DRAFT
Congestion Management Process:
Freeway Performance Measures

Type of Performance Measure	Performance Measure	Definition/Description	Required Metrics	Why It Is Important to the MPO Region	How It Will be Displayed	Previously Used by Boston Region MPO?	Performance Measure Recommended by MPO Staff?
Duration[1]	Congested Time	The average number of minutes that drivers experience congested conditions, at speeds below 35 mph, during the peak period. *Congested Time (Minutes) = (# of Minutes with Speeds below 35 mph / Total Number of Minutes in Sample) * (Number of Minutes in Peak Period)*	● Speed ● Congested speed threshold (35 mph)	● Can track the average number of minutes that each Traffic Messaging Channel (TMC)[2] or corridor segment is experiencing congestion ● Can be a key factor for a corridor analysis in the LRTP needs assessment	GIS mapping for the region by TMC	No	Yes
Duration	Annual Traveler-Hours of Delay and Annual Vehicle-Hours of Delay[3]	Measures the total amount of delay that a TMC will experience on an annual basis. It is calculated by factoring the amount of time it takes to traverse a given TMC during the peak period minus the amount of time it would take to traverse that TMC in free-flow conditions, multiplied by vehicle volume per period, multiplied by vehicle occupancy, multiplied by the number of weekdays per year, divided by 60 minutes. For this measure it is assumed that there are 250 weekdays per year. *Annual Traveler-Hours of Delay = (Average Travel Time - Free-Flow Travel Time) * Vehicle Volume per Period * Vehicle Occupancy * 250 weekdays* *Annual Vehicle-Hours of Delay = (Average Travel Time - Free-Flow Travel Time) * Vehicle Volume per period * 250 weekdays*	● Average travel time ● Free-flow travel time ● Vehicle volumes ● Vehicle occupancy data	● Can be a key factor for a regional or subregional analysis for the LRTP needs assessment ● Displays the extent of delay experienced throughout the region on a per-traveler basis	GIS mapping for the region by corridor; Histogram bar; or table	No	No
Extent[4]	Lane-Miles of Congestion	Measures the extent of congestion on a facility based on geographic span. Each TMC is categorized as congested or uncongested depending on the Speed Index value (under Intensity, below). This measure is stated as a percentage of total lane-miles.	● Lane-miles ● Number of lanes for each roadway segment ● Speed Index thresholds	● Shows the regional congestion level by facility ● May be suitable for a regional or subregional analysis in the LRTP	Stacked bar graph or table	No	Yes
Extent	Percent of Congested Roadway Miles	This measures the percentage of freeway miles that experiences an average speed of less than 35 mph (congestion threshold).	● Segment length ● Average Speed	● Can give a regional or subregional snapshot of what facilities are congested ● Can be used to compare subregions for the LRTP	Stacked bar graph or table	No	No
Extent	Freeway Congestion Scan	Visually displays average speeds for a corridor for multiple times of the day, at multiple locations.	● Average speed	● Enables users to visually see where and at what time a roadway is congested	Line chart and/or table	No	Yes
Extent	Congested Travel[3]	Captures the extent of congestion by displaying the amount of vehicle-miles traveled under congested conditions (less than 35 mph). *Congested Travel = Congested Segment Length * Vehicle Volumes*	● Segment length ● Vehicle volume ● Average speed ● Congestion threshold	● Displays the extent of congestion, as it affects traveling vehicles, on a corridor level	Histogram bar graph or table	No	No
Extent	Vehicle-Hours of Travel[3]	Total amount of time that every vehicle spends traveling through a roadway segment, corridor or region within a specified period of time. *Vehicle-Hours of Travel = Travel Time * Vehicle Volumes*	● Traffic volume ● Travel time	● Displays the extent of congestion	Histogram bar graph or table	Yes, through the regional travel demand model	No
Extent	Vehicle-Miles of Travel[3]	Total number of miles that every vehicle travels through a roadway segment, corridor or region within a specified period of time. *Vehicle-Miles of Travel = Segment Length * Vehicle Volumes*	● Vehicle volumes ● TMC length ● Average speed	● Displays the extent of congestion on a corridor level	Histogram bar graph or table	Yes, through the regional travel demand model	No
Extent	Delay per Traveler or Vehicle[3]	Measures the amount of delay that a vehicle or a traveler would experience each time it traverses the TMC at a given time. This measure can be used to communicate to a nontechnical audience. Vehicle occupancy data would be required for Delay per Traveler, and it would be difficult to obtain for all locations. *Delay per Traveler (Minutes) = (Average Travel Time - Free-Flow Travel Time) * Vehicle Volume * Vehicle Occupancy* *Delay Per Vehicle (Minutes) = (Average Travel Time - Free-Flow Travel Time) * Vehicle Volume*	● Vehicle volumes ● Free-flow travel time ● Average travel time ● Vehicle occupancy data (for Delay per Traveler only)	● Communicates to the public the impact of delay caused by traffic congestion on a user level	Histogram bar graph or table	No	No

