across Interstate corridors would be reported for locations where the reliability index is greater than 1.0.

# National Highway Performance Program

## System Performance: Delay

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### Definition

- **Annual Hours of Delay (AHD)**—Travel time above a congestion threshold (defined by State DOTs and MPOs) in units of vehicle -hours of delay on Interstate and NHS corridors.

AHD is the amount of extra time spent by each vehicle traveling due to congestion (based on a state-determined threshold of congestion). AHD is a summation of the number of daily vehicle -hours of delay due to congestion along Interstate and NHS corridors within a state. Extra travel time shows where long distance trips by many commuters are occurring in slow conditions. It is composed of miles traveled, vehicles traveling (volumes,) and the speed of travel.

AHD, is a well-tested , widely used, robust and scalable measure. It is easy to communicate and understood by many audiences. It can be measured across different time frames (i.e. peak/off-peak, daily, weekly, monthly, annually) and spatial and geographic areas (i.e. statewide, metropolitan area, commute or corridor route and project specific). AHD is a flexible measure used at the facility level (e.g., individual corridors) or at the system-level and can also be used as input to compute person hours of delay or hours of delay per commuter for a region, or hours of delay per mile of road to identify the most congested road sections. AHD, and its derivatives, can also be calculated for public transportation systems, making it a good basis for a multi-modal performance measure.

AHD is the most agreed upon metric employed by various state agencies, MPOs, and research organizations to measure congestion. This measure is easy to communicate and understand and it is sensitive enough to account for the effects of many types of transportation investments, travel patterns and land use changes. Better operations, shorter trips, improved transit, and mixed land uses that promote non-motorized travel will reduce the congestion measure values. Shorter trips (or trips that are not made) in particular will decrease regional and corridor delay by decreasing the person trips and the miles traveled. Regions that have achieved shorter trip lengths have seen their total travel delay increase slower than the decline in traffic speed-based measures; in these regions, more trips are made in congested conditions, but the shorter distance more than makes up for the slower speeds. The data are available and the calculations are straight-forward. Vehicle and person-miles can be used to illustrate the positive congestion reducing effects of high-occupancy vehicle lanes and high-occupancy/toll lanes. These roadways move many people with little delay, improving the regional or corridor delay measure.

### Data

Implementation of AHD performance measure is dependent on U.S. DOT providing to State DOTs and MPOs private sector speed data and vehicle miles traveled data from HPMS volume data and the respective analysis tools. Several federal databases and private sector data can be used to compute the AHD and various AHD ratios. A combination of the HPMS data set and nationwide private sector speed data provided to states in a ready-to-use format by FHWA will be the basis for states to produce these measures. Hourly volumes can be estimated from traditional planning processes. Other data such as commuter population can be accessed from the Census Transportation Planning Products (CTPP)

Program website and Gross Domestic Product (GDP) data can be accessed from Bureau of Economic Analysis (BEA) website. GDP is reported at the state and regional/metropolitan levels.

## Methodology

### Input Data:

- Corridor Segments—Definition of Interstate and NHS Corridors being analyzed and established by State DOTs and MPOs.
- Measurement Period—Peak/Off Peak or Daily.
- Vehicle Miles Traveled (VMT)—VMT needs to be available in appropriate units depending on the measurement being analyzed. Hourly values would be estimated for both passenger vehicles and trucks for each of the 24 hours during each of the seven days of the average week.
- Average number of persons per vehicle – Initially can be an assumed value for most roads, with data collection focused on roads with higher bus and carpool volumes
- Travel Speed—Average speed of the vehicles during the measurement period on the corridor segments. An hourly value would be used for each road segment and day.
- Agency-specified threshold speed—This is the agency-specified threshold speed for the analysis time period; below this speed delay is calculated (e.g., free-flow, posted speed [60mph], maximum throughput speed [50mph], severe congested speed [35mph])

