System Performance Monitoring

BACKGROUND

The following sections describe the findings of the system performance monitoring conducted by the CMP. Monitoring results are described in detail for roadways (limited-access and arterial), HOV lanes, public transit, park-and-ride lots, and bicycle and pedestrian facilities. This section applies the performance measures and thresholds to the CMP network to indicate where congestion is present. Performance monitoring is integral to determining problems when conducting a needs assessment.

ROADWAYS

The roadway network monitored by the CMP comprises approximately 900 centerline miles (or 1,800 bidirectional miles) of arterial roadway and 377 centerline miles of limited-access highway—over 10% of all of the roadway miles in the region. This section describes the variables that are monitored on the region's roadways and presents the latest data available.

Methods for Measuring Highway Performance

The CMP identifies congestion on monitored roadway segments by examining a combination of the following travel-time-based measures: average observed travel speed, speed index, and delay. These performance measures are calculated from travel time data collected at peak commute times in typical traffic conditions. Some of the information below has already been included in the description of performance measures above and additional information is provided here to shed light on the way data are collected and processed.

Average Observed Travel Speed

Travel speed is a typical measure of performance for a roadway segment. The level of service (LOS) for a roadway or highway segment is determined using average-speed data.

Travel Speed Index

The travel speed index is a ratio that is calculated by dividing a roadway segment's average observed travel speed by the posted speed limit for that roadway segment. For example, if the speed limit is 50 miles per hour and the average observed travel speed is 40 miles per hour, the speed index is 0.80.

Delay

For purposes of CMP monitoring, delay is defined as the time a vehicle's travel speed is less than 5 mph on a roadway segment (including the time the vehicle is stopped), as long as the speed has been less than 5 mph for at least three consecutive seconds. The observed delay is closely related to "control delay" (for arterial roadways), which is the delay that occurs when a vehicle moves forward in a queue, a slow stop-and-go process. Congestion is defined as traffic conditions that involve an average delay of 55 seconds or more on arterial roadways.

Travel Times and Speeds

Travel time data are collected using a “floating car,” which is a probe vehicle that travels with the flow of traffic. Each probe vehicle is equipped with a global positioning system (GPS) and with a data collection device (portable computer) that records travel times and distances at one-second intervals. For each roadway segment, a valid sample size of travel time runs is obtained in order to calculate a significant average peak-period measurement. A segment usually begins immediately after a significant intersection and ends immediately after the next significant intersection.

The roadway monitoring captures typical traffic conditions during commute times. Roadways are monitored during weekday morning and evening peak commute periods—arterial roadways primarily between 6:30 AM and 9:30 AM and between 3:00 PM and 6:30 PM, and limited access highways, including HOV lanes, between 6:00 AM and 10:00 AM and between 3:00 PM and 7:00 PM. Note that peak periods do not necessarily represent the absolutely worst traffic conditions which actually occur during the peak hours. Monitoring does not occur on weekends, Monday mornings, or Friday evenings; nor does monitoring occur during the peak period preceding, during, or following a local, state, or national holiday. Monitoring is conducted during the public school year, in the spring and fall.

The CMP staff is currently investigating the possibility of acquiring travel speed data through methods other than the floating-car method. Crowd-sourced data from smart phones, GPS-enabled vehicles, and other real-time sources may prove to be more accurate and cost-effective than the current method.

Observed Travel Speeds

Limited-Access Highways

AM Peak Period

In the AM peak period, most of the slower speeds occur close to the urban core of the Boston region. In this area, almost all of the limited-access highways experience a slowdown, to some degree, in both directions. There are also some slower speeds on some of the limited-access highways leading to the urban core between I-95 and I-495. The highways that experience a slowdown of travel speeds include I-93 north and south of Boston, and Route 1A. Route 2 experiences an extreme slowdown of travel speeds in both directions between I-495 and I-95. The AM travel speeds for expressways are shown in figure 4-1.

PM Peak Period

With the exception of I-93 north of Boston, all limited-access highways experience a slowdown in both directions in the urban core. There is some slowdown on I-95, especially along the southern portion of I-95 just north of its interchange with I-93 (in Canton), where it occurs in the northbound direction. On I-95 between I-93 and I-90, the slowdown occurs in the southbound direction. Areas of slowdown between I-495 and I-95 include those along Route 2, Route 3, and I-90. The PM travel speeds for expressways are shown in figure 4-2.

Arterial Roadways

AM Peak Period

In the urban core, a slowdown in travel speeds occurs in both directions in the AM peak period. The main slowdown occurs in arterials inside of I-95. Outside of I-95, slow travel speeds occur mainly at major intersections. The AM travel speeds for arterial roadways are displayed in figures 4-3 and 4-5.

PM Peak Period

Near the urban core, the travel speeds in the PM peak period are slower than the AM peak-period travel speeds. The PM travel speeds are usually slow in all travel directions. The lowest PM travel speeds occur mostly inside of I-95. The PM travel speeds for arterial roadways are displayed in figures 4-4 and 4-6.

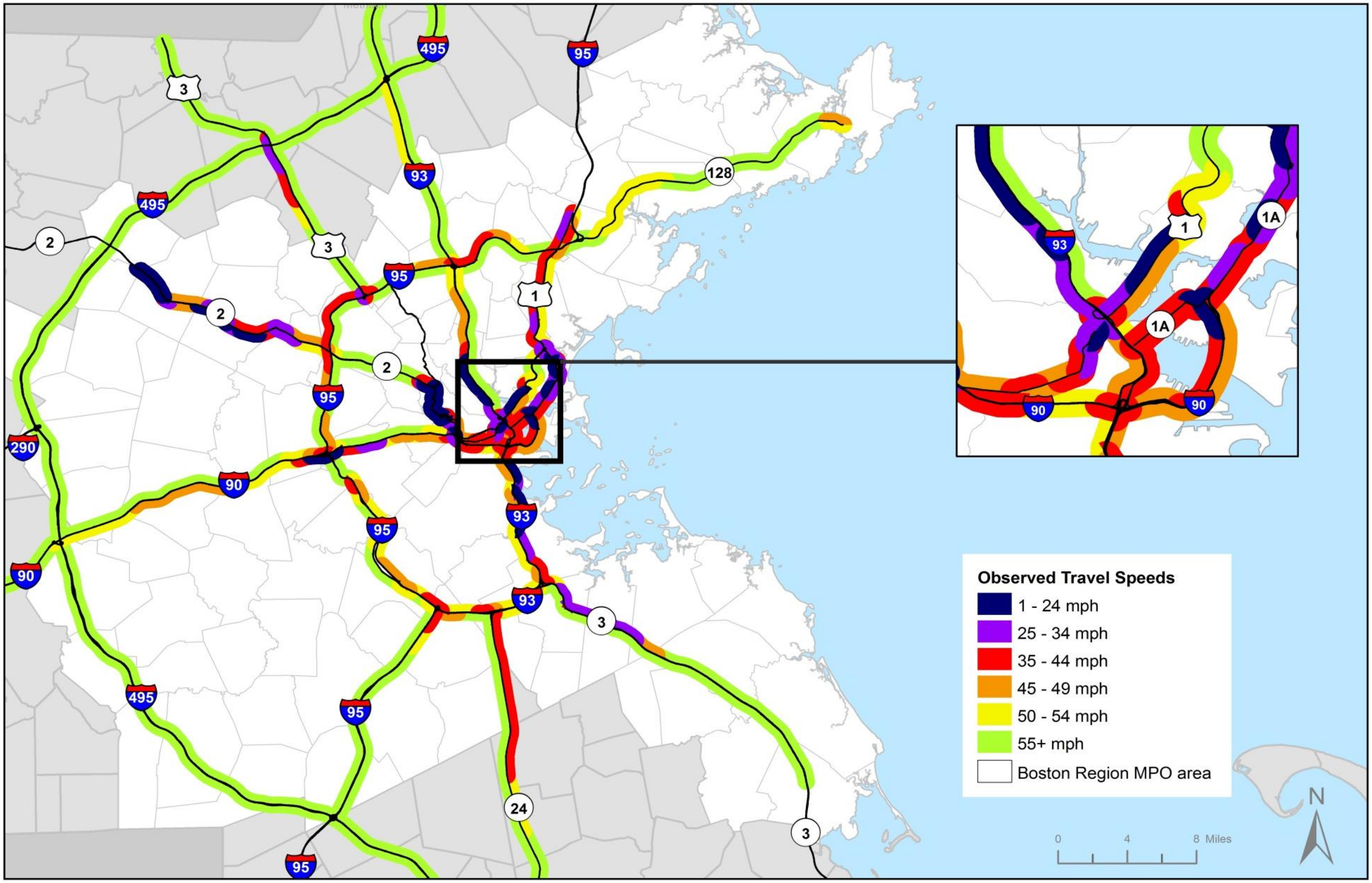

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FIGURE 4-1
Travel Speeds for Expressways:
AM Peak Period, 2004-07

Congestion Management Process

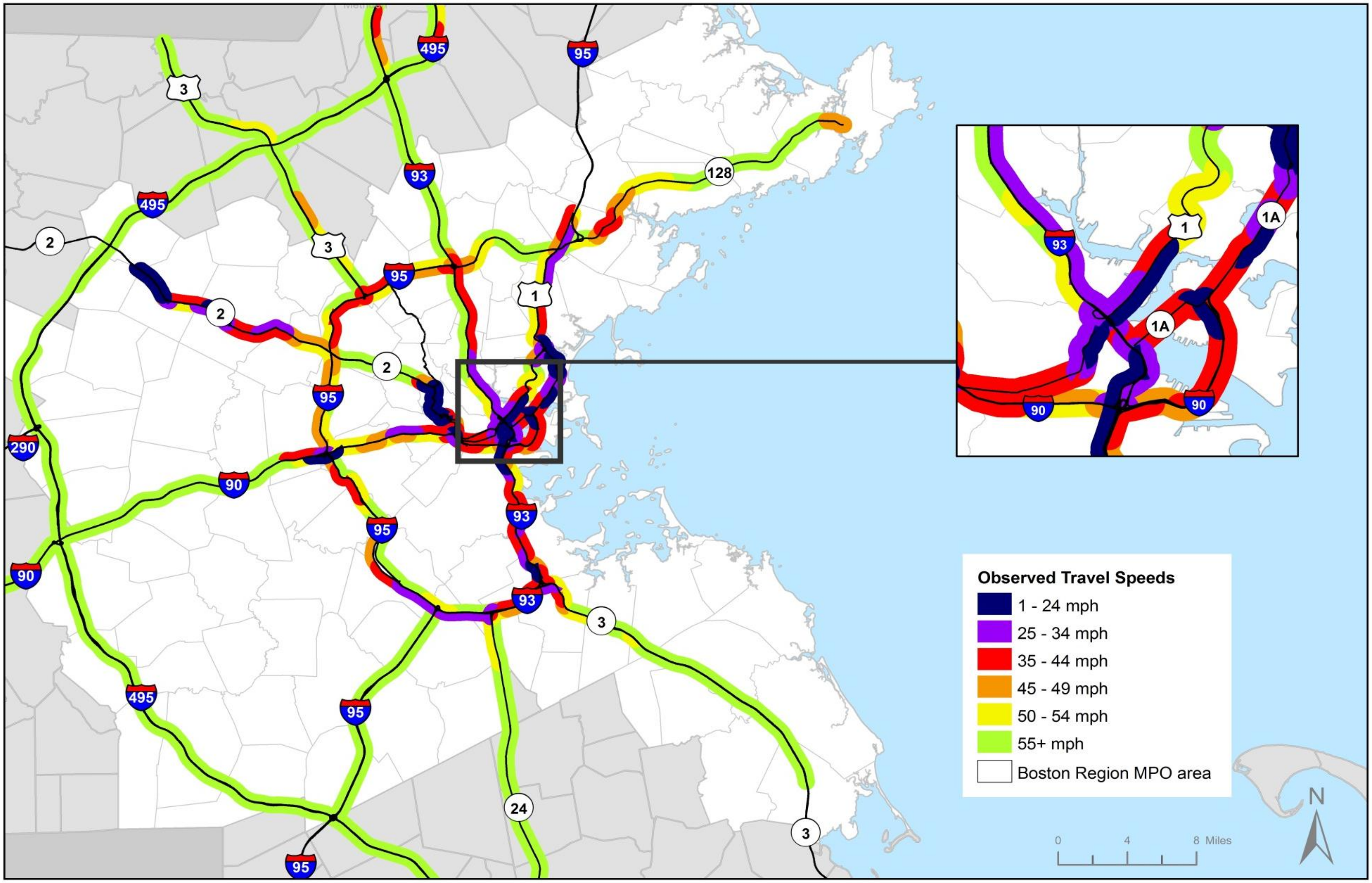

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FIGURE 4-2
Travel Speeds for Expressways:
PM Peak Period, 2004-07

Congestion Management Process

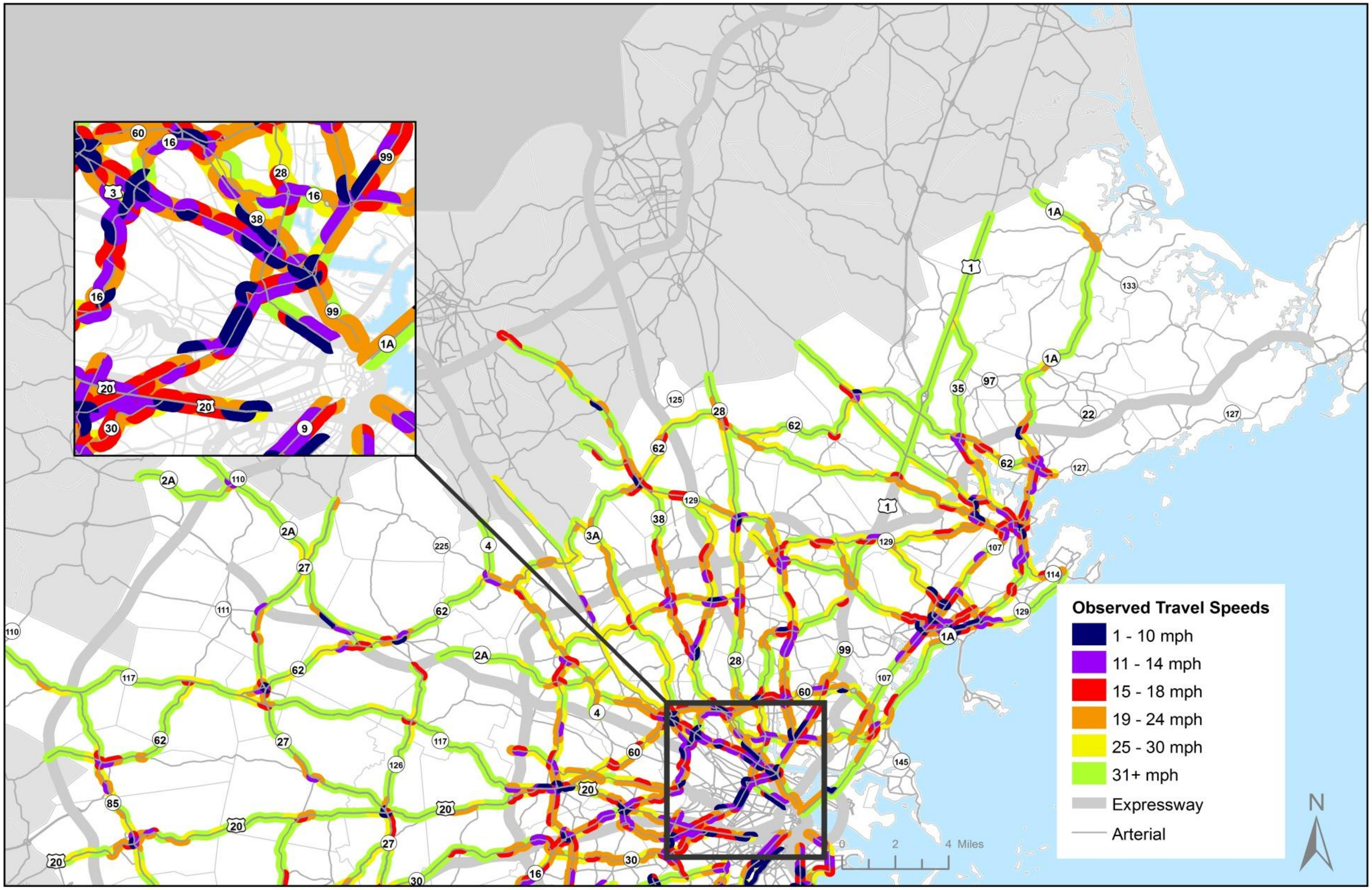

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FIGURE 4-3
Travel Speeds for Arterials: Northern Half of MPO Area,
AM Peak Period, 2001-08

Congestion Management Process

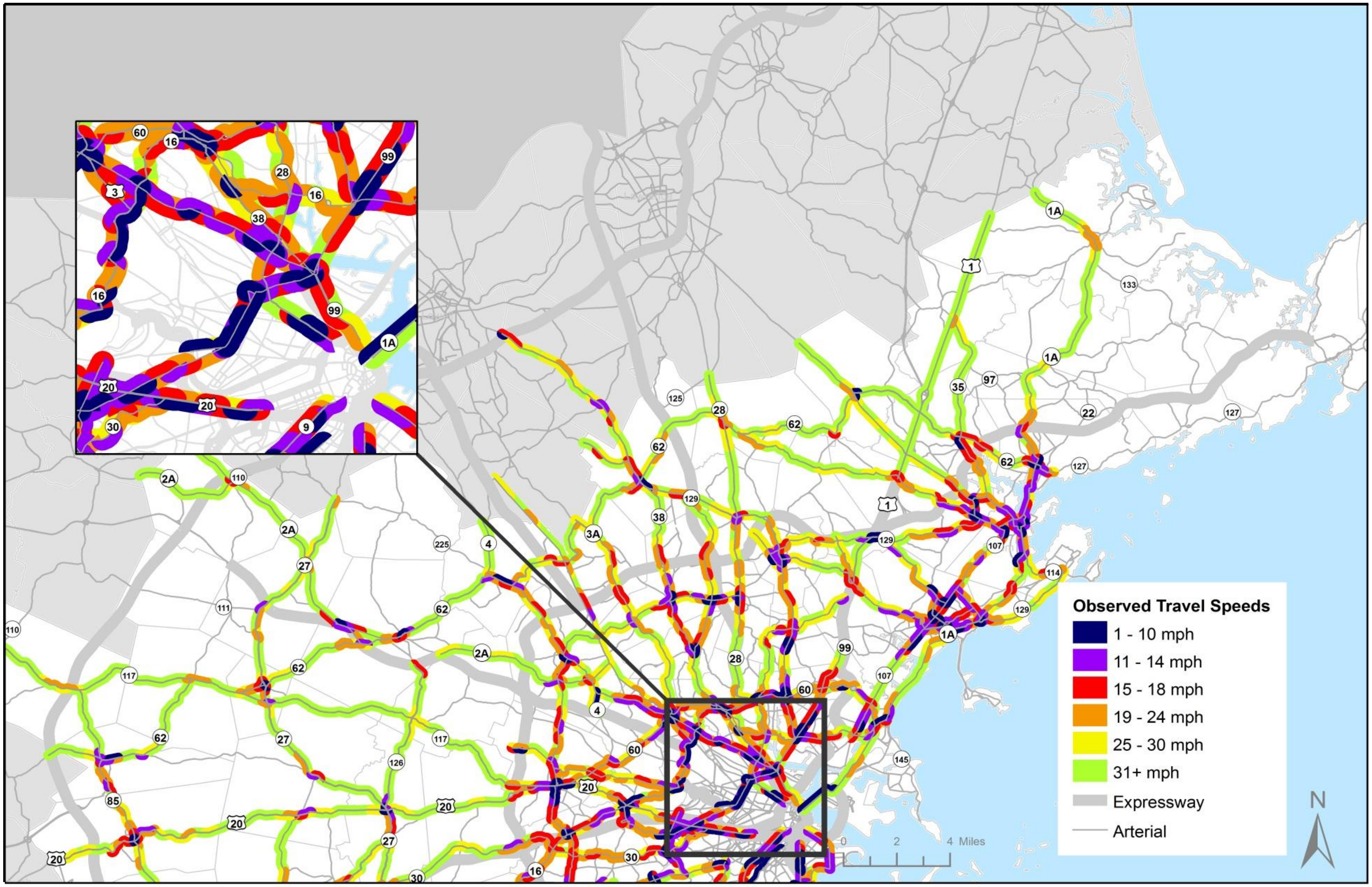

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FIGURE 4-4
Travel Speeds for Arterials: Northern Half of MPO Area,
PM Peak Period, 2001-08

Congestion Management Process

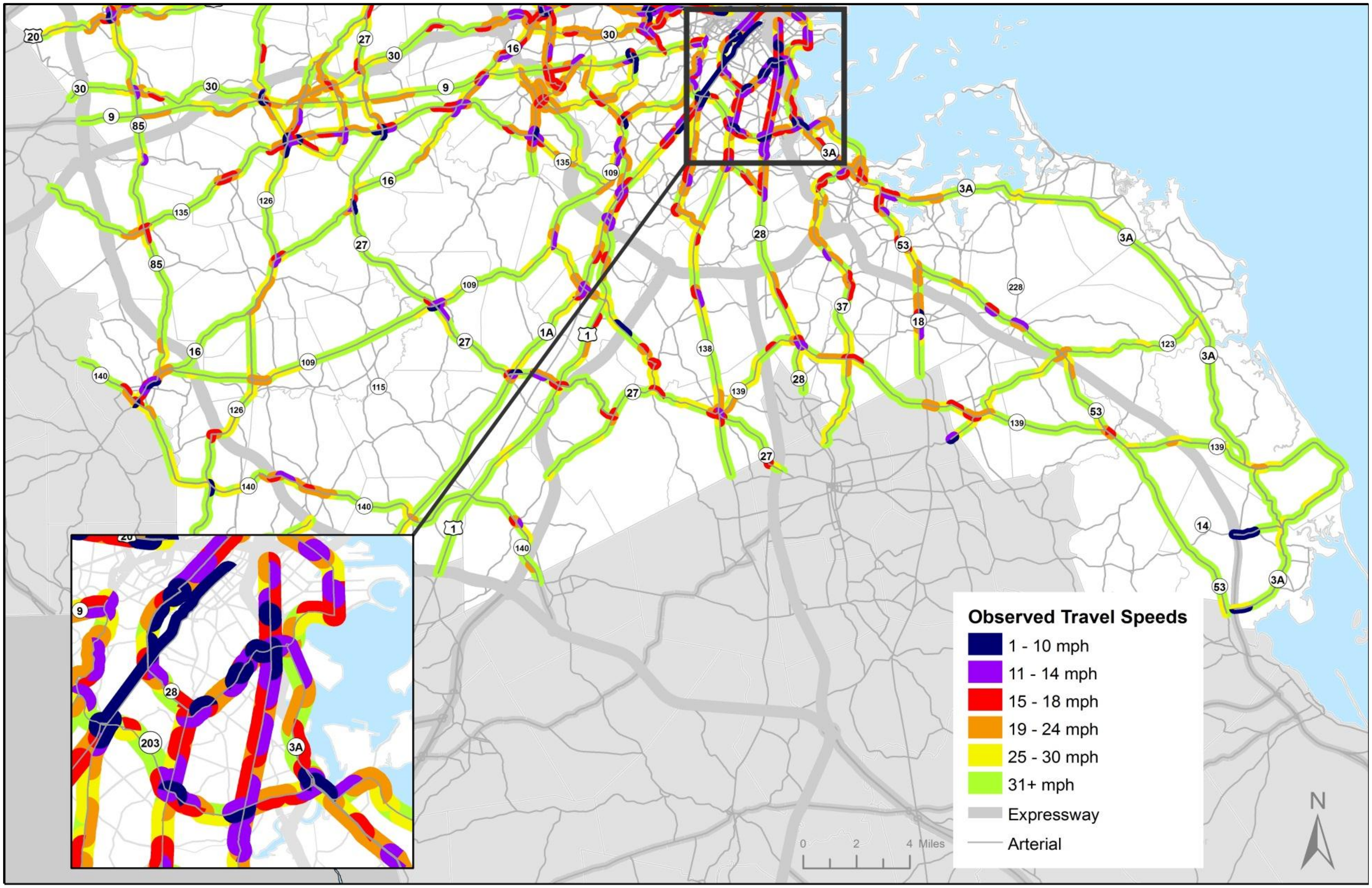

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FIGURE 4-5
Travel Speeds for Arterials: Southern Half of MPO Area,
AM Peak Period, 2001-08