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Intensity[5]	Average Travel Speed	Average Travel Speed is associated with specific roadway TMCs and is calculated using travel times and segment lengths. The average observed travel speed is a good indicator of a deficiency in mobility in the roadway network and is used for determining solutions to mobility problems.	● Average travel speed	● Indicates where congestion is located by corridor segment ● It is an integral entity for calculating other performance measures. ●Measure can be converted into travel time.	GIS mapping for the region by corridor	Yes	Yes
Intensity	Average-to-Posted-Speed Ratio (Speed Index)	Equal to the average speed divided by the posted speed limit of a TMC. TMCs with an Average-to-Posted-Speed Ratio of 0.70 or less are considered to be congested. This measure indicates congestion more accurately than travel speeds alone because low travel speeds may be a result of low speed limits on certain facilities. *Speed Index = Average Travel Speed / Posted Speed*	● Posted speed (speed limit) ● Average travel speed	● Shows speeds in relation to the posted speed limit	GIS mapping for the region by TMC	Yes	Yes
Intensity	Bottleneck Factor	This factor combines both the duration of time a TMC is congested and the intensity of congestion. It can be used to rank problem areas of the freeway network. *Bottleneck Factor = Minutes of Congestion per Peak-Period Hour / Congested Speed*	● Congested Time ● Average speed, when congested	● May be used to further evaluate sections of the roadway network for bottlenecks ● Can be used to rank bottlenecks on a regional or subregional basis in the LRTP needs assessments	GIS mapping for the region by TMC	No	Yes
Intensity	Delay per Mile	Delay shows the extra time needed to traverse a TMC or corridor. Delay can be converted into delay-per-mile by factoring in the length of the roadway segment. *((Average Travel Time (Minutes) - Free-Flow Travel Time (Minutes)) / Segment Length*	● Free-flow travel time ● Average travel time ● TMC length	● Displays the impact of delay on a corridor ● Can be a key factor for corridor analysis in the LRTP needs assessment	GIS mapping for the region by corridor	No	Yes
Intensity	Calculation of Congestion Score	Calculated by integrating the results of several performance measures by applying weight factors. To calculate congestion scores, performance measure values are placed in several classes. Each class is assigned a point value representing the intensity of congestion associated with that performance measure value. The point values are then totaled, giving the segment a final congestion score. A segment's final congestion score is an indicator of the intensity of congestion for that segment, with the level of intensity increasing with the score value.	● Various performance measures of extent, duration, reliability, and intensity. The selection of performance measures for analyses often varies.	● Can be used in the LRTP ● Can be a tool for determining congested locations for the Congestion Management Process ● Possibly useful for evaluating TIP projects	GIS mapping for the region by TMC	No	No
Reliability[6]	Travel-Time Index (TTI)	Dimensionless quantity that compares travel conditions during the peak period to travel conditions during free-flow conditions, defined as the ratio of peak-period time to free-flow time. For example, a TTI of 1.20 indicates that a trip that takes 20 minutes in the off-peak period will take 24 minutes in the peak period, or 20 percent longer. *Travel-Time Index = Average Travel Time / Free-Flow Travel Time*	● Average travel time ● Free-flow travel time	● Can indicate how severe peak-period congestion is on a facility, compared to off-peak travel ● Can influence future decisions that may be proposed to alleviate a congested corridor ● Good tool for gauging reliability through the LRTP and CMP	GIS mapping for the region by TMC	No	Yes
Reliability	Planning-Time Index	Defined as the ratio of the total time needed to ensure on-time arrival 95 percent of the time to free-flow travel time. It differs from the Buffer-Time Index (below) in that it includes typical delay as well as unexpected delay. Thus, the Planning-Time Index compares near-worst-case travel time to free-flow travel time. For example, a value of 1.4 means that, to arrive on time 95 percent of the time, a traveler should budget an additional 8 minutes for a trip that takes 20 minutes during free-flow conditions. *Planning-Time Index = 95 Percentile Travel Time / Free-Flow Travel Time*	● 95th percentile travel time ● Free-flow travel time	● Can be used in the needs assessment as a corridor measure. Parallel routes can be compared with one another, which can indicate what route is ideal for commuters and incident responders. ● Can tell daily commuters how much extra time to budget to ensure on-time arrival	GIS mapping for the region by corridor	No	Yes

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Reliability	Buffer-Time Index	Measures trip reliability that expresses the amount of extra buffer time needed to arrive on time for 95 percent of the trips taken. The difference between the Buffer-Time Index and Planning-Time Index is that the Buffer-Time Index factors in the average travel time instead of free-flow travel time. *Buffer-Time Index = (95 Percentile Travel Time - Average Travel Time) / Average Travel Time*	• 95th percentile travel time • Average travel time	• Can tell a commuter what to expect if a certain amount of time is allowed for a commute (e.g., late for work on one day out of the typical 20-workday month.)	GIS mapping for the region by corridor	No	No

[1] Duration performance measures indicate the amount of time congestion affects a region, corridor, or roadway segment.
[2] The TMC location code is a common industry convention, developed and maintained by the leading electronic map database vendors to uniquely define road segments. For freeways, a TMC is defined as the segment between two interchanges.
[3] MPO staff may not have the required metrics to calculate this performance measure.
[4] Extent performance measures estimate the number of people or vehicles affected by congestion, and the geographic distribution of congestion.
[5] Intensity performance measures indicate the severity of congestion. It is typically used to differentiate between levels of congestion on transportation corridors.
[6] Reliability performance measures show the impact of nonrecurring as well as recurring congestion in the travel network.