### Procedure State DOTs Would Use:

1. Establish corridor segments.
2. For each Interstate and NHS corridor, determine expected travel speed to be used as Agency-specified Threshold Speed.
3. For each day and Interstate and NHS corridor, calculate the Daily Vehicle-Hours of Delay:

$$\text{Daily Hours of Delay} = \frac{\text{Daily VMT}}{\text{Travel Speed}} - \frac{\text{Daily VMT}}{\text{Agency-specified Threshold Speed}}$$

4. Sum the Daily Hours of Delay for each Day.
5. Sum the Hours of Delay for each Interstate and NHS corridor

### Output Data:

- AHD on each Interstate and NHS Corridor
- Statewide AHD for all Interstate and NHS Corridors

## Threshold Setting

The Agency-specified Threshold Speed would be set by DOTs based on established agency practices and defensible factors. These factors could include:

- corridor characteristics
- local conditions; operational factors
- community opinion about the desirability of additional capacity in a corridor; existing capacity
- population growth
- rural/urban routes
- level of existing revenues
- potential investment required to achieve performance levels



Agencies use speed thresholds to address these types of criteria and investment levels. For example, California uses 35 mph on freeways as a threshold to identify serious congestion problems. Washington State uses a maximum productivity-based threshold where a value of 85% of the free-flow speed (51 mph) is used to define the point where the maximum vehicle volume per hour per lane occurs; the freeway is not as productive at moving people at speeds above this level. Rural areas, or areas with less congestion, may use the speed limit or free-flow speeds as the basis to identify the size of the congestion problem.

Any of these threshold approaches can be used for communicating the congestion problems or for analysis of potential solutions. They all can illustrate the effect of a full range of congestion reduction strategies.

Using one condition, the agency-determined threshold speed, for both System Performance Measures (Annual Vehicle-Hours of Delay and Reliability Index) simplifies the communication of the performance measure results (particularly with non-technical audiences) and supports the expectations of the local community as expressed in the threshold. It is important to note that selecting a threshold speed only applies to corridors that experience congestion (based on the historic speed data).

### Example

A state would use their Agency-specified Threshold Speed in comparison with a dataset of hourly speeds for each day of the average week on each road section. Any of the 168 speeds (7 days x 24 hours) that are below the agency-specified threshold speed would be determined “experiencing delay”; the vehicle-miles of travel for that hour on that road section would be multiplied by the minutes of extra travel time (determined by the difference in the time to travel the section at the average speed and the agency-specified threshold speed) to estimate delay.

### Target Setting

AASHTO supports state flexibility in the setting of targets; as provided in MAP-21. To that end, the AHD target would be set by individual state DOTs and MPOs expressed in terms of annual vehicle-hours of delay. Targets may vary by facility, by corridor, by region, by rural or urban, by freight versus commute route or other factors such as investment levels, available transit options, remaining capacity and levels of recurrent versus non recurrent congestion levels.

Targets could have a negative or positive direction. For example “annual delay should not increase more than 5 percent per year”. Another example of a target could be a comparison of the growth in the delay to the growth in regional economy. The economic recession has played a major role in reducing congestion in recent years, but population and job growth have had a significant role in congestion increases in many regions over the past several decades. Measuring the percent change in delay compared to percent change in gross metropolitan product could provide a more relevant comparison of the role of transportation and land use decisions during periods of rapid growth with periods of slow or no growth. An example target for this measure may state that the percent increase in delay should be no more than the percent increase of the gross metropolitan product.

### Reporting

AHD would be reported on individual Interstate and NHS corridors, as determined by the State DOT.

- Individual Corridors—AHD for Interstate and NHS corridors would be reported separately.
- Statewide— Accumulation of AHD across Interstate and NHS corridors.