Congestion Management Process

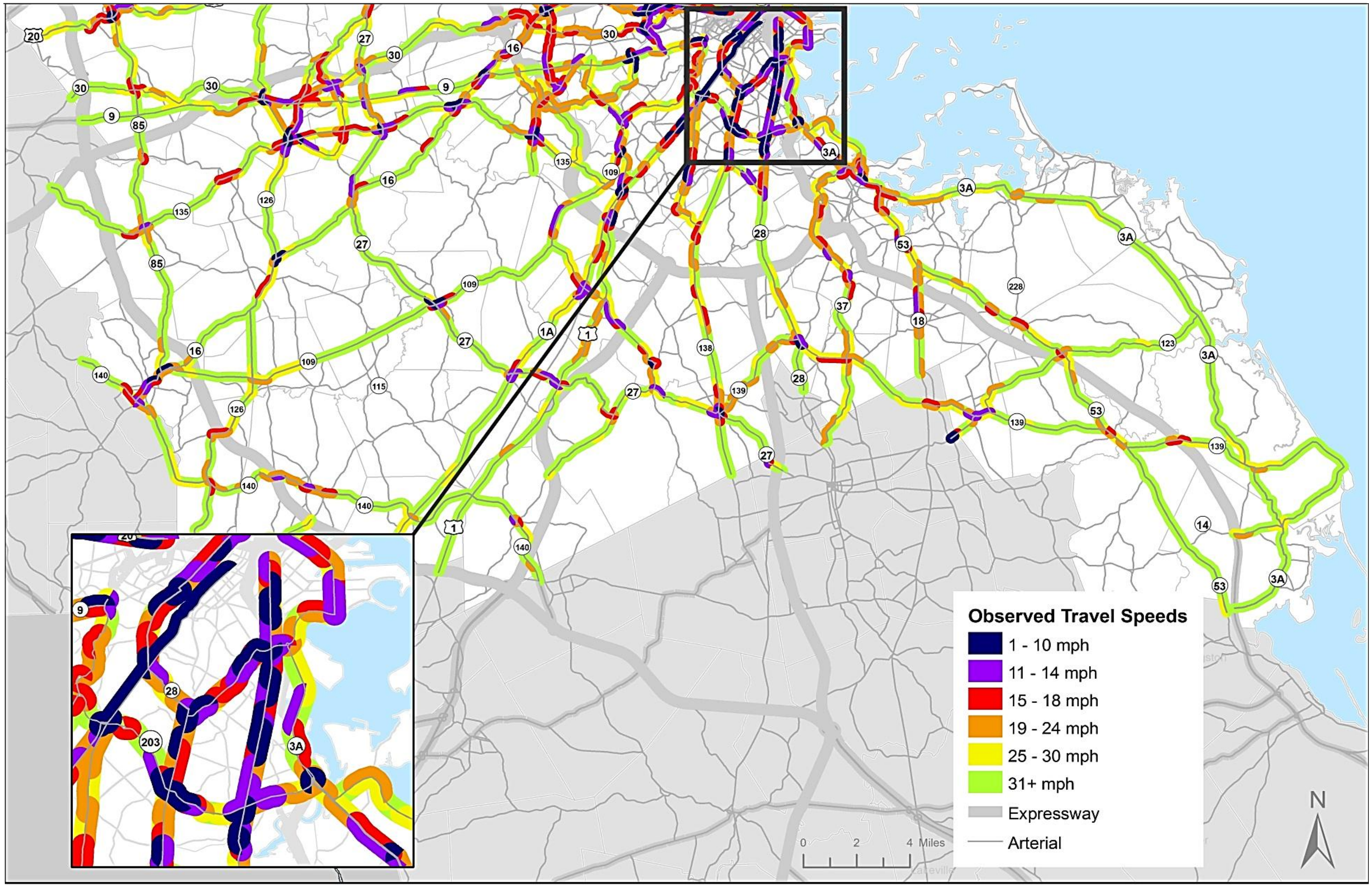

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FIGURE 4-6
Travel Speeds for Arterials: Southern Half of MPO Area,
PM Peak Period, 2001-08

Congestion Management Process

Speed Index

Limited-Access Highways

AM Peak Period

Most of the low speed indexes occur in the urban core. The limited-access highways outside of I-95 that have congestion, as indicated by speed index, are Route 3 northbound, Route 24 northbound, Route 2 in both directions, and I-90 eastbound. The AM speed indexes for expressways are displayed in Figure 4-7.

PM Peak Period

The speed indexes overall are slightly higher in the PM peak period, indicating less congestion. The main roadways that are congested are the Southeast Expressway (I-93) southbound, I-90 westbound, I-93 north of Boston, Route 1 northbound, and Route 2. The PM speed indexes for expressways are displayed in Figure 4-8.

Arterial Roadways

AM Peak Period

The speed indexes indicate that there is a lot of congestion in the urban core, with nearly all of the arterials in Boston having a speed index of less than 0.70. The speed indexes generally increase farther away from the urban core. Most of the low speed indexes that are located outside of I-95 occur on circumferential arterials. The AM speed indexes for arterial roadways are displayed in Figures 4-9 and 4-11.

PM Peak Period

During the PM peak period, most arterials throughout the MPO region, including those in the urban core, experience significant congestion, with a very low speed index. For both the PM and peak periods, most of the low speed indexes occur inside of I-95 or along circumferential arterials. The PM speed indexes for arterial roadways are displayed in Figures 4-10 and 4-12.

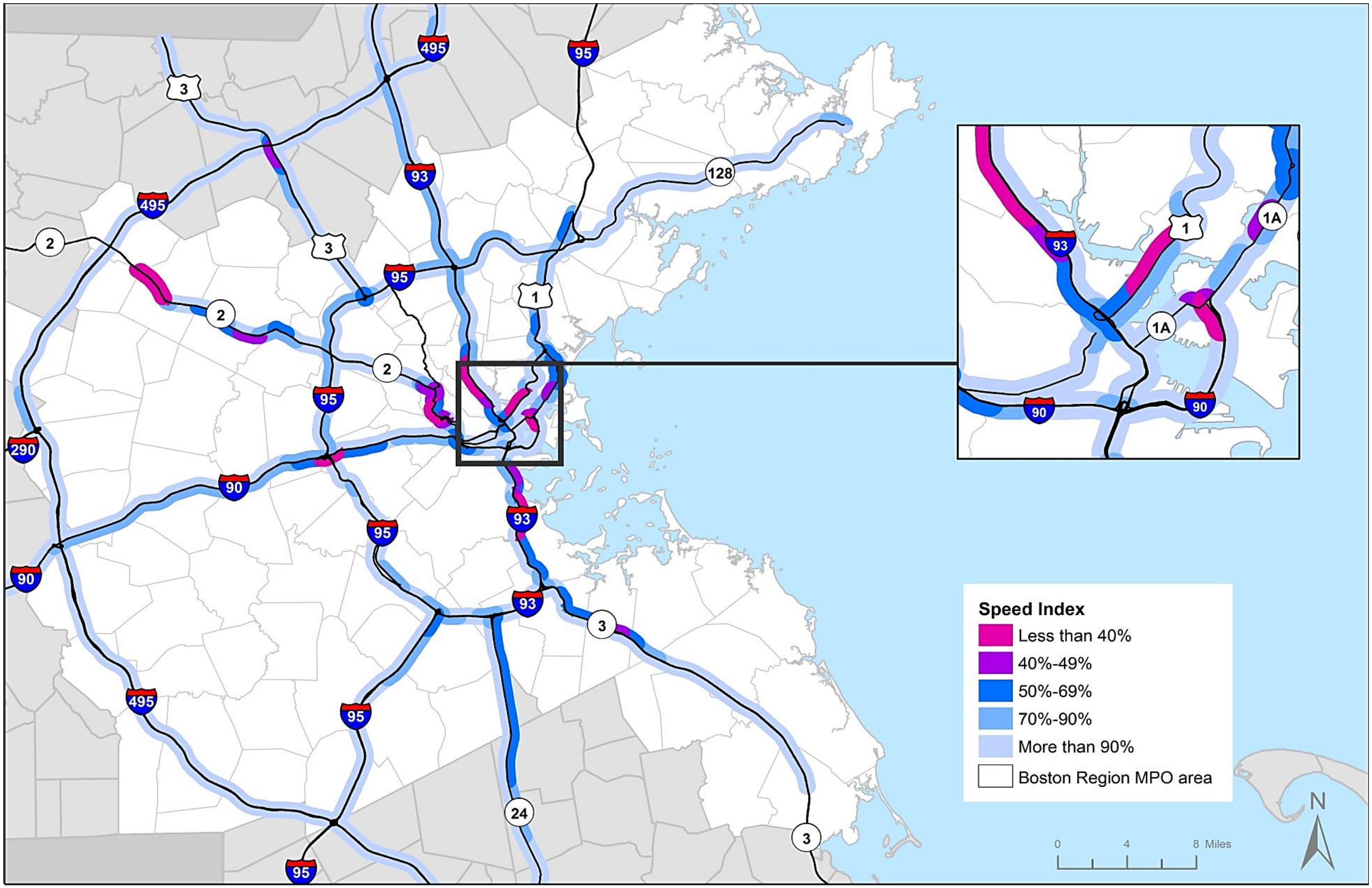

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FIGURE 4-7
Speed Indexes for Expressways:
AM Peak Period, 2004-07

Congestion Management Process

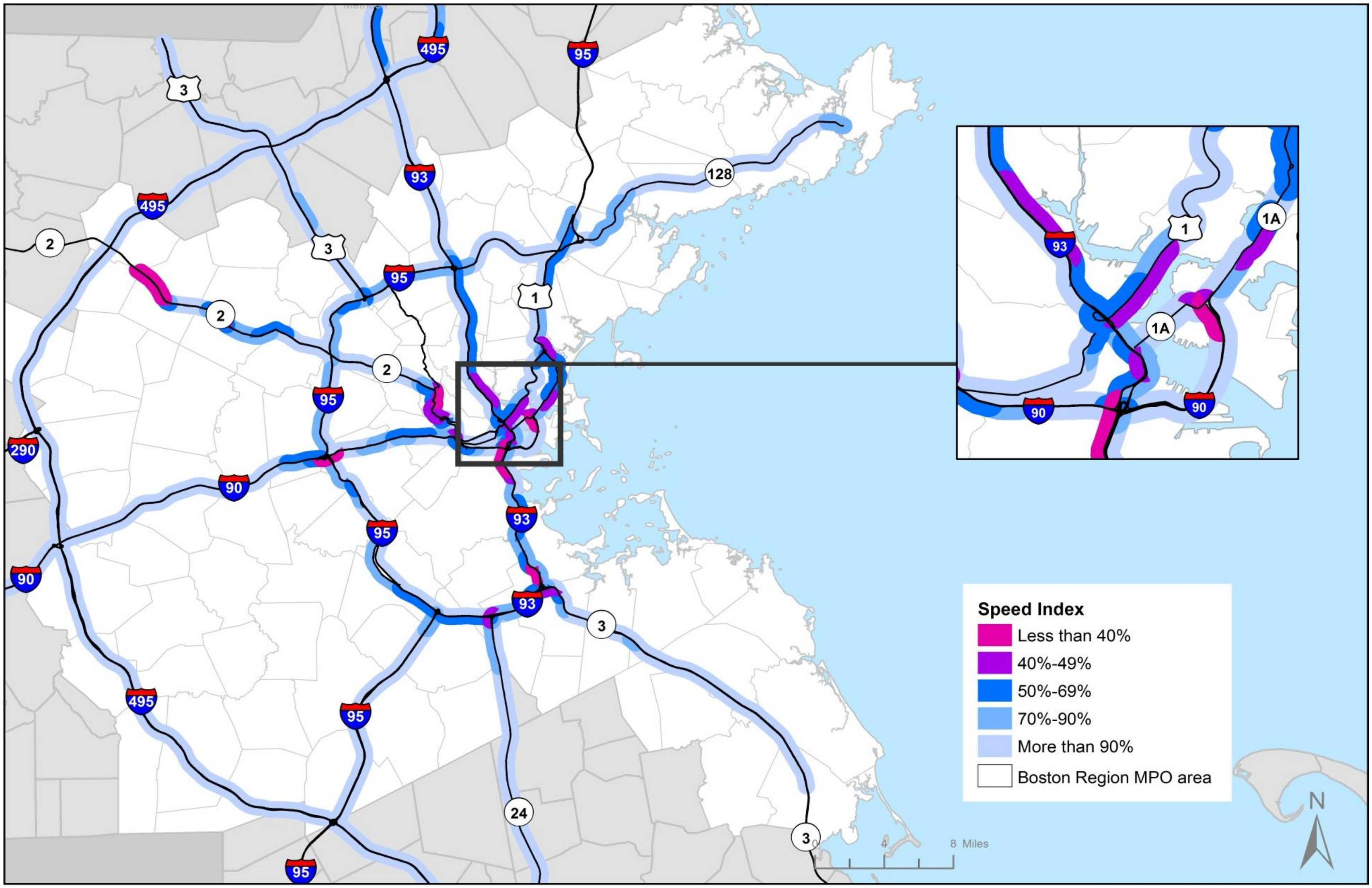

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FIGURE 4-8
Speed Indexes for Expressways:
PM Peak Period, 2004-07

Congestion Management Process

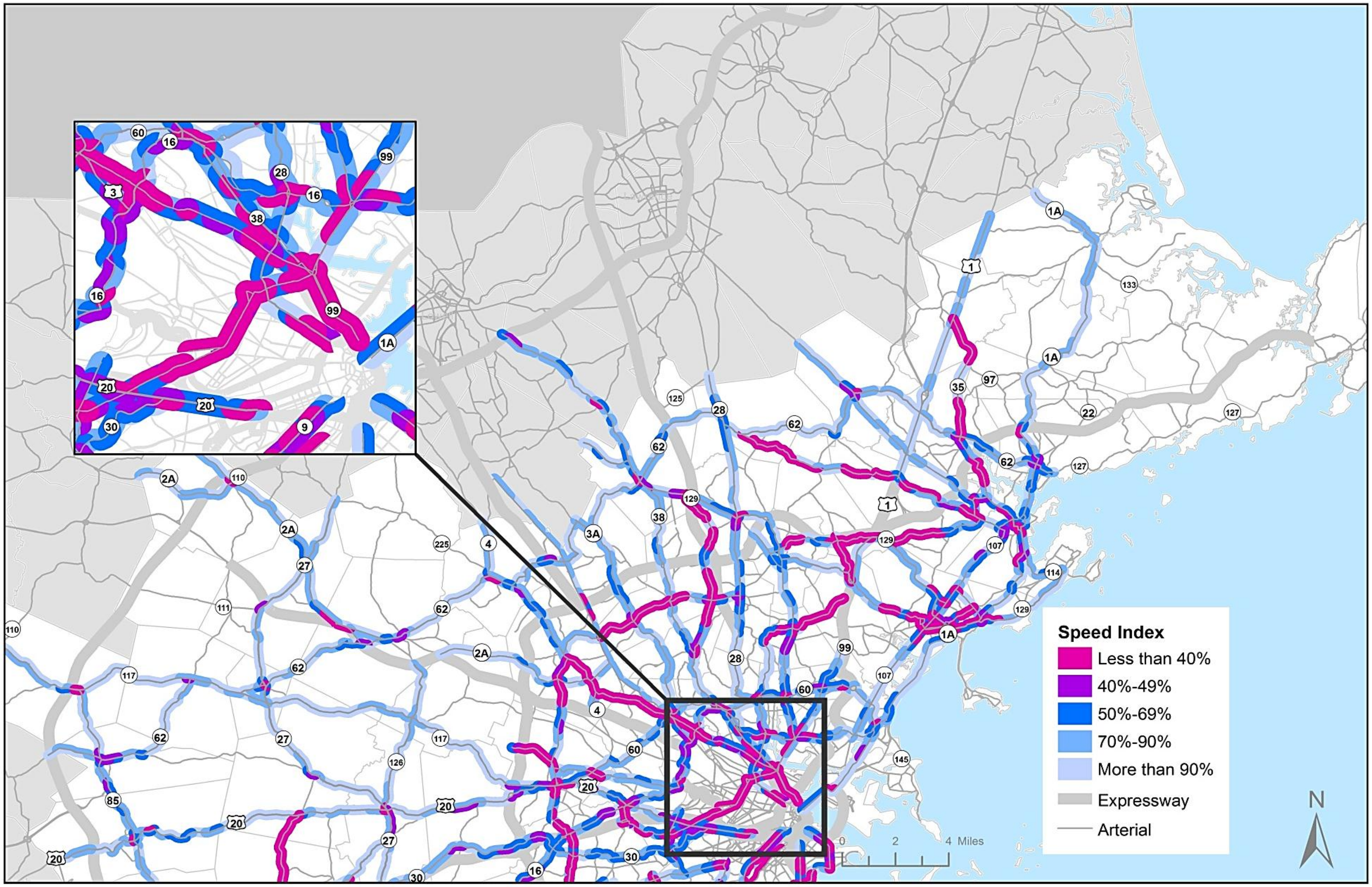

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FIGURE 4-9
Speed Indexes for Arterials: Northern Half of MPO Area, AM Peak Period, 2001-08

Congestion Management Process

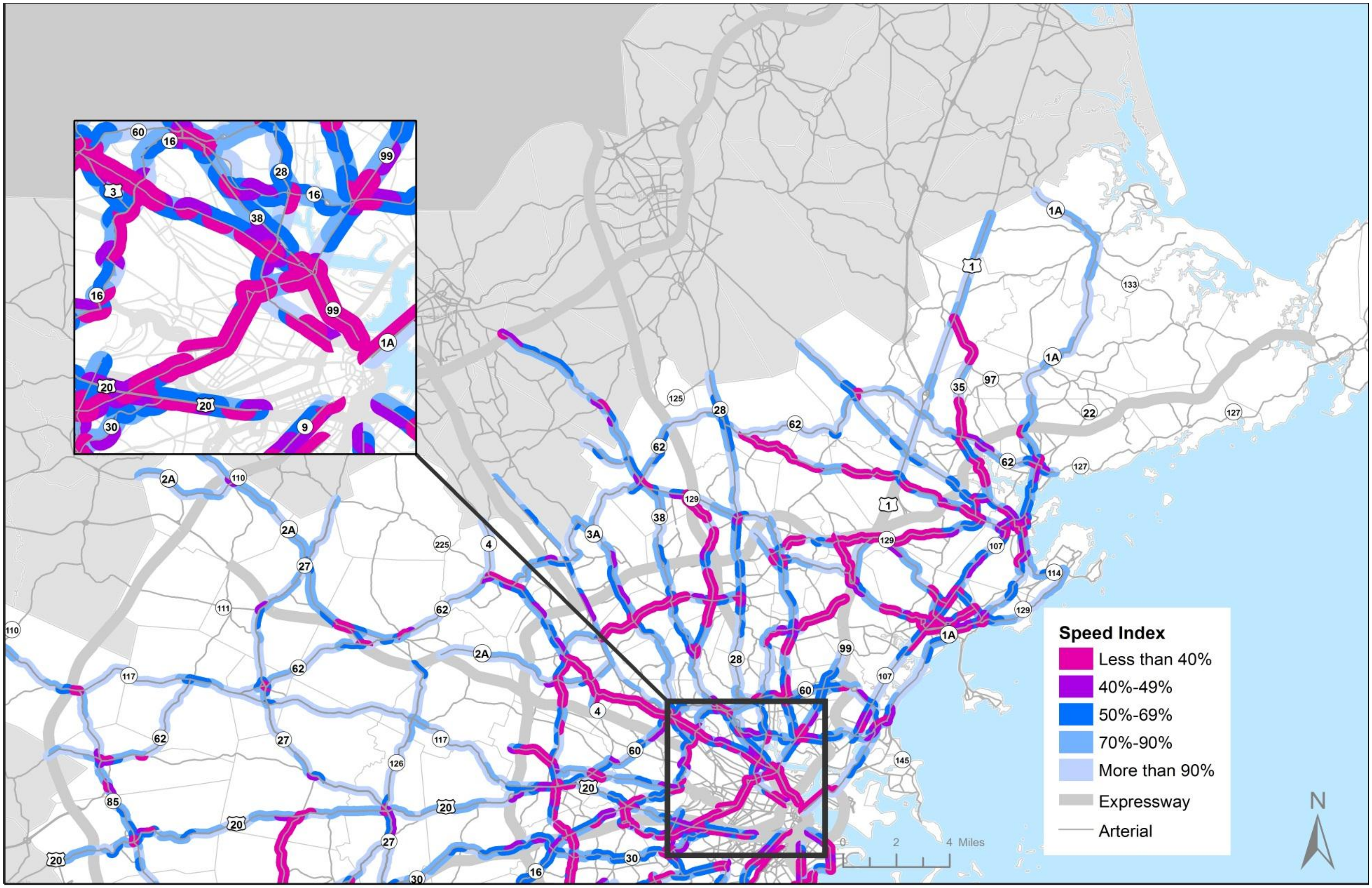

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FIGURE 4-10
Speed Indexes for Arterials: Northern Half of MPO Area,
PM Peak Period, 2001-08

