Appendix A: Detailed Performance Measures Description

Table 40
Performance Measures

Mode	Type of Performance Measure	Performance Measure	Definition/Description	Required Metrics	Threshold	How measure will be displayed
Highway	Duration	Congested Time	Congested time is the average number of minutes that drivers experience congested conditions (speeds below 35 MPH on expressways, or 19 MPH on arterials), during a specific time period. Congested Time is measured in minutes per analyzed hour. *Congested Time (Minutes) = (Number of Minutes with Speeds below 35 MPH / Total Number of Minutes in Sample) x 60*	Congested speed threshold Number of records with congested speed	Roadway segments that have more than 30 minutes of congestion per hour during an event are considered to have a long duration of congestion.	GIS mapping Line graphs
Highway	Intensity	Average Travel Speed	Average travel speed associated with a specific roadway is calculated using travel times and segment lengths. The average observed travel speed is a good indicator of a mobility deficiency in the roadway network and is used to identify solutions to mobility problems. Average Travel Speed is also a factor in calculating other performance measures, such as travel time. *Average Travel Speed (MPH) = (Segment Length/Travel Time) x 60*	Average travel speed Roadway segment length	Typically expressway segments with an average speed of less than 35 MPH or arterial segments with an average speed of less than 19 MPH are considered to be congested.	GIS mapping Line graphs
Highway	Intensity	Corridor/Segment Delay	Delay is an effective means of measuring on a roadway network between two landmark locations. Example: 14 minute delay between the Braintree Split and the Masspike on I-93 northbound. *Corridor Delay=Travel time during event - Free-Flow Travel Time*	Average travel time Free-flow travel time	Threshold would vary by corridor	Line graph reference to compare different corridors
Highway	Intensity	Bottleneck Factor	Bottleneck factor combines the intensity of congestion (average speed of congested records) with duration of time that a TMC location is congested (congested time). Bottleneck factor can be used to rank roadway network problem areas. A high bottleneck factor indicates severe congestion. A location that has a bottleneck factor of 0 indicates that the location is not congested. *Bottleneck Factor = Minutes of Congestion per Hour during an event/ Congested Speed*	Minutes of congestion per peak-period hour Congested speed	Any roadway segment that has a bottleneck factor of more than 0 has some degree of congestion.	GIS mapping for the region by TMC
Highway	Reliability	Travel-Time Index	Travel-time index compares travel conditions during the peak period to travel conditions during free-flow periods. Travel-time index is the ratio of peak-period time to free-flow time. Travel-time index indicates how severe peak-period congestion is for a facility. For example, a travel-time index of 1.20 indicates a trip that takes 20 minutes in the off-peak period will take 24 minutes in the peak period, which is 20 percent longer. *Travel-Time Index = Travel Time during event / Free-Flow Travel Time*	Average travel time during event Free-flow travel time	Any roadway segment that has a travel-time index of more than 1.3 is considered to be congested.	GIS mapping for the region by TMC

GIS =Geographic Information System. MPH = miles per hour. PTI = Planning Time Index. TMC = Traffic Messaging Channel.
Source: Central Transportation Planning Staff.

Table 40
Performance Measures (Cont.)