AHD is a cumulative number. While AASHTO is not proposing a ratio as the national measure, State DOTs and MPOs can incorporate it into many different ratio calculations. For example, Delay per Commuter; Delay per Peak Period Traveler; Delay per Capita. Many DOTs are concerned about measuring what they can influence. While delay has many variables, an analysis that compares delay per vehicle or per commuter to percent change in gross metropolitan product would be a good way to account for the impact of economic activity on delay. Comparing AHD to a gross state, regional, or metropolitan product captures both the positive and negative effects of the economy on congestion. Other variations could include Delay reduced per dollars invested.

# National Highway Performance Program

## System Performance: Reliability

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### Definition

- **Reliability Index (RI<sub>80</sub>)**—The Reliability Index is defined as the ratio of the 80th percentile travel time<sup>7</sup> to the agency-determined threshold travel time.

The Reliability Index is defined as the ratio of the total travel time needed to ensure on-time arrival at the desired destination to the agency-determined threshold travel time. For System Performance, the measure will use the 80th percentile worst travel time recorded during the weekday peak periods each year.

The Reliability Index performance measure, which is a ratio, removes the distance variable and therefore can be used to measure and compare corridors of any length. Travel time is defined as the time taken to traverse a fixed distance between the origin and destination of the route and is not independent of the distance traveled. For example, travelers can apply the Reliability Index to a trip of any length to identify the amount of time that should be allowed so that they arrive on-time for 4 out of 5 trips. A Reliability Index of 1.50, for example, indicates that travelers should allow 30 minutes for a trip that would take only 20 minutes at the agency-determined congestion threshold conditions (20 minutes times 1.50 = 30 minutes).

By comparing this number for each corridor and/or system year by year, the agency can determine if the corridor or the system has become less or more reliable. A lower index for a succeeding year means reliability has improved relative to the previous year.

### Data

Implementation of RI<sub>80</sub> performance measure is dependent on U.S. DOT providing to State DOTs and MPOs private sector speed data and vehicle miles traveled data from HPMS volume data and the respective analysis tools.

- **Public Sector Data**—Various existing federal databases and private sector data can be used to compute the RI<sub>80</sub>. A combination of the HPMS data set and nationwide private sector speed data provided to states in a ready-to-use format by FHWA will be the basis for states to produce the measure.
- **Private Sector Data**—To ensure the private sector historic speed data is of high quality, FHWA can institute a requirement for evaluation of the datasets – similar to the I-95 Corridor Coalition

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<sup>7</sup> 80th percentile was chosen instead of the 95th percentile because in congested urban areas, SHRP2 research project data indicates that the 95th percentile travel times usually involves non routine events that are difficult to predict and are well outside of an agency's ability to control (for example, extreme weather, law enforcement criminal investigations, and similar events). SHRP2 data shows that, in general, events that contribute to travel times around the 80th percentile are more common events such as multi-lane injury crashes and secondary crashes. These 80th percentile travel times are more likely to be affected by agency actions such as changes in infrastructure, policy actions and operational strategies.

evaluations. The cost of historic data is relatively inexpensive (compared to the cost of real-time data). FHWA would require a third-party evaluation of the private sector vendor data that validates the speed data for performance analyses.

## Methodology

There are multiple ways to determine 80th percentile travel time, below is an example of one such methodology using the following equation based upon Travel Time. However, given a fixed travel distance between the origin and destination of a trip, speed and travel time are inversely related. Meaning, higher travel speeds result in lower travel times for a given commute distance and vice versa. Hence the RI can be calculated using the speed input as well:

$$RI_{80} = \frac{80^{th} \text{ percentile Travel Time}}{\text{Travel Time at the Agency specified Threshold Speed}}$$