Congestion Management Process

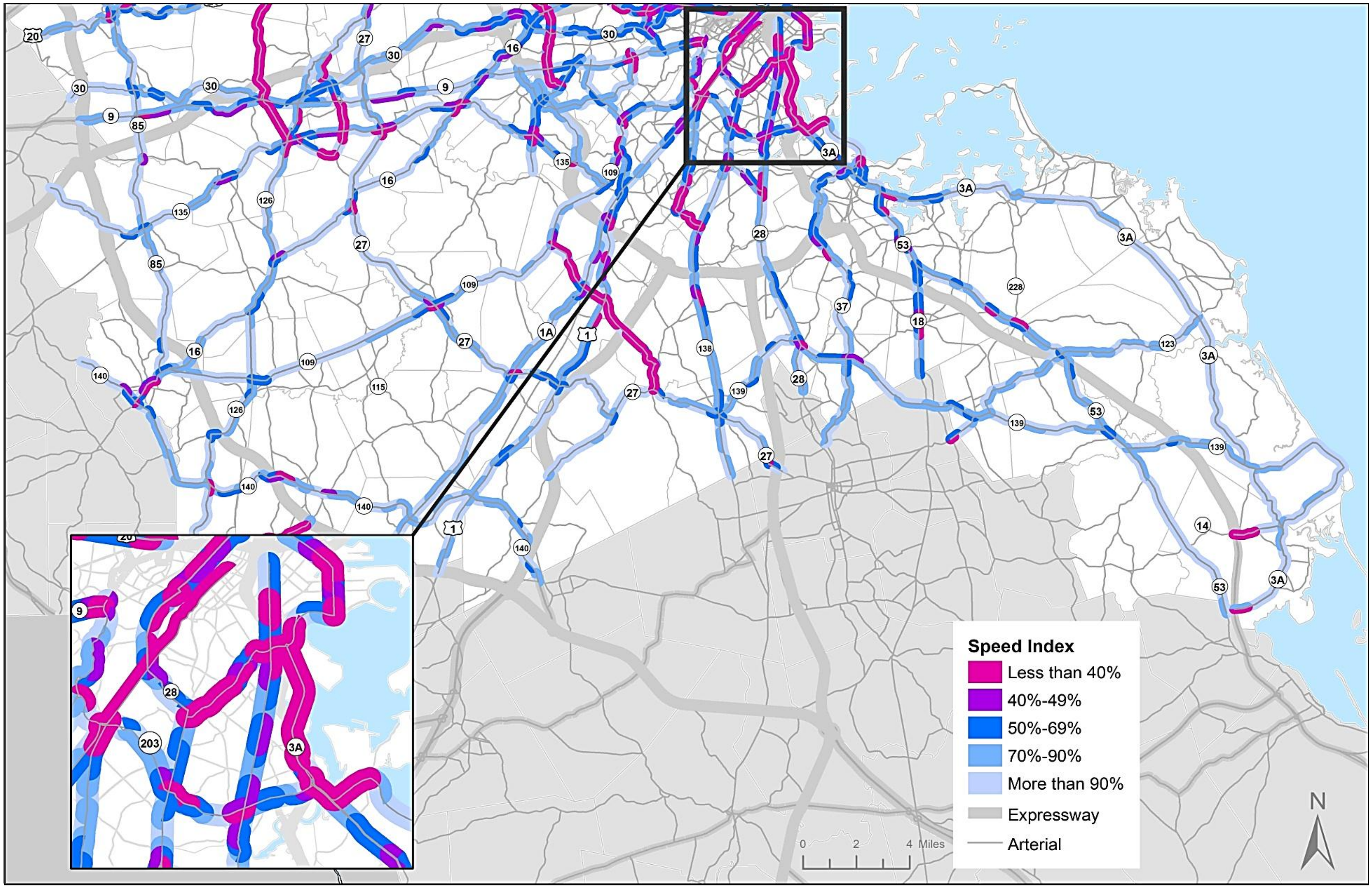

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FIGURE 4-11
Speed Indexes for Arterials: Southern Half of MPO Area,
AM Peak Period, 2001-08

Congestion Management Process

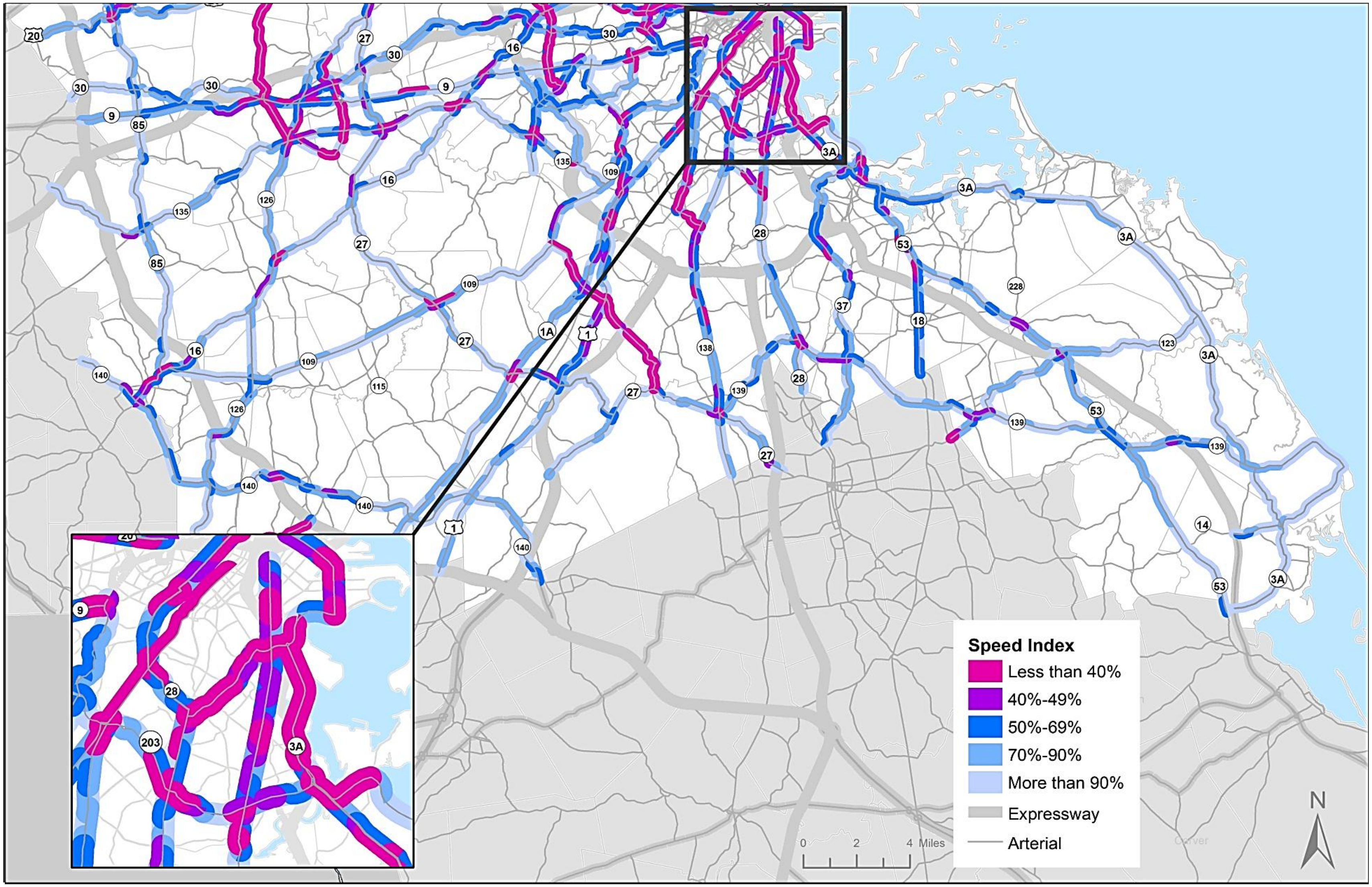

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FIGURE 4-12
Speed Indexes for Arterials: Southern Half of MPO Area,
PM Peak Period, 2001-08

Congestion Management Process

Congested Hours

An important relationship to acknowledge is between the traffic volumes of a roadway and the amount of congested hours a roadway experiences in a given day. The following maps illustrate this relationship by displaying the change in congestion between the late 1980s and the years 2005–08. The following maps show the AM and PM peak-period hours of congestion and traffic volumes for the Boston region in the late 1980s and in the period between 2005 and 2008 for the region's limited-access roadways. Overall, in the late1980s, most roadway congestion was located close to the urban core. Traffic volumes in the late 1980s were at or near capacity for at least 1.5 to 3.0 hours during each peak period for most of the circumferential portion of Route 128, and parts of Route 1 North, Route 3 North and South, and I-93 North to its interchange with Route 128. Traffic conditions were already worsening on the Central Artery and the Southeast Expressway by the late 1980s, with some sections experiencing traffic volumes at or near capacity for 3.0–4.5 hours during each daily peak period of travel.

Over the course of the 20-year period, traffic conditions have continued to deteriorate. Much of I-95, the Southeast Expressway, and the Central Artery tunnel (Thomas P. "Tip" O'Neill Tunnel) routinely experienced 3.0 to 4.5 hours a day of volumes at or near capacity during each of the daily peak periods of travel, with some roadway sections experiencing more than 4.5 congested hours twice a day. Congestion on I-93 downtown was initially reduced in the early years following the completion of the CA/T project in 2005. Traffic congestion has also been extending into the outer reaches of the Boston region, as almost the entire northern half of I-495 experiences some traffic congestion during the daily peak periods of travel. Parts of Route 3 North and I-93 are also experiencing 1.5 to 3.0 hours of traffic volumes at or near capacity. Significant congestion is also beginning to be experienced on certain express-highway segments in the Worcester area (which is outside the Boston Region MPO area). This increase in traffic congestion in the outer reaches of the MPO region is due to the increase of circumferential commutes in the region caused by the emergence of job centers in those areas. Figures 4-13 through 4-16 display the congested hours on the regions' expressways in the late 1980s and in 2005–08.

Summary of Roadway Monitoring

Overall, the majority of the congestion in this region occurs inside of I-95. There are, however, some suburban areas that experience extreme congestion as well. Many limited-access expressways are congested in the peak-period direction of travel regardless of where the roadway is located in the region. There is also some congestion on many of the circumferential routes in the MPO region. The causes of these patterns could be that while there are many employment centers located in the suburbs, the region still has a large central business district in Boston that continues to attract jobs and produce congestion.

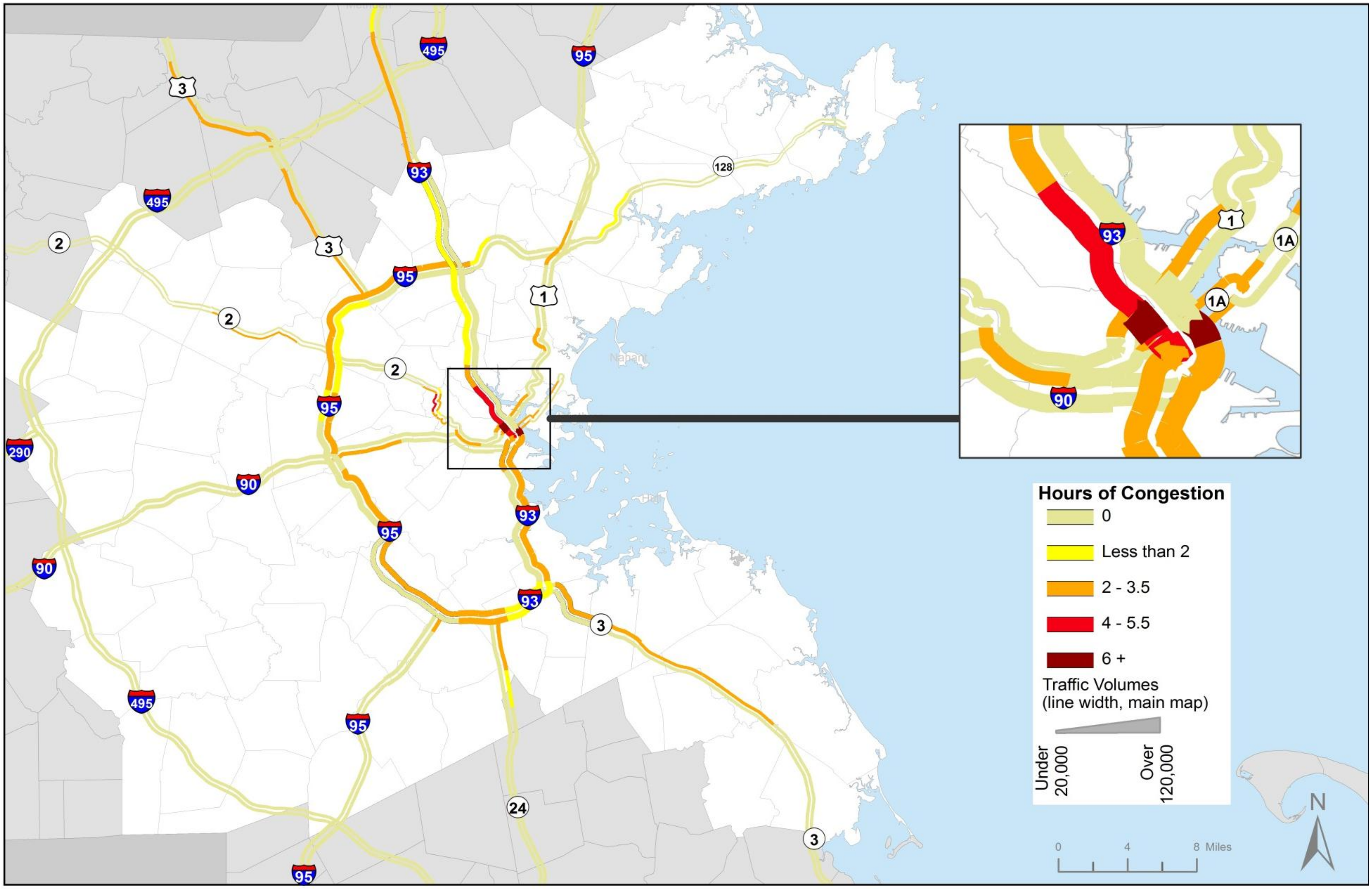

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FIGURE 4-13
Boston Region Expressways: AM Peak-Period Hours of Congestion
Late 1980s

Congestion Management Process

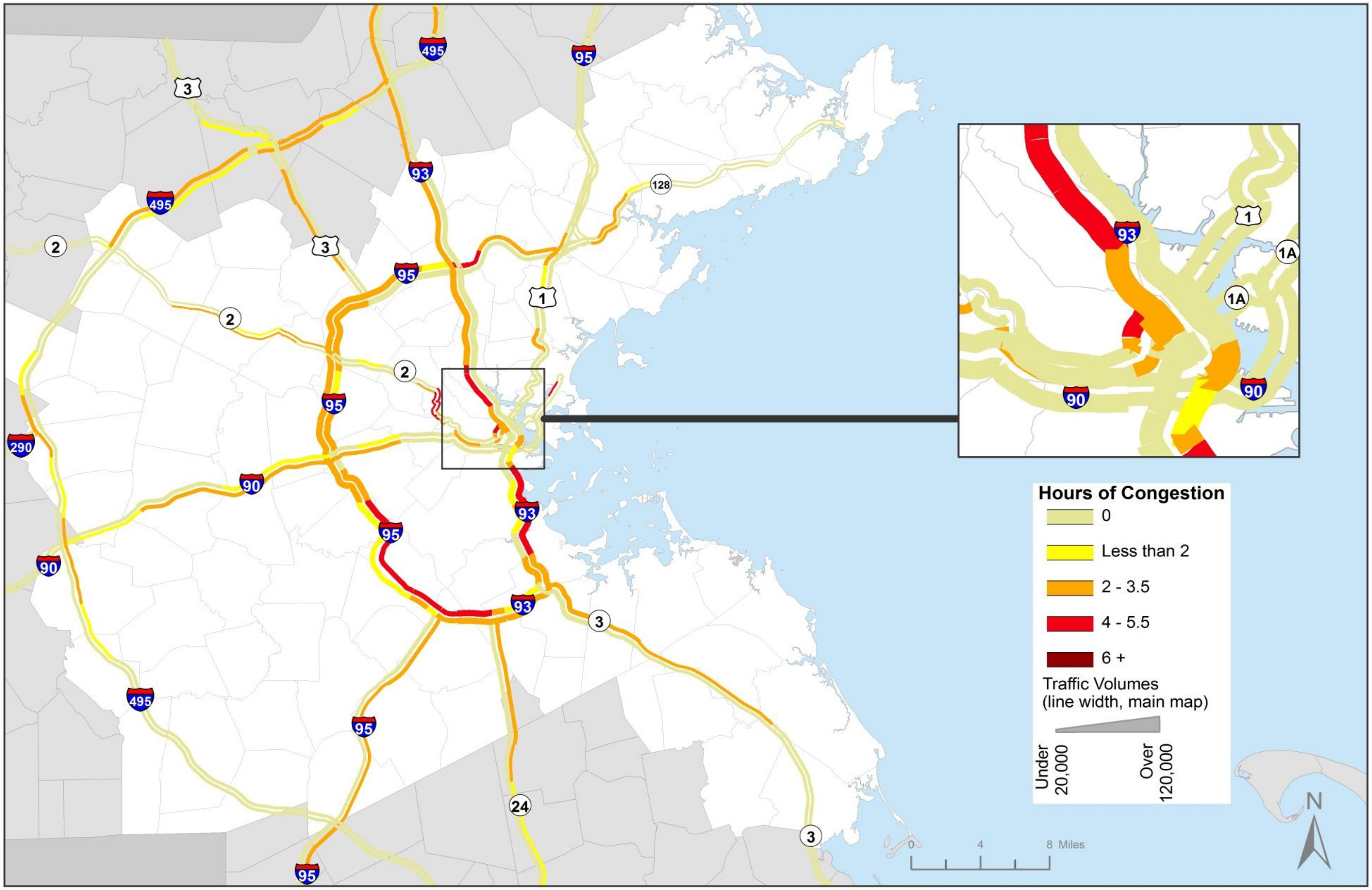

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FIGURE 4-14
Boston Region Expressways: AM Peak-Period Hours of Congestion
2005-08

Congestion Management Process

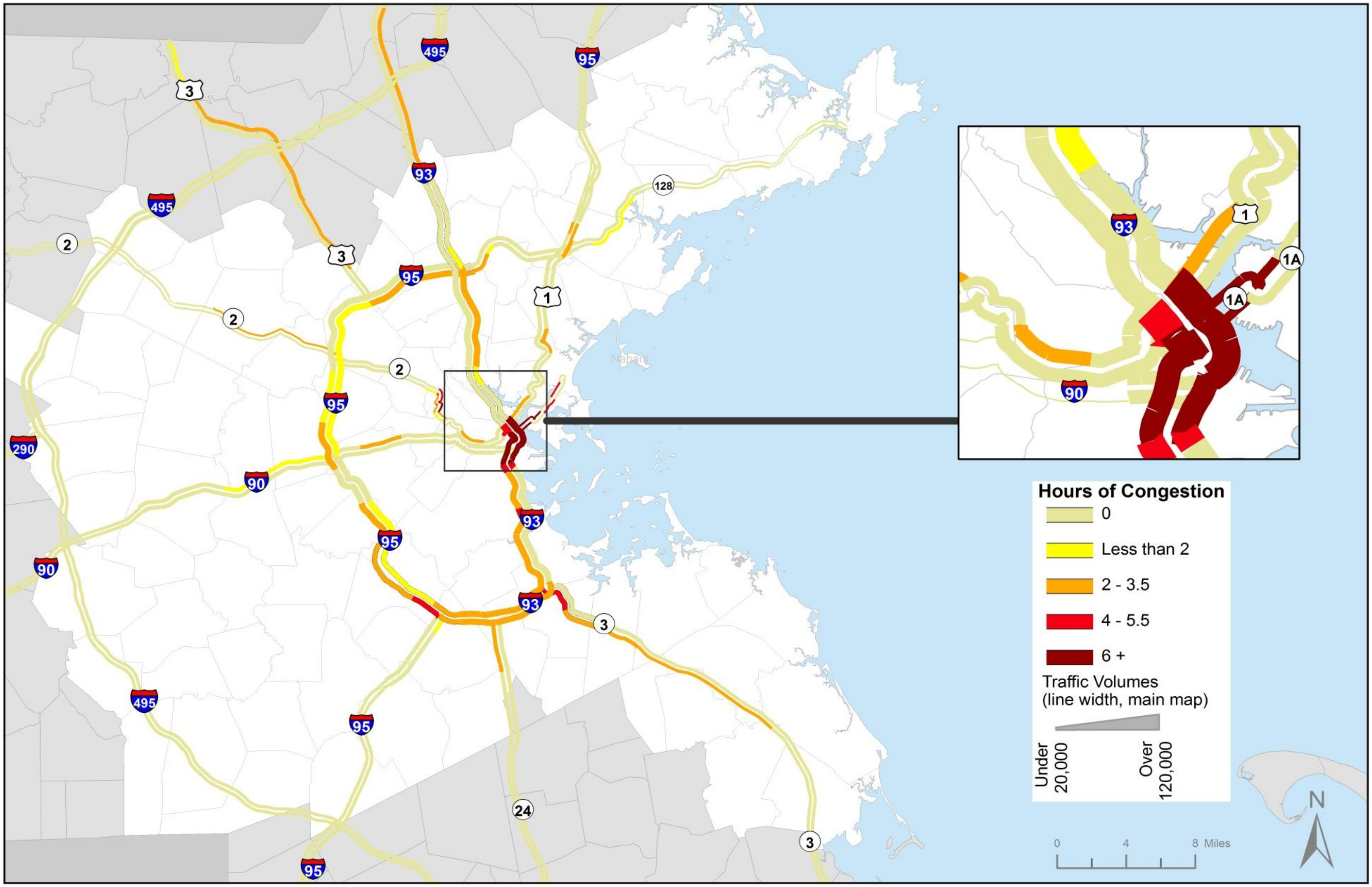

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FIGURE 4-15
PM Peak-Period Hours of Congestion
Boston Region Expressway: Late 1980s

Congestion Management Process

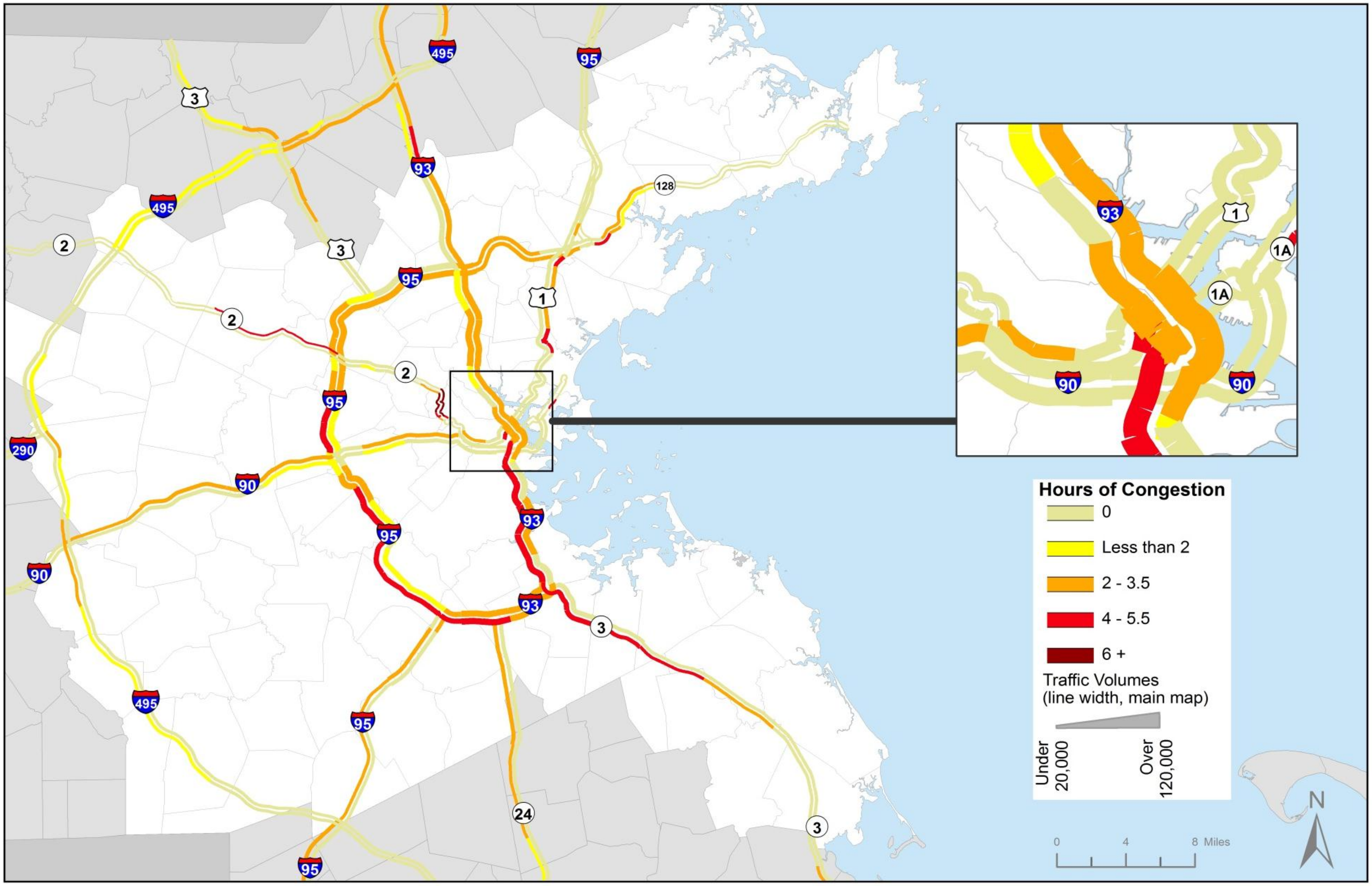

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FIGURE 4-16
PM Peak-Period Hours of Congestion
Boston Region Expressways: 2005-08

Congestion Management Process

INTERSECTION MONITORING

Since 2000, CMP staff has monitored the performance of over 1,500 intersections in the Boston region. Approximately 300 intersections were monitored through detailed evaluations that included staff site visits, data collection, and subsequent analysis and assessment, or through the gathering of data from existing MPO reports. These intersections are displayed in Figure 4-17. The rest were monitored for approach delay data gathered during travel time runs and by analyzing safety statistics. Information about all of these intersections can be found in an interactive database hosted on the CMP webpages on the Boston Region MPO’s website.