Mode	Type of Performance Measure	Performance Measure	Definition/Description	Required Metrics	Threshold	How measure will be displayed
Highway	Reliability	Planning-Time Failure	Planning-time failure shows instances where the travel time during an event is longer than the planning time index travel time of a typical weekday. This performance measure shows where there is an extreme spike in congestion at a certain time and location. Locations that have a planning time failure index of more than 1 have a travel time during an event that is higher than the planning time index travel time during a typical weekday. *Planning-Time Failure Index = travel time during event/ 95 percentile peak period travel time*	Weekday planning time index Average travel time during event	Any roadway that has a planning time failure index of more than 1 is experiencing extreme congestion.	Line graph GIS mapping
Highway	Duration	Minutes of Planning-Time Failure	This performance measure shows the duration of time that the travel time during an event is longer than the planning time travel time for a typical weekday. *Minutes exceeding PTI = Number of records that are under PTI speed x Number of minutes per epoch*	Weekday planning time index Average travel time during event Number of records that are under PTI speed	Any roadway that has any minutes of planning time failure is considered to be congested	displayed in a table
Safety	Intensity	Number of Crashes during the day (s) of event	The number of crashes during an event are compared to the number of crashes that occur during a typical day. The number of crashes for the day of the event is compared to the number of crashes that occur during a typical day.	Date, time, and location of crashes	Threshold would vary by location	Bar graph Maps of crash locations
Safety	Intensity	Number of crashes that occur on a typical day during the year of the event	This performance measure compares the number of crashes that occur during an event to the number of crashes that occur during a typical day. This performance measure may look at crashes that occur during a typical weekday/weekend day, or the performance measure can look at a particular day of the week (example: typical Thursday versus the Thursday of the event). *number of crashes that occur on a typical day during the year of the event=total number of crashes per year/number of days per year*	Number of crashes during event. Number of crashes during year of event	Threshold would vary by location	Bar graph
Transit/Bus	Reliability	On-time performance	On-time performance data can be obtained from the MBTA Back on Track website. Bus speed is measured at timepoints along the bus route, at both terminuses of the route and at midpoints. • For buses that have headway of 15 minutes or less, an on-time trip is defined as a trip that departs a timepoint no more than three minutes later than the scheduled time. • For buses scheduled less frequently than every 15 minutes, a bus that leaves a timepoint between less than one or as much as six minutes earlier than the scheduled time is considered to be on time. This performance measure compares the day of the event to a typical day during that season. On-time performance is provided in peak/off peak periods, so only periods during a day (AM, PM and Off-peak) can currently be analyzed. *On-time performance = Number of timepoints made on time/number of total timepoints*	Number of timepoints made on time Number of total timepoints	Bus routes that make less than 60 percent of their timepoints on time are considered to be congested.	Bar graph Maps

GIS = Geographic Information System. MPH = miles per hour. PTI = Planning Time Index. TMC = Traffic Messaging Channel.
Source: Central Transportation Planning Staff.

Appendix B: Nonrecurring Congestion

Various types of events that affect traffic patterns and cause nonrecurring congestion occur in the Boston region. Different types of events can have different effects on traffic congestion. Some of these events are unique or rare, while others recur many times over a defined period like a baseball season.

B.1   SPORTING EVENTS

Oftentimes, sporting events occur on multiple days at the same time throughout the season. These events attract as many as 70,000 people. This study analyzed traffic associated with two sporting events: Boston Red Sox weekday night games held at 7:00 PM on weeknights and New England Patriots games held at 1:00 PM on Sundays.

B.2   WEEKENDS AND OTHER OFF-PEAK TIMES

Even though the CMP focuses on recurring congestion during peak travel periods, there is significant congestion that occurs on off-peak days and weekends. Most of this traffic is generated from non-work trips, such as those made for shopping or visiting. This study examined congestion that occurs on Saturday afternoons, Saturday evenings, and Fridays evenings.

B.3   BLACK FRIDAY

Black Friday is a popular shopping day that occurs on the day after the Thanksgiving holiday every year. Oftentimes on this day, there is significant congestion, especially near shopping malls. This study examined traffic on Black Friday of 2015.

B.4   HOLIDAYS

Holidays are designated days of the year, where certain groups in the United States celebrate, depending on the specific holiday. On many holidays, businesses and school are closed. Over the course of the year, there are several holidays that dramatically alter traffic patterns. Sometimes, traffic increases on the date of the holiday. Other times, traffic increases either the day preceding or succeeding the holiday. The holiday that was chosen for this study is the Wednesday before Thanksgiving.

B.5   PARADES

Parades are gatherings that occur at a designated location, which performances are given in the form synchronized marching along a corridor. Parades often

increase traffic to a specific area, and temporary road closures may be put in place. Depending on the location and size, parades can also affect travel on public transportation as well. This study examined the effects of the parade that celebrated the New England Patriots' 2015 Super Bowl championship.