1. Measurement Intervals: The day is divided into 288 five-minute intervals (24X12 = 288).
2. For each of these five minute intervals array 240 workdays or 365 calendar days of travel times.
3. From these 240 workdays (or 365 calendar days) travel times are arranged in ascending order. From this list, the 80th percent worst travel time is selected. This will be the annual average 80th percentile travel time for that 5-minute interval across all days.
4. Repeat the same process for the other 287 five-minute intervals.
5. From the weekday peak periods of this set of travel times (i.e., Monday to Friday between 6 and 9 a.m. and 4 to 7 p.m.); again pick the five-minute interval that corresponds to the highest peak period 80th percentile travel time. (Note: refine/discuss AM and PM peak period vs. all day; 240 work days vs. 365 calendar days)
6. Determine the base speed threshold: This may be the same threshold as agency's delay/congestion threshold (e.g., a percentage of posted speed – see threshold discussion). This provides the average travel time that travelers should be able to travel this corridor (note: freight and passenger car could have different thresholds). Please note selecting a threshold speed only applies to corridors that experience congestion (based on the historic speed data). In uncongested corridors the 80th percentile travel time will be equal to the posted speed.
7. Divide the 80th percentile worst travel time by the comparison travel time to compute the Reliability Index.
8. The individual corridor RI values will be weighted by the number of miles traveled in each corridor (or truck-miles traveled for the freight measure) and a statewide average RI value is calculated. This step requires (vehicle miles traveled data) volume data in addition to speed data and should be available in the same manner as volume data is provided in the delay measure proposal.

## Threshold Setting

The Reliability Index performance measure uses the “base speed thresholds” determined by the State DOTs and MPOs to define the comparison standard for congested corridors. The agency-determined threshold speed for congested corridors could be based on several factors that the state considers appropriate, such as (and among others): corridors' characteristics; local conditions; community opinion about the desirability of additional capacity in a corridor; freight movement goals; rural/urban routes; capacity assumptions and/or level of potential investment required to achieve performance levels.

Using one condition, the agency-determined threshold speed, for both System Performance Measures (Annual Vehicle-Hours of Delay and Reliability Index) simplifies the communication of the performance measure results (particularly with non-technical audiences) and supports the expectations of the local community as expressed in the threshold. It is important to note that selecting a threshold speed only applies to corridors that experience congestion (based on the historic speed data). In uncongested corridors the 80<sup>th</sup> percentile travel time will be equal to the posted speed. For the purpose of reliability measurements for uncongested corridors posted speed would be used for the base speed threshold.

### Example

The distance between an origin A and Destination B is 10 miles, and the posted speed is 60 mph. During congested conditions, however, the system is not stable; incidents, weather conditions or special events could impact performance and reliability of the corridor. An agency X has decided that based on local conditions, community concern for neighborhoods and environment and investment levels required to achieve a solution, the desired speed threshold is 70% of posted speed for freight (42 mph) and 85% of posted speed (51 mph) for all other traffic. The 80th percentile worst recorded 5 minute interval travel time during the peak period is 24 minutes for commuters and 26 minutes for trucks. What is the 80th percentile reliability index for commute traffic?

This example shows the same calculation using the commuter speed threshold. In this case the base line speed for general traffic is 85% of the posted speed (60 mph) or 51 mph or 11.8 minutes. This is calculated as follows: (60 minutes in an hour x 10 miles) / 51 miles per hour = 11.8 minutes)

$$RI_{80} = \frac{80^{th} \text{ percentile Travel Time}}{\text{Travel Time at the Agency specified Threshold Speed}} = \frac{24 \text{ minutes}}{11.8 \text{ minutes}} = 2.03$$

The passenger car RI80 of 2.03 means that the commuter traffic has to plan for travel times more than twice as long as the speeds the agency has determined represent the beginning of congestion (24 minutes).

### Target Setting

AASHTO supports state flexibility in the setting of targets; as provided in MAP-21. To that end, the targets would be set by individual State DOTs and MPOs expressed in terms of the Reliability Index. Targets may vary by facility, by corridor, by region, by rural or urban, by freight versus commute route or other factors such as investment levels, available transit options, remaining capacity and levels of recurrent versus non recurrent congestion levels.

### Reporting

The reliability index would be reported on individual Interstate and NHS corridors, as determined by the State DOT.