The vast majority of intersections selected for performance monitoring are on regionally significant arterial roadways. They were identified as problem locations through travel time monitoring; from safety analyses for vehicle, pedestrian, and bicycle modes; and from outside data sources in relation to conceptual and pre-TIP projects. The database contains, at a minimum, information on peak-hour approach delays on the main road going through each intersection, as well as traffic volumes, crash data, transit routes, and bicycle and pedestrian facilities. In the CMP, delay is defined as the time, over three seconds, for which a vehicle travels less than 5 mph on a segment of roadway that approaches a signalized intersection. Intersections analyzed in more detail include level-of-service analysis, field observations, and recommendations for improvements and for further study.

As a component of the Congestion Management Process, information from intersection performance monitoring is used to inform decisions about projects funded in the Transportation Improvement Program (TIP). In addition, intersection performance monitoring supports the Long-Range Transportation Plan (LRTP) by providing data for the needs assessment.

Interactive Database for Intersections

The CMP interactive database shows monitored intersections using Google maps for the 1,500 CMP-monitored intersections. The data in this interactive database come from several different sources, including “speed runs” (travel-time data collection), turning-movement counts, and crash data. Most of the data on the intersections in the database come from the speed runs. For approximately 300 intersections, there are more detailed data available about the level of service and turning-count movements of the intersection. Some intersections also display the crash data and crash rate.

Survey to Select Intersections for Low-Cost Improvements

In the summer of 2010, CMP staff solicited feedback from city and town staff regarding intersection locations in their municipalities where they thought that problems could be corrected with low-cost improvements.

Initial screening excluded intersections that were:

- Previously monitored
- Included in programmed TIP projects
- Complicated (intersections that were at interchanges or had more than four legs)

Equivalent Property Damage Only (EPDO) is a weighted scoring system that MassDOT uses to rank intersections by crash severity. This measure enables the intersections to be ranked by the severity of crashes, rather than the number of crashes.

The weighting system is as follows;

- Property damage only = 1 per crash
- Personal injury = 5 per injury
- Fatality=10 per fatality

The list of remaining intersections was sorted to produce, for each city or town, the five intersections with the highest EPDO ratings for crashes. This resulted in a list of 505 intersections, which were posted on the MPO's website by municipality for review and feedback from the public and staff from the MPO's 101 cities and towns. In addition, CMP staff solicited from them recommendations for locations other than the five provided online for a given city or town. A total of 234 responses from 33 cities and towns was received.

This list was then sorted by the number of responses received and by the EPDO rating to produce a final list of 15 priority intersections, listed in Table 4-1. The priority intersections file is used by staff to select, in coordination with municipal officials and staff, the locations to be studied in detail as part of the MPO's program Safety and Operational Improvements for Selected Intersections. As part of the FFY 2011 UPWP study "Safety and Operations Analyses at Selected Intersections," the Arlington and Bedford intersections in the table were studied. The study included field reconnaissance, safety and traffic analysis, and short- and long-term recommendations for traffic management, safety, and bicycle and pedestrian accommodations.

TABLE 4-1
2010 CMP Survey: Priority Intersections

Town	Streets at Intersection	EPDO
Acton	Concord Road at Great Road	23
Arlington	Park Avenue Extension at Lowell Street (Downing Square)	25
Bedford	Brooksbie Road at The Great Road	32
Boston	Bynner Street/Willow Pond Road at Jamaicaway	78
Holliston	Hollis Street at Highland Street	21
Lexington	Bedford Street at Hill Street/Revere Street	38
Malden	Commercial Street at Medford Street	94
Medford	Harvard Street at Main Street	69
Medway	Main Street (Route 109) at Holliston Street	83
Sharon	Canton Street at North Main Street	25
Stoughton	Central Street at Canton Street	30
Waltham	Grant Street at Main Street	46
Watertown	Arsenal Street at Greenough Boulevard	91
Weston	Boston Post Road/Boston Post Road Bypass at Wellesley Street	75
Wrentham	Common Street at East Street	40

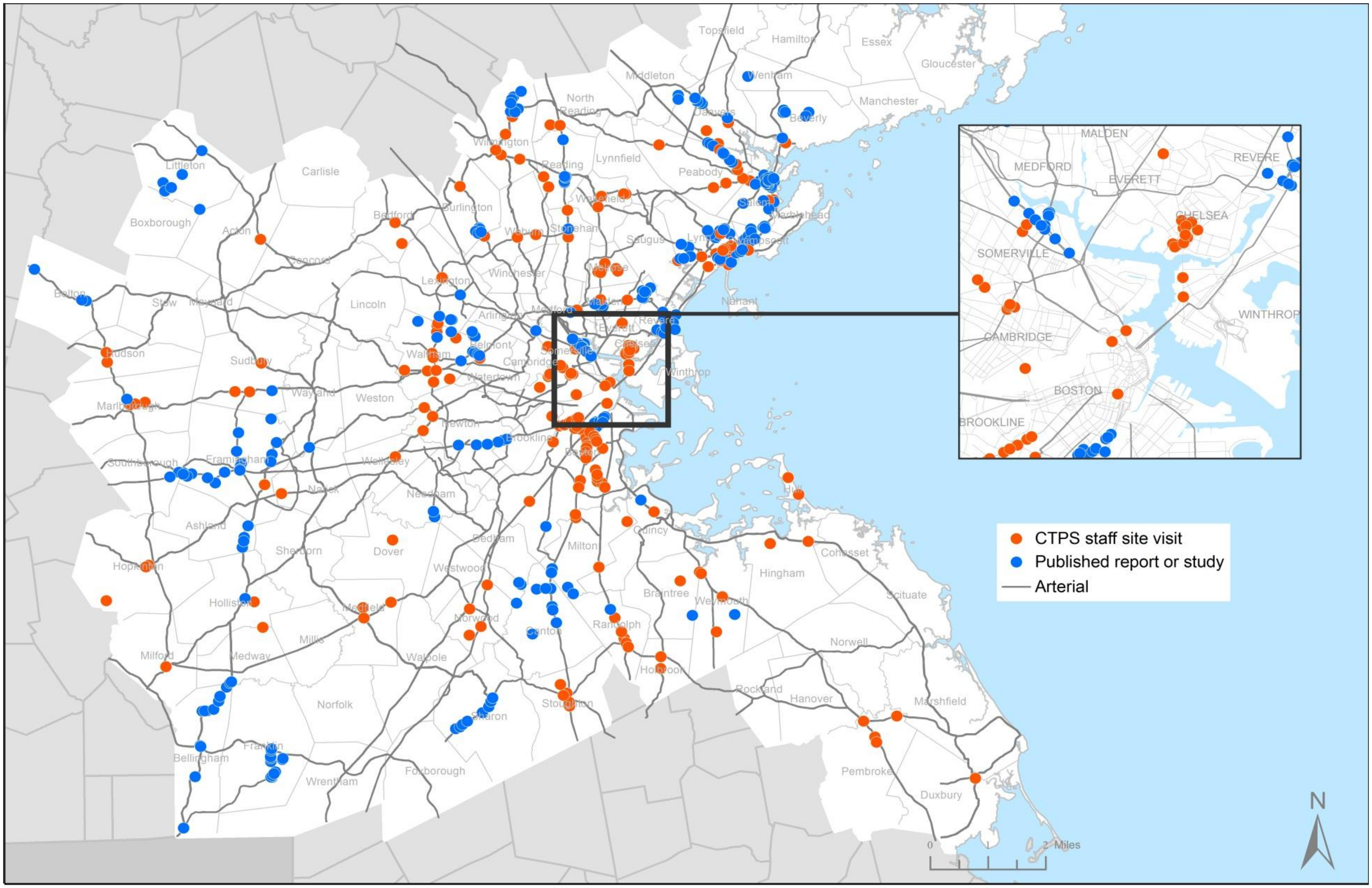

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FIGURE 4-17
CMP-Monitored Intersections
2004-11

Congestion Management Process

HIGH-OCCUPANCY-VEHICLE (HOV) LANES

Historical Background

I-93 North HOV Lane

In February 1974, a southbound high-occupancy-vehicle (HOV) lane was established on I-93 North. In response to ever-increasing queue lengths, this HOV lane was lengthened in August 1974, and then again in October 1979, when it stretched a total of 1.07 miles from the beginning of the I-93 double-deck elevated structure near Sullivan Square to a point 900 feet north of the merge of I-93 and Route 1. The lane was later extended farther, to a length of 2.0 miles, to run from a point just south of Mystic Avenue in Somerville to a point 0.12 mile north of the Route 1 merge in Charlestown. On March 5, 2005, it was extended by more than half a mile, from the lower deck onto the Leonard P. Zakim Bunker Hill Bridge. This extension coincided with the full opening of the southbound lanes of the bridge and the Central Artery tunnel, increasing the length of the lane to 2.6 miles.

When the I-93 North HOV lane was initially opened, it was made available to buses, to motorcycles, and to carpools and vanpools having at least three persons per vehicle. This entry criterion provided acceptable levels of usage in spite of the relatively small numbers of carpools, because the lane was available to all vehicles traveling from I-93 southbound to Route 1 North (including significant numbers of commuters traveling to downtown Boston via the Navy Yard off-ramp and Charlestown Bridge). When the Central Artery North Area project began in 1987, however, the ramp to Route 1 North was closed and vehicles could no longer travel directly from I- 93 southbound to Route 1 North using the HOV lane. The consequent case of “empty lane syndrome” ultimately led to the 1988 change of the HOV-lane entry requirement to the two-plus-persons criterion that has been retained to date. By 1992 the HOV lane was carrying about 1,100 vehicles during the AM peak hour, which was near its capacity, given the geometry of its merge with the general-purpose lanes at its southern end. Access from the HOV lane to the Leverett Circle Connector was cut off when the latter was completed in 1999. This reduced the volumes in the HOV lane, which are presently between 700 and 800 vehicles per peak hour.

I-93/Southeast Expressway HOV Lane

The I-93/Southeast Expressway HOV lane opened in 1995 as mitigation for the Central Artery project. Entry has been limited to carpools, vanpools, private vehicles meeting the occupancy criteria, motorcycles, and buses. This five-mile-long HOV lane has one terminus south of Columbia Road (Exit 15) and another located south of Furnace Brook Parkway (Exit 8) in Quincy, just north of the Braintree Split (Exit 7) and Route 3 (Exit 20). The occupancy requirement for the lane has changed over the years: initially the entry rule was three or more occupants per vehicle; after that there was a sticker program (red and green) that allowed vehicles with two occupants to enter the lane on alternate days. This was later expanded to allow all vehicles with stickers to use the lane on all days. Presently, any vehicle with two or more occupants meets the entry requirement for the HOV lane. This change did not result in any negative effects to either the general-purpose or HOV lanes.[1] The Southeast Expressway HOV lane's original three-or-more occupancy rule resulted in maximum volumes of 375 and 400 vehicles per hour for the AM and PM peak periods, respectively. With the introduction of the two-person-occupancy sticker program in 1998, these volumes increased to a maximum of 550 and 525 vehicles per hour for the AM and PM peak periods, respectively. In February 1999, when the two-person-occupancy sticker program was expanded to all days, the maximum volumes increased to 825 vehicles per hour during the AM peak period and 550 during the PM peak period. In June 1999, when the HOV lane was opened to all vehicles with two or more occupants, with no sticker required, the lane use increased to 1,300 vehicles per hour during the AM peak hour and 1,000 during the PM peak hour. Presently, the volume in the HOV lane typically does not exceed 1,300–1,400 vehicles per hour either northbound during the AM peak hour or southbound during the PM peak period.

Data Collection Method

Data for each HOV lane that are collected quarterly by the MPO staff include passenger counts and travel times on both the HOV lane and the adjoining general-purpose lanes. Seasonal performance data are collected on the two HOV lanes as part of an ongoing, mandated monitoring program. Two separate data collection efforts take place: one collects travel times, and the other collects vehicle occupancies and traffic volumes.

Travel time data samples are obtained by using probe vehicles. During the hours of operation of the HOV lanes, these vehicles drive in both the I-93 general-purpose lanes adjacent to the HOV lane and the HOV lanes themselves, collecting travel speeds.

Vehicle-occupancy data are collected and reported on in the fall and spring and are used to measure and compare the numbers of person-trips in the general-purpose lanes and the HOV lanes. Data are obtained by observers using tally counting equipment.

[1] Tom Lisco and Kate Wall, "Short-Term Speed and Travel Time Effects of the Change to a Two-Plus Occupancy Requirement for Use of the Southeast Expressway Carpool Lane," a memorandum prepared by the Central Transportation Planning Staff for Luisa Paiewonsky, then Director of MassHighway's Bureau of Transportation Planning and Development, June 9, 1999.

For the following facilities, travel time data are collected between 6:00 AM and 10:00 AM:

- I-93 North HOV lane, southbound
- I-93 North general-purpose lanes, southbound
- Southeast Expressway HOV lane, northbound
- Southeast Expressway general-purpose lanes, northbound

For the following facilities, travel-time data are collected between 3:00 PM and 7:00 PM:

- Southeast Expressway HOV lane, southbound
- Southeast Expressway general-purpose lanes, southbound

Travel Time Trends During the Four-Hour Monitoring Periods[2]

I-93 North: Southbound HOV Lane and General-Purpose Lanes

Summary of findings:

Figure 4-18 presents 2002–11 travel-time data and associated curves for the four-hour PM monitoring period for the I-93 North HOV lane and general-purpose lanes. This diagram is an example of the HOV data analysis that has been done.

Findings of the analysis include the following:

- In 2002 and 2003, travel times in the HOV lane during each daily period of operation were significantly higher than in 2004–08 and 2009–11, and they showed considerable peaking. The travel times rose gradually from 6:00 AM until around 8:00 AM, when they reached a maximum, and then they decreased until the end of operations at 10:00 AM. However, from 2004 through 2011, the travel times in the HOV lane showed no peaking at all, as the congestion at the point where it merges with the general-purpose lanes was eliminated when the Zakim Bridge and the southbound tunnel opened.[3]
- In general, the travel times in the general-purpose lanes from 2004 through 2011 were significantly lower than those observed in 2002 and 2003, because the major

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[2] This section originally appeared, in different form, in Asante et al.

[3] Seth Asante, Ryan Hicks, and Efi Pagitsas, MPO staff, memorandum to the Boston Region MPO dated January 12, 2012, “Historical Trends: Travel Times and Vehicle Occupancy Levels for I-93 North and Southeast Expressway HOV and General-Purpose Lanes,” Table A-1, “Central Artery/Tunnel Project Milestones with Potential Effects on I-93 HOV Facilities.”

cause of congestion at the point where the general-purpose lanes merge with the HOV lane was eliminated when the Zakim Bridge and southbound tunnel opened.

- The HOV lane was 10% to 24% more efficient than the general-purpose lanes, in terms of persons moved per lane per hour, during 2002–11.
- For the I-93 North HOV southbound lane, the travel time advantage over the general-purpose lanes has been ranging over the years from 4 to 6 minutes, approximately. The lowest travel times for both types of lanes were in 2008, but they have increased slightly since, more so for the general-purpose lanes than for the HOV lanes.

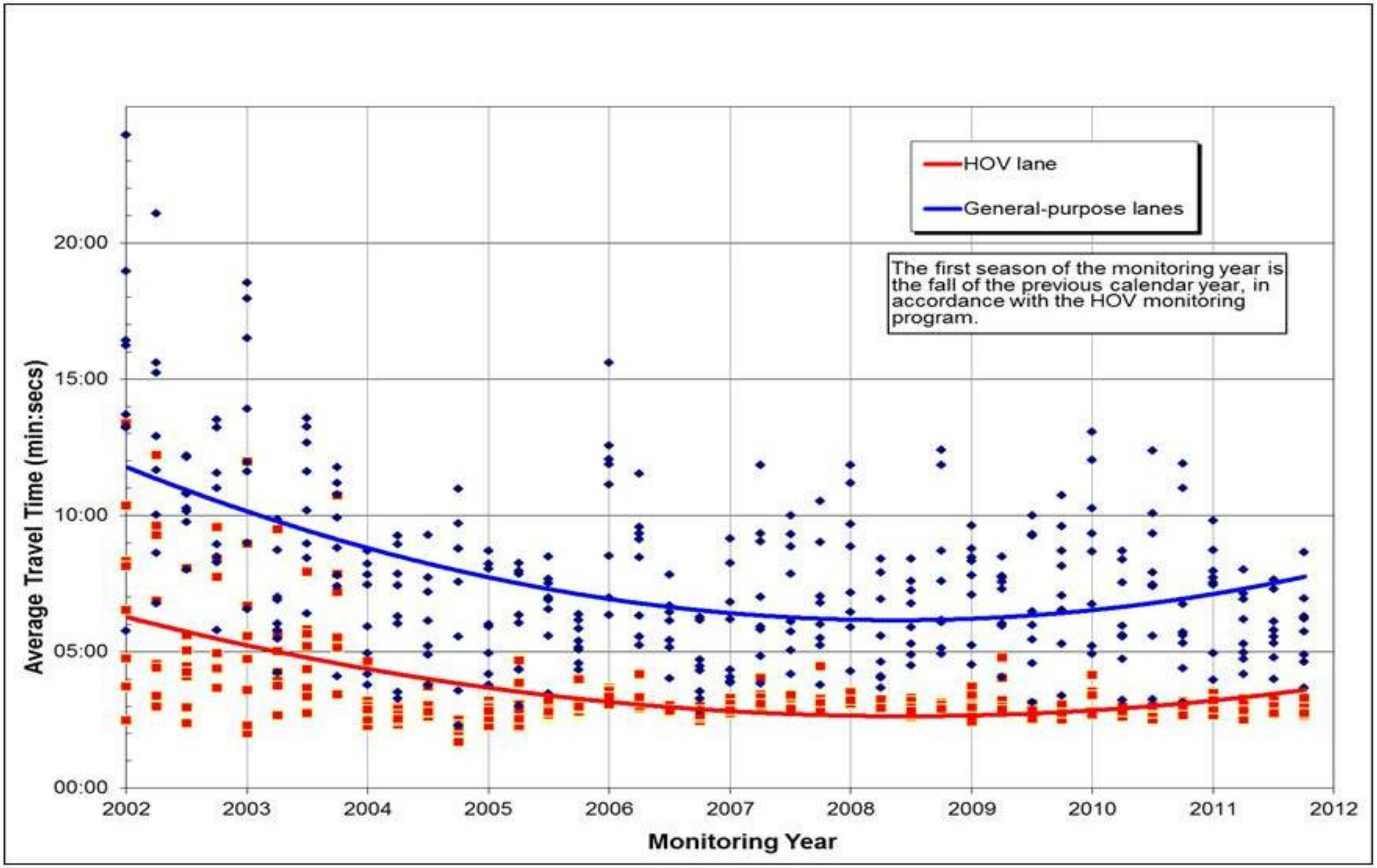

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FIGURE 4-18
I-93 North Travel Times: Southbound Travel Lanes, AM Peak Period, 2002-11

Congestion Management Process

Southeast Expressway: Northbound HOV Lane and General-Purpose Lanes

Summary of findings:

- There were significant increases in travel times from 2002 to 2011 in the HOV lane. Travel times in the HOV lane increased over a substantial portion of the four-hour monitoring period for each year of observation.
- The gradual increase in travel times for the HOV lane in recent years might be attributable to several factors. One possible factor is that the merging of HOV traffic with general-purpose-lane traffic at the north end of the HOV lane may be a cause of delay in the HOV lane.

Southeast Expressway: Southbound HOV Lane and General-Purpose Lanes

Summary of findings:

- The HOV lane's average travel times in 2009 through 2011 appear to be slightly lower than those in 2003 through 2008.
- The general-purpose lanes' average travel time curve for the 2009–11 period is slightly lower than their average travel time curve for the 2003–08 period for most of the four-hour monitoring period.
- Although the average travel times in the HOV lanes are faster than the average travel times in the general-purpose lanes, the travel time savings that the HOV lanes offer do not meet the standard set by the Department of Environmental Protection (DEP).