- Individual Corridors— $RI_{80}$  for Interstate and NHS corridors would be reported separately.
- Statewide—Averages across Interstate and NHS corridors would be reported for locations where the  $RI_{80}$  is greater than 1.0.

# CMAQ

## On-Road Mobile Source Emissions

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### Definition

- **Criteria Pollutant Emissions**—Daily kilograms of on-road, mobile source criteria air pollutants (VOC, NO<sub>x</sub>, PM, CO) reduced by the latest annual program of CMAQ projects.

The definition above limits this measure to CMAQ-targeted on-road mobile source emissions. The measures for CMAQ in MAP-21 are directed to those that tie to “the purpose of carrying out section 149.” Since greenhouse gases and mobile source air toxics (MSATs) are not pollutants targeted by CMAQ, measures targeting these emissions would not relate to the purpose of CMAQ, and would expand beyond what is included in MAP-21. Therefore, measures should be limited to CMAQ-targeted on-road mobile source emissions as specified in the definition above.

It is also important to identify who this measure applies to and to what extent targets must be set for the on-road mobile source emissions measures<sup>8</sup>. First, these measures apply only to MPOs that serve Transportation Management Areas (TMAs) with populations of over 1,000,000 and that are nonattainment or maintenance areas. This aligns air quality measure reporting with the CMAQ ‘performance plan’ requirements in MAP-21, which apply only to those MPOs serving TMAs with populations of 1 million or more that are nonattainment or maintenance areas. Second, analyzing, calculating, target setting, and reporting of the CMAQ On-Road Mobile Source Emission measure is to be limited only to the criteria pollutant(s) for which portions of the applicable area is in either nonattainment or maintenance status.

### Data

Data with which to calculate the on-road mobile source emission measure would come from current CMAQ reporting methodologies that State DOTs and MPOs employ that are based on reproducible and logical analytical procedures.

### Methodology

AASHTO supports continuation of a flexible approach for measuring CMAQ project emission reductions that is consistent with current CMAQ reporting practices and that gives states and MPOs freedom to choose calculation approaches that work best in the context of their region, while ensuring every effort is taken to make credible estimates that are based on reproducible and logical analytical procedures. Given the central role of MPOs in the current air quality planning process and in the new CMAQ performance plan requirements, working closely with MPOs on national measures is essential. AASHTO encourages FHWA to adopt an approach that allows states and MPOs to work together.

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<sup>8</sup> Note that the National Performance Measurement requirements associated with CMAQ developed through rulemaking are separate from any requirements included in guidance developed specifically for the CMAQ program under MAP-21

For example, as part of annual CMAQ reporting requirements, FHWA requires states and MPOs to report a quantitative estimate of expected emissions reductions attributable to each CMAQ project<sup>9</sup>. In some instances, FHWA allows projects to be bundled together for purposes of estimating benefits, or a qualitative estimate may be used in place of quantitative data. All data is reported electronically to FHWA via the web-based CMAQ Tracking System. Project sponsors and project types differ greatly and no single model is required by FHWA to calculate emissions reductions. Therefore, we recommend continued flexibility with FHWA's specification: "every effort must be taken to ensure that determinations of air quality benefits are credible and based on a reproducible and logical analytical procedure."

It is also important that FHWA maintain consistency with current practices with regard to national-level reporting of the on-road mobile source emissions measure. Estimation of on-road mobile source criteria pollutants for areas where most CMAQ dollars are spent is already required as part of Clean Air Act Amendments requirements and CMAQ program administration responsibilities. AASHTO recommends continuing current practices. To the extent USDOT would consider making any changes to current practices in this regard, such changes should be minimal and any new performance data and reporting should be consistent with current requirements, and with outputs of existing travel demand and air quality models.