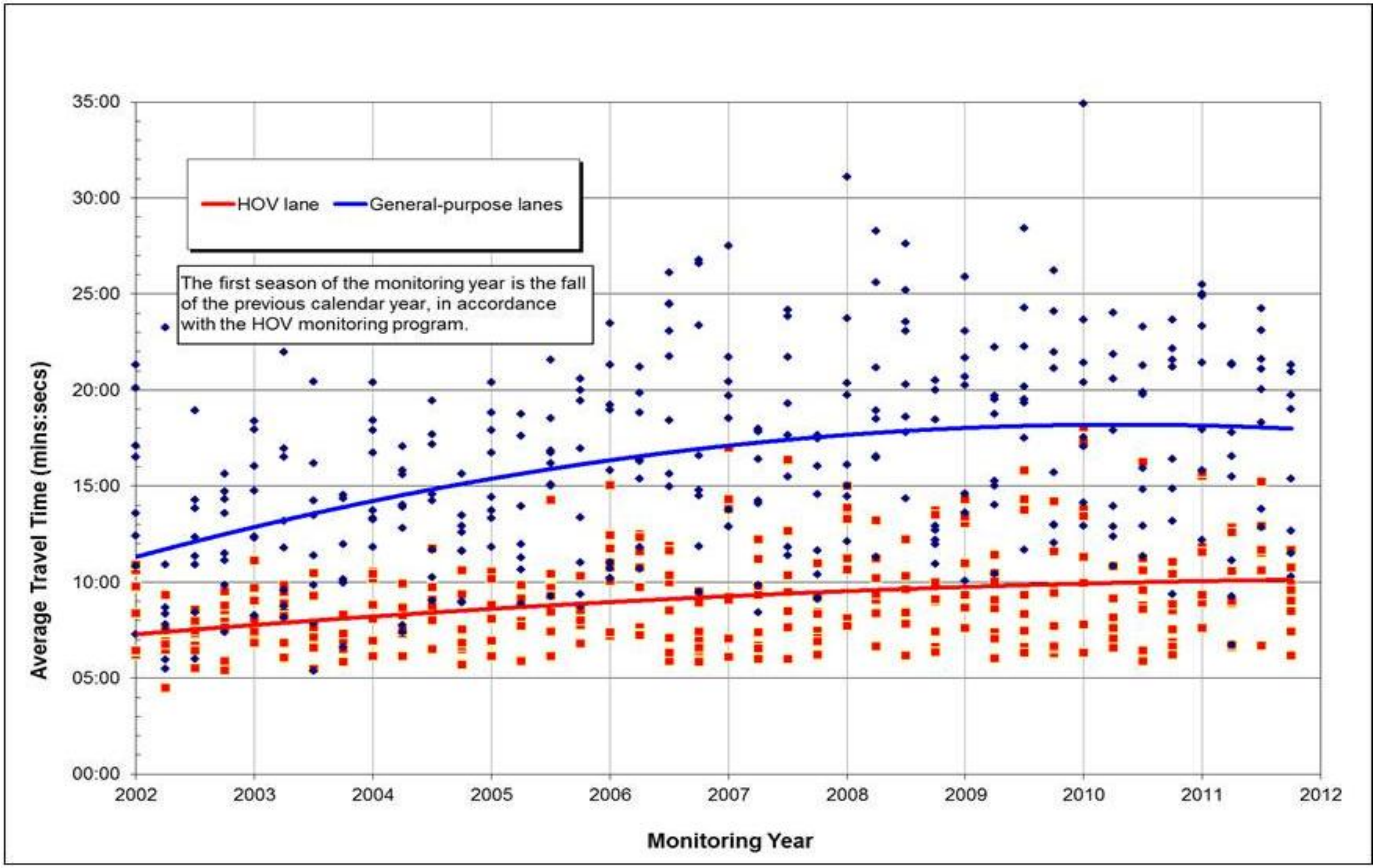

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FIGURE 4-19
Southeast Expressway Travel Times: Northbound Travel Lanes, AM Peak Period, 2002-11

Congestion Management Process

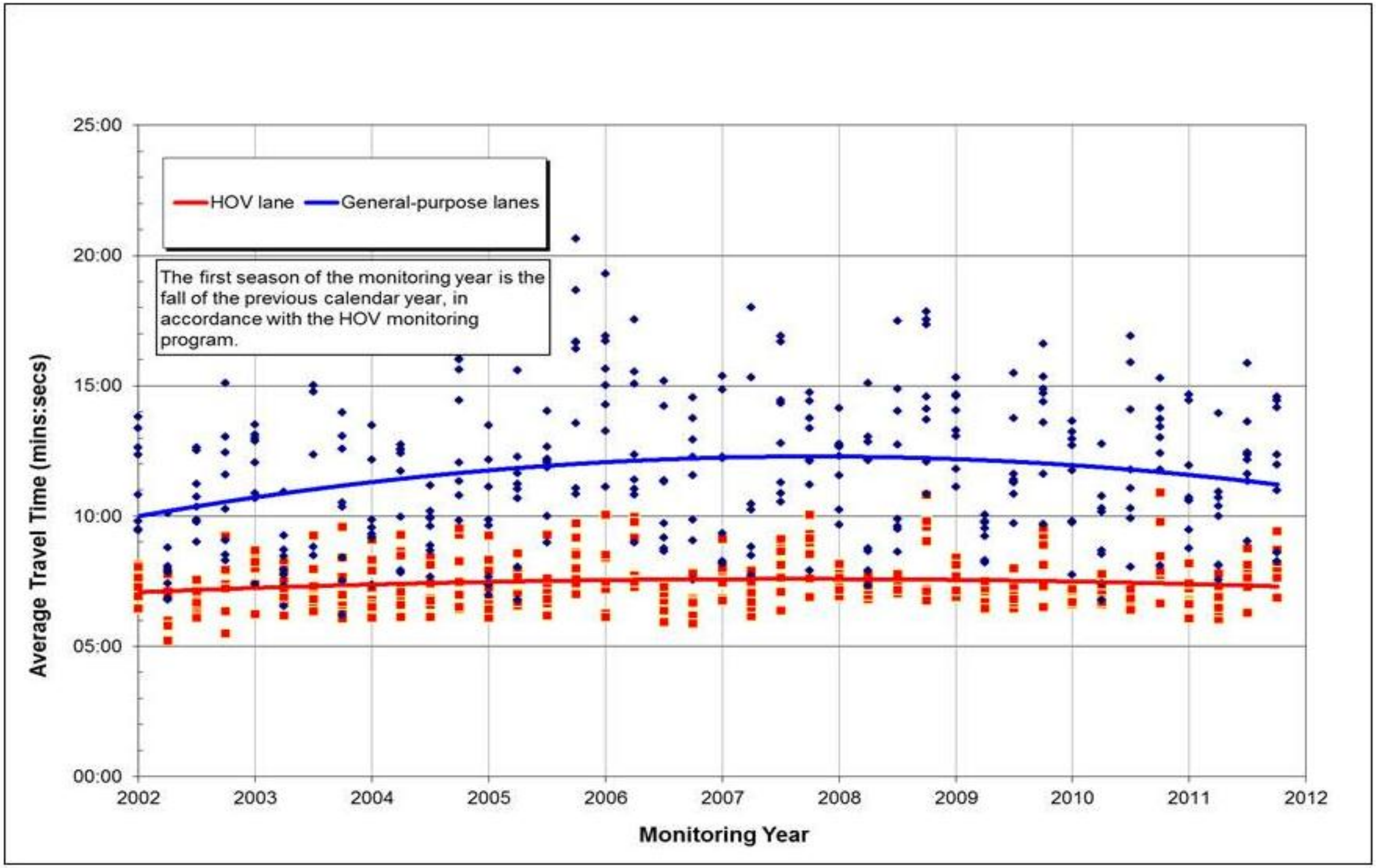

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FIGURE 4-20
Southeast Expressway Travel Times: Southbound Travel Lanes, PM Peak Period, 2002-11

Congestion Management Process

Vehicle Volumes and Occupancy Levels

MPO staff and MassDOT Highway Division staff also collect vehicle-occupancy data by lane. This effort takes place during the spring and fall and is carried out only for the AM hours of operation. The vehicle-occupancy counts are not conducted for the Southeast Expressway's southbound HOV lane or for its general-purpose lanes during the PM hours of operation because, typically, the amount of daylight does not allow for it when this collection takes place in the spring and fall quarter. For most vehicles smaller than a microbus, data collectors count persons, up to five. Since occupancy of large buses, microbuses, and police, fire, and emergency-medical-services vehicles is difficult to count accurately, data collectors simply tally the number of vehicles in each of these categories without counting passengers.

I-93 North: Southbound HOV Lane and General-Purpose Lanes

Table 4-2 presents the total number of vehicles and persons, average vehicle occupancy levels, number of persons per hour per lane, and other data for the I-93 North HOV lane and general-purpose lanes.

- Between 2006 and 2009, the average volume of vehicles in the general-purpose lanes was 1,617 to 1,689 vehicles per hour per lane. The average vehicle occupancy level in the general-purpose lanes remained fairly constant between 2004 and 2011 (between 1.08 and 1.13).
- The HOV lane was more efficient than the general-purpose lanes, as it carried more persons per hour per lane (16% more persons per hour per lane than the general-purpose lanes in 2011).

Southeast Expressway: Northbound HOV Lane and General-Purpose Lanes

The total number of vehicles and persons, average vehicle occupancy levels, persons per hour per lane, and other data are given for the HOV lane and general-purpose lanes of the Southeast Expressway in Table 4-3.

From 2005 through 2011, the average vehicle occupancy levels for the HOV lane were 2.71 to 2.84 persons per vehicle, and there was no noticeable trend emerging from these values. For the same period, the average vehicle occupancy level for the general-purpose lanes was 1.05 to 1.12 persons per vehicle.

Southeast Expressway: Southbound HOV Lane and General-Purpose Lanes

Vehicle occupancy counts are not conducted for the PM hours of operations on the Southeast Expressway; therefore, vehicle occupancy analysis was not performed for the Southeast Expressway southbound HOV lane or general-purpose lanes.

Non-HOV Occupancy Counts

In the federal fiscal year 2011 Unified Planning Work Program (UPWP), the CMP work program was updated to include monitoring of vehicle occupancies at certain locations where there are currently no HOV lanes. The purpose of this monitoring is to provide data for future HOV system planning and other transportation-demand-management work. Vehicle occupancy data collection took place between June 15 and July 7, 2010, at seven locations:

- Route 3 South, northbound, between Exits 15 and 16 in Weymouth
- Route 24, northbound, near the I-93 ramps in Randolph
- Route 24, southbound, near the I-93 ramps in Randolph
- I-90, eastbound, between Exits 13 and 14 in Natick
- I-95 North, northbound, between Exits 30A and 30B in Lexington
- I-93 North, northbound, between Exits 41 and 42 in Wilmington
- I-93 North, southbound, between Exits 41 and 42 in Wilmington

Table 4-4 summarizes and analyzes the results from the occupancy counts.

TABLE 4-2
Historical Vehicle Counts: I-93 North, Southbound, AM Peak Period (6:00 AM–10:00 AM)

Year	Facility	Total Vehicles	Total Persons	Vehicles per Hour per Lane	Persons per Lane	HOV Lane Efficiency Rate*	Persons per Vehicle
2004	HOV	2,300	7,015	575	1,754	1.21	3.05
	General	10,291	11,556	1,286	1,445		1.12
	All	12,591	18,571	1,049	1,548		1.47
2005	HOV	2,669	8,017	667	2,004	1.24	3
	General	11,746	12,888	1,468	1,611		1.1
	All	14,415	20,905	1,201	1,742		1.45
2006	HOV	2,820	8,022	705	2,005	1.1	2.84
	General	13,007	14,568	1,626	1,821		1.12
	All	15,827	22,589	1,319	1,882		1.43
2007	HOV	2,989	8,372	747	2,093	1.14	2.8
	General	12,934	14,640	1,617	1,830		1.13
	All	15,923	23,012	1,327	1,918		1.45
2008	HOV	3,090	8,545	772	2,136	1.13	2.77
	General	13,512	15,164	1,689	1,896		1.12
	All	16,602	23,709	1,383	1,976		1.43
2009	HOV	2,982	8,347	745	2,087	1.19	2.8
	General	12,980	14,062	1,623	1,758		1.08
	All	15,962	22,409	1,330	1,867		1.4
2010	HOV	2,920	7,599	730	1,900	1.23	2.6
	General	11,066	12,403	1,383	1,550		1.12
	All	13,986	20,002	1,166	1,667		1.43
2011	HOV	3,192	8,876	798	2,219	1.16	2.78
	General	13,410	15,255	1,676	1,907		1.14
	All	16,602	24,131	1,383	2,011		1.45

* HOV lane efficiency rate = Persons per hour per HOV lane divided by persons per hour per general-purpose lane, multiplied by 100.

TABLE 4-3
Historical Vehicle Counts: Southeast Expressway, Northbound, AM Peak Period (6:00 AM–10:00 AM)

Year	Facility	Total Vehicles	Total Persons	Vehicles per Hour per Lane	Persons per Hour per Lane	HOV Lane Efficiency Rate*	Persons per Vehicle
	HOV	3,898	10,769	975	2,692	1.7	2.76
2005	General	22,688	25,367	1,418	1,585		1.12
	All	26,586	36,135	1,329	1,807		1.36
	HOV	4,156	10,954	1,039	2,738	2.28	2.64
2006	General	18,237	19,215	1,140	1,201		1.05
	All	22,393	29,937	1,120	1,497		1.34
	HOV	4,104	11,229	1,026	2,807	2.02	2.74
2007	General	20,301	22,204	1,269	1,388		1.09
	All	24,405	33,432	1,220	1,672		1.37
	HOV	3,559	9,855	890	2,464	1.73	2.77
2008	General	21,004	22,751	1,313	1,422		1.08
	All	24,563	32,606	1,228	1,630		1.33
	HOV	3,925	10,630	981	2,658	1.81	2.71
2009	General	21,779	23,515	1,361	1,470		1.08
	All	25,704	34,145	1,285	1,707		1.33
	HOV	4,030	11,455	1,008	2,864	2.16	2.84
2010	General	19,383	21,169	1,211	1,323		1.09
	All	23,413	32,623	1,171	1,631		1.39
	HOV	4,568	12,420	1,142	3,105	2.42	2.72
2011	General	18,528	20,547	1,158	1,284		1.11
	All	23,096	32,967	1,155	1,648		1.43

* HOV lane efficiency rate = Persons per hour per HOV lane divided by persons per hour per general-purpose lane, multiplied by 100.

TABLE 4-4
Non-HOV-Lane Occupancy Counts: Summary, Summer 2010 Monitoring

Location	Direction of Traffic	Date of Data Collection	Time of Data Collection	Number of Lanes	Total Vehicles	Total Persons	Average Weighted Vehicle Occupancy	Fraction of Vehicles with 1 Person	Fraction of Vehicles with 2 Persons
Route 3	Northbound	June 15, 2010	7:00–9:00 AM	3	5,965	7,279	1.22	0.88	0.1
Route 24	Northbound	July 7, 2010	7:00–9:00 AM	3	9,112	11,284	1.24	0.84	0.12
Route 24	Southbound	June 29, 2010	4:00–6:00 PM	3	11,078	14,384	1.3	0.8	0.17
I-90	Eastbound	June 23, 2010	7:00–9:00 AM	3	9,208	10,912	1.19	0.88	0.11
I-95	Northbound	June 22, 2010	4:00–6:00 PM	4	10,376	11,794	1.14	0.91	0.08
I-93	Northbound	July 7, 2010	4:00–6:00 PM	4	12,843	15,936	1.24	0.83	0.12
I-93	Southbound	June 29, 2010	7:00–9:00 AM	4	11,630	12,858	1.11	0.93	0.06

PUBLIC TRANSIT

Using data from the U.S. Census Bureau's 2006–10 American Community Survey (ACS), CTPS staff estimated that approximately 16% of residents of the Boston Region MPO area commute to work via some form of public transit; this is slightly higher (by 1 percentage point) than the transit mode share for 2000 given in the census for that year. Of all work trips within the MPO region, 62% have destinations in Boston and Cambridge; 39% of all trips destined to the urban core are made by transit.[4] Based on the 2010 census figures, approximately 56% of the population in the MPO region lives within walking distance of MBTA transit service.[5]

This chapter provides performance data on the bus, rapid transit, and commuter rail services that have been collected by CTPS's Transit Service Planning Group and the MBTA. The data reported in this chapter are taken from service planning efforts that include data collection, monitoring, and assessment that support the MBTA's biennial service plans, in addition to its Capital Investment Program, Program for Mass Transportation (the MBTA's long-range plan), and other ongoing service planning evaluations.

The established performance measures used by the CMP with regard to public transit are on-time performance and passenger crowding.

System Ridership

According to the most recent data, the MBTA system provides, on average, slightly more than 1.2 million total passenger trips each weekday: about 711,800 on the rapid transit system, 368,100 on the bus system, 129,400 on the commuter rail system, and 4,372 on commuter ferries .[6,7] Figure 4-21 shows the total annual MBTA system

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4 As stated in the Program for Mass Transportation (PMT), prepared by the Central Transportation Planning Staff for the Massachusetts Bay Transportation Authority (MBTA), December 2009, p. G-8.

5 Walking distance to transit (used to identify the potential transit market area) is defined as a distance of 1/2 mile or less from a rail station and 1/4 mile or less from a bus stop. Population is based on the 2010 U.S. census.

6 American Public Transportation Association, *APTA 2011 Q3 Ridership Report,* December 2011.

7 Massachusetts Bay Transportation Authority, "Ridership and Service Statistics," thirteenth edition, 2010.

ridership for rapid transit, bus, and commuter rail from 2002 to 2011. [8,9] The subsequent figures show a more detailed view of ridership trends for each mode in the MBTA system. During the period shown, overall system ridership was lowest in 2002 (with slightly under 342 million total trips provided) and peaked in 2004 (with over 392 million total trips). Total commuter rail ridership was highest in late 2008, and steadily decreased to levels significantly lower than in the years leading up to 2008 (see Figure 4-22). Rapid transit ridership was lowest in 2002–04 and has generally remained high since then (see Figure 4-23). Bus ridership peaked in 2004, with over 12 million trips per month, and has remained near or below 11 million trips per month since 2005 (see Figure 4-24). Commuter boat ridership has remained fairly stable but exhibits distinct seasonal patterns, with higher ridership in the summer months (see Figure 4-25). Rail and bus ridership also exhibit seasonal patterns, with lower ridership in the winter months, but these patterns are less consistent.

[8] Data source: National Transit Database, “Monthly Module Adjusted Data Release" (accessed June 30, 2011). The figures represent the total number of unlinked passenger trips. Bus ridership includes both directly operated and third-party-operated MBTA services, as well as bus rapid transit and trackless trolleys. Demand-response ridership and boat ridership are excluded because the totals are too low to represent visually in the same chart.

[9] Boston Region MPO’s definition of an unlinked trip: the number of passengers who board public transportation vehicles. When a count is conducted to ascertain this number, passengers are counted each time they board a vehicle no matter how many vehicles they use to travel from their origin to their destination. An unlinked trip is any segment of a linked trip.

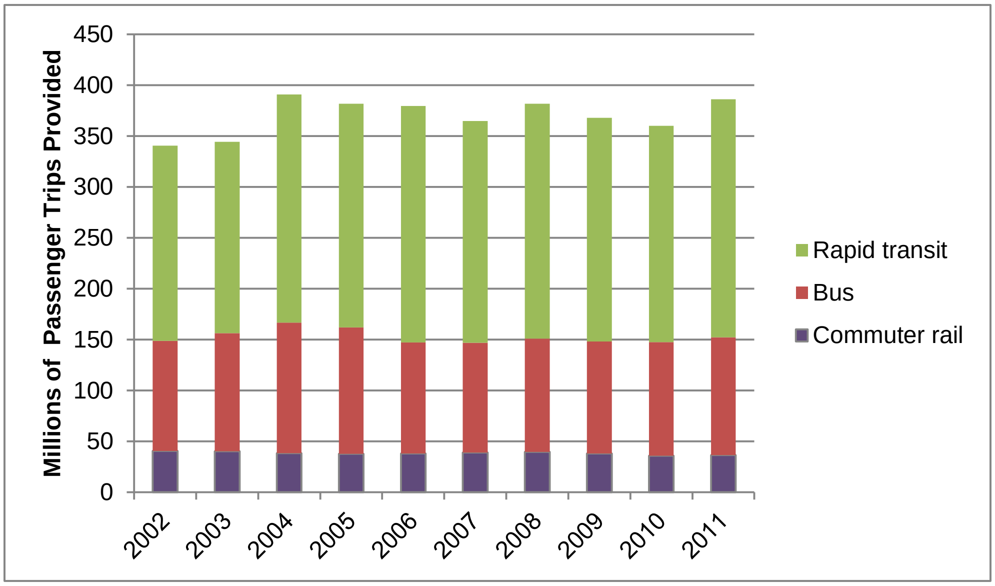


FIGURE 4-21
MBTA System Ridership, 2002–11

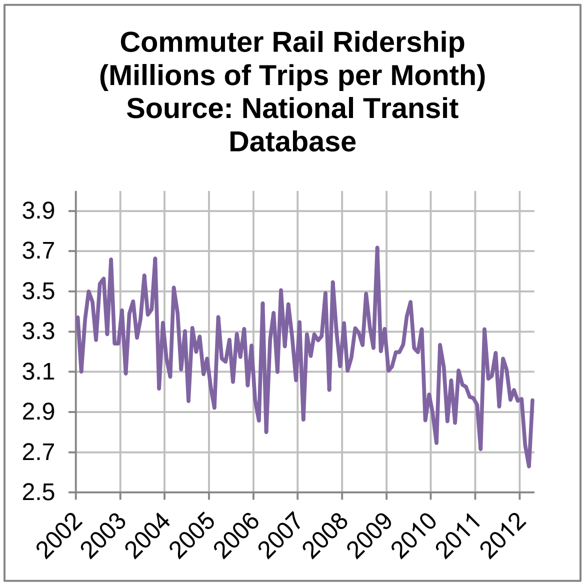


Figure 4-22
Commuter Rail Ridership
2002–12

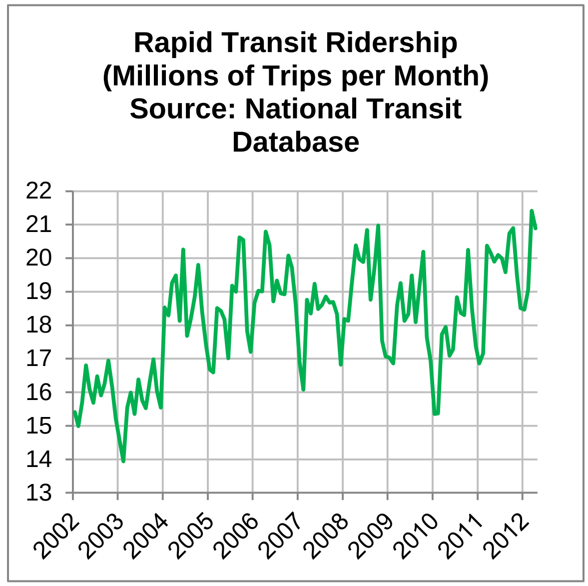


Figure 4-23
Rapid Transit Ridership
2002–12

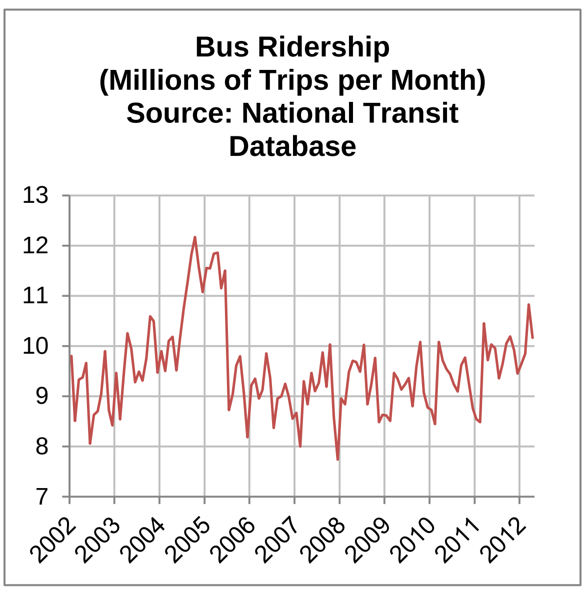


Figure 4-24
Bus Ridership
2002–12

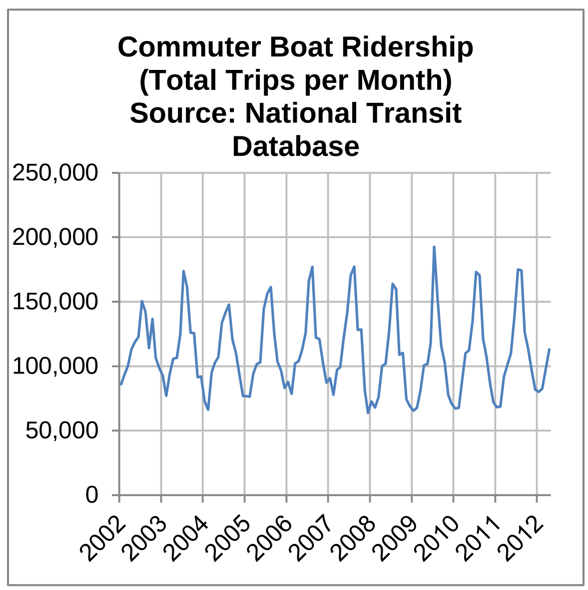


Figure 4-25
Commuter Boat Ridership
2002–12

Specific Transit Performance Measures Methodology

On-Time Performance (Schedule Adherence)

All of the on-time performance (schedule adherence) measures are established by the MBTA.[10] The measures used by the CMP are:

- A commuter train is considered on time if it arrives five minutes or less after the scheduled arrival time. A commuter rail line is considered to be on time if 95% of train trips met this criterion. *(MBTA performance measure)*
- A commuter boat is considered on time if it arrives five minutes or less after the scheduled arrival time. A commuter boat route is considered to be on time if 95% of boat trips met this criterion. *(MBTA performance measure)*
- A rapid transit (light rail or heavy rail) train is considered on time if it leaves the first station on the line within 1.5 times the scheduled interval between trains (a headway of at most 150%). Rapid transit trains and Green Line trains on the Central Subway (from Lechmere to Copley) are considered to be on time if 95% of trips met this criterion. Surface Green Line trains are considered to be on time if 85% of trips met this criterion. *(MBTA performance measures)*
- For MBTA bus routes, the standard used for measuring on-time performance has two parts, as described below. The first part of the standard (the bus timepoint tests) generates information that is used by the second part of the standard (the bus route test) to determine whether or not a bus route is considered on time. *(MBTA performance measures)* Bus Timepoint Tests: To determine whether a bus is on time at an individual timepoint after the beginning of a route, such as the end of a route, or scheduled point in between, the MBTA uses two different tests based on service frequency:
    - Scheduled Departure Service: A route is considered to provide scheduled departure service for any part of the day in which it operates less frequently than one trip every 10 minutes (headway greater than 10 minutes). For scheduled departure services, customers generally time their arrival at bus stops to correspond with the specific scheduled departure times. Using the bus timepoint test for scheduled departure service, a trip must leave its origin timepoint within 3 minutes after the scheduled departure time, leave its mid-timepoint within 7 minutes of the scheduled departure time, and arrive at its destination between 3 minutes and 5 minutes after the scheduled arrival time. The CMP does not factor in scheduled departure service into on-time performance because the objective of on-time

[10] MBTA 2010 Service Delivery Policy, available on the MBTA's website, www.mbta.com (accessed June 24, 2011).

performance as a CMP performance measure is to measure the congestion that a bus would experience while in transit.

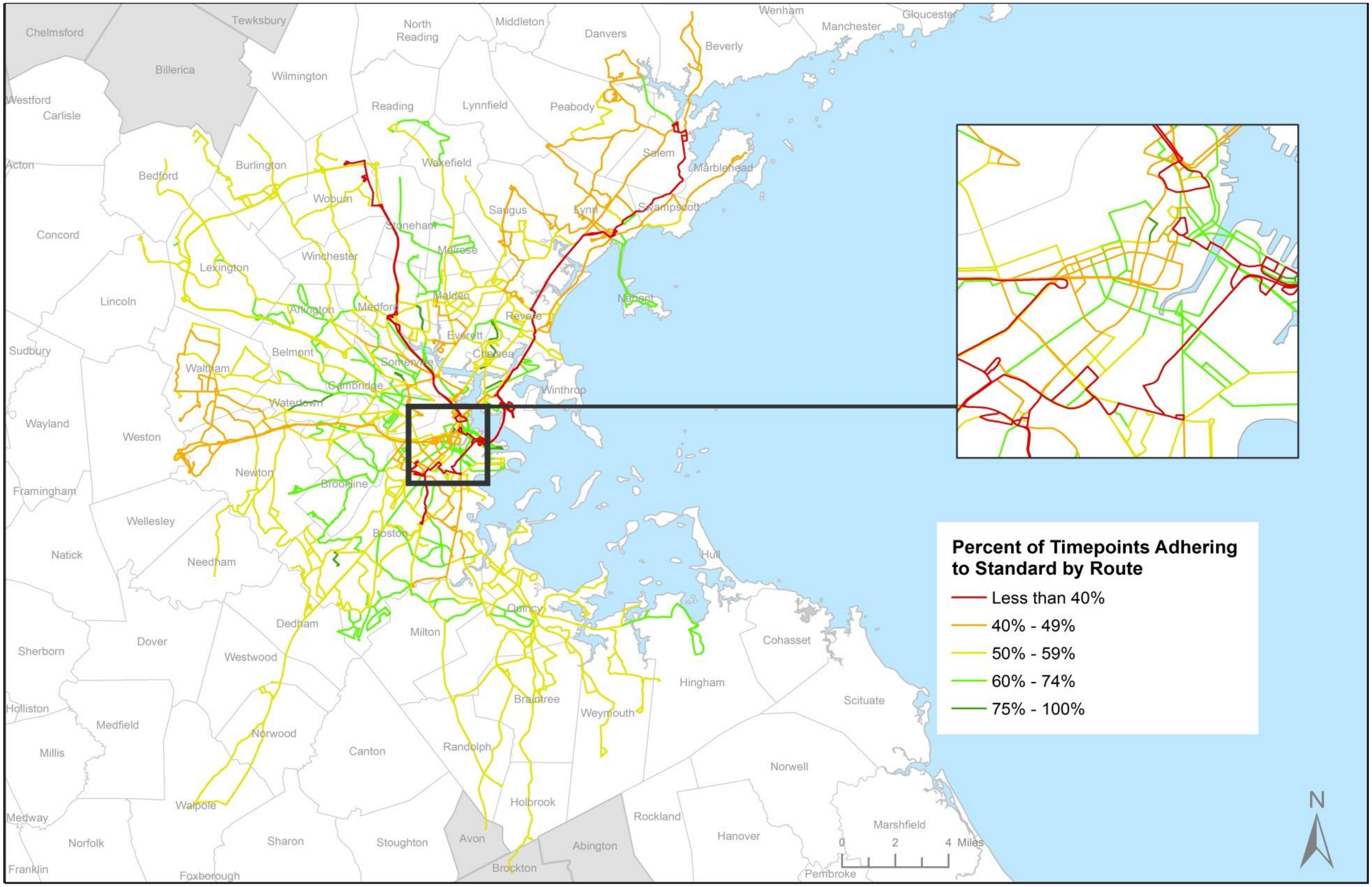
- Walk-Up Service: A route is considered to provide walk-up service for any part of the day in which it operates every ten minutes or oftener (headway less than or equal to 10 minutes). For walk-up service, customers can arrive at a stop without looking at a schedule and expect only a brief wait. Using the bus timepoint test for walk up service, a trip must arrive at the destination timepoint within 20 percent of the scheduled run time.

- Bus Route Test: The second part of the bus on-time performance standard determines whether or not a route is on time by measuring the proportion of timepoints on the routes that are on time. Using the bus route test, over the entire service day, 75 percent of all timepoints on the route must pass their timepoint tests to be considered on time.

Buses

In 1996, CTPS began an ongoing comprehensive manual ridecheck program to collect ridership and schedule adherence data for all MBTA bus routes. In late 2007, the MBTA began to acquire buses that are equipped with automated passenger counters (APCs). Until sufficient buses with APC equipment are fully deployed and functional throughout the bus system, a combination of APC data and existing ridecheck data will be used to determine vehicle loads. The MBTA expects that they will soon be able to use only vehicle load data that are collected using the APCs. CTPS currently augments the APC and ridecheck data with manual pointchecks.

Figure 4-26 shows the MBTA’s routes color-coded by the percentage of timepoints that met the bus route timepoint test.



BOSTON REGION MPO

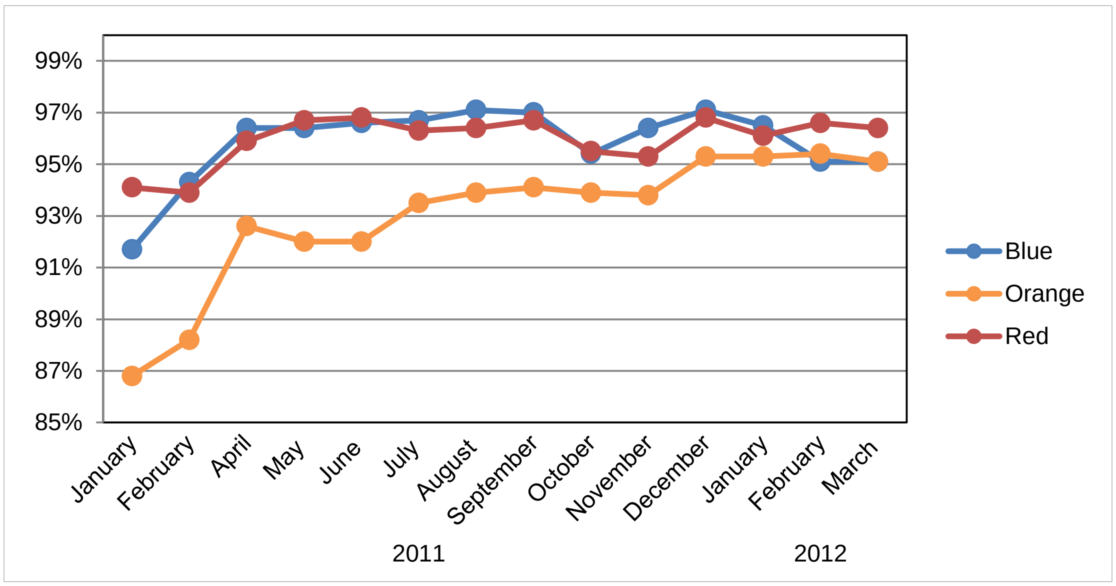
FIGURE 4-26
On-Time Performance (Schedule Adherence)
2010

Congestion Management Process

Heavy Rail

Figure 4-27 shows the percentage of trips in the heavy rail system that were on time (within 150% of the scheduled headway) from January 2011 to March 2012. On average, 95.6% of Blue Line trains, 91.3% of Orange Line trains, and 95.7% of Red Line trains were on time during that period.

Figure 4-27
Heavy Rail: Percent of Trips Operating on Time, January 2011–March 2012



Light Rail

On-time performance data for the Green Line trains (the Mattapan line does not have an AVI detector) are collected using MBTA AVI (automatic vehicle identification) detectors. The Mattapan line on-time performance data is collected through staff ridechecks. Table 4-5 shows the percentage of light rail trips that met the on-time performance threshold (within 1.5 times of the scheduled headway, as described above) for each light rail line in the MBTA system. The Mattapan High-Speed Line and the outbound B Branch (west of Kenmore Station) of the Green Line did not meet the 85% performance threshold; the other lines met the threshold.[11]

[11] For details regarding the on-time performance threshold for light rail, see Performance Measures. For Green Line trains, AVI detector data from 3/8/2011 were used; for the Mattapan Line, data were provided by a CTPS pointcheck at Ashmont Station on March 8, 2011. Data for the Mattapan High-Speed Line in the outbound direction were not collected. Data for the E Branch of the Green Line were collected at Copley Square Station.

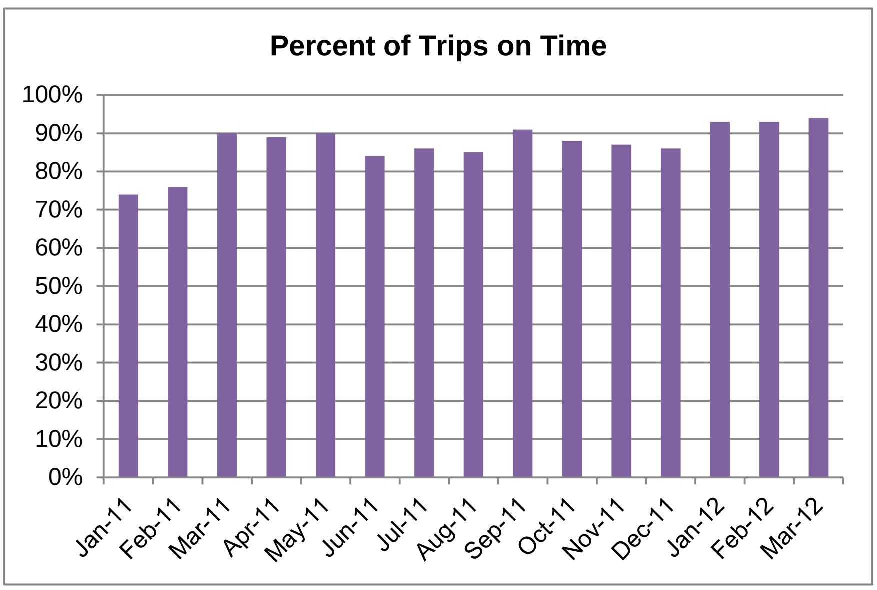
TABLE 4-5
Light Rail: Percent of Trips Operating on Time, March 2011

Line	Inbound	Outbound	All Trips
Green Line: B	90%	81%	85%
Green Line: C	90%	87%	89%
Green Line: D	90%	86%	87%
Green Line: E	87%	92%	89%
Mattapan High-Speed Line	81%	no data	81%

Commuter Rail

Figure 4-28 shows the percentage of commuter rail trips, throughout the entire system that operated on time (within five minutes of the scheduled arrival time) from January 2011 through March 2012. Table 4-6 shows the percentage of trips that operated on time for each line in December 2011, February 2012, and March 2012.[12]

Figure 4-28
Commuter Rail: Percent of Trips Operating on Time (Entire System), January 2011–March 2012



[12] Data source: MBTA monthly "ScoreCards," available on the MBTA's website, www.mbta.com (last accessed July 4, 2011). Data for November 2010 and March 2011 were not available.

TABLE 4-6
Commuter Rail: Percent of Trips Operating on Time, December 2011, February 2012, and March 2012

Line	Dec. 2011	Feb. 2012	Mar. 2012
Fairmount	97%	98%	96%
Fitchburg	90%	88%	87%
Franklin	95%	96%	96%
Greenbush	98%	99%	97%
Haverhill	94%	95%	94%
Kingston/Plymouth	96%	99%	99%
Lowell	94%	97%	96%
Middleborough	95%	99%	97%
Needham	94%	97%	94%
Newburyport	89%	93%	91%
Providence	88%	91%	91%
Rockport	87%	84%	84%
Providence/Stoughton	93%	96%	94%
Worcester	95%	96%	96%

Commuter Boat

The commuter boat routes have good on-time performance. Table 4-7 displays the percentages of on-time arrival for commuter boats in the region. All routes performed better than the schedule adherence standard (95% of trips on time) by at least 2% between January 2011 and April 2011.[13]

TABLE 4-7
Commuter Boat: Percent of Trips Operating on Time, January–April 2011

Commuter Boat Route	Percentage of Weekday Trips on Time
F1: Boston – Hingham	98%
F2/F2H: Boston – Quincy/Hull/Logan Airport	97%
F4 Inner Harbor Ferry: Boston – Charlestown	100%

[13] MBTA, Final 2008 Service Plan, p. 49, 2008.

Passenger Crowding

Passenger crowding is measured in terms of the ratio of the number of passengers to the number of seats on the vehicle. A value at or above the established threshold indicates crowded conditions. For purposes of identifying mobility concerns, CMP staff use the MBTA thresholds for passenger crowding, which are set forth in the 2010 Service Delivery Policy.[14] The passenger load thresholds are summarized in Table 4-8.

[14] MBTA, 2010,Service Delivery Policy, p. 14.

TABLE 4-8
Passenger Loads: MBTA Thresholds

			Crowding Threshold (Passengers per Seat)	
Service Type	**Seats per Vehicle/Car/ Vessel**	**Area**	**Early AM, AM Peak, Midday School, & PM Peak**	**Midday Base, Evening, Late Evening, Night/Sunrise, & Weekends**
Bus	31–57 (depending on model)	Surface routes	1.40	1.00
		Tunnel portions of BRT routes	1.40	1.40
Green Line	44–46 (depending on model)	Core Area	2.25	1.40
		Surface	2.25	1.00
Mattapan (High-Speed Line)	40	(All)	2.10	2.10
Blue Line	42	Core Area	2.25	1.40
		Outside Core Area	2.25	1.00
Orange Line	58	Core Area	2.25	1.40
		Outside Core Area	2.25	1.00
Red Line: #1 and #2 cars	62–63 (depending on model)	Core Area	2.70	1.40
		Outside Core Area	2.70	1.00
Red Line: #3 cars	50	Core Area	3.34	1.74
		Outside Core Area	3.34	1.00
Commuter Rail	94–185 (depending on model)	(All)	1.10	1.00
Boat	149–400 (depending on model)	(All)	1.00	1.00

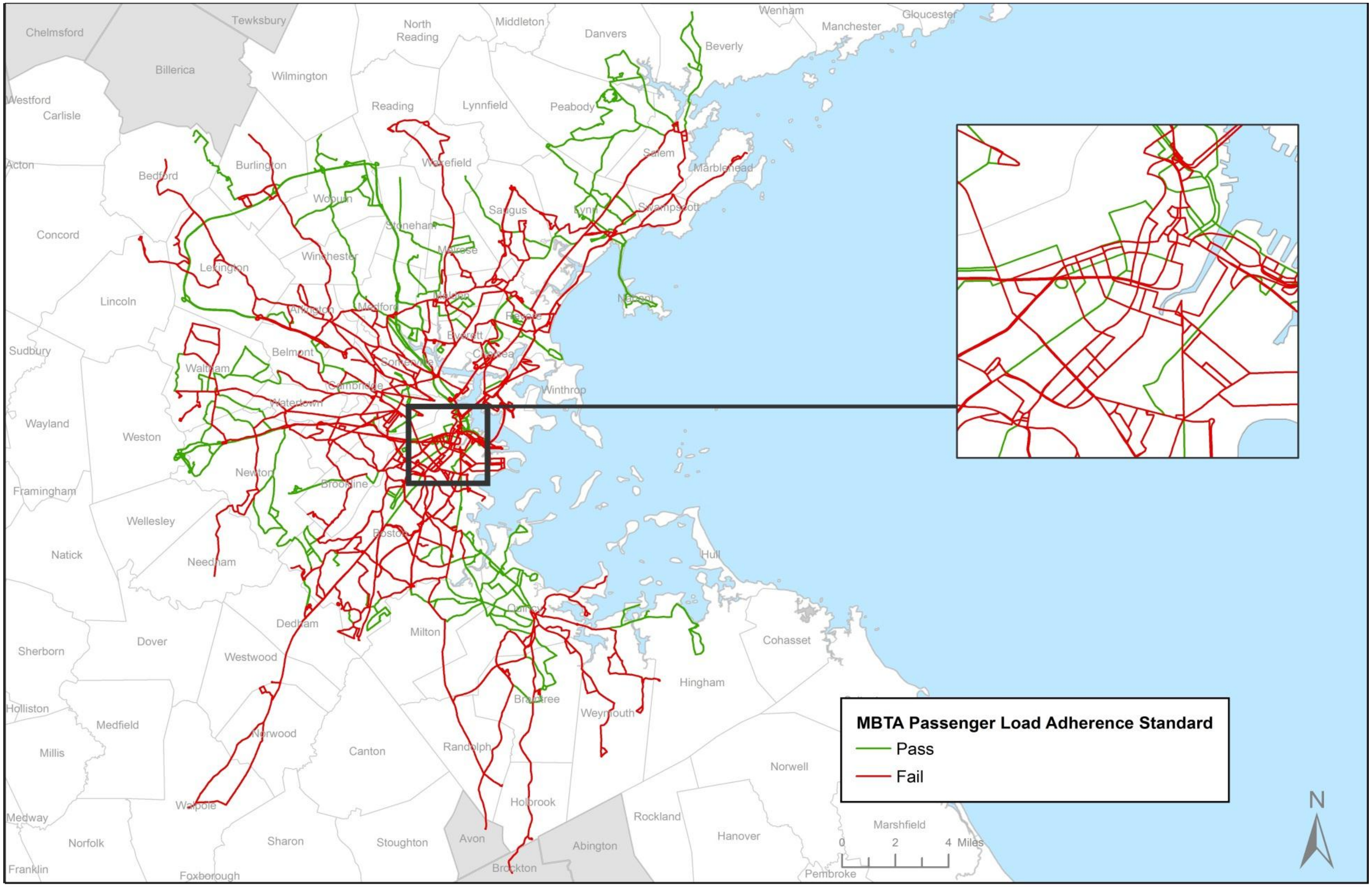
Buses

For buses (including bus rapid transit and trackless trolley routes), the passenger crowding threshold is 1.40 passengers per seat during peak periods. Passenger load data are collected through a combination of CTPS ridechecks (onboard observations by CTPS staff) and APC data from MBTA vehicles. Each MBTA bus route is indicated as having passed or failed the passenger load standards for the weekday, Saturday, and Sunday monitoring times. Figure 4-29 displays the MBTA bus routes that either passed or failed the passenger load standards on any day of the week.

Rapid Transit

The most recently available load data for the rapid transit system are contained in the MBTA's 2008 Service Plan.[15] Only pass/fail data are available. These are summarized in Table 4-9. The lines that have excessive passenger loads include the Blue Line, the Green Line's B, C, and D branches in the evenings, and the Green Line's B and D branches and Red Line in midday.

[15] MBTA. 2008. Final 2008 Service Plan, p. 49 (accessed July 11, 2011).



BOSTON REGION MPO

FIGURE 4-29
Passenger Load Adherence for MBTA Bus Routes
2011

Congestion Management Process

TABLE 4-9
Passenger Loads: Rapid Transit

Line	Area	Early AM	AM Peak	Midday Base	Midday School	PM Peak	Evening	Late Evening
Blue	Core	Pass	Pass	Pass	Pass	Pass	**Fail**	**Fail**
	Non-core	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Orange	Core	Pass	Pass	Pass	Pass	Pass	Pass	Pass
	Non-core	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Red (Ashmont)	Non-core	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Red (Braintree)	Non-core	Pass	Pass	**Fail**	Pass	Pass	Pass	Pass
Red (main)	Core	Pass	Pass	Pass	Pass	Pass	Pass	Pass
	Non-core	Pass	Pass	**Fail**	Pass	Pass	Pass	Pass
Green (subway)	Core	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Green (B)	Core	Pass	Pass	Pass	Pass	Pass	Pass	Pass
	Non-core	Pass	Pass	**Fail**	Pass	Pass	**Fail**	**Fail**
Green (C)	Core	Pass	Pass	Pass	Pass	Pass	Pass	Pass
	Non-core	Pass	Pass	Pass	Pass	Pass	**Fail**	Pass
Green (D)	Core	Pass	Pass	Pass	Pass	Pass	Pass	Pass
	Non-core	Pass	Pass	**Fail**	Pass	Pass	**Fail**	**Fail**
Green (E)	Core	Pass	Pass	Pass	Pass	Pass	Pass	Pass
	Non-core	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Mattapan High-Speed Line	Non-core	Pass	Pass	Pass	Pass	Pass	Pass	Pass

Commuter Rail

Table 4-10 shows the average and maximum passenger loads on peak-period commuter trains, as observed in the fall of 2010. Only the Lowell Line violated the MBTA vehicle load standard for commuter rail, and only in the PM peak period. All of the other lines met the standard.