## Target Setting

AASHTO supports state flexibility in the setting of targets; as provided in MAP-21. To that end, affected states and MPOs should have flexibility to set their own targets for the national reporting of the CMAQ On-road Mobile Source Emissions performance measure. Affected State DOTs and MPOs should work together to establish targets. Targets should be required only for areas required to report emissions reductions which are those States and MPOs that serve TMAs with populations of over 1 million and that are nonattainment or maintenance areas. This ensures alignment of the MAP-21 measures with CMAQ 'performance plan' requirements in MAP-21, which apply only to those MPOs serving TMAs with populations of over 1 million and that are nonattainment or maintenance areas.

## Reporting

In general, states and MPOs should work together to prepare reports detailing CMAQ program emission reductions. States already are required to prepare annual reports detailing how CMAQ funds have been invested. Since 2004, states have submitted their CMAQ annual reports electronically through FHWA's web-based CMAQ Tracking System<sup>10</sup>. That this reporting is already in place reinforces the appropriateness of focusing this new performance measure and targeting for CMAQ on MPOs serving TMAs with populations of 1 million or more and that are nonattainment or maintenance areas.

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<sup>9</sup> Final CMAQ Program Guidance, FHWA (2008)

[www.fhwa.dot.gov/environment/air\\_quality/cmaq/policy\\_and\\_guidance/2008\\_guidance/index.cfm](http://www.fhwa.dot.gov/environment/air_quality/cmaq/policy_and_guidance/2008_guidance/index.cfm)

<sup>10</sup> More information on the CMAQ system is available at:

[www.fhwa.dot.gov/environment/air\\_quality/cmaq/reporting/tracking\\_system/index.cfm](http://www.fhwa.dot.gov/environment/air_quality/cmaq/reporting/tracking_system/index.cfm).

# CMAQ

## Traffic Congestion

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### Definition

- **Annual Hours of Delay (AHD)**—Travel time above a congestion threshold (defined by State DOTs and MPOs) in units of vehicle -hours of delay reduced by the latest annual program of CMAQ projects.

The definition above limits the traffic congestion measure to those programs and projects directly funded through the CMAQ program. The measures for CMAQ in MAP-21 are directed to those that tie to “the purpose of carrying out section 149.” MAP-21 is silent on whether other “passengership” and multimodal measures should be reported. Unlike other areas of transportation performance measurement, there is no universally accepted methodology that can be easily implemented nationally for estimating or measuring “passengership” or multimodal measures. Basic methodological approaches continue to evolve, data collection remains a challenge for much of the transportation system, and measurement details will naturally vary from state to state and region to region. The traffic congestion measure should be limited to Annual Hours of Delay as specified in the definition above.

AHD is the amount of extra time spent by each vehicle traveling due to congestion. AHD is the most agreed upon metric employed by various state agencies, MPOs, and research organizations to measure traffic congestion. This measure is easy to communicate and understand and it is sensitive enough to account for the effects of many types of transportation investments, travel patterns and land use changes. Better operations, shorter trips, improved transit, and mixed land uses that promote non-motorized travel will reduce the traffic congestion measure values and are the types of projects included in CMAQ programs.

It is also important to identify who this measure applies to and to what extent targets must be set for the traffic congestion measure. First, this measure applies only to MPOs that serve Transportation Management Areas (TMAs) with populations of over 1,000,000 and that are nonattainment or maintenance areas. This aligns with current air quality measure reporting with the CMAQ ‘performance plan’ requirements in MAP-21, which apply only to those MPOs serving TMAs with populations of 1 million or more that are nonattainment or maintenance areas. Second, analyzing, calculating, target setting, and reporting of the CMAQ traffic congestion measure is to be limited only to annual hours of delay for which portions of the applicable area is in either nonattainment or maintenance status.

### Data

AHD is a summation of the number of daily vehicle-hours of delay due to congestion along the transportation network. It is composed of miles traveled, vehicles traveling (volumes,) and the speed of travel. All of these necessary data elements are available in the regional forecasting models State DOTs and MPOs use in the current planning practices and CMAQ modeling procedures. Thus, the data with which to calculate the traffic congestion measure would come from current CMAQ reporting methodologies that State DOTs and MPOs employ that are based on reproducible and logical analytical procedures.



## Methodology

AASHTO supports adopting a similar approach for traffic congestion as is done with on-road mobile source emissions. The methodology (including the procedures and tools) employed by most MPOs to calculate on-road mobile source emissions, could also be used to estimate traffic congestion reductions. Currently, reporting of the on-road mobile source emissions consists of a flexible approach for measuring CMAQ project emission reductions that is consistent with current CMAQ reporting practices and that gives states and MPOs freedom to choose calculation approaches that work best in the context of their region, while ensuring every effort is taken to make credible estimates that are based on reproducible and logical analytical procedures. Given the central role of MPOs in the current air quality planning process and in the new CMAQ performance plan requirements, working closely with MPOs on national measures is essential. AASHTO encourages FHWA to adopt an approach that allows states and MPOs to work together.

For example, as part of annual CMAQ reporting requirements, FHWA requires states and MPOs to report a quantitative estimate of expected emissions reductions attributable to each CMAQ project<sup>11</sup>. In some instances, FHWA allows projects to be bundled together for purposes of estimating benefits, or a qualitative estimate may be used in place of quantitative data. All data is reported electronically to FHWA via the web-based CMAQ Tracking System. Project sponsors and project types differ greatly and no single model is required by FHWA to calculate emissions reductions. Therefore, we recommend continued flexibility with FHWA's specification: "every effort must be taken to ensure that determinations of air quality benefits are credible and based on a reproducible and logical analytical procedure."

It is also important that FHWA maintain consistency between the national-level reporting of CMAQ traffic congestion and on-road mobile source emissions performance measures. Currently, estimation of on-road mobile source criteria pollutants for areas where most CMAQ dollars are spent is already required as part of Clean Air Act Amendments requirements and CMAQ program administration responsibilities. AASHTO recommends continuing current practices. To the extent USDOT would consider making any changes to current practices in this regard, such changes should be minimal and any new performance data and reporting should be consistent with current requirements, and with outputs of existing travel demand and air quality models.

## Target Setting

AASHTO supports state flexibility in the setting of targets; as provided in MAP-21. To that end, affected states and MPOs should have flexibility to set their own targets for the national reporting of the CMAQ traffic congestion performance measure. Affected State DOTs and MPOs should work together to establish targets. Targets should be required only for areas required to report emissions reductions which are those States and MPOs that serve TMAs with populations of over 1 million and that are nonattainment or maintenance areas. This ensures alignment of the MAP-21 measures with CMAQ 'performance plan' requirements in MAP-21, which apply only to those MPOs serving TMAs with populations of over 1 million and that are nonattainment or maintenance areas .

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<sup>11</sup> Final CMAQ Program Guidance, FHWA (2008)  
[www.fhwa.dot.gov/environment/air\\_quality/cmaq/policy\\_and\\_guidance/2008\\_guidance/index.cfm](http://www.fhwa.dot.gov/environment/air_quality/cmaq/policy_and_guidance/2008_guidance/index.cfm)

## Reporting

In general, states and MPOs should work together to prepare reports detailing CMAQ program traffic congestion reductions. States already are required to prepare annual reports detailing how CMAQ funds have been invested. Since 2004, states have submitted their CMAQ annual reports electronically through FHWA's web-based CMAQ Tracking System<sup>12</sup>. That this reporting is already in place reinforces the appropriateness of focusing this new performance measure and targeting for CMAQ on MPOs serving TMAs with populations of 1 million or more and that are nonattainment or maintenance areas.

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<sup>12</sup> More information on the CMAQ system is available at:  
[www.fhwa.dot.gov/environment/air\\_quality/cmaq/reporting/tracking\\_system/index.cfm](http://www.fhwa.dot.gov/environment/air_quality/cmaq/reporting/tracking_system/index.cfm).