TABLE 4-10
Passenger Loads: Commuter Rail, AM and PM Peak Periods, Fall 2010

Line	Average Passengers per Seat (All Peak Trains)	Maximum Passengers per Seat (AM-Peak Trains)	Maximum Passengers per Seat (PM-Peak Trains)
Fairmount	.09	.16	.15
Fitchburg	.71	.97	.96
Franklin	.66	.87	.93
Greenbush	.47	.70	.56
Haverhill	.66	.97	.92
Lowell	.67	.92	1.12
Needham	.52	.74	.74
Newburyport/Rockport	.73	1.05	.93
Old Colony	.52	.77	.69
Providence	.77	.96	.98
Stoughton	.68	.82	.91
Worcester	.72	.87	1.00

Commuter Boat

Table 4-11 displays the commuter boat passenger-load data that was collected in July 2008. All three MBTA-monitored commuter boat routes have a PM maximum passenger load of 95% or above; however, all AM and PM average passenger loads for all commuter boat routes are less than 26%. If a commuter boat is filled to capacity on a given trip, the extra passengers must wait for the next departing boat to complete their trip.

Table 4-11
Passenger Loads: Commuter Boat,
AM and PM Peak Periods, July 2008

Commuter Boat Line	AM Average Passenger Load	PM Average Passenger Load	AM Maximum Passenger Load	PM Maximum Passenger Load
F1 Boston (Rowes Wharf-Hingham)	.23	.22	.84	.95
F2 Boston (Long Wharf-(Quincy/Hull/Logan)	.18	.26	.76	1.00
F4 Boston - Charlestown	.07	.20	.29	1.00

PARK-AND-RIDE LOTS[16]

The CMP staff conducts regular inventories of park-and-ride lots at MBTA commuter rail, commuter boat, rapid transit, and express bus stations. Inventories were conducted in 2000, 2002, 2005–06, and 2009–10. For each station, detailed information is recorded, including: general, disability, and bicycle parking capacity and utilization; parking fee payment methods; pedestrian and bicycle access to the station; station accessibility for individuals with disabilities; and amenities such as shelters and benches.

The tables in this section show the results of the most recent park-and-ride lot survey in detail. Results relating to bicycle parking are summarized in the section on Bicycle and Pedestrian Facilities in System Performance Monitoring.

Park-and-Ride Lot Performance Measures

The performance measures used for assessing park-and-ride lots are *percent lot utilization* and the *observed time that a lot fills up*.

Lot Utilization

The CMP classifies lot utilization results for each station into one of three categories:

- Full – 85% or more of the general spaces (as opposed to disability spaces) are typically filled.
- Partially full – 50% to 85% of the general spaces are filled; the lot is well utilized, but there would still be spaces available if demand were to increase.
- Underutilized – Less than 50% of the general spaces are filled.

A *mobility concern* is defined as a situation where a lot is full or underutilized according to the above definitions. (Note: Several stations are served by more than one lot; in such cases, the available parking for all lots, regardless of owner [for example, MBTA, private, or town ownership], is combined into one utilization measure.)

Data Collection Method

The most recent inventory of park-and-ride lots was conducted during the morning peak period of a typical weekday between January 2009 and August 2010.[17] Previous

[16] Resident-only parking at a station is municipally owned, and its use is restricted to residents of the municipality that owns the parking facility. Resident-only parking is excluded from all totals and utilization percentages.

inventories were conducted in 2000, 2002, and 2005–06. The types of data collected included the parking lot's ownership, parking cost and restrictions, number of parking spaces, number of occupied spaces, the time at which all the parking spaces became occupied (if this occurred before the end of the peak period), commuter amenities at the station, accessibility to the station, accessibility to the platform, and bicycle and pedestrian amenities at and around the station.

Surveyors were instructed to stay at each parking lot until it was full or until the end of the AM peak period, whichever occurred first. This varied by station. After the parking lot filled or after the last AM-peak-period train, the surveyor inventoried the parking lot and filled in all the questions on the survey form. A separate survey form was filled out for each parking lot, as some stations have more than one lot. In this way, it is known at what time each individual parking lot filled.

All park-and-ride lots that are known to serve commuters on the MBTA system were inventoried (lots serving only commuters who use non-MBTA transportation were not surveyed). This includes all MBTA, private, and town-owned lots at all commuter rail, rapid transit, and commuter boat stations, and origin locations of all express buses. The locations of these lots were ascertained from past inventories, information provided on the MBTA's website, and anecdotal information provided by MBTA and CTPS staff.

Parking utilization was defined for this survey as the percentage of public non-disability parking spaces used by the end of the MBTA-defined AM peak period. All of the parking spaces referred to in this chapter are public non-disability spaces, unless otherwise indicated.

Many stations have permit-only parking lots in addition to public lots. Permit parking lots are either municipally or privately owned, and their use is restricted to permit holders; in many cases, local residency is required in order to secure a permit.

This collection and evaluation method that the Boston Region MPO uses to collect park-and-ride utilization rates differs from the MBTA's collection method. The MBTA collects utilization rates based on parking revenue for an entire day, in which the rates are averaged out for one month per year. Once the number of vehicles parked is calculated, the utilization rates for each MBTA lot is increased five percent for contingency

[17] The survey for each lot was a one-time observation performed on a day that was believed to be a typical working weekday. If unusual circumstances occurred on the day of observation and were known to the surveyor, the survey of that parking lot was done again. Examples of unusual circumstances include delays in MBTA service, inclement weather, construction, major events, holidays, and traffic incidents with major impacts throughout the transportation network.

purposes. The MBTA does not collect parking utilization data for any private lots near MBTA stations. Due to differences in the collection methods between the MBTA and the performance standards of the Boston Region MPO's Congestion Management Process, the park-and-ride utilization data displayed in this document may not match the data for park-and-ride lots shown on the MBTA website.

Monitoring Results

An analysis of inventory results indicated that 58% of parking at all stations combined, for all modes in the MBTA system, was utilized on a typical weekday morning. The breakdown by type of service is 56% utilization for the commuter rail system, 61% utilization for the rapid transit system, 93% utilization for express bus lots, and 69% utilization for commuter boat lots.[18] Figure 4-30 shows the park-and-ride utilization rates by individual station. Table 4-12 displays the park-and-ride utilization by commuter rail line.

[18] Some stations with parking are served by both commuter rail and rapid transit. To avoid confusion, these stations are all categorized as rapid transit stations in this inventory.

TABLE 4-12
Park-and-Ride Lot Utilization Overview for MBTA-Owned and Municipal Lots: Commuter Rail System

Commuter Rail Line(s)	Number of Parking Spaces	Percent Utilization
Lines Terminating at North Station	*9,929*	*61%*
Fitchburg Line	1,543	62%
Haverhill Line	1,832	61%
Lowell Line	3,162	82%
Newburyport/Rockport Line	3,392	40%
Lines Terminating at South Station	*23,917*	*53%*
Fairmount Line	389	34%
Framingham/Worcester Line	3,543	59%
Franklin Line	3,589	60%
Greenbush Line	2,662	37%
Kingston/Plymouth Line	3,127	51%
Middleborough/Lakeville Line	2,924	43%
Needham Line	1,122	53%
Providence/Stoughton Line	6,561	61%
Total	**33,846**	**56%**

Fitchburg Line **–** At the 15 stations on the Fitchburg Line that provide parking, no lot filled[19] during the AM peak period. There are a total of 1,543 parking spaces available for public use on the Fitchburg Line. Sixty-two percent of all parking spaces on this line were full. There are an additional 467 parking spaces on this line, all resident-only; 88% of them were used.

Haverhill Line **–** At the 12 stations on the Haverhill Line that have parking lots, no lot filled to capacity during the AM peak period. Sixty-one percent of the 1,832 parking spaces available for public use at the 12 stations were full. There are an additional 300 parking spaces, exclusively for residents of Reading, at Reading Station. Of those parking spaces, 84% were used by the end of the morning peak period. There are also 29 permit parking spaces at Bradford Station, 21 of which were occupied.

Lowell Line **–** Of the seven stations on the Lowell Line that have parking, Wedgemere was the only one whose lot filled during the AM peak period. A total of 3,162 parking spaces are available for public use on this line, and 82% of them were full. Of the 45

[19] Full or filled lots are lots with 85% or more utilization.

resident-only parking spaces at West Medford Station, 44 were in use during the AM peak period.

Newburyport/Rockport Line **–** Of the 16 stations on the Newburyport/Rockport Line that have parking lots, Ipswich was the only one whose lot was full during the AM peak period. There are 3,392 parking spaces available for public use on the Newburyport/Rockport Line, 40% of which were used.[20] There are 174 parking spaces that require parking permits at Beverly Station, 76% of which were used.[21] There are 121 permit parking spaces at Salem Station, 120 of which were used. There are an additional 16 parking spaces, all resident-only, at Swampscott Station. All of those parking spaces were full.

Fairmount Line **–** Readville[22] and Fairmount are the only two stations on the Fairmount Line that have parking. Of the 389 parking spaces, 34% filled during the AM peak period. There are no permit-only parking spaces on this line.

Framingham/Worcester Line **–** Of the 14 stations on the Framingham/Worcester Line that have parking, no lot filled during the AM peak period. Of the 3,543 parking spaces on this line, 59% filled during the AM peak period. Sixty-eight percent of the 71 resident-only parking spaces at Natick Station were in use during the AM peak period. There are an additional 68 permit parking spaces at Framingham Station, 44% of which were full.

Franklin Line **–** Of the 11 stations on the Franklin Line, Endicott was the only one whose parking lot filled completely during the AM peak period. There are 3,589 parking spaces on the Franklin Line that are available for public use, 60% of which filled during the AM peak period.[23] There are an additional 45 permit parking spaces at Franklin Station, 36 of which were full.

Greenbush Line – At the seven stations on the Greenbush Line that have parking, no lot filled during the AM peak period. There are 2,662 parking spaces available for public use, 37% of which filled during the AM peak period.

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[20] This low percentage reflects in part the very low parking rate at Lynn Station, where only 23% of the 914 available spaces were utilized.

[21] In late 2009, after the station was surveyed, a new lot was opened at Beverly Depot, with an additional 102 spaces.

[22] Readville Station is served by both the Fairmount Line and the Franklin Line. To avoid confusion, Readville is included under the Fairmount Line.

[23] These totals exclude Readville Station; see the previous note.

Kingston/Plymouth Line **–** Of the seven stations on the Kingston/Plymouth Line that have parking, no lot filled during the AM peak period. There are 3,127 parking spaces available on this line, 51% of which filled during the AM peak period. There are an additional 175 permit parking spaces at Kingston Station; 81% of these spaces were full. There is no AM-peak-period train service at Plymouth Station; all of the 96 parking spaces there were empty.

Middleborough/Lakeville Line **–** Of the six stations on the Middleborough/Lakeville Line that have parking, no lot filled during the AM peak period. There are 2,924 parking spaces available for public use; 43% filled during the AM peak period.

Needham Line **–** None of the eight station parking lots filled during the AM peak period. There are 1,122 parking spaces available for public use; 53% filled during the AM peak period.

Providence/Stoughton Line **–** At the 10 stations on the Providence/Stoughton Line that have parking, no lot filled completely during the AM peak period. There are 6,561 parking spaces available for public use on the Providence/Stoughton Line, 61% of which filled during the AM peak period. There are an additional 1,126 parking spaces, all resident-only parking; 80% were in use during the AM peak period.

Rapid Transit

Table 4-13 shows the percentage of parking utilization by rapid transit line.

TABLE 4-13
Park-and-Ride Lot Utilization Overview for MBTA-Owned and Municipal Lots: Rapid Transit System

Rapid Transit Line	Number of Parking Spaces	Percent Utilization
Blue Line	3,739	55%
Green Line	1,960	44%
Orange Line	4,469	66%
Red Line and Mattapan High-Speed Line	8,926	64%
Total	**19,094**	**61%**

Blue Line – The Blue Line has six stations that have parking lots. None of those lots filled during the AM peak period. Fifty-five percent of the 3,739 public parking spaces were used by the end of the AM peak period.[24] At Wonderland Station, 39 spaces are for permit holders only; 11 of those spaces were occupied.

Green Line – None of the six parking lots at stations on the Green Line was observed to be full during the AM peak period. Forty-four percent of the 1,960 parking spaces on the Green Line available for public use were in use.

Orange Line – Six stations on the Orange Line have parking lots. Parking was not filled to capacity at any of these stations during the AM peak period. There are 4,469 parking spaces on this line available for public use, 66% of which were used. In addition, there are 39 permit parking spaces at Green Street stations, 24 of which were used.

Red Line and Mattapan High-Speed Line – Ten stations on the Red Line and Mattapan High-Speed Line have parking lots. Parking was not filled to capacity at any of those stations during the AM peak period. Of the 8,926 parking spaces available for public use, 64% filled.

Commuter Boat

Quincy/Fore River, Hingham, and Hull are the three commuter boat terminals that have parking lots. Quincy/Fore River has 350 parking spaces, only 17% of which were in use during the AM peak period. This parking lot is also available for overnight parking for Logan Airport and Harbor Island users. The parking rates are different for day and overnight users. Seventy-eight percent of the 1,986 parking spaces at the Hingham terminal were in use during the morning peak period. There are 240 parking spaces at the Hull terminal, 67% of which were in use.

Express Bus

The express bus parking lot in Woburn was surveyed. The Woburn lot has 75 spaces, 70 of which filled during the AM peak period. The Watertown lot was not surveyed for this inventory but had been surveyed in 2005. At that time, the lot had 194 spaces, 79% of which were full by the end of the AM peak period.

Comparison with 2000 and 2005–06 Inventory Results

An inventory of park-and-ride parking lots was conducted as part of the Mobility Management System (MMS), now called the CMP, in the fall of 2005 and winter of

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[24] Over 1,000 of the available parking spaces on the Blue Line are provided by private operators at Wonderland Station. These spaces are included in the totals and utilization percentages.

2006. Another inventory had been conducted in the fall of 2002 for the CMP, known at that time as the Congestion Management System (CMS). The 2002 inventory included only park-and-ride lots located within Boston Region MPO municipalities. A prior inventory, covering the entire MBTA system, was conducted in 2000; that inventory was not associated with the CMP but is comparable to the later inventories. This section primarily compares the 2009–10 inventory results with those from 2005–06; it also compares them with the 2000 results for selected subjects. A direct comparison with the 2002 inventory results was not possible because complete data were not available for 2002.

In the 2009–10 inventory, far fewer park-and-ride lots at commuter rail stations were found to be full than in previous inventories. In 2009–10, the lots at only two commuter rail stations (Endicott and Wedgemere) were 100% full, compared to 28 stations in the 2005–06 inventory and 14 stations in 2000. The percentage of parking utilization also decreased, from 82% in 2000 and 73% in 2005–06 to 56% in 2009–10. Only two lines saw an increase in parking utilization between the 2005–06 and 2009–10 inventories: the Haverhill Line and the Lowell Line. Figure 4-31 shows the change in utilization rates between the 2005–06 monitoring period and the 2009–10 monitoring period.

Results were similar for park-and-ride lots at rapid transit stations. In 2009–10, no rapid transit stations were 100% full, compared to 11 stations in the 2005–06 inventory and 14 stations in the 2000 inventory. All four rapid transit lines saw decreases in parking utilization, and the total parking utilization percentage for all rapid transit stations that had park-and-ride lots decreased from 97% in 2000 to 85% in 2005–06, and to 61% in 2009–2010.

The decreased parking utilization rates observed between the 2009–10 inventory and that in 2005–06 may have been the result of the MBTA increases in parking fees or the downturn of the economy at the time, as the former counts were taken during that period.

Parking utilization increased at the commuter boat terminals, from 62% in 2005–06 to 69% in 2009–10. The express bus parking lot at Woburn was 93% full in the 2009–10 inventory, a decrease from 2005–06, when it filled to 100% of capacity. Commuter boat lots and express bus parking lots were not monitored in the 2000 inventory.

Since the 2005–06 inventory, daily parking fees at many park-and-ride lots have increased. On November 15, 2008, the rates for most MBTA lots had increased by $2.00. This meant that at most commuter rail stations, daily parking fees went from $2.00 to $4.00, and at most rapid transit stations, fees went from between $3.00 and $5.00 to between $5.00 and $7.00. Previous parking rate increases took place on January 6, 2003 (by 50 cents at rapid transit stations and one dollar at commuter rail stations), and on July 1, 2005 (a 50-cent increase at most rapid transit stations). In January 2011, the MBTA announced the availability of monthly parking permits for 65 stations. The rate for these lots is $70 per month.

In January 2007, the MBTA increased commuter rail fares and restructured rapid transit fares. When paying with a CharlieCard (a reloadable, plastic fare medium), the rapid transit fare is now a flat fee of $1.70. Rapid transit fares were previously subject to a more complex structure in which they varied depending on trip length, origin, and destination.

There have been changes in parking capacity since the 2005–06 inventory was completed. Systemwide, public (non-permit) parking capacity decreased by about 1,000 spaces. This resulted from the removal of approximately 3,500 parking spaces at certain stations and the addition of about 2,500 spaces at other stations. This figure does not include more than 3,000 spaces that were added for the Greenbush Line, which opened in October 2007.

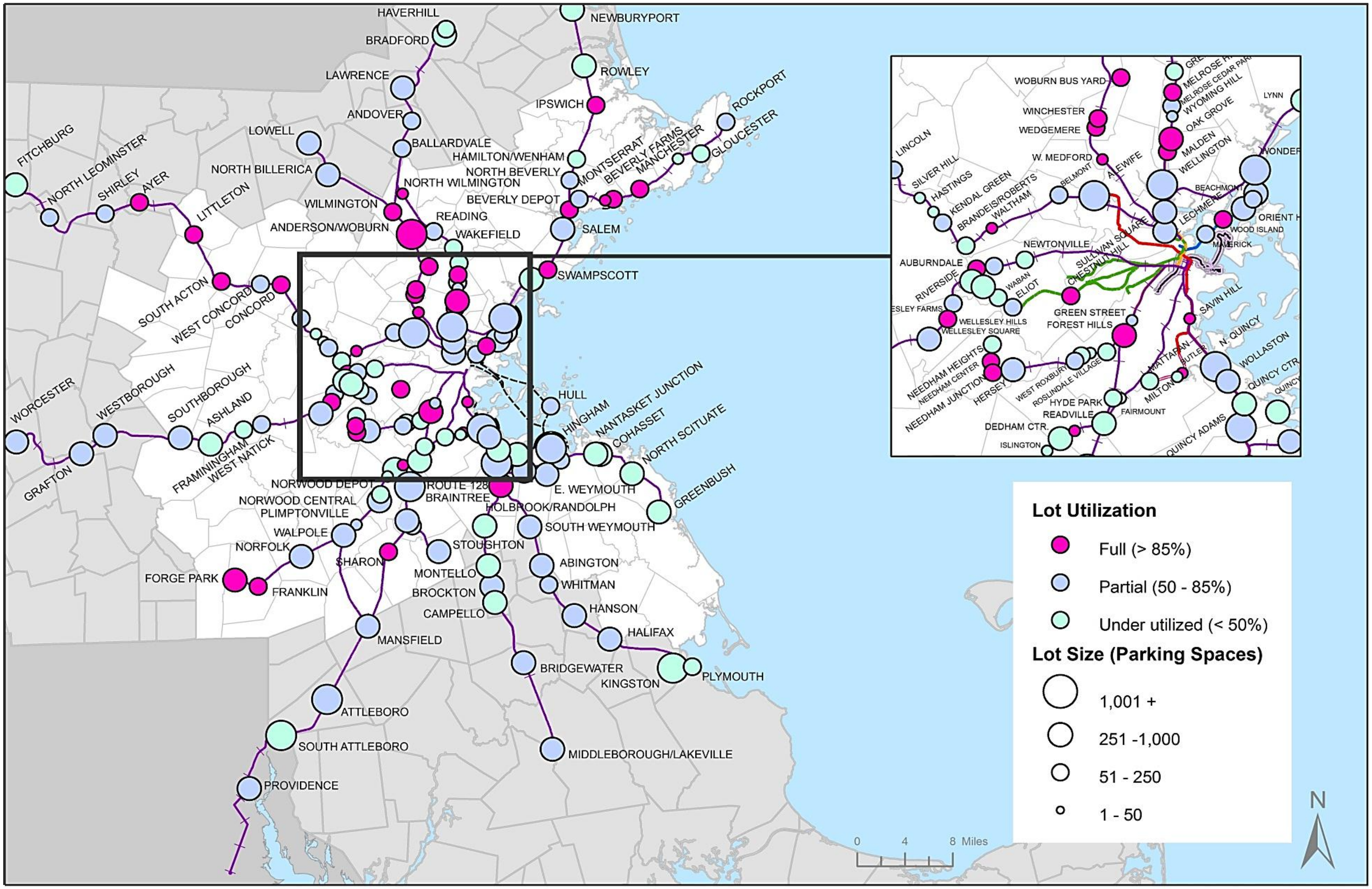

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FIGURE 4-30
Park-and-Ride Lot Capacity and Utilization,
2009-10 Inventory

Congestion Management Process

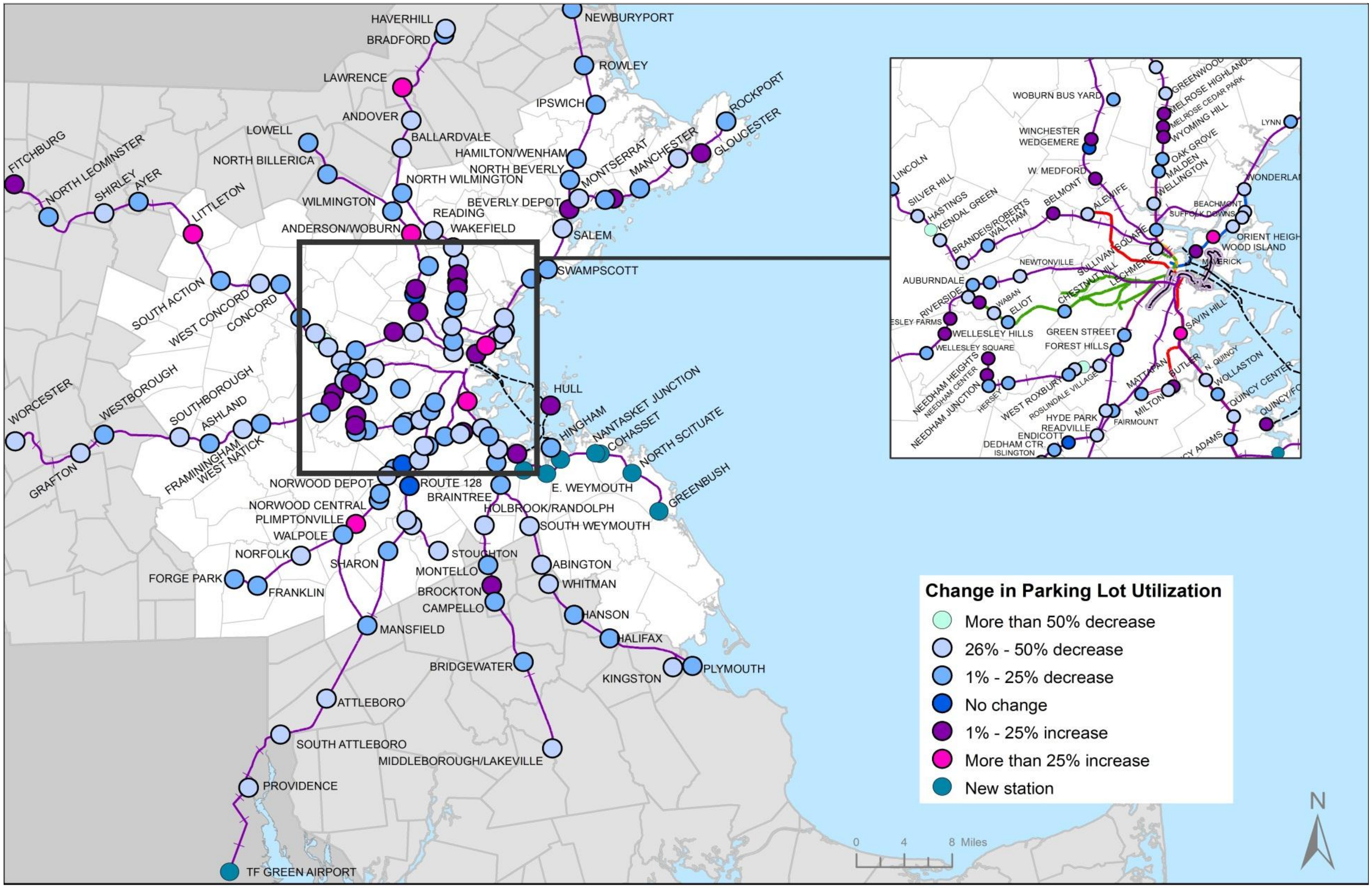

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FIGURE 4-31
Change in Park-and-Ride Utilization Rates,
2005-06 Inventory and 2009-10 Inventory

Congestion Management Process

MassDOT Park-and-Ride Lots

MassDOT park-and-ride lots are located along major highways. All-day parking is usually free. Table 4-14 shows utilization rates for the seven MassDOT park-and-ride lots within the MPO region for which data were available.[25]

The Rockland park-and-ride lot has 440 parking spaces, which is the most of any MassDOT park-and-ride lot, and the highest parking utilization rate at 76%. The reason behind the high usage rate could be that both the Plymouth and Brockton and the Logan Express bus services serve this lot. The reason the Framingham bus lot has relatively low parking utilization, despite bus service, is that there is another park-and-ride lot nearby that is also served by bus service and is located closer to the MassPike.

[25] Data were provided to CTPS directly by MassDOT for February 2005 through June 2009.

TABLE 4-14
Park-and-Ride Lot Utilization for MassDOT-Operated Lots*

Location	Highway	Operating Agency	Date Monitored	Capacity	Utilization
Canton	I-93 & Rte. 138	MassDOT Highway Division	Nov-07	120	57%
Framingham	**Near Rte. 9 and Rte. 30**	**MassDOT Highway Division**	**Jun-08**	**114**	**18%**
Framingham	**I-90/MassPike**	**MassDOT Highway Division**	**Jun-09**	**120**	**66%**
Milton	I-93 & Granite Ave.	MassDOT Highway Division	Nov-07	200	47%
Pembroke	Rte. 3 & Rte. 139	MassDOT Highway Division	May-07	90	7%
Rockland	**Rte. 3 & Rte. 228**	**MassDOT Highway Division**	**Nov-07**	**440**	**76%**
West Newton (Exit 16)	I-90/MassPike	MassDOT Highway Division	Feb-05	165	65%
Total				**1,249**	**57%**

*Park-and-ride lots that are served by bus service are indicated in bold.

BICYCLE AND PEDESTRIAN FACILITIES

Background

The bicycle and pedestrian modes were added to the CMP program in response to feedback on earlier reports. The approach used for reporting on these modes is different from the approach used for the roadway, transit, park-and-ride, and HOV-lane facilities. Bicycle and pedestrian facilities are not evaluated for congestion; instead the focus here is on how the region's transportation infrastructure accommodates these modes. Bicycling and walking provide an alternative to motorized roadway travel, especially when they can be used in conjunction with transit, and thus they are instrumental in reducing motorized, single-occupancy-vehicle travel and improving air quality.

The MBTA's Bikes and Transit Advisory Committee (which was active until it was disbanded in 2009) was composed of interested members of the public and representatives from the MBTA, the Executive Office of Transportation and Public Works (which merged with other agencies to form MassDOT in November 2009), the Metropolitan Area Planning Council, and other interested organizations; it advised the MBTA on issues related to bicyclist access to transit. Using qualitative and quantitative data, as well as personal experience, the committee recommended which stations should have bicycle racks installed. Following the advice of the committee, the MBTA has been funding the installation of bicycle racks as resources become available. CMP staff participated in the committee meetings in an advisory capacity. Even though the Bikes and Transit Advisory Committee no longer meets as a committee, it played an important role in implementing bicycle accessibility improvements on the MBTA.

Progress and Achievements

The Bikes and Transit Advisory Committee advised the MBTA in its process of outfitting a portion of its bus fleet with bicycle racks, which began in 2006. Bicycle racks on buses allow customers to use their bicycles at both ends of their transit trips (arriving at and departing from a station or stop). The racks make it easier for customers to make connections to and from transit via bicycle. Recently the MBTA started another bicycle accessibility project—a pilot program that extends the hours when bicycles are allowed on the Blue Line. In 2009, the MBTA was awarded stimulus funds to improve bicycle facilities. With these funds, the MBTA planned to install six additional Pedal & Parks (bike cages) and 50 Bike Ports (sheltered bicycle parking); they have already installed some Pedal & Park facilities and Bike Port facilities. As of the fall of 2011, over 70% of the MBTA's bus fleet, representing 83 bus routes, had been equipped with bicycle racks.

U.S Census Estimates

The estimated mode share of walking as the primary means of traveling to work increased slightly between 2000 and the 2006–10 period for commuters residing in the Boston Region MPO area .[26,27] From the 2000 census to the 2006–10 period, the number of Boston area residents who reported bicycling as their main means of traveling to work increased by over 7,000, to an estimated 16,100 (a mode share of just under 1%). This figure does not include those who used only a bicycle for a portion of their commute trip—for example, those who bicycled to a rail station where they transferred modes from bicycling to transit.

Based on Census 2000 figures, CTPS estimated that approximately 56% of the population within the Boston Region MPO area lives within walking distance of MBTA transit service.[28] Because so much of the Boston Region MPO's population lives near transit service (one-fourth mile from bus stops or one-half mile from rail), it is especially important to promote public transit use, particularly by providing a safe environment for pedestrians and bicyclists in the areas served by transit.

An interactive map of bicycle and pedestrian facilities in the region is hosted by the Metropolitan Area Planning Council (MAPC).

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[26] The 2005–09 census figures represent an average over a five-year period and are the most recent data currently available that distinguish among transportation modes with smaller mode shares (for example, bicycle, taxicab, motorcycle).

[27] Journey-to-work figures are percentages based on a sample questionnaire. Only workers over 16 years of age are included; all primary and secondary school students, including those over 16 years of age, are excluded from the census survey. Furthermore, these are census data that are collected in early spring, when, according to counts in the Boston metropolitan area, bicycle volumes are about one-quarter of the peak-season volumes. The seasonal variations in pedestrian activity are not known; however, pedestrian volumes are assumed to be less variable than bicycle volumes. Another factor to consider is that the census questionnaire asks for the mode used for the longest portion of the work commute. Hence, a trip involving a two-mile bicycle trip to a rail station, a five-mile train ride, and a half-mile walk to the office would be classified by the census as a rail commute trip.

[28] Walking distance to transit is defined as 1/2 mile or less from a rapid rail station and 1/4 mile or less from a bus stop. This measure is used to identify the potential transit market area.

Data Collection

Inventories were conducted on a typical fair-weather workday between January 2009 and August 2010 and between August 2011 and October 2011. Bicycle parking and utilization data were collected during the first time period (January 2009 to August 2010) in concurrence with the inventory of vehicle parking at park-and-ride lots at MBTA stations (part of an earlier project). The remaining stations, those without vehicle parking, were inventoried separately, during the second time period (August 2011 to October 2011). A nearly identical methodology was used to conduct inventories in 2005–06 and 1999–2002.

In general, CTPS surveyors inventoried each station once. In some cases, the data obtained from the first visit were collected during cooler weather, and staff were concerned that it would adversely affect the number of bicycles parked at the station; in other cases, a major addition of bicycle parking spaces had occurred (such as a Pedal & Park facility). In these cases, an additional visit was made to the station. Data were collected using a survey form that recorded the number, location, and condition of bicycle racks, as well as the number of bicycles parked in the racks and elsewhere at the station. Data on amenities and other characteristics of the station and its vicinity were also collected, including the presence of bicycle paths and trails and bicycle lanes, lighting, and security, in and around the station.

At many of the MBTA stations that do not have bicycle parking, bicycle racks are located near the station on municipal property or along the sidewalks. These bicycle racks were included in the inventory if there was no bicycle parking at the transit station or if it appeared likely that the municipal bicycle racks would be convenient for transit riders. If bicycle racks were nearby but were very inconvenient for transit riders, they were not included in the inventory.

The observed utilization of the bicycle racks is assumed to be typical for the station. Detailed observations over time—an effort beyond the scope of the CMP—would be necessary to gather the true bicycle rack utilization due to the fluctuation of weather and work schedules, among other factors.

Bicycle Parking at Transit Stations

Bicycle parking at transit stations in the MBTA system is surveyed as part of the park-and-ride lot survey program. Additional stations that lack park-and-ride lots were surveyed by staff in the fall of 2011. Staff inventoried MBTA bike racks and racks owned by cities and towns at each of the 134 rapid transit stations, 122 commuter rail stations, three commuter boat terminals, and three major bus stops. Some of these stations have a significant amount of bicycle parking (for example, Davis Square on the Red Line), while some have no bicycle parking facilities. The MPO hopes that the CMP will survey bicycle parking at all of the MBTA stations in the future.

The most recent inventory of some stations with park-and-ride lots and some stations that lack park-and-ride lots was conducted in 2009–11. Of the 265 stations included in the inventory, 80% have bicycle racks. This includes 116 of the 122 commuter rail stations, 91 of the 134 rapid transit stations, and three of the six boat terminals. Also included in this inventory were three major bus stops, two of which have bicycle racks. The station with the highest bike parking capacity is Alewife, with 321 spaces. Table 4-15 shows the percentages of bicycle rack utilization (on a typical weekday morning) by mode and line throughout the system. Figure 4-32 shows bicycle parking capacity and utilization by commuter rail station. Figure 4-33 shows bicycle parking capacity and utilization by rapid transit station.

Table 4-15
Bicycle Parking Capacity and Utilization, 2009–11 Inventory

Transit Line or Mode	Bicycles Parked	Number of Bicycle Parking Spaces	Percent Utilization
Commuter Rail			
Fairmount Line	3	76	4%
Fitchburg Line	49	191	26%
Framingham/Worcester Line	35	224	16%
Franklin Line	21	163	13%
Greenbush Line	18	57	32%
Haverhill Line	38	241	16%
Kingston/Plymouth Line	8	91	9%
Lowell Line	48	153	31%
Middleborough/Lakeville Line	17	79	22%
Needham Line	20	101	20%
Newburyport/Rockport Line	43	230	19%
Providence/Stoughton Line	71	296	24%
Commuter Rail Total	***370***	***1,856***	***20%***
Commuter Ferry			
Hingham - Rowes Wharf	9	16	56%
Charlestown Navy Yard	0	2	0%
Hull - Long Wharf	2	8	25%
Commuter Ferry Total	***11***	***26***	***42%***
Rapid transit			
Blue Line	72	240	30%
Green Line	195	612	32%
Orange Line	219	700	35%
Red Line	775	1,258	62%
Rapid Transit Total	***1,314***	***3,039***	***43%***
Silver Line Total	***53***	***229***	***23%***
Local Bus Total	***12***	***17***	***71%***
Total for all modes	**1,707**	**4,938**	**35%**

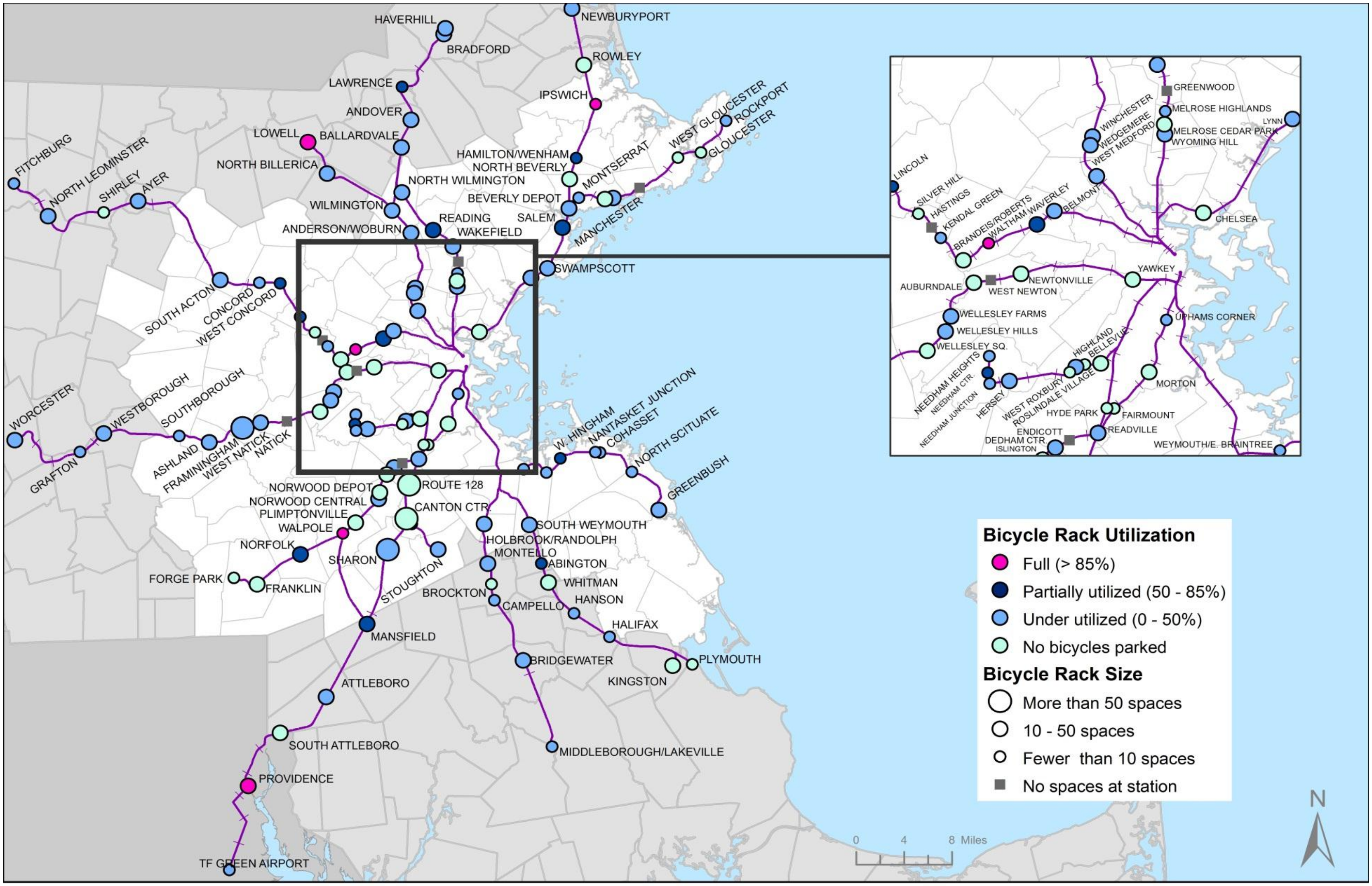

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FIGURE 4-32
Bicycle Parking Capacity and Utilization for Commuter Rail Stations, 2009-11 Inventory

Congestion Management Process

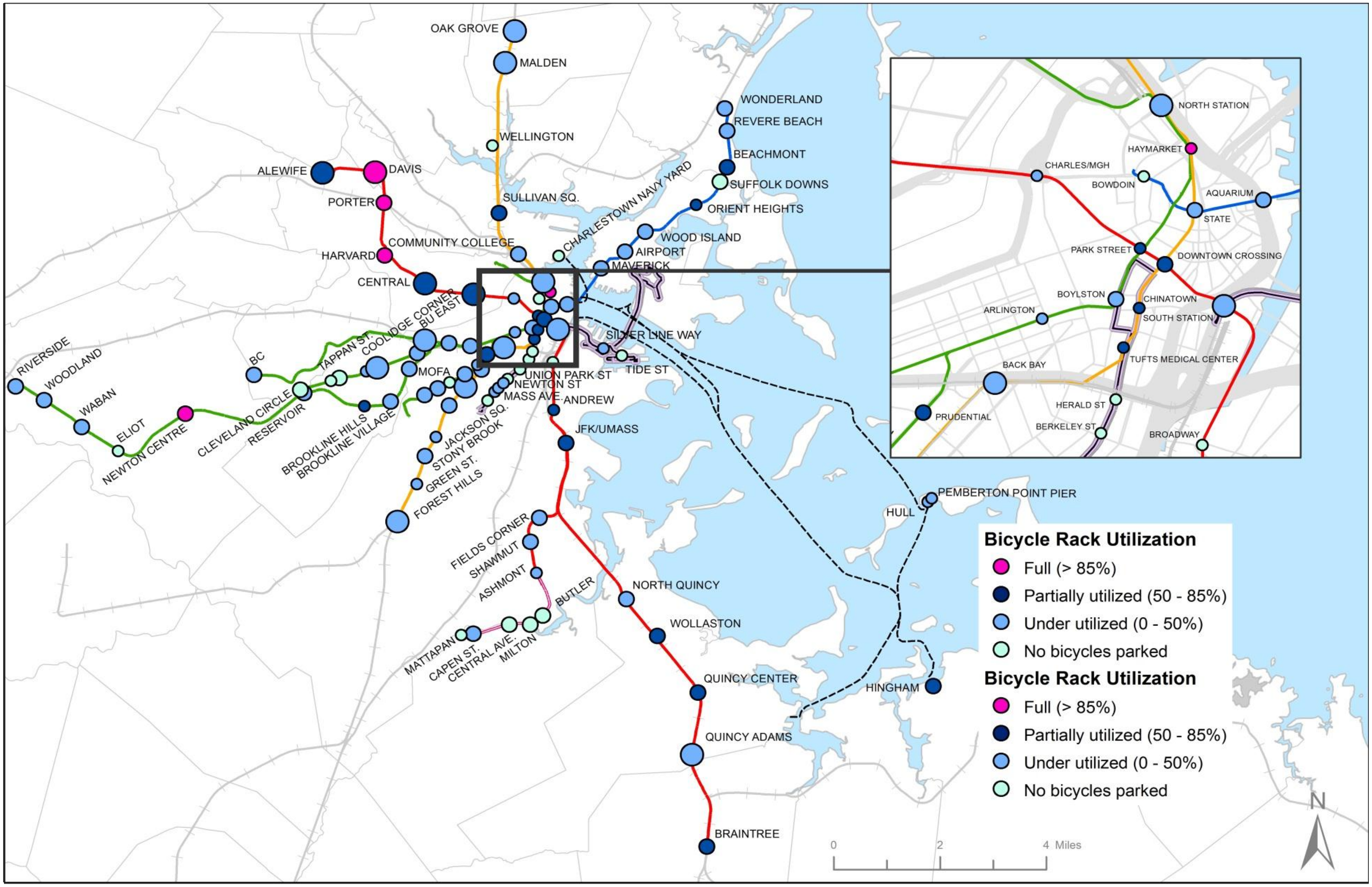

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FIGURE 4-33
Bicycle Parking Capacity and Utilization for Rapid Transit Stations, 2009-11 Inventory

Congestion Management Process

Bicycle Parking for Rapid Transit

Porter, Harvard, and Haymarket stations are at or over 100% of their capacity. Haymarket has only two parking spaces, both of which were full. Porter and Harvard have 39 and 27 parking spaces, respectively. Bicyclists sometimes attach their bicycles to poles, railings, and trees once the bicycle racks are full.

Harvard Station (Red Line), Central Station (Red Line), and Harvard Avenue Station (Green Line B Branch) were the only stations observed during the 2009–11 inventory to have more than 10 bicycles parked in areas other than the bicycle racks provided (such as locked to signs, benches, and railings) at the time of observation. This may be an indication that the existing racks are not located in areas that are perceived as safe; the racks are located in an inconvenient location; or the racks are at, near, or over their design capacity.

Bicycle Parking for Commuter Rail

The bicycle parking space utilization rate was 20% in the 2009–11 inventory. Ninety-five percent of the 122 stations in the commuter rail system have bicycle racks. The Providence/Stoughton Line had the most bicycles parked, with 71 parked at the racks. The Lowell and Greenbush lines had the highest bicycle rack utilization, with just over 30% of the bicycle rack spaces occupied. The Fairmount Line had the lowest bicycle rack utilization, at 4%. In all, 40 of the 122 commuter rail stations that had bike racks were observed to have zero bicycles parked. Six of the 122 stations observed did not currently have bicycle racks.

Bicycle Parking for Commuter Boat and Buses

Six commuter boat facilities were monitored in the 2009–11 inventory, which was the most recent inventory. Utilization was relatively high, at 42%. The number of bicycles parked at the Hingham terminal had almost doubled since the previous inventory (in 2006), while the number of bicycle parking spaces had decreased. The Hingham commuter boat terminal has racks that accommodate 16 bicycles, and in the 2009–11 inventory, 9 were parked there. In the 2009–11 inventory, eight bicycle parking spaces were installed at Hull; two bicycles were parked in the spaces. The Charlestown Navy Yard also had one bicycle rack installed (an inverted-U); no bicycles were parked at the rack. The Quincy/Fore River commuter boat terminal does not have bicycle racks, and no bicycles were parked near the dock. The only dock where people parked bikes somewhere other than a bicycle rack was Long Wharf.

Watertown Yard, Watertown Square, and Woburn Yard were the only major bus stops monitored in the 2009–11 inventory. Watertown Yard had five spaces, and there was one parked bicycle; several bicycles were parked near the bus shelter (which is several hundred feet away from the rack). Watertown Square has 12 spaces, and 11 bicycles were observed parked there during the 2009–11 inventory. Several bicycles were parked at poles and trees around the area. Those bikes were probably parked there when the bicycle rack was full or very nearly full. There were no parking spaces at Woburn Yard, nor were any bicycles parked in the area.

Access to Transit Stations

Data related to pedestrian and bicycle access to transit stations were obtained from the 2009–11 CMP survey of MBTA park-and-ride lots.

The Boston MPO’s website lists four types of pedestrian and bicycle amenities at the transit stations surveyed: sidewalks leading to the station, crosswalks leading to the station, bicycle paths (only significant multi-use paths) connecting the station to residential areas, and bicycle